Northwest Las Vegas Flood Insurance Study Restudy
Clark County, Nevada

Technical Data Notebook

Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

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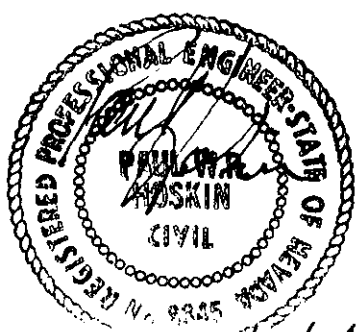

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Acknowledgements

The Northwest Las Vegas Flood Insurance Study Restudy represents a cooperative effort between the Clark County Regional Flood Control District, a Committee consisting of representatives from Clark County, City of Las Vegas and City of North Las Vegas, and the firms of Aerial Mapping Company, Pentacore Engineering, Inc., and CVL Consultants, Inc.

The following individuals have each played an important role in the successful completion of this study:

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1.0 Introduction

CVL Consultants, Inc. (CVL), in association with *Pentacore Engineering, Inc. (PEI)*, has been contracted by the Clark County Regional Flood Control District (CCRFCD) to perform a flood insurance study restudy for the Northwest Las Vegas study area (Figure 1).

The study involved a review and restudy of the effective Flood Insurance Rate zones, within the area bounded by Grand Teton Drive to the north, Highway 95 to the south, Buffalo Drive to the west, I-15 to the east, and the west side of Las Vegas Wash to the northeast (see Figure 1).

1.1 Purpose of Study

Flood zones for the Northwest Las Vegas area are currently depicted on separate Flood Insurance Rate Maps (FIRM) for unincorporated areas of Clark County and the cities of Las Vegas and North Las Vegas, Nevada. The Federal Emergency Management Agency (FEMA) is in the process of converting existing FIRMs into digital FIRMs (DFIRM), which will encompass multi-jurisdictional boundaries within Clark County. A compilation of flood insurance mapping coverages (Plate 1) illustrates the Zone "A" and Zone "AO" floodplain limits, as depicted on the preliminary DFIRMs (dated July 29, 1993), and the locations of recently constructed flood control facilities.

The construction or planning of CCRFCD funded flood control facilities and rapid changes in urban development have changed, and will continue to change, the characteristics of watersheds and flow paths in the area, outdating many of the currently depicted flood zones. Acceptance of this restudy by FEMA will allow the update of current Flood Insurance Rate Maps to depict the current flooding conditions within the study area.

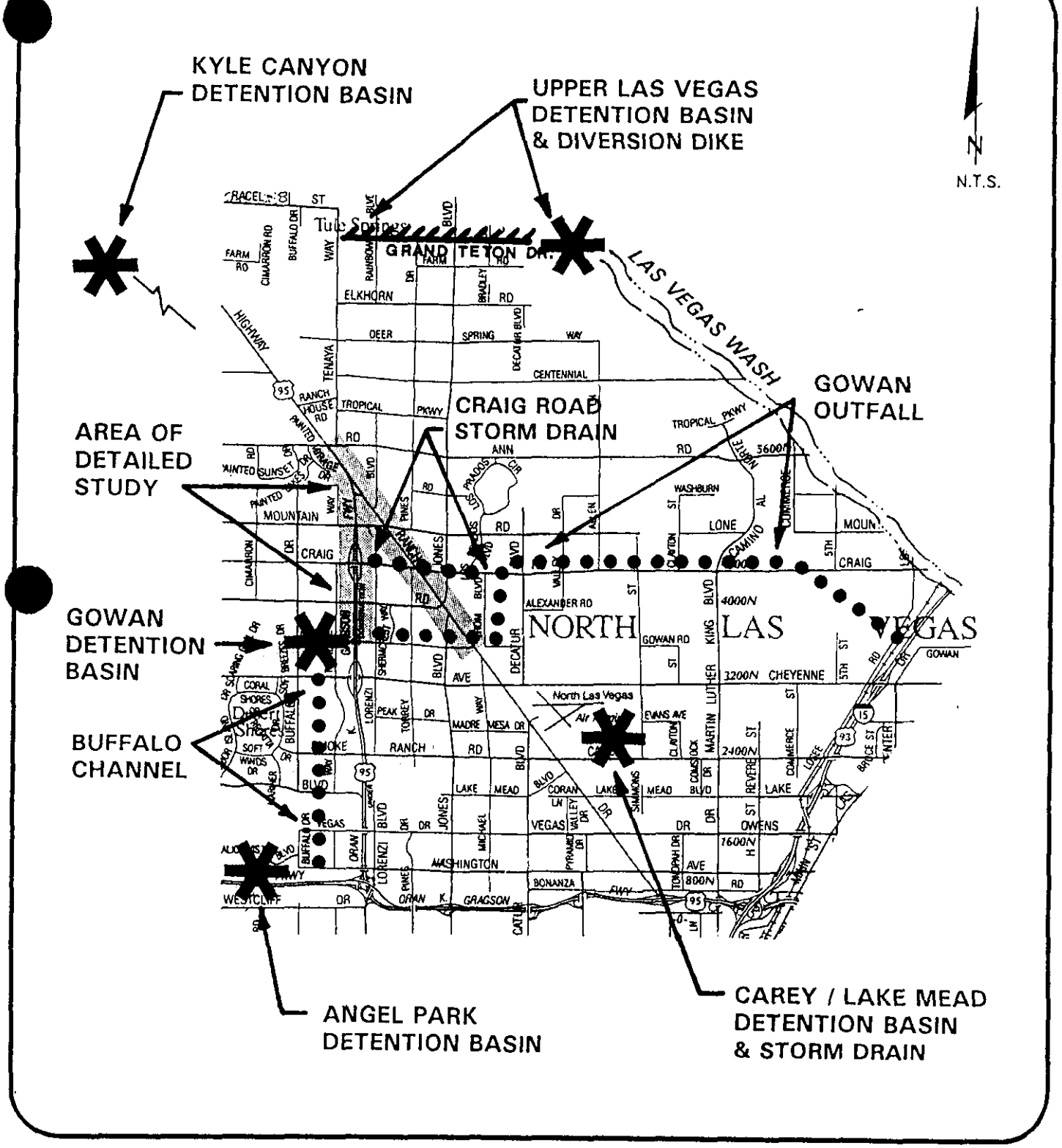

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FIGURE 1
LOCATION MAP

JOB NO. 930017 OCT. 1993

1.2 Authority for Study

An agreement was made and entered into between the Clark County Regional Flood Control District (CCRFCD) and CVL Consultants, Inc. on May 13, 1993, for the Northwest Las Vegas Flood Insurance Study Restudy. Details of the project's scope of work are described in the contract agreement and "Scope of Services" (Appendix I - Section 1).

1.3 Community Coordination and Acknowledgement

The study area includes lands within the jurisdiction of the City of Las Vegas, the City of North Las Vegas, and unincorporated areas of Clark County. Monthly progress meetings and technical reviews were conducted by a committee comprised of representatives of the CCRFCD and the aforementioned jurisdictions. The names of each of the committee and study members, their telephone numbers and addresses, are included in Appendix I - Section 3.

On October 12, 1993, the preliminary Hydrologic Analysis report was submitted to the Committee for their review and comments. The preliminary delineations of floodplain boundaries within the detailed study area were presented to the Committee at the meeting on March 9, 1994. The final results of the study were submitted on June 22, 1994, and reviewed at a final committee meeting held on June 29, 1994.

1.4 Community Concurrence

The study members of CVL and PEI have maintained close contact with each of the Committee members throughout the project. Committee members of each of the affected communities have had the opportunity, through continued meetings and review submittals, to provide input regarding the results of the study. Upon the submittal of this study to FEMA, the floodplain administrators for the CCRFCD, the City of Las Vegas,

and the City of North Las Vegas concur with the results of this study. Letters of concurrence from each community are included in Appendix I - Section 2.

1.5 Floodplain Management Application

The primary purpose of the National Flood Insurance Program (NFIP) is to encourage state and local government to adopt a sound floodplain management program. Through detailed engineering analyses and construction implementation, the Clark County Regional Flood Control District has developed a program of flood mitigation throughout the Las Vegas Valley. The impact of this program is now being realized through the gradual reduction or removal of existing floodplains as demonstrated by this study.

1.5.1 Floodplain Boundary

This study includes revised 100-year floodplain boundaries determined by both detailed and approximate study methods. In some cases, the removal of existing floodplain boundaries is appropriate.

For areas studied by detailed methods, the 100-year floodplain boundaries were delineated based on water surface elevations computed using new digital cross-sections. Between cross-sections, the floodplain boundaries were interpolated using new topographic maps produced by Aerial Mapping Company (AMC) at a scale of 1" = 200' with a contour interval of 2 feet (AMC, 1993). The result is a new floodplain delineation with Base Flood Elevations (BFEs) which is proposed to be designated as Zone "AE".

For areas studied by approximate methods, the 100-year floodplain boundaries were delineated based upon a variety of sources including U.S.G.S. topographic maps, detailed topographic maps, aerial photographs and as-built construction documents. Existing floodplains designated as Zone "A" or "AO"

have been revised or removed and new flood Zones "A" and "X" have been added. (See Appendix V).

1.5.2 Floodways

There are no existing floodways within the study area and floodways were not determined as a part of this study.

1.6 Insurance Application

For flood insurance rating purposes, flood insurance rate zones are designated to floodplains based on the results of engineering analyses and FEMA criteria. The general flood zones defined by FEMA, and as used in this study, are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No BFEs or depths are shown within this zone.

2.0 Area Studied

2.1 Scope of Study

The study involved a review and restudy of the effective Flood Insurance Rate zones, within the area bounded by Grand Teton Drive to the north, Highway 95 to the south, Buffalo Drive to the west, I-15 to the east, and the west side of Las Vegas Wash to the northeast (see Figure 1). The study also included compilation and modification of existing hydrologic models, for a study area which includes watersheds which extend west into the Spring Mountains.

Areas of strip flooding along Highway 95 and Rancho Drive between Ann Road and Gowan Road were studied according to detailed study methods (see Figure 1, Reference Section 5.0). Approximate study methods were used for the following areas (as discussed in Section 6.0):

Carey/Lake Mead Area
West Cheyenne and North Buffalo
Gowan Detention Basins
Durango Drive
Buffalo Channel and Tributary
Camino El Norte/Centennial Parkway
Las Vegas Wash Diversion Dike
Lone Mountain Road/Rancho Drive
Craig Road/Rancho Drive
Washington Avenue

2.2 Community Description

The Las Vegas Valley is located within central Clark County in southern Nevada. The climate is arid, characterized by sparse rainfall and wide extremes in daily temperatures. The average annual precipitation is approximately 3.94 inches.

The area is characterized by north-south trending mountains with wide piedmont plains extending from the base of the mountains. The surrounding mountains are

vegetated predominantly by creosote bush, yuccas, mesquite, and sagebrush. The lower watersheds continue to urbanize mainly with single family residences, multiple family residence complexes, and some small businesses. Development within the study area occurs predominantly south of Lone Mountain Road along Highway 95 and Rancho Drive. Some of the oldest neighborhoods occur along Washington Avenue while newer development is occurring within the foothills west of Highway 95.

2.3 Principal Flood Problems

Several different types of storms occur in this area, ranging from low intensity rainfall, during the winter months, to high intensity localized thunderstorms, during the summer. Historically, the majority of the flood events in the Las Vegas Valley have resulted from intense, short duration thunderstorms.

Current flood maps illustrate that there is a flood potential along Rancho Drive which is elevated above existing ground. Construction of Highway 95, in recent years, has also changed the flood characteristics of the area by providing an impediment to sheet flow from the west. The Gowan Road has historically been a low lying area and previous studies illustrates this area's flood potential. Recent construction of flood control facilities, including the Gowan detention basin has done much to help alleviate this situation.

2.4 Flood Protection Measures

Several major flood control facilities within the study area have been constructed since the FIRMs for the area were first published (see Plate 1). These flood control facilities include: Upper Las Vegas diversion dike and detention basin, Gowan north and south detention basins, Gowan outfall pipe and channel, Carey/Lake Mead detention basin, Craig Road storm drain system, Lake Mead and Carey Avenue storm drain

system, Angel Park detention basin, and Buffalo channel from Westcliff to Gowan south basin.

The Angel Park detention basin outfall facilities are in place and the basin has been partially excavated. A schedule for completion of the Angel Park basin is unknown at this time. Construction of Buffalo Channel from Westcliff to Doe Avenue is planned within the next two years. The Kyle Canyon detention basin and outfall facilities are currently under construction and they are planned for completion in February 1995. Completion of all of the above flood control facilities (excluding Angel Park) has been assumed for this study.

3.0 Previous Studies and Reports

3.1 Introduction

Several drainage studies have been conducted within the study area and are relevant to this study. These studies have been a reference for this study and have been used as a basis for the information and hydrologic models represented in this report. The U.S. Army Corps of Engineers' computer program *HEC-1 Flood Hydrograph Package* was used as the base hydrologic model for many of the drainage studies. The four hydrologic models used as a basis for this study's model are depicted in Figure 2. The following are brief descriptions of relevant studies conducted in the area.

3.2 Angel Park Detention Basin

The report, *Hydrology Study - Angel Park Detention Basin* (VTN, Feb. 1983) and its supplement (VTN, Mar. 1983) document the hydrology used in the design of the Angel Park Detention Basin Phase IIB (see Appendix II - Section 4). These reports document the hydrologic parameters and assumptions used in the development of the HEC-1 computer model. Design was based upon a 100-year, 3-hour precipitation over a 20 square mile watershed. The supplement also models future watershed conditions.

The basin's emergency spillways and outfall facilities have been constructed in accordance with the design plans by VTN, dated February, 1985. Full excavation of the North basin, however, has been ongoing as part of a gravel mining operation. Since excavation is incomplete, the City of Las Vegas performed cross-section surveys of the North basin in June, 1993 (see Appendix II - Section 4). An analysis of the basin's actual storage volumes has been completed and is included in Appendix III - Section 4.

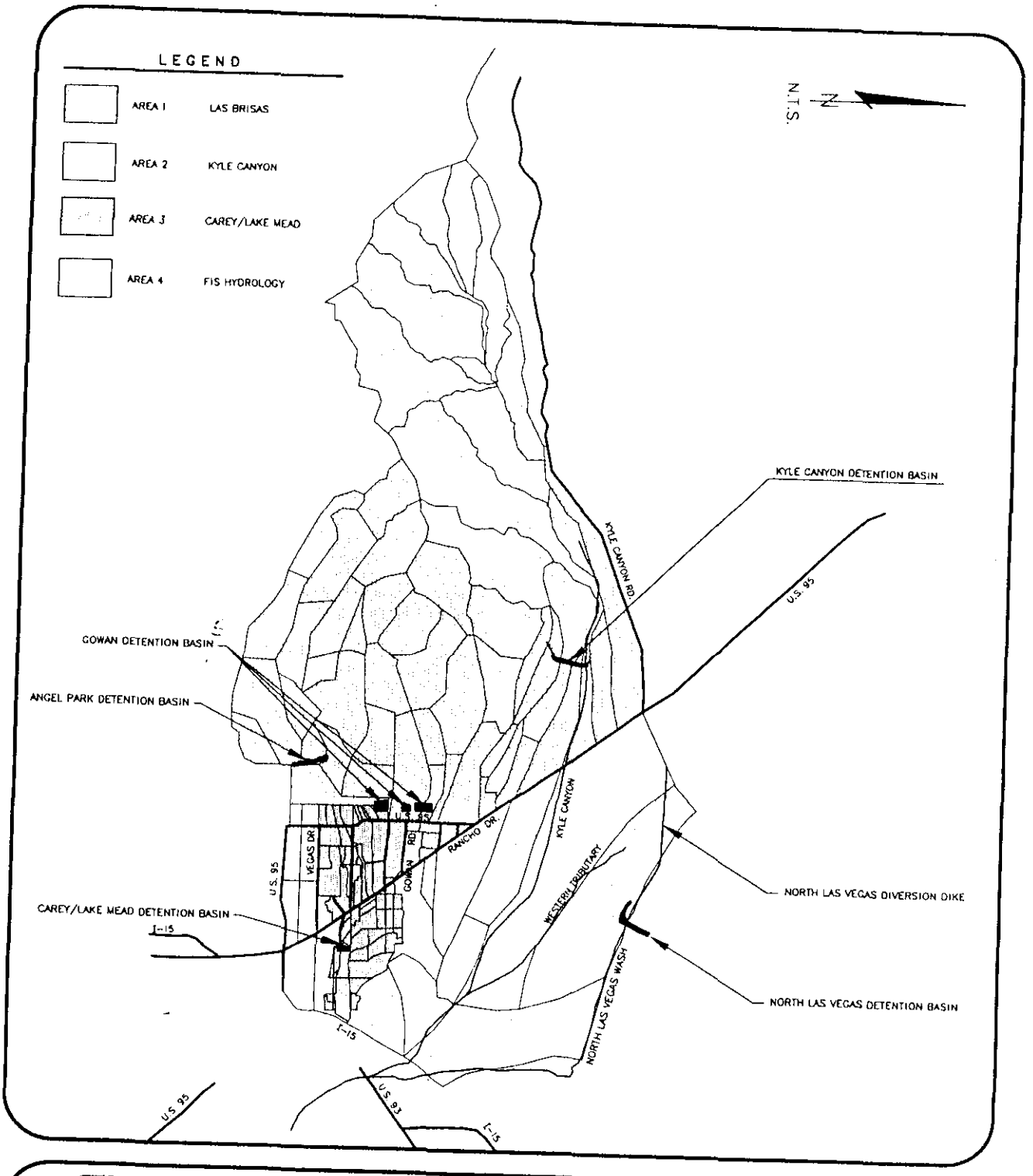

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FIGURE 2
PREVIOUS STUDIES
INDEX MAP

3.3 Gowan Detention Basin

Two reports, *Hydrology Report Methodologies and HEC-1 Model Predesign of the Gowan Detention Basin* (Wallace, 1988), and *Gowan Detention Basin Volume III Alternatives Evaluation* (Wallace, 1989), document hydrologic analyses, using the HEC-1 computer program, for watersheds contributing to the Gowan detention basin. These pre-design reports (see Appendix II - Section 5), which were prepared in three volumes over a time span from August 1988 to March 1989, present hydrology for the (then proposed) Gowan detention basins. These reports present the 100-year peak discharges for the "existing" development and existing facilities (prior to the Gowan detention basins). Also included are the 100-year peak discharges for the future development and future facilities condition. Basin design and pipe/channel conveyance alternatives were also evaluated as part of these reports.

3.4 Carey/Lake Mead Detention Basin

The report titled *Final Hydrology Study - Lake Mead Boulevard Phase 1A Project* (VTN, 1989) presents detailed hydrologic and hydraulic analyses for the design of the Carey/Lake Mead Detention Basin and Lake Mead Boulevard (see Figure 2, Area 3, and Appendix II - Section 3). The analysis assumes that no diversion flows enter the study area from the Gowan Road and Rancho Drive intersection to the north, and that the entire watershed runoff is intercepted by the constructed storm drainage facilities. The study also assumes that diversion flows do not leave the study area at Vegas Drive. The 100-year, 6-hour storm with Storm Distribution Number 3 (SDN3) was used for this watershed based upon information presented in the CCRFCD's *Hydrologic and Drainage*

Criteria Manual (CCRFCD, 1990). The hydrologic model also includes the existing Smoke Ranch Road storm drain system and drop inlets along Lake Mead Boulevard.

The report titled *Predesign Memorandum for Carey/Lake Mead Detention Basin* (VTN, 1990) documents the selected alternative for design of the basin. The hydrologic analysis incorporates the basin's operating characteristics including inflow, outflow, volume, stage and spillway elevation.

3.5 Silver Mesa Study

In the report titled *Drainage Study for Silver Mesa, North Las Vegas, Nevada* (VTN, April 1989), offsite hydrology that may affect the Silver Mesa development site is evaluated using the HEC-1 model. The report includes a hydraulic analysis of anticipated 100-year flood flows, along Gowan Road between Highway 95 and Rancho Drive, using the U.S. Army Corps of Engineers' HEC-2 computer model. The analysis includes an evaluation of the flow distributions and diversions that would occur along Gowan Road, near Jones Boulevard, and also near Rancho Drive.

VTN Nevada utilized aerial photography, topographic mapping and visual field inspections to establish HEC-2 cross-sections, areas of ineffective flow, and Manning's roughness values. They established that flow diversions occur at the intersection of Morro Bay Avenue (one block south of Gowan Road) and Jones Boulevard, and also on Gowan Road approximately 700 feet west of its intersection with Rancho Drive.

Results from the HEC-2 analysis were incorporated into VTN's existing condition HEC-1 hydrologic model. This study was completed prior to the construction of the Gowan basins.

3.6 FIS Hydrology Report

The report titled *Las Vegas Valley Flood Insurance Study Hydrology Report* (James M. Montgomery, Sept. 1991) presents the results of a hydrologic analysis prepared for use in Flood Insurance Studies (FIS) within the Las Vegas Valley (Figure 2, Area 4 and Appendix II - Section 7). Numerous previous reports and HEC-1 models, some of which are mentioned herein, were used as the basis for this study. In particular, the FIS hydrology combined the hydrologic models presented by G.C. Wallace for the Gowan Detention Basins (1988) with those used in the preparation of the *Las Vegas Valley Master Plan Update* (CCRFCD, 1991).

The analyses performed by J.M. Montgomery (JMM) were based on existing development conditions including "existing" flood control improvements. Flood control improvements for which construction had been completed or which were scheduled for construction within two years of the report were incorporated as "existing facilities." According to JMM, *"point precipitation was reduced by depth-area reduction factors (DARFs) given in the CCRFCD Manual. Unique DARFs were computed for each concentration point of interest based on contributing drainage area or assumed upstream storm area. Hydrographs were computed from rainfall excess using the SCS unit hydrograph method, except in subbasins where kinematic runoff parameters were already available. The Muskingum routing method was used for channel routing except where improved channels were involved, in which case the kinematic method was used. Losses were computed using the SCS curve number (CN) method, based on standard CN tables provided in the CCRFCD manual. HEC-1 models were executed using the 1988 version of the program."*

The report is divided into four technical appendices. Two appendices are relevant to this study as follows:

Northern Las Vegas Wash FIS Hydrology

HEC-1 models are presented for the 10-, 50- and 100-year storms with existing conditions and existing facilities. The Upper Las Vegas Wash Detention Basin, modifications to the existing North Las Vegas Detention Basin, and the West Range Wash Diversion Dike were all considered as existing.

Gowan Area FIS Hydrology

HEC-1 models are presented for the 10-, 50- and 100-year storms with existing conditions and existing facilities. The Gowan-North and Gowan-South Detention Basins and outfall channel, Cheyenne Channel, Angel Park Detention Basin expansion and outfall channel, the Hualapai Diversion into the Angel Park Detention Basin and the Buffalo Channel were all considered as existing facilities for the purposes of the hydrology model.

3.7 Las Brisas Norte Study

The *Revised Technical Study for the Las Brisas Norte Residential Subbasin* (Church, 1992) was prepared for the purposes of evaluating the offsite hydrology and hydraulics that may affect the Las Brisas Norte residential subdivision. Las Brisas is located between Craig Road and Alexander Road, one half mile east of Decatur Boulevard. This study made revisions to the HEC-1 model presented in the FIS hydrology, for the purpose of better evaluating conditions at the subdivision site (Figure 2, Area 1). The study included an evaluation of split flows that may affect the site. This study indicates that much of the upper watershed does not currently contribute to the

Gowan North detention basin, as previously assumed in the FIS Hydrology Report. The hydrologic model presented in this report includes modifications to the assumed drainage areas contributing to the Gowan Basin. The analysis indicates that flow from some of the drainage basins would bypass the Gowan Basin to the north. This flow would reach Rancho Drive and Highway 95 undetained. When construction is completed on the proposed Lone Mountain and CAM-10 detention basins and the Gowan North conveyance system, it will be possible for the upper watersheds to contribute to the Gowan North detention basins as planned in the *Las Vegas Valley Master Plan Update Report* (JMM, 1991).

3.8 Craig Road Storm Drain

The City of Las Vegas has conducted a study for storm drain improvements to Craig Road entitled *Hydrology Study for Craig Road between Highway 95 and Decatur Boulevard*, (CLV, 1992). This study (See Appendix II - Section 6) analyzes alternatives for the interception of flood flows along Craig Road and conveyance of these flows within a storm drainage system along Craig Road. The storm drain, which is now built, extends from a culvert crossing of Highway 95, east to Decatur Boulevard where it joins the Gowan outfall pipe. A HEC-1 hydrologic analysis was performed for existing and future conditions with the Gowan detention basin and Gowan North channel in place. The Kyle Canyon detention basin was not assumed to be constructed for the purposes of this study. The study concludes that the storm drain will have a capacity of 223 cfs at the intersection of Craig Road and Rancho Drive. Flow in excess of 223 cfs will flow southeast along the west side of Rancho Drive.

3.9 Buffalo Channel

Three reports, *Hydrology Report Methodologies and HEC-1 Model for Pre-Design of the Gowan Detention Basin* (Wallace, 1988), *Design Memorandum for Buffalo Channel, Summerlin Parkway to Vegas Drive* (VTN, May 1992) and *Design Report for the Buffalo Drive Road and Channel Improvements* (VTN, Feb. 1993) document the design hydrology and hydraulics for the Buffalo Drive channel.

The Buffalo Channel forms the eastern boundary of the Gowan Area Flood Control Master Plan and extends from its outfall to the Gowan South Basin, near Peak View Drive, south to Summerlin Parkway. The main outfall of the Angel Park Detention Basin outlets into the Buffalo Channel near Vegas Drive. A closed conduit to be constructed as part of the Buffalo Drive Road and channel improvement will extend the Buffalo Channel to a point 1,200 feet south of Charleston Boulevard where it intercepts flows from the upper Holmby Wash.

The first report documents the hydrology and design parameters associated with the construction of the Buffalo Channel and Angel Park outfall from Vegas Drive north to the Gowan South basin. Extension of the Buffalo Channel from Vegas Drive to the Summerlin Parkway is addressed in the second report. The channel design flowrate varies from 695 cfs at Summerlin Parkway to 1,040 cfs at the Vegas Drive box culvert.

The third report documents the road and storm drainage improvements for Buffalo Drive from Sahara Avenue to Westcliff Drive. The drainage areas that contribute to Buffalo Drive south of Oakey Boulevard and north of Sahara Avenue are tributary to the Oakey Detention Basin and are therefore outside the limits of the Northwest Las Vegas FIS Restudy. Flows north of Oakey Boulevard will be diverted north to the Buffalo Channel via a storm drainage pipe system. Since this system forms part of a CCRFCD

master plan facility, inlet structures have been designed for 100-year flow interception. The study evaluated various channel conveyance systems but recommended the use of a rectangular closed conduit system.

3.10 Kyle Canyon Detention Basin

The report titled *Outfall Study for the Kyle Canyon Detention Basin* (VTN, Jan. 1993) includes a HEC-1 model for the Kyle Canyon Detention Basin and three alternatives for the outfall channel (Figure 2, Area 2 and Appendix II Section 2). The Kyle Canyon Detention Basin is located in Sections 14 and 23, Township 19 South, Range 59 East, and as proposed, will have a contributing drainage area of 58 square miles. Based upon results from the HEC-1 model, the 100-year peak discharge inflow to the basin would be 13,310 cfs. Flow attenuation results in a peak discharge outflow of 359 cfs.

3.11 Upper Las Vegas Wash Detention Basin

The study titled *Predesign Report for the Upper Las Vegas Wash Detention Basin* (Black & Veatch, March 1991) describes a diversion dike and a 2,870 acre-ft. flood control dam. The dam is located on the Main Reach of Las Vegas Wash, south of Quail Springs wilderness and east of Floyd R. Lamb State Park (see Appendix II - Section 1). The purpose of this detention basin is to lessen the runoff from the Spring & Sheep Mountains, and to discharge flows into a 3.6 mile outfall channel which conveys flows to the Main Reach of the Las Vegas Wash.

Site specific inflow hydrographs used for the design of the flood control facilities were developed using the HEC-1 model with a 100-year, 6-hour storm event. The watershed upstream is undeveloped and no significant development is anticipated in the near future, therefore, only one model was assembled for the hydrologic analysis.

4.0 Hydrologic Analyses

4.1 Engineering Methods

4.1.1 Introduction

The Las Vegas Valley FIS hydrology reports were prepared by James M. Montgomery in September 1991 with the intent that they would be used in conducting Flood Insurance Studies (FIS) in the Las Vegas Valley, Nevada. Since the preparation of the FIS hydrology report, changes in urban development, and recently constructed (or under construction) flood control facilities have changed some of the flow paths and characteristics of watersheds contributing to the study area. As a result, it was necessary to revise and update the existing condition hydrology before use in this study. The purpose of the hydrology prepared for this study is, therefore, to update the current FIS hydrology for the "Gowan" and "Northern Las Vegas Wash" areas.

4.1.2 Methodology

The U.S. Army Corps of Engineer's (COE) *Flood Hydrograph Package, HEC-1* (Version 4.0, COE, 1990) rainfall model was used to estimate the 100-year, 6-hour discharges for the Northwest Las Vegas FIS Restudy. The 100-year event is an event with a one percent chance of occurring in any given year. All methods utilized in the analysis are based upon methods outlined in the *Hydrologic Criteria and Drainage Design Manual* (CCRFCD, October 1990). The SCS Unit Hydrograph method, as described in detail in the *National Engineering Handbook Section 4, Hydrology*, (SCS, 1972), was used.

A network of sub-basins and connecting channels was configured to simulate the natural drainage patterns of the watershed. Due to the size of the watersheds, and the desire to vary precipitation data according to geographical location, four HEC-1 models were developed for this study, as illustrated in Figure 3.

As mentioned earlier in Section 3, the following previous studies were used to develop the HEC-1 models used in this study (see Figure 2):

1. Areas 1 & 2 *Revised Technical Hydrology Study for the Las Brisas Norte Residential Subbasin* (Church Engineering, Inc., 1992).
2. Area 2 *Outfall Study for the Kyle Canyon Detention Basin* (VTN, Jan. 1993).
3. Area 3 *Final Hydrology Study - Lake Mead Boulevard Phase 1A Project* (VTN, 1989).
4. Area 4 *CCRFCD Las Vegas Valley Flood Insurance Study Hydrology Report* (James M. Montgomery, Sept. 1991).

4.1.3 Watershed Boundaries

For the most part, the models used in this study retain the same watershed and sub-basin parameters as developed by their authors. In certain cases, however, review of the watershed areas and constructed facilities required modifications to the basin parameters.

A detailed watershed boundary map (Figure 4) illustrates the sub-basins for all hydrologic models within the study area. Schematic flow diagrams, which

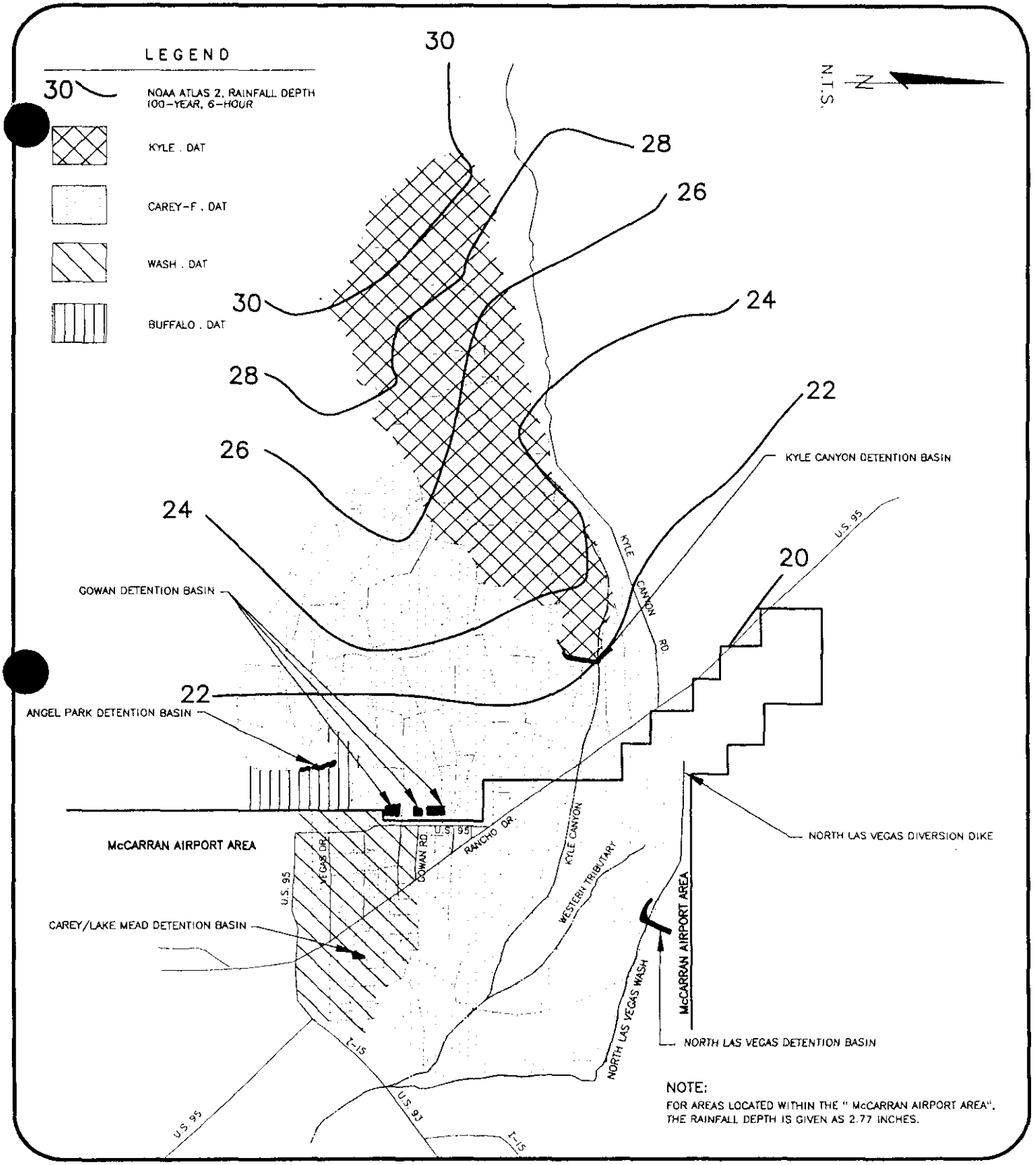

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FIGURE 3
HEC-1 MODELS
INDEX MAP

illustrate the drainage sub-basin boundaries and HEC-1 basin routing networks, are provided in Figures 5 through 9. Watershed subbasin areas vary in size, configuration and complexity due to varying levels of detail provided by the various author's models.

4.1.4 Rainfall

The 100-year, 6-hour point precipitation depths were obtained from the National Oceanic and Atmospheric Administration's (NOAA) Atlas 2, Volume VII - Nevada (Figure 6, *Hydrologic Criteria and Drainage Design Manual*, CCRFCD, 1990). The Centroid of each model area was used to estimate the point precipitation values (see Figure 3), and then a Precipitation Adjustment Ratio of 1.43 was applied. The use of a Precipitation Adjustment Ratio is described in detail in the *Hydrologic Criteria and Drainage Design Manual* (CCRFCD, 1990).

Different point precipitation values were not applied for each hydrologic subbasin, but rather for a grouping of subbasins. A comparison of the point precipitation values thus obtained, with those from the FIS hydrology study (JMM, 1991), indicates that the FIS study underestimated the point precipitation for certain watersheds.

4.1.5 Depth Area Reduction Factors (DARF)

In order to account for increasing watershed size, depth-area reduction factors (DARFs) were applied to the point precipitation values obtained from Figure 3. The NOAA Atlas 2 (NOAA, 1973) explains this technique and presents the depth-area reduction curves for Western United States. More recent research for the arid western United States, presented in *Technical Memorandum,*

HYDRO-40 (NOAA, 1984), gives revised reduction factors applicable specifically to Arizona and New Mexico. For areas greater than 30 square miles, the Corps of Engineers presents slightly different depth-area reduction factors than those given in "HYDRO 40". These factors are based on an analysis of thunderstorms in the greater Las Vegas area. The six-hour Corps of Engineers' depth-area reduction factors, as presented in Table 502 of the *Hydrologic Criteria and Drainage Design Manual* (CCRFCD, 1990) were used for this study.

For the case where the flows from upstream watersheds are diverted and do not impact the point of interest, the entire upstream watershed area was not used in the determination of the applicable DARF. Since the outfall flow from the Gowan detention basin interacts with downstream watersheds, the watersheds upstream of the Gowan Basin were used to determine the applicable DARF's for certain points of interest downstream of the Gowan Basins.

For the Carey/Lake Mead area, two separate HEC-1 models were used in order to consider the worst case scenario. The first model (CAREY-F.DAT) was used for areas contributing to the Carey/Lake Mead detention basin, and the second model (WASH.DAT) was used for street flows downstream of the Carey/Lake Mead detention basin and along Washington Avenue. The second model utilized a higher DARF, a different storm distribution and assumed no flow diversions from north of Gowan Road.

Table 1 illustrates some of the depth-area reduction factors used in this study. In order to account for the increasing drainage area as stream flow routing proceeds downstream, the JR-card option of HEC-1 was used for adjustment of the point precipitation.

Table 1. Depth Area Reduction Factors (DARF)

Point of Interest	Area (mi)[2]	DARF[1]
Gowan Detention Basin	51.7	0.68
Kyle Canyon Detention Basin	58	0.67
Highway 95 and Rancho Drive Intersection	3.8	0.91
Highway 95 and Craig Road Intersection	15	0.83
Highway 95 and Gowan Road Intersection	18.6	0.80
Rancho Dr. and Washington Ave.[2] Intersection	3.1 (80.9)	0.92 (0.63)
Washington Ave. and Highland Dr. Intersection	6.4	0.9
Carey/Lake Mead Detention Basin[2]	8 (79.7)	0.88 (0.63)
Gowan Outfall Channel	80.8	0.63

[1] DARF factors are estimated by interpolation using Table 502, *Hydrologic Criteria and Drainage Design Manual*, CCRFCD.

[2] Two different storm centerings are modeled at these locations.

4.1.6 Storm Distribution

The *Hydrologic Criteria and Drainage Design Manual* (CCRFCD, 1990) recommends that two different six-hour duration storm distributions should be used in the Clark County area. Storm Distribution Number (SDN) 3 should be used for drainage areas less than ten square miles and SDN5 for drainage areas equal to or greater than ten square miles. For the large watershed models which include flow splits and diversions, the SDN5 rainfall distribution type was used to distribute point precipitation values. For the local area model (WASH.DAT), established in the Carey/Lake Mead and the Washington Avenue area, SDN3 was used and the upstream flow diversions were eliminated.

4.1.7 Curve Numbers

All curve numbers used in this study's hydrologic models were duplicated from the previous studies mentioned earlier. Antecedent moisture condition "II" was applied in all cases. No attempt was made to revise the curve numbers for this study.

4.1.8 Basin Lag

Basin travel time, or time of concentration (Tc), is the time required for water to flow from the most remote part of the drainage area to the point under consideration. The HEC-1 model utilizes the Soil Conservation Services' (SCS) lag time which is defined as "the time from the center of mass of rainfall excess to the peak discharge." As documented in the *Hydrologic and Drainage Criteria Manual* (CCRFCD, 1990), the SCS lag is given as approximately equal to 0.6 Tc.

Most lag time values used in the models are from previous studies. Procedures outlined in the *Hydrologic Criteria and Drainage Design Manual* (CCRFCD, 1990) were used to estimate lag times where it was necessary.

4.1.9 Stream Routing

In previous study HEC-1 models, Muskingum Routing and Kinematic Wave Routing Methods were used to route channel and overland flows. Within subbasin areas on the west side of Rancho Drive, the Kinematic Wave Routing Method resulted in many warnings and error messages. To correct this problem, the Kinematic Wave routings were replaced with the Muskingum routing method.

The parameters used in the Muskingum method were estimated using the same channel lengths, slopes, and Manning's "n" values specified in Kinematic

Wave Routing methods. The guidelines set forth in the HEC-1 manual were used to estimate values of K, t, and X.

4.1.10 Reservoir Routing

The Modified Puls routing method was used to route hydrographs through ponded areas and through detention basins. The outflow rating curves for each of the detention basins were taken from previous studies and design reports as referenced earlier. Modifications were made for the Angel Park and Carey/Lake Mead detention basins to reflect "as-built" conditions.

The Angel Park detention basin outfall facilities have been constructed, however, the basin excavation has not been completed and the gravel mining operator has ceased excavation. To account for the reduced volumes of storage, field surveyed data was used to develop storage rating curves (refer to Appendix II - Section 4). The Carey/Lake Mead detention basin storage rating curves were modified based upon construction plans prepared by VTN.

4.1.11 Diversions

Flows which exceed the capacity of a channel may leave the channel either temporarily or permanently. In such cases, the diversion card option in the HEC-1 model was used to quantify diverted flows.

A majority of the diversions modeled in this study were taken from previous studies. Flow diversions along Highway 95 and Rancho Drive, between Ann Road and Gowan Road, and also along Rancho Drive between Lake Mead Boulevard and Washington Drive, were reviewed in detail and revised as appropriate as a part of this study. Diversion ratings were based upon physical measurements of culvert and channel structures (see Appendix III - Section 4),

and a review of topographical maps in the area (Aerial Mapping Co., 1993, and Cooper Aerial of Nevada, Inc., 1984).

4.2 *Study Assumptions and Modifications*

As previously mentioned, many hydrologic studies within the study area have been prepared and these studies have been used as a basis for the hydrologic models presented in this report. The FIS hydrology models (JMM, 1991) were used as the base HEC-1 models and other hydrologic studies were used to update and modify them (see Figure 2).

4.2.1 Modifications to Existing FIS Hydrology (Gowan and Northern Las Vegas Area)

The existing FIS hydrology models were modified as follows:

1. Many kinematic wave routings were replaced with Muskingum routings to minimize errors and warning messages. The same hydraulic parameters, which were used in the Kinematic wave routing cards (RK cards), were used to develop the Muskingum routing cards (RM cards).
2. The Kyle Canyon detention basin was not modeled in the existing FIS hydrology. VTN Nevada's report *Outfall Study for the Kyle Canyon Detention Basin* and a copy of the HEC-1 model were used to model the effect of the Kyle Canyon detention basin in place (Appendix III - Section 2, KYLE.DAT).
3. The existing FIS hydrology indicates that watersheds north of Craig Road and west of Highway 95 predominantly contribute runoff to the Gowan North basin. Contrary to the FIS hydrology, the report *Revised Technical Study for the Las Brisas Norte Residential Subbasin* (Church,

1992) indicates that many of these watersheds do not currently contribute to the Gowan basin.

After a review of both reports and field inspections, it was found that some runoff from the watersheds to the north would likely bypass the Gowan basins, as presented in the Las Brisas study. This runoff will reach the west side of Highway 95 and flow south to Gowan Road. The detailed hydraulic analysis, as presented in Section 5.0 and in Appendix IV of this report, documents flow diversions that occur along Highway 95. Modifications to the FIS hydrology were made accordingly.

4. Multiple flow diversions occur along Rancho Drive, north of Ann Road, and were modeled in the FIS hydrology. It was assumed that these diversions occur as originally modeled. While the diversion cards remain unaltered, the magnitude of flow diversions across Rancho Drive has changed as a result of the inclusion of the Kyle Canyon Detention Basin in the HEC-1 model.

5. Diversions within the detailed study area were modified to reflect field measured conditions. These diversions were based upon culvert, channel and weir hydraulic analyses as presented in Appendix III - Section 4.

6. The Angel Park detention basin is partially constructed, but the construction has temporarily ceased due to a dispute between the gravel mining operator and the Bureau of Land Management. Since the completion date is unpredictable, the existing capacity of the detention basin was modeled rather than the design capacity. This is a change from the FIS hydrology. It was also assumed that any overflow from

the south Angel Park detention basin spillway will leave the study area because there are no downstream facilities to collect and convey the overflow into the study area.

7. The Buffalo Channel is planned to be extended south to Doe Avenue. Extension of the Buffalo Channel south of Summerlin Parkway will be via a closed conduit system (VTN, 1993). It is assumed that the storm drain inlets will intercept the 100-year street drainage per the design report. Watershed GC35 (see Figure 5) is included and routed to the Gowan south basin.

8. VTN Nevada indicated in their report titled *Drainage Study for Silver Mesa* that split flows would occur along Gowan Road between Highway 95 and Rancho Drive. The first split flow occurs near the intersection of Jones Boulevard and Gowan Road. Results from the HEC-2 analysis in VTN's report indicate that some drainage that reaches Jones Boulevard will flow west along Morro Bay Lane. This diverted flow will reach Rancho Drive, south of Gowan Road. Another flow diversion would occur behind the True Value Hardware store, which is located west of the intersection of Rancho Drive and Gowan Road (see Section 5.4.4). The diversions at these locations were first noted in the Silver Mesa Study (VTN, 1989) and were modified for use in this study. Results were found to be similar to those given in the Silver Mesa study.

9. At the intersection of Gowan Road and Rancho Drive, flow splits would occur in three directions (see Section 5.4.3). Flow diversions at this location were determined by the use of the HEC-2 model and weir flow

computations, as documented in Appendix IV - Section 3). The FIS hydrology was modified accordingly. Parameters used in calculation of diversion flows were taken from field measurements and detailed topography and are presented in Appendix III - Section 4.

10. The FIS HEC-1 model hydrology does not account for the construction of the Carey/Lake Mead detention basin and the Lake Mead and Carey Avenue storm drain systems. The *Predesign Memorandum for Carey/Lake Mead Detention Basin* (VTN, 1990) studied this area in detail. In this area, the FIS HEC-1 model (see Figure 2) was replaced with the HEC-1 model presented in the above mentioned report. The Carey/Lake Mead detention basin storage rating curves were modified based upon construction plans prepared by VTN.

11. The FIS HEC-1 model hydrology does not account for an existing concrete lined channel which flows north to south from Washington Avenue to Bonanza Drive, just west of Valley View Drive. This channel diverts a portion of watershed 309E (Figure 9) to a 48-inch diameter pipe which crosses Bonanza Drive and exits at a culvert structure across Highway 95. A portion of watershed 310E also drains directly to this culvert structure. The two flows combine and leave the study area.

4.3 Results

The computed 100-year, 6-hour peak discharges at key concentration points are compared with the results from previous studies in Table 2. Differences may be attributed in part due to higher point precipitation values, changes in the DARF,

inclusion of new flood control facilities, and modification of flow diversions. The computed 100-year discharges presented used in the approximate and detailed hydraulic analysis for this flood insurance study restudy.

Where significant flow diversions occur upstream of the point of interest, the watershed was modeled for two scenarios as follows: (1) with the larger drainage area, a correspondingly smaller DARF and the diversion into the watershed; and (2) with a smaller drainage area, larger DARF and no diversions. Where warranted, SDN 3 was used instead of SDN 5. It is recommended that the larger peak discharge, as highlighted in Table 2, is used for flood insurance purposes.

6.0 Approximate Study Area

The currently effective Flood Insurance Rate Maps identify numerous floodprone areas within the study area. A rapid growth in urban development, and recently constructed flood control facilities have altered the risk of flooding within portions of the study area. In many areas, designated as Zone "A" or Zone "AO", the magnitude of flood risk has been substantially reduced or even eliminated. The Committee selected several areas to be restudied and these areas are identified in Figure 13. The currently regulated Zone "A" and Zone "AO" flood zones and recently constructed major flood control facilities are illustrated in Plate 1.

For major flood control facilities, design reports and construction plans of flood control facilities were compiled and reviewed (extracts are included in Technical Appendix II). Approximate study methods based upon field reconnaissance, available topographic maps, revised hydrology per Section 4.0, and as-built construction drawings, were used to determine whether the existing areas of Zone "A" or Zone "AO" should be removed or revised. All supporting calculations, Annotated D-FIRMs, and FEMA forms for requests for LOMRs are included in Appendix V.

6.1 Carey/Lake Mead Area

The Carey/Lake Mead Detention Basin is located along the alignment of Simmons Street between Carey Avenue and Lake Mead Boulevard, Section 20, Township 20S, Range 61E, M.D.M. The purpose of this study is to revise the existing flood zone to indicate Zone "A" within the limits of the basin.

The Carey/Lake Mead Detention Basin was designed by VTN, Nevada. Abstracts taken from the design and construction documents are included in Appendix II - Section 3. This project was funded by the Clark County Regional Flood Control District, with a final walk through inspection on September 6, 1992. This study concludes that the

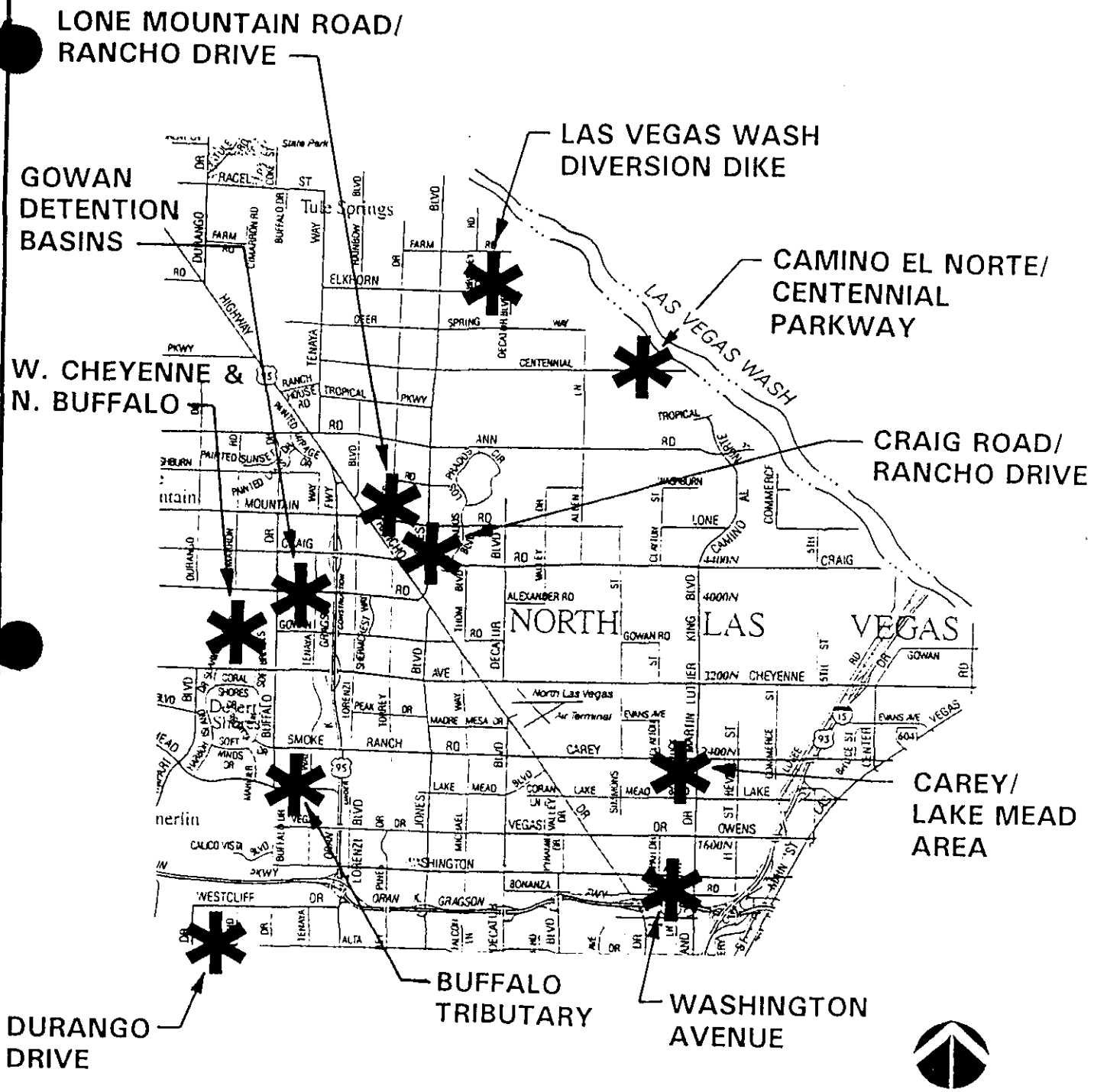

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FIGURE 13
APPROXIMATE STUDY
LOCATION MAP

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limits of the detention basin should be designated as Zone "A" (refer to Appendix V - Section 1).

6.2 West Cheyenne and North Buffalo

This flood Zone "A" is located in the Southeast Quarter of the Southwest Quarter of Section 9, Township 20S, Range 60E, M.D.M., adjacent to West Cheyenne Avenue and North Buffalo Drive, Las Vegas, Nevada (FIRM Map No. 32003C, Panel 2135D). The zone was mapped as a local, depressed area designated by FEMA as Zone "A". The enclosed topographic map (refer to Appendix V - Section 2) indicates that this local depression which existed on the western edge of the flood zone has subsequently been removed.

6.3 Gowan Detention Basins

6.3.1 Gowan South Detention Basin

The Gowan South Detention Basin is located southeast of the intersection of Cheyenne Avenue and North Buffalo Drive, Section 15, Township 20S, Range 60E, M.D.M. The purpose of this analysis is to revise the existing limits of the Zone "A" at the Gowan South Detention Basin. The proposed revision would reduce the existing Flood Zone "A" to the limits of the basin itself (refer to Appendix V - Section 3).

The Gowan South detention basin was designed by the Poggemeyer Design Group. This project was coordinated and funded by the Clark County Regional Flood Control District. The purpose of the Gowan South Detention Basin is to reduce the peak discharge from the upstream hydrograph by flow detention and discharge of the attenuated flow into the Gowan outfall.

6.3.2 Gowan North Detention Basin

The Gowan Detention Basins, Lower and Upper North are located adjacent to Gowan Road between Buffalo Drive and Highway 95, in Section 10, Township 20S, Range 60E, M.D.M. The purpose of this study is to revise the Flood Insurance Rate Map to add Flood Zone "A" at the location of each basin. The existing Flood Insurance Rate Map shows no Flood Zone "A" at the Gowan Basins.

The Gowan Detention Basins were designed by the Poggemeyer Design Group. The project was coordinated and funded by the Clark County Regional Flood Control District. The purpose of the Gowan Detention Basins, Lower and Upper North is to reduce downstream flooding (refer to Appendix V - Section 3).

6.4 Durango Drive

This study area is located northeast of the Durango Drive and Charleston Boulevard intersection, in the City of Las Vegas, Nevada, within the southwest corner of Section 33, Township 20S, Range 60E, M.D.M. The purpose of this request for a LOMR is to eliminate the existing Zone "A" due to changed conditions which have resulted from the construction of Durango Drive.

Durango Drive was designed by Engineers and Surveyors, Inc. (ESI). Funding for Durango Drive was shared by the Clark County Regional Transportation Commission (CCRTC) and the Clark County Regional Flood Control District (CCRFCD). Portions of the CCRFCD funding provided for the installation of a 84-inch storm drain in Durango Drive. This storm drain, along with street flows in Durango Drive, direct storm runoff north, thereby removing the source of flooding for the existing Zone "A". The results of this study conclude that the existing Zone "A" is no longer necessary

because Durango Drive would act as a barrier to upstream flows from the west and would divert these flows to the north (refer to Appendix V - Section 4).

6.5 Buffalo Channel and Tributary

This study area is located north of Lake Mead Drive, and west of Highway 95 in the City of Las Vegas, Nevada, within Sections 22 and 23, Township 20S, Range 60E, M.D.M. The purpose of this LOMR is to reduce the existing Zone "A" designation west of the Buffalo Channel based upon revised 100-year water surface elevation computations and to remove the existing Zone "A" designation east and downstream of the Buffalo Channel.

The natural drainage channel to the west outlets into the existing Buffalo Channel, a construction project funded by the Clark County Regional Flood Control District (CCRFCD), the City of Las Vegas, and Clark County. Design plans for Buffalo Channel from Vegas Drive to 500 feet north of Peak Drive were prepared by G.C. Wallace, Inc. Design plans for Buffalo Channel from Summerlin Parkway to Vegas Drive were prepared by VTN Nevada.

This study concludes that the Zone "A" delineation should be reduced to the 100-year water surface elevation, as plotted on the enclosed exhibit (refer to Appendix V - Section 5). The Zone "A" located downstream (east of the Buffalo Channel) should be removed and shown as "contained within the Buffalo Channel."

6.6 Camino El Norte/Centennial Parkway

The effective FIRM and preliminary D-FIRM both show a large approximate Zone "A" located north of Centennial Parkway near Clayton Road. This flood zone lies within the City of North Las Vegas, in portions of Section 21, 28, and 33, Township 19S, Range 61E, M.D.M., Clark County, Nevada. This area is located downstream of the Upper Las Vegas Wash Detention Basin and Diversion Dike. The diversion

structures were designed by Black and Veatch, and funded by the Clark County Regional Flood Control District. The City Council of North Las Vegas accepted the Notice of Completion on January 19, 1994.

The purpose of the Diversion Dike is to route flows from the Upper Las Vegas Wash to the Upper Las Vegas Wash Detention Basin. As a result, the contributing drainage area to the currently designated Zone "A" has been reduced. This restudy reviews the hydrology and hydraulics of the upstream drainage with the diversion dike in place. It concludes that much of the Zone "A" delineated on the preliminary D-FIRM can be reduced as a result of the new upstream Diversion Dike and Upper Las Vegas Wash Detention Basin.

6.7 Las Vegas Wash Diversion Dike

The purpose of this revision is to change an existing Zone "A" to Zone "X". The Zone "A" is located in portions of Sections 2, 3, 11, 12, 13, and 14, Township 19 South, Range 60 East, FIRM No. 320003-0775B and 325276-0010B.

The Upper Las Vegas Wash Diversion Dike and Detention Basin were constructed as a part of the CCRFCD *Flood Control Master Plan*. The dike's purpose is to contain runoff within the Las Vegas Wash, and to discharge flow into the Upper Las Vegas Wash Detention Basin. The construction plans were prepared by Black & Veatch for the City of North Las Vegas in 1991, and the construction was completed in January 1994. This project was funded by the Clark County Regional Flood Control District.

As a result of construction of the Upper Las Vegas Wash Diversion Dike, the flow which used to inundate the subject area is now diverted east to the Upper Las Vegas Wash Detention Basin. Only local runoff with a drainage area of less than one square mile now contributes to the currently designated flood zone (refer to Appendix V - Section 7).

6.8 Lone Mountain Road/Rancho Drive

The purpose of this revision is to change an existing Zone "A" to Zone "X". The Zone "A" is located in Section 35, Township 19 South, Range 60 East and Section 2, Township 20 South, Range 60 East, FIRM No. 325276-0015C.

The construction of Highway 95 between Gowan Road and Rancho Drive was completed in 1979. This project was federally funded and was designed by the Nevada Department of Transportation (NDOT). The Highway 95 is elevated above adjacent ground and forms a barrier to drainage flows along its length.

Highway 95 would divert a majority of the 100-year discharge south along its east side toward Gowan Road. As a result, the flows reaching Rancho Drive have been much reduced and only minor diverted flows and local runoffs impact areas along Rancho Drive.

At the intersection of Rancho Drive and Lone Mountain Road, approximately 120 cfs diverts west through culverts under Rancho Drive and inundate the subjected area, designated as Zone "A". A hydraulic analysis was performed to evaluate the flow depth. The average flow depth was found to vary from 0.2 feet to 0.5 feet. Hydraulic calculations and cross section locations are included in Appendix V - Section 8.

6.9 Craig Road/Rancho Drive

The purpose of this revision is to eliminate an existing Zone "A", east of Rancho and Craig Road intersection. The Zone "A" is located in Sections 1 and 2, T20S, R60E, FIRM No. 325760015C.

The Craig Road storm drain system was constructed as a part of the Regional Transportation Commission's (RTC) Craig Road Project. The project was funded by RTC and sponsored by the City of Las Vegas and its purpose was to widen the existing

road and to reduce flooding along Rancho Drive. The design was started and largely finished by Hefner Engineering but was finalized by the City of Las Vegas. The construction of the Craig Road storm drain system has recently been completed.

The Craig Road storm drain system intercepts and conveys the 100-year discharge at the intersection of Craig Road and Rancho Drive to east. No flow continues south along Rancho Drive past Craig Road. Only minor local runoff impacts the area along Rancho Drive between Craig Road and Alexander Road. Therefore, the flow which used to impact the subjected area, currently designated as Zone "A", has been eliminated (refer to Appendix V - Section 9).

6.10 Washington Avenue

The existing Zone "AO" is located in Sections 20, 27, 28 and 29, Township 20 South, Range 61 East, D-Firm Numbers 2155, 2160, and 2170 as shown on enclosed maps. Rapid urban development and construction of upstream flood control facilities have resulted in a reduction of the magnitude of flooding in the subject area. The purpose of this revision is to redelineate and revise the flood zones within the area. Two HEC-2 models were created to analyze the flood hazards in the area north of Highway 95 and south of Vegas Drive between Rancho Drive and Interstate 15.

Results from the HEC-2 analysis indicate that the flood zone, currently designated as Zone "AO" has an average depth of less than one foot. A change to Zone "X" is therefore requested with the boundary changes as indicated on the exhibit and annotated D-FIRM presented in Appendix V - Section 10. South of Bonanza Drive, the results indicate that a new flood zone exists with average depths over one foot. It is requested that this area be designated as Zone "A".

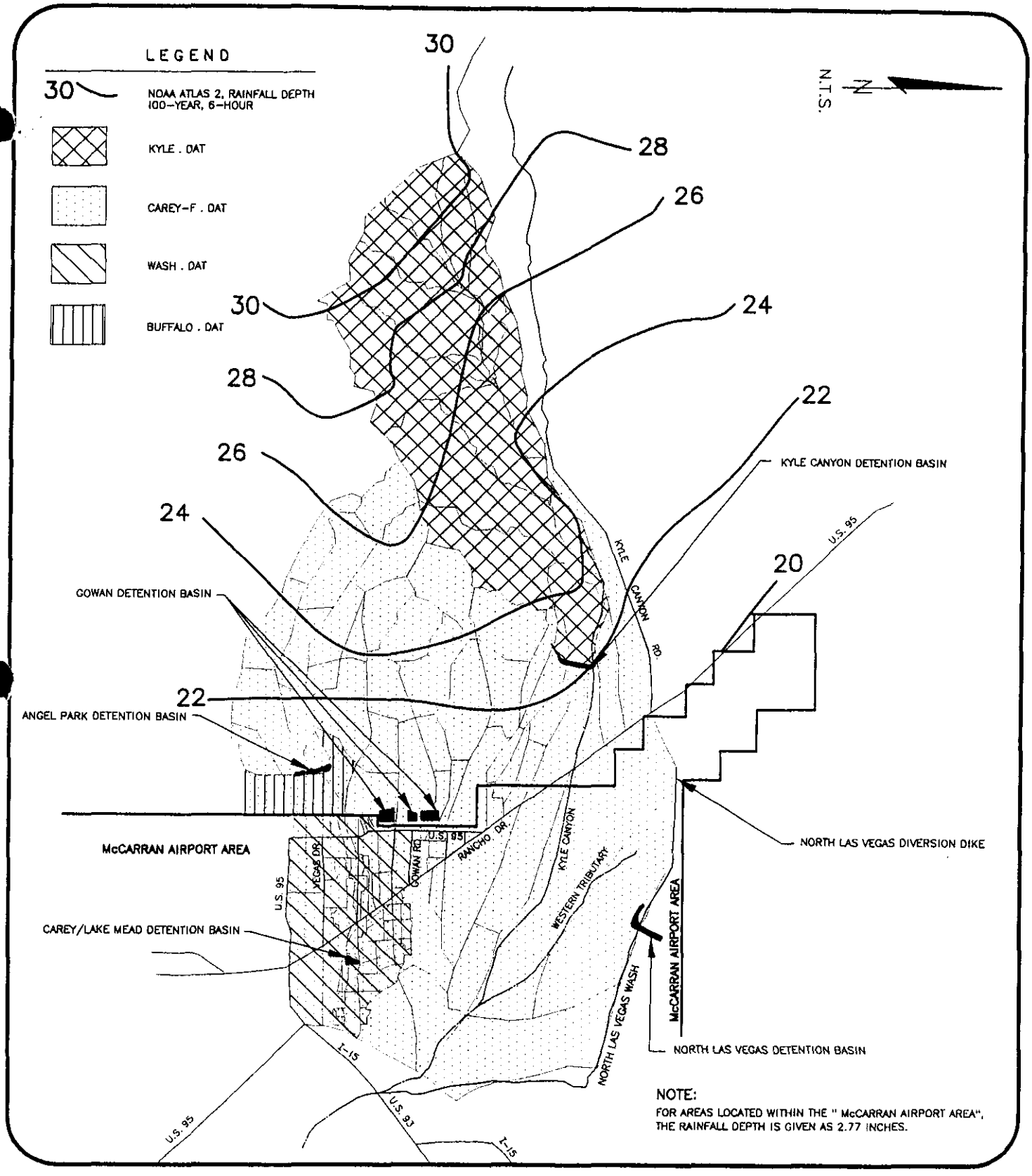

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FIGURE 3
HEC-1 MODELS
INDEX MAP

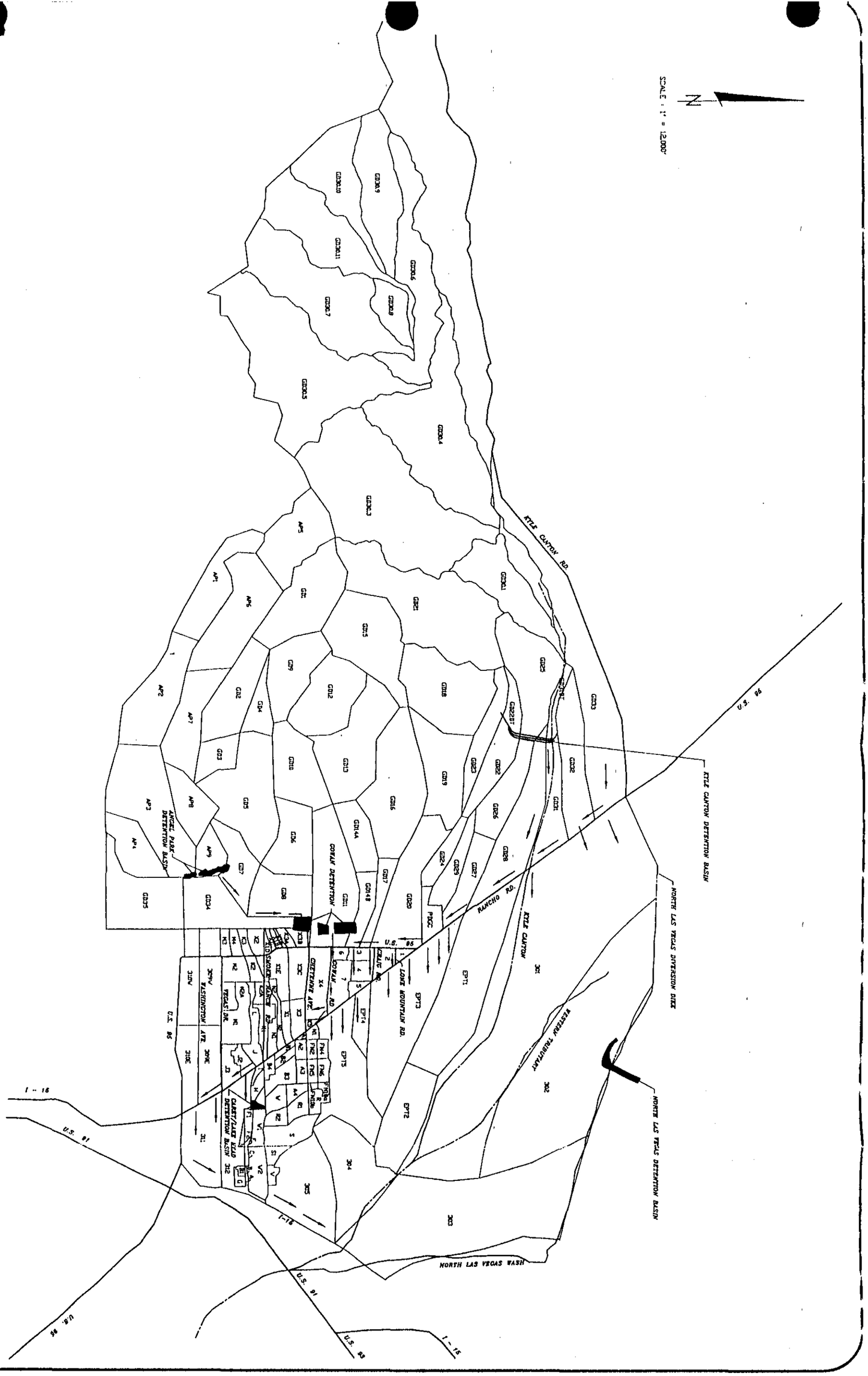

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FIGURE 4

WATERSHED MAP

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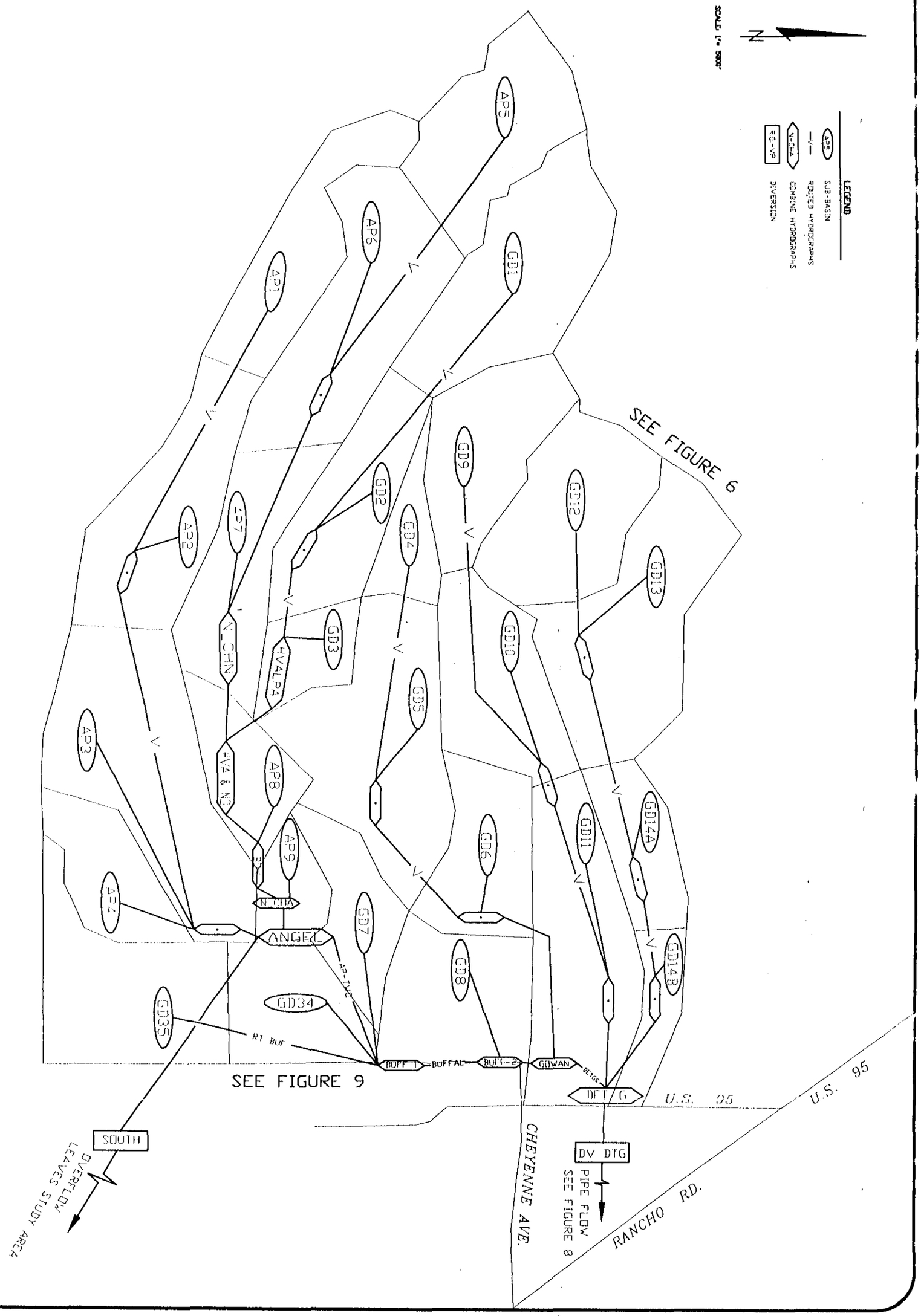

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FIGURE 5

WATERSHED/SCHEMATIC MAP

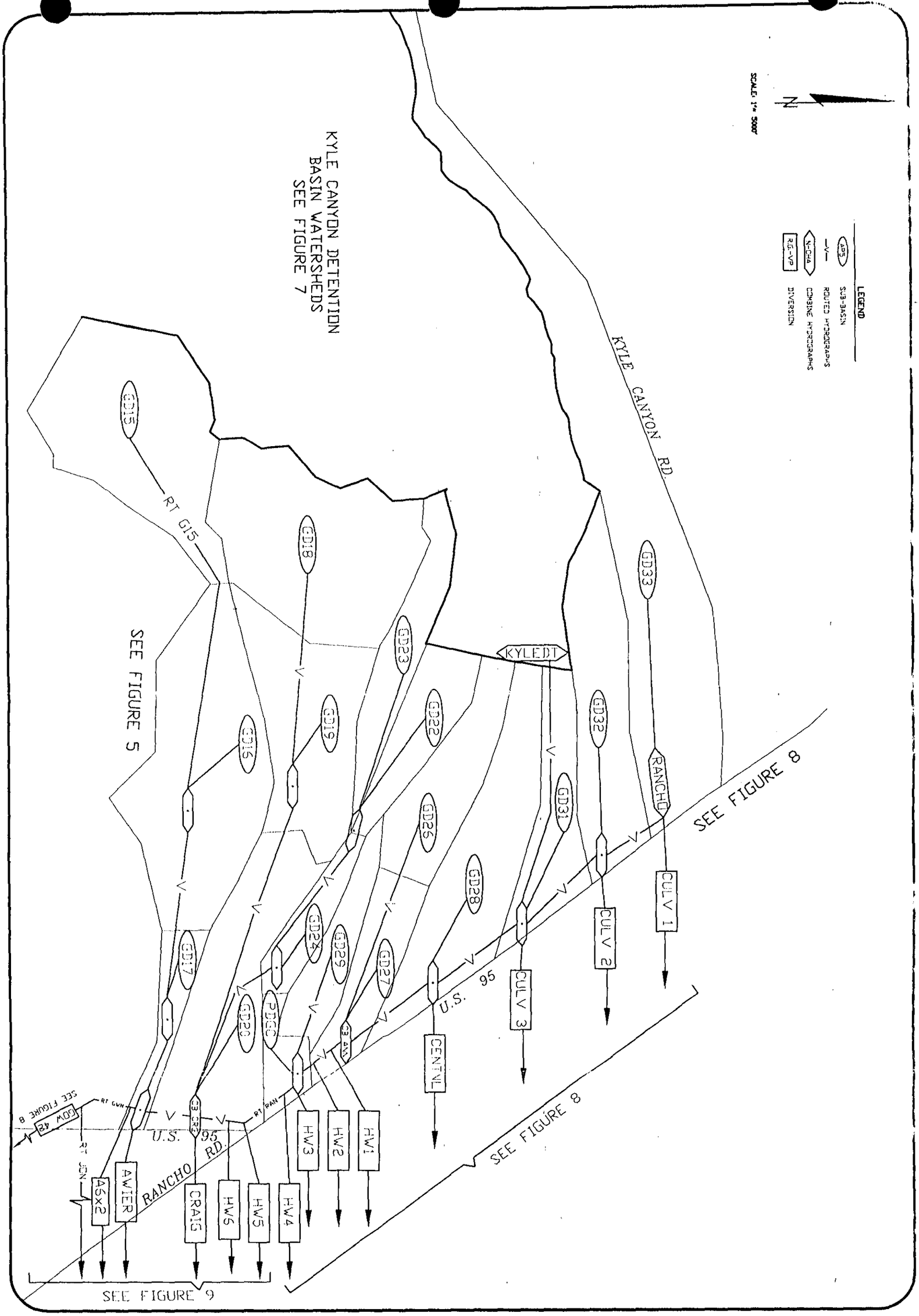

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FIGURE 6
WATERSHED/SCHEMATIC MAP

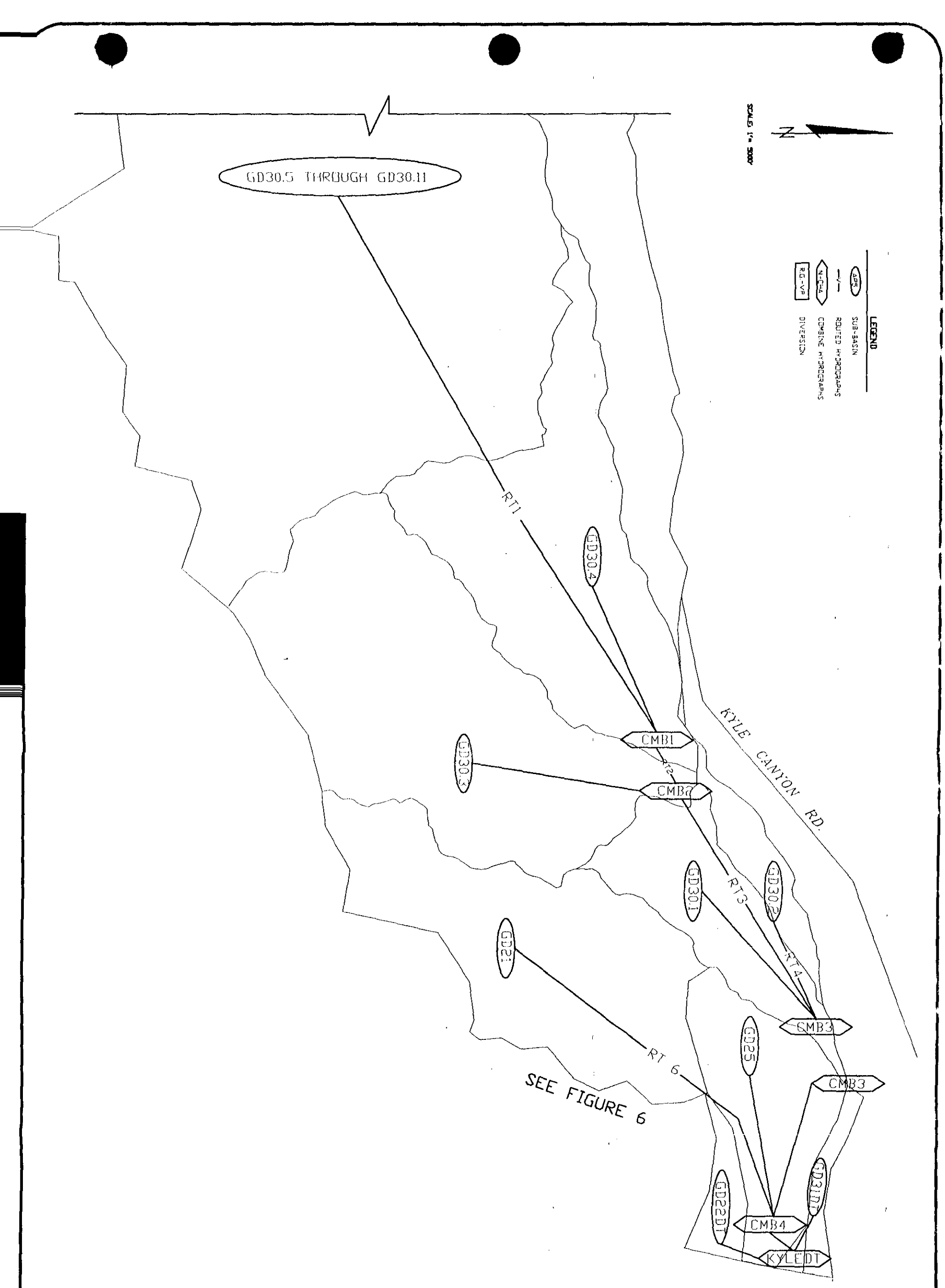

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FIGURE 7

WATERSHED/SCHEMATIC MAP

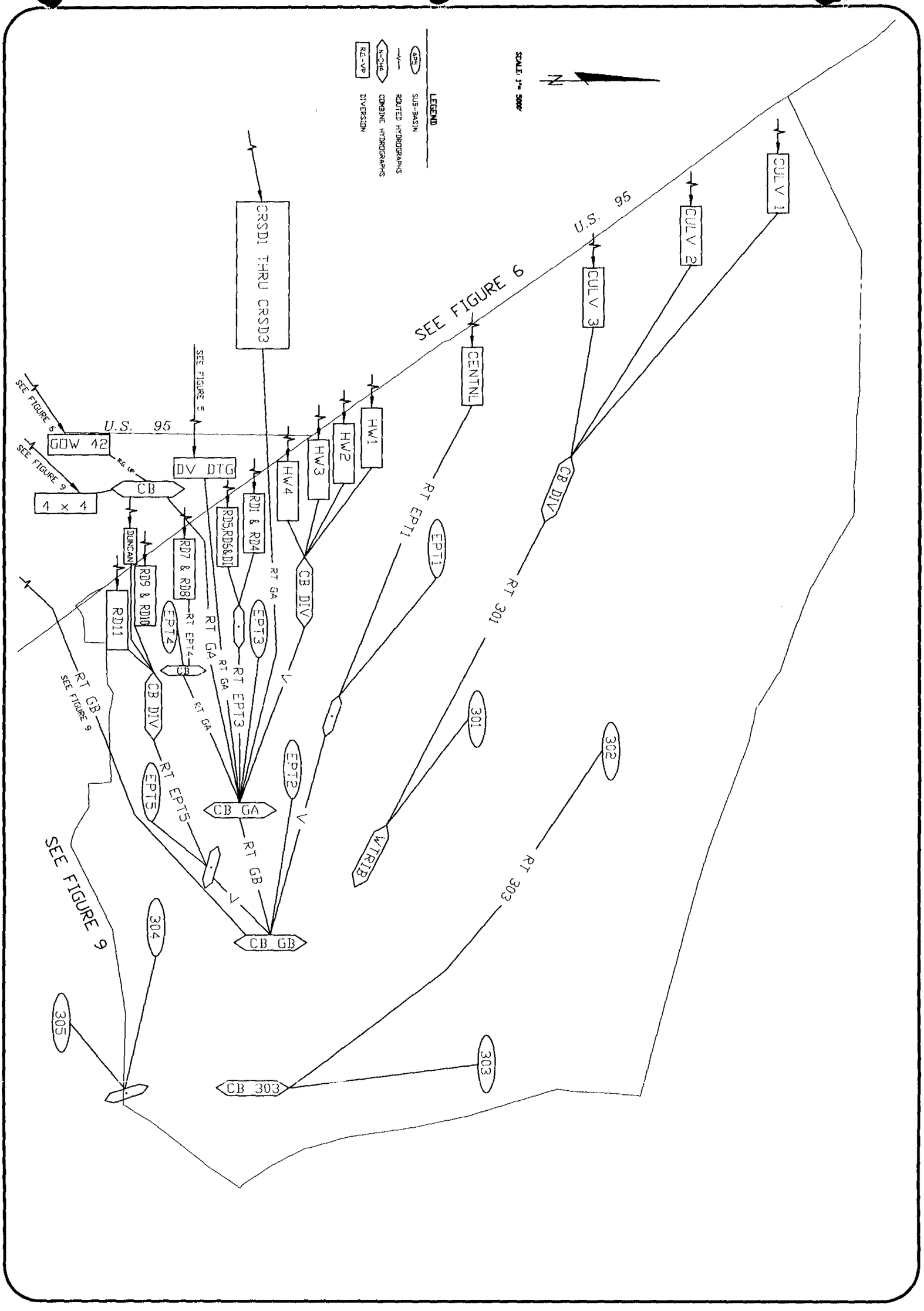

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FIGURE 8
WATERSHED/SCHEMATIC MAP

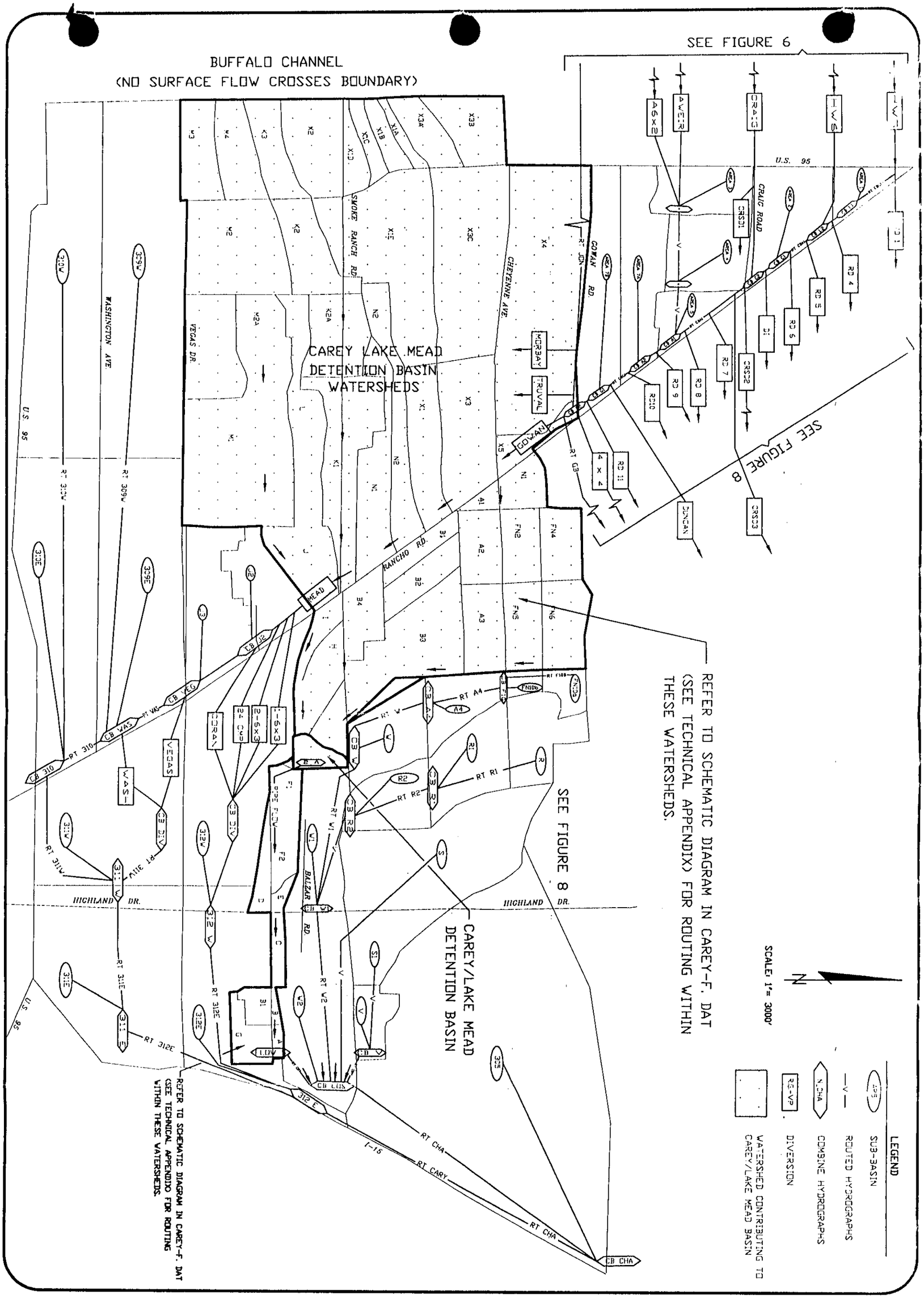

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FIGURE 9

WATERSHED/SCHEMATIC MAP

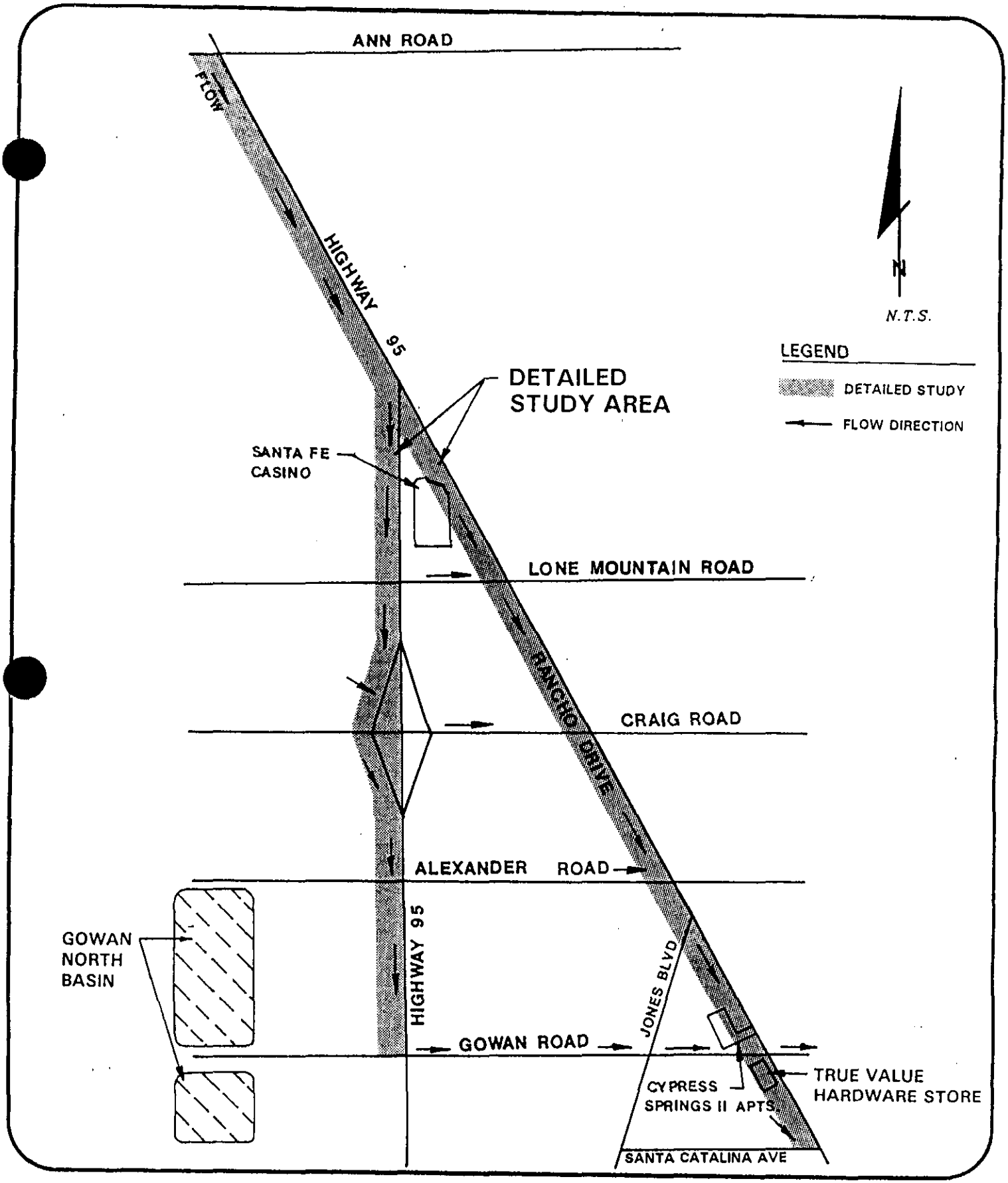

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FIGURE 10
LIMIT OF DETAILED STUDY AREA

5.0 Detailed Study Area

5.1 Introduction

The area of detailed study was selected by the Committee and extends from Ann Road on the north, south along both Rancho Drive and Highway 95 to Gowan Road (Figure 10). Selection was based upon funding limitations and the need to study areas of known flooding. New 1 inch = 200 feet mapping, with a contour interval of 2 feet, was obtained for the purposes of this study. Mapping was limited to a strip of approximately 2000 feet in width along both Highway 95 and Rancho Drive. Detailed hydraulic analyses and floodplain delineation maps with Base Flood Elevations (BFEs), were prepared for the area of detailed study.

The effective FIRM shows an approximate Zone "A" along the west side of Rancho Drive from Ann Road to Washington Avenue. Approval by FEMA will result in replacement of this approximate zone with the detailed analysis from Ann Road to just south of Gowan Road. The effective FIRM does not depict the flooding that can now occur along the west side of Highway 95 since it was constructed after the original FIS was conducted.

5.2 Engineering Method

5.2.1 Methodology

The U.S. Army Corps of Engineers' (COE) *HEC-2 Water Surface Profiles*, (1991) computer model was used to compute the 100-year water surface elevations within the detailed study area.

The detailed study reaches were modeled as sub-critical profiles. The downstream starting water surface elevation was based on either the slope-area method or computed water surface elevations obtained by weir flow or culvert

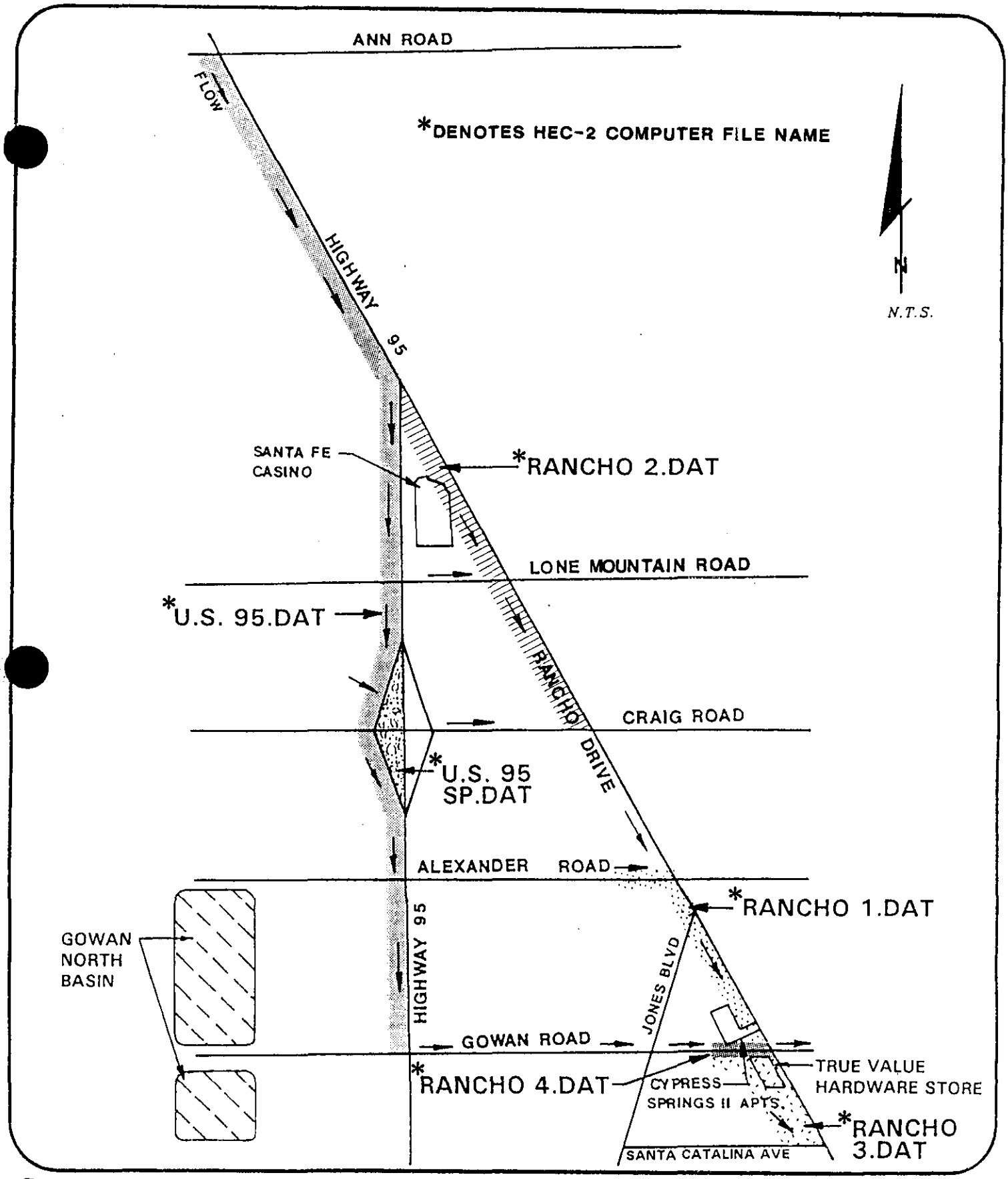

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FIGURE 11
HEC-2 MODEL
INDEX MAP

flow rating curves. Many complex hydraulic conditions exist within the detailed study area which cannot be modeled through the use of the HEC-2 computer program alone. At certain locations, culvert rating curves were developed using charts based upon inlet control flow conditions. The water surface elevations computed by rating curves were input into HEC-2 models using X5 cards. All rating calculations were based upon physical measurement of culverts and channel structures, and a review of topographical maps. Culvert rating computations are included in Appendix III - Section 4 and Appendix IV - Section 3.

The 100-year floodplain boundaries (see Appendix IV - Section 4) were delineated based on HEC-2 computed water surface elevations at each cross-section. HEC-2 cross-section information was obtained from spot elevations digitized by the aerial mapping contractor. The floodplain boundaries were then interpolated between cross-sections using topographic maps at a scale of 1 inch = 200 feet with a contour interval of 2 feet.

In some areas, the digital cross-sections do not yield the same floodplain width as the topographic contours. This discrepancy is the result of the difference in accuracy between spot elevations and contours; however, in these areas, the results are within National Map Accuracy Standards. Floodplain boundaries were delineated based on contours. In some areas, encroachment cards (ET cards) were used to block out ineffective flow areas. Therefore, "SSTA" and "ENDST" do not always represent the actual flooding limits.

5.2.2 Cross-section Description

All cross-sections are stationed from left to right looking downstream. Cross-section numbers for both Rancho Drive and Highway 95 are stationed in

river miles assuming river mile 10.00 starts at the center line of Gowan Road. The cross-sections are generally placed perpendicular to the direction of the flow and extend across the entire floodplain. Most cross-sections were photogrametrically digitized by the aerial mapping company; however, some cross-sections were derived from the topographic mapping

5.2.3 Manning's "N" Values

The roughness factors ("N" values) were estimated based on field investigations, topographic mapping, and photographs of the area.

Table 3. Manning's "N" Values

Highway 95	
"N" value for the channel	0.025 - 0.030
"N" value for the overbanks	0.025 - 0.055
Rancho Drive	
"N" value for the channel	0.025 - 0.030
"N" value for the overbanks	0.030 - 0.055

5.2.4 Expansion and Contraction Coefficients

Within a given reach, expansion and contraction coefficients were used to model energy losses that may result from changes in shape of the conveyance cross-sections. For changes in conveyance cross-section, the contraction and expansion coefficients used were 0.1 and 0.3, respectively, whereas coefficients of 0.3 and 0.5 were used in the vicinity of culverts.

5.3 Highway 95

Many complex hydraulic conditions exist along Highway 95 which cannot be modeled with the use of the HEC-2 computer model alone. To supplement the HEC-2 analysis, the 100-year water surface elevations at certain locations were calculated from rating curves developed for weir and culvert flows (see Appendix IV - Section 3 for calculations). The water surface elevations thus computed were input into the HEC-2 model using X5 cards.

Two HEC-2 models were created to compute the water surface elevations along Highway 95 between Ann Road and Gowan Road (see Figure 11). HEC-2 models and flow rating calculations are included in Appendix IV.

5.3.1 Lone Mountain Road & Highway 95 Intersection

Flow near the Lone Mountain overpass of Highway 95 would be conveyed east, under Highway 95, by two existing 6' x 2' box culverts (see HW6, Figure 12). These box culverts would divert flow east to Rancho Drive along Lone Mountain Road. Since it is not practical to model culverts that are aligned perpendicular to the main flow cross-sections using HEC-2, split flow rating curves were calculated outside of the HEC-2 model (see Appendix III - Section 4 for calculations).

5.3.2 Craig Road and Highway 95 Intersection

Approximately 1400 feet north of Craig Road, a total 100-year peak discharge of 1680 cfs would be diverted through six 8' x 3.1' box culverts (see HW7, Figure 12) and overtop the off-ramp into an area between Highway 95 and the southbound off ramp. This diverted discharge would continue south under Craig Road through a concrete channel and four 10' x 4' box culverts (HW8)

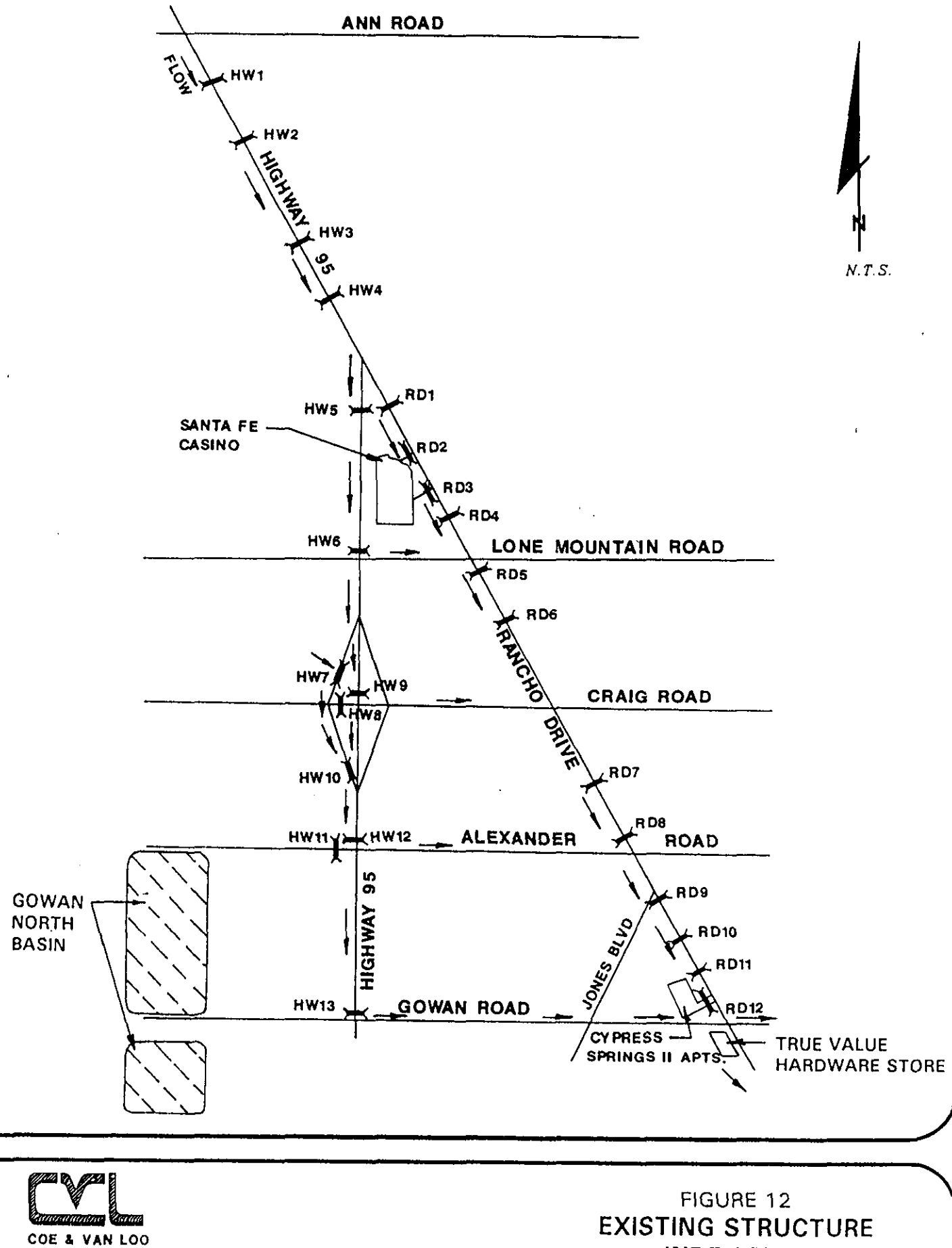

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FIGURE 12
EXISTING STRUCTURE INDEX MAP

After overtopping the southbound on-ramp and flowing through six 8' x 3' box culverts (see HW10, Figure 12), this flow would combine with the main flow to the west.

A separate HEC-2 model was created to compute 100-year water surface elevations for areas between Highway 95 and the southbound on and off ramps.

5.3.3 Alexander Road and Highway 95 Intersection

At approximately 750 feet north of Alexander Road, the capacity of the flow conveyance area decreases to a point where it would cause water to overtop Highway 95 and flow east toward Rancho Drive. The HEC-2 split flow routine was used to compute the amount of weir flow over Highway 95. Some minor flow would flow south in the median area and recombine with the main channel at approximately 1100 feet north of Gowan Road.

At the intersection of Alexander Road and Highway 95, two 6' x 2' box culverts under Highway 95 (see HW12, Figure 12) would divert some flow east toward Rancho Drive. The remaining flow would continue south under Alexander Road in a concrete channel and 4 - 10' x 4' box culverts (see HW11, Figure 12).

5.3.4 Gowan Road and Highway 95 Intersection

Immediately north of Gowan Road, flow splits would occur in three directions. Two 9' x 2.2' box culverts (see HW13, Figure 12) under Highway 95 would convey flow to the east and a drop inlet would divert flow to the Gowan Pipe outfall system. The remaining flows would weir over a dike to the south and then flow east within Gowan Road. Split flow rating curves were

prepared (see Appendix IV - Section 3) and the X5 card used to input the calculated starting water surface elevation into the HEC-2 model.

5.4 Rancho Drive

Similar to Highway 95, many complex hydraulic conditions exist along Rancho Drive which cannot be modeled within the HEC-2 computer model alone. The 100-year water surface elevations at such locations were calculated using flow rating curves (see Appendix IV - Section 3). The calculated water surface elevations were input into the HEC-2 models using X5 cards at appropriate cross-sections.

Four HEC-2 models were created to compute water surface elevations for Rancho Drive between Highway 95 and Santa Catalina Avenue (see Figure 11). HEC-2 models and hand calculations are included in Appendix IV.

5.4.1 Rancho Drive and Lone Mountain Road Intersection

Approximately 171 cfs would flow east along Lone Mountain Road to Rancho Drive where it would combine with the main channel flow within Rancho Drive at the intersection of Lone Mountain Road. The total 100-year peak discharge would weir flow over Lone Mountain Road and flow south along the west side of Rancho Drive. Weir flow computations were performed and the calculated water surface elevations were incorporated into the HEC-2 model.

5.4.2 Rancho Drive and Craig Road Intersection

Prior to the intersection of Rancho Drive and Craig Road, the total 100-year peak discharge would be intercepted by the Craig Road storm drain system. The Craig Road storm drain system conveys flows east to the Gowan outfall pipe system. No flow would continue along Rancho Drive south of Craig Road. Only

local runoff would impact areas between Craig Road and Alexander Road along Rancho Drive.

5.4.3 Rancho Drive and Gowan Road Intersection

The 100-year peak discharge would split into three directions near the intersection of Gowan Road and Rancho Drive. A 4' x 4' box culvert inlet would divert flow to the Gowan pipe outfall system. The remaining flow would weir flow over both Rancho Drive and Gowan Road and flow to the east and south, respectively.

The starting WSEL for the HEC-2 model was based upon split flow rating curves (see Appendix IV - Section 3). An X5 card was used to input the starting WSEL.

5.4.4 Split Flow Behind True Value Hardware Store

A 100-year peak discharge of 1840 cfs would flow east in Gowan Road to Rancho Drive. As documented in Section 4.2.1 - Item 8, some of the flow would be diverted away from Gowan Road near Jones Boulevard. At approximately 500 feet west of Rancho Drive, near the True Value hardware store, a flow split would occur in two directions. Approximately 800 cfs would continue east in Gowan Road and 1040 cfs would overtop Gowan Road and flow south behind the True Value hardware store.

Since the split flow is not controlled by either the weir flow or the channel flow alone, the split flow routine option in the HEC-2 was not used to estimate the diversions. Instead two HEC-2 models, with the same cross sections at the upstream end, were generated. The split flow was estimated by changing

discharges in both HEC-2 models until the energy grade elevations at the upstream cross-sections matched in both models.

Table 2. Summary of Discharges

Location[1]	HEC-1 I.D.	100-Year, 6-Hour Discharges (cfs)																		
		Storm Centering	SDN 3 (from model WASH.DAT unless otherwise noted)							SDN 5 (from model CAREY-F.DAT unless otherwise noted)							FIS Hydrology by JMM 1991	Church[5] *Engineering* 1992	Master Plan *Design* Q	VTN Nevada[6] 1989, 1993
		DARF (sq. mi.)	0.98 (0.6)	0.95 (1.5)	0.92 (3.1)	0.91 (4.6)	0.9 (6)	0.89 (7)	0.88 (8)	0.91 (4)	0.83 (15)	0.8 (18.6)	0.75 (28.7)	0.68 (52)	0.67 (58)	0.63 (80.5)				
Kyle Canyon Detention Basin Inflow	INFLOW														3427[9]					13310
Below Kyle Canyon Detention Basin	KYLEDT														360[9]					359
Ann Rd. and Highway 95 Intersection	CB ANN									555								1123		
Highway 95 and Rancho Dr. Intersection (North)	RT RAN									437								1179		
Highway 95 and Craig Rd. Intersection	CB CRG										2943							3540		
Highway 95 and Gowan Rd. Intersection	RT GWN											2829						3709		
Gowan North Detention Basin Inflow	GN_IN													3925			4063	2455	3080	
Gowan Outfall Pipe[2]	DET.G													539			2454	424	560	
Rancho Dr. and Gowan Rd. Intersection	CB G2											1108								
Rancho Dr. and Lake Mead Dr. Intersection[3]	CB MED						400									478				
Rancho Dr. and Vegas Dr. Intersection[3]	CB VEG		364													142				
Diversion from Rancho Dr. and Vegas Dr. Intersection to East[3]	VEGAS		164													64				
Rancho Dr. and Washington Avenue Intersection[3]	CB WAS				537											92				
Diversion from Rancho Dr. and Washington Ave. Intersection to south along Washington Ave.[3]	WASH				151											26				
At Intersection of US 95 and Rancho Dr. (south)[3]	CB 310						1199									401				
Near Intersection of Washington Ave. & Highland Dr.[3]	311W						914									284				
Near Intersection of I-15 and Owens[3]	311E							987								329				
Carey/Lake Mead Detention Basin Inflow[3]	CB LMD								2236							1583			2800	2822
Below Carey/Lake Mead Detention Basin[3]	2A								310[7]							349			370	281
Highland and Balzar Intersection	CB W1			598																
At Outlet of Gowan Outfall Pipe	CB GA															1556			1550	
At Outlet of Gowan Outfall Pipe w/o Flow from Gowan Det.	CP GA											1524								
Gowan Outfall Channel Near Craig Ranch Golf Course[4]	CP GB															2755			3600	
Buffalo Channel Near Lake Mead Blvd.[8]	BUFF 1					1542[10]							1576							

NOTES:

1 Discharge values given at street intersections are for the northwest corner.
2 The outfall flow is contained in the Gowan Outfall pipe system.
3 Two different storm centerings are modeled at these locations. Higher peak discharges are chosen to reflect the worst case.
4 Does not include inflow from Western Tributary, 100-year discharge may be underestimated.
5 Church engineering study does not assume construction of the Kyle Canyon detention basin. Rainfall values used for the study were underestimated.
6 Distribution type SDN3 was used since contributing drainage area modeled is less than 10 square miles.
7 Flow contained in Carey/Lake Mead outlet pipe.
8 Modeled with and without outflow from the Angel Park Detention Basin.
9 From the model KYLE.DAT.
10 Concentration point CB LKM from the model BUFFALO.DAT.

7.0 Survey Control Report

Topographic mapping for the detailed study area (Figure 10) was obtained using aerial photogrammetric methods by Aerial Mapping Company, Inc (AMC, 1993). Final maps were produced at a scale of 1 inch = 200 feet with a contour interval of 2 feet. Pentacore Engineering, Inc. provided horizontal and vertical control for the mapping and results of their control surveys are included in Technical Data Notebook, Section 7, under a separate cover.

8.0 References

Aerial Mapping Company, *Topographical Mapping along Rancho Drive/Highway 95 from Gowan Drive to Ann Road*, 1"=200', 2' contour interval, Flown June 2, 1993.

Black & Veatch Engineers-Architects, *Flood Control Facilities Plan for the Northern Las Vegas Wash, City of North Las Vegas*, August 1989.

Black & Veatch Engineers-Architects, *Predesign Report for the Upper Las Vegas Wash Detention Basin*, March, 1991.

Church Engineering of Nevada, Inc., *Revised Technical Study for the Las Brisas Norte Residential Subdivision*, November 24, 1992.

City of Las Vegas, Department of Public Works, *Hydrology Study for Craig Road Between Highway 95 and Decatur Boulevard*, November 2, 1992.

Clark County Regional Flood Control District, *Hydrologic Criteria and Drainage Design Manual*, October 1990.

Clark County Regional Flood Control District, *Volume II, the Master Plan Update of the Las Vegas Valley*, August 1991.

Cooper Aerial of Nevada, *Topographical Mapping of Portions of the City of Las Vegas*, 1" = 200', 2' contour interval, Flown July 7, 1984.

Dodson & Associates, Inc., *The Dodson Professional HEC-1 System, ProHEC-1 Program Documentation*. April 1991.

Dodson & Associates, Inc., *The Dodson Professional HEC-2 System Program Documentation*. April 1991.

Dodson & Associates, Inc., *PROHEC-2, The Dodson Professional HEC-1 System Program Documentation*. April 1991.

Montgomery, James M., Consulting Engineers, Inc., *CCRFCD Las Vegas Valley Flood Insurance Study Hydrology Report*, September 1991.

National Oceanic and Atmospheric Administration, *Technical Memorandum, HYDRO-40*, 1994.

Soil Conservation Service, *National Engineering Handbook, Section 4, Hydrology*, 1972.

U.S. Army Corps of Engineers, *Hydrology Documentation for Feasibility Study Las Vegas Wash and Tributaries, Clark County, Nevada*, April 1988.

U.S. Army Corps of Engineers, Hydrologic Engineering Center, *HEC-1 Flood Hydrograph Package User's Manual*, September 1990.

U.S. Army Corps of Engineers, Hydrologic Engineering Center, *HEC-2 Water Surface Profiles User's Manual*, September 1991.

U.S. Department of the Commerce, National Oceanic and Atmospheric, National Weather Service, NOAA Atlas 2, Precipitation - Frequency Atlas of the Western United States, Volume VII - Nevada, 1973.

U.S. Department of the Interior, Geologic Survey, 7.5 Minute Series Topographic Map, Scale 1:24,000: *Las Vegas NE, NV 1967 (Photorevised 1984), Las Vegas NW, NV 1967 (Photorevised 1983), Las Vegas SE, NV 1989 (Photorevised 1984), Las Vegas SW, NV 1969 (Photorevised 1984).*

VTN Nevada, *Hydrology Study - Angel Park Detention Basin*, February 1983.

VTN Nevada, *Supplement to Hydrology Study - Angel Park Detention Basin*, March 1983.

VTN Nevada, *Drainage Study for Silver Mesa, North Las Vegas, Nevada*, April, 1989.

VTN Nevada, *Final Hydrology Study - Lake Mead Boulevard Phase 1A Project*, October 2, 1989.

VTN Nevada, *Buffalo Drive Improvement Plans Sahara to Westcliff, 70% Submittal*, February 1990.

VTN Nevada, *Predesign Memorandum for Carey/Lake Mead Detention Basin*, August 24, 1990.

VTN Nevada, *Predesign Report for the Kyle Canyon Detention Basin*, April 1992.

VTN Nevada, *Design Memorandum for Buffalo Channel, Summerlin Parkway to Vegas Drive*, May 1992.

VTN Nevada, *Buffalo Channel, Summerlin Parkway to Vegas Drive Improvement Plans*, October 1992.

VTN Nevada, *Outfall Study for the Kyle Canyon Detention Basin*, January 1993.

VTN Nevada, *Design Calculations for the Kyle Canyon Detention Basin*, February 1993.

VTN Nevada, *Design Report for Buffalo Drive Road and Channel Improvements*, February 1993.

Wallace, G.C., Inc., *Drainage Study for Highway 95 Interchanges and Overpasses Between Smoke Ranch Road and Lone Mountain Road*, January 1989.

Wallace, G.C., Inc., *Gowan Detention Basin Volume III Alternatives Evaluation*, March 31, 1989.

Wallace, G.C., Inc., *Hydrology Report Methodologies and HEC-1 Model Predesign of the Gowan Detention Basin*, August 17, 1988.

Wallace, G.C., Inc., *Rancho Alta Mira Drainage Study*, January 1989.

CVL CONSULTANTS, INC.

Land Planning
Land Surveying
Civil Engineering
Water Resources Engineering

June 21, 1994

Clark County Regional Flood Control District
301 E. Clark Avenue, Suite 301
Las Vegas, NV 89101

Attn: Mr. Kevin Eubanks, P.E.

Re: Northwest Las Vegas FIS Restudy
Draft Submittal of Technical Data Notebook

Dear Kevin:

In accordance with the contract Scope of Services, Section 7.1, please find enclosed five (5) copies of the Technical Data Notebook and all Appendices for the above referenced project.

Following the Committee's review we will incorporate all requested changes prior to submittal to FEMA. The Scope of Services calls for fifteen (15) final copies of the report to be submitted upon final acceptance. In order to minimize reproduction costs, we request that minor changes be handled by insertion and removal of pages from this submittal.

We look forward to reviewing this document with you and the rest of the Committee on Wednesday, June 29, 1994.

Sincerely,

COE & VAN LOO
Consultants, Inc.

Paul W. R. Hoskin, P.E.
Vice President

PWRH:rbb
Enclosures

NORTHWEST FLOOD STUDY_a

NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY

Clark County, Nevada

Technical Data Notebook Section 7
Survey Control Report

Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

CVL CONSULTANTS, INC., 6655 W. SAHARA, SUITE A-200, LAS VEGAS, NV 89103 (702) 368-3008
PENTACORE ENGINEERING, INC., 6763 W. CHARLESTON BLVD., LAS VEGAS, NV 89102 (702) 258-0115

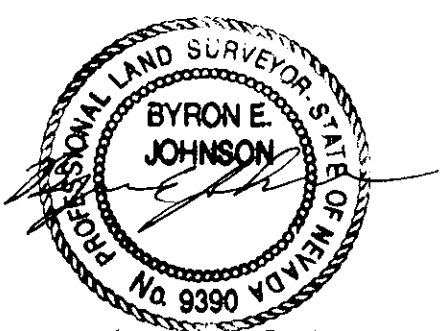
HORIZONTAL and VERTICAL CONTROL TABULATION

for the

NORTHWEST FLOOD STUDY, LAS VEGAS, NEVADA

Prepared for:
Clark County Regional Flood Control District
301 East Clark Avenue, Suite 301
Las Vegas, Nevada 89101

Prepared by:
Pentacore Surveying, Inc.
6763 West Charleston Boulevard
Las Vegas, Nevada 89102



5-31-94

Byron E. Johnson, P.L.S
Pentacore Surveying, Inc.
6763 West Charleston Boulevard
Las Vegas, Nevada 89102

Flood Insurance Study Restudy
for
Northwest Las Vegas

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Flood Insurance Study Restudy
for
Northwest Las Vegas

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May 25, 1994

SURVEY CONTROL REPORT

NORTHWEST FLOOD STUDY

SUMMARY OF CONTROL SURVEY

Field survey began in May of 1993 and was completed in September of 1993. Field checks were completed during August of 1993 using GPS (Global Positioning System) equipment to verify position of aerial control.

Horizontal Datum for this project is NAD 83, Nevada State Plane Coordinate System, East Zone. This was originated from three (3) Clark county GIS Stations: GIS 805, 809, & 818. This horizontal control consisted of 16 miles of traverse.

Angles and distances were measured with a one second reading Nikon total station. Angles were turned four times, and distances were recorded in horizontal, slope, vertical difference and vertical angle. Final closures were adjusted using least squares STAR* net adjustment software. Relative distance precision ranged from 1:26,000 to 1:131,000.

Vertical Datum is originated from Clark County vertical control benchmarks. All levels were run using a wild NA2 automatic level. All elevations were established using conventional differential level networks. The majority of ERM's established were existing Clark County or City of Las Vegas benchmarks as referenced in the listing of ERM's.

Position verification was performed on the following aerial control points, HV #12, HV #9, HV #17, and HV #1. This was accomplished using Trimble 4000SE GPS single frequency receivers, and the data processed with GP Survey Software and network adjusted with Trimnet Software. Eleven baselines were observed to include the four aerial control, and the three GIS control points to verify positions completed conventionally. Horizontal precision ranged from 1:364,000 to 1:3,499,000. Positional coordinate differences from coordinates completed conventionally ranged from 0.02' north and 0.01' east to 0.10' north and 0.20' east. The largest differences occurred in the aerial control points that were radial tied and not within the conventional adjusted traverse.

GIS
805

TRAVERSE
NETWORK

HV
#11

HV
#12

HV
#19

HV
#9

HV
#13

HV
#6

HV
#17

HV
#18

HV
#1

HV
#2

GIS
809

GIS

LAS VEGAS

Home of the Good Shepherd

Memory Gardens (Cem)

Gravel Pit

Gravel Prospects

Park

JONES

RAINBOW

DURANGO

GOWAN

CHEYENNE

ANN ROAD

LONE MTN RD

CRAIG ROAD

BRADLEY

PINES

TORREY

CORPORATE

BOUNDARY

LAS VEGAS CORP BDY

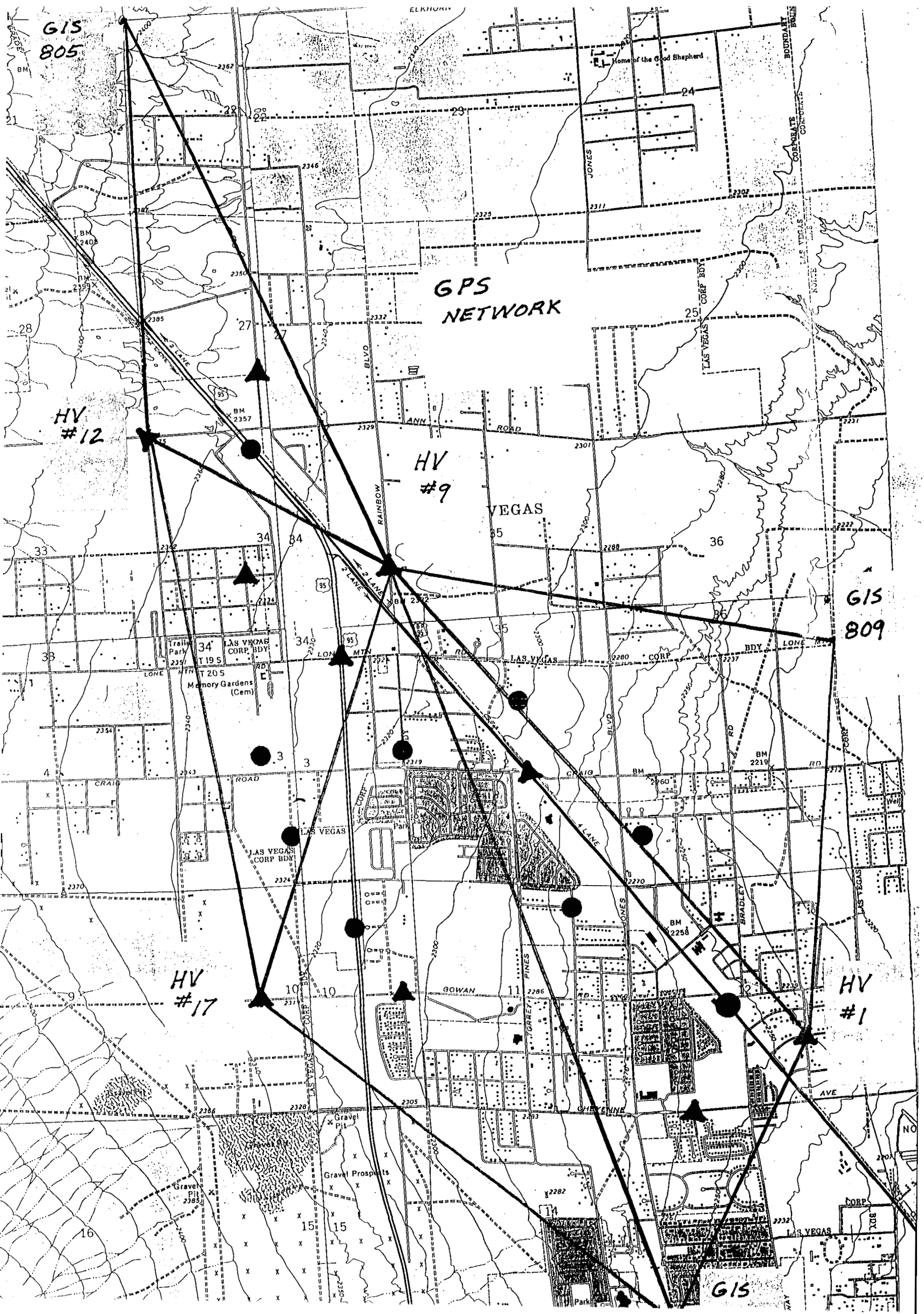
2 LANE

95

LEVEL LOOP ROUTES

LAS VEGAS

#809


GIS
805
GPS
NETWORK
HV
#12
HV
#9
HV
#17
HV
#1
GIS
809
GIS
Home of the Good Shepherd
Memory Gardens
(Cem)
Gravel
Pit
Gravel Prospects
Park
Well
LAS VEGAS
ELKHORN
ANN
ROAD
RAINBOW
BLVD
JONES
CRAIG
GOWAN
PINES
TORREY
CHEYENNE
LONE
MTN
RD
AVE
BOUNDARY
CORPORATE
CORP BDY
2 LANE
BM
2408
BM
2357
BM
2512
BM
2219
BM
2260
BM
2258
T 19 S
T 20 S

STAR*NET Adjustme... Pro...
Copyright 1992 STARPLUS SOFTWARE, INC.
Licensed for Use by Pentacore Surveying Inc.
Serial Number 20032

STAR*NET V4.072
Run Date : Mon Jun 21 11:04:46 1993

Summary of Files Used

Input data file	: C:\STAR\ALEX.DAT
Output listing (this file)	: C:\STAR\ALEX.LST
Coordinates	: C:\STAR\ALEX.PTS
Project parameters	: C:\STAR\ALEX.PRJ
Error log	: C:\STAR\ALEX.ERR
Plot File	: C:\STAR\ALEX.SPL

Adjustment Options

STAR*NET Run Mode	: Adjust with Error Propagation
Type of Adjustment	: 2D
Input Order for Coordinates	: N,E
Coordinate System	: Mercator NAD83 NV East 2701
Average Project Elevation	: 2300.0
Average Project Geoid Height, Meters	: -27.3
Input Lineal Units	: US Feet
Input Order for Angle Stations	: At-From-To
Maximum Number of Iterations	: 6
Convergence Limit Test Value	: 0.010000

Listing Options

Print Copy of Input Data File	: No
Print Summary of All Input Observations	: Yes
Print Coordinate Changes Each Iteration	: No
Print Horiz Traverse Closure Summaries	: Yes

Default Instrument Settings

Default Standard Error for Distances	: 0.03000
Default Standard Error for Angles	: 4.000
Default Standard Error for Directions	: 4.000
Default Standard Error for Az/Bearings	: 4.000
Centering Error for Instrument	: 0.0000
Centering Error for Target	: 0.0000

Summary of All Unadjusted Input Observations

Number of Stations with Coordinates = 9

Fixed Stations	N	E	RefElev	Description
U	26789285.731	753374.303	2329.000	POINT U
PL13	26786617.351	753374.664	2326.000	POINT PL13
G	26786265.070	761657.770	2267.000	POINT G
F	26784828.095	762715.834	2256.000	POINT F

Free Stations	N	E	RefElev	Description
PL12	26786614.091	755351.959	2339.000	POINT PL12
PL11	26786627.387	756739.165	2304.000	POINT PL11
PL10	26786377.007	759226.520	2283.000	POINT PL10
PL9	26786251.581	760470.372	2271.000	POINT PL9

Number of Angle Observations = 6

At	From	To	Obs Angle	t-T	Grid Angle	StdErr
PL13	U	PL12	90-06-08.00	0.06	90-06-08.06	4.00
PL12	PL13	PL11	179-21-23.00	-0.00	179-21-23.00	4.00
PL11	PL12	PL10	186-17-50.00	0.01	186-17-50.01	4.00
PL10	PL11	PL9	180-00-36.00	0.01	180-00-36.01	4.00
PL9	PL10	G	173-34-04.00	0.00	173-34-04.00	4.00
G	PL9	F	234-18-22.00	0.04	234-18-22.04	4.00

Number of Distance Observations = 5
Distance Units Are US Feet

From	To	Obs Dist	Comb Grid	Grid Dist	StdErr
PL13	PL12	1977.6860	0.9998038	1977.2979	0.030
PL12	PL11	1387.5420	0.9998047	1387.2710	0.030
PL11	PL10	2500.4110	0.9998065	2499.9271	0.030
PL10	PL9	1250.4000	0.9998077	1250.1595	0.030
PL9	G	1187.7270	0.9998084	1187.4994	0.030

Number of Azimuth/Bearing Observations = 2

From	To	Grid Bearing	StdErr
U	PL13	S00-00-28.00E	4.00
G	F	S36-21-53.00E	4.00

Network Solution

Solution Has Converged in 3 Iterations

Final Results

Updated Coordinates and Changes from Last Iteration

Station	N	E	dN	dE
U	26789285.731	753374.303	0.000	0.000
PL13	26786617.351	753374.664	0.000	-0.000
G	26786265.070	761657.770	-0.000	-0.000
F	26784828.095	762715.834	0.000	0.000
PL12	26786614.027	755351.959	0.000	-0.000
PL11	26786627.247	756739.167	0.000	-0.000
PL10	26786376.695	759226.508	0.000	-0.000
PL9	26786251.179	760470.352	-0.000	-0.000

Statistical Summary

ALEX

Number of Observations = 13
Number of Unknowns = 8
Degrees of Freedom = 5

Data Type	Count	Weighted Residuals	Error Factor
Distances	5	0.00	0.04
Angles	6	4.96	1.47
Directions	0	0.00	0.00
Az/Bearings	2	0.00	0.03
Stations	8	0.00	0.00
Total	21	4.96	1.00

Adjustment passes the Chi Square test at 5% level

Adjusted Observations and Residuals

Adjusted Azimuth/Bearing Observations

At	From	To	Adj Angle	Residual	StdErr	StdRes
PL13	U	PL12	90-06-14.62	0-00-06.62	4.00	1.7
PL12	PL13	PL11	179-21-27.54	0-00-04.54	4.00	1.1
PL11	PL12	PL10	186-17-53.09	0-00-03.09	4.00	0.8
PL10	PL11	PL9	180-00-36.47	0-00-00.47	4.00	0.1
PL9	PL10	G	173-34-03.17	-0-00-00.83	4.00	0.2
G	PL9	F	234-18-19.92	-0-00-02.08	4.00	0.5

Adjusted Distance Observations [US Feet]

At	To	Adj Dist	Residual	StdErr	StdRes
PL13	PL12	1977.6860	0.0000	0.030	0.0
PL12	PL11	1387.5419	-0.0001	0.030	0.0
PL11	PL10	2500.4122	0.0012	0.030	0.0
PL10	PL9	1250.4013	0.0013	0.030	0.0
PL9	G	1187.7269	-0.0001	0.030	0.0

Adjusted Azimuth/Bearing Observations

From	To	Adj Bearing	Residual	StdErr	StdRes
U	PL13	S00-00-27.91E	0-00-00.09	4.00	0.0
G	F	S36-21-52.97E	0-00-00.03	4.00	0.0

Error Propagation

Station [illegible] Standard Deviations

Station	N	E
U	0.000	0.000
PL13	0.000	0.000
G	0.000	0.000
F	0.000	0.000
PL12	0.026	0.027
PL11	0.033	0.033
PL10	0.028	0.033
PL9	0.017	0.027

Station Coordinate Error Ellipses
Confidence Region = 95%

Station	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis
U	0.000	0.000	0-00
PL13	0.000	0.000	0-00
G	0.000	0.000	0-00
F	0.000	0.000	0-00
PL12	0.066	0.063	84-52
PL11	0.081	0.080	37-27
PL10	0.080	0.068	93-27
PL9	0.066	0.041	89-43

Adjusted Bearings and Horizontal Distances

From	To	Grid Bearing	Grnd Dist	BgErr	DisErr	Precision
PL13	PL12	S89-54-13.22E	1977.2980 1977.6860	2.67	0.027	1: 73678
PL12	PL11	N89-27-14.32E	1387.2709 1387.5419	2.53	0.027	1: 51685
PL11	PL10	S84-14-52.58E	2499.9283 2500.4122	2.02	0.027	1: 93164
PL10	PL9	S84-14-16.10E	1250.1608 1250.4013	2.81	0.027	1: 46589
PL9	G	N89-19-47.07E	1187.4993 1187.7269	2.94	0.027	1: 44241
PL13	U	N00-00-27.91W	2668.3800 2668.9037	0.00	0.000	FIXED
G	F	S36-21-52.97E	1784.4878 1784.8287	0.00	0.000	FIXED

Convergence Angles and Factors at Stations

(Elevation Factor Includes -27.30 Meter Geoid Height Correction)

Station	Convergence Angle	Factors: Grid	x Elevation	= Combined
U	0-11-41.57	0.99991081	0.99989289	0.99980371
PL13	0-11-41.39	0.99991081	0.99989304	0.99980386
G	0-12-41.12	0.99991273	0.99989586	0.99980860
F	0-12-48.65	0.99991299	0.99989638	0.99980938
PL12	0-11-55.65	0.99991126	0.99989241	0.99980368
PL11	0-12-05.66	0.99991157	0.99989409	0.99980567
PL10	0-12-23.59	0.99991215	0.99989509	0.99980726
PL9	0-12-32.56	0.99991245	0.99989567	0.99980812
Project Averages:	0-12-13.77	0.99991185	0.99989443	0.99980629

Elapsed time = 00:00:02

STAR*NET Adjustment Program
Copyright 1992 STAR[illegible] INC
Licensed for Use by Pentacore Surveying Inc.
Serial Number 20032

STAR*NET V4.072
Run Date : Mon Jun 21 10:40:42 1993

Summary of Files Used

Input data file	: C:\STAR\HWY95.DAT
Output listing (this file)	: C:\STAR\HWY95.LST
Coordinates	: C:\STAR\HWY95.PTS
Project parameters	: C:\STAR\HWY95.PRJ
Error log	: C:\STAR\HWY95.ERR
Plot File	: C:\STAR\HWY95.SPL

Adjustment Options

STAR*NET Run Mode	: Adjust with Error Propagation
Type of Adjustment	: 2D
Input Order for Coordinates	: N,E
Coordinate System	: Mercator NAD83 NV East 2701
Average Project Elevation	: 2300.0
Average Project Geoid Height, Meters	: -27.3
Input Lineal Units	: US Feet
Input Order for Angle Stations	: At-From-To
Maximum Number of Iterations	: 6
Convergence Limit Test Value	: 0.010000

Listing Options

Print Copy of Input Data File	: No
Print Summary of All Input Observations	: Yes
Print Coordinate Changes Each Iteration	: No
Print Horiz Traverse Closure Summaries	: Yes

Default Instrument Settings

Default Standard Error for Distances	: 0.03000
Default Standard Error for Angles	: 4.000
Default Standard Error for Directions	: 4.000
Default Standard Error for Az/Bearings	: 4.000
Centering Error for Instrument	: 0.0000
Centering Error for Target	: 0.0000

Summary of All Unadjusted Input Observations

Fixed Stations	N	E	RefElev	Description
J	26791445.936	757734.138	2315.000	POINT J
K	26792085.519	757256.585	2314.000	POINT K
HV3	26783539.666	763681.147	2252.000	POINT HV3
F	26784828.095	762715.834	2256.000	POINT F

Free Stations	N	E	RefElev	Description
TPL17	26791999.054	753411.514	2331.000	POINT TPL17
U	26789285.795	753374.225	2329.000	POINT U
PL13	26786617.419	753374.515	2326.000	POINT PL13
HV17	26783927.561	753305.520	2328.000	POINT HV17
HV18	26783926.863	756396.284	2300.000	POINT HV18
V	26783738.941	758550.183	2287.000	POINT V
PL3	26783563.219	760429.691	2277.000	POINT PL3
PL2	26783432.250	761763.380	2266.000	POINT PL2
HV13	26791975.035	755413.451	2300.000	

Number of Angle Observations = 11

At	From	To	Obs Angle	t-T	Grid Angle	StdErr
K	J	HV13	123-19-01.00	-0.01	123-19-00.99	4.00
[illegible]3	K	TPL17	184-07-04.00	0.00	184-07-04.00	4.00
[illegible]L17	HV13	U	90-06-00.00	0.06	90-06-00.06	4.00
U	TPL17	PL13	179-12-23.00	0.12	179-12-23.12	4.00
PL13	U	HV17	181-28-32.00	0.12	181-28-32.12	4.00
HV17	PL13	HV18	88-32-37.00	0.06	88-32-37.06	4.00
HV18	HV17	V	184-58-24.00	0.00	184-58-24.00	4.00
V	HV18	PL3	180-21-18.00	0.01	180-21-18.01	4.00
PL3	V	PL2	180-16-02.00	0.01	180-16-02.01	4.00
PL2	PL3	HV3	171-11-20.00	0.00	171-11-20.00	4.00
HV3	PL2	F	56-21-48.00	-0.04	56-21-47.96	4.00

Number of Distance Observations = 10
Distance Units Are US Feet

From	To	Obs Dist	Comb Grid	Grid Dist	StdErr
K	HV13	1846.8020	0.9998054	1846.4427	0.030
HV13	TPL17	2002.4700	0.9998046	2002.0787	0.030
TPL17	U	2714.0480	0.9998037	2713.5152	0.030
U	PL13	2668.9000	0.9998038	2668.3763	0.030
PL13	HV17	2691.2710	0.9998038	2690.7430	0.030
HV17	HV18	3091.3710	0.9998048	3090.7675	0.030
HV18	V	2162.5010	0.9998063	2162.0822	0.030
V	PL3	1888.0690	0.9998074	1887.7053	0.030
PL3	PL2	1340.3620	0.9998083	1340.1050	0.030
[illegible]	HV3	1920.8900	0.9998092	1920.5236	0.030

2

From	To	Grid Bearing	StdErr
J	K	N36-44-50.00W	4.00
HV3	F	N36-50-28.00W	4.00

Network Solution

Solution Has Converged in 3 Iterations

Final Results

Updated Coordinates and Changes from Last Iteration

Station	N	E	dN	dE
J	26791445.936	757734.138	0.000	0.000
K	26792085.519	757256.585	-0.000	-0.000
HV3	26783539.666	763681.147	0.000	-0.000
F	26784828.095	762715.834	0.000	0.000
TPL17	26791998.994	753411.524	-0.000	0.000
U	26789285.731	753374.303	-0.000	0.000
PL13	26786617.351	753374.664	-0.000	0.000
HV17	26783927.488	753305.733	-0.000	0.000
HV18	26783926.845	756396.504	-0.000	0.000
V	26783738.957	758550.411	-0.000	0.000
PL3	26783563.266	760429.926	0.000	0.000
PL2	26783432.324	761763.622	-0.000	0.000
.3	26791975.015	755413.455	-0.000	0.000

Statistical Summary

Number of Observations = 23
Number of Unknowns = 18
Degrees of Freedom = 5

Data Type	Count	Weighted Residuals	Error Factor
Distances	10	0.13	0.25
Angles	11	1.00	0.65
Directions	0	0.00	0.00
Az/Bearings	2	0.01	0.18
Stations	13	0.00	0.00
Total	36	1.15	0.48

Adjustment passes the Chi Square test at 5% level

Adjusted Observations and Residuals

Adjus[illegible]ervatio[illegible]

At	From	To	Adj Angle	Residual	StdErr	StdRes
K	J	HV13	123-18-58.68	-0-00-02.32	4.00	0.6
HV13	K	TPL17	184-07-02.24	-0-00-01.76	4.00	0.4
TPL17	HV13	U	90-05-58.80	-0-00-01.20	4.00	0.3
U	TPL17	PL13	179-12-22.62	-0-00-00.38	4.00	0.1
PL13	U	HV17	181-28-32.41	0-00-00.41	4.00	0.1
HV17	PL13	HV18	88-32-38.23	0-00-01.23	4.00	0.3
HV18	HV17	V	184-58-24.36	0-00-00.36	4.00	0.1
V	HV18	PL3	180-21-17.80	-0-00-00.20	4.00	0.1
PL3	V	PL2	180-16-01.32	-0-00-00.68	4.00	0.2
PL2	PL3	HV3	171-11-18.98	-0-00-01.02	4.00	0.3
HV3	PL2	F	56-21-46.40	-0-00-01.60	4.00	0.4

Adjusted Distance Observations [US Feet]

At	To	Adj Dist	Residual	StdErr	StdRes
K	HV13	1846.7987	-0.0033	0.030	0.1
HV13	TPL17	2002.4665	-0.0035	0.030	0.1
TPL17	U	2714.0512	0.0032	0.030	0.1
U	PL13	2668.9033	0.0033	0.030	0.1
PL13	HV17	2691.2742	0.0032	0.030	0.1
HV17	HV18	3091.3745	0.0035	0.030	0.1
HV18	V	2162.5047	0.0037	0.030	0.1
V	PL3	1888.0727	0.0037	0.030	0.1
PL3	PL2	1340.3658	0.0038	0.030	0.1
PL2	HV3	1920.8933	0.0033	0.030	0.1

Adjusted Azimuth/Bearing Observations

From	To	Adj Bearing	Residual	StdErr	StdRes
J	K	N36-44-50.42W	-0-00-00.42	4.00	0.1
HV3	F	N36-50-28.24W	-0-00-00.24	4.00	0.1

Error Propagation

Station Coordinate Standard Deviation

Station	N	E
J	0.000	0.000
K	0.000	0.000
HV3	0.000	0.000
F	0.000	0.000
TPL17	0.057	0.041
U	0.063	0.048
PL13	0.067	0.056
HV17	0.072	0.063
HV18	0.065	0.057
V	0.058	0.050
PL3	0.043	0.041
PL2	0.029	0.030
HV13	0.029	0.030

Station Coordinate Error Ellipses
Confidence Region = 95%

Station	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis
J	0.000	0.000	0-00
K	0.000	0.000	0-00
HV3	0.000	0.000	0-00
F	0.000	0.000	0-00
TPL17	0.141	0.098	14-30
U	0.156	0.114	163-07
PL13	0.170	0.131	157-27
HV17	0.186	0.142	150-05
HV18	0.161	0.139	169-49
V	0.141	0.123	179-04
PL3	0.106	0.101	173-18
PL2	0.073	0.071	87-44
HV13	0.075	0.069	47-26

Adjusted Bearings and Horizontal Distances

From	To	Grid Bearing	Grid Dist	BgErr	Distr	Precision
K	HV13	S86-34-08.25W	1846.4394 1846.7987	3.26	0.030	1: 62112
HV13	TPL17	N89-18-49.51W	2002.0752 2002.4665	3.65	0.030	1: 67396
TPL17	U	S00-47-09.35W	2713.5184 2714.0512	3.07	0.030	1: 91437
U	PL13	S00-00-27.91E	2668.3796 2668.9033	2.73	0.030	1: 89928
PL13	HV17	S01-28-04.63W	2690.7462 2691.2742	2.96	0.030	1: 90658
HV17	HV18	S89-59-17.08E	3090.7709 3091.3745	3.01	0.030	1:104033
HV18	V	S85-00-52.72E	2162.0859 2162.5047	2.93	0.030	1: 72839
V	PL3	S84-39-34.91E	1887.7090 1888.0727	3.14	0.030	1: 63599
PL3	PL2	S84-23-33.58E	1340.1087 1340.3658	3.41	0.030	1: 45152
PL2	HV3	N86-47-45.39E	1920.5268 1920.8933	3.10	0.030	1: 64607
K	J	S36-44-50.42E	798.2000 798.3554	0.00	0.000	FIXED
[illegible]	F	N36-50-28.24W	1609.9312 1610.2378	0.00	0.000	FIXED

Convergence Angles and Factors at Stations

(Elevation Factor Includes -27.30 Meter Geoid Height Correction)

Station	Convergence Angle	Grid	x	Elevation	=	Combined
J	0-12-13.20	0.99991180		0.99989356		0.99980538
K	0-12-09.80	0.99991169		0.99989361		0.99980531
HV3	0-12-55.51	0.99991323		0.99989657		0.99980981
F	0-12-48.65	0.99991299		0.99989638		0.99980938
TPL17	0-11-42.03	0.99991082		0.99989280		0.99980363
U	0-11-41.57	0.99991081		0.99989289		0.99980371
PL13	0-11-41.39	0.99991081		0.99989304		0.99980386
HV17	0-11-40.70	0.99991080		0.99989294		0.99980375
HV18	0-12-02.99	0.99991150		0.99989428		0.99980578
V	0-12-18.52	0.99991200		0.99989490		0.99980691
PL3	0-12-32.06	0.99991244		0.99989538		0.99980783
PL2	0-12-41.67	0.99991276		0.99989591		0.99980867
HV13	0-11-56.48	0.99991127		0.99989428		0.99980556
Project Averages:	0-12-11.12	0.99991176		0.99989435		0.99980612

Elapsed time = 00:00:01

STAR*NET Adjustment Program
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Serial Number 20032

STAR*NET V4.072
Run Date : Mon Jun 21 12:17:28 1993

Summary of Files Used

Input data file	: C:\STAR\NWALL.DAT
Output listing (this file)	: C:\STAR\NWALL.LST
Coordinates	: C:\STAR\NWALL.PTS
Project parameters	: C:\STAR\NWALL.PRJ
Error log	: C:\STAR\NWALL.ERR
Plot File	: C:\STAR\NWALL.SPL

Adjustment Options

STAR*NET Run Mode	: Adjust with Error Propagation
Type of Adjustment	: 2D
Input Order for Coordinates	: N,E
Coordinate System	: Mercator NAD83 NV East 2701
Average Project Elevation	: 2300.0
Average Project Geoid Height, Meters	: -27.3
Input Lineal Units	: US Feet
Input Order for Angle Stations	: At-From-To
Maximum Number of Iterations	: 6
Convergence Limit Test Value	: 0.010000

Listing Options

Print Copy of Input Data File	: No
Print Summary of All Input Observations	: Yes
Print Coordinate Changes Each Iteration	: No
Print Horiz Traverse Closure Summaries	: Yes

Default Instrument Settings

Default Standard Error for Distances	: 0.03000
Default Standard Error for Angles	: 4.000
Default Standard Error for Directions	: 4.000
Default Standard Error for Az/Bearings	: 4.000
Centering Error for Instrument	: 0.0000
Centering Error for Target	: 0.0000

Summary of All Unadjusted Input Observations

Number of Stations ... rdir ... 0

Fixed Stations	N	E	RefElev	Description
GIS818	26775798.367	762258.433	2259.000	GIS POINT 818
GIS805	26807618.962	751432.929	2412.000	GIS POINT 805
HV3	26783539.666	763681.147	2252.509	HV
F	26784828.095	762715.834	2256.000	POINT F
G	26786265.070	761657.770	2267.000	POINT G
J	26791445.936	757734.138	2315.000	POINT J
K	26792085.519	757256.585	2314.000	POINT K

Free Stations	N	E	RefElev	Description
HV13	26791975.035	755413.451	2326.694	POINT HV13
TPL17	26791999.054	753411.517	2331.319	POINT TPL17
U	26789285.795	753374.228	2329.000	POINT U
PL13	26786617.419	753374.518	2326.650	POINT PL13
HV17	26783927.561	753305.522	2328.584	POINT HV17
HV18	26783926.863	756396.286	2299.894	POINT HV18
V	26783738.941	758550.185	2287.000	POINT V
PL3	26783563.219	760429.693	2277.244	POINT PL3
PL2	26783432.250	761763.382	2266.333	POINT PL2
PL12	26786614.106	755351.813	2339.632	POINT PL12
PL11	26786627.365	756739.019	2304.261	POINT PL11
PL10	26786376.920	759226.368	2283.196	POINT PL10
	26786251.460	760470.216	2271.271	POINT PL9

Unused Stations	N	E	RefElev	Description
GIS809	26791714.739	766927.669	2208.000	GIS POINT 809
B	26780745.648	761641.088	2267.000	POINT B
HV2	26780777.099	762993.237	2259.939	HV
C	26780807.880	764283.866	2249.000	POINT C
D	26781863.676	764300.474	2250.000	POINT D
E	26782795.978	764234.695	2251.000	POINT E
H	26787797.407	760519.555	2278.000	POINT H
HV6	26789265.574	759414.669	2296.096	HV
I	26790629.449	758588.857	2308.000	POINT I
L	26792842.551	756754.323	2320.000	POINT L
M	26794480.257	755685.493	2328.000	POINT M
HV10	26797670.321	753428.257	2356.196	HV
N	26800071.578	751730.144	2374.000	POINT N
O	26801557.777	750931.841	2397.000	POINT O
P	26802921.293	750873.642	2399.000	POINT P
R	26803959.372	751299.902	2390.000	POINT R
S	26805656.769	751211.025	2417.000	POINT S
X	26791844.660	758178.340	2307.000	POINT X
Y	26791516.377	761591.278	2270.000	POINT Y
Z	26791484.733	763904.457	2241.000	POINT Z

Number of Angle Observations = 17

			Obs Angle	t-T	Grid Angle	StdErr
	J	HV13	123-19-01.00	-0.01	123-19-00.99	4.00
HV13	K	TPL17	184-07-04.00	0.00	184-07-04.00	4.00
TPL17	HV13	U	90-06-00.00	0.06	90-06-00.06	4.00
U	TPL17	PL13	179-12-23.00	0.12	179-12-23.12	4.00
PL13	U	HV17	181-28-32.00	0.12	181-28-32.12	4.00
HV17	PL13	HV18	88-32-37.00	0.06	88-32-37.06	4.00
HV18	HV17	V	184-58-24.00	0.00	184-58-24.00	4.00
V	HV18	PL3	180-21-18.00	0.01	180-21-18.01	4.00
PL3	V	PL2	180-16-02.00	0.01	180-16-02.01	4.00
PL2	PL3	HV3	171-11-20.00	0.00	171-11-20.00	4.00
HV3	PL2	F	56-21-48.00	-0.04	56-21-47.96	4.00
PL13	U	PL12	90-06-08.00	0.06	90-06-08.06	4.00
PL12	PL13	PL11	179-21-23.00	-0.00	179-21-23.00	4.00
PL11	PL12	PL10	186-17-50.00	0.01	186-17-50.01	4.00
PL10	PL11	PL9	180-00-36.00	0.01	180-00-36.01	4.00
PL9	PL10	G	173-34-04.00	0.00	173-34-04.00	4.00
G	PL9	F	234-18-22.00	0.04	234-18-22.04	4.00

Number of Distance Observations = 17
Distance Units Are US Feet

From	To	Obs Dist	Comb Grid	Grid Dist	StdErr
K	HV13	1846.8020	0.9998048	1846.4415	0.030
3	TPL17	2002.4700	0.9998039	2002.0774	0.030
L17	U	2714.0480	0.9998037	2713.5151	0.030
U	PL13	2668.9000	0.9998038	2668.3763	0.030
PL13	HV17	2691.2710	0.9998038	2690.7429	0.030
HV17	HV18	3091.3710	0.9998048	3090.7674	0.030
HV18	V	2162.5010	0.9998063	2162.0822	0.030
V	PL3	1888.0690	0.9998074	1887.7053	0.030
PL3	PL2	1340.3620	0.9998082	1340.1050	0.030
PL2	HV3	1920.8900	0.9998092	1920.5235	0.030
HV3	F	1610.2290	0.9998096	1609.9224	0.030
PL13	PL12	1977.6860	0.9998037	1977.2979	0.030
PL12	PL11	1387.5420	0.9998047	1387.2710	0.030
PL11	PL10	2500.4110	0.9998065	2499.9271	0.030
PL10	PL9	1250.4000	0.9998077	1250.1595	0.030
PL9	G	1187.7270	0.9998084	1187.4994	0.030
G	F	1784.8210	0.9998090	1784.4801	0.030

Number of Azimuth/Bearing Observations = 1

From	To	Grid Bearing	StdErr
GIS818	GIS805	N18-47-19.00W	4.00

Number of SideShots = 14

	From	To	Angle	Distance
	E	HV1	73-24-48.00	1526.808
[illegible]	F	[illegible]	[illegible]	627.616
G	F	PL7	149-57-38.00	485.205
G	F	HV5	240-03-46.00	1247.652
K	L	PL14	141-18-12.00	574.327
K	L	PL15	296-05-37.00	495.018
L	M	HV9	32-36-25.00	1368.959
HV10	M	HV12	120-53-59.00	2159.456
HV10	N	HV11	60-46-52.00	1256.912
HV10	M	PL18	312-33-06.00	887.914
HV13	K	PL16	302-17-10.00	60.920
TPL17	U	HV19	178-05-48.00	2078.801
HV18	HV17	PL4	180-00-01.00	457.771
PL9	PL10	PL8	171-52-47.00	401.983

Network Solution

Solution Has Converged in 3 Iterations

Final Results

Updated Coordinates and Changes from Last Iteration

Station	N	E	dN	dE
GIS818	26775798.367	762258.433	0.000	0.000
GIS805	26807618.962	751432.929	0.000	-0.000
HV3	26783539.666	763681.147	0.000	-0.000
F	26784828.095	762715.834	0.000	0.000
G	26786265.070	761657.770	-0.000	0.000
J	26791445.936	757734.138	0.000	0.000
K	26792085.519	757256.585	-0.000	-0.000
HV13	26791975.004	755413.461	-0.000	0.000
TPL17	26791998.970	753411.536	0.000	0.000
U	26789285.700	753374.318	-0.000	0.000
PL13	26786617.313	753374.654	-0.000	0.000
HV17	26783927.452	753305.717	-0.000	0.000
8	26783926.815	756396.491	0.000	0.000
	26783738.937	758550.401	0.000	0.000
PL3	26783563.255	760429.920	-0.000	0.000
PL2	26783432.318	761763.620	-0.000	0.000
PL12	26786613.987	755351.950	-0.000	0.000
PL11	26786627.213	756739.160	-0.000	-0.000
PL10	26786376.680	759226.504	-0.000	-0.000
PL9	26786251.173	760470.350	0.000	-0.000

Statistical Summary

NW ALL

Number of Observations		35
Number of Unknowns	=	26
Degrees of Freedom	=	9

Data Type	Count	Weighted Residuals	Error Factor
Distances	17	0.78	0.42
Angles	17	4.10	0.97
Directions	0	0.00	0.00
Az/Bearings	1	0.01	0.15
Stations	20	0.00	0.00
Total	55	4.89	0.74

Adjustment passes the Chi Square test at 5% level

Adjusted Observations and Residuals

Adjusted Angle Observations

At	From	To	Adj Angle	Residual	StdErr	StdRes
K	J	HV13	123-18-57.43	-0-00-03.57	4.00	0.9
HV13	K	TPL17	184-07-02.15	-0-00-01.85	4.00	0.5
TPL17	HV13	U	90-05-59.90	-0-00-00.10	4.00	0.0
U	TPL17	PL13	179-12-24.84	0-00-01.84	4.00	0.5
PL13	U	HV17	181-28-30.86	-0-00-01.14	4.00	0.3
HV17	PL13	HV18	88-32-37.36	0-00-00.36	4.00	0.1
HV18	HV17	V	184-58-23.88	-0-00-00.12	4.00	0.0
V	HV18	PL3	180-21-17.65	-0-00-00.35	4.00	0.1
PL3	V	PL2	180-16-01.46	-0-00-00.54	4.00	0.1
PL2	PL3	HV3	171-11-19.32	-0-00-00.68	4.00	0.2
HV3	PL2	F	56-21-46.97	-0-00-01.03	4.00	0.3
PL13	U	PL12	90-06-12.85	0-00-04.85	4.00	1.2
PL12	PL13	PL11	179-21-26.41	0-00-03.41	4.00	0.9
PL11	PL12	PL10	186-17-52.39	0-00-02.39	4.00	0.6
PL10	PL11	PL9	180-00-36.61	0-00-00.61	4.00	0.2
PL9	PL10	G	173-34-03.72	-0-00-00.28	4.00	0.1
G	PL9	F	234-18-20.85	-0-00-01.15	4.00	0.3

Adjusted Distance Observations (US Feet)

At	To	Adj Dist	Residual	StdErr	StdRes
K	HV13	1846.7945	-0.0075	0.030	0.3
HV13	TPL17	2002.4617	-0.0083	0.030	0.3
TPL17	U	2714.0582	0.0102	0.030	0.3
U	PL13	2668.9103	0.0103	0.030	0.3
PL13	HV17	2691.2726	0.0016	0.030	0.1
HV17	HV18	3091.3774	0.0064	0.030	0.2
HV18	V	2162.5076	0.0066	0.030	0.2
V	PL3	1888.0756	0.0066	0.030	0.2
PL3	PL2	1340.3686	0.0066	0.030	0.2
PL2	HV3	1920.8963	0.0063	0.030	0.2
HV3	F	1610.2378	0.0088	0.030	0.3
PL13	PL12	1977.6877	0.0017	0.030	0.1
PL12	PL11	1387.5436	0.0016	0.030	0.1
PL11	PL10	2500.4136	0.0026	0.030	0.1
PL10	PL9	1250.4026	0.0026	0.030	0.1
PL9	G	1187.7286	0.0016	0.030	0.1
G	F	1784.8287	0.0077	0.030	0.3

Adjusted Azimuth/Bearing Observations

From	To	Adj Bearing	Residual	StdErr	StdRes
GIS818	GIS805	N18-47-18.69W	0-00-00.31	4.00	0.1

Error Propagation

Station Coordinate Standard Deviations

Station	N	E
GIS818	0.000	0.000
GIS805	0.000	0.000
HV3	0.000	0.000
F	0.000	0.000
G	0.000	0.000
J	0.000	0.000
K	0.000	0.000
HV13	0.028	0.029
TPL17	0.053	0.040
U	0.058	0.041
PL13	0.061	0.043
HV17	0.067	0.053
HV18	0.062	0.050
V	0.056	0.046
PL3	0.043	0.039
PL2	0.029	0.029
PL12	0.056	0.043
PL11	0.051	0.042
PL10	0.032	0.037
PL9	0.018	0.028

Station Coordinate Error Ellipses
Confidence Region = 95%

Station	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis
GIS818	0.000	0.000	0-00
GIS805	0.000	0.000	0-00
HV3	0.000	0.000	0-00
F	0.000	0.000	0-00
G	0.000	0.000	0-00
J	0.000	0.000	0-00
K	0.000	0.000	0-00
HV13	0.074	0.066	53-22
TPL17	0.134	0.092	21-23
U	0.141	0.100	175-09
PL13	0.152	0.101	168-03
HV17	0.170	0.122	156-36
HV18	0.151	0.123	177-39
V	0.136	0.112	3-53
PL3	0.104	0.096	3-27
PL2	0.071	0.070	67-24
PL12	0.137	0.106	175-20
PL11	0.124	0.102	0-32
PL10	0.091	0.077	94-46
PL9	0.069	0.044	89-52

Adjusted Bearings and Horizontal Distances

From	To	Grid Bearing	Grid Dist Grnd Dist	Relative BgErr	 DisErr	RelDist Precision
K	HV13	S86-34-07.00W	1846.4340 1846.7945	3.13	0.029	1: 62848
HV13	TPL17	N89-18-50.85W	2002.0691 2002.4617	3.43	0.029	1: 68223
TPL17	U	S00-47-09.12W	2713.5253 2714.0582	2.77	0.029	1: 92601
U	PL13	S00-00-25.92E	2668.3866 2668.9103	2.37	0.029	1: 91080
PL13	HV17	S01-28-05.07W	2690.7445 2691.2726	2.94	0.030	1: 90729
HV17	HV18	S89-59-17.51E	3090.7738 3091.3774	2.98	0.029	1:106850
HV18	V	S85-00-53.62E	2162.0888 2162.5076	2.86	0.029	1: 74837
V	PL3	S84-39-35.96E	1887.7118 1888.0756	3.06	0.029	1: 65345
PL3	PL2	S84-23-34.49E	1340.1115 1340.3686	3.35	0.029	1: 46391
PL2	HV3	N86-47-44.83E	1920.5298 1920.8963	3.07	0.029	1: 66327
HV3	F	N36-50-28.24W	1609.9312 1610.2378	0.00	0.000	FIXED
3	PL12	S89-54-13.01E	1977.2996 1977.6877	3.16	0.028	1: 70186
PL12	PL11	N89-27-13.40E	1387.2726 1387.5436	3.08	0.028	1: 49237
PL11	PL10	S84-14-54.21E	2499.9296 2500.4136	2.79	0.028	1: 88778
PL10	PL9	S84-14-17.59E	1250.1621 1250.4026	3.24	0.028	1: 44396
PL9	G	N89-19-46.14E	1187.5010 1187.7286	3.09	0.028	1: 42145
G	F	S36-21-52.97E	1784.4878 1784.8287	0.00	0.000	FIXED
K	J	S36-44-50.42E	798.2000 798.3554	0.00	0.000	FIXED
GIS818	GIS805	N18-47-18.69W	33611.6320 33618.2107	0.00	0.000	FIXED

Convergence Angles and Factors at Stations

(...ludes -27.30 Meter Geoid Height Correction)

Station	Convergence Angle	Factors ------- Grid	x Elevation	= Combined
GIS818	0-12-44.65	0.99991288	0.99989624	0.99980913
GIS805	0-11-28.83	0.99991039	0.99988892	0.99979932
HV3	0-12-55.51	0.99991323	0.99989655	0.99980979
F	0-12-48.65	0.99991299	0.99989638	0.99980938
G	0-12-41.12	0.99991273	0.99989586	0.99980860
J	0-12-13.20	0.99991180	0.99989356	0.99980538
K	0-12-09.80	0.99991169	0.99989361	0.99980531
HV13	0-11-56.48	0.99991127	0.99989300	0.99980428
TPL17	0-11-42.03	0.99991082	0.99989278	0.99980361
U	0-11-41.57	0.99991081	0.99989289	0.99980371
PL13	0-11-41.39	0.99991081	0.99989300	0.99980383
HV17	0-11-40.70	0.99991080	0.99989291	0.99980372
HV18	0-12-02.99	0.99991150	0.99989428	0.99980579
V	0-12-18.52	0.99991200	0.99989490	0.99980691
PL3	0-12-32.06	0.99991244	0.99989537	0.99980782
PL2	0-12-41.67	0.99991276	0.99989589	0.99980866
PL12	0-11-55.65	0.99991126	0.99989238	0.99980365
PL11	0-12-05.66	0.99991157	0.99989408	0.99980566
PL10	0-12-23.59	0.99991215	0.99989508	0.99980725
PL9	0-12-32.56	0.99991245	0.99989565	0.99980811
...ject Averages:	0-12-12.83	0.99991182	0.99989417	0.99980599

Sideshot Coordinates Computed After Adjustment

Station	N	E	Description
HV1	26782401.330	765729.175	
PL1	26783509.175	764307.902	
PL7	26786459.252	761213.217	
HV5	26787407.297	762159.126	
PL14	26791910.551	757803.494	
PL15	26792021.183	756765.863	
HV9	26794211.186	756741.828	
HV12	26797505.325	751275.542	
HV11	26798804.434	753969.543	
PL18	26797557.996	754308.861	
PL16	26792028.350	755442.855	
HV19	26794076.967	753371.001	
PL4	26783926.719	756854.173	
PL8	26786267.712	760871.916	

Elapsed time = 00:00:04

STAR*NET Adjustment Program
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Serial Number 20032

STAR*NET V4.072
Run Date : Mon Jun 21 06:55:57 1993

Summary of Files Used

Input data file	: C:\STAR\NWSTUDY.DAT
Output listing (this file)	: C:\STAR\NWSTUDY.LST
Coordinates	: C:\STAR\NWSTUDY.PTS
Project parameters	: C:\STAR\NWSTUDY.PRJ
Error log	: C:\STAR\NWSTUDY.ERR
Plot File	: C:\STAR\NWSTUDY.SPL

Adjustment Options

STAR*NET Run Mode	: Adjust with Error Propagation
Type of Adjustment	: 2D
Input Order for Coordinates	: N,E
Coordinate System	: Mercator NAD83 NV East 2701
Average Project Elevation	: 2300.0
Average Project Geoid Height, Meters	: -27.3
Input Lineal Units	: US Feet
Input Order for Angle Stations	: At-From-To
Maximum Number of Iterations	: 6
Convergence Limit Test Value	: 0.010000

Listing Options

Print Copy of Input Data File	: Yes
Print Summary of All Input Observations	: Yes
Print Coordinate Changes Each Iteration	: No
Print Horiz Traverse Closure Summaries	: Yes

Default Instrument Settings

Default Standard Error for Distances	: 0.03000
Default Standard Error for Angles	: 4.000
Default Standard Error for Directions	: 4.000
Default Standard Error for Az/Bearings	: 4.000
Centering Error for Instrument	: 0.0000
Centering Error for Target	: 0.0000

Listing of Input Data File

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[   1]
[   2] C      GIS818   26775798.367    762258.433      2259    ! ! *   'GIS POIN
[   3] C      GIS809   26791714.739    766927.669      2208    ! ! *   'GIS POIN
[   4] C      GIS805   26807618.962    751432.929      2412    ! ! *   'GIS POIN
[   5] B      GIS818-GIS805   N18-47-19W   3361/632
[   6]
[   7] C      B        26780746.6388   761641.4110     2267    * * *   'POINT B
[   8] C      HV2      ?               ?               2259    * * *   'HV#2
[   9] C      C        ?               ?               2249    * * *   'POINT C
[  10] C      D        ?               ?               2250    * * *   'POINT D
[  11] C      E        ?               ?               2251    * * *   'POINT E
[  12] C      HV3      ?               ?               2252    * * *   'HV#3
[  13] C      F        ?               ?               2256    * * *   'POINT F
[  14] C      G        ?               ?               2267    * * *   'POINT G
[  15] C      H        ?               ?               2278    * * *   'POINT H
[  16] C      HV6      ?               ?               2296    * * *   'HV#6
[  17] C      I        ?               ?               2308    * * *   'POINT I
[  18] C      J        ?               ?               2315    * * *   'POINT J
[  19] C      K        ?               ?               2314    * * *   'POINT K
[  20] C      L        ?               ?               2320    * * *   'POINT L
[  21] C      M        ?               ?               2328    * * *   'POINT M
[  22] C      HV10     ?               ?               2356    * * *   'HV#10
[  23] C      N        ?               ?               2374    * * *   'POINT N
[  24] C      O        ?               ?               2397    * * *   'POINT O
[  25] C      P        ?               ?               2399    * * *   'POINT P
[  26] C      R        ?               ?               2390    * * *   'POINT R
[  27] C      S        ?               ?               2417    * * *   'POINT S
[  28] C      X        ?               ?               2307    * * *   'POINT X
[  29] C      Y        ?               ?               2270    * * *   'POINT Y
[  30] C      Z        ?               ?               2241    * * *   'POINT Z
[  31]
[  32] A      B-GIS818-HV2      275-46-49
[  33] A      HV2-B-C           179-57-57
[  34] A      C-HV2-D           92-16-00
[  35] A      D-C-E             175-03-44
[  36] A      E-D-HV3           147-22-25
[  37] A      HV3-E-F           179-49-10
[  38] A      F-HV3-G           180-28-33
[  39] A      G-F-H             179-45-34
[  40] A      H-G-HV6           179-38-27
[  41] A      HV6-H-I           185-46-09
[  42] A      I-HV6-J           164-53-02
[  43] A      J-I-K             189-33-48
[  44] A      K-J-L             183-11-05
[  45] A      L-K-M             180-25-59
[  46] A      M-L-HV10          177-50-52
[  47] A      HV10-M-N          180-00-58
[  48] A      N-HV10-O          187-01-32
[  49] A      O-N-P             205-47-56
[  50] A      P-O-R             204-46-08
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[  51] A       R-P-S            154-40-44
[  52] A       S-R-GIS805       189-26-59
[  53] A       K-L-X            138-12-25
[  54] A       X-K-Y            170-51-00
[  55] A       Y-X-Z            175-17-22
[  56] A       Z-Y-GIS809       174-51-56
[  57]
[  58] D       GIS818-B         4986.593
[  59] D       B-HV2            1352.775
[  60] D       HV2-C            1291.244
[  61] D       C-D              1056.118
[  62] D       D-E              934.788
[  63] D       E-HV3            927.253
[  64] D       HV3-F            1610.229
[  65] D       F-G              1784.820
[  66] D       G-H              1909.176
[  67] D       H-HV6            1837.813
[  68] D       HV6-I            1594.703
[  69] D       I-J              1182.252
[  70] D       J-K              798.346
[  71] D       K-L              908.663
[  72] D       L-M              1955.999
[  73] D       M-HV10           3908.651
[  74] D       HV10-N           2941.597
[  75] D       N-O              1687.358
[  76] D       O-P              1365.021
[  77] D       P-R              1122.405
[  78] D       R-S              1700.053
[  79] D       S-GIS805         1975.088
[  80] D       K-X              952.887
[  81] D       X-Y              3429.350
[  82] D       Y-Z              2313.835
[  83] D       Z-GIS809         3032.518
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Summary of All Unadjusted Input Observations

Number of Stations with Coordinates = 27

Fixed Stations	N	E	RefElev	Description
GIS818	26775798.367	762258.433	2259.000	GIS POINT 818
GIS809	26791714.739	766927.669	2208.000	GIS POINT 809
GIS805	26807618.962	751432.929	2412.000	GIS POINT 805

Free Stations	N	E	RefElev	Description
B	26780746.639	761641.411	2267.000	POINT B
HV2	26780777.973	762993.564	2259.000	HV
C	26780808.651	764284.197	2249.000	POINT C
D	26781864.437	764300.875	2250.000	POINT D
E	26782796.733	764235.147	2251.000	POINT E
HV3	26783540.436	763681.632	2252.000	HV
F	26784828.882	762716.357	2256.000	POINT F
G	26786265.866	761658.318	2267.000	POINT G
H	26787798.204	760520.119	2278.000	POINT H
HV6	26789266.367	759415.240	2296.000	HV
I	26790630.235	758589.433	2308.000	POINT I
J	26791446.716	757734.719	2315.000	POINT J
K	26792086.293	757257.173	2314.000	POINT K
L	26792843.319	756754.920	2320.000	POINT L
M	26794481.027	755686.112	2328.000	POINT M
HV10	26797671.122	753428.931	2356.000	HV
	26800072.417	751730.885	2374.000	POINT N
	26801558.639	750932.644	2397.000	POINT O
P	26802922.149	750874.516	2399.000	POINT P
R	26803960.194	751300.837	2390.000	POINT R
S	26805657.589	751212.079	2417.000	POINT S
X	26791845.431	758178.924	2307.000	POINT X
Y	26791517.137	761591.856	2270.000	POINT Y
Z	26791485.487	763905.031	2241.000	POINT Z

Number of Angle Observations = 25

At	From	To	Obs Angle	t-T	Grid Angle	StdErr
B	GIS818	HV2	275-46-49.00	-0.12	275-46-48.88	4.00
HV2	B	C	179-57-57.00	-0.00	179-57-57.00	4.00
C	HV2	D	92-16-00.00	-0.03	92-15-59.97	4.00
D	C	E	175-03-44.00	-0.05	175-03-43.95	4.00
E	D	HV3	147-22-25.00	-0.04	147-22-24.96	4.00
HV3	E	F	179-49-10.00	-0.05	179-49-09.95	4.00
F	HV3	G	180-28-33.00	-0.07	180-28-32.93	4.00
G	F	H	179-45-34.00	-0.07	179-45-33.93	4.00
H	G	HV6	179-38-27.00	-0.07	179-38-26.93	4.00
HV6	H	I	185-46-09.00	-0.07	185-46-08.93	4.00
I	HV6	J	164-53-02.00	-0.05	164-53-01.95	4.00
J	I	K	189-33-48.00	-0.03	189-33-47.97	4.00
	J	L	183-11-05.00	-0.03	183-11-04.97	4.00

L	K	M	180-25-59.00	-0.06	180-25-58.94	4.00
	L	HV10	177-50-52.00	-0.11	177-50-51.89	4.00
HV10	M	N	180-00-58.00	-0.13	180-00-57.87	4.00
N	HV10	O	187-01-32.00	-0.09	187-01-31.91	4.00
O	N	P	205-47-56.00	-0.06	205-47-55.94	4.00
P	O	R	204-46-08.00	-0.05	204-46-07.95	4.00
R	P	S	154-40-44.00	-0.06	154-40-43.94	4.00
S	R	GIS805	189-26-59.00	-0.08	189-26-58.92	4.00
K	L	X	138-12-25.00	0.02	138-12-25.02	4.00
X	K	Y	170-51-00.00	0.01	170-51-00.01	4.00
Y	X	Z	175-17-22.00	0.01	175-17-22.01	4.00
Z	Y	GIS809	174-51-56.00	-0.01	174-51-55.99	4.00

Number of Distance Observations = 26
Distance Units Are US Feet

From	To	Obs Dist	Comb Grid	Grid Dist	StdErr
GIS818	B	4986.5930	0.9998089	4985.6399	0.030
B	HV2	1352.7750	0.9998090	1352.5166	0.030
HV2	C	1291.2440	0.9998097	1290.9983	0.030
C	D	1056.1180	0.9998101	1055.9174	0.030
D	E	934.7880	0.9998100	934.6104	0.030
E	HV3	927.2530	0.9998099	927.0767	0.030
HV3	F	1610.2290	0.9998096	1609.9224	0.030
F	G	1784.8200	0.9998090	1784.4791	0.030
	H	1909.1760	0.9998082	1908.8098	0.030
	HV6	1837.8130	0.9998072	1837.4587	0.030
HV6	I	1594.7030	0.9998063	1594.3941	0.030
I	J	1182.2520	0.9998056	1182.0222	0.030
J	K	798.3460	0.9998053	798.1906	0.030
K	L	908.6630	0.9998051	908.4859	0.030
L	M	1955.9990	0.9998046	1955.6168	0.030
M	HV10	3908.6510	0.9998034	3907.8824	0.030
HV10	N	2941.5970	0.9998018	2941.0140	0.030
N	O	1687.3580	0.9998006	1687.0215	0.030
O	P	1365.0210	0.9997999	1364.7478	0.030
P	R	1122.4050	0.9998001	1122.1806	0.030
R	S	1700.0530	0.9997997	1699.7125	0.030
S	GIS805	1975.0880	0.9997992	1974.6914	0.030
K	X	952.8870	0.9998056	952.7017	0.030
X	Y	3429.3500	0.9998072	3428.6887	0.030
Y	Z	2313.8350	0.9998094	2313.3940	0.030
Z	GIS809	3032.5180	0.9998116	3031.9465	0.030

Number of Azimuth/Bearing Observations = 1

From	To	Grid Bearing	StdErr
GIS818	GIS805	N18-47-19.00W	4.00

Network Solution

Solution Has Converged in 3 Iterations

Final Results

Updated Coordinates and Changes from Last Iteration

Station	N	E	dN	dE
GIS818	26775798.367	762258.433	-0.000	0.000
GIS809	26791714.739	766927.669	-0.000	-0.000
GIS805	26807618.962	751432.929	0.000	-0.000
B	26780745.648	761641.088	-0.000	-0.000
HV2	26780777.099	762993.237	-0.000	-0.000
C	26780807.880	764283.866	-0.000	0.000
D	26781863.676	764300.474	-0.000	-0.000
E	26782795.978	764234.695	-0.000	-0.000
HV3	26783539.666	763681.147	-0.000	-0.000
F	26784828.095	762715.834	-0.000	-0.000
G	26786265.070	761657.770	-0.000	-0.000
H	26787797.407	760519.555	-0.000	-0.000
	26789265.574	759414.669	-0.000	-0.000
	26790629.449	758588.857	-0.000	-0.000
J	26791445.936	757734.138	-0.000	-0.000
K	26792085.519	757256.585	-0.000	-0.000
L	26792842.551	756754.323	-0.000	-0.000
M	26794480.257	755685.493	-0.000	-0.000
HV10	26797670.321	753428.257	-0.000	-0.000
N	26800071.578	751730.144	-0.000	-0.000
O	26801557.777	750931.841	-0.000	-0.000
P	26802921.293	750873.642	-0.000	-0.000
R	26803959.372	751299.902	-0.000	-0.000
S	26805656.769	751211.025	-0.000	-0.000
X	26791844.660	758178.340	-0.000	-0.000
Y	26791516.377	761591.278	-0.000	-0.000
Z	26791484.733	763904.457	-0.000	-0.000

Statistical Summary

NW STUDY

Number of Observations	=	52
Number of Unknowns	=	48
Degrees of Freedom	=	4

Data Type	Count	Weighted Residuals	Error Factor
Distances	26	1.95	0.99
Angles	25	4.44	1.52
Directions	0	0.00	0.00
Az/Bearings	1	0.01	0.27
Stations	27	0.00	0.00
Total	79	6.40	1.26

Adjustment passes the Chi Square test at 5% level

Adjusted Observations and Residuals

Adjusted Angle Observations

At	From	To	Adj Angle	Residual	StdErr	StdRes
B	GIS818	HV2	275-46-49.53	0-00-00.53	4.00	0.1
HV2	B	C	179-57-58.62	0-00-01.62	4.00	0.4
C	HV2	D	92-16-02.65	0-00-02.65	4.00	0.7
D	C	E	175-03-46.89	0-00-02.89	4.00	0.7
E	D	HV3	147-22-28.03	0-00-03.03	4.00	0.8
HV3	E	F	179-49-12.74	0-00-02.74	4.00	0.7
F	HV3	G	180-28-35.23	0-00-02.23	4.00	0.6
G	F	H	179-45-35.68	0-00-01.68	4.00	0.4
H	G	HV6	179-38-28.08	0-00-01.08	4.00	0.3
HV6	H	I	185-46-09.50	0-00-00.50	4.00	0.1
I	HV6	J	164-53-02.12	0-00-00.12	4.00	0.0
J	I	K	189-33-47.61	-0-00-00.39	4.00	0.1
K	J	L	183-11-04.36	-0-00-00.64	4.00	0.2
L	K	M	180-25-58.07	-0-00-00.93	4.00	0.2
M	L	HV10	177-50-50.78	-0-00-01.22	4.00	0.3
HV10	M	N	180-00-56.07	-0-00-01.93	4.00	0.5
N	HV10	O	187-01-29.54	-0-00-02.46	4.00	0.6
O	N	P	205-47-53.41	-0-00-02.59	4.00	0.6
P	O	R	204-46-05.85	-0-00-02.15	4.00	0.5
R	P	S	154-40-42.58	-0-00-01.42	4.00	0.4
S	R	GIS805	189-26-58.11	-0-00-00.89	4.00	0.2
[illegible]	L	X	138-12-25.15	0-00-00.15	4.00	0.0
[illegible]	K	Y	170-51-00.16	0-00-00.16	4.00	0.0
Y	X	Z	175-17-22.14	0-00-00.14	4.00	0.0
Z	Y	GIS809	174-51-56.10	0-00-00.10	4.00	0.0

Adjusted Distance Observations [US Feet]

At	To	Adj Dist	Residual	StdErr	StdRes
GIS818	B	4986.6025	0.0095	0.030	0.3
B	HV2	1352.7728	-0.0022	0.030	0.1
HV2	C	1291.2418	-0.0022	0.030	0.1
C	D	1056.1272	0.0092	0.030	0.3
D	E	934.7974	0.0094	0.030	0.3
E	HV3	927.2619	0.0089	0.030	0.3
HV3	F	1610.2379	0.0089	0.030	0.3
F	G	1784.8289	0.0089	0.030	0.3
G	H	1909.1849	0.0089	0.030	0.3
H	HV6	1837.8219	0.0089	0.030	0.3
HV6	I	1594.7122	0.0092	0.030	0.3
I	J	1182.2601	0.0081	0.030	0.3
J	K	798.3549	0.0089	0.030	0.3
K	L	908.6732	0.0102	0.030	0.3
L	M	1956.0093	0.0103	0.030	0.3
M	HV10	3908.6612	0.0102	0.030	0.3
HV10	N	2941.6072	0.0102	0.030	0.3

N	O	1687.3684	0.0104	0.030	0.3
O	P	1365.0307	0.0097	0.030	0.3
P	R	1122.4122	0.0072	0.030	0.2
R	S	1700.0627	0.0097	0.030	0.3
S	GIS805	1975.0970	0.0090	0.030	0.3
K	X	952.8888	0.0018	0.030	0.1
X	Y	3429.3518	0.0018	0.030	0.1
Y	Z	2313.8368	0.0018	0.030	0.1
Z	GIS809	3032.5197	0.0017	0.030	0.1

Adjusted Azimuth/Bearing Observations

From	To	Adj Bearing	Residual	StdErr	StdRes
GIS818	GIS805	N18-47-18.69W	0-00-00.31	4.00	0.1

Error Propagation

Station Coordinate Standard Deviation

Station	N	E
GIS818	0.000	0.000
GIS809	0.000	0.000
GIS805	0.000	0.000
B	0.034	0.117
HV2	0.036	0.118
C	0.053	0.118
D	0.059	0.121
E	0.063	0.123
HV3	0.064	0.121
F	0.068	0.116
G	0.075	0.108
H	0.081	0.096
HV6	0.086	0.082
I	0.088	0.070
J	0.090	0.063
K	0.091	0.060
L	0.090	0.064
M	0.086	0.075
HV10	0.073	0.095
N	0.063	0.104
O	0.057	0.104
P	0.050	0.096
R	0.042	0.084
S	0.030	0.053
X	0.088	0.052
Y	0.076	0.042
Z	0.057	0.030

Station Coordinate Error Ellipses
Confidence Region = 95%

Station	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis
GIS818	0.000	0.000	0-00
GIS809	0.000	0.000	0-00
GIS805	0.000	0.000	0-00
B	0.290	0.072	81-08
HV2	0.289	0.088	91-08
C	0.291	0.128	95-40
D	0.299	0.140	96-52
E	0.302	0.151	96-40
HV3	0.296	0.153	96-03
F	0.284	0.166	95-00
G	0.265	0.183	93-34
H	0.236	0.199	94-14
HV6	0.211	0.201	164-11

I	0.216	0.171	0-30
J	0.221	0.153	4-06
K	0.224	0.143	9-04
L	0.223	0.154	12-14
M	0.215	0.177	21-58
HV10	0.234	0.177	78-41
N	0.255	0.153	85-55
O	0.254	0.139	88-57
P	0.236	0.122	90-32
R	0.205	0.102	89-13
S	0.129	0.073	93-58
X	0.216	0.126	5-00
Y	0.186	0.103	179-30
Z	0.139	0.073	176-41

Adjusted Bearings and Horizontal Distances

From	To	Grid Bearing	Grid Dist Grnd Dist	Relative BgErr	 DisErr	RelDist Precision
GIS818	B	N07-06-46.34W	4985.6494 4986.6025	4.90	0.030	1:168015
B	HV2	N88-40-03.06E	1352.5144 1352.7728	4.63	0.030	1: 45125
HV2	C	N88-38-01.68E	1290.9961 1291.2418	4.62	0.030	1: 43072
C	D	N00-54-04.30E	1055.9267 1056.1272	4.69	0.030	1: 35571
D	E	N04-02-08.86W	934.6198 934.7974	4.72	0.030	1: 31493
E	HV3	N36-39-40.88W	927.0856 927.2619	4.59	0.030	1: 31180
HV3	F	N36-50-28.19W	1609.9313 1610.2379	4.27	0.030	1: 54145
F	G	N36-21-53.03W	1784.4880 1784.8289	4.00	0.030	1: 60019
G	H	N36-36-17.43W	1908.8187 1909.1849	3.93	0.030	1: 64199
H	HV6	N36-57-49.42W	1837.4676 1837.8219	4.10	0.030	1: 61796
HV6	I	N31-11-39.99W	1594.4033 1594.7122	4.38	0.030	1: 53663
	J	N46-18-37.92W	1182.0304 1182.2601	4.53	0.030	1: 39694
J	K	N36-44-50.35W	798.1995 798.3549	4.38	0.030	1: 26845
K	L	N33-33-46.02W	908.4962 908.6732	3.59	0.030	1: 30579
L	M	N33-07-48.01W	1955.6270 1956.0093	3.59	0.030	1: 65825
M	HV10	N35-16-57.35W	3907.8926 3908.6612	3.28	0.030	1:131525
HV10	N	N35-16-01.41W	2941.0242 2941.6072	3.30	0.030	1: 98984
N	O	N28-14-31.96W	1687.0318 1687.3684	3.55	0.030	1: 56790
O	P	N02-26-38.61W	1364.7575 1365.0307	3.77	0.030	1: 45870
P	R	N22-19-27.19E	1122.1878 1122.4122	4.08	0.030	1: 37579
R	S	N02-59-50.29W	1699.7222 1700.0627	4.60	0.030	1: 57133
S	GIS805	N06-27-07.74E	1974.7004 1975.0970	5.51	0.030	1: 66292
K	X	S75-21-20.85E	952.7035 952.8888	3.72	0.030	1: 31869
X	Y	S84-30-20.68E	3428.6904 3429.3518	3.03	0.030	1:114654

	Z	S89-12-58.53E	2313.3958 2313.8368	3.03	0.030	1: 77344
	GIS809	N85-38-57.57E	3031.9483 3032.5197	3.86	0.030	1:101348
GIS818	GIS805	N18-47-18.69W	33611.6320 33618.2107	0.00	0.000	FIXED

Convergence Angles and Factors at Stations

(Elevation Factor Includes -27.30 Meter Geoid Height Correction)

Station	Convergence Angle	Factors ------- Grid	x Elevation	= Combined
GIS818	0-12-44.65	0.99991288	0.99989624	0.99980913
GIS809	0-13-19.58	0.99991404	0.99989868	0.99981273
GIS805	0-11-28.83	0.99991039	0.99988892	0.99979932
B	0-12-40.58	0.99991273	0.99989586	0.99980860
HV2	0-12-50.33	0.99991306	0.99989624	0.99980931
C	0-12-59.64	0.99991338	0.99989672	0.99981010
D	0-12-59.85	0.99991338	0.99989667	0.99981006
E	0-12-59.44	0.99991336	0.99989662	0.99981000
HV3	0-12-55.51	0.99991323	0.99989657	0.99980981
F	0-12-48.65	0.99991299	0.99989638	0.99980938
G	0-12-41.12	0.99991273	0.99989586	0.99980860
H	0-12-33.03	0.99991246	0.99989533	0.99980780
HV6	0-12-25.16	0.99991220	0.99989447	0.99980668
I	0-12-19.31	0.99991200	0.99989390	0.99980591
J	0-12-13.20	0.99991180	0.99989356	0.99980538
K	0-12-09.80	0.99991169	0.99989361	0.99980531
L	0-12-06.23	0.99991158	0.99989332	0.99980491
M	0-11-58.63	0.99991133	0.99989294	0.99980428
HV10	0-11-42.55	0.99991082	0.99989160	0.99980244
N	0-11-30.45	0.99991045	0.99989074	0.99980120
O	0-11-24.79	0.99991028	0.99988964	0.99979993
	0-11-24.46	0.99991026	0.99988954	0.99979982
	0-11-27.61	0.99991036	0.99988998	0.99980034
S	0-11-27.09	0.99991034	0.99988868	0.99979903
X	0-12-16.43	0.99991191	0.99989394	0.99980586
Y	0-12-41.04	0.99991272	0.99989571	0.99980844
Z	0-12-57.74	0.99991328	0.99989710	0.99981039
Project Averages:	0-12-20.21	0.99991206	0.99989403	0.99980610

Elapsed time = 00:00:04

MAP PROJECTION TRANSFORMATION

Projection: 1983 State Plane Transverse Mercator
Zone = Nevada East
Central Meridian = W 115°35'00.000000"
Latitude of Origin = N 34°45'00.000000"
Origin Northing = 8000000.0000 Easting = 200000.0000
Scale along Central Meridian = 0.999900000000

Linear units = meter

POINT	NAME	GEODETIC	MAP	SCALE & CONVERGENCE
1	3005	N 36°17'26.724540" W 115°15'36.218970"	8170978.6014 229037.2148	0.999910385250 + 0°11'28.8272"
2	3009	N 36°14'46.727520" W 115°13'04.611880"	8166060.8788 232838.5441	0.999913282510 + 0°12'57.7404"
3	3018	N 36°12'11.658120" W 115°13'25.418420"	8161279.6648 232336.8352	0.999912879869 + 0°12'44.6529"
4	4000	N 36°13'16.828689" W 115°12'42.758805"	8163292.2472 233394.7241	0.999913736329 + 0°13'10.1914"
	4001	N 36°13'32.364112" W 115°15'14.326503"	8163757.3728 229608.0067	0.999910797715 + 0°11'40.6990"
6	4002	N 36°15'13.948678" W 115°14'31.943911"	8166891.8956 230655.3462	0.999911575067 + 0°12'06.2340"
7	4003	N 36°15'46.710380" W 115°15'38.556119"	8167895.9267 228989.1710	0.999910350977 + 0°11'26.9898"

ADJUSTMENT STATISTICS SUMMARY
NETWORK = NWFS
TIME = Mon Aug 23 10:34:14 1993

ADJUSTMENT SUMMARY

Network Reference Factor = 1.00
Chi-Square Test (α = 95%) = PASS
Degrees of Freedom = 18.00

GPS OBSERVATIONS
Reference Factor = 1.00
r = 18.00

GPS Solution	1	Reference Factor =	0.66	r =	1.99
GPS Solution	2	Reference Factor =	0.53	r =	0.96
GPS Solution	3	Reference Factor =	0.80	r =	1.59
GPS Solution	4	Reference Factor =	1.31	r =	1.81
GPS Solution	5	Reference Factor =	1.22	r =	2.11
GPS Solution	6	Reference Factor =	1.08	r =	1.28
GPS Solution	7	Reference Factor =	0.90	r =	1.40
GPS Solution	8	Reference Factor =	0.62	r =	1.69
GPS Solution	9	Reference Factor =	0.52	r =	1.34
GPS Solution	10	Reference Factor =	0.89	r =	1.67
GPS Solution	11	Reference Factor =	1.47	r =	2.14

WEIGHTING STRATEGIES:

GPS OBSERVATIONS:
Scalar Weighting Strategy:
User-Defined Scalar Set Applied Globally = 13.58

No summation weighting strategy was used

Station Error Strategy:
Horizontal error = 0.0000
Vertical error = 0.0000

SUMMARY OF COVARIANCES
NETWORK = NWFS
TIME = Mon Aug 23 10:35:04 1993

FROM/ TO	AZIMUTH/ DELTA H	1.00σ 1.00σ	DISTANCE/ DELTA h	1.00σ 1.00σ	HOR PREC
3005 3009	-**- -50.8948m	-**- 0.0228m	-**- -**-	-**- -**-	-**-
3005 3018	-**- -46.6292m	-**- 0.0230m	-**- -**-	-**- -**-	-**-
3005 4000	150°27'02" -51.8445m	0.07" 0.0226m	8835.606m -**-	0.0025m -**-	1: 3499368
3005 4001	175°28'50" -25.1356m	0.09" 0.0231m	7243.752m -**-	0.0034m -**-	1: 2110290
3005 4002	158°23'56" -28.1560m	0.15" 0.0218m	4395.397m -**-	0.0025m -**-	1: 1726307
3005 4003	180°53'34" -12.4992m	0.33" 0.0212m	3083.049m -**-	0.0054m -**-	1: 574247
3[redacted] 30[redacted]	-**- +4.2656m	-**- 0.0107m	-**- -**-	-**- -**-	-**-
3009 4000	168°38'29" -0.9497m	0.20" 0.0067m	2823.944m -**-	0.0026m -**-	1: 1073645
3009 4001	234°30'34" +25.7591m	0.18" 0.0125m	3967.683m -**-	0.0032m -**-	1: 1226763
3009 4002	290°50'20" +22.7388m	0.27" 0.0083m	2336.010m -**-	0.0028m -**-	1: 844757
3009 4003	295°29'16" +38.3956m	0.25" 0.0128m	4264.396m -**-	0.0053m -**-	1: 810070
3018 4000	27°43'41" -5.2153m	0.23" 0.0093m	2273.679m -**-	0.0028m -**-	1: 803981
3018 4001	312°14'19" +21.4936m	0.18" 0.0114m	3685.857m -**-	0.0034m -**-	1: 1093980
3018 4002	343°19'16" +18.4732m	0.11" 0.0096m	5858.715m -**-	0.0026m -**-	1: 2266794
3018 4003	333°09'42" +34.1300m	0.13" 0.0131m	7414.970m -**-	0.0055m -**-	1: 1347472
4000 4001	277°00'09" +26.7088m	0.24" 0.0118m	3815.176m -**-	0.0040m -**-	1: 961945
4000 4002	322°43'42" +23.6885m	0.20" 0.0076m	4523.457m -**-	0.0030m -**-	1: 1495029
4[redacted] 4[redacted]	316°15'35" +39.3453m	0.19" 0.0123m	6372.030m -**-	0.0058m -**-	1: 1094746
4001 4002	18°28'34" -3.0204m	0.22" 0.0102m	3304.868m -**-	0.0027m -**-	1: 1206438
4001 4003	351°29'44" +12.6364m	0.24" 0.0113m	4184.565m -**-	0.0051m -**-	1: 820251
4002 4003	301°04'23" +15.6568m	0.41" 0.0101m	1945.307m -**-	0.0053m -**-	1: 364276

3005	8170978.601439 229037.214798	731.9165 -27.6000	YX--	YXHh
3009	8166060.878774 232838.544070	681.0218 -27.6000	YX--	YXHh
3018	8161279.664820 232336.835227	685.2873 -27.6000	YX--	YXHh
4000	8163292.247187 233394.724053	680.0721 0.0000	----	YXH-
4001	8163757.372755 229608.006656	706.7809 0.0000	----	YXH-
4002	8166891.895580 230655.346163	703.7605 0.0000	----	YXH-
4003	8167895.926662 228989.170983	719.4174 0.0000	----	YXH-

SYSTEM PARAMETERS

rk status = reduced computed adjusted
n = NAD-83
ordinate System = 1983 State Plane Transverse Mercator
one = Nevada East
inear units = meter

1	3005		N 36°17'26.724540" W 115°15'36.218970"	2401.2961 -90.5510	YX--	YXHh
2	3009		N 36°14'46.727520" W 115°13'04.611880"	2234.3189 -90.5510	YX--	YXHh
3	3018		N 36°12'11.658120" W 115°13'25.418420"	2248.3135 -90.5510	YX--	YXHh
4	4000	HV #1	N 36°13'16.828689" W 115°12'42.758805"	2231.2031 0.0000	----	YXH-
5	4001	HV #17	N 36°13'32.364112" W 115°15'14.326503"	2318.8304 0.0000	----	YXH-
6	4002	HV #9	N 36°15'13.948678" W 115°14'31.943911"	2308.9210 0.0000	----	YXH-
7	4003	HV #12	N 36°15'46.710380" W 115°15'38.556119"	2360.2884 0.0000	----	YXH-

SYSTEM PARAMETERS

[illegible]rk status = reduced computed adjusted
[illegible]m = NAD-83
Coordinate System = Geographic
Zone = Global
Linear units = US Survey Foot

8/23/1993

Original Coordinates on NAD 83 Geographic Coordinates
Translated Coordinates on NAD 83 State Plane Zone 2701,U.S. FOOT

NAME	INPUT	OUTPUT
3005	36 17 26.72454 N 115 15 36.21897 W	26807618.96191 N 751432.92886 E
Convergence		00 11 28.82720
Scale Factor		0.999910385
3009	36 14 46.72752 N 115 13 04.61188 W	26791484.73346 N 763904.45664 E
Convergence		00 12 57.74037
Scale Factor		0.999913282
3018	36 12 11.65812 N 115 13 25.41842 W	26775798.36733 N 762258.43355 E
Convergence		00 12 44.65289
Scale Factor		0.999912880
HV1	36 13 16.82869 N 115 12 42.75881 W	26782401.31472 N 765729.19006 E
Convergence		00 13 10.19141
Scale Factor		0.999913736
HV17	36 13 32.36411 N 115 15 14.32650 W	26783927.31392 N 753305.60209 E
Convergence		00 11 40.69895
Scale Factor		0.999910798
HV9	36 15 13.94868 N 115 14 31.94391 W	26794211.16128 N 756741.74826 E
Convergence		00 12 06.23404
Scale Factor		0.999911575
HV12	36 15 46.71038 N 115 15 38.55612 W	26797505.21975 N 751275.30503 E
Convergence		00 11 26.98985
Scale Factor		0.999910351

Section 2

ERM'S

1. Rivet - In top of curb, northwest corner of Cheyenne and Rancho Drive, near the BCR on Rancho Drive.

   Clark County Station No.: 7C00-12SSE6
   Elevation: 2238.83 Feet

10. Rivet and 2" x 2" aluminum plate in top of curb, southwest corner of Michael Way and Rancho Drive, near the BCR on Rancho Drive.

    Clark County Station No.: 7C00-12S6
    Elevation: 2251.10 Feet

11. Revet and 2" x 2" aluminum plate in top of curb, southwest corner of Gowan Road and Rancho Drive, near the BCR on Gowan Road.

    Clark County Station No.: 7C00-12C4
    Elevation: 2251.83 Feet

12. USC & GS BBASS Cap, T-398, 1980, located in dirt, 4 ft. +/- east of west curb of centerline island of Rancho Drive, 250 ft. +/- south of Duncan Road along Rancho Drive.

    Clark County Station No.: T-398 USC & GS
    Elevation: 2254.24 Feet

13. Rivet and 2" x 2" aluminum plate in top of curb, on the west side of Rancho Drive, south of the north driveway to Crystal Palace Skating Rink, 1200 ft. +/- north of Duncan Road.

    Clark County Station No.: 7600-12NW6
    Elevation: 2259.94 Feet

14. Rivet and 2" x 2" aluminum plate in the top of the south end of a concrete headwall, 7 ft. +/- east of easterly edge of pavement of Rancho Drive, 450 ft. +/- south of Jones Blvd. along Rancho Drive.

    Clark County Station No.: 7C00 - 12 NES
    Elevation: 2263.21 Feet

15. Rivet and 2" x 2" aluminum plate in top of the south end of a concrete headwall 3.6 ft. +/- east of easterly edge of pavement of Rancho Drive, 450 ft. +/- north of Jones Blvd. along Rancho Drive.

Clark County Station No.: 7C00 - 2 SES
Elevation: 2259.87 Feet

16. Rivet and 2" x 2" aluminum plate in top of curb, on the west side of Rancho Drive, just south of the north driveway into Horizon Recovery Center, 0.3 mile +/- south of Craig Road along Rancho Drive.

Clark County Station No.: 7C00 - 2 SE6
Elevation: 2280.55 Feet

30. Rivet and 2" x 2" aluminum plate in top of curb, of planter, just east of driveway into 7-11 Store on Craig road at northwest corner of Craig Road and Rancho Drive.

Clark County Station No.: RM 1, T-365
Elevation: 2294.29 Feet

30A. Rivet and 2" x 2" aluminum plate in top of curb, southeast corner of Lone Mountain Road and Rancho Drive, near the BCR of Rancho Road.

Clark County Station No.: Unknown
Elevation: 2316.93 Feet

47. 3" brass cap in concrete, northwest corner of Rainbow Blvd. and Rancho Drive, USC & GS BM No. R169.

City of Las Vegas Station No.: 1LV90 - 34SEE6
Elevation: 2318.40 Feet

46. 5/8" rebar in ground at southeast corner of Rainbow and Hammer Lane, 1ft. +/- off edge of pavement at mid curve.

City of Las Vegas Station No.: 1LV90 - 34E4
Elevation: 2319.05 Feet

29. USC & GS brass cap, BM No. S169, located 400 ft. +/- north of Ann Road and 100 ft. +/- east of US Hwy 95.

City of Las Vegas Station No.: 1LV90 - 27SSW6
Elevation: 2356.48 Feet

31. Rivet and 2" x 2" aluminum plate in top of curb, southwest BCR of Painted Mirage Road and Ann Road.

City of Las Vegas Station No.: 1LV90 - 34NNW6
Elevation: 2360.01 Feet

31A. Rivet and 2" x 2" aluminum plate in top of headwall east side of US Hwy. 95, 900 ft. +/- south of Ann Road along US Hwy. 95.

Clark County Station No.: OC90 - 34N6
Elevation: 2347.40 Feet

31B. Rivet and 2" x 2" aluminum plate in top of headwall, east side of US Hwy. 95, 1500 ft. +/- south of ann Road along US Hwy. 95.

Clark County Station No.: OC90 - 34E6
Elevation: 2335.69 Feet

48. Rivet and washer in top of west headwall, north side of Alexander Road at US Hwy. 95.

City of Las Vegas Station No.: 1LV00 - 355E6
Elevation: 2317.87 Feet

ERM'S

ERM-95A Top of southerly end of headwall, west side of US Hwy. 95, on line with north fence line of Santa Fe Casino parking lot.

Elevation: 2326.42 Feet

ERM-95B Broken rivet in top of south end of headwall at northwest corner of Lone Mountain Road and US Hwy. 95.

Elevation: 2325.06 Feet

ERM-95C Top of south end of headwall, 25 ft. +/- west of the edge of pavement of US Hwy. 95 southbound, and 100 ft. +/- north of Craig Road.

Elevation: 2322.85 Feet

ERM-95D Middle of north edge of 7 ft. x 7 ft concrete drain inlet structure, 100 ft. +/- West of US Hwy. 95, and 75 ft. +/- North of Gowan Road.

Elevation: 2307.81 Feet

G.I.S. RECOVERY CARD

30	31
1	6

TOWNSHIP

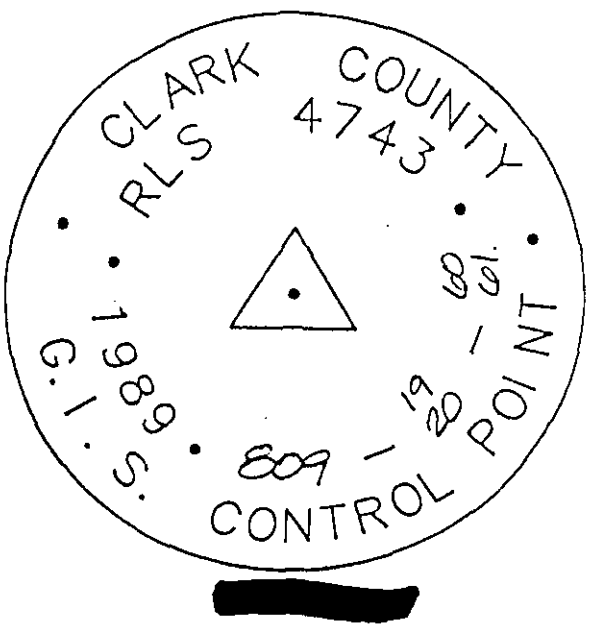
19S
20S

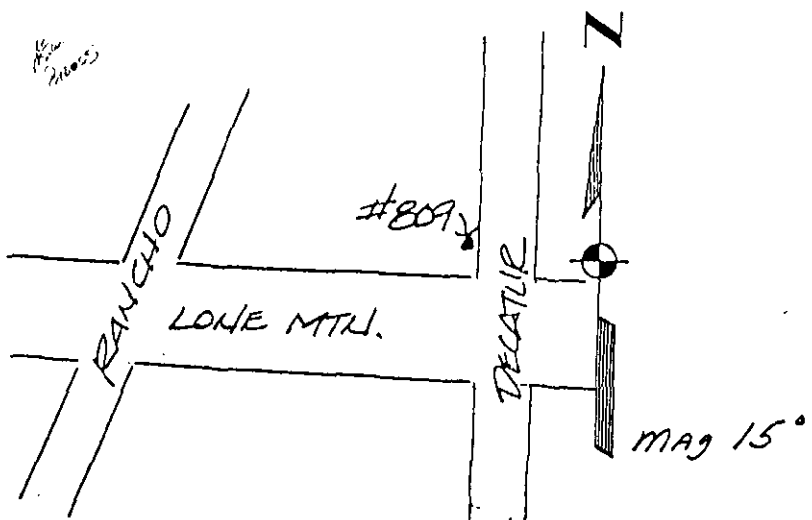
RANGE

60E	61E

MERIDIAN

[redacted]





DATE: 3/89

BY: EATON

DESCRIPTION: MONUMENT SET 80' NW OF FOUND SECTION CORNER, IN CURB @ NW CURB RETURN DECATUR & LONE MOUNTAIN.

S 89°W 88.3' Northeast corner of Concrete slab for Transformer

S 54°E 169.1' Center of Light Pole

N 26791714.739

E 766927.669

G.I.S. RECOVERY CARD

16	15
21	22

SECTION

19S
TOWNSHIP

66E
RANGE

M.DM
MERIDIAN

[redacted]

CLARK COUNTY RLS 4743 · 09 - 19 - 805 · 1989 G.I.S. CONTROL POINT

[redacted]

N

Mag 15°

DATE: 2/89

BY: EATON

Ties S 42°W 72.5' - Section Corner
N 45°W 43.0' - Junction of Road and Ditch

DESCRIPTION: TAKE US95 NORTH PAST RANCHO DRIVE INTERSECTION TO ANN RD. TURN EAST ON ANN RD. ± 300' TO TENAYA WAY, TURN LEFT (NORTH) 1.5 MILES TO DEER SPRING WAY, CONTINUE NORTH 0.1 MILES TO A DIRT ROAD, TURN WEST 0.3 MILES TO A JEEP TRAIL, CONTINUE 0.2 MILES ALONG JEEP TRAIL, TURN NORTH ON A JEEP TRAIL 0.4 MILES TO THE SECTION CORNER, ABOUT 15' WEST OF JEEP TRAIL. FOUND 3" BRASS CAP ON 2" IRON PIPE PROTRUDING 0.4' ABOVE GROUND.
SET MONUMENT 60' NORTH OF SECTION CORNER.

CADASTRAL SURVEY
CLV 72
T19S R66E

16	15
21	22

U.S. BUREAU OF LAND MANAGEMENT 1956

N 26807618.962
E 751432.929

5

G.I.S. RECOVERY CARD

14	13
23	24

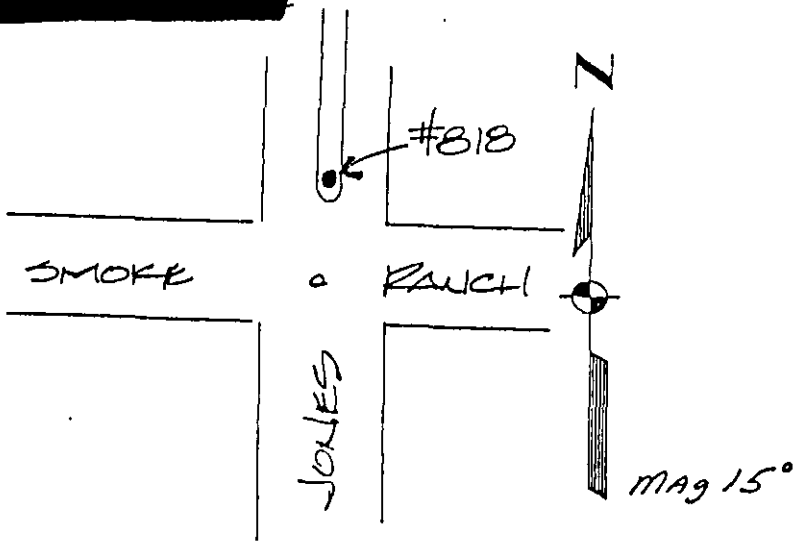
SECTION

20S
TOWNSHIP

60E
RANGE

MDM
MERIDIAN

[redacted]



DATE: 3/89

BY: EATON

DESCRIPTION: MONUMENT SET 5' NORTH OF SOUTH END OF THE MEDIAN ISLAND ON JONES, ON NORTH SIDE OF SMOKE RANCH.

N 83°E 90.0' Center of Traffic Signal Pole

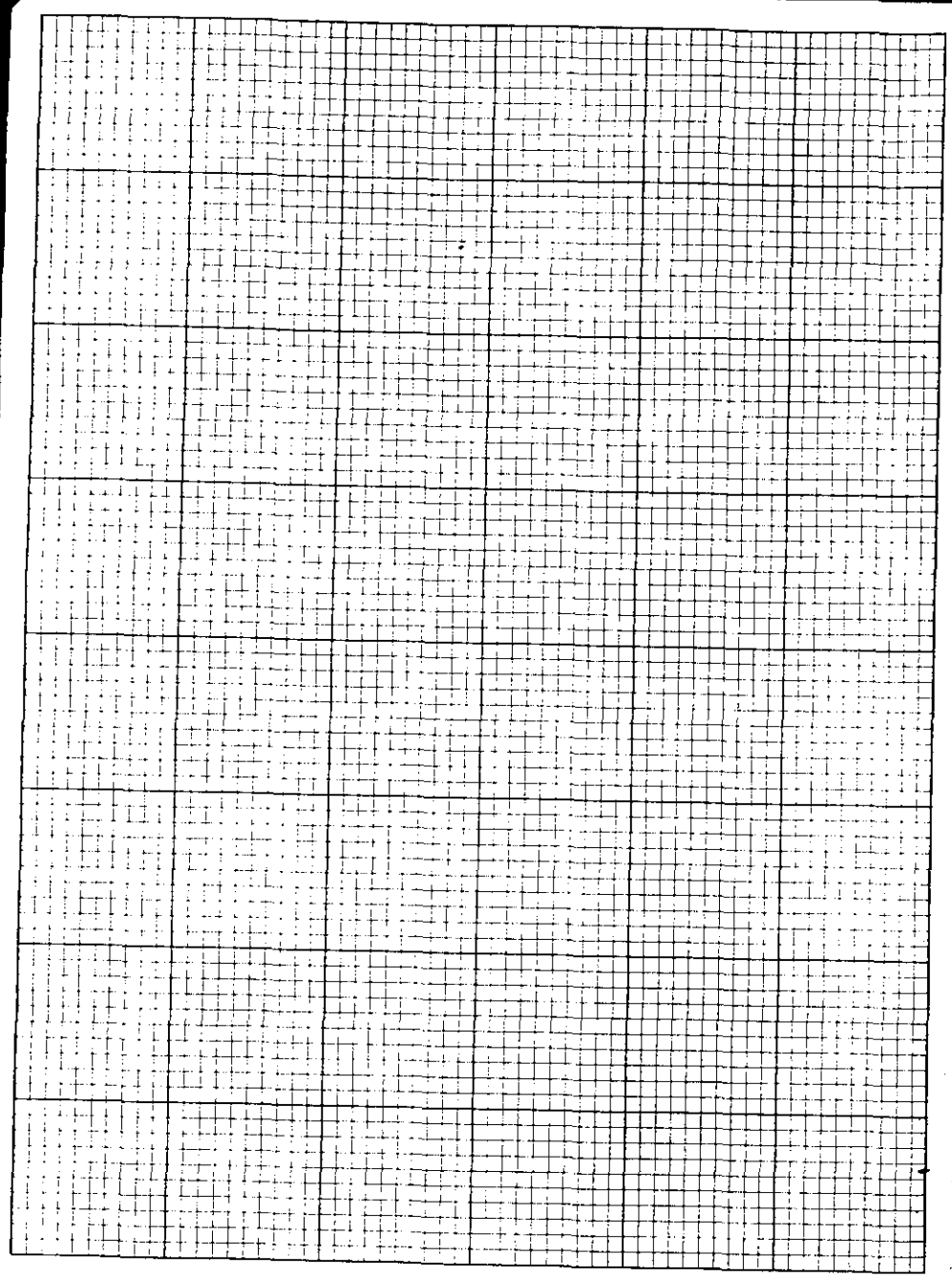
N 30°W 96.5' Center of Light Pole

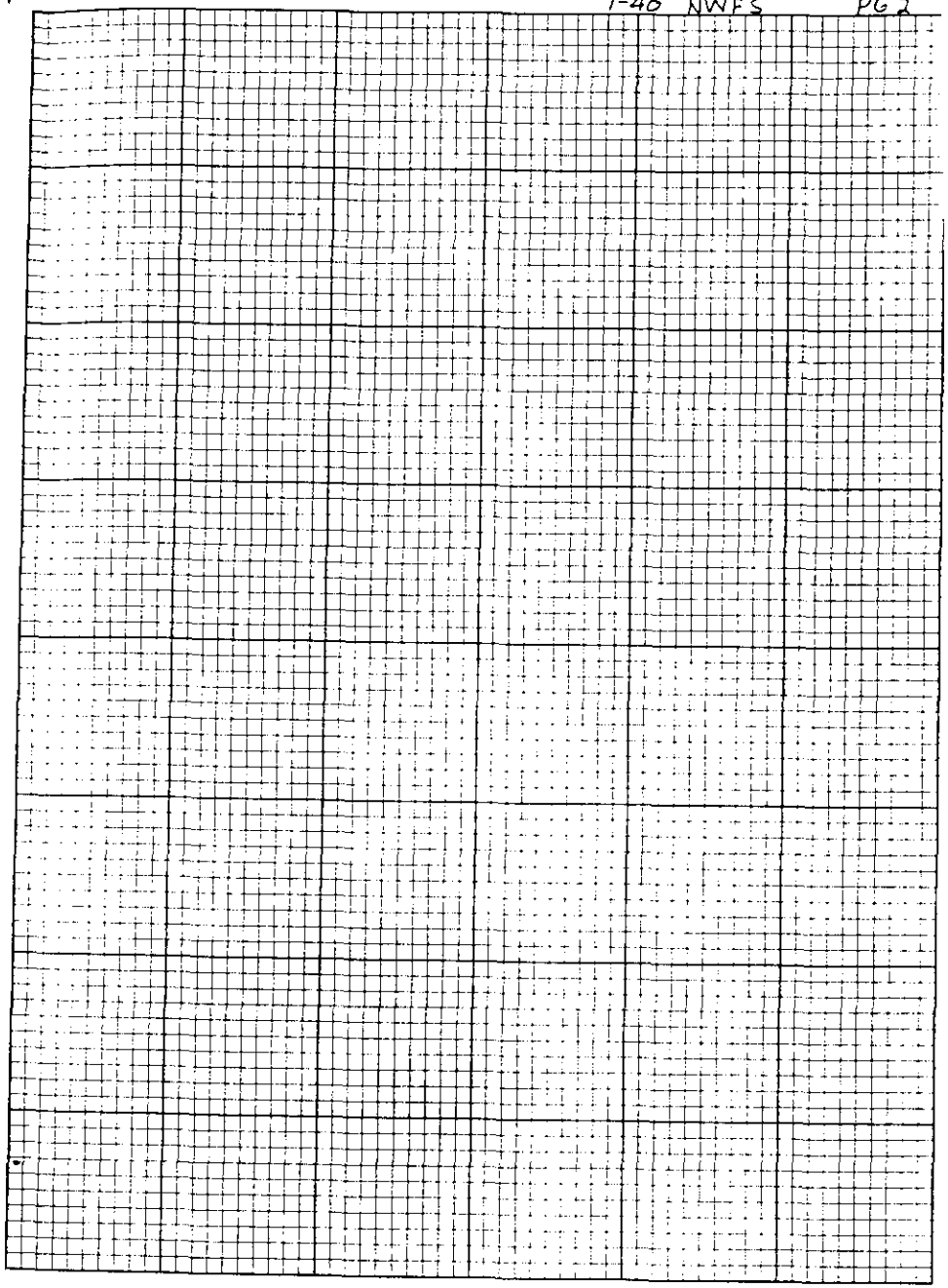
N 26775798.367

E 76258.433

Section 3

FG-1-78 NORTHWEST FLOOD STUDY





NORTHWEST FLOOD STUDY

VERTICAL CONTROL

DESCRIPTIONS

#11 FOUND RIVET NO PLATE NORTHWEST CORNER OF CHEYENNE AVE & RANCHO DR. AT T/C BCR RANCHO
PAINTED V 7C00 - 12SSE6 EL. 2238.827

#10 FOUND CLV RIVET & PLATE # 7C00 - 12S6 SOUTHWEST CORNER OF RANCHO RD. & MICHAEL WAY AT T/C BCR RANCHO EL. 2251.095
PAINTED V

#11 FOUND CLV RIVET & PLATE # 7C00 - 12C6 SOUTHWEST CORNER OF RANCHO RD. & GOWAN RD. AT T/C E.L. DUAL RD. EL. 2251.833
PAINTED V

#12 FOUND MONUMENT BRASS CAP T-398 1980 IN CENTERLINE MEDIAN ISLAND OF RANCHO RD. 250'± SOUTHWEST OF GOWAN DR. EL. 2254.237
PAINTED V

#13 FOUND CLV RIVET & PLATE WEST SIDE OF RANCH RD. SOUTH OF NORTH D/W TO CRYSTAL PALACE 1500'± NORTH OF GOWAN RD. IN T/C 7C00 - 12NW6 EL. 2259.94
PAINTED V

#14 FOUND CLV RIVET & PLATE IN SOUTH END OF CONCRETE HEADWALL 7'± EAST OF E/P 450'± SOUTHEAST OF JONES BLVD (EAST) 7C00 - 12NE6 EL. 2263.208
PAINTED H/W [redacted]

#15 FOUND CLV RIVET & PLATE SOUTH END OF CONCRETE HEADWALL 4'± EAST OF RANCHO RD. 450'± NORTHWEST OF JONES BLVD. 7C00 - 12NE6 EL. 2269.868
PAINTED H/W [redacted]

Q - 0001 T-48 NWES PG 3

5:24:93 BRULAND SOMMA

#16 FOUND CLV RIVET & PLATE IN T/C WEST SIDE OF RANCHO RD JUST SOUTH OF THE NORTH D/W TO HORIZON RECOVERY CENTER 7C00-12SE6 EL. 2280.546
PAINTED V

#30 FOUND CLV RIVET & PLATE IN T/C RM 1 T-365 NORTHWEST CORNER RANCHO RD. & CRAIG RD TOP OF PLANTER ON CRAIG RD.
PAINTED V EL. 2294.290

FOUND CLV RIVET & PLATE IN T/C 0C00 - 7NNW6 SOUTHEAST CORNER RANCHO RD. & LONE MT. RD. BCR RANCHO RD. NO DATUM
PAINTED V

FOUND 3" BRASS CAP IN CONCRETE, NW COR OF RAINBOW BLVD. & RANCHO RD. USC&GS BM #R 169 1LV90 - 34SE6 EL. 2318.399
PAINTED V

#47 FOUND 5/8" REBAR IN GROUND 50' WEST OF CENTERLINE RAINBOW BLVD. & WELCOME LANE 13' NORTH OF TELEPHONE STAND PIPE 1LV90 - 34E4 EL. 2319.049
PAINTED V

#29 FOUND U.S.C.&G.S. BRASS CAP BM # S 169 (RESET 1963) 400'± NW OF ANN ROAD & 100'± EAST OF US-95 1LV90 - 27SSW6 EL. 2356.485
PAINTED V

#31 FOUND CLV RIVET & PLATE IN T/C SW RETURN PAINTED MIRAGE ROAD & ANN ROAD. 1LV90 - 13E NNW W6 EL. 2360.006
PAINTED V

NORTHWEST FLOOD STUDY
VERTICAL CONTROL
DESCRIPTIONS

FOUND RIVET & ALUMINUM PLATE NUMBER 0C90 34NG IN TOP OF HEADWALL EASTERLY SIDE OF US-95 900± FEET SOUTHEASTERLY FROM ANN ROAD
NO DATUM

FOUND RIVET & ALUMINUM PLATE NUMBER 0C90 34EG IN TOP OF HEADWALL EASTERLY SIDE OF US-95 1500± FEET SOUTHEASTERLY FROM ANN ROAD
NO DATUM

#48 FOUND RIVET & WASHER IN TOP OF WEST HEADWALL AT NORTH SIDE OF ALEXANDER RD. & US-95
1KVDOT-35SEG EL. 2317.775

0163.0001 T-48 NWES PG 4

5-24-93
BROWN
SOMMA

NORTHWEST FLOOD STUDY

DESCRIPTIONS H.V.'S

#1 FOUND 1/2" AL/CAP RLS 7008 AT INTERSECTION OF THOM BLVD. AND RICKEY RD.
PAINTED

#2 SET P.K. NAIL 30' EAST OF CENTERLINE CREVOLE & TERRY ST. TO SOUTH
PAINTED

#3 SET P.K. NAIL IN LEFT TURN LANE FOR EAST BOUND TRAFFIC FROM NORTH, 30'± NORTHERLY FROM CENTERLINE OF GOWAN RD & RANCHO RD.
PAINTED

#4 FOUND 1/2" AL/CAP 45 CY (Could not read #) AT TRACK BOUNDARY, ON MAVERICK 230'± NORTH OF FENCELET AT
PAINTED

#5 SET 2"X2" HUB W/TACK IN EL TRAIL 400'± EAST JONES AND 1500'± SOUTH OF CRAIG RD.
PAVELED

#6 SET P.K. NAIL IN MEDIAN ISLAND 500'± NORTH OF INTERSECTION OF RANCHO RD. & CRAIG RD.
PAINTED

#7 SET 2"X2" HUB 25'± EAST OF TORREY PINES AND 800'± SOUTH OF LOUIE N.T. RD.
PAVELED

0-42,000!

SQUIRES BRULAND SOMMA

#8 SET 2"X2" HUB 30'± WEST OF THE INTERSECTION OF RAINBOW BLVD & WHEELBARROW PEAK
PAVELED

#9 FOUND P.K. NAIL & SHINER ON RAINBOW BLVD. 100'± NORTH OF RANCHO DR. AT NORTH ENTRANCE TO AMARGOSA FARMS. 5050 N. RAINBOW
PAINTED

#10 SET 2"x2" HUB W/TACK 200'± NORTHEAST OF INTERSECTION OF ANN RD & U.S. 95
PAVELED

#11 FOUND 1/2" AL/CAP RLS 607 JACK LEAVITT CENTERLINE TEANAWAY 200'± NORTH OF DREXEL DR.
PAINTED

#12 FOUND 3" BRASS CAP IN WELL MONUMENT AT INTERSECTION OF ANN RD & BUFFALO DR., -0.68 FROM FINISHED SURFACE TO TOP OF B/C
PAINTED

#13 SET 2"X2" HUB W/TACK IN MEDIAN ISLAND 30'± SOUTH OF INTERSECTION OF LOUIE N.T. RD. & U.S.-95
PAVELED

#14 SET 2"X2" HUB W/TACK 25'± EAST OF TELEPHONE POLE 1000' NORTH OF INTERSECTION CRAIG RD. AND TELUSA
PAVELED

0142.0001

T-48 NWFS Pg 6

5-25-93 BRUMD. SOMMA

NORTHWEST FLOOD STUDY

DESCRIPTIONS H.V.'S

#15 FOUND 3" AL/CAP AT CENTERLINE TENAYA WAY + LARKVALE WAY (COULD NOT READ CAP)

3 LEGS PAINTED

1 LEG PAVERED

#16 SET 2"x2" HUB W/TACK IN CENTERLINE U.S. 95 APPROX. 1000' SOUTH OF ALEXANDER RD. SIERRA #0052 SALT TAGU AT WEST R.O.W.

PAVERED

#17 SET P.K. NAIL CENTERLINE GOWAN RD. 2000' WEST OF TENAYA RD.

PAINTED

#18 FOUND 3" AL/CAP PLS 7466 AT INTERSECTION OF GOWAN RD. & IRV MARCUS DR.

PAINTED

#19 FOUND 3" AL/CAP (COULD NOT READ) INTERSECTION OF ROSADA WAY & MONTE CRISTO WAY

PAINTED

NORTHWEST FLOOD STUDY

LEVEL CIRCUIT #1

MUM RD TO ZONE MT ON US-95

BM				2360.006
	4.38	2364.336		
			8.45	2355.886
	5.44	2359.326		
			3.13	2356.196
	1.93	2358.126		
			6.70	2351.426
	0.56	2352.916		
			5.02	2347.896
	0.56	2347.356		
			12.27	2335.086
	1.34	2340.046		
			8.45	2331.596
	3.245	2335.291		
			4.24	2327.051
	4.26	2332.766		
			6.35	2326.416
	5.56	2331.976		
			5.17	2326.806
	4.70	2330.506		
VP 10			7.895	2326.611
	9.21	2330.221		
			1.165	2325.056

T-48 P67

5-26-95 BRUNAU SOMMA

V 10 - 34NMWG RIVET IN S/C IN S/W RETURN OF PAINTED FENCE RD. & ANCHOR (#31) DESC PG. #3 THIS BOOK

V # 10 DES. PG. #5 THIS BOOK

COR OF HEADWALL EAST SIDE U.S. 95 400' SO. OF ARA RD.

C90 - 34NG DESC. PG #4 THIS BOOK

C90 - 34EG DESC. PG #4 THIS BOOK

ED A/C

ED A/C

#8 HEADWALL END OF HEADWALL WEST SIDE US-95 ON LINE SOUTH FENCE LINE SANTA FE PARKING LOT PAINTED

ED A/C

ED A/C

(CHISLED) 12V90 - 34 SSE (CAP NUT PLATE) RIVET IN TOP SOUTHEAST END OF HEADWALL NORTHEAST CORNER ADJACENT TO US 95 PAINTED

NORTH WEST FLOOD STUDY

LEVEL CIRCUIT #2

	+	HI	−	ELEV
BM (50)				2325.0510
A (52)	3.9011	2328.9521		
TP 1 (51)			2.2629	2326.6942
A (52)	3.2045	2329.8987		
TP 2 (51)			5.0145	2324.8842
A (52)	4.1709	2329.2951		
TP 3 (51)			5.1240	2324.1711
A (52)	3.3342	2327.5053		
TP 4 (51)			3.7910	2323.714
A (52)	4.5141	2328.228		
TP 5 (51)			5.216	2323.012
A (52)	5.0040	2328.0116		
TP 6 (51)			5.1712	2322.845
A (52)	3.6163	2326.450		
TP 7 (51)			4.5760	2321.880
A (52)	4.1602	2326.04		
TP 8 (51)			5.2274	2320.812
A (52)	3.7025	2324.515		
TP 9 (51)			4.9225	2319.592
A (52)	1.3338	2321.5259		
TP 10 (51)			2.8751	2318.6508
A (52)	1.7158	2320.4227		
TP 11 (33)			2.5613	2317.8615

2317.775

0142.0001 T-48 PG 8

5-27-93 BRULAND GATES

BM #106 1270 90-3455E DESC. PG. #7 THIS BOOK

H.V.# 13 DESC. PG. #5 THIS BOOK

PK @ EP S'LY EDGE AC. 75'± EAST OF EXIT 85 CRAIG RD OFFRAMP SIGN

PK @ N'LY A/C NORTH SIDE OF OFFRAMP @ EXIT 85 SIGN

PK @ EP S'LY A/C FWY SOUTH OF W'LY EDGE OF MINI STORAGE BLDG

1/2 HUB 3' SOUTH OF W'LY END GUARD RAIL

PK X' BOX SOUTH END HDWALL 25' WEST SOUTH FWY 100' NORTH (PRINTED) WEST OF CRAIG RD

PK @ EP S'LY A/C FWY 45' W'LY OF ADOBE HWY SIGN

PK @ EP S'LY A/C FWY 90'± E'LY OF MERGE SIGN

PK @ EP S'LY A/C FWY @ END OF ONCOMING MERGE LANE FOR CRAIG RD

PK @ EP S'LY A/C FWY 100'± WEST OF BEG GUARD RAIL ALCHANOCR RD

ELEV BM #48 DESC. PG. #4 THIS BK

NORTHWEST FLOOD STUDY

LEVEL CIRCUIT #2

STA	±	HI	–	ELEV.
ELEV.				2317.8165
PT (50)	7.8513	2325.7177		
PP 12 (51)			6.5143	2319.2034
PT (52)	5.1855	2324.9221		
PP 13 (51)			5.8353	2321.0868
PT (52)	8.2488	2329.3356		
PP 14 (53)			6.7796	2322.555
PT (50)	6.2940	2328.849		
PP 15 (51)			3.7753	2325.0737
PT (52)	3.6220	2328.696		
PP 16 (50)			4.4192	2324.277
PT (52)	4.8957	2329.173		
PP 17 (51)			4.2156	2324.9569
PT (50)	5.1728	2328.1297		
PP 18 (51)			5.3133	2323.2164
PT (52)	5.3957	2328.8121		
PP 19 (51)			4.3368	2324.475
PT (52)	5.1009	2329.576		
PP 20 (51)			5.0284	2324.548
PT (52)	5.2049	2329.752		
PP 1 (51)			4.9933	2324.759
PT (52)	6.2242	2330.983		
PP 22 (51)			6.0528	2324.930

T-48 Pg 9

5-27-93 BRIARWOOD SUMMA

PK @ EP W/LH SIDE OF ALEXANDER 200'± SOUTH OF SW END GUARD RAIL

TBM EP MONUMENT TO WEST SIDE ALEXANDER 500' NORTH TELAYA/ALEXANDER

ELEV RIVET WASHER LLV003514 T/C MIDDLE OF RADIUS N.E. COR OF TELAYA WAY & ALEXANDER

PK @ EP SW SIDE TELAYA 250' EAST OF TELAYA/LAURELVALE INT

BM #15 FOR DESC SEE P# 6 THIS BOOK

PK @ EP NORTH SIDE TELAYA 100' W/LY OF END GUARD RAIL (SIGN)

PK @ EP NORTH SIDE TELAYA @ E PROP. VACANT LOT ; EXIST CUSTOM HOME

PK @ EP @ BCR NE RETURN CRAIG RD ; TELAYA

IXZ HUB SOUTH SIDE STEEP TRAIL 100'± WEST OF RED CLED

HV 14 SEE P#5 OF THIS BOOK FOR DESC.

IXZ HUB 200'± NE OF CH LIN. TAKE SIDE

NORTHWEST FLOOD STUDY
LEVEL CIRCUIT #2

STA	+	HI	−	ELEV	ADD ELEV
ELEV				2324.93	
⅄ (52)	6.1034	2331.034			
TP213 (51)			4.4570	2326.5716	
⅄ (52)	4.6282	2331.204			
TP24 (51)			5.45.119	2325.552	
⅄ (52)	E-8405	23313928			
TP25 (53)			4.8041	2326.9287	2326.5069
⅄ (50)	4.0213	2330.556			
TP26 (51)			6.3374	2324219	
⅄ (52)	9.6597	2328.878			
TP27 (53)			3.174	2325.138	2325.050

0.23.00 D1

T-48 PG 10

5-27-93 BRULAUD GATES

SES PREV. PAGE

1X2 HUB 15" NORTH OF CEMETERY RD & 100' WEST OF BOSSHELDS.

1X2 HUB 15" NORTH CEMETERY RD & 50' EAST OF LOUDT MTN RD

CE1 BM 14V0034S4 RIVET & PLATE T/C IN MIDDLE OF RADIUS NE COR. TENAYA & LOUE INT.

SET PK, ED A/C

SAME AS BEGINNING BM#16 DESC PG#1 THIS BK

NORTHWEST FLOOD STUDY

LEVEL CIRCUIT #3

BM				2326.529
⊼	6.984	2333.489		
TP1			2.17	2331.319
⊼	6.255	2337.574		
TP2			1.14	2336.434
⊼	8.141	2345.144		
			3.51	2341.634
⊼	5.675	2347.309		
T.4			3.685	2343.624
⊼	3.664	2347.288		
			5.665	2341.634
⊼	3.125	2344.759		
TP6			8.32	2336.439
⊼	1.605	2338.044		
TP7			6.725	2331.319
⊼	2.22	2333.539		
TP8			7.01	2326.529 2326.529

A42.0001

T-48 PG 11

5-28-93 BRULAND SOMMA

CL. BM ILV00345A DESC. PG # 10 THIS BOOK (TP 15)

PROFILE END POINT P.K. NAIL & AT INTERSECTION OF LONE MT. RD. & MONTE CRISTO TRAVERSE PT. "T" PG. 47

P.K. ED A/C

FOUND P.K. NAIL & MONTE CRISTO & LA MADRE

H.V. # 19 DESC. PG. # 16 THIS BOOK

P.K. NAIL

P.K. NAIL

P.K. NAIL

SAME AS 1826 ILV 106

NORTHWEST FLOOD STUDY

LEVEL CIRCUIT #4

BM				2360.006
+	9.35	2369.556		
TP 1			4.565	2364.991
+	9.62	2374.611		
TP 2			4.17	2370.441
			4.85	2369.761
+	4.88	2374.641		
TP 3			9.65	2364.991
+	4.33	2369.321		
TP 4			9.31	2360.011 2360.006

0142.0001

T-48 PG 12

5-28-93 BROLAND SOMMA

BM ALV90-34NNVV6 DESC. PG. #3 THIS BOOK (C# 31)

P.K. ED A/C

TEMP WELL MON. H.V.#12

H.V.#12 B/C DESC. PG.#5 THIS BK

SAME AS BEGINNING

NORTHWEST FLOOD STUDY
LEVEL CIRCUIT #5

BM				2325.0516
⊼	3.14	2328.196		
SS			1.94	2326.256
TP 1			2.185	2321.051
⊼	3.49	2324.541		
TP 2			6.095	2318.446
⊼	4.415	2322.861		
TP 3			5.205	2317.6556
⊼	3.335	2321.011		
SS			2.845	2318.1706
TP 4			4.085	2316.926
⊼	5.80	2322.726		
TP 5			3.845	2318.881
⊼	5.09	2323.971		
T 6			5.685	2318.2866 2318.339
⊼	4.26	2324.546		
TP 7			1.155	2323.391
⊼	5.93	2329.321		
TP 8			1.24	2328.081
⊼	5.75	2333.165		
TP 9			0.645	2333.186
⊼	7.07	2340.256		
TP 10			4.575	2335.681

0142.0001 T-48 PG 13

6-1-93 BROWARD SMMA

LV90-3455E6 DES PG.# 7 THIS BK.

PROFILE LINE 4 PT. LONE MT. & U.S. 95 SET PK NAIL

P.K. ED A/C

P.K. ED A/C

CLV LLV903 USE6 RIVET & PLATE IN T/C NORTH SIDE OF LONE MT. AT RAINBOW BLVD.

PROFILE LINE 4 PT. LONE MT. & RAINBOW BLVD P.I.# 15

CLV LL000-2NNW6 DESC. PG.# 3. THIS BK.

P.K. ED A/C

CM # R-169 USC&GS DESC. PG.# 3 THIS BK

P.K. ED A/C

P.K. ED A/C

P.K. ED A/C

TP#5 LEVEL CIRCUIT #1 PG. # 7 THIS BK.

NORTHWEST FLOOD STUDY

LEVEL CIRCUIT #5

ELEV.				2335.681	2335.686
↓	7045	2342.726			
TP 11			0.80	2341.926	
↓	6.795	2348.671			
TP 12			1.31	2347.361	2347.396
↓	6.69	2354.051			
TP 13			2.41	2351.641	
↓	7.25	2358.891			
TP 14			2.18	2356.711	
↓	7.23	2363.941			
TP 15			3.955	2359.986	2359.986

0142.0001 T-48 PG 14

L-193 BRULAND SOMMA

TP#3 LEVEL CIRCUIT #1 PG.#7 THIS BK.

TP#4 LEVEL CIRCUIT #1 PG.#7 THIS BK.

3K ED A/C

PK ED A/C

BM 14V90-34NNWL DESC. PG #5 THIS BK

NORTHWEST FLOOD STUDY

LEVEL CIRCUIT #6

BM				2356.196	
∧	3.725	2359.921			
TP 1			7.225	2352.696	
∧	8.80	2354.996			
TP 2			5.14	2349.856	
∧	4.97	2354.826			
TP 3			2.30	2352.526	
∧	4.145	2356.671			
TP 4			6.825	2349.846	
∧	7.745	2357.591			
TP 5			4.105	2353.266	
∧	8.09	2361.356			
TP 6			4.835	2356.521	2351.485
∧	3.625	2360.046			
TP 7			3.82	2356.226	2352.186

2142.0001 T-48 PG 15

6-11-93 BRULAND SOMMA

H.V.# 10 DESC. # PG. 5 THIS BK

TIE TO A/C

H.V.# 11 DESC. PG. # 5 THIS BK

PL #18

PROFILE LINE END LINE TRUNK 4 AND ROAD

TIED A/C

TM # S 169 USC&GS B/C DESC. PG # 3 THIS BK

NORTHWEST FLOOD STUDY

LEVEL CIRCUIT #7

BM				2318.286	
X	4.965	2323.251			
TP 1			4.765	2318.486	
X	5.175	2323.661			
TP 2			4.95	2318.691	
X	4.23	2322.921			
TP 3			4.045	2318.876	2318.69
X	4.105	2322.981			
TP 4			4.27	2318.686	
X	4.86	2323.546			
TP 5			5.05	2318.496	
X	4.72	2323.216			
TP 6			4.95	2318.266	2318.286

0142-0001 T-48 PG 16

6-1-93 BRUCATO SOMMA

BM #R-169 USC&GS DESC PG # 3 THIS BK (TP 6 PG # 13 THIS BK)

TP 1 ED A/C

H.V. # 9 DESC PG # 5 THIS BK

CLV IKV90-34E4

TP 2 ED A/C

TP 3 ED A/C

TP 4 ED A/C

TP 5 ED A/C

TP 6 SAME AS BEGINNING

NORTHWEST FLOOD STUDY
LEVEL CIRCUIT #8

BM				2316.926
∧	3.184	2320.911		
TP 1			5.74	2315.171
∧	4.116	2319.331		
TP 2			6.895	2312.436
∧	1.92	2314.356		
TP 3			6.23	2308.126
∧	2.75	2311.876		
TP 4			7.98	2303.896
∧	2.72	2306.616		
TP 5			7.34	2299.276
∧	3.52	2302.796		
TP 6			6.70	2296.096
∧	4.144	2300.24		
TP 7			6.49	2294.651 2294.29
∧	2.01	2296.241		
TP 8			7.715	2288.526
∧	3.104	2291.586		
TP 9			8.015	2283.571
∧	3.31	2286.881		
TP 10			6.42	2280.461 2280.546
∧	1.93	2282.391		
TP 11			7.19	2275.201

6142.0001 T-48 PG 17

6-2-93 BRULAND SOMMA GATES

TP #4 LEVEL CIRCUIT #5 PG. #13 THIS BK

P.K. ED A/C

B.K. ED A/C

2½" AUB W/TACK 50' EAST OF THIRD RP NORTH OF WENDY'S ON EAST SIDE OF PALCO 9 1000' NORTH OF TORREY PINES FUTURE TRAVERSE PT. 4 I

P.K. ED A/C

P.K. ED A/C

U.V. #6 DESC PG. # 5 THIS BK

CAV RAIL T-365 DESC PG. # 3 THIS BK. (# 30)

PK ED A/C

PK ED A/C

CLV 7000-2564 DESC PG. # 3 THIS BK (# 16)

PK ED A/C

NORTHWEST FLOOD STUDY
LEVEL CIRCUIT #8

ELEV.				2275.201	
⊼	2.83	2278.031			
TP 12			8.27	2269.761	2269.868
⊼	4.55	2274.311			
TP 13			7.08	2267.231	
⊼	5.54	2272.771			
SS			3.785	2268.9846	
TP 14			3.59	2269.1E.1	
⊼	6.98	2276.161			
SS			4.89	2271.271	
TP 15			1.43	2274.731	
⊼	2.875	2282.606			
TP 16			2.40	2280.206	
⊼	6.43	2286.636			
TP 17			3.44	2283.196	
⊼	8.515	2291.711			
TP 18			1.70	2290.011	
⊼	8.235	2298.246			
TP 19			2.91	2295.336	
⊼	7.22	23021.556			
TP 20			2.46	2300.096	
⊼	7.05	2307.146			
TP 21			4.33	2302.816	

0142 0021 T-48 Pg 18

6-2-93 BRULAND SOMMA GATES

CLV 7000-10NES DESC PG. #3 THIS BK (#15)

PROFILE LINE & PT 200± WEST OF INTERSECTION RANCHO & ALEXANDER P.I. #7

PROFILE LINE & PT 350± WEST OF TP 13 P.I. #8

PK ED A/C

PROFILE LINE & PT INTERSECTION OF ALEXANDER & MAVERICK END A/CAP P.I. #9

PK ℄ A/C

PK ℄ A/C

PROFILE LINE END PT B/C ℄ ℄ TORREY PINES ALEXANDER RLS 7008 P.I. #10

PK ℄ A/C

PK ℄ A/C

PK ℄ A/C

PK ℄ A/C

NORTHWEST FLOOD STUDY
LEVEL CIRCUIT #8

ELEV.				2302.816
⊼	5.555	2308.371		
TP 22			4.111	2304.261
⊼	4.315	2310.576		
TP 23			3.001	2307.566
⊼	10.21	2317.776		
TP 24			0.64	2317.236
⊼	5.134	2322.570		
TP 24			4.755	2317.821 2317.860
BM				2317.865
⊼	4.86	2322.725		
TP 26			6.18	2316.595
⊼	5.05	2321.645		
TP 27			6.90	2314.745
⊼	6.60	2321.345		
TP 28			4.45	2316.895
⊼	5.85	2322.745		
TP 29			4.87	2317.875 2317.865

C142.0001 T-48 PG 19

16-2-93 BROWARD SOMMA GATES

TAPE END PT @ RAINBOW & ALEXANDER PT # 11

TO ED A/C

END OF MEADOWALL EAST SIDE US-95

CLV ILNCO-355E6 DESC PG # 8 THIS BK (#48)

ILNCO-355E6

PT ED A/C

H.V. # 16 DESC PG # 6 THIS BK

PT ED A/C

SAME AS BEGINNING

NORTHWEST FLOOD STUDY

LEVEL CIRCUIT #8

BM				2308.126
T	2.78	2310.906		
TP 1			9.09	2301.816
T	9.40	2311.216		
TP 2			3.09	2308.126
BM				2308.126

2142-0001 T-48 PG 20

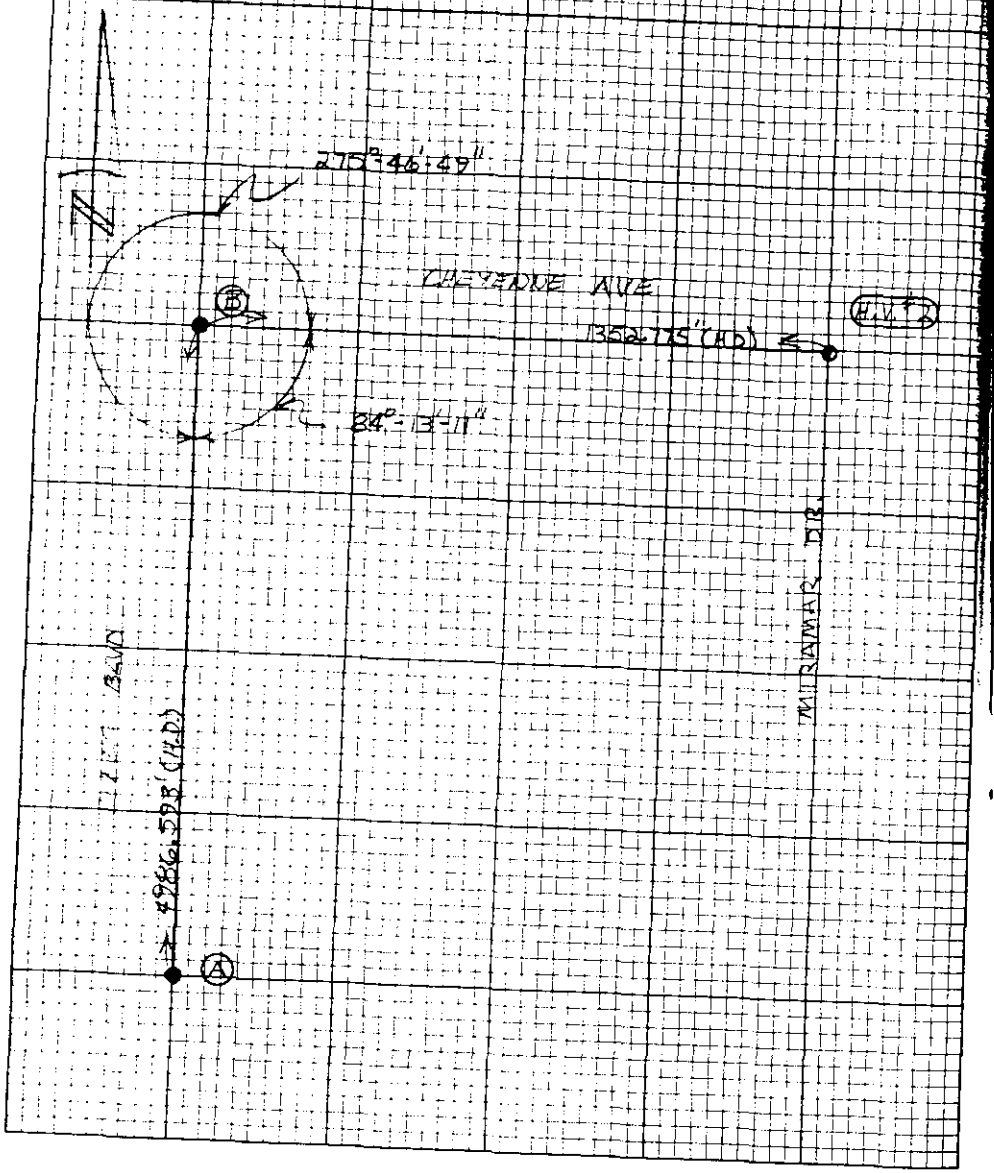
6-2-93 BRULAND SOMMA GATES

FR #3 PG.#17 THIS BR. LEVEL CIRCUIT #8

N.V. #7 DESC. PG.# 5

SAME AS BEGINNING

NORTHWEST FLOOD STUDY
HORIZONTAL CONTROL

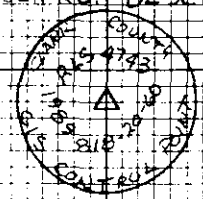


C42.001 T-48 PG 21

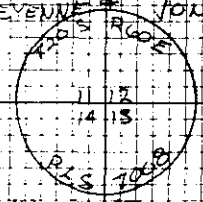
6-8-93 BRYLANE SUMMA GATES

PT #	HOR. & RT.	DISTANCE	ZENITH &
	T@ "B" B.S. "A"		H.I. - (B) 5.69
	00°00'00"		B.S. H.P. - (A) 4.26
H.V.# 2	1) 275°46'52"	1352.775'	56°21'19" E.S. H.P. (H.V.#2) 4.69
	2) 191°33'42"	-8.395'	V.D.
	4) 53°07'13"	1352.801'	S.D.
	M) 275°46'48"		
	MM) 275°46'49"		
	B.S. H.V.#2 & RT. TO "A"		
"A"	1) 84°13'19"	4986.593'	90°07'49"
	2) 168°24'27"	-0.024'	V.D.
	4) 336°55'40"	4986.606'	S.D.
	M) 84°13'10"		
	MM) 84°13'11"		

A FND B/C W/ CENTERLINE ISLAND ON JONES BLVD JUST NORTH OF SMOKE RANCH RD. DESC.



B FND B/C W/ WELL MONUMENT DESC. CHEYENNE & JONES

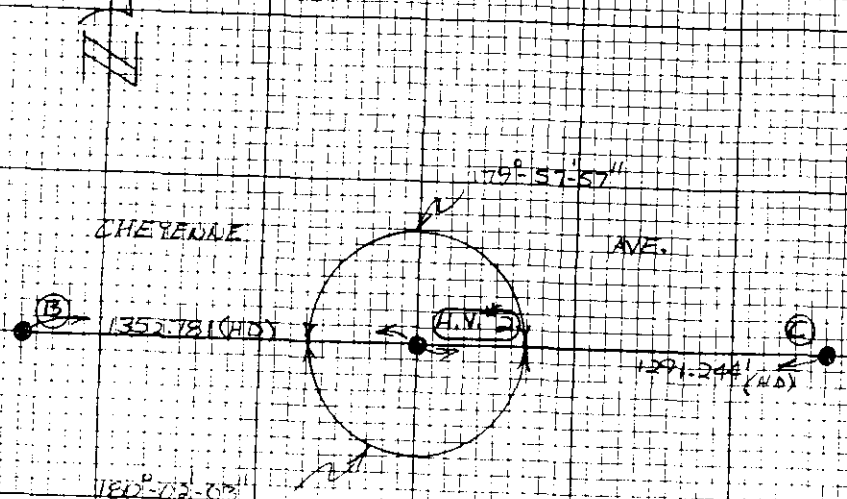


DOWN -0.42

H.V.#2 SET PK NAIL CENTERLINE OF CHEYENNE AVE. EAST OF MIRAMAR DR.

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



16,001 T-48 PG 22

6-8-93 BRULAND GATES SOMMA

PT #	HORZ ∠	DISTANCE	ZENITH
	@ "H.V.#2" B.S. "B"		
	00°-00'-00"		
"B"	1) 179°-57'-55"	1291.244'	90°-28'-07"
	2) 359°-55'-52"	-10.574	V.D.
	4) 359°-57'-46"	1291.287'	S.D.
	M) 179°-57'-56"		
	AM) 179°-57'-57"		
	B.S. "C" # RT. TO "B"		
"B"	1) 180°-02'-01"	1352.781'	89°-40'-42"
	2) 00°-04'-03"	+7.588	V.D.
	4) 0°-08'-07"	1352.802'	S.D.
	M) 180°-02'-02"		
	AM) 180°-02'-03"		

H.I. (H.V.#2) 4.95

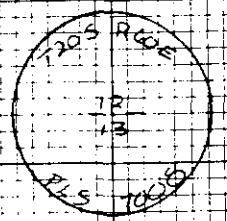
H.P. - (B) - 5.42

H.P. - (C) - 5.39

B DESC. PG. 21 THIS BOOK

H.V.#2 DESC. PG. 21 THIS BK.

C FND BIC IN WELL MONUMENT CHEYENNE & MICHAEL WAY DESCRIPTION

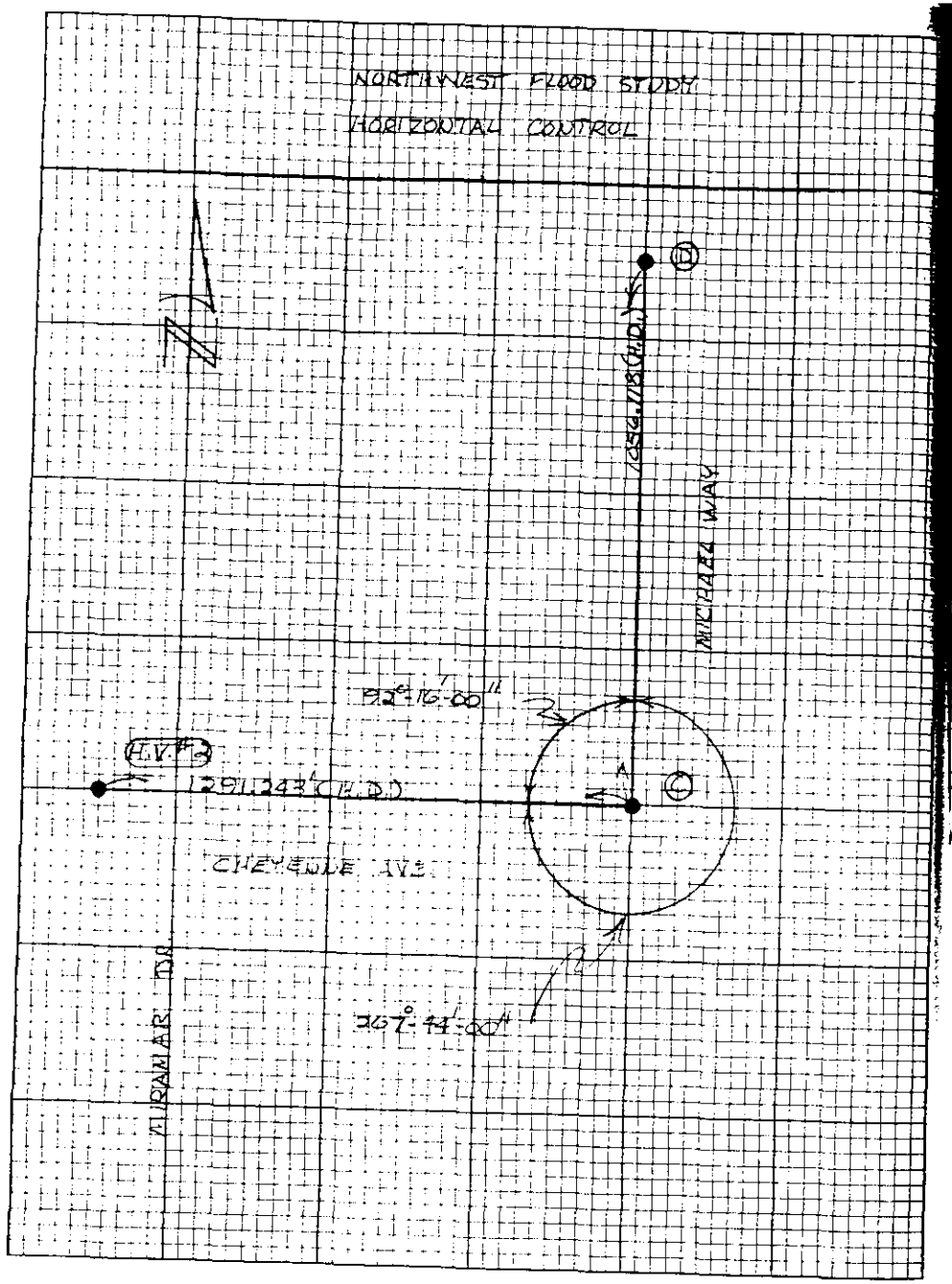


DOWN -0.32

0142.0001

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



6-8-93 BRULAND GATES SOMMA

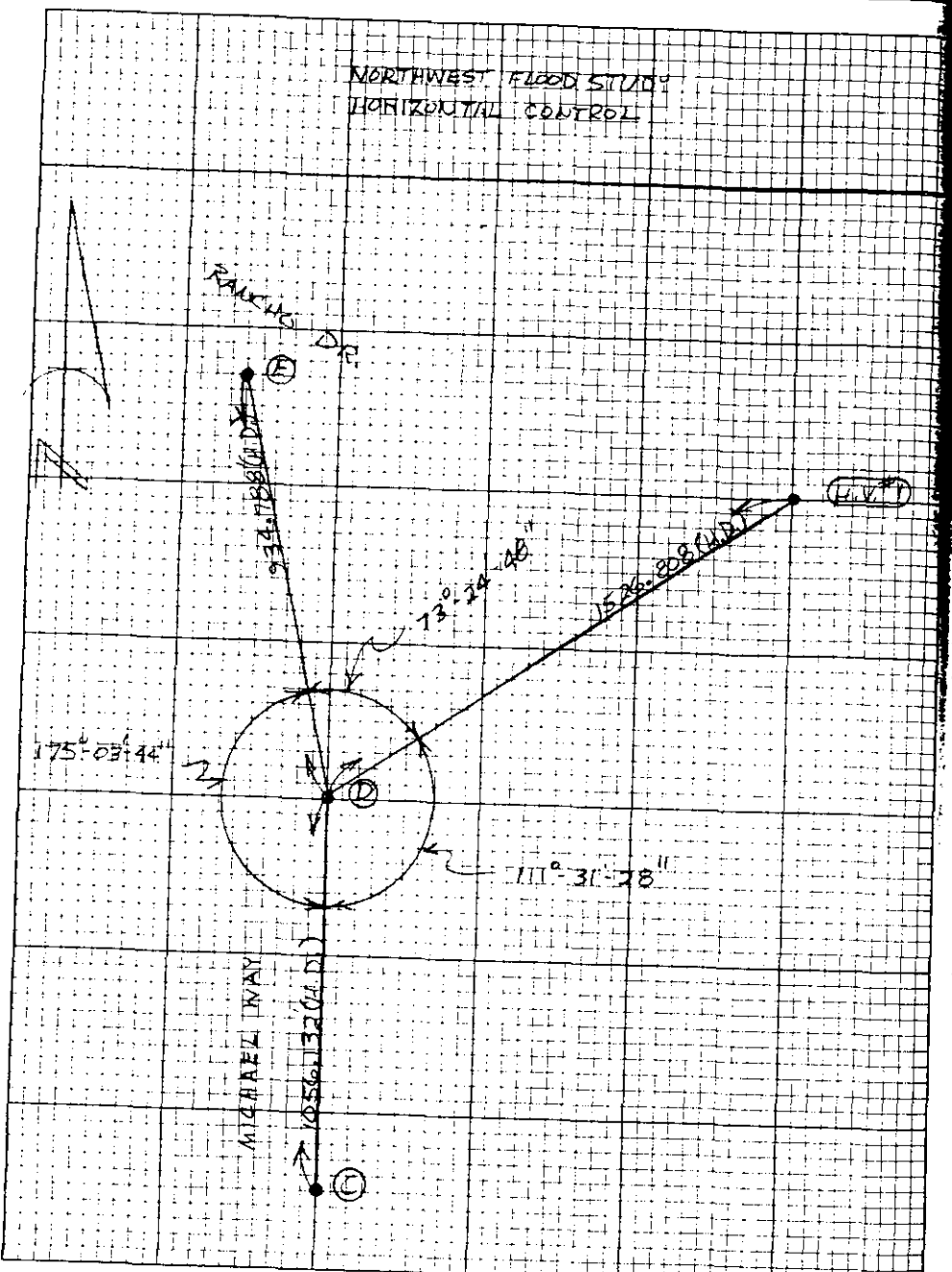
PT #	HORZ & RT. ANGLE "C"	DISTANCE	ZENITH ∠	DESCRIPTION
	TO "C" 00°-00'-00"	B.S. H.V.#2		H.I. Ⓒ = 5.64 H.R. - (H.V.#2) = 4.69 H.R. Ⓓ = 4.11
D	1) 92°-16'-02"	1056.118'	89°-56'-23"	
	2) 189°-32'-06"	# 01.125'	V.D.	
	4) 89°-04'-05"	1056.119'	S.D.	
	M) 92°-16'-01"			
	AM) 92°-16'-00"			
	B.S. "D" & RT. TO H.V.#2			
#2	1) 267°-43'-57"	1291.243'	89°-33'-55"	
	2) 175°-27'-53"	+9.810	V.D.	
	4) 350°-55'-58"			
	M) 267°-44'-00"	1291.280'	S.D.	
	AM) 267°-44'-00"			

H.V.#2 DESC. PG. 21 THIS BOOK

C DESC PG. 22 THIS BOOK

D SET PK & HUB N/ TACK EAST SIDE MICHAEL WAY 150'± NORTH OF MAXINE PLACE

NORTHWEST FLOOD STUDY
HORIZONTAL CONTROL



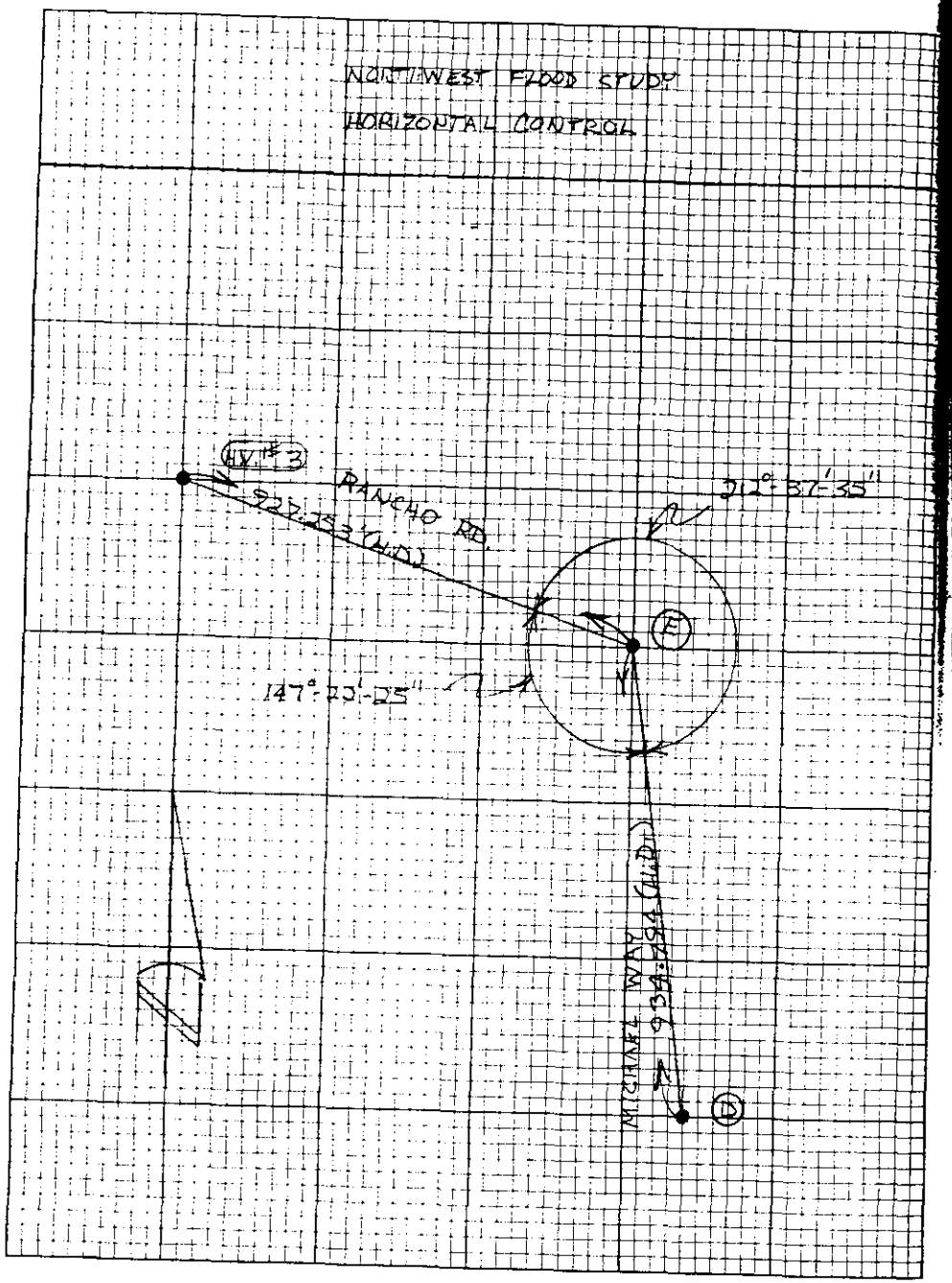
T-48 PG 24

6-8-93 ERVLAND GATES SOMMA

PT #	HORZ. & RT	DISTANCE	ZENITH &	DESCRIPTION
	TO "D" B.S. "C"			H.I. - (D) = 5.37
	00°-00'-00"			H.P. - (C) = 5.39
	1) 175°-03'-42"	934.788'	89°-57'-52"	H.P. - (E) = 4.99
	2) 350°-07'-25"	±0.580'	V.D.	H.P. H.V.#1 = 5.11
	4) 340°-14'-50"	934.788'	S.D.	
	M) 175°-03'-43"			
	AM) 175°-03'-44"			
	B.S. "E" & RT. TO H.V.#1			
H.V.#1	1) 73°-24'-46"	1526.808'	90°-21'-43"	
	2) 146°-49'-33"	-9.653'	V.D.	C DESC. PG. 22 THIS BOOK
	4) 293°-39'-09"	1526.838'	S.D.	
	M) 73°-24'-47"			D. DESC. PG. 23 THIS BOOK
	AM) 73°-24'-48"			
	B.S. "H.V.#1" & RT TO "C"			E SET 2½" IRON IN CENTERLINE ISLAND WORTH OF INTERSECTION OF RANCHO RD & MICHAEL WAY
	1) 111°-31'-27"	1056.132'	90°-06'-00"	
	2) 223°-02'-53"	-1.838'	V.D.	
	4) 82°-05'-43"	1056.133'	S.D.	
	M) 111°-31'-26"			
	AM) 111°-31'-28"			H.V.#1 FND. AL/CAP AT INTERSECTION DESC PG. 5 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



2:42.000

T-48 PG 25

BRUNOD
6-8-93 SUMMA
SPRAGUE

	HORZ. BRG.	DISTANCE	ZENITH ∠	DESCRIPTION
	∠@ "E" B.S. "D"			H.I. - (E) = 5.43
	00°-00'-00"			H.P. - (D) = 5.13
				H.P. - (H.V.#3) = 5.18
H.V.#3 1)	147°-22'-18"	927.253	89°-58'-46"	
2)	294°-44'-37"	+0.346	V.D.	
4)	229°-29'-23"	927.253	S.D.	
M)	147°-22'-21"			
AM)	147°-22'-25"			
	B.S. "H.V.#3" SRT TO "D"			
1)	212°-37'-38"	934.794	90°-03'-08"	
2)	65°-14'-53"	-1.378	V.D.	
4)	132°-30'-03"	934.795	S.D.	
M)	212°-37'-31"			
AM)	212°-37'-35"			

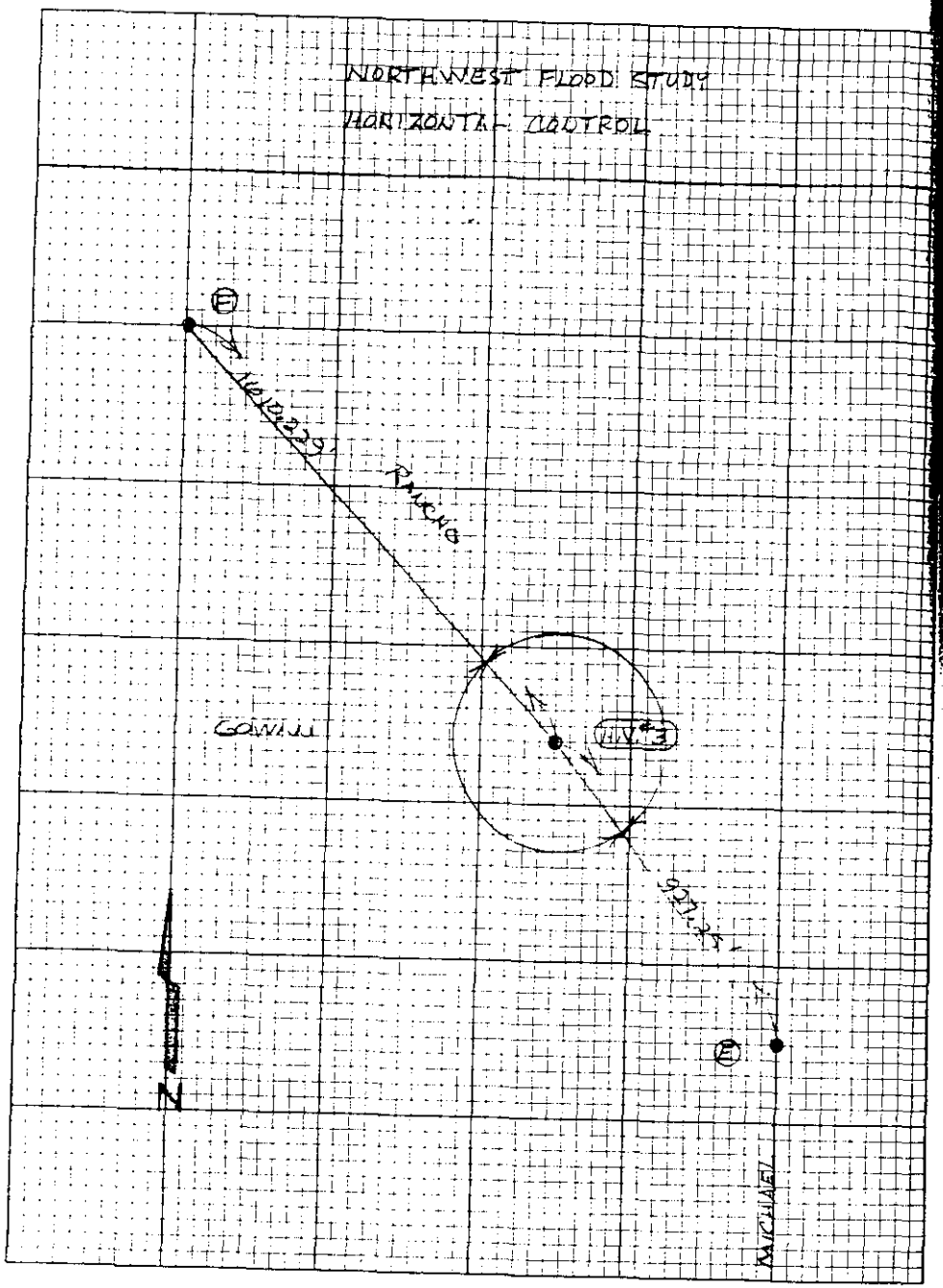
D DESC PG. 23 THIS BOOK

E DESC. PG. 24 THIS BOOK

H.V.#3 SET PK DESC. PG. 5 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG 26

6-8-93 BRUVALDIS SOMMA SPRAGUE

Pt. #	Horz. & Rt. Distance		Zenith &	DESCRIPTION
	A @ H.V.#3	B.S. "E"		H.I. (H.V.#3) - 5.16
5"	00°-00'-00"			H.R. - (E) - 5.18
				H.P. - (F) - 4.92
"F"	1) 179°-49'-07"	1610.229	89°-51'-32"	
	2) 359°-38'-20"	+ 3.974	V.D.	
	4) 359°-16'-49"	1610.234	S.D.	
	M) 179°-49'-12"			
	AM) 179°-49'-10"			
	B.S. "F" & Rt. To "E"			
E"	1) 180°-10'-57"	927.250	90°-02'-51"	
	2) 00°-21'-50"	- 0.760	V.D.	
	4) 00°-43'-33"	927.250	S.D.	
	M) 180°-10'-53"			
	AM) 180°-10'-50"			

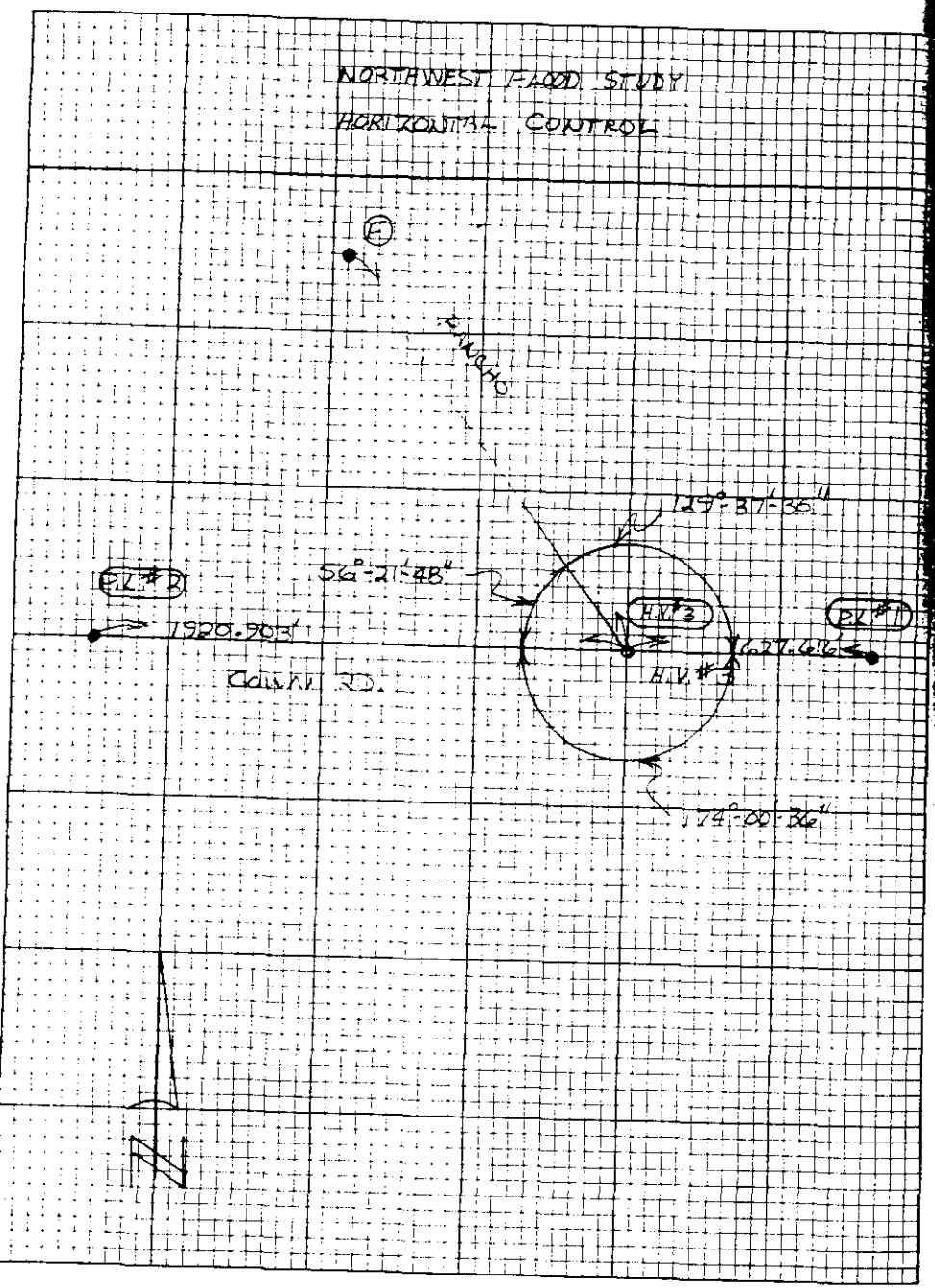
E DESC. PG. 24 THIS BOOK

H.V.#3 DESC. PG. 5 THIS BOOK

E SET 2x2" AUB. W/TACK IN CENTERLINE ISLAND OF RANCHO RD. 250' NORTH OF DUNCAN ST.

NORTHWEST I-4000 STUDY

HORIZONTAL CONTROL



BROLAND
SPRAGUE
SOMMA

6-8-93

Pt.#	HORZ. & RT. DISTANCE	ZENITH'S	DESCRIPTION
	T@ H.V.#3 B.S. "F"		H.I. - H.V.#3
	00°-00'-00"		H.I. - R.A.#2 - 5.01
			H.I. - P.L.#1 - 5.16
P.L.#1	1) 129°-37'-34"	6227.616	90°-40'-35"
	2) 359°-15'-08"	-7.391	V.D.
	4) 158°-30'-25"	6227.660	S.D.
	M) 129°-37'-31"		
	AM) 129°-37'-35"		
	B.S. "P.L.#1" & R.T. TO "P.L.#2"		
P.L.#2	1) 174°-00'-32"	1920.903'	89°-35'-45"
	2) 348°-01'-00"	+13.540	V.D.
	4) 336°-02'-07"	1920.951'	S.D.
	M) 174°-00'-32"		
	AM) 174°-00'-36"		
	B.S. "P.L.#2" & RT. TO "F"		
	1) 56°-21'-48"		
	2) 112°-43'-28"		
	4) 225°-26'-51"		
	M) 56°-21'-43"		
	AM) 56°-21'-48"		

H.V.#3 DESC. PG #5 THIS BOOK

F DESC. PG. #26 THIS BOOK

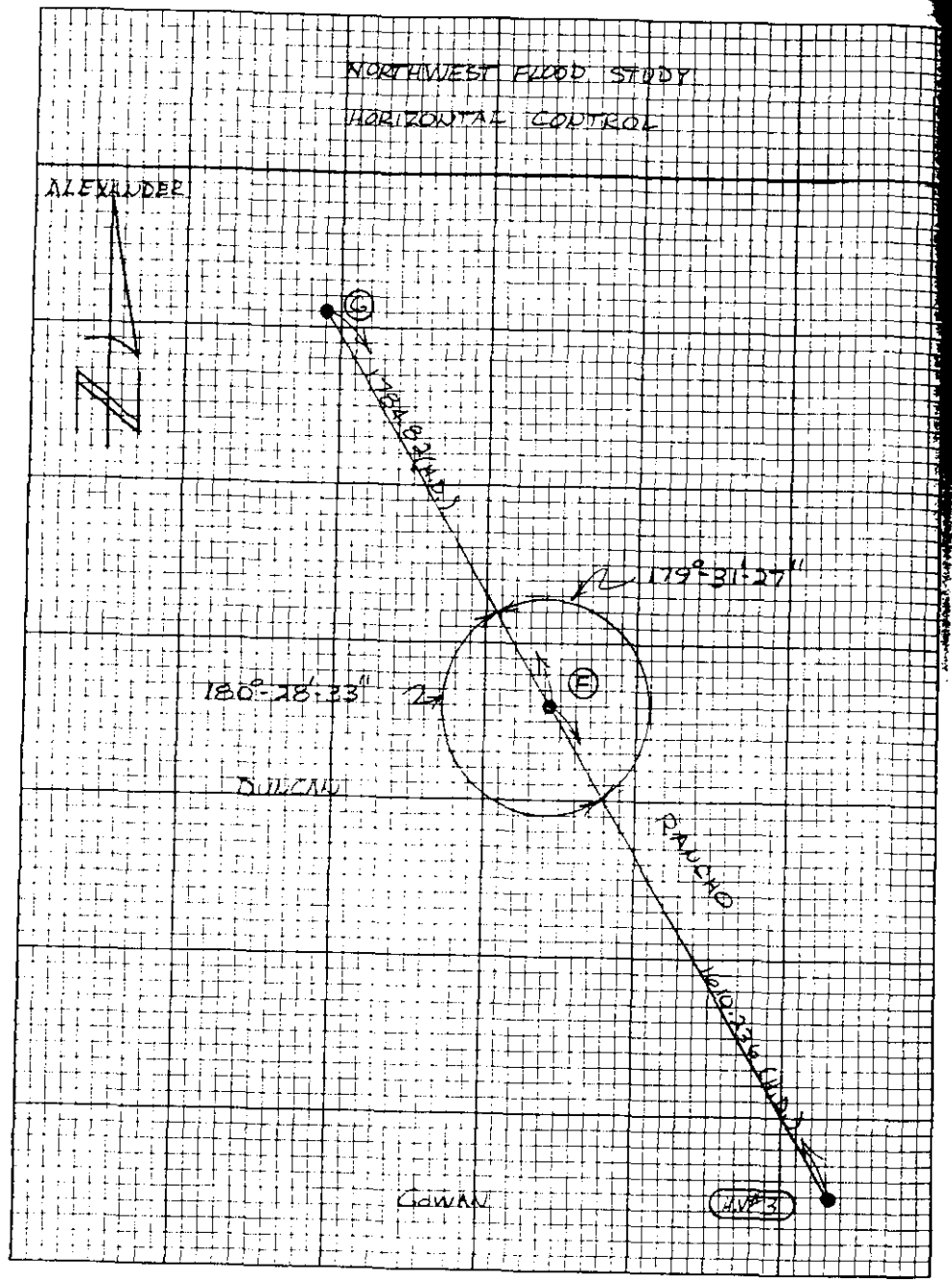
P.L.#1 PROFILE LINE END POINT P.K. NAIL 50± NORTH OF INTERSECTION BRADLEY & GOWAN RD.

P.L.#2 PROFILE LINE END POINT P.K. NAIL 50± EAST OF JOVES ON GOWAN RD.

42.0001

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



6-9-93 BRUERUD SOMMA

PT.#	HORZ. SRT DISTANCE ZENITH'S	DESCRIPTION
	TO "F" B.S. "H.V.#3"	
H.V.#3	00°-00'-00"	H.I. (F) 5.47
		H.P. (H.V.#3) 5.20
		H.P. (G) 5.09
G	1) 180°-28'-30" 1784.820 89°-40'-11"	
	2) 00°-56'-38" +10.789 V.D.	
	4) 1°-54'-04" 1784.850 S.D.	
	M) 180°-28'-31"	
	AM) 180°-28'-33"	
	B.S. "G" & SRT. TO "H.V.#3"	
H.V.#3	1) 179°-31'-31" 1610.236 90°-10'-28"	
	2) 359°-02'-53" -3.895 V.D.	
	4) 358°-05'-41" 1610.244 S.D.	
	M) 179°-31'-25"	
	AM) 179°-31'-27"	

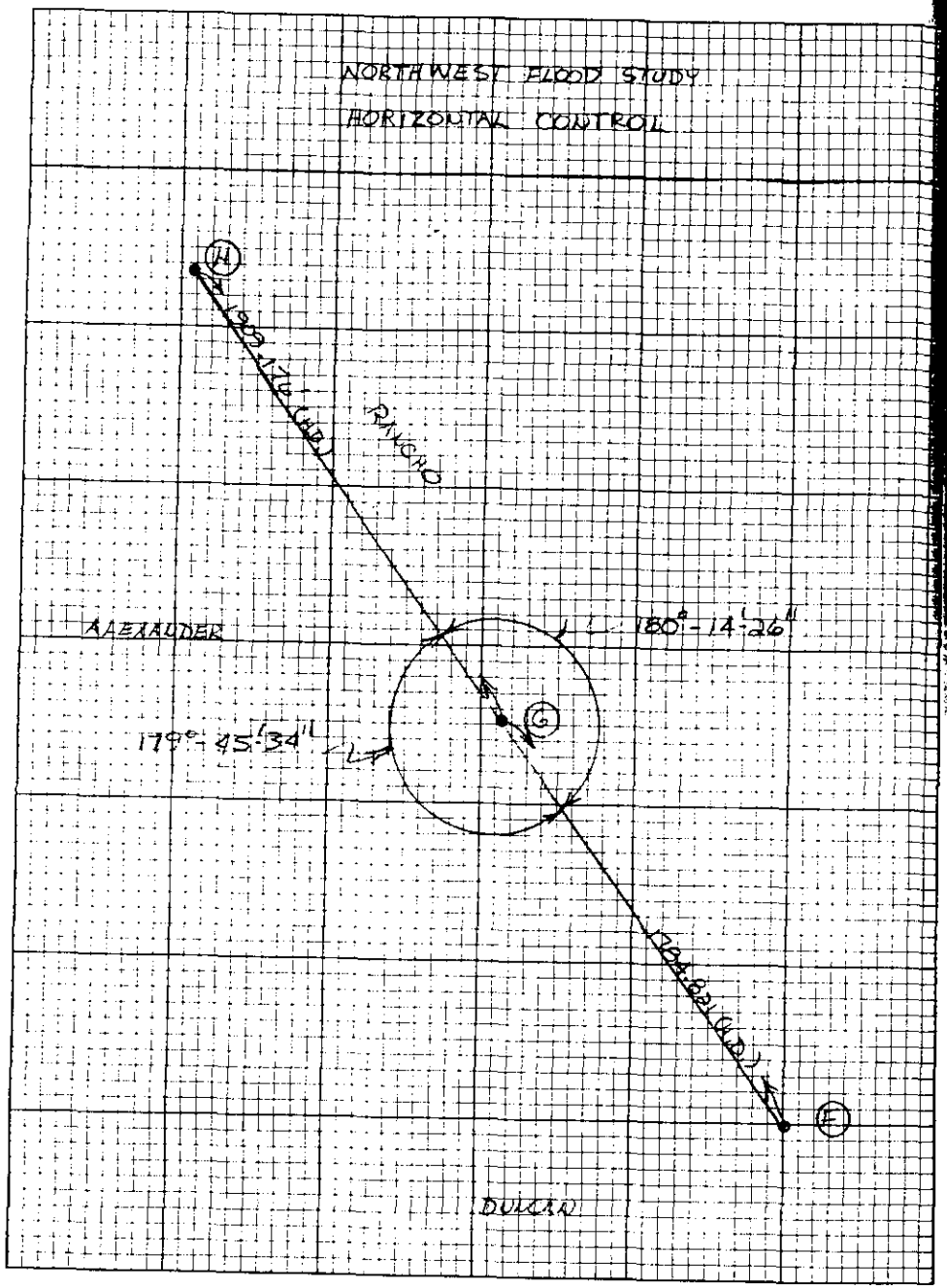
H.V.#3 DESC. PG. 5 THIS BOOK

E DESC. PG. 26 THIS BOOK

G SET P.K. & SHINER CENTERLINE ISLAND. 400' ± SOUTH OF ALEX. OLD RALCAO RD.

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



C42 0001

6-9-93 BRIKAND SOMMA

PT. #	HORZ. & RT. DISTANCE ZENITH & DESCRIPTION
	∠@ "C" B.S. "F"
F	00-00-00
	A.I. - (C) - 5.35
	H.I. - (F) - 5.19
	M.P. - (H) - 5.20
H	1) 179°-46'-31" 2909.176' 89°-41'-33"
	2) 359°-31'-07" +10.246' V.D.
	4) 359°-02'-13" 2909.204' S.D.
	M) 179°-45'-33"
	AM) 179°-45'-34"
	B.S. "H" & RT. TO "F"
F	1) 180°-14'-27" 1784.821 90°-21'-31"
	2) 00°-28'-32" -11.17 V.D.
	4) 00°-57'-37" 1784.856' S.D.
	M) 180°-14'-24"
	AM) 180°-14'-26"

F DES PG. 26 THIS BOOK

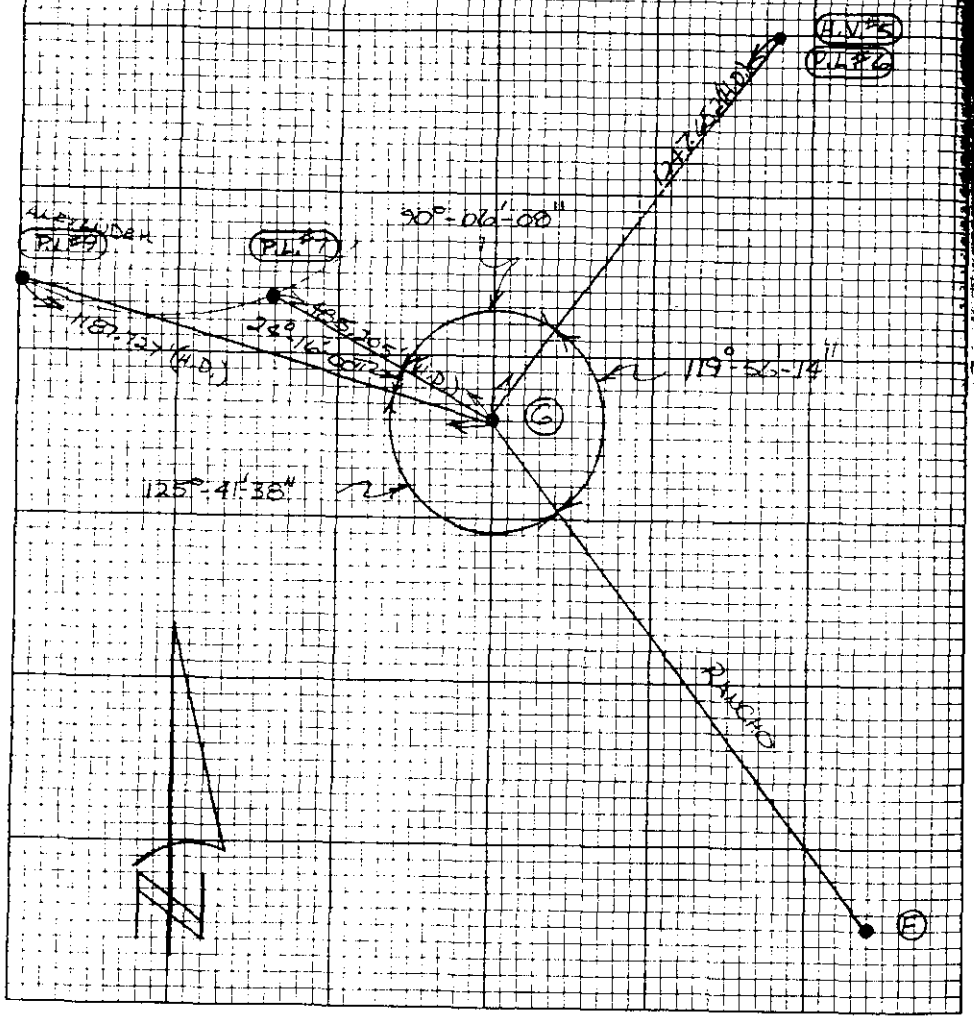
C DES PG. 28 THIS BOOK

H SET 2½" HUB WITH CENTERLINE ISLAND SOUTH SIDE ENTRANCE TO HORIZON RECOVERY CENTER

5142.0001

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



6-9-93 BRUMADD SCM MA

PT.#	HORZ. & RT. DISTANCE @ "C"	ZENITH ∠ B.S. "F"	DESCRIPTION
	00-00-00		H.I. - C - 5.35
			H.P. - P.L.#9 - 5.25
			H.P. - P.L.#7 - 5.28
P.L.#9	D) 125°-41'-37"	1187.727	89°-50'-39"
	DD) 251°-23'-13"	+3.27	V.D.
	4) 142°-16'-23"	1187.732	S.D.
	M) 125°-41'-36"		
	AM) 125°-41'-38"		
	B.S. "P.L.#9" ∡ RT. TO "P.L.#7"		
P.L.#7	D) 24°-15'-57"	485.205'	90°-04'-52"
	DD) 48°-31'-57"	-0.685'	V.D.
	4) 97°-03'-57"	485.205'	S.D.
	M) 24°-15'-59"		
	AM) 24°-16'-00"		
	B.S. "P.L.#7" ∡ RT. TO "H.V.#5 (P.L.#6)"		
H.V.#5	D) 90°-06'-04"	1247.652	90°-29'-31"
	DD) 180°-12'-15"	-10.718	V.D.
	4) 0°-24'-29"	1247.652	S.D.
	M) 90°-06'-07"		
	AM) 90°-06'-08"		
	B.S. "H.V.#5 (P.L.#6)" ∡ RT. TO "E"		
E	D) 119°-56'-15"		
	DD) 239°-52'-28"		
	4) 119°-44'-51"		
	M) 119°-56'-13"		
	AM) 119°-56'-14"		

H.V.#5 DES. PG. 5 THIS BOOK

E DES PG. 26 THIS BOOK

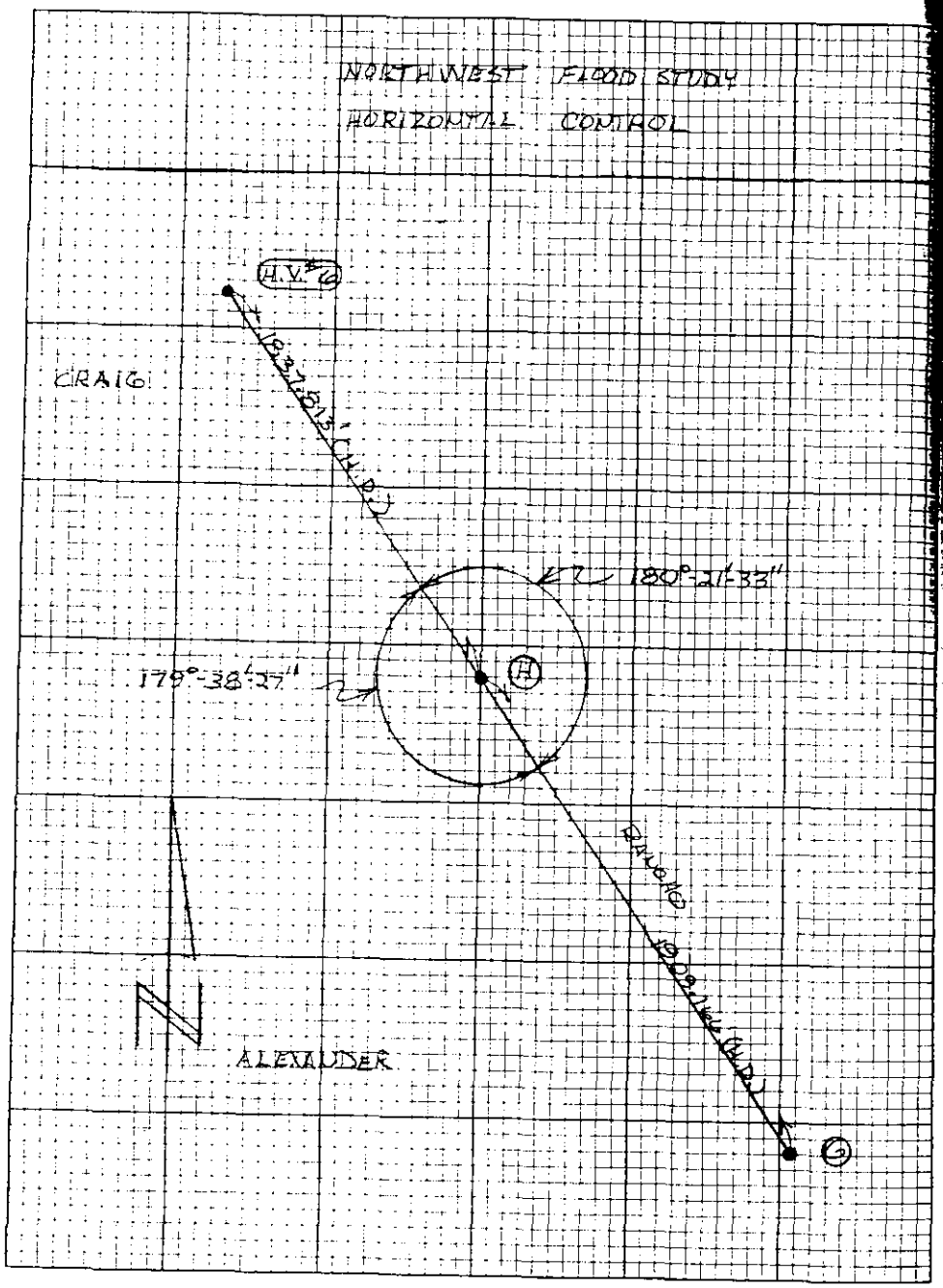
G DESC. PG. 28 THIS BOOK

P.L.#9 PROFILE LINE #9 ALIGN AT ℄ ALEXANDER & MAVERICK

P.L.#7 PROFILE LINE #7 SET PK ℄ ALEXANDER 200' WEST OF RANCHO

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



0142-0001 T-48 PG 31

6-4-93 BRUMUND SMITH

PT #	HORZ & RT. DISTANCE	ZENITH	DESCRIPTION
	TO "H" B.S. "G"		H.I. (H) 5.45
G	00°-00'-00"		H.I. (G) 5.07
			H.I. (H.V.#6) 5.13
H.V.#6 (D)	179°-38'-27"	1837.813'	89°-27'-49"
(2)	359°-16'-55"	+17.206'	V.D.
(4)	358°-33'-54"	1837.894'	S.D.
(M)	179°-38'-29"		
(AM)	179°-38'-27"		
	B.S. "H.V.#6" & RT. TO "G"		
G (1)	180°-21'-38"	1909.166'	90°-20'-11"
(2)	0°-43'-14"	-11.163'	V.D.
(4)	1°-26'-18"	1909.189'	S.D.
(M)	180°-21'-35"		
(AM)	180°-21'-33"		

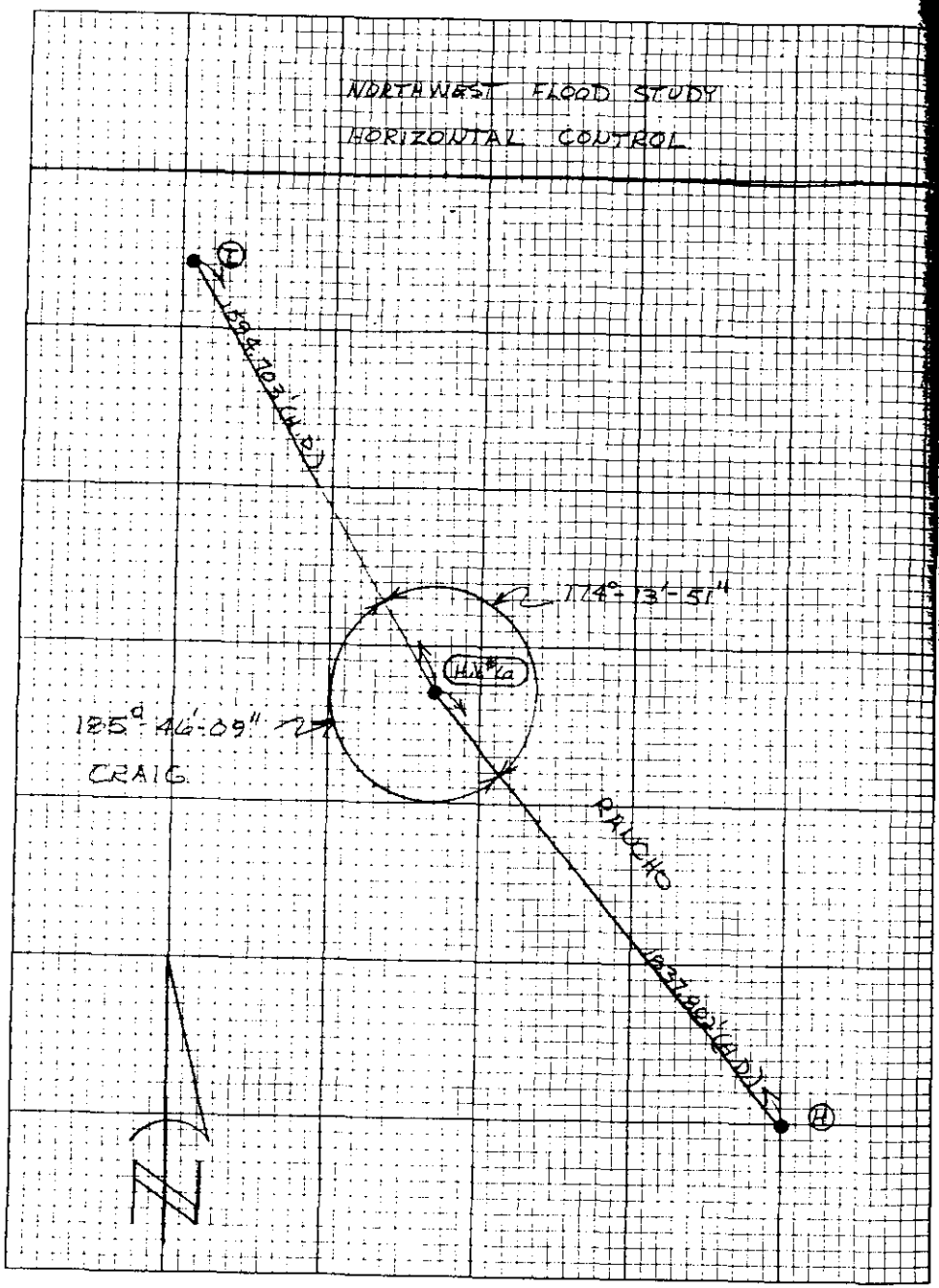
G DESC. PG. 28 THIS BOOK

H DESC. PG. 29 THIS BOOK

H.V.#6 DES. PG. 5 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



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6-9-93 BRUCE SOMMA

PT #	HORZ & RT. ANGLE "A.M.#6" TO "BS "H" 00°-00'-00"	DISTANCE	ZENITH ∠	DESCRIPTION
				H.I. - A.V.#6
				H.P. - (H) 5.18
				H.P. - (I) 5.14
I	1) 185°-46'-08"	1594.703'	89°-34'-59"	
	2) 11°-32'-14"	+11.605'	V.D.	
	#) 33°-04'-29"	1594.745'	S.D.	
	M) 185°-46'-07"			
	AM) 185°-46'-09"			
	BS "I" & RT. TO "H"			
II	1) 174°-13'-47"	1831.802'	90°-33'-46"	
	2) 348°-27'-41"	-18.070'	V.D.	
	#) 336°-55'-14"	1831.891'	S.D.	
	M) 174°-13'-49"			
	AM) 174°-13'-51"			

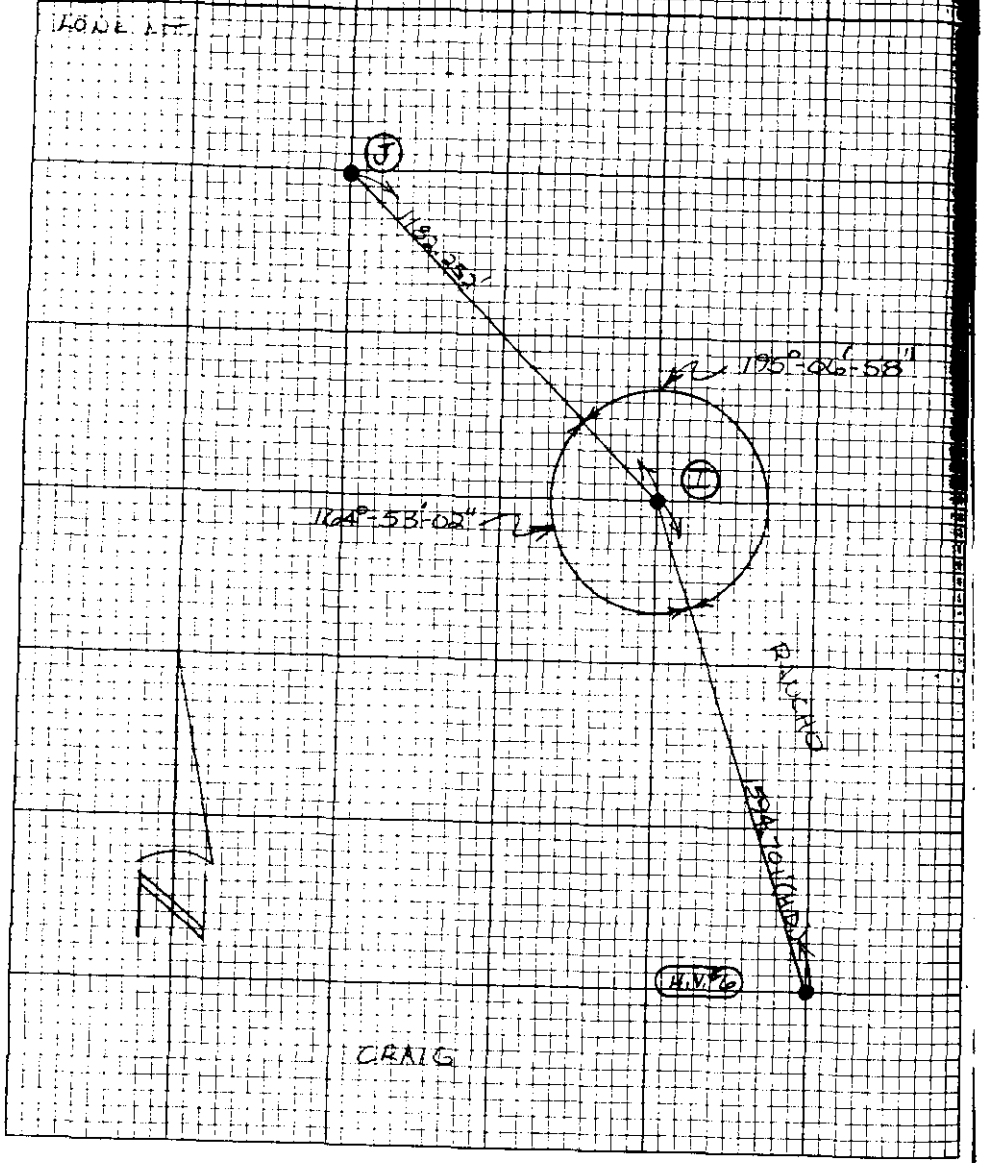
H.M.#6 DESC. PG. 5 THIS BOOK

H DES. PG. 29 THIS BOOK

I DES. PG. 7 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



6-9-93 BROADUS SOMMA

PT. #	HORZ. & RT.	DISTANCE	ZENITH &
	TO "I" B.S. H.V.#6		
H.V.#6	00°-00'-00"		
J	1) 164°-52'-56"	11882.252'	89°-38'-40"
	2) 329°-45'-57"	+7.342	V.D.
	4) 299°-32'-04"	11882.274'	S.D.
	M) 164°-53'-01"		
	AM) 164°-53'-02"		
	B.S. "J" & RT. TO H.V.#6		
H.V.#6	1) 195°-07'-01"	1594.701'	90°-26'-42"
	2) 30°-13'-47"	-12.386	V.D.
	4) 60°-27'-53"	1594.750'	S.D.
	M) 195°-06'-58"		
	AM) 195°-06'-58"		

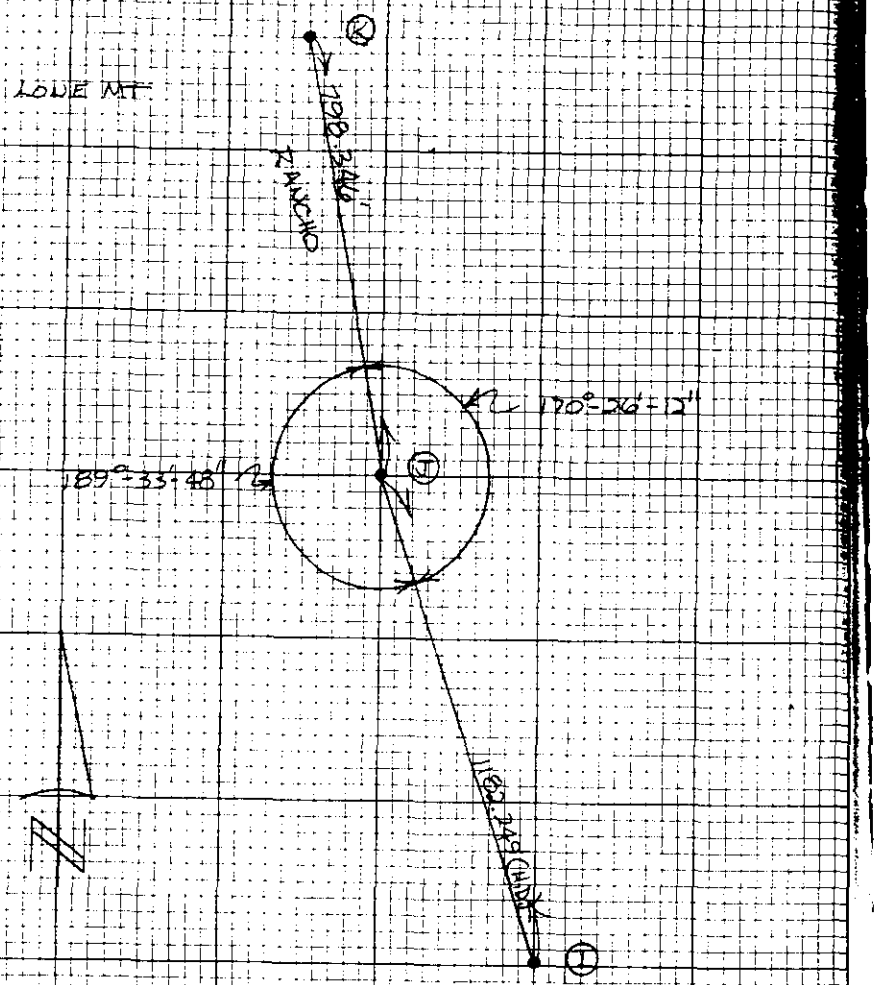
H.V.#6 DES. PG.#5 THIS BOOK

I DES. PG. 11 THIS BOOK

J SET PK NAIL WEST SIDE RANCH ROAD 600 ± SOUTH OF LONE MT.

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



6-9-95

BRULAND SOMMA

PT. #	HORZ. & RT. DISTANCE	ZENITH &	DESCRIPTION
	TO "J" B.S. "I"		
I	00°-00'-00"		
			H.I. = Ⓙ = 5.50'
			H.P. = Ⓘ = 5.125
			H.P. = Ⓚ = 5.017
K	1) 189°-33'-53"	798.346'	89°-52'-56"
	2) 19°-07'-35"	+1.641	V.D.
	4) 38°-15'-17"	798.347'	S.D.
	M) 189°-33'-49"		
	AM) 189°-33'-48"		
	B.S. "K" & RT. TO "I"		
I	1) 170°-26'-19"	1182.249'	90°-23'-30"
	2) 340°-52'-28"	-8.045'	V.D.
	4) 321°-44'-50"	1182.277'	S.D.
	M) 170°-26'-13"		
	AM) 170°-26'-12"		

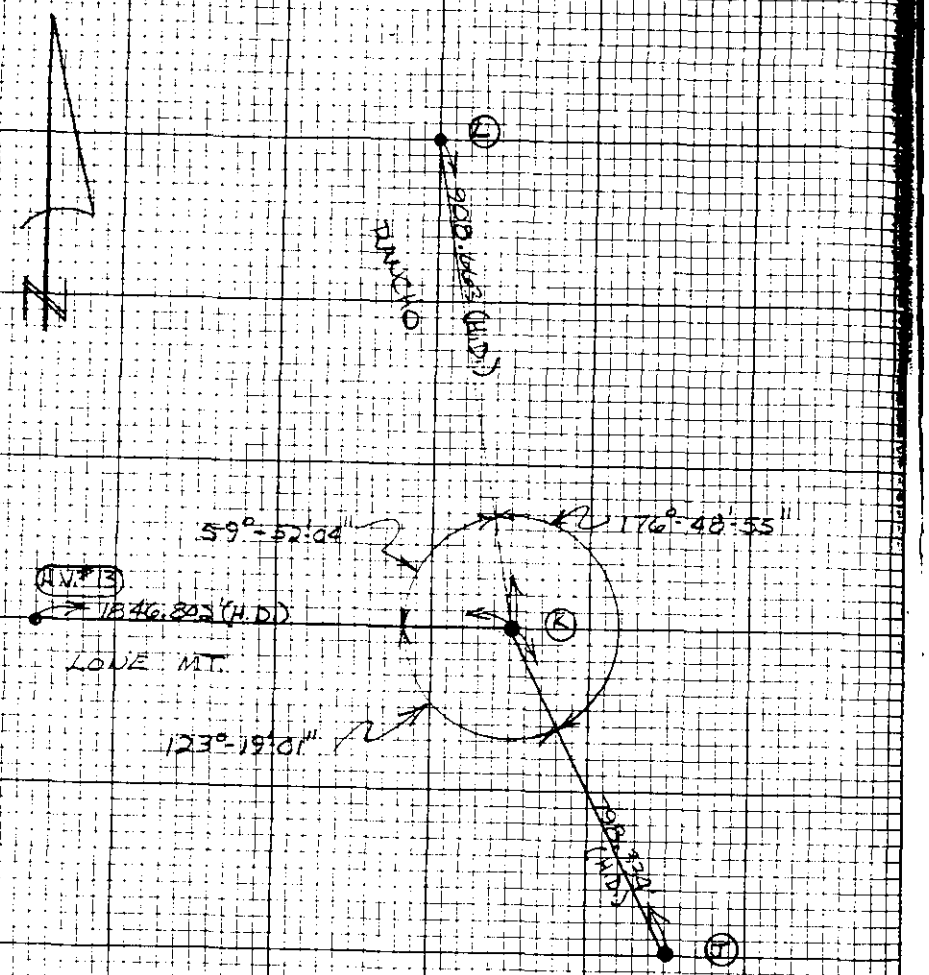
I DES PG. 17 THIS BOOK

J DESC PG 33 THIS BOOK

K SET PK NAIL WEST SIDE OF RANCHO RD. 150' NORTH OF LOWE MT.

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG 35

6-9-93 BRUCE ALLEN SOMMA

PT.#	HORZ. BRG	DISTANCE	ZENITH ∠	DESCRIPTION
	@ "K" B.S. "J"			H.I.- Ⓚ 5.33
J	00°-00'-00"			H.P.- Ⓙ 5.25
				H.P.- Ⓛ 5.13
H.V.#13	1) 123°-19'-14"	1846.802'	89°-44'-20"	H.P.- H.V.#13 5.14
	2) 246°-38'-18"	+83.416'	V.D.	
	4) 138°-16'-13"	1846.821'	S.D.	
	M) 123°-19'-03"			
	AM) 123°-19'-01"			
	B.S. H.V.#13 RT. TO "L"			
	1) 59°-52'-10"	908.663'	89°-48'-54"	
	2) 119°-44'-13"	+2.938'	V.D.	
	4) 239°-28'-18"	908.668'	S.D.	
	M) 59°-52'-05"			
	AM) 59°-52'-04"			
	B.S. "L" RT. TO "J"			
J	1) 176°-48'-52"	198.334'	90°-09'-31"	
	2) 353°-37'-49"	-2.216'	V.D.	
	4) 347°-15'-48"	198.337'	S.D.	
	M) 176°-48'-56"			
	AM) 176°-48'-55"			

T DESC PG 33 THIS BOOK

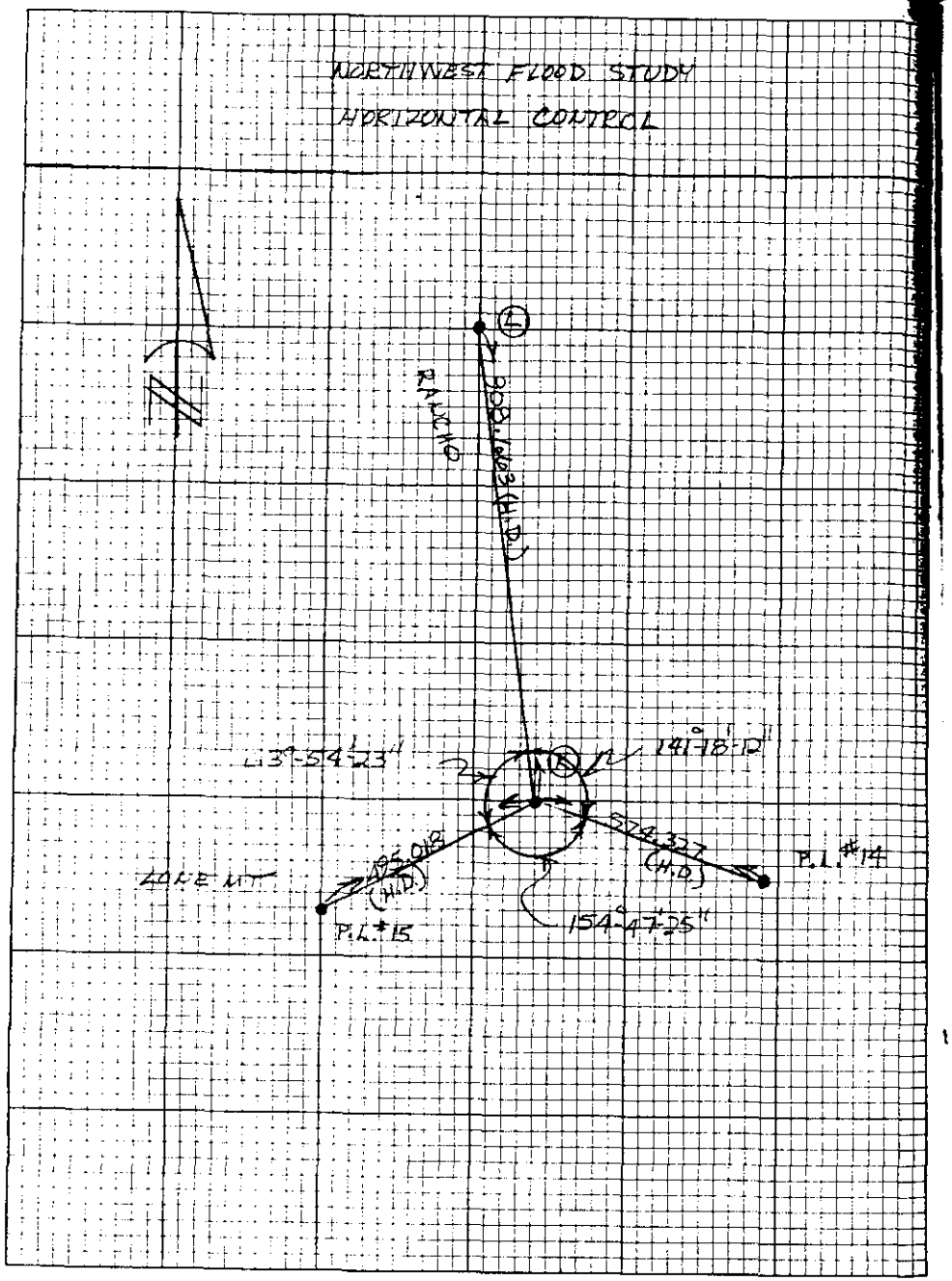
K DESC PG 34 THIS BOOK

L SET 2X2" HUB W/TACK IN CENTERLINE ISLAND 50± NORTH OF SOUTH T.D/W TO SW. CORNER

H.V.#13 DESC PG 5 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



12-9-93 BRUNARD SOMMA

P.I.#	HORZ. ∠ RT.	DISTANCE	AZIMUTH	DESCRIPTION
	TO "K" B.S. "L"			U.I. - (K) - 5.33
	00°-00'-00"			H.P. - (P.I.#14) - 5.20
P.I.#14	1) 141°18'-07"	574.327	90°-28'-27"	H.P. - (P.I.#15) - 5.25
	2) 282°-36'-13"	-4.756	V.D.	
	4) 205°-12'-38"	574.327	S.D.	
	M) 141°-18'-10"			
	AM) 141°-18'-12"			
	B.S. P.I.#14 & RT. TO P.I.#15			
P.I.#15	1) 154°-47'-23"	495.018	89°-58'-18"	
	2) 359°-34'-46"	+0.335	V.D.	
	4) 259°-09'-30"	495.018	S.D.	
	M) 154°-47'-23"			
	AM) 154°-47-25"			
	B.S. P.I.#15 & RT. TO "L"			
	1) 63°-54'-19"			
	2) 127°-48'-38"			
	4) 255°-37'-23"			
	M) 63°-54'-21"			
	AM) 63°-54'-23"			

K DESC. PG. 34 THIS BOOK

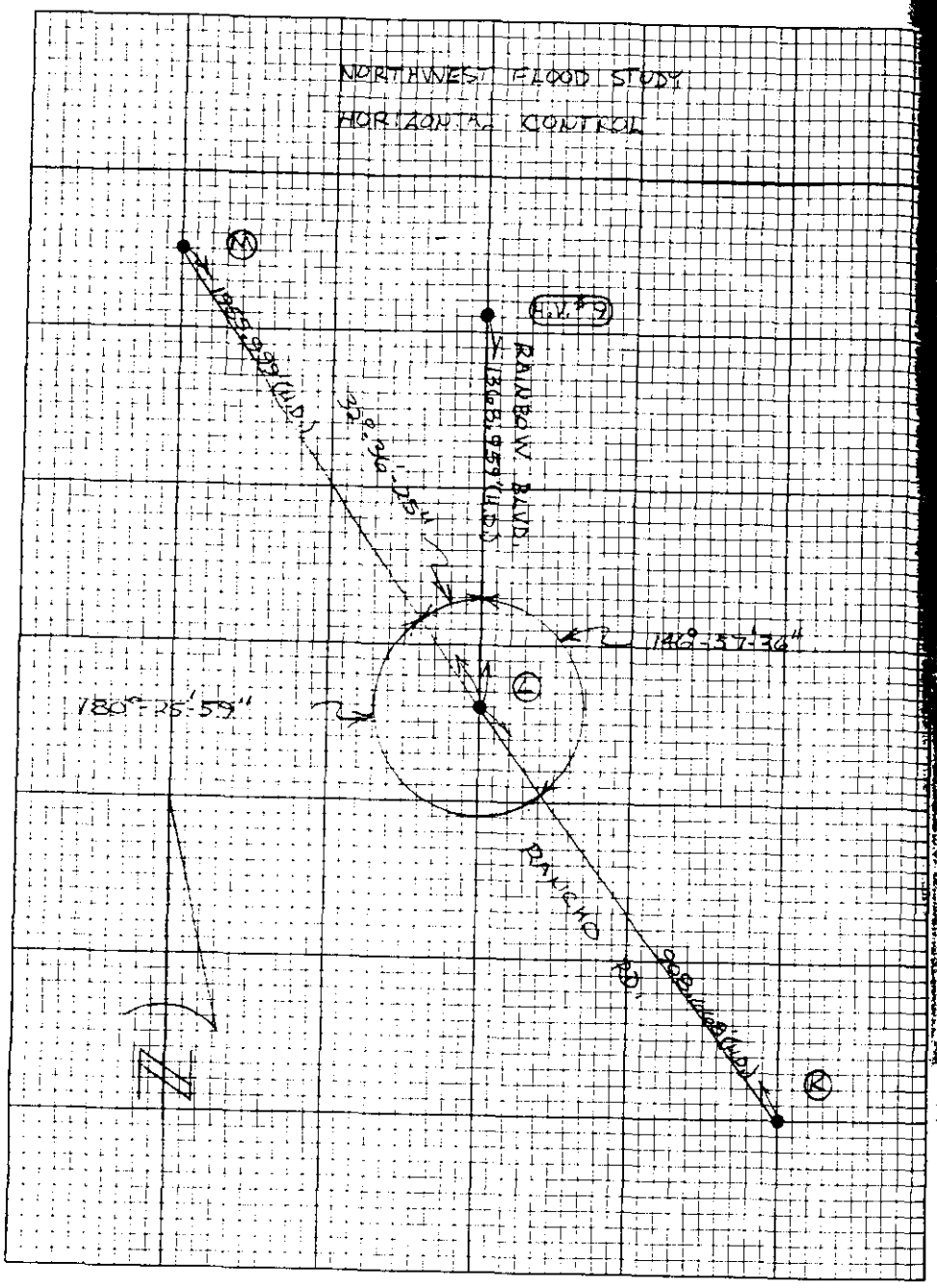
L DESC. PG. 35 THIS BOOK

P.I.#14 PROFILE LINE #14 RR & SHINER & LOWE MT. & SERENE DR.

P.I.#15 DESC PG. 13 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



B-K-93 BRULAND SOMMA

PT.	HORZ ∠ RT.	DISTANCE	ZENITH ∠	DESCRIPTION
	TO "K" B.S. "K"			
	00°-00'-00"			H.I. - (L) - 5.32
				H.I. - (K) - 4.93
				H.I. - (M) - 5.08
				H.I. (H.M. #9) - 5.25
K	1) 180°-25'-58"	1355.999'	89°-48'-09"	
	2) 0°-51'-58"	16.743'	V.D.	
	3) 1°-43'-55"	1356.010'	S.D.	
	M) 180°-25'-59"			
	AM) 180°-25'-55"			
	B.S. "M" ∠RT. TO "H.M. #9"			
L	1) 32°-36'-25"	1348.959'	90°-06'-03"	
	2) 65°-12'-53"	-2.409'	V.D.	
	3) 130°-25'-40"	1348.961'	S.D.	
	M) 32°-36'-25"			
	AM) 32°-36'-25"			
	B.S. "H.M. #9" ∠RT. TO K			
K	1) 146°-57'-35"	508.668'	90°-13'-38"	
	2) 293°-55'-14"	-3.604'	V.D.	
	3) 127°-50'-20"	508.675'	S.D.	
	M) 146°-57'-36"			
	AM) 146°-57'-36"			

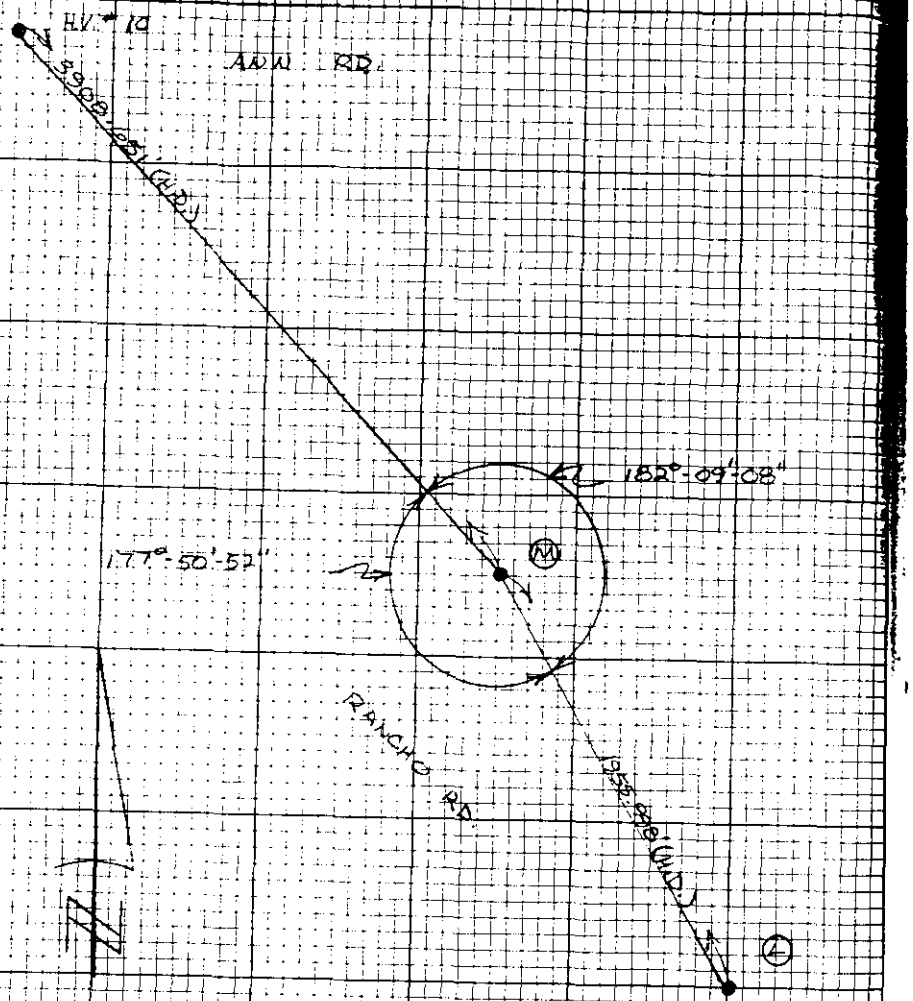
K DESC. PG. 34 THIS BOOK

L DESC. PG. 35 THIS BOOK

M SET PK NAIL IN A/C EAST SIDE OF RANCHO TP18 PG. 17 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



9-10-93 BRUNO SOMMA

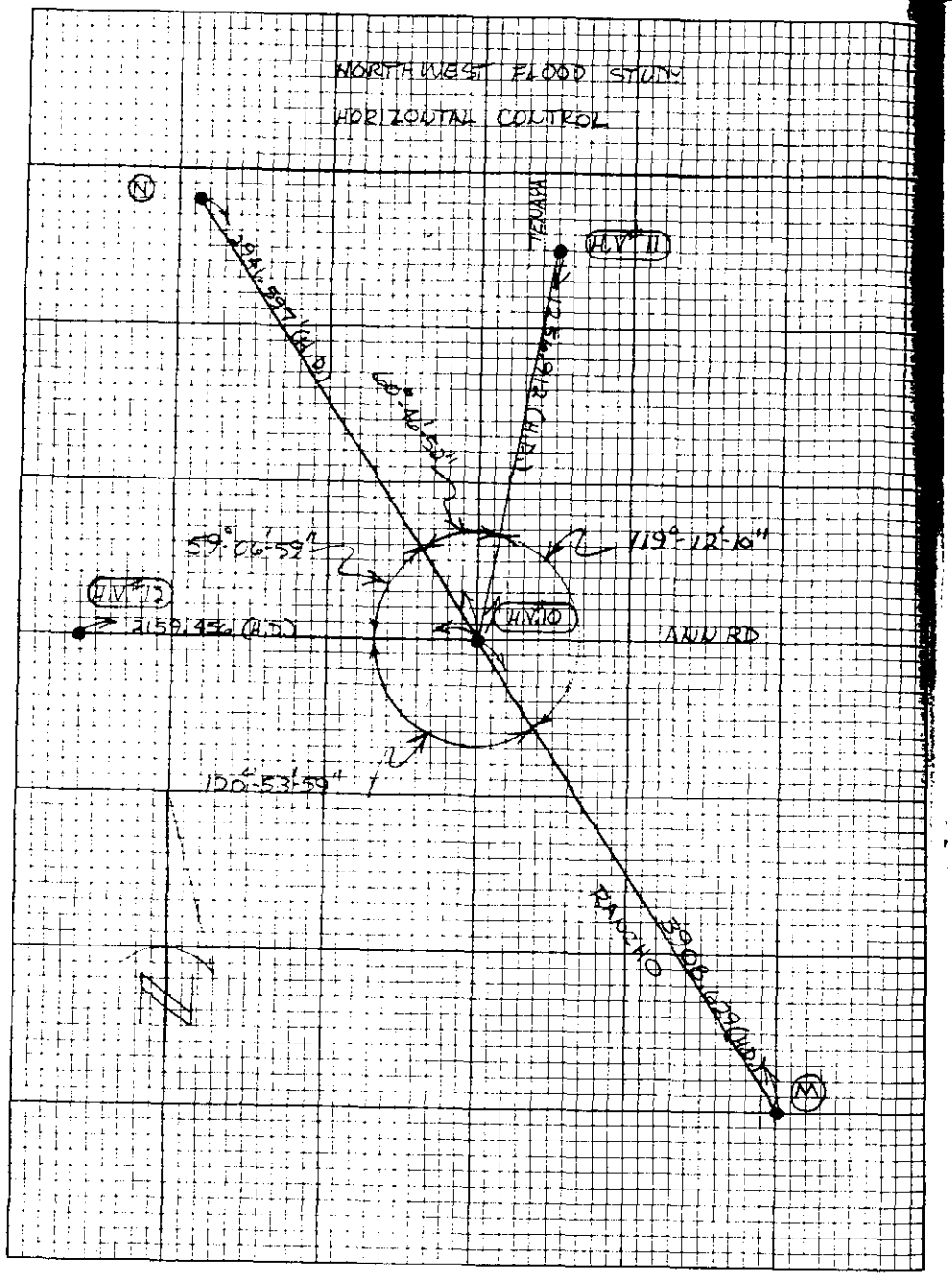
	HOR'Z. ∠ RT.	DISTANCE	ZENITH ∠	DESCRIPTION
	T@ M	B.S.	L	
	00°-00'-00"			H.I. - M = 5.37
				H.P. - L = 5.06
				H.I. - H.V.# 10 = 4.99
HD	1) 177°-50'-54"	3908.651'	89°-36'-04"	
	2) 355°-41'-42"	+27.212'	V.D.	
	4) 351°-28'-25"	3908.745'	S.D.	
	M) 177°-50'-51"			
	AM) 177°-50'-52"			

	B.S. H.V.# 10 ∠ RT.	10	"L"
	1) 182°-09'-04"	1955.998'	90°-13'-21"
	2) 4°-18'-10"	-7.596'	V.D.
	4) 8°-36'-30"	1956.013'	S.D.
	M) 182°-09'-08"		
	AM) 182°-09'-08"		

L DES PG. 35 THIS BOOK

M DESC. PG. 37 THIS BOOK

H.V.# 10 DESC PG. 5 THIS BOOK



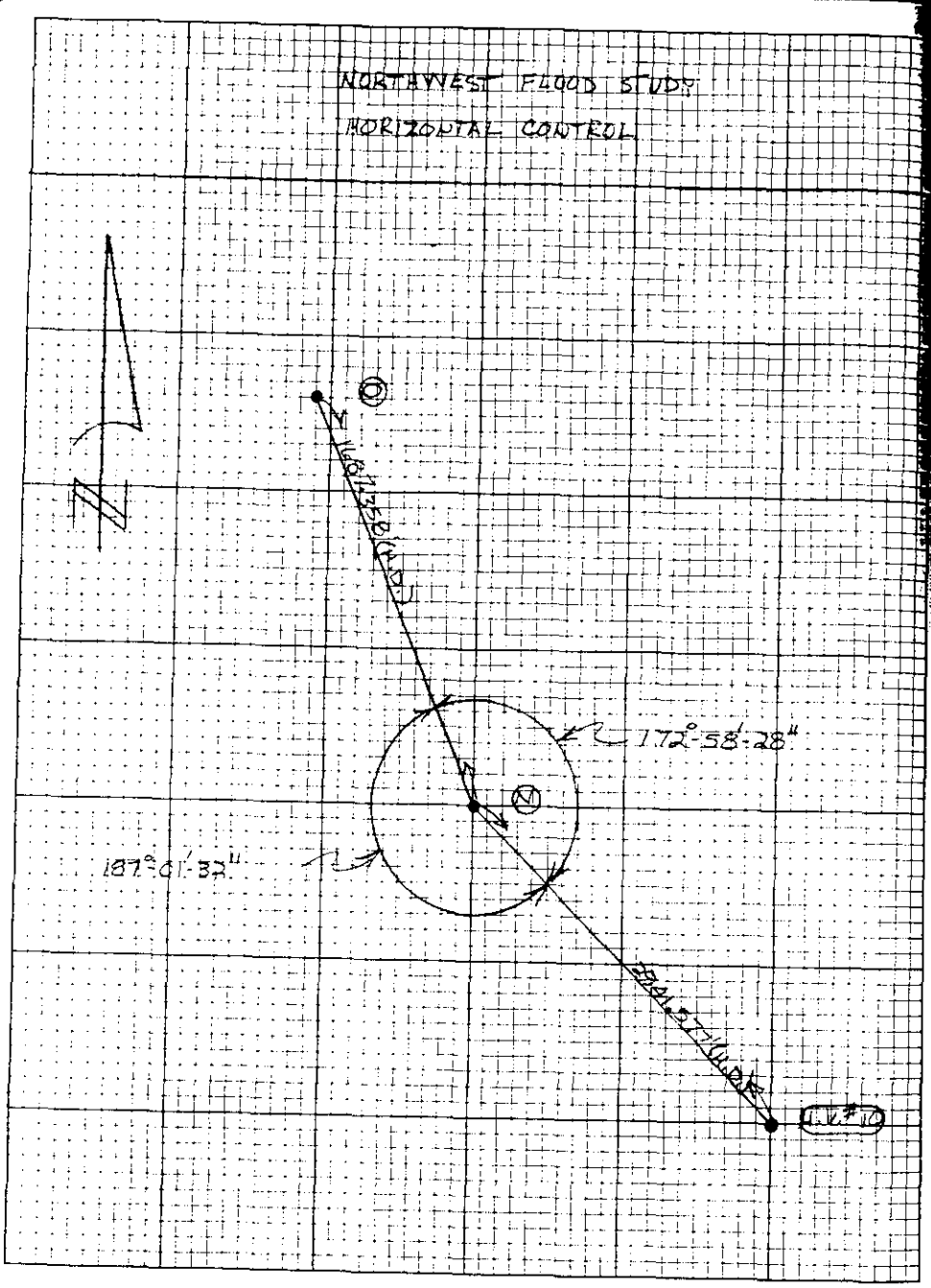
1"=2,000'

6-10-93 BRUANS SUMMA

PT #	HORZ. & RT.	DISTANCE	ZENITH #	DESCRIPTION
	AT @ H.V.#10 "B.S." M			H.I. - H.V.#10 - 5.28
	0°-00-00"			H.P. - M - 5.10
				H.P. - H.V.#11 - 5.33
#12	1) 120°-53'-56"	2159.456	89°-37'-52"	H.P. - H.V.#12 - 5.82
	2) 239°-47'-53"	+13.903	V.D.	H.P. - N - 5.07
	4) 123°-35'-49"	2159.501	S.D.	
	M) 120°-53'-57"			
	AM) 120°-53'-57"			
	B.S. "H.V.#12" & RT. TO "N"			
N	1) 59°-06'-56"	2941.597'	89°-39'-32"	
	2) 118°-13'-56"	+17.518	V.D.	
	4) 236°-27'-50"	2941.650	S.D.	
	M) 59°-06'-58"			M DESC PG. 37 THIS BOOK
	AM) 59°-06'-59"			
	B.S. "N" & RT. TO "H.V.#11"			H.V.#10 DESC PG. 5 THIS BOOK
H.V.#11	1) 60°-46'-53"	1256.912'	90°-17'-28"	
	2) 121°-33'-47"	-6.405'	V.D.	H.V.#12 DESC PG. 5 THIS BOOK
	4) 243°-07'-24"	1256.928	S.D.	
	M) 60°-46'-51"			H.V.#11 DESC PG 5 THIS BOOK
	AM) 60°-46'-52"			
	B.S. "H.V.#11" & RT. TO "M"			
M	1) 119°-12'-08"	3908.629	90°-25'-32"	N SET 2x2" HUB W/TACK EAST SIDE FRONTAGE RD. 300± SOUTH OF RANCH HOUSE ROAD
	2) 238°-24'-17"	-28.903	V.D.	
	4) 116°-48'-34"	3908.737'	S.D.	
	M) 119°-12'-09"			
	AM) 119°-12'-10"			

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



6-10-93 BRUJADO SOMMA

PT #	HORZ ∠ RT	DISTANCE	ZENITH ∠	DESCRIPTION
	T@ "N"	B.S. H.V.#10		H.I. - N - 5.34
#10	00°-00'-00"			H.P. - H.V.#10 - 5.00
				H.P. - O - 4.85
O	1) 187°-01'-43"	@87.358'	89°-14'-37"	
	2) 14°-03'-10"	+22.277'	V.D.	
	3) 28°-06'-12"	@87.506'	S.D.	
	M) 187°-01'-38"			
	AM) 187°-01'-32"			
	B.S. O & RT. TO	H.V.#10		
#10	1) 172°-58'-30"	2941.577'	90°-21'-26"	
	2) 345°-57'-05"	-18.811'	V.D.	
	3) 331°-53'-58"	2941.438'	S.D.	
	M) 172°-58'-30"			
	AM) 172°-58'-28"			

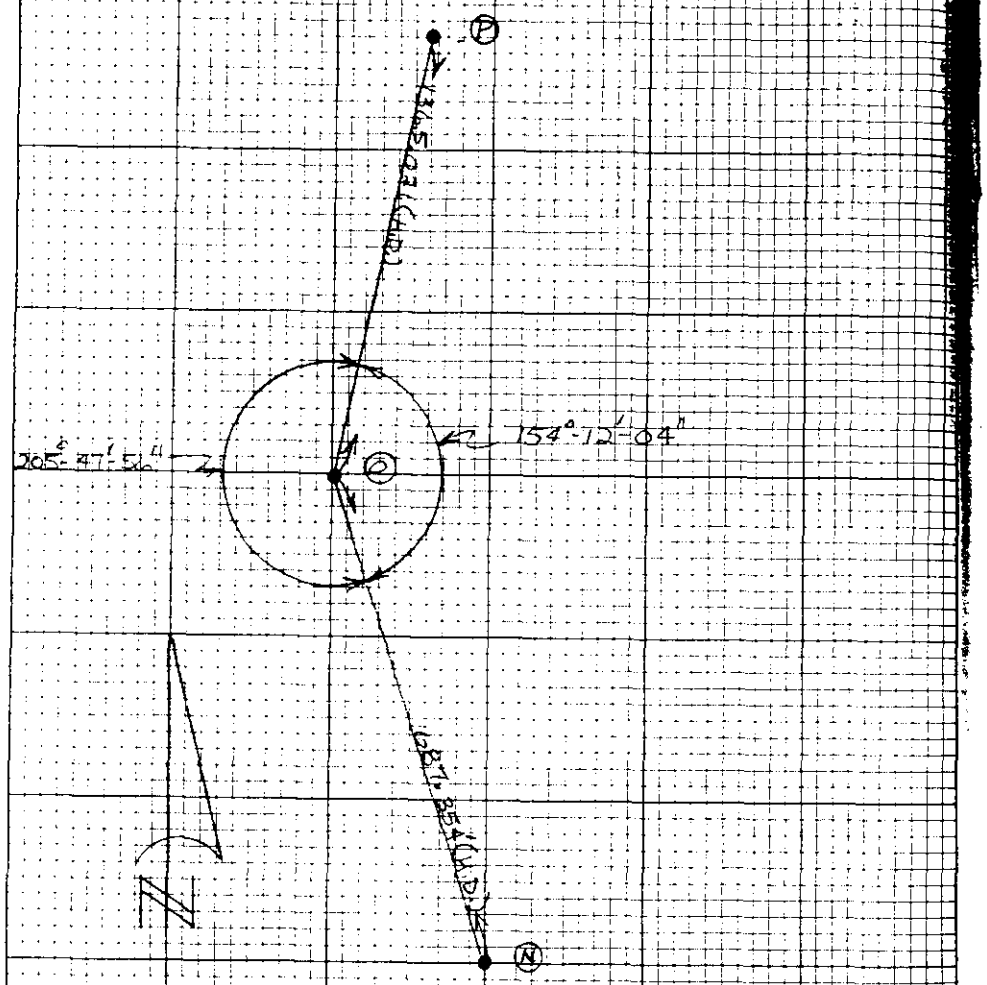
H.V.#10 DESC PG. 5 THIS BOOK

N DESC PG 39 THIS BOOK

O SET 2"x2" HUB W/TACK .00' EAST OF FRONTAGE ROAD IN DESERT

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG 41

6-10-92 BRUAUD SOMMA

	HORZ ∢ RT. AT "O"	DISTANCE	ZENITHS	DESCRIPTION
	00°-00'-00"			H.I.- O - 5.02
				H.P.- N - 5.06
				H.P.- P - 4.78
F	1) 205°-47'-51"	1365.021	89°-55'-43"	
	2) 51°-35'-54"	+11.694	V.D.	
	3) 103°-11'-46"	1365.022	S.D.	
	M) 205°-47'-57"			
	MD 205°-47'-56"			
	B.S. "P" ∢ RT. TO "N"			
N	1) 154°-12'-03"	1687.354	90°-47'-07"	
	2) 308°-24'-10"	-23.120	V.D.	
	3) 256°-48'-17"	1687.512	S.D.	
	M) 154°-12'-04"			
	MD 154°-12'-04"			

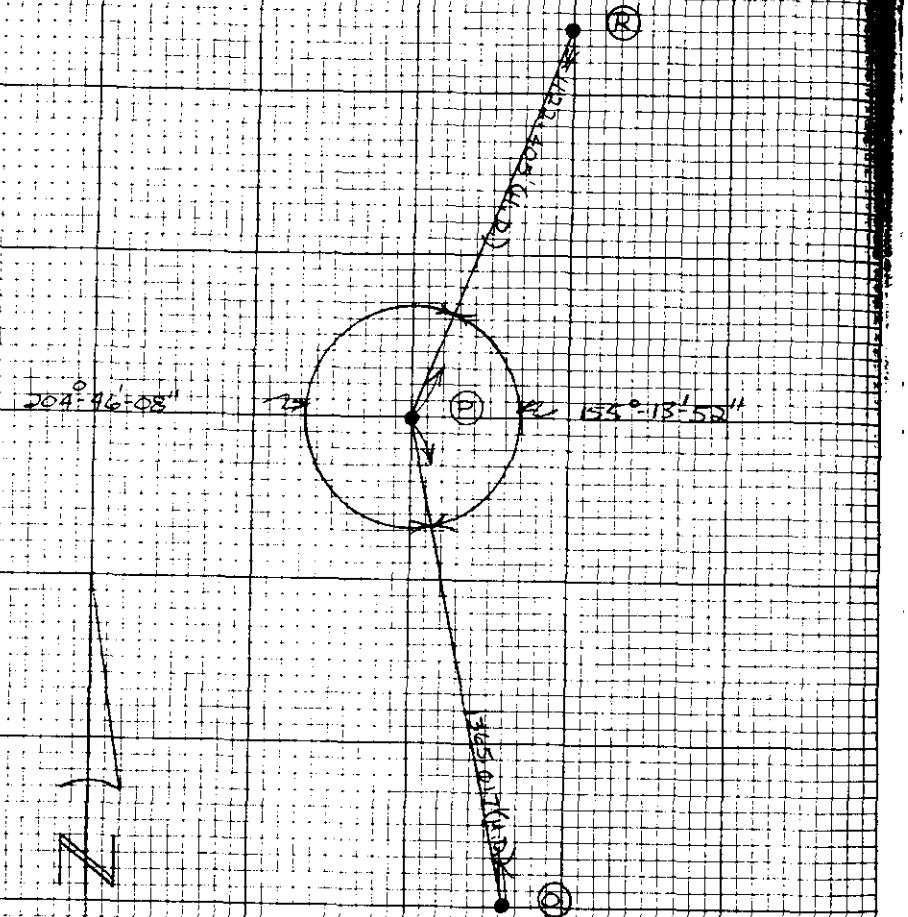
N DESC. PG. 39 THIS BOOK

O DESC. PG. 40 THIS BOOK

P SET 2X2 HUB W/TACK 250± OF S.PT. FRONTAGE RD. ON GAS EASEMENT

NORTHWEST FLOOD STUDY

HORIZONTAL



T-48 PG. 42

6-10-83 BRUFALO SOM MD

X @ "P" B.S. "O"

00°-00'-00"

3	1]	204°-45'-59"	1122.405'	90°-26'-14"
	2]	49°-32'-07"	-8.577'	V.D.
	4]	90°-04'-26"	1122.438'	S.D.
	M]	204°-46'-07"		
	AM]	204°-46'-08"		

B.S. "R" & RT. TO "O"

5	1]	155°-13'-43"	1365.017'	90°-06'-09"
	2]	310°-27'-37"	-2.427'	V.D.
	4]	260°-55'-20"	1365.019'	S.D.
	M]	155°-13'-50"		
	AM]	155°-13'-51"		

H.I. = P - 5.04

H.P. = Q - 4.82

H.P. = R - 5.26

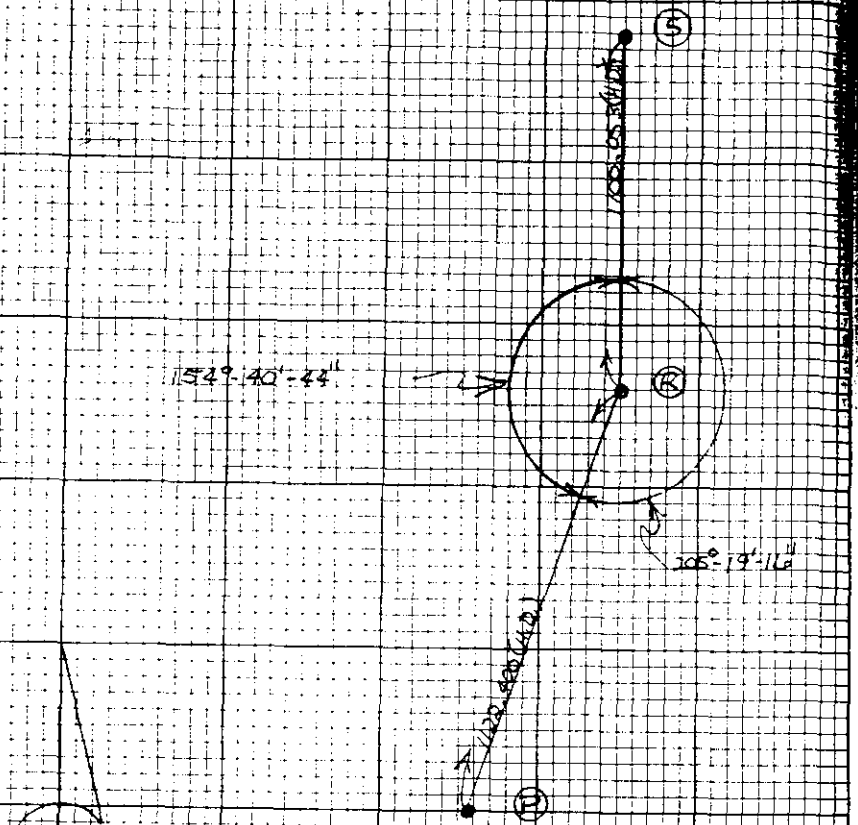
Q DESC. PG. 40 THIS BOOK

P DESC. PG. 41 THIS BOOK

R: SET 2"x2' HUB W/TACK 157' S.E. OF INTERSECT OF ROME & BUFFALO

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



G·D-83 BRYLAND SOMMA

T-#	HORZ & RT. ANGLES	DISTANCE	ZENITHS	DESCRIPTION
	AT "R" B.S. "P"			
T	00°-00'-00"			
S	1) 154°-40'-40"	1700.053	89°-07'-20"	
	2) 309°-21'-25"	+ 26.047	V.D.	
	4) 258°-40'-58"	1700.353	S.D.	
	M) 154°-40'-45"			
	AM) 154°-40'-44"			
	B.S. "S" & RT. TO "P"			
P	1) 205°-19'-18"	1122.400'	89°-35'-43"	
	2) 50°-38'-34"	+ 0.023'	V.D.	
	4) 101°-17'-13"	1122.423	S.D.	
	M) 205°-19'-18"			
	AM) 205°-19'-16"			

H.I. - R - 5.53

H.P. - P - 4.75

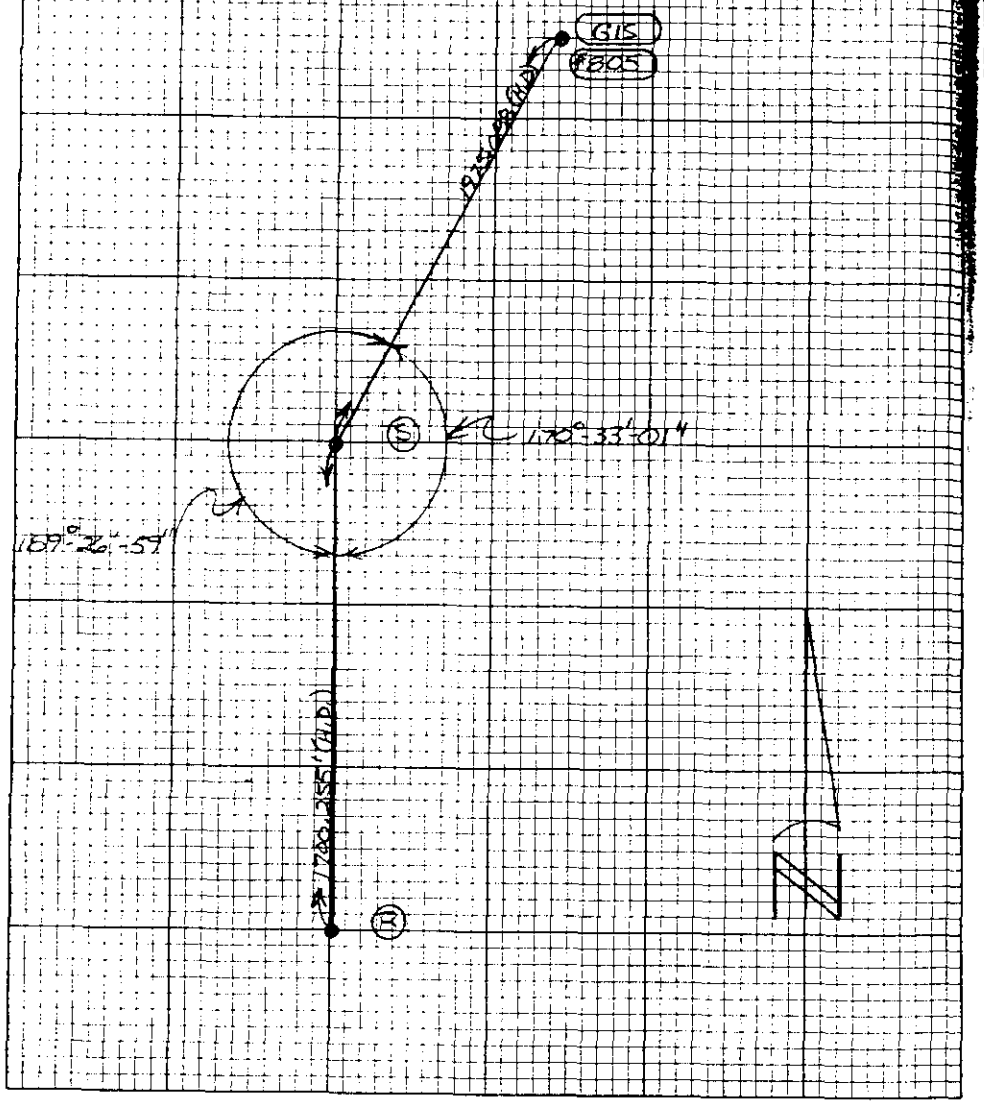
H.P. - S - 4.88

P DESC. PG. 41 THIS BOOK

R DESC. PG. 42 THIS BOOK

S SET 2½x2" HUB W/TACK TOP OF RIDGE 500± NORTH OF BUFFALO DEER SPRINGS

NORTHWEST FLOOD STUDY
HDR SURVEY CONTROL



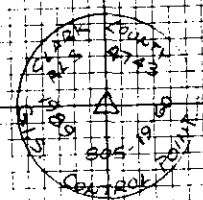
6-10-93 BRUNAU SOMMA

ITEM	HORZ. & RT. DISTANCE FROM/TO			DESCRIPTION
	T@ "S" B.S. "R"			H.I. - S - 5.14
R	00°-00'-00"			H.P. - R - 5.24
				H.P. - GIS - 5.74
GIS	1) 189°-26'-59"	1975.088'	90°-11'-26"	805
805	2) 18°-53'-59"	+ 16.559	V.D.	
	4) 32°-47'-52"	1975.079'	S.D.	
	M) 189°-26'-58"			
	AM) 189°-26'-59"			
	B.S. GIS "R" B.S. 805	& RT. TO	"R"	
R	1) 170°-33'-05"	1700.043'	90°-34'-14"	
	2) 341°-06'-08"	- 24.822		
	4) 322°-12'-00"	1700.055	S.D.	
	M) 170°-33'-00"			
	AM) 170°-33'-01"			

R DESC PG. 42 THIS BOOK

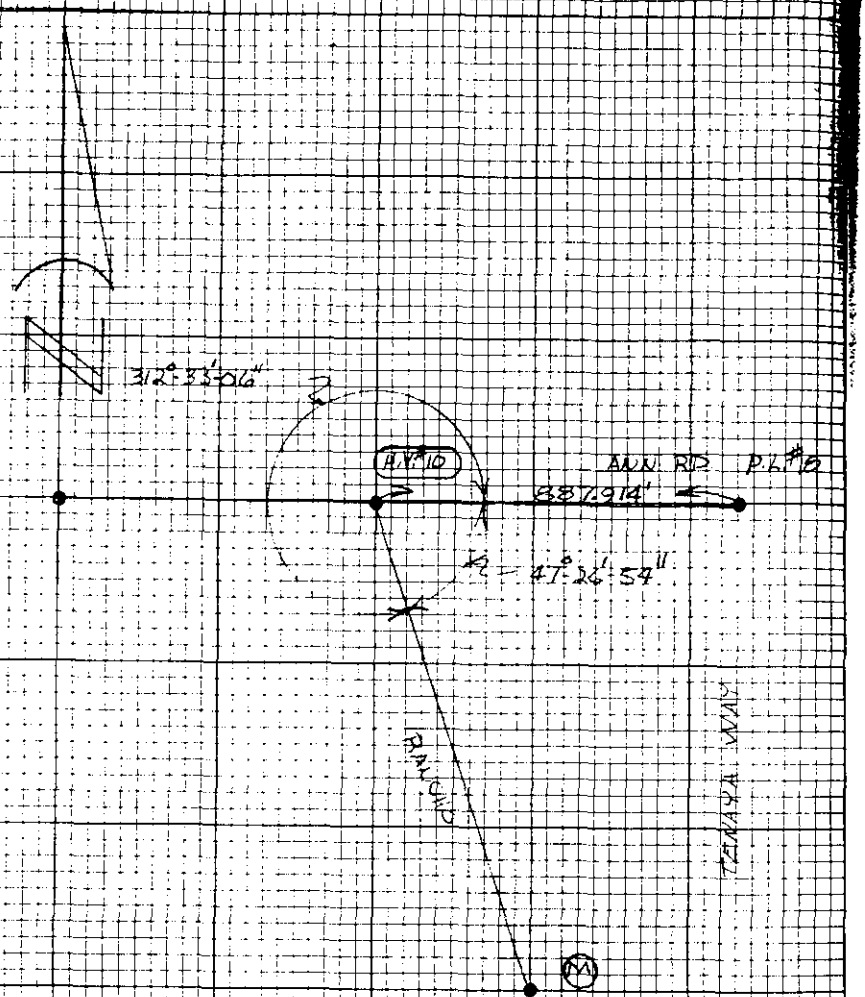
S DESC PG. 43 THIS BOOK

GIS 805 FND 2" B/C 0.6' BELOW N/G MARKED AS FOLLOWS



NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



6-14-93 BRUSADO SOMMA

PT. #	HORIZ. BRG.	DISTANCE	ZENITH ∠	DESCRIPTION
	From "H.I. #10" to "B.S. M" 00°00'00"			H.I. - H.I. #10 = 5.53
				H.R. - P.I. #18 = 5.32
P.I. #18	1) 312°33'05"	887.914	90°26'17"	
	2) 26°02'10"	-6.81	V.D.	
	3) 170°12'19"	887.941	S.D.	
	M) 312°33'05"			
	AM) 312°33'06"			
	B.S. "P.I. #18 & RT. TO" M"			
M	1) 47°26'55"			
	2) 94°53'47"			
	3) 189°47'26"			
	M) 47°26'52"			
	AM) 47°26'54"			

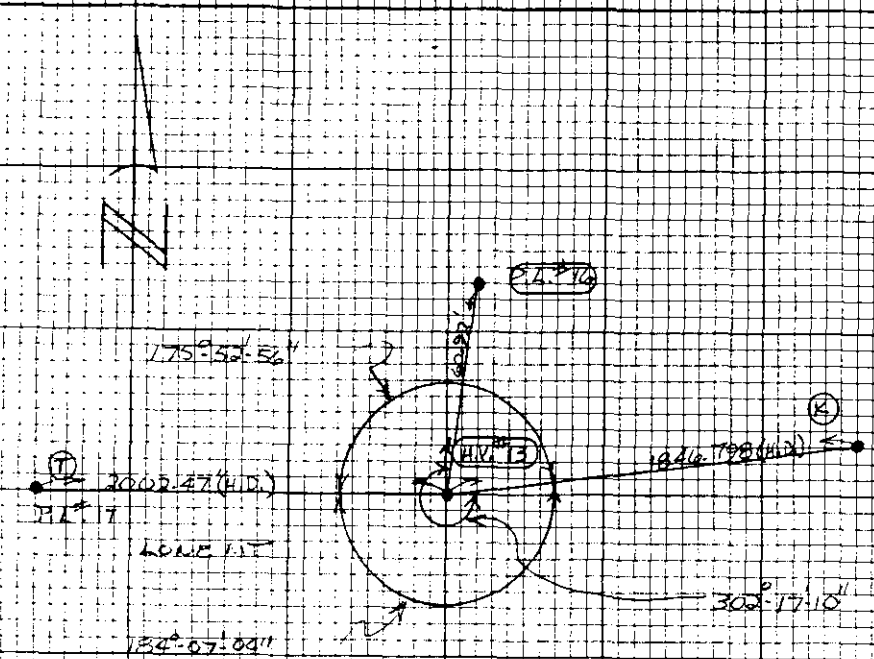
M - DESC. PG. 87 THIS BOOK

H.I. #10 PG. 5 THIS BOOK

P.I. #18 SET PK NAIL CENTERLINE ANN ROAD 25± EAST OF TENAYA WAY

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



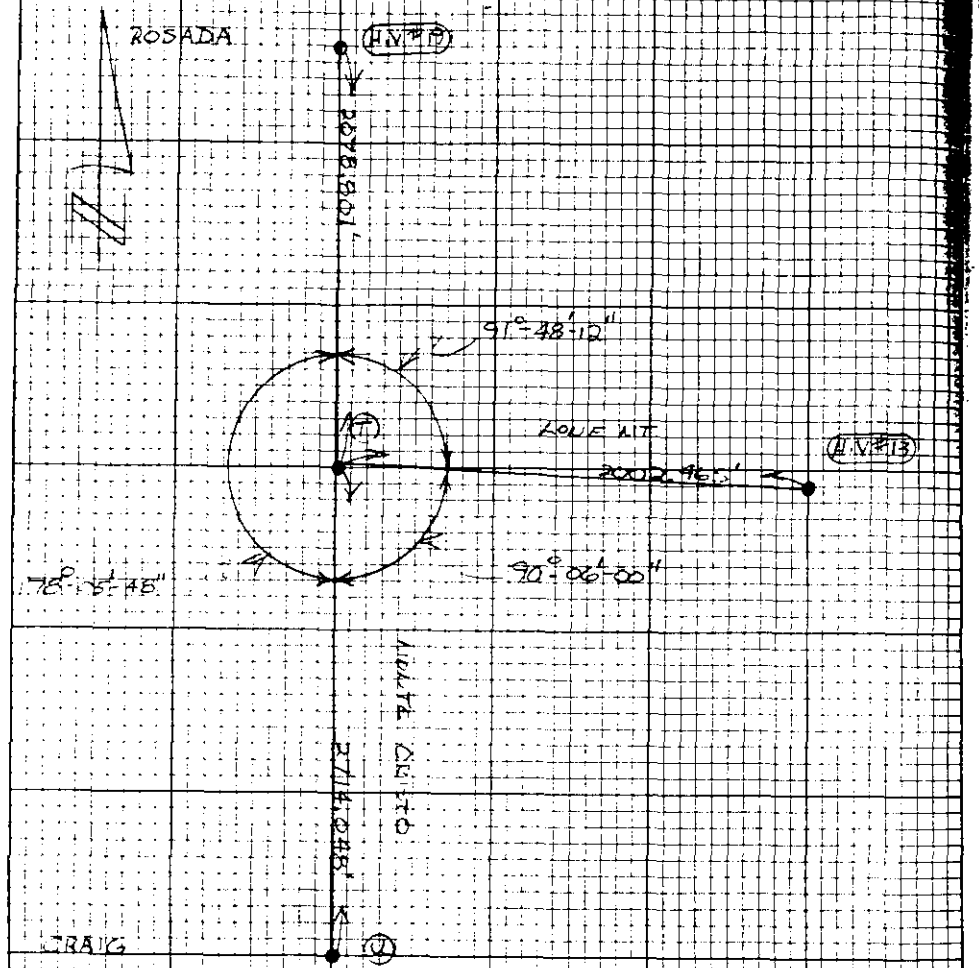
T-48 PG 46

6-11-73 BRUCE SMITH

ET #	HORZ ART	DISTANCE	ZENITHS	DESCRIPTION
	T @ H.W. #13 B.S. "K"			H.I. H.W. #13 = 5.38
	00°-00'-00"			H.I. - K = 5.20
T	I) 184°-07'-05"	2002.470'	89°-52'-27"	H.I. - T = 5.30
	2) 8°-14'-04"	+ 4.388'	V.D.	H.I. - B.M. #16 = 4.64
	4) 14°-28'-14"	2002.475'	S.D.	
	M) 191°-07'-04"			
	AM 184°-07'-04"			
	B.S. "T" ART TO "K"			
K	1) 175°-52'-55"	1844.798'	90°-16'-56"	
	3) 351°-45'-55"	+ 9.097'	V.D.	
	4) 343°-37'-43"	1844.800	S.D.	K DESC. PG. 34 THIS BOOK
	M) 175°-52'-56"			H.W. #13 DESC PG 5 THIS BOOK
	AM) 175°-52'-56"			T DESC. PG. 11 THIS BOOK ALSO B.M. #17
	T @ "H.W. #13" B.S. "K"			
P.I. #16	1) 302°-17'-08"	60.929'	91°-04'-41"	B.M. #16 DESC PG. 13 THIS BOOK
	2) 244°-34'-17"	+ 1.182	V.D.	
	4) 129°-08'-36"	60.931	S.D.	
	M) 302°-17'-10"			
	AM) 302°-17'-10"			

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



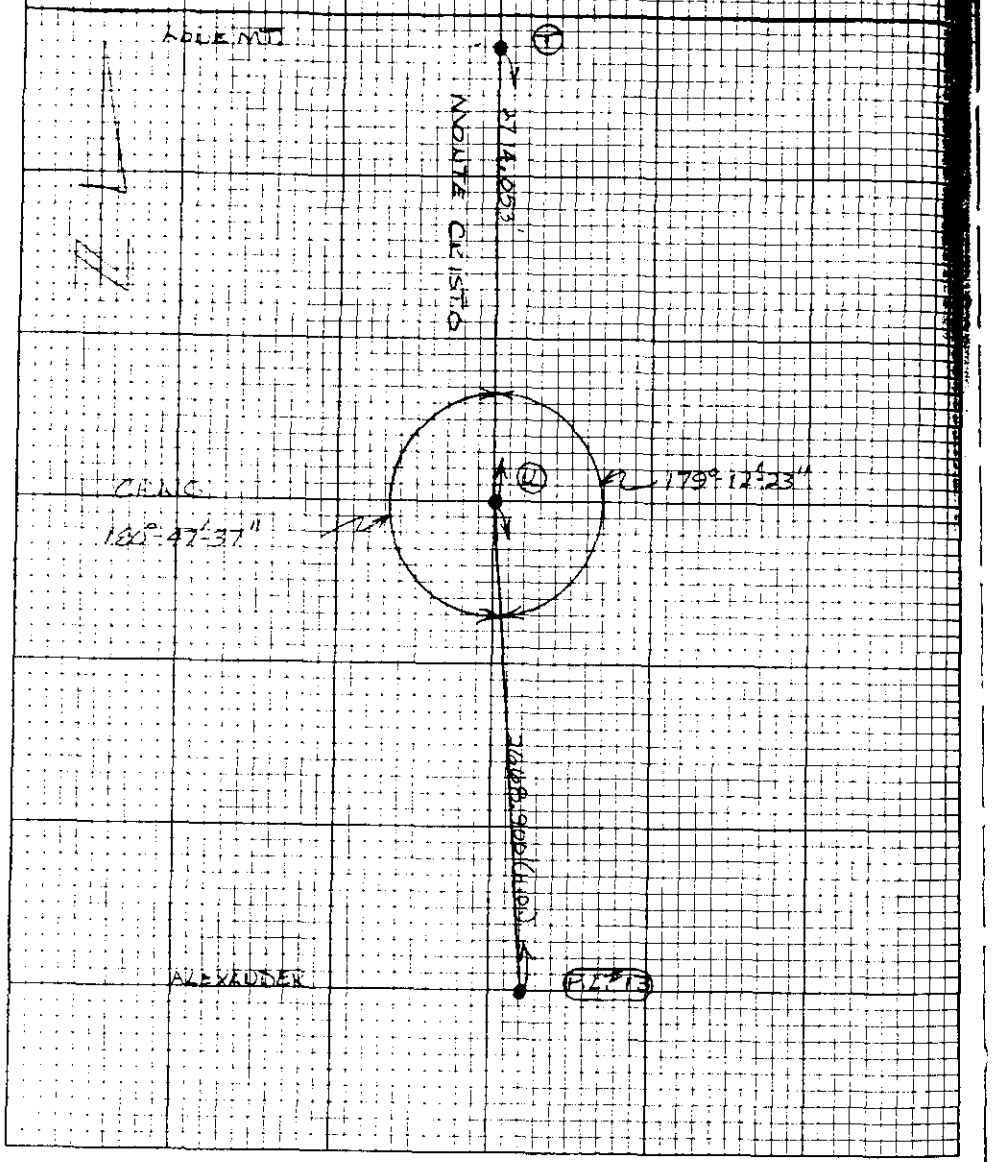
T-44 PG 47

2-11-93 BRUZAS SOMMA

T #	HORZ. #	DISTANCE	ZENITH	DESCRIPTION
	T @ "T" TO B.S. H.V.#13			H.I.-T- 5.56
T#13	00°00'-00"			H.P.-H.V.#13-5.09'
				H.P.-H.V.#19-5.26'
U	1) 90°-05'-57"	2714.048'	90°-05'-05"	H.P.-U- 5.22'
	2) 180°-12'-00"	-2421"	V.D.	
	4) 0°-23'-56"	2714.045'	S.D.	
	M) 90°-05'-59"			
	AM) 90°-06'-00"			
	B.S. U & R.T. TO "H.V.#19"			
T#19	1) 178°-05'-45"	2078.801'	89°-40'-31"	
	2) 356°-11'-30"	+16.182	V.D.	
	4) 352°-23'-05"	2078.835'	S.D.	
	M) 178°-05'-46"			
	AM) 178°-05'-48"			
	H.V.#19 S.R.T. TO H.V.#13			H.V.#13 DES. PG. 5 THIS BOOK
#13	1) 91°-48'-09"	2000.96'	90°-08'-54"	T DES. PG. 11 THIS BOOK (P.I.#17)
	2) 183°-36'-20"	-5.184'	V.D.	
	4) 7°-12'-41"	2003.977'	S.D.	H.V.#19 DES. PG. 6 THIS BOOK
	M) 91°-48'-10"			
	AM) 91°-48'-16"			U 2½" HUB W/TACK 50' SOUTH OF EXTRA SECTION MONTE CRISTO & CRAIG

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG 48

45,000'

6-11-93 BRULAND SOMMA

#	HOR. & RT.	DISTANCE	ZENITH ∠	DESCRIPTION
	∠ @ "U" B.S. "T"			H.I. - (U) 5.49
	00°-00'-00"			H.P. - (T) 5.38
				H.P. (P.I. #13) 5.35
P.I. #13	D 179°-12'-22"	26468.900'	90°-04'-10"	
	2) 358°-24'-45"	- 3.335'	V.D.	
	4) 356°-49'-26"	26468.902'	S.D.	
	M) 179°-12'-22"			
	AM) 179°-12'-25"			
	B.S. "P.I. #13" & RT. TO "T"			
	1) 180°-47'-33"	27141.053'	89°-58'-16"	
	2) 1°-35'-10"	+ 1.355	V.D.	
	4) 3°-10'-23"	27141.058'	S.D.	
	M) 180°-47'-36"			
	AM) 180°-47'-37"			

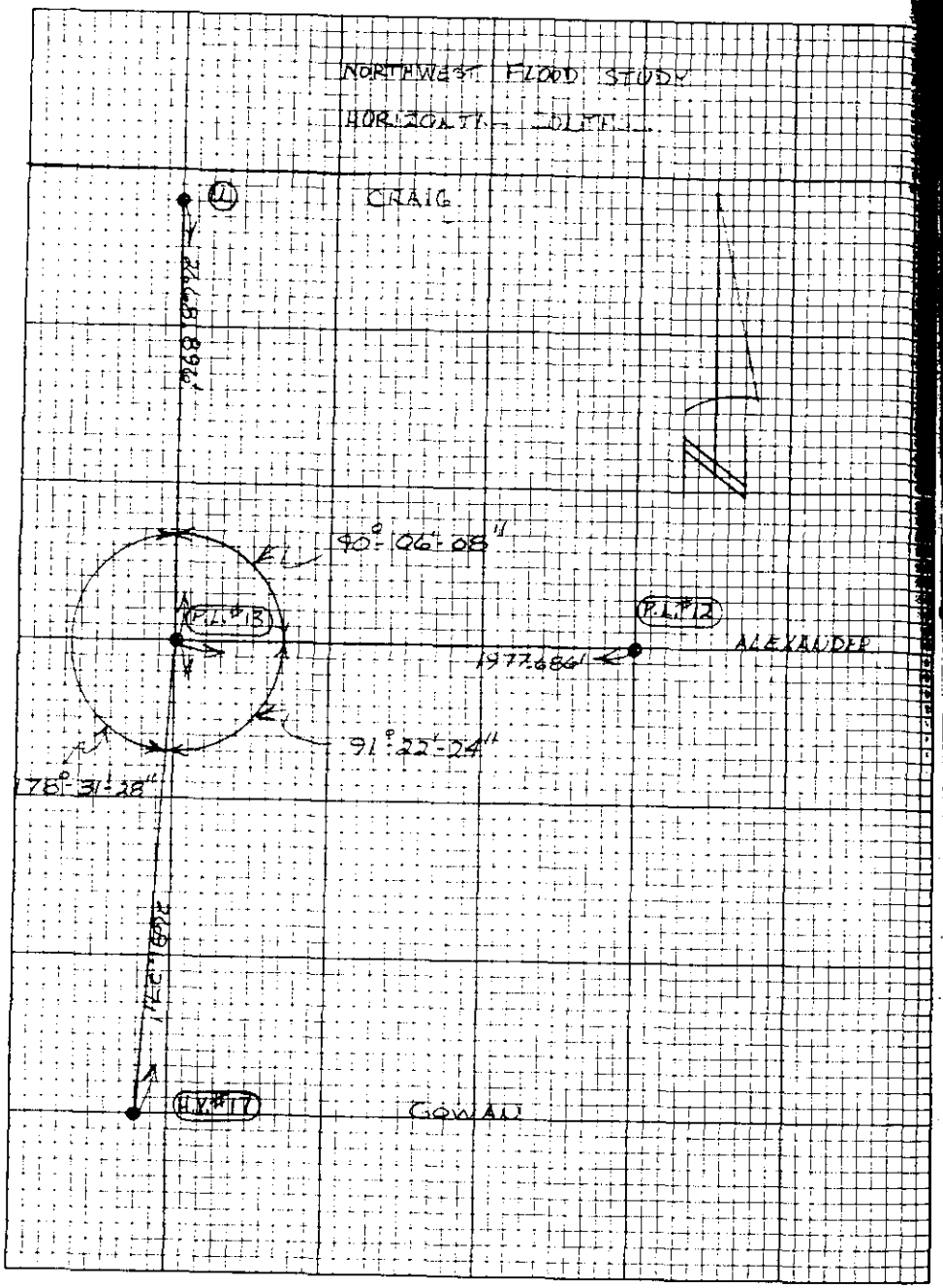
T DESC. PG. 11 THIS BOOK

U DESC. PG. 47 THIS BOOK

P.I. #13: PROFILE SET P.K. IN CENTERLINE ALEXANDER 500' E WEST OF TENAYA

NORTHWEST FLOOD STUDY

HOR. SCALE 1" = 200'



T-48 PG. 49

C-11-93 BRULAND SOMMA

PT #	HORZ. ANGLE	DISTANCE	ZENITH ∠	DESCRIPTION
	AT P.I.#13 B.S. U			H.I. P.I.#13 - 5.59
"	00°-00'-00"			H.P. - U - 5.20
				H.P. - P.I.#12 - 5.22
P.I.#12 D	90°-06'-00"	1977.686'	89°-37'-48"	H.P. - H.V.#17 - 5.46
2)	180°-12'-16"	+12.772'	V.D.	
4)	0°-24'-28"	1977.727'	S.D.	
M)	90°-06'-07"			
AM)	90°-06'-08"			
	B.S. P.I.#12	ANGLE TO	H.V.#17	
H.V.#17 D	91°-22'-19"	2691.271'	89°-58'-18"	
2)	180°-44'-37"	+1.331'	V.D.	
4)	0°-29'-32"	2691.271'	S.D.	
M)	91°-22'-23"			
AM)	91°-22'-24"			
	B.S. H.V.#17	ANGLE RT TO	U	
U 1)	178°-31'-24"	2668.896'	89°-57'-34"	
2)	357°-02'-53"	+1.889'	V.D.	
4)	354°-05'-50"	2668.894'	S.D.	
M)	178°-31'-26"			
AM)	178°-31'-28"			

U DESC. PG. 47 THIS BOOK

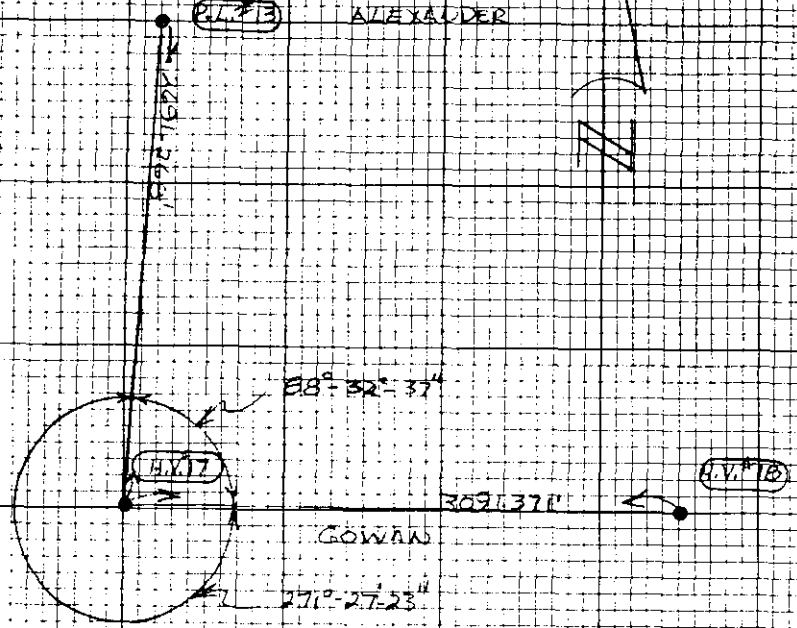
P.I.#13 DESC. PG. 48 THIS BOOK

P.I.#12 SAT. P.K. NAIL CELTELLIE ALEXANDER BRIDGE OVER US-85

H.V.#17 DESC. PG. 6 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



6-11-93 BRUCE SOMMA

PT #	WORK ART.	DISTANCE	ZENITH'S	DESCRIPTION
	TO H.V.#17 FR B.S. P.L.#13			H.I. - H.V.#17 = 5.48
P.L.#18	1) 88°-32'-37"	309L.371'	90°-32'-39"	H.P. - P.L.#13 = 4.31
	2) 177°-05'-10"			H.R. - H.V.#18 = 5.27
	4) 354°-10'-21"	- 29.271'	V.D.	
	M) 88°-32'-35"	3091.510'	S.D.	
	AM) 88°-32'-37"			
	B.S. H.V.#18 & RT TO P.L.#13			
P.L.#13	1) 271°-27'-24"	2691.768'	90°-04'-25"	
	2) 182°-54'-42"			
	4) 5°-45'-24"	+ 3.471'	V.D.	
	M) 271°-27'-21"	2691.270'	S.D.	
	AM) 271°-27'-23"			

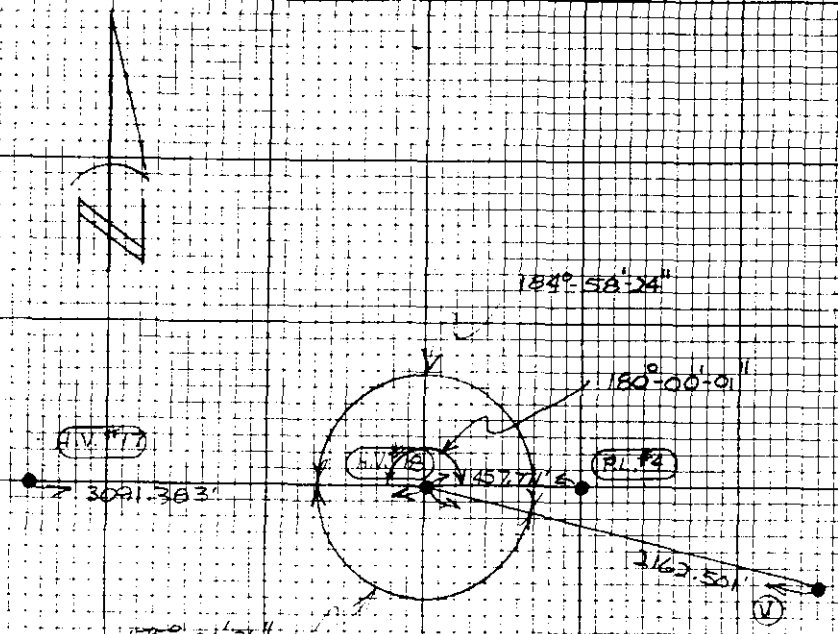
P.L.#13 DESC PG. 48 THIS BOOK

H.V.#17 DESC PG. 6 THIS BOOK

H.V.#18 DESC PG. 6 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG 51

4-11-93 BRULAND SURVEY

AZ "H.V.#18" B.S. "H.V.#17"

AT	00°-00'-00"			
V 1)	184°-58'-59"	2162.501'	90°-20'-06"	
2)	3°-56'-35"			
4)	17°-58'-33"	-12.454'	V.D.	
M)	184°-58'-23"	2162.538'	S.D.	
AM)	184°-58'-24"			

B.S. "V" AZ TO "H.V.#17"

#17 1)	175°-01'-36"	3091.383'	89°-28'-55"
2)	350°-03'-12"	+27.967'	V.D.
4)	340°-02'-18"	3091.509'	S.D.
M)	175°-01'-35"		
AM)	175°-01'-36"		

AZ H.V.#18 B.S. H.V.#17

AT	00°-00'-00"			
P.I. #4 1)	179°-59'-50"	4577.71'	90°-12'-54"	
2)	0°-00'-00"	-2.521'	V.D.	
4)	00°-00'-04"	4577.728'	S.D.	
M)	180°-00'-01"			
AM)				

H.I. - H.V.#18 - 5.53

H.I. - H.V.#17 - 5.19

H.I. - V - 5.18

H.I. - P.I.#4 - 5.32

H.V.#17 DES. PG 6 THIS BOOK

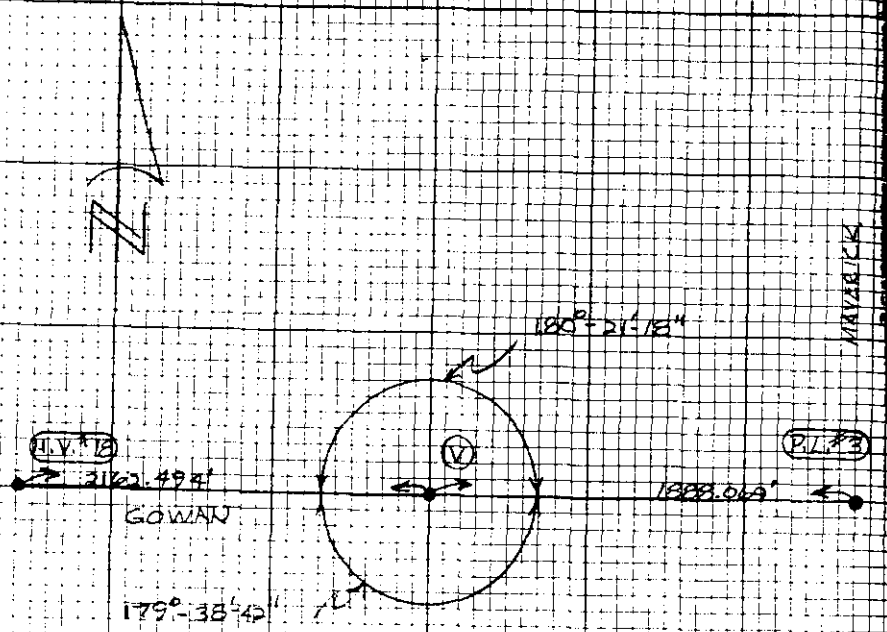
H.V.#18 DESC. PG 6 THIS BOOK

P.I. #4 SET P.K. NAIL CENTERLINE COLGATE 100' EAST OF RAILING

V SET 60D SPIKE IN DIRT SOUTH SIDE COLGATE 500' EAST OF SHERMCREST

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



G.L.O. 0001

G.L.O. BRG. BROLAND SOMMA

TIE V BS H.V.#18
F.I.B. 000°00'-00"

F.I.B. 1) 180°-21'-16" 1888.069' 90°-19'-55"
2) 0°-42'-29" -10.948' V.D.
4) 1°-25'-10" 1888.100' S.D.
M) 180°-21'-18"
AM) 180°-21'-18"

B.S. P.L.#3 & R.T. TO H.V.#18

F.I.B. 1) 179°-38'-39" 2162.494' 89°-41'-32"
2) 359°-17'-22" +11.616' V.D.
4) 358°-34'-48" 2160.526' S.D.
M) 179°-38'-42"
AM) 179°-38'-42"

H.I. - (V) = 5.44'
H.P. - (H.V.18) = 5.25'
H.P. - P.L.#3 = 5.29'

H.V.#18 DESC. PG 6 THIS BOOK

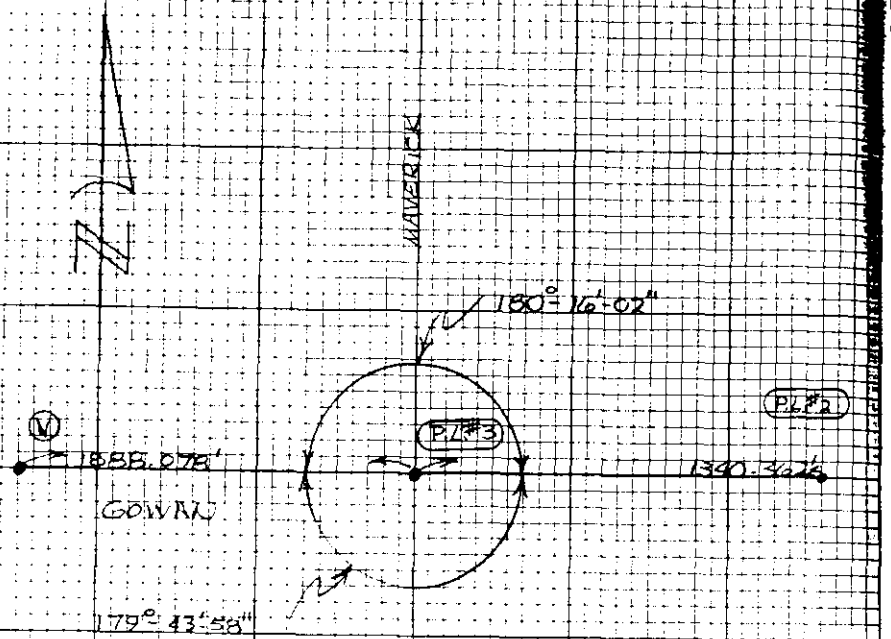
V DESC. PG 51 THIS BOOK

P.L.#3 P.I. NAIL & GOWAN & MAVERICK FOR PROFILE LINE

T-48 PG 53

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



6-11-93 BRULAND SOMMA

H.I. PI.#3 = 5.55

H.I. V = 5.16

H.I. PI.#2 = 5.11

1℄ PI.#3 BS V

00°-00'-00"

PI.#2	1) 180°-16'-02"	1340.362'	50°-29'-12"	
	2) 0°-32'-08"	+11.405'	V.D.	
	4) 1°-03'-04"	1340.410'	S.D.	
	M) 180°-16'-01"			
	AM) 180°-16'-02"			

BS PI.#2 4 RT TO V

V	1) 179°-43'-58"	1888.078'	89°-41-50"	
	2) 359°-27'-53"	+9.978'	V.D.	
	4) 358°-55'-47"	5888.104'	S.D.	
	M) 179°-43'-57"			
	AM) 179°-43'-58"			

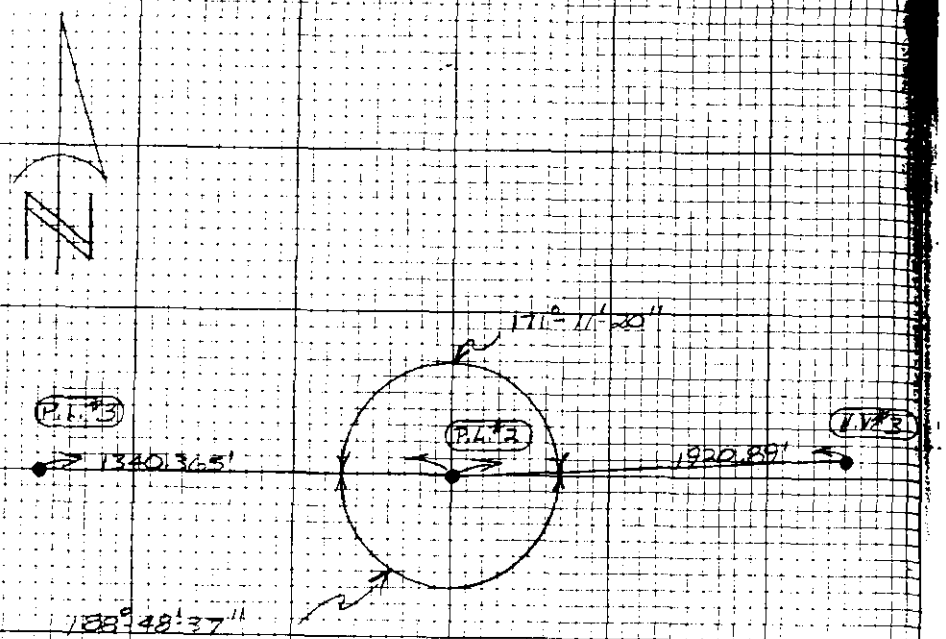
V DESC. PG 51 THIS BOOK

PI.#3 DESC PG 52 THIS BOOK

PI.#2 DESC PG 27 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG 54

C42.0001

6-11-93 BRULAND SOMMA

P.I. #	HORIZ & R	DISTANCE	ZENITH	DESCRIPTION
	TO "P.I. #2" FROM "P.I. #3"			H.I. - P.I. #2 - 5.38
P.I. #3	00°-00'-00"			H.I. - P.I. #3 - 5.27
				H.I. - H.V. #3 - 5.19
H.I. #3	1) 171°-11'-19"	1920.890'	90°-25'-25"	
	2) 339°-22'-43"	-14.202'	V.D.	
	4) 324°-35'-21"			
	M) 171°-11'-20"	1920.942'	S.D.	
	AM)			
	FROM "H.V. #3" & R TO "P.I. #3"			
P.I. #3	1) 188°-48'-37"	1340.345'	89°-32'-27"	
	2) 17°-37'-14"	+ 10.748'	V.D.	
	4) 35°-14'-36"	1340.408'	S.D.	
	M) 188°-48'-39"			
	AM) 188°-48'-40"			

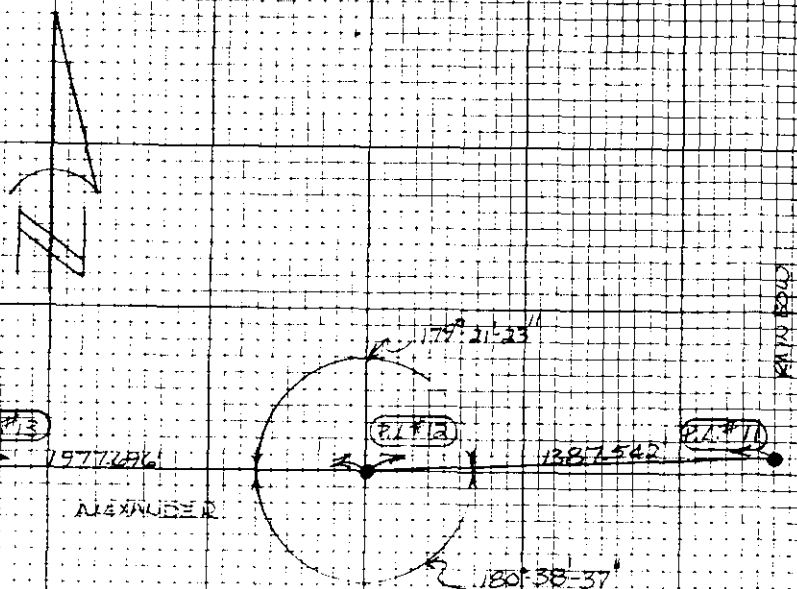
P.I. #3 DESC. PG. 50 THIS BOOK

P.I. #2 DESC. PG. 27 THIS BOOK

H.V. #3 DES. PG. 5 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG 55

6-14-93 BRULAND SOMMA

PT #	HORZ & RT. DISTANCE FROM P.I.	DESCRIPTION
	A@ P.I. #12 B.S. P.I. #13	
P.I. #12	90°00'00"	
P.I. #11	79°21'54" 1387.542' 91°28'00"	
2	358°42'55" -35.573' V.D.	
A	357°25'39" 1387.998' S.D.	
M	179°21'25"	
AM	179°21'23"	
	B.S. P.I. #11 & RT. TO P.I. #13	
P.I. #13	180°38'39" 1977.696 90°23'12"	
2	19°17'09" -13.856 V.D.	
4	2°34'01" 1977.741 S.D.	
A	180°38'37"	
AM	180°38'37"	

N.E. PI #10 = 5.49

H.P. - P.I. #11 = 5.35

H.P. - P.I. #13 = 5.32

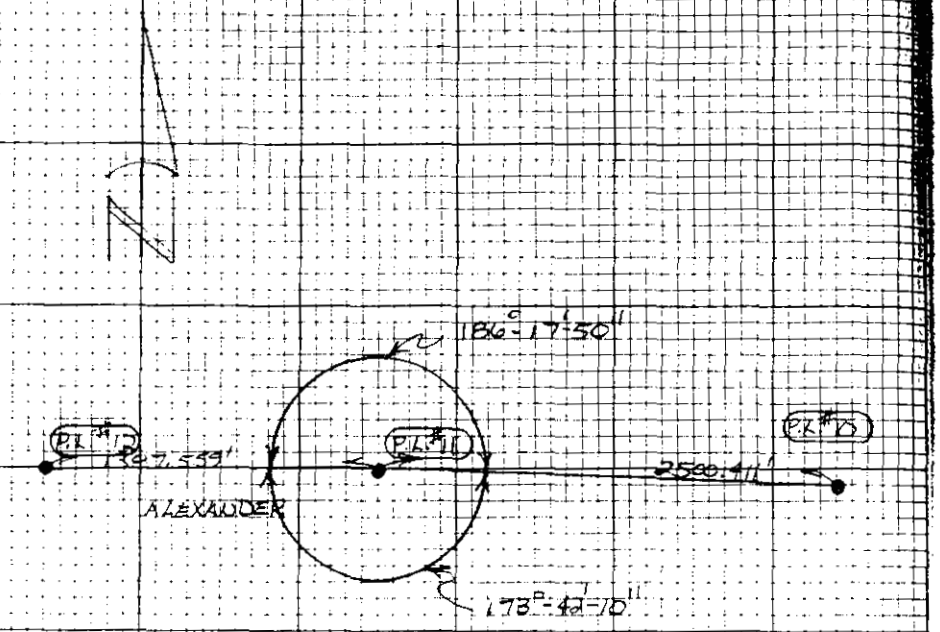
P.I. #13 DESC. PG. 48 THIS BOOK

P.I. #12 DESC. PG. 49 THIS BOOK

P.I. #11 DESC. PG. 19 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG 56

-142,000]

4-4-93 BRULAIP SOMMA

PT. #	HORZ. & RT.	DISTANCE	ZENITHS	DESCRIPTION
	TO P.I. #11 B.S. P.I. #10			I - P.I. #11 - 5.63
T. #10	00°-00'-00"			H.P. - P.I. #12 - 5.23
				H.P. - P.I. #10 - 5.21
P.I. #12	1) 173°-42'-05"	1387.559'	88°-33'-37"	
	2) 347°-24'-21"	+3.880	V.D.	
	4) 334°-48'-37"	1387.997'	S.D.	
	M) 173°-42'-09"			
	AM) 173°-42'-10"			
	B.S. P.I. #12 HRT. 10	P.I. #10		
P.I. #10	1) 186°-17'-57"	2500.411'	90°-29'-53"	
	2) 10°-35'-47"	+21.772'	V.D.	
	4) 26°-11'-21"	2500.505'	S.D.	
	M) 186°-17'-50"			
	AM) 186°-17'-50"			

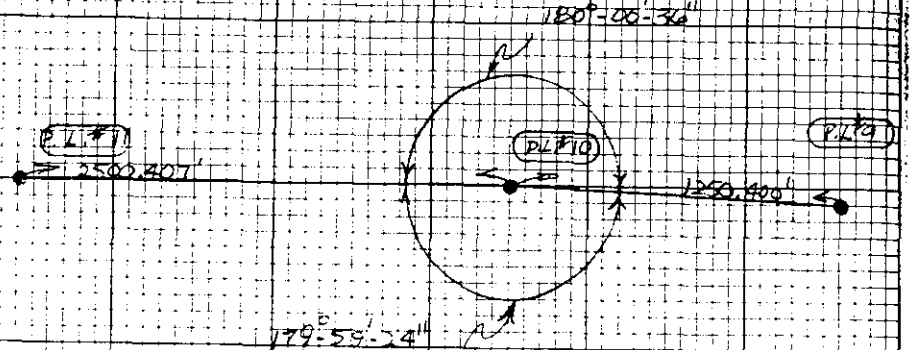
P.I. #12 DESC. PG. 49 THIS BOOK

P.I. #11 DESC. PG. 19 THIS BOOK

P.I. #10 DESC. PG. 18 THIS BOOK

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG 57

6-14-93 BRUNNER SDM M.A.

PT #	HOR'Z BRG	DISTANCE	ZENITH	DESCRIPTION
	TO P.I. #10 FROM B.S. P.I. #11			A.I. - P.I. #10 - 5.48
P.I. #11	00°-00'-00"			H.I. - P.I. #11 - 5.36
				H.I. P.I. #9 5.29
P.I. #9	1) 180°-00'-31"	1250.400'	90°-33'-34"	
	2) 0°-01'-04"	-12.209'	V.D.	
	4) 0°-02'-22"	1250.400'	S.D.	
	M) 180°-00'-35"			
	AM) 180°-00'-36"			
	B.S. P.I. #9 + BRG. TO P.I. #11			
P.I. #11	1) 179°-59'-21"	2500.407'	89°-31'-46"	
	2) 359°-58'-49"	+20.48'		
	4) 359°-57'-32"	2500.492'		
	M) 179°-59'-23"			
	AM) 179°-59'-24"			

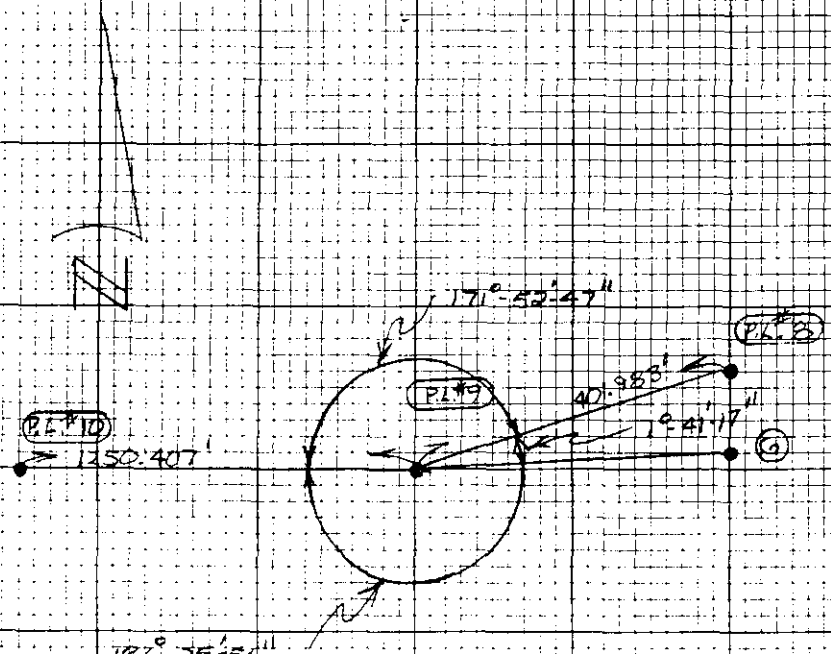
P.I. #11 DES. PG. 18 THIS BOOK

P.I. #10 DESC. PG. 18 THIS BOOK

P.I. #9 DESC. PG. 18 THIS BOOK

NORTH WEST FLOOD STUDY

HORIZONTAL CONTROL



T-48 PG. 58

2143.000

U-14-93 BRUNING SONATA

PT.#	HORZ. ART.	DISTANCE	ZENITH'S	DESCRIPTION
	AT @ "PT.#9" B.S "PT.#10"			HI - PT.#9 = 5.51
PT.#10	00°-00'-00"			H.P - PT.#10 = 5.21
PT.#8	1) 171°-52'-47"	401.983'	90°-34'-26"	H.P - PT.#8 = 5.32
	2) 343°-45'-35"			H.P - G = 5.03
	3) 327°-38'-03"	-2.450'	V.D.	
	M) 171°-52'-46"	401.990'	S.D.	
	AM) 171°-52'-47"			
	B.S "PT.#8" ART TO "G"			
	1) 1°-41'-15"	1182.727'	90°-29'-22"	
	2) 3°-22'-35"	-3.967'	V.D.	
	3) 6°-45'-08"	1182.733'	S.D.	
	M) 1°-41'-17"			
	AM) 1°-41'-17"			
	B.S "G" ART TO "PT.#10"			
PT.#10	1) 186°-25'-53"	1250.407'	89°-28'-07"	
	2) 12°-51'-50"	11.603'	V.D.	
	3) 25°-43'-45"	1250.461'	S.D.	
	M) 186°-25'-56"			
	AM) 186°-25'-56"			

PT.#9 DESC. PG. 18 THIS BOOK

PT.#8 DESC. PG. 18 THIS BOOK

G DESC. PG. 28 THIS BOOK

T-48 P659

NORTHWEST FLOOD STUDY

HORIZONTAL CONTROL

LEVEL CIRCUIT #10

STA	+	HT	−	ELEV.
BM				2317.656
K	4.515	2322.171		
TP 1			5.23	2316.941
K	5.095	2322.036		
TP 2			4.66	2317.376
K	4.965	2322.341		
TP 3			5.35	2316.991
K	4.19	2321.181		
TP 4			5.05	2316.131
K	4.88	2321.011		
TP 5			4.03	2316.981
K	5.01	2321.991		
TP 6			4.985	2317.006
K	4.63	2321.636		
TP 7			3.99	2317.646
BM				2269.761
K	0.97	2270.731		
TP 1			13.19	2257.541
K	13.117	2270.711		
TP 2			0.95	2269.761

62.0001

6-14-93 BRULAND SOMMA

TP3 DESCRIPTION PG 13 THIS BOOK (CLV ILV 2934 5EG)

TP1 ED A/C

TP2 ED A/C

CLV ILV 103NE EG RIVET & PLATE SW BOX OF RAILROAD & RED CORCH

H.V.# 8 DESC. PG# 5 THIS BOOK

TP# 3

BK ED A/C

SAME AS BEGINNING

TP2 PG 18 THIS BOOK CLV 7000 2525 DESC PG# 3 THIS BOOK

H.V.# 5 PG. 5 THIS BOOK

SAME AS BEGINNING

NORTHWEST FIXED STUDY

KEWEEN CIRCUIT #111

STA	#	HZ	=	ELEV.	
BM				2252.509	
∡	4.78	2257.289			
TP1			4.93	2252.369	
∡	4.53	2256.889			
TP2			5.79	2251.099	2251.095
∡	5.35	2256.449			
TP3			5.425	2251.024	
∡	3.165	2254.189			
TP4			7.40	2246.789	
∡	1.335	2248.124			
TP5			7.185	2240.939	
∡	4.185	2245.324			
TP6			6.34	2238.984	2238.827
∡	5.23	2244.214			
TP7			4.63	2239.584	
∡	10.12	2249.604			
SP			0.24	2249.364	
TP8			0.51	2249.044	
∡	7.925	2254.969			
TP9			2.87	2254.099	
∡	7.135	2261.449			
TP10			1.51	2259.939	
∡	5.89	2265.829			

(illegible) 26.62

6-15-93 BRIDLAND SUMMIT

BM #3 DESC. PG 5 THIS BOOK

PK TOP ISLAND CURB

CAV. 7600 - 12516 DESC PG 3 THIS BOOK

PK IN INVSE & CURB ISLAND

PK TOP ISLAND CURB

CAV. 7600 - 12556 DESC PG 5 THIS BOOK

PK ES A/C

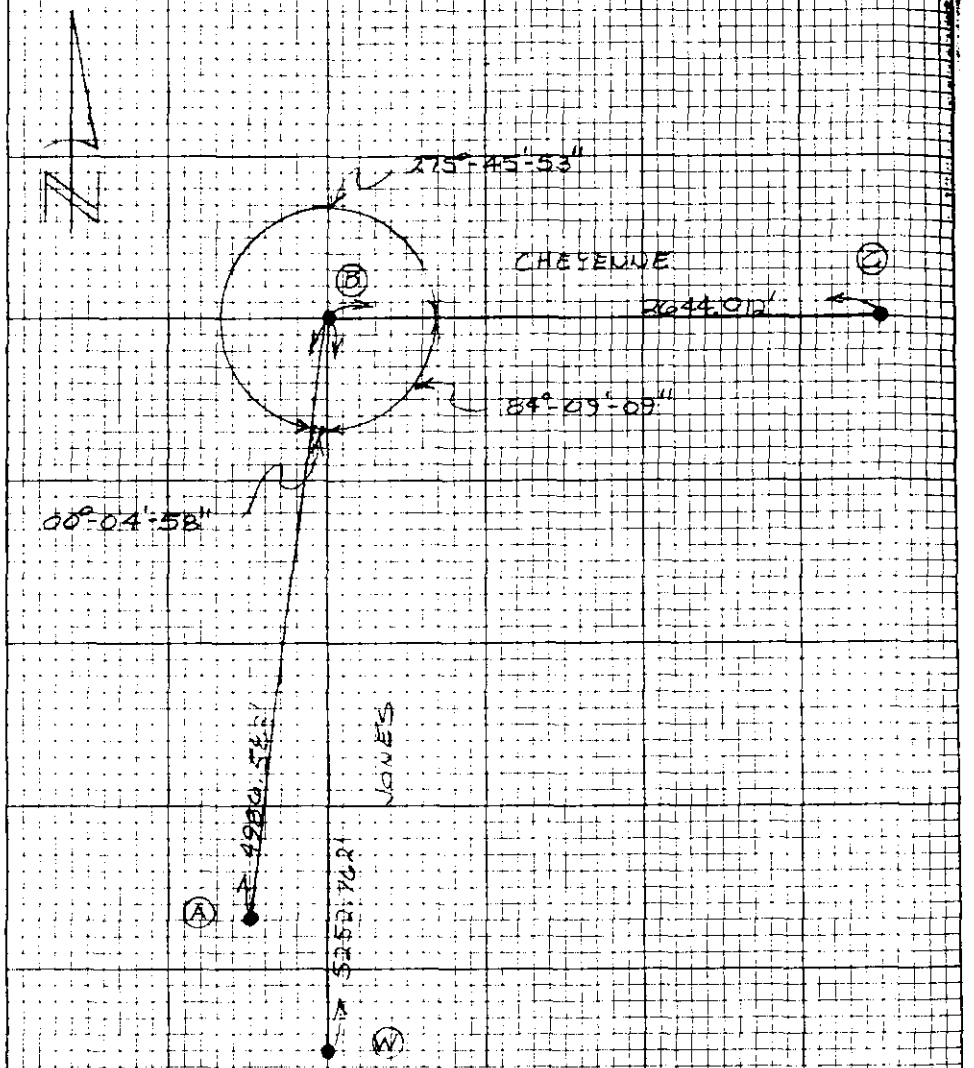
TOP WELL MON. PT #C DESC PG 32 THIS BK

B/C IN WELL MON PT #C

PK @ ISLAND

BM #2 DESC PG 5 THIS BOOK

NORTHWEST FLOOD STUDY



2149.0001

T-48 PG 61

2-16-93 BRUCE SUMMER

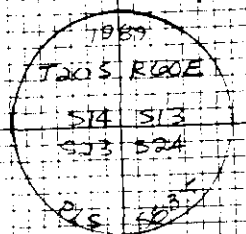
PT #	HORZ & DT	DISTANCE	ZENITH ∠	DESCRIPTION
	TO "B"		B.S. "A"	H.I. = B = 5.84
	00°-00'-00"			H.P. A 4.78
	275°-45'-49"	3684.015'	90°-24'-00"	H.P. C 5.83
D	191°-31'-34"	-18.446	V.D.	H.P. W 5.57
1	23°-03'-23"	2644.074'	S.D.	
M	275°-45'-50"			
AM	275°-45'-53"			
	B.S. "C"	& RT	TO "W"	
W	84°-09'-06"	5252.762'	90°-07'-25"	
2	168°-18'-14"	-10.852'	V.D.	
4	11°-12'-02"	5252.773'	S.D.	
M	84°-09'-06"			
AM	84°-09'-09"			
	B.S. "W"	& RT	TO "A"	
A	00°-04'-55"	4284.83'	90°-07'-25"	
D	00°-0'-53"	HI0.807'	V.D.	
2	00°-19'-40"	4284.534'	S.D.	
M	00°-04'-55"			
AM	00°-04'-58"			

A DESC. PG. 21 THIS BOOK

B DESC. PG. 21 THIS BOOK

C DESC. PG. 22 THIS BOOK

W. FND B/C IN WELL ANGLE IS 0.35 FROM E/S



NORTHWEST FLOOD STUDY

LEVEL CIRCUIT #III

STA	+	HI	−	ELEV
AI		2265.809		
TP 11			5.46	2260.349
℄	3.07	2263.429		
TP 12			6.98	2256.959
℄	4.10	2261.059		
TP 13			4.72	2256.339
℄	4.14	2260.479		
TP 14			6.80	2256.679
℄	5.84	2261.939		
TP 15			5.30	2256.639
℄	5.58	2262.219		
TP 16			6.245	2255.974

CONTINUE FROM PAGE 60

149.0001

6-17-93 BRULATE SOLANA

BK. ED A/C

P.I. ED A/C

P.R. ED A/C

P.I. ED A/C

P.R. ED A/C

TP #14 LEVEL CIRCUIT # 9 Pg. 9 BK 7-A

NORTHWEST FLOOD STUDY
LEVEL CIRCUIT #II

BM				2251.034
℄	9.28	2251.304		
TP 1			6.07	2245.234
℄	4.215	2249.449		
TP 2			7.90	2241.549
℄	7.84	2249.389		
TP 3			4.16	2245.229
℄	6.08	2251.309		
TP 4			9.28	2251.029
BM				2309.719
℄	7.81	2317.529		
TP 1			9.22	2307.809
℄	9.23	2317.039		
TP 2			7.32	2309.719

6-17-93 BRUCANDO SOMMA

TP 3 PG 60 THIS BOOK

P.I. ED A/C

H.W.# II DESC PG 5 THIS BOOK

P.I. ED A/C

SAME AS BEGINNING

TP #27 LEVEL CIRCUIT #9 PG #3 T-41

MIDDLE OF NORTH SIDE 75 x 75 DRAIN INLET 100' WEST OF US-95 & 75± NORTH OF EDWARD RD.

SAME AS BEGINNING

NORTHEAST FLOOD STUDY

STA	+	HI	−	ELEV.
BM				2316.926
+	1.03	2318.956		
TP 1			5.80	2313.156
+	5.78	2318.936		
#2			2.01	2316.926

142.000

T-48 PG 64

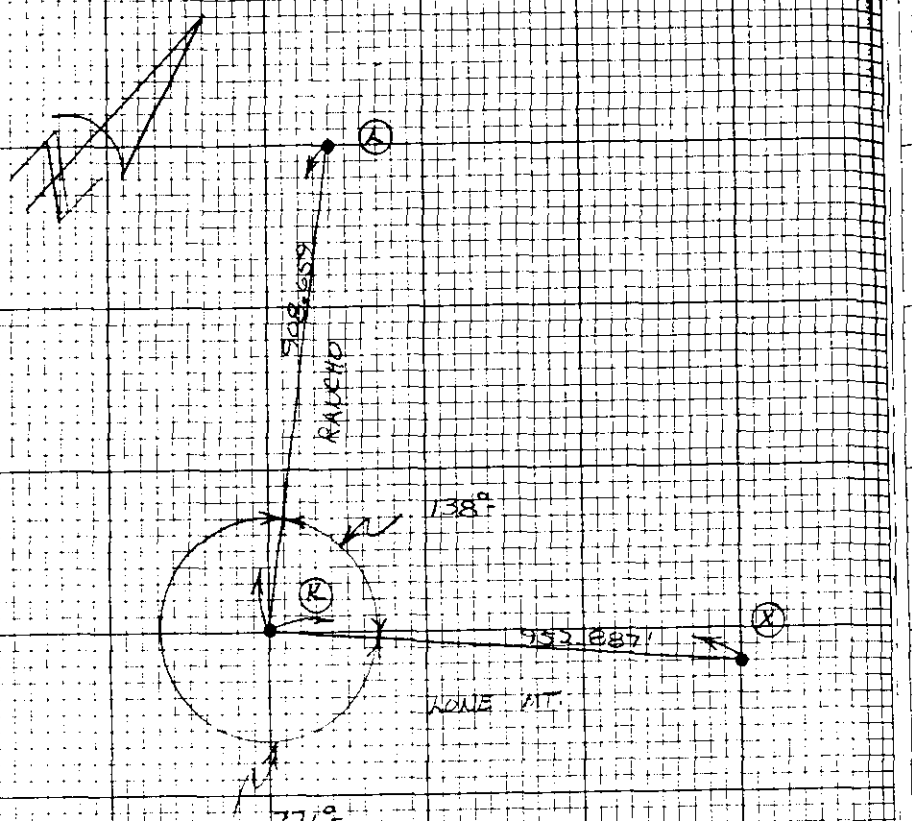
6-17-93 BRULATO SUMMA

TP 4 AERIAL CIRCUIT #5 PG #13 THIS BOOK

P.I. # 14 DESC. PG 36 THIS BOOK

SAME AS BEGINNING

NORTHWEST FLOOD STUDY



AR.civil

6-18-95 BRUNNS GATES

	"L"	"K"	B.S. "L"	
L		1@ 00°00'00"		
X	1)	138°12'25"	552.887'	90°27'10"
	2)	276°24'43"		
	4)	192°49'35"	-7.516'	V.D.
	M)	138°12'25"	552.916'	S.D.
	AM)	138°12'25"		

	B.S. "X"		4 RT. TO "X"	
X	1)	231°47'27"	308.659'	89°49'37"
	2)	83°35'10"		
	4)	167°10'12"	+2.786'	V.D.
	M)	201°47'33"	308.663'	S.D.
	AM)	201°47'33"		

H.I. - (K) =
H.P. - (L) = 4.746
H.P. - (X) = 4.958

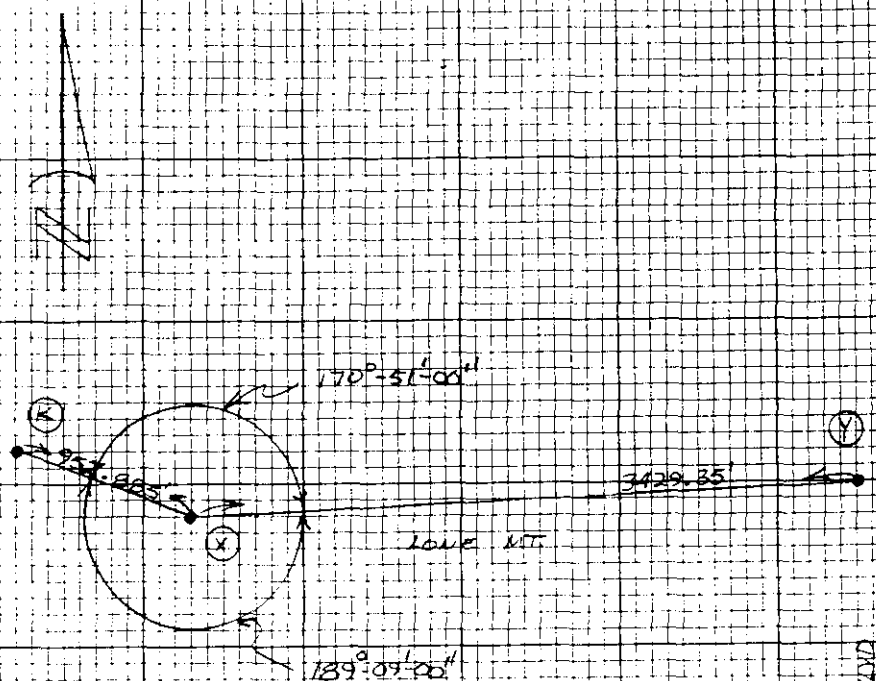
L DES PG 35 THIS BOOK

K DESC PG 34 THIS BOOK

X SET 60-D SPIKE SCRIBE H. SIDE LONE PT. AT EAST END OF FEED STORE

T-48 PG 66

NORTH WEST FLOOD STUDY



6-18-93 BRUCE D GATES

@ "X"	B.S. "K"		
K	60°-00'-00"		
Y 1)	170°-50'-36"	3429.350'	90°-37'-42"
2)	341°-41'-53"		
4)	323°-23'-52"	+ 37.56'	V.D.
M)	170°-50'-58"	3429.556'	S.D.
AM)	170°-51'-00"		

	B.S. "Y"	& RT. TO "K"	
K' 1)	189°-08'-57"	952.885'	69°-34'-10"
2)	18°-17'-54"	+ 2.160'	V.D.
4)	36°-35'-53"	953.912'	S.D.
M)	189°-08'-58"		
AM)	189°-09'-00"		

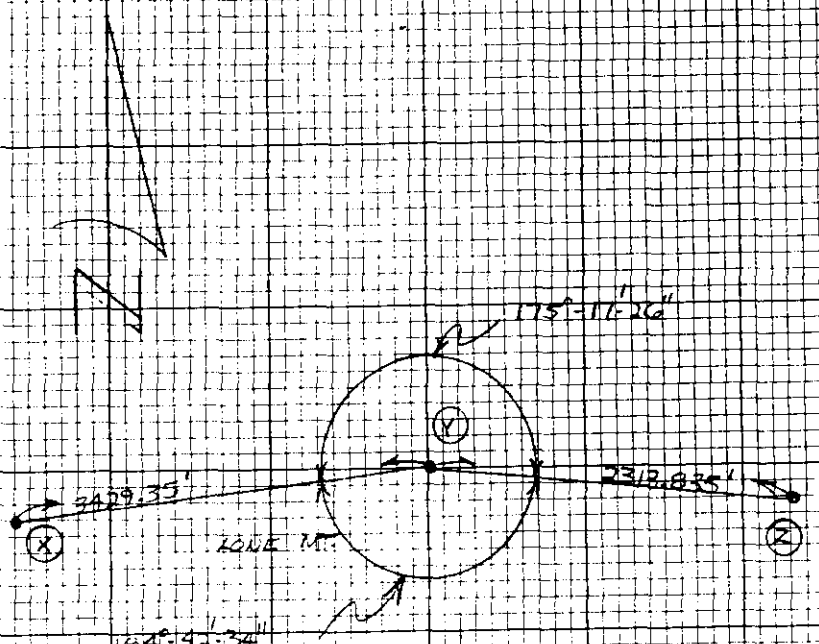
A.I. (X) = 5.18
H.I. (K) = 5.11
H.I. (X) = 4.97

K DESC. PG. 34 THIS BOOK

X DESC PG. 65 THIS BOOK

Y SET 60D SPIKE DOWN SIDE ROAD AT JONES BLVD

NORTHWEST FLOOD STUDY



JONES BAND

T-48 PG. 67

142.0001

6-18-93 BRIDLE GATES

AT "Y" B.S. "X"

X Ck. 0°-00'-00"

Z	1)	175°-11'-25"	2313.835'	90°-44'-09"
	2)	350°-34'-46"		
	3)	341°-09'-34"	-29.706'	V.D.
	M)	175°-17'-24"	2119.026'	S.D.
	AM)	175°-17'-26"		

HI - (Y) 5.23
H.P. - (X) 4.89
H.P. - (Z) 5.00

B.S. "Z" & RT. TO "X"

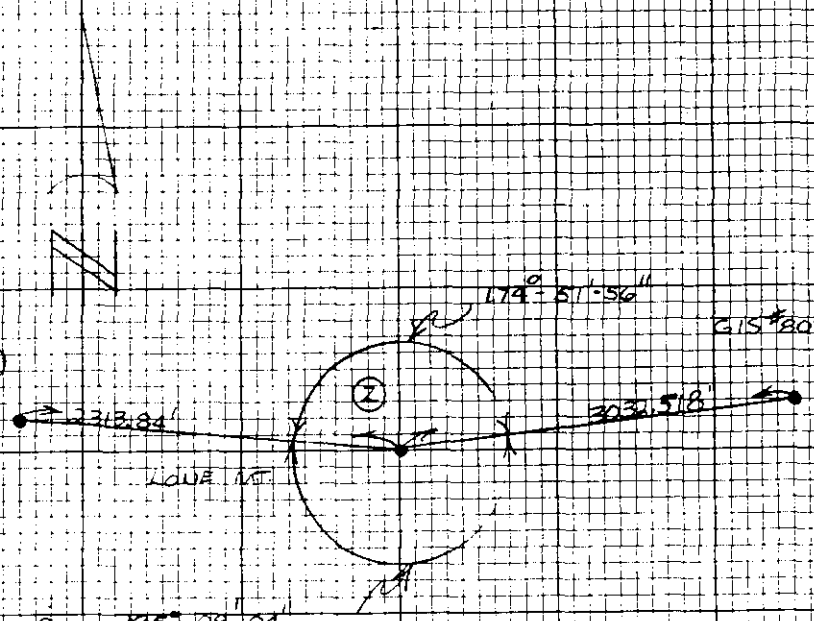
X	1)	184°-42'-33"	3409.350'	89°-23'-48"
	2)	9°-25'-01"	336.113'	V.D.
	3)	18°-50'-10"	3429.540'	S.D.
	M)	184°-42'-33"		
	AM)	184°-42'-34"		

X DES. PG. 65 THIS BOOK

Y DESC. PG. 66 THIS BOOK

Z END B/C R.M. S.W. B/C LOMA M. & CAMINO DEL ORO

NORTHWEST FLOOD STUDY



42.0001

6-18-93 BRUCANN GATES

	TO "X" 00°-00'-00"	B.S. "Y"	
"Y"			
GIS #809	1) 174°-51'-58"	3032.518'	90°-42'-58"
	2) 349°-43'-52"	- 37.860'	V.D.
	4) 329°-27'-45"	3032.754'	S.D.
	M) 174°-51'-56"		
	AM) 174°-51'-56"		

B.S. "GIS #809" & RT. TO "Y"

Y	1) 185°-08'-09"	2313.840'	89°-17'-34"
	2) 10°-16'-11"	+ 28.551'	V.D.
	4) 20°-32'-20"	2314.076'	S.D.
	M) 185°-08'-05"		
	AM) 185°-08'-04"		

A.I. = (Z) = 5.26

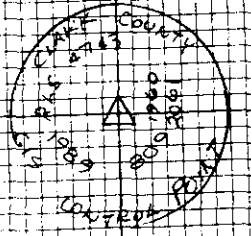
A.I.P. = (Y) = 4.99

A.I.P. = (GIS #809) = 4.74

Y DESC. PG 666 THIS BOOK

Z DESC. PG. 667 THIS BOOK

GIS #809 FND 2" B/C IN NW BOX AT LOUE MT & DECATUR BLVD.



NORTHWEST FLOOD STUDY

CHECK PROFILE LINES

STARTING AT H.V.#17 DESC. PG. 6 THIS BOOK

H.V.#17 IS STATION 0+00 EAST

BM	2328.584	H.V.#17 (PK#5)			
1+00E	2325.29		20+00E	2306.00	
2+00E	2327.06		21+00E	2305.63	
3+00E	2325.59		22+00E	2305.33	
4+00E	2324.87		23+00E	2305.10	
5+00E	2320.91		24+00E	2304.85	
6+00E	2318.22		25+00E	2304.68	
7+00E	2316.51		26+00E	2304.20	
8+00E	2317.84		27+00E	2303.40	
9+00E	2315.24		28+00E	2302.76	
10+00E	2314.74		29+00E	2301.51	
11+00E	2314.20		30+00E	2300.48	
12+00E	2313.69		30+91.37	2299.88	2299.89 H.V.#18
13+00E	2313.24		32+00E	2299.09	
14+00E	2312.85		33+00E	2298.68	
15+00E	2312.48		34+00E	2298.43	
16+00E	2311.70		35+00E	2297.80	
17+00E	2309.84		35+49.14	2297.49	2297.509 PK.4
18+00E	2311.11				
19+00E	2312.96				

T-48 PG 69

2.0001

7-16-93 BRUCE STRICKLER M. TOMASELLO

STARTING AT P.I.#3 DESC. PG. 52 THIS BOOK

P.I.#3 STATION 0+00 EAST

BM	2277.24				
1+00E	2276.58		19+00E	2260.81	
2+00E	2276.08		20+00E	2259.58	
3+00E	2275.35		21+00E	2258.96	
4+00E	2274.77		22+00E	2258.09	
5+00E	2274.18		23+00E	2257.30	
6+00E	2273.36		24+00E	2256.59	
7+00E	2272.80		25+00E	2255.85	
8+00E	2272.05		26+00E	2255.07	
9+00E	2271.36		27+00E	2254.45	
10+00E	2271.01		28+00E	2253.76	
11+00E	2269.91		29+00E	2253.05	
12+00E	2268.80		30+00E	2252.64	
13+00E	2266.86		31+00E	2252.05	
13+40.36	2266.38	PK#6, 38 P.I.#2	32+00E	2251.74	
14+00E	2264.50	NOTE!	32+37E	2251.23	
15+00E	2264.65	NEW AVG FROM 3PT.	33+00E	2251.44	
16+00E	2263.60	P.I.#2 TO	33+43.5E	2251.55	EP RK RANCHO
17+00E	2262.55	H.V.#3	34+00E	2247.61	
18+00E	2261.54		34+46E	2246.62	TOE

NORTHWEST FLOOD STUDY

CHECK PROFILE LINES

7-19-93 BRYLAND SPRAGUE M. YOUNGBERG

COULTULE PROFILE #PL 2 TO PROFILE #PL 1

BS+E	22 45.45				
4+E	2246.14				
3+E	2245.12				
BB+E	2244.87				
BE+BB	22 45.16	2245.16 PL.# 1			
	STARTING BOOK PL.#13 ON EAST	PROFILE PL #13	DESC. PG. 48 THIS		
BM	2326.65	PL.#13	11+E	2319.50	
1+E	2320.22		12+E	2318.94	
2+E	2325.55		13+E	2318.38	
3+E	2325.05		14+E	2319.15	
A+E	2324.53		15+E	2321.93	
5+E	2324.13		16+E	2326.73	
6+E	2323.18		17+E	2332.92	
7+E	2322.58		18+E	2336.26	
8+E	2321.91		19+E	2338.97	
9+E	2321.16		10+77.7	2339.63	2339.63 PL.#12
10+E	2320.35				

20+E	2339.53				
21+E	2337.92				
22+E	2334.92				
23+E	2328.59				
24+E	2321.40				
25+E	2316.39				
26+E	2311.24				
27+E	2309.27				
28+E	2307.87				
29+E	2307.09				
30+E	2306.13				
31+E	2305.98				
32+E	2306.20				
33+E	2304.54				
B+65.21	2301.27	2304.26 PL.# 11			

NORTHWEST FLOOD STUDY

CHECK PROFILE LINES

BRULAND SPRAGUE M. YOUNGBERG 7-19-93

STARTING PROFILE PT. #10 DESC. PG. 18 THIS BOOK

B.M.	2283.196 (P.I.#10)				
1+E	2282.71		17+E	2268.43	
2+E	2281.96		18+E	2267.86	
3+E	2281.09		19+E	2267.39	
4+E	2280.23		20+E	2267.26	
5+E	2279.05		20+43E	2267.21	2267.23 P.I.#7
6+E	2278.06		21+00	2266.33	
7+E	2277.47		22+E	2266.97	
8+E	2276.80		23+E	2266.10	
9+E	2276.82		24+E	2266.86	
10+E	2273.96		25+E	2269.98	
11+E	2273.00		25+71	2268.97	EOL 1C
12+E	2271.10	2271.37 P.I.#9	26+E	2263.65	
12+50.1	2271.22		27+E	2262.98	
13+E	2270.64		28+E	2262.14	
14+E	2269.60		29+E	2261.74	
15+E	2269.67		30+E	2260.20	
16+E	2269.02		31+E	2259.34	
16+52.5	2268.96	2268.75 P.I.#5	32+E	2258.98	
			33+E	2258.30	
			33+33.5	2257.37	LINE 5 2256.54

42.0001

STARTING AT PROFILE PT. #11 DESC. PG # 11 THIS BOOK

P.I. #11 0+EAST

BM	2331.319'			
1+E	2330.45	20+E	2326.38	
2+E	2329.95	20+31.9	2326.33	+ PT. P.I. #16
3+E	2329.42	21+E	2324.53	2326.256
4+E	2328.91	22+E	2324.91	
5+E	2327.84	23+E	2323.37	
6+E	2327.01	24+E	2322.00	
7+E	2326.77	25+E	2320.73	
8+E	2326.34	26+E	2320.28	
9+E	2325.54	27+E	2320.16	
10+E	2325.57	28+E	2319.81	
11+E	2325.19	29+E	2319.32	
12+E	2324.15	30+E	2317.37	
13+E	2324.29	31+E	2317.07	
14+E	2323.95	32+E	2318.65	
15+E	2324.05	33+E	2318.30	
16+E	2324.53	33+55E	2318.16	5 PT P.I. #15 2318.17
17+E	2324.64	34+E	2317.73	
18+E	2324.80	35+E	2317.16	
19+E	2324.85	36+E	2316.77	

VERIFIED PROFILE LINE 16 7017

P.I. #8 2325.95

7-19-93 BRILAND SPRAGUE M. QUINZANO

NORTHWEST FLOOD STUDY

CHECK PROFILE LINES

STARTING AT PL #17 -0- EAST

37+E	2311654	
38+E	231635	
39+E	2316.51	
40+E	2311793	
41+E	2316.05	
42+E	2315.07	
43+E	2314.07	
43+98.93	2313.15	PL #14 2318.156

NORTH WEST FLOOD STUDY

CHECK PROFILE LINE 1

START ING AT PROFILE LINE POINT #19

ALSO M.P. ID DESC. PG. 5. THIS BOOK.

P.L. #19 IS 0+00 EAST

BM		2370.44		L.L. # 12 TOP OF WELL MON.			
14	E	2367.61		18+44 E	2355.90	M.G. TOP	
15	E	2368.53		18+82 E	2354.40	M.G. TOE	
16	E	2367.68		19+ E	2358.20	M.G. TOP	
17	E	2366.28		19+19.3	2358.40	M.G. TOP	
C	E	2363.28		19+63.4	2355.30		
D	E	2361.11		19+81.8	2356.88	ED A/C	
A	E	2364		20+ E	2355.13		
B	E	2362.97		20+46.8	2357.33	ED A/C	
1	E	2362.55		20+64.3	2353.48	M.G. TOE	
18	E	2361.07		21+ E	2352.87	M.G. TOE	
2	E	2360.21		21+25.4	2356.35	ED A/C	
19	E	2359.07		21+72.7	2355.30	ED A/C	
3	E	2359.50		22+ E	2353.12	M.G. TOE	
4	E	2359.11		22+72.1	2351.98	ED A/C	
15	E	2358.96		23+ E	2351.82		
16	E	2358.11		24+ E	2351.40		
17	E	2357.53	ED M.C. TOP	25+ E	2351.09		
17+87.4		2355.66	M.C. TOE	26+ E	2351.75		
18	E	2355.97	M.C. TOP	27+ E	2353.10	HIGH PT	

C142.0001

2-21-93

BRUNK'D SPRAGUE M. WOOLDRIDGE

18	E	2352.02					
29	E	2350.80					
20	E	2349.54					
434.4		2345.60	P.L. #18 2349.626				

NORTHWEST FLOOD STUDY

ELEVATION OF INTERSECTION

BM				2313.14	
A	4.46	2317.70			
TP 1			3.51	2314.19	
A	5.11	2319.30			
TP 2			2.86	2316.44	
A	2.28	2318.72			
TP 3			4.52	2314.20	
A	3.50	2317.70			
TP 4			4.865	2312.835	2312.85
BM				2299.89	
A	6.43	2306.32			
TP 1			3.92	2302.40	
A	3.74	2306.14			
TP 2			6.23	2299.91	2299.89

0142.0001 T-48 PG 74

9-28-93 BRYLAND ROGERS

13+42 EAST PG 69 THIS BOOK

2 Ø DALECREST & LODGE FND 60D SPIKE W/ WASHER RLS 2050 (PANEL POINT)

14+00 EAST PG 69 THIS BOOK

H.V. #16 DESC PG 6 THIS BOOK

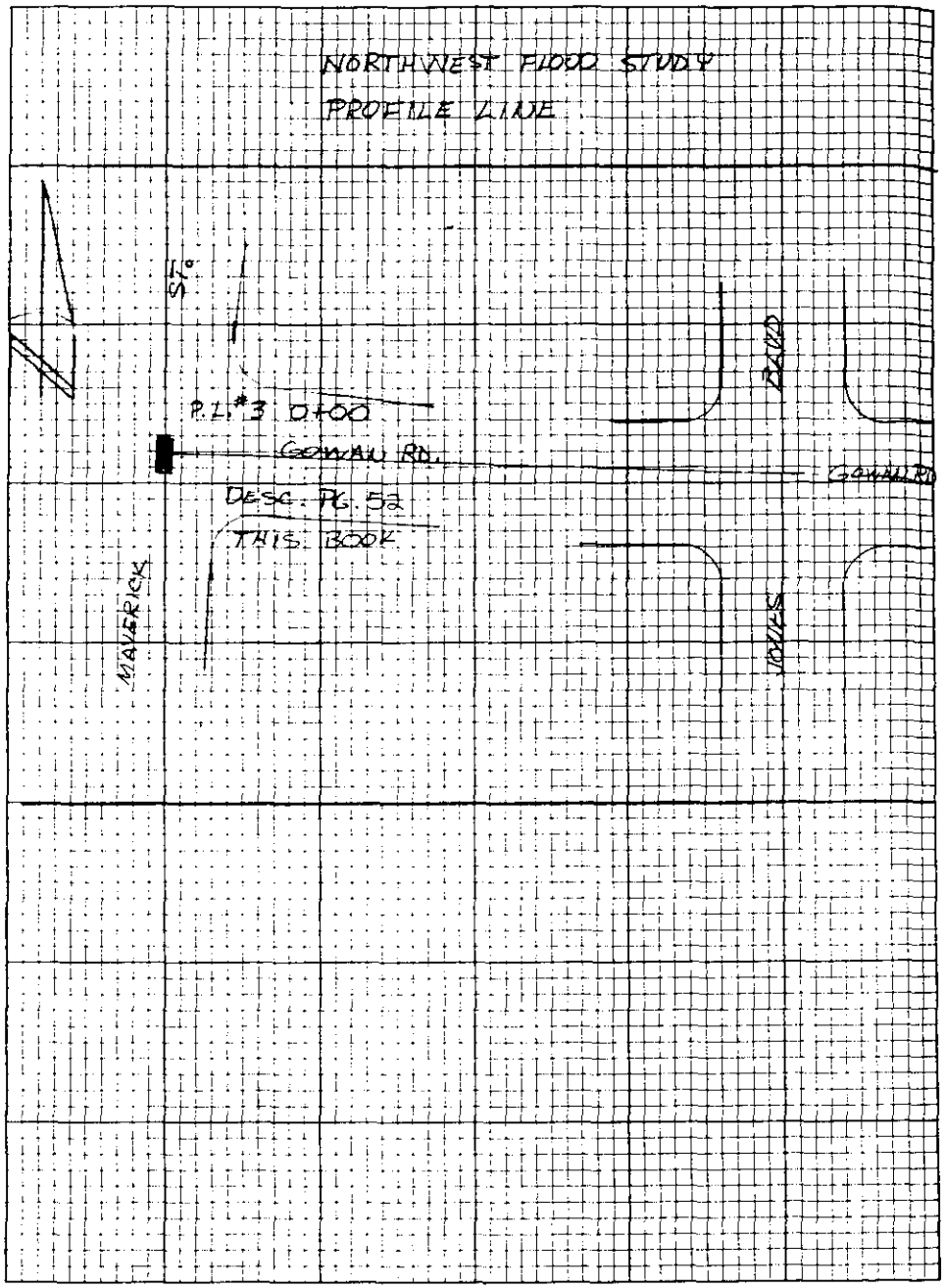
FND 2½" B/C IN CONCRETE RLS 2050

2" WHITE SHELL & ARV MARKUS

SAME AS BEGINNING

NORTHWEST FLOOD STUDY

PROFILE LINE



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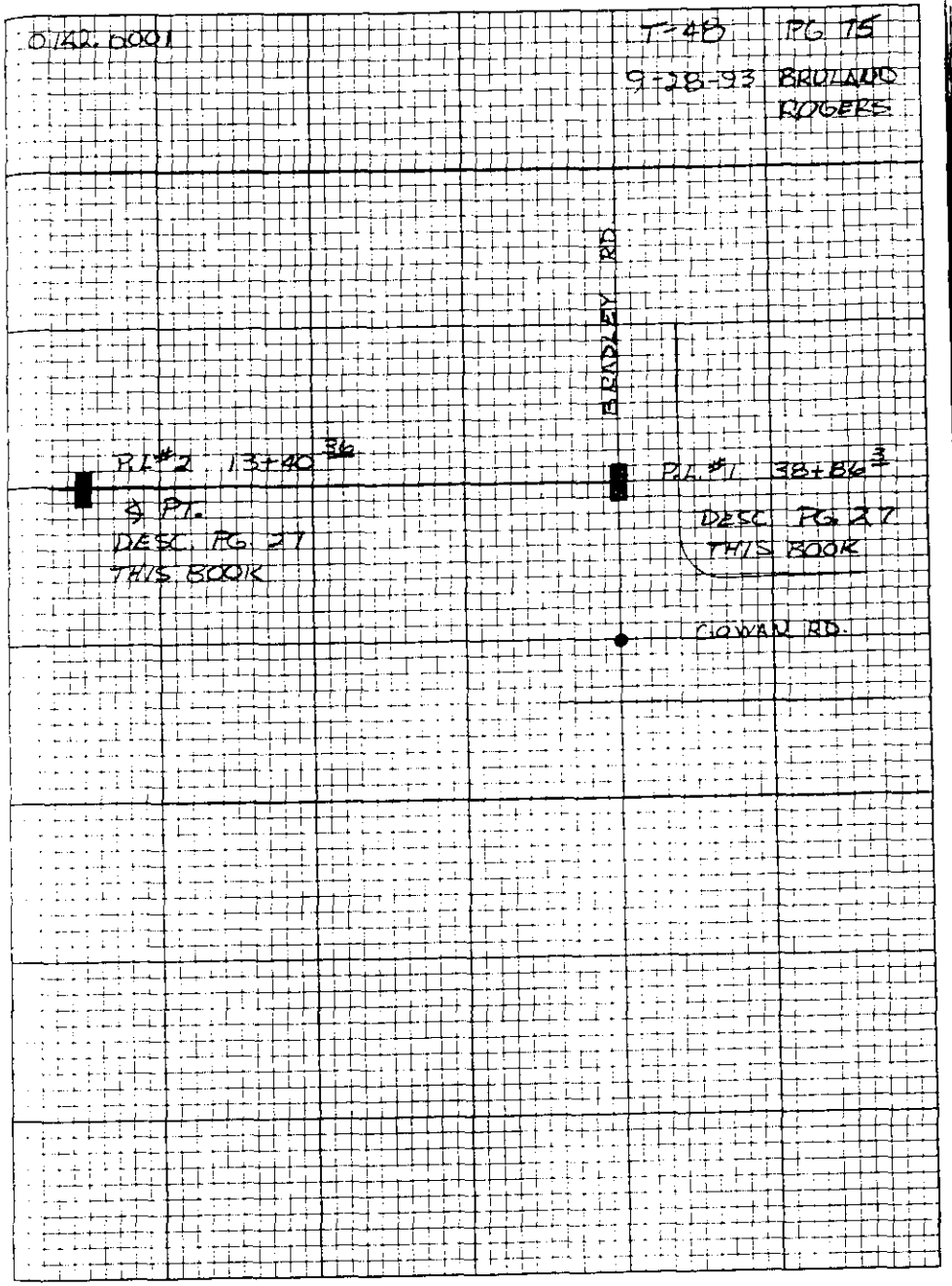
T-48 PG 75

9-28-93 BRUNNO ROGERS



NORTH WEST FLOOD STUDY
PROFILE LINE

TEWAHA WAY

(P.I. #5)
H.V. #17 0+00
DESC. PG. 6
THIS BOOK

US-95

GOWAN RD.

0142.0001

T-48
9-28-93

PG 76
BRUNNER
ROGERS

BLVD.

H.V. #18 30+91.37
DESC. PG. #6
THIS BOOK

P.I. #4 35+49.14
DESC. PG. 51
THIS BOOK

TEV MAELUS

RAILROAD

NORTHWEST FLOOD STUDY
PROFILE LINE

TORREY PINES DR.

ALEXANDER RD.

P.I. #10 0+00
DESC. Pg. 18
THIS BK

Q142.5001

T-48

9-28-93

PG 77
BEUDAN
ROGERS

(P.I. #6)
P.V. #5
33+83.3
DESC. PG.
#5 THIS
BOOK

P.I. #7
20+43.8
DESC. PG. 18
THIS BOOK

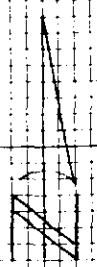
P.I. #8 16+52.9
DESC. PG. 18
THIS BOOK

P.I. #9
12+50.4
DESC. PG. 18
THIS BOOK

MAYA WAY

NORTHWEST FLOOD STUDY

PROFILE LINE



P.L. #13 0+00

ALEXANDER J.D.

DESC. PG. 98
THIS BOOK

TAWAYA WAY

D42.0001

T-48 PG 78

9-28-93 BRUNOLD
ROGERS

I-45

P.L. #12 19+77.2

DESC. PG. 49
THIS BOOK

BLVD

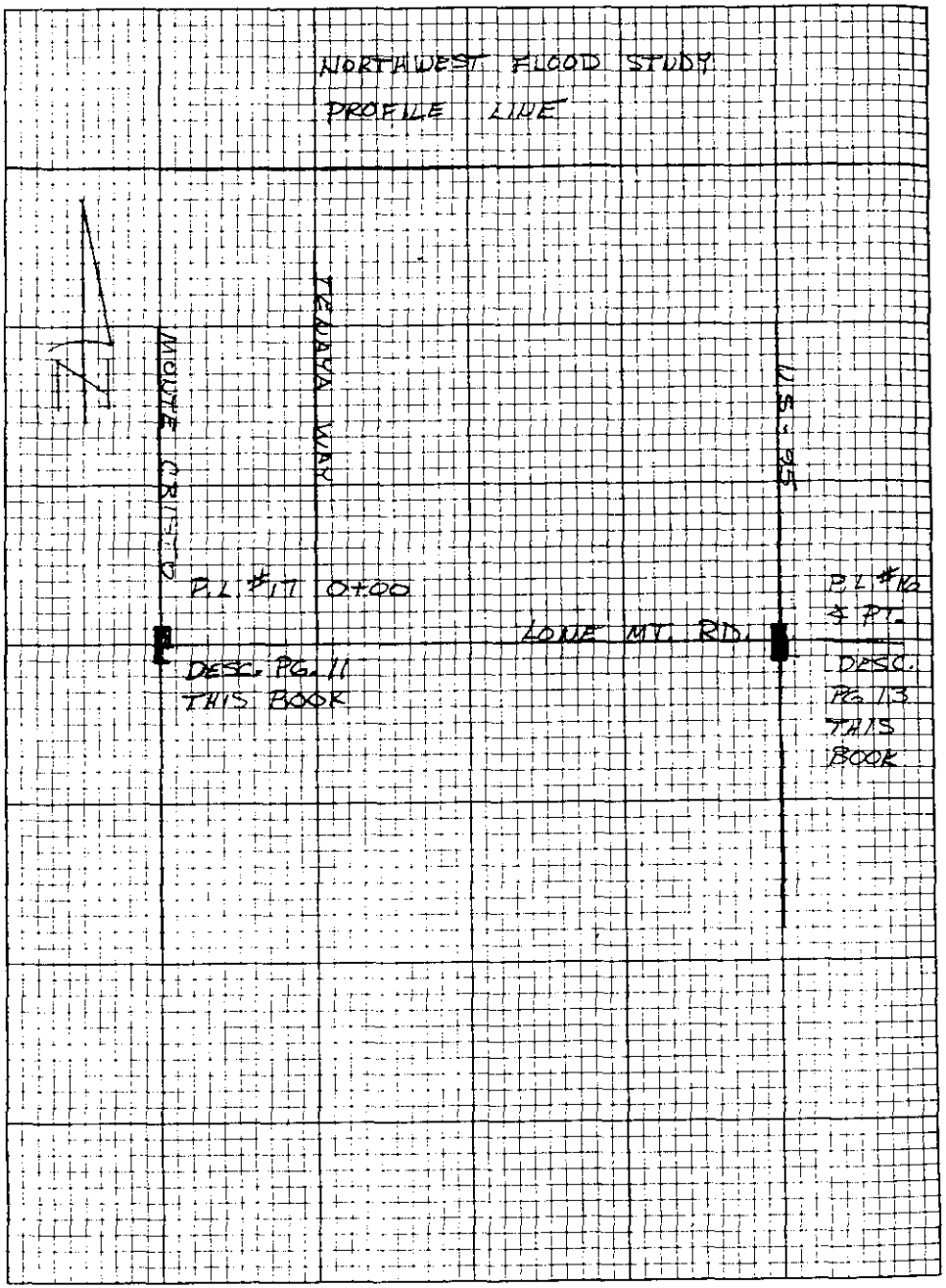
RAINBOW

P.L. #11 33+65.2

DESC. PG. 19
THIS BOOK

NORTHWEST FLOOD STUDY

PROFILE LINE

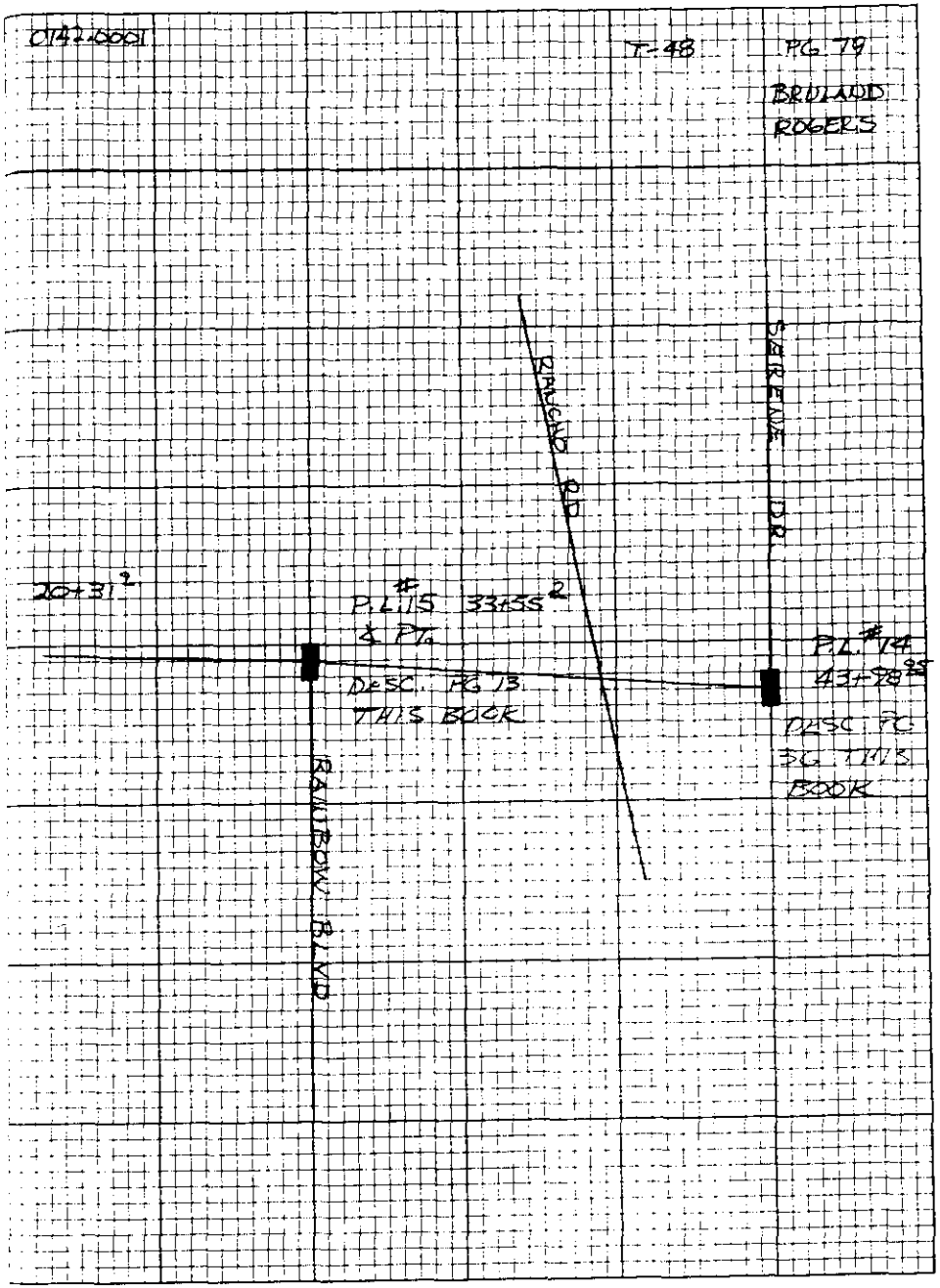


0142.0001

T-48

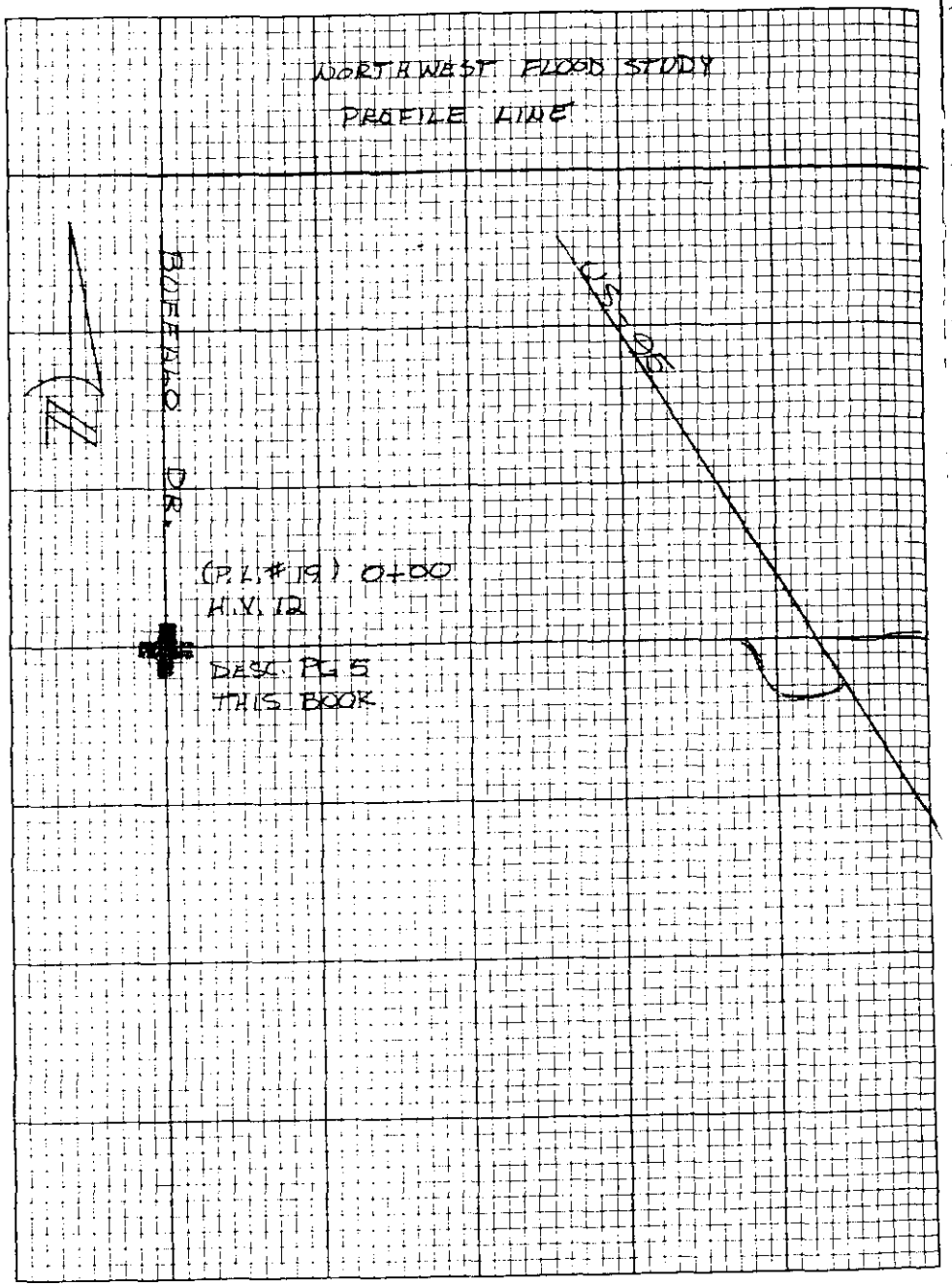
PG. 79

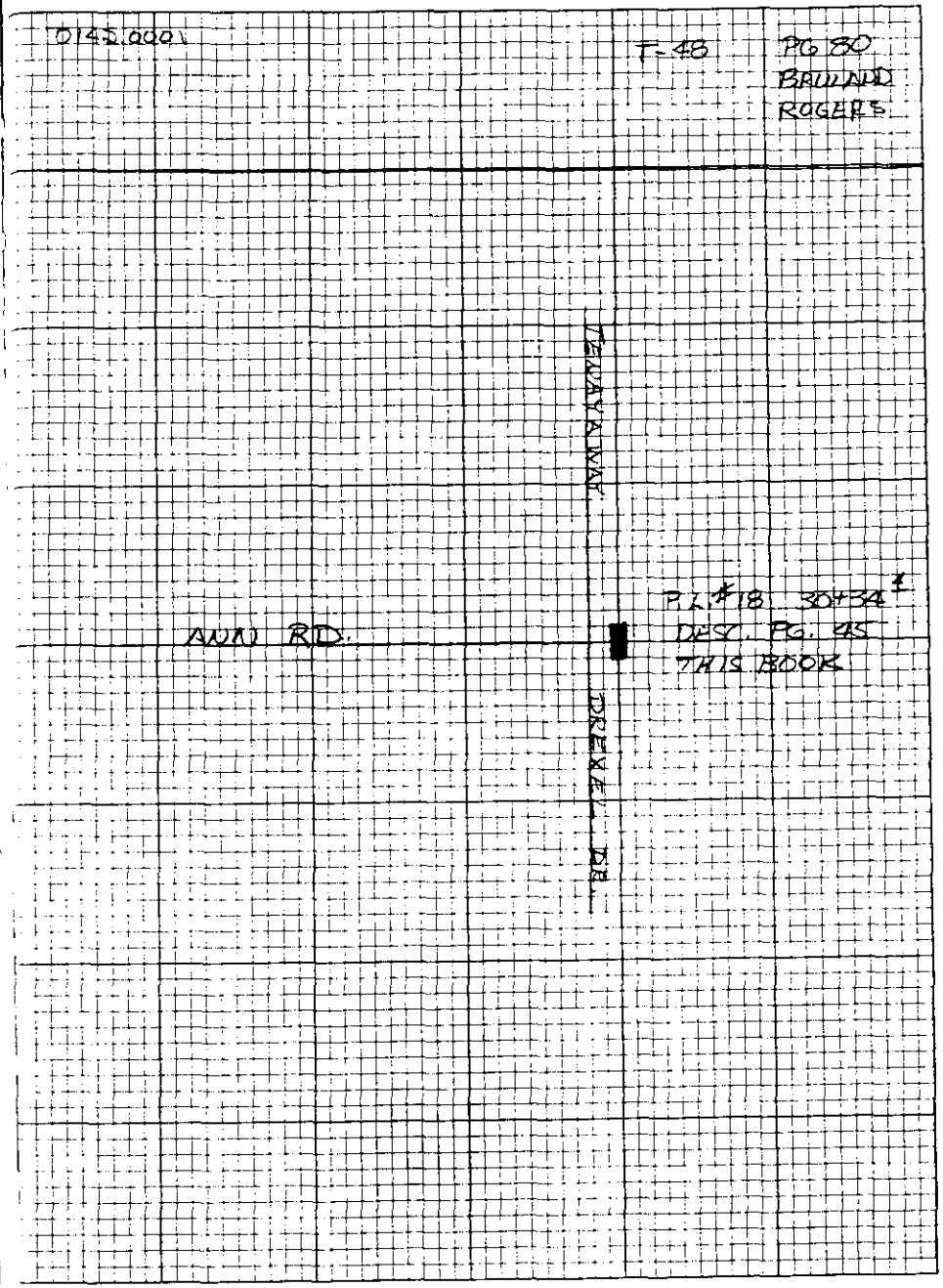
BRILLIOD ROGERS



NORTHWEST FLOOD STUDY

PROFILE LINE





NORTHWEST FLOOD STUDY

STA	—	H+	—	ELEVATION
				2267.23
TP-1	2.43	73.64	0.358	2266.838
	3.710	69.92		
TP-2			0.916	2263.080
	4.049	67.129		
TP-3			0.086	2261.040
	3.988	65.028		
TP-4			5.180	2259.948
	3.641	63.488		
TP-5			0.638	2256.351
	2.489	59.140		
TP-6			4.276	2254.63
	3.030	57.93		
TP-7			1.834	2252.359
	0.337	52.697		
TP-8			0.323	2246.373
	3.268	49.64		
TP-9			1.481	2245.160
	7.003	52.463		
TP-10			5.160	2246.503

LEVEL CIRCUIT #9

L.B.93
S.GATES
S.SANDELIN
0140.000

DESC.

TP-13 SEE T-48 PG 18

SET PK NAIL ± 1 N/O W64 ER RANCHO 8:48
I 35 S/O ALEXANDER

FIVET & PLATE IN TOP OF HEADWALL @ S/E COR RANCHO
JONES BM # 7600 JONES (2263.208)

SET PK NAIL IN W64 ER RANCHO ± 400 S/O
JONES

FIVET & PLATE IN TC W/SIDE RANCHO & CRYSTAL PALACE
SKATE CTR BM # 7600 12 HWY

SET PK NAIL IN SE ER TOWER W/L 95 RANCHO
± 250 N/O DUNCAN DR

4" BRASS DISC & RANCHO ± 250 S/O DUNCAN
NATIONAL GEODETIC SURVEY BM = 3.43 (1.430)

SET PK IN E64 ER RANCHO ± 500 N/O GOWAN

SET 1 x 2

PK NAIL ± 80 N/O GOWAN ON BRADLEY, PROFILE PT. #1

SET 1 x 2

T-2 24 3

NORTHWEST FLOOD STUDY

STA	Δ	HI	=	ELEV.
				2226.503
	6.714	53.217		
TP-11			0.798	2252.509
	3.444	55.923		
TP-12			4.067	2251.856
	4.210	58.066		
TP-13			3.063	2255.003
	4.496	62.470		
TP-14			.509	2255.961
	7.716	63.677		
TP-15			3.526	2261.151
	8.212	69.363		
TP-16			3.030	2263.333
	4.847	71.230		
TP-17			3.637	2267.594
PI	8.41	2276.004		
TP 18			3.68	2272.324
PI	7.50	2279.824		
TP19			2.58	2277.244
PI	7.12	2284.364		
TP20			3.54	2280.824
PI	7.07	2287.894		

LEVEL CIRCUIT #9

6-9-93
S. GATES
S. SPINELLI
OLAT. 0001

DESC.	
I & 2	
HV-3, SEE T-43 24 5	
RIVET & PLATE IN TC @ 3rd STA SCR. GOWAN & GINGKO CUT 3rd NO. 2	
SET PK NAIL IN TC 6.42 FT E/STAE GOWAN T 150' E/O MILLIMAN	
RIVET & PLATE IN TC @ ECR S/E COR GOWAN & MIRAMAR BM # 7000 12W6	
SET PK NAIL IN TC @ ECR SE CORNER COPPER PEG MKR E/GOWAN	
PK NAIL PROFILE P.I. #2 GOWAN ST 100' EAST OF JONES	
RIVET & PLATE TC @ BCR SE COR GOWAN AND JONES BM # 7000 12W4	
P.E. ED A/C	
P.I. # 3	CENTERLINE GOWAN & MAVER CR. PK NAIL
P.L. ED A/C	

NORTHWEST FLOOD STUDY

STA	+	HF	=	ELEV.
HF		2287.894		
TP 21			2.39	2285.504
A	7.10	2292.604		
TP 22			3.515	2289.089
A	7.11	2296.199		
TP 23			3.31	2292.889
A	7.77	2300.659		
TP 24			3.15	2297.509
A	5.945	2303.454		
TP 25			3.56	2299.894
A	8.66	2308.554		
TP 26			3.76	2304.794
A	6.09	2310.884		
TP 27			1.165	2309.719
A	8.085	2317.804		
TP 28			3.79	2314.014
A	7.22	2321.234		
TP 29			0.05	2321.184
A	8.78	2329.964		
TP 30			1.39	2328.584
A	0.06	2328.644		
TP 31			7.82	2320.824
A	2.94	2323.764		

0142-0001 T-41 PG 3

LABEL CIRCUIT #9 D-15-93 BRUSH'S TOMAH

P.K. ED A/C

P.K. ED A/C

P.R. ED A/C

P.K. CENTERLINE CL WWW 100' EAST OF RAINBOW
P.I. # 4

U.V. # 15 ± 12' WWW 3 & 7.01 A/C DET. PG 5
T-48

P.R. ED A/C

P.K. ED A/C

P.K. ED A/C

U.V. # 17 & COMM & RESERVOIRS DESC. PG 6 T-48
P.I. # 5

P.R. ED A/C

NORTHWEST FLOOD STUDY

STA	+	HI	−	ELEV	
HI		2323.764			
TP 32			3.72	2320.044	
″	7.165	2327.209			
TP 33			3.55	2323.659	
″	4.305	2327.964			
TP 34			3.76	2324.204	
″	3.88	2328.084			
TP 35			5.515	2322.569	2322.515
BM					2322.515
″	6.99	2325.545			
TP 1			2.895	2322.650	
″	7.37	2329.52			
TP 2			6.965	2322.555	
BM				2319.202	
″	7.15	2326.352			
TP 1			0.08	2326.272	
″	8.74	2335.012			
TP 2			0.21	2334.802	
″	8.765	2343.567			
TP 3			3.935	2339.632	
″	1.08	2340.712			
TP 4			8.545	2332.167	
″	0.45	2332.617			

Q142.C001 T-41 PG 4

LEVEL CIRCUIT #9 6-15-95 BRUNO SCHULZ

PK. EX A/C

PK. ED A/C

PK. ED A/C

CLV ILV00354 RIVET&WASHER TELLIA & ALEXANDER
DESC. PG 9 BOOK T-48

CLV ILV00354 RIVET&WASHER

PK # 13 CENTERLINE TELLIA & ALEXANDER AT PARK

SAME AS BEGINNING

TP 12 LEVEL CIRCUIT #2

PK. ED A/C

PK. ED A/C

PK # 12 @ ALEXANDER + 05-25

NORTHWEST FLOOD STUDY

HI		2332.617			
TP 5			8.73	2323.887	
A	0.81	2324.697			
TP6			8.73	2315.967	
A	1.68	2317.647			
TP7			2.99	2309.657	
A	4.08	2313.737			
TP8			6.105	2307.632	2307.50
BM				2268.181	
A	8.63	2277.871			
TP1			5.00	2272.871	
A	5.17	2278.041			
TP2			5.05	2272.991	
A	4.99	2277.981			
TP3			5.11	2272.871	
A	5.005	2277.876			
TP4			6.60	2271.276	2271.27

LEVEL CIRCUIT 169 6-15-93 BRULAND SOMMA

P.K. ED A/C

P.K. IN A/C

P.K. ED A/C

TP # 23 LEVEL CIRCUIT # 8 PG#19 T=48

TP 14 LEVEL CIRCUIT # 8 PG. 18 T=48

H.V. #4 DESC. PG. 5 T-48

B.L. # 9 PG. 18 T-48

NORTHWEST FLOOD STUDY-b

NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY

Clark County, Nevada

Technical Data Notebook Appendix I
General Documents

Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

CVL CONSULTANTS, INC., 6655 W. SAHARA, SUITE A-200, LAS VEGAS, NV 89103 (702) 368-3008
PENTACORE ENGINEERING, INC., 6763 W. CHARLESTON BLVD., LAS VEGAS, NV 89102 (702) 258-0115

Northwest Las Vegas Flood Insurance Study Restudy
Clark County, Nevada

Technical Data Notebook
Appendix I - General Documents

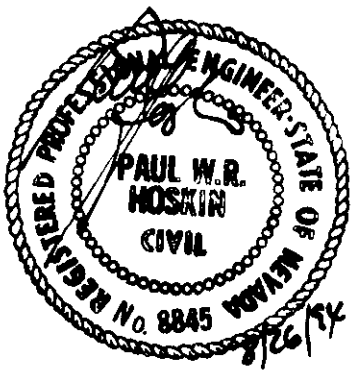
Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

301 East Clark Avenue, Suite 300
Las Vegas, Nevada 89101

August 26, 1994



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PENTACORE ENGINEERING, INC., 6763 W. CHARLESTON BLVD., LAS VEGAS NV 89102 (702) 258-0115

Flood Insurance Study Restudy
for
Northwest Las Vegas

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Section 3 General Correspondence

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for
Northwest Las Vegas

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Northwest Las Vegas

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Section 1
Contract Agreement & Scope of Service

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

RECEIVED
5/14/93

Virginia Valentine, P.E.
Chief Engineer/General Manager

BOARD OF DIRECTORS

Michael R. Harris
Chairman
City of Henderson

Iris Bletsch
Vice-Chairman
City of Boulder City

Yvonne Atkinson Gates
Clark County

Theron Goynes
City of North Las Vegas

Scott Higginson
City of Las Vegas

Bruce Jensen
City of Mesquite

Jan Laverty Jones
City of Las Vegas

Bruce L. Woodbury
Clark County

May 12, 1993

Mr. Michael Koizumi, P.E.
CVL Consultants, Inc.
6655 W. Sahara, Suite A-200
Las Vegas, Nevada 89102

Northwest Area Flood Insurance Study
Notice To Proceed

Dear Mr. Koizumi:

At their May 13, 1993 meeting the Clark County Regional Flood Control District Board approved and authorized the Chairman to sign the **Agreement for Professional Services** between the District and CVL Consultants, Inc. to perform a Flood Insurance Restudy of the Northwest Study Area. Please find attached an original signed copy of the executed agreement for your files. The District has retained a copy for their files. This letter will serve as notice to proceed on May 14, 1993 with the Basic Services as outlined in the agreement. Kevin Eubanks, P.E., Senior Engineer, has been designated as the District's Project Manager for this study should you have any questions.

The District looks forward to working with CVL Consultants, Inc. on this project.

Sincerely,

Virginia Valentine

VIRGINIA VALENTINE, P.E.
General Manager/Chief Engineer

Enclosure

cc: Paul Hoskin, CVL Consultants, (W/O Enclosure)

VBV:KLE:jwp

File: Northwest FIS

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

Agreement for Professional Services

AGREEMENT FOR PROFESSIONAL SERVICES

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

AND

CVL CONSULTANTS, INC.

THIS AGREEMENT is made and entered into this 13th day of May, 1993, by and between the CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT (hereinafter referred to as "DISTRICT") and CVL CONSULTANTS, INC. (hereinafter referred to as "CONSULTANT"), for the Northwest Las Vegas Flood Insurance Study Restudy (hereinafter referred to as the "PROJECT").

WITNESSETH

WHEREAS, the DISTRICT desires to complete a Flood Insurance Study (FIS) restudy for the PROJECT, and

WHEREAS, the CONSULTANT is experienced and is knowledgeable in the completion of such works, and

WHEREAS, the CONSULTANT and the DISTRICT recognize the need to coordinate the PROJECT with the Clark County Technical Review Committee established by the DISTRICT for this project, and

WHEREAS, the CONSULTANT represents that it is properly registered and qualified in accordance with the Nevada Revised Statutes and has the personnel and facilities necessary to accomplish the PROJECT within the required time, and

WHEREAS, the parties desire to set forth the responsibilities, terms, and conditions of completing the PROJECT,

NOW, THEREFORE, in consideration of the premises and terms contained herein, the parties agree as follows:

Section I

RESPONSIBILITY OF CONSULTANT

A. The CONSULTANT shall be responsible for the professional quality, technical accuracy, timely completion, and coordination of all services furnished by the CONSULTANT, its subcontractors and subconsultants and its and their principals, officers, employees, and agents under this AGREEMENT. In performing the specified services, CONSULTANT shall follow practices consistent with generally accepted current professional and technical engineering standards.

B. It shall be the duty of CONSULTANT to assure that all work products are technically sound and in conformance with all pertinent and current federal, State, and local statutes, codes, ordinances, resolutions, and other regulations -- in particular, the federal Endangered Species Act. If, during the term of this contract, there are any changes or new laws, ordinances, statutes, rules, or regulations not known or foreseeable at the time of signing this contract which become effective and which affect the cost or time of performance of the contract, CONSULTANT shall immediately notify DISTRICT in writing and submit detailed documentation of such effect in terms of both time and cost of performing the contract. Upon concurrence by DISTRICT as to the effect of such changes, an adjustment in time of performance and/or compensation for an increase or decrease in labor, materials, and equipment directly required to be in compliance will be made. Except for an extension of time, no payment or compensation of any kind shall be made to CONSULTANT for damages caused by such changes or new laws, ordinances, statutes, rules, or regulations, including, but not limited to, those which may arise due to delay, disruption, acceleration, or inefficiency. If any discrepancy or inconsistency should be discovered between this contract and any law, ordinance, regulation, order, or decree, CONSULTANT shall immediately report the same in writing to DISTRICT, who will issue such instruction as may be necessary. The CONSULTANT shall, without additional compensation, correct or revise any errors or deficiencies in its recommended plans, policies, designs, drawings, and other sections of the PROJECT. It is also understood and agreed by both parties that if any variation in

measurements, calculations, or observations of a quantity due to mistakes, hereinafter referred to as "erroneous work," is found, the CONSULTANT will expeditiously perform the necessary work, at no expense to the DISTRICT, to correct the erroneous work. The reviewing process by the DISTRICT during the progress of the PROJECT will not relieve the CONSULTANT's obligation for erroneous work in the preparation of the different sections of the PROJECT. Any revisions or updates of the PROJECT after submittal would be considered outside the scope of services for this AGREEMENT.

C. The CONSULTANT will be responsible for holding monthly progress meetings with the DISTRICT. Minutes of these meetings and a summary of the PROJECT status will be submitted by the CONSULTANT to the DISTRICT with each monthly invoice for professional services.

D. It is agreed that any and all documents prepared and submitted by the CONSULTANT to the DISTRICT, and all information required of the CONSULTANT by the AGREEMENT, become the property of the DISTRICT. The CONSULTANT may retain copies and reproducible copies of all documents produced as a result of the PROJECT. In the event of the termination of the AGREEMENT, all documents produced shall be and become the property of the DISTRICT. The CONSULTANT agrees to surrender all such documents to the DISTRICT.

E. The CONSULTANT agrees that its officers and employees will cooperate with the DISTRICT in the performance of services under this AGREEMENT and will be available for consultation with the DISTRICT at such reasonable times and with advance notice so as to not conflict with their other responsibilities.

F. The rights and remedies of the DISTRICT provided for under this section are in addition to any other rights and remedies provided by law or under other sections of the AGREEMENT.

Section II

DISTRICT'S RESPONSIBILITY

A. The DISTRICT agrees that its officers and employees will cooperate with CONSULTANT in the performance of services under this AGREEMENT and will be available for consultation with CONSULTANT at such reasonable times with advance notice as to not conflict with their other responsibilities.

B. The services performed by CONSULTANT under this AGREEMENT shall be subject to review and approval by DISTRICT General Manager. The DISTRICT General Manager may delegate any or all of the General Manager's responsibilities under this AGREEMENT to appropriate staff members, and shall so inform CONSULTANT by written notice before the effective date of each such delegation.

C. The services to be performed by the CONSULTANT under this AGREEMENT shall be subject to periodic review by DISTRICT's General Manager. The review comments of DISTRICT's General Manager shall be reported in writing to the CONSULTANT by the DISTRICT's General Manager. To prevent an unreasonable delay in the CONSULTANT's work, the DISTRICT's General Manager will endeavor to examine all documents and will make authorizations in writing to the CONSULTANT to proceed with work within 10 working days of receipt of such documents. It is understood that the DISTRICT's representative's review comments do not relieve the CONSULTANT from the responsibility for professional and technical accuracy of all work delivered under this AGREEMENT.

D. DISTRICT shall, without charge, furnish to or make available for examination or use by the CONSULTANT as it may request, any relevant data which the DISTRICT has available, including as examples only and not as a limitation:

1. Copies of reports, maps, plans, surveys, records, and other documents pertinent to flooding, flood control facilities, public properties, property developments, and other physical features related to the PROJECT.

2. Copies of previously prepared reports, publications, design hydrologic and hydraulic data, flooding information, flooding data, rainfall/runoff data, representative local drainage requirements (i.e., subdivision, planning and zoning regulations, ordinances, codes, criteria, and special agreements or procedures), analyses, and computation manuals, computer programs, other documents and information related to the PROJECT and services specified by this AGREEMENT. CONSULTANT shall return original data provided by the DISTRICT.

E. Upon written request from the CONSULTANT, the DISTRICT shall reasonably assist CONSULTANT in obtaining data and documents from public officers or agencies and from private citizens and business firms whenever the DISTRICT determines that such material is necessary for the completion of the services specified by the AGREEMENT. DISTRICT shall provide the CONSULTANT with a list of names of individuals, agencies, or any other parties that should receive written communication related to the PROJECT from the CONSULTANT.

F. CONSULTANT will not be responsible for accuracy of information or data supplied by the DISTRICT or other sources, but will use such data to the extent such information or data would be relied upon by a reasonably prudent professional engineer.

Section III
SCOPE OF WORK

A. The CONSULTANT shall perform Tasks 1 through 7 including services discussed in the project description as specified in Exhibit A, which is attached hereto, and by this reference made a part of this AGREEMENT. In addition, the CONSULTANT will perform Task 8, "Supplemental Services" described in Exhibit A if, as, and when requested in writing by the General Manager. Exhibits B and C attached hereto and by this reference are also made a part of this agreement.

B. The DISTRICT may at any time, by written order, make changes within the general scope of this AGREEMENT and in the services or work to be performed by the CONSULTANT. If such changes cause an increase or decrease in the CONSULTANT's cost or time required for performance of any services under this AGREEMENT, an equitable adjustment shall be made and this AGREEMENT shall be modified in writing accordingly. Any claim of the CONSULTANT for adjustment under this clause must be asserted in writing within 30 days from the date of receipt by the CONSULTANT of notification of changes unless the DISTRICT grants a further period of time before the date of final payment under this AGREEMENT.

C. No services for which an additional compensation will be charged by the CONSULTANT shall be furnished without the written authorization of the DISTRICT.

Section IV

COMPENSATION AND TERMS OF PAYMENT

A. Once each month, the DISTRICT shall pay the CONSULTANT for services performed under *Section III, Scope of Work. Invoices* are prepared and submitted on a monthly basis and are due upon receipt. Payment is past due thirty (30) days from the invoice date. In the event the DISTRICT fails to make any payments, the CONSULTANT may cease work immediately until payment for the invoice and service charge is made. An additional charge at the rate of 1½ percent per month will be charged against invoices which are past due.

B. Compensation and Method of Payment for Engineering Services are:

1. The DISTRICT shall pay the CONSULTANT on a time and materials basis under the CONSULTANT's fee schedule, which is attached hereto as Exhibit D and by this reference made a part of this AGREEMENT.

2. The maximum cost to the DISTRICT for Task 1 through Task 7 including services discussed in Project Description accomplished under this AGREEMENT shall not exceed $218,630 unless the DISTRICT receives a written request, with justification, and the DISTRICT approves a change in scope and an increase in compensation. If approved, a supplement to this AGREEMENT must be executed. An estimated cost based on a detailed breakdown of the cost by tasks, and direct costs is shown on Exhibit E, which is attached hereto and by this reference made a part of this AGREEMENT. While the maximum cost to the District shall not exceed $218,630, the cost figures presented in Exhibit E are only estimates, and are not intended to limit the compensation to be paid for an individual task. Payments will be made to the CONSULTANT on a monthly basis upon receipt of a progress report and itemized invoices for work accomplished.

3. Supplemental services will be performed only upon written authorization by the General Manager and at the discretion of the General Manager. Payment for Supplemental services will be made according to the terms described in this section for basic professional services. The maximum cost to the DISTRICT for Supplemental Services accomplished under this AGREEMENT shall not exceed $28,870. An estimated cost based on a detailed breakdown of the cost by tasks, and direct costs in shown on Exhibit E, which is attached hereto and by this reference made a part of this AGREEMENT. While the maximum cost to the District for supplemental services shall not exceed $28,870, the cost figures presented in Exhibit E are only estimates and are not intended to limit the compensation to be paid for an individual task. Payments will be made to the CONSULTANT on a monthly basis upon receipt of a progress report and itemized invoices for work accomplished.

Section V

TIME AND PERFORMANCE

A. The Project Time Schedule for work under this AGREEMENT is attached as Exhibit C and by this reference made a part of this AGREEMENT. The CONSULTANT will perform the work in accordance with said Project Time Schedule, and will provide the DISTRICT's representative a progress report in conjunction with the monthly invoice describing changes in schedule.

Work shall begin immediately upon receipt by the CONSULTANT of the Notice to Proceed by General Manager. All work necessary to prepare the project deliverables for submittal to the Federal Emergency Management Agency (FEMA) for review and publication shall be completed 270 calendar days from notice to proceed. Services required to coordinate with FEMA during the review and approval process will continue as required for up to 365 calendar days from notice to proceed. Supplemental services, if requested by the General Manager, will be completed within 270 calendar days from notice to proceed.

B. The DISTRICT and CONSULTANT recognize the scope of work as detailed in Exhibit A - SCOPE OF SERVICES and as outlined in Exhibit C - PROJECT TIME SCHEDULE can be altered by unforeseen events which may occur. Therefore, a supplement to this AGREEMENT will be prepared, negotiated, and executed when the CONSULTANT establishes, and the DISTRICT agrees, that there has been, or is to be a significant change, including but not limited to:

1. Scope, complexity, or character of the services to be performed such as additional meetings and coordination over those identified in Exhibit A, analysis of additional alternatives, or preparation of additional reports.

2. Conditions under which the work is required to be performed, such as a change in standards or a change in available base data which would require additional work.

3. Duration of work if the time period for completion of the work warrants such adjustment.

C. An alteration required by the DISTRICT which results in changes in the scope of work will also be specified in a supplemental AGREEMENT which will set forth the nature and scope thereof and payment therefor.

D. Neither party shall be considered in default in the performance of its obligations hereunder, or any of them, to the extent that performance of such obligations, or any of them is prevented or delayed by any cause, existing or future, which is beyond the reasonable control of such party. Delays arising from the actions or inactions of one or more of CONSULTANT's principals, officers, employees, agents, subcontractors, subconsultants, vendors, or suppliers are expressly recognized to be within the CONSULTANT's control.

Section VI
MISCELLANEOUS PROVISIONS

A. The CONSULTANT and its subconsultant(s) shall maintain all books, documents, papers, accounting reports, and other evidence pertaining to costs incurred and/or work performed and that such evidence shall be made available for inspection by the DISTRICT at all reasonable times during the AGREEMENT period for three (3) years from the date of final payment.

B. The DISTRICT has the right to terminate this AGREEMENT upon seven (7) days written notice to the CONSULTANT. This AGREEMENT may also be terminated by either party by seven (7) calendars days' written notice in the event of substantial failure to perform in accordance with the terms hereof by the one party through no fault of the other party. If said termination occurs prior to completion of the PROJECT, the CONSULTANT shall deliver to the DISTRICT all documents, calculations, and all other work performed whether complete or incomplete. Thereafter, the DISTRICT will reimburse the CONSULTANT for all services performed prior to such notice, provided the services performed are satisfactory to the DISTRICT. Termination shall be by written notice, which will be sent by certified mail or hand delivered. Such notice will be deemed effective after the third business day of the mailing post date, or hand delivered, in which case such notice will be deemed effective upon receipt of the written termination to the CONSULTANT or the DISTRICT.

C. The CONSULTANT does hereby agree to indemnify, defend, and save harmless the DISTRICT from loss, damage, liability, costs, or expense to the proportionate extent caused by the CONSULTANT, its employees, agents, or consultants and/or consultants arising out of its performance of this AGREEMENT, including, but not limited to the negligent acts, errors, omissions, or intentional misconduct of the CONSULTANT, its employees, agents or consultants and/or subconsultants in connection with this AGREEMENT.

D. During the life of this AGREEMENT, the CONSULTANT shall not engage the services of any person or persons who are currently employed by the DISTRICT without the DISTRICT's prior approval.

E. The CONSULTANT shall at all times maintain control over and have complete responsibility for all work performed under the AGREEMENT. Any attempted assignment of rights or delegation of duties under this AGREEMENT, without the written consent of the DISTRICT, shall be void.

F. The CONSULTANT shall submit for review and documentation purposes copies of all subconsultant agreements.

G. The CONSULTANT shall place his professional engineer stamp on the final FIS report substantiating that the work has been accomplished under the direct supervision of a professional engineer and in accordance with acceptable professional standards.

H. The CONSULTANT, at its own expense, shall obtain and maintain, for the duration of the Contract, insurance against claims for injuries to persons or damages to property or other losses which may arise from or in connection with CONSULTANT sole negligence or fault in the performance of the work hereunder of the CONSULTANT, his agents, representatives, employees, or subcontractors of any tier.

The CONSULTANT will provide the DISTRICT with certificates of insurance for coverage as listed below and endorsements, establishing coverage required by the Contract within ten (10) calendar days after approval of this Agreement by the DISTRICT's Board. The certificate of endorsements for each insurance policy are to be signed by a person authorized by the insurer and licensed by the State of Nevada.

The CONSULTANT will:

1. Maintain commercial general liability coverage at limits of no less than $1,000,000 combined single limit per occurrence and $1,000,000 annual aggregate for bodily injury (including death), personal injury and property damages. The coverage shall be on an "occurrence" basis only and not on a "claims made" basis; and the coverage must be provided on ISO commercial liability or on ISO broad form comprehensive general liability forms with no exceptions to the coverage for bodily injury, personal injury, broad form property damages, premises operations, severability of interest, products and completed operations, contractual and independent contractors. The DISTRICT, its officers, and employees must be expressly covered as additional insureds.

2. Maintain automobile coverage at limits of no less than $1,000,000 combined single limit "per accident" for bodily injury and property damage for all owned automobiles, nonowned automobiles, hired automobiles, or any automobile. The DISTRICT, its officers and employees must be expressly covered as additional insureds.

3. Maintain professional liability insurance at limits of no less than $1,000,000 per claim and $1,000,000 annual aggregate to insure against claims for losses arising out of the services rendered by the CONSULTANT, its agents, representatives or employees pursuant to the CONSULTANT's Contract with the DISTRICT. "Claims made" insurance coverage will continue for a period of three (3) years beyond the term of the Contract. Any retroactive date must coincide with or predate the date of the Contract and may not be advanced without the DISTRICT's consent. The CONSULTANT's professional liability insurance must provide coverage for the CONSULTANT's subcontractor if the subcontractor does not maintain professional liability insurance in the same amounts and manner as required for the CONSULTANT.

All deductibles and self-insured retention shall be fully disclosed in the certificate of insurance. No deductible of self-insured retention may exceed $250,000 for commercial general liability, $250 for automobile, or $250,000 for professional liability without the written approval of the DISTRICT. If aggregate limits are imposed on bodily injury and property damage, then the amount of such limits must not be less than twice the amount of the limits required herein. All aggregate must be fully disclosed and the amount entered on the required certificate of insurance. Any notice given to the CONSULTANT with respect to exhaustion of limits of insurance shall also be sent to the DISTRICT. The adequacy of the insurance supplied by the CONSULTANT, including the rating and financial health of each insurance company providing coverage, is subject to the approval of the DISTRICT.

4. Maintain Nevada Industrial Insurance and Occupational Disease Acts; such insurance will protect it and the DISTRICT from claims made by the CONSULTANT due to work-related injuries.

5. The CONSULTANT's insurance shall be primary as respects to the DISTRICT, its officers, employees, and volunteers. Any other coverage available to the DISTRICT, its officers and employees shall be excess over the insurance required of the CONSULTANT.

The insurance requirements specified herein do not relieve the CONSULTANT of its responsibility or limit the amount of its liability to the DISTRICT or other persons, and the CONSULTANT is encouraged to purchase such additional insurance as it deems necessary.

6. The insurance certificate supplied by the CONSULTANT must provide for a 30-day notice to the DISTRICT before the implementation of a proposal to cancel the required insurance coverage. This notice requirement does not waive the

insurance requirements contained herein. In addition, CONSULTANT shall notify DISTRICT within thirty (30) days of any reduction in coverage or limits.

7. If the CONSULTANT fails to maintain any of the insurance coverage required herein, then the DISTRICT will have the option to either terminate the Contract; declare the CONSULTANT in breach; purchase replacement insurance; or pay the premiums that are due on existing policies in order that the required coverage may be maintained. The CONSULTANT is responsible for any expenses paid by the DISTRICT to maintain such insurance, and the DISTRICT may collect the same from the CONSULTANT or deduct the amount paid from any sums due the CONSULTANT under this Contract.

I. Project Staffing

CONSULTANT shall provide the DISTRICT with a list of CONSULTANT's employees who will be performing work on the PROJECT. This list shall indicate the employee's name, classification, and hourly billing rate. This list will be used by the DISTRICT in reviewing and evaluating changes as a result of CONSULTANT's fiscal year increases (decreases).

J. Governing Law

Nevada law shall govern the interpretation of this AGREEMENT.

K. Notice

Any notice required to be given hereunder shall be deemed to have been given when received by the party to whom it is directed by personal service, hand delivery, or U.S. mail at the following addresses:

To DISTRICT: Clark County Regional Flood Control District
301 East Clark Avenue, Suite 300
Las Vegas, Nevada 89101

To CONSULTANT: CVL Consultants, Inc.
6655 W. Sahara, Ste. A-200
Las Vegas, Nevada 89102

Attention: Mr. Michael Koizumi, P.E.
President

IN WITNESS WHEREOF, the parties have caused this AGREEMENT to be executed the day and year first above written.

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

By: _____ Date: May 13, 1993
MICHAEL R. HARRIS
CHAIRMAN

CVL CONSULTANTS, INC.

By: _____ Date: May 13, 1993
Michael Koizumi, P.E.
President

ATTEST:

By: Deanna J. Lefko Date: May 13, 1993

Deanna Lefko

Secretary

APPROVED AS TO LEGALITY ONLY:

Chris Figgins Date: 5/13/93

Chris Figgins

Deputy District Attorney

Exhibit "A"
Scope of Services

April 13, 1993

Exhibit "A"
Flood Insurance Study
Restudy
Northwest Study Area

SCOPE OF SERVICES

Project Description

The project involves revision of the flood insurance rate zones, within the area bound by Grand Teton Drive, Buffalo Drive, I-15 and the west side of Las Vegas Wash (see Exhibit "B") as they are affected by the completion of the following Regional Flood Control District projects:

Upper Las Vegas Detention Basin
Kyle Canyon Detention Basin
Carey/Lake Mead Detention Basin
Angel Park Detention Basin
Gowan Detention Basin & Outfall
Buffalo Channel

In addition the Consultant will research all letters of map revision (LOMRs), conditional letters of map revision (CLOMRs) and letters of map amendment (LOMAs) and any private development and public works flood control improvements that can be credited for the removal of flood hazard zones. The Consultant will also determine base flood elevations and flood insurance rate zones for flooding along Rancho Boulevard between Ann Road and Gowan Road and for U.S. 95 from Rancho Boulevard to Gowan Road. The Consultant will determine base flood elevations and floodplain delineations for the 100-year peak flow by developing a backwater model of the detailed study reaches. Floodplain delineations will be reconciled with current applicable flood insurance study delineations.

The study area includes lands within the jurisdiction of the City of Las Vegas, the City of North Las Vegas and Clark County. Progress meetings and technical reviews will be carried out by a committee comprised of representatives of the District and the aforementioned jurisdictions (Committee).

All work will be performed in accordance with The Federal Emergency Management Agency's (FEMA) Document No. 37, Flood Insurance Study Guidelines and Specifications for Study Contractors dated March, 1991 (FEMA Document No. 37). All design reports and construction plans for the District projects mentioned above will be provided to the Consultant by the District or the owning entity. Additional technical data for private development and other public works projects will be made available to the Consultant by the responsible governmental entity. Only technical data which currently exists and is in sufficient form to warrant credit for flood hazard zone removal will be used under this contract. To the fullest extent possible the Clark County Regional Flood Control District adopted Las Vegas Valley Flood Insurance Study Hydrology Report, dated September, 1991, prepared by James M. Montgomery Consulting Engineers, Inc. will be used. Additional hydrologic studies that effect the study area will be provided to the

consultant for incorporation into a synopsis report. No new hydrologic modeling is anticipated. The need for any additional hydrologic analyses will be identified in writing by the Consultant with [illegible] work as Supplemental Services as identified in Task 8. Authorization to proceed under a Supplemental Services portion of this contract must be granted by the General Manager in writing prior to proceeding with these tasks.

Work under this scope must be reviewed and accepted by FEMA prior to finalization of this contract. As a part of this requirement, the Consultant shall be responsible for Public Notification regarding this project. Work under this scope, through first submittal to FEMA, will be completed within 270 days from the date of the notice to proceed, including 60 days for District reviews. The estimated Project Schedule is shown on Exhibit "C".

Task 1 - Data Collection

1.1 The Consultant will collect pertinent design and other technical data from, but not limited to, FEMA, the District, the City of Las Vegas, the City of North Las Vegas, NDOT and Clark County Public Works Department. Pertinent data under this task will include but not be limited to previous flood control design reports for public and private projects within the study area; historical flooding information; as-built plans for existing structures; construction plans for projects scheduled for or under construction; FEMA Flood Insurance Rate Maps and Letters of Map Revision and/or Amendments and supporting data; available topography; the Las Vegas Valley Flood Insurance Study Hydrology Report, dated September, 1991, prepared by James M. Montgomery Consulting Engineers, Inc. (FIS Hydrology Study). The FIS Hydrology study has been adopted by the CCRFCD Board. The Consultant will be provided with a copy of the FIS Hydrology Study, supporting appendices and a computer diskette containing model input; other pertinent information.

1.2 A Data Collection Report with an index map detailing the data collected and summarizing the technical data derived and its bearing on the study will be submitted to the District and the Committee for review and informational purposes.

1.3 The Consultant will submit a project schedule showing coordination meetings and completion dates for each of the tasks in this contract.

Task 2 - Detailed Floodplain Delineations

2.1 The information necessary to determine base flows (100-year) for the subject reaches will be provided to the Consultant by the District and the affected entities as a result of completion of Task 1. The consultant shall review available hydrologic analyses and compile information as a part of Task 1.2, Data Collection Report. If necessary, the HEC-1 model provided in the FIS Hydrology Study will be expanded to reflect information from other sources and/or to develop flow rates for additional concentration points. The need for additional hydrologic analysis will be identified to the District and will be performed as part of Task 8, Supplemental Services agreement. Any additional hydrologic calculations will be submitted to the District for review and approval prior to commencing the affected hydraulic analysis.

2.2 The Consultant will conduct a field reconnaissance of the study area. This will include observation of channel and floodplain conditions for estimation of Manning's "n" values, photographic documentation of floodplain characteristics, determination of channel bank stations, observation of possible overflow areas and inspection of levees and other flood control structures.

2.3 Field Reconnaissance Notes will be prepared and referred to during the project.

2.4 Cross section stationing will be from left to right looking downstream. Cross sections will be spaced at 500 foot intervals unless topographic or physical constraints dictate otherwise. Identification of cross sections shall be in river miles, increasing in the upstream direction from each confluence and will be consistent with existing FIS stationing if available. The location and alignment of cross sections and channel centerline will be submitted to the District for review and approval prior to digitizing cross section data. Cross section orientation may need to be altered after initial profile executions to ensure proper orientation perpendicular to flow per FEMA criteria.

2.5 Determine base flood elevations and flood insurance rate zones for flooding along Rancho Boulevard between Ann Road and Gowan Road and for U.S. 95 from Rancho Boulevard to Gowan Road. Floodplain delineations and base flood elevations (BFEs) will be determined for the 100-year flood using the most recent version of the U.S. Army Corps of Engineers HEC-2 Water Surface Profiles computer model and/or methodologies acceptable to FEMA. These models will simulate the effects of flow changes, bridges, culverts, hydraulic roughness, effective flow limitations, split flows, and other considerations to most realistically and accurately represent flooding conditions. Floodplain delineations will be reconciled with current applicable flood insurance study delineations. No floodway will be determined.

2.6 Cross sections will be plotted using either pen or laser plotter. The plots will show water surface elevations, ineffective flow areas, roughness values, encroachments, channel stationing and all other pertinent input and output data.

2.7 The Consultant will prepare draft work maps, technical data and models of the 100-year floodplain during the course of the hydraulic analysis for review by the Committee and approval by the District. Flood zones will be established according to FEMA criteria. Draft maps may consist of copies of redlined maps submitted to each Committee member (5 total) at each review stage.

2.8 Final work maps and technical data will be prepared which incorporate all review comments prior to FEMA submission. Final maps may consist of either ink on Mylar or electrostatic plots reproduced from a digital form.

2.9 Profiles for the 100-year water surface will be prepared in FEMA format for the detailed study reaches. Multiple profiles will not be required.

Task 3 Flood Zone Revisions

3.1 Review existing data and as built plans for the following projects as obtained in Task 1:

Upper Las Vegas Detention Basin
Kyle Canyon Detention Basin
Carey/Lake Mead Detention Basin
Angel Park Detention Basin
Gowan Detention Basin & Outfall
Buffalo Channel
Other Private Projects .
Other Public Works Projects

The information for these projects will be reviewed to target presently mapped flood hazard zones which are candidates for removal or revision.

3.2 Compile the information for these projects in a form sufficient to present to FEMA in support of flood hazard zone removals and/or revision.

3.3 Utilizing the project information provided, field reconnaissance and approximate study methods, the Consultant shall prepare approximate floodplain delineations. Base mapping may include U.S.G.S., 1"=2000' quadrangle maps. A final product will include maps of existing FIRMs with the new flood zone delineations superimposed.

Task 4 Final Report Preparation

The Floodplain Report for detailed delineations and flood zone revisions will include, but is not limited to the following:

I. Introduction
   A. Purpose of Study
   B. Authority for Study
   C. Coordination and Acknowledgements

II. Area Studied
   A. Scope of Study
   B. Community Description
   C. Principal Flood Problems
   D. Flood Protection Measures

      1. Upper Las Vegas Detention Basin
      2. Kyle Canyon Detention Basin
      3. Carey/Lake Mead Detention Basin
      4. Angel Park Detention Basin
      5. Gowan Detention Basin & Outfall
      6. Buffalo Channel

7. Other Private Projects
   a.
   b.
   c.
8. Other Public Works Projects
   a.
   b.
   c.

III. Engineering Methods
   a. Hydrologic Analysis
   b. Hydraulic Analysis

IV. Floodplain Management Applications

V. Insurance Applications

VI. Other Studies

VII. Bibliography

Appendix I - Supporting Technical Data for FEMA submission

Appendix II - Survey Control Report

Appendix III - FEMA and Community review comments and responses.

Appendix IV - Other Pertinent Information developed during the course of the study (not necessary for FEMA submission).

Following receipt of all comments for FEMA, the Consultants shall make revisions to the Final Work Maps, the Final Floodplain Report and FEMA profiles.

Task 5 Coordination

5.1 The Consultant will coordinate and participate in regular progress meetings with the District and the Committee on a monthly basis and at milestones in the development of the restudy. Detailed meeting minutes will be prepared for each meeting and will document all participants' comments and decisions reached.

5.2 Project coordination and management will include telephone, facsimile and written communications between the District, Committee members, subconsultants and other parties. A record will be kept of written and verbal communications.

5.3 The Consultant shall prepare brief reports to accompany each month's invoice.

5.4 The Consultant will submit maps, report and the hydraulic analyses to Committee reviewers through the District.

5.5 The Consultant will coordinate with FEMA and FEMAs Technical Evaluation Contractor (TEC) at appropriate stages of the restudy effort.

5.6 The Consultant will be responsible for responding to and interacting with FEMAs TEC throughout the review and community appeals process as outlined in FEMA document No. 37.

Task 6 Topographic Mapping Services

6.1 New topographic maps developed in accordance with the detailed mapping identified in Task 2.5 of this contract will be tied to 1983 NAD, and Clark County Vertical datum prior to encoding hydraulic models.

6.2 For detailed study reaches, existing Clark County survey control markers will be identified and described for use as elevation reference markers (ERMs). ERM description, location and elevation will be tabulated and submitted with the Final Floodplain Report.

6.3 The Consultant is responsible for obtaining all necessary rights-of-entry for the study area. The Committee will assist as may be necessary.

6.4 The Consultant shall perform topographic cross-section checks to verify mapping accuracy to FEMA standards. Check cross-sections shall be plotted versus aerial mapped contours. Consultant shall verify that standards have been met.

6.5 The Consultant will systematically set panel points and establish horizontal and vertical control throughout the areas to be mapped for use in compilation by the aerial survey subconsultant. Where readily available, surveys will be tied to the State Plane Coordinate System. Field control will use existing documented Clark County survey points where possible and be of an adequate density and location to meet the requirements of the aerial surveying subconsultant and FEMA Document No. 37.

6.6 Following completion of the ground control, setting of ERM's and cross-section checks, the Consultant shall produce a Survey Control Report to document the work. This report shall be signed and sealed by a Professional Land Surveyor registered in the State of Nevada.

6.7 An aerial survey subconsultant will be retained by the Consultant as part of this contract. The Consultant will coordinate the work of the aerial surveying subconsultant to ensure that the specifications of the aerial surveying work are met. Quality control of aerial surveys will be per FEMA Document No. 37, Flood Insurance Study Guidelines and Specifications for Study Contractors, dated March 1991.

Control aerial fly, produce contact prints, compile analytics and prepare topographic mapping with a 2-foot contour interval at a scale of 1-inch = 200-feet for the detailed study reaches identified in Task 2.5 and as shown in Exhibit "B".

Task 7 Final Products

7.1 Prior to submission to FEMA, the Consultant will provide to the District for distribution to the Committee members five (5) copies of all maps, technical data and reports being prepared for submittal to FEMA. A final review will be completed and the District will authorize submittal to FEMA.

7.2 Mapping

a. Available topography identified under Task 1 will be reproduced from their source in a durable reproducible form and submitted to the District; one (1) copy.

b. New topographic maps including contact prints, photo mylars, etc. developed in Task 5 of this scope will be submitted to the District; one (1) copy.

c. Final work maps for detailed and approximate study areas. The maps will be plotted on mylar sheets measuring 24" X 36" at the scale and contour interval specified in Task 3.3 and Task 6.7. A cover sheet will be provided with project title, date of topography and sheet index. Maps will include section and quarter corners, street names, State Plane Coordinate information, major drainage features, corporate and town boundaries, cross section lines, channel centerline station, 100-year flood limits, base flood elevations, description and elevation of control points and ERMs and reference marks used in ground control; one (1) copy.

7.3 Report

a. The Consultant will produce the Final Floodplain Report incorporating all previous comments from the District, the Committee and FEMA. FEMA comments and Consultant responses will be included in an appendix. Fifteen (15) hard copies of the report and appendices will be submitted to the District for distribution to the Committee members (3 each).

b. Five (5) copies of the report text in Wordperfect 5.1 format on a 3 1/2 inch. 1.440 Mb, diskette compatible with IBM personal computers will be submitted to the District for distribution to the Committee members (1 each).

c. Copy of the HEC-2 model input/output on 3-1/2, 1.440 mb diskette compatible with IBM personal computers; Give (5) copies.

d. FEMA forms fully completed.

Task 8 Supplemental Services

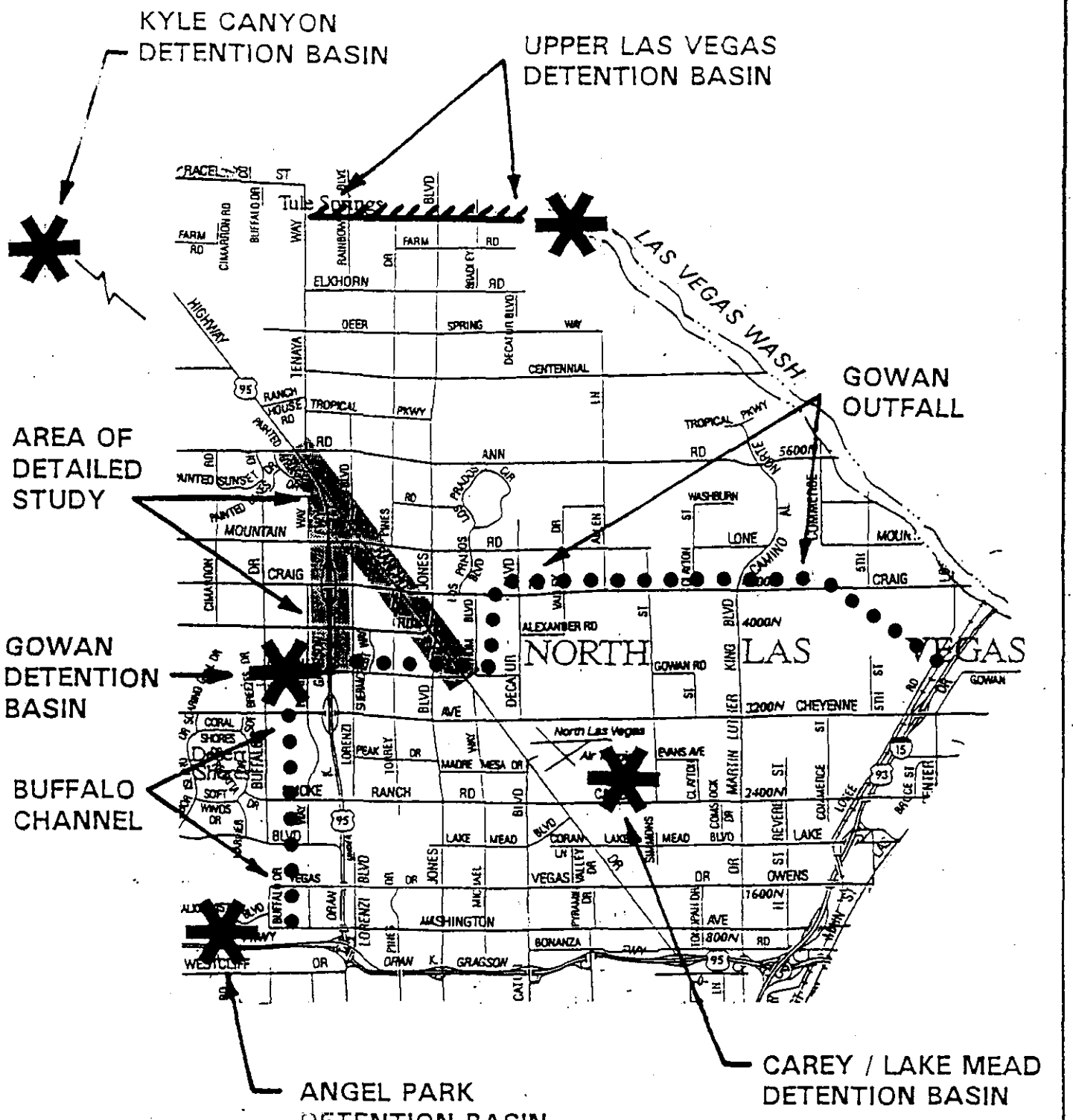
The Consultant will issue a written request for authorization to proceed with each task under Supplemental Services. The request will include a detailed description of the work to be done and the estimated cost and time schedule to complete the work. No work under this task will proceed prior to written authorization from the General Manager/Chief Engineer of the District.

8.1 The Consultant will identify proposed revisions to watershed sub-basins and concentration points and coordinate them with the District before proceeding with hydrologic modeling. Flow rates for additional concentration points will be established through refinement of the FIS HEC-1 model. Changes resulting from the in-place flood control structures over those assumed in the FIS Hydrology Study will also be modeled. Any hydrologic computations will be submitted to the Committee for review. Prior to commencing any analyses affected by these hydrologic calculations, approval must be obtained from the District.

8.2 Consultant shall prepare a Hydrology Report to document the hydrology used for the study area including additional concentration points added. Included in this report shall be a watershed area map and HEC-1 input/output.

8.3 Final work maps for detailed and approximate mapping areas identified in Task 2 and Task 3 will be provided in ARC/INFO compatible format tied to state plane coordinate system, NAD 1983 and Clark County datum on 3 1/2 inch, 1.44 Mb, high density diskette or TK50 magnetic tape. These files will include at a minimum the digital contour and planimetric data developed under Task 7.2c. The District will be responsible for providing digital data for section lines, street center lines and state plane coordinates from the Clark County Geographic Information System Management Office. The time and cost to complete this task assumes that Task 2.8 is completed in digitized form. A decision to implement Task 8.3 must be made prior to commencement of Task 2.8. Failure to provide adequate notice may be cause for renegotiation of the fee for Supplemental Services.

Exhibit "B"
Study Area Features



N.T.S.

EXHIBIT "B"
STUDY AREA FEATURES

CVL
COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

Exhibit "C"
Project Schedule

Exhibit "C" - Project Time Schedule
Flood Insurance Study Restudy for Northwest Las Vegas

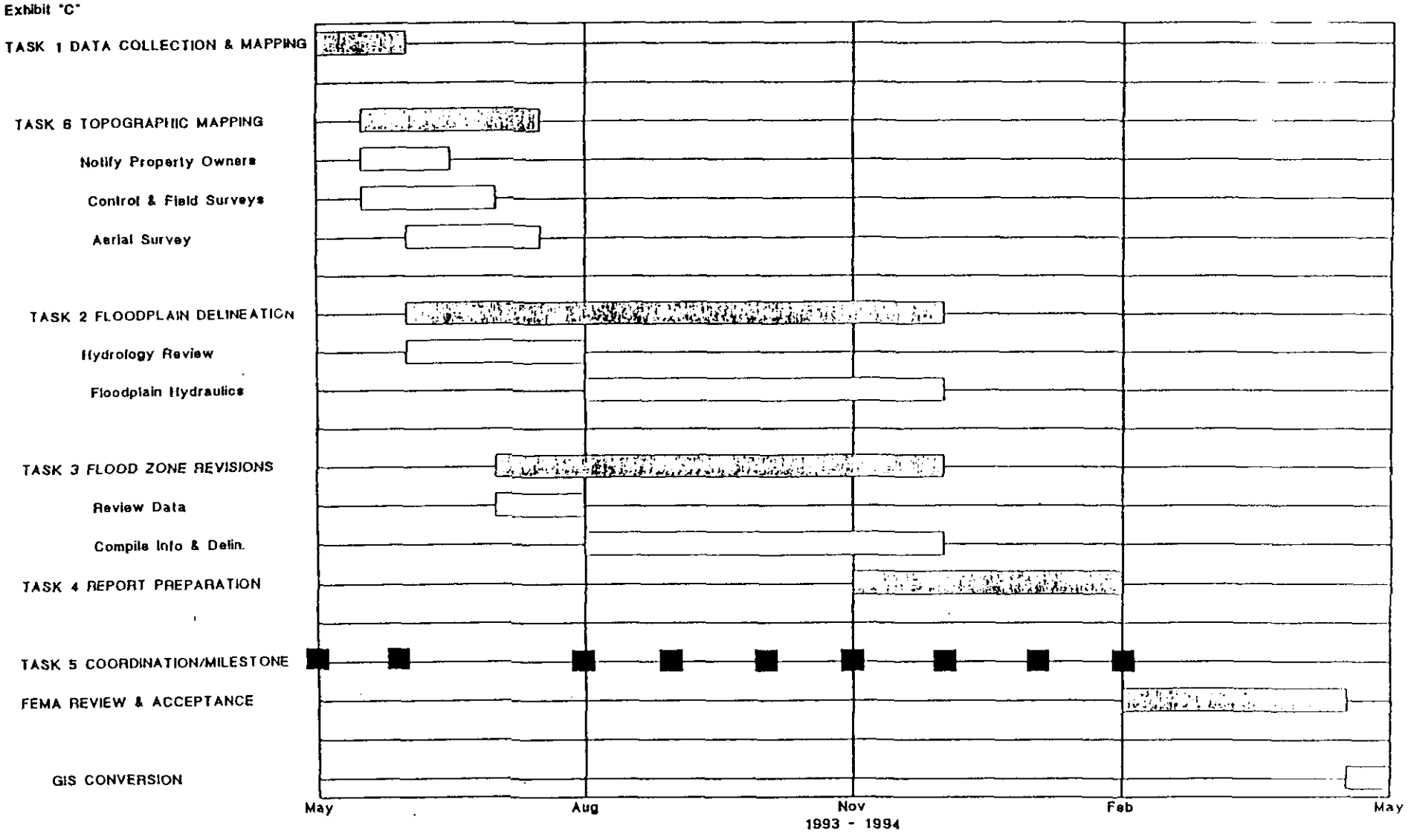


Exhibit "D"
Fee Schedule

13-Apr-93

Time & Materials Fee Schedule
Flood Insurance Study Restudy
for North West Las Vegas

	HOURLY RATES
PRINCIPAL ENGINEER Michael Koizumi	$100
PROJECT MANAGER Paul Hoskin	$90
PROJECT ENGINEER Dean Rasmuson David Dust Jack Moody	$80
HYDROLOGIST Douglas Both Russel Best Tim Moreno	$60
DRAFTER Various	$45
CLERICAL Various	$30
SURVEY CREW	$120
REIMBURSABLE COSTS	
Auto or Truck	$0.30/mile
Deliveries & postage	At Actual Cost
Prints,Reproductions and photowork	At Actual Cost

Exhibit "E"
Fee Estimate for Professional Services, Topographic Mapping and Field Survey Services

13-Apr-93

Manhours & Fees are for Estimating Purposes only. Billings will be based upon actual manhours expended and the Fee & Rate Schedule.

Manhour & Fee Estimate
Flood Insurance Study Restudy
for North West Las Vegas

PROFESSIONAL SERVICES		P	PM	PE	HY	DR	CL	SURVEY CREW	TOTAL MANHOURS	TOTAL FEE
TASK 1	DATA COLLECTION									
1.1	Collect Data	1	20	20			6		47	$3,710
1.2	Prepare Data Collection Report	2	8	16	12	8	6		52	$3,490
1.3	Prepare Project Schedule	1	6	2		8			17	$1,160
TASK 2	FLOODPLAIN DELINEATION									
2.1	Review Hydrologic Model	2	16	24	20	12			74	$5,300
2.2	Conduct Field Reconnaissance	8	20	40	40				108	$8,200
2.3	Prepare Field Reconnaissance Notes	1	2	16	10	16	6		51	$3,090
2.4	Cross-Section selection (75 assumed)	1	4	10	8	4			27	$1,920
2.5	Floodplain Hydraulics (5.5 mi. assumed)	4	20	60	72		6		162	$11,530
2.6	Plot Cross-Sections (75 assumed)	1	2	4	12	8			27	$1,680
2.7	Draft Floodplain Delineation Work Maps	2	6	12	25	20	4		69	$4,240
2.8	Prepare Final Floodplain Delineation Work Map	2	8	16	8	60	6		100	$5,590
2.9	Plot FEMA Profiles(8 shts)	1	2	4	12	12			31	$1,860
TASK 3	FLOOD ZONE REVISIONS									
3.1	Review Design Data	8	20	40	20				88	$7,000
3.2	Compile Information	12	60	100	80	20	20		292	$21,000
3.3	Approximate Floodplain Delineation	8	30	80	60	60	20		258	$16,900
TASK 4	FINAL REPORT PREPARATION									
4.1	Floodplain Report	18	40	80	60	50	24		272	$18,490
TASK 5	COORDINATION									
5.1	Attend Regular Meetings with Committee(1/mo.)	27	54	36	27		18		162	$12,690
5.2	Phone & Written Correspondence	18	54	18	18		18		126	$9,810
5.3	Progress Reports	6	24			8	12		50	$3,540
5.4	Submit for Review to District & Committee	12	24	24			8		68	$5,560
5.5	Coordinate with FEMA & TEC	4	16	24					44	$3,760
5.6	FEMA Review & Acceptance	2	20	24			8		54	$4,200

13-Apr-93

TASK 7	FINAL PRODUCTS								
7.1	FEMA Submittal (5)								
7.2 a	Available Topography (1)								
7.2 b	Topographic Maps & Prints (1)		4			20		24	$1,260
7.3 a	Rev. Work Maps & Repts per FEMA comments (15)	2	10	20	24	20	6	82	$5,250
7.3 b	WordPerfect Report (5)						1	1	$35
7.3 c	Copy of HEC-2 Input/Output (5)				4			4	$240
7.3 d	Completed FEMA forms (5)	2	12	20		40	40	114	$6,080
	Subtotal	145	482	690	512	366	209	0 2404	$167,585
	REIMBURSABLES								
	Mylars							0	$2,000
	Photographic Reproductions							0	$2,000
	Computer Supplies							0	$600
	Photographic Supplies & Developing							0	$500
	Report Xeroxing							0	$7,800
	Blueprints							0	$1,500
	Mileage							0	$600
	Deliveries							0	$419
	Subtotal							0	$15,419

13-Apr-93

SURVEY SERVICES

TASK 6	RANCHO DRIVE & HWY 95 STRIP				
6.1	Tie Topo to Clark County Datum, etc.			0	$0
6.2	Locate & set ERMs			0	$1,400
6.3	Notify Property Owners			0	$500
6.4	Verify & Plot Cross-Sections			0	$2,500
6.5	Ground Control			0	$12,400
6.6	Survey Control Report			0	$1,000
6.7	Aerial Mapping subconsultant Coordination			0	$500
	Subtotal			0	$18,300

AERIAL PHOTOGRAMMETRY SERVICES

TASK 6	RANCHO DRIVE & HWY 95 STRIP				
6.7a	Flying, Analytics, & Mapping			0	$16,600
6.7a	Replot Strip Mapping Areas			0	$0
6.7b	Prepare Photographic transparencies			0	$726
6.7c	Produce Digital Cross-Sections	5.5 mi.	72.6 assumed	72.6	$0
	Subtotal				$17,326

13-Apr-93

SUMMARY OF SERVICES

Professional Services	$167,585
Reimbursables	$15,419
Ground Control Survey	$18,300
Aerial Photogrammetry	$17,326
GRAND TOTAL	$218,630

SUPPLEMENTAL SERVICES

TASK 8	SUPPLEMENTAL SERVICES	2	16	80	100		6	204	$14,250
8.1	Update Hydrologic Model	2	20	40	24	40	20	146	$9,140
8.2	Hydrology Report	2	8	12		80		102	$5,480
8.3	Digital Version of Work Maps in ARC/INFO comp. format								
	TOTAL SUPPLEMENTAL SERVICES								$28,870
	COMBINED CONTRACT AMOUNT								$247,500

Section 2

Section 2
Community Concurrence

C L A R K C O U N T Y
REGIONAL FLOOD CONTROL DISTRICT

Gale Wm. Fraser, II, P.E.
General Manager / Chief Engineer

BOARD OF DIRECTORS

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Jan Laverty Jones
City of Las Vegas

Larry Scheffler
City of Henderson

Bruce L. Woodbury
Clark County

October 14, 1994

Federal Emergency Management Agency
Federal Insurance Administration
Office of Risk Assessment
500 C Street, SW
Washington, DC 20472

OCT 17 1994

Attn: Mr. Karl Mohr

REQUEST FOR LETTER OF MAP REVISION (LOMR)
NORTHWEST LAS VEGAS FIS RESTUDY

Dear Mr. Mohr:

On May 13, 1993, the Clark County Regional Flood Control District Board approved and authorized the Chairman to sign an Agreement for Professional Services between the District and CVL Consultants, Inc. to prepare a Flood Insurance Study Restudy for an area of Northwest Las Vegas. A Committee, consisting of staff members from the District, Clark County, City of Las Vegas, and the City of North Las Vegas has worked with CVL to produce the enclosed documents. The Committee has had the opportunity to review and comment on the study results throughout and is in agreement with the study findings.

This restudy is based, in part, on the construction of new flood control facilities within the study area. These facilities have been constructed as a part of a comprehensive flood control master plan, with major funding provided by the District. The following facilities have been completed since the current FIRMS were last studied and form a part of our request for a LOMR:

Upper Las Vegas Diversion Dike and Detention Basin

Design Engineer:	Black and Veatch
Design Completed:	5/25/91
Construction Completed:	7/1/93
Funded By:	Regional Flood Control District (RFCD)
Lead Agency:	City of North Las Vegas

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

Kyle Canyon Detention Basin

Design Engineer:	VTN Nevada
Design Completed:	4/1/93
Construction Completed:	2/15/95 (estimated completion date)
Funded By:	RFCD
Lead Agency:	City of North Las Vegas

Carey/Lake Mead Detention Basin

Design Engineer:	VTN-Nevada
Design Completed:	4/1/91
Construction Completed:	8/31/92 w/dust pollution work comp. 1/20/93
Funded by:	RFCD
Lead Agency:	City of Las Vegas

Angel Park Detention Basin

Design Engineer	GC Wallace
Design Completed	12-1-89
Construction Completed:	5/1/92
Funded by:	RFCD & Clark County 1981/84 Bond Issue
Lead Agency:	City of Las Vegas

Gowan Detention Basin and Outfall Pipe and Channel

Design Engineer:	Poggemeyer/VTN
Design Completed:	5/1/91
Construction Completed:	7/31/93
Funded By:	RFCD
Lead Agency:	City of Las Vegas/City of North Las Vegas

Craig Road Storm Drain System

Design Engineer	Hefner/City of Las Vegas
Design Completed:	12-18-92
Construction Completed:	4-29-94
Funded By:	City of Las Vegas
Lead Agency:	City of Las Vegas

Buffalo Channel

Design Engineer	VTN/Wallace/Poggemeyer
Design Completed:	8-31-92
Construction Completed:	8-18-94
Funded by:	RFCD
Lead Agency:	City of Las Vegas

Please accept this letter as our concurrence with the results of the study findings.

Sincerely,

Gale Wm. Fraser II

Gale Wm. Fraser, II, P.E.
General Manager/Chief Engineer

GWF:KLE:jwp

Enclosure

cc: Daryl Hathaway, Michael Baker Jr., Inc., w/enclosures
The Honorable Jan Laverty Jones, Mayor of Las Vegas
The Honorable John Seastrand, Mayor of North Las Vegas
The Honorable Jay Bingham, Chairman, Clark County Commission

NW FIS

MAYOR
JAN LAVERTY JONES

COUNCILMEN
ARNIE ADAMSEN
SCOTT HIGGINSON
FRANK HAWKINS JR.
KEN BRASS

CITY MANAGER
LARRY K. BARTON

CITY of LAS VEGAS

October 5, 1994

William R. Locke, Chief
Risk Studies Division
Federal Insurance Administration
Federal Emergency Management Agency
Washington, D.C. 20472

Dear Mr. Locke:

SUBJECT : NORTHWEST AREA RESTUDY/CITY OF LAS VEGAS/CLARK COUNTY, NV

This letter will serve as formal written request to consider revision of the flood insurance rate maps affected by the restudy of the Northwest Area in accordance with Section 65.4 of the National Flood Insurance Program regulations. Technical data was prepared by CVL Consultants, Inc. and Pentacore Engineering, Inc. and submitted by the Clark County Regional Flood Control District.

If you should have any questions or require any further information, please contact Kevin Eubanks of the Clark County Regional Flood Control District at (702) 455-3139.

Sincerely,

Jan Laverty Jones
Mayor

xc: Karl Mohr, FEMA, Washington, D.C.
Ken Nauman, FEMA, Region IX
Gale Fraser, P.E., Clark County Regional Flood Control District
Richard Goecke, CLV
Jack Moody, CVL Consultants, Inc.

File H:\home\tom\wpdata\ds\ors\nwarmayr

400 E. STEWART AVENUE • LAS VEGAS, NEVADA 89101-2986
(702) 229-6011 (VOICE) • (702) 386-9108 (TDD)

Section 3

Section 3
General Correspondence

STUDY CONTACTS

August 17, 1993

Northwest Las Vegas Flood Insurance Study Restudy

Review Committee Members

Name	Address	Phone #	Fax #
Mark Sorensen/ Tom Chiatovich	City of Las Vegas 400 E. Stewart Las Vegas, NV 89101	229-2338 229-6276 (Secretary)	382-8551
Bob Murnane Randy Tarr	City of North Las Vegas 2266 Civic Center Dr. North Las Vegas, NV 89030	657-2264 657-2265	649-4696
Phu Simpson	Clark County Public Works Community Development Dept. 401 S. 4th Street Las Vegas, NV 89101	455-4603	388-2550
Bill Brandt	Clark County Public Works Design Engineering Dept. 6655 W. Sahara, #C102 Las Vegas, NV 89102	455-7707	455-8314
Kevin Eubanks	Clark County Regional Flood Control District 301 E. Clark, #301 Las Vegas, NV 89101	455-3139	455-3870

Study Members

Name	Address	Phone #	Fax #
Michael Koizumi Paul Hoskin	CVL Consultants, Inc. 6655 W. Sahara, Ste. A-200 Las Vegas, NV 89102	368-3008	368-0047
	Coe & Van Loo Consultants, Inc. 4550 N. 12th Street Phoenix, AZ 85014	387-0314	(602) 264-0928
Gary Spinkelink Dean Rasmuson Doug Blatchford	Pentacore Engineering, Inc. 6763 W. Charleston Blvd. Las Vegas, NV 89102	258-0115	258-0865
Richard Cook	Aerial Mapping Co. 3141 W. Clarendon Ave. Phoenix, AZ 85017	(602) 455-7707	(602) 263-0165

AERIAL MAPPING COMPANY, INC.

3141 west clarendon avenue, phoenix, arizona 85017, (602) 263-5728 fax (602) 263-0165

Gerald E. Francis - President Richard D. Cook, R.L.S. - Executive Vice President

To: Mr. Paul W. R. Hoskin, P.E.
Coe & Van Loo Engineers
6655 West Sahara, Suite A200
Las Vegas, NV 89102

March 9, 1993

Re: Las Vegas Wash FEMA Study

We are pleased to present this proposal for certified professional photogrammetric services on the above project.

We will use photography at a scale of 1:7200 for the 2' CI accuracy strip mapping along Rancho Drive and along U.S. Hiway 95. Hiway 95 and Rancho Drive coverage will include 1500' upstream (west) and 500' downstream (east) along Rancho Drive. Mapping will be to FEMA guidelines and optimized for ARC-INFO conversion. We will show contours, spot elevations, major identifiable buildings, roads, streets, and highways. Street names will be shown for major roads. Final maps will be plotted in a mask with title block information.

Our fees are as follows:

RANCHO DRIVE and HIWAY 95 STRIP:

Aerial Photography flights at 1:7200. 2' CI mapping on 1" = 200' base sheets as above. Sixteen Thousand Six Hundred Dollars ($16,600.00).

CROSS SECTIONS:

Cross Sections will be digitized, measured, and converted to HEC-2 format. Up to 80 cross sections will be digitized and converted. Additional cross sections will be measured for a per cross section fee of $25.00 each.

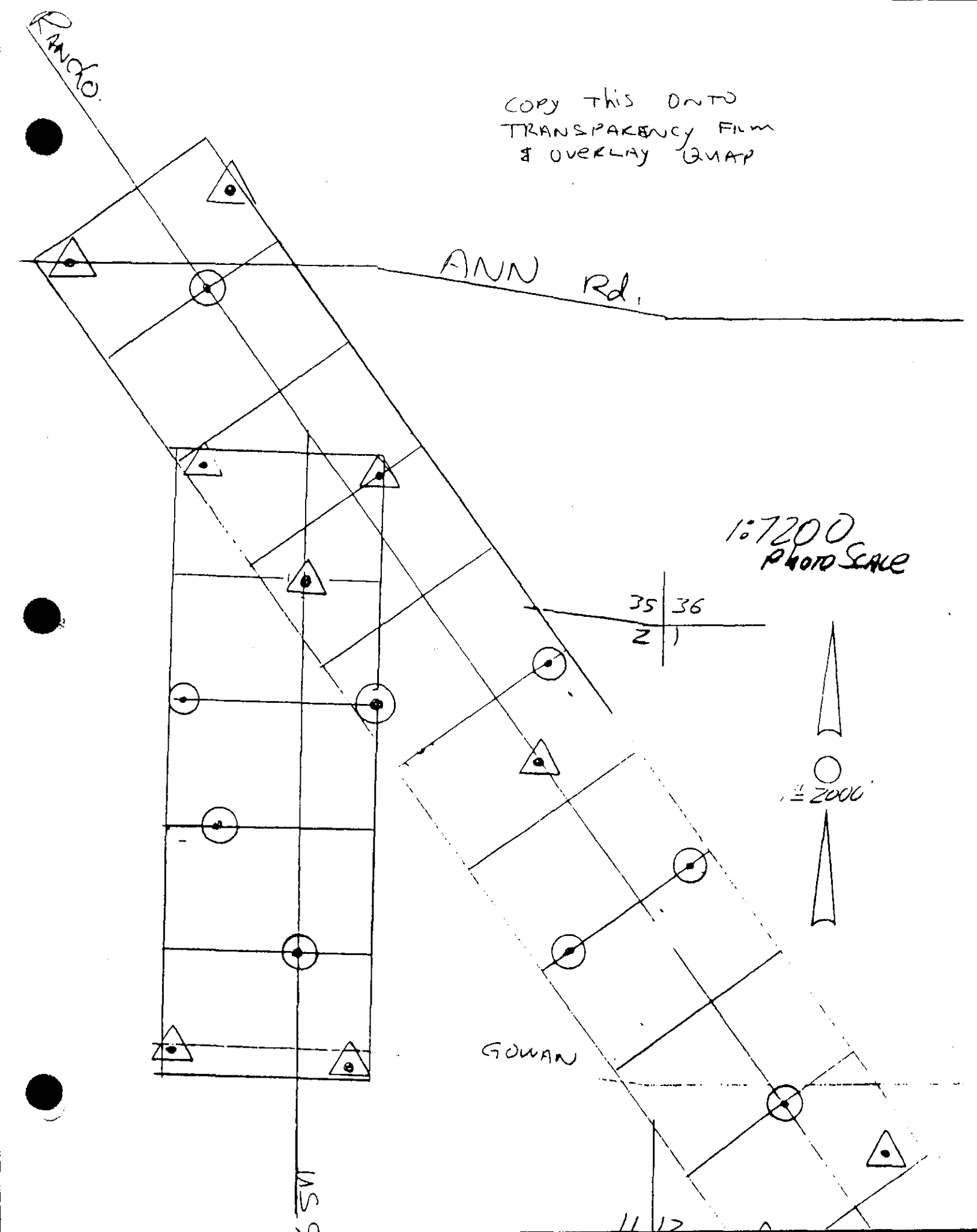
PHOTO MYLARS

Semi rectified photo mylars at +\- 1" = 200' may be included in this proposal. The photography for these sheets must be flown with the mapping photography. The fee for each sheet at 1" = 200' will be $125.00 per sheet ordered.

Thank you for this opportunity to be of service on this project. If there are any questions, please feel free to call.

Sincerely yours,

Richard D. Cook, P.L.S.
Executive Vice President
Aerial Mapping Company, Inc.


RANCHO.
COPY THIS ONTO TRANSPARENCY FILM & OVERLAY QUAD
ANN Rd.
1:7200 PHOTO SCALE
35
36
2
1
1" = 2000'
GOWAN

VTN NEVADA

CONSULTING ENGINEERS • PLANNERS • SURVEYORS

FAX TRANSMITTAL

TO: COO & VAN LOO

Fax: 602-264-0928

ATTN: YOUNG SON

Date: September 7, 1993

FROM: KEN GILBRETH

W.O.#:

REGARDING PROJECT/SUBJECT:

2 NUMBER OF PAGES INCLUDING THIS COVER SHEET.

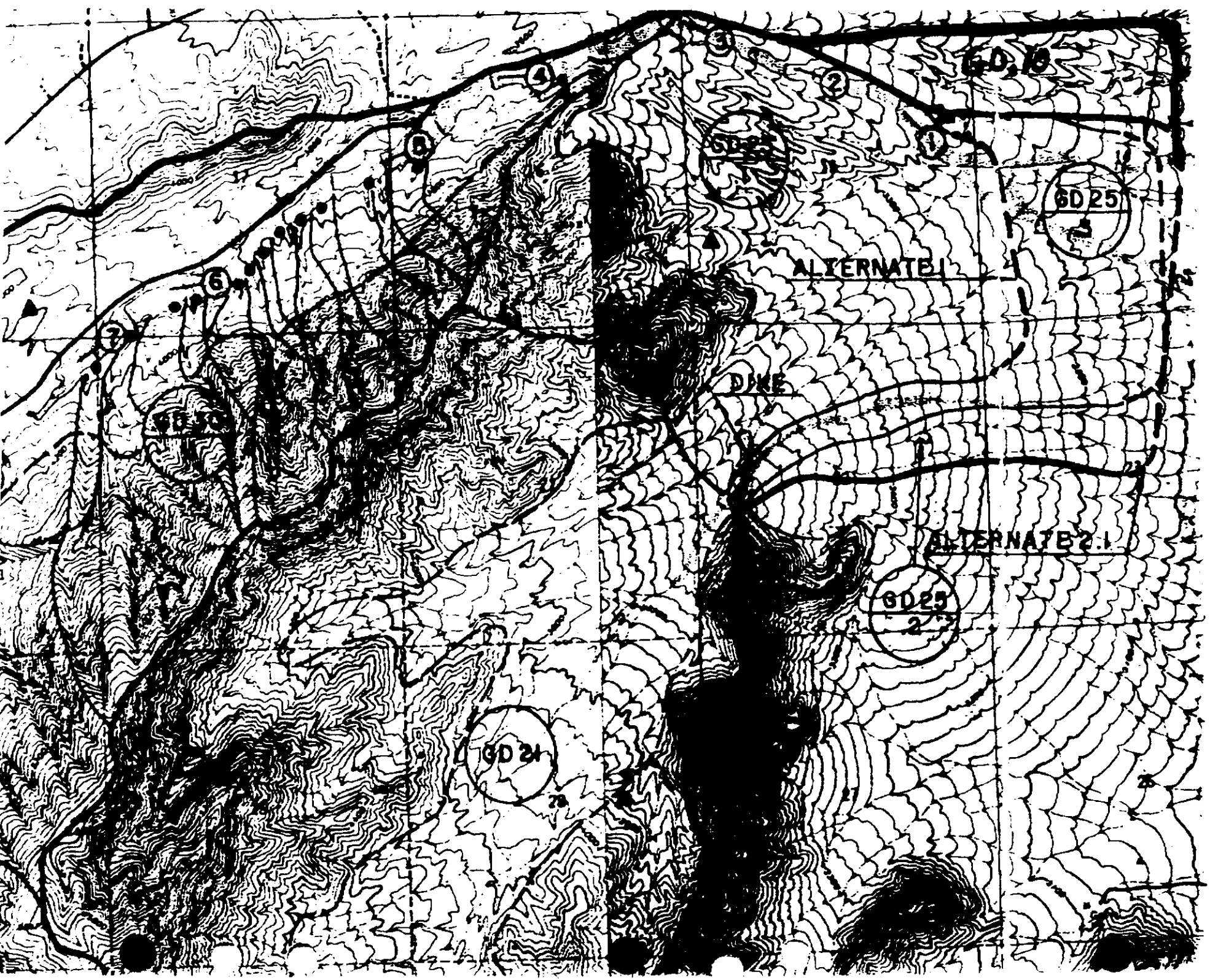
COMMENTS:

PLEASE NOTE BASIN GD 10.

Fax Machine Operator: Melissa Hedrick

COPY TO FOLLOW IN THE MAIL - NO

2727 SOUTH RAINBOW BOULEVARD LAS VEGAS, NEVADA 89102-5148
TEL. (702) 873-7550 FAX: 362-2597


GD 10
GD 25
ALTERNATE 1
DIKE
ALTERNATE 2.1
GD 25
2
GD 21

PENTACORE
Engineering, Inc.

FACSIMILE TRANSMITTAL FORM
PEI FAX NO. (702) 258-0865 OR 258-3477

COMPANY: Cox & Yen Loo FAX #: 1-602-264-0928

ATTENTION: Yong Song

FROM: Dean

SUBJECT: FTS

DATE: 9/15

Please find 6 pages (including cover sheet). If you do not receive all pages, please call (702) 258-0115.

Comments:

____ Original Sent by 1st Class Mail

____ Original Sent by Federal Express

Reply Requested ____ Yes

____ Original Sent by Certified Mail

X Original Will Not be Sent

____ No

Sent by: ____

Date: ____

Time: ____

Job #: ____

PREDESIGN MEMORANDUM

FOR

CAREY/LAKE MEAD DETENTION BASIN

VTN NEVADA
AUGUST 24, 1990

MEMORANDUM/TRANSMITTAL

Northwest Las Vegas Flood Insurance Study Restudy

DATE: October 19, 1993 TIME:

FAX NO.: OTHER

TO: Jack Moody FROM Dean Rasmuson

RE: Angel Park Detention Basin North

COMMENTS: I have completed the storage calculations for the detention basin and have verified the results using a variety of methods. The following is the stage-storage tabulation

Elev.	Storage (Ac-Ft)
2595	137.8
2600	214.3
2610	518.1
2615	728.3
2618.5	872.6
2620	936.6

Also attached is calculation for Angel Park Detention Basin South provided to us by the City of Las Vegas

CVL DISTRIBUTION:

cc:
- ☐ Mike Koizumi
- ☐ Paul Hoskin
- ☐ Doug Schneider
- ■ Other Jack Moody

PENTACORE DISTRIBUTION:

- ☐ Gary Spinkelink
- ☐ Dean Rasmuson
- ☐ Other

COMMITTEE DISTRIBUTION:

- ☐ Gale Fraser - CCRFCD
- ☐ Kevin Bubenik - CCRFCD
- ☐ Mark Sorenson - CLV
- ☐ Bob Murnane - NLV
- ☐ Phu Simpson - CCCD
- ☐ Bill Brandt - CCFWD
- ☐ Other

SHEET 1 OF _

GOWAN DETENTION BASIN PREDESIGN

HYDRAULIC
AND
COST ESTIMATE
CALCS. & SUPPORTING
DATA

G.C. WALLACE, INC.
Engineering/Architecture

DATE 1/89

CLIENT GLV JOB NO 412 BOAC CALC BY MNK

DESCRIPTION ANGEL PARK - SOUTH BASIN CHECKED BY

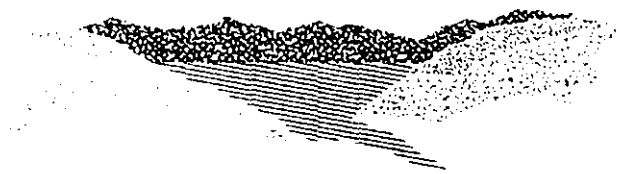
ANGEL PARK DETENTION : SOUTH BASIN - COMPUTE

#	STAGE	AREA Ac	STORAGE AC. FT.		STAGE	AREA Ac.	STORAGE AC. FT.
1.	2590	0	0	TO	2622	27.17	353.2
2.	2595	2.39	3.75	TO	2622.5	28.08	367.01
3.	2600	6.50	25.16		2623	29.01	381.25
4.	2605	9.56	65.06				
5.	2610	13.40	122.19				
6.	2615	17.68	199.64				
7.	2618	21.17	257.83				
8.	2618.5	21.75	268.6				
9.	2619	22.34	279.62				
10.	2619.5	22.92	290.93				
11.	2620	23.5	302.53				
12.	2620.5	24.12	314.51				
13.	2621	25.33	326.95				
14.	2621.5	26.25	339.85				

NOTE : SEE ADJUSTED STAGE - STORAGE CURVE & DATA SHEET 3 & 4.

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT



RECEIVED
OCT 25 1993
CVL CONSULTANTS INC

Gale Wm. Fraser, II, P.E.
Acting Chief Engineer/General Manager

BOARD OF DIRECTORS

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City of Las Vegas

Ken Carter
City of Mesquite

Yvonne Atkinson Gates
Clark County

Theron Goynes
City of North Las Vegas

Jan Laverty Jones
City of Las Vegas

Larry Scheffler
City of Henderson

Bruce L. Woodbury
Clark County

October 21, 1993

Mr. Michael Koizumi, P.E., President
Coe & Van Loo Consultants, Inc.
6655 West Sahara, A200
Las Vegas, NV 89107

Dear Mr. Koizumi:

Enclosed are two originals of the:

AMENDMENT TO THE AGREEMENT FOR PROFESSIONAL SERVICES CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT AND CVL CONSULTANTS, INC.

The contract was approved by the Regional Flood Control District
Board of Directors on October 14, 1993. Please execute both agreements and mail one of the originals back to the District.

Thank you for your prompt attention to this matter. If you have any questions, please feel free to call.

Sincerely,

Deanna Lefko

Deanna Lefko
Management Analyst
Secretary to the Board

Enclosures

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

RECEIVED
NOV 01 1993
COE & VAN LOO

Gale Wm. Fraser, II, P.E.
Acting Chief Engineer/General Manager

BOARD OF DIRECTORS

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City of Mesquite

Yvonne Atkinson Gates
Clark County

Theron Goynes
City of North Las Vegas

Jan Laverty Jones
City of Las Vegas

Larry Scheffler
City of Henderson

Bruce L. Woodbury
Clark County

October 25, 1993

Mr. Michael Koizumi, P.E.
CVL Consultants, Inc.
6655 W. Sahara, Suite A-200
Las Vegas, NV 89102

Northwest Area Flood Insurance Study
Notice To Proceed - Supplemental Services

Dear Mr. Koizumi:

This letter will serve as official notice to proceed with Task Numbers 8.1 and 8.2, Supplemental Services, of the Agreement for Professional Services entered into between the District and CVL Consultants, Inc. on May 13, 1993 and amended on October 14, 1993. These services include additional hydrologic analyses and report preparation to incorporate future and existing flood control facilities and field conditions into this study and to provide a higher level of detail to support revised floodplain delineations.

The supplemental services authorized by this notice will be in conformance with the "Scope of Services for FIS Hydrology Update" (Exhibit F) presented in Paul Hoskin's October 11, 1993 letter to Kevin Eubanks at a cost not to exceed $23,390.

If you should have any questions, please contact Kevin Eubanks.

Sincerely,

Gale Wm. Fraser, II, P.E.
Acting General Manager/Chief Engineer

cc: Paul Hoskin, Coe & Van Loo, Phoenix Office

GWF:KLE:jwp

File: NW FIS

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

RECEIVED
OCT 01 1993
COE & VAN LOO
PHOENIX, AZ

LETTER OF TRANSMITTAL

Coe & Van Loo

4550 N. 12th Street

Phoenix, AZ 85014

DATE	JOB NO
10-28-93	93-0017-01

ATTENTION: Paul Hoskin

RE: Flood Control

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Mail the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1			Signed Contract Agreement for the above referenced project

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit_____copies for approval

☐ For your use ☐ Approved as noted ☐ Submit_____copies for distribution

XXX As requested ☐ Returned for corrections ☐ Return_____corrected prints

☐ For review and comment ☐ _____

☐ FOR BIDS DUE _____ 19_____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS Paul - I have sent the other original signed Contract Agreement to Deanna Lefko at the Flood Control District and made an additional copy for our files here.

RECEIVED BY:

DATE:

COPY TO FILE

SIGNED: Susan Pugh

40% Pre-Consumer Content • 10% Post-Consumer Content

PRODUCT 248 NEBS Inc. Bedford, Mass. 01471.

If enclosures are not as noted, kindly notify us at once.

MAYOR
JAN LAVERTY JONES

COUNCILMEN
ARNIE ADAMSEN
SCOTT HIGGINSON
FRANK HAWKINS JR.
KEN BRASS

CITY of LAS VEGAS

Date: November 15, 1993

To: Clark County Regional Flood Control District
301 E. Clark Ave., Suite 301
Las Vegas, Nevada 89101

Attention: Mr. Kevin Eubanks, P.E.

Subject: Flood Insurance Study Restudy Northwest Study Area

Dear Mr. Eubanks

The City of Las Vegas has reviewed the draft Hydrologic Analysis Report for the subject project received on 10-13-93 and offers the following comments:

1. The HEC-1 runs are difficult to review without large scale basin maps identifying all basins, concentration points, flow splits, detention basin discharges, etc. A more complete review of the HEC-1 runs will be performed when the improved figures are provided.

2. Flows into the Gowan North Basin appear too large for existing conditions. CLV staff feel that more flow will roughly follow Alexander Road and bypass the basin.

3. CLV staff have significant concerns regarding the model results that indicate over-topping of the Angel Park and Carey/Lake Mead detention basins, when more detailed basin maps (as requested in Comment 1 above) are provided to the City additional review of the basin modeling will be performed.

Sincerely,

Mark A. Sorensen, P.E.
Principal Civil Engineer
Department of Public Works

cc: Tom Chiatovich, P.E.
Charles Kajkowski, P.E.
CVL

400 E. STEWART AVENUE • LAS VEGAS, NEVADA 89101-2986
(702) 229-6011 (VOICE) • (702) 386-9108 (TDD)

Mike Kagimi - CVL

Doug

VLC

FAX SHEET

HDR

Memorandum

Date: January 5, 1994

Number of Pages (includes cover page): 4

To: Marty Manning FAX Number: 702.455.7764

Firm: Public Works Department

City: Las Vegas State: Nevada

From: HDR ENGINEERING, INC., PHOENIX

Name: Oliver Antony Dept. 044/Job Number:

Telephone: (602) 264-0731 FAX (602) 265-6472

Subject: Interchange on U.S. 95 at Rancho Drive and Ann Road -- Public Information Meeting

There will be a public information meeting held on Thursday, January 13, 1994, from 4:00 p.m. to 7:00 p.m. at the Mare Kahre Elementary School Multipurpose Room, 7887 West Gowan Road. You are most cordially invited to attend. The subject of the meeting is the interchange on U.S. 95 at Rancho Drive and Ann Road.

RECEIVED
JAN 10 1994
CONSULTANTS, INC.

Copy to Dave

JASP
01/07/94

HDR Engineering, Inc.

5353 N. 16th Street
Suite 205
Phoenix, Arizona
85016-3226

Telephone: (602) 264-0731
FAX Number: (602) 265-6472

TRANSPORTATION NOTICE
PUBLIC INFORMATION MEETING

PURPOSE OF MEETING:

The Nevada Department of Transportation (NDOT), in cooperation with the Federal Highway Administration (FHWA), is developing an interchange project on US 95 to serve traffic to and from both Ann Road and Rancho Drive. We will display alternate interchange layouts that are being considered and receive input from individuals, groups, and agencies interested in the project.

WHEN AND WHERE:

The meeting will be held Thursday, January 13, 1994 from 4:00 p.m. to 7:00 p.m. at the Mary Kahre Elementary School Multipurpose Room, 7887 West Gowan Road. Meeting participants should enter through the west door.

WHY:

The proposed project will replace the existing at-grade intersections of US 95 with Ann road and Rancho Drive. An interchange with ramps and overpass structures is anticipated. This will increase traffic capacity and enhance safety.

WHERE YOU COME IN:

Members of the public are invited to attend the meeting at their convenience any time during the meeting hours (4:00 to 7:00 p.m.) and submit their comments in writing on a comment sheet provided at the meeting or in person to a public stenographer who will be available throughout the meeting. This meeting format increases the opportunity for public comment and provides for one-on-one discussion with staff involved with the project.

In addition to any comments received at the meeting, written comments also will be accepted until 5:00 p.m., Friday, January 28, 1994. Please submit your comments to:

Daryl N. James, P.E., Chief
Environmental Services Division
Nevada Department of Transportation
1263 South Stewart Street
Carson City, Nevada 89712

12:52PM NDOT CARSON CITY

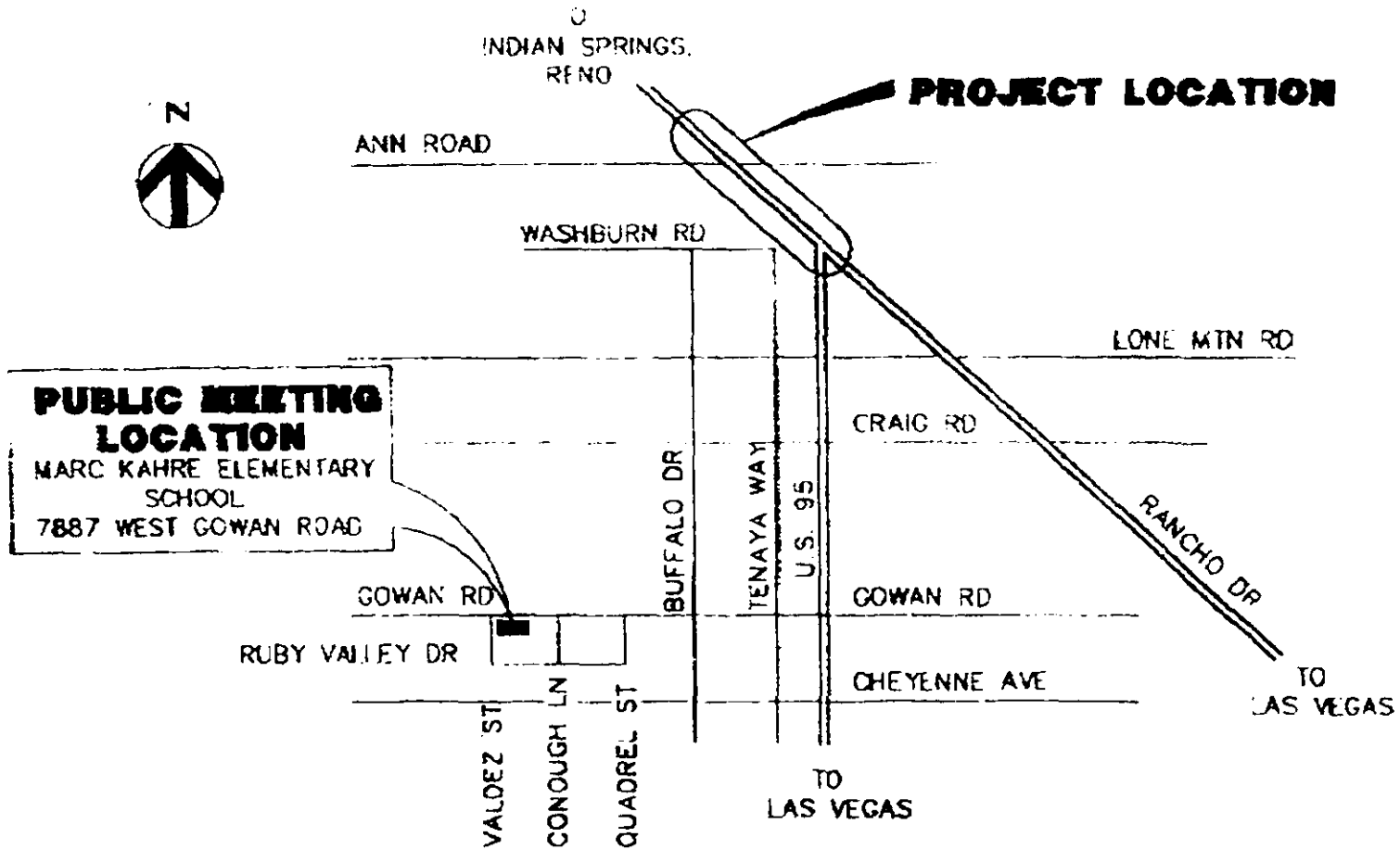
IF RIGHT-OF-WAY IS REQUIRED: The Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 will govern the acquisition of any right-of-way necessary for this project. More detailed information on right-of-way acquisition and relocation assistance can be obtained by calling or visiting the Nevada Department of Transportation, Right-of-Way Office, 123 East Washington, Las Vegas, Nevada, telephone (702) 385-6540.

General information about the meeting can be obtained from the NDOT District Office, P. O. Box 170, 123 East Washington, Las Vegas, Nevada 89101, telephone (702) 385-6500 or from Ted P. Bendure, Environmental Studies Supervisor, Nevada Department of Transportation, 1263 South Stewart Street, Carson City, Nevada 89712, telephone (702) 687-5680.

Certain project materials are available on alternative formats upon request. A sign language interpreter will be available upon request. Contact Ted P. Bendure, Environmental Studies Supervisor, Nevada Department of Transportation, 1263 South Stewart Street, Carson City, Nevada 89712, telephone (702) 687-5680 no later than Monday, January 3, 1994, so that arrangements can be made.

The Equal Opportunity Bus (EOB) 646-2052 is available for handicapped individuals to allow for participation in the meeting. Check with them for scheduling.

INTERCHANGE ON U.S. 95 AT RANCHO DR AND ANN RD
PROJECT LOCATION MAP



HDR

HDR Engineering, Inc.

CVL CONSULTANTS, INC.
6655 W. Sahara, Suite A200
Las Vegas, Nevada 89102
Telephone: (702) 368-3008 FAX: (702) 368-0047

FAX TRANSMITTAL COVER SHEET

Date: 1/10 Time: 4:37 Job No.:

To: Paul Haskin Fax No.:

Company/Department:

From: Dave for M. Kazemi

Number of Pages Being Sent Including Cover Sheet 5

Comments:

If there are any problems with this transmission, please call (702) 368-3008.

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

DATE	JOB NO.
1-11-94	93-0017-01

ATTENTION: Kevin Eubanks

RE: Northwest Las Vegas Flood Insurance Study (NWLVFIS)

TO: Clark County Regional Flood Control
Design Enginnering Dept.
~~301 E. Clark, #301~~
Las Vegas, NV 89101

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Delivery the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	1-10-94	1	NWLVFIS Hydrologic Analysis Report
1	1-10-94	1	NWLVFIS Technical Appendix

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit_____copies for approval
XXX For your use ☐ Approved as noted ☐ Submit_____copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return_____corrected prints
☐ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 19_____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS Enclosed you will find a draft copy of the NWLVFIS Hydrologic Analysis Report and Technical Appendix. Please review the documents and compile your review comments for discussion at the the next scheduled committee meeting on Tuesday, January 18, 1994. If you have any questions prior to the meeting, please give me or Paul Hoskin a call.

RECEIVED BY:

DATE:

COPY TO FILE

SIGNED: Jack Moody

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

TO City of Las Vegas
400 E. Stewart Street
Las Vegas, NV 89101

DATE	JOB NO.
1-11-94	93-0017-01

ATTENTION: Mark Sorensen

RE: Northwest Las Vegas Flood Insurance Study (NWLVFIS)

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Delivery the following items:

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DATE:

COPY TO FILE

SIGNED: Jack Moody

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

TO City of N. Las Vegas
2266 Civic Center Drive
N. Las Vegas, NV 89030

DATE	JOB NO.
1-11-94	93-0017-01

ATTENTION: Bob Murnane

RE: Northwest Las Vegas Flood Insurance Study (NWLVFIS)

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RECEIVED BY:

DATE:

COPY TO FILE

SIGNED: Jack Moody

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

DATE	JOB NO.
1-11-94	93-0017-01

ATTENTION: Phil Simpson

RE: Northwest Las Vegas Flood Insurance Study (NWLVFIS)

TO: Clark County Public Works
Community Development Dept.
401 S. Fourth Street
Las Vegas, NV 89101

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Delivery the following items:

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RECEIVED BY:

DATE:

COPY TO: FILE

SIGNED: Jack Moody
Jack Moody

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

TO Clark County P.W.
6655 W. Sahara, Suite C102
Las Vegas, NV 89102

DATE 1-11-94 | JOB NO. 93-0017-01
ATTENTION Bill Brandt
RE: Northwest Las Vegas Flood Insurance Study (NWLVFIS)

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Delivery the following items:

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RECEIVED BY:

DATE:

COPY TO FILE

Jack Moody
SIGNED: Jack Moody

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

DATE	JOB NO
1-11-94	93-0017-01

ATTENTION: Dean Rasmuson

RE: Northwest Las Vegas Flood Insurance Study (NWLVFIS)

TO: Pentacore Engineering, Inc.
6763 W. Charleston Blvd.
Las Vegas, NV 89102

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Delivery the following items:

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☐ Copy of letter ☐ Change order ☐ _____

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RECEIVED BY:

DATE:

COPY TO FILE

SIGNED: Jack Moody

40% Pre-Consumer Content • 10% Post Consumer Content

CVL CONSULTANTS, INC.
6655 W. Sahara, Suite A200
Las Vegas, Nevada 89102
Telephone: (702) 368-3008 FAX: (702) 368-0047

FAX TRANSMITTAL COVER SHEET

Date: 1/12 Time: 11:30 a.m. Job No.: 93-0017-01

To: Paul Hoskin / Jack Moody Fax No.: _____

Company/Department: _____

From: Dan Rude

Number of Pages Being Sent Including Cover Sheet: 6

Comments: Signed Sts. of Transmittals attached.

If there are any problems with this transmission, please call (702) 368-3008.

THESE ARE TRANSMITTED as checked below:

☐ For approval	☐ Approved as submitted	☐ Resubmit_____ copies for approval
XXX For your use	☐ Approved as noted	☐ Submit_____ copies for distribution
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RECEIVED BY: _____

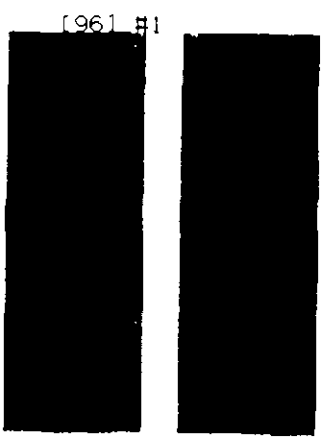
DATE: 1-11-94

COPY TO FILE

SIGNED: Jack Moody

Jack Moody

40% Pre-Consumer Content • 10% Post-Consumer Content



CITY OF NORTH LAS VEGAS

Dept. of Public Works

FAX TRANSMITTAL

DATE : 2/17/94

TO : Jack Moody

FROM : Randy Tarr

City of North Las Vegas
Dept. of Public Works
P. O. Box 4086
2266 Civic Center Drive
North Las Vegas, NV 89030
Phone: 657-2267

Number of Pages 2 **Plus Cover Sheet**

SENT BY: RT

FAX # : 702-649-4696

COMMENTS:

Copy to Follow in Mail: ____ **YES** ✓ **NO**

City of
North Las Vegas

2200 Civic Center Drive
P.O. Box 4086
North Las Vegas, Nevada 89036
(702) 649-5811

Mayor
James K. Seastrand

Councilmen
Theron H. Goynes
Mary J. Kincaid
William E. Robinson
John K. Rhodes

City Manager
Michael Dyal

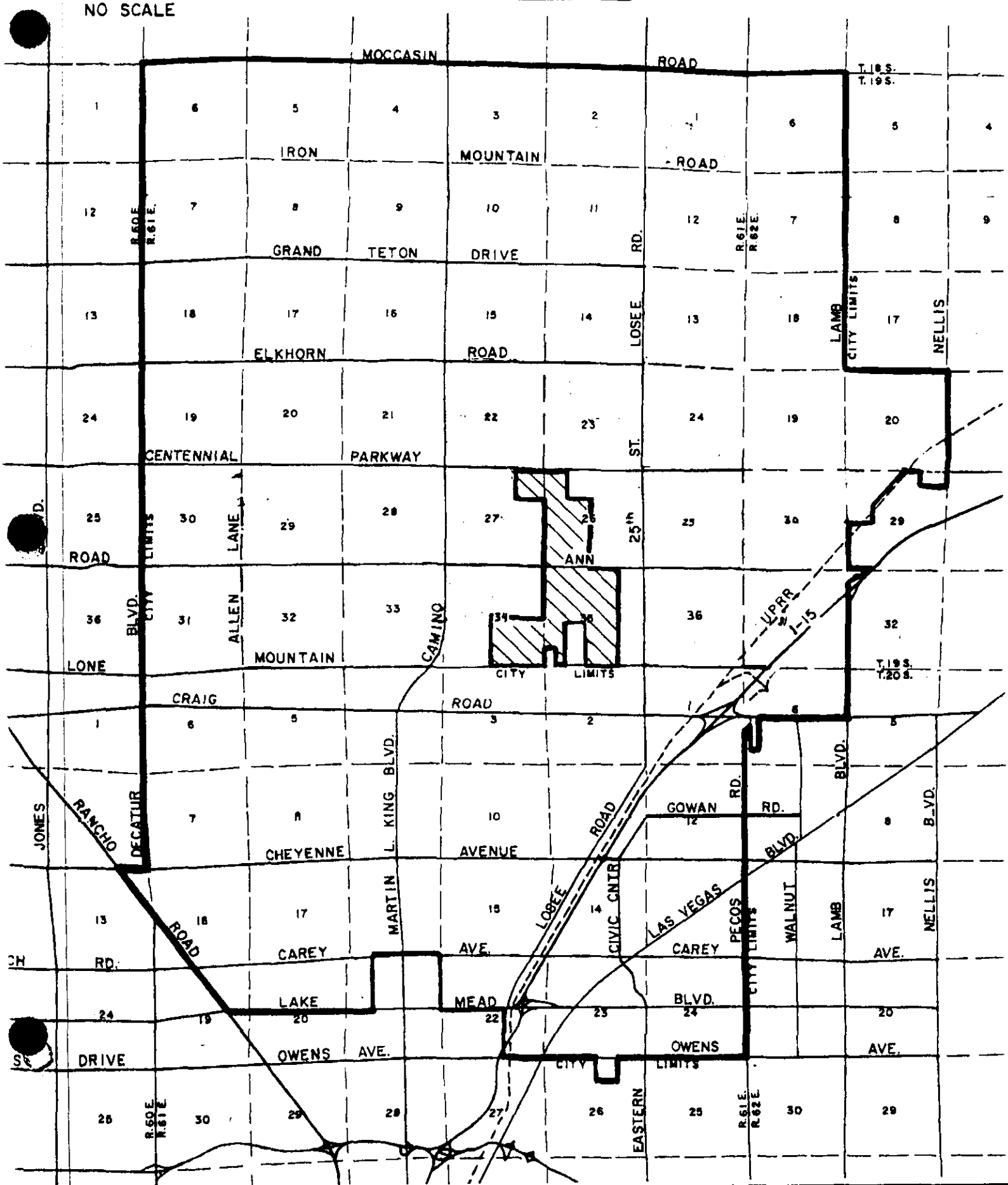
City of N. Las Vegas 6494696 02-17-94 02:10PM [96] #2

CITY OF NORTH LAS VEGAS

REVISED: 10-1-93

CORPORATE BOUNDARY

NORTH
NO SCALE



Coe & Van Loo Consultants, Inc.
4550 North 12th Street
Phoenix, Arizona 85014
Telephone: (602) 264-6831 FAX: (602) 264-0928

FAX TRANSMITTAL COVER SHEET

Date: 2-25-94

Time: 4:15

Job No: _____

To: Mark Sorenson FAX No: (702) 382-8551

Company/Department: CLV 229-2338

From: Jack Moody

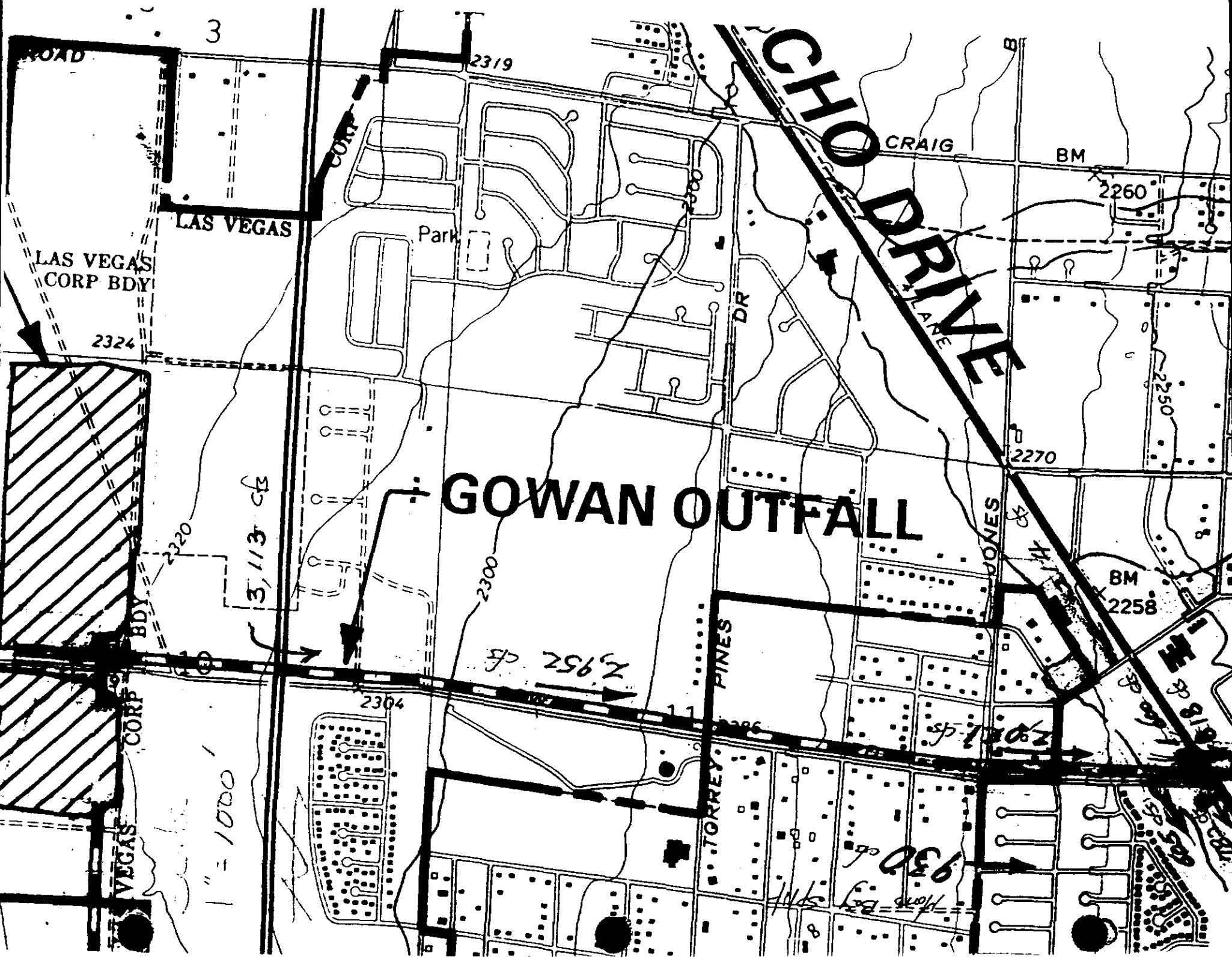
Number of Pages Being Sent Including Cover Sheet: 2

Comments:

Here are the 100-year flows along Gowan Rd. that you asked for.

Jack

If there are any problems with this transmission, please call (602) 264-6831 ext. ____


3
ROAD
2319
CORP
LAS VEGAS
LAS VEGAS
CORP BDY
2324
Park
CRAIG
BM
2260
CHO DRIVE
LANE
DR
2250
2270
GOWAN OUTFALL
3,113 cfs
2320
2300
JONES
BM
2258
2,952 cfs
2304
TORREY PINES
CORP
VEGAS
1" = 1000'
930 cfs

PENTACORE

Surveying, Inc.

FACSIMILE TRANSMITTAL FORM

COMPANY: COE & VAN LOE FAX #: 1-602-264-0928

ATTENTION: YONG SONG

FROM: BYRON JOHNSON

SUBJECT: NORTHWEST FLOODSTUDY ERM's

DATE: 2-28-94

Please find 4 pages (including cover sheet). If you do not receive all pages, please call (702) 258-4110.

Fax # (702) 258-4790

Comments:

Sent by: BYRON

Date: 2-28-94

Time:

Job #:

ERM's ON RANCHO

#1-RIVET IN T/C NW CORNER OF CHEYENNE & RANCHO @ BCR OF RANCHO
7C00-12SSE6 Elev. 2238.83'

#10 RIVET & PLATE SW CORNER OF RANCHO & MICHAEL WAY T/C BCR ON RANCHO
7C00-1256 Elev. 2251.095'

#11 RIVET & PLATE SW CORNER RANCHO & GOWAN T/C BCR ON GOWAN
7C00-12C4 Elev. 2251.85'

#12 USC&GS BRASS CAP T-398 IN CENTERLINE MEDIAN OF RANCHO 250' +/- SOUTH OF DUNCAN DR.
Elev. 2254.24'

#13 RIVET & PLATE WEST SIDE OF RANCHO SOUTH OF NORTH D/W TO CRYSTAL PALACE SKATE RINK 1200' +/- NORTH OF DUNCAN DR.
7C00-12NW6 Elev. 2259.94'

#14 RIVET & PLATE IN SOUTH END OF HEADWALL 7' +/- EAST OF E/P 450' +/- SOUTH OF JONES
7C00-12NE5 Elev. 2263.21'

#15 RIVET & PLATE SOUTH END OF HEADWALL 4' +/- EAST OF E/P ON RANCHO 450' +/- NORTH OF JONES
7C00-12NE Elev. 2269.87'

#16 RIVET & PLATE T/C WEST SIDE OF RANCHO JUST SOUTH OF NORTH D/W TO HORIZON RECOVERY CENTER
7C00-2SE6 Elev. 2280.55'

ERVI's ON RANCHO

#30 RIVET & PLATE NORTHWEST CORNER RANCHO & CRAIG ON CRAIG RD.
Elev. 2294.29'

#47 BRASS CAP IN CONCRETE, NW CORNER RAINBOW & RANCHO USC & GS BM #R169
1LV90-34SEE6 Elev. 2318.40'

#46 5/8" REBAR IN NG 50' W OF ℄ RAINBOW & WELCOME LN. 8' N OF TELEPHONE STANDPIPE
1LV90-34E4 Elev. 2319.05'

#29 BRASS CAP USC & GS BM #S169 (RESET 1963) 400' NW OF ANN RD. & 100' EAST OF 95
1LV90-27S5W6 Elev. 2356.49'

#31 RIVET & PLATE IN T/C SW CORNER PAINTED MIRAGE RD. & ANN RD.
1LV90-34NNW6 Elev. 2360.01'

EBM's ON HWY 95

#8 Top of southerly end of headwall west side of US 95 on line with north fence line of Santa Fe Parking lot

Elev. 2326.42'

#26 Broken rivet in top of south end of headwall northwest cor. of Lone Mtn Rd & US 95

Elev. 2325.06'

#53 South end of headwall 25' west of edge of pavement US 95 southbound, 100' +/- north of Craig Rd.

Elev. 2322.85'

#48 Found rivet & washer in top of west headwall at northwest side of Alexander & US 95

Elev. 2317.87'

#50 Middle of north edge of 7'x7' concrete drain inlet structure 100' +/- west of US 95 & 75' +/- north of Gowan Rd.

Elev. 2307.81'

TRANSMITTAL

COE & VAN LOO

TO: Clark County Regional Flood Control Dist.

301 E. Clark, #301

Lask Vegas, NV 89101

ATTN: Kevin Eubanks

TRANSMITTING VIA: Fed Ex

DATE: 5-12-94

PROJECT: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Rancho Drive-Workmaps

ENCLOSED x UNDER SEPARATE COVER _____

THE FOLLOWING ARE SUBMITTED:

_____ ORIGINALS
_____ PHOTOCOPIES
__x__ PRINTS
_____ FEES (SEE BELOW)
_____ OTHER (SEE BELOW)

__x__ AS REQUESTED
_____ FOR YOUR INPUT
_____ FOR YOUR APPROVAL
_____ FOR YOUR SIGNATURE

_____ FOR YOUR REPLY/ACTION
__x__ FOR YOUR INFORMATION/FILE

NO. OF COPIES	DATED	DESCRIPTION
2	5-12-94	Workmaps for Rancho Drive

REMARKS OR REPLY Please call me if you have any questions.

Thanks.

COPY TO: _____

RECEIVED BY: _____ DATE: _____

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LOO

TO: Clark County Public Works
Design Engineering Dept.
6655 W. Sahara, #C 102
Las Vegas, NV 89102

ATTN: Bill Brandt

TRANSMITTING VIA: Fed Ex

DATE: 5-12-94

PROJECT: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Rancho Drive-Workmaps

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

___ ORIGINALS	x AS REQUESTED	___ FOR YOUR REPLY/ACTION
___ PHOTOCOPIES	___ FOR YOUR INPUT	x FOR YOUR INFORMATION/FILE
x PRINTS	___ FOR YOUR APPROVAL	
___ FEES (SEE BELOW)	___ FOR YOUR SIGNATURE	
___ OTHER (SEE BELOW)		

NO. OF COPIES	DATED	DESCRIPTION
2	5-12-94	Workmaps for Rancho Drive

REMARKS OR REPLY: Please call me if you have any questions.

Thanks.

COPY TO:

RECEIVED BY: DATE:

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LOO

TO: Clark County Public Works
Community Development Dept.
401 S. 4th Street
Las Vegas, NV 89101

ATTN: Phu Simpson

TRANSMITTING VIA: Fed Ex

DATE: 5-12-94

PROJECT: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Rancho Drive-Workmaps

ENCLOSED x UNDER SEPARATE COVER

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___ OTHER (SEE BELOW)		

NO. OF COPIES	DATED	DESCRIPTION
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REMARKS OR REPLY Please give me a call if you have any questions.

Thanks.

COPY TO:

RECEIVED BY: DATE:

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LOO

TO: City of North Las Vegas

2266 Civic Center Drive

North Las Vegas, NV 89030

ATTN: Bob Murnane/Randy Tarr

TRANSMITTING VIA: Fed Ex

DATE: 5-12-94

PROJECT: NORTHWEST LAS VEAGS FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Rancho Drive-Workmaps

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

- ___ ORIGINALS
- ___ PHOTOCOPIES
- x PRINTS
- ___ FEES (SEE BELOW)
- ___ OTHER (SEE BELOW)

- x AS REQUESTED
- ___ FOR YOUR INPUT
- ___ FOR YOUR APPROVAL
- ___ FOR YOUR SIGNATURE

- ___ FOR YOUR REPLY/ACTION
- x FOR YOUR INFORMATION/FILE

NO. OF COPIES	DATED	DESCRIPTION
2	5-12-94	Workmaps for Rancho Drive

REMARKS OR REPLY Please call if you have any questions.

Thanks.

COPY TO: ___

SINCERELY,
COE & VAN LOO

RECEIVED BY: ___ DATE: ___

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LOO

TO: City of Las Vegas

400 E. Stewart

Las Vegas, NV 89101

DATE: 5-12-94

PROJECT: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Rancho Drive-Workmaps

ATTN: Mark Sorensen/Tom Chiatovich

TRANSMITTING VIA: Fed Ex

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

_____ ORIGINALS
_____ PHOTOCOPIES
x PRINTS
_____ FEES (SEE BELOW)
_____ OTHER (SEE BELOW)

x AS REQUESTED
_____ FOR YOUR INPUT
_____ FOR YOUR APPROVAL
_____ FOR YOUR SIGNATURE

_____ FOR YOUR REPLY/ACTION
x FOR YOUR INFORMATION/FILE

NO. OF COPIES	DATED	DESCRIPTION
2	5-12-94	Workmaps for Rancho Drive

REMARKS OR REPLY: Please call if you have any questions.

Thanks.

COPY TO: _____

SINCERELY,
COE & VAN LOO

RECEIVED BY: _____ DATE: _____

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

Coe & Van Loo Consultants, Inc.
4550 North 12th Street
Phoenix, Arizona 85014
Telephone: (602) 264-6831 FAX: (602) 264-0928

FAX TRANSMITTAL COVER SHEET

Date: 5/16/94

Time: 5:20 PM

Job No: 83017

To: John Vega FAX No: (702) 362-7602

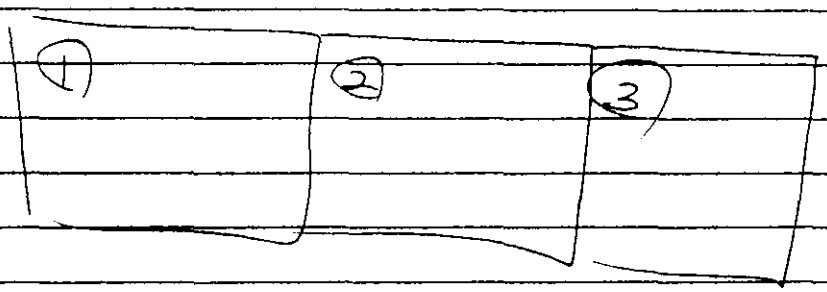
Company/Department:

From: Yong K Song

Number of Pages Being Sent Including Cover Sheet: 4

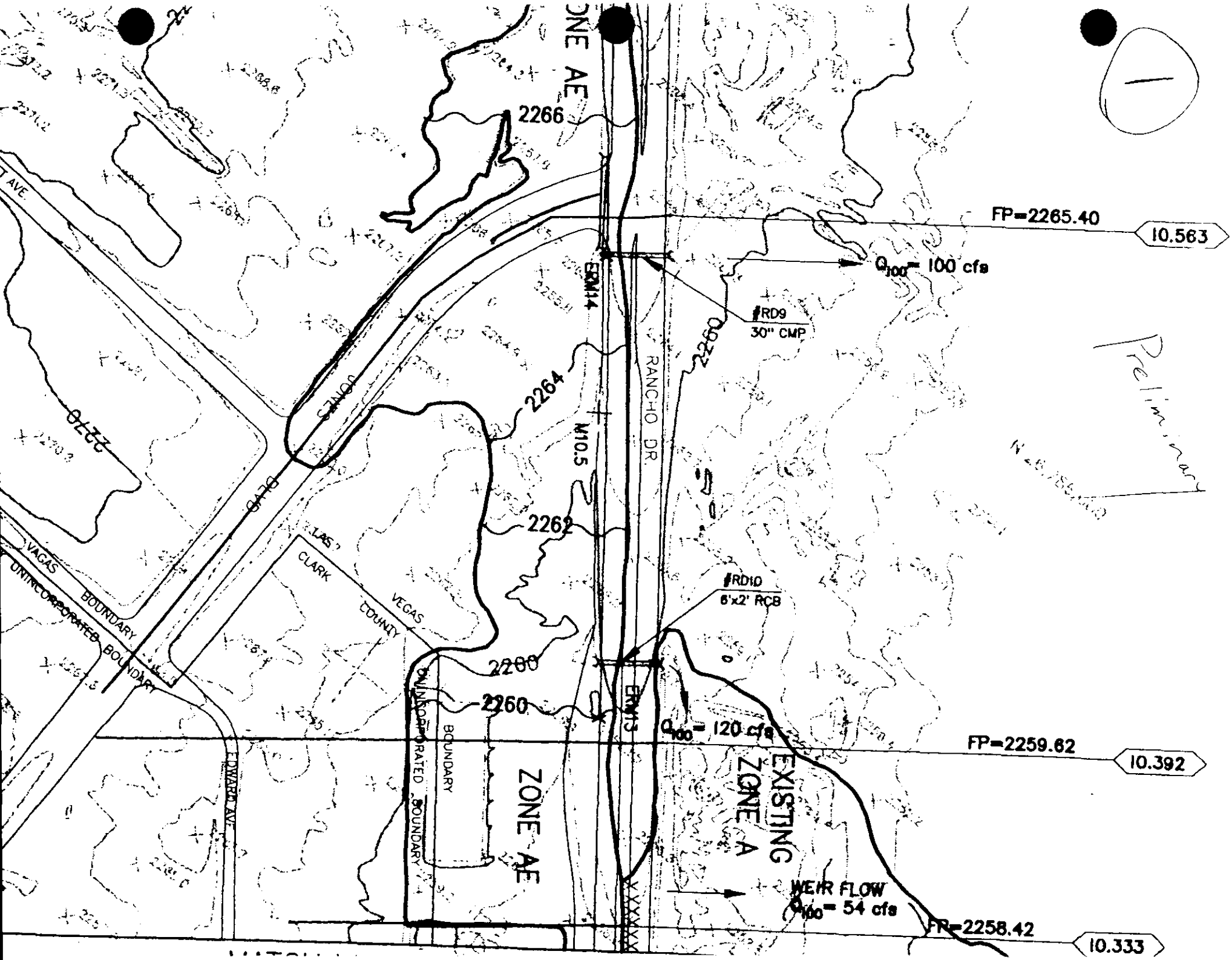
Comments:

Please call me if you have any other questions



If there are any problems with this transmission, please call (602) 264-6831 ext. 65

K:\240\FORMS\FAX.FRM


ZONE AE
2266
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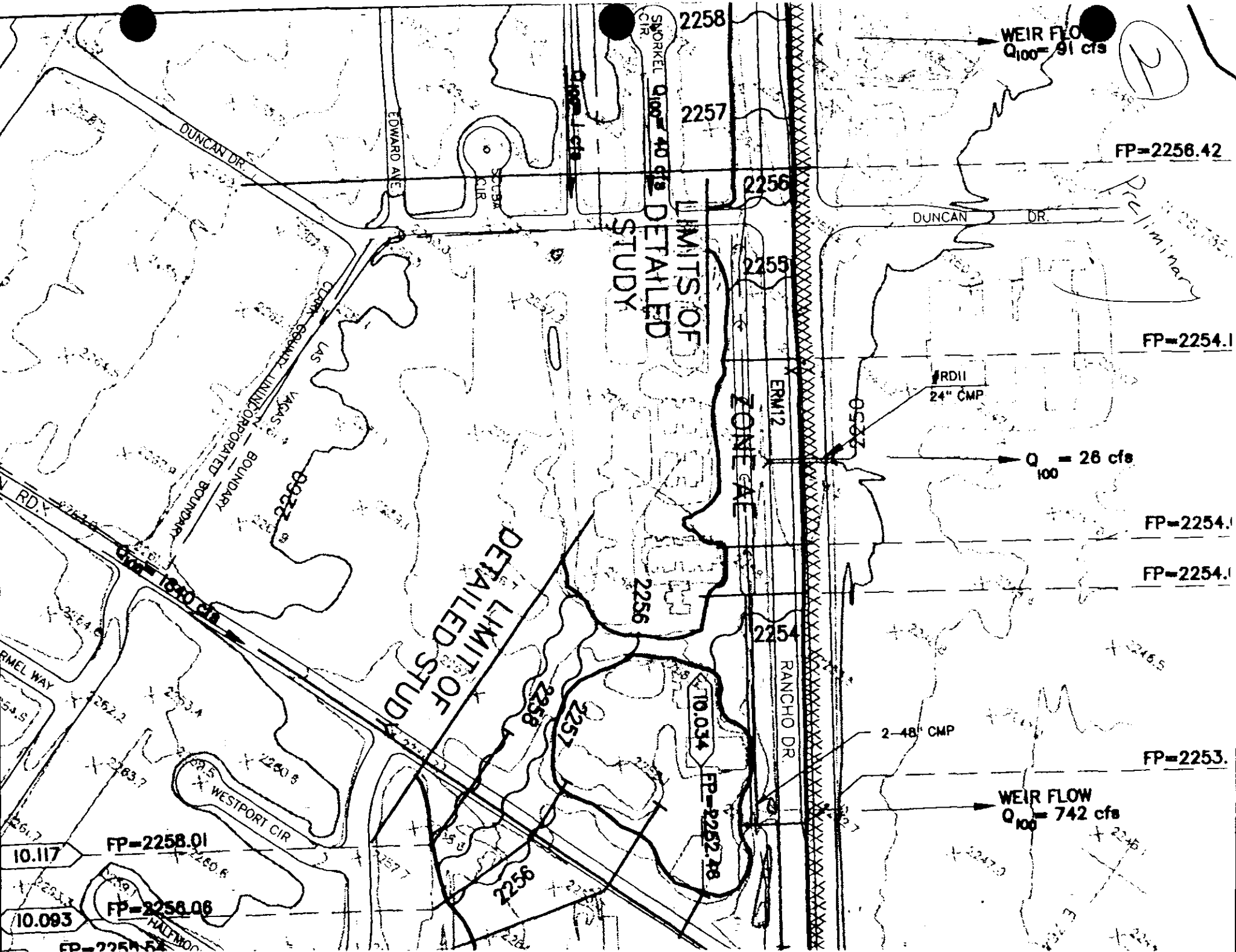
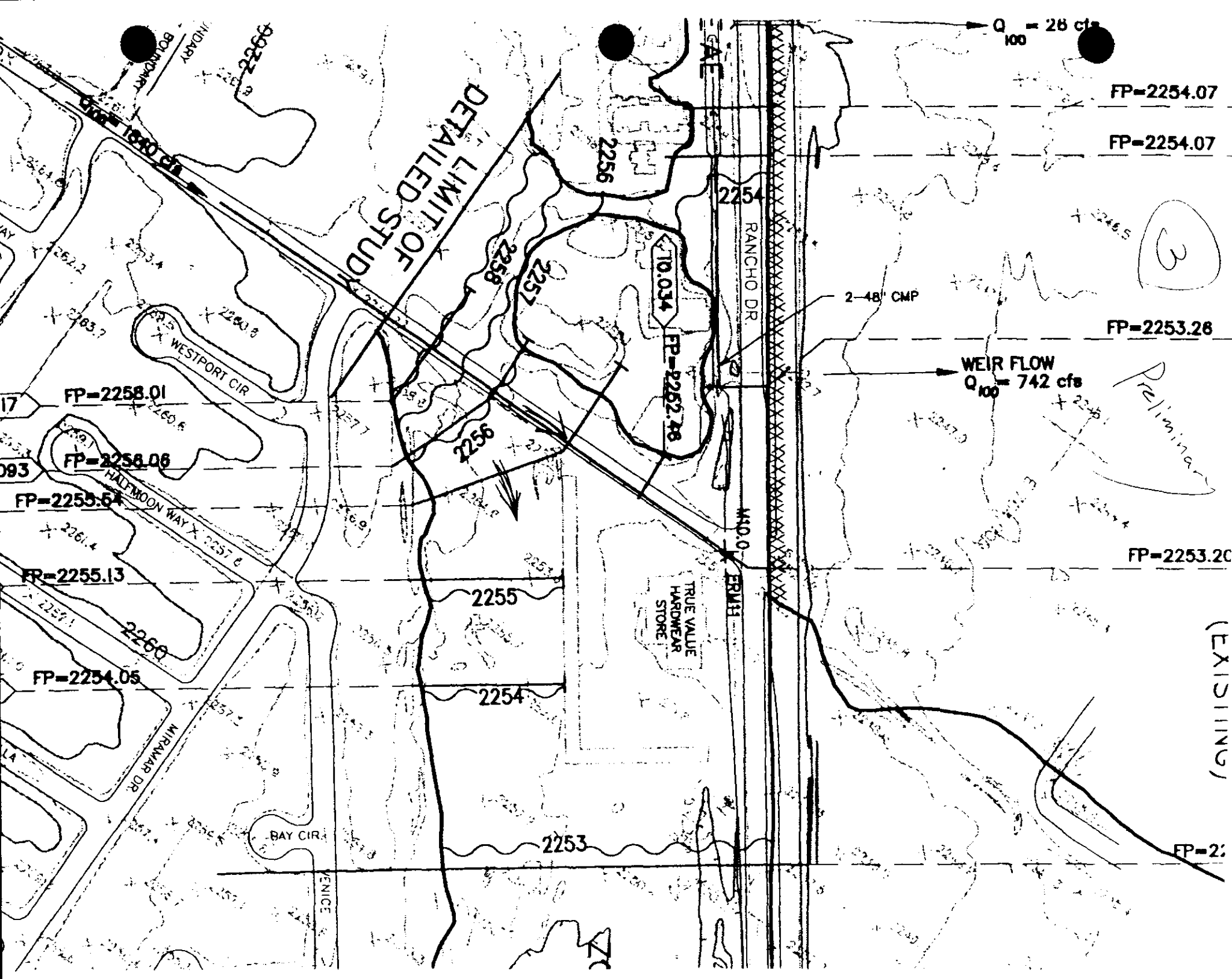
Q_{100}= 100 cfs
RD9
30" CMP
ERM14
RANCHO DR.
2260
2264
M10.5
2262
RD10
6'x2' RCB
ERM13
Q_{100}= 120 cfs
FP=2259.62
10.392
EXISTING ZONE A
WEIR FLOW
Q_{100}= 54 cfs
FP=2258.42
10.333
ZONE AE
UNINCORPORATED BOUNDARY
CLARK COUNTY
LAS VEGAS
EDWARD AVE
Preliminary


DUNCAN DR.
EDWARD AVE
SCUBA CIR
SNORKEL CIR
Q100 = 40 cfs
Q100 = 1 cfs
2258
2257
2256
2255
2254
2268
LIMITS OF DETAILED STUDY
ZONE AE
ERM12
RDII
24" CMP
Q100 = 26 cfs
FP=2256.42
FP=2254.1
FP=2254.
FP=2254.
Q100 = 1040 cfs
RANCHO DR
2-48" CMP
FP=2253.
WEIR FLOW
Q100 = 742 cfs
FP=2252.78
10.034
WESTPORT CIR
FP=2258.01
10.117
FP=2258.06
10.093
HALFMOON
WEIR FLO
Q100 = 91 cfs
Preliminar
BOUNDARY
UNINCORPORATED
CLARK COUNTY NEVADA
VEGAS
RD


Q_{100} = 28 cfs
FP=2254.07
FP=2254.07
2256
2254
RANCHO DR.
2-48" CMP
FP=2253.26
WEIR FLOW
Q_{100} = 742 cfs
Preliminary
2256
2258
2257
TO.034
FP=2252.48
M10.0
ERM11
FP=2253.20
TRUE VALUE HARDWEAR STORE
2255
2254
2253
FP=2258.01
FP=2256.06
FP=2255.64
FP=2255.13
FP=2254.05
WESTPORT CIR
HALFMOON WAY
MIRAMAR DR
BAY CIR
VENICE
LIMIT OF DETAILED STUDY
BOUNDARY
2266
Q_{100} = 1640 cfs
(EXISTING)

TRANSMITTAL

COE & VAN LOO

TO: City of Las Vegas

400 E. Stewart

Las Vegas, NV 89101

DATE: 5-18-94

PROJECT: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Final Work Maps & HEC-2 Models

ATTN: Mark Sorenson/Tom Chiatovich

TRANSMITTING VIA: Fed Ex

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

_____ ORIGINALS
x PHOTOCOPIES
x PRINTS
_____ FEES (SEE BELOW)
_____ OTHER (SEE BELOW)

x AS REQUESTED
_____ FOR YOUR INPUT
x FOR YOUR APPROVAL
_____ FOR YOUR SIGNATURE

_____ FOR YOUR REPLY/ACTION
x FOR YOUR INFORMATION/FILE

NO. OF COPIES	DATED	DESCRIPTION
1	5-18-94	HEC-2 Models
8	"	Work Maps

REMARKS OR REPLY: Enclosed are Final HEC-2 Models and Work Maps for Highway 95 and Rancho Drive. Please call us if you have any questions.

Thanks.

COPY TO: _____

RECEIVED BY: _____ DATE: _____

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LOO

TO: Clark County Public Works
Design Engineering Dept.
6655 W. Sahara, #C102
Las Vegas, NV 89102

ATTN: Bill Brandt

TRANSMITTING VIA: Fed Express

DATE: 5/18/94

PROJECT: NORTHWEST L.V. FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Final Work Maps and Models

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

___ ORIGINALS	x AS REQUESTED	___ FOR YOUR REPLY/ACTION
x PHOTOCOPIES	___ FOR YOUR INPUT	x FOR YOUR INFORMATION/FILE
___ PRINTS	x FOR YOUR APPROVAL	
___ FEES (SEE BELOW)	___ FOR YOUR SIGNATURE	
___ OTHER (SEE BELOW)		

NO. OF COPIES	DATED	DESCRIPTION
1	5/18/94	HEC-2 Models
8	5/18/94	Work Maps

REMARKS OR REPLY

Enclosed are final HEC-2 models and work maps for Highway 95 and Rancho Drive. Please call us if you have any questions.

COPY TO:

RECEIVED BY: DATE:

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LOO

TO: Clark County Public Works
Community Development Dept.
401 S. 4th Street
Las Vegas, NV 89101

ATTN: Phu Simpson

TRANSMITTING VIA: Fed Express

DATE: 5-18-94

PROJECT: NORTHWEST L.V. FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Final Work Maps & HEC-2 Models

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

___ ORIGINALS	x AS REQUESTED	___ FOR YOUR REPLY/ACTION
x PHOTOCOPIES	___ FOR YOUR INPUT	x FOR YOUR INFORMATION/FILE
___ PRINTS	x FOR YOUR APPROVAL	
___ FEES (SEE BELOW)	___ FOR YOUR SIGNATURE	
___ OTHER (SEE BELOW)		

NO. OF COPIES	DATED	DESCRIPTION
1	5/18/94	HEC-2 Models
8	5/18/94	8 - Work Maps

REMARKS OR REPLY

Enclosed are final HEC-2 models and work maps for Highway 95 and Rancho Drive. Please call us if you have any questions.

COPY TO:

RECEIVED BY: DATE:

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LOO

TO: Clark County Regional
Flood Control District
301 E. Clark, #301
Las Vegas, NV 89101

DATE: 5/18/94

PROJECT: NORTHWEST L.V. FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Final Work Maps and Models

ATTN: Kevin Eubanks

TRANSMITTING VIA: Fed Express

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

_____ ORIGINALS
x PHOTOCOPIES
x PRINTS
_____ FEES (SEE BELOW)
_____ OTHER (SEE BELOW)

x AS REQUESTED
_____ FOR YOUR INPUT
x FOR YOUR APPROVAL
_____ FOR YOUR SIGNATURE

_____ FOR YOUR REPLY/ACTION
x FOR YOUR INFORMATION/FILE

NO. OF COPIES	DATED	DESCRIPTION
1	5/18/94	HEC-2 Models
8	5/18/94	Work Maps

REMARKS OR REPLY

Enclosed are final HEC-2 models and work maps for Highway 95 and Rancho Drive. Please call us if you have any questions.

COPY TO: _____

RECEIVED BY: _____ DATE: _____

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LOO

TO: City of North Las Vegas

2266 Civic Center Dr.

North Las Vegas, NV 89030

ATTN: Bob Murnane/ Randy Tarr

TRANSMITTING VIA: Fed Ex

DATE: 5-18-94

PROJECT: NORTHWEST L.V. FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: Final Work Maps & HEC-2 Models

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

___ ORIGINALS	x AS REQUESTED	___ FOR YOUR REPLY/ACTION
XX PHOTOCOPIES	___ FOR YOUR INPUT	x FOR YOUR INFORMATION/FILE
XX PRINTS	x FOR YOUR APPROVAL	
___ FEES (SEE BELOW)	___ FOR YOUR SIGNATURE	
___ OTHER (SEE BELOW)		

NO. OF COPIES	DATED	DESCRIPTION
1	5-18-94	HEC-2 Models
8	"	Work Maps

REMARKS OR REPLY Enclosed are Final HEC-2 Models and Work Maps for Highway 95 and Rancho Drive. Please call us if you have any questions.

Thanks.

COPY TO: ___

RECEIVED BY: ___ DATE: ___

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LOO

TO: City of Las Vegas

400 E. Stewart

Las Vegas, NV 89101

ATTN: Randy Fultz

TRANSMITTING VIA: Fed Ex

DATE: 5-26-94

PROJECT: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY

PROJECT NO: 93-0017-01

SUBJECT: HEC-1 Model

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

_____ ORIGINALS
_____ PHOTOCOPIES
_____ PRINTS
_____ FEES (SEE BELOW)
__x__ OTHER (SEE BELOW)

__x__ AS REQUESTED
_____ FOR YOUR INPUT
_____ FOR YOUR APPROVAL
_____ FOR YOUR SIGNATURE

_____ FOR YOUR REPLY/ACTION
_____ FOR YOUR INFORMATION/FILE

NO. OF COPIES	DATED	DESCRIPTION
1	5-25-94	HEC-1 Model (Carey-F. dat) Diskette

REMARKS OR REPLY: Enclosed is the HEC-1 Model as you requested. Please note that this HEC-1 Model is not final.

Thank you.

COPY TO: _____

RECEIVED BY: _____ DATE: _____

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

PENTACORE
Engineering Inc

0142.0001.0024

June 2, 1994

Jack K. Moody, P.E.
Coe & Van Loo Consultants, Inc.
4550 North 12th Street
Phoenix, Arizona 85014-4291

Subject: Northwest Las Vegas FIS Restudy

Dear Mr. Moody:

Thank you for the recent telephone conversation regarding the above referenced project. Revisions have been made to the Effective D-FIRM's at the following locations:

1. Gowan Detention Basins, Upper and Lower North;
2. Gowan Detention Basin, South;
3. The Eldorado Project Site;
4. East of Durango Drive, City of Las Vegas;
5. Buffalo Drive east to Pioneer Channel;
6. W. Cheyenne Avenue and North Buffalo Drive

Please find enclosed recent, updated forms for each location, the annotated FIRM's, and exhibits required by FEMA for processing map revisions. Also, Jerry Romero at the City of Las Vegas Geographic Information System will be contacted next week for an updated, corporate boundary map of Las Vegas. We will be pleased to forward the information to you on diskette as soon as it becomes available.

If you have any questions, or if I can be of further assistance, please do not hesitate to call at (702) 258-0115.

Very truly yours,

Douglas B. Blatchford

Douglas B. Blatchford, P.E.

aa

Enclosures

6763 W. Charleston Blvd. • Las Vegas, Nevada 89102 • (702) 258-0115 • Fax (702) 258-0865

TRANSMITTAL

COE & VAN LOO

TO: Pentacore Engineering

6763 W. Charleston Blvd.

Las Vegas, NV 89102

DATE: 6/3/94

PROJECT: NWLVFIS

PROJECT NO: 93-0017-01

SUBJECT: Carey/Lake Mead

ATTN: Dean Rasmuson

TRANSMITTING VIA: FED EX

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

- ___ ORIGINALS
- x PHOTOCOPIES
- x PRINTS
- ___ FEES (SEE BELOW)
- x OTHER (SEE BELOW)

- x AS REQUESTED
- ___ FOR YOUR INPUT
- ___ FOR YOUR APPROVAL
- ___ FOR YOUR SIGNATURE

- ___ FOR YOUR REPLY/ACTION
- ___ FOR YOUR INFORMATION/FILE

NO. OF COPIES	DATED	DESCRIPTION
1	6/3/94	1 diskette - HEC-1 model
5	6/3/94	Maps
1	6/3/94	HEC-1 Print out

REMARKS OR REPLY

Please call me if you have any questions.

COPY TO:

RECEIVED BY: DATE:

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

TRANSMITTAL

COE & VAN LO

TO: Pentac... Engineering

5763 W. Charleston Blvd.

Las Vegas, NV 89102

ATTN: Douglas Blatchford

TRANSMITTING VIA: FED EX

DATE: 6/7/94

PROJECT: NWLVFIS

PROJECT NO: 93-0017-01

SUBJECT: Cary/Lake Mead

ENCLOSED x UNDER SEPARATE COVER

THE FOLLOWING ARE SUBMITTED:

- ___ ORIGINALS
- x PHOTOCOPIES
- ___ PRINTS
- ___ FEES (SEE BELOW)
- ___ OTHER (SEE BELOW)

- x AS REQUESTED
- ___ FOR YOUR INPUT
- ___ FOR YOUR APPROVAL
- ___ FOR YOUR SIGNATURE

- ___ FOR YOUR REPLY/ACTION
- ___ FOR YOUR INFORMATION/FILE

NO. OF COPIES	DATED	DESCRIPTION
3	6/7/94	Carey/Lake Mead Retention Basin Maps

REMARKS OR REPLY

Please call me if you need more information.

COPY TO:

RECEIVED BY: DATE:

SINCERELY,
COE & VAN LOO

Yong Song

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602)264-6831 FAX(602)264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

PENTACORE
Engineering, inc

To: Coe & Van Loo
4550 N. 12th Street
Phoenix, AZ 85014-4291

Date: June 8, 1994

Project No.: 0142.0001

Attention: Mr. Yong K. Song, E.I.T.

Subject: **FIS Study**

FEDERAL EXPRESS

The following items are:

X	Forwarded	X	Herein
____	Returned	____	Under Separate Cover by:

Description:

Upper Las Vegas Wash Detention Basin Plans

These items are submitted:

X	At your request	____	For your action
____	For your review and approval	____	For your files
____	For your review and comments	____	For your information

Remarks:

Copies to:

By: Dean W. Rasmuson

Dean W. Rasmuson, P.E.

6763 W. Charleston Blvd. • Las Vegas, Nevada 89102 • (702) 258-0115 • Fax (702) 258-0865

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

DATE	JOB NO.
June 22, 1994	

ATTENTION: Dean Rasmuson DBB

RE: NORTHWEST LAS VEGAS FLOOD
INSURANCE STUDY RESTUDY

TO: PENTACORE
6763 W. Charleston Blvd.
Las Vegas, NV 89117

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Hand Delivered the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	6/21/94	1	DRAFT RESTUDY REPORT

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit_____copies for approval
☐ For your use ☐ Approved as noted ☐ Submit_____copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return_____corrected prints
☒ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 19_____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS _____

RECEIVED BY: _____

DATE: _____

COPY TO FILE

JACK K. MOODY

SIGNED: _____

40% Pre-Consumer Content • 10% Post-Consumer Content

If enclosures are not as noted, kindly notify us at once.

PRODUCT 240 NEBS Inc. Groton, Mass. 01471

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

DATE	JOB NO.
June 22, 1994	

ATTENTION: Phu Simpson

RE: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY

TO: CLARK COUNTY PUBLIC WORKS
401 S. 4th Street
Las Vegas, NV 89101

455-4603

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Hand Delivered the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	6/21/94	1	DRAFT RESTUDY REPORT

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit_____copies for approval
☐ For your use ☐ Approved as noted ☐ Submit_____copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return_____corrected prints
☒ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 19_____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS _____

RECEIVED BY: Phu Simpson

DATE:

COPY TO FILE

JACK K. MOODY

SIGNED: Jack K. Moody

40% Pre-Consumer Content • 10% Post-Consumer Content

PRODUCT 240 NEBS Inc. Groton, Mass. 01471.

If enclosures are not as noted, kindly notify us at once.

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

DATE	JOB NO.
June 22, 1994	

ATTENTION: Kevin Eubanks

RE: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY

TO: CLARK COUNTY REGIONAL FLOOD CONTROL
301 E. Clark Avenue, Suite 300
Las Vegas, NV 89101

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Hand-Delivered the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	6/21/94	1	DRAFT RESTUDY REPORT

THESE ARE TRANSMITTED as checked below:

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☐ For your use ☐ Approved as noted ☐ Submit_____copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return_____corrected prints
☒ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 19_____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS _____

RECEIVED BY: _____

DATE: _____

COPY TO FILE

JACK K. MOODY

SIGNED: Jack K. Moody

40% Pre-Consumer Content • 10% Post-Consumer Content

PRODUCT 240 NEBS Inc. Groton, Mass. 01471.

If enclosures are not as noted, kindly notify us at once.

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

DATE	JOB NO.
June 22, 1994	

ATTENTION: Mark Sorenson

RE: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY

TO: CITY OF LAS VEGAS
400 E. Stewart, 4th Floor
Las Vegas, NV 89101

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Hand-Delivered the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	6/21/94	1	DRAFT RESTUDY REPORT

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit_____copies for approval
☐ For your use ☐ Approved as noted ☐ Submit_____copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return_____corrected prints
☒ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 19_____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS _____

RECEIVED BY: Theresa Burns

DATE:

COPY TO FILE

JACK K. MOODY

SIGNED: Jack K. Moody

40% Pre-Consumer Content • 10% Post-Consumer Content

PRODUCT 240 NEBS Inc., Groton, Mass. 01471

If enclosures are not as noted, kindly notify us at once.

CVL CONSULTANTS, INC.
6655 W. Sahara, A-200
LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

DATE	JOB NO.
June 22, 1994	

ATTENTION Bill Brandt

RE: NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY

TO CLARK COUNTY DEPT. OF PUBLIC WORKS
6655 W. Sahara Ave., Suite B-206
Las Vegas, NV 89102

WE ARE SENDING YOU XX Attached ☐ Under separate cover via Hand-Delivered the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	6/21/94	1	DRAFT RESTUDY REPORT

THESE ARE TRANSMITTED as checked below:

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REMARKS _____

Received
June 22 1994

RECEIVED BY:

DATE:

COPY TO FILE

JACK K. MOODY

SIGNED: Jack K. Moody

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CVL CONSULTANTS, INC.
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LAS VEGAS, NV 89102

(702) 368-3008
FAX (702) 368-0047

LETTER OF TRANSMITTAL

DATE	JOB NO.
June 22, 1994	

ATTENTION: Randy Tarr

RE: NORTHWEST LAS VEGAS FLOOD
INSURANCE STUDY RESTUDY

TO: CITY OF NORTH LAS VEGAS
2200 Civic Center Drive
North Las Vegas, NV 89030

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via Hand-Delivered the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	6/21/94	1	DRAFT RESTUDY REPORT

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REMARKS _____

RECEIVED BY: Randy Tarr

DATE:

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JACK K. MOODY

SIGNED: Jack K. Moody

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CVL CONSULTANTS, INC.

Land Planning
Land Surveying
Civil Engineering
Water Resources Engineering

July 14, 1994

Clark County Regional Flood Control District
301 E. Clark Avenue, Suite 301
Las Vegas, NV 89101

Attn: Mr. Kevin Eubanks, P.E.

Re: Northwest Las Vegas FIS Restudy
Angel Park Detention Basin
Buffalo Channel

Dear Kevin:

As you requested, listed below are the 100-year inflows and outflows at Angel Park Detention Basin, and the 100-year peak discharge in the Buffalo Channel near Lake Mead Boulevard.

The Angel Park Detention Basin consists of two basins which are hydraulically interconnected. Both north and south basins have spillways and outflow pipes. The basin routing card provided in the HEC-1 by J.M. Montgomery in the FIS Hydrology Report, in conjunction with modifications to the precipitation and depth-area reduction factors by CVL, was used to determine the design condition inflows and outflows. Construction of the Angel Park Detention Basin has not yet been completed and therefore CVL made modifications to the basin storage volume curves to reflect the "As-Built" condition. Both design and "As-Built" inflow and outflow conditions are listed below.

Angel Park Detention Basin

Location	Q_{100} (cfs)	
	Design	As-Built
Angel Park Detention Basin Total Inflow	6,494	6,494
Total Outflow from Angel Park Detention Basin	559	3,225
Outflow from Angel Park North Detention Basin		
54" RCP	374	387
Spillways	67	1,227
Outflow from Angel Park South Detention Basin		
24" RCP	33	33
Spillway	85	1,578

Total Contributing Area = 24.13 mi^2
DARF = 0.77

North & South Spillway Elev.	100-Year WSEL	
	Design	As-Built
2618.40	2618.55	2619.26

Outflow from the south basin enters Westcliff Drive and leaves the study area. Outflow from the north basin is routed into the Buffalo Channel.

Using the above information, we have conducted a further evaluation of the downstream effects of discharges on the Buffalo Channel. Two different storm centerings were modeled for the Buffalo Channel near Lake Mead Boulevard. For the first case, it was assumed that the entire watershed upstream and downstream of the Angel Park detention basin would contribute to runoff in the Buffalo Channel, while the second case assumed a zero outflow from the basin, and modeled a storm over the watersheds below the basin.

Buffalo Channel

Location	Q_{100} (cfs)		
	w/Angel Park Basin Outflow		w/o Angel Park Basin Outflow
	Design	As-Built	
Buffalo Channel Near Lake Mead Boulevard	1,486	1,576	1,542

	DARF	Contributing Area (Mi^2)	Storm Distribution
With Angel Park Basin Outflow	0.75	28.7	SDN5
Without Angel Park Basin Outflow	0.91	4.6	SDN3

For the purposes of this study, the worst case scenario is recommended. With this information we will proceed with inclusion of the Buffalo Channel in the LOMR submittal package. If you have any further questions, please feel free to contact me.

Sincerely,

COE & VAN LOO
Consultants, Inc.

Paul W. R. Hoskin, P.E.
Vice President

PWRH:rbb

cc: Mark Sorensen, CLV
Randy Tarr, NLV
Bill Brandt, CCPWD
Phu Simpson, CCPWD
Dean Rasmuson, PEI
Mike Koizumi, CVL
Jack Moody, CVL

AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Tuesday, May 18, 1993

RE: Review Committee Meeting TIME: 3:00 - 4:30 P.M.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Introduction
  Team & Committee Member Responsibilities
  Lines of Communication & Correspondence
  Monthly Meeting Date
- Overview of Study Limits
- Study Goals
- Study Schedule & Milestones
- Areas of Historical Flooding - General Discussion
- Field Reconnaissance
  FEMA Visit May 20; 1993
- Data Collection - General Discussion
- Open Discussion

CVL DISTRIBUTION:

cc:
- ☐ Mike Koizumi
- ☐ Paul Hoskin
- ☐ Doug Schneider
- ☐ Other_____

PENTACORE DISTRIBUTION:
- ☐ Gary Spinkelink
- ☐ Dean Rasmuson
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COMMITTEE DISTRIBUTION:
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- ☐ Kevin Eubanks - CCRFCD
- ☐ Mark Sorenson - CLV
- ☐ Bob Murnane - NLV
- ☐ Phu Simpson - CCPWD
- ☐ Bill Brandt - CCPWD
- ☐ Other_____

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MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: May 18, 1993, 3:00 p.m.

ATTENDEES: See Below

PURPOSE: Kick-Off Meeting
A "kick-off" meeting was held to introduce the study team and committee members to the project and to discuss various items indicated on a pre-prepared agenda.

COMMENTS:

Discussion

- **Introduction**

- Mr. Paul Hoskin introduced himself and the study team and thanked all committee members for selecting the CVL/Pentacore team.

- The District has established lines of communication through the monthly meetings and reviews. Meetings will be documented in minutes.

- Mr. Hoskin expressed his desire to meet with each of the committee members individually during the data collection phase so as to further enhance communications. All decisions and study goals, however, should be discussed during the monthly meetings.

- Mr. Kevin Eubanks expressed his concern that on similar past projects committee attendance has not always been consistent or always by the same person. This should be avoided when possible.

- Mr. Gale Fraser said that there will be no fancy color exhibits for the project and there will be no formal presentation to the Board of Commissioners. For the FEMA submittal and before project end (9 months), each community will need to establish a Chief Executive Officer (CEO) who will send a letter endorsing the study.

- The third Tuesday of every month at 3:00 p.m. was selected as a meeting date and time suitable for all present. The meeting should be scheduled for one hour.

- A study contact list with telephone numbers was reviewed and corrected by Committee members. Revised copies will be redistributed.

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- **Overview of Study Limits**

- Mr. Hoskin referenced a large study area map which delineates the study limits and existing FEMA floodplains. He explained the location of detailed mapping.

- Mr. Fraser said that HDR engineers (Mike Hollaway) are the study and design engineers for the Highway 95/Rancho Boulevard interchange. The concept report will be completed by August 1993 and design completed nine months later. Construction is scheduled to start in mid-1994. This study may have to ignore the effects of the interchange due to timing. The interchange effects would need to be re-modeled after completion of this FIS.

- Mr. Fraser said that there is a difference in opinion between the District and the City of Las Vegas (CLV) regarding the construction of the Kyle Canyon detention basin. The CLV does not want the basin built until improvements along the path of the the outfall have been completed. This could delay the project 10 years. If the project is not approved, then its effect on the study area should be ignored. Hydrology should not be reviewed until the decision is made (June 10, 1993). An option to be discussed at the next meeting would be to increase the size of the outlet structure to allow 1000 cfs versus 350 cfs. The result would be a shorter bleed-off time.

- Mr. Hoskin explained that CVL/Pentacore needs agency input regarding the hydrology. At the scope negotiation stage, it was agreed that only existing hydrology studies would be reviewed and no new hydrology generated. Mr. Hoskin handed out some review comments CVL has made on the current J.M. Montgomery FIS hydrology study. He asked for further input later.

- **Study Goals**

- It was agreed upon that the intent of the study is to eliminate the many discontinuities that occur across jurisdictional boundaries. No new approximate floodplain boundaries will be established. Floodplains will be narrowed or eliminated where possible. An exception is for the detailed mapping area where the CLV believes there are new floodplains.

- Everybody agreed that the master plan facilities were constructed for a future condition with all upstream facilities in place. The interim flooding condition may be worse in certain study locations.

- **Schedule**

- Project schedule is for nine months to FEMA submittal. Field work will be completed by May 26 or 27. The aerial flight will occur on Saturday, May 29 so as to have fewer traffic obstructing the view and panels. Control to be completed June 15 and final maps by July 15.

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- The data collection report will be submitted at the next meeting.

• **Field Reconnaissance**

- Mr. Mark Sorenson indicated that a flow split occurs at Alexander and Highway 95. NDOT design is for a 50-year storm event and thus drainage along Rancho will occur as a series of weirs and flow splits. Mr. Sorenson will attend a field visit along Rancho Drive and Highway 95.

- Mr. Randy Tarr showed concern over the direction of flow splits crossing Rancho Drive. The hydrology and hydraulics in this area are interrelated and the flow splits will not be known until a later phase of study.

- FEMA will visit the study area on May 20, 1993, meeting at the District at 10:00 a.m. This will be a "windshield" review. Committee members are welcome.

• **Data Collection**

- VTN has completed a detailed hydrology study for the Gowan outfall.

- Church Engineering completed a study for "Las Brisas" which took into account the Gowan system hydrologic model.

- Church - Gowan North Channel.

- The agencies do not keep detailed technical information for LOMRs. This information could be requested from FEMA.

- There are no District funded County projects.

- Mr. Bill Brandt suggested the Northwest Area Development Plan may be of use.

- CVL/Pentacore will schedule meetings with each of the committee members next week.

CVL DISTRIBUTION:		PENTACORE DISTRIBUTION:		COMMITTEE DISTRIBUTION:
cc:	☑ Mike Koizumi	☑	Gary Spinkelink	☑ Gale Fraser - CCRFCD
	☑ Paul Hoskin	☑	Dean Rasmuson	☑ Kevin Eubanks - CCRFCD
	☐ Doug Schneider	☐	Other_____	☑ Mark Sorensen - CLV
	☐ Other_____			☐ Bob Murnane - NLV
				☑ Phu Simpson - CCPWD
				☑ Bill Brandt - CCPWD
				☑ Randy Tarr - NLV

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AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Tuesday, June 15, 1993

RE: Review Committee Meeting TIME: 3:00 - 4:00 P.M.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Last Meeting
- FEMA Field Visit
- Data Collection Report
- Field Reconnaissance
- Aerial Topography
  - Flight 6/2/93
  - Ground Control
  - Map Compilation
- Open Discussion

CVL DISTRIBUTION:

cc:
- ☐ Mike Koizumi
- ☐ Paul Hoskin
- ☐ Doug Schneider
- ☐ Other_____

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- ☐ Dean Rasmuson
- ☐ Other_____

COMMITTEE DISTRIBUTION:
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- ☐ Kevin Eubanks - CCRFCD
- ☐ Mark Sorenson - CLV
- ☐ Bob Murnane - NLV
- ☐ Phu Simpson - CCPWD
- ☐ Bill Brandt - CCPWD
- ☐ Other_____

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MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: June 15, 1993, 3:00 p.m.

ATTENDEES: See Below

PURPOSE: Second monthly meeting to discuss data collection and ongoing study progress.

COMMENTS:

- **Minutes of Meeting**

- The minutes of the last meeting were reviewed and some corrections noted. Revised minutes will be distributed at the next meeting. It was requested that the minutes from each meeting be faxed to each individual prior to the next meeting so as to allow time for any review comments.

- **FEMA Field Visit**

- Representatives from FEMA (Karl Mohr) and Michael Baker Jr. (Ed Mifflin), FEMA's technical evaluation contractor (TEC) visited Clark County on May 19 and May 20, 1993. On May 20, 1993, these two representatives met with Kevin Eubanks and Paul Hoskin for a field review ("Windshield Survey") of the study area and District facilities, either in place or under construction. The results from that meeting were encouraging.

- In evaluating the hydrology, FEMA will compare the results against regression curves established by the Corps of Engineers. FEMA will accept and review hydrology prior to completion of the rest of the study.

- FEMA has digital base maps for Clark County which can be requested by the District.

- **Data Collection Report**

- Each of the Committee members was provided with a copy of the *Data Collection and Reconnaissance Report*. This is intended to document sources of data, field observations and notes made through the course of the study. It is anticipated that the report will be dynamic in nature and will be updated on a monthly or as needed basis.

- Some corrections to the study dates in the Bibliography were noted.

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- The next meeting will be scheduled for Tuesday, August 17, 1993 at 3:00 p.m., two months from now. The delay is to allow for mapping compilation and a decision on the hydrology.

CVL DISTRIBUTION:

cc:
- ☑ Mike Koizumi
- ☑ Paul Hoskin
- ☐ Doug Schneider
- ☑ Jack Moody

PENTACORE DISTRIBUTION:
- ☒ Gary Spinkelink
- ☑ Dean Rasmuson
- ☐ Other_____

COMMITTEE DISTRIBUTION:
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- ☑ Kevin Eubanks - CCRFCD
- ☑ Mark Sorensen - CLV
- ☑ Bob Murnane - NLV
- ☑ Phu Simpson - CCPWD
- ☑ Bill Brandt - CCPWD
- ☑ Randy Tarr - NLV
- ☑ Michael Cuddy

✓ In attendance
☒ Not in attendance, but to receive distribution

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AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Tuesday, August 17, 1993

RE: Review Committee Meeting TIME: 3:00 - 4:00 p.m.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Meeting
- Data Collection
- Field Reconnaissance
- Hydrology & Revised Schedule
- Aerial Photogrammetry
- FEMA map revisions

CVL DISTRIBUTION:

cc:
- ☐ Mike Koizumi
- ☐ Paul Hoskin
- ☐ Doug Schneider
- ☐ Other_____

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- ☐ Dean Rasmuson
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- ☐ Phu Simpson - CCCD
- ☐ Bill Brandt - CCPWD
- ☐ Other_____

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ATTENDANCE ROSTER

Northwest Las Vegas Flood Insurance Study Restudy

DATE: August 17, 1993 TIME: 3:00 p.m.

LOCATION: 301 E. CLARK, SUITE 300, CONFERENCE ROOM

RE: REVIEW COMMITTEE MEETING

NAME	REPRESENTING	TELEPHONE NO.
PAUL HOSKIN	CVL	387-0314
KEVIN QUBANKS	CCRFCD	455-3139
Rand. Farr	CLV	[illegible]
GARY SPINKELINK	PENTACORE	258-0115
MIKE KOIZUMI	CVL	368-3008
Dean Rasmussen	Pentacore	258-0115
Tim Christian	CLV	220-2142
Jack Moody	CVL	387-0314
Bill Brandt	CC PW - Design	455-7707
Bob Fraser	CCRFCD	455-3139

SHEET 1 OF __

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MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

(Revised September 17, 1993)

DATE: August 17, 1993

ATTENDEES: See Below

PURPOSE: Third monthly meeting held to discuss data collection, aerial topography and hydrology

COMMENTS:

- **Minutes of Meeting**

- The minutes of the last meeting were provided to committee members prior to the meeting. Individuals did not have sufficient time to review the minutes in detail.

- **Data Collection**

- Data collection is essentially complete. Still need to obtain the HEC-1 computer diskettes from Church Engineering and VTN for the hydrology update.

- **Hydrology**

- The FIS hydrology by J.M. Montgomery (JMM) was compared with hydrology by Church Engineering and VTN. The Church hydrology takes into account several flow diversions in the vicinity of Highway 95, Rancho Drive and Gowan Road. The Church study also accounts for watershed runoff which cannot reach the Gowan detention basins as presumed by JMM.

- Neither the Church study nor the JMM study incorporated the effects of the Kyle Canyon detention basin. A preliminary review of the flow diversions along Rancho Drive indicates that the Kyle Canyon detention basin will help in reducing discharges across Highway 95 and in the vicinity of Gowan Road. The exact hydrology cannot be quantified without detailed modeling to include the VTN HEC-1 model.

- It was agreed by the District that the Hydrology needs to be revised to incorporate Kyle Canyon and that since this work was included in the Supplemental Services portion of the contract, CVL shall seek authorization to proceed with detailed hydrology modeling. An estimate of the manhours to complete this task will be submitted to Kevin. Included in this estimate will be any revisions that are likely to occur as a result of detailed hydraulic modeling in the detailed study area.

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- **Revised Schedule**

- It was agreed upon by Kevin that the delayed decision by the Board of Directors regarding funding for the Kyle Canyon detention basin has caused a delay in the project. Kevin has agreed to a contract time extension of 60 days. A supplement to the agreement will be submitted to the Board.

- **Aerial Photogrammetry**

- CVL presented three panels of the detailed topography. The topography is set in a title block frame. Kevin concurred with the format.

- **FEMA Map Revisions**

- Kevin has obtained digital FIRMs for Clark County. These maps are preliminary in nature and may be subject to revision before they are adopted. Some of the discontinuities in the flood zones have been removed from the maps. The study team will confirm the status of these maps.

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- ☑ Paul Hoskin
- ☐ Doug Schneider
- ☑ Jack Moody

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- ☑ Dean Rasmuson
- ☐ Other_____

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- ☒ Mark Sorensen - CLV
- ☒ Bob Murnane - NLV
- ☒ Phu Simpson - CCPWD
- ☑ Bill Brandt - CCPWD
- ☑ Randy Tarr - NLV
- ☑ Michael Cuddy - CCRFCD
- ☑ Tom Chiatovich - CLV

✓ In attendance
☒ Not in attendance, but to receive distribution

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RECORD OF CONVERSATION

Northwest Las Vegas Flood Insurance Study Restudy

DATE: September 16, 1993

TEL. NO.: (703) 960-8800

INITIATED BY: ☑ Paul Hoskin

CONTACT NAME:

☐ Gale Fraser	☐ Bob Murnane	☐ Paul Hoskin
☐ Kevin Eubanks	☐ Phu Simpson	☐ Mike Koizumi
☐ Mark Sorensen	☐ Bill Brandt	☐ Dean Rasmuson
☑ Ed Mifflin, Michael Baker, Jr., Inc.		☐ Gary Spinkelink

COMMENTS:

A telephone conversation was initiated with Mr. Ed Mifflin from Michael Baker, Jr. Inc. to determine the status of the D-FIRM received by the District.

Ed indicated that by publishing the preliminary D-Firms, FEMA has completed its evaluation of the flood prone areas. In reaching this evaluation, they will have used all available information in the area including:

- Review of back-up Flood Insurance Information
- Structural improvements on the watershed
- Map provided by CVL at the last FEMA field visit

The final Community Meeting for the D-FIRM has not yet been held or scheduled. A schedule for adoption of the D-FIRM is likely to be as follows:

Community Meeting - 30+ days (1 mo. cum.)
Commencement of Appeals Period - 30+ days (2 mo.)
Appeals Period - 90 days (5 mo.)
Address Appeals/Amend Maps - 60+ days (7 mo.)
Finalize maps for publishing - 120 days (11 mo.)

Based upon the above estimated schedule, which could be extended if there are delays due to appeals, a LOMR submittal within 7 months would allow time for publishing as a part of the D-FIRM update. Ed suggested that the LOMR process is easier than the appeals process and therefore advised that the LOMR submittal be made after the end of the appeals period. In that way, the information will not be considered a part of the appeal.

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Record of Conversation
September 16, 1993

I noted that portions of the flood prone areas previously mapped have now been removed from the D-FIRM and I asked Ed if, for the purposes of this study, it could be assumed that they will not re-appear on the D-FIRM. Ed indicated that since FEMA has completed their evaluation, any change would have to result from an appeal. He noted that it is rare (unlikely) that an individual would protest the removal of a flood zone although there have been instances in the past.

I noted that the area along Washington Avenue, east of Rancho Drive, is still shown as within a Zone A. This is an area where the upstream watershed has been intercepted by the Buffalo Channel. The downstream watershed is predominantly urban in nature. Ed indicated that this is a case of a flooding area which could be considered to have had two flooding sources (upstream and downstream). Since one of the flooding sources has been removed (upstream), an analysis must be made of the other (downstream) watershed. The analysis would be similar to the original study and would identify hydrology and analyze the new floodplain by approximate methods. FEMA would then make the determination as to whether to remove the floodplain or remap it.

I reminded Ed that we would like to make an early submission for the hydrology per our meeting with him and Karl Mohr. Ed said that we could submit hydrology during the appeals period. Ed said he would discuss our conversation with Karl.

CVL DISTRIBUTION:

cc:
- ☐ Mike Koizumi
- ☐ Paul Hoskin
- ☐ Doug Schneider
- ☐ Other_____

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- ☐ Dean Rasmuson
- ☐ Other_____

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- ☐ Bob Murnane - NLV
- ☐ Phu Simpson - CCPWD
- ☐ Bill Brandt - CCPWD
- ☐ Other_____

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AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Friday, September 17, 1993

RE: Review Committee Meeting TIME: 3:00 - 4:00 p.m.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Meeting
- Data Collection
- Field Reconnaissance
- Aerial Photogrammetry
  - Photo Mylars
  - Topography
- Field Survey Cross Section Checks
- Conversation with Michael Baker, Jr.
- Hydrology Revisions
  - Kyle Canyon
  - Church Engineering
  - Carey/Lake Mead
  - Washington Avenue

CVL DISTRIBUTION:

cc:
- ☐ Mike Koizumi
- ☐ Paul Hoskin
- ☐ Doug Schneider
- ☐ Other_____

PENTACORE DISTRIBUTION:
- ☐ Gary Spinkelink
- ☐ Dean Rasmuson
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- ☐ Phu Simpson - CCCD
- ☐ Bill Brandt - CCPWD
- ☐ Other_____

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ATTENDANCE ROSTER

Northwest Las Vegas Flood Insurance Study Restudy

DATE: 9-17-93 TIME: 3:00

LOCATION: 301 E. CLARK, SUITE 300, CONFERENCE ROOM

RE: REVIEW COMMITTEE MEETING

NAME	REPRESENTING	TELEPHONE NO.
Jack Moody	CVL Consultants	368-3008
Dan Kosman	Pentacore Engineering	258-0115
GARY SPINKELINK	" "	258-0115
KEVIN EUBANKS	CCRFCD	455-3139
BOB MURIANTE	CVLC	657-2264
Randy Tarr	CVLC	657-2225
PAUL HOSKIN	CVL Consultants	368-3008
Tom Chiatovich	CLV	229-2142
Bill Brandt	CCPW - Design	455-7707

SHEET 1 OF __

MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: Friday, September 17, 1993

ATTENDEES: See Below

PURPOSE: Fourth monthly meeting to discuss study progress

COMMENTS:

- **Minutes of Meeting**

- Kevin noted that while he is aware that work on the FIS hydrology update is ongoing, it has not yet been officially approved. CVL will prepare a manpower and cost estimate for these services which then needs to be authorized in writing by the General Manager. The contract time extension is a part of the contract and authorization needs to come from the Board.

- **Data Collection**

- The computer diskettes for the HEC-1 hydrology models have been obtained from VTN and Church Engineering.

- The Carey/Lake Mead "as-built" drawings and the Lake Mead Drive storm drain plans need to be obtained from the City of Las Vegas. Tom Chiatovich will obtain this information for CVL. This information will be used for the hydrology and LOMR for the basin and downstream Zone A floodplain.

- HDR Engineering has been contacted regarding their study for the Highway 95/Rancho Drive interchange. They anticipate a notice to proceed from NDOT next week. It was noted that, with Committee and District approval, CVL's work can be provided to assist them in their study. VTN is the drainage subconsultant to HDR.

- Charlie Johnson at VTN will be added to the mailing list to receive minutes of meetings.

- **Field Reconnaissance**

- A field reconnaissance was conducted this week to verify the hydrology and a structures survey was performed within the area of detailed mapping. Next week, the field reconnaissance will continue for further study areas.

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- **Aerial Photogrammetry**

- Aerial topography is now available for the entire detailed study mapping area.

- This topography is a draft copy. Other consultants have asked if the topography is available for their use. The Committee had no problem with providing this information. Until maps are finalized, it was recommended that a disclaimer be placed on the topography sheets.

- The Committee asked for reproducibles of the maps without any floodplains on them. The contract calls for one set to be provided to the District. After the maps are finalized (approximately 2 weeks), a reproducible will be provided to the District for use or reproduction by the Committee. At this stage in the project, CVL will keep the photomylars and will provide them to the District at the end of the job.

- **Field Survey Cross-Section Checks**

- Cross-sections have been taken in the field, but the results have not yet been compared with the maps to verify accuracy. This information will be provided in the survey report along with all ground control. Kevin said the cross-section checks do not need to be sent to FEMA unless they ask for them.

- **Conversation with Michael Baker, Jr.**

- Paul Hoskin (CVL) had a recent telephone conversation with Ed Mifflin of Michael Baker Jr., Inc. Results of this conversation and its consequences to this study were discussed. A record of conversation report was provided to all Committee members which summarizes the items discussed.

- **Revised Project Schedule**

- A revised project schedule was provided to all present. The schedule reflects the 60-day extension. Submittal of the study documents to FEMA in 7 months (April 15, 1994) appears to fit well for the information to be included on the D-FIRM.

- For the detailed study areas (areas with BFEs), it will be necessary to go through a 90-day appeals period. Contact should be made with Karl Mohr to confirm this.

- **Hydrology Revisions**

- Since the last meeting, hydrology for the Kyle Canyon detention basin has been incorporated into a revised HEC-1 model. The results indicate that the decrease in

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flowrate along Rancho Drive near Ann Road is greater than the estimated 450 cfs presented at last month's meeting. Exact flowrates are not known at this time since adjustments need to be made to the Depth Area Reduction Factors (DARF).

- The use of the DARF was discussed in detail. The FIS hydrology study shows the NOAA point rainfall and then on the JR card a combined factor which includes the DARF and the 1.43 multiplier. All present agreed that this is confusing. Additionally, a DARF was applied for only three major concentration points on the watershed and includes large areas which will be detained within detention basins. All present agreed that the DARF should be specific to the sub-basin or concentration point in question and that it should not include large detained watersheds. The JD card allows a watershed's varying size to be accounted for at each specific concentration point. Only one discharge value is thus listed. The flowrate is interpolated based upon the drainage area. It was agreed that while the model will take longer to run, ultimately the use of the JD card is desirable.

- The FIS hydrology model does not account for the Carey/Lake Mead detention basin being in place. More accurate definition of the hydrology in the southern portion of the study area will be necessary in order to define flowrates along the Washington Avenue floodplain and for the floodplain downstream of Carey/Lake Mead.

- Large drainage sub-basins in the north study area may need to be subdivided. Concern was expressed about the possibility of discharges downstream increasing if sub-basins are further subdivided.

- **Floodplain Delineations**

- Dean will check the availability of existing topography to cover a flood zone A upstream of Buffalo Channel. The LOMR that Pentacore obtained for the Summerlin project upstream of Buffalo Drive was performed using HEC-2 to generate water surface elevations. If topography is available, this hydraulic model can be extended downstream to the Buffalo Channel. The flood zone is shown as a Zone A because the developer did not want to go through the 90-day appeals process.

- The Buffalo Channel will be shown with a Zone A over it and the statement "100-year flow contained within channel." If it does not take too long, this can be done for the Gowan Outfall Channel although it will not be necessary for the removal of any flood zones.

- Flood zones with elevations will be shown for the detention basins. The Kyle Canyon is not yet built and may need to be submitted as a CLOMR.

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- A CLOMR has been submitted for Becker's property. Construction is in progress.

- In the past, FEMA has not given consideration for the sedimentation of culverts. This policy appears to be changing based upon the detailed information required on FEMA form 7. The way of handling culverts for hydrologic purposes may differ from that used in the hydraulic analysis.

- **Next Meeting**

- The next meeting was scheduled for Wednesday, October 13, 1993.

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- ☑ Bill Brandt - CCPWD
- ☑ Randy Tarr - NLV
- ☒ Michael Cuddy - CCRFCD
- ☑ Tom Chiatovich - CLV

✓ In attendance
☒ Not in attendance, but to receive distribution

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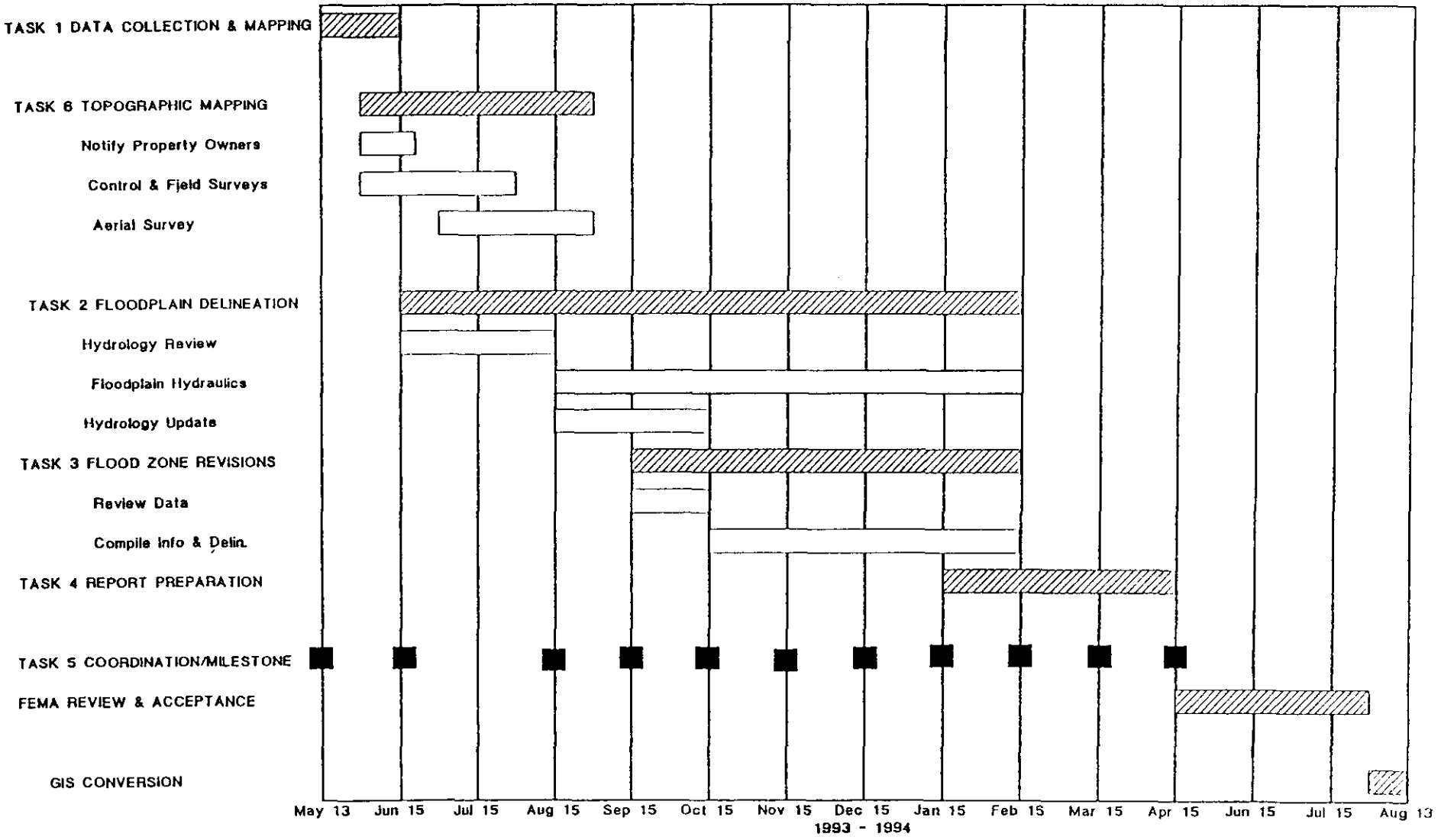
Exhibit "C" - Revised Project Time Schedule

Flood Insurance Study Restudy for Northwest Las Vegas

Project schedule has been revised due to delays in the funding of Kyle Canyon Detention Basin



AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Wednesday, October 13, 1993

RE: Review Committee Meeting TIME: 3:00 - 4:00 p.m.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Meeting
- Data Collection
- Field Reconnaissance
- Field Survey Cross Section Checks
- Hydrology Report
  - DARF
  - Precipitation
  - Basin Models
  - Box Canyon
  - Flow Diversions
  - Angel Park, Gowan and Carey/Lake Mead
  - Discussion of Results
- Hydraulic Cross-Sections

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ATTENDANCE ROSTER

Northwest Las Vegas Flood Insurance Study Restudy

DATE: 10-13-93 TIME: 3:00 p.m.

LOCATION: 301 E. CLARK, SUITE 300, CONFERENCE ROOM

RE: REVIEW COMMITTEE MEETING

NAME	REPRESENTING	TELEPHONE NO.
[illegible]		
Kevin EUBANKS	CCRFCD	
Mark Sorenson	CLV	
Dean Kasmiersa	Pentacore	
Jack Moody	CVL	
PAUL HOSKIN	CVL	
Bob MURNANE	CNLV	657-2264

SHEET 1 OF __

MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: Wednesday, October 13, 1993

ATTENDEES: See Below

PURPOSE: Fifth monthly meeting to discuss study progress

COMMENTS:

- **Minutes of Meeting**

- The minutes of the last meeting were reviewed for those that were not present at the last meeting. The 1" = 2000' composite map taken from the preliminary DFIRMs was left with Kevin at the last meeting. The Committee expressed an interest in receiving copies of this map. A reproducible will be provided to the District.

- The timetable for adoption of the DFIRMs was discussed. Kevin did not know when the community meeting was scheduled so it would appear that FEMA's time schedule for map adoption may be increasing. For changed BFEs, a 90-day appeals period will be necessary. Mark Sorenson asked if it may be possible to delay the maps in order to allow the results from the LOMR to be included.

- **Data Collection**

- VTN is the engineer for Becker's Property which is located east of Camino El Norte and north of Cheyenne Avenue.

- **Field Reconnaissance**

- A field reconnaissance was conducted along Rancho Drive in order to assess flow splits and diversions. Particular note was given to diversions near Jones and Morro Bay and behind the True Value hardware store. A diversion is shown to occur into the Carey/Lake Mead detention basin watershed.

- Field review indicates that the drainage area reaching the Carey/Lake Mead basin is not as extensive as noted by VTN.

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- **Field Survey Cross-Section Checks**

- Cross-section checks have been performed by Pentacore. Per FEMA criteria, 90% of points are within half contour. Dean will provide documentation to substantiate this conclusion.

- **Hydrology Report**

- The Depth Area Reduction Factors (DARF) have been changed to reflect only the adjustment for area based upon the area contributing to the point of interest. Downstream of detention basins, the DARF does not include the effect of the area upstream of the basin. It was discussed that the basin would not be full of water under these circumstances; however, unless spill of the basins occurs, the outflow is insignificant and is controlled by a channel/pipe system.

- Precipitation
  The precipitation used in the hydrologic model is based upon the CCRFCD's manual. The centroid of each major study watershed was used to determine the point rainfall. Point rainfall thus determined is higher than in the JMM FIS hydrology. Kevin indicated that adjustments may have been made in the precipitation in order to calibrate to the Corp's results.

- It was found that the JD cannot be used when multiple point precipitations are used. The JR card was therefore used.

- Basin Models
  The watershed was divided into four models as indicated in the report.

- Box Canyon
  Results of a recent field investigation by JMM and Kevin Eubanks indicated that one of the study area's upper watersheds contributes to a large gravel mine. The mine's volume is said to exceed the watershed's 100-year runoff potential and the hydrology model has therefore been adjusted.

- Flow Diversions
  See discussion under field reconnaissance.

- Angel Park, Gowan and Carey/Lake Mead
  Angel Park basin is shown to overtop its spillways. An increase in discharge of the FIS hydrology is attributable to the change in precipitation. Even the FIS hydrology indicates the basin would overtop its spillways. Adjustments have not yet been made for the measured volume of Angel Park.

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- The appropriate flowrate for use in Buffalo Channel was discussed. Currently, the outflow (overtopping) into Buffalo is added to local runoff from small watersheds adjacent to Buffalo. This may be too conservative due to the different DARFs. There may be two alternative ways to model this channel, either (1) eliminate the Buffalo Channel model, or (2) add only the outfall pipe capacity to flow which contributes directly to the channel.

- The question was asked, "How long does the basin overflow occur?" The outflow from the Gowan basin is indicated to be contained within the pipe system. This is in contrast to the FIS hydrology which indicates large overflow volumes. The difference may be attributable to a decrease in the area contributing to the Gowan basin since the collection channels are not yet in place.

- Carey/Lake Mead detention basin is shown to overtop its spillways. Part of the difference is due to the increase in volume reaching the basin as a result of flow diversions near Gowan and Rancho Drive. The inflow peak is lower than that by VTN due to the decrease in effective contributing drainage area. Model differences include use of SDN3 by VTN versus SDN5 for this study.

- Mark Sorensen indicated that inlets along Lake Mead Drive may not be large enough for flow to enter the basin. The Carey storm drain acts as both an inlet and an outlet. Mark said don't try to figure it out.

- VTN Study
  VTN, as part of their study for the Rancho Drive/Highway 95 interchange is reviewing the watersheds that are tributary to Painted Desert. They indicate that lag times in the FIS hydrology are longer than reasonable.

- VTN is scheduled to make a hydrology study submittal on October 25, 1993.

- Kevin says they assumed Lone Mountain diverts all drainage to U.S. 95.

- **Discussion of Results**

- Concern was expressed over the basins not meeting design capacity. Committee members will review the report and comment back a week before the next meeting.

- **Hydraulic Cross-Sections**

- Digital cross-sections now available for U.S. 95. An initial HEC-2 run has been completed.

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- **Next Meeting**

- Next meeting was scheduled for Tuesday, November 16, 1993 at 3:00 p.m.

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✓ In attendance
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Section 4

AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Tuesday, November 16, 1993

RE: *Review Committee Meeting* TIME: 3:00 - 4:00 p.m.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Meeting
- Data Collection
  - Angel Park Design Plans
- Field Survey Cross Section Checks
- Hydrology Report
  - Review Comments
  - Use of DARF
  - Network Diagram
  - Gowan/Rancho Diversions
  - Gowan Outfall Pipe
  - Angel Park Rating Curve
  - Discussion of Results
- LOMR Submittal Format

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- ☐ Randy Tarr - NLV
- ☐ Phu Simpson - CCPWD
- ☐ Bill Brandt - CCPWD
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ATTENDANCE ROSTER

Northwest Las Vegas Flood Insurance Study Restudy

DATE: Nov 16 1993 TIME: 3:00

LOCATION: 301 E. CLARK, SUITE 300, CONFERENCE ROOM

RE: REVIEW COMMITTEE MEETING

NAME	REPRESENTING	TELEPHONE NO.
Joel Noordy	CVL	384-6231
Ron Rasmussen	Pentacore	258-0115
Mark Swenson	[redacted] CLV	229-6276
KEVIN EUBANKS	CCRFCD	455-3139
RANDY TAFT	CLV	451-2205
GARY SPINKELINK	PENTACORE	258-0115
PAUL HOSKIN	CVL	387-031X
William C Brandt	CCPW - Design	455-7707
Phil Simpson	CCPW - Community Development	455-4603

SHEET 1 OF __

MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: Tuesday, November 16, 1993

ATTENDEES: See Below

PURPOSE: Sixth monthly meeting to discuss study progress

COMMENTS:

- **Minutes of Meeting**

- The minutes of the last meeting were reviewed for those that were not present at the last meeting. A reproducible copy of the DFIRM was requested at the last meeting. It was not available at this meeting but has since been delivered to the District. The use of the DARF continues to be an item of concern and discussion. It was noted that the "Box canyon" on the upper watershed is over 100 feet deep and no drainage flows will leave it.

- **Data Collection**

- The Angel Park Detention Basin plans are available from VTN.

- **Field Survey Cross Section Checks**

- Pentacore presented a tabulation of the field surveyed cross-section checks. Results indicate that they do meet the criterion of 90% within one half contour interval.

- **Hydrology Report**

- The committee had no specific comments regarding the Preliminary Hydrology Report. The City of Las Vegas provided a letter to the District with cursory review comments. All agreed that the drainage map exhibit needs to be improved so that a detailed review can be easily accomplished. Revised watershed maps with HEC-1 schematic diagrams were provided to all present.

- **Use of DARF**

- If a smaller drainage area downstream of the detention basins is used to compute the DARF then the outflow from the basins should not be included. This will only be of significance within the Buffalo channel and the Gowan outfall channels. In these cases, the worst case scenario should be evaluated as (1) smaller DARF including areas upstream of detention basin, or (2) larger DARF and upstream outflow reduced to zero. Kyle Canyon basin area is so large, and the outflow so small, that option (1) is not applicable. The DARF for the Carey/Lake Mead detention basin should be checked.

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- **Network Diagram**

- Network diagrams were provided to all committee members. All agreed that a detailed review could now be performed.

- **Gowan/Rancho Diversions**

- Currently, the Carey/Lake Mead detention basin is shown to overtop, partly due to the volume of flow diversion that occurs near Gowan Road and Rancho Drive. A diversion occurs at Jones Boulevard which appears high, especially at the lower end discharges.

  The City of North Las Vegas said that the Boulevard has been regraded and could possibly have changed since the VTN Study was completed.

  VTN conducted the Silver Mesa Study to evaluate the flow split at Jones and Morro Bay. The City of North Las Vegas has provided copies of this study to CVL for review. The Church study utilizes information provided by VTN for the Las Brisas study.

- **Gowan Outfall Pipes**

- The Craig Road now has an 80 inch diameter storm drain pipe which connects to the Gowan outfall.

  The City of Las Vegas believes that less drainage areas contribute to the Gowan basins than shown in the Las Brisas (Church) study.

  A third hydrologic model should be run to evaluate the Gowan outfall using a DARF derived from the entire contributing watershed area.

- **Angel Park Rating Curves**

- Storage rating curves for the Angel Park detention basin were compared for both "as-built" and designed conditions. The results indicate that Angel Park is currently under capacity by over 200 acre-feet. The impact of this reduced volume is not yet known but will result in an increase in flow overtopping the spillways. The spillways are also shown to overtop in the design conditions.

  An 84 inch storm drain pipe discharges into the Angel Park detention basin.

  Pecole Ranch now drains into the Buffalo channel and a 1000 cfs storm drain pipe capacity is currently under construction south of Summerlin Parkway. A VTN report is available for the Buffalo storm drain design.

- **Discussion of Results**

- The team recommends eliminating the Angel Park detention basin from inclusion in the LOMR submittal. Review of the FEMA "Dam Form" indicates that the outflow impact

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must be noted. To show the Angel Park overtopping its spillway could potentially result in new downstream floodplains.

- **LOMR Submittal Format**

- It was agreed that the LOMR submittal will consist of a large package divided into sections for each structure. FEMA forms will be prepared separately for each structure.

  East of Durango there is a small flood zone for which the City of Las Vegas thought a LOMR submittal may have been made. Mark will check on this.

  There are three floodplain fingers east of Rancho Drive which are addressed on the Rancho Alta Mira LOMR. The City has assured responsibility for maintenance of the new development's dike and would like an unofficial estimate of whether the floodplain will be removed and thus allow the maintenance responsibilities to cease.

- **Other Discussion**

- There is a re-development area near Washington Avenue and Martin Luther King Boulevard which might be considered for community grant money from HUD. This area lies within a currently delineated approximate Zone A flood zone. The city is reviewing the possibility of performing a detailed study if removal of the flood zone appears feasible. CVL will get back with Mark to give an opinion on this at the next meeting and possibly prepare a proposal.

  A recent field reconnaissance revealed that construction of an apartment complex north of Gowan Road and west of Rancho Drive is installing twin 48 inch pipes within the Rancho Drive drainage ditch.

  The next meeting was scheduled for 1:30 p.m. on Friday, December 17, 1993.

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✓ In attendance
☒ Not in attendance, but to receive distribution

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RECORD OF CONVERSATION

Northwest Las Vegas Flood Insurance Study Restudy

DATE: November 17, 1993

FAX NO.:

INITIATED BY: ☑ Other

CONTACT NAME:

☐ Gale Fraser	☐ Bob Murnane	☐ Paul Hoskin
☑ Kevin Eubanks	☐ Phu Simpson	☐ Mike Koizumi
☐ Mark Sorensen	☐ Bill Brandt	☐ Dean Rasmuson
☐ Other _____		☐ Gary Spinkelink

COMMENTS:

Kevin called as a follow-up to the hydrology discussions from the regular meeting of November 16, 1993. He had discussed the situation with Gale Fraser and Gale had the following requests:

1. Use a DARF for the entire watershed including drainage areas upstream of the Gowan and Angel Park basins. The DARF used for the Carey/Lake Mead basin should be determined for both its local area (45 $mi^2 \pm$) and the entire area including the contribution to flow breakouts.

   The entire watershed area (200 $mi^2 \pm$ with a DARF = 0.51) should be used to model the flow breakouts.

2. Check to see if the storm drainage delivery system to the Carey/Lake Mead basin functions as modeled (i.e., is it possible that the interception and conveyance system is inadequate for the flows it is shown to handle?).

3. The Carey/Lake Mead detention basin has a flowby system. Low flows bypass and continue down the Lake Mead storm drain. We should check the top of the rating curve to ensure that the HEC-1 model is not overestimating the discharge capabilities.

4. Start to set up the detailed hydraulics model. The hydrology can be refined later.

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- ☐ Bill Brandt - CCPWD
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AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Friday, December 17, 19933

RE: Review Committee Meeting TIME: 1:30 - 2:30 p.m.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Meeting
- Data Collection
- Hydrology Report
  - Review Comments
  - Use of DARF
  - Morro Bay/Jones Diversions
  - Gowan Channel Concentration Points
  - Washington Avenue
  - Discussion of Results
- Hydraulic Analysis
  - Cross-Section Review

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- ☐ Other_____

COMMITTEE DISTRIBUTION:
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- ☐ Mark Sorensen - CLV
- ☐ Tom Chiatovich - NLV
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- ☐ Bill Brandt - CCPWD
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ATTENDANCE ROSTER

Northwest Las Vegas Flood Insurance Study Restudy

DATE: December 17, 1993 TIME: 1:30 p.m.

LOCATION: 301 E. CLARK, SUITE 300, CONFERENCE ROOM

RE: REVIEW COMMITTEE MEETING

NAME	REPRESENTING	TELEPHONE NO.
William C Brandt	CC Pub - Develop	455-7707
MIKE KOIZUMI	CVL	368-3008
KEVIN EUBANKS	CCRFCD	455-3139
Lisa Ramirez	Pentacore	258-0115
Mark Sorensen	CLV	224-6276
Phil Simpson	CCDW	455-4603
Jack Moody	CVL	368-3008

SHEET 1 OF __

MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: Friday, December 17, 1993

ATTENDEES: See Below

PURPOSE: Seventh monthly meeting to discuss study progress

COMMENTS:

- **Minutes of Meeting**

- The minutes of the last meeting were reviewed for those that were not present at the last meeting.

- **Data Collection**

- Angel Park Detention Basin plans have now been obtained.

- **Hydrology Report**

- Review Comments
  No review comments were available

- Buffalo Channel
  Concern remains about the adequacy of the Buffalo channel to handle flows which are shown to overtop the Angel Park detention basin spillways. Hydrology for the channel will be based upon the design reports.

  There is a 24-inch pipe along Westcliff Drive. The Angel Park south spillway will continue south of study area and not enter the Gowan system.

- Gowan Basin Drainage Area
  In his November 15, 1993 letter, Mark Sorensen raised a question about whether all of the drainage sub-basins depicted in the hydrology model could reach the Gowan basin. In particular, concern was focused on the northern sub-basins. In order to settle the issue, it was agreed that the City of Las Vegas, City of North Las Vegas, the CCRFCD and CVL would conduct a field investigation. The trip was scheduled for 9:30 a.m. on Tuesday, December 28, 1993 near Gowan Road and the basin.

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- Use of DARF
  In the continuing efforts to establish appropriate DARFs for the study, CVL indicated that the drainage area downstream of the Gowan basin has an irregular form. CVL will conduct some preliminary research into the use of a standard ellipse shape storm. Elliptical isoheytals are used for distribution of the PMF, can a case be made for their use in this study?

- Morro Bay/Jones Diversion
  CVL reviewed the Silver Mesa study by VTN in which the flow split at Morro Bay and Jones Boulevard is assessed. VTN used a HEC-2 model to determine the flow splits. CVL recreated the VTN HEC-2 analyses and modeled for a lower discharge. Some changes were made in the Manning's 'n' values. Results did not substantially change the HEC-1 diversion, however, the CVL model shows more of the lower flows being concentrated in Jones. CVL will review the impact of both diversions.

- Gowan Outfall Concentration Point
  On the FIS hydrology model, the Western Tributary of Las Vegas Wash is not shown as adding into flows along the Gowan channel. Dean said that an engineering study shows that a diversion occurs along Camino El Norte. The Gowan channel has already received a LOMR in this area, it was therefore agreed that no additional ~~times of~~ concentration points will be modeled.

- Craig Road
  The Craig Road storm drain should be added to the hydrology model.

- Gowan Channel Concentration Points
  An apartment complex called "Cypress Springs" is located north of Gowan Road on Rancho Drive. The City of Las Vegas gave CVL copies of the design plans which show two 48-inch pipes which replace the existing ditch along Rancho Drive.

  All present agreed that the Kyle Canyon detention basin should not be considered in the application of the DARF.

  Bob Murnane asked that a check be made on the area contributing to Carey/Lake Mead.

- **Hydraulic Analysis**

- Cross-Section Review
  Locations of cross-sections in the detailed study area were submitted for review.

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Meeting Minutes
December 17, 1993

- LOMR Submittal
  Dean presented working maps being prepared for the Buffalo channel and Gowan basin LOMR.

The next meeting was scheduled for Tuesday, January 18, 1994 at 3:00 p.m.

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cc:
- ☑ Mike Koizumi
- ☑ Paul Hoskin
- ☐ Doug Schneider
- ☑ Jack Moody

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- ☑ Dean Rasmuson
- ☐ Other_____

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- ☒ Randy Tarr - NLV
- ☒ Michael Cuddy - CCRFCD
- ☒ Tom Chiatovich - CLV

✓ In attendance
☒ Not in attendance, but to receive distribution

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OBSERVATION REPORT

Northwest Las Vegas Flood Insurance Study Restudy

DATE: December 28, 1993

PLACE: Gowan Detention Basin Drainage Area

ATTENDEES: Kevin Eubanks, CCRFCD
Michael Cuddy, CCRFCD
Mark Sorensen, CLV
Yong Song, CVL
Paul Hoskin, CVL

PURPOSE: To Verify the Watershed Sub-Basin Boundaries Presented in the FIS Hydrology.

COMMENTS BY: Paul Hoskin

The drainage sub-basins in question extend north of Alexander Road (sub-basins GD14A, GD14B, GD13 and GD12). Initial review of the U.S.G.S. topographic maps suggested that portions of these sub-basins may not drain toward the Gowan basin until the CAM-10 detention basin and outlet channel are in place.

The area north of Alexander Road north to Craig Road, between Tenaya Way and Buffalo Drive was driven.

It was determined that portions of sub-basin GD14B cross Buffalo Drive north of Alexander Drive, however, the subdivision street system and storm drains direct flow toward Alexander Drive. A diversion channel on the south side of Alexander Drive intercepts street runoff and conveys it into the basin. Further to the west, a drainage ditch along the south side of Alexander Drive directs runoff to the east.

It was concluded that the sub-basins GD14A, GD14B, GD13 and GD12 should be modeled as contributing to the Gowan North basin.

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AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Tuesday, January 18, 1994

RE: Review Committee Meeting TIME: 3:00 - 4:00 p.m.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Meeting
- Data Collection
- Hydrology Report
  - Review Comments
  - Discussion of Results
  - Results of Field Reconnaissance
  - Washington Avenue
- Hydrauiic Analysis
  - Cross-Section Review
  - Preliminary Floodplain for U.S. 95

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- ☐ Doug Schneider
- ☐ Jack Moody
- ☐ Other_____

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MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: Tuesday, January 18, 1994

ATTENDEES: See Below

PURPOSE: Eighth monthly meeting to discuss study progress

COMMENTS:

- **Minutes of Meeting**

- Randy Tarr asked if minutes of meeting could be provided a week in advance of the meeting so as to serve as a reminder. Future minutes will be provided within a week of the meeting.

- The minutes from the last meeting were reviewed to recap decisions reached.

- Results of the December 28, 1993 field reconnaissance were discussed and an Observation Report provided to all present.

- **Data Collection**

- Mark Sorensen will provide HEC-2 runs and design plans for the Cypress Springs project located on Rancho Drive north of Gowan Road.

- No new information is available since the last meeting. The Data Collection Report will be updated by the next meeting.

- **Hydrology Report**

- Review Comments
  Bill Brandt provided some verbal comments regarding the report text. Detailed review comments were not available from the Committee members. All comments will be submitted to Kevin by Friday, January 28, 1994.

- Discussion of Results
  Since a thorough review of the hydrology had not been made by any of the Committee members, it was not possible to discuss the results.

  Paul explained changes that have been made to the hydrology model as follows:

  1) The area south of Summerlin Parkway to Doe Avenue is drained by a storm drain system capable of intercepting 100 percent of the 100-year discharge. It can be

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assumed that flow in excess of the design capacity will flow east and out of the study area. The Angel Park detention basin south overflow spillway was therefore modeled to divert spill flows out of the model area.

2) The Buffalo Channel design report indicates a discharge of approximately 1350 cfs rather than the 1000 cfs presented in the master plan report. Kevin explained that the difference in discharge is the result of dividing the drainage basin into several sub-basins. VTN was instructed to use the lower discharge developed for the master plan.

3) Dean suggested that submittal of the Buffalo Channel LOMR alongside the FIS hydrology might result in a question being raised about removal of the flood zone downstream of the Buffalo Channel. It was suggested that a separate LOMR submittal be made for Buffalo Channel in advance of the main submittal. Since the communities will be making their comments about the DFIRM to FEMA by the end of the week, this offers a good opportunity to submit the Buffalo LOMR. A submittal package will be prepared by Friday.

4) The Carey/Lake Mead area and south to U.S. 95 was modeled in two ways; (1) using the drainage area which contributes to the Gowan system and flow diversions from Gowan/Rancho; and (2) assuming that Gowan Road is a drainage boundary and that flow is not diverted south along Rancho Drive.

   Using the lesser drainage area for Carey/Lake Mead basin results in the use of SDN3 as opposed to SDN5. The summary tables indicate that in some cases the reduced drainage area does result in a higher discharge.

5) The flow out of the Carey/Lake Mead basin is now shown to be 487 cfs. In the table, it will be shown which discharge occurs within a pipe system.

6) Dean suggested that the discharge summary table have an additional column for the adopted discharge. Instead, shading of the selected discharge will be used.

7) Randy brought the Black & Veatch *Upper Las Vegas Wash Study*. Black & Veatch used three different storms of 200 mi^2 to model the hydrology. The drainage basins for this study are not of that size and therefore this approach cannot be used.

- Washington Avenue

Along Washington Avenue, the discharge at Martin Luther King Drive is shown to be 1904 cfs. Clearly, the flow is not concentrated in one location but will occur down several streets. The possibility still exists for some economic development funds to be provided to study the area in detail. Mark will check again with the Economic Development Director.

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AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Tuesday, February 15, 1994

RE: Review Committee Meeting TIME: 3:00 - 4:00 p.m.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Meeting
- Data Collection
- Hydrology Report
  - Review Comments
- Hydraulic Analysis
  - Preliminary Floodplain for U.S. 95
  - Preliminary Floodplain for Rancho Drive
  - Final Floodplain product
  - LOMR for Buffalo Channel
  - Washington Avenue

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- ☐ Mike Koizumi
- ☐ Paul Hoskin
- ☐ Doug Schneider
- ☐ Jack Moody
- ☐ Other_____

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ATTENDANCE ROSTER

Northwest Las Vegas Flood Insurance Study Restudy

DATE: February 15, 1994 TIME: 3:00 p.m.

LOCATION: 301 E. CLARK, SUITE 300, CONFERENCE ROOM

RE: REVIEW COMMITTEE MEETING

NAME	REPRESENTING	TELEPHONE NO.
PAUL HOSKIN	CVL	387-031X
KEVIN EUBANKS	CCRFCD 702	455-3139
William C Brandt	CCPW - Design	455-7707
Randy Tarr	CNLV	657-2295
Dean Rasmussen	Pentacore	258-0115
Jack Moody	CVL	357-0314
Mark Sorensen	CLV	224-6276

SHEET 1 OF __

MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: February 15, 1994

ATTENDEES: See Below

PURPOSE: Ninth monthly meeting to discuss study progress

COMMENTS:

- **Minutes of Meeting**

- Last month's meeting minutes were provided a week after the meeting and all present therefore had an opportunity to review.

- **Data Collection**

- The Cypress Springs design plans were received from Mark Sorensen.

- Bill Brandt will provide copies of the Lone Mountain, Rancho Drive to Decatur, design plans.

- Mark Sorensen will provide construction plans for Craig Road improvements from Highway 95 to Rancho Drive.

- **Hydrology Report**

- The City of Las Vegas provided CVL with a written letter of comment.

- General Review Comments
  - Shade the proposed discharges shown in Table 2
  - Identify HEC-1 concentration points by highlighting or shading on the exhibits
  - Identify whether flow from detention basins is either in a pipe or over spillways.

- **Hydraulic Analysis**

- Preliminary Floodplain for U.S. 95
  A "final" copy of the floodplain map near U.S. 95 and Gowan Road was presented for discussion purposes. Two areas of the floodplain were discussed in detail. One flooding area near Gowan Road could be delineated in such a way that Dalecrest Road would also be shown in the floodplain. A stockpile would thus be shown in the floodplain. It was decided to show the floodplain around the stockpile and not within Dalecrest Road. At the second location, the floodplain delineation could result in some lots along Flower Road being included in the floodplain. Mark Sorensen said this is the Charleston Heights

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subdivision which experienced some recent flooding. It was thus decided to leave within the floodplain.

- Rancho Drive
  Kevin asked whether removal of the flood zones east of Rancho Drive could be achieved. Review of the maps indicates that the flood zones near Lone Mountain Road and Craig Road can probably be removed, but that a large overspill area still occurs east of Rancho Drive near Gowan Road.

- Craig Road
  In the CVL HEC-1 analysis, it was assumed that all flow which reaches the north side of Craig Road will be directed east along Craig Road within the storm drain, up to a maximum of 230 cfs. Mark Sorensen indicated that Rancho Drive has a high point and that flows in excess of the storm drain capacity will be diverted south along Rancho Drive. Flow goes around behind a 7-Eleven and is intercepted by a grated inlet.

• **Gowan & Rancho**

- The District would like to extend the detailed study limits south of Gowan Road to the extent of topographic mapping. This will include the area behind the TrueValue hardware store.

• ***City Boundaries***

- Both Randy Tarr and Mark Sorensen will obtain copies of the City's jurisdictional boundaries. These maps will accompany the FEMA submittal. A letter from the mayor will be required to accompany the maps when submitted to FEMA.

• **LOMR for Buffalo Channel**

- The hydrology prepared for the design of the Buffalo Channel was based upon future flood control facilities in place.

  In the Wallace report, the Buffalo Channel is sized for a 4 square mile watershed which does not include outflow from the Angel Park detention basin.

  CVL to check what the channel flow is excluding Angel Park. CVL to check what the computed overflow from Angel Park is and how much goes south. The question remains as to what happens to the channel under existing conditions. It may be that now is not an appropriate time to submit for a LOMR.

  In the meantime, CVL/Pentacore had prepared a draft LOMR submittal and presented it to Kevin.

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Upstream of the Buffalo Channel, Dean has prepared a HEC-2 analysis of the approximate flood zone which shows a reduction in floodplain width. It should be possible to submit that regardless of the Buffalo Channel submittal.

- **Washington Avenue**

- A 1" = 400' scale map was prepared for the Washington Avenue area floodplain. Initial indications suggest that flow near Rancho Drive and Vegas Drive may be contained within Vegas Drive. The grade of Vegas Drive is fairly flat just east of Rancho and flows may turn south through subdivision streets, as the current floodplain suggests.

The next meeting was scheduled for Tuesday, March 15, 1994 at 3:00 p.m.

cc: Attendees

CVL DISTRIBUTION:

cc:
- ☒ Mike Koizumi
- ☑ Paul Hoskin
- ☐ Doug Schneider
- ☑ Jack Moody

PENTACORE DISTRIBUTION:
- ☒ Gary Spinkelink
- ☑ Dean Rasmuson
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- ☒ Michael Cuddy - CCRFCD
- ☒ Tom Chiatovich - CLV

✓ In attendance
☒ Not in attendance, but to receive distribution

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MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: March 9, 1994, 10:00 a.m.

ATTENDEES: See Below

PURPOSE: Informal meeting to discuss the hydraulic analysis and floodplain delineation within the detailed study area.

COMMENTS:

A review was made of the previously submitted floodplain delineation and recommendations for its adjustment in certain areas. Concurrence was reached by all by the end of the meeting and Jack Moody agreed to buy all present two beers for each floodplain area where FEMA does not approve the floodplain maps without comment. Time and date yet to be set, a practice run will be scheduled prior to submittal.

The following specific comments were made:

- The HEC-2 indicates that some flow may weir across the U.S. 95 median north of Alexander Road. A weir flow analysis will be performed to determine the approximate overflow width and quantity. Limits of detailed mapping will be shown. The HEC-1 model will be updated to include this diversion along Alexander.

- In some areas, the digital cross-sections do not yield the same floodplain width as the topographic contours. The discrepancy is within National Map Accuracy Standards. The entire job should be reviewed and the delineation made consistent throughout. Later review indicated that credence should be given to the contours and that an explanation made to FEMA as to why the cross-sections and computed topwidths are not consistent with the delineated floodplain.

- Where Rancho Drive and U.S. 95 converge/diverge, a matchline will be placed. The topography will be trimmed so there is no overlap.

- At U.S. 95 and Lone Mountain, the computed discharge increases dramatically due to flow along Lone Mountain from the west. A limit of detailed study line will be shown so as to acknowledge this large floodplain which enters the study area. CVL will check to see if it is possible to move the matchline so that Lone Mountain occurs on Sheet 2.

- At U.S. 95 and Washburn Road, a channel enters from the west. The HEC-2, however, indicates a decrease in flow downstream of this point. CVL will check.

- Near U.S. 95 and Painted Mirage Road, there is a ditch which appears as a channel, but does not have a gravity outflow. This may be a utility trench. It was decided to remove this ditch from the cross-section since it could have a significant impact on the water surface elevation and the floodplain.

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- The northern limit of detailed study will be set just south of Ann Road.

- Near Rancho Drive and Gowan Road, a flow split occurs behind the True Value hardware store. Mark asked that CVL take another look at the flowrates and possibly use weir flow computatations. The HEC-1 will be modified accordingly. Mark thinks a substantial amount of flow can go behind the True Value.

- The detailed study limits are shown just east of Rancho Drive. An approximate study will be made of the floodplain to the east to show that it matches the detailed study boundaries.

- Kevin has responded to FEMA regarding the DFIRM and has asked them to remove the flood zone east of Buffalo Channel and also the flood zone east of the Carey/Lake Mead detention basin. This request is not supported by technical data and is based purely upon the physical existence of these two structures. To avoid a conflict with our study, Kevin suggests that CVL not make a submittal to FEMA until after the DFIRM is adopted by FEMA. The final community meeting will be scheduled approximately one (1) month after the comments go in. Comments will go in Friday.

- Along Rancho Drive near Jomax, there is a roller skating rink called Crystal Palace. Mark said that this rink has flooded in the past. CVL will review the floodplain downstream to see if there is a restriction in the channel size.

- Flow occurs along Alexander road. This will be shown on the limits of detailed study.

- CVL asked about the peak discharges which are intercepted by the Craig Road storm drain near Rancho Drive. CVL is unclear how the storm drain and culvert system functions. Mark said that Dennis Moyer should be able to answer these questions. CVL later visited CLV and obtained a plan which details the grated inlet near the 7-Eleven. The inlet capacity of pipe, grate and culvert will be evaluated.

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	☑ Paul Hoskin	☒	Dean Rasmuson	☑ Kevin Eubanks - CCRFCD
	☐ Doug Schneider	☐	Other_____	☑ Mark Sorensen - CLV
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AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Tuesday, March 15, 1994

RE: Review Committee Meeting TIME: 3:00 - 4:00 p.m.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Meeting
- Data Collection
- DFIRM Community Meeting
- Hydraulic Analysis
  - Floodplain for U.S. 95
  - Floodplain for Rancho Drive
  - Hydrology Update
  - Final Floodplain product
  - LOMR for Buffalo Channel
  - Washington Avenue
  - Floodplains East of Rancho Drive
  - Floodplain South of Las Vegas Wash Diversion Dike
  - Floodplain East of Carey/Lake Mead
- Final Report Format

CVL DISTRIBUTION:

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MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

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- Near U.S. 95 and Painted Mirage Road, there is a ditch which appears as a channel, but does not have a gravity outflow. This may be a utility trench. It was decided to remove this ditch from the cross-section since it could have a significant impact on the water surface elevation and the floodplain.

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- The northern limit of detailed study will be set just south of Ann Road.

- Near Rancho Drive and Gowan Road, a flow split occurs behind the True Value hardware store. Mark asked that CVL take another look at the flowrates and possibly use weir flow computatations. The HEC-1 will be modified accordingly. Mark thinks a substantial amount of flow can go behind the True Value.

- The detailed study limits are shown just east of Rancho Drive. An approximate study will be made of the floodplain to the east to show that it matches the detailed study boundaries.

- Kevin has responded to FEMA regarding the DFIRM and has asked them to remove the flood zone east of Buffalo Channel and also the flood zone east of the Carey/Lake Mead detention basin. This request is not supported by technical data and is based purely upon the physical existence of these two structures. To avoid a conflict with our study, Kevin suggests that CVL not make a submittal to FEMA until after the DFIRM is adopted by FEMA. The final community meeting will be scheduled approximately one (1) month after the comments go in. Comments will go in Friday.

- Along Rancho Drive near Jomax, there is a roller skating rink called Crystal Palace. Mark said that this rink has flooded in the past. CVL will review the floodplain downstream to see if there is a restriction in the channel size.

- Flow occurs along Alexander road. This will be shown on the limits of detailed study.

- CVL asked about the peak discharges which are intercepted by the Craig Road storm drain near Rancho Drive. CVL is unclear how the storm drain and culvert system functions. Mark said that Dennis Moyer should be able to answer these questions. CVL later visited CLV and obtained a plan which details the grated inlet near the 7-Eleven. The inlet capacity of pipe, grate and culvert will be evaluated.

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	☐ Doug Schneider	☐	Other_____	☑ Mark Sorensen - CLV
	☑ Jack Moody			☒ Bob Murnane - NLV
				☒ Phu Simpson - CCPWD
				☒ Bill Brandt - CCPWD
				☒ Randy Tarr - NLV
				☒ Michael Cuddy - CCRFCD
				☒ Tom Chiatovich - CLV

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AGENDA

Northwest Las Vegas Flood Insurance Study Restudy

TO: All Committee and Team Members

FROM: Paul Hoskin - CVL DATE: Tuesday, April 19, 1994

RE: Review Committee Meeting TIME: 3:00 - 4:00 p.m.

LOCATION: 301 E. Clark, Suite 300, Conference Room

A meeting will be held to discuss the project status and schedule. Please be prepared to discuss any other relevant issues. The following topics of discussion are proposed:

- Minutes of Meeting
- Data Collection
- Hydrology Update
- Hydraulic Analysis
  - Final Work Maps
  - Rancho/Gowan Area
- Final Report Format
- Completion Schedule

CVL DISTRIBUTION:

cc:
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- ☐ Doug Schneider
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ATTENDANCE ROSTER

Northwest Las Vegas Flood Insurance Study Restudy

DATE: March 15, 1994 TIME: 3:00

LOCATION: 301 E. CLARK, SUITE 300, CONFERENCE ROOM

RE: REVIEW COMMITTEE MEETING

NAME	REPRESENTING	TELEPHONE NO.
Jack Moody	CVL	368-3008
Dean Rasmussen	Pentacore	258-0115
Ty [illegible]	CVL	368-3008
Mark Sorensen	CLV	229-6276
Tom Chiatovich	"	"
Phil [illegible]	CCFW	455-4603
Bill Brandt	CCFW - Design	455-7707
Michael P. Cuddy	CCRFCD	455-3139
Randy Tarr	CNLV	657-2295
Gary Spinkelink	Pentacore	258-0115

SHEET 1 OF _

MEETING MINUTES

Northwest Las Vegas Flood Insurance Study Restudy

DATE: March 15, 1994

ATTENDEES: See Below

PURPOSE: Tenth monthly meeting to discuss study progress

COMMENTS:

- **Minutes of Meeting**

- Last month's meeting minutes and the results of the March 9, 1994 hydraulic analysis meeting were reviewed. At the last meeting, Mark Sorenson provided construction plans for Craig Road improvements from Highway 95 to Rancho Drive. Randy Tarr asked that he be included in future review meetings.

- **Data Collection**

- Bill Brandt will check on the availability of the Lone Mountain, Rancho Drive to Decatur, design plans. (A subsequent telephone call from Bill indicated that these streets are not in unincorporated Clark County.)

- The recent LOMR for Rancho Alta Mira is based upon permanent maintenance of a dike by the City. The Northwest Las Vegas Flood Insurance Study Restudy will hopefully show that the flooding source has been removed.

- City of North Las Vegas has detailed topography in the north part of study area (Montgomery, 1981). The team needs detailed topography in the area of the Pardee property. Michael Cuddy will check the availability of topography.

- CVL received the community boundary map from the two cities.

- **DFIRM Community Meeting**

- The DFIRM meeting may be scheduled within the next five weeks, currently scheduled in April. District proposed revisions were recently mailed. FEMA is expected to take 6 months to adopt the LOMR. Included in the revision request by the District was the removal of flood zones associated with the Buffalo Channel and the Carey/Lake Mead basin areas. These two areas will not be included in the Northwest study at this time. Care must be taken to avoid a contradiction.

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- The Northwest study is scheduled for completion in two months. CVL will evaluate the anticipated completion date.

- **Hydraulic Analysis**

- Mark Sorensen would like another opportunity to review the detailed floodplain maps before they are finalized.

- Hydrology Update
  Revisions to a flow diversion along U.S. 95 result in some flow being directed down Alexander. As a result, the HEC-1 model will be revised. An increase in flow will occur at Alexander and Rancho. Flow south of Alexander will reach Gowan Road.

- Floodplain for U.S. 95
  In an area south of Alexander is the new Quail Tree development which was graded after the mapping was flown. Engineering work was by VTN. Mark does not want the results of this development to be included in the hydraulic analysis.

- Floodplain for Rancho Drive
  Near Rancho and Gowan, a large quantity of flow enters along Gowan Road and goes behind the True Value. The HEC-2 should be extended to the west along Gowan Road. A limit of detailed study will be established near Jones Boulevard if it is possible for the flow not to breakout out from the area. Results shall be submitted to the City of Las Vegas in a non-formal form before maps are finalized.

- LOMR for Buffalo Channel
  No submittal will be made at this time. Area west of channel will be removed by the LOMR submitted for the Park at Summerlin.

- Washington Avenue
  CVL has not received a call from the Community Services director. In the area of interest for the HUD grant it would appear the floodplain change will not be substantial.

- Floodplain East of Rancho Drive
  Floodplain east of Gowan Road has not been analyzed yet and depends upon detailed hydraulics noted above. Floodplain will be similar to the previous study. The other two area will probably be removed based upon approximate analyses. For the Craig Road storm drain, there is an inlet behind the 7-Eleven. CVL asked for clarification of the report results. Mark suggested that a detailed analysis be made of the grate an box culvert inlet.

- Floodplain South of Las Vegas Wash Diversion Dike
  CVL prepared a watershed map for the floodplain which indicates that the watershed area does not exceed 1.0 square miles until near the end of the current Zone A. Topography

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used was USGS. Michael Cuddy indicated that there is more recent topography. Dean will reproduce these topographic maps.

- CVL asked for copies of the construction plans for the dike. Michael indicated that these plans would probably not be required because of the LOMR which was accepted for Pacific Legends East by G.C. Wallace. CVL will need the case number. Dean will check.

- In the Camino El Norte area, Dean is waiting for detailed topographic maps.

- Floodplain East of Carey/Lake Mead
  Although the District has submitted a letter as a part of the DFIRM, there is the possibility that FEMA will not accept the District's request. Overflows from the dam are minimal and the flow can probably be contained in Lake Mead. CVL will check with Kevin before deleting from area of study.

- Gowan Basins Area
  The Gowan basins will be re-delineated to show zones within the basins. Detailed topography is available in the area of the former gravel basin. It will be assumed that the Cheyenne Channel has adequate capacity for the 100-year event. Re-design of the channel is currently underway.

- Final Report Format
  An outline of the proposed final report format was distributed for Committee comment. The format has been changed somewhat from that shown in the Scope of Work. Many culvert forms have already been completed for the detailed study area.

The next meeting was scheduled for Tuesday, April 19, 1994 at 3:00 p.m.

cc: Attendees

CVL DISTRIBUTION:

cc:
- ☒ Mike Koizumi
- ☑ Paul Hoskin
- ☐ Doug Schneider
- ☑ Jack Moody

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- ☑ Tom Chiatovich - CLV

✓ In attendance
☒ Not in attendance, but to receive distribution

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ATTENDANCE ROSTER

Northwest Las Vegas Flood Insurance Study Restudy

DATE: 4-19-94 TIME: 3:00

LOCATION: 301 E. CLARK, SUITE 300, CONFERENCE ROOM

RE: REVIEW COMMITTEE MEETING

NAME	REPRESENTING	TELEPHONE NO.
KEVIN EUBANKS	CCRFCD	455-3139
Randy Tarr	CNLV	657-2295
BARRY THOMPSON	CLV	229-6276
William C. Brandt	CCPW-Design	455-7707
GARY SPINKELINK	PENTACORE	258-0115
[illegible] Kissinger	Pentacore	258-0115
MIKE KOIZUMI	CVL	368-3008
Jack Moody	CVL	368-3008
Phil Simpson	CC Public Works	455-4603
Paul Hosking	CVL	368-3008

SHEET 1 OF __

Observation Reports

OBSERVATION REPORT

Northwest Las Vegas Flood Insurance Study Restudy

DATE: June 3, 1993 and June 4, 1993

PLACE: Various Flood Control Structures within the Study Area

ATTENDEES: Jack Moody (CVL)

Dean Rasmuson (PEI)

PURPOSE: To Verify the Hydrologic Model

COMMENTS BY: Jack Moody

Angel Park Detention Basin: The outlet works, consisting of a storm drain pipe with trash rack and the emergency spillways, are in place. A large box culvert under Summerlin Parkway acting as a detention basin interconnect structure is in place. Excavation is not complete; stockpiles of gravel and dirt occur throughout the basin.

Buffalo Channel: The channel is currently under construction south of Vegas Drive. It is being constructed as a concrete lined rectangular channel. At Vegas Drive, the Angel Park Detention Basin outlet storm drain pipe outfalls into Buffalo Channel. Buffalo Channel is in place from Vegas Drive to the Gowan South Detention Basin. It is a concrete lined trapezoidal channel, with box culverts for major road crossings.

Cheyenne Channel: The Cheyenne Channel is a concrete lined trapezoidal channel with periodic culvert crossings. The channel is unlined and appears to be incomplete from Buffalo Drive east to the Gowan South Detention Basin.

Gowan South Detention Basin: The Buffalo Channel outfall appears to be complete with a siltation basin and concrete low flow channel. The grading appears to be complete on the Detention Basin, and the low flow channel continues through to the outlet works. The outlet consists of a storm drain pipe with a trash rack. A concrete emergency spillway is in place. No landscaping has been done on this basin.

Gowan North Detention Basin: The grading of this detention basin appears to be complete. A concrete low flow channel continues through the basin. A concrete box culvert acts as a detention basin interconnect under Gowan Road. The outfall is through a storm drain that continues east under Gowan Road. Concrete emergency spillways are in place. No landscaping has been done in this basin.

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Highway 95: Numerous box culverts and channel sections convey flow south along the east side of Highway 95 from Rancho Drive to Gowan Road. Periodic small culverts allow flow to cross Highway 95. The Gowan Road Underpass will allow the remaining flow to continue east under Highway 95.

Rancho Drive: Flow is conveyed southeast along the southwest side of Rancho Drive. Several locations have the potential for breakout to the east across Rancho Drive.

Upper Las Vegas Wash Diversion Dike and Detention Basin: The soil cement diversion dike appears to be complete. A large roller compacted concrete dam is in place with an emergency spillway. A large double barrel concrete box culvert is the principal outlet. The detention basin is currently being graded.

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OBSERVATION REPORT

Northwest Las Vegas Flood Insurance Study Restudy

DATE: June 9, 1993

PLACE: Gowan Outfall Channel

ATTENDEES: Jack Moody (CVL)

Dean Rasmuson (PEI)

PURPOSE: To Verify the Hydrologic Model

COMMENTS BY: Jack Moody

Gowan Outfall Channel: A double barrel concrete box culvert outlets into the channel. The channel is a concrete lined trapezoidal or rectangular channel with box culverts for major road crossings. The channel is continuous from the culvert outlet to the Las Vegas Wash.

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Northwest Las Vegas Flood Insurance Study Restudy
Clark County, Nevada

Technical Data Notebook
Appendix II - Supporting Technical Data for Flood Control Facilities

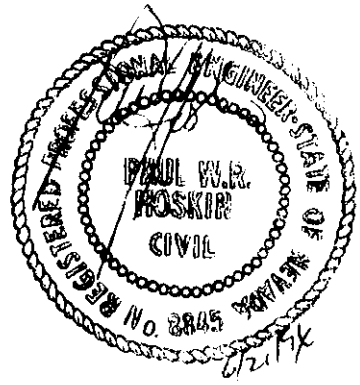
Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

301 East Clark Avenue, Suite 300
Las Vegas, Nevada 89101

June 20, 1994



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Flood Insurance Study Restudy
for
Northwest Las Vegas

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Section 1
Upper Las Vegas Wash Diversion Dike and Retention Basin

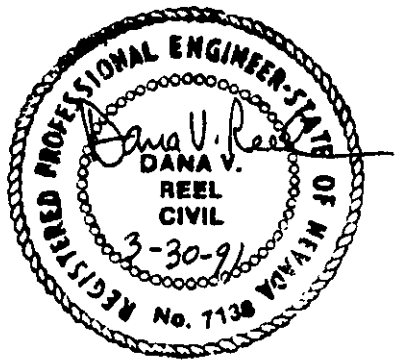
Predesign Report for the Upper Las Vegas Wash Detention Basin

Included in this section:

Excerpts from *Predesign Report for the Upper Las Vegas Wash Detention Basin*, by Black & Veatch, March 1991.

PREDESIGN REPORT
for the
UPPER LAS VEGAS WASH DETENTION BASIN

City of North Las Vegas



Prepared By

Black & Veatch
Las Vegas, Nevada

Project 17149.200
March 1991

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Table A-2 Runoff Parameters for Mountainous Subbasins/Existing Conditions Modeled Using SCS Unit Hydrograph Method

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Figure A-1 Storm S, (159 Square Miles)

Figure A-2 Storm B5, (100 Square Miles)

Figure A-3 Storm Locations

Chapter One - Introduction

Background

In 1986, construction of the Kyle Canyon Diversion was recommended in the Clark County Regional Flood Control District's (District) "Flood Control Master Plan" (Master Plan). The proposed location of this structure was on Las Vegas Wash north of Floyd R. Lamb State Park. This diversion was sized to direct runoff away from existing and future development on the Western Tributary to the Main Reach of Las Vegas Wash. In August 1989, Black & Veatch submitted a flood control planning study to the City of North Las Vegas, Nevada (City) entitled "Flood Control Facilities Plan for the Northern Las Vegas Wash" (Facilities Plan). The study describes results of a hydrologic analysis for 810 square miles of the Las Vegas Wash watershed, and recommends a network of flood control facilities for the northern Las Vegas Wash. One of the key structures in this network is the Upper Las Vegas Wash detention basin, a 2,870 acre-ft flood control dam located on the Main Reach of Las Vegas Wash. The purpose of this proposed detention basin is to attenuate runoff from the Spring Mountains and Sheep Mountains, and to discharge flows into a 3.6 mile outfall channel which conveys flows to the Main Reach. This facility, which superseded the Kyle Canyon Diversion, was adopted into the Master Plan in July 1989.

Completion of a draft Environmental Impact Statement (EIS) for the District near the end of 1989 indicated that the proposed site of the Upper Las Vegas Wash detention basin was located on Quail Springs Wilderness Study Area. Although the Bureau of Land Management (BLM) suggested that Quail Springs Wilderness Study Area may be unsuitable as wilderness, the Federal Land Policy and Management Act prohibits development on a wilderness study area that has interim status. The BLM stated that the U.S. Congress may take years to resolve the status of the wilderness study area, so Black & Veatch identified an alternate detention basin site in the Proposal for Design Services subsequently submitted to the City in November 1989. This proposal included an interception berm/channel, located north of Floyd R. Lamb State Park, to direct floodwaters to the detention basin and away from the state park and developing areas to the south on the Western Tributary.

The City awarded a design contract to Black & Veatch for the detention basin, spillway, and interception berm/channel in February 1990. Two possible sites for the detention basin were identified for evaluation based on site topography, geology,

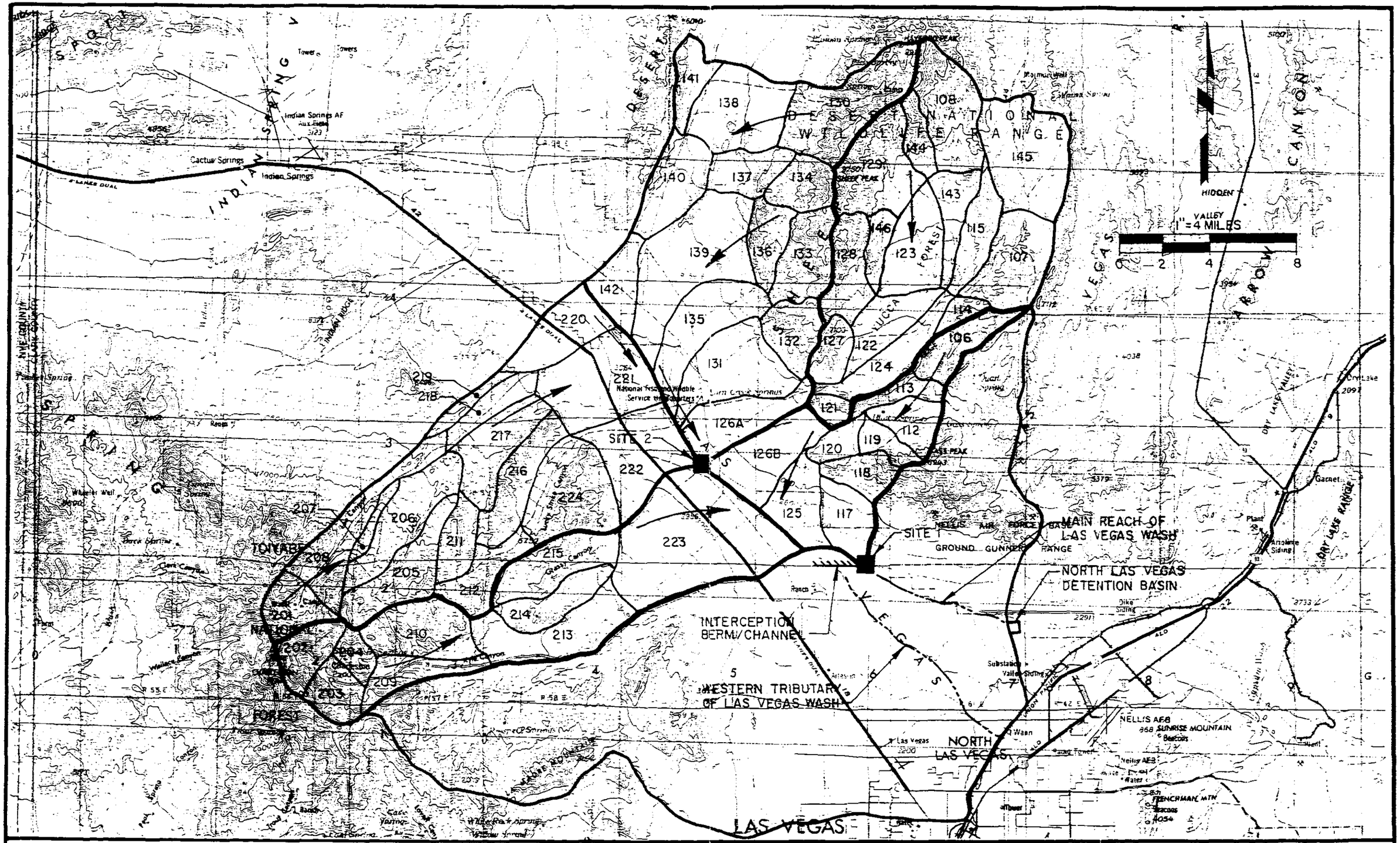
hydrology, land availability, and construction cost. Site 1, which is the site identified in the proposal, is located on the Main Reach east of Floyd R. Lamb State Park and south of Quail Springs Wilderness Study Area. Site 2 is located north of the state park and west of Quail Springs Wilderness Study Area. The locations of the two sites and the interception berm/channel are shown on Figure 3-1.

Scope of Services

The scope of services for this project is described in Section 1 of the contract executed between City of North Las Vegas and Black & Veatch. The scope of services is divided into predesign services, design services, and bidding phase services. Tasks completed for predesign services are described in this report and include the identification of alternate sites; development of the 100-year inflow design flood and the spillway design flood; evaluation of alternate sites; selection of a site; and preliminary design of the embankment, spillway, and interception berm/channel.

Authority

This report was prepared by Black & Veatch for the City of North Las Vegas under Agreement for Engineering Services, dated May 2, 1990.



■ PROPOSED DETENTION BASIN SITE

207 SUB-BASIN NUMBER

GENERAL DIRECTION OF FLOW

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Las Vegas, Nevada

Project # 17149.200

NORTH LAS VEGAS
UPPER LAS VEGAS WASH DETENTION BASIN

SITE MAP
AND
SUBBASIN DELINEATION

FIGURE
NO. 2-1

Chapter Four - Hydrologic Analysis

Inflow Design Flood

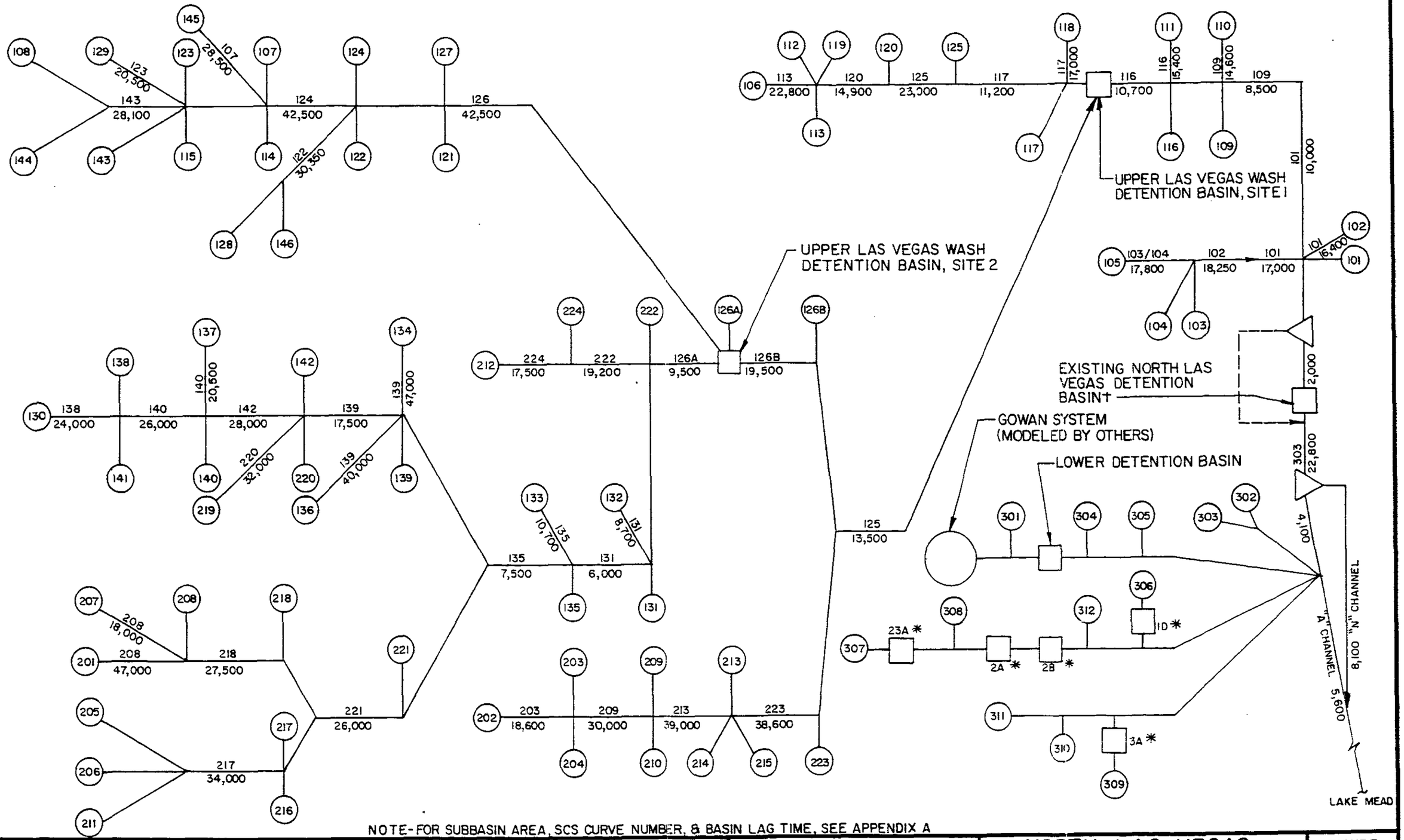
Introduction

The purpose of the hydrologic analysis is to determine the magnitude of the 100-year inflow design flood for a proposed detention basin located at Site 1 or Site 2, and for the interception berm/channel. The physiographic features of the Las Vegas Wash watershed were modeled using the U.S. Army Corps of Engineers' HEC-1 program, version 3.21, which simulates the surface runoff response to precipitation. This model, which was originally assembled for the Facilities Plan, was also used for this predesign report to determine the site specific inflow hydrographs for the design of the proposed flood control facilities. Subbasin delineation, runoff parameters, and routing parameters that were defined for the Facilities Plan were used in this analysis. The Soil Conservation Service (SCS) Curve Number Method was used to approximate initial precipitation losses, the SCS Unitgraph Method was used to determine surface runoff, and the Kinematic Wave Method was used to route runoff along collector channels. A routing diagram for the Las Vegas Wash watershed is shown on Figure 4-1. The watershed upstream of Site 1 and Site 2 are entirely undeveloped, and no significant development is anticipated in the foreseable future. Consequently, only one model was assembled for the hydrologic analysis.

Precipitation

The point precipitation for each subbasin was derived from NOAA Atlas 2, "Precipitation Frequency Atlas of the Western United States", Volume VII, Nevada. Point precipitation values were modified by frequency-specific and duration-specific adjustment factors that reflect a more accurate estimate of point precipitation. These adjustment factors are based upon analysis of recent local storm events not yet incorporated into the NOAA Atlas. Depth-area reduction factors were applied to point precipitation data to obtain depth-averaged precipitation for storms of various areal extent. The depth averaged precipitation was distributed temporally as defined by Standard Design Storm 5 (SDS-5), developed by the Los Angeles District of the Corps of Engineers.

The depth-area reduction factors used in this study were derived from an analysis of the 1981 Valley of Fire storm performed by the Los Angeles District of the Corps of Engineers. This storm has been adopted by the Corps as the 6-hour Standard Project Storm for southern Nevada. Previous Black & Veatch models incorporated



NOTE-FOR SUBBASIN AREA, SCS CURVE NUMBER, & BASIN LAG TIME, SEE APPENDIX A

LEGEND

(123) SUBBASIN NUMBER

DETENTION BASIN

◁ DIVERSION

NUMBER / LENGTH (ft.) ROUTING

*LOCAL DETENTION BASINS RECOMMENDED IN MASTER PLAN

†EXISTING NORTH LAS VEGAS DETENTION BASIN IS MODIFIED BY BLOCKING ONE OF FIVE OUTLET PIPES

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Project # 17149.200

NORTH LAS VEGAS
UPPER LAS VEGAS WASH DETENTION BASIN

HEC-1 WATERSHED MODEL SCHEMATIC

FIGURE NO.4-1

511060

interception berm/channel. This study focused on storms covering less than 200 square miles. Based on an analysis performed by the Los Angeles District of the Corps of Engineers, larger events are not expected in southern Nevada. However, several larger storms were analyzed to evaluate the sensitivity of peak runoff resulting from a particular storm centering due to varying areal coverage.

Results

The critical 100-year inflow design flood for Site 1 results from Storm SP, a 144 square mile storm centered over the Spring Mountains. This storm produces a runoff hydrograph with a peak discharge of 13,880 cfs and a volume of 4,120 acre-ft. If a detention basin is located at Site 1, the interception berm/channel must also be designed for the peak discharge of 13,880 cfs.

The critical 100-yr inflow design flood for Site 2 results from Storm A, a 121 square mile storm also centered over the Spring Mountains. This storm produces a hydrograph with a peak discharge of 11,950 cfs and a volume of 3,189 acre-ft. Even though the modeling results show that Storm ADC produces a hydrograph with a greater peak discharge and volume, this storm, with an area of 369 square miles, was considered unrealistically large for a thunderstorm over southern Nevada. If a detention basin is located at Site 2, the design flow for the interception berm/channel is approximately 12,440 cfs. This flow results from Storm C1.

The results of the hydrologic analyses for the Upper Las Vegas Wash Detention Basin are shown in Table 4-1. Figures 4-2 through 4-5 show the areal extent of the corresponding design storms.

J. M. Montgomery Engineers (JMM), as part of the Las Vegas Valley Flood Control Master Plan Update, is developing peak discharges appropriate for use in future flood insurance studies within the Las Vegas valley. The basis of this hydrologic analysis for the northern Las Vegas Wash was the HEC-1 models developed by Black & Veatch for "Flood Control Facilities Plan for the Northern Las Vegas Wash." JMM revised Black & Veatch's 1985 HEC-1 models so that the program can be executed by the 1988 version of HEC-1. The principal revision involved changing Kinematic Wave routing to Muskingum routing. The 100-yr discharge at the detention basin site obtained by JMM for the flood insurance study and by Black & Veatch for the detention basin design differed slightly. The adopted FIS discharge is 11,700 cfs and the design flow for the detention basin is 13,880 cfs.

TABLE 4-1

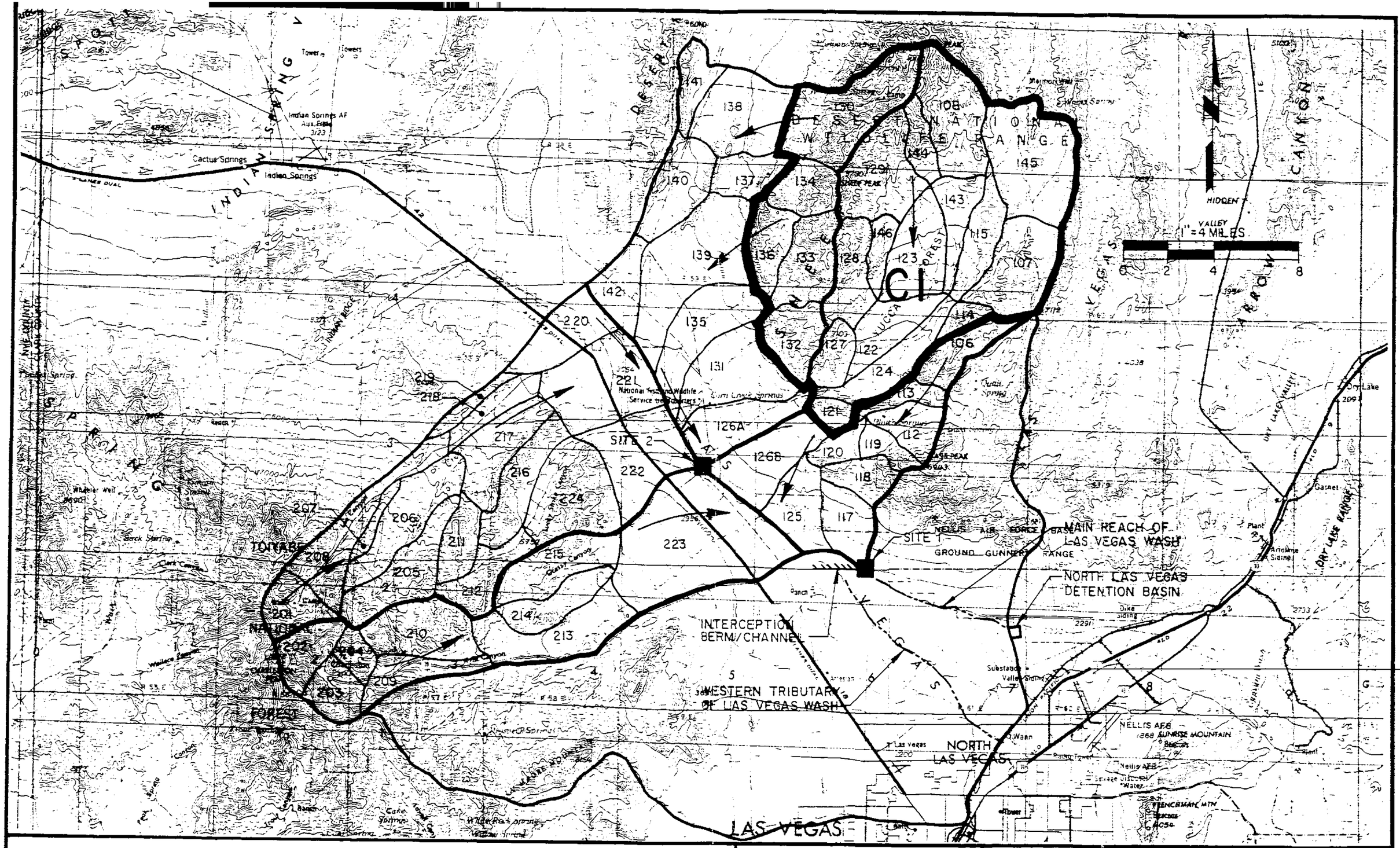
100-YR DESIGN DISCHARGES

DESIGN STORM			SITE 1		SITE 2 (WITH DRAINAGE AREA C)		INTERCEPTION BERM WITH SITE 1		INTERCEPTION BERM WITH SITE 2	
Drainage Area[1]	Size (mi^2)	DARF[2]	Qp (cfs)	tp (hrs)	Qp (cfs)	tp (hrs)	Qp (cfs)	tp (hrs)	Qp (cfs)	tp (hrs)
ABC	369	0.43	10,530	7.4	12,270	6.3	10,530	7.4	8,270	7.1
ABCD	421	0.41	9,530	7.6	10,560	6.4	9,530	7.6	9,150	7.2
ABCDE	516	0.39	10,680	7.6	8,930	6.5	10,680	7.6	14,610	7.1
BC	248	0.49	7,700	7.5	8,810	6.3	7,700	7.5	10,290	7.1
AB	252	0.48	8,620	7.4	10,200	6.2	8,620	7.4	3,250	-
B	131	0.57	4,860	9.3	5,320	8.0	4,860	9.3	3,250	-
C1	160	0.54	9,270	7.2	10,640	6.1	9,270	7.2	<9,270	7.1
CD	169	0.53	8,670	7.2	8,160	6.1	8,670	7.2	8,670	7.1
SP	144	0.56	13,880	6.8	9,690	5.9	13,880	6.8	3,250	-
UV	167	0.54	4,440	8.8	3,520	7.5	4,440	8.8	3,250	-
E	95	0.61	10,460	5.9	-	-	10,460	5.9	10,460	5.9
C	117	0.58	9,190	7.1	10,110	6.0	9,190	7.1	9,190	7.1
A	121	0.58	10,430	7.2	11,950	6.1	10,430	7.2	3,250	-

(1) The areal extent of the storm is defined by the lettered subbasins shown on Figures 4-2 through 4-5. For example, Storm ABC covers Subbasins A, B, and C as shown on Figure 4-2.

(2) Depth Area Reduction Factor

NL7/071601


DESERT NATIONAL WILDLIFE RANGE
CI
INTERCEPTION BERM/CHANNEL
WESTERN TRIBUTARY OF LAS VEGAS WASH
MAIN REACH OF LAS VEGAS WASH
NORTH LAS VEGAS DETENTION BASIN
SITE 1
SITE 2
NELLIS AFB GUNNERY RANGE
NELLIS AFB
NORTH LAS VEGAS
LAS VEGAS
TOTAABE
INDIAN SPRINGS
Indian Springs AF Aux. Field
Cactus Springs
Indian Springs
Las Vegas Wash
Las Vegas Wash
Dry Lake
Dry Lake Wash
Sunrise Mountain
Frenchman Mtn
Gass Peak
Sheep Peak
Lucy Gray Mts
Sheep Range
Spotted Range
Pintwater Range
Desert National Wildlife Range
Nellis AFB
Indian Springs AF Aux. Field
Las Vegas
Dry Lake
Garnet
Valley
Hidden Valley
Substation
Dike Siding
Valley Siding
Plant
Ammonite Siding
Nellis AFB
Service Discharge Water
Nellis AFB
1868 Sunrise Mountain
Nellis AFB
Nellis AFB
Nellis AFB

Chapter Five - Preliminary Design

General Design Criteria

The primary purpose of the Upper Las Vegas Wash detention basin is to reduce the peak discharge of the 100-year inflow design flood to a discharge that can be conveyed without damage through the natural channel of the Main Reach of Las Vegas Wash, the existing North Las Vegas detention basin, and the improved and unimproved portions of "A" Channel in North Las Vegas. To accomplish this task, sufficient impoundment volume must be provided by the detention basin to temporarily store a significant portion of the inflow design flood. Sufficient outlet capacity will be provided to release flows up to, but not exceeding, the capacity of the existing downstream conveyance system.

To protect the dam embankment from damage during floods larger than the inflow design flood, a spillway will be constructed to safely pass the spillway design flood, which is defined as the maximum flood that might reasonably occur in the watershed above the detention basin. Elevations of the spillway crest and the dam crest will be established using the following criteria:

- The crest of the spillway will be set at an elevation that will provide sufficient impoundment volume to route the inflow design flood through the outlet works without conveying water over the spillway.

- The crest of the dam will be set above the crest of the spillway at an elevation providing sufficient head to convey the spillway design flood through the spillway without overtopping the dam embankment.

The selection of design features that will effectively and economically accomplish these objectives is discussed in this chapter.

Site Selection

A preliminary evaluation of Site 1 and Site 2 indicates that the topography of Site 2 is more favorable for construction of a detention basin. A detention basin constructed at this site will cost less than one at Site 1. However, a detention basin located at Site 1 will control runoff from an additional 150 square miles of the northern Las Vegas Wash watershed, and will provide the Las Vegas metropolitan

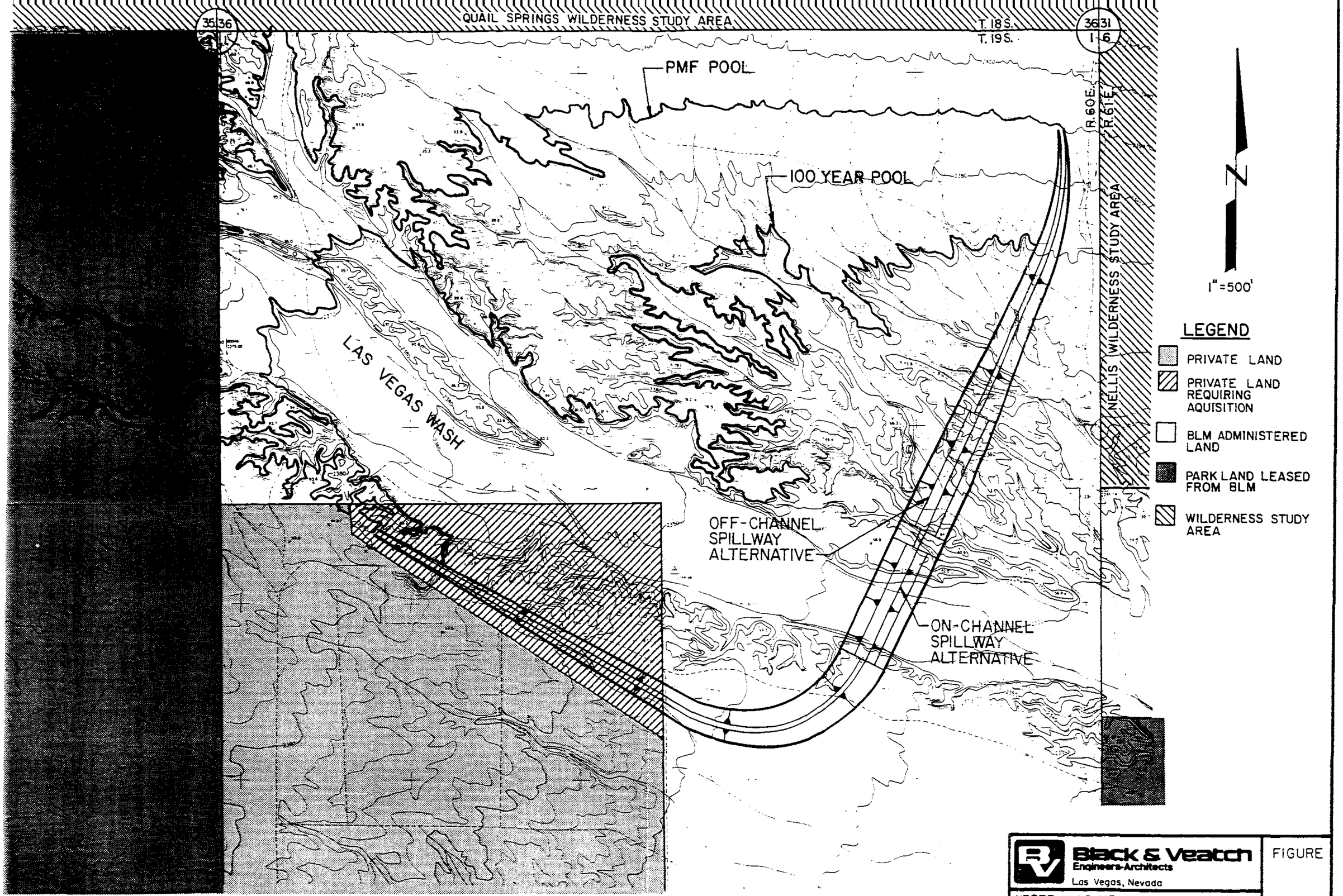
area with a substantial amount of additional flood protection. If a detention basin is constructed at Site 2, additional flood control facilities will be required to control runoff from this 150 square mile watershed. The combined cost of a detention basin at Site 2 and of these additional facilities will be more than the cost of a single structure at Site 1. Consequently, Site 1 was selected as the preferred location for a detention basin on the Main Reach of Las Vegas Wash.

Embankment Alignment Selection

Embankment alignment constraints for Site 1 consist of private property to the south of the proposed detention basin, Nellis Wilderness Study Area to the east, and Quail Springs Wilderness Study Area to the north. If necessary, private property along the southern portion of the embankment alignment can be purchased. However, land acquisition will be minimized to control project costs. The recommended embankment alignment is shown on Figure 5-1.

The BLM has indicated that development on wilderness study areas is not permitted. In addition, the BLM has prohibited impoundment of water on wilderness study areas during the spillway design flood. Because it is economically desirable to limit the size of the spillway by maximizing the impoundment volume behind the dam, the embankment will be constructed as high as possible without impounding water on the Quail Springs Wilderness Study Area, and located as far downstream as possible while remaining west of Nellis Wilderness Study Area.

The pool elevation for the 100-year inflow design flood is 2,371.5. The basin volume at this pool elevation is 1,780 acre-ft, including a 100 acre-ft allowance for sediment deposition and debris storage. The 100-yr flood pool will not impound water on the wilderness study area to the north nor the Nevada Division of Parks land to the west. The pool elevation for the spillway design flood is 2,390, and the basin volume at this elevation is 6,680 acre-ft. The pool will briefly impound water on 0.1 acres in one minor wash on Quail Springs Wilderness Study Area for approximately 1.5 hrs. The City of North Las Vegas contacted BLM and received approval to briefly impound water on the minor wash during the spillway design flood. The stage vs. storage relationship is for the detention basin is shown on Figure 5-2.



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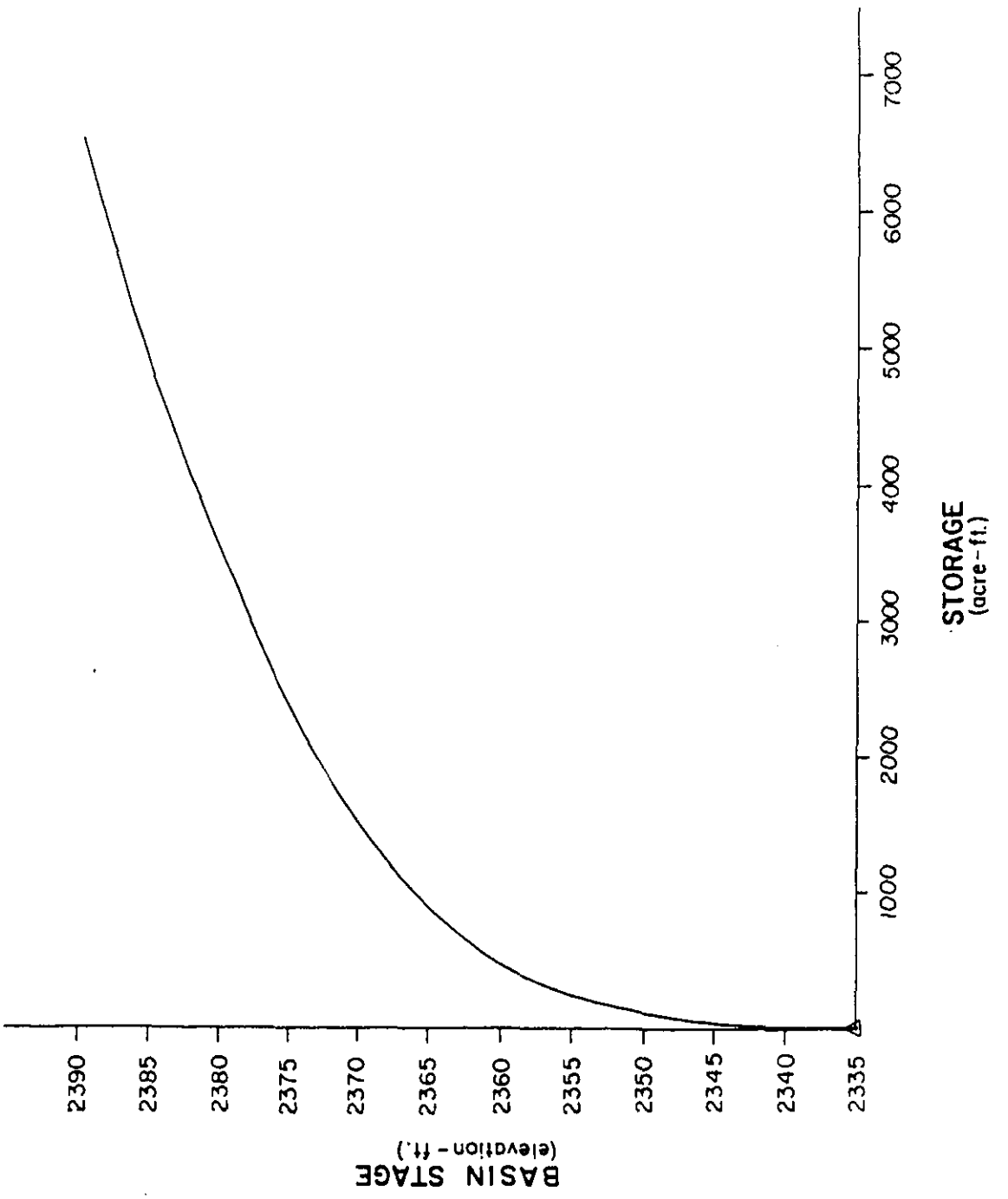
UPPER LAS VEGAS WASH DETENTION BASIN PRELIMINARY ALIGNMENT

FIGURE NO. 5-1



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Project # 17149.200

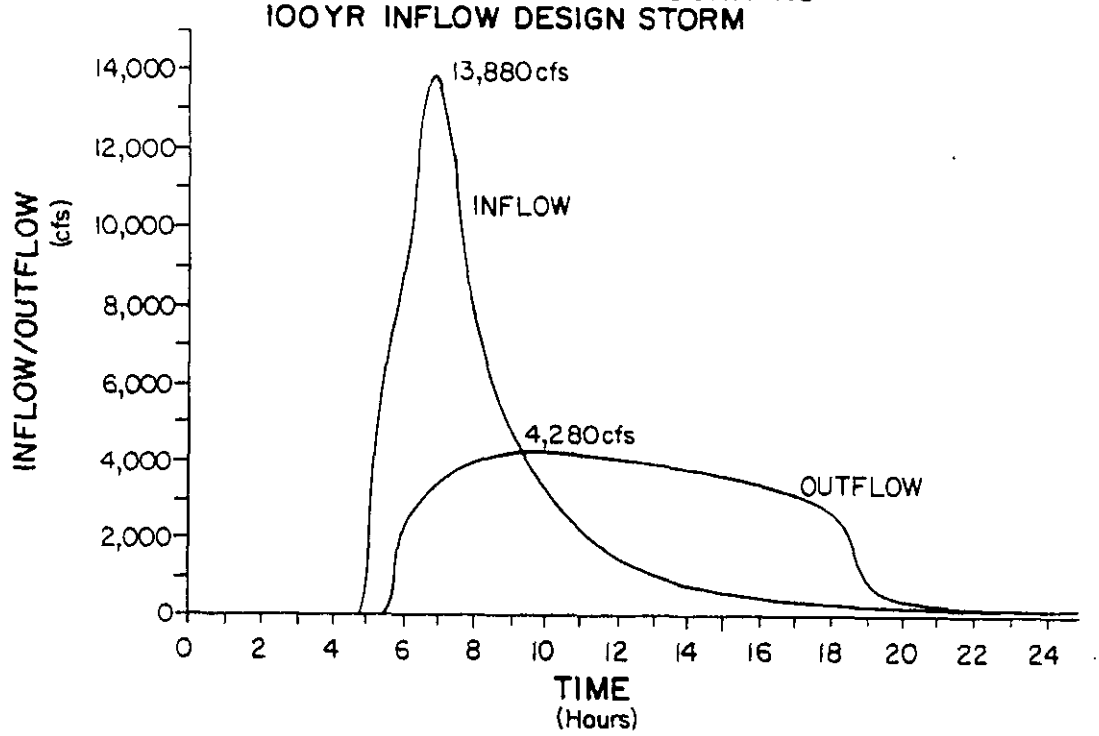
NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

BASIN STAGE VS. STORAGE

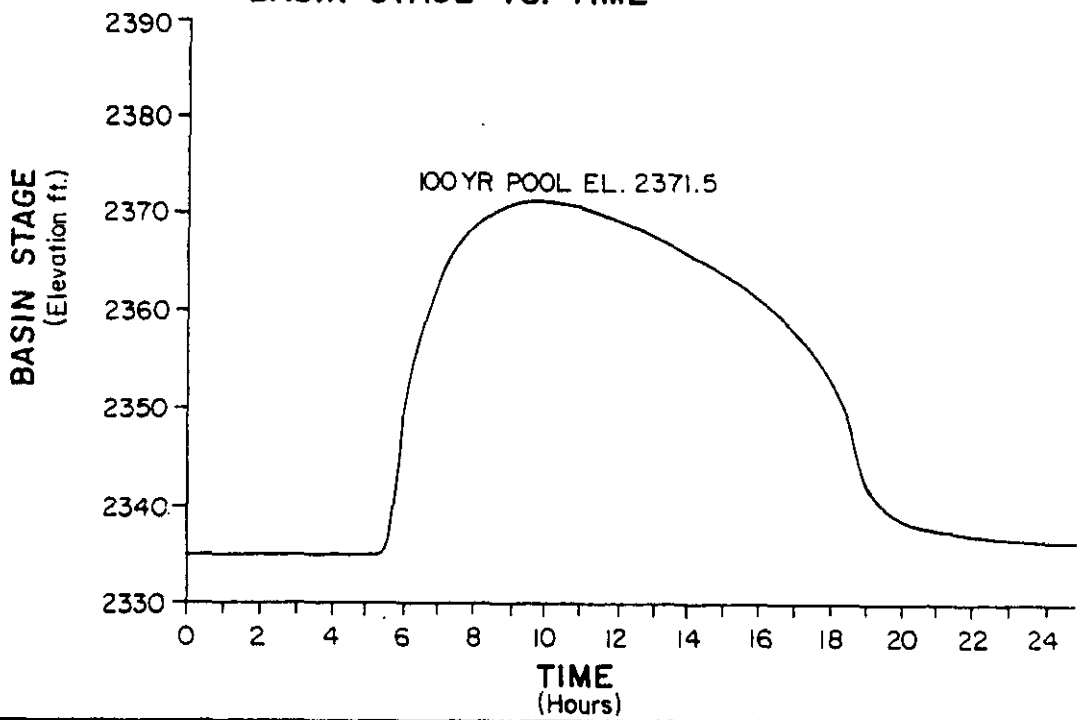
FIGURE
NO. 5-2

511060

INFLOW/OUTFLOW HYDROGRAPHS
100YR INFLOW DESIGN STORM



BASIN STAGE VS. TIME



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Project # 17149.200

NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

INFLOW/OUTFLOW HYDROGRAPHS

BASIN STAGE VS. TIME

FIGURE NO. 5-5

511060

Interception Berm/Channel

As shown on Figures 5-10 and 5-11, the 9,200-ft long interception berm/channel will be located north of the Floyd R. Lamb State Park. The structure will intercept runoff from the Western Tributary for floods up to the 100-yr inflow design flood and will direct these flows into the proposed detention basin on the Main Reach of Las Vegas Wash. The interception berm/channel will provide flood protection for the rapidly developing cities of Las Vegas and North Las Vegas to the south. The peak flow of the inflow design flood is for the berm/channel 13,880 cfs.

The alignment of the interception berm/channel is restricted by Quail Springs Wilderness Study Area to the north. As discussed in Chapter Three, an agreement in principle has been reached with the Nevada Division of Parks allowing the construction of the interception berm within a 600 ft strip of land along the northern boundary of Sections 2, 3, and 4. The interception berm/channel will be constructed on an east-west alignment and, consequently, must direct runoff approximately 45 degrees from the natural flow path.

Flow conditions of the 100-yr flood were evaluated upstream of the interception/berm channel to determine the design flow for the facility. Two large fan systems, located at the base of the Spring Mountains to the southwest and Sheep Mountains to the northeast, coalesce along the alignment of the Las Vegas Wash. Approximately 2.5 miles upstream of the interception berm/channel, the two fan system diverge and create a fan-like landform where the Las Vegas Wash bifurcates into two channels: the Western Tributary and the Main Reach. Hydrologic and hydraulic analyses indicate that the critical inflow design flood that originates in the Spring Mountains will be concentrated in the Western Tributary that follows the western edge of the fan. Lesser floods that originate in the Sheep Mountains will follow the Main Reach before being intercepted by the berm or conveyed directly into the detention basin.

Preliminary analyses indicate that a channel 300 ft wide and 5 ft deep is required to convey the 100-yr inflow design flood without impounding water on the Quail Springs Wilderness Study Area to the north. A berm with a maximum height of 8 ft will be required along the southern boundary of the channel to contain the 100-year flood and provide 3.75 ft of freeboard. The northern slope of the channel will be or varying height and will follow the natural ground surface. To maintain an 8 ft depth along the southern channel bank, a continuous berm will be constructed. As shown on Figure 5-12, the side slopes of the channel will be 3:1. A concrete cut off

N

SCALE: 1" = 300'

NEVADA POWER CO. EASEMENT

QUAIL SPRINGS WILDERNESS STUDY AREA

33 | 34
4 | 3

600' EASEMENT

BEGIN INTERCEPTION BERM/CHANNEL

ACCESS ROAD

STATE PARK LAND LEASED FROM BLM

WILDERNESS STUDY AREA

PRIVATE LAND

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Las Vegas, Nevada

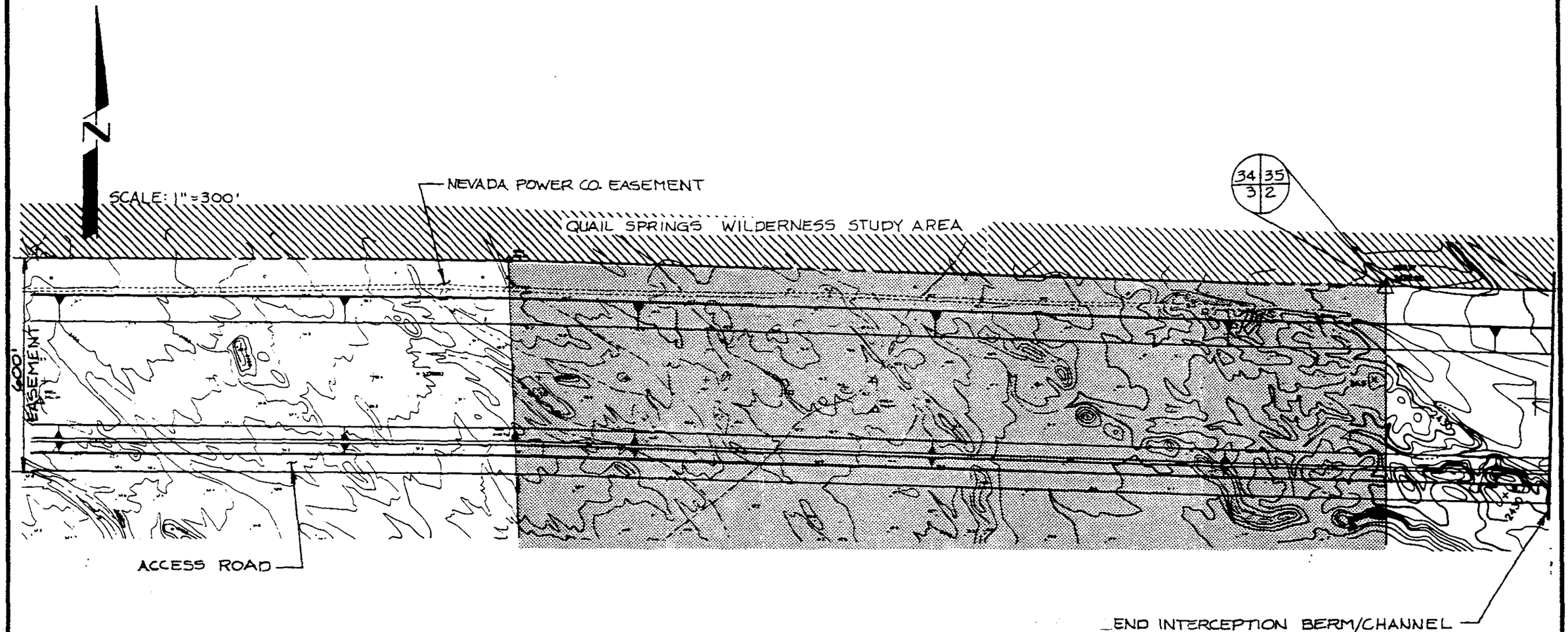
RV Project # 17149.320

NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

INTERCEPTION BERM/CHANNEL
ALIGNMENT

FIGURE
NO. 5-10

511060



STATE PARK LAND LEASED FROM BLM

WILDERNESS STUDY AREA

PRIVATE LAND

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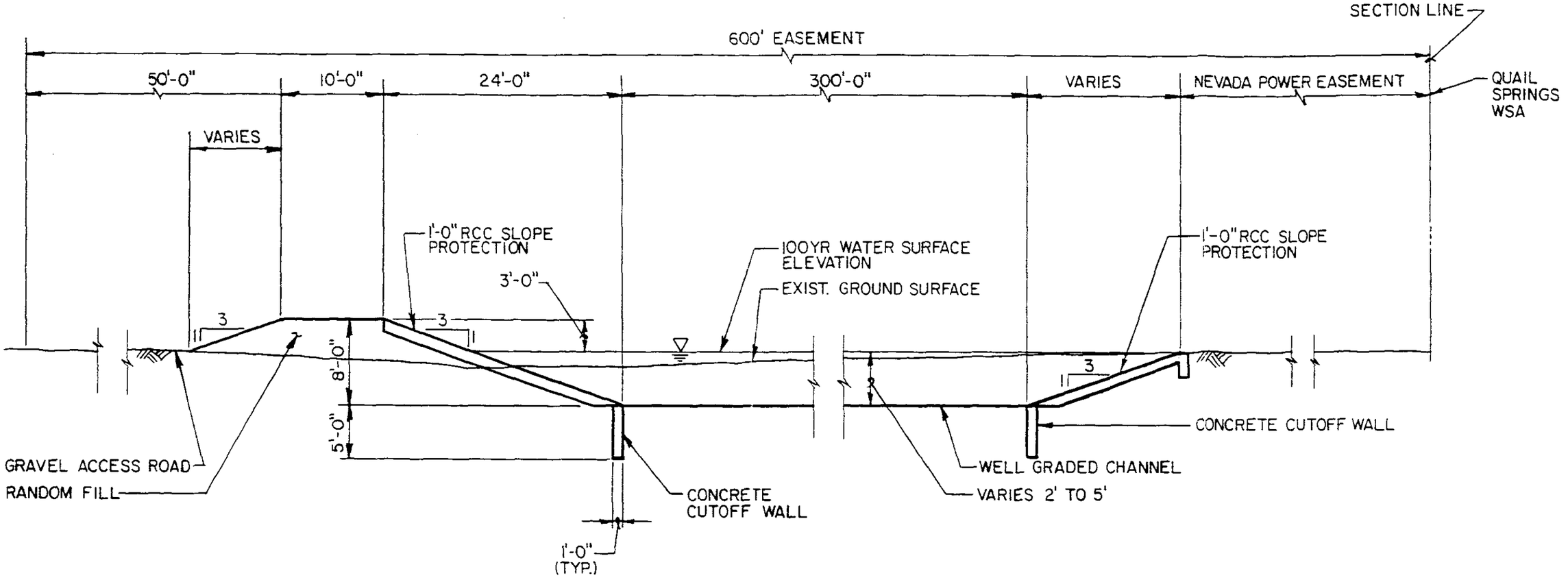
NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

INTERCEPTION BERM/CHANNEL
ALIGNMENT

FIGURE
NO. 5-11

511980



INTERCEPTION BERM/CHANNEL CROSS SECTION

SCALE: 1"=10'-0"

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Las Vegas, Nevada

INTERCEPTION BERM/CHANNEL CROSS SECTION

FIGURE NO. 5-12

wall will be provided along the toe of the berm to prevent failure of the berm during the 100-yr flood. The channel banks will be protected from erosion with a 9-in thick RCC lining. During final design, a sediment transport analysis will be conducted to optimize the channel geometry and minimize deposition and scour in the channel over a range of flood flows up to the 100-year flood.

Construction Plans for the *Upper Las Vegas Wash Detention Basin and Interception Berm/Channel*

N:\930017\ADMIN\17-094RP.WP5

Included in this section:

Construction Plans for the *Upper Las Vegas Wash Detention Basin and Interception Berm/Channel* by Black & Veatch - 26 sheets.

CITY OF NORTH LAS VEGAS

UPPER LAS VEGAS WASH DETENTION BASIN AND INTERCEPTION BERM/CHANNEL

BID NO. 817

FUNDED BY:

THE CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

PLANS REVIEWED BY:

CITY OF LAS VEGAS	5-26-91 DATE	SOUTHWEST GAS	DATE
NEVADA POWER	5/7/91 DATE	CENTEL	5-26-91 DATE
NEVADA DIVISION OF STATE PARKS	4/25/91 DATE	CITY OF NORTH LAS VEGAS SUPT. OF QUALITY CONTROL	DATE

Black & Veatch
Las Vegas, Nevada

PROJECT NO. 17149

1991

APPROVALS:

GARY W. HOLLER, R.P.E. #1920 — 5-21-91 DATE
DIRECTOR OF PUBLIC WORKS
CITY OF NORTH LAS VEGAS, NEVADA

VIRGINIA E. BAX VALENTINE, P.E. — DATE
CLARK COUNTY REGIONAL
FLOOD CONTROL DISTRICT
GENERAL MANAGER/CHIEF ENGINEER

JAMES B. BELL, R.P.E. #4524 — DATE
CITY ENGINEER
CITY OF NORTH LAS VEGAS, NEVADA

GENERAL SYMBOLS

- HEDGE, BRUSH, SHRUBS, WOODS
- 10" — DECIDUOUS TREE AND TRUNK DIAMETER
- 4" — CONIFEROUS TREE AND TRUNK DIAMETER
- GRAVEL STREET, ROAD OR DRIVE
- SURFACED STREET, ROAD OR DRIVE WITH CURBS
- NON-SURFACED STREET, ROAD OR DRIVE
- CONCRETE WALK
- T.H.#2 — TEST HOLE AND NUMBER
- TELEPHONE OR POWER POLE WITH GUY ANCHOR
- DRAINAGE COURSE OR FLOW LINE
- 326 — EXISTING GROUND CONTOUR
- 326 — FINISH GRADE CONTOUR
- BANK OR SLOPE LINES
- NEW BUILDINGS, STRUCTURES
- EXISTING BUILDINGS, STRUCTURES
- FUTURE BUILDINGS, STRUCTURES
- TORTOISE PROOF FENCE
- CHAIN LINK FENCE
- MANHOLE
- CONCRETE REACTION BLOCKING AT BEND, PLUG OR TEE
- FIRE HYDRANT
- YARD HYDRANT
- STREET LIGHT POLE
- DRAINS OR CULVERTS
- GV — WATER OR GAS VALVE
- WM / GM — WATER OR GAS METER
- CENTERLINE
- SMALLER THAN 24" / 24" AND LARGER — EXISTING
- SMALLER THAN 24" / 24" AND LARGER — NEW — GENERAL LAYOUT YARD PIPING
- NON-CONNECTING PIPING
- P — PROPERTY LINE
- SURVEY LINE WITH PI, PT, OR POT
- E/L — EASEMENT LINE
- P—T— POWER OR TELEPHONE LINES
- R/W — RIGHT-OF-WAY LINE
- E — ELECTRICAL (UNDERGROUND)
- T — TELEPHONE (UNDERGROUND)
- 1 / 1E-10 — SECTION NUMBER OR DETAIL LETTER; DRAWING NUMBER ON WHICH SECTION OR DETAIL APPEARS, OR WHERE SECTION IS CUT OR DETAIL IS NOTED
- 1 / 1E-3 — WALL ELEVATION
- D / 1F14 — ABBREVIATION DOOR, WINDOW AND LOUVER SCHEDULE REFERENCE; AREA DESIGNATION
- 1F102 — ROOM NUMBER; AREA DESIGNATION
- SURVEY CONTROL MONUMENT

ABBREVIATIONS

AC	ACRE	MAX	MAXIMUM
AC FT	ACRE FEET	MIN	MINIMUM
ALUM	ALUMINUM	MISC	MISCELLANEOUS
APPROX	APPROXIMATE		
		N	NORTH
B	BORING	NO	NUMBER
BC	BEGINNING OF CURVE	NPC	NEVADA POWER COMPANY
BO	BOTTOM OF	NTS	NOT TO SCALE
C	CENTERLINE	O/S	OFF SET
CFS	CUBIC FEET PER SECOND		
CJ	CONSTRUCTION JOINT	PC	POINT OF CURVE
CM	CONCRETE SURVEY MONUMENT	PI	POINT OF INTERSECTION
CMP	CORRUGATED METAL PIPE	PL	PLATE
CONC	CONCRETE	PLCS	PLACES
CONST	CONSTRUCTION	PMF	PROBABLE MAXIMUM FLOOD
CTR	CENTER	PT	POINT OF TANGENT
CU YD	CUBIC YARD	PVC	POLYVINYL CHLORIDE
CLR	CLEARANCE		
		RCC	ROLLER COMPACTED CONCRETE
DET	DETAIL	REINF	REINFORCING
DIA	DIAMETER	REQ'D	REQUIRED
DIM	DIMENSION	R/W	RIGHT OF WAY
E	EAST	S	SLOPE OR SOUTH
EA	EACH	SEC	SECTION
EF	EACH FACE	SH	SHEET
EL	ELEVATION	SIM	SIMILAR
EW	EACH WAY	SPEC	SPECIFICATION
EXIST	EXISTING	STA	STATION
EXP	EXPANSION	STD	STANDARD
		STR	STRUCTURAL
FG	FINISH GRADE	SQ	SQUARE
FL	FLOW LINE		
		TO	TOP OF
GALV	GALVANIZED	T&B	TOP AND BOTTOM
GA	GAGE	TP	PIT OR TRENCH
		TYP	TYPICAL
H	HEIGHT		
HORIZ	HORIZONTAL	USGS	UNITED STATES GEOLOGICAL SURVEY
HR	HANDRAIL		
HT	HEIGHT	VERT	VERTICAL
ID	INSIDE DIAMETER	W	WEST
INCL	INCLUDED	W/	WITH
INV	INVERT	W/O	WITHOUT
JT	JOINT	YD	YARD
		YR	YEAR
LS	LUMP SUM		
LIN FT	LINEAR FOOT	&	AND

MATERIALS

- EARTH OR GRADE
- GRANULAR FILL (CRUSHED ROCK OR GRAVEL)
- ROCK
- NEW CONCRETE (CUT)
- ALUMINUM
- EXISTING CONCRETE, PRECAST OR PRESTRESSED CONCRETE
- WOOD, STUDS, BEAMS, JOISTS, ETC.
- INSULATION (RIGID)
- RIPRAP
- ROLLER-COMPACTED CONCRETE
- BRICK, FACE
- BRICK, COMMON
- CONCRETE MASONRY UNITS (CMU)
- CUT STONE, SAND FILL, GROUT MORTAR OR PLASTER
- CHECKERED PLATE
- STEEL (1" SCALE & LARGER)
- STEEL (SMALL SCALE)
- BAR GRATING (LINES IN DIRECTION OF SPAN)
- WOOD, SHEATHING, PANELING, DECKING, ETC.

GENERAL NOTES

1. THE CONTRACTOR SHALL CONFINE CONSTRUCTION ACTIVITIES WITHIN THE PROJECT BOUNDARIES AS DEFINED BY THE LOCATION OF THE TORTOISE PROOF FENCE SHOWN ON SHT 3, EXCEPT ACCESS ROAD CONSTRUCTION.
2. PRIOR TO THE CONSTRUCTION OF THE USGS GAGE VAULT AND ALL AFFILIATED WORK, AS INDICATED ON SHTS 9, 18, & 23, THE CONTRACTOR SHALL CONTACT MR. DAVE BLACKSTUN OF THE USGS AT (702)-295-1770.
3. THE CONTOUR INTERVAL IS 2.0 FT, UNLESS OTHERWISE INDICATED.
4. STANDARD CONCRETE DETAILS ARE SHOWN ON SHEET 25.

SHEET LIST

SHEET NO.	TITLE
C	COVER SHEET
1	LEGEND, ABBREVIATIONS, GENERAL NOTES, SHEET LIST & APPROXIMATE QUANTITIES
2	MAPS, PERTINENT DATA & HYDROGRAPHS
3	SITE PLANS, SURVEY DATA & BORING LOCATIONS
4	INTERCEPTION BERM/CHANNEL PLAN & PROFILE STA 0+00 TO STA 32+00
5	INTERCEPTION BERM/CHANNEL PLAN & PROFILE STA 32+00 TO STA 64+00
6	INTERCEPTION BERM/CHANNEL PLAN & PROFILE STA 64+00 TO STA 91+41.43
7	INTERCEPTION BERM/CHANNEL SECTIONS & DETAILS
8	DAM EMBANKMENT GRADING PLAN NO. 1 STA 0+00 TO STA 18+50
9	DAM EMBANKMENT GRADING PLAN NO. 2 STA 18+50 TO STA 37+00
10	DAM EMBANKMENT GRADING PLAN NO. 3 STA 37+00 TO STA 65+93.92
11	DAM EMBANKMENT CENTERLINE PROFILE STA 0+00 TO STA 20+00 & STA 45+00 TO STA 65+93.92
12	DAM EMBANKMENT CENTERLINE PROFILE STA 20+00 TO STA 45+00
13	DAM EMBANKMENT TYPICAL CROSS SECTION & DETAILS
14	DAM EMBANKMENT CROSS SECTIONS STA 3+00 TO STA 19+00
15	DAM EMBANKMENT CROSS SECTIONS STA 22+00 TO STA 26+00
16	DAM EMBANKMENT CROSS SECTIONS STA 27+10 TO STA 33+00.65
17	DAM EMBANKMENT CROSS SECTIONS STA 33+50 TO STA 62+00
18	SPILLWAY PLAN
19	SPILLWAY SECTIONS
20	SPILLWAY SECTIONS & DETAILS
21	OUTLET WORKS SECTIONS & DETAILS
22	TRASH RACK PLAN, SECTIONS & DETAILS
23	MISCELLANEOUS SECTIONS & DETAILS
24	MISCELLANEOUS SECTIONS & DETAILS
25	STANDARD CONCRETE SHEET

SUMMARY OF APPROXIMATE QUANTITIES

ITEM NO.	DESCRIPTION	QUANTITY	UNIT
1.	MOBILIZATION	1	LS
2.	SURVEYING	1	LS
3.	ACCESS ROADS	18,400	LIN FT
4.1	TEMPORARY TORTOISE PROOF FENCING	53,850	LIN FT
4.2	HANDRAIL AND CHAIN LINK FENCING WITH GATES	1,024	LIN FT
4.3	STEEL GATES	3	EACH
5.	STRIPPING	150	ACRES
6.	REMOVAL AND DISPOSAL OF EXISTING STRUCTURES AND DEBRIS	1	LS
	EMBANKMENT QUANTITIES		
7.1	EMBANKMENT OVEREXCAVATION	274,000	CU YD
7.2	CUTOFF TRENCH FILL	54,000	CU YD
7.3	RANDOM ZONE FILL	470,000	CU YD
7.4	CORE ZONE FILL	83,000	CU YD
7.5	DRAINAGE BLANKET	26,150	CU YD
8.1	GENERAL EXCAVATION	310,000	CU YD
8.2	GENERAL FILL	90,000	CU YD
9.	12" CLASS "A" RIP RAP	82,400	SQ YD
	SPILLWAY & OUTLET QUANTITIES		
10.1	INCLINED GRAVEL DRAIN	11,000	CU YD
10.2	GRADED GRAVEL BLANKET	3,500	CU YD
10.3	RCC FOR SPILLWAY	44,500	CU YD
10.4	TYPE II COLD JOINT PREPARATION	10,000	SQ FT
10.5	SHEET PILE CUTOFF	1	LS
10.6	TRASH RACK & OUTLET WORKS	1	LS
	INTERCEPTION BERM/CHANNEL QUANTITIES		
11.	INTERCEPTION CHANNEL EXCAVATION	472,000	CU YD
12.	INTERCEPTION BERM GENERAL FILL	75,000	CU YD
13.	INTERCEPTION BERM RCC SLOPE PROTECTION	17,700	CU YD
14.	INTERCEPTION CHANNEL 18" CLASS "B" RIP RAP	39,000	SQ YD
15.	PORTLAND CEMENT FOR RCC	8,750	TON
16.	CONSTRUCTION CONFLICTS	1	LS

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

DESIGNED PJR SDC
DETAILED MLR
CHECKED DJH
APPROVED
DATE 7-15-91

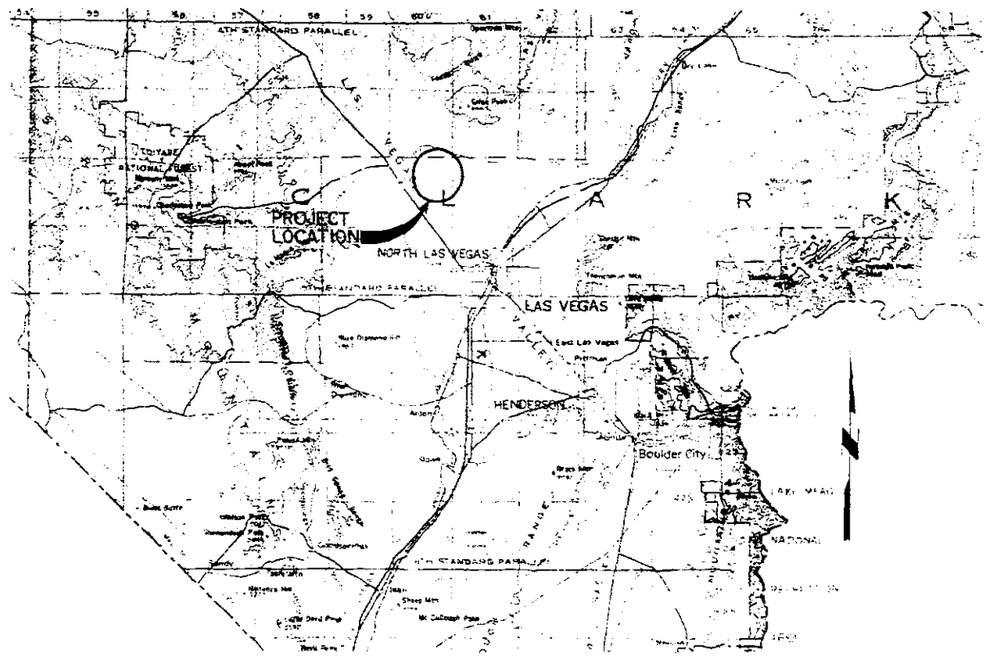
Black & Veatch
Engineers-Architects
Las Vegas, Nevada

PROJECT NO
17149

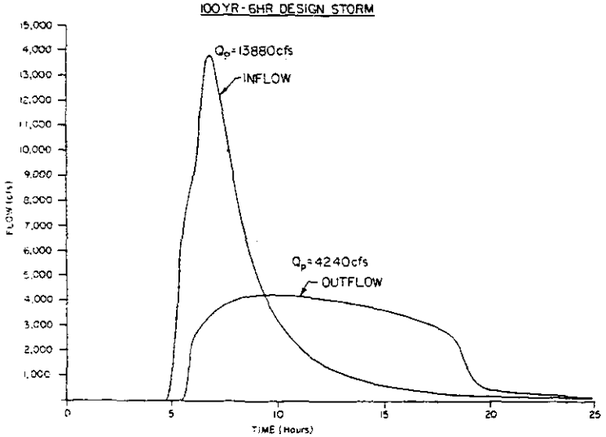
CITY OF NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

LEGEND, ABBREVIATIONS, GENERAL NOTES, SHEET LIST & APPROXIMATE QUANTITIES

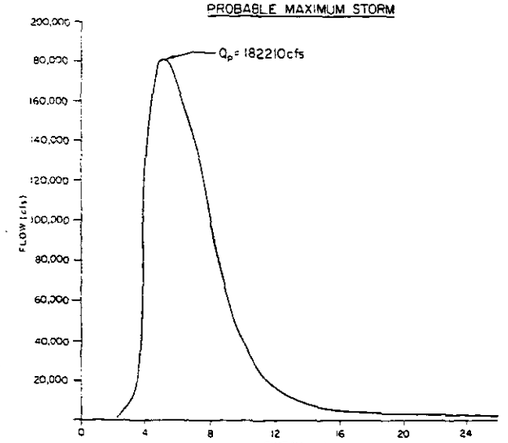
SHEET 1 OF



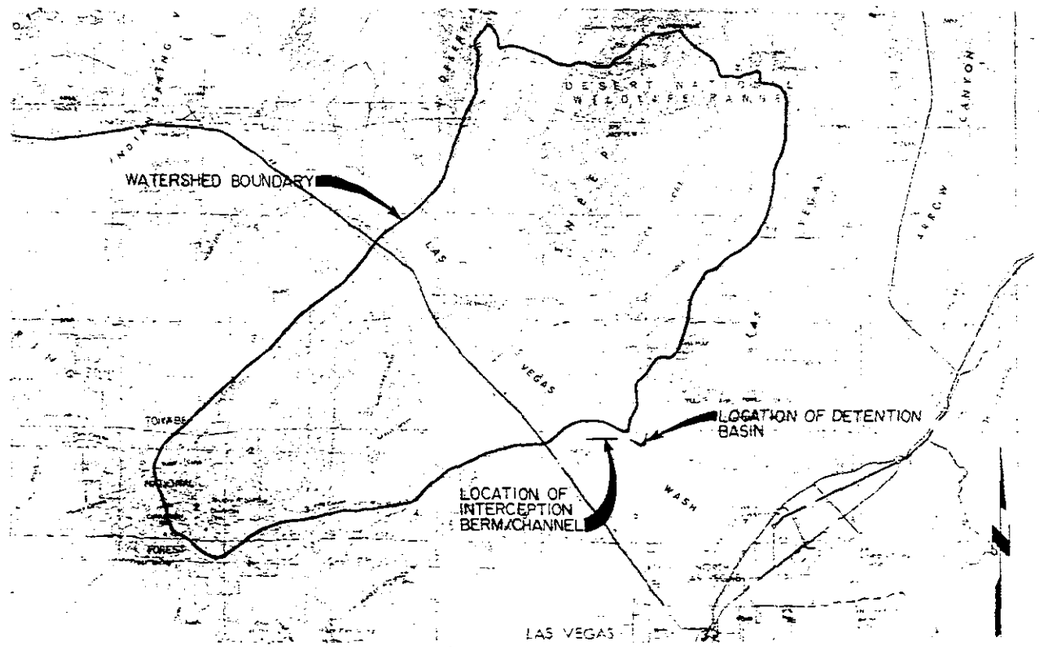
VICINITY MAP



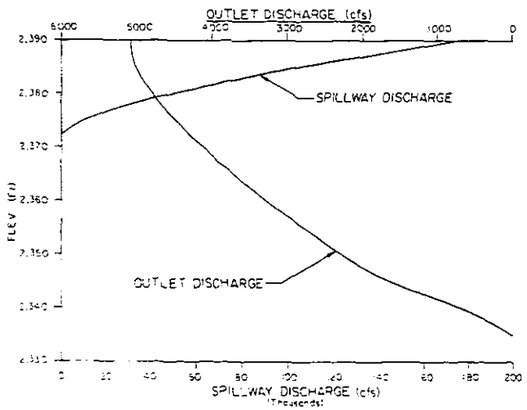
DETENTION BASIN INFLOW & OUTFLOW HYDROGRAPHS



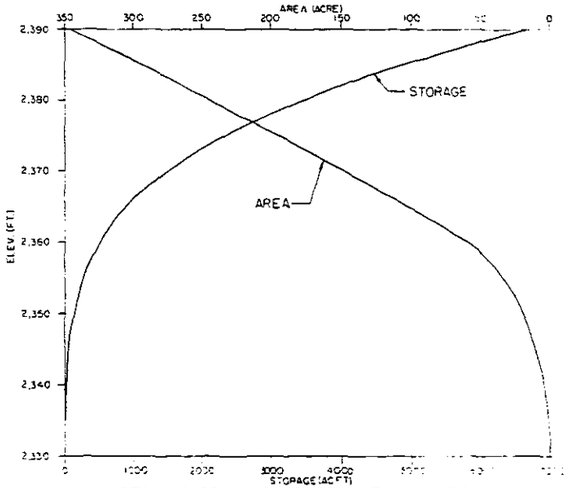
EMERGENCY SPILLWAY DESIGN HYDROGRAPH



WATERSHED BOUNDARY MAP



STAGE-DISCHARGE CURVES



STAGE-STORAGE & STAGE-AREA CURVES

PERTINENT DATA

LOCATION: TOWNSHIP 19 SOUTH, RANGE 60 EAST
CLARK COUNTY, NEVADA

DESIGN STORMS:

INFLOW DESIGN FLOOD - 100 YR-6 HR THUNDERSTORM
- STORM AREA - 144 sq mi — PEAK INFLOW - 13,880 cfs
- TOTAL RAINFALL - VARIES 2.53 - 4.23 in — VOLUME OF INFLOW HYDROGRAPH - 4,080 ac ft

SPILLWAY DESIGN FLOOD - PROBABLE MAXIMUM STORM
- STORM AREA - 516 sq mi — PEAK INFLOW - 182,210 cfs
- TOTAL RAINFALL - 4.9 in — VOLUME OF INFLOW HYDROGRAPH - 75,000 ac ft

DETENTION BASIN EMBANKMENT:
- TYPE: ZONED EARTHFILL WITH HORIZONTAL DRAINAGE BLANKET
- LENGTH: 6,593 ft
- MAXIMUM HEIGHT ABOVE GRADE: 49 ft
- TOP ELEVATION: 2,390 ft
- FREEBOARD:
  - FOR 100-YR - 6 HR STORM - 18.5 ft — FOR PROBABLE MAXIMUM STORM - 0 ft
- SLOPES:
  - UPSTREAM SLOPE - 3:1 — DOWNSTREAM SLOPE - 2.5:1

IMPOUNDMENT AREA:
- FOR 100 YR - 6 HR STORM
  - POOL ELEV - 2,371.5 ft
  - SURFACE AREA - 165 ac
  - VOLUME - 1,760 ac ft
- FOR THE PROBABLE MAXIMUM STORM
  - POOL ELEV - 2,390 ft
  - SURFACE AREA - 340 ac
  - VOLUME - 6,880 ac ft

SPILLWAY:
- TYPE: ROLLER-COMPACTED CONCRETE CAPPED BROAD-CRESTED WEIR
- CREST ELEVATION - 2,372 ft
- CREST LENGTH - 750 ft
- CREST WIDTH - 75 ft
- DISCHARGE CAPACITY AT 100-YR POOL - 0 cfs
- DISCHARGE CAPACITY AT PMF POOL - 175,650

OUTLET WORKS:
- TYPE: CAST-IN-PLACE CONCRETE BOX CULVERT
- CULVERT DIMENSIONS - 2 BARREL 8'-0" x 8'-0"
- DISCHARGE CAPACITY AT 100-YR POOL - 4,240 cfs
- DISCHARGE CAPACITY AT PMF POOL - 5,080 cfs

INTERCEPTION BERM:
- TYPE: EARTHEN EMBANKMENT WITH ROLLER COMPACTED CONCRETE SLOPE PROTECTION
- CREST WIDTH: 15 ft — SIDE SLOPES: 3:1

INTERCEPTION CHANNEL:
- TYPE: TRAPEZOIDAL WITH UNLINED INVERT AND LINED SIDE SLOPES
- LENGTH: 9,100 ft — DEPTH AT 100-YR FLOOD: 4.6 ft
- WIDTH: 300 ft — FREEBOARD AT 100-YR FLOOD: 3.9 ft
- SLOPE: 0.0067 ft/ft

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

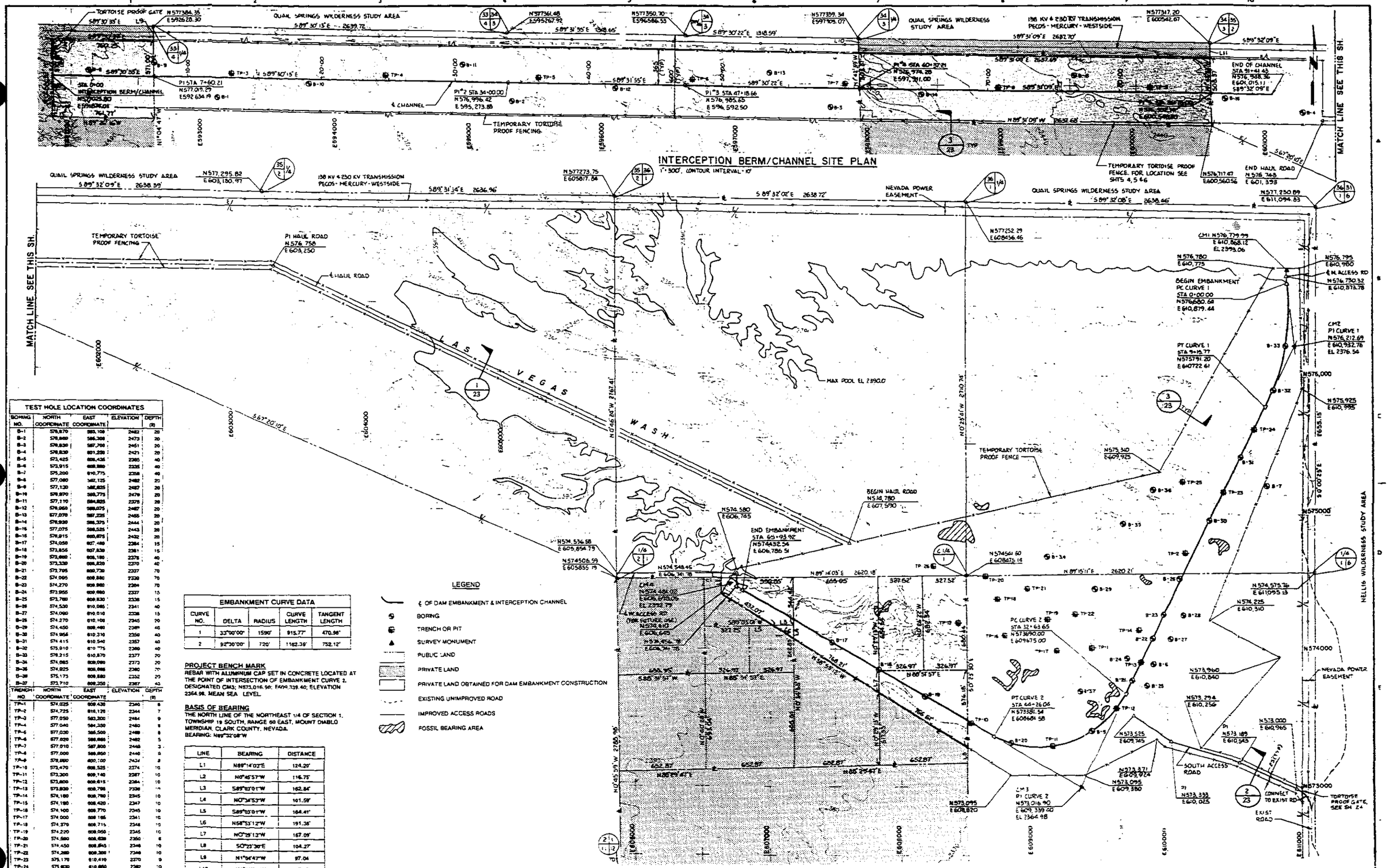
DESIGNED RJR
DETAILED RST
CHECKED DJH
APPROVED
DATE

Black & Veatch
Engineers-Architects
Las Vegas, Nevada

PROJECT NO 17149

CITY OF NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

MAPS, PERTINENT DATA & HYDROGRAPHS


INTERCEPTION BERM/CHANNEL SITE PLAN
1"=300', CONTOUR INTERVAL = 10'
DAM EMBANKMENT SITE PLAN
1"=300', CONTOUR INTERVAL = 10'
MATCH LINE SEE THIS SH.
TEMPORARY TORTOISE PROOF FENCE
QUAIL SPRINGS WILDERNESS STUDY AREA
138 KV & 230 KV TRANSMISSION PECOS - MERCURY - WESTSIDE
NEVADA POWER EASEMENT
℄ HAUL ROAD
LAS VEGAS WASH
MAX POOL EL 2390.0
℄ CHANNEL
INTERCEPTION BERM/CHANNEL
BEGIN EMBANKMENT PC CURVE 1 STA 0+00.00 N576680.68 E610,879.44
END EMBANKMENT STA 65+93.92 N574432.54 E606,786.51
END OF CHANNEL STA 91+41.43 N576,508.36 E601,015.11 S89°32'09"E
END HAUL ROAD N 576,748 E 601,393
BEGIN HAUL ROAD N514,780 E 607,590
SOUTH ACCESS ROAD
CONNECT TO EXIST RD
EXIST ROAD
TORTOISE PROOF GATE, SEE SH. Z4
NELLIS WILDERNESS STUDY AREA
NEVADA POWER EASEMENT
TEMPORARY TORTOISE PROOF FENCE. FOR LOCATION SEE SHTS 4, 5 & 6
CM1 N576,729.99 E 610,868.12 EL 2393.06
CM2 PI CURVE 1 N576,212.69 E 610,932.76 EL 2376.56
CM3 PI CURVE 2 N573,016.90 E 609,339.20 EL 2364.98
PC CURVE 2 STA 32+63.65 N573690.00 E 609675.00
PT CURVE 2 STA 44+26.04 N 573381.54 E 608684.58
PT CURVE 1 STA 9+19.77 N575791.20 E 610722.61
PI HAUL ROAD N 576 758 E 603,250
TEMPORARY TORTOISE PROOF FENCE
N577,295.82 E 603,180.97
N577273.75 E 605877.84
N577252.29 E 608456.46
N577,230.89 E 611,094.83
N576,717.47 E 600,560.56
N576,780 E 610,775
N576,795 E 610,980
N576,730.32 E 610,873.78
N575,340 E 609,925
N575,925 E 610,995
N574,580 E 606,745
N574,536.58 E 605,854.79
N574506.59 E 605855.79
N574548.45 E 606,341.78
N574,575.76 E 611095.13
N574,225 E 610,510
N573,960 E 610,840
N573,294 E 610,256
N573,525 E 609,745
N573,189 E 610,545
N573,000 E 610,965
N573,371 E 609,924
N573,095 E 609,380
N573,333 E 610,025
N573,095 E 608,820
N574560.60 E 608675.16
N574000
N573000
N575000
N576000
E609000
E610000
E611000
E608000
E607000
E606000
E605000
E604000
E603000
E602000
E600000
E599000
E598000
E597000
E596000
E595000
E594000
E593000
E592000
S89°30'35"E
S89°30'15"E 2639.72'
S89°31'55"E 1318.65'
S89°30'22"E 1318.59'
S89°31'09"E 2637.70'
S89°32'09"E
S89°31'34"E 2636.96'
S 89°32'08"E 2638.72'
S89°32'08"E 2638.46'
S89°32'09"E 2638.39'
N89°14'03"E 2620.18'
N89°15'11"E 2620.21'
N89°31'09"W 2652.68'
S67°20'10"E
N0°46'56"W 2767.41'
N0°45'39"W 2760.96'
N0°29'41"W 2710.74'
N0°23'23"W 2710.74'
N0°23'23"W 2710.74'
N0°23'23

TORTOISE PROOF GATE, SEE SH 24

S89°30'33"E

SECTION LINE

138 KV & 230 KV TRANSMISSION

S89°30'15"E

QUAIL SPRINGS WILDERNESS STUDY AREA

INTERCEPTION BERM ACCESS ROAD SEE PROFILE SH 23

N577384.35
E592628.30

90' APC EASEMENT

TORTOISE-PROOF FENCING

365'

600' EASEMENT

150'

PI #1 STA 7+60.21
N577,079.29
E592,634.19

PI #2
15' INSIDE RADIUS (TYP)
PI #3
PI #4
PI #5

N577025.85
E591813.97

S 89°30'33"E

0+00 1+00 5+00 10+00 15+00 20+00 25+00 30+00

STA 26+00 ACCESS RAMPS SEE DETAIL A & B SH 7

MATCH LINE STA 32+00 SEE SH 5

STA 0+55.60 BEGIN RCC SLOPE PROTECTION

NEVADA DIVISION OF STATE PARKS LAND

TORTOISE-PROOF FENCING

PE/L

INTERCEPTION BERM ACCESS ROAD LOCATION DATA

P.I. NO.	NORTH COORDINATE	EAST COORDINATE
1	577,289.66	591,911.87
2	577,273.86	591,936.73
3	577,232.86	591,936.39
4	577,175.18	591,952.90
5	576,842.06	591,964.90

NOTE:
FOR SECTION LINES AND PROPERTY BOUNDARIES, SEE INTERCEPTION BERM/CHANNEL SITE PLAN, SH 3.

KEY PLAN

SCALE
HORIZ 1"=100'
VERT 1"=4'

ACCESS ROAD
EL 2496.00
EL 2487.00
EL 2481.20
STA 0+55.60 BEGIN RCC SLOPE PROTECTION
STA 1+00
STA 1+30

NORTH BANK (T.O. 5:1 SLOPE)
SOUTH BANK (TOP OF BERM)
CHANNEL ℄
EXIST GRADE @ CHANNEL ℄
EXIST GRADE @ BERM ℄
5=0.0067 Ft/Ft
80 RCC SLOPE PROTECTION (SOUTH BANK)
EL 2474.93
EL 2466.43

2496 2492 2488 2484 2480 2476 2472 2468 2464 2460

0+00 1 2 3 4 5+00 6 7 8 9 10+00 11 12 13 14 15+00 16 17 18 19 20+00 21 22 23 24 25+00 26 27 28 29 30+00 31 32+00

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

DESIGNED ALK JWS
DETAILED SHR
CHECKED DKH
APPROVED
DATE

Black & Veatch
Engineers - Architects
Las Vegas, Nevada

PROJECT NO. 17149

CITY OF NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

INTERCEPTION BERM/CHANNEL
PLAN & PROFILE STA. 0+00 TO 32+00

SHEET 4 OF 25

N 577361.48
E 595267.92

N 577350.70
E 596586.53

N 577339.36
E 597905.07

QUAIL SPRINGS WILDERNESS STUDY AREA

138KV & 230KV TRANSMISSION

TORTOISE-PROOF FENCING

NPC EASEMENT

SCE EASEMENT

MATCH LINE STA. 32+00 SEE SH. 4

MATCH LINE STA. 64+00 SEE SH. 6

S 89° 30' 13" E

S 89° 31' 55" E

S 89° 30' 22" E

S 89° 31' 09" E

P.I. 2 STA 36+00.00
N 576,996.42
E 595,273.88

STA. 39+50
ACCESS RAMP
SEE DET. 6, SH 7

STA. 39+50
ACCESS RAMP
SEE DETAIL A, SH 7

P.I. 3 STA. 47+18.66
N 576,985.65
E 596,592.50

P.I. 4 STA. 60+32.31
N 576,974.28
E 597,911.00

NEVADA DIVISION OF STATE PARKS LAND

NOTE:
FOR SECTION LINES AND PROPERTY BOUNDARIES, SEE INTERCEPTION BERM/CHANNEL SITE PLAN SH 3

KEY PLAN

NORTH BANK (10.3:1 SLOPE)

EL 2478.95

EL 2466.43

EL 2461.43

EXIST GRADE @ CHANNEL ℄

EXIST GRADE @ BERM ℄

SOUTH BANK (TOP OF BERM)

5.0 CUBIC FEET/SEC/FOOT

CHANNEL ℄

EL 2453.49

EL 2444.95

SLOPE PROTECTION (SOUTH BANK)

2476
2472
2468
2464
2460
2456
2452
2448
2444
2440

32+00 33 34 35+00 36 37 38 39 40+00 41 42 43 44 45+00 46 47 48 49 50+00 51 52 53 54 55+00 56 57 58 59 60+00 61 62 63 64+00

SCALE
HORIZ 1"=100'
VERT 1"=10'

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

DESIGNED ALK 1/93
DETAILED HLB
CHECKED DJH
APPROVED
DATE 5-21-93

Black & Veatch
Engineers - Architects
Las Vegas, Nevada

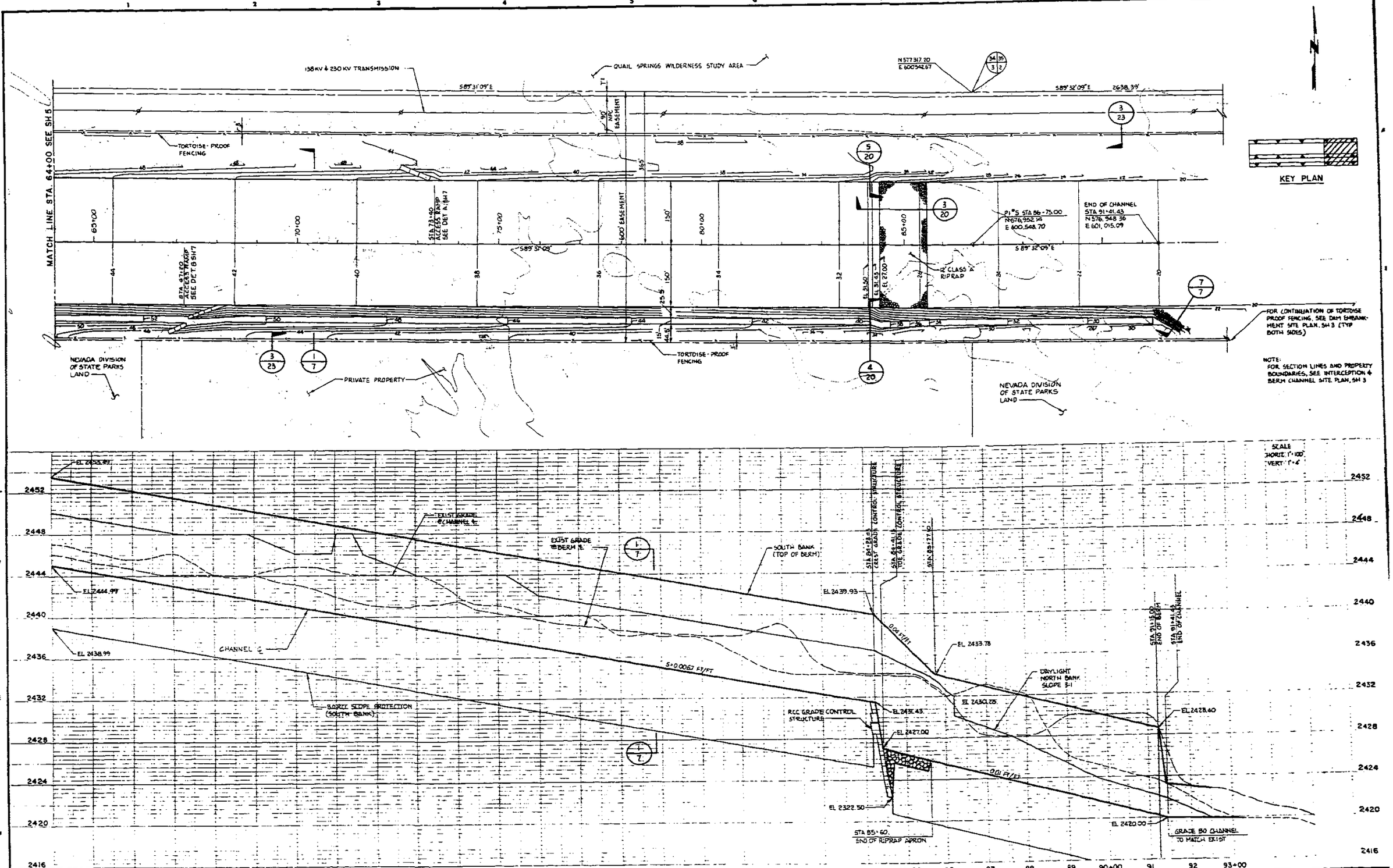
PROJECT NO. 17149

CITY OF NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

INTERCEPTION BERM/CHANNEL
PLAN & PROFILE STA. 32+00 TO 64+00

REGISTERED PROFESSIONAL ENGINEER — STATE OF NEVADA — DIANA J. WEZL — CIVIL — No. 9118

SHEET 5 OF 2



DESIGNED	ALK, JWS, SDC
DETAILED	MLR
CHECKED	DEH
APPROVED	[illegible]
DATE	5-28-91

Black & Veatch
Engineers - Architects
Las Vegas, Nevada

PROJECT NO. 17149

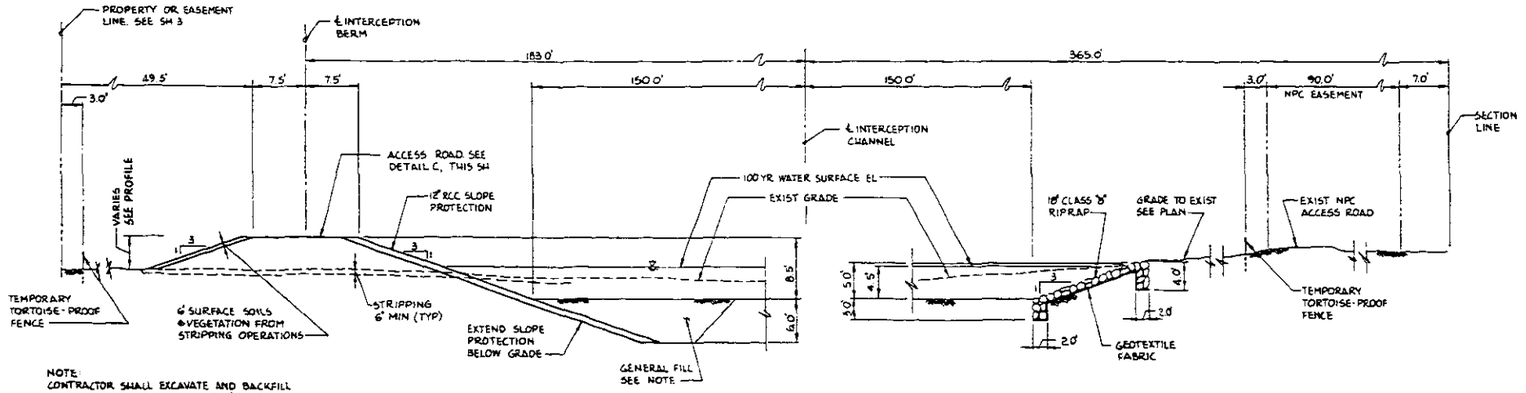
CITY OF NORTH LAS VEGAS

UPPER LAS VEGAS WASH DETENTION BASIN

INTERCEPTION BERM/CHANNEL PLAN & PROFILE STA. 64+00 TO 93+00

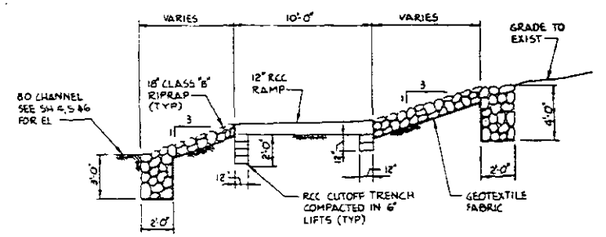
SHEET 6 OF 25

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

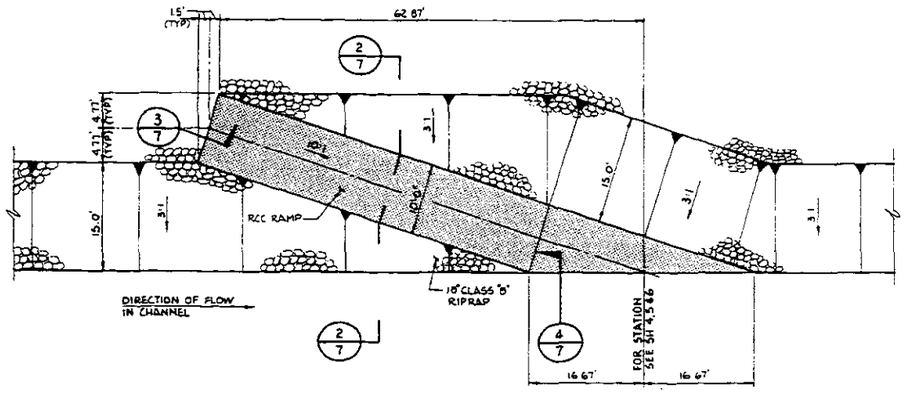


NOTE:
CONTRACTOR SHALL EXCAVATE AND BACKFILL TRENCH AT TOE OF BERM AS REQ'D TO EXTEND SLOPE PROTECTION BELOW GRADE.

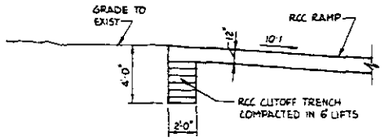
INTERCEPTION BERM/CHANNEL CROSS SECTION (1/4,5,6)
1"=10'



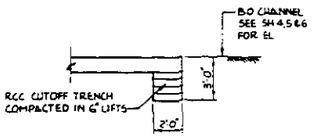
SECTION (2/7)
1"=5'



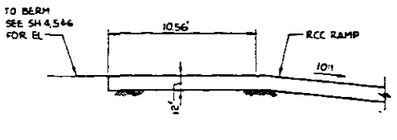
NORTH BANK ACCESS RAMP PLAN (A 4,5,6)
1"=10'



SECTION (3/7)
1"=5'



SECTION (4/7)
1"=5'



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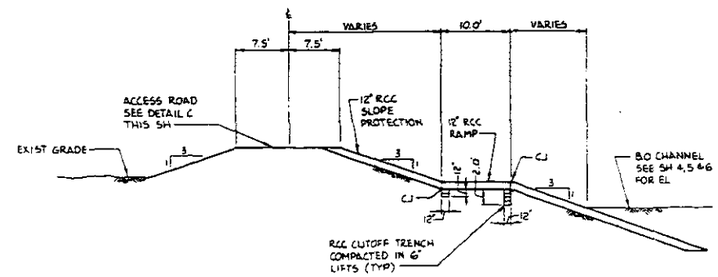
1"=5'



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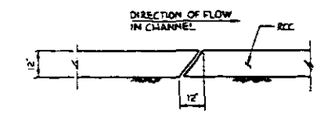
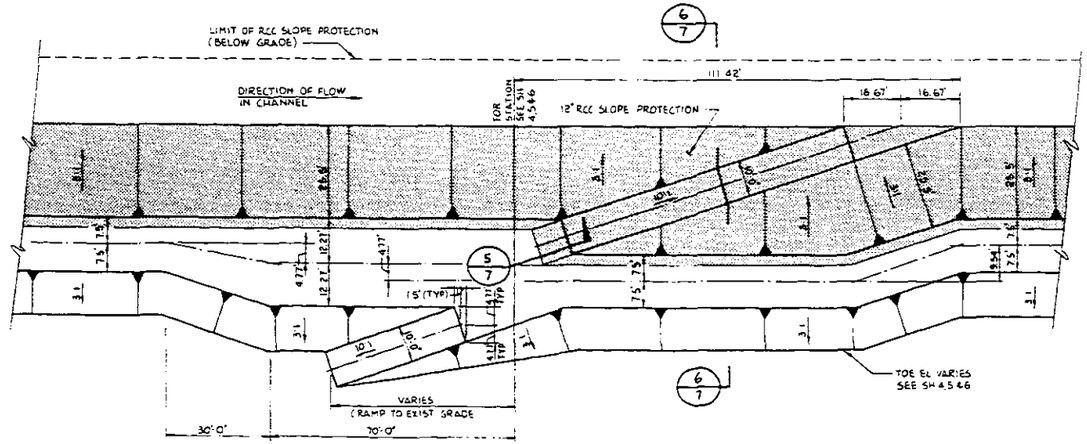
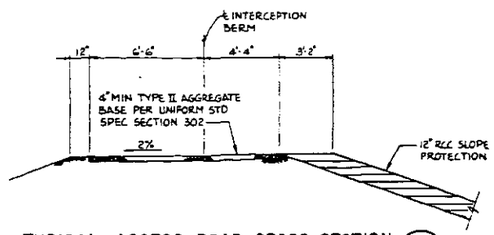


TYPICAL CONSTRUCTION JOINT DETAIL
3/8"=1'-0"

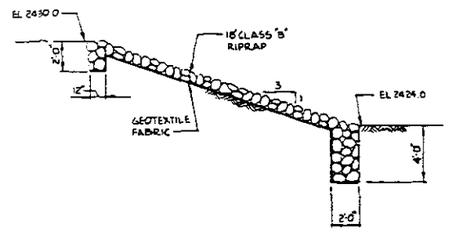
NOTE CONTRACTOR SHALL PROVIDE CONSTRUCTION JOINT AT THE END OF EACH SECTION OF RCC PLACED AND AT THE END OF EACH DAY.



SOUTH BANK ACCESS RAMP PLAN (B 4,5,6)
1"=20'



TYPICAL ACCESS ROAD CROSS SECTION (C 4,5,6)
NO SCALE



SECTION (7/7)
1"=5'

DESIGNED	ALK SDC
DETAILED	HER
CHECKED	DJM
APPROVED	
DATE	5-29-91

Black & Veatch
Engineers-Architects
Las Vegas, Nevada

PROJECT NO 17149

CITY OF NORTH LAS VEGAS
UPPER LAS VEGAS WASH DETENTION BASIN
INTERCEPTION BERM/CHANNEL SECTIONS & DETAILS

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA DAVID V. REED CIVIL No. 7138

SHEET 7 OF 25

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BAY IC 8428-0

NOTES

1. CONTRACTOR SHALL NOT DISTURB AREAS BEYOND LIMITS OF TORTOISE PROOF FENCE EXCEPT AS INDICATED ON THE DWGS.
2. CONTRACTOR SHALL NOT EXCAVATE BELOW FINISH CONTOUR ELEVATIONS WITHIN 200 FT OF THE UPSTREAM TOE OF EMBANKMENT SLOPE
3. FOR LOCATION AND ELEVATION OF SURVEY CONTROL MONUMENTS, SEE SH 3.

N576,795
E610,980

2/23

25' R (TYP)

NORTH ACCESS ROAD

ACCESS ROAD PI
N576,730.32
E610,873.78

N576,780
E610,775

90°

BEGIN DAM STA 0+00

PC 1 STA 0+00
N576,680.64
E610,879.44

A/24 GATE STA 2+00

1/14

PI N576,212.69
E610,932.76

TOE DRAIN SEE TYPICAL DETAIL SH 13

N575,925
E610,995

2/14

EXIST UNIMPROVED ROAD

TEMPORARY TORTOISE PROOF FENCE

PT 1 STA 9+15.77
N575,791.20
E610,722.69

3/14

3/23 TYP

12" CLASS A RIPRAP SLOPE PROTECTION (TYP)

4/14

5/14

6/14

N575,310
E609,925

MATCH LINE STA 18+50 SEE SH. 9

KEY PLAN

CITY OF NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

DAM EMBANKMENT GRADING PLAN NO. 1
STA. 0+00 TO STA. 18+50

DESIGNED SJC
DETAILED MLR
CHECKED DJH
APPROVED
DATE

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17149

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DATE | REVISIONS AND RECORD OF ISSUE | NO. | BY | CK | APP

MATCH LINE STA. 18+50 SEE SH 8

NOTES:
1. CONTRACTOR SHALL NOT DISTURB AREAS BEYOND LIMITS OF TORTOISE PROOF FENCE EXCEPT AS INDICATED ON THE PLANS.
2. CONTRACTOR SHALL NOT EXCAVATE BEYOND FINISH CONTOUR ELEVATIONS WITHIN 200 FT OF THE UPSTREAM TOE OF EMBANKMENT SLOPE.
3. FOR LOCATION AND ELEVATION OF SURVEY CONTROL MONUMENTS, SEE SH 3.
4. FOR SPILLWAY FENCE TYPE AND LOCATION SEE SH 18.
5. FOR SECTION LINES AND PROPERTY BOUNDARIES SEE DAM EMBANKMENT SITE PLAN SH 3.
6. DOWNSTREAM SLOPE OF DAM EMBANKMENT VARIES FROM 2.5:1 TO 4:1 BETWEEN STA 23+25.66 TO STA 28+76.65 & STA 33+00.65 TO STA 35+00.65 SEE SHTS 15, 16 & 17.
7. PARKING AREA SHALL BE SURFACED WITH A 4" MIN. THICKNESS OF TYPE II AGGREGATE BASE PER UNIFORM STD SPEC SECTION 308.
8. THE CENTER QUARTER OF SECTION 1 SHALL BE REESTABLISHED FOLLOWING FINAL GRADING OF THE DETENTION BASIN IMPOUNDMENT AREA.

1"=100'

KEY PLAN

18" CLASS A RIPRAP SLOPE PROTECTION (TYP)

10:1 SLOPE

2.5:1

2:1 SLOPE

3:1 SLOPE

6:1 SLOPE

SEE NOTE 6

N574,225
E610,310

N573,940
E610,840

TEMPORARY TORTOISE PROOF FENCE

STA 27+40

STA 27+60

FOR SPILLWAY PLAN SEE SH 18

TRASH RACK SEE SH 22

USGS METER BOX. SEE SH 15

2" DIA PVC COATED RIGID STEEL CONDUIT

FOR OUTLET WORKS SEE SH 21

PC 2
STA 32+63.65
N573,690.00
E609,675.00

SEE NOTE 5

RCC AGGREGATE SOURCE

FLOW GAUGE VAULT SEE SH 24

PARKING AREA SEE NOTE 7

SOUTH ACCESS ROAD (EXIST ROAD TO BE IMPROVED)

TEMPORARY TORTOISE PROOF FENCING

PI
N573,399
E610,543

N573,000
E610,965

FOR CONTINUATION SEE SH 3

PI
N573,333
E610,025

N573,294
E610,256

N573,371
E609,924

END OF ROAD
N573,525
E609,745

MATCH LINE STA. 37+00 SEE SH. 10

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PROJECT NO
17149

CITY OF NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

DAM EMBANKMENT GRADING PLAN NO.2
STA.18+50 TO STA.37+00

SHEET
9 OF 25

TEMPORARY TORTOISE PROOF FENCE

BEGIN HAUL ROAD
N 574,780
E 607,590

HAUL ROAD
SEE SH 3 FOR CONTINUATION

1/73

SPOIL AREA 2

EXIST CONSTRUCTION DEBRIS TO BE REMOVED

SPOIL AREA 1

N574,000
E609,000

1" = 100'

WEST ACCESS ROAD
SEE SH 3 FOR CONTINUATION

N 574,548.45
E 606,341.78

GENERAL FILL (TYP) FILL SLOPE SHALL BE 2.5 HORIZ TO 1 VERT OR FLATTER. SEE SECTION 1, SH 11 FOR FOUNDATION FILL REQUIREMENTS BENEATH EMBANKMENT

MATCH LINE STA. 37+00 - SEE SH 9

12" CLASS "A" RIPRAP SLOPE PROTECTION (TYP)

EXIST STRUCTURES TO BE DEMOLISHED & REMOVED

2/23

STA 65+93.92
END DAM

N 574,432.54
E 606,785.51

N 574,456.78
E 606,741.78

N 574,610
E 606,645

26/17

25/17

24/17

23/17

A/24 GATE STA 65+00

3/23 TYP

N574,000
E607,000

TEMPORARY TORTOISE PROOF FENCE

PT 2
STA 44+26.04
N 573,381.54
E 608,681.56

N573,095
E609,380

P.I 2
N 573,046.90
E 609,339.40

N573,000
E609,000

N573,095
E608,780

N573,000
E607,000

KEY PLAN

NOTES

1. CONTRACTOR SHALL NOT DISTURB AREAS BEYOND LIMITS OF TORTOISE PROOF FENCE EXCEPT AS INDICATED ON THE DWGS
2. CONTRACTOR SHALL NOT EXCAVATE BELOW FINISH CONTOUR ELEVATIONS WITHIN 200 FT OF THE UPSTREAM TOE OF EMBANKMENT SLOPE
3. FOR LOCATION AND ELEVATION OF SURVEY CONTROL MONUMENTS SEE SH 3.
4. FOR SECTION LINES AND PROPERTY BOUNDARIES, SEE DAM EMBANKMENT SITE PLAN SH 3.

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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DETAILED HLR
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APPROVED 4/4/71
DATE 5-4-71

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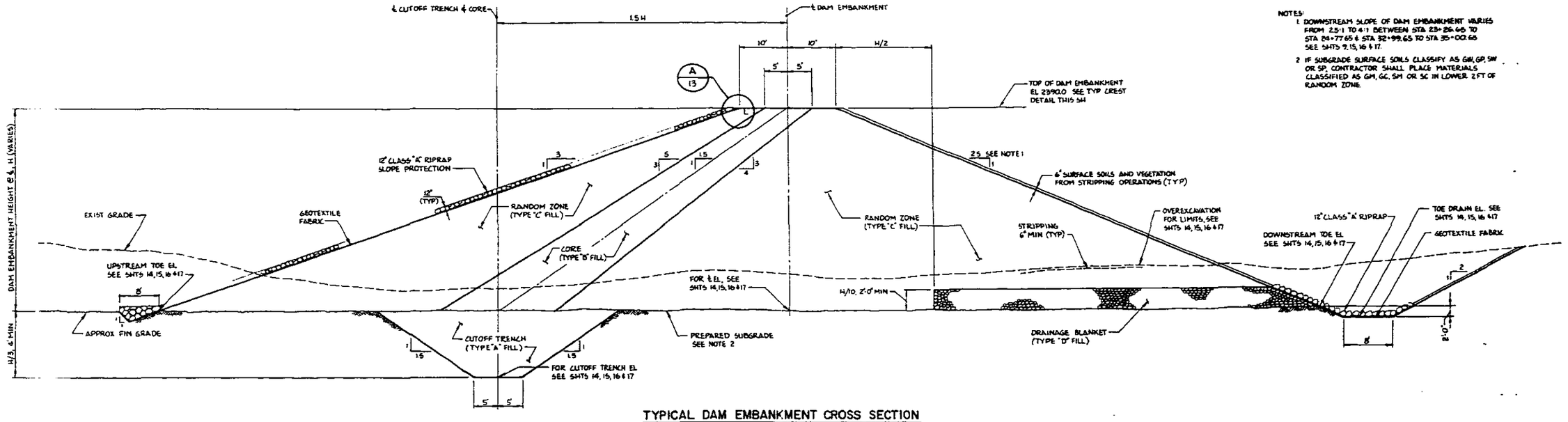
Engineers-Architects
Las Vegas, Nevada

PROJECT NO
17149

CITY OF NORTH LAS VEGAS
UPPER LAS VEGAS WASH
DETENTION BASIN

DAM EMBANKMENT GRADING PLAN NO. 3
STA. 37+00 TO STA. 65+93.92

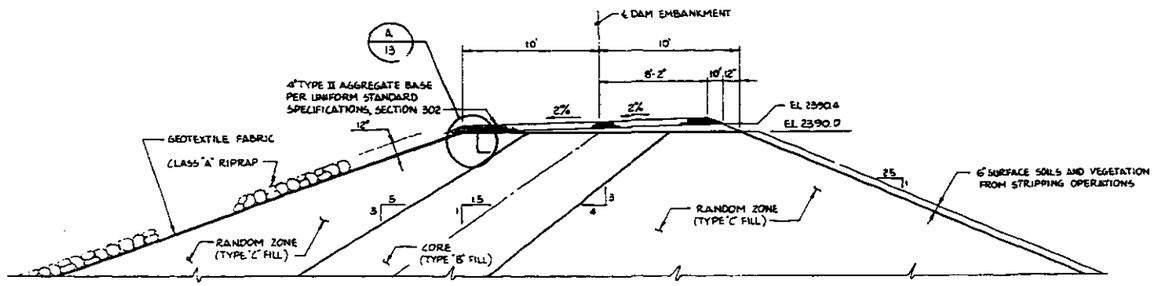
SHEET
10 OF 25



NOTES:
1. DOWNSTREAM SLOPE OF DAM EMBANKMENT VARIES FROM 2.5:1 TO 4:1 BETWEEN STA 23+26.65 TO STA 24+77.65 & STA 32+99.65 TO STA 35+02.65 SEE SHTS 9, 15, 16 & 17.
2. IF SUBGRADE SURFACE SOILS CLASSIFY AS GW, GP, SW OR SP, CONTRACTOR SHALL PLACE MATERIALS CLASSIFIED AS GM, GC, SM OR SC IN LOWER 2 FT OF RANDOM ZONE.

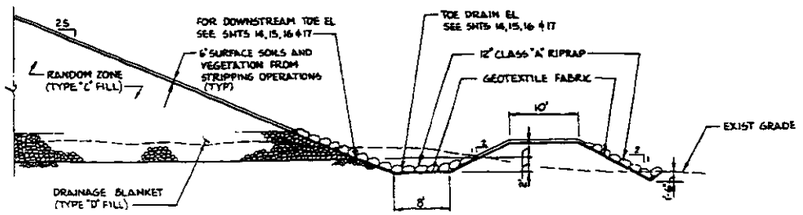
TYPICAL DAM EMBANKMENT CROSS SECTION

1" = 10'



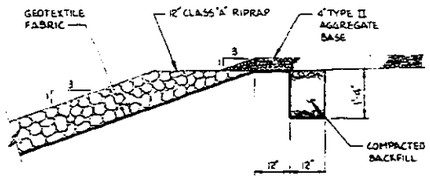
TYPICAL CREST DETAIL

1" = 5'



TYPICAL TOE DRAIN DETAIL STA. 0+00 TO STA. 10+70

1" = 10'



GEOTEXTILE ANCHOR TRENCH DETAIL (A)

1/2" = 1'-0"

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DETAILED WLR
CHECKED DTH
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Las Vegas, Nevada

PROJECT NO. 17149

CITY OF NORTH LAS VEGAS
UPPER LAS VEGAS WASH DETENTION BASIN

DAM EMBANKMENT
TYPICAL CROSS SECTION & DETAILS

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA DAVID V. REEL CIVIL No. 7136

SHEET 13 OF 25

Section 2
Kyle Canyon Detention Basin

Predesign Report and Technical Appendix for the Kyle Canyon Detention Basin

Included in this section:

Excerpts from *Predesign Report and Technical Appendix for the Kyle Canyon Detention Basin*, April 1992 by VTN Nevada.

PREDESIGN REPORT

FOR THE

KYLE CANYON DETENTION BASIN

APRIL, 1992

PREPARED BY:
VTN NEVADA

In association with:
CRSS CIVIL ENGINEERS, INC.
CONVERSE CONSULTANTS SOUTHWEST, INC.

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FIGURE 8.2 Alternative 2.1 ..... located in pocket at end of report

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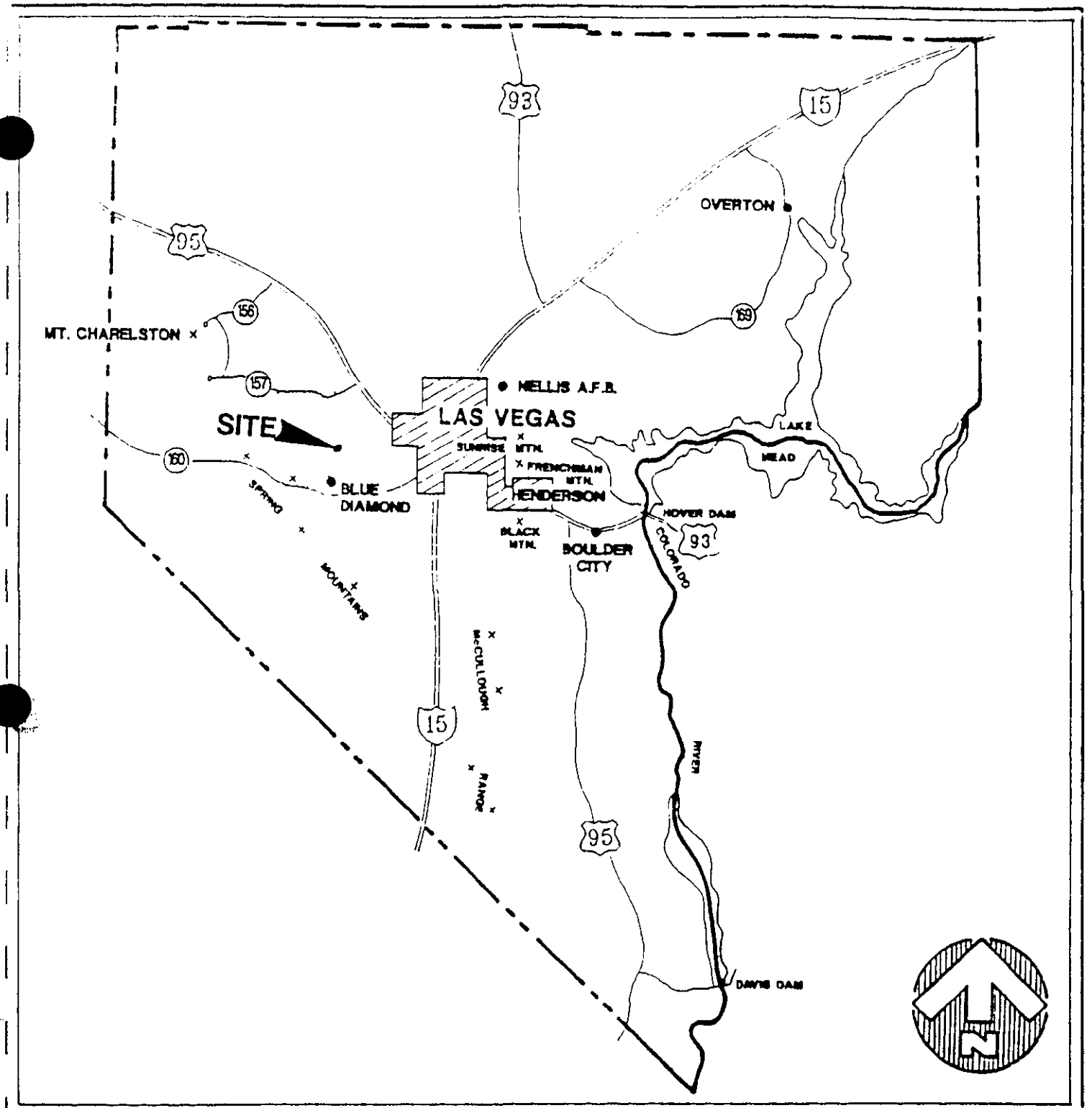
1.0 INTRODUCTION

On February 11, 1992 VTN Nevada was retained by the City of North Las Vegas (NLV) to design the Kyle Canyon Detention Basin. The predesign services for this project include the analysis of alternative detention basin sites. On March 6, 1992, VTN submitted three alternatives in the Detention Basin Alternative Proposed for Analysis for the Kyle Canyon Detention Basin report. A review meeting for this report was held on March 19, 1992. Alternative 1 and a modified Alternative 2 were selected for analysis in the predesign phase of this project. This report is the analysis of these alternatives.

This report contains three alternatives for the Kyle Canyon Detention Basin, Alternative 1, Alternative 2.1, and Alternative 2.2. Alternative 2.1 is the modified Alternative 2 previously discussed. Alternative 2.2 is situated in generally the same location as Alternative 2.1 but is shorter in length and has a higher dam embankment, similar to Alternative 1.

Alternative 1 is located within existing mining claims (see Figures 6.1 and 2.1). The northern portion of the dam and the diversion dike are located in Section 22 within existing mining claims. The Alternative 2.1 upstream diversion dike is located in Section 22, Township 19 South, Range 59 East within existing mining claims (see Figure 6.5). Alternative 2.1 is the only alternative that is not located within the currently active mining claims. This alternative is longer than the other two alternatives, but is not as deep as shown in Figure 6.2.

All alternatives were designed for a total storage capacity of approximately 2,800 acre ft. The spillway capacity of each alternative is based upon the discharge associated with the probable maximum flood. The calculations and HEC-1 runs for this report are bound as a separate document, Predesign Report Technical Appendix for the Kyle Canyon Detention Basin.



KYLE CANYON DETENTION BASIN

VICINITY MAP

FIGURE 1.1

3.0 HYDROLOGY

3.1 Introduction

The Kyle Canyon Detention Basin will receive runoff from approximately 57 square miles of watershed. This runoff will include a substantial sediment load which will be stored during the operation of the detention basin. The purpose of this hydrologic analysis is to provide additional runoff/frequency data for the Harris Springs Wash and Lyle Canyon Wash. This hydrologic data will then be used to estimate the sediment yield over the life of the project to the Kyle Canyon Detention Basin.

In the previous Master Plan Update of the Las Vegas Valley (JMM, 1991), the Harris Springs Wash basin is analyzed as a single subbasin. In this analysis, the rainfall/runoff for the drainage system is evaluated as network of eleven subbasins. These subbasins correspond to the major valleys and ridges that follow the geologic formations in Harris Springs Canyon. The distribution of soils and the configuration the drainage network is strongly effected by the prevailing geology, and a more refined delineation of the basin characteristics. The hydrologic analysis of the Harris Springs Canyon watershed for the Master Plan Update considers the terrain conditions in the watershed in a very general manner. The design hydrology provides a more accurate operation hydrology for the proposed detention basin sites.

It should be noted that the design hydrology for the Kyle Canyon Detention Basin did not verify the more general analysis which was part of the Master Plan Update. In particular, the more detailed computations conducted for a number of key hydrologic parameters differed between this analysis and the Master Plan Update. This resulted in an increase in both the estimated peak inflow rate and the total runoff volume. Key parameters which effected the revised hydrology were: areal precipitation, SCS curve number, and hydrograph lag time. Differences between the Master Plan parameter values and the values for this study are as follows:

	Areal Precip. (in)	SCS Curve Number	Lag Time
Master Plan Update	2.23	80.0	2.69
Design Hydrology	2.43	83.4	1.70

These parameter differences each contributed to both a higher peak discharge and increased runoff volume for the 100-year design storm. The difference in the inflow hydrograph characteristics between the Master Plan Update and the Design Hydrology are as follows:

	Peak Flow (cfs)	Vol. (acre-ft)
Master Plan Update	6,940	2,140
Design Hydrology	13,170	2,920

The following sections provide a discussion of the various hydrologic parameters used to estimate the flood hydrographs for a range of flood frequencies.

3.2 Physical Basin Characteristics

Several physical characteristics of a watershed area are used for the runoff hydrograph method adopted by the Clark County Regional Flood Control District for the Las Vegas Valley. This section describes the measurement of these characteristics.

Sections 3.3 through 3.9 provide a discussion of the various hydrologic parameters used to estimate the flood hydrographs for a range of flood frequencies.

A. Basin Area

The Kyle Canyon detention basin facility was described in the Master Plan Update of the Las Vegas Valley (JMM, 1991). The contributing area to this facility was described by essentially two subbasins, GD-30 and GD-21. The GD-30 subbasin encompasses the approximately 50 square miles of Harris Springs Canyon, and GD-21 about seven square miles of the canyon immediately south of the Harris Springs watershed (identified as Lyle Canyon on mining claims in that area). A portion of the GD-25 subbasin which is located between the mouth of Harris Springs Canyon and the alternative sites for the detention basin.

For the design hydrology, the Harris Springs watershed area was subdivided into eleven subbasins. This permitted the identification of the major channels and the contributing drainage area to each (see Figure 3.1, located in pocket at the end of this report). For flood hydrograph development, the seven upper basins were aggregated. Table 3.1 below summarizes subbasin areas used for the design hydrology. The Technical Appendix, under separate cover, provides computations of basin areas.

3.11 Flood Hydrograph Characteristics

The results of the flood hydrograph analysis are given in Tables 3.6A and 3.6B for various frequency storm events and alternative detention basin sites. Output for the 100-year HEC-1 analysis is given in Technical Appendix.

TABLE 3.6A FLOOD PEAK/FREQUENCY DATA

Return Period	Alternative 1 (cfs)	Alternative 2.1 (cfs)	Alternative 2.2 (cfs)
2	223	179	168
5	2,359	2,326	2,301
10	4,662	4,637	4,620
25	7,418	7,427	7,447
50	10,210	10,246	10,285
100	13,118	13,165	13,215

TABLE 3.6B FLOOD VOLUME/FREQUENCY DATA

Return Period	Alternative 1 (acre ft)	Alternative 2.1 (acre ft)	Alternative 2.2 (acre ft)
2	56	46	40
5	456	442	434
10	950	936	930
25	1,589	1,577	1,573
50	2,241	2,233	2,231
100	2,922	2,918	2,918

4.0 SEDIMENTATION

4.1 Introduction

The rate of sediment delivery from the Harris Springs Canyon watershed and the "Lyle Canyon" watershed to the south affects several design issues for the Kyle Canyon Detention Basin. These design issues include the volume required within the detention basin for sediment storage, the stability of the existing channel system, and the potential for large changes in sediment loading over the life of the project.

The discussion here is based on field reconnaissance that was conducted February 17-19, 1992, and computations of sediment movement and watershed sediment yield. The field work consisted of inspection of the lower 4.5 miles of the Harris Springs Canyon channel and basin. Ten transects were established approximately every half mile beginning at an existing diversion dike below the mouth of Harris Springs Canyon, (see Appendix A). At each transect, the gradation of surface sediments and the channel bottom width were measured. In addition, large bulk sediment samples were taken of channel sediments at the mouth of both Harris Springs Canyon and "Lyle Canyon." Supplemental documentation which was collected includes: photographs taken at the transect locations and a video record of basin characteristics at each transect location.

4.2 Potential Sediment Sources

There are three possible sources of sediment above the Kyle Detention basin, including mountain slopes, valley deposits and terraces, and the bed and bank of main stem and tributary channels in the watershed. The channel network provides the most available supply of sediments, followed by inter-channel areas on the valley terraces, and finally mountain slopes, which are the most distant source area.

Areas that are covered with fine, non-cohesive and uncemented soils provide a large potential for sediment yield in a watershed. Such sediments are readily detached and transported during major storm events. The reconnaissance of the lower-portion of the Kyle Canyon system focused on identifying such areas. The following findings resulted from the reconnaissance:

4.3 Bed Material Gradation

Two large bulk bed material samples were taken for the Kyle Canyon system: one at the mouth of Harris Springs Canyon in the channel bed, and the second at the mouth of Lyle Canyon. The Harris Springs Canyon bulk sample weighed 860 lbs. and included small boulders up to 145 lbs. which were often observed in the lower reaches of the canyon. The Lyle Canyon sample did not contain large cobbles or boulders, and it was only necessary to collect a 24 lb. sample. Bulk sample gradations are provided in the Technical Appendix Section 3.0 for the Harris Springs and Lyle Canyon samples.

To characterize the surface sediments of the lower 4.5 miles of Harris Springs Canyon, transects were established every 0.5 miles beginning near the mouth of the canyon. Along each transect, a sample of 50 stones from the channel surface was collected and measured. Using a relation of stone size to stone weight developed from the large bulk sample measurement, the count of stone sizes was then converted to a weight.

Appendix A provides information on each transect, including a photo of the channel section, a general description of the channel section, a photo of the channel surface, and the stone count/gradation data. Also provided is the procedure used for surface sediment sampling by particle count and the calibration of particle weight and diameter.

4.4 Sediment Movement

The transport of sediments which are located in the channel system was identified during the field review as one of the largest sources of sediment in the contributing watershed to the Kyle Canyon Detention Basin. Sediments are transported in two modes from a watershed drainage network. The material scoured from the channel will be transported as bed load and will be transported in contact with the channel bed. The material eroded from the terrace areas of the watershed will consist of finer material not found in the channel bed. This material will be transported as wash load and will remain suspended in the flow.

There are many sediment transport relationships in the literature, and much debate over accuracy and general theoretical concepts. Gomez and Church (1989) provided an assessment of 12 sediment transport formula for gravel bed channels. Based on this review, the Meyer, Peter and Muller (MPM) formula was selected. This formula has the advantage of using parameters that can be obtained from standard engineering analysis. The Gomez and

Church's assessment found the MPM formula to be conservative in that it tends to overpredict relative to actual measured values. In application, the MPM formula has other advantages which are useful. Since it is a tractive force formula, it is possible to route sediments by size fraction. Therefore, certain threshold conditions related to movement of larger particle sizes, such as the formation of a pavement or armor layer can be evaluated. Also, it is relatively easy to adjust the MPM formula to account for variations in form resistance versus grain resistance, and for active and inactive portions of the channel section.

For the transport of washload from the watershed, the Modified Universal Soil Loss Equation (MUSLE) was used (Williams, 1975). This equation substitutes a runoff energy term for the rainfall energy term in the conventional USLE formula (Wischmeier, 1961). Factors for soil erodability, land slope, and cover conditions are the same for both equations.

The total yield of sediment was computed for a series of flood events (2-, 5-, 10-, 25-, 50- and 100-year). The yield of sediment was computed separately for Harris Springs Wash and the Lyle Canyon channel because of the significant difference in gradation. Table 4.1 summarizes the estimates of total sediment yield for each watershed.

TABLE 4.1 SEDIMENT YIELD FOR SINGLE EVENTS

Recurrence Interval (years)	Lyle Canyon Sediment (1) (tons)	Harris Springs Sediment (2) (tons)
2	980	2,900
5	3,400	23,600
10	6,300	51,800
25	10,300	84,200
50	14,300	120,000
100	18,500	158,000

(1) Area = 6.8 square miles
(2) Area = 48.4 square miles

6.0 ALTERNATIVES

Three alternatives are presented herein for the Kyle Canyon Detention Basin. All three of these alternatives assume approximately 2,800 acre ft of storage volume at the crest of the spillway. All three alternatives are located within Bureau of Land Management property. These alternative dam configuration are based on the hydrology, hydraulic parameters as well as planning level topographic mapping (1" = 500 ft horizontal and 1" = 5 ft vertical). Once an alternative is selected for design, 1" = 40 ft scale topographic mapping of 1 ft vertical contour will be used to fine tune the basin site.

6.1 Alternative 1

The location of the dam for Alternative 1 is located generally within the SW 1/4 of Section 15, Township 19 South, Range 59 East (see Figure 6.1). This is basically the same location shown in the Master Plan Update. Figure 6.1 shows that the dam embankment and temporary outfall structure is located within the boundary of an active mining claim application. The configuration and alignment of the Alternative 1 dam takes advantage of the natural channels associated with the Harris Springs Canyon Wash and the Lyle Canyon Wash.

The dam will be an earthfill structure, approximately 4,030 ft in length and 51 ft in height. The side slopes of the dam will be constructed at a 4:1 slope. The spillway elevation of this alternative is 3,413 ft above M.S.L. The top of the dam elevation is approximately 3,421 ft. The spillway is 1,390 ft long with 8 ft height.

The outlet of the Alternative 1 dam is designed to release a maximum flow of 996 cfs during the 100-year storm event. Figure 6.7 shows the 100-year inflow hydrograph and 100-year outflow hydrograph.

6.2 Alternative 2.1

Alternative 2.1 is situated just east of the centerline of Sections 14 and 23, Township 19 South, Range 59 East, (see Figure 6.3). The earthfill dam structure is approximately 6,000 ft in length and 34 ft high at the top of the dam. The spillway invert elevation is 3,294 with the top of the dam at 3,299. Both the upstream and downstream embankment slopes are 4:1.

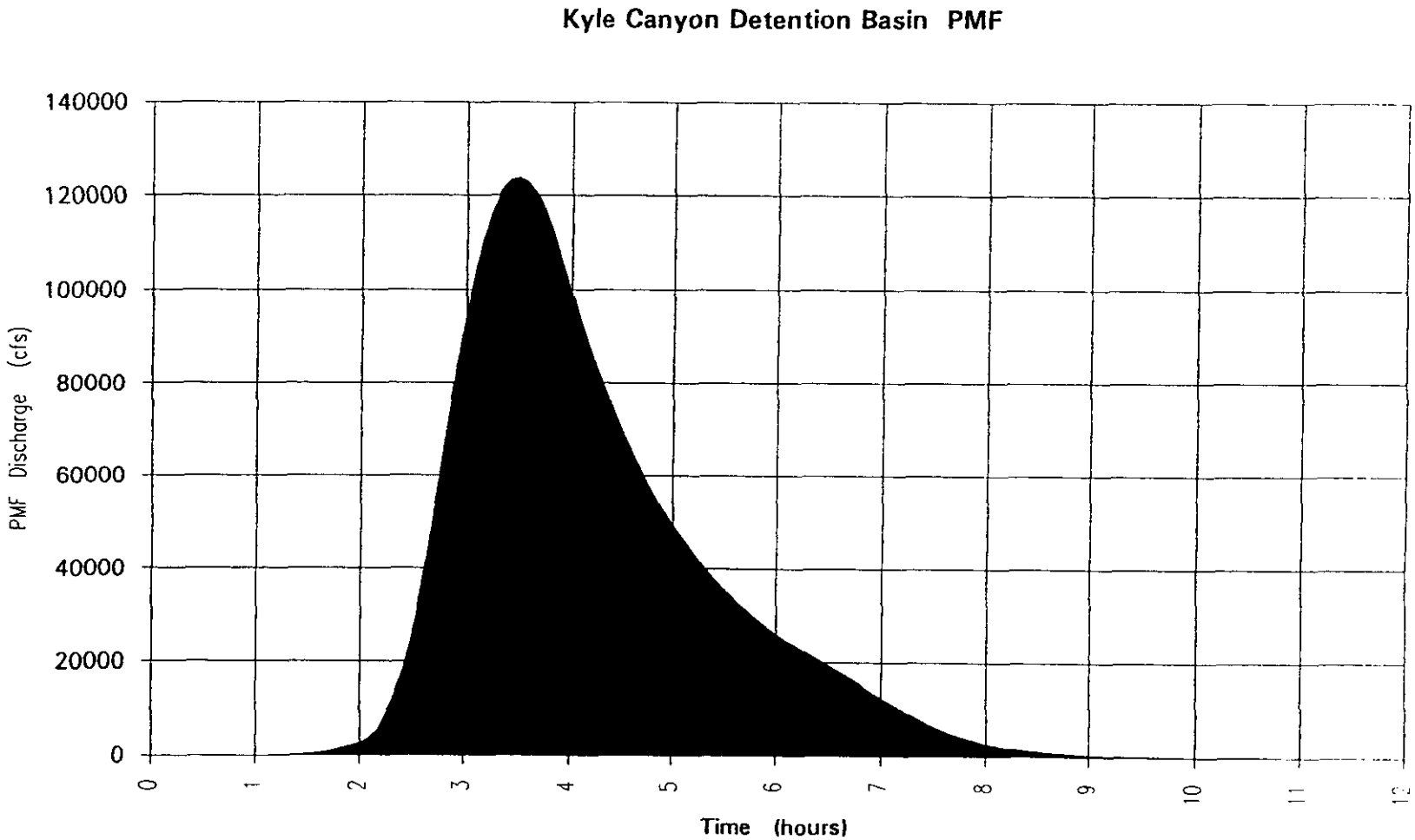
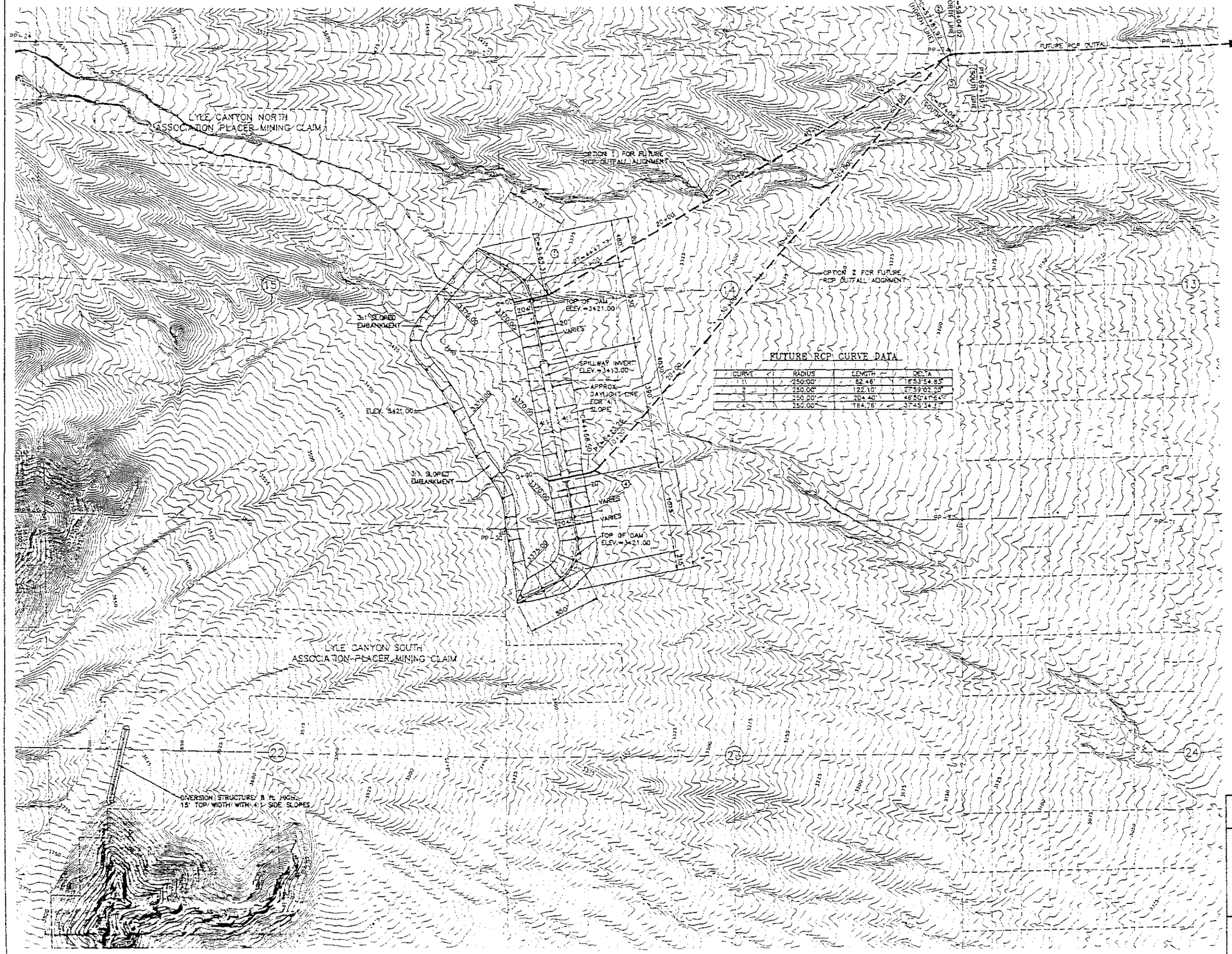

Kyle Canyon Detention Basin PMF
140000
120000
100000
80000
60000
40000
20000
0
PMF Discharge (cfs)
0
1
2
3
4
5
6
7
8
9
10
11
12
Time (hours)

FIGURE 5.2

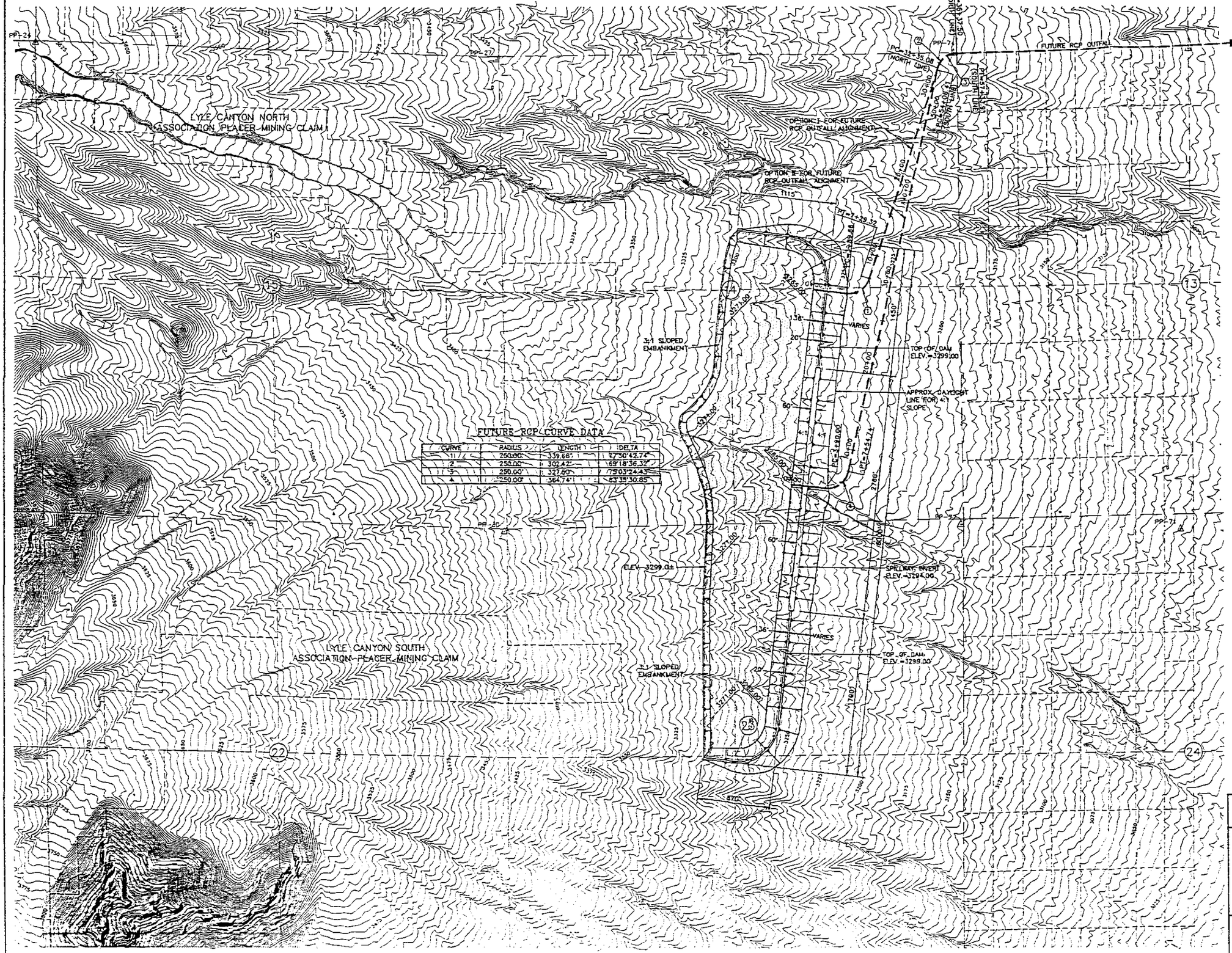


CITY OF NORTH LAS VEGAS
CLARK COUNTY, NEVADA

KYLE CANYON DETENTION BASIN ALTERNATIVE 1

VTN nevada

FIGURE 6.1



FUTURE RCP CURVE DATA

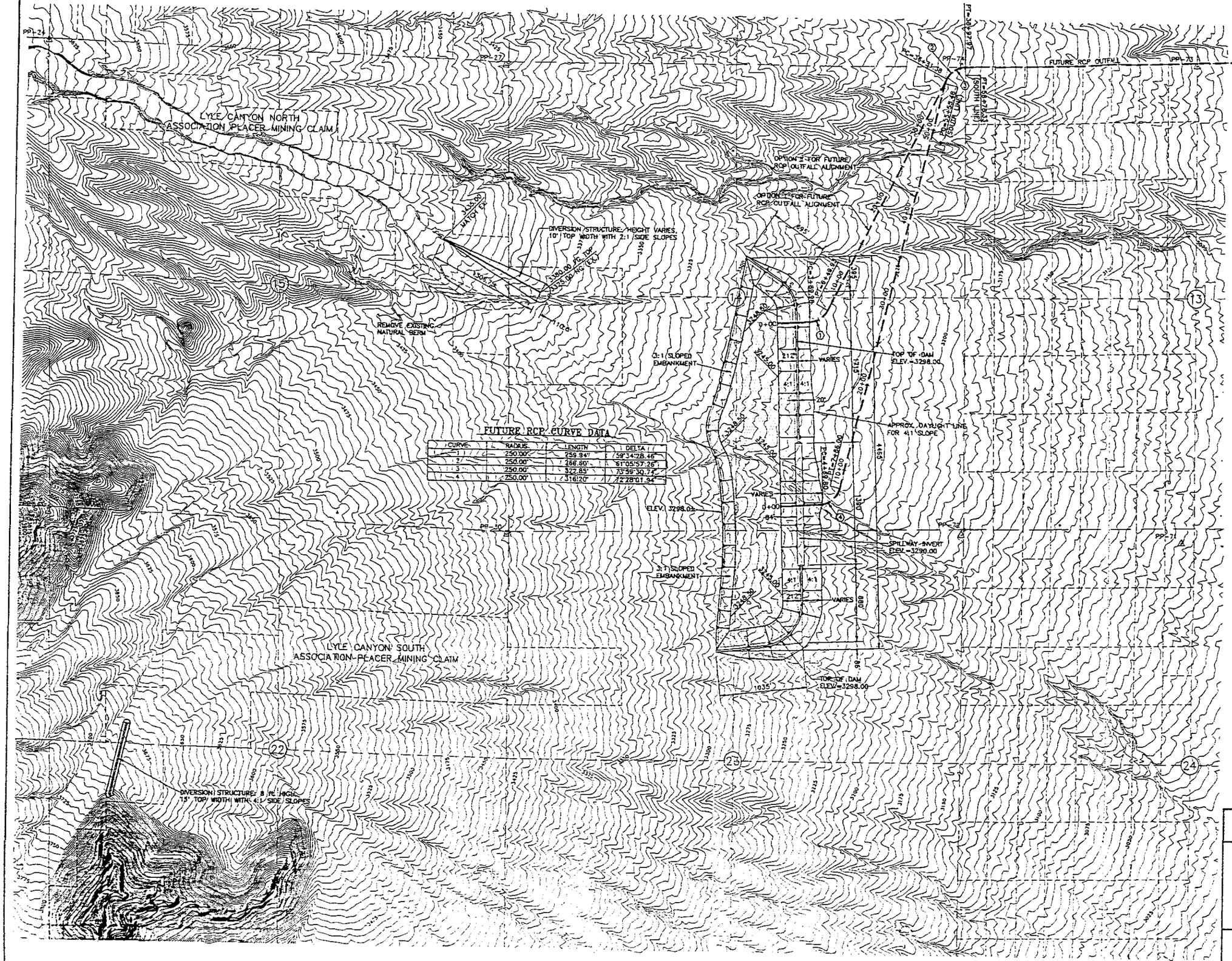
CURVE	RADIUS	LENGTH	DELTA
1	250.00'	339.66'	77°50'42.74"
2	250.00'	309.42'	169°18'36.32"
3	250.00'	327.60'	75°03'24.43"
4	250.00'	364.74'	83°35'30.85"

CITY OF NORTH LAS VEGAS
CLARK COUNTY, NEVADA

KYLE CANYON DETENTION BASIN ALTERNATIVE 2.1

VTN nevada

FIGURE 6.3



FUTURE RCP CURVE DATA

CURVE	RADIUS	LENGTH	DELTA
1	250.00'	259.94'	59°34'28.46"
2	250.00'	366.90'	81°05'57.76"
3	250.00'	322.85'	73°59'30.72"
4	250.00'	316.20'	72°28'01.94"

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KYLE CANYON DETENTION BASIN ALTERNATIVE 2.2

VTN nevada

FIGURE 6.5

KYLE CANYON DETENTION BASIN
STAGE VS STORAGE

Alternative 1		Alternative 2.1		Alternative 2.2	
elev	vol	elev	vol	elev	vol
3370	0	3265	0	3245	0
3375	141.5	3271	294	3248.5	85
3413	2809	3294	2850	3290	2834
3420	3294	3299	3379	3298	3358
3423	3502	3302	3706	3301	3554

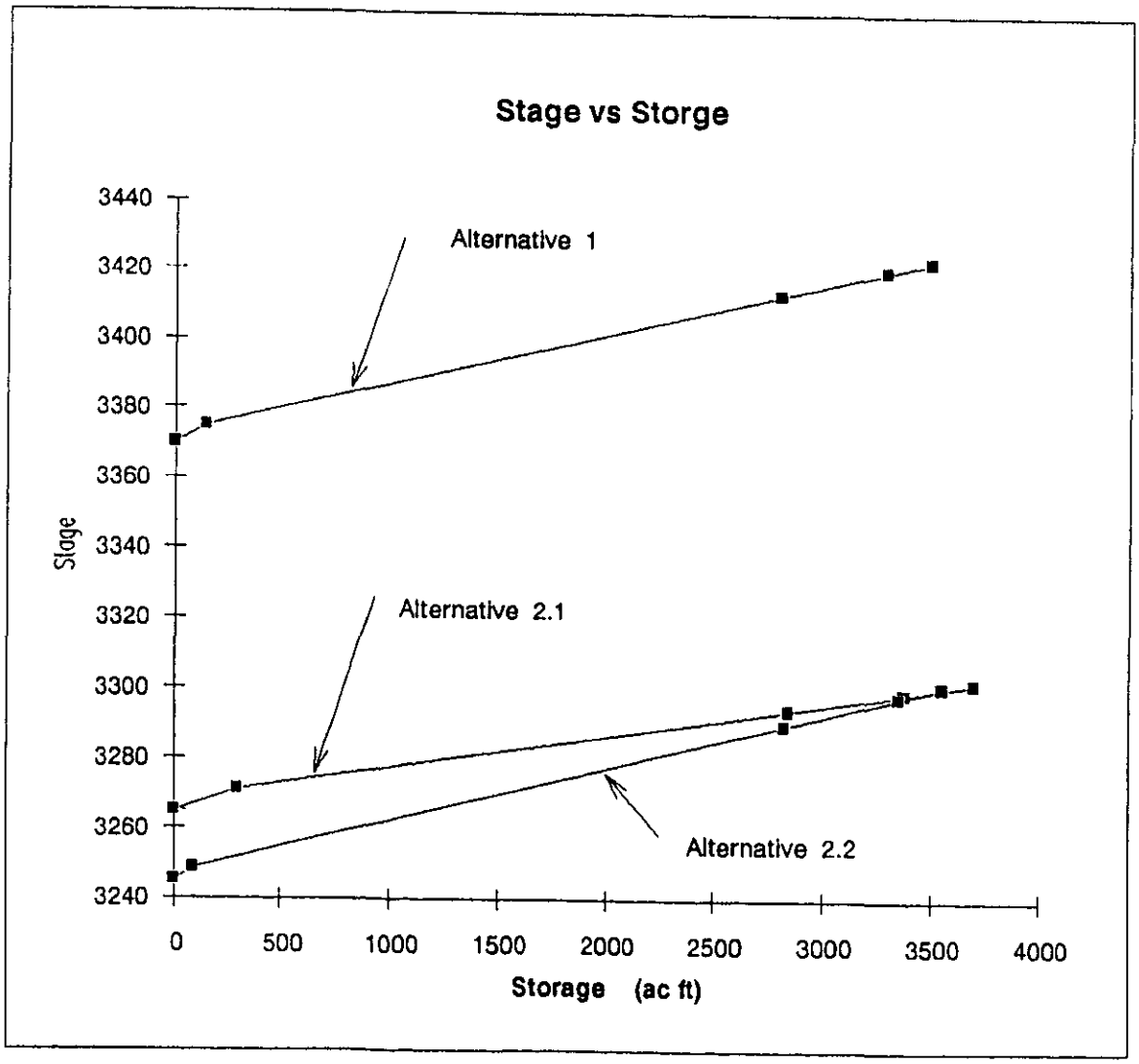

FIGURE 6.6A

Alternative 1 Detention Basin Hydrographs

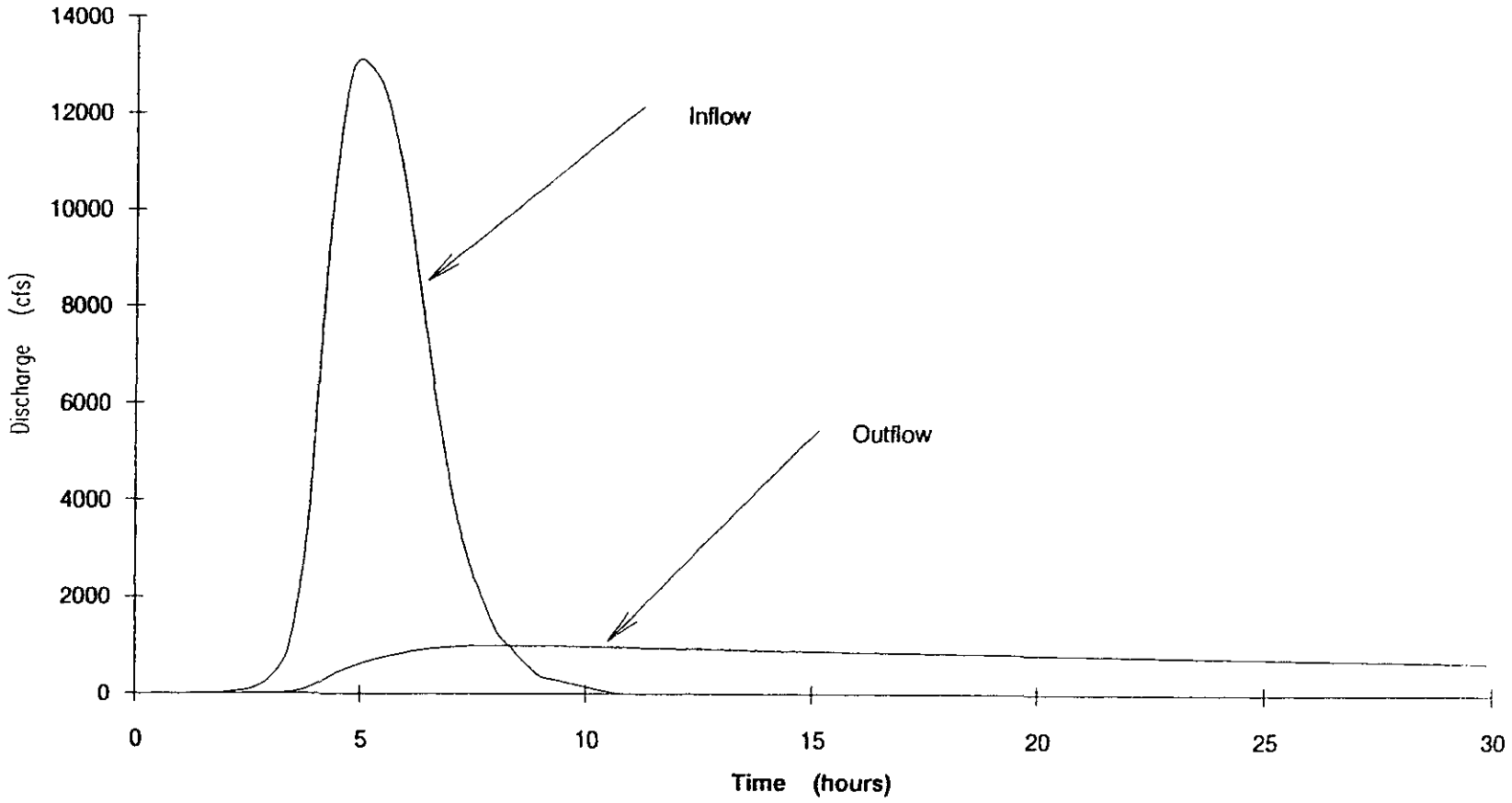

FIGURE 6.7

The length of the dam allows for the elimination of an upstream diversion dike near the mouth of the Harris Springs Canyon Wash.

The basin outlet was designed to be 84 inches in diameter in accordance with the parameters outlined in Alternative 1. The flow through this outlet is 923 cfs during a 100-year storm event. Figure 6.8 shows the inflow hydrograph and the outflow hydrograph. The spillway is 3,560 ft with a 5 ft height.

6.3 Alternative 2.2

Alternative 2.2 is located in the same area as Alternative 2.1, (see Figure 6.5). Alternative 2.1 is substantially higher than Alternative 2.2 due to the decreased length of 4,465 ft. The dam is 45 ft deep at the crest of the spillway. The top of the dam is 8 ft above the spillway invert at elevation 3,298. An upstream diversion dike at the mouth of Harris Springs Canyon Wash is required to divert flow from the wash south into the basin.

The basin outlet was sized at 78 inches in diameter to release 1014 cfs. During a 100-year storm event Figure 6.9 shows the inflow versus outflow. The spillway is 1,390 ft with 8 ft height.

6.4 Stage-Storage

A stage verses storage relationship was developed for each of the three alternatives based on the preliminary grading of the basin reservoir. Figure 6.6A shows a plot of the basin stage, starting at the basin invert elevation, versus the storage volume, in acre ft.

TABLE 6.1 STAGE VERSES STORAGE

Alternative 1		Alternative 2.1		Alternative 2.2	
elev.	vol.	elev.	vol.	elev.	vol.
3,370	0	3,265	0	3,245	0
3,375	142	3,271	294	3,248.5	85
3,413	2,809	3,294	2,850	3,290	2,834
3,420	3,294	3,299	3,379	3,298	3,358
3,423	3,502	3,302	3,706	3,301	3,554

Alternative 2.1 Detention Basin Hydrographs

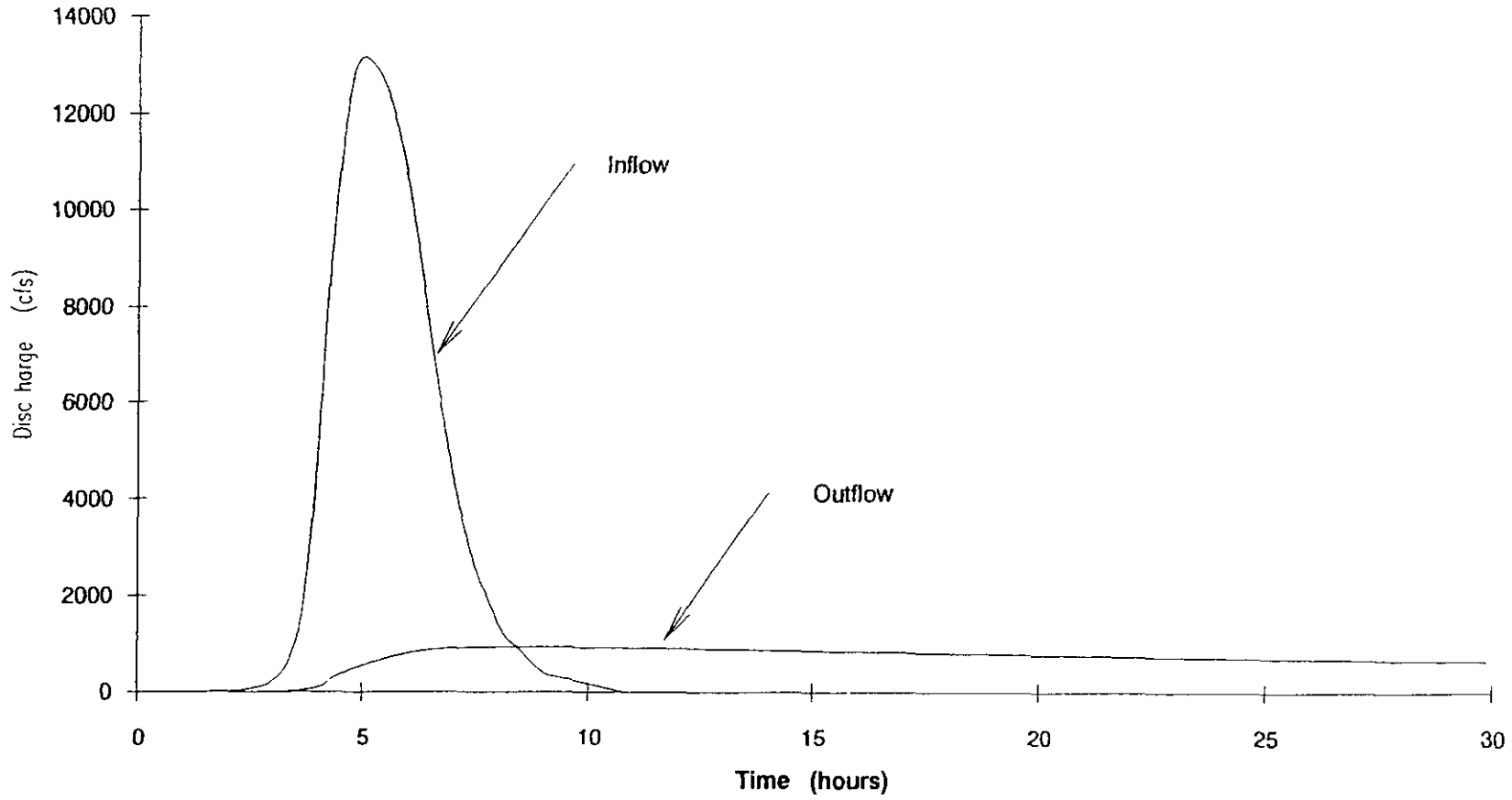

FIGURE 6.8

Alternative 2.2 Detention Basin Hydrographs

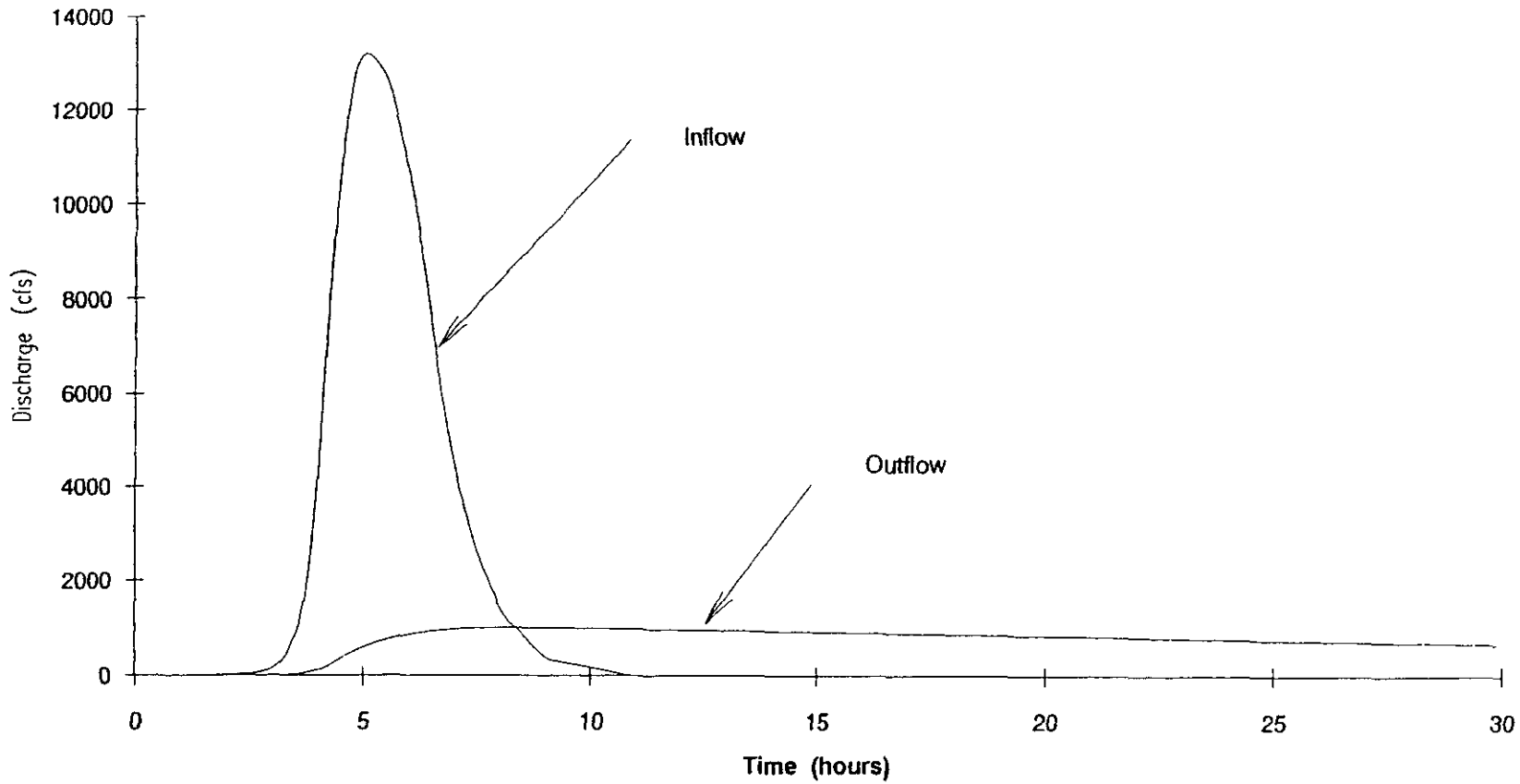

FIGURE 6.9

6.5 Stage-Discharge

The outlet consists of a single barrel reinforced concrete pipe with a trash rack on the inlet running through the detention basin embankment from the detention basin invert to the outlet channel on the downstream side of the detention basin. The outlets for all three alternatives were sized to develop an inlet control condition under which the dam will outlet through an "orifice", into a large diameter pipe which will act as an open channel. This methodology was used in an effort to reduce high outlet velocities associated with an outlet control system. See Section 8.0 for the dimensions of the outfall structure. Alternatives 1 and 2.2 utilize a 78 inch diameter pipe. Due to the difference in spillway type for alternative 2.1, (maximum head over the spillway of 5 feet versus 8 feet for 1 and 2.2), an 84 inch diameter pipe is used to produce a comparative peak discharge at the outlet. Figures 6.10, 6.11 and 6.12 show the stage vs pipe outflow for the three alternatives.

TABLE 6.2 STAGE VERSUS DISCHARGE

Alternative 1		Alternative 2.1		Alternative 2.2	
Elev	Q	Elev	Q	Elev	Q
3370	0	3265	0	3245	0
3374.6	150	3269.5	150	3249.6	150
3377	300	3271.69	300	3252	300
3380	429	3275	489	3255	429
3385	566	3280	650	3260	566
3390	676	3285	779	3265	676
3395	770	3290	889	3270	770
3400	854	3294	968	3275	854
3405	930	3296	1006	3280	930
3410	1001	3299	1059	3285	1001
3413	1041			3290	1067
3415	1067			3293	1104
3418	1104			3296	1141
3421	1141			3298	1165

KYLE CANYON DETENTION BASIN
Alternative 1 Stage vs Pipe Outflow

Elev	Q
3370	0
3374.6	150
3377	300
3380	429
3385	566
3390	676
3395	770
3400	854
3405	930
3410	1001
3413	1041
3415	1067
3418	1104
3421	1141

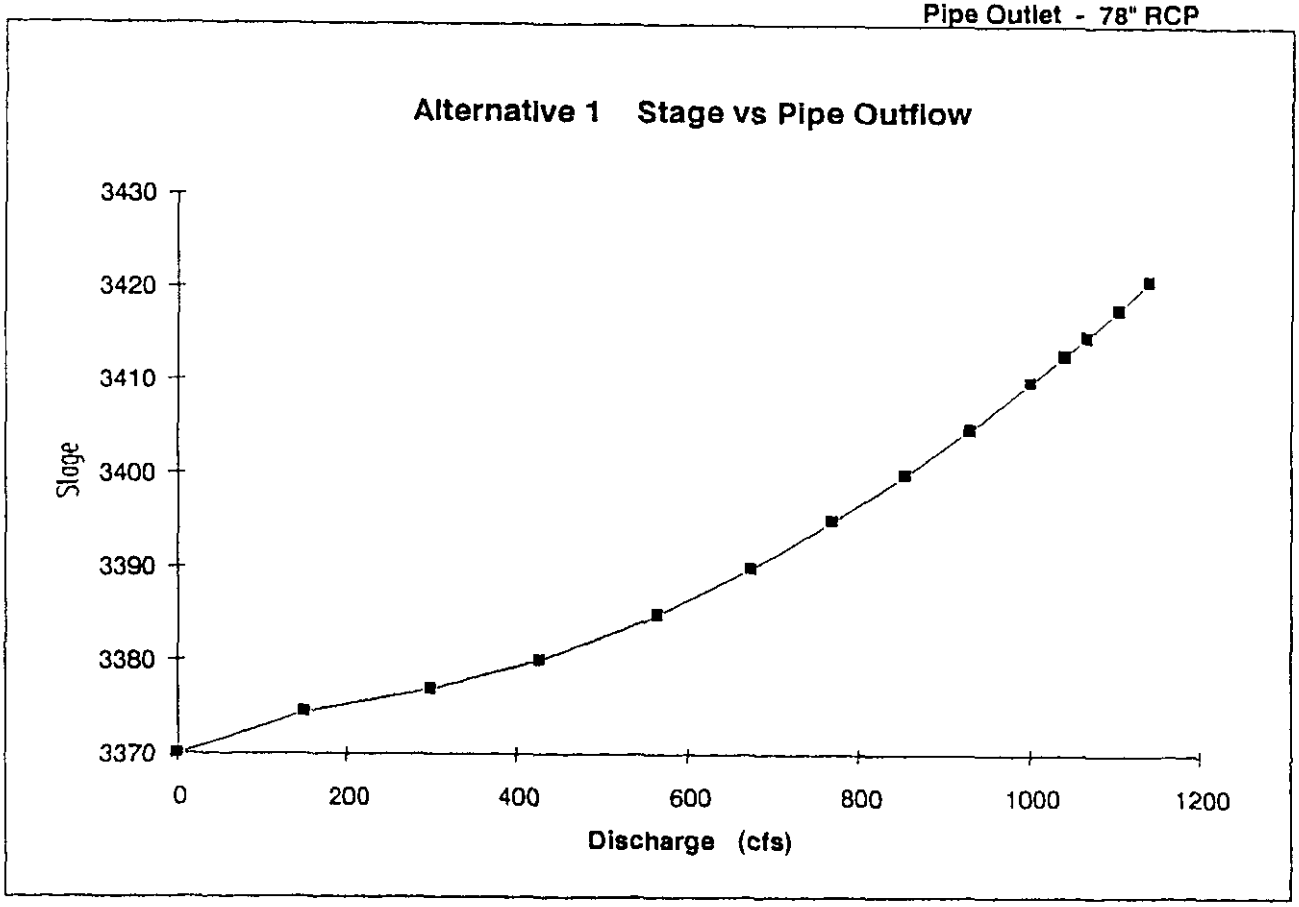

FIGURE 6.10

KYLE CANYON DETENTION BASIN
Alternative 2.1 Stage vs Pipe Outflow

Elev	Q
3265	0
3269.5	150
3271.69	300
3275	489
3280	650
3285	779
3290	889
3294	968
3296	1006
3299	1059

Pipe Outlet - 84" RCP

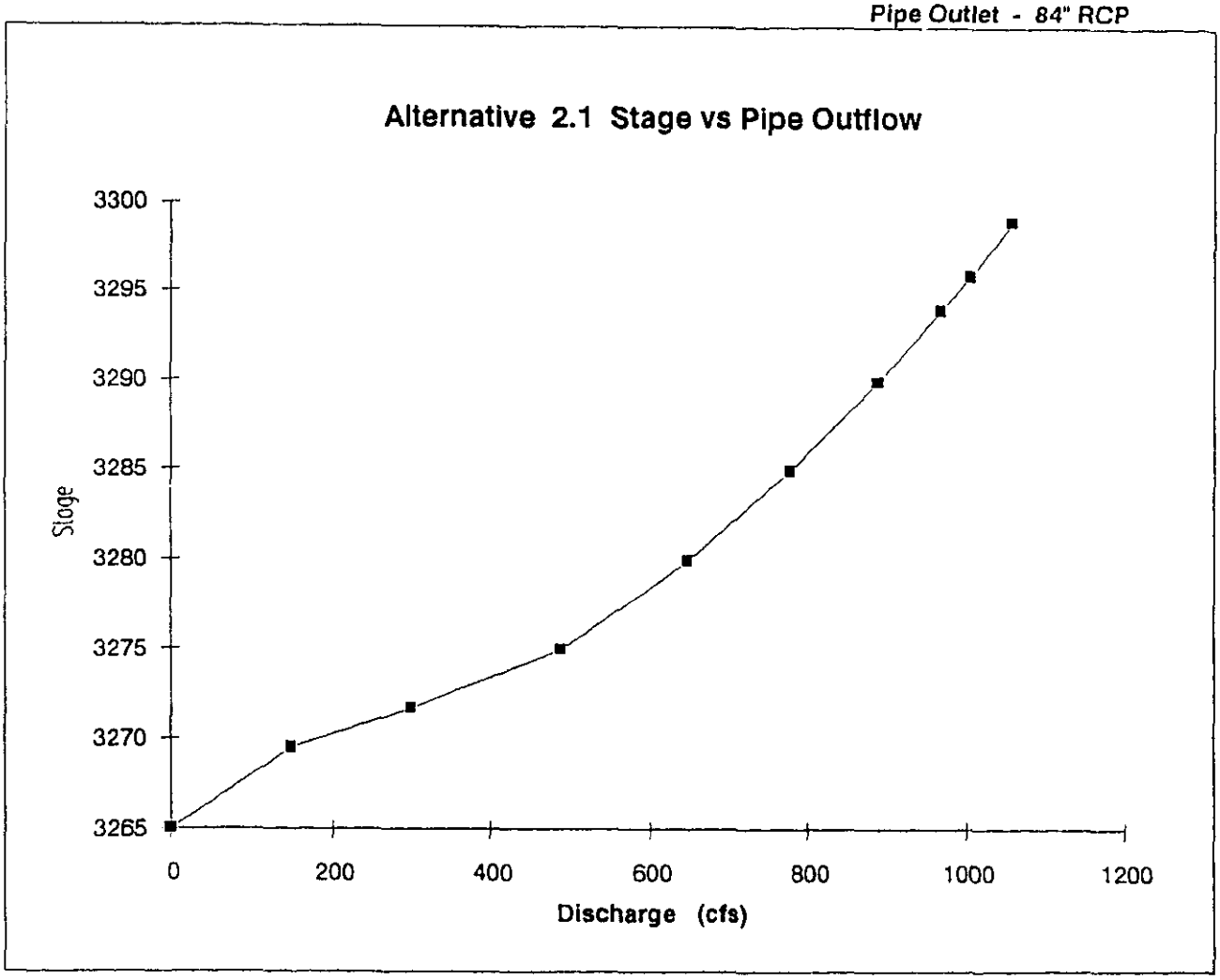

FIGURE 6.11

KYLE CANYON DETENTION BASIN
Alternative 2.2 Stage vs Pipe Outflow

Elev	Q
3245	0
3249.6	150
3252	300
3255	429
3260	566
3265	676
3270	770
3275	854
3280	930
3285	1001
3290	1067
3293	1104
3296	1141
3298	1165

Pipe Outlet - 78" RCP

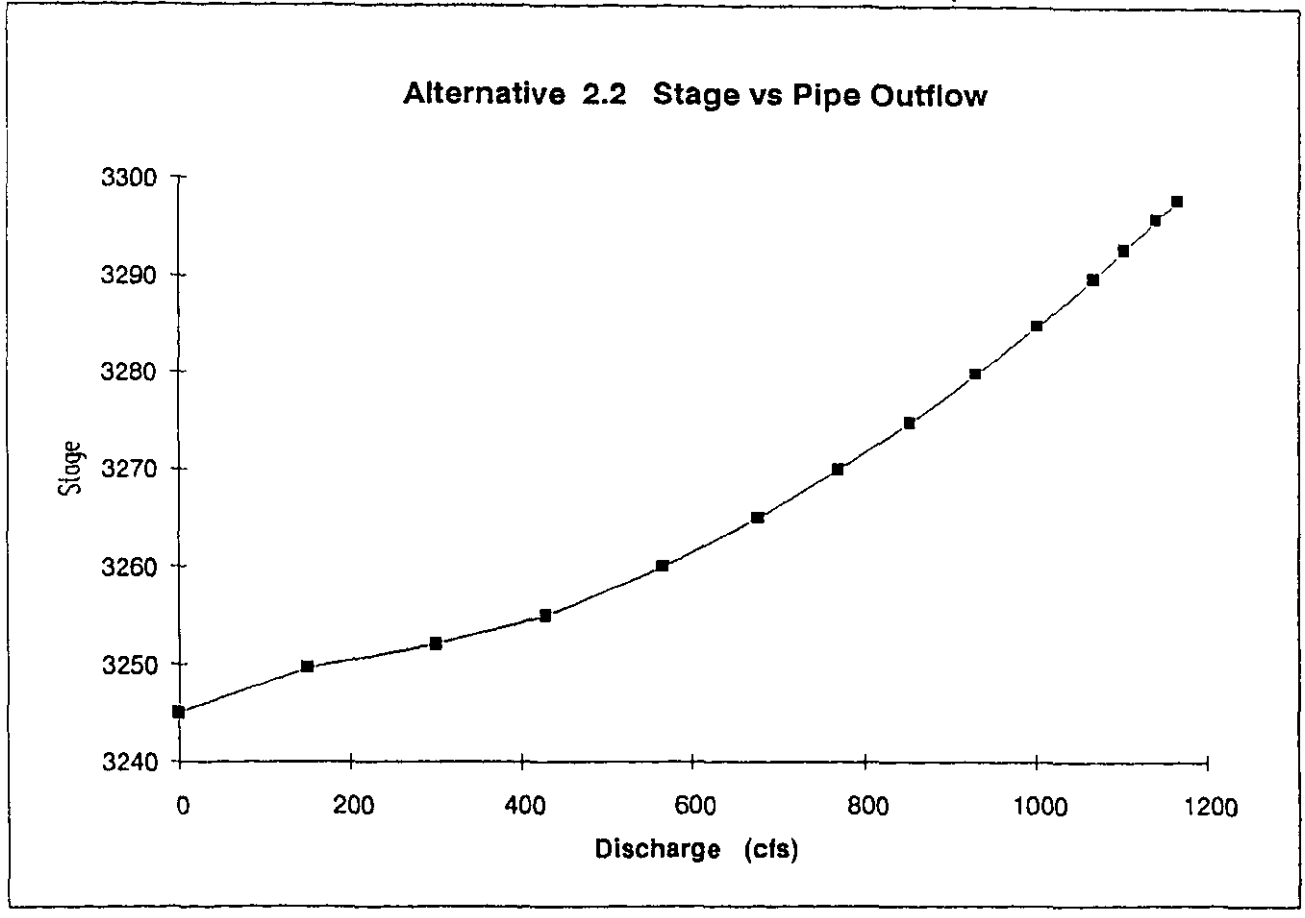

FIGURE 6.12

6.6 Routing

The 100-year hydrographs are routed through the detention basin using the stage vs storage, stage vs outlet discharge relationships and the HEC-1 inflow hydrograph. Table 6.3 gives a results of the routing analysis for the 100-year event for the three alternative basin configurations. For every alternative, 100-year storm event is contained by the detention basin with no spill over the emergency spillway. The detention basin also includes 210 acre ft of volume for dead storage to be used for the sediment transport to the detention basin.

TABLE 6.3 ROUTING ANALYSIS

Alternative	Qin (cfs)	Qout (cfs)	Max. Stage	Stored Vol. AF	Vol. AF @ Spillway Elevation	Spillway Elevation	Drain Time (hr)
1	13,118	996	3,409.67	2,576	2,807	3,413	46
2.1	13,165	923	3,291.67	2,594	2,850	3,294	51
2.2	13,215	1,014	3,285.97	2,567	2,834	3,290	46

6.7 Mining Claims

Alternative 2.1 is not currently effected by mining claims or any other claims on Bureau of Land Management land (see Figure 6.3). Alternative 1 is the most effected of the three alternatives by current mining claims (see Figure 6.1). The north part of the Kyle Canyon Detention Basin and diversion dike in Section 22 are both within current active mining claims. Alternative 2.2 is effected by currently mining claims by the diversion dike in Section 22 and the grading of the existing channel/dike in Section 15 (see Figure 6.5).

7.0 SPILLWAY

7.1 Introduction

The Kyle Canyon Detention Basin will have an operational outlet which is designed to provide a controlled release of flood flows up to the 100-year flood conditions, and an emergency spillway for flood flows in excess of 100-year conditions. Design of the operational outlet for the detention basin was based on the detention basin volume (the stage-volume relationship) and the capacity of the outlet structure (stage-discharge relationship). Design of the emergency spillway is based on the probable maximum flood (PMF) for the watershed.

7.2 Stage-Discharge

Figure 7.1 shows the spillway or emergency discharge rating. This rating is a function of the crest shape, head at the crest of the spillway and the crest length. Alternatives 1 and 2.2 have ogee spillway configurations and alternative 2.1 is a broad crested configuration due to the length of the dam and the less height of the embankment. The following table lists spillway conditions.

TABLE 7.1 SPILLWAY CONDITIONS

Alternative	Crest Elevation	Crest Length	Discharge Coefficient
1	3,413	1,390'	3.91
2.1	3,294	3,560'	3.09
2.2	3,290	1,390'	3.91

7.3 Routing

The detention basin has very little affect on the PMF hydrograph. For the routing analysis of the PMF it is assumed that the detention basin will fill to the crest of the emergency spillway just before the start of the PMF inflow. The following table summarizes flow conditions for the PMF.

KYLE CANYON DETENTION BASIN
SPILLWAY HEAD VS DISCHARGE

	Discharges	
Head	max = 8'	max = 5'
0	0	0
2	15372	31113
3	28241	57158
5	60764	122984
6	79876	
8	122978	

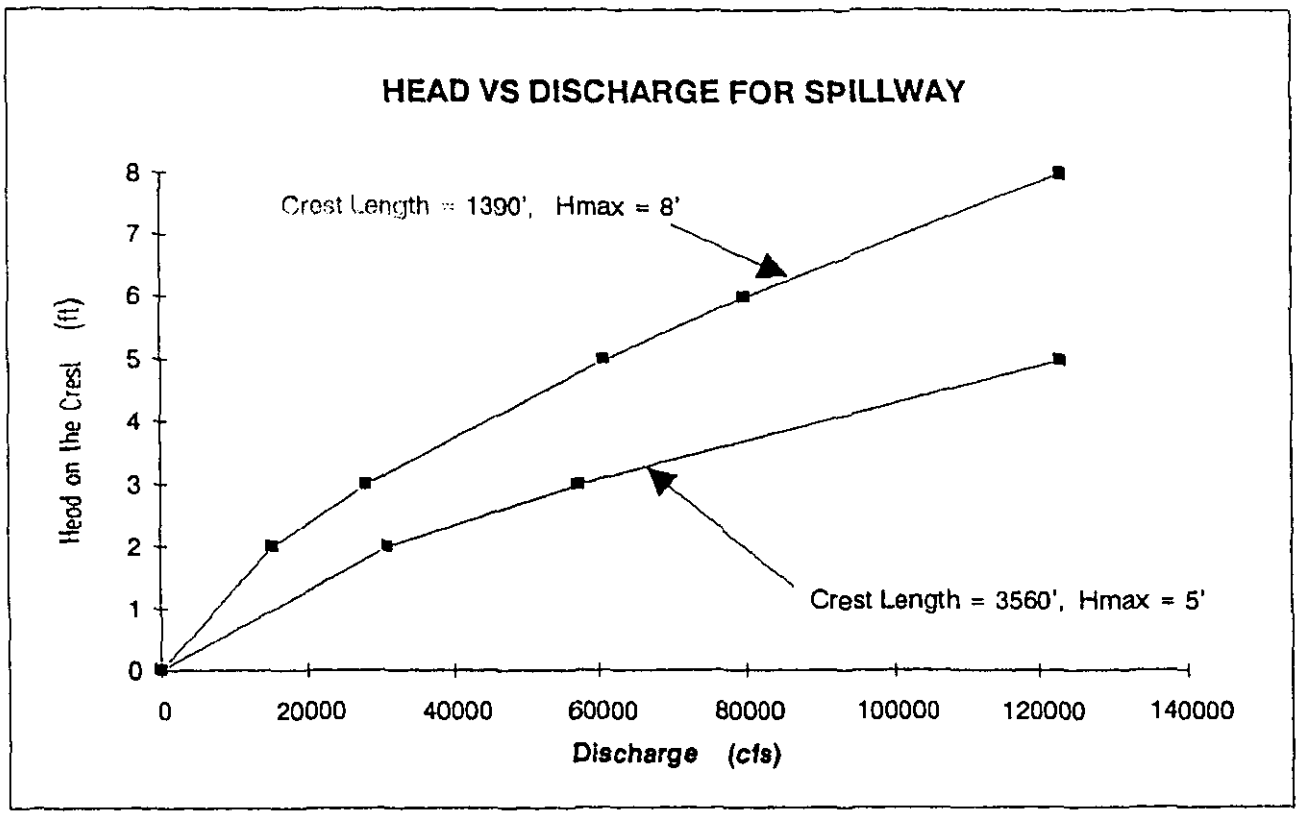

FIGURE 7.1

PREDESIGN REPORT
TECHNICAL APPENDIX

FOR THE

KYLE CANYON DETENTION BASIN

APRIL, 1992

PREPARED BY:
VTN NEVADA

In association with:
CRSS CIVIL ENGINEERS, INC.
CONVERSE CONSULTANTS SOUTHWEST, INC.

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SECTION 5.0 ..... HEC-1 Run - Alternative 1

SECTION 6.0 ..... HEC-1 Run - Alternative 2.1

SECTION 7.0 ..... HEC-1 Run - Alternative 2.2

SECTION 8.0 ..... Spillway Calculations

SECTION 9.0 ..... Outfall Calculations/Preliminary HGL Model

Outfall Study for the Kyle Canyon Detention Basin

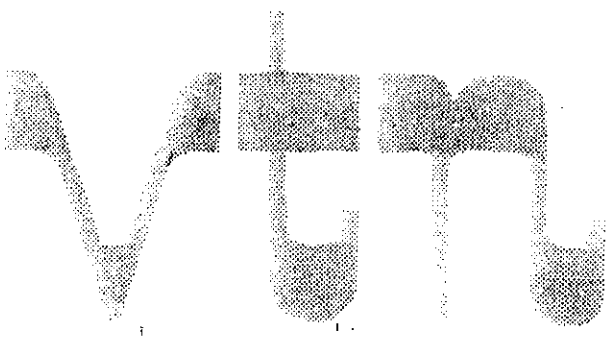
Included in this section:

Excerpts from *Outfall Study for the Kyle Canyon Detention Basin*, January 1993 by VTN Nevada.

OUTFALL STUDY

FOR THE

KYLE CANYON DETENTION BASIN



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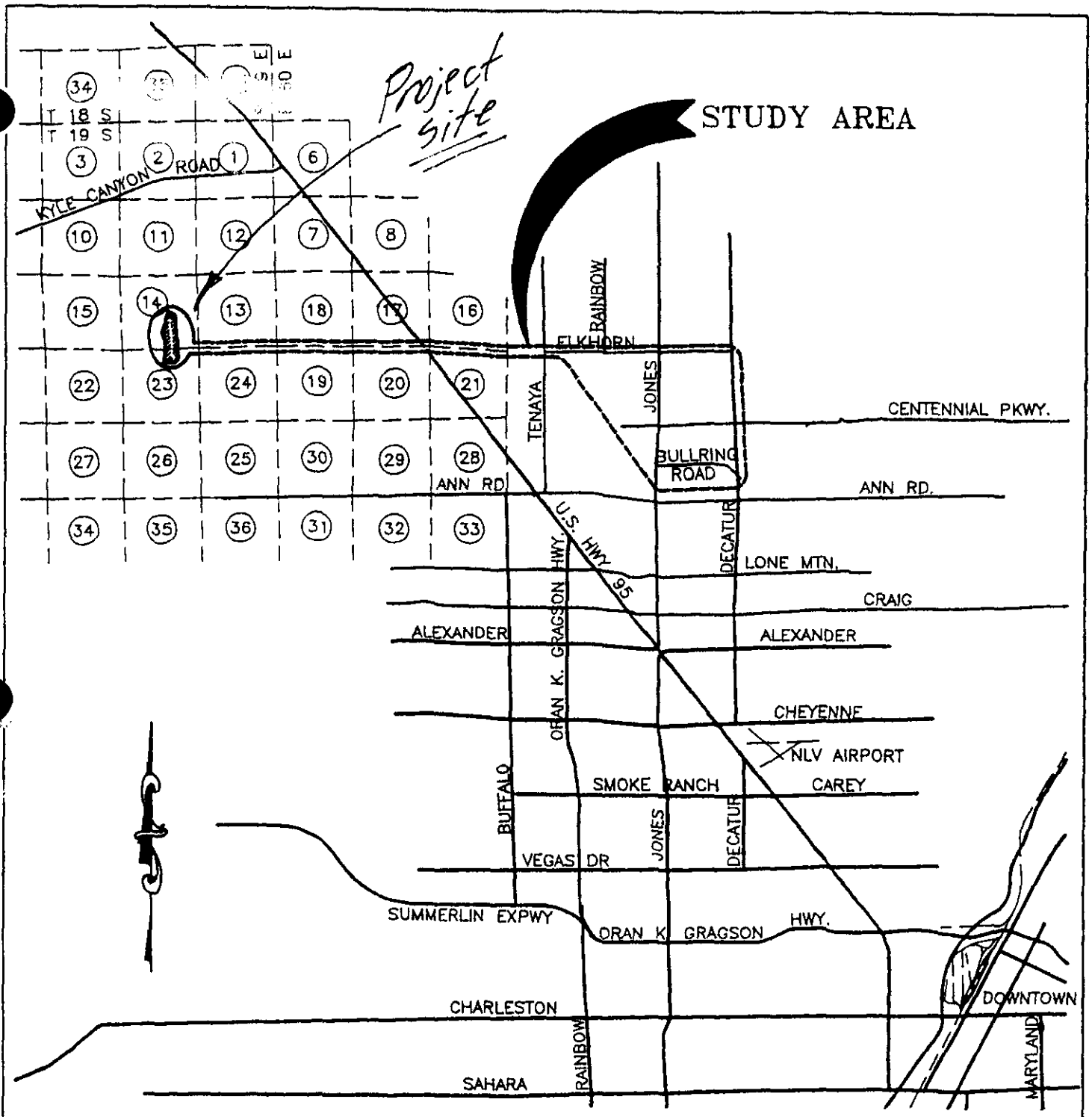
1.0 INTRODUCTION

VTN Nevada was retained by the City of North Las Vegas (CNLV) to provide engineering services for the Kyle Canyon Detention Basin facilities. As a supplement to those services, the CNLV requested VTN Nevada to prepare an Outfall Study for the proposed Kyle Canyon Detention Basin. VTN Nevada is preparing the study to present to the CNLV, the City of Las Vegas (CLV), and the Clark County Regional Flood Control District (CCRFCD) technical data which will allow the entities to determine the effects of constructing the detention basin in advance of the outfall structure. To accomplish this objective, the following parameters must be analyzed: 1) the downstream conveyance of outfall flows from the proposed detention basin; 2) any adverse effects of flows on existing improvements; and 3) prevention of damage to existing improvements which may be caused by outfall flows.

For this study, the detention basin outfall was located in accordance with the Kyle Canyon Detention Basin design drawings, prepared by VTN Nevada for the 90% submittal on August 24, 1992. Hydrology incorporated herein was taken directly from the Predesign Report for the Kyle Canyon Detention Basin, prepared by VTN Nevada, April 1992. A detailed sedimentation/erosion analysis was determined by CNLV to be unnecessary for this study. Any references to sedimentation or erosion herein are general in nature and should not be construed to represent results of sedimentation prediction calculations.

The study was performed for the natural drainage area between the proposed detention basin and Decatur Boulevard (see Figure 1.1). Within this area, normal depths of design flows were calculated at typical natural channel sections, existing roadway crossings, and the area vulnerable to sustained nuisance flows. Calculations of the above values are



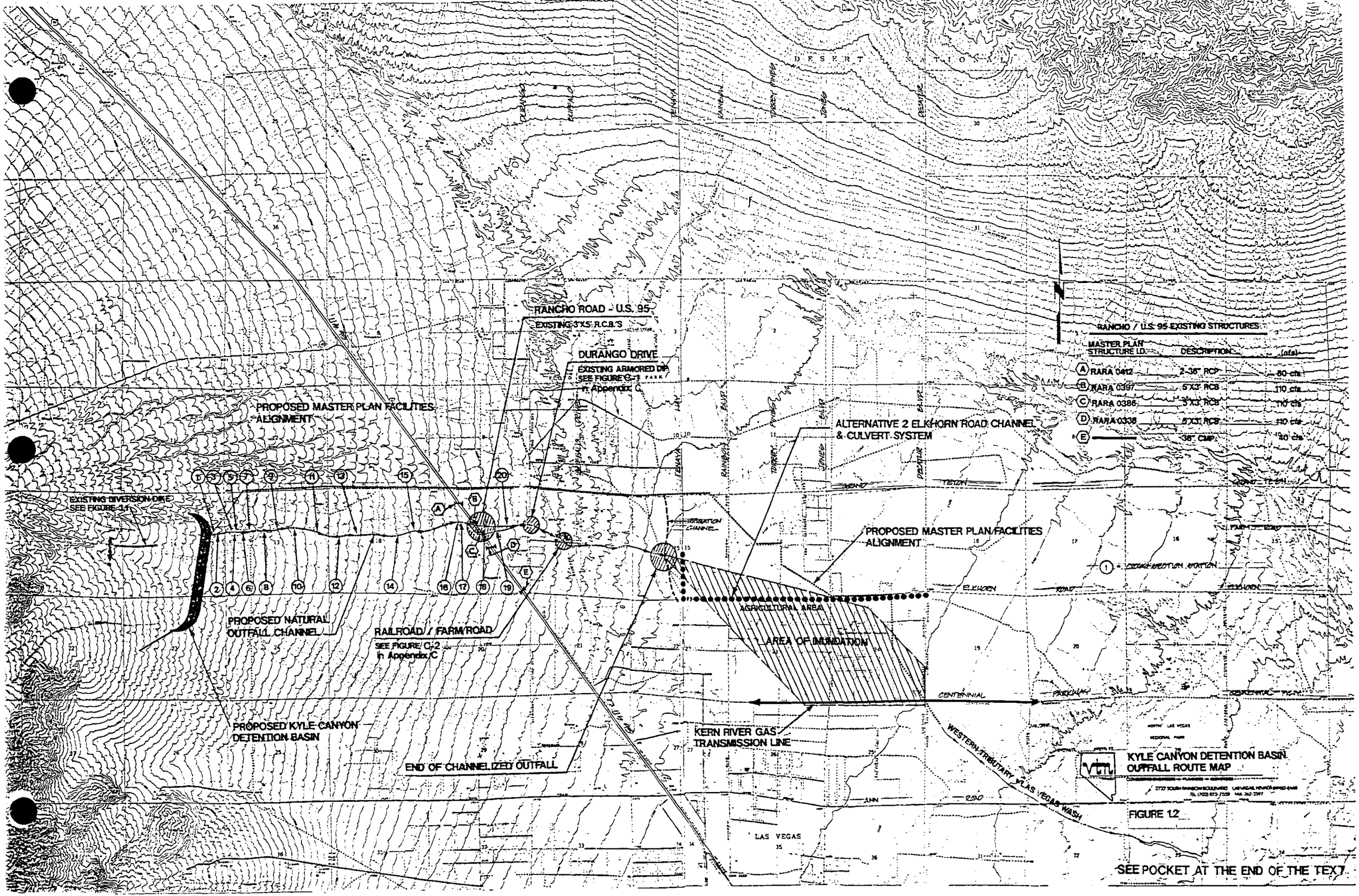
VICINITY MAP

1"=APPROXIMATELY 10,000'

FIGURE 1.1

located in Appendix A. The study does not include backwater curve calculations for the natural outfall system. Channel water surface elevations and ponding depths referenced herein are based solely on normal depth calculations.

The proposed detention basin, natural channel outfall system, and area susceptible to nuisance flows are shown on Figure 1.2.



KYLE CANYON DETENTION BASIN
OUTFALL ROUTE MAP

FIGURE 1.2

SEE POCKET AT THE END OF THE TEXT

2.0 HYDROLOGIC AND HYDRAULIC METHODOLOGY

As stated previously, flood hydrology used in this study was taken directly from the Predesign Report for the Kyle Canyon Detention Basin, prepared by VTN Nevada, April 1992. The Predesign Report includes detailed analyses of the detention basin and outfall for several return periods. The peak inflow to the basin and storage volume for several return periods are shown in Tables 2.1A and 2.1B respectively. These values were used as the basis for design outfall flows evaluated herein.

TABLE 2.1A FLOOD PEAK/FREQUENCY DATA

Return Period	Peak Flow (cfs)
2	179
5	2,326
10	4,637
25	7,427
50	10,246
100	13,165

TABLE 2.1B FLOOD VOLUME/FREQUENCY DATA

Return Period	Volume (acre ft)
2	46
5	442
10	936
25	1,577
50	2,233
100	2,918

In addition, the Predesign Report includes a detailed sedimentation/erosion analysis of the drainage area upstream of the detention basin. Although this information was not specifically used in this study, it is incorporated herein by reference.

The location of the detention basin outfall was determined during the predesign phase of this project. This location was chosen based on the capacity and integrity of the natural channel downstream. Analysis of the hydraulics of this channel, performed during the predesign phase of this project, indicates that the channel has historically carried flows greater than 1,000 cfs, which apparently was the basis for sizing the CCRFCD Master Plan Update Basin Outflow from the Kyle Canyon Detention Basin. The natural channel is also the most deeply incised over the greatest length of any of the natural channels downstream of the proposed detention basin, an indication that this channel has historically carried the greatest percentage of flows from Harris Springs Canyon. Using this natural channel for the conveyance of detention basin outflows perpetuates the historical drainage patterns while reducing the quantity of storm water reaching downstream developments.

Outfall flows from the detention basin will be conveyed from the basin via an existing natural channel and sheet flow through an agricultural/low density residential (less than 1 dwelling unit per acre) area to the Western Tributary of the Las Vegas Wash. Hydraulic analysis of the historical flow path was performed to Decatur Boulevard, the corporate limit of North Las Vegas. The CNLV did not request an analysis of the area between Decatur Boulevard and the Western Tributary.

The analysis of the natural outfall between the proposed detention basin and Decatur Boulevard was based on the following:

1. Normal depth at peak, average, and CCRFCD Master Plan Update flows for typical reaches of the natural outfall channel.
2. Capacity of existing culverts crossing U.S. 95 (Tonopah Highway).
3. Normal depth of flows in the area of inundation and their effect on existing structures in the area.

Calculations of the above values are located in Appendix A.

The following Table 2.2 is a summary of the hydraulic analyses at key locations in the outfall system.

TABLE 2.2 ANALYSIS SUMMARY

Flow (cfs)	Channel Conveyance (cfs)	Culvert Conveyance at U.S. 95 (cfs)	Ponding Depth of Nuisance Flows
250	250	250	0.2 ft
350	350	350	0.3 ft
1,000	1,000	350	0.3 ft

HYDRAULICS

This study analyzes the conveyance of outfall flows of 250 cfs, 350 cfs and 1,000 cfs. These flows were chosen based upon the average and peak predesign outfall flows and the CCRFCD Master Plan Update outfall flow (actual = 995 cfs), respectively. The normal depth of design flows was calculated for several individual cross sections downstream of the detention basin. The Manning's roughness coefficient is assumed to be 0.035 for the natural channel and overbanks and the channel slopes were established by field survey and existing topographic mapping of the area.

Cross sections were taken through the defined outfall channel between the detention basin and Durango Road (see Appendix A). The normal depth and critical depth of design flows were calculated using NCH, a computer program by CIVILSOFT.

The calculated normal depth of flow was used to analyze the effects of sustained flows on the existing natural channel and any existing downstream improvements. The width of flow, based on normal depth calculations, for each flow rate is shown on the individual cross sections in Appendix A and the flow path of the outfall flows is indicated on Figure 1.2. A summary of outfall channel hydraulic characteristics is shown in Table 4.1 on the following page.

The 2 - 5' X 3' RCB's at U.S. 95 were analyzed using Pennsylvania State University's HY 8 Culvert Analysis Program; computer output is shown in Appendix A. The CCRFCD Master Plan Update assumes that the 2 - 5' X 3' R.C.B.'s will carry 110 cfs under Rancho Road. According to the calculations mentioned above, the culvert capacities are 175 cfs each, incorporating the ponding area and available head. Detailed topography of the area (see Figure 4.2) indicates that outfall flows of 350 cfs or less will not flow to the existing 36 inch

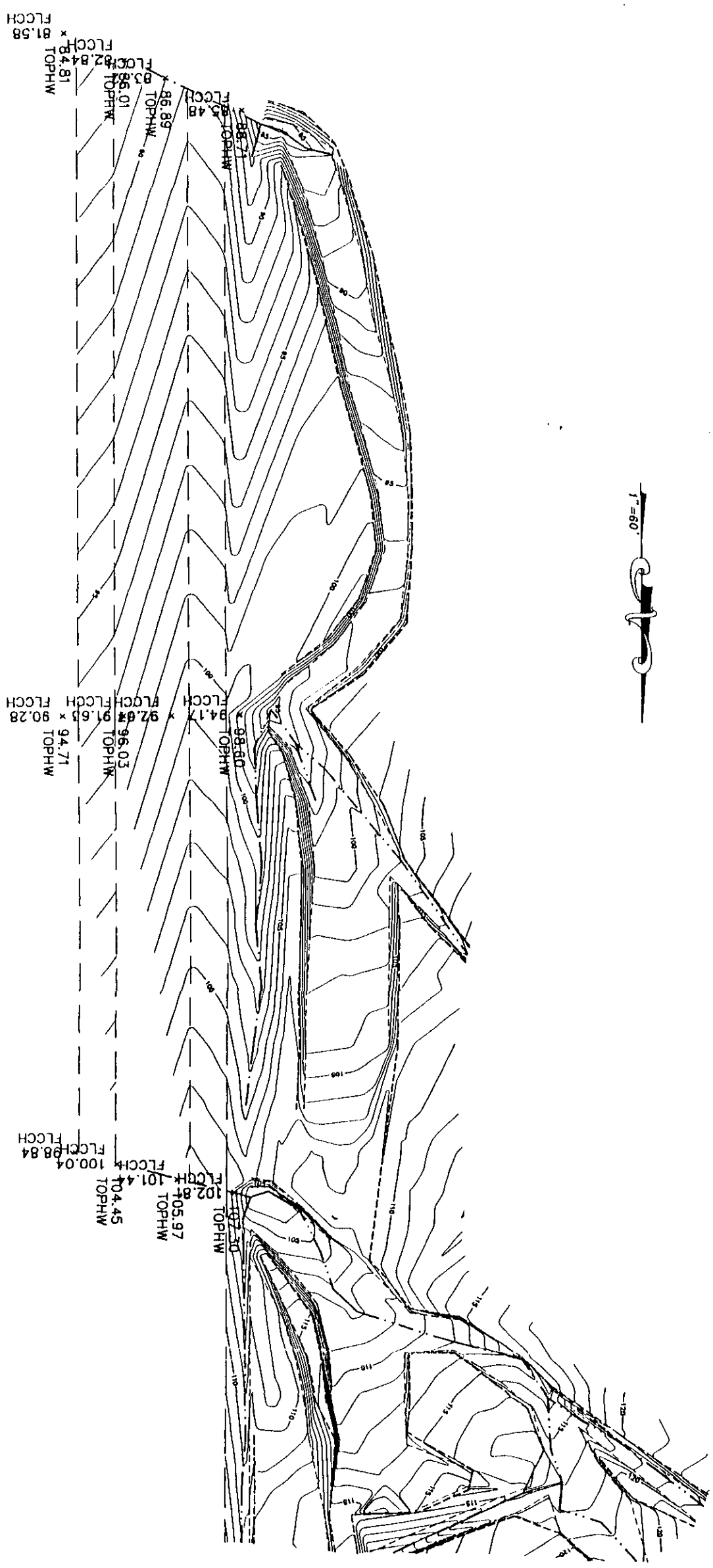


FIGURE 4.2

JOB NO	4254
BY	DJB
DATE	11/23/92
SCALE	1"=60'
SHEET	1 OF 1 SHEETS

TITLE: OUTFALL TOPO AT HIGHWAY FOR IN-HOUSE USE PER FIELD SHOTS

PROJECT: KYLE CANYON DETENTION BASIN AND DRAINAGE IMPROVEMENTS

CITY OF NORTH LAS VEGAS

CLARK COUNTY, NEVADA

REV	DATE	BY	REVISION

VTN nevada

CONSULTING ENGINEERS • PLANNERS • LAND SURVEYORS

2727 SOUTH RAINBOW BOULEVARD

LAS VEGAS, NEVADA 89102-5148 PHONE (702) 873-7550 FAX (702) 362-2597

CMP crossing under U.S. 95 downstream of the RCB's. Flows through the 2 - 5' X 3' R.C.B.'s will be erosive (v > 5 fps) and both the inlets and the outlets of the R.C.B systems will require additional erosion protection.

In addition to improvements to crossings at U.S. 95, the crossings at Durango Drive and Farm Road will require additional improvements to prevent further erosion. The opinion of probable cost for construction of these improvements is $100,000, regardless of the outfall alternative selected. Preliminary concept drawings of these improvements are shown in Appendix C.

The projected area of nuisance flows from Tenaya Way to Jones Boulevard was determined using existing 1984 topographic mapping by James M. Montgomery Consulting Engineers, Inc., U.S.G.S. quadrangle mapping, and field surveys. It should be noted that though existing topography of the area is available, it is difficult to accurately determine the floodway width and location. This area was historically an agricultural area and, as such, was graded at an extremely low slope for irrigation purposes. As stated earlier in this study, the slope in this area is so low that channelized flows upstream do not braid before moving overland as sheet flows.

Converse Consultants Southwest, Inc., performed field infiltrometer tests at key locations in the drainage area. Results of these tests can be found in Appendix D. These tests show that the soils in the area will become saturated in 3-5 hours. Due to underlying caliche shelves in the area, infiltration will not continue after the soil becomes saturated. As the outfall flows will be sustained for 7 days during the 100-year event, the flow path will be saturated and full flows for each analysis will be realized downstream.

The analysis suggests three alternatives for the outfall alignment which warrant consideration. The first is to allow outfall flows to perpetuate the historical flow path. The second alternative is the construction of a channel along Elkhorn Road from Rainbow Boulevard to Decatur Boulevard. The third alternative is to reduce or eliminate outfall flows through the area, by revising the outlet of the detention basin to hold the short return period rainfall events (5-year or less) while maintaining the CCRFCD criteria of a 7 day maximum draw down time for return periods greater than 5 years.

It should be noted that regardless of the method which outfall flows are carried from the detention basin to the Western Tributary of the Las Vegas Wash, there will be some inconvenience to the residents of the area. Due to the flat terrain in the area southeast of the intersection of Elkhorn Road and Rainbow Boulevard, outfall flows will spread over a large area. The land use in this area is largely agricultural parcels (+/-10 acres) with scattered residential parcels. The depth of flow through this area under peak outflow conditions is less than 1 ft. Hydrologic calculations show that, as presently designed, the detention basin outfall flows are approximately equal to the 2-year storm event flows emanating from the upstream drainage basins.

4.1 ALTERNATIVE 1

Implementation of Alternative 1 does not require additional expenditures in excess of the detention basin budget. Detention basin outfall flows will follow the historical drainage patterns shown in Figure 1.2. This alternative will cause inconvenience to developments located south and east of the intersection of Elkhorn Road and Tenaya Way because discharge will occur over 7 days. However, at a peak flow rate of 350 cfs, this is, in the view of CNLV Technical Staff, an overwhelming improvement over the existing flood peak flows from the 5-year storm (1,500 cfs).

Outfall flows and existing flows will spread over a very large area and, as a result of the minimal slope in the area, much of the water will pond in portions of the area indicated in Figure 1.2. This area of potential inundation represents the resultant pond from the 7 day draw down of the proposed basin at a peak flow of 350 cfs. Outfall flows are contained and carried in the natural channel to a point approximately 1,200 ft west of Tenaya Way. As the channel becomes undefined and flow begins to spread over the downstream basin, it encroaches upon several residences in the area. However, the depth of flow will be minimal (<1 ft) at any one location. To alleviate the nuisance of sustained flows across roadways in the area of inundation, temporary drainage structures should be constructed prior to the construction of the CCRFCD Master Plan Update outfall conveyance system.

4.2 ALTERNATIVE 2

Unlike the first alternative, this will require the expenditure of additional funds to construct these improvements. This alternative must be designed so that driveways along the proposed route are not impacted while minimizing the number of structures which must be installed at street and intersection crossings.

This alternative limits the inconvenience to area residents by conveying outfall flows to Decatur Boulevard in an earthen channel. The channel section would begin on the east side of Tenaya Way; proceed south to Elkhorn Road, and then east to Decatur Boulevard. To avoid isolating any residents along Elkhorn Road, the channel must cross Elkhorn Road several times to flow adjacent to undeveloped areas. The benefits realized by this alternative may be outweighed by the cost of construction.

One disadvantage to this alternative is that it may be considered a diversion of historical flow patterns. Another disadvantage is, as this alternative is temporary in nature,

costs do not contribute any long-term benefit. The advantage to this alternative is the minimization of inconvenience to the residents of this area.

In addition, there are several inherent difficulties involved in the construction of this alternative. Due to the flat terrain in this area ($R \leq 0.40\% \pm$), the channel section must be wide and shallow to carry the required flow. Any future improvements along either Tenaya Way or Elkhorn Road would have to convey the outfall flows until the outfall structure is constructed. The opinion of probable construction cost for this alternative is $1.2 million. A breakdown of these costs and a preliminary channel profile is located in Appendix C. This does not include any freeboard in the channel at the peak flow of 350 cfs.

4.2.1 ALTERNATIVE 2.1

This alternative is to construct the CCRFCD Master Plan Update outfall structure for the proposed Kyle Canyon Detention Basin. According to the Master Plan Update, the construction cost for the outfall structure from the detention basin to the Western Tributary of the Las Vegas Wash is $21 million. The advantages to the construction of this structure are the elimination of inconvenience to local residents and the money spent to eliminate this inconvenience will be spent on a permanent structure. The disadvantage to this alternative is that if money is allocated to the construction of the outfall structure, the detention basin will not be constructed until additional funds are available. Until the Kyle Canyon Detention Basin is funded and constructed, the outfall structure does not offer any flood protection to residents of the area.

ATIVE 3

The focus of this alternative is to reduce the outfall flow rate of short return period storms from 350 cfs, thus reducing the impact of the short return period storm on downstream development. In order to accomplish this, the current outfall structure design must be modified to stage the basin outlet and basin storage.

The peak outfall flow rate of the 5-year event for the current outlet design is 300 cfs. To maintain the required 7 day maximum draw down time required by the CCRFCD Hydrologic Criteria and Drainage Design Manual, the minimum peak flow rate through the low flow outlet under the 5-year event is 250 cfs. A reduction of 50 cfs does not warrant construction of a low flow outlet based upon current design criteria. To significantly reduce the outfall flow rate, the maximum allowable draw down time must be increased. While this is a deviation from the CCRFCD Hydrologic Criteria and Drainage Design Manual, it will not affect the performance of the embankment. Additional seepage generated by the increased detention time will be carried to the toe drain channel from the filter blanket and drainage gallery.

Table 4.2, on the following page, shows a low flow outlet system designed to reduce the outfall flow rate of the 5-year storm from 300 cfs to 100 cfs, and its corresponding draw down time, compared to the predesign dam outlet configuration. The opinion of probable construction cost for this low flow outlet is $100,000.

TABLE 4.2 ALTERNATIVE OUTLET COMPARISON

	DESIGN	LOW FLOW SYSTEM
Low Flow Diameter	--	24"
Outlet Diameter	44"	44"
Low Flow Q Peak	--	100 cfs
Outlet Q Peak	350 cfs	350 cfs
Draw Down Time	7 days	14 days

Analyses of several other outlet configurations which were considered in this study are located in Appendix A.

A variation of this alternative is to retain all storm flows for the 5-year return period or less. In order to accomplish this, the embankment must be redesigned to retain water and the volume of the basin must be increased to compensate for the retention of the 5-year storm. While this alternative is appealing from the standpoint of reducing nuisance flows, it does not solve that problem for longer return period storms. This option, like Alternative 3, requires a variance from the CCRFCD Hydrologic Criteria and Drainage Design Manual and approval from the State Engineer's Office. Probable cost of implementation of this variation of Alternative 3 is $1.5 million.

5.0 CONCLUSIONS

Of the three alternatives considered, Alternative 2/2.1, the construction of an outfall channel, either temporary or permanent, is the most expensive. The substantial financial investment in Alternative 2 offers short-term benefits. This alternative may also be considered to be a diversion of natural storm flows and, as such, may be a liability concern. The investment in Alternative 2.1 will prove to be beneficial in the long-term but Alternative 2.1 offers no immediate flood protection to area residents without the construction of the detention basin.

Alternative 1 is the least expensive of the three alternatives offered herein as there are no additional costs associated with implementation of this alternative. The reduction in storm flows provided by the construction of the detention basin is demonstratably an improvement over the existing conditions. This alternative perpetuates historical drainage patterns but increases the normal duration of nuisance flows in the area.

Alternative 3 will increase the probable construction cost of the detention basin. The addition of Alternative 3 to the existing design of the detention basin is inexpensive when compared with Alternative 2/2.1 above. However, unless a variance to the CCRFCD Hydrologic Criteria and Drainage Design Manual to allow the maximum allowable draw down time to be increased from 7 days to 14 days, Alternative 3 offers little reduction in peak outflows when compared to Alternative 1.

The primary objective of this study is to determine if it is more beneficial to construct the detention basin in advance of the outfall structure. It is evident that the detention basin protects downstream development from a catastrophic flood event without changing the existing conditions in the area, with the exception of the duration of flood flows. The

[illegible] of the outfall structure will reduce the nuisance of sustained flows to area residents, but offers no protection from a major storm event.

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*             SEPTEMBER 1990            *
*              VERSION 4.0              *
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*         (916) 756-1104                *
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


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      LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

                    * *DIAGRAM
        1           ID          SPRING MOUNTAIN 100-YEAR STORM
        2           ID
        3           ID   KYLE CANYON DETENTION BASIN SELECTED ALT
        4           ID   PEAK DISCHARGE 350 CFS @ CREST OF SPILLWAY
        5           ID   FILE KYLE.DAT
*** FREE ***
        6           IT       5       0       0     300
        7           IO       5       0       0
        8           IN       5       0       0
        9           JR    PREC   .4650       1

       10           KK  GD30.5
       11           KM   Total for basins; GD 30.5 THRU GD 30.11
       12           BA   28.60
       13           PB    2.43
       14           PC    .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
       15           PC    .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
       16           PC    .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
       17           PC    .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
       18           PC    .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
       19           PC    .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
       20           PC    .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
       21           PC    .997    .999   1.00
```

```
22          LS       0    83.6
23          UD    1.04

24          KK     RT1
25          KM   Route flows to CP at GD 30.4
26          RS       5    FLOW      -1       0
27          RC     .06     .04     .06   21950   .0349
28          RX       0       1      26      27     177     178     203     204
29          RY      10       3       3       0       0       3       3      10
30          RL       0       0       2

31          KK  GD30.4
32          KM   Runoff from basin GD 30.4
33          BA    6.89
34          PB    2.43
35          LS       0    82.3
36          UD    0.60

37          KK    CMB1
38          KM   Combine hydrographs at cp GD 30.4
39          HC       2

40          KK     RT2
41          KM   Route flows to CP at GD 30.3
42          RS       1    FLOW      -1       0
43          RC     .06     .04     .06    2075   .0386
44          RX       0       1      26      27     177     178     203     204
45          RY      10       3       3       0       0       3       3      10
46          RL       0       0       2
```



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LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

47          KK  GD30.3
48          KM   Runoff from basin GD 30.3
49          BA    9.43
50          PB    2.43
51          LS       0    86.9
52          UD    0.96

53          KK    CMB2
54          KM   Combine hydrographs at cp GD 30.3
55          HC       2

56          KK     RT3
57          KM   Route flows to CP at GD 30.1
58          RS       4    FLOW      -1       0
59          RC     .06     .04     .06   18000   .0383
60          RX       0       1      26      27     177     178     203     204
61          RY      10       3       3       0       0       3       3      10
62          RL       0       0       2

63          KK  GD30.2
64          KM   Runoff from basin GD 30.2
65          BA    0.85
66          PB    2.43
67          LS       0      77
68          UD    0.41

69          KK     RT4
70          KM   Route flows to CP at GD 30.1
```

```
 71          RS       3    FLOW      -1       0
 72          RC     .06     .04     .06    4800    .0323
 73          RX       0       1      26      27     177     178     203     204
 74          RY      10       3       3       0       0       3       3      10
 75          RL       0       0       2

 76          KK  GD30.1
 77          KM   Runoff from basin GD 30.1
 78          BA    2.61
 79          PB    2.43
 80          LS       0    83.1
 81          UD    0.85

 82          KK    CMB3
 83          KM   Combine hydrographs at cp GD 30.1
 84          HC       3

 85          KK     RT5
 86          KM   Route flows to CP at GD 25-3
 87          RS       2    FLOW      -1       0
 88          RC     .06     .04     .06   10000    .0390
 89          RX       0       1      26      27     177     178     203     204
 90          RY      10       3       3       0       0       3       3      10
 91          RL       0       0       2
1                                        HEC-1 INPUT                                    PAGE  3

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 92          KK    GD25
 93          KM   Runoff from basin GD 25-3
 94          BA    2.34
 95          PB    2.43
 96          LS       0    79.3
 97          UD    0.38

 98          KK    GD21
 99          KM   Runoff from basin GD 21
100          BA    6.79
101          PB    2.43
102          LS       0    83.9
103          UD    0.86

104          KK     RT6
105          KM   Route flows from GD 21 to CP at GD 25-3
106          RS       5    FLOW      -1       0
107          RC     .06     .04     .06   10500    .0438
108          RX       0       1      26      27     177     178     203     204
109          RY      10       3       3       0       0       3       3      10
110          RL       0       0       2

111          KK    CMB4
112          KM   Combine hydrographs at CP GD 30.3
113          HC       3

114          KK    GD10
115          BA    0.22
116          PB    2.43
117          LS       0    79.3
118          UD     0.4
             * ************************
             * * PEAK INFLOW TO BASIN *
```

```
                * ************************

          119           KK +INFLOW
          120           KO       1
          121           HC       2

          122           KK KYLEDET
          123           KM   Route flows through Kyle Canyon Detention Basin
          124           KO       1
          125           RS       1    STOR      -1
          126           SV       0      11     205     769    1738    3059    4320
          127           SE    3235    3240    3250    3260    3270    3281    3290
          128           SQ       0      27      40      50     301     343     369  124142
          129           SE    3235    3245    3255    3265    3266    3275    3281    3290
          130           ZZ
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*            VERSION 4.0                *                 *         609 SECOND STREET            *
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*  RUN DATE  12/17/1992  TIME  23:28:47 *                 *          (916) 756-1104              *
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                                SPRING MOUNTAIN 100-YEAR STORM

                             KYLE CANYON DETENTION BASIN SELECTED ALT
                             PEAK DISCHARGE 350 CFS @ CREST OF SPILLWAY
                             FILE KYLE.DAT

   7 IO          OUTPUT CONTROL VARIABLES
                       IPRNT          5  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME       0000  STARTING TIME
                          NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE     2    0  ENDING DATE
                       NDTIME       0055  ENDING TIME
                       ICENT         19  CENTURY MARK

                    COMPUTATION INTERVAL      .08 HOURS
                         TOTAL TIME BASE    24.92 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
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NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.47 1.30

*** ***

119 KK +INFLOW

120 KO OUTPUT CONTROL VARIABLES
IPRNT 1 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

121 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION +INFLOW
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .47

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1		0005	2	0.	1		0620	77	2103.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	2016.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	1921.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	1819.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	1713.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	1605.	1		1300	157	0.	1		1915	232	0.
1		0035	8	0.	1		0650	83	1498.	1		1305	158	0.	1		1920	233	0.
1		0040	9	0.	1		0655	84	1394.	1		1310	159	0.	1		1925	234	0.
1		0045	10	0.	1		0700	85	1295.	1		1315	160	0.	1		1930	235	0.
1		0050	11	0.	1		0705	86	1211.	1		1320	161	0.	1		1935	236	0.
1		0055	12	0.	1		0710	87	1149.	1		1325	162	0.	1		1940	237	0.
1		0100	13	0.	1		0715	88	1083.	1		1330	163	0.	1		1945	238	0.
1		0105	14	0.	1		0720	89	1013.	1		1335	164	0.	1		1950	239	0.
1		0110	15	0.	1		0725	90	938.	1		1340	165	0.	1		1955	240	0.
1		0115	16	0.	1		0730	91	864.	1		1345	166	0.	1		2000	241	0.
1		0120	17	0.	1		0735	92	792.	1		1350	167	0.	1		2005	242	0.
1		0125	18	0.	1		0740	93	717.	1		1355	168	0.	1		2010	243	0.
1		0130	19	0.	1		0745	94	643.	1		1400	169	0.	1		2015	244	0.
1		0135	20	0.	1		0750	95	570.	1		1405	170	0.	1		2020	245	0.
1		0140	21	0.	1		0755	96	500.	1		1410	171	0.	1		2025	246	0.
1		0145	22	0.	1		0800	97	437.	1		1415	172	0.	1		2030	247	0.
1		0150	23	0.	1		0805	98	384.	1		1420	173	0.	1		2035	248	0.
		0155	24	0.	1		0810	99	344.	1		1425	174	0.	1		2040	249	0.
		0200	25	0.	1		0815	100	329.	1		1430	175	0.	1		2045	250	0.

1	0205	26	0.	*	1	0820	101	314.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	0.	*	1	0825	102	299.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	0.	*	1	0830	103	285.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	0.	*	1	0835	104	270.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	0.	*	1	0840	105	255.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	0.	*	1	0845	106	240.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	0.	*	1	0850	107	224.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	0.	*	1	0855	108	209.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	0.	*	1	0900	109	193.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	0.	*	1	0905	110	176.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	0.	*	1	0910	111	160.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	0.	*	1	0915	112	143.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	0.	*	1	0920	113	126.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	0.	*	1	0925	114	108.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	0.	*	1	0930	115	91.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	2.	*	1	0935	116	73.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	8.	*	1	0940	117	55.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	21.	*	1	0945	118	38.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	41.	*	1	0950	119	22.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	65.	*	1	0955	120	8.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	82.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	91.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	94.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	94.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	97.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	111.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	131.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	155.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	198.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	251.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	317.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	398.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	502.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	629.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	798.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	988.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	1127.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	1238.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	1353.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	1493.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	1693.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	1873.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	2024.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	2143.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	2231.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	2287.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	2313.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	2311.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	2286.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	2241.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*				

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 2313.	5.92		879.	220.	212.	212.
		(INCHES)	.142	.142	.142	.142
		(AC-FT)	436.	437.	437.	437.

CUMULATIVE AREA = 57.73 SQ MI

HYDROGRAPH AT STATION +INFLOW
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	9095.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	8543.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	7976.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	7402.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	6840.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	6296.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	5786.	1		1300	157	0.	1		1915	232	0.
1		0035	8	0.	1		0650	83	5335.	1		1305	158	0.	1		1920	233	0.
1		0040	9	0.	1		0655	84	4902.	1		1310	159	0.	1		1925	234	0.
1		0045	10	0.	1		0700	85	4491.	1		1315	160	0.	1		1930	235	0.
1		0050	11	0.	1		0705	86	4119.	1		1320	161	0.	1		1935	236	0.
1		0055	12	0.	1		0710	87	3807.	1		1325	162	0.	1		1940	237	0.
1		0100	13	0.	1		0715	88	3496.	1		1330	163	0.	1		1945	238	0.
1		0105	14	0.	1		0720	89	3182.	1		1335	164	0.	1		1950	239	0.
1		0110	15	0.	1		0725	90	2882.	1		1340	165	0.	1		1955	240	0.
1		0115	16	0.	1		0730	91	2613.	1		1345	166	0.	1		2000	241	0.
1		0120	17	0.	1		0735	92	2394.	1		1350	167	0.	1		2005	242	0.
1		0125	18	0.	1		0740	93	2208.	1		1355	168	0.	1		2010	243	0.
1		0130	19	0.	1		0745	94	2013.	1		1400	169	0.	1		2015	244	0.
1		0135	20	1.	1		0750	95	1816.	1		1405	170	0.	1		2020	245	0.
1		0140	21	2.	1		0755	96	1626.	1		1410	171	0.	1		2025	246	0.
1		0145	22	5.	1		0800	97	1450.	1		1415	172	0.	1		2030	247	0.
1		0150	23	8.	1		0805	98	1296.	1		1420	173	0.	1		2035	248	0.
1		0155	24	12.	1		0810	99	1173.	1		1425	174	0.	1		2040	249	0.
1		0200	25	18.	1		0815	100	1098.	1		1430	175	0.	1		2045	250	0.
1		0205	26	24.	1		0820	101	1026.	1		1435	176	0.	1		2050	251	0.
1		0210	27	31.	1		0825	102	950.	1		1440	177	0.	1		2055	252	0.
1		0215	28	37.	1		0830	103	870.	1		1445	178	0.	1		2100	253	0.
1		0220	29	40.	1		0835	104	788.	1		1450	179	0.	1		2105	254	0.
1		0225	30	40.	1		0840	105	704.	1		1455	180	0.	1		2110	255	0.
1		0230	31	39.	1		0845	106	622.	1		1500	181	0.	1		2115	256	0.
1		0235	32	46.	1		0850	107	543.	1		1505	182	0.	1		2120	257	0.
1		0240	33	59.	1		0855	108	470.	1		1510	183	0.	1		2125	258	0.
1		0245	34	74.	1		0900	109	407.	1		1515	184	0.	1		2130	259	0.
1		0250	35	94.	1		0905	110	359.	1		1520	185	0.	1		2135	260	0.
1		0255	36	120.	1		0910	111	334.	1		1525	186	0.	1		2140	261	0.
1		0300	37	159.	1		0915	112	318.	1		1530	187	0.	1		2145	262	0.
1		0305	38	216.	1		0920	113	303.	1		1535	188	0.	1		2150	263	0.
1		0310	39	289.	1		0925	114	287.	1		1540	189	0.	1		2155	264	0.
1		0315	40	379.	1		0930	115	272.	1		1545	190	0.	1		2200	265	0.
1		0320	41	495.	1		0935	116	256.	1		1550	191	0.	1		2205	266	0.
1		0325	42	644.	1		0940	117	240.	1		1555	192	0.	1		2210	267	0.
1		0330	43	846.	1		0945	118	224.	1		1600	193	0.	1		2215	268	0.
1		0335	44	1104.	1		0950	119	208.	1		1605	194	0.	1		2220	269	0.
1		0340	45	1441.	1		0955	120	191.	1		1610	195	0.	1		2225	270	0.
1		0345	46	1897.	1		1000	121	174.	1		1615	196	0.	1		2230	271	0.
1		0350	47	2506.	1		1005	122	157.	1		1620	197	0.	1		2235	272	0.
1		0355	48	3366.	1		1010	123	139.	1		1625	198	0.	1		2240	273	0.
1		0400	49	4369.	1		1015	124	121.	1		1630	199	0.	1		2245	274	0.
1		0405	50	5621.	1		1020	125	103.	1		1635	200	0.	1		2250	275	0.

1	0410	51	7039.	*	1	1025	126	85.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	8234.	*	1	1030	127	67.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	9272.	*	1	1035	128	49.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	10162.	*	1	1040	129	31.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	10945.	*	1	1045	130	16.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	11650.	*	1	1050	131	3.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	12295.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	12777.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	13080.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	13244.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	13310.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	13297.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	13226.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	13124.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	12996.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	12836.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	12639.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	12392.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	12085.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	11730.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	11351.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	10971.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	10579.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	10127.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	9627.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*				

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
13310.	5.00		5841.	1476.	1422.	1422.
		(INCHES)	.941	.951	.951	.951
		(AC-FT)	2896.	2928.	2928.	2928.

CUMULATIVE AREA = 57.73 SQ MI

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          *            *
122 KK    *   KYLEDET  *
          *            *
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124 KO OUTPUT CONTROL VARIABLES

IPRNT	1	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

110 RL ROUTING LOSSES

QLOSS	.00	INITIAL LOSS
CLOSS	.00	ADDITIONAL FRACTION LOST

:S STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	STOR	TYPE OF INITIAL CONDITION
RSVRIC	-1.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

SV	STORAGE	.0	11.0	205.0	769.0	1738.0	3059.0	4320.0
127 SE	ELEVATION	3235.00	3240.00	3250.00	3260.00	3270.00	3281.00	3290.00
128 SQ	DISCHARGE	0.	27.	40.	50.	301.	343.	369. 124142.
129 SE	ELEVATION	3235.00	3245.00	3255.00	3265.00	3266.00	3275.00	3281.00 3290.00

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COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	11.00	108.00	205.00	487.00	769.00	1253.50	1350.40	1738.00	2338.45
OUTFLOW	.00	13.50	27.00	33.50	40.00	45.00	50.00	301.00	319.67	343.00
ELEVATION	3235.00	3240.00	3245.00	3250.00	3255.00	3260.00	3265.00	3266.00	3270.00	3275.00

STORAGE	3059.00	4320.00
OUTFLOW	369.00	124142.00
ELEVATION	3281.00	3290.00

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HYDROGRAPH AT STATION KYLEDET
PLAN 1, RATIO = .47

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MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000	1	0.	.0	3235.0	1		0820	101	38.	405.8	3253.6	1		1640	201	38.	401.0	3253.5
1	0005	2	0.	.0	3235.0	1		0825	102	38.	407.7	3253.6	1		1645	202	38.	400.7	3253.5
1	0010	3	0.	.0	3235.0	1		0830	103	38.	409.4	3253.6	1		1650	203	38.	400.5	3253.5
1	0015	4	0.	.0	3235.0	1		0835	104	38.	411.0	3253.7	1		1655	204	38.	400.2	3253.5
1	0020	5	0.	.0	3235.0	1		0840	105	38.	412.6	3253.7	1		1700	205	38.	400.0	3253.5
1	0025	6	0.	.0	3235.0	1		0845	106	38.	414.0	3253.7	1		1705	206	38.	399.7	3253.5
1	0030	7	0.	.0	3235.0	1		0850	107	38.	415.4	3253.7	1		1710	207	38.	399.4	3253.4
1	0035	8	0.	.0	3235.0	1		0855	108	38.	416.6	3253.8	1		1715	208	38.	399.2	3253.4
1	0040	9	0.	.0	3235.0	1		0900	109	38.	417.7	3253.8	1		1720	209	38.	398.9	3253.4
1	0045	10	0.	.0	3235.0	1		0905	110	38.	418.7	3253.8	1		1725	210	38.	398.6	3253.4
1	0050	11	0.	.0	3235.0	1		0910	111	38.	419.6	3253.8	1		1730	211	38.	398.4	3253.4
1	0055	12	0.	.0	3235.0	1		0915	112	38.	420.4	3253.8	1		1735	212	38.	398.1	3253.4
1	0100	13	0.	.0	3235.0	1		0920	113	38.	421.0	3253.8	1		1740	213	38.	397.9	3253.4
1	0105	14	0.	.0	3235.0	1		0925	114	38.	421.6	3253.8	1		1745	214	38.	397.6	3253.4
1	0110	15	0.	.0	3235.0	1		0930	115	39.	422.0	3253.8	1		1750	215	38.	397.3	3253.4
1	0115	16	0.	.0	3235.0	1		0935	116	39.	422.3	3253.9	1		1755	216	38.	397.1	3253.4
1	0120	17	0.	.0	3235.0	1		0940	117	39.	422.5	3253.9	1		1800	217	38.	396.8	3253.4
1	0125	18	0.	.0	3235.0	1		0945	118	39.	422.5	3253.9	1		1805	218	38.	396.6	3253.4
1	0130	19	0.	.0	3235.0	1		0950	119	39.	422.5	3253.9	1		1810	219	38.	396.3	3253.4
1	0135	20	0.	.0	3235.0	1		0955	120	39.	422.3	3253.9	1		1815	220	38.	396.0	3253.4
1	0140	21	0.	.0	3235.0	1		1000	121	39.	422.1	3253.8	1		1820	221	38.	395.8	3253.4
1	0145	22	0.	.0	3235.0	1		1005	122	38.	421.8	3253.8	1		1825	222	38.	395.5	3253.4
1	0150	23	0.	.0	3235.0	1		1010	123	38.	421.5	3253.8	1		1830	223	38.	395.2	3253.4
1	0155	24	0.	.0	3235.0	1		1015	124	38.	421.3	3253.8	1		1835	224	38.	395.0	3253.4
1	0200	25	0.	.0	3235.0	1		1020	125	38.	421.0	3253.8	1		1840	225	38.	394.7	3253.4
1	0205	26	0.	.0	3235.0	1		1025	126	38.	420.8	3253.8	1		1845	226	38.	394.5	3253.4
	0210	27	0.	.0	3235.0	1		1030	127	38.	420.5	3253.8	1		1850	227	38.	394.2	3253.4
	0215	28	0.	.0	3235.0	1		1035	128	38.	420.2	3253.8	1		1855	228	38.	393.9	3253.4

1	0220	29	0.	.0	3235.0	*	1	1040	129	38.	420.0	3253.8	*	1	1900	229	38.	393.7	3253.3
1	0225	30	0.	.0	3235.0	•	1	1045	130	38.	419.7	3253.8	•	1	1905	230	38.	393.4	3253.3
1	0230	31	0.	.0	3235.0	*	1	1050	131	38.	419.4	3253.8	*	1	1910	231	38.	393.2	3253.3
1	0235	32	0.	.0	3235.0	•	1	1055	132	38.	419.2	3253.8	*	1	1915	232	38.	392.9	3253.3
	0240	33	0.	.0	3235.0	*	1	1100	133	38.	418.9	3253.8	*	1	1920	233	38.	392.6	3253.3
	0245	34	0.	.0	3235.0	•	1	1105	134	38.	418.6	3253.8	*	1	1925	234	38.	392.4	3253.3
1	0250	35	0.	.0	3235.0	*	1	1110	135	38.	418.4	3253.8	*	1	1930	235	38.	392.1	3253.3
1	0255	36	0.	.0	3235.0	*	1	1115	136	38.	418.1	3253.8	*	1	1935	236	38.	391.9	3253.3
1	0300	37	0.	.0	3235.0	*	1	1120	137	38.	417.8	3253.8	•	1	1940	237	38.	391.6	3253.3
1	0305	38	0.	.0	3235.0	•	1	1125	138	38.	417.6	3253.8	*	1	1945	238	38.	391.3	3253.3
1	0310	39	0.	.0	3235.0	*	1	1130	139	38.	417.3	3253.8	•	1	1950	239	38.	391.1	3253.3
1	0315	40	0.	.0	3235.0	*	1	1135	140	38.	417.0	3253.8	*	1	1955	240	38.	390.8	3253.3
1	0320	41	0.	.0	3235.0	•	1	1140	141	38.	416.8	3253.8	•	1	2000	241	38.	390.6	3253.3
1	0325	42	0.	.0	3235.0	•	1	1145	142	38.	416.5	3253.8	•	1	2005	242	38.	390.3	3253.3
1	0330	43	0.	.1	3235.1	•	1	1150	143	38.	416.3	3253.7	*	1	2010	243	38.	390.0	3253.3
1	0335	44	0.	.4	3235.2	•	1	1155	144	38.	416.0	3253.7	*	1	2015	244	38.	389.8	3253.3
1	0340	45	1.	.7	3235.3	*	1	1200	145	38.	415.7	3253.7	•	1	2020	245	38.	389.5	3253.3
1	0345	46	1.	1.2	3235.6	•	1	1205	146	38.	415.5	3253.7	*	1	2025	246	38.	389.3	3253.3
1	0350	47	2.	1.8	3235.8	•	1	1210	147	38.	415.2	3253.7	*	1	2030	247	38.	389.0	3253.3
1	0355	48	3.	2.4	3236.1	*	1	1215	148	38.	414.9	3253.7	*	1	2035	248	38.	388.7	3253.3
1	0400	49	4.	3.0	3236.4	*	1	1220	149	38.	414.7	3253.7	*	1	2040	249	38.	388.5	3253.3
1	0405	50	5.	3.7	3236.7	•	1	1225	150	38.	414.4	3253.7	*	1	2045	250	38.	388.2	3253.2
1	0410	51	5.	4.4	3237.0	•	1	1230	151	38.	414.1	3253.7	*	1	2050	251	38.	388.0	3253.2
1	0415	52	6.	5.1	3237.3	•	1	1235	152	38.	413.9	3253.7	*	1	2055	252	38.	387.7	3253.2
1	0420	53	7.	6.1	3237.8	•	1	1240	153	38.	413.6	3253.7	•	1	2100	253	38.	387.4	3253.2
1	0425	54	9.	7.2	3238.3	*	1	1245	154	38.	413.3	3253.7	*	1	2105	254	38.	387.2	3253.2
1	0430	55	11.	8.7	3239.0	*	1	1250	155	38.	413.1	3253.7	*	1	2110	255	38.	386.9	3253.2
1	0435	56	13.	10.6	3239.8	*	1	1255	156	38.	412.8	3253.7	*	1	2115	256	38.	386.7	3253.2
1	0440	57	14.	13.0	3240.1	*	1	1300	157	38.	412.6	3253.7	*	1	2120	257	38.	386.4	3253.2
1	0445	58	14.	16.0	3240.3	•	1	1305	158	38.	412.3	3253.7	*	1	2125	258	38.	386.1	3253.2
1	0450	59	15.	19.8	3240.5	*	1	1310	159	38.	412.0	3253.7	*	1	2130	259	38.	385.9	3253.2
1	0455	60	15.	24.6	3240.7	•	1	1315	160	38.	411.8	3253.7	•	1	2135	260	38.	385.6	3253.2
	0500	61	16.	30.6	3241.0	*	1	1320	161	38.	411.5	3253.7	*	1	2140	261	38.	385.4	3253.2
	0505	62	17.	37.8	3241.4	•	1	1325	162	38.	411.2	3253.7	*	1	2145	262	38.	385.1	3253.2
1	0510	63	18.	45.8	3241.8	•	1	1330	163	38.	411.0	3253.7	*	1	2150	263	38.	384.8	3253.2
1	0515	64	20.	54.6	3242.2	*	1	1335	164	38.	410.7	3253.6	*	1	2155	264	38.	384.6	3253.2
1	0520	65	21.	64.3	3242.7	•	1	1340	165	38.	410.5	3253.6	•	1	2200	265	38.	384.3	3253.2
1	0525	66	22.	75.1	3243.3	•	1	1345	166	38.	410.2	3253.6	•	1	2205	266	38.	384.1	3253.2
1	0530	67	24.	87.2	3243.9	•	1	1350	167	38.	409.9	3253.6	*	1	2210	267	38.	383.8	3253.2
1	0535	68	26.	100.5	3244.6	*	1	1355	168	38.	409.7	3253.6	•	1	2215	268	38.	383.5	3253.2
1	0540	69	27.	114.6	3245.3	•	1	1400	169	38.	409.4	3253.6	*	1	2220	269	38.	383.3	3253.2
1	0545	70	28.	129.5	3246.1	*	1	1405	170	38.	409.1	3253.6	*	1	2225	270	38.	383.0	3253.2
1	0550	71	29.	144.9	3246.9	•	1	1410	171	38.	408.9	3253.6	*	1	2230	271	38.	382.8	3253.2
1	0555	72	31.	160.5	3247.7	*	1	1415	172	38.	408.6	3253.6	•	1	2235	272	38.	382.5	3253.1
1	0600	73	32.	176.2	3248.5	•	1	1420	173	38.	408.3	3253.6	•	1	2240	273	38.	382.3	3253.1
1	0605	74	33.	191.8	3249.3	*	1	1425	174	38.	408.1	3253.6	*	1	2245	274	38.	382.0	3253.1
1	0610	75	34.	207.2	3250.0	*	1	1430	175	38.	407.8	3253.6	•	1	2250	275	38.	381.7	3253.1
1	0615	76	34.	222.2	3250.3	•	1	1435	176	38.	407.6	3253.6	*	1	2255	276	38.	381.5	3253.1
1	0620	77	34.	236.7	3250.6	*	1	1440	177	38.	407.3	3253.6	•	1	2300	277	38.	381.2	3253.1
1	0625	78	35.	250.6	3250.8	*	1	1445	178	38.	407.0	3253.6	*	1	2305	278	38.	381.0	3253.1
1	0630	79	35.	263.9	3251.0	*	1	1450	179	38.	406.8	3253.6	•	1	2310	279	38.	380.7	3253.1
1	0635	80	35.	276.6	3251.3	*	1	1455	180	38.	406.5	3253.6	*	1	2315	280	38.	380.4	3253.1
1	0640	81	35.	288.5	3251.5	*	1	1500	181	38.	406.2	3253.6	*	1	2320	281	38.	380.2	3253.1
1	0645	82	36.	299.7	3251.7	•	1	1505	182	38.	406.0	3253.6	•	1	2325	282	38.	379.9	3253.1
1	0650	83	36.	310.1	3251.9	•	1	1510	183	38.	405.7	3253.6	*	1	2330	283	38.	379.7	3253.1
1	0655	84	36.	319.8	3252.0	*	1	1515	184	38.	405.5	3253.6	•	1	2335	284	38.	379.4	3253.1
1	0700	85	36.	328.8	3252.2	*	1	1520	185	38.	405.2	3253.5	*	1	2340	285	38.	379.1	3253.1
1	0705	86	37.	337.2	3252.3	•	1	1525	186	38.	404.9	3253.5	*	1	2345	286	38.	378.9	3253.1
1	0710	87	37.	345.1	3252.5	*	1	1530	187	38.	404.7	3253.5	*	1	2350	287	38.	378.6	3253.1
1	0715	88	37.	352.5	3252.6	*	1	1535	188	38.	404.4	3253.5	•	1	2355	288	37.	378.4	3253.1
	0720	89	37.	359.5	3252.7	•	1	1540	189	38.	404.1	3253.5	•	2	0000	289	37.	378.1	3253.1
	0725	90	37.	365.9	3252.9	•	1	1545	190	38.	403.9	3253.5	*	2	0005	290	37.	377.9	3253.1

1	0730	91	37.	371.9	3253.0	*	1	1550	191	38.	403.6	3253.5	*	2	0010	291	37.	377.6	3253.1
1	0735	92	37.	377.3	3253.1	*	1	1555	192	38.	403.4	3253.5	*	2	0015	292	37.	377.3	3253.1
1	0740	93	38.	382.3	3253.1	*	1	1600	193	38.	403.1	3253.5	*	2	0020	293	37.	377.1	3253.1
1	0745	94	38.	386.7	3253.2	*	1	1605	194	38.	402.8	3253.5	*	2	0025	294	37.	376.8	3253.0
1	0750	95	38.	390.6	3253.3	*	1	1610	195	38.	402.6	3253.5	*	2	0030	295	37.	376.6	3253.0
1	0755	96	38.	394.0	3253.4	*	1	1615	196	38.	402.3	3253.5	*	2	0035	296	37.	376.3	3253.0
1	0800	97	38.	397.0	3253.4	*	1	1620	197	38.	402.0	3253.5	*	2	0040	297	37.	376.1	3253.0
1	0805	98	38.	399.6	3253.4	*	1	1625	198	38.	401.8	3253.5	*	2	0045	298	37.	375.8	3253.0
1	0810	99	38.	401.8	3253.5	*	1	1630	199	38.	401.5	3253.5	*	2	0050	299	37.	375.5	3253.0
1	0815	100	38.	403.8	3253.5	*	1	1635	200	38.	401.3	3253.5	*	2	0055	300	37.	375.3	3253.0

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 39.	9.75		38.	31.	30.	30.
		(INCHES)	.006	.020	.020	.020
		(AC-FT)	19.	62.	62.	62.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	24.92-HR
+ (AC-FT)	(HR)				
423.	9.75	416.	313.	301.	301.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	24.92-HR
+ (FEET)	(HR)				
3253.86	9.75	3253.74	3249.98	3249.43	3249.43

CUMULATIVE AREA = 57.73 SQ MI

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HYDROGRAPH AT STATION KYLEDET
PLAN 1, RATIO = 1.00

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	3235.0	*	1		0820	101	359.	2769.4	3278.6	*	1		1640	201	352.	2591.5	3277.1
1		0005	2	0.	.0	3235.0	*	1		0825	102	359.	2773.7	3278.6	*	1		1645	202	352.	2589.1	3277.1
1		0010	3	0.	.0	3235.0	*	1		0830	103	359.	2777.5	3278.7	*	1		1650	203	352.	2586.6	3277.1
1		0015	4	0.	.0	3235.0	*	1		0835	104	359.	2780.7	3278.7	*	1		1655	204	352.	2584.2	3277.0
1		0020	5	0.	.0	3235.0	*	1		0840	105	359.	2783.4	3278.7	*	1		1700	205	352.	2581.8	3277.0
1		0025	6	0.	.0	3235.0	*	1		0845	106	359.	2785.5	3278.7	*	1		1705	206	352.	2579.4	3277.0
1		0030	7	0.	.0	3235.0	*	1		0850	107	359.	2787.0	3278.7	*	1		1710	207	352.	2576.9	3277.0
1		0035	8	0.	.0	3235.0	*	1		0855	108	359.	2788.0	3278.7	*	1		1715	208	352.	2574.5	3277.0
1		0040	9	0.	.0	3235.0	*	1		0900	109	359.	2788.6	3278.7	*	1		1720	209	351.	2572.1	3276.9
1		0045	10	0.	.0	3235.0	*	1		0905	110	359.	2788.7	3278.7	*	1		1725	210	351.	2569.7	3276.9
1		0050	11	0.	.0	3235.0	*	1		0910	111	359.	2788.7	3278.7	*	1		1730	211	351.	2567.3	3276.9
1		0055	12	0.	.0	3235.0	*	1		0915	112	359.	2788.4	3278.7	*	1		1735	212	351.	2564.8	3276.9
1		0100	13	0.	.0	3235.0	*	1		0920	113	359.	2788.1	3278.7	*	1		1740	213	351.	2562.4	3276.9
1		0105	14	0.	.0	3235.0	*	1		0925	114	359.	2787.7	3278.7	*	1		1745	214	351.	2560.0	3276.8
1		0110	15	0.	.0	3235.0	*	1		0930	115	359.	2787.1	3278.7	*	1		1750	215	351.	2557.6	3276.8
1		0115	16	0.	.0	3235.0	*	1		0935	116	359.	2786.5	3278.7	*	1		1755	216	351.	2555.2	3276.8
1		0120	17	0.	.0	3235.0	*	1		0940	117	359.	2785.7	3278.7	*	1		1800	217	351.	2552.8	3276.8
		0125	18	0.	.0	3235.0	*	1		0945	118	359.	2784.8	3278.7	*	1		1805	218	351.	2550.3	3276.8
		0130	19	0.	.0	3235.0	*	1		0950	119	359.	2783.8	3278.7	*	1		1810	219	351.	2547.9	3276.7

1	0135	20	0.	.0	3235.0	*	1	0955	120	359.	2782.7	3278.7	*	1	1815	220	350.	2545.5	3276.7
1	0140	21	0.	.0	3235.0	*	1	1000	121	359.	2781.5	3278.7	*	1	1820	221	350.	2543.1	3276.7
1	0145	22	0.	.0	3235.0	*	1	1005	122	359.	2780.2	3278.7	*	1	1825	222	350.	2540.7	3276.7
1	0150	23	0.	.1	3235.0	*	1	1010	123	359.	2778.7	3278.7	*	1	1830	223	350.	2538.3	3276.7
	0155	24	0.	.2	3235.1	*	1	1015	124	359.	2777.1	3278.7	*	1	1835	224	350.	2535.9	3276.6
	0200	25	0.	.3	3235.1	*	1	1020	125	359.	2775.5	3278.6	*	1	1840	225	350.	2533.4	3276.6
1	0205	26	0.	.4	3235.2	*	1	1025	126	359.	2773.6	3278.6	*	1	1845	226	350.	2531.0	3276.6
1	0210	27	1.	.6	3235.3	*	1	1030	127	359.	2771.7	3278.6	*	1	1850	227	350.	2528.6	3276.6
1	0215	28	1.	.8	3235.4	*	1	1035	128	359.	2769.6	3278.6	*	1	1855	228	350.	2526.2	3276.6
1	0220	29	1.	1.1	3235.5	*	1	1040	129	358.	2767.4	3278.6	*	1	1900	229	350.	2523.8	3276.5
1	0225	30	2.	1.3	3235.6	*	1	1045	130	358.	2765.1	3278.6	*	1	1905	230	350.	2521.4	3276.5
1	0230	31	2.	1.6	3235.7	*	1	1050	131	358.	2762.7	3278.5	*	1	1910	231	350.	2519.0	3276.5
1	0235	32	2.	1.9	3235.9	*	1	1055	132	358.	2760.3	3278.5	*	1	1915	232	349.	2516.6	3276.5
1	0240	33	3.	2.2	3236.0	*	1	1100	133	358.	2757.8	3278.5	*	1	1920	233	349.	2514.2	3276.5
1	0245	34	3.	2.7	3236.2	*	1	1105	134	358.	2755.3	3278.5	*	1	1925	234	349.	2511.8	3276.4
1	0250	35	4.	3.2	3236.5	*	1	1110	135	358.	2752.9	3278.5	*	1	1930	235	349.	2509.4	3276.4
1	0255	36	5.	3.9	3236.8	*	1	1115	136	358.	2750.4	3278.4	*	1	1935	236	349.	2507.0	3276.4
1	0300	37	6.	4.8	3237.2	*	1	1120	137	358.	2747.9	3278.4	*	1	1940	237	349.	2504.6	3276.4
1	0305	38	7.	6.1	3237.8	*	1	1125	138	358.	2745.5	3278.4	*	1	1945	238	349.	2502.2	3276.4
1	0310	39	10.	7.8	3238.5	*	1	1130	139	358.	2743.0	3278.4	*	1	1950	239	349.	2499.8	3276.3
1	0315	40	12.	10.0	3239.5	*	1	1135	140	358.	2740.5	3278.3	*	1	1955	240	349.	2497.4	3276.3
1	0320	41	14.	12.9	3240.1	*	1	1140	141	357.	2738.1	3278.3	*	1	2000	241	349.	2495.0	3276.3
1	0325	42	14.	16.7	3240.3	*	1	1145	142	357.	2735.6	3278.3	*	1	2005	242	349.	2492.6	3276.3
1	0330	43	15.	21.8	3240.6	*	1	1150	143	357.	2733.2	3278.3	*	1	2010	243	348.	2490.2	3276.3
1	0335	44	16.	28.4	3240.9	*	1	1155	144	357.	2730.7	3278.3	*	1	2015	244	348.	2487.8	3276.2
1	0340	45	17.	37.0	3241.3	*	1	1200	145	357.	2728.2	3278.2	*	1	2020	245	348.	2485.4	3276.2
1	0345	46	19.	48.4	3241.9	*	1	1205	146	357.	2725.8	3278.2	*	1	2025	246	348.	2483.0	3276.2
1	0350	47	21.	63.4	3242.7	*	1	1210	147	357.	2723.3	3278.2	*	1	2030	247	348.	2480.6	3276.2
1	0355	48	24.	83.5	3243.7	*	1	1215	148	357.	2720.9	3278.2	*	1	2035	248	348.	2478.2	3276.2
1	0400	49	27.	110.0	3245.1	*	1	1220	149	357.	2718.4	3278.2	*	1	2040	249	348.	2475.8	3276.1
1	0405	50	29.	144.2	3246.9	*	1	1225	150	357.	2715.9	3278.1	*	1	2045	250	348.	2473.4	3276.1
1	0410	51	32.	187.5	3249.1	*	1	1230	151	357.	2713.5	3278.1	*	1	2050	251	348.	2471.0	3276.1
	0415	52	34.	239.9	3250.6	*	1	1235	152	356.	2711.0	3278.1	*	1	2055	252	348.	2468.6	3276.1
	0420	53	36.	300.0	3251.7	*	1	1240	153	356.	2708.6	3278.1	*	1	2100	253	348.	2466.2	3276.1
	0425	54	37.	366.6	3252.9	*	1	1245	154	356.	2706.1	3278.1	*	1	2105	254	348.	2463.8	3276.0
1	0430	55	39.	439.0	3254.1	*	1	1250	155	356.	2703.7	3278.0	*	1	2110	255	347.	2461.4	3276.0
1	0435	56	41.	516.6	3255.5	*	1	1255	156	356.	2701.2	3278.0	*	1	2115	256	347.	2459.0	3276.0
1	0440	57	42.	598.7	3257.0	*	1	1300	157	356.	2698.8	3278.0	*	1	2120	257	347.	2456.6	3276.0
1	0445	58	44.	684.8	3258.5	*	1	1305	158	356.	2696.3	3278.0	*	1	2125	258	347.	2454.2	3276.0
1	0450	59	45.	773.5	3260.0	*	1	1310	159	356.	2693.9	3278.0	*	1	2130	259	347.	2451.8	3275.9
1	0455	60	46.	863.9	3261.0	*	1	1315	160	356.	2691.4	3277.9	*	1	2135	260	347.	2449.4	3275.9
1	0500	61	47.	955.0	3261.9	*	1	1320	161	356.	2689.0	3277.9	*	1	2140	261	347.	2447.0	3275.9
1	0505	62	48.	1046.3	3262.9	*	1	1325	162	356.	2686.5	3277.9	*	1	2145	262	347.	2444.7	3275.9
1	0510	63	49.	1137.3	3263.8	*	1	1330	163	355.	2684.1	3277.9	*	1	2150	263	347.	2442.3	3275.9
1	0515	64	50.	1227.7	3264.7	*	1	1335	164	355.	2681.6	3277.9	*	1	2155	264	347.	2439.9	3275.8
1	0520	65	214.	1316.7	3265.7	*	1	1340	165	355.	2679.2	3277.8	*	1	2200	265	347.	2437.5	3275.8
1	0525	66	304.	1403.9	3266.6	*	1	1345	166	355.	2676.7	3277.8	*	1	2205	266	346.	2435.1	3275.8
1	0530	67	308.	1489.5	3267.4	*	1	1350	167	355.	2674.3	3277.8	*	1	2210	267	346.	2432.7	3275.8
1	0535	68	312.	1573.6	3268.3	*	1	1355	168	355.	2671.8	3277.8	*	1	2215	268	346.	2430.3	3275.8
1	0540	69	316.	1655.7	3269.2	*	1	1400	169	355.	2669.4	3277.8	*	1	2220	269	346.	2428.0	3275.7
1	0545	70	320.	1735.5	3270.0	*	1	1405	170	355.	2666.9	3277.7	*	1	2225	270	346.	2425.6	3275.7
1	0550	71	323.	1812.8	3270.6	*	1	1410	171	355.	2664.5	3277.7	*	1	2230	271	346.	2423.2	3275.7
1	0555	72	325.	1887.4	3271.2	*	1	1415	172	355.	2662.1	3277.7	*	1	2235	272	346.	2420.8	3275.7
1	0600	73	328.	1959.4	3271.8	*	1	1420	173	355.	2659.6	3277.7	*	1	2240	273	346.	2418.4	3275.7
1	0605	74	331.	2028.4	3272.4	*	1	1425	174	355.	2657.2	3277.7	*	1	2245	274	346.	2416.0	3275.6
1	0610	75	334.	2094.1	3273.0	*	1	1430	175	354.	2654.7	3277.6	*	1	2250	275	346.	2413.7	3275.6
1	0615	76	336.	2156.3	3273.5	*	1	1435	176	354.	2652.3	3277.6	*	1	2255	276	346.	2411.3	3275.6
1	0620	77	338.	2214.7	3274.0	*	1	1440	177	354.	2649.9	3277.6	*	1	2300	277	346.	2408.9	3275.6
1	0625	78	340.	2269.3	3274.4	*	1	1445	178	354.	2647.4	3277.6	*	1	2305	278	345.	2406.5	3275.6
1	0630	79	342.	2319.9	3274.8	*	1	1450	179	354.	2645.0	3277.6	*	1	2310	279	345.	2404.1	3275.5
	0635	80	344.	2366.6	3275.2	*	1	1455	180	354.	2642.5	3277.5	*	1	2315	280	345.	2401.8	3275.5
	0640	81	346.	2409.4	3275.6	*	1	1500	181	354.	2640.1	3277.5	*	1	2320	281	345.	2399.4	3275.5

1	0645	82	347.	2448.6	3275.9	*	1	1505	182	354.	2637.7	3277.5	*	1	2325	282	345.	2397.0	3275.5
1	0650	83	348.	2484.5	3276.2	*	1	1510	183	354.	2635.2	3277.5	*	1	2330	283	345.	2394.6	3275.5
1	0655	84	349.	2517.4	3276.5	*	1	1515	184	354.	2632.8	3277.5	*	1	2335	284	345.	2392.3	3275.4
1	0700	85	351.	2547.3	3276.7	*	1	1520	185	354.	2630.4	3277.4	*	1	2340	285	345.	2389.9	3275.4
1	0705	86	352.	2574.6	3277.0	*	1	1525	186	353.	2627.9	3277.4	*	1	2345	286	345.	2387.5	3275.4
1	0710	87	352.	2599.4	3277.2	*	1	1530	187	353.	2625.5	3277.4	*	1	2350	287	345.	2385.1	3275.4
1	0715	88	353.	2622.1	3277.4	*	1	1535	188	353.	2623.1	3277.4	*	1	2355	288	345.	2382.8	3275.4
1	0720	89	354.	2642.7	3277.5	*	1	1540	189	353.	2620.6	3277.3	*	2	0000	289	345.	2380.4	3275.3
1	0725	90	355.	2661.1	3277.7	*	1	1545	190	353.	2618.2	3277.3	*	2	0005	290	344.	2378.0	3275.3
1	0730	91	355.	2677.6	3277.8	*	1	1550	191	353.	2615.8	3277.3	*	2	0010	291	344.	2375.6	3275.3
1	0735	92	356.	2692.4	3277.9	*	1	1555	192	353.	2613.3	3277.3	*	2	0015	292	344.	2373.3	3275.3
1	0740	93	356.	2705.8	3278.1	*	1	1600	193	353.	2610.9	3277.3	*	2	0020	293	344.	2370.9	3275.3
1	0745	94	357.	2717.9	3278.2	*	1	1605	194	353.	2608.5	3277.2	*	2	0025	294	344.	2368.5	3275.3
1	0750	95	357.	2728.6	3278.2	*	1	1610	195	353.	2606.0	3277.2	*	2	0030	295	344.	2366.2	3275.2
1	0755	96	357.	2738.0	3278.3	*	1	1615	196	353.	2603.6	3277.2	*	2	0035	296	344.	2363.8	3275.2
1	0800	97	358.	2746.1	3278.4	*	1	1620	197	352.	2601.2	3277.2	*	2	0040	297	344.	2361.4	3275.2
1	0805	98	358.	2753.1	3278.5	*	1	1625	198	352.	2598.8	3277.2	*	2	0045	298	344.	2359.1	3275.2
1	0810	99	358.	2759.2	3278.5	*	1	1630	199	352.	2596.3	3277.1	*	2	0050	299	344.	2356.7	3275.2
1	0815	100	358.	2764.5	3278.5	*	1	1635	200	352.	2593.9	3277.1	*	2	0055	300	344.	2354.3	3275.1
						*							*						

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 359.	9.08		358.	289.	279.	279.
		(INCHES)	.058	.186	.186	.186
		(AC-FT)	177.	574.	574.	574.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	24.92-HR
(AC-FT)	(HR)				
2789.	9.08	2749.	2118.	2040.	2040.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	24.92-HR
+ (FEET)	(HR)				
3278.75	9.08	3278.42	3270.55	3269.24	3269.24

CUMULATIVE AREA = 57.73 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION	
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2
					.47	1.00
HYDROGRAPH AT						
+	GD30.5	28.60	1	FLOW	1461.	7216.
				TIME	5.42	4.50
ROUTED TO						
+	RT1	28.60	1	FLOW	1280.	6962.
				TIME	5.83	4.83

** PEAK STAGES IN FEET **

			1	STAGE	1.14	3.16
				TIME	5.83	4.83
HYDROGRAPH AT						
	GD30.4	6.89	1	FLOW	373.	2203.
				TIME	5.17	4.00
2 COMBINED AT						
+	CMB1	35.49	1	FLOW	1538.	8309.
				TIME	5.42	4.92
ROUTED TO						
•	RT2	35.49	1	FLOW	1523.	8292.
				TIME	5.42	5.00
			** PEAK STAGES IN FEET **			
			1	STAGE	1.21	3.38
				TIME	5.42	5.00
HYDROGRAPH AT						
+	GD30.3	9.43	1	FLOW	693.	2969.
				TIME	4.50	4.42
2 COMBINED AT						
+	CMB2	44.92	1	FLOW	2184.	10856.
				TIME	5.42	4.75
ROUTED TO						
+	RT3	44.92	1	FLOW	2003.	10690.
				TIME	5.83	5.00
			** PEAK STAGES IN FEET **			
			1	STAGE	1.45	3.91
				TIME	5.83	5.00
HYDROGRAPH AT						
+	GD30.2	.85	1	FLOW	32.	235.
				TIME	5.08	3.83
ROUTED TO						
+	RT4	.85	1	FLOW	0.	177.
				TIME	.08	4.17
			** PEAK STAGES IN FEET **			
			1	STAGE	.01	.29
				TIME	5.33	4.17
HYDROGRAPH AT						
+	GD30.1	2.61	1	FLOW	135.	720.
				TIME	5.33	4.33
3 COMBINED AT						
+	CMB3	48.38	1	FLOW	2112.	11345.
				TIME	5.75	5.00
ROUTED TO						
+	RT5	48.38	1	FLOW	2010.	11254.
				TIME	6.00	5.17
			** PEAK STAGES IN FEET **			
			1	STAGE	1.44	4.01
				TIME	6.00	5.17

HYDROGRAPH AT

+	GD25	2.34	1	FLOW	114.	781.
				TIME	5.00	3.75

[redacted]OGRAPH AT

+	GD21	6.79	1	FLOW	377.	1947.
				TIME	5.33	4.33

ROUTED TO

+	RT6	6.79	1	FLOW	289.	1858.
				TIME	5.83	4.50

** PEAK STAGES IN FEET **

1	STAGE	.40	1.32
	TIME	5.83	4.50

3 COMBINED AT

+	CMB4	57.51	1	FLOW	2311.	13261.
				TIME	5.92	5.00

HYDROGRAPH AT

+	GD10	.22	1	FLOW	11.	71.
				TIME	5.08	3.83

2 COMBINED AT

+	+INFLOW	57.73	1	FLOW	2313.	13310.
				TIME	5.92	5.00

ROUTED TO

+	KYLEDET	57.73	1	FLOW	39.	359.
				TIME	9.75	9.08

[redacted]

** PEAK STAGES IN FEET **

1	STAGE	3253.86	3278.75
	TIME	9.75	9.08

*** NORMAL END OF HEC-1 ***

[redacted]

Construction plans for the *Kyle Canyon Detention Basin*

N:\930017\ADMIN\17-094RP.WP5

Included in this section:

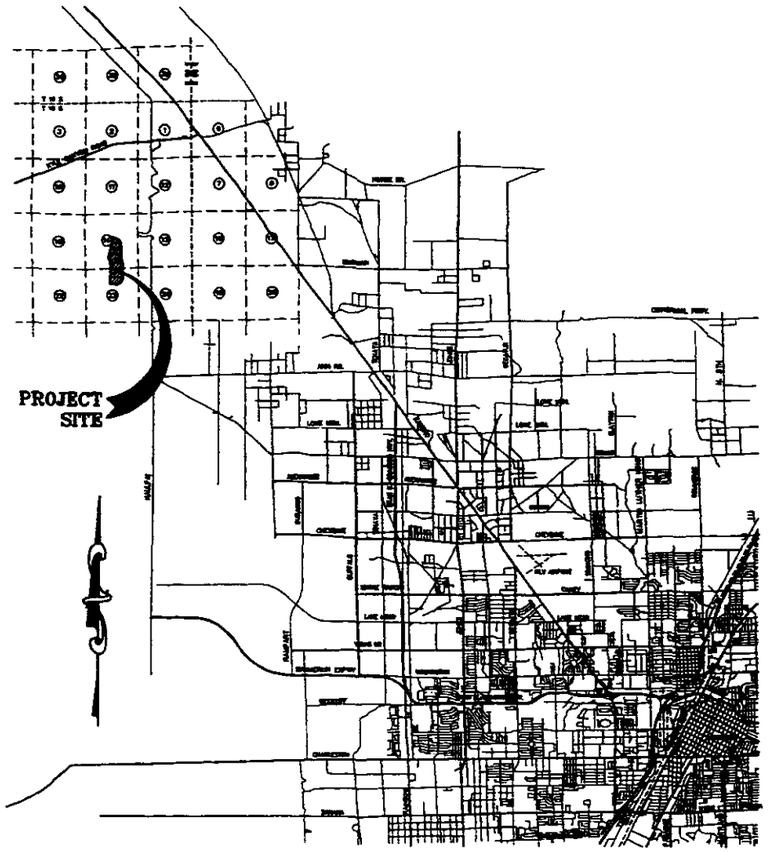
Construction plans for the *Kyle Canyon Detention Basin*, prepared by VTN Nevada.

CITY OF NORTH LAS VEGAS, NEVADA

KYLE CANYON DETENTION BASIN

1993

BID NO. 873



VICINITY MAP
NO SCALE

CITY OF NORTH LAS VEGAS NEVADA living at its best

FUNDED BY:

CLARK COUNTY REGIONAL
FLOOD CONTROL DISTRICT

CITY OF NORTH LAS VEGAS

Mayor:

JAMES K. SEASTRAND

Council Members:

THERON H. GOYNES
MARY J. KINCAID
WILLIAM E. ROBINSON
W. BRENT HARDY

APPROVALS:

Gary W. Holler, R.P.E. #1920 — Date
Director of Public Works
City of North Las Vegas

James A. Bell, R.P.E. #4524 — Date
City Engineer
City of North Las Vegas

PRINTED
JAN 19 1993
VTN NEVADA

PLANS REVIEWED BY:

Clark County Regional Flood Control District — Date

North Las Vegas Surveyor — Date

North Las Vegas Utilities — Date

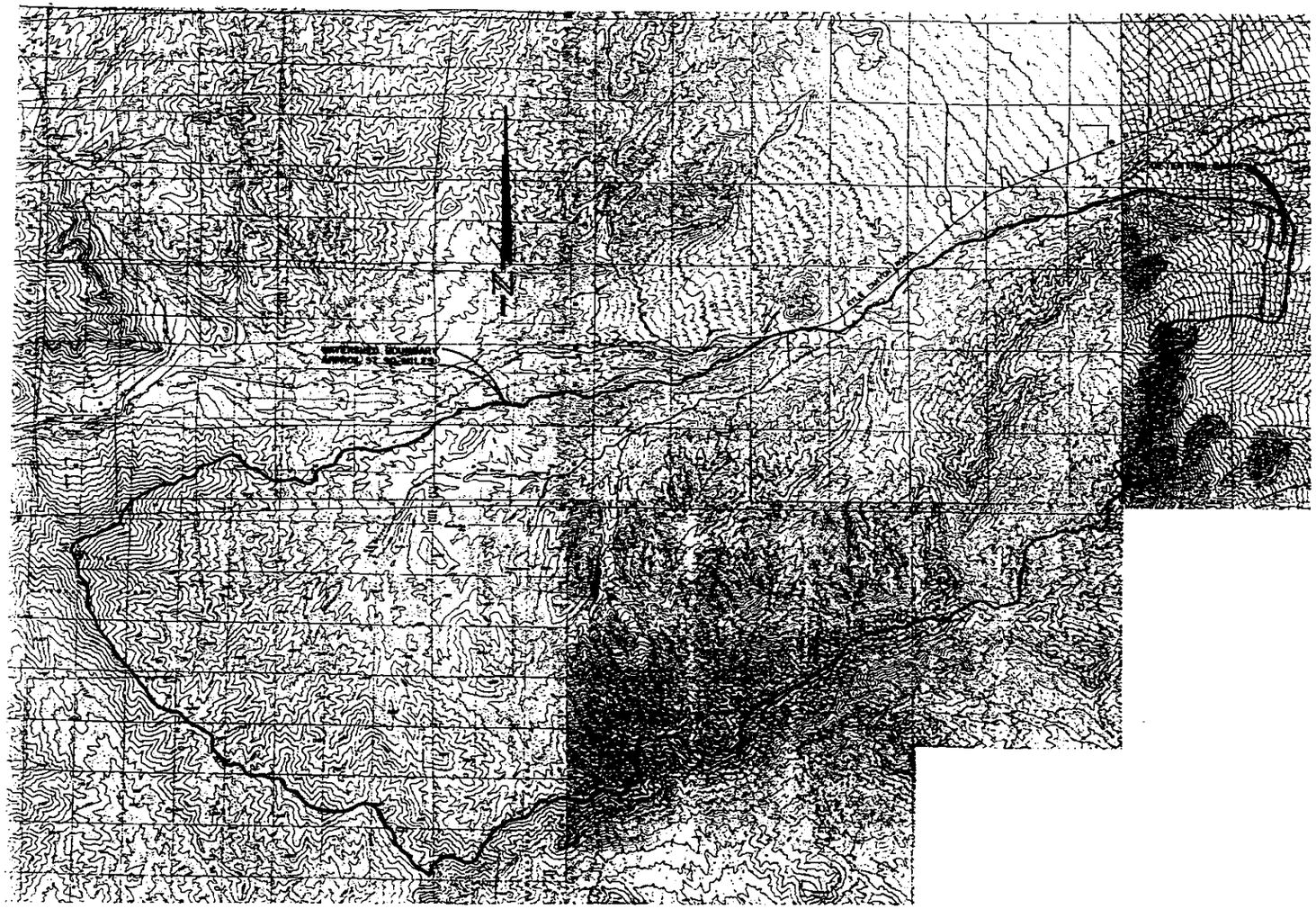
Joseph A. Uttaro — Nevada Power Company — 10/13/92 Date

J. P. Hyndl — Southwest Gas Corporation — 10-13-92 Date

Kyle Smith — Centel Telecommunications, Inc. — 10-13-92 Date

DAYS | BID DATE: | BID NO.: | IMPROVEMENTS

PROJECT: KYLE CANYON DETENTION BASIN AND DRAINAGE IMPROVEMENTS



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50.) ACCESS ROAD DESIGN PLAN AND PROFILE: STA. 34+50 TO STA. 44+50
51.) ACCESS ROAD DESIGN PLAN AND PROFILE: STA. 44+50 TO STA. 51+80.58
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GENERAL NOTES

1.) ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD DRAWING FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA (LATEST EDITION)" AND UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS' CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA (LATEST EDITION)", UNLESS OTHERWISE SPECIFIED BY NOTE ON THE PLANS AND/OR SPECIAL PROVISIONS.

2.) ALL UTILITY COMPANIES SHALL BE NOTIFIED BY THE CONTRACTOR AT LEAST 48 (FORTY EIGHT) HOURS PRIOR TO COMMENCEMENT OF CONSTRUCTION.

3.) NEITHER THE OWNER NOR ENGINEER ASSUMES ANY RESPONSIBILITY FOR EXISTING UTILITIES OR STRUCTURES NOT SHOWN. IT IS THE CONTRACTOR'S RESPONSIBILITY REGARDING UTILITIES AS REQUIRED UNDER SECTION 105.08 OF THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS' CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA (LATEST EDITION)".

4.) CONTRACTOR SHALL OBTAIN APPROVAL FROM THE CITY OF NORTH LAS VEGAS FOR DISPOSAL SITES AND HAUL ROUTES.

5.) ALL BARRICADING AND TEMPORARY TRAFFIC CONTROL DEVICES OR METHODS USED DURING CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS' CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA, (LATEST EDITION)" AND "STATE OF NEVADA TRAFFIC CONTROL MANUAL" (LATEST EDITION) AND "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (LATEST EDITION) AND THE NEVADA DEPARTMENT OF TRANSPORTATION REGULATIONS.

6.) PROTECTION AND REPLACEMENT OF SURVEY MONUMENTS OR PROPERTY STAKES NOT DELINEATED ON THE CONTRACT DRAWINGS SHALL BE THE CONTRACTOR'S RESPONSIBILITY.

7.) THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF *EXISTING UTILITIES AND EXISTING STRUCTURES DURING CONSTRUCTION.*

8.) THE CONTRACTOR WILL BE RESPONSIBLE FOR OBTAINING CONSTRUCTION AND TEMPORARY EASEMENTS OUTSIDE OF THE EXISTING RIGHT-OF-WAY FOR THE CONSTRUCTION OF THIS JOB.

9.) A SOILS REPORT HAS BEEN PERFORMED BY CONVERSE CONSULTANTS SOUTHWEST, INC. AND IS AVAILABLE FOR REVIEW AT THE OFFICE OF VTN NEVADA.

BASIS OF BEARING

N 88°11' W, BEING THE NORTH LINE OF SECTION 15, AS SHOWN ON THE BLM MAP OF DEPENDANT RESURVEY DATED FEBRUARY 28, 1957 OF T 19 S, R 59 E, M.D.M.

BENCHMARK

U.S. DEPARTMENT OF AGRICULTURE, BUREAU OF PUBLIC ROADS, 2" BRASS CAP DATED 1934, NORTHEAST 1/4 OF SECTION 8, TOWNSHIP 19 SOUTH, RANGE 59 EAST, M.D.M., CLARK COUNTY, NEVADA, 25'± NORTH OF THE EDGE OF PAVEMENT OF STATE HIGHWAY NO. 157, ELEVATION 3681.03

ABBREVIATIONS

APPROX.	APPROXIMATE	O.C.E.F.	ON CENTER EACH FACE
BLM	BUREAU OF LAND MANAGEMENT	O.C.E.W.E.F.	ON CENTER EACH WAY EACH FACE
BVC	BEGIN VERTICAL CURVE	PC	POINT OF CURVATURE
CL OR C/L	CENTERLINE	PERF.	PERFORATED
CLR.	CLEARANCE	PT	POINT OF TANGENCY
CONC.	CONCRETE	PVC	POLYVINYL CHLORIDE
CONST.	CONSTRUCT OR CONSTRUCTION	PVI	POINT OF VERTICAL INTERSECTION
DIA.	DIAMETER	R.	RADIUS
E.F.	EACH FACE	RCC	ROLLER COMPACTED CONCRETE
EL. OR ELEV.	ELEVATION	RCP	REINFORCED CONCRETE PIPE
EVC	END VERTICAL CURVE	REF.	REFER OR REFERENCE
EX.	EXISTING	REQ'D.	REQUIRED
FG	FINISH GRADE	RT.	RIGHT
GALV.	GALVANIZED	S	SLOPE
H	HEIGHT	SCH.	SCHEDULE
HP	HIGH POINT	SEC. OR SECT.	SECTION
I.D.	INSIDE DIAMETER	SHT.	SHEET
INV.	INVERT	SPEC.	SPECIFICATION(S)
L.F.	LINEAR FEET	SPWY.	SPILLWAY
LT.	LEFT	STA.	STATION
MAX.	MAXIMUM	STD.	STANDARD
MIN.	MINIMUM	STL.	STEEL
NO.	NUMBER	TYP.	TYPICAL
O.C.	ON CENTER	U.N.O.	UNLESS NOTED OTHERWISE

2 working days

Call before you Dig

1-800-227-2600

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CITY OF NORTH LAS VEGAS
CLARK COUNTY, NEVADA

REV	DATE	BY	REVISION

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vtn nevada

TITLE: SHEET INDEX
WATERSHED BOUNDARY MAP
AND GENERAL INFORMATION
KYLE CANYON DETENTION BASIN
DRAINAGE IMPROVEMENTS

PROJECT

SEAL
EXPIRE 12-31-93
2-1-93

WO NO.	4254
BY	DJB
DATE	JAN. 1993
SCALE	
SHEET	2 OF 52 SHEETS

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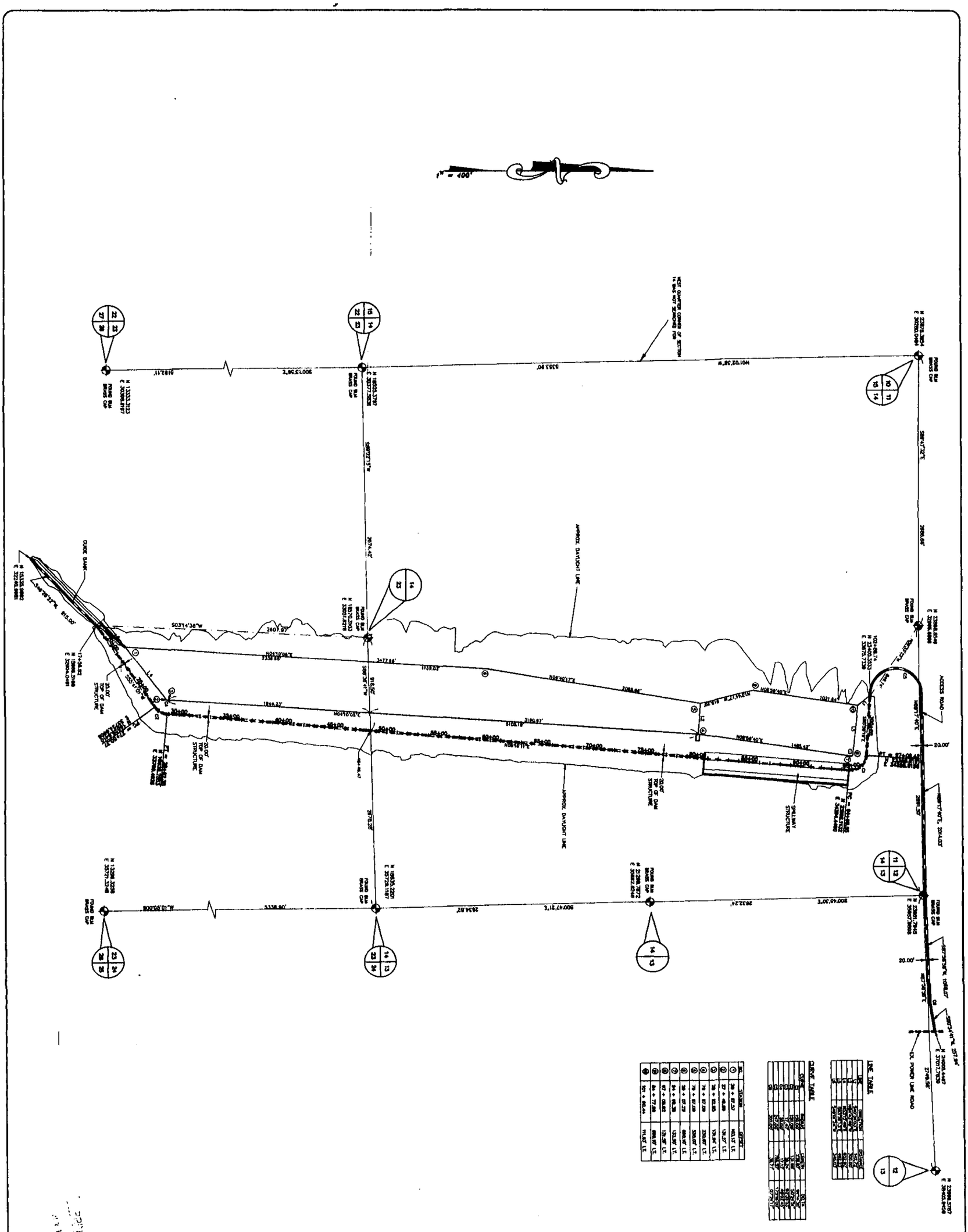
TITLE: CAPACITY CURVES AND HYDROLOGIC INFORMATION

PROJECT: KYLE CANYON DETENTION BASIN

SEAL: GEORGE K. COTTON CIVIL 1/15/93

JOB NO. VKYLE.00
BY JFM/GKC
DATE 15 JAN 93
SCALE
SHEET 3 OF 52 SHEETS


1" = 400'
CLARK DAM
CENTERLINE OF DAM STRUCTURE
APPROX. DAYLIGHT LINE
SPILLWAY STRUCTURE
ACCESS ROAD
20.00'
POWER LINE ROAD
CURVE TABLE
LINE TABLE

1" = 100'

MATCH LINE

GUIDE BANK-SEE DETAILS ON SHEET 24

160.00'

12' GATE AND 6' HIGH CHAIN LINK FENCE PER DETAILS ON SHEET 44-TYP.

NO EXCAVATION OR EQUIPMENT SHALL BE ALLOWED WEST OF THIS LINE FROM THE GUIDE BANK EDGE TO THE NORTH LINE OF SECTION 23

LIMITS OF BORROW TO ELEV. 3290.0

100 YEAR PONDING ELEV. 3281.0

APPROX. DAYLIGHT LINE

JEEP TRAIL AND SOUTHERN ACCESS ROAD-SEE NOTE 2 ON THIS SHEET

LIMITS OF BORROW TO ELEV. 3290.0

100 YEAR PONDING ELEV. 3281.0

INLET NO. 1 SEE SHEET 18

APPROX. DAYLIGHT LINE

100 YEAR PONDING ELEV. 3281.0

CENTERLINE OF CUT-OFF TRENCH SEE CROSS SECTIONS ON SHEETS 25 THROUGH 41

14' WIDE x 9' DEEP MATERIAL FROM REC GRAVEL STOCKPILE FOR ROAD SURFACE CENTERED ON TOP OF DAM-TYP.

JEEP TRAIL AND SOUTHERN ACCESS ROAD-SEE NOTE 2 ON THIS SHEET

100 YEAR PONDING ELEV. 3281.0

14' WIDE x 9' DEEP MATERIAL FROM REC GRAVEL STOCKPILE FOR ROAD SURFACE CENTERED ON TOP OF DAM-TYP.

CENTERLINE OF CUT-OFF TRENCH SEE CROSS SECTIONS ON SHEETS 25 THROUGH 41

TOP OF DAM ELEV.=3280.00

EMBANKMENT TOE DRAIN

JEEP TRAIL AND SOUTHERN ACCESS ROAD-SEE NOTE 2 ON THIS SHEET

SEE SHEET 9

NOTES:

1.) TOE DRAIN SHALL BE GRADED TO DRAIN TO THE NEAREST NATURAL CHANNEL (S≥ 0.005 Ft./Ft.)

2.) JEEP TRAIL AND SOUTHERN ACCESS ROAD SURFACE SHALL BE BLADED EXISTING MATERIAL 15'± IN WIDTH. EXACT LOCATION AND ALIGNMENT SHALL BE DETERMINED IN THE FIELD BY THE ENGINEER.

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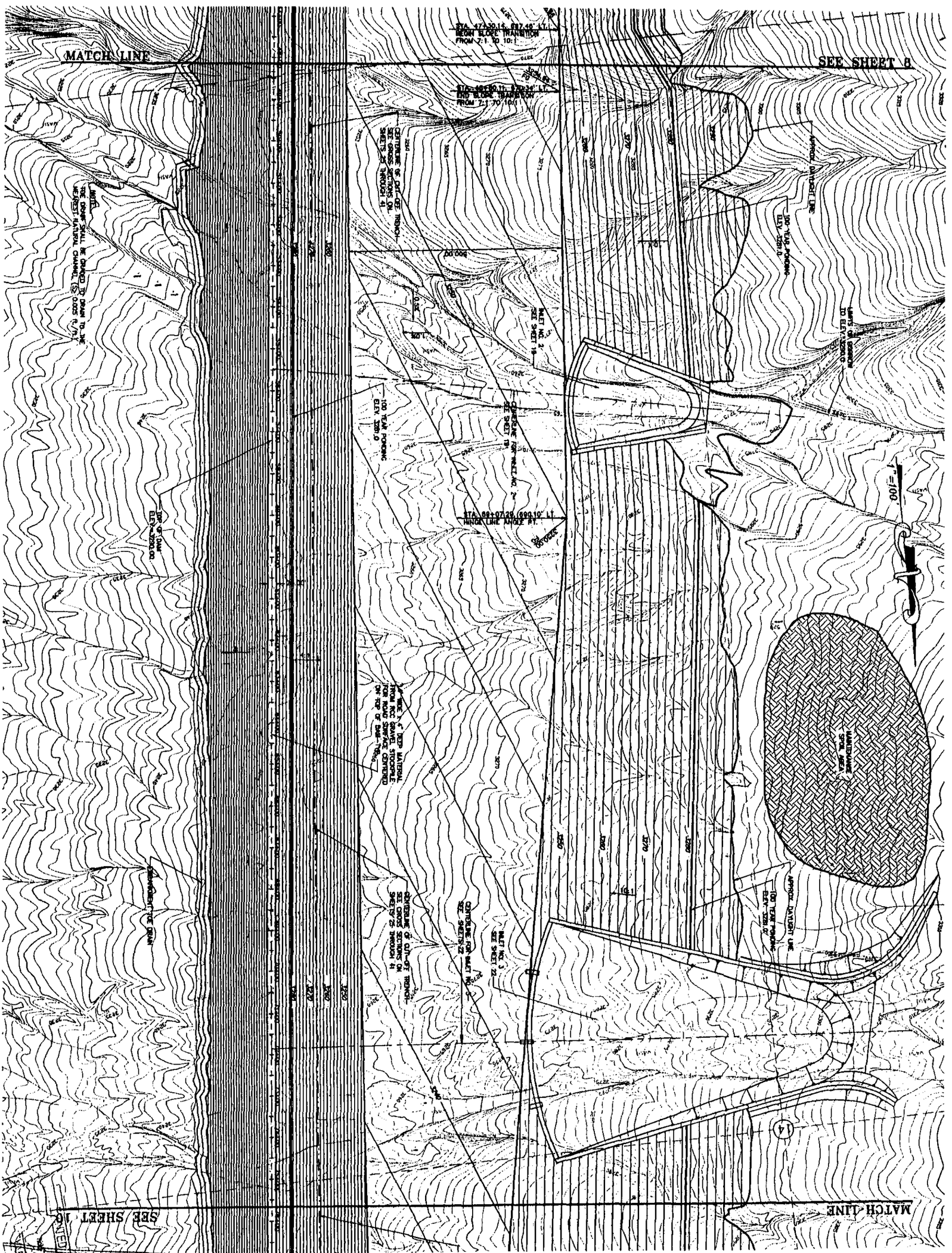
CITY OF NORTH LAS VEGAS
CLARK COUNTY, NEVADA

TITLE: GRADING PLAN

PROJECT: KYLE CANYON DETENTION BASIN
DRAINAGE IMPROVEMENTS

SEAL
REGISTERED PROFESSIONAL ENGINEER
KEN D. GILBERT
2-1-93

WD NO.	4254
BY	DJB
DATE	JAN. 1993
SCALE HORIZ. VERT.	1"=100'
SHEET	8 OF 52 SHEETS



SHEET	9 of 52 SHEETS
SCALE (HORIZ. / VERT.)	1"=100'
DATE	JAN 1993
BY	DJB
JOB NO.	4254

TITLE

GRADING PLAN

PROJECT

KYLE CANYON DETENTION BASIN
DRAINAGE IMPROVEMENTS

CITY OF NORTH LAS VEGAS

CLARK COUNTY, NEVADA

REV	DATE	BY	REVISION
4			
3			
2			
1			

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SEE SHEET 9

100 YEAR PONDING ELEV. 3281.0

APPROX. DAYLIGHT LINE

UNITS OF BORROW TO ELEV. 3290.0

100 YEAR PONDING ELEV. 3281.0

MAINTENANCE SPOIL AREA

FILL TO MATCH EX. GROUND SURFACE AT CLOSE MIN.

ACCESS ROAD-SEE PLAN AND PROFILES ON SHEETS 47 THRU. 51

STA. 84+79.88, 899.10' LT. HINGE LINE/ANGLE PT.

STA. 79+87.10, 530.00' LT. HINGE LINE/ANGLE PT.

STA. 102+08 CHAIN LINK FENCE AND 12' GATE CENTERED ON DAM PER DETAILS ON SHEET 44. FENCING TO EXTEND TO EDGE OF TOE DRAIN

CENTERLINE OF CUT-OFF TRENCH SEE CROSS SECTIONS ON SHEETS 25 THROUGH 41

14' WIDE x 4" DEEP MATERIAL FROM RCC GRAVEL STOCKPILE FOR ROAD SURFACE CENTERED ON TOP OF DAM-TYP.

100 YEAR PONDING ELEV. 3281.0

STA. 79+87.10, 230.00' LT. HINGE LINE/ANGLE PT.

INLET STRUCTURE "A" SEE SHEETS 45 AND 46

TOP OF SPILLWAY ELEV.=3278.00

CENTERLINE OF CUT-OFF TRENCH SEE CROSS SECTIONS ON SHEETS 25 THROUGH 41

PT = 97+05.48

STA. 80+51.72, 7.0' LT. - E. USGS MONITORING STATION-SEE DETAILS ON SHEET 43

8" MONITORING WELLS-SEE CROSS-SECTION ON SHEET 37 AND DETAIL ON SHEET 43

8' CHAIN LINK FENCE PER DETAILS ON SHEET 44

EMBANKMENT TOE DRAIN

OUTLET STRUCTURE "A" SEE PROFILE ON SHEET 42 AND DETAILS ON SHEET 48

TOP OF CREST ELEV.=3281.00

SPILLWAY-SEE SHEET 13

SEE SHEETS 11, 15 AND 17 FOR GRADING DOWNSTREAM OF SPILLWAY-TYP.

8' CHAIN LINK FENCE PER DETAILS ON SHEET 44

EMBANKMENT TOE DRAIN

1390.00'

MATCH LINE

NOTE:
TOE DRAIN SHALL BE GRADED TO DRAIN TO THE NEAREST NATURAL CHANNEL (S2.0.005 ft./ft.)

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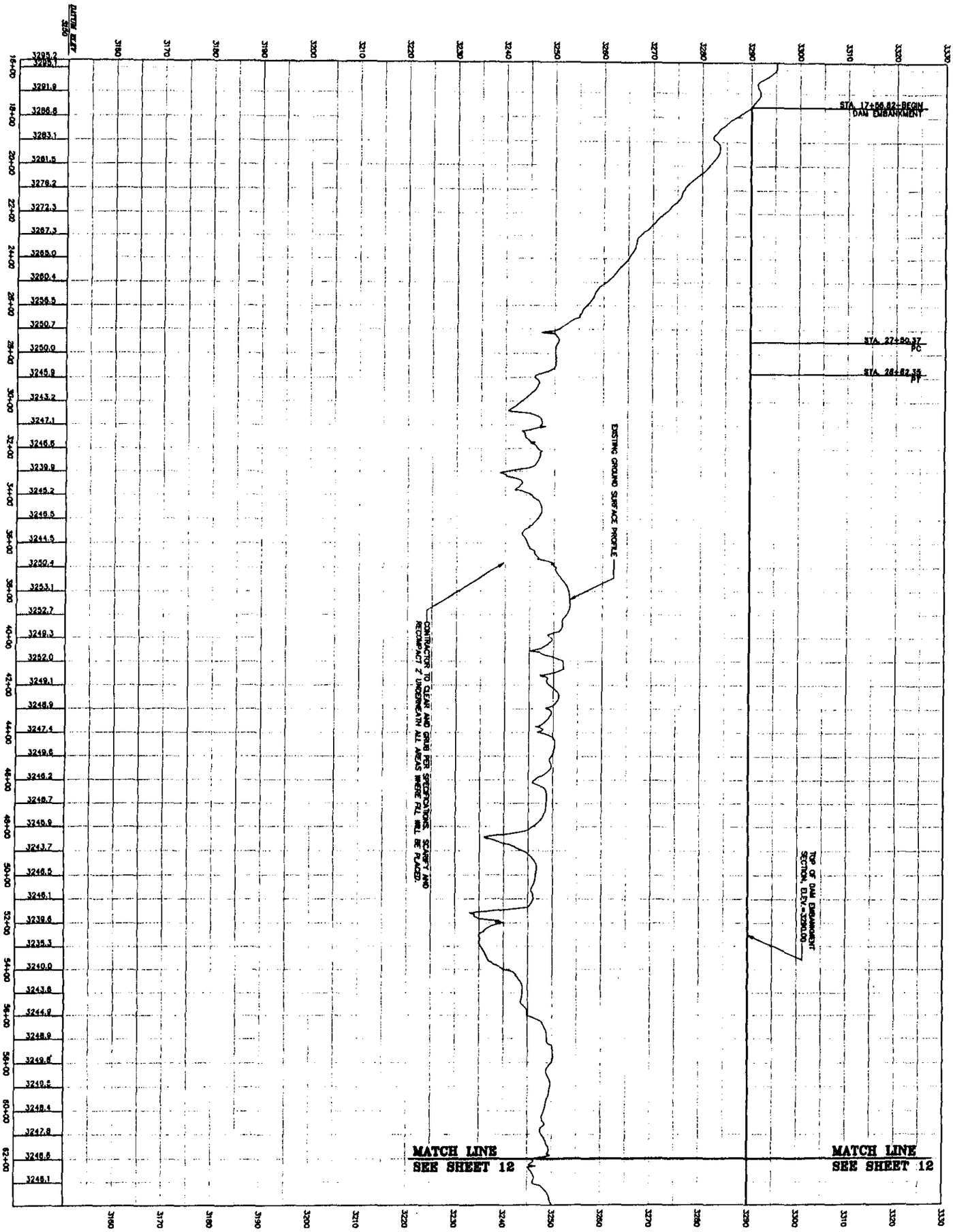
TITLE: GRADING PLAN

PROJECT: KYLE CANYON DETENTION BASIN
DRAINAGE IMPROVEMENTS

SEAL

WO NO.	4254
BY	DJB
DATE	JAN. 1993
SCALE HORIZ. VERT.	1"=100'
SHEET	10 OF 52 SHEETS



RENEWED JUN 30 '93

SHEET 11 OF 52 SHEETS

BY DJB

DATE JAN. 1993

JOB NO. 4254

TITLE
PROFILE
DAM EMBANKMENT AND SURVEY CONTROL CENTERLINE

PROJECT
KYLE CANYON DETENTION BASIN
DRAINAGE IMPROVEMENTS

CITY OF NORTH LAS VEGAS
CLARK COUNTY, NEVADA

REV	DATE	BY	REVISION
1			
2			
3			
4			

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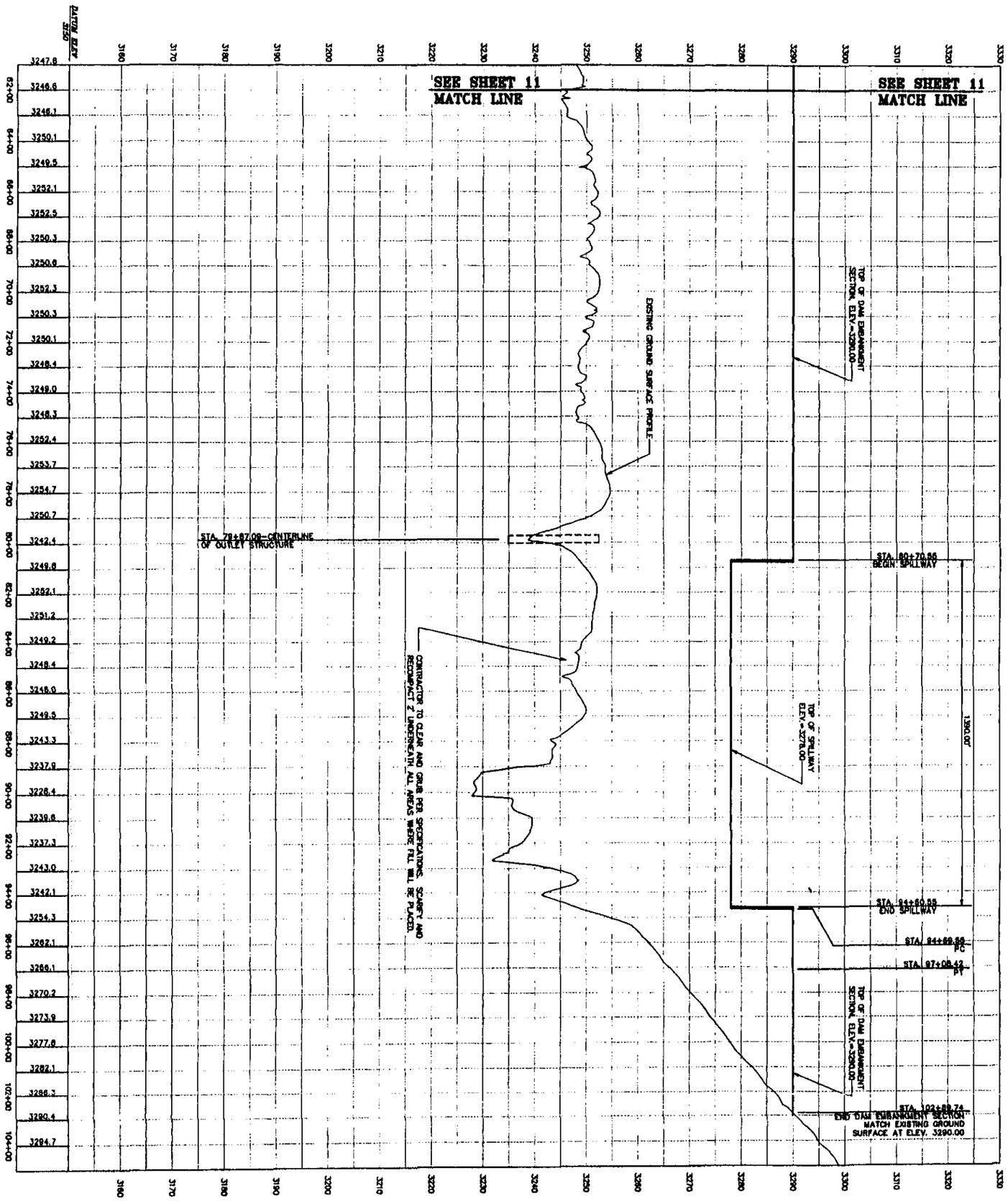

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PROFESSIONAL ENGINEER

PROJECT NO. 4254

DJB

JAN 1998

SHEET 12 OF 52 SHEETS

TITLE

PROFILE
DAM EMBANKMENT AND SURVEY CONTROL CENTERLINE

PROJECT

KYLE CANYON DETENTION BASIN
DRAINAGE IMPROVEMENTS

CITY OF NORTH LAS VEGAS
CLARK COUNTY, NEVADA

REV	DATE	BY	REVISION
1			
2			
3			
4			

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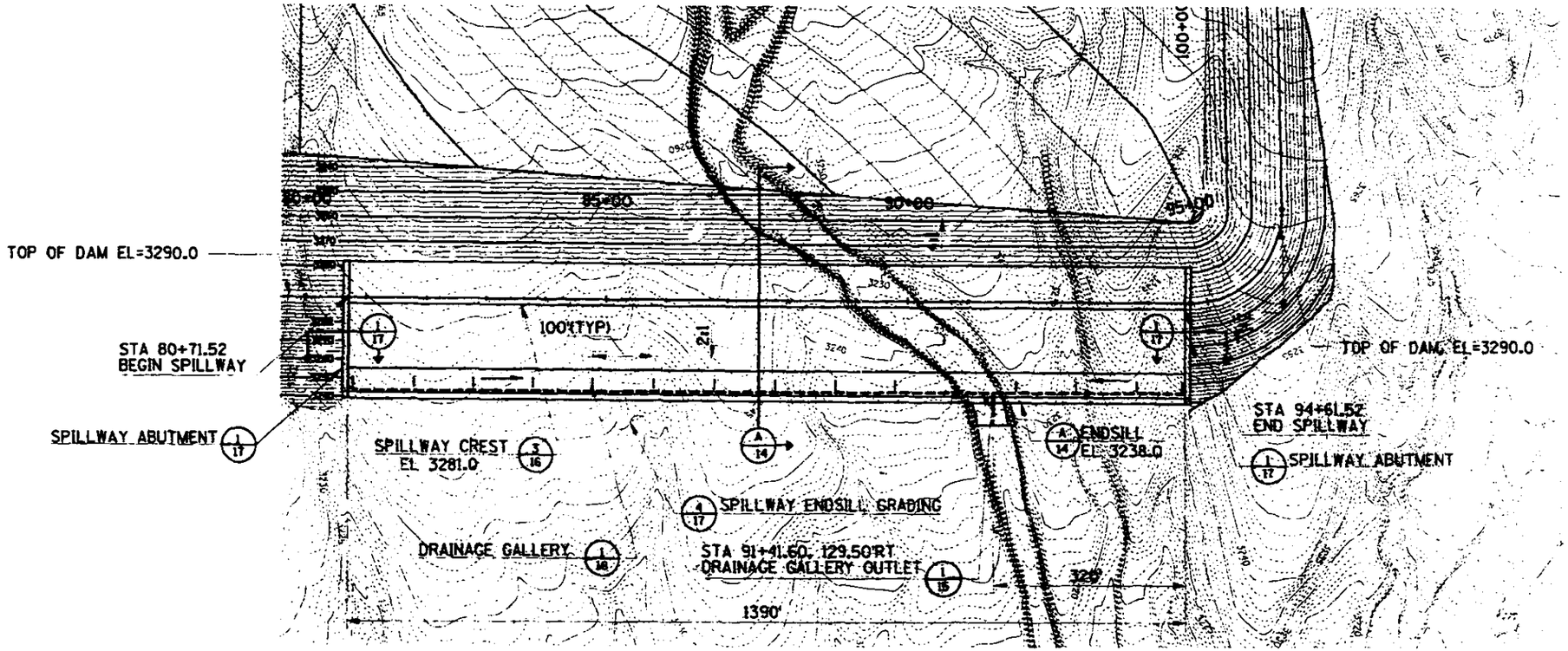

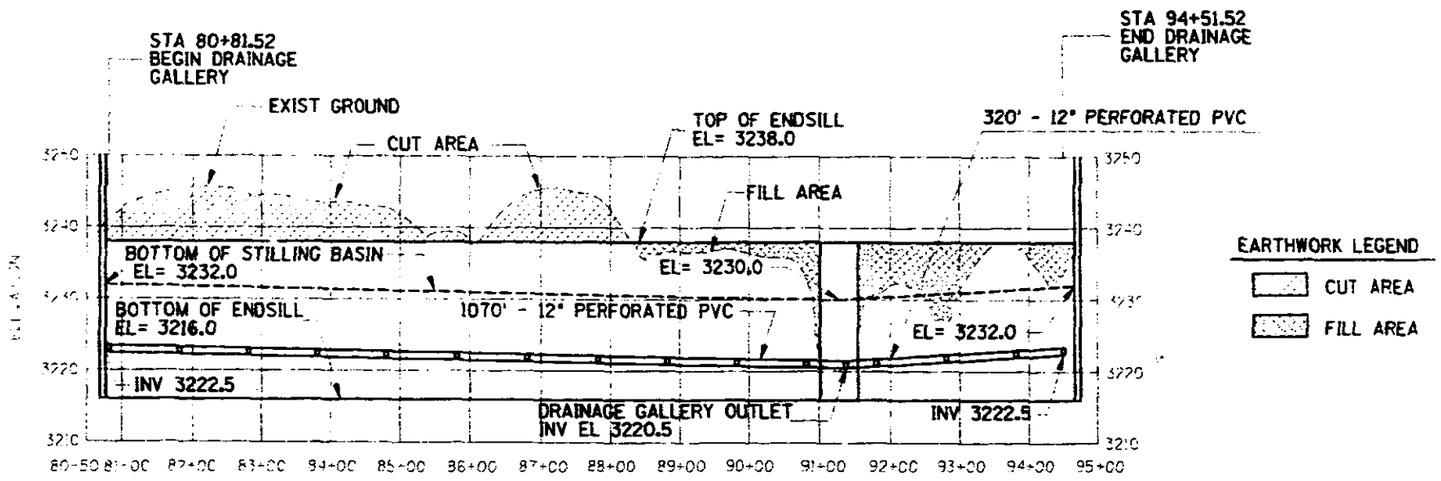

ENDSILL AND DRAINAGE GALLERY
PROFILE

Kyle01.101

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SPILLWAY PLAN AND PROFILE

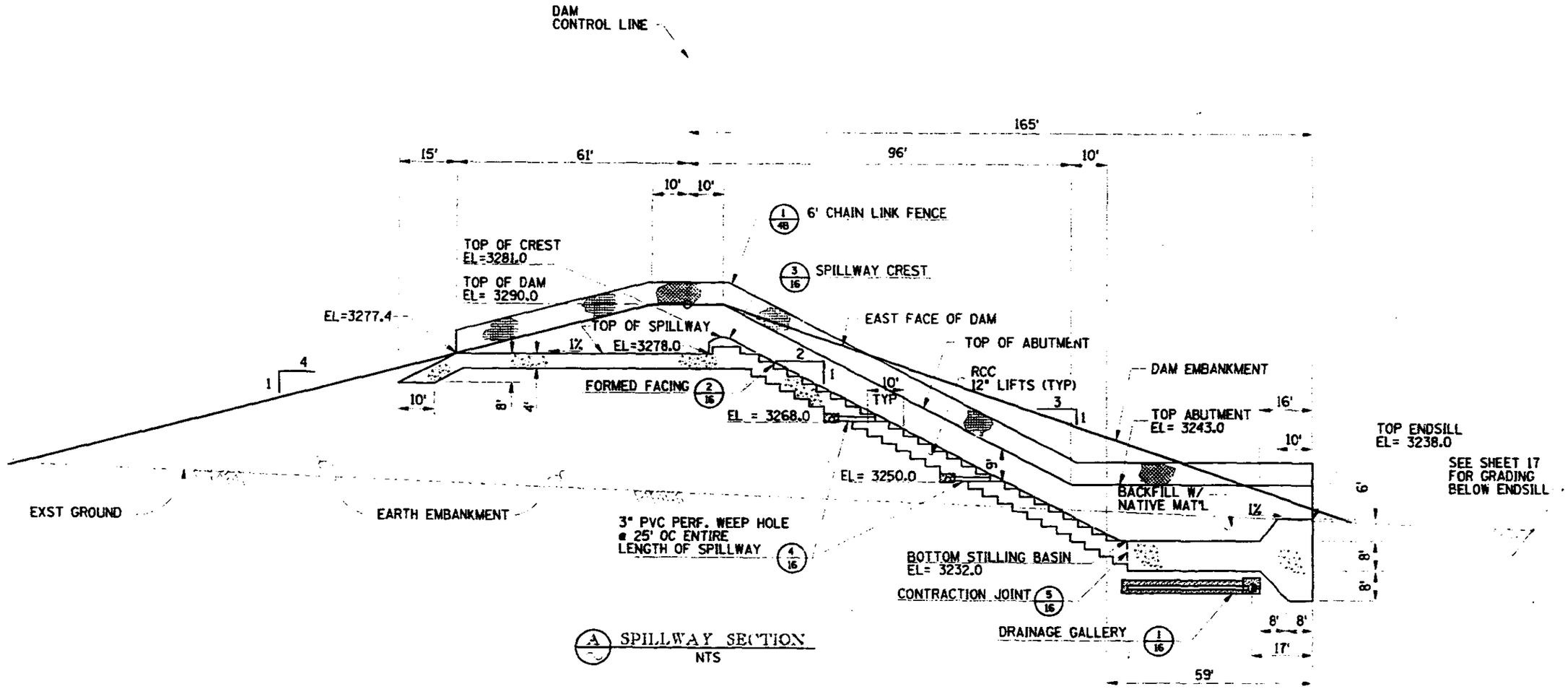
KYLE CANYON
DETENTION BASIN

GEORGE K. COTTON
CIVIL
No. 9808
1/15/93

PRINTED
JUN 10 1993
VTN NEVADA

VKYLE.00
JFM/GKC
15 JAN 93
1"=10'

13 of 52



A/- SPILLWAY SECTION
NTS

KYLE01.IOP

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TITLE: SPILLWAY TYPICAL SECTION

PROJECT: KYLE CANYON DETENTION BASIN

SEAL: GEORGE R. COTTON, CIVIL, No. 6098, REGISTERED PROFESSIONAL ENGINEER, STATE OF NEVADA
1/15/93

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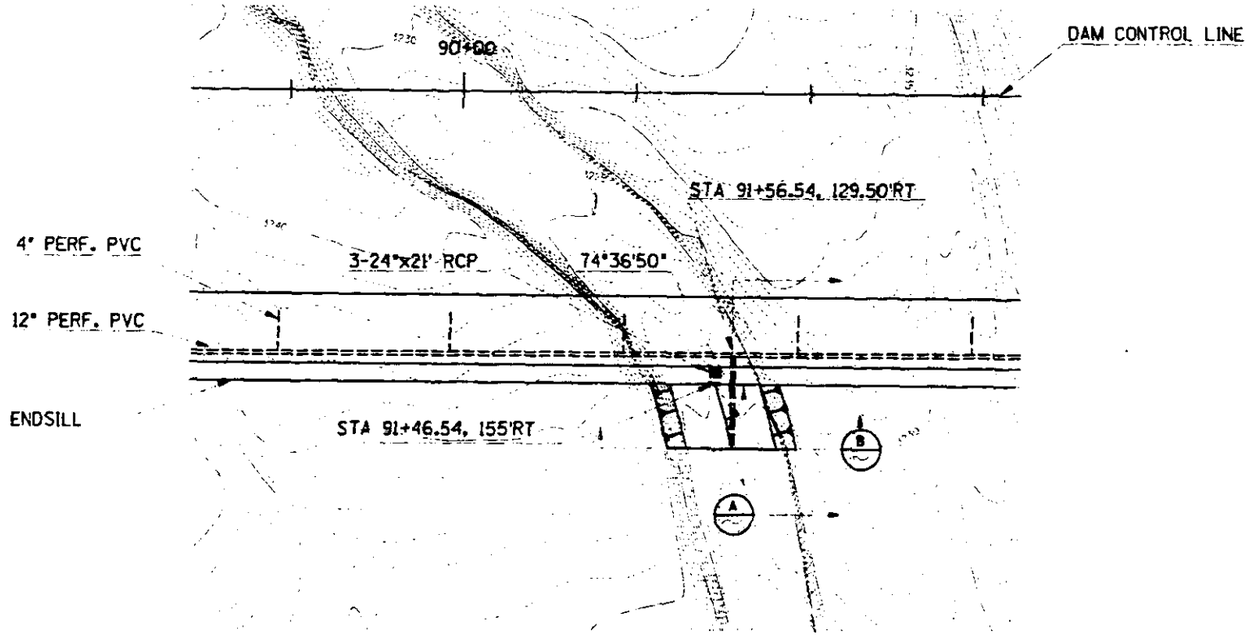
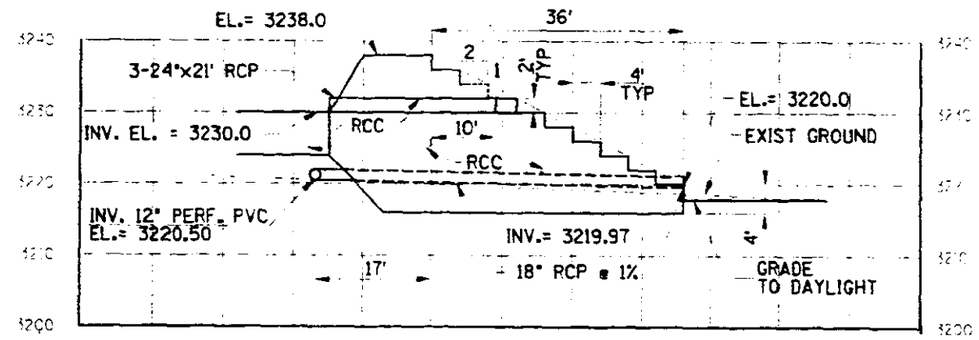
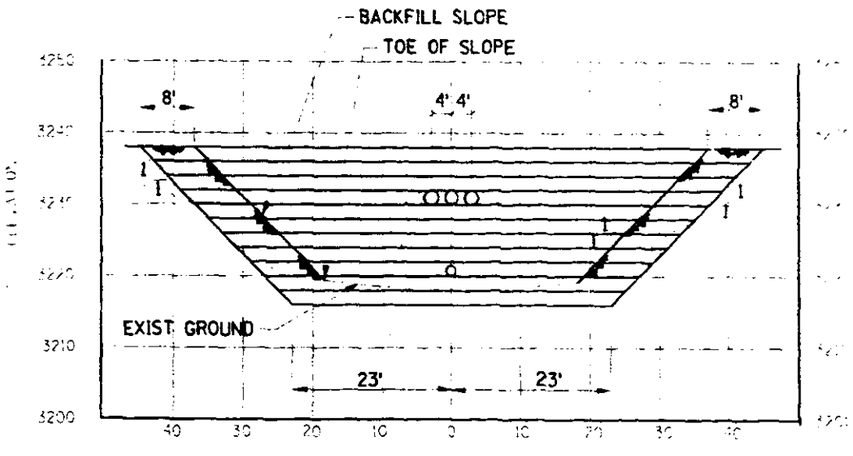
JOB NO. VKYLE.00
BY JFM/GRC
DATE 15 JAN 93
SCALE/HORIZ./VERT. NTS
SHEET 14 OF 52 SHEETS



1 DETAIL
SCALE: 1"=40'



SECTION A



ELEVATION B

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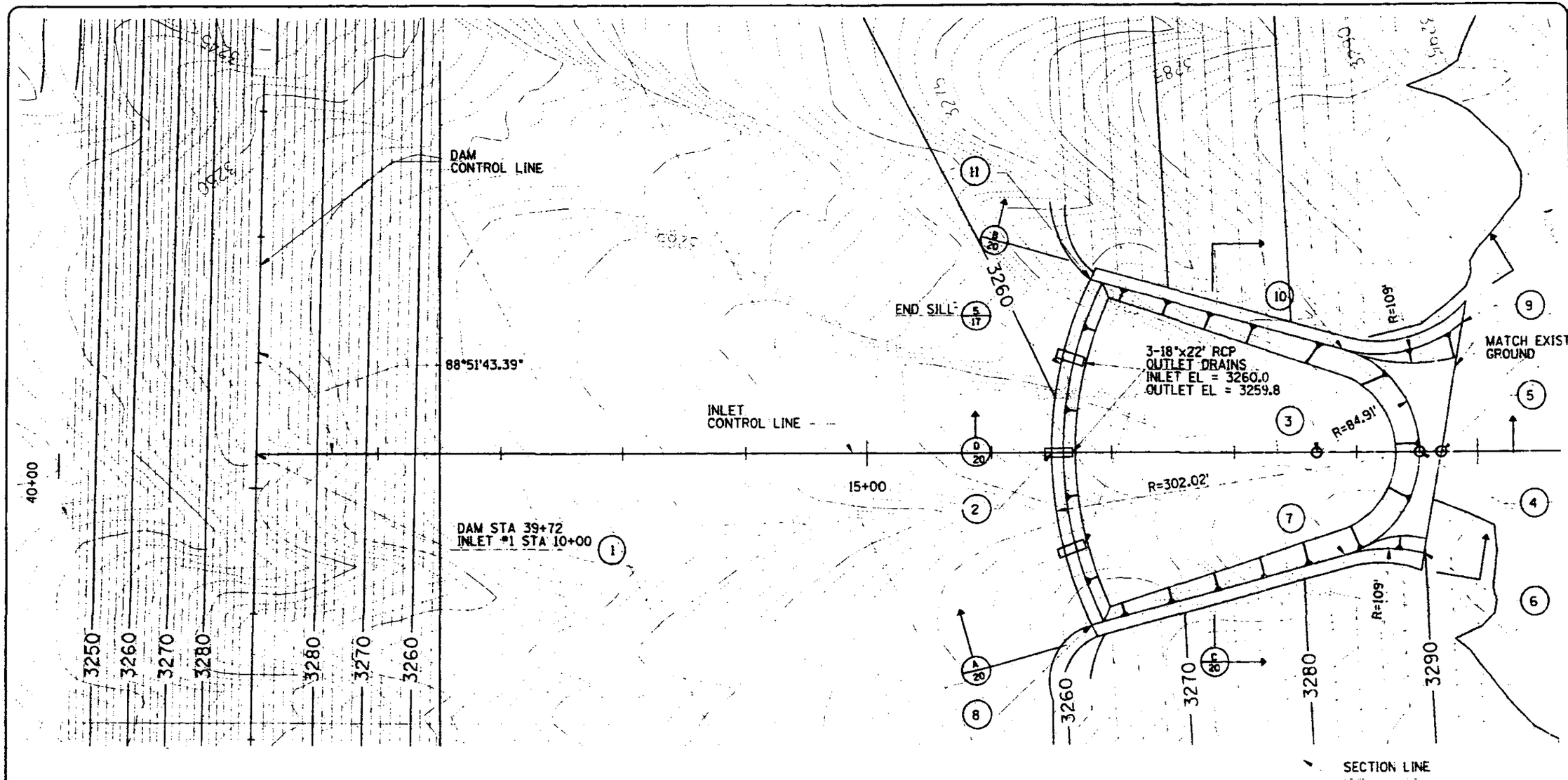
NO	DATE	BY	REVISION

TITLE: STILLING BASIN & DRAINAGE GALLERY OUTLETS
PROJECT: KYLE CANYON DETENTION BASIN

Gary K. Hilton
No. 10643
CIVIL
1/15/93

JOB NO. VKYLE.00
BY JFM/GKC
DATE 15 JAN 93
SCALE HORIZ. 1"=40' VERT. 1"=10'

SHEET 15 OF 52 SHEETS



INLET NO. 1 POINT LOCATION ON TABLE

POINT NO.	STA.	OFFSET	ELEV.	
1	10+00	0'	3290.00	
2	16+50.22	0'	3264.00	
3	18+67.33	0'		RADIUS PT.
4	19+52.24	0'	3289.38	RADIUS PT.
5	19+70.17	0'	3290.12	
6	19+55.02	80.57'	3294.12	
7	18+90.40	81.72'	3293.38	
8	16+83.15	137.14'	3264.12	
9	19+88.32	102.59'	3294.00	
10	18+90.40	81.72'	3293.38	
11	16+83.15	137.14'	3264.00	

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REV | DATE | BY | REVISION

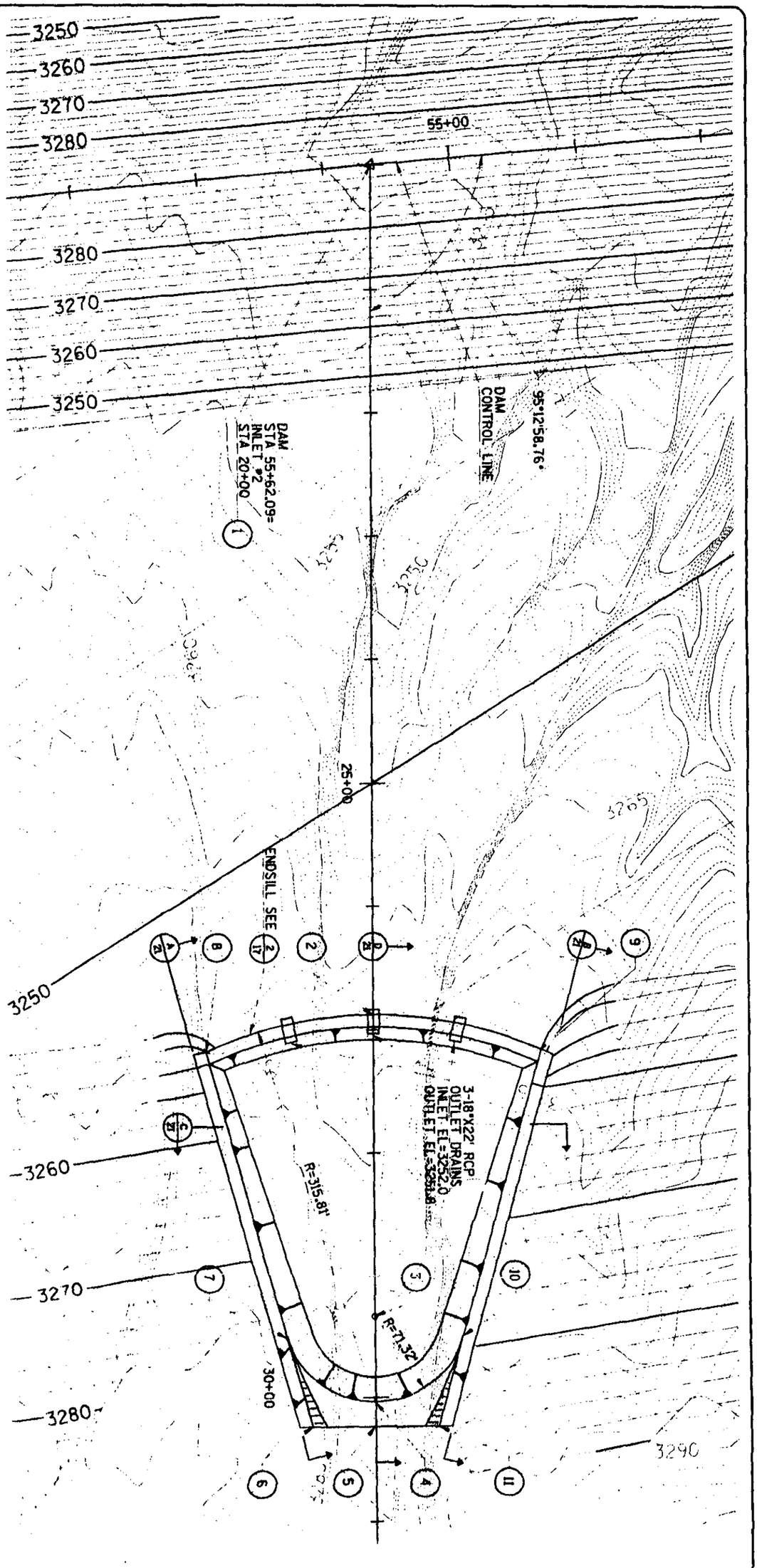
TITLE: INLET NO.1
PROJECT: KYLE CANYON DETENTION BASIN

SEAL: GEORGE COTTON CIVIL 1/15/93

JOB NO. VKYLE.00
BY JFM/GKC
DATE 15 JAN 93
SCALE HORIZ. VERT.
SHEET 18 OF 52 SHEETS

Inlet#1.101

Inlet#2.101



INLET NO. 2 POINT LOCATION ON TABLE

POINT NO.	STA.	OFFSET	ELEV.	
1	20+00	0'	3290.00	
2	26+87.71	0'	3256.00	
3	29+32.20	0'		RADIUS PT.
4	30+03.52	0'	3272.63	
5	30+23.60	0'	3273.10	RADIUS PT.
6	30+23.52	49.28'	3280.00	
7	29+50.39	68.96'	3279.00	
8	27+16.57	131.89'	3256.00	
9	27+16.57	131.89'	3256.00	
10	29+50.39	68.96'	3279.00	
11	30+23.52	49.28'	3286.41	

PRINTED JUN 10 1993

TITLE: INLETS NO.2 PLAN

PROJECT: KYLE CANYON DETENTION BASIN

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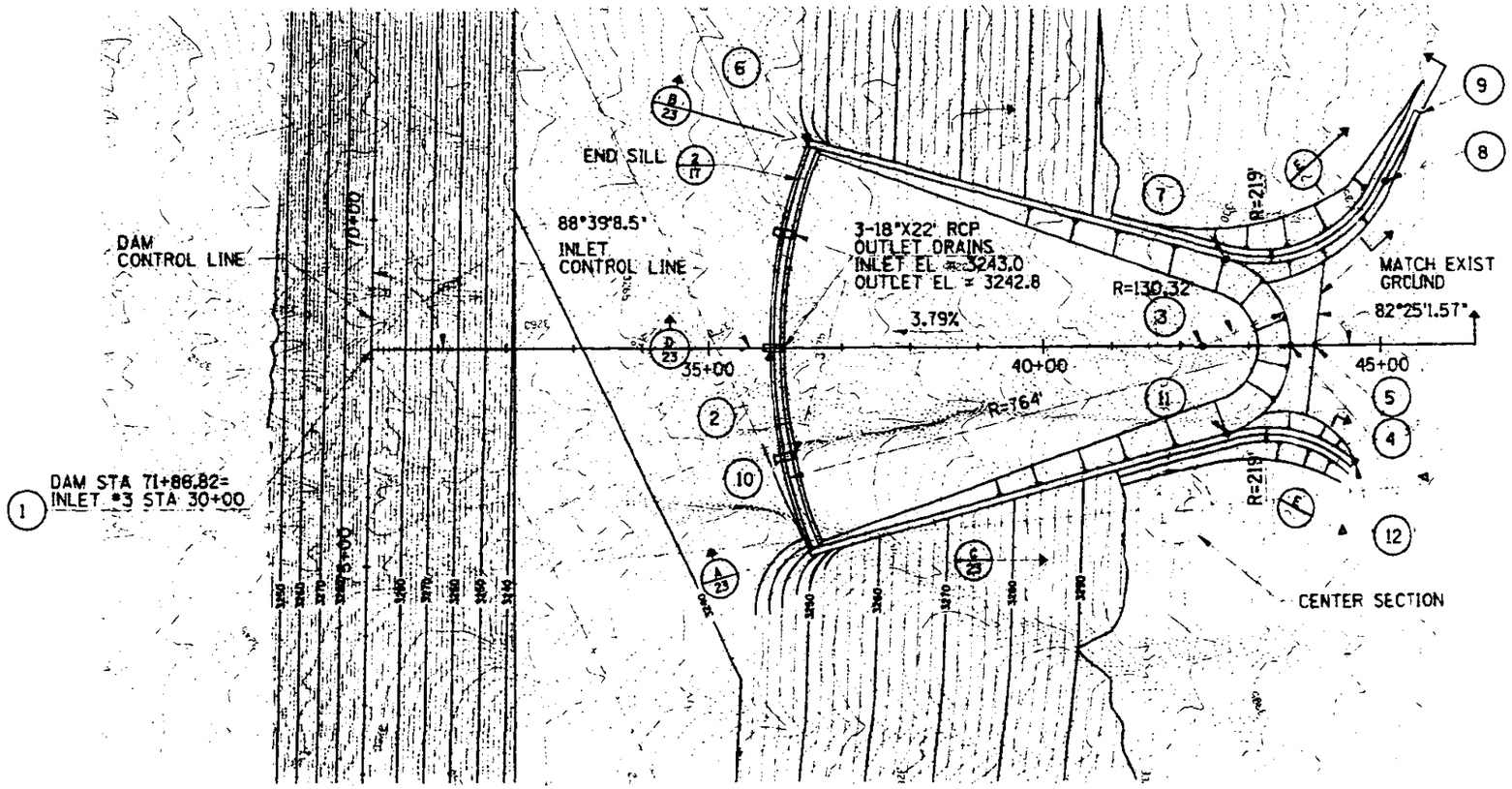
REV | DATE | BY | REVISION

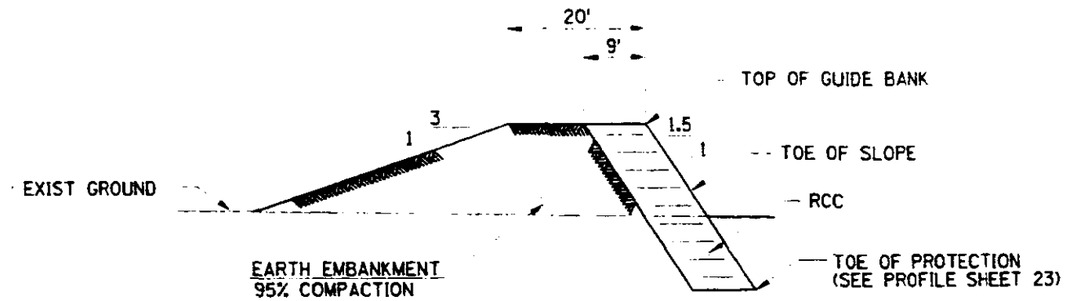
19 of 52 SHEET

JOB No. VKYLE.00 BY JFW/GKC

DATE 15 JAN 93

SCALE 1"=40'





E SECTION
GUIDE BANK
SOUTH SIDE SIMILIAR

INLET NO. 3 POINT LOCATION ON TABLE

POINT NO.	STA.	OFFSET	ELEV.	
1	30+00	0'	3290.00	
2	35+98.78	0'	3247.00	
3	42+32.46	0'		RADIUS PT.
4	43+62.78	0'	3303.30	RADIUS PT.
5	44+00.76	0'	3304.63	
6	36+55.74	289.45'	3247.00	
7	42+66.20	125.88'	3308.00	
8	45+11.00	236.73'	3310.00	
9	45+67.08	333.62'	3310.00	
10	36+55.74	289.45'	3247.00	
11	42+66.20	125.88'	3308.00	
12	44+61.18	167.94'	3310.00	

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TITLE: INLET NO.3 PLAN

PROJECT: KYLE CANYON DETENTION BASIN

SEAL: GEORGE K. COTTON CIVIL
1/15/93

JOB NO. VKYLE.00
BY JFM/GKC
DATE 15 JAN 93
SCALE
SHEET 22 OF 52 SHEETS

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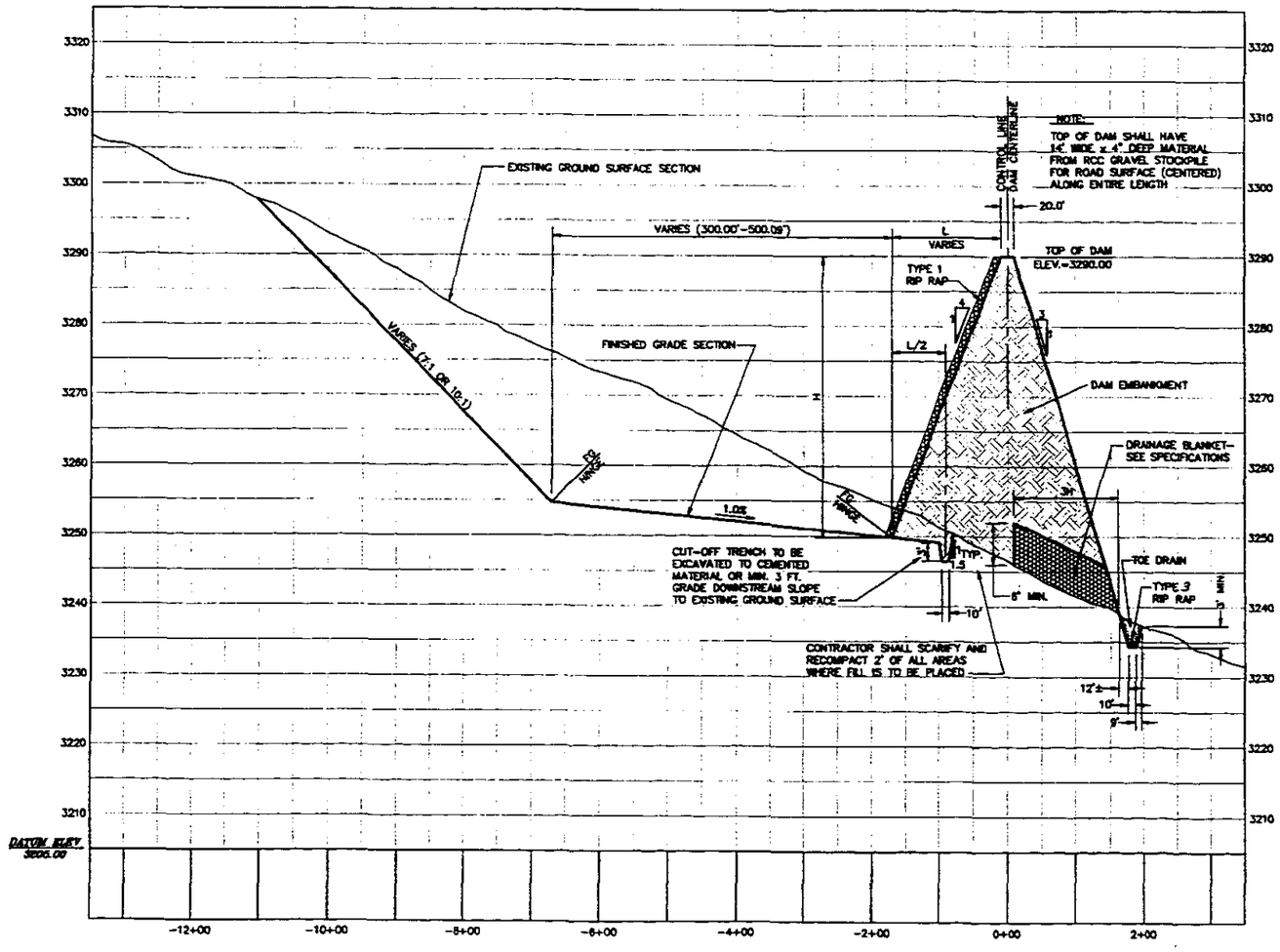

TYPICAL
CROSS SECTION

NOTES:

1.) THE TYPE 1 RIP RAP ON THE INSIDE FACE OF THE DAM EMBANKMENT IS TO BE INSTALLED FROM STA. 20+00 TO STA. 102+90

2.) TOE DRAIN SHALL BE GRADED TO DRAIN TO THE NEAREST NATURAL CHANNEL ($S_o \geq 0.005$ ft./ft.)

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REV	DATE	BY	REVISION

CITY OF NORTH LAS VEGAS
CLARK COUNTY, NEVADA

TITLE: DETENTION BASIN
CROSS SECTIONS
TYPICAL CROSS SECTION

PROJECT: KYLE CANYON DETENTION BASIN
DRAINAGE IMPROVEMENTS

SEAL

PRINTED JUN 10 1993 NEVADA

WO NO. 4254
BY DJB
DATE JAN. 1993
SCALE HORIZ. 1"=100' VERT. 1"=10'
SHEET 25 OF 52 SHEETS

LYLE CANYON SOUTH ASSOCIATION PLACER MINING CLAIM

LYLE CANYON NORTH ASSOCIATION PLACER MINING CLAIM

(9) 3" DIA. RED REFLECTORS EQUALLY SPACED

18" x 18" DIAMOND SHAPED RED REFLECTORIZED PANEL

SIGN SHALL BE MOUNTED 4' ABOVE GROUND LEVEL AND SPACED AT 4' ON-CENTERS.

DETAIL
END OF ROAD MARKERS
NO SCALE

INSTALL TYPICAL TORTOISE FENCE 100' FROM CONSTRUCTION FEATURES AND LIMITS AROUND ENTIRE SITE EXCEPT AS NOTED IN SECTION 23. CONTRACTOR MAY ADJUST LOCATION OF FENCE AS SHOWN HERE WITH PRIOR APPROVAL FROM THE ENGINEER

INSTALL (10) TYPICAL END OF ROAD MARKERS @ 20' O.C.

INSTALL (4) W1-8R's @ 5' O.C.

NO EXCAVATION OR EQUIPMENT WEST OF THIS LINE FROM GUIDE BANK LIMITS TO THE NORTH LINE OF SECTION 23-SEE SHEET 8

JEEP TRAIL AND SOUTHERN ACCESS ROAD

INSTALL (5) TYPICAL END OF ROAD MARKERS @ 20' O.C.

INSTALL (5) TYPICAL END OF ROAD MARKERS @ 20' O.C.

CHAIN LINK FENCE AND 12' GATE PER DETAILS ON SHEET 44

INSTALL (5) TYPICAL END OF ROAD MARKERS @ 4' O.C.

NORTH ACCESS ROAD-SEE SHEETS 47 THROUGH 51

INSTALL (2) TYPICAL END OF ROAD MARKERS @ 4' O.C.

JEEP TRAIL AND SOUTHERN ACCESS ROAD

20+00 25+00 30+00 35+00 40+00 45+00 50+00 55+00 60+00 65+00 70+00 75+00 80+00 85+00 90+00 95+00 100+00

USGS MONITORING STATION-SEE DETAILS ON SHEET 43

STA. 102+00-CHAIN LINK FENCE AND 12' GATE CENTERED ON DAM PER DETAILS ON SHEET 44. FENCING TO EXTEND TO EDGE OF TOE DRAIN

INSTALL (4) W1-8's @ 5' O.C.

INSTALL (5) TYPICAL END OF ROAD MARKERS @ 4' O.C.

NOTES:

1.) REFER TO DETAIL SHEETS OF INDIVIDUAL STRUCTURES FOR PLACEMENT OF CHAIN LINK FENCE ALONG OR AROUND THESE STRUCTURES.

2.) EXACT LOCATION OF THE NEW JEEP TRAIL AND SOUTHERN ACCESS ROAD AND ALL SIGNS AND MARKERS SHALL BE DETERMINED IN THE FIELD BY THE ENGINEER.

PRINTED JUN 1 1993 VTN NEVADA

REV	DATE	BY	REVISION

CITY OF NORTH LAS VEGAS
CLARK COUNTY, NEVADA

CONSULTING ENGINEERS ● PLANNERS ● LAND SURVEYORS
2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89102-5148 PHONE (702) 873-7550 FAX (702) 362-2597
VTN Nevada

TITLE
FENCE LAYOUT PLAN

PROJECT
KYLE CANYON DETENTION BASIN
DRAINAGE IMPROVEMENTS

SEAL
2-1-93

VTN NO.	4254
BY	DJB
DATE	JAN. 1993
SCALE	1"=200'
SHEET	52 OF 52 SHEETS

Section 3
Carey/Lake Mead Detention Basin

Predesign Memorandum for Carey/Lake Mead Detention Basin

Included in this section:

Excerpts from *Predesign Memorandum for Carey/Lake Mead Detention Basin*, August 1990 by VTN Nevada.

PREDESIGN MEMORANDUM

FOR

CAREY/LAKE MEAD DETENTION BASIN

VTN NEVADA
AUGUST 24, 1990

Predesign Memorandum
Carey/Lake Mead
Detention Basin

VTN Nevada
W.O. 3996

To: Ken Trompeter, Project Engineer - City of Las Vegas

From: Ken Gilbreth, Project Manager - VTN Nevada

Subject: Predesign Memorandum for the
Carey/Lake Mead Detention Basin

1.0 DISTRIBUTION

Ken Trompeter- CLV 5 Copies
Gale Fraser - CCRFCD
John Palm - Dam Safety
Tom Donaldson - MIA
Stan Putman - NDOT
John Murchie - NLV 2 Copies

2.0 SCOPE

This is the Predesign Memorandum for the Carey/Lake Mead Detention Basin. The Final Hydrology Study of Lake Mead Boulevard, Phase 1A Study (Lake Mead Study), by VTN Nevada, October 1989 is the major reference for this memorandum and for the actual design of the detention basins. The general intent of this Predesign Memorandum is to summarize the review of the Lake Mead Study and the design parameters to be used for the design of the Carey/Lake Mead Detention Basin. This memorandum will also serve as a guide for preparing the design memorandum. The draft design memorandum

will be submitted with the 70 percent submittal of the improvement plans and the final will be submitted with the 90 percent submittal.

Alternative 3 as presented in the Lake Mead Study was selected as the final alternative for the Carey/Lake Mead Detention Basin by the City of Las Vegas, North Las Vegas, and CCRFCD. This Alternative will be a single detention basin located within the clear zones of the future runways of the North Las Vegas Airport. This detention basin will be bound by the new alignment of Lake Mead Boulevard on the south, Carey Avenue to the north, and Simmons Street to the east. The proposed detention basin site will cover approximately 54 acres of land. The maximum berm elevation is approximately 2121. This elevation is also approximately the existing elevation at the end of the future NLV Airport runway(s) expansion. This will keep the ponding storm water during a 100-year event from backing up on the runways. This detention basin will have outlets into the Lake Mead Boulevard storm drain and the Carey Avenue storm drain. The Carey Avenue storm drain will only receive discharge from the detention basin during storm events greater than a 25-year flood. Storm events less than a 25-year will discharge only into the Lake Mead storm drain.

The scope of this project does not include any drainage facilities north of Carey Avenue (NLV Airport). The North Las Vegas Airport will construct drainage facilities on the west and east side of the airport for conveyance of storm water to Carey Avenue. This project will, include two drainage structures under Carey Avenue for conveyance of this runoff from the west side and east side of the NLV Airport into the detention basin.

3.0 HYDROLOGY

The majority of the hydrology analysis for this detention basin was performed in the Lake Mead Study. Some modifications were made to the HEC-1 model prepared in the Lake Mead Study, mainly to the routing cards of the detention basin and to the Lake Mead and Carey Avenue storm drains. The modifications to the Lake Mead and Carey Avenue storm drains were to model the 50 c.f.s. per storm drain that will bypass the detention basin. The bypass will minimize the amount of nuisance flow that will reach the detention basin. Figures 3.1, 3.2, 3.3, and 3.4 show the inflow 10-year, 25-year and 100-year hydrographs for this detention basin.

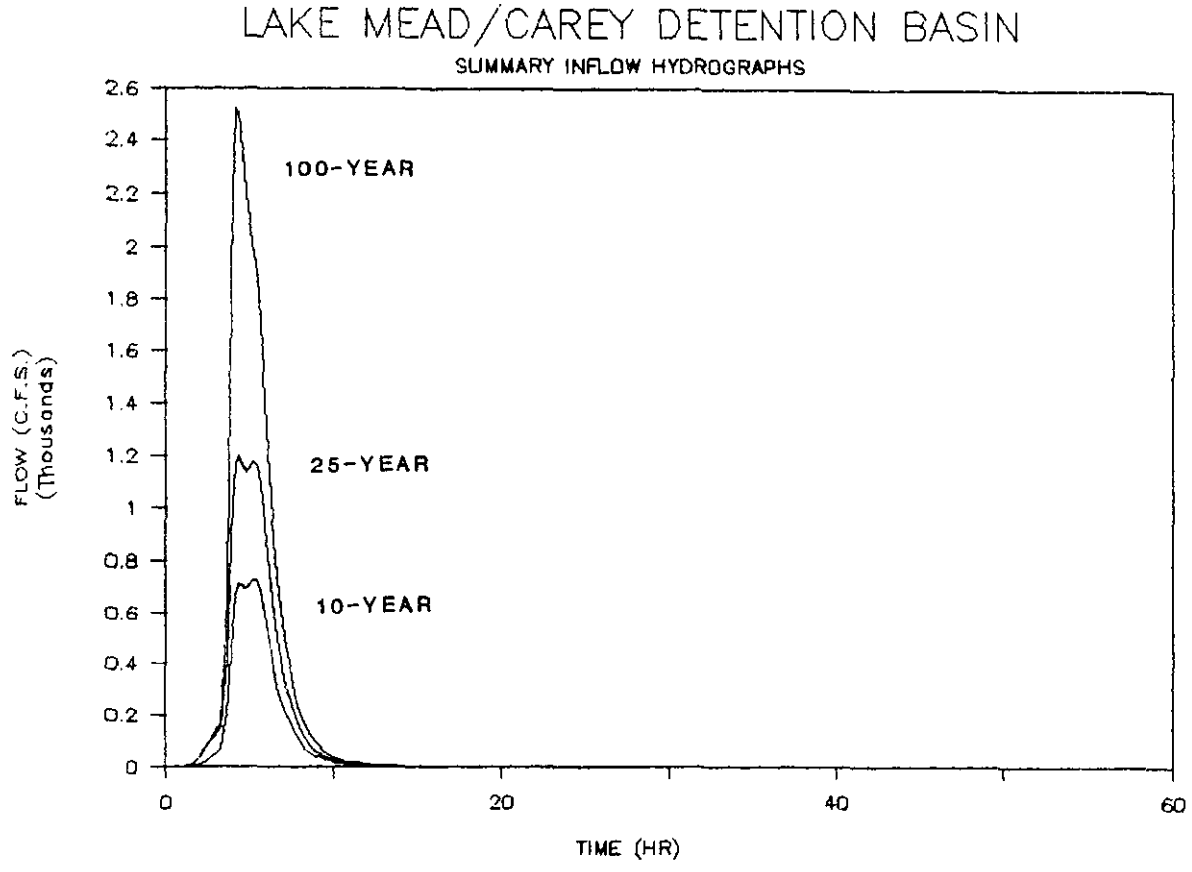

LAKE MEAD/CAREY DETENTION BASIN
SUMMARY INFLOW HYDROGRAPHS
FLOW (C.F.S.) (Thousands)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
100-YEAR
25-YEAR
10-YEAR
0
20
40
60
TIME (HR)

FIGURE 3.1

4.0 INFLOW TO THE DETENTION BASIN

The Carey/Lake Mead Detention Basin has four major inlet points, the Carey Avenue and Lake Mead Boulevard storm drains, the west side of the North Las Vegas Airport and the east side of the North Las Vegas Airport. The following table summarizes the peak inflows to the detention basin.

TABLE 4.0
PEAK INFLOW TO THE DETENTION BASIN
FOR THE 6-HOUR STORM EVENT

Flow Description	100-Year (c.f.s.)	25-Year (c.f.s.)	10-Year (c.f.s.)
East Side NLV Airport @ Detention Basin	1400	700	450
West Side NLV Airport	500	300	200
Carey Avenue storm drain	250	150	100
Lake Mead storm drain	800	360	220
Total Combined	2800	1400	870

4.1 INFLOW STRUCTURES

The Lake Mead storm drain outlet pipe discharging into the detention basins is a 90" diameter pipe. The Carey Avenue storm drain outlet pipe discharging into the detention basin is preliminarily sized to be a 72" diameter pipe. The drainage structure under Carey Avenue for conveyance of the runoff from the west side of the NLV Airport is preliminarily sized as a 10 X 4 RCB. The drainage structure under Carey Avenue for conveyance of the runoff from the east side of the NLV Airport is preliminarily sized as a 15 X 5 RCB.

The preliminary analysis of these drainage structures determined that high velocities can be anticipated at their outlets. Erosion protection may be needed at the outlet point of these structures, in order to minimize the erosion.

5.0 OUTFLOW FROM THE DETENTION BASIN

The outlets for this detention basin will be the Lake Mead Boulevard and Carey Avenue storm drains. The maximum discharge allowed from the Lake Mead Storm Drain into the I-15 Channel is 330 c.f.s. (See NDOT's letter). The detention basin design will limit outflow into Lake Mead Storm Drain combined with the runoff downstream to 330 c.f.s. at the I-15 Channel. VTN prepared an analysis of the Carey Avenue storm drain in the Lake Mead Study. Based on this analysis the Carey Avenue storm drain at the discharge point into the I-15 Channel had a capacity of approximately 340 c.f.s. The outflow into the Carey Avenue storm drain combined with runoff downstream will be limited to 340 c.f.s. at the I-15 Channel. Table 5.1 is a summary of the outflows from the detention basin routed downstream to the I-15 Channel. Figures 5.1, 5.2, and 5.3 show the inflow/outflow hydrographs.

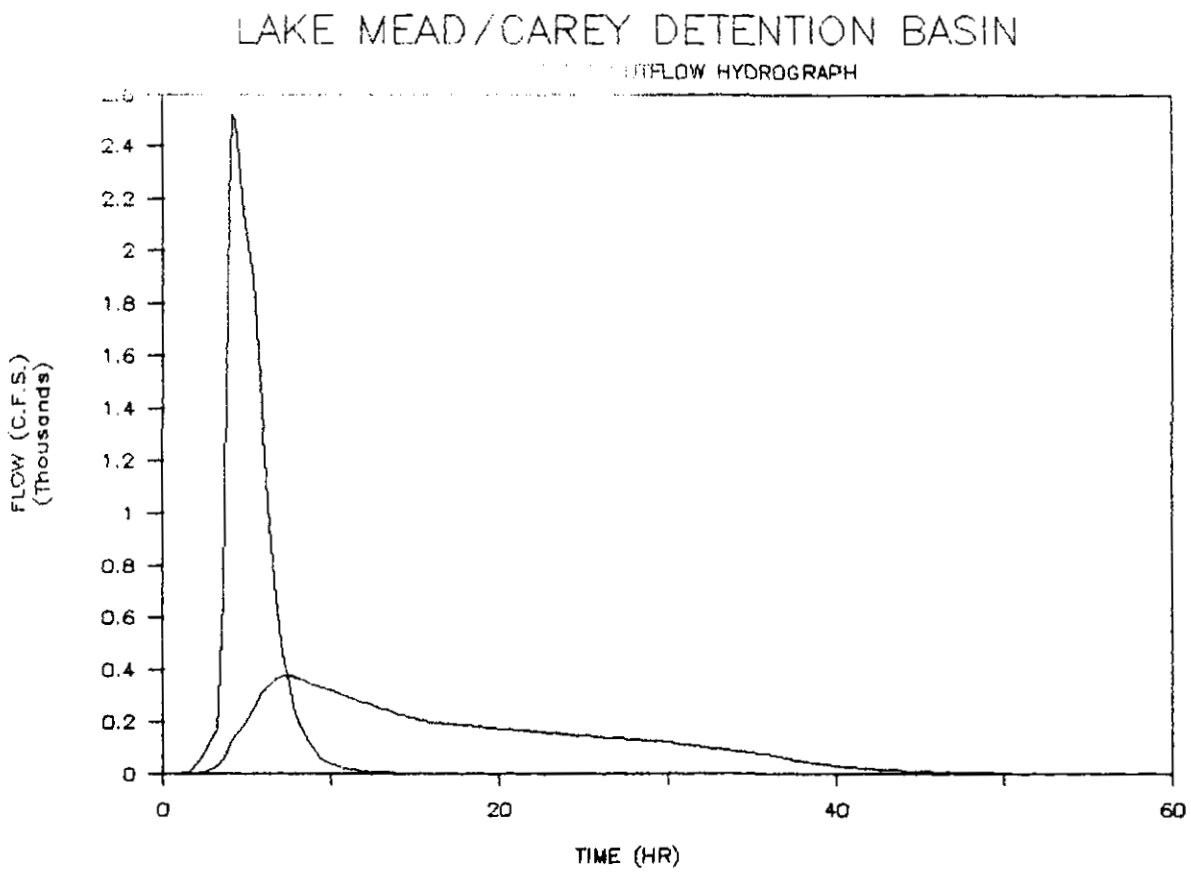

LAKE MEAD/CAREY DETENTION BASIN
OUTFLOW HYDROGRAPH
FLOW (C.F.S.)
(Thousands)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
20
40
60
TIME (HR)

FIGURE 5.1

TABLE 5.1
PEAK OUTFLOW SUMMARY

Location in Storm Drain	100 Year 6-Hour	25-Year 6-Hour	10-Year 6-Hour
Det. Outlet Lake Mead	205	191	147
Lake Mead/Simmons	255	239	196
Lake Mead/I-15 Channel	331	255	206
Det. Outlet Carey	168	0	0
Carey/Simmons	218	50	50
Carey/I-15 Channel	319	255	192

5.1 OUTLET STRUCTURES

The detention basin outlet size modeled for this predesign memorandum included a 42" opening over a 78" diameter pipe which will discharge into the Lake Mead storm drain. The detention basin outlet to the Carey Avenue storm drain was modeled as a 6 X 3 RCB opening which transitions into a 66" diameter pipe that discharges into the Carey Avenue storm drain. Tables 5.2, 5.3, 5.4 and 5.5 are a summary of the stage - discharge parameters of this detention basin.

TABLE 5.2
DETENTION BASIN DATA
100-YEAR STORM EVENT

Time Hr	Stage ft	Discharge c.f.s.	Storage ac-ft	Storage Remaining ac-ft.
0	0	0	0	480
4	2105	111	65	415
8	2118	373	420	60
24	2110	151	142	338
36	2102	74	28	452
40	2100	31	11	469
48	2098	5	2	478
54	2098	0	0	480

TABLE 5.3
DETENTION BASIN DISCHARGE SUMMARIES
100-YEAR STORM EVENT

Time Hr	Stage ft	Discharge c.f.s.	Discharge to Lake Mead	Discharge to Carey
0	0	0	0	0
4	2105	111	111	0
6	2116	312	200	112
8	2118	373	204	164
12	2116	272	199	73
16	2114	197	197	0
18	2113	185	185	0
24	2110	151	151	0
36	2102	74	74	0
40	2100	31	31	0
48	2098	5	5	0
54	2098	0	0	0

TABLE 5.3
DETENTION BASIN DISCHARGE SUMMARY
25-YEAR STORM EVENT

Time Hr	Stage ft	Discharge c.f.s.	Discharge to Lake Mead	Discharge to Carey
0	0	0	0	0
4	2103	84	84	0
6	2112	175	175	0
8	2113	191	191	0
12	2112	172	172	0
16	2110	151	151	0
18	2108	140	140	0
24	2105	102	102	0
36	2099	12	12	0
40	2098	5	5	0
48	2098	1	1	0

TABLE 5.5
DETENTION BASIN DISCHARGE SUMMARY
10-YEAR STORM EVENT

Time Hr	Stage ft	Discharge c.f.s.	Discharge to Lake Mead	Discharge to Carey
0	0	0	0	0
4	2100	49	49	0
6	2108	138	138	0
8	2109	147	147	0
12	2107	131	131	0
16	2105	104	104	0
18	2103	89	89	0
24	2100	32	32	0
36	2098	2	2	0

6.0 DETENTION BASIN PARAMETERS

The Carey/Lake Mead Detention Basin will be sized for approximately 480 acre-feet of storage at the spillway elevation. The storage require this detention basin will take into account additional storage needed for sediment/debris deposits into the detention basin (See Section 9.0). Tables 6.1 and 6.2 summarize the detention basin parameters. Figures 6.1, 6.2, and 6.3 show the stage - discharge and stage - storage curves for this detention basin.

TABLE 6.1
DETENTION BASIN ANALYSIS
6-HOUR DURATION

Return Period	Time to Fill	Time to Empty	Stage (El.)	Inflow (c.f.s.)	Outflow (c.f.s.)	Storage (ac-ft)
100-Yr	8 hr	48 hr	2118	2800	373	420
25-Yr	8 hr	40 hr	2113.5	1400	191	240
10-Yr	8 hr	36 hr	2109	870	150	135

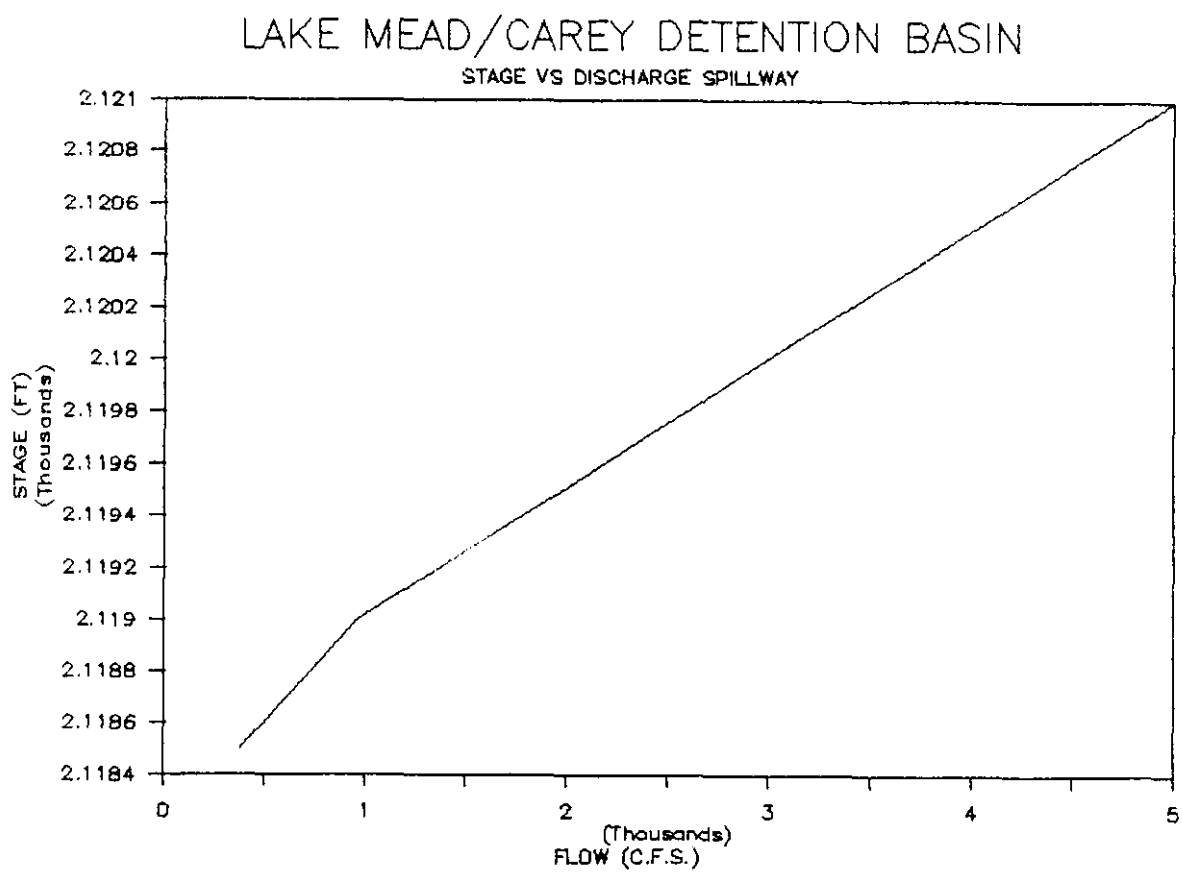

LAKE MEAD/CAREY DETENTION BASIN
STAGE VS DISCHARGE SPILLWAY
STAGE (FT)
(Thousands)
2.121
2.1208
2.1206
2.1204
2.1202
2.12
2.1198
2.1196
2.1194
2.1192
2.119
2.1188
2.1186
2.1184
0
1
2
3
4
5
(Thousands)
FLOW (C.F.S.)

FIGURE 6.2

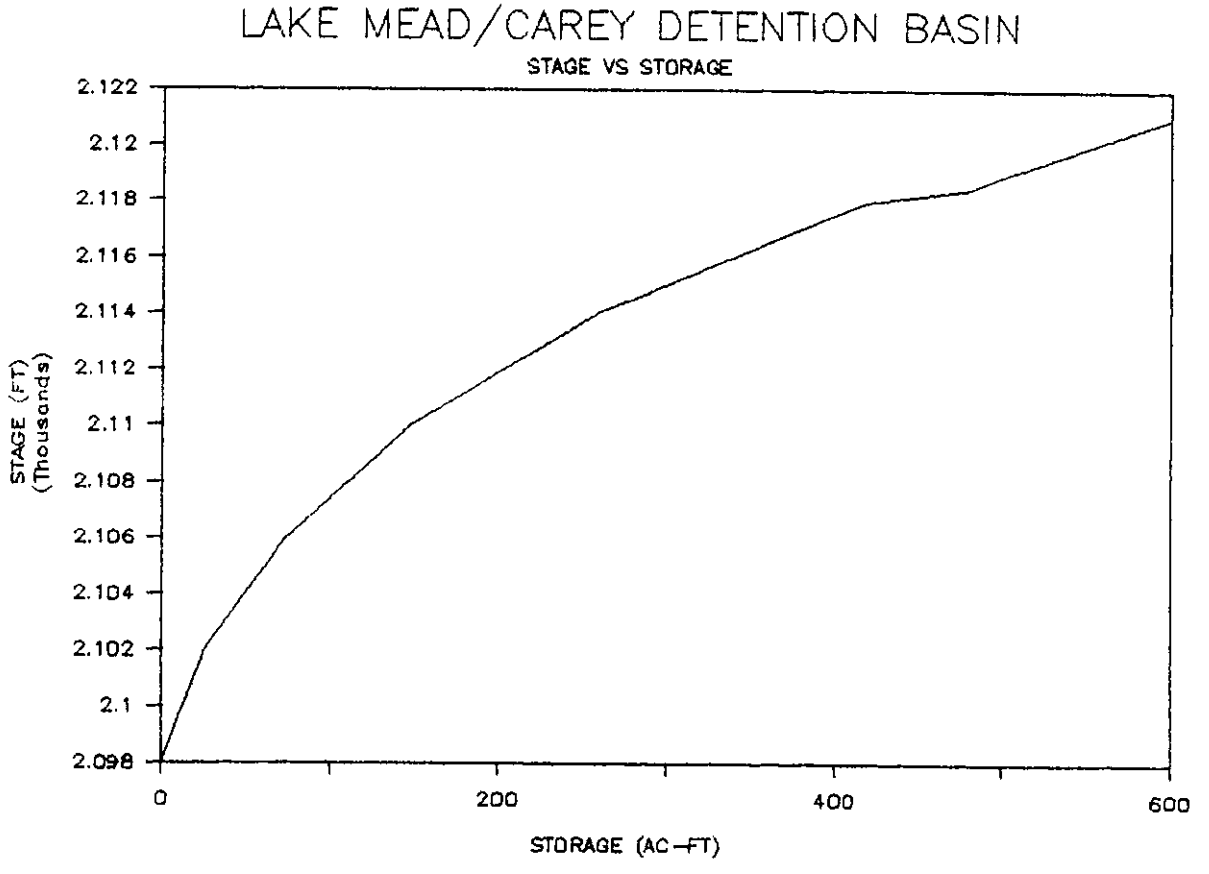

LAKE MEAD/CAREY DETENTION BASIN
STAGE VS STORAGE
STAGE (FT)
(Thousands)
2.122
2.12
2.118
2.116
2.114
2.112
2.11
2.108
2.106
2.104
2.102
2.1
2.098
0
200
400
600
STORAGE (AC-FT)

FIGURE 6.3

TABLE 6.2
DETENTION BASIN PARAMETERS

Stage (feet)	Surface Area (acre)	Volume (acre-feet)	Discharge (c.f.s.)
2098	4	0	0
2102	9	26	72
2106	15	74	120
2110	22	148	154
2114	33	258	198
2118	47	418	372
2118.5	49	480	380
Spillway Elevation = 2118.5			
2119	50	500	960
2121	54	600	4900

Construction plans for
Carey/Lake Mead Detention Basin

Included in this section:

Construction plans for *Carey/Lake Mead Detention Basin*, prepared by VTN Nevada, June 1991.

DEPARTMENT OF PUBLIC WORKS

Mayor:
JAN LAVERTY JONES

Councilmen:
BOB NOLEN
FRANK HAWKINS, JR.
ARNIE ADAMSEN
SCOTT HIGGINSON

City Manager:
WILLIAM J. NOONAN

Director of Public Works:
RICHARD D. GOECKE

City Engineer:
GARY A. PRESSWOOD, P.E.

CAREY/LAKE MEAD DETENTION BASIN

FUNDED BY:

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

PREPARED BY:

VTN NEVADA

APPROVALS

City Engineer	4-5-91 Date
Chief of Construction Services	Date
C.C. Regional Flood Control District	5/29/91 Date
City of North Las Vegas	5/31/91 Date
McCarran International Airport	6-3-91 Date
Central Telephone Company	2-12-91 Date
Las Vegas Valley Water District	4-24-91 Date
Nevada Power Company	4/26/91 Date
Southwest Gas Company	5-2-91 Date
Community Cable T.V., Inc.	Date
Southern Nevada Water System	Date

REVISIONS | DATE

W.A. # WU6481
DESIGN BY VTN Nevada
SCALE (V) N/A | DATE N/A
SCALE (H) N/A | TUD. BK. N/A

ENGINEERING DESIGN DIVISION

DEPARTMENT OF PUBLIC WORKS

PROJECT CAREY/LAKE MEAD DETENTION BASIN

SHEET COVER SHEET

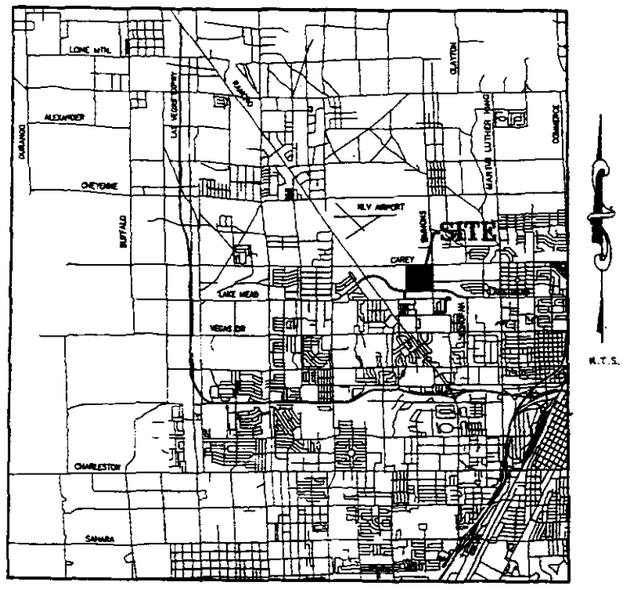
BID NO.92.1730.17

DRAWING NO. 731-91 | 1/31

GENERAL NOTES

1. All construction shall be in accordance with the Clark County "Uniform Standard Specifications for Public Works Construction, Off-site Improvements, Clark County Area, Nevada, 1986", unless otherwise specified or shown on the Contract drawings, or otherwise directed by the Engineer.
2. "Standard Drawings" are the "Uniform Standard Drawings for Public Works Construction, Off-site Improvements, Clark County, Area, Nevada, 1988", unless otherwise specified or shown on the drawings.
3. The Contractor shall notify all utility companies and the City of Las Vegas 48 hours prior to commencing construction.
4. Locations of underground utilities shown on the drawings were obtained from information received from the applicable utility companies. Neither the City of Las Vegas, nor the Engineer assumes any responsibility for utilities or structures not shown, or not in the location shown on the drawings. The Contractors responsibility regarding utilities shall be as stated in Section 105.06 of the Standard Specifications and other applicable sections of the specifications. Contractor to field verify the location of all existing underground utilities and notify the Engineer prior to construction.
5. The Contractor shall take all precautionary measures necessary to protect existing improvements, which are to remain in place. All such improvements damaged by the Contractor's operations shall be repaired or reconstructed satisfactory to the Engineer at the expense of the Contractor.
6. All barricading and temporary traffic control devices and methods used during construction shall be in accordance with the "Workzone Traffic Control Handbook, 1985", published by the State of Nevada, Department of Transportation, and the "Manual of Uniform Traffic Control Devices, 1988", published by the U.S. Department of Transportation, except as otherwise provided in the contract specifications or required by the Engineer.
7. Contractor to comply with all requirements of the Southern Nevada Water Systems (SNWS) Encroachment Permit. (Also see Section 2.Cooperation with Utilities of the General Conditions in the Specifications).
8. The Contractor shall construct RCP's and RCB's from downstream to upstream to limit damage from flooding during construction. It shall be the Contractor's sole responsibility to protect proposed improvements from flooding during the construction period. The Contractor shall also take all necessary precautions to avoid increasing, diverting or concentrating flood waters affecting surrounding property during the construction period. Any damage caused thereby shall be the Contractor's responsibility.
9. Contractor to field verify horizontal and vertical location of all existing utilities which may be effected by the proposed construction and notify the engineer prior to construction. (See specifications)

VICINITY MAP



SHEET INDEX

1. COVER SHEET
2. GENERAL NOTES, VICINITY MAP, ETC.
3. HYDROGRAPHS & PROFILE ON AXIS OF DAM
4. SURVEY CONTROL MAP AND FENCING PLAN
5. DAM & IMPOUNDMENT GRADING PLAN
6. UTILITY PLAN & CROSS SECTION INDEX
7. DAM & IMPOUNDMENT CROSS SECTIONS
8. DAM & IMPOUNDMENT CROSS SECTIONS
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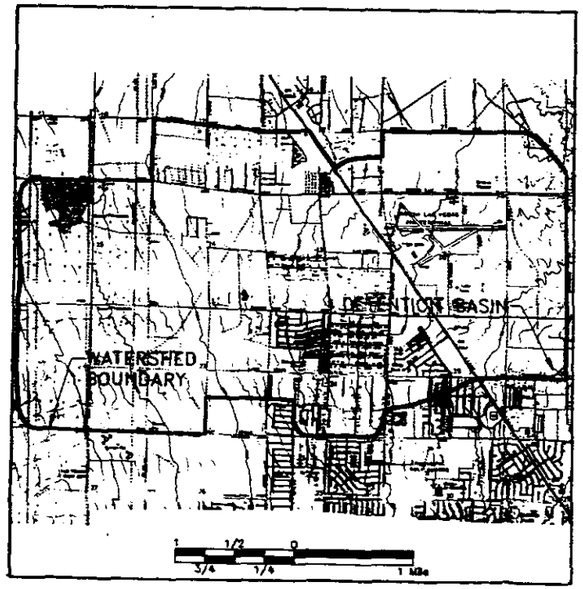
13. DAM & IMPOUNDMENT CROSS SECTIONS
14. DAM & IMPOUNDMENT CROSS SECTIONS
15. DAM & IMPOUNDMENT CROSS SECTIONS
16. DAM & IMPOUNDMENT CROSS SECTIONS
17. SPILLWAY PLAN & DETAILS
18. SPILLWAY DETAILS
19. PLAN & PROFILE, LAKE MEAD BLVD. STORM DRAIN
    BASIN INLET PIPE
20. PLAN & PROFILE, LAKE MEAD BLVD. STORM DRAIN
    BASIN OUTLET PIPE
21. PLAN & PROFILE, CAREY AVE. CULVERT & EAST CHANNEL
22. PLAN & PROFILE, CAREY AVE. CHANNEL
23. PLAN & PROFILE, CAREY AVE. CHANNEL & DROP STRUCTURE C
24. BASIN INLET A
25. BASIN OUTLET A
26. DROP STRUCTURE A
27. DROP STRUCTURE B
28. BASIN INLET B
29. MISC. DETAILS
30. CAREY AVE. STORM DRAIN CONNECTION STRUCTURE
31. MISC. DETAILS



WATERSHED BOUNDARY MAP

ABBREVIATIONS

AC.-FT.	ACRE FEET	MIN.	MINIMUM
ALCAP	ALUMINUM CAP	N.T.S.	NOT TO SCALE
ANG.	ANGLE	O.C.	ON CENTER
APN	ASSESSOR PARCEL NUMBER	O.C.E.F.	ON CENTER, EACH FACE
BM	BENCH MARK	O.C.E.W.	ON CENTER, EACH WAY
BLVD	BOULEVARD	O.D.	OUTSIDE DIAMETER
CL	CENTERLINE	PVMT	PAVEMENT
CLR.	CLEAR	P.C.	POINT OF CURVE
CONC.	CONCRETE	P.T.	POINT OF TANGENCY
CONST.JT.	CONSTRUCTION JOINT	PP	POWER POLE
CONT.	CONTINUOUS	PT.,PNT.	POINT
COR.	COORDINATE	PRC	POINT OF REVERSE CURVE
C.Y.	CUBIC YARD	RP	RADIUS POINT
C.F.S.	CUBIC FEET PER SECOND	R.C.B.	REINFORCED CONCRETE BOX
DWG.	DRAWING	R.C.P.	REINFORCED CONCRETE PIPE
EA.	EACH	R.O.W.	RIGHT OF WAY
EF	EACH FACE	REINF.	REINFORCED
E.W.	EACH WAY	SNWS	SOUTHERN NEVADA WATER SYSTEMS
ELEV.,EL.	ELEVATION	SD	STORM DRAIN
EX., EXIST.	EXISTING	S.F.	SQUARE FEET
EXP.JT.	EXPANSION JOINT	S. S.S.	SANITARY SEWER
FH	FIRE HYDRANT	STA.	STATION
FL	FLOW LINE	STD.	STANDARD
FT.	FOOT	SIM.	SIMILAR
FND	FOUND	SYM.	SYMMETRICAL
G	GAS	STL.	STEEL
HORIZ.	HORIZONTAL	TEL	TELEPHONE
HRS.	HOURS	T&B	TOP AND BOTTOM
I.D.	INTERNAL DIAMETER	TMH	TOP OF MANHOLE
INV.	INVERT	T.P.O.B.	TRUE POINT OF BEGINNING
I.E.	INVERT ELEVATION	TYP.	TYPICAL
KV	KILO VOLT	VERT.	VERTICAL
L.F.	LINEAR FEET	W	WATER
MH.	MANHOLE	W/	WITH
MAX.	MAXIMUM	WT.	WEIGHT
MIA.	McCARREN INTERNATIONAL AIRPORT		
MEA	MUNDHIR EL JUMILY ASSOCIATES		

BENCHMARK

A 2"x2" ALUMINIUM PLATE IN THE TOP OF THE CURB RETURN AT THE NORTHEAST CORNER OF STACEY AND WINWOOD, NORTH OF LAKE MEAD BOULEVARD, B.M. #0602488, CITY OF LAS VEGAS, ELEV. = 2243.30

BASIS OF BEARING

THE WEST 1/2 MILE OF THE E-W 1/4 SECTION LINE OF SECTION 23, T.20S., R.60E., BEARS S.89°13'45"E. AS PER SURVEY RECORDED IN FILE 35, PAGE 87 OF THE CLARK COUNTY, NEVADA, RECORDER'S OFFICE.

2 working days — Call before you Dig — 1-800-227-2600

CONSULTING ENGINEERS • PLANNERS • LAND SURVEYORS
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LAS VEGAS, NEVADA 89102-5148 PHONE (702) 873-7550 FAX (702) 362-2597

REV | DATE | BY | REVISION

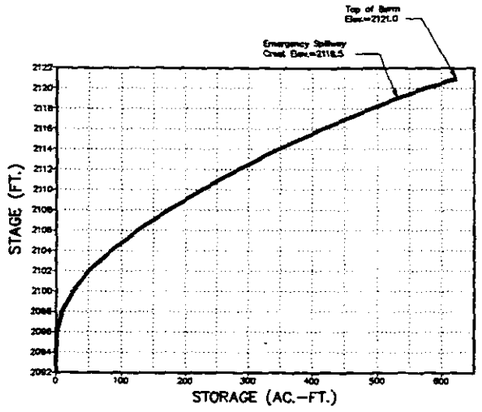
CITY OF LAS VEGAS
CLARK COUNTY, NEVADA

TITLE: GENERAL NOTES, VICINITY MAP, ETC.
PROJECT: CAREY / LAKE MEAD DETENTION BASIN

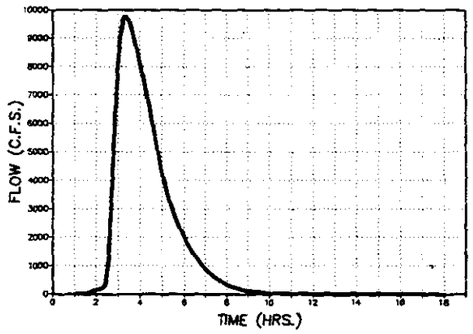
SEAL

WO NO. 3996
BY BKP
DATE JUNE 5, 1991
SCALE NONE
SHEET 2 OF 31 SHEETS

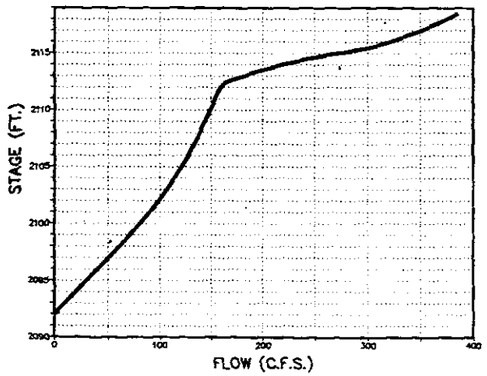
STAGE vs. STORAGE



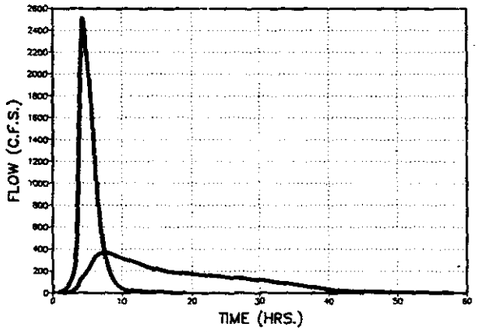
P.M.F. INFLOW HYDROGRAPH



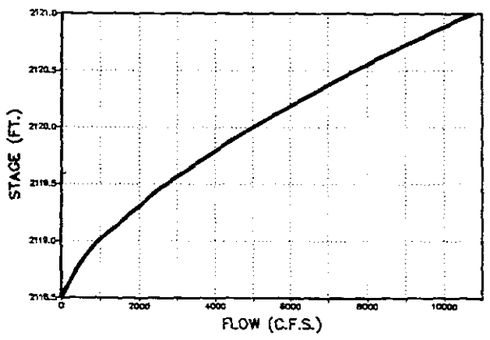
STAGE vs. DISCHARGE OUTLETS



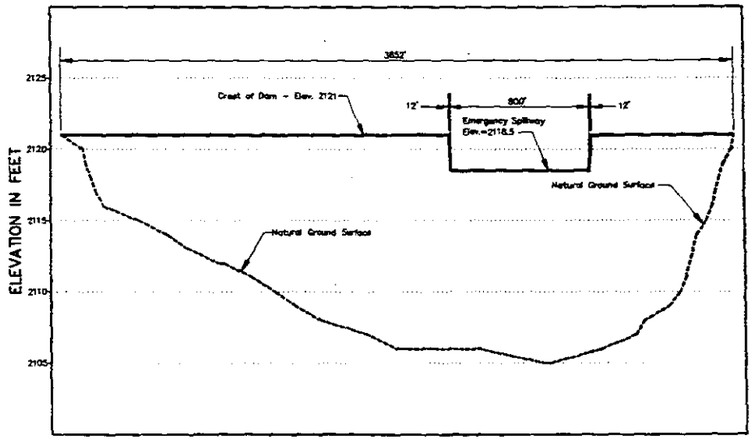
100 YEAR INFLOW/OUTFLOW HYDROGRAPH



STAGE vs. DISCHARGE SPILLWAY



PROFILE ON AXIS OF DAM



CITY OF LAS VEGAS
CLARK COUNTY, NEVADA

REV | DATE | BY | REVISION

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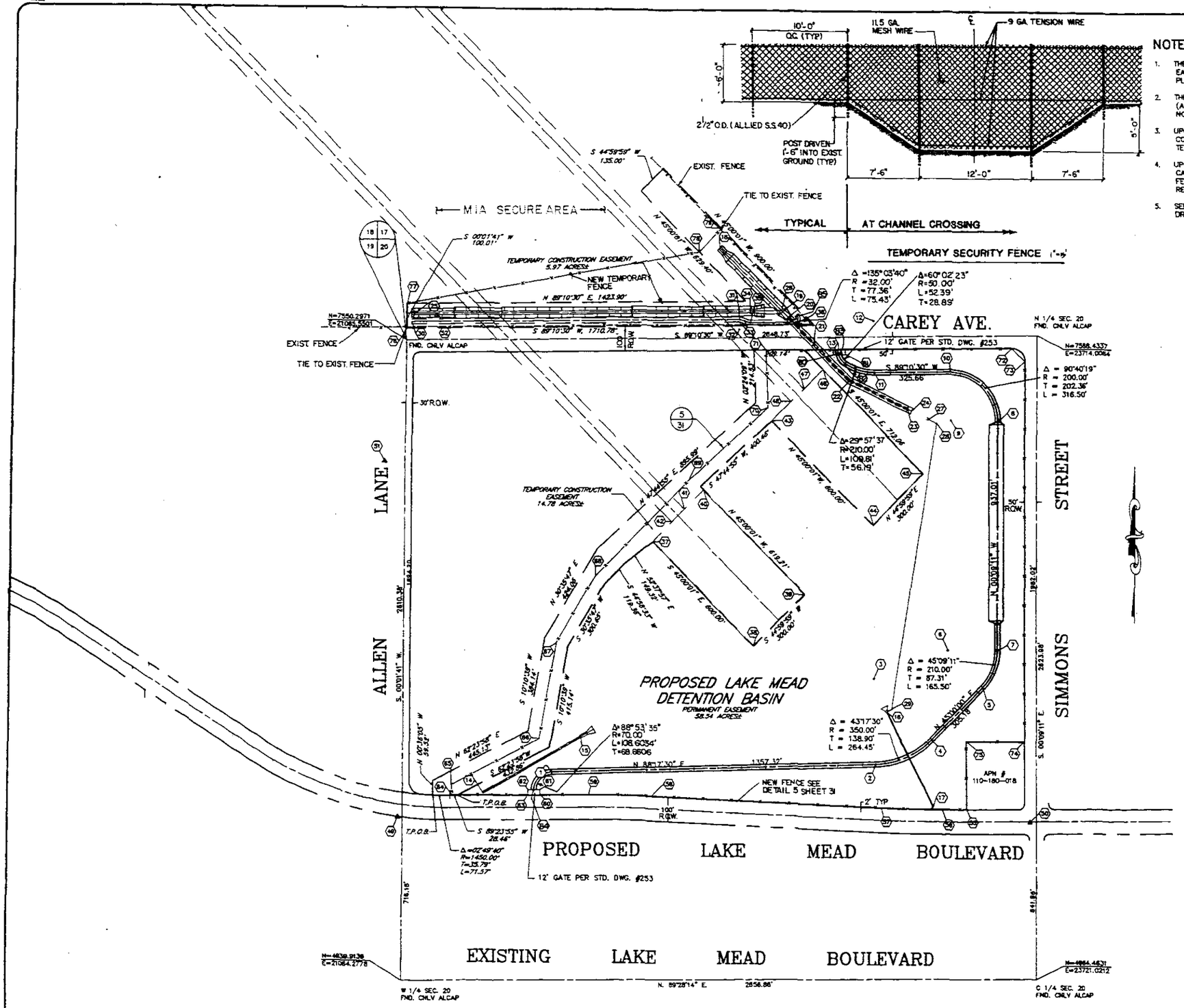
TITLE: HYDROGRAPHS AND PROFILE ON AXIS OF DAM

PROJECT: CAREY / LAKE MEAD DETENTION BASIN

SEAL

JOB NO.	3996
BY	BKP
DATE	JUNE 5, 1991
SCALE	NONE / NONE
SHEET	2



NOTES

1. THE CONTRACTOR SHALL KEEP ALL CONSTRUCTION ACTIVITIES WITHIN THE EASEMENTS AND RIGHTS OF WAY SHOWN ON THIS PLAN (EXCEPT AS EXPLAINED BELOW).
2. THE ONLY EXCEPTION TO NOTE #1 ABOVE SHALL BE FENCE CONSTRUCTION (AS SHOWN ON THIS SHEET) TO MAINTAIN SECURITY OF MIA PROPERTY NORTH OF CAREY AVE.
3. UPON STARTING CONSTRUCTION OPERATIONS NORTH OF CAREY AVE. THE CONTRACTOR'S FIRST ORDER OF ACTIVITY SHALL BE CONSTRUCTING NEW TEMPORARY SECURITY FENCE AS SHOWN AT LEFT.
4. UPON COMPLETION OF CHANNEL AND CULVERT CONSTRUCTION NORTH OF CAREY AVE. THE CONTRACTOR SHALL REPAIR ANY EXISTING SECURITY FENCE OR GRAVEL ACCESS ROAD DAMAGED BY HIS ACTIVITIES AND SHALL REMOVE AND DISPOSE OF NEW TEMPORARY SECURITY FENCE.
5. SEE SHEETS 20, 26 & 27 FOR FENCE ASSOCIATED WITH WEATHER STATION & DROP STRUCTURES "A" & "B".

COORDINATE TABLE

#	NORTHING	EASTING	DESCRIPTION
1	5793.9063	21660.2242	BERM CL STA. 0+00
2	5834.5534	23043.0892	BERM CL STA.
3	6184.3979	23032.6552	R.P.
4	5936.9105	23280.1426	BERM CL STA.
5	6152.7067	23495.9387	BERM CL STA.
6	6301.1991	23347.4463	RP
7	6301.7605	23357.4456	BERM CL STA.
8	7238.7622	23354.9406	BERM CL STA.
9	7238.2275	23354.9413	RP
10	7438.2068	23352.0617	BERM CL STA.
11	7433.5180	23026.4386	BERM CL STA.
12	7643.4962	23023.4150	RP
13	7226.6378	22859.1805	BERM CL STA.
14	5706.0804	21399.9759	INLET PIPE STA.
15	5937.5801	21806.0126	INLET PIPE STA.
16	6047.9468	23089.7492	OUTLET PIPE STA.
17	5662.0382	23288.0709	OUTLET PIPE STA.
18	7938.0134	22377.4883	BEGIN EAST CHAN.
19	7678.8395	22644.8055	EAST CHAN. ANG. PNT.
20	7654.0908	22669.5544	END EAST CHAN.
21	7549.0139	22774.6323	VERT. ANG. PNT.
22	7400.4675	22923.1802	HORIZ. ANG. PNT.
23	7284.9406	23171.4786	END BOX CULVERT
24	7276.5036	23189.6120	END APRON
25	7660.8268	21101.5408	CAREY CHAN STA. 0+34.58
26	7682.9875	22640.5272	INTERSECTION POINT
27	7243.2619	23281.0573	BEGIN 18" PIPE
28	7226.3879	23297.3239	MANHOLE
29	6061.0404	23110.8483	MANHOLE
30	7626.6287	21088.0317	BEGIN ACCESS ROAD
31	7646.4465	22464.3091	PC
32	7606.4506	22464.8850	RP
33	7639.7727	22488.2627	PRC
34	7673.0947	22509.1406	TP
35	7633.0989	22509.7166	PT
36	7635.3864	22668.5754	CL ACCESS ROAD
37	6737.9752	22106.7489	COR. SAFETY AREA
38	6313.7129	22531.0185	COR. SAFETY AREA
39	6525.8463	22743.1460	COR. SAFETY AREA
40	6950.1083	22318.8799	COR. SAFETY AREA
41	6870.5584	22239.3308	END RUNWAY
42	6817.5251	22186.2980	END RUNWAY
43	7232.9524	22601.7212	COR. SAFETY AREA
44	6808.6926	23025.9852	COR. SAFETY AREA
45	7020.8234	23238.1184	COR. SAFETY AREA
46	7445.0854	22813.8522	COR. SAFETY AREA
47	7365.5355	22734.3031	END RUNWAY
48	7312.5023	22681.2703	END RUNWAY
49	5606.4219	21046.0391	NLV BM 2
50	5602.5585	23691.5012	NLV BM 3
51	7056.4133	20979.1162	NLV BM 4
52	7852.4820	21197.9004	NLV BM 5
53	6424.8050	23557.1166	SPILLWAY
54	7224.8022	23554.9780	SPILLWAY
55	5655.3566	23427.1732	FENCE
56	5654.2896	23325.5278	FENCE
57	5658.3532	23068.4854	FENCE
58	5698.5709	22108.4738	FENCE
59	5702.7199	21841.9867	FENCE
60	5700.5739	21637.5537	FENCE
61	5720.5728	21637.3438	FENCE
62	5720.0480	21587.3466	FENCE
63	5700.0491	21587.5565	FENCE
64	5696.7262	21271.0121	FENCE
65	5739.2773	21270.5655	FENCE
66	5928.4693	21832.4479	FENCE
67	6321.8194	21703.0632	FENCE
68	6593.7915	21863.8840	FENCE
69	6988.6296	22258.3892	FENCE
70	7285.7002	22585.4224	FENCE
71	7520.0356	22575.5906	FENCE
72	7534.9240	23609.5394	FENCE
73	7483.0884	23662.2879	FENCE
74	5932.2807	23666.4337	FENCE
75	5931.6396	23426.4352	FENCE
76	7600.2146	21067.5727	FENCE
77	7700.3146	21067.6218	FENCE
78	7919.9026	22290.2872	FENCE
79	8016.8385	22384.2701	FENCE
80	7506.2799	22870.4710	FENCE
81	7506.9996	22920.4658	FENCE
82	7460.0669	22921.1717	BERM CL STA.
83	7503.0207	22895.5205	BERM CL STA.
84	5720.3104	21612.3452	BERM CL STA.
85	7690.3577	22690.3895	END ACCESS ROAD

BASIS OF BEARINGS

S.89°13'45"E., BEING THE SOUTH LINE OF THE NORTHWEST QUARTER (NW 1/4) OF SECTION 23, T. 20 S., R. 60 E., M.D.M., AS SHOWN ON A MAP ON FILE AT THE CLARK COUNTY RECORDER'S OFFICE IN FILE 35 OF RECORD OF SURVEYS, PAGE 87.

COORDINATE CONVERSION

TO CONVERT VTN COORDINATES TO NLV/MEA COORDINATES:

1. ROTATE VTN COORDINATES CLOCKWISE 0°00'50" AROUND THE W 1/4 COR. OF SEC. 20 (VTN = N 4939.9139, E 21064.2778)
2. NLV/MEA NORTHING = VTN NORTHING + 521,468.6026
   NLV/MEA EASTING = VTN EASTING + 595,872.6265

BENCH MARK CONVERSION

TO CONVERT VTN DATUM TO NLV/MEA DATUM SUBTRACT 0.17' FROM VTN ELEVATIONS

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REV	DATE	BY	REVISION

CITY OF LAS VEGAS
CLARK COUNTY, NEVADA

TITLE: SURVEY CONTROL MAP AND FENCING PLAN

PROJECT: CAREY / LAKE MEAD DETENTION BASIN

SEAL

JEROME MAZZOLI CIVIL STATE OF NEVADA 7871

WO NO. 3996
BY MAS/BKP
DATE JUNE 5, 1991
SCALE 1"=200'
SHEET 4 OF 31 SHEETS

CAREY AVE.

LANE

ALLEN

LAKE MEAD BLVD.

LETTIS STREET

SIMMONS

FUTURE RUNWAY

FUTURE RUNWAY

FUTURE RUNWAY SAFETY AREA

FUTURE RUNWAY SAFETY AREA

LIMITS OF GRADING

LIMITS OF GRADING

INV. ELEV.=2094.00

INV. ELEV.=2098.00

2098.9

18" LOW FLOW PIPE

TOP OF EMERGENCY SPILLWAY ELEV.=2102.0

TOP OF BERM ELEV.=2101.00

RIPRAP PROTECTION

18:1

REV	DATE	BY	REVISION
	4-5-91	CW	Fig's per Steve Abbott

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vtn nevada

CITY OF LAS VEGAS
CLARK COUNTY, NEVADA

TITLE: DAM & IMPOUNDMENT
GRADING PLAN

PROJECT: CAREY / LAKE MEAD
DETENTION BASIN

SEAL

WO NO. 3996
BY MAS/BKP
DATE JUNE 5, 1991
SCALE 1"=100'
SHEET 5 OF 31 SHEETS

CAREY AVE. CHANNEL SEE SHEETS 22 & 23

EXIST. MEA. CHANNEL

DROP STRUCTURE "A" SEE SHEET 28

EAST CHANNEL SEE SHEET 21

DROP STRUCTURE "B" SEE SHEET 27

CAREY AVE. CULVERT SEE SHEET 21

16' GRAVEL ACCESS ROAD

DROP STRUCTURE "C" SEE SHEET 27

16"-4" TEL.

CAREY AVE.

EX 12 KV OVERHEAD POWERLINE

20' GRAVEL ACCESS ROAD

FUTURE RUNWAY

75'

CAREY AVE. STORM DRAIN CONNECTION M.H. SEE SHEET # 30

BASIN INLET "B" SEE SHEET 28

2094.20 INV.

TMH ELEV.=2102.50
INV. ELEV.=2094.13

2101.48 TMH ASBUILT

48" I.D. MH. W/ BOLT DOWN LID PER STD. DWG. # 403

FUTURE RUNWAY SAFETY AREA

600'

300'

LANE

ALLEN

STREET

SIMMONS

EMERGENCY SPILLWAY SEE SHEET 17

18" LOW FLOW PIPE 1180.17 LF S=.00177

TOP OF EMERGENCY SPILLWAY ELEV. = 2110.50

PROPOSED 12' WIDE

NOTES

1. EXIST. POWER POLES TO BE RELOCATED BY OTHERS. (FUNDED BY NPC.)
2. EXIST. SNWS 24" WATER (TRANSITE) SEE GEN. NOTE 7.
3. EXIST. MEA. SECURITY FENCE, SEE NOTE 4, SHEET 4.
4. EXIST. MEA. GRAVEL ROAD, SEE NOTE 4, SHEET 4
5. SEE SHEET 4 FOR FENCING PLAN.
6. EXIST. POWER POLE TO BE RELOCATED BY OTHERS. (FUNDED BY CLV.)

BASIN INLET "A" SEE SHEET 24

LAKE MEAD BLVD. BASIN INLET PIPE SEE SHEET 19

PROPOSED 90" STORM DRAIN

20' GRAVEL ACCESS ROAD

BASIN OUTLET "A" SEE SHEET 25

INV. ELEV.=2092.00

TMH ELEV.(2099.50)
INV ELEV.=2092.04

TMH 2098.41 ASBUILT

48" I.D. M.H. W/ BOLT DOWN LID PER STD. DWG #403

LAKE MEAD BLVD. BASIN OUTLET PIPE SEE SHEET 20

EX 12 KV OVERHEAD POWERLINE

EX 12 KV UNDERGROUND POWERLINE

S.N.W.S. PUMPING STATION

PROPOSED 48" STORM DRAIN

LAKE MEAD BLVD.

PROPOSED 12" SEWER

PROPOSED 90" STORM

PROPOSED 12" WATER

PROPOSED 36" STORM

PROPOSED 12" SEWER

PROPOSED 78" STORM

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REV	DATE	BY	REVISION
1	4/4/91	CM	Asbuilt

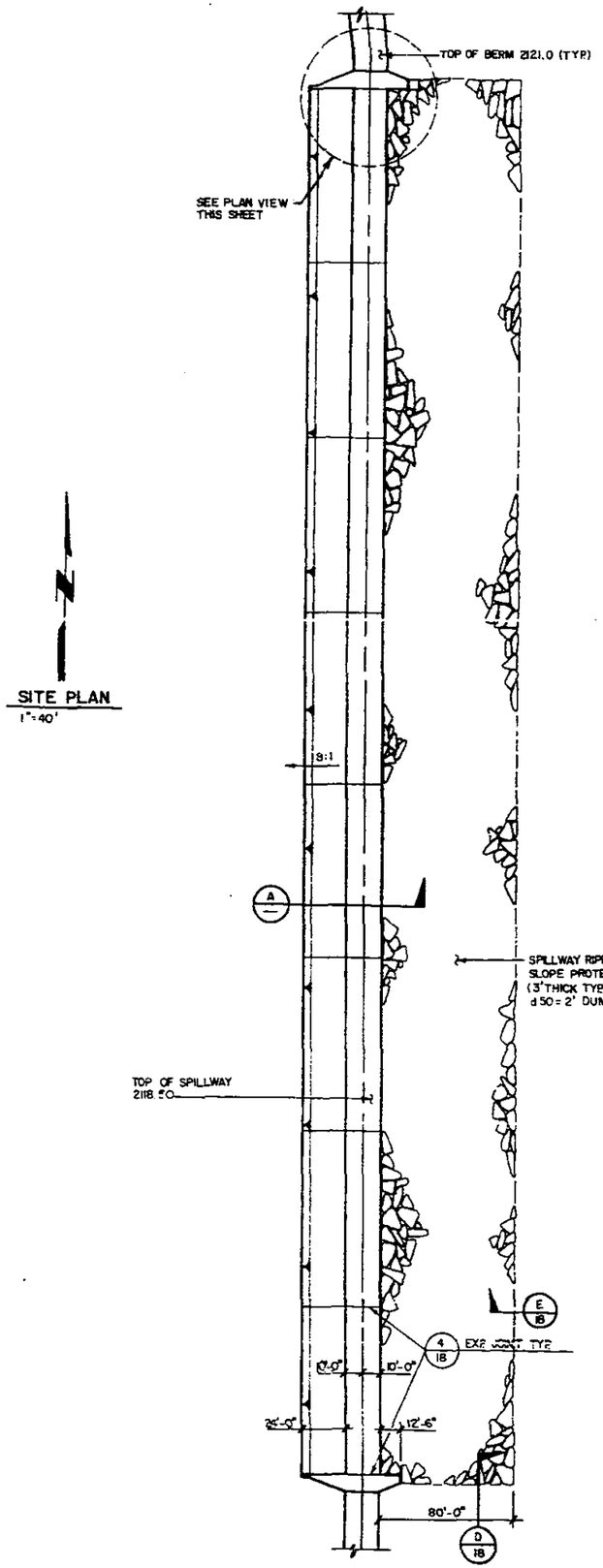
CITY OF LAS VEGAS
CLARK COUNTY, NEVADA

TITLE: UTILITY PLAN & CROSS SECTION INDEX

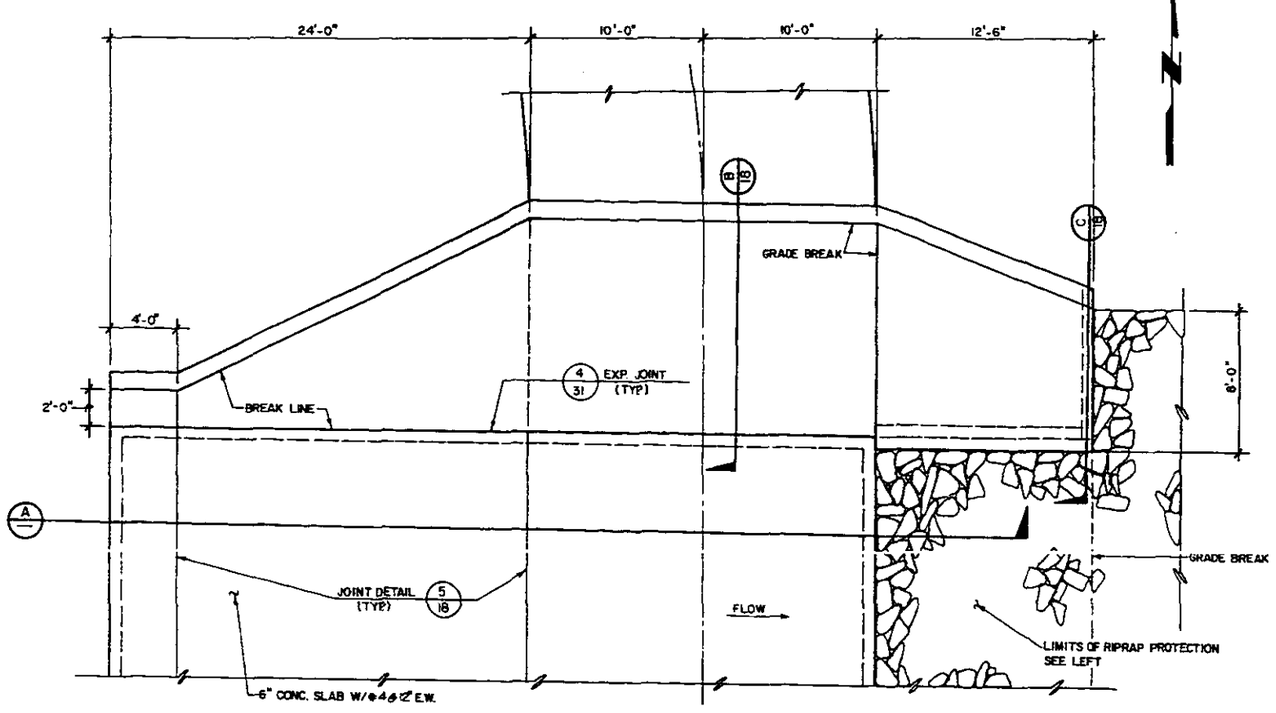
PROJECT: CAREY / LAKE MEAD DETENTION BASIN

4/24/91

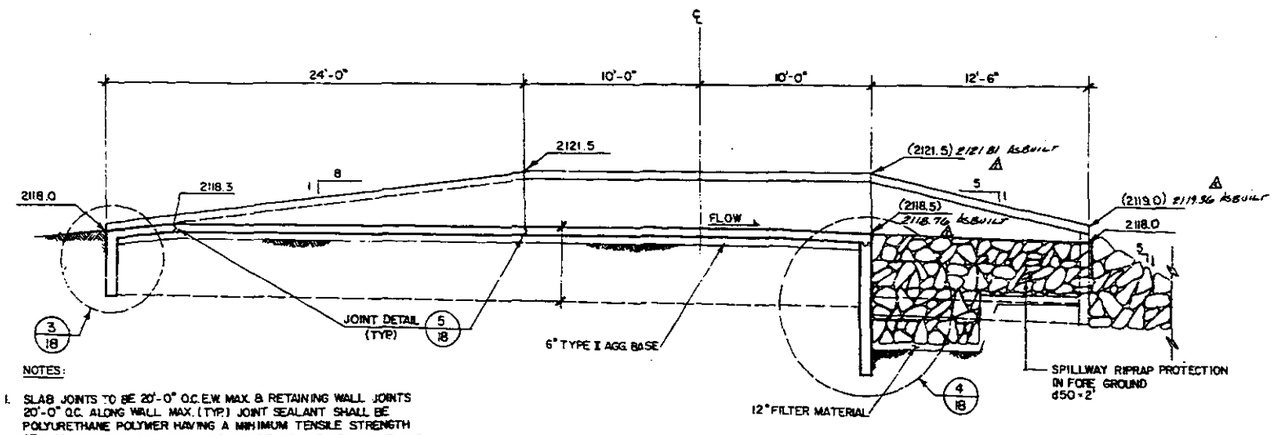
WO NO. 3996
BY MAS/BKP
DATE JUNE 6, 1991
SCALE 1"=100'
SHEET 6 OF 31



SITE PLAN
1" = 40'



SPILLWAY & END WALL PLAN
1" = 4'



NOTES:

1. SLAB JOINTS TO BE 20'-0" O.C. E.W. MAX. & RETAINING WALL JOINTS 20'-0" O.C. ALONG WALL MAX. (TYP.) JOINT SEALANT SHALL BE POLYURETHANE POLYMER HAVING A MINIMUM TENSILE STRENGTH OF 250 P.S.I. SEALANT SHALL BE PACIFIC POLYMER ELASTOTHANE 227R OR APPROVED EQUAL.

2. EXPANSION JOINTS TO BE AT 100' MAX. SPACING ALONG SPILLWAY PERPENDICULAR TO ℄ OF DAM.

SPILLWAY SECTION A
1" = 4'

REV	DATE	BY	REVISION
1	10-8-91	CW	As Built

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TITLE: SPILLWAY PLAN & DETAILS

PROJECT: CAREY / LAKE MEAD DETENTION BASIN

WO NO. 3996
BY MAS, WIR
DATE JUNE 5, 1991
SCALE AS NOTED AS NOTED
SHEET 17 OF 31 SHEETS

CONNECTION DETAIL (1 / 19,20)
N.T.S.
NOTE: IF EXIST. PIPE BELL IS UNDAMAGED, USE STANDARD CONNECTION METHOD.

TYPICAL TRENCH DETAIL (2 / 19,20)
N.T.S.

CITY OF LAS VEGAS
CLARK COUNTY, NEVADA

NO.	DATE	BY	REVISION
	10.8.92	CM	Asbuilt

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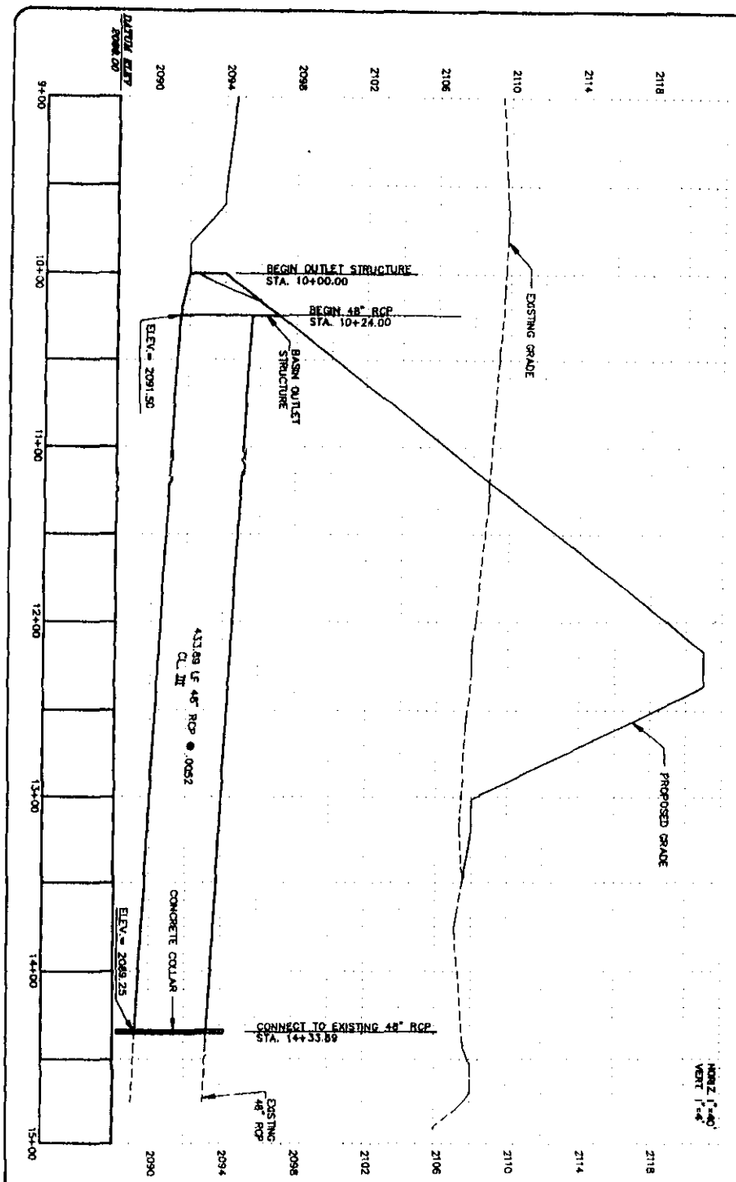
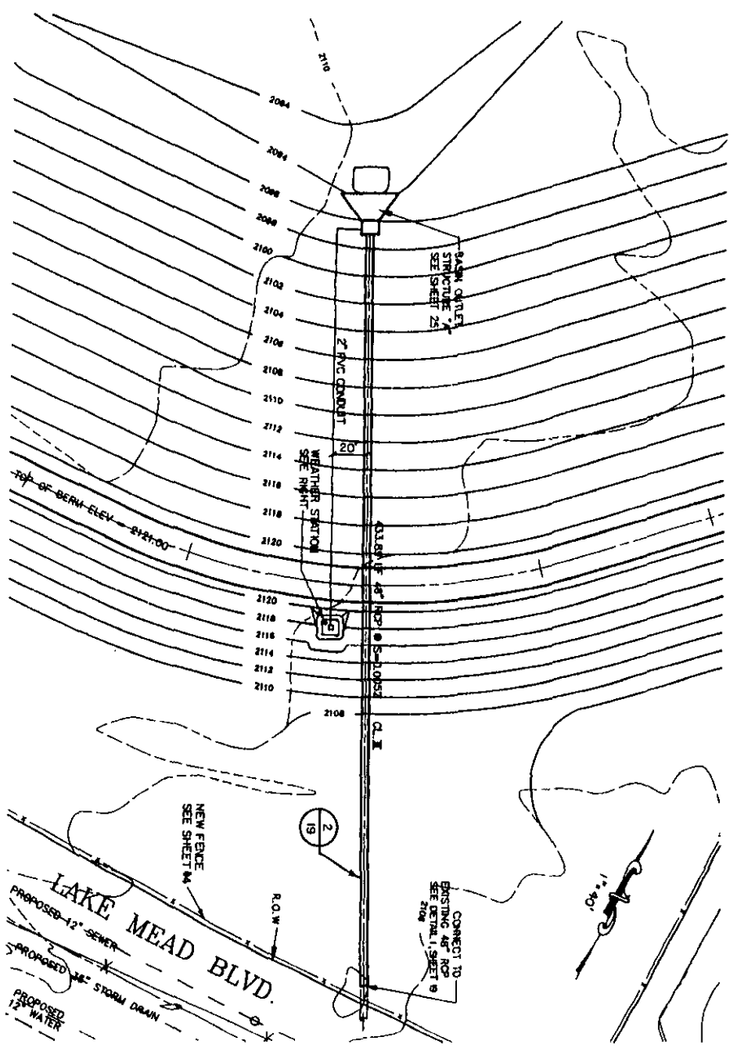
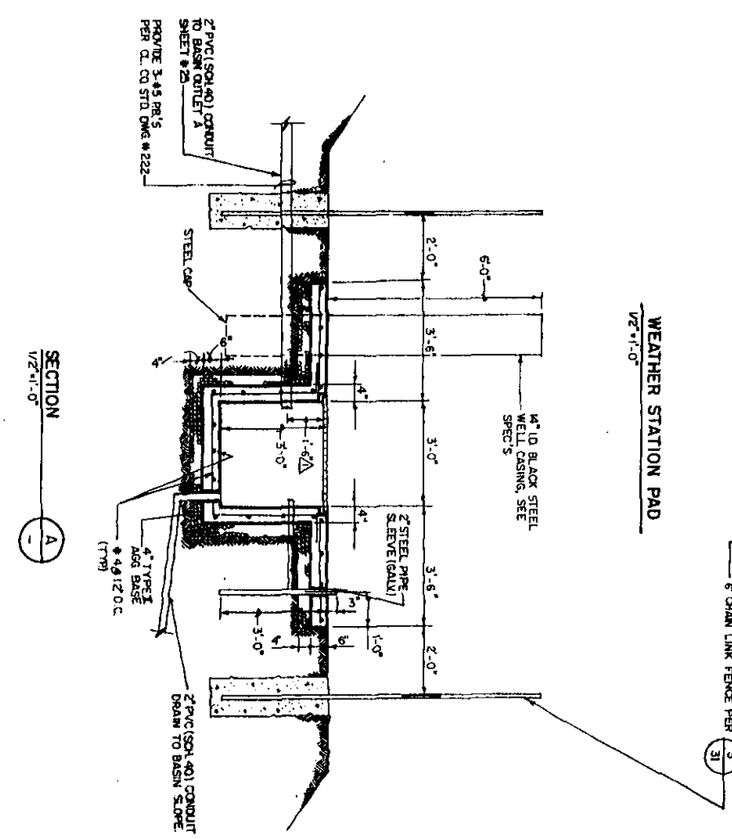
TITLE: PLAN & PROFILE
STORM DRAIN INLET PIPE

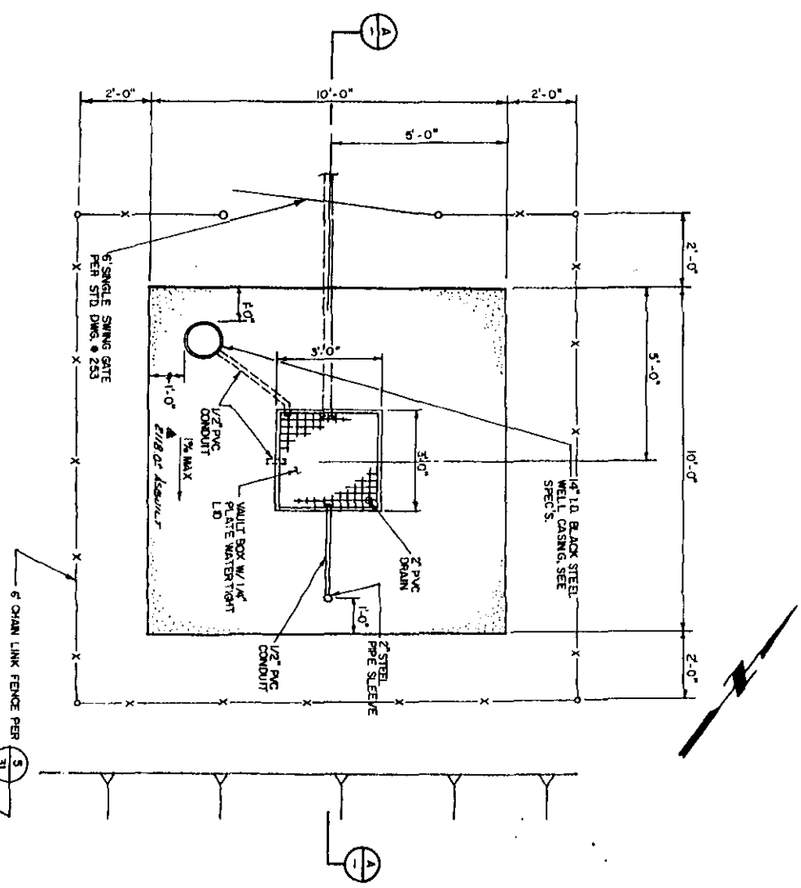
PROJECT: CAREY / LAKE MEAD
DETENTION BASIN

JOB NO. 3996
BY MAS/BKP/WJR
DATE JUNE 5, 1991
SCALE AS SHOWN
SHEET 19 OF 31 SHEETS









PLAN & PROFILE
STORM DRAIN OUTLET PIPE

CAREY / LAKE MEAD
DETENTION BASIN

CITY OF LAS VEGAS
CLARK COUNTY, NEVADA

REV	DATE	BY	REVISION
4	10-8-96	DH	REVISED
3	8-17-91	KG/DB	DIM. TO PIPE ℄

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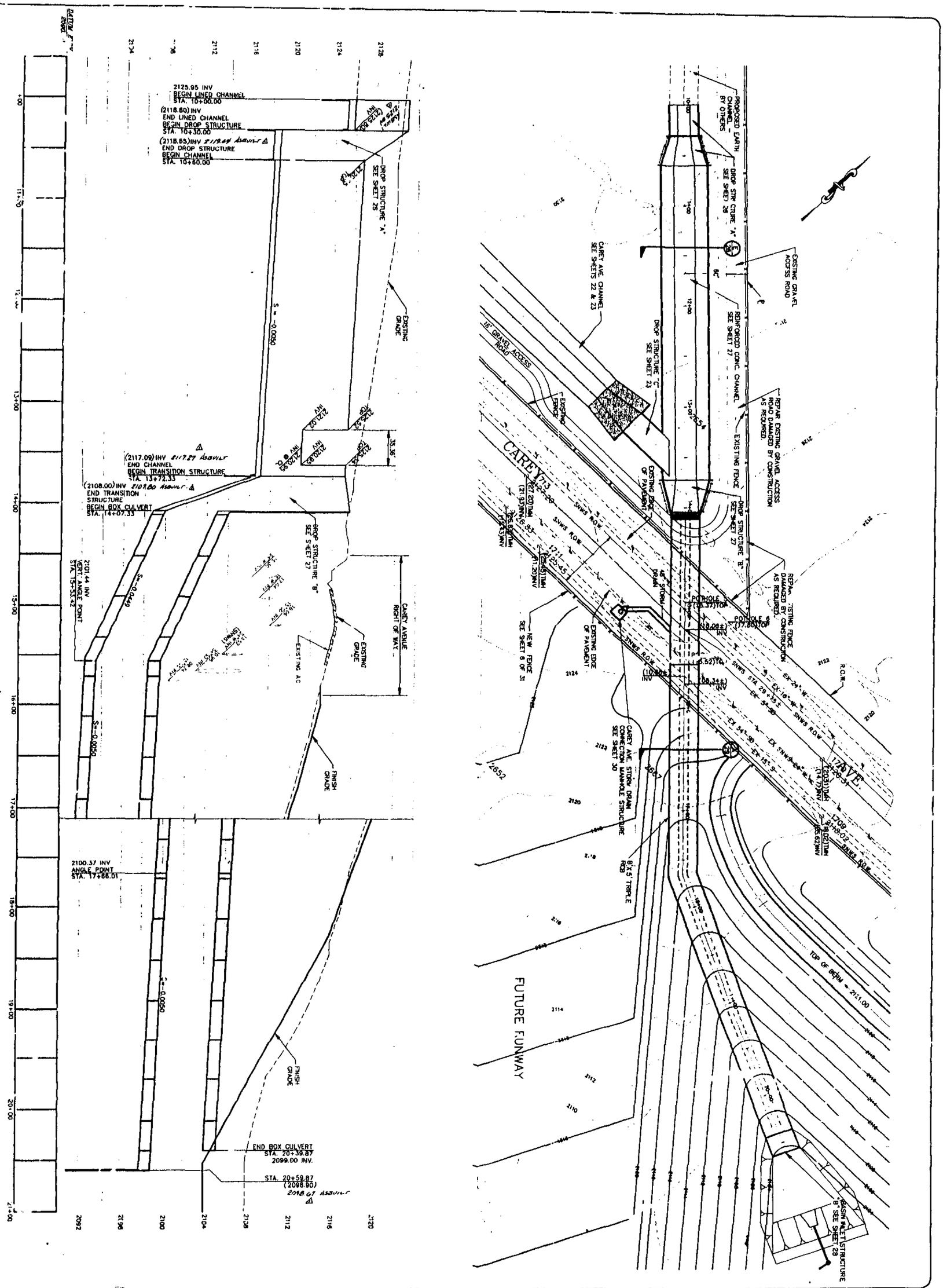
JOB NO. 3998
BY MAS/BKP/MAR
DATE JUNE 5, 1991
SCALE AS SHOWN
SHEET 20 OF 31 SHEETS



SHEET	21 OF 31 SHEETS
BY	PVER/BKP
DATE	JUNE 5, 1991
SCALE	HORIZ. 1" = 50' VERT. 1" = 5'
JOB NO.	3266

TITLE
PLAN & PROFILE
CAREY AVE.
CULVERT & EAST CHANNEL

PROJECT
CAREY / LAI'E MEAD
DETENTION BASIN

CITY OF LAS VEGAS

CLARK COUNTY, NEVADA

REV	DATE	BY	REVISION
	10-8-92	ON	ASBUILT

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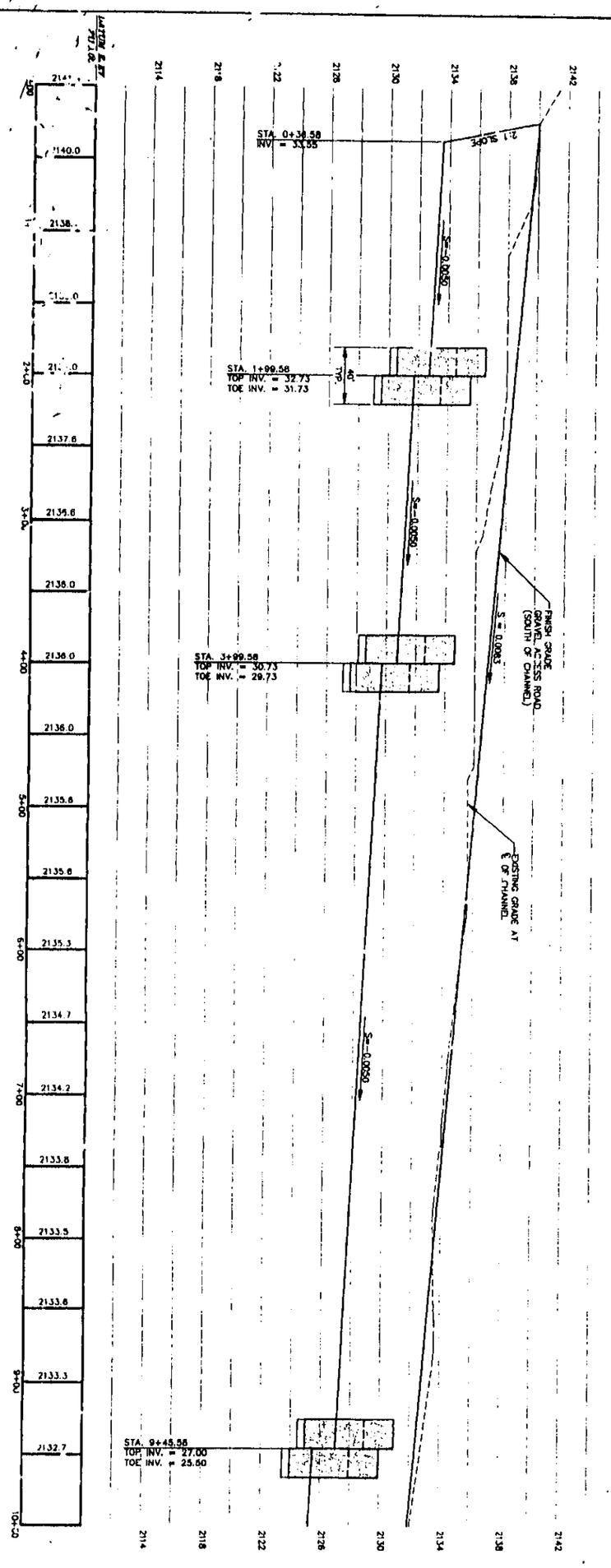

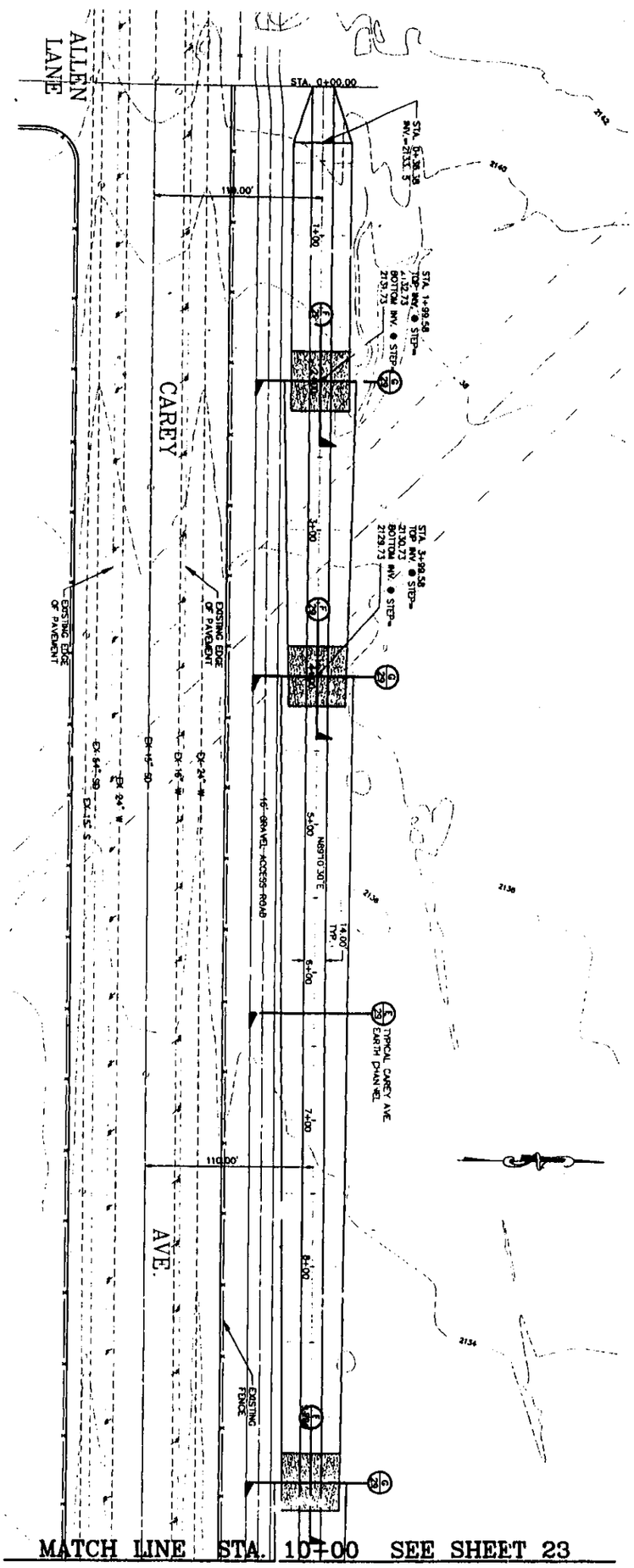

PLAN & PROFILE
CAREY AVE. CHANNEL
STA. 0+00 TO 10+00

CAREY / LAKE MEAD
DETENTION BASIN

CITY OF LAS VEGAS
CLARK COUNTY, NEVADA

REV	DATE	BY	REVISION

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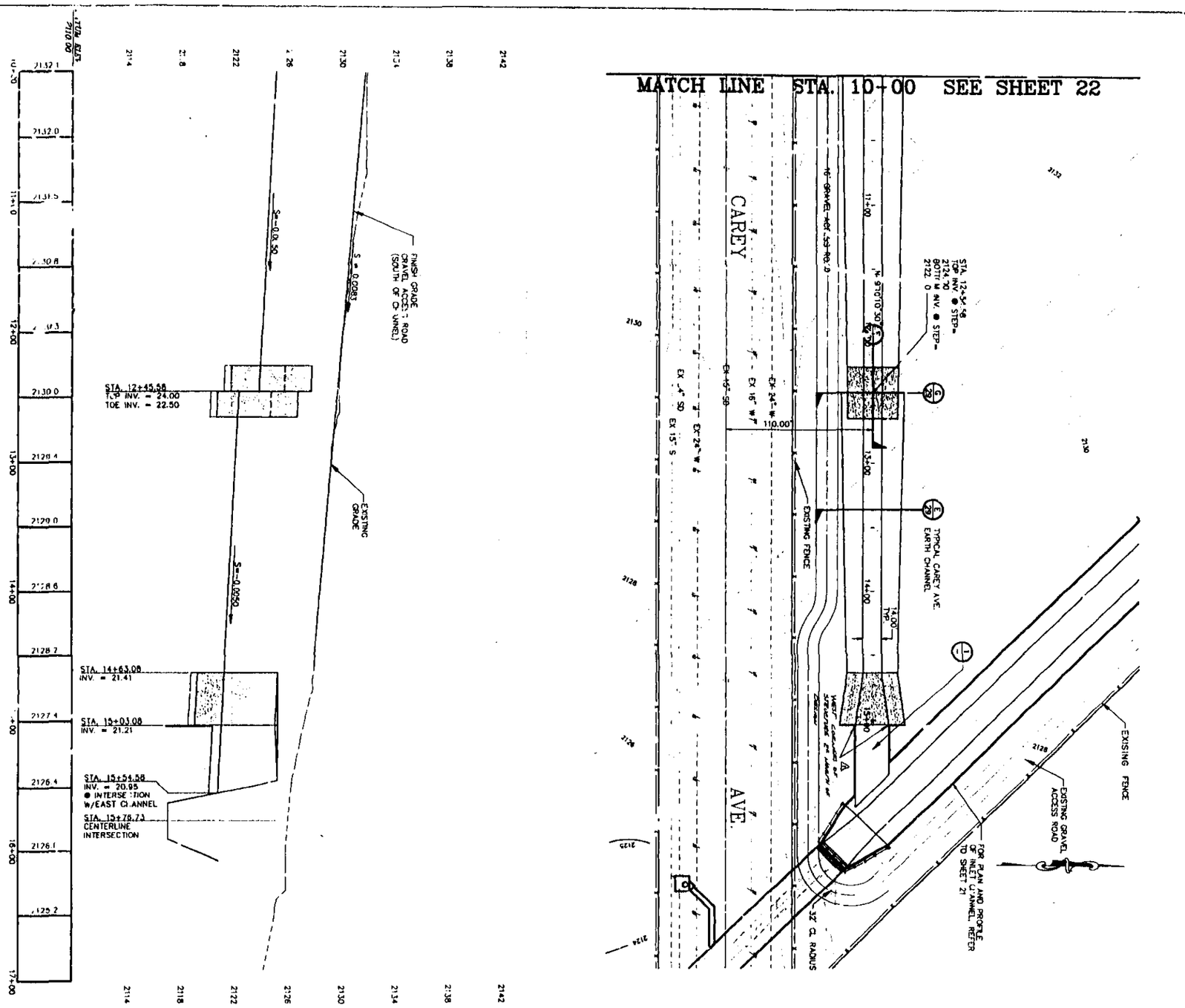
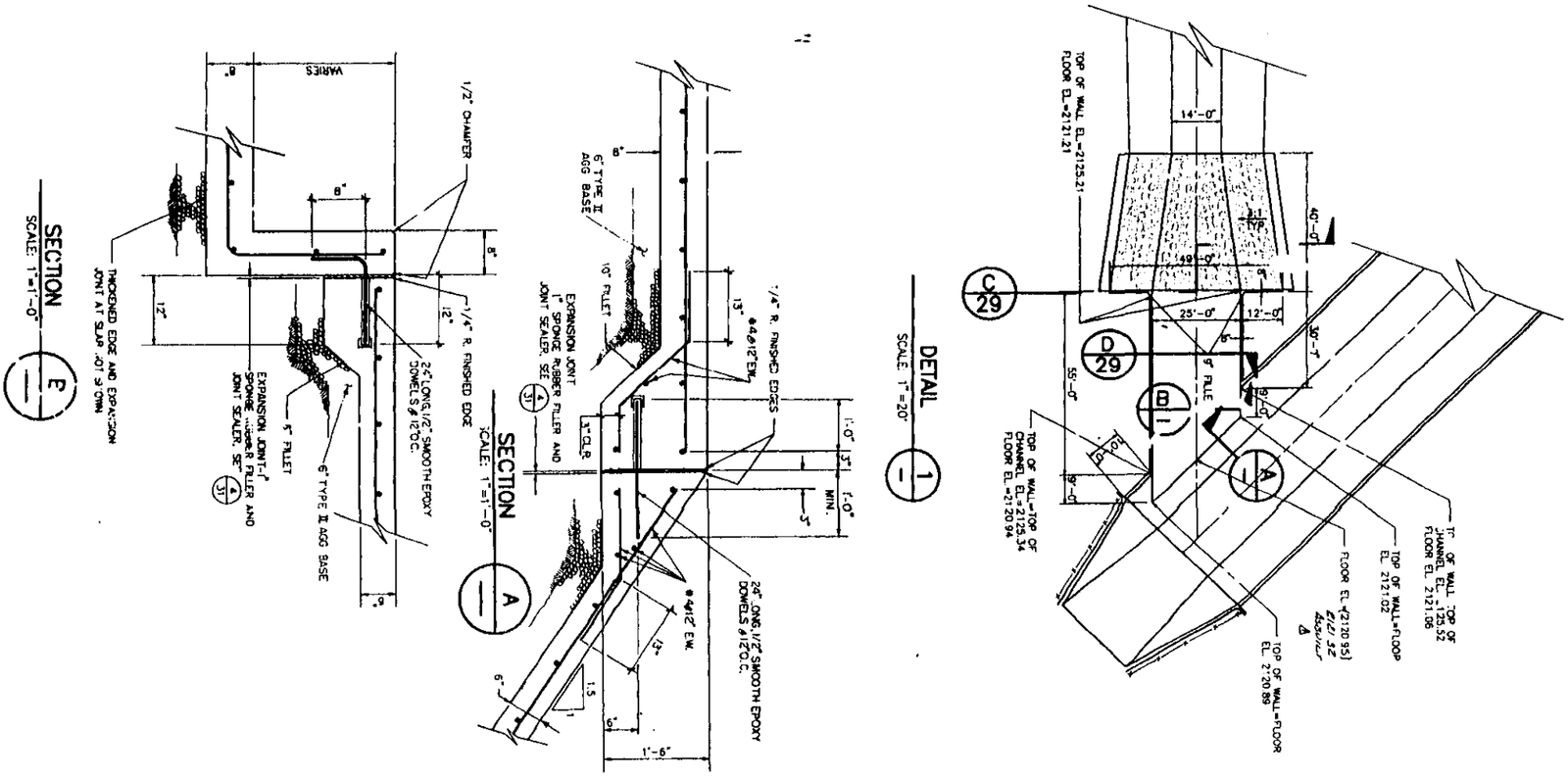
SHEET 22 OF 31 SHEETS
DATE JUNE 5, 1991
BY PWD/BKP
JOB NO. 3996
SCALE HOR. 1"=40'
VERT. 1"=4'





CITY OF LAS VEGAS	
CLARK COUNTY, NEVADA	
PLAN & PROFILE CAREY AVE CHANNEL STA. 10+00 TO END	
CAREY / LAKE MEAD DETENTION BASIN	
JOB NO. 3996	
DATE JUNE 5, 1991	
BY PMH/BKP	
SHEET 23 OF 31 SHEETS	

KEY	DATE	BY	REVISION
	10.8.91	HV	thomas

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Section 4
Angel Park Detention Basin

Hydrology Study, Angel Park Detention Basin

N:\930017\ADMIN\17-094RP.WP5

Included in this section:

Excerpts from *Hydrology Study, Angel Park Detention Basin*, February 1983 by VTN Nevada.

CITY OF LAS VEGAS

Hydrology Study
ANGEL PARK DETENTION BASIN

FEBRUARY 1983

VTN
NEVADA

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2. Model Description
3. Input Parameters
4. Findings and Recommendations

III. Computer Analysis

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2. Kinematic Wave Method--Soil Group D
3. SCS Dimensionless Unit Hydrograph Method--Soil Group A
4. SCS Dimensionless Unit Hydrograph Method--Soil Group D
5. Probable Maximum Precipitation Hydrograph

IV. Plates

V. References

I. INTRODUCTION

The City of Las Vegas has commissioned VTN Nevada to design Angel Park Detention Basin based upon the "Angel Park Detention Basin Phase IIB Design Report" dated November, 1982 prepared by John M. Tettemer & Associates, Ltd. Since VTN was given the responsibility for the design of the detention basin, VTN considered that it was its professional responsibility to verify the results of the design report. The work performed and discussed herein is a simplifed model of the watershed and intended to verify on gross terms the findings of the design report. The model used was the Corps of Engineers HEC-1 computer program which is available on VTN's computer and is widely used for hydrologic analysis.

II. HYDROLOGY STUDY

1. Description of the Study Area

The watershed tributary to the Angel Park Detention Basin (Phase I, Phase IIA and Phase IIB) studied in this report has a drainage area of approximately 29 square miles. Its boundaries are the City of Las Vegas to the east and the La Madre Mountains to the west, Brownstone Basin and Red Rock Wash to the south and Box Canyon to the north.

The study area was divided into three major well-defined watersheds (canyons) contributing directly to the retention basin on the south (areas "B", "C", and "D" on Plate 1). The slopes and areas of the drainage basins and water courses were taken from U.S.G.S. 7.5-minute quadrangle maps. The northern part of the study area (Area "A" Plate 1) is presently criss-crossed by several small canyons in a radial manner. The design report considers 68% of this watershed to be diverted into the Angel Park Retention Basin upon future development, since this area is not presently master planned.

The main characteristic of the tributary watersheds is a very large length to width ratio. Since the shape of the drainage basin directly effects the shape of the hydrograph, a long watershed will normally produce long lagtime. The upper one-third of the drainage basin has steep slopes and is assumed to remain in its natural undeveloped state, while the lower two-thirds is assumed to be developed. Presently, the entire drainage basin is undeveloped.

2. Model Description

The model chosen to simulate the rainfall-runoff process of the above described study area was the kinematic wave method or kinematic flow approximation model. This method has proven to be a very useful tool in stormwater modeling of overland flow on long impermeable planes

such as streets and parking lots in urbanized areas, or converging surfaces like watersheds of natural canyons.

Due to the scope of this report the drainage basin has not been subdivided in detailed subbasins bounded by existing and/or future traffic arteries. As previously discussed, the study area has been divided into four major basins. Each major drainage basin was further subdivided into an initial area considered as a flow plan that will remain on its initial-undeveloped condition in the future, and an area that will be developed and will have collector channels (streets) and main channels (storm drains). The kinematic wave technique was applied to transform rainfall excess into subbasin outflow using the HEC-1 flood Hydrograph computer program, developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers, September 1981 (Reference 4).

In the kinematic wave interpretation of the flow of the runoff it is assumed that the bed slope and water surface slope are equal, therefore slopes from the U.S.G.S. 7.5-minute quadrangle maps can be used for hydraulic calculations. This method also assumes that runoff is constant within a time step. The overland flow element is treated as a wide rectangular channel. Runoff from overland flow elements travel to a subbasin outlet through channels or storm drains.

The Soil Conservation Service (S.C.S.), dimensionless unit hydrograph method was used in the design report. As a cross check to our findings, we used the SCS unit hydrograph in conjunction with the HEC-1 computer program for the entire undivided drainage area.

3. Input Parameters

In order to perform the modeling analysis using the HEC-1 program, two general types of input are needed: job control data and basin simulation data.

Job Control Data includes type of hydrograph, report title, and time increments. The basin simulation data is directly related to the hydrologic and hydraulic characteristics of the watershed and consists of the following:

a. Precipitation Data

The precipitation volume and distribution is the single most important meteorological characteristic in estimating runoff volumes. The specified precipitation (uniformly distributed over the study area and all the subbasins) is the 100-year, 3-hour duration storm, and the Probable Maximum Participations (P.M.P.) 6-hour duration storm as used in the design report (see Reference 1 and Reference 6).

The design amount of the specified rainfall was obtained from Technical Paper No. 40 "Rainfall Frequency Atlas of the United States" by the Department of Commerce, Weather Bureau. The rainfall distribution curves for both the 100-year and P.M.P. were prepared by the U.S. Geological Survey and included in the design report. For the 100 year, 3-hour duration storm, the precipitation amount is 2 inches, while the P.M.P. 6-hour duration storm is 12.5 inches.

VTN reviewed these assumptions and the data takeoff and found them acceptable.

b. Time of Concentration

Time is an important element in hydrologic forecasting. Most hydrology methods for runoff determination include the time variable as an input in the model. There is a delay in time, after a brief heavy rain over a watershed before the runoff reaches its maximum peak (time to peak, "T_p"). This delay is a watershed characteristic, called lag (L). The Soil Conservation Service defines lag as the time in hours from the center of mass of rainfall excess to the peak discharge of the hydrograph.

It is worthwhile to note that the shape of rainfall hyetograph for Angel Park (time distribution of precipitation) is typical for the desert areas of the western United States, with the major percentage of the precipitation occurring during the first hour of the event. This phenomenon normally will produce a sharp peak of the hydrograph at the beginning of the event. However, as described in Reference 2, "A Guide to Hydrologic Analysis Using SCS Methods," the lag time depends strongly on basin characteristics.

Lag is determined by the following equation as recommended by the Soil Conservation Service:

$$L = \frac{l^{0.8}\,(S + 1)^{0.7}}{1900\ Y^{0.5}}$$

L = lag in hours

l = hydraulic length in ft.

S = potential maximum retention (function of S.C.S.'s curve number CN)

Y = Slope in percent

The very long drainage basin (as is the case of subareas A and D contributing to the Angel Park Detention Basin) will produce lag, therefore time to peak of around three hours.

The lag time in hours computed by the above equation will be the time input for the Soil Conservation Service (SCS) dimensionless unit hydrograph method.

The estimation of the time of concentration using the kinematic wave method is based on the ratio of the hydraulic flow length to the velocity of the flow:

$$t_c = \frac{l}{V}$$

l = length of plane (ft)
v = velocity of the water wave (ft/sec)

c. Land Use

The land use element consists of undeveloped natural watershed, developed foothills and alluvial plains. The developed areas are considered residential, commercial, industrial and open space. The SCS *Runoff Curve Numbers have been selected for an assumed mix of future* land use (see Table 2, Reference 2).

d. Hydrologic Soil Groups and Antecedent Moisture Condition

The volume and rate of runoff depends on both meteorologic and watershed characteristics. While precipitation volume is the single most important meteorological factor in estimating runoff, the hydrologic condition of the watershed, soil type and antecedent soil moisture will also be important determinants of runoff volume.

Losses abstracted from the total rainfall are:

1. Interception losses (rainfall caught by vegetation)
2. Evapotranspiration losses
3. Depression storage
4. Infiltration losses

These four groups of losses, as well as the soil type, land use, hydrologic condition of the watershed cover and soil moisture condi-

tion, are linked together by the Soil Conservation Service with the SCS runoff curve number (CN).

The SCS curve number is an input into the HEC-1 computer program representing the hydrologic soil group (clay, sand, silt, etc.), the vegetative soil cover complex, the effect of the development and antecedent moisture condition of the soil. Antecedent Soil Moisture Condition II (Average Condition) was selected to be used for the watershed. Calculations were performed for the two extreme Soil Groups, A and D. (Soil Group A represents sands and silts, and Soil Group D heavy plastic clays, and saline soils, see page 12, Reference 2).

e. Overland Flow and Channel Elements

The overland flow element input includes the overland flow length, slope and roughness factor of the watershed and percent of the subbasin with identical characteristics. Overland flow elements are assumed to travel to a subbasin outlet through successive channel elements.

The portion of the watershed assumed to be developed in the future is modeled as a typical suburban community with a drainage area of one square mile. Runoff from this area is intercepted by a local drainage system of storm drain pipes with 36 inches diameter. Flow from the local drainage system is conveyed to concrete open channels flowing through the watershed, following the path and slope of the existing natural canyons. The channel elements are defined as length, slope, roughness, shape and geometrical characteristics.

4. Findings and Recommendations

The results of the computer analysis are attached in Section III, "Computer Analysis."

The analysis includes the derived hydrographs for the following conditions:

1. 100-year, 3-hour duration rainfall--runoff hydrograph, kinematic wave method--watershed divided into four subbasins corresponding to drainage subareas A, B, C and D, Soil Group "A".

2. 100-year, 3-hour duration rainfall--runoff hydrograph, kinematic wave method--watershed divided into four subbasins corresponding to drainage subareas A, B, C and D, Soil Group "D".

3. 100-year, 3-hour duration rainfall--runoff hydrograph, SCS dimensionless unit hydrograph method, undivided watershed, Soil Group "A".

4. 100-year, 3-hour duration rainfall--runoff hydrograph, SCS dimensionless unit hydrograph method, undivided watershed, Soil Group "D".

5. Probable maximum 6-hour precipitation--runoff hydrograph, undivided watershed, Soil Group "A".

6. Tettemer Design Report, peak flows, time to peak and total runoff volumes.

For ease of discussion, the peak discharge, time to peak and total runoff volumes are tabulated on the following page.

	Drainage Area	Peak Discharge (cfs)	Time to Peak (hrs)	Total Runoff (ac-ft)
1.	100-year, 3-hour, Soil Group "A"			
	Kinematic Wave			
	A (Subareas A1, A2)	1,740	2.75	570
	B	267	1.50	61
	C	193	1.50	44
	D (Subareas D1, D2)	2,277	2.75	758
				1,433
2.	100-year, 3-hour, Soils Group "D"			
	Kinematic Wave			
	A (Subareas A1, A2)	2,515	2.50	746
	B	374	1.25	76
	C	270	1.25	55
	D (Subareas D1, D2)	3,375	2.50	1,005
				1,882
3.	100-year, 3-hour Soil Group "A"			
	S.C.S. Dimensionless Unit Hydrograph			
	A, B, C and D	3,859	4.50	1,623
4.	100-year, 3-hour Soil Group "D"			
	S.C.S. Dimensionless Unit Hydrograph			
	A, B, C and D	4,757	4.50	1,995
5.	Probable Maximum Precipitation (P.M.P.)	19,634	5.5	11,177
6.	Tettemer Design Report (pg. 22 & 12)			
	A (1)	1,800	1.24	
	B (3)	400	to	
	C (5)	300	1.78	949.9
	D (6)	2,400		

A general pattern of similarity exists for the values of the peaks obtained by the VTN analysis (the 100-year, 3-hour, Soil Group "A"; kinematic wave method) and those indicated in the Table on page 22 of the design report. Also, the total incoming runoff volume of 1400 ac-ft obtained by the VTN analysis is in agreement with the volume obtained by the design report. Plate 1, "Drainage Area Map", presented in the design report, shows Zone B with a drainage area of 9.3 square miles contributing only 68% of its runoff to the Angel Park Detention Basin. The basis for this assumption is questionable.

The similarity is irrespective of the fact that the patterns of the drainage subbasins may be different. A considerable difference exists between the values of hydrograph peak times. The method of determining the time elements as an input for the runoff determination has been outlined under the "Time of Concentration" paragraph of this study. The assumptions made for the hydrology soil groups and SCS curve numbers are not shown in the design report, therefore we could not resolve the difference. Since the analysis presented hereon is a reconnaissance level study, with some data accepted from the prior report, others assumed independently, and applied to a much simplified watershed model, analyzed with a different computer method, it is hard to expect a total similarity of the results.

If the watershed is primarily soil group A, no significant difference exists. However, if soil group D is the primary soil type, then there is a significant difference. This difference would require a greater amount of retention (1882 ac.ft. vs. 950 ac.ft.).

It is our recommendation that the City resolve the issues of soil type, total volume, and the runoff percentage of drainage area A out of the basin.

Supplement to Hydrology Study, Angel Park Detention Basin

Supplement to Hydrology Study, Angel Park Detention Basin

Included in this section:

Excerpts from *Supplement to Hydrology Study, Angel Park Detention Basin*, March 1983 by VTN Nevada.

CITY OF LAS VEGAS

SUPPLEMENT TO

Hydrology Study
ANGEL PARK DETENTION BASIN

MARCH 1983

VTN
NEVADA

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2) Hydrology Study--Watershed Under Existing Conditions

3) Findings and Recommendations

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2) SCS Method--Future Conditions

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4) Probable Maximum Precipitation

IV. PLATES

I. INTRODUCTION

VTN is pleased to submit this supplement to the original "Hydrology Study--Angel Park Detention Basin," dated February 1983. The purpose of the original study was to verify in general terms the findings of the "Angel Park Detention Basin Phase IIB Design Report," dated November 1982, prepared by John M. Tettmer & Associates, Ltd.

This supplement includes revisions to the original computer model for future developed conditions. It also presents a schematic hydrology study of the watershed presently tributary to the basin under existing undeveloped conditions.

II. HYDROLOGY STUDY

1. Revisions--Existing Computer Model--Future Developed Conditions

During the March 22, 1983 meeting between John M. Tettmer & Associates, Ltd. and VTN staff, certain input parameters for the runoff model and the assumptions used in both studies were clarified. Consequently, the VTN study has been revised accordingly.

a. Precipitation Data

The 100-year 3-hour duration storm and the Probable Maximum Precipitation (PMP) 6-hour duration storm were used in both the design report and the VTN study.

For the 100-year 3-hour storm, both studies used the procedures outlined in the National Oceanic and Atmospheric Administration Precipitation-Frequency Atlas of the Western United States, Volume VII, Nevada. As outlined in the Atlas, the 100-year 1-hour values were estimated for the Virgin River Basin from the 100-year 6-hour and 100-year 24-hour values. Using this method, the 100-year 3-hour value was estimated and the amount of 2 inches was uniformly used over the drainage area by VTN. Based on the same reference and procedure, an isohyetal map was prepared and a weighted average point rainfall was determined in the design report, with a 1.87 inch depth of rain being used for runoff determination. Since 1.87 inches for the 3-hour 100-year precipitation was found acceptable, the VTN model was revised.

Both studies agree on the amount of the 6-hour Probable Maximum Precipitation (PMP).

b. Time of Concentration

The design report and the VTN study are not in agreement on the time of concentration.

In the design report the entire watershed has been divided into 1/4 square mile subbasins covering 818 subareas. The flow was routed through streets and drains using the SCS method. Flow velocities and travel times were calculated and summed to obtain the time of concentration.

The VTN study, due to its limited scope of work, subdivided the entire watershed into four major subareas and used the kinematic wave method to estimate the elements of the hydrographs (including the time to peak). The Soil Conservation Services unit hydrograph method was applied for the entire undivided drainage area as a cross check.

The disagreement of the time element could be due to the different methods and "depth" of the two studies. This discrepancy can only be solved by a detailed analysis of the design report runoff model.

c. Antecedent Moisture Condition

The Antecedent Soil Moisture Condition II (average condition) was selected for use in both the design report and the VTN study.

d. Land Use and Hydrologic Soil Groups

Land use and hydrologic soil groups directly affect the amount of precipitation lost from a total rainfall. Precipitation loss was estimated based on values of the Curve Number (CN) supplied in both studies. Following the March 22, 1983 meeting, VTN revised its runoff model using the weighted average CN as established in the design report.

After taking into consideration that a major percentage of the watershed will be developed in the future and consists of soil group D, with a very high runoff potential, a high CN was found acceptable.

2. Hydrology Study--Watershed Under Existing Conditions

The major function of the Angel Park Detention Basin is to store all contributing 100-year runoff. By containing this volume, areas in the City, east and northeast of the basin, will benefit due to a reduced flood potential resulting from reduced peak flow rates and depths. Portions of the drainage area are presently developed, while others are zoned for future development (see Plates 8, 9 and 10 of design report).

The volume of the Angel Park Detention Basin, about 1000 acre-feet, was based upon available funding. In addition to the runoff directly contributing to the basin at present, additional areas were assumed in the design report to be diverted into the basin during successive development.

The basis for this assumption is questionable, since numerous complex variables are involved.

This supplement to the original VTN report presents the results of a schematic hydrology study for the watershed presently tributary to the basin under existing conditions. The intent of this addition is discussed in the following chapter.

The SCS method in conjunction with the HEC1 program was used for the entire undivided drainage area in this supplemental study. All the input parameters used were discussed in the previous chapter "Revisions--Existing Computer Model" except the Curve Number. The latter has been slightly reduced due to existing land uses. The drainage area presently contributing to the detention basin is shown on Plate 1-S and is approximately 20 square miles.

Runoff volume, peak flow and time to peak flow from this area are presented in "Findings and Recommendations."

3. Findings and Recommendations

The results of the revised and additional computer analyses are included in Section III, "Computer Analyses."

The analyses include the revised hydrographs for the following conditions:

1. 100-year 3-hour duration rainfall-runoff hydrograph--kinematic wave method.

2. 100-year 3-hour duration rainfall-runoff hydrograph--SCS method.

3. The Probable Maximum Precipitation (PMP) runoff hydrograph.

Additional hydrographs were determined for:

1. 100-year 3-hour duration rainfall, existing conditions, watershed directly tributary to Angel Park Detention Basin.

2. The Probable Maximum Precipitation (PMP) runoff hydrograph--existing conditions, watershed directly tributary to Angel Park Detention Basin.

The peak discharge, time to peak and total runoff volumes are tabulated on the following page.

		Peak Discharge (cfs)	Time to Peak (hrs)	Total Runoff (ac-ft)
1.	100-year 3-hour Kinematic Wave			
	A (Subareas A1, A2)	1,548	2.75	466 x 68% = 317
	B	235	1.75	46 46
	C	170	1.75	33 33
	D (Subareas D1, D2)	1,921	3.00	633 633
				1,178 1029 A-F
2.	100-year 3-hour Soil Conservation Service A, B, C and D	3,860	3.50	1,239
3.	Probable Maximum Precipitation (PMP) (Basin IIA)	20,900*	3.25	7,000
4.	100-year 3-hour Soil Conservation Service	2,320	3.50	745
5.	Probable Maximum Precipitation (PMP)	31,280	3.00	11,313
6.	Tettmer Design Report (pg. 22 & 12)			
	A (1)	1,800	1.24	949.9
	B (3)	400	to	
	C (5)	300	1.78	
	D (6)	2,400		

(*) 44% of the total inflow as divided on page 12 in the design report

Conclusions derived from the prior analyses can be stated as follows:

- o A similarity exists between the design report and the VTN Study--Kinematic Wave Method. The inflow volume is 950 ac-ft versus 1028 ac-ft, accepting the assumption that Zone B contributes 68 percent of its total runoff to the basin (page 11, design report).

- o Accepting the same assumption, there is an additional similarity between the design report and the VTN study, SCS method (950 ac-ft versus 1116 ac-ft).

- o The 20 sq.mi. watershed, tributary to the basin, under existing conditions will yield about 750 ac-ft of runoff with a peak of 2,320 cfs. At this time, without further development and diversion, the areas downstream from the basin will benefit only from the corresponding reduction of runoff.

- o The management of the development of future areas to be diverted into the basin will have to be strictly controlled by the City. Excess runoff diverted to the basin might cause operational failures, while under-utilization might create downstream flooding.

- o Volume reduced by sedimentation has not been addresed in either study. This is of major importance if storms are consecutive with insufficient time for debris removal between the successive storms.

- o VTN is responsible for the design of the basin's outflow structures for runoff in excess of the 100-year flood. There is a discrepancy between the PMP peak discharge in the design report and the hydrology study. This discrepancy must be clarified.

The following points are recommended for further study:

- The amount of present flood protection.
- The reduction of detention volume due to the incoming sediment in the present and future.
- A stormwater management plan to secure future development patterns compatible with the design report.
- Clarification of the peak discharge for the Probable Maximum Precipitation (PMP).

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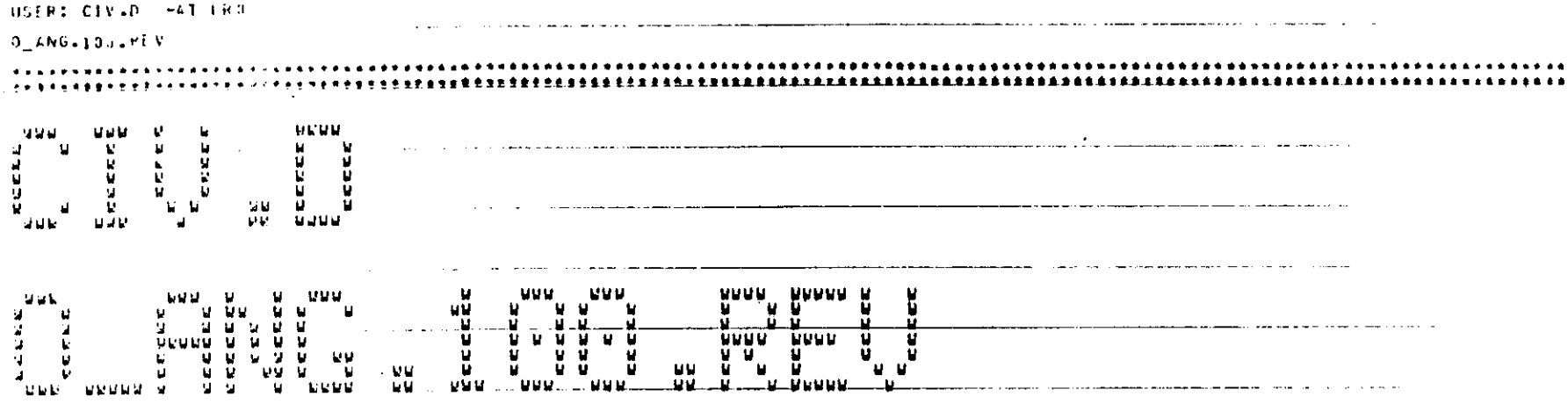

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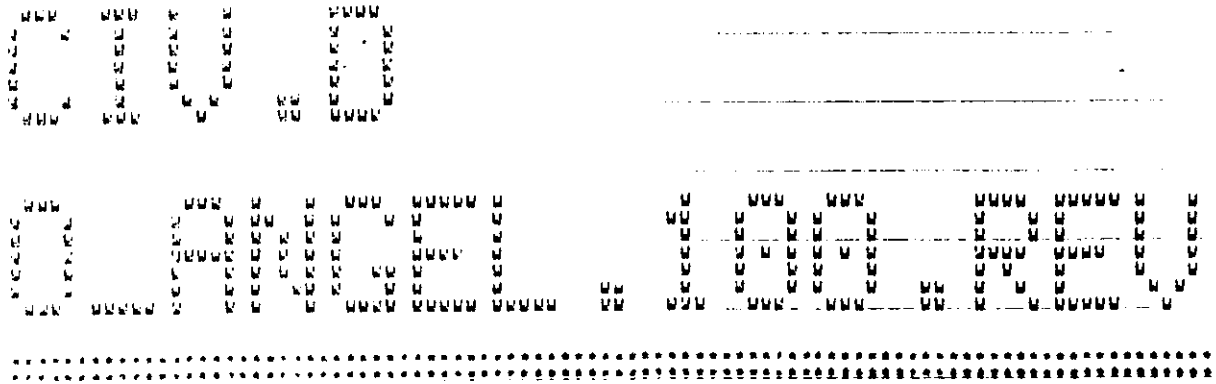

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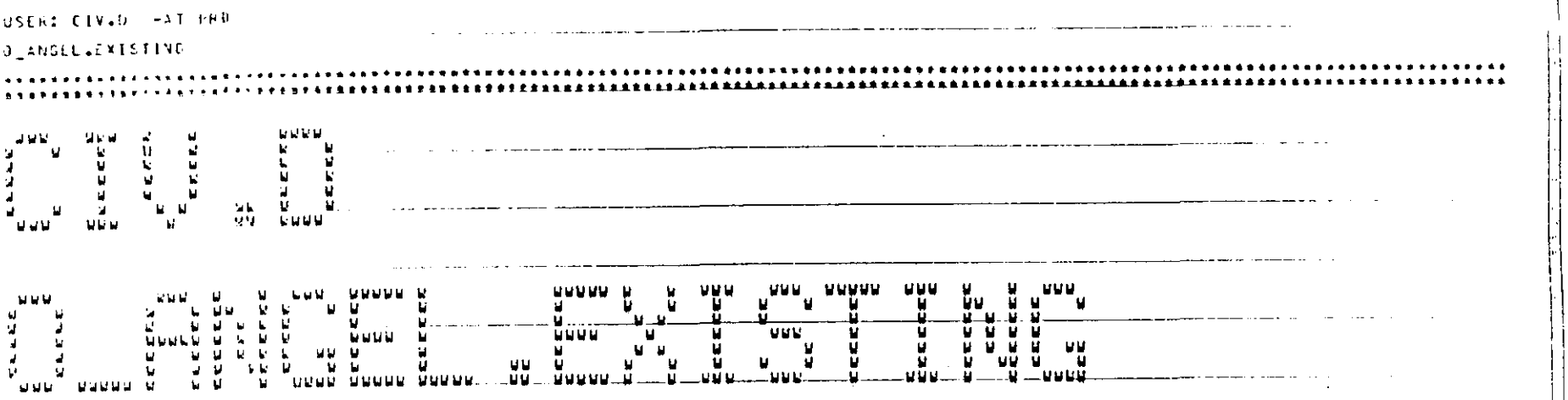

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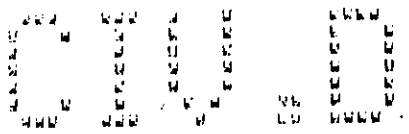

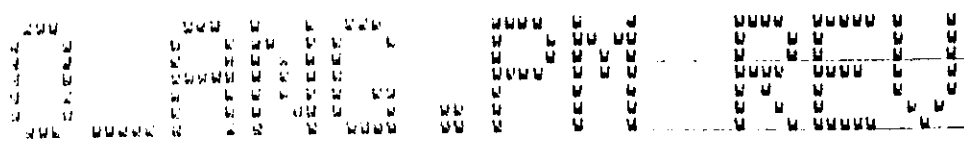

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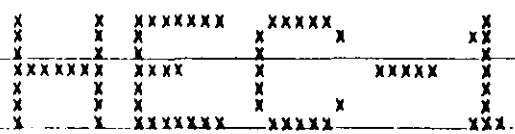


Construction plans for *Angel Park Detention Basin, Phase IIB*

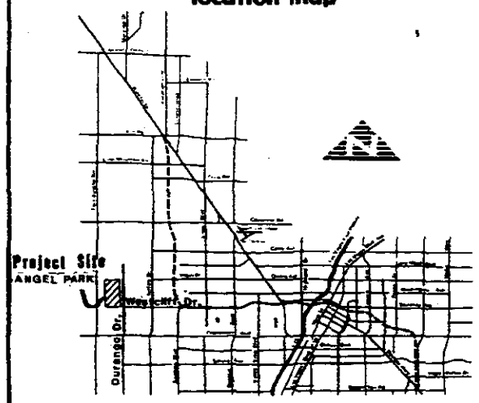
N:\930017\ADMIN\17-094RP.WP5

Included in this section:

Construction plans for *Angel Park Detention Basin, Phase IIB*, prepared by VTN Nevada, February 1985.

agency	approved	date
Deputy City Manager		
Director of Design & Development	By:	21 Dec '84
City Engineer		21 Dec '84
Chief of Civil Engineering	N/A	
Chief of Traffic Engineering	N/A	
City Project Administrator	N/A	
Chief of Project Control	N/A	
Director of General Services	N/A	
Chief of Maintenance	N/A	
Director of Parks, Recreation & Senior Activities	N/A	
Director of Public Services	By:	21 Dec '84
Chief of Electrical Services	N/A	
Director of Community Planning & Development	N/A	
Director of Building & Safety	N/A	
Regional Transportation Commission	N/A	
Nevada State Department of Transportation	N/A	
Central Telephone Company		12-10-84
Las Vegas Valley Water District		12-10-84
Nevada Power Company		12/7/84
Southwest Gas		12/10/84
Cable Television	N/A	
CLARK COUNTY DIRECTOR OF PUBLIC WORKS		1/2/85

location map



City of Las Vegas

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mayor:
Bill Briare

councilmen:
Ron Lurie
W. Wayne Bunker
Al Levy
Bob Nolen

city manager:
Ashley Hall

director of design & development:
Thomas B. Graham

index of sheets

no.	description
1.	Cover, Location Map, Index of Sheets
2.	Abbreviations, Legend, General Notes
3.	Horizontal Control Plan, Watershed Boundary
4.	Grading Plan Sheet Index
5.	Grading Plan 1
6.	Grading Plan 2
7.	Grading Plan 3
8.	Grading Plan 4
9.	Grading Plan 5
10.	Grading Plan Sections
11.	Grading Plan Details
12.	Spillway Details
13.	Outlet Piping Plan and Profile
14.	Outlet Sluice Gate
15.	Outlet Pipe Discharge Structure
16.	Box Culvert Between Basins

revisions

no.	description	by	date	app.

BID NO. 85.3550.1

ANGEL PARK DETENTION BASIN
PHASE IIB

date 2/6/85
drawing number 85E.14-V8
sheet 1 of 16

ABBREVIATIONS

AF	ACRE FOOT
AC.	ASPHALT CONCRETE
AHR.	ANCHOR
BCR	BEGIN CURB RETURN
B.S.W.	BACK OF SIDEWALK
B.V.C.	BEGIN VERTICAL CURVE
C & G	CURB & GUTTER
C.L. INT	CENTER LINE INTERSECTION
C.B.	CATCH BASIN
C.F.S.	CUBIC FEET PER SECOND
C.Y.	CUBIC YARDS
C.L.V.	CITY OF LAS VEGAS
CONC.	CONCRETE
CML & CSP	CEMENT MORTAR LINED & COATED STEEL PIPE
D/W	DRIVEWAY
D.I.	DROP INLET
DIA., Ø	DIAMETER
EX.	EXISTING
E.V.C.	END VERTICAL CURVE
EL.	ELEVATION
F.L.	FLOW LINE
F.G.	FINISH GRADE
FUT.	FUTURE
G.B., GR. BRK.	GRADE BREAK
INV.	INVERT ELEVATION
L.F.	LINEAL FOOT
M.H.	MANHOLE
M.V.C.	MIDDLE OF VERTICAL CURVE
N.P.	NEVADA POWER
PVC	POLYVINYL CHLORIDE
P.P.	POWER POLE
R/W	RIGHT OF WAY
R.60E.	RANGE 60 EAST
SMH	SEWER MANHOLE
S/W	SIDEWALK
SEC. LINE	SECTION LINE
T.C.	TOP OF CURB ELEVATION
TYP.	TYPICAL
T.20S.	TOWNSHIP 20 SOUTH
U.G.	UNDERGROUND
VCP	VITRIFIED CLAY PIPE
V.C.	VERTICAL CURVE
∢ PT.	ANGLE POINT

LEGEND

5:1	5 TO 1 SLOPE
2.5%	DIRECTION & RATE OF GRADE
49+34.47	STATION
	DAYLIGHT CUT (TOP)
	DAYLIGHT FILL (TOE)
C-F	CUT-FILL TRANSITION
	RIP RAP
	CONCRETE
	REINFORCING STEEL
	AC PAVING
	AGGREGATE BASE
	EDGE AC
	CENTER LINE OR SECTION LINE
	PROPERTY/ROW LINE
33" @ 0.023	SIZE OF PIPE AND SLOPE

SECTION NUMBER OR LETTER

A
5

SHEET LOCATION OF SECTION

	EXISTING MANHOLE
W	WATER
S	SEWER
T	TELEPHONE
G	GAS
B1	BORING LOCATION & NUMBER, SEE NOTE 2 BELOW
	SCARP SLOPE
N89°36'13"W	BEARING
2550	NATURAL GROUND CONTOUR & ELEVATION
	POWER POLE
	STREET LIGHT
W	VALVE IN WATER LINE
#4	REINFORCING STEEL BAR SIZE
5 / 1	5 HORIZONTAL TO 1 VERTICAL
32 29 / 33 28	SECTION CORNER

DETAIL DESCRIPTION — DETAIL NUMBER

5
1

SHEET LOCATION OF DETAIL

GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFF SITE IMPROVEMENTS, CLARK COUNTY NEVADA, 1978 UNLESS OTHERWISE SHOWN ON THE DRAWINGS OR SPECIFIED IN THE CONTRACT.
2. A SUBSURFACE SOILS INVESTIGATION WAS PERFORMED. A COPY OF THE SOILS REPORT CAN BE REVIEWED AT THE OFFICE OF VTN NEVADA. THE CITY OF LAS VEGAS ASSUMES NO RESPONSILITY FOR *THE INFORMATION CONTAINED IN THE REPORT. THE CONTRACTOR SHALL NOT BE RELIEVED OF* LIABILITY UNDER THE CONTRACT AS A RESULT OF VARIANCE BETWEEN ACTUAL SOILS CONDITIONS AND CONDITIONS INDICATED IN THE REPORT.
3. PHASE IIB SHALL BE COMPLETED, AS DETERMINED BY THE ENGINEER, PRIOR TO BREECHING THE BERM BETWEEN PHASE IIA AND PHASE IIB.
4. THE CONTRACTOR SHALL EXCERCISE CARE TO PROTECT THE NATURAL GROUND SURFACE AND PLANT GROWTH ADJACENT TO THE PROJECT. ALL WORK SHALL BE CONFINED TO A LIMIT OF 20 FEET FROM LINES EXCAVATION AND FILL SHOWN ON THE DRAWINGS.

REVISION | BY | DATE | REV

CITY OF LAS VEGAS, NEVADA

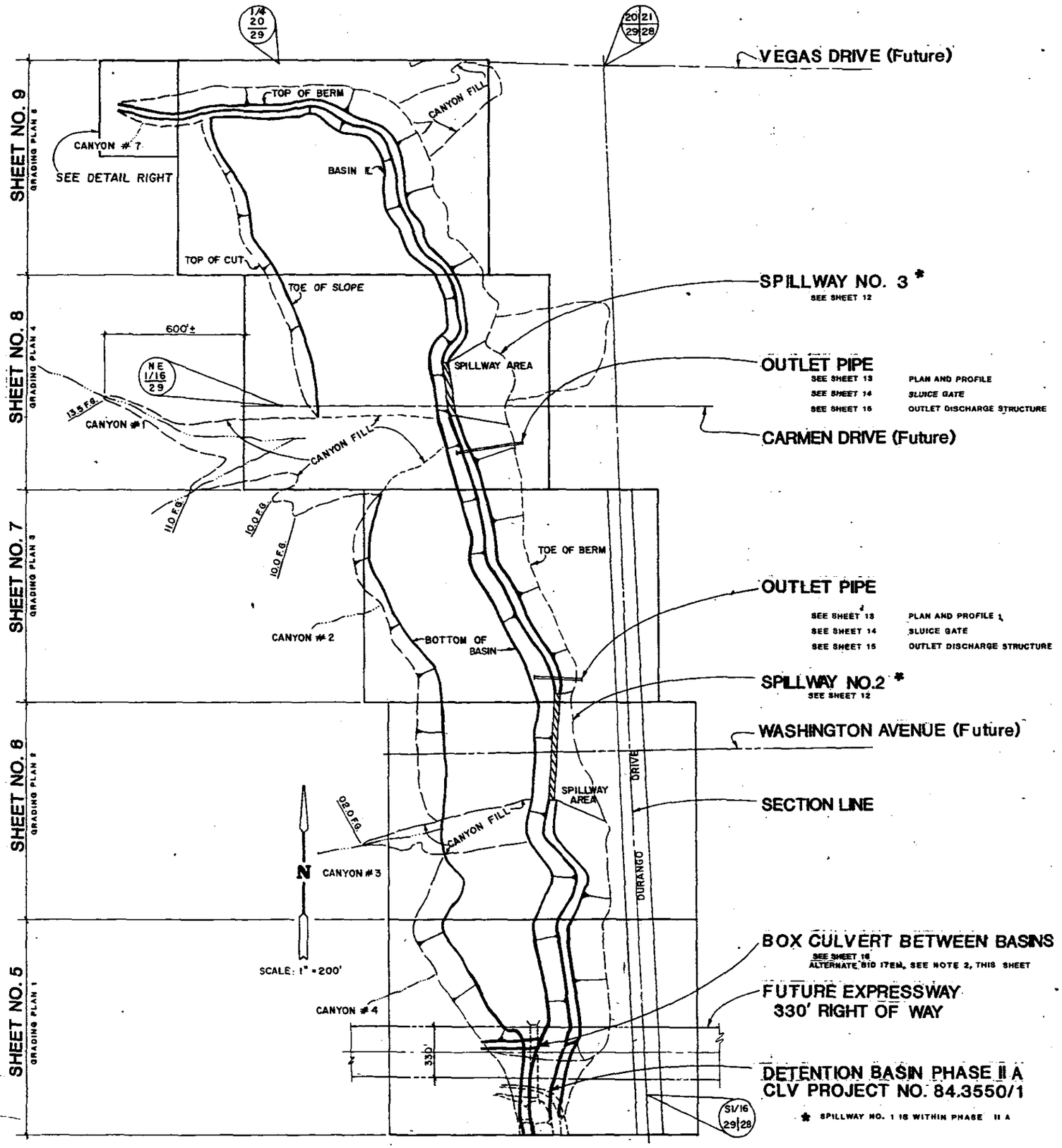
CONSULTING ENGINEERS • PLANNERS
2300 PASEO DEL PRADO BUILDING A SUITE 100
LAS VEGAS, NEVADA 89102 PHONE (702) 873-7550
vtn nevada

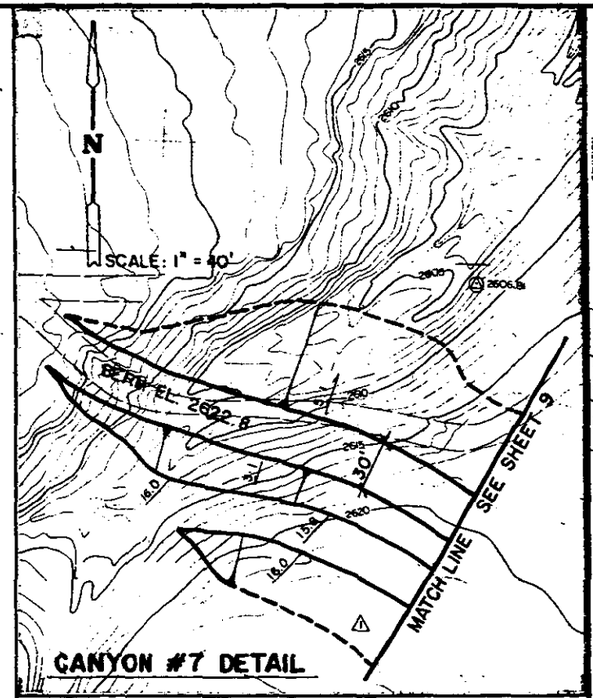
TITLE: ABBREVIATIONS, LEGEND AND GENERAL NOTES

PROJECT: ANGEL PARK DETENTION BASIN PHASE II B

WO NO 3061/B
BY MRW/RLG
DATE 2/6/85
SCALE

SHEET 2 OF 16 SHEETS





GRADING PLAN NOTES

1. THE BOX CULVERT SHOWN IN PLAN ON SHEET 5 AND IN DETAIL ON SHEET 16 IS AN ALTERNATE BID ITEM. THE ALTERNATE BID PRICE INCLUDES THE ADDITION OF THE BOX CULVERT AND REDUCTION OF 23,000 CUBIC YARDS OF EXCAVATION.
2. PAYMENT FOR EXCAVATION SHALL BE BASED UPON THE VOLUME OF EXCAVATION, AS DETERMINED BY THE ENGINEER, FROM FINISHED GRADES SHOWN ON THE DRAWINGS.
3. STAKING FOR EXCAVATION SHALL BE PROVIDED BY THE OWNER, AS REQUESTED BY THE CONTRACTOR. THE QUANTITY OF STAKING IS PROVIDED IN THE SPECIFICATIONS.
4. THE CONTRACTOR SHALL NOTIFY THE SOUTHWEST GAS CORPORATION WHEN WORKING WITHIN 100 FEET OF THE GAS LINE NEAR DURANGO DRIVE.
5. PRIOR TO PLACING EMBANKMENT MATERIAL, EXISTING SURFACE SHALL BE OVER EXCAVATED IN ACCORDANCE WITH DETAILS ON SHEET 13.

REV	DATE	BY	REVISION
1	7-29-85	MRW	CANYON #7 GRADING

CITY OF LAS VEGAS, NEVADA

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vtn nevada

TITLE: GRADING PLAN SHEET INDEX

PROJECT: ANGEL PARK DETENTION BASIN PHASE II B

WO NO.	3061/B
BY	VJS/RLG
DATE	2/6/85
SCALE	1" = 200'

SHEET 4 OF 16 SHEETS

MATCH LINE SEE SHEET 6

TOP OF CUT

TOE OF SLOPE

99.3 FG

95.35 TOE

96.2 FL

96.3 TOE

BOTTOM OF BASIN

96.0 FL

BERM EL. 2622.8

BASIN FL

96.2 TOE

94.8 FL

TOP OF BERM

TOE OF BERM

98.3 FG

98.1 FG

97.9 FG

96.0 TOE

95.45 FL ELEV.

N89°14'52"W

N02°07'15"W

FUTURE DURANGO DRIVE 100' R/W

SEE NOTE 4, SHT. 4

FUTURE EXPRESSWAY R/W 330'

TOP OF BERM (ALTERNATE BID) (BID GROUP II)

12'x14' BOX CULVERT (ALTERNATE BID) SEE SHEET 16 (BID GROUP II)

EXISTING PHASE II A BERM EL. 2622.8

EXISTING PHASE II A DETENTION BASIN

1.0±%

5:1

3:1

2:1

10%

30'

10'

SCALE: 1"=40'

0 50 100

N

13700 N

13600 N

13500 N

13400 N

13300 N

13200 N

13100 N

13000 N

E 10011

E 10111

E 10211

E 10311

E 10411

E 10511

E 10611

E 10711

E 10811

E 10911

E 11011

E 11111

E 11211

E 11311

E 11411

E 11511

E 11611

E 11711

E 11811

E 11911

E

MATCH LINE SEE SHEET 7

BASIN FLOW LINE

BOTTOM OF BASIN

SPILLWAY EROSION PROTECTION

N88°38'49"W

N00°42'26"E (405.41)

EL. 2618.4

SPILLWAY NO.2 (SEE SHT. 12)

N02°07'15"W

SCALE: 1"=40'

TOP OF CUT

TOE OF SLOPE

N14245.0
E11595.0

N14211.0
E11528.0

DUMPED RIP RAP

CANYON FILL

CANYON #3

SEE SHEET 4
FOR CONTINUATION OF
CANYON FILL

N14034.0
E11527.0

BOTTOM OF BASIN

BERM EL. 2622.8

DURANGO DRIVE (FUTURE)

TOP OF BERM

TOE OF BERM

SEE NOTE 4, SHT. 4

MATCH LINE SEE SHEET 5

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vtn nevada

REVISION | BY | DATE | REV

GRADING PLAN 2

ANGEL PARK DETENTION BASIN
PHASE IIB

TITLE | PROJECT

WO NO 3061/B
BY VJS/RLG
DATE 2/6/85
SCALE 1" = 40'

SHEET 6 OF 16 SHEETS

MATCH LINE SEE SHEET 8

MATCH LINE SEE SHEET 6

BASIN FLOW LINE

TOP OF CUT

CANYON #2

TOE OF SLOPE

BOTTOM OF BASIN

TOP OF BERM

TOE OF BERM

BERM EL. 2622.8

33" RCP OUTLET PIPELINE (SEE SHEET 13)

N14763.5
E11542.4

N14758.5
E11731.0

S88°28'53"E 188.7 L.F.

N14650.0
E11600.0

SPILLWAY EROSION PROTECTION

SPILLWAY NO. 2
EL. 2618.4 (SEE SHEET 12)

FUTURE S. DURANGO DRIVE

N02°07'15"W

SCALE: 1" = 40'

07.9 FG
07.3 FG
06.7 FG
06.3 FG
05.9 FG
05.5 FG
05.1 FG
04.5 FG

03.3 FL
02.8 FL
02.6 FL
02.2 FL
01.7 FL
01.3 FL
01.1 FL
00.9 FL
00.5 FL
00.0 FL

1.0%
5:1
3:1

B-8
B-9
B-26
B-25

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LAS VEGAS, NEVADA 89102 PHONE (702) 873-7550

REVISION | BY | DATE | REV

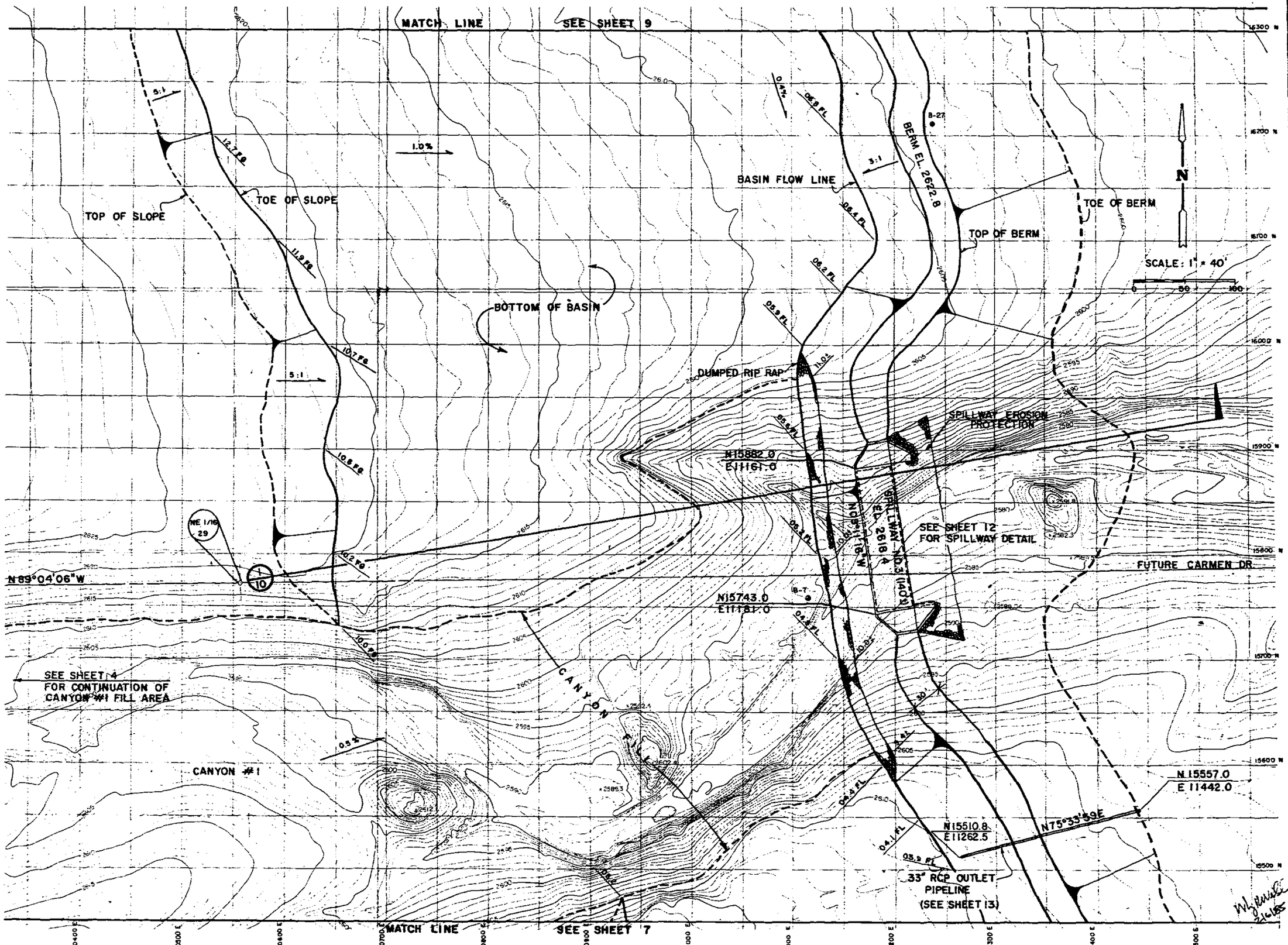
CITY OF LAS VEGAS, NEVADA

GRADING PLAN 3

ANGEL PARK DETENTION BASIN PHASE IIB

WO NO 3061/B
BY VJS/RLG
DATE 2/6/85
SCALE 1" = 40'

SHEET 7 OF 16 SHEETS



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2300 PASEO DEL PRADO BUILDING A SUITE 100
LAS VEGAS, NEVADA 89102 PHONE (702) 870-7060

vtn nevada

GRADING PLAN 4

ANGEL PARK DETENTION BASIN PHASE II B

WO NO	3061/B
BY	VJS/RLG
DATE	2/6/85
SCALE	1" = 40'

SHEET 8 OF 16 SHEETS

N89°29'29"E

SECTION LINE
(FUTURE VEGAS DRIVE)

NOTE: CANYON FILL IS NOT TO EXTEND NORTH OF SECTION LINE.

MATCH LINE SEE SHEET 4

SEE SHEET 4
CONTINUATION OF BERM

BERM EL 2622.8

B-29

B-28

B-16

B-6

B 5

TOP OF BERM

TOE OF BERM

SEE SHEET 4
FOR CONTINUATION OF CANYON FILL

CANYON FILL

TOP OF CUT

TOE OF SLOPE

BOTTOM OF BASIN

BASIN FLOW LINE

MATCH LINE SEE SHEET B

SCALE: 1" = 40'

0 50 100

1.0%

0.4%

3:1

5:1

30

15.8 FG
13.5 FL
14.5 FL
13.8 FL
12.5 FL
11.5 FL
10.5 FL
10.0 FL
09.8 FL
09.6 FL
11.4 FG
15.0 FG
14.6 FG
14.4 FG
14.2 FG
14.9 FG
13.9 FG
13.6 FG
13.2 FG
09.2 FL
08.8 FL
08.4 FL
07.9 FL
07.7 FL
07.5 FL

2606.81
2593.41

17100 N
17000 N
16900 N
16800 N
16700 N
16600 N
16500 N
16400 N
16300 N

10800 E
10900 E
11000 E
11100 E
11200 E
11300 E

1/4 20 29

3 10

CITY OF LAS VEGAS
NEVADA

REV	DATE	BY	REVISION
1	7-29-88	MRW	GRADING

CONSULTING ENGINEERS • PLANNERS
2300 PASEO DEL PRADO BUILDING A SUITE 100
LAS VEGAS, NEVADA 89102 PHONE (702) 873-7550

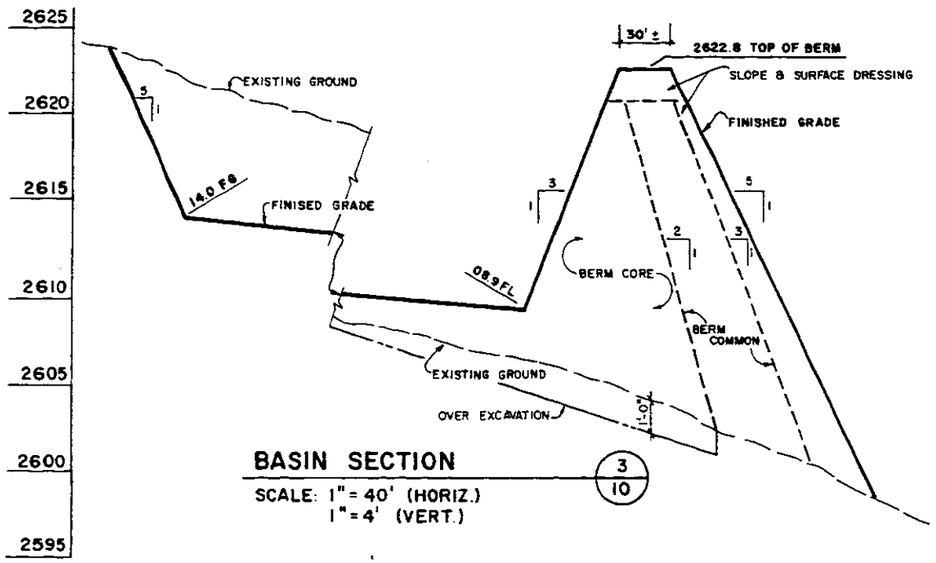
vgt nevada

TITLE: GRADING PLAN 5

PROJECT: ANGEL PARK DETENTION BASIN PHASE IIB

WO NO 3061/B
BY VJS/RLG
DATE 2/6/85
SCALE 1" = 40'

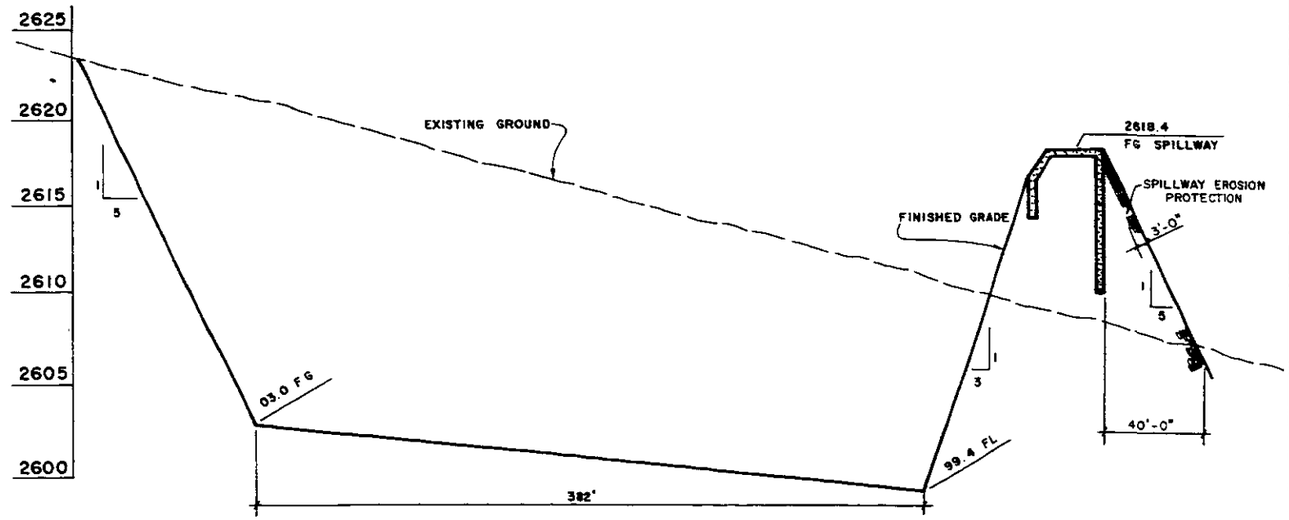
SHEET 9 OF 16 SHEETS



BASIN SECTION

SCALE: 1" = 40' (HORIZ.)
1" = 4' (VERT.)

3/10

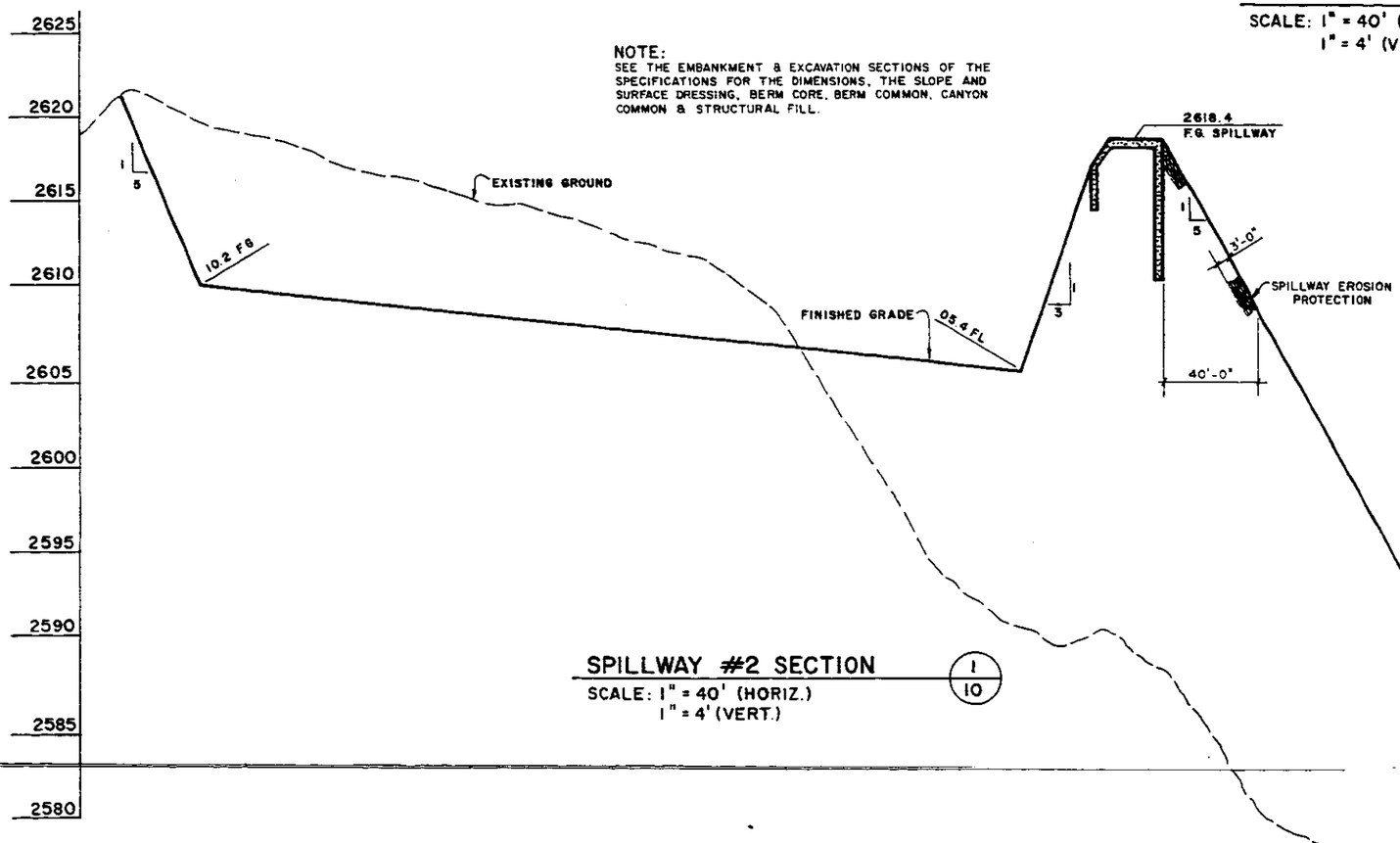


SPILLWAY #3 SECTION

SCALE: 1" = 40' (HORIZ.)
1" = 4' (VERT.)

2/10

NOTE:
SEE THE EMBANKMENT & EXCAVATION SECTIONS OF THE SPECIFICATIONS FOR THE DIMENSIONS, THE SLOPE AND SURFACE DRESSING, BERM CORE, BERM COMMON, CANYON COMMON & STRUCTURAL FILL.



SPILLWAY #2 SECTION

SCALE: 1" = 40' (HORIZ.)
1" = 4' (VERT.)

1/10

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vtn nevada

REV	DATE	BY	REVISION

TITLE: GRADING PLAN SECTIONS

PROJECT: ANGEL PARK DETENTION BASIN PHASE II B

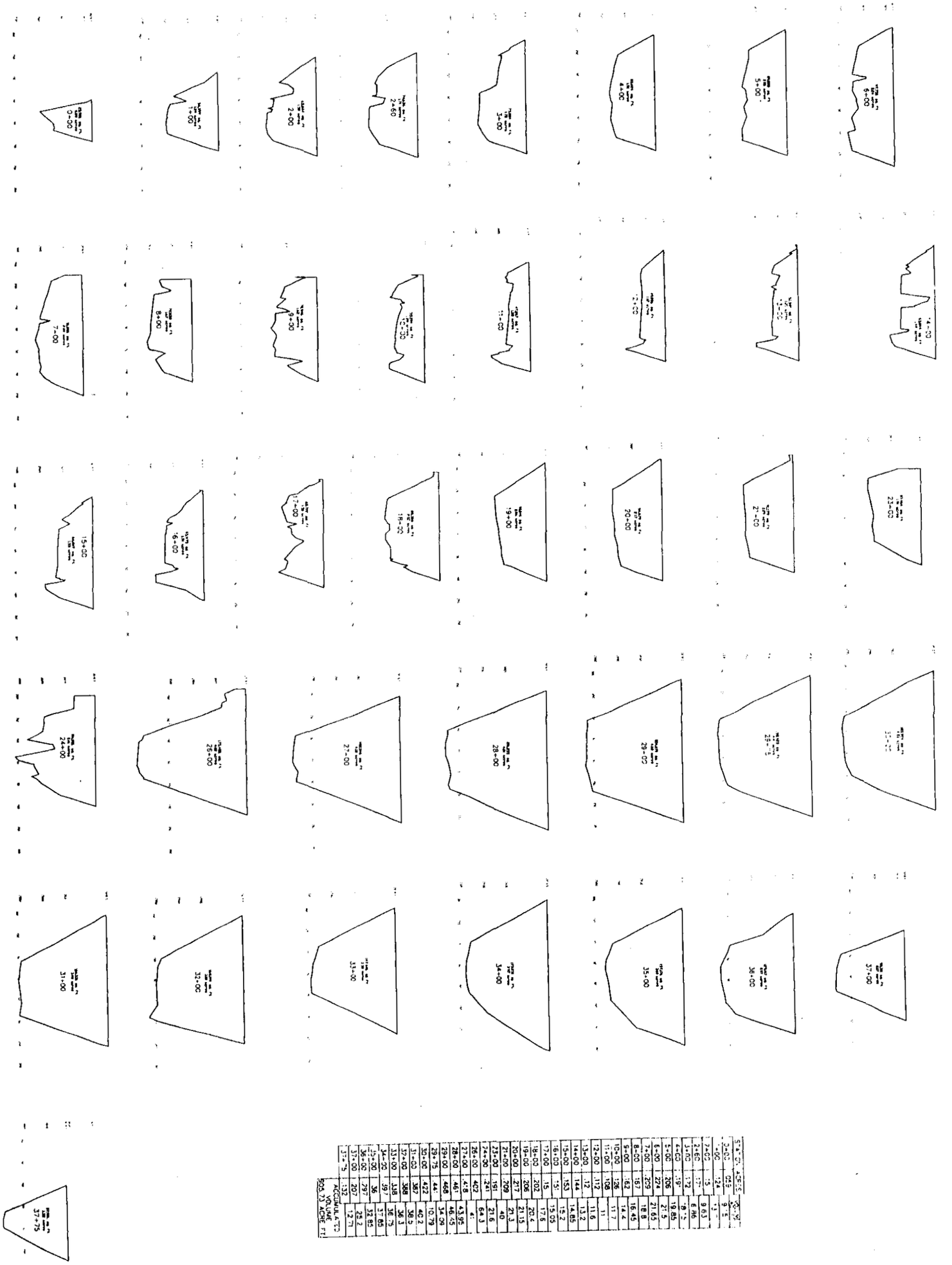
WO NO	3061/B
BY	VJS/RLG
DATE	2/6/85
SCALE	1"=40'(H) 1"=4'(V)

SHEET 10 OF 16 SHEETS

Survey Sections for Angel Park North Detention Basin

Included in this section:

Survey sections for Angel Park north detention basin.



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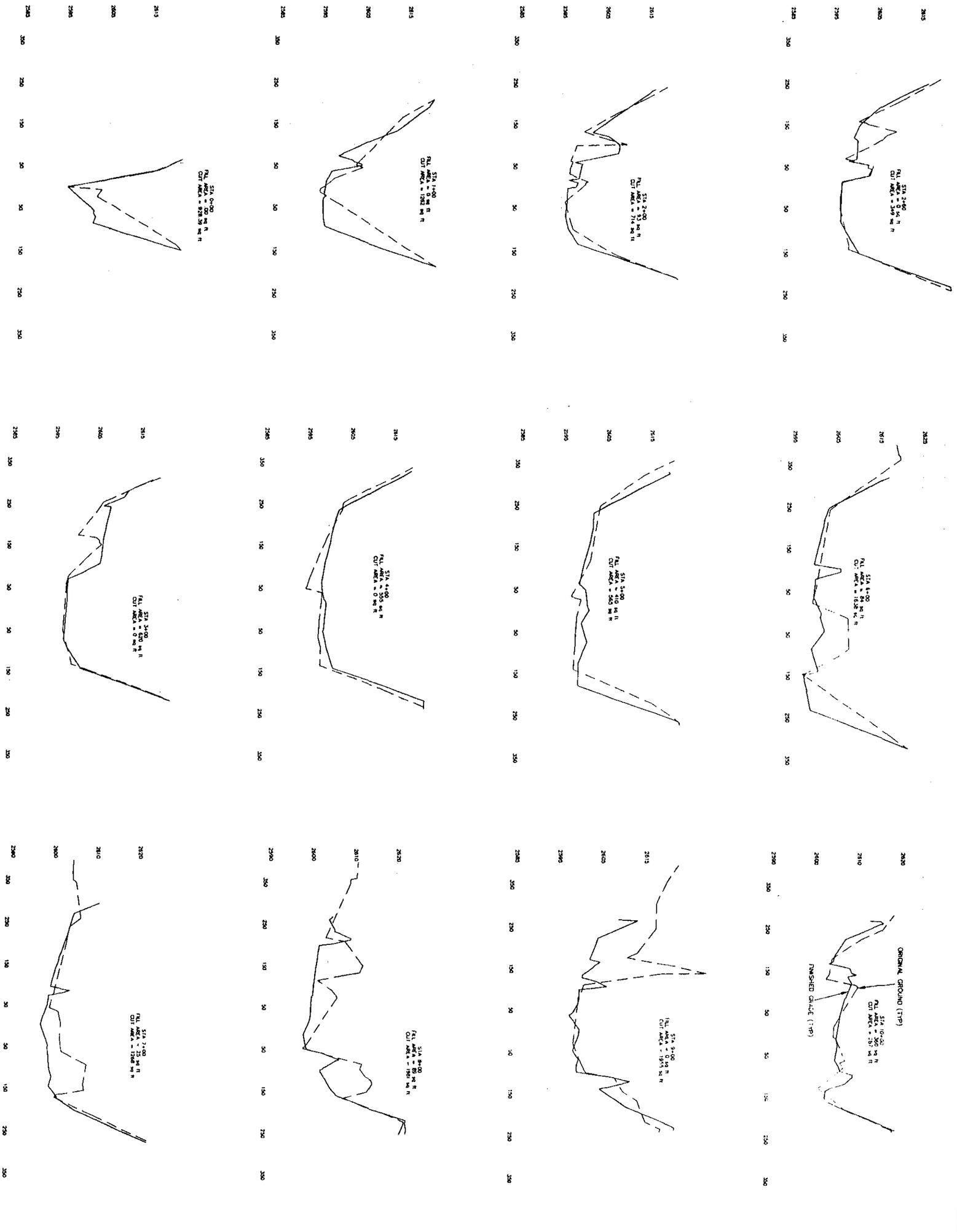
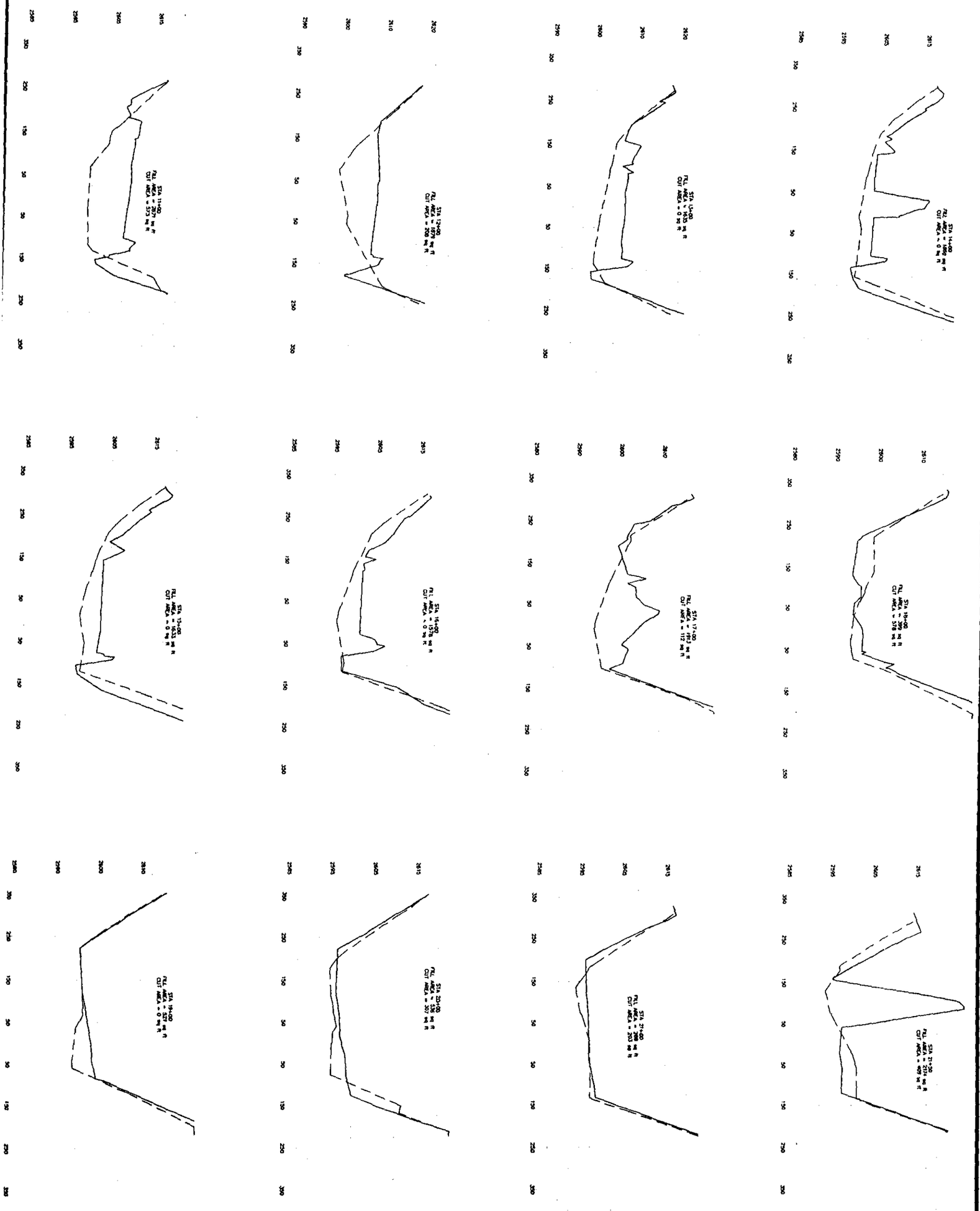


DRAWING NO. 2/5	CITY OF LAS VEGAS NEVADA	DEPARTMENT OF PUBLIC WORKS	SURVEY SECTION	SCALE HORIZONTAL 1"=100' VERTICAL 1"=10'	REVISIONS NO. / DESCRIPTION/DATE / BY
		ANGEL PARK NORTH DETENTION BASIN	CROSS SECTIONS	DESIGNED / DRAWN RMM / CHECKED / DATE JUNE 1993 / FIELD BOOK NO.	



DRAWING NO.

CITY OF LAS CRUCES

DEPARTMENT OF PUBLIC WORKS

SURVEY SECTION

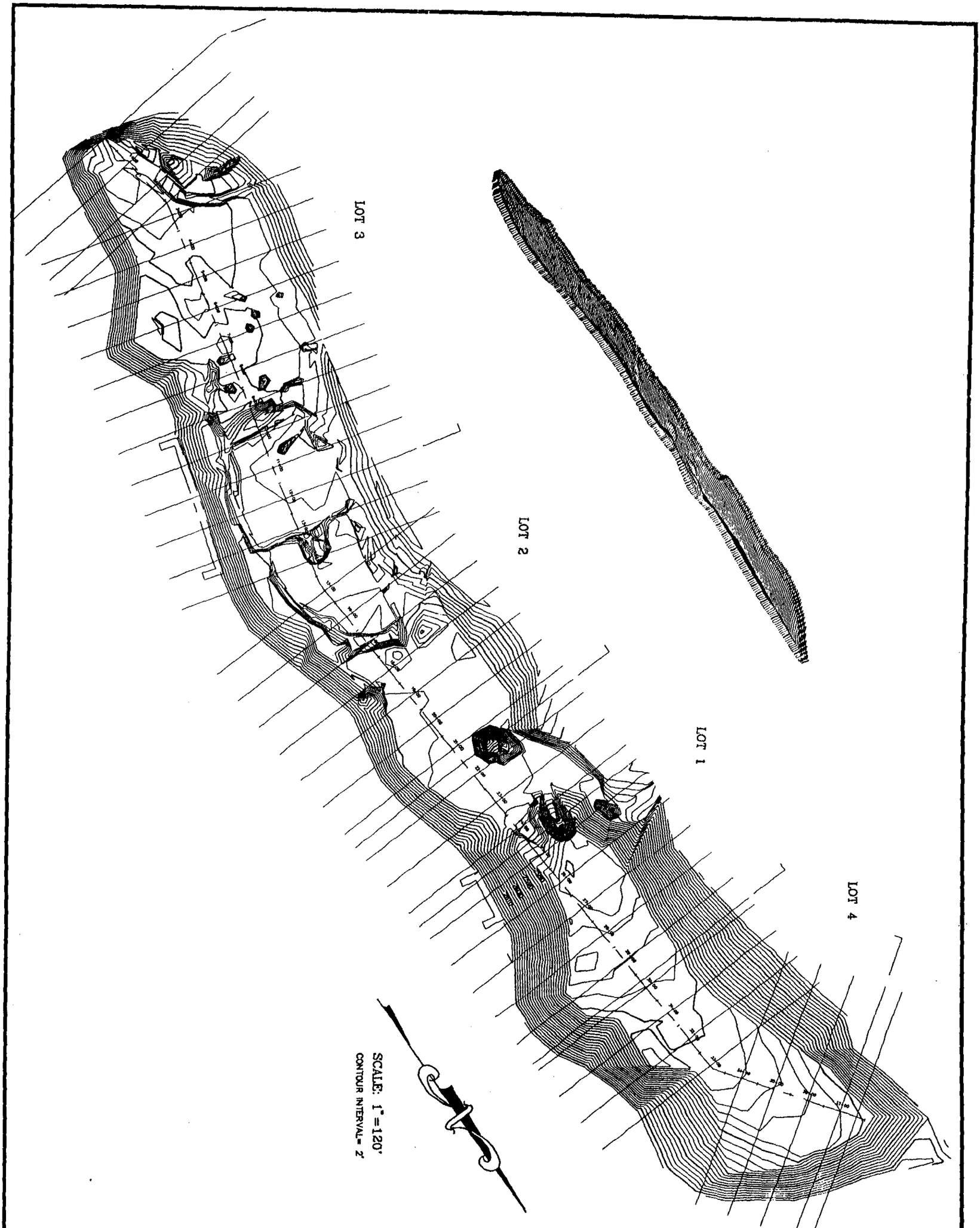
ANGEL PARK NORTH DETENTION BASIN

CROSS SECTIONS

DESIGNED	DRAWN
CHECKED	RMM

SCALE
HORIZONTAL: 1" = 100'
VERTICAL: 1" = 10'

REVISIONS		
NO.	DESCRIPTION/DATE	BY



DEPARTMENT OF PUBLIC WORKS

SURVEY SECTION

ANGEL PARK NORTH
DETENTION BASIN

FINISH GRADE
CONTOURS
APRIL 1993

DESIGNED

DRAWN RMM

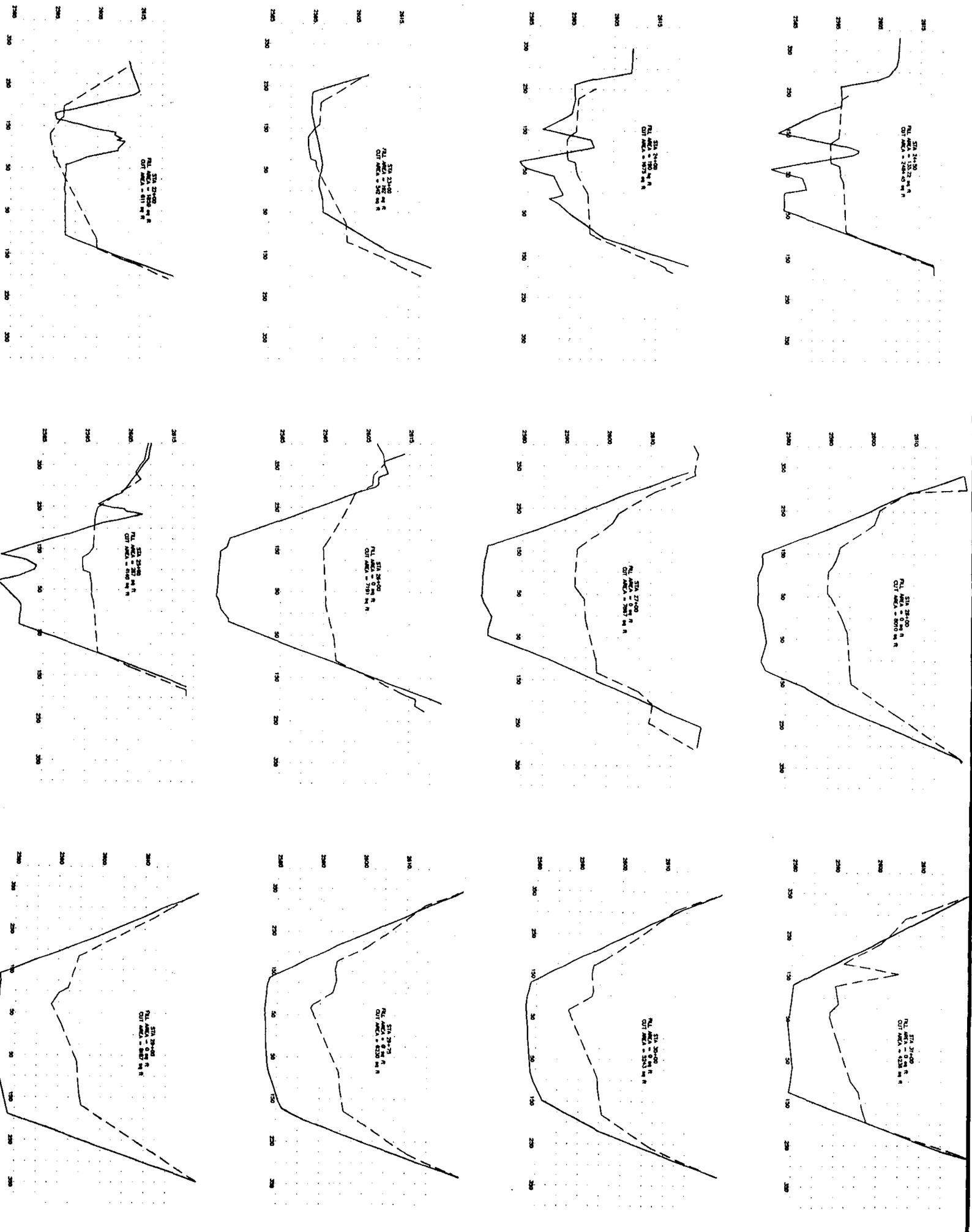
CHECKED

DATE JUNE 1993

FIELD BOOK NO.
FILE ANGEL

DRAWING NO. 1

REVISIONS		
NO.	DESCRIPTION/DATE	BY



DRAWING NO.

DEPARTMENT OF PUBLIC WORKS

SURVEY SECTION

DESIGNED | DRAWN RMM | CHECKED

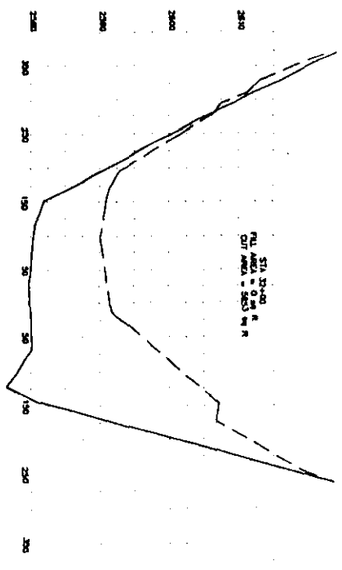
SCALE
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

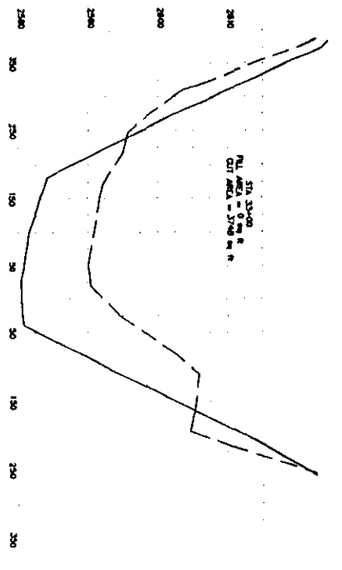
REVISIONS

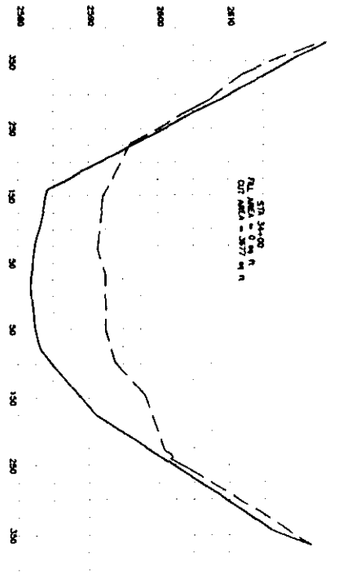
NO.	DESCRIPTION/DATE	BY

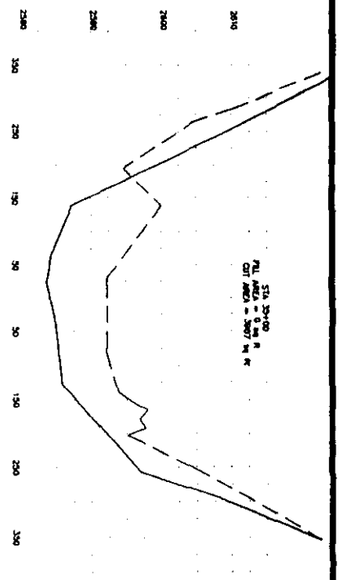
ANGEL PARK NORTH DETENTION BASIN

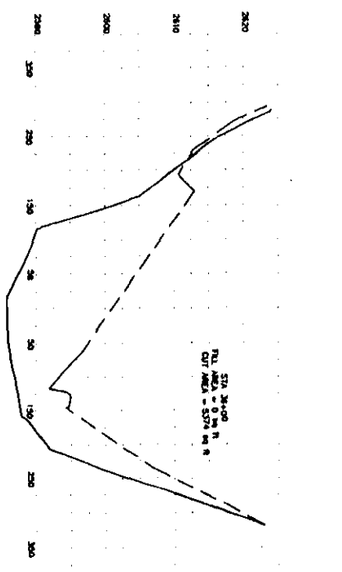
CROSS SECTIONS

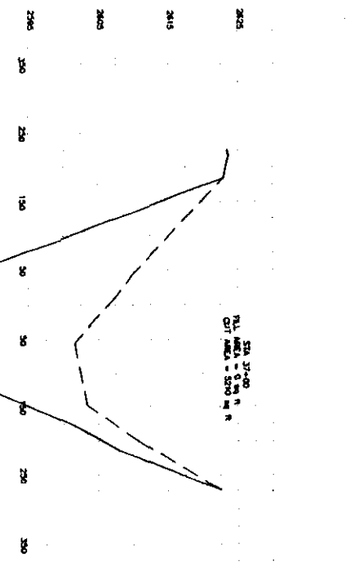


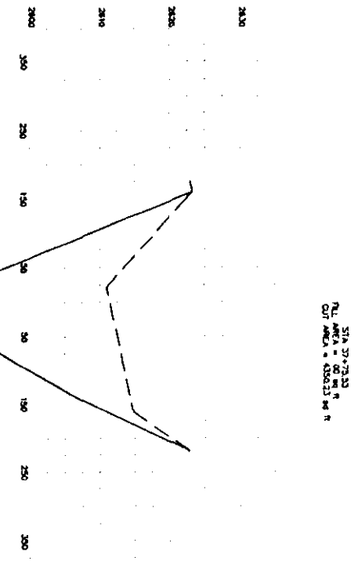












STATION	AREA(S) = SQ. FT.	FILL	CUT	VOLUME = CU. YDS.	FILL	CUT
0+00	1383.96	.00	1383.96			
1+00	1383.96	.00	1383.96	51254.81	.00	51254.81
1+50	1383.96	.00	1383.96	38441.11	.00	38441.11
2+00	746.62	92.39	654.23	19202.74	3422.87	15779.87
2+50	.00	.00	.00	6908.64	6908.64	.00
3+00	.00	.00	.00	.00	.00	.00
3+50	364.69	654.23	.00	6908.64	13817.28	.00
4+00	8637.89	654.23	7983.66	15545.33	25344.11	1798.69
4+50	1287.77	24.97	1262.80	20833.33	1798.69	19034.64
5+00	1980.89	69.89	1910.99	29833.33	4629.63	25203.70
5+50	2187.9	308.33	1879.57	37962.96	12037.04	25925.93
6+00	1850.23	308.33	1541.90	37962.96	20833.33	17129.63
6+50	2187.9	308.33	1879.57	37962.96	29629.63	8333.33
7+00	2187.9	308.33	1879.57	37962.96	38425.93	.00
7+50	2187.9	308.33	1879.57	37962.96	47222.22	.00
8+00	1850.23	308.33	1541.90	37962.96	56018.52	.00
8+50	2187.9	308.33	1879.57	37962.96	64814.81	.00
9+00	2187.9	308.33	1879.57	37962.96	73611.11	.00
9+50	2187.9	308.33	1879.57	37962.96	82407.40	.00
10+00	2187.9	308.33	1879.57	37962.96	91203.70	.00
10+50	2187.9	308.33	1879.57	37962.96	100000.00	.00
11+00	2187.9	308.33	1879.57	37962.96	108796.29	.00
11+50	2187.9	308.33	1879.57	37962.96	117592.59	.00
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27+00	2187.9	308.33	1879.57	37962.96	390277.73	.00
27+50	2187.9	308.33	1879.57	37962.96	399074.03	.00
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30+50	2187.9	308.33	1879.57	37962.96	451851.80	.00
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35+00	2187.9	308.33	1879.57	37962.96	531018.45	.00
35+50	2187.9	308.33	1879.57	37962.96	539814.75	.00
36+00	2187.9	308.33	1879.57	37962.96	548611.04	.00
36+50	2187.9	308.33	1879.57	37962.96	557407.34	.00
37+00	2187.9	308.33	1879.57	37962.96	566203.63	.00
37+73.53	1429.63	.00	1429.63	25764.30	573968.56	.00

LOT 3 ACCUMULATED MASS ORDINATE 19,272 CU YDS CUT	573968.56	0	573968.56
LOT 2 ACCUMULATED MASS ORDINATE 36,879 CU YDS FILL	573968.56	36879	537089.56
LOT 1 ACCUMULATED MASS ORDINATE 134,336 CU YDS CUT	537089.56	0	537089.56
LOT 4 ACCUMULATED MASS ORDINATE 137,292 CU YDS CUT	537089.56	0	537089.56
TOTAL ACCUMULATED MASS ORDINATE 254,025			

DRAWING NO. 5/5

CITY OF LAS VEGAS NEVADA

DEPARTMENT OF PUBLIC WORKS

SURVEY SECTION

ANGEL PARK NORTH DETENTION BASIN

CROSS SECTIONS

DESIGNED

DRAWN RMM

CHECKED

DATE JUNE 1993

FIELD BOOK NO.

SCALE
HORIZONTAL 1"=100'
VERTICAL 1"=10'

REVISIONS

NO.	DESCRIPTION/DATE	BY

Section 5
Gowan Detention Basin and Outfall Pipe and Channel

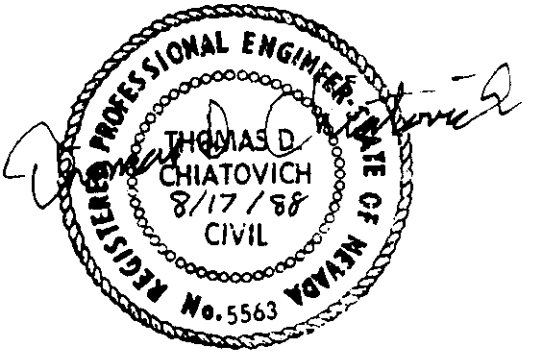
Hydrology Report, Methodologies and HEC-1 Model for Pre-Design of the Gowan Detention Basin

Included in this section:

Excerpts from *Hydrology Report, Methodologies and HEC-1 Model for Pre-Design of the Gowan Detention Basin*, August 1988, G.C. Wallace, Inc.

Mark Sorensen

HYDROLOGY REPORT
METHODOLOGIES AND HEC-1 MODEL
FOR
PRE-DESIGN OF THE GOWAN DETENTION BASIN



EXECUTIVE SUMMARY

G. C. Wallace, Inc., was contracted by the City of Las Vegas to prepare a pre-design report for the Gowan Detention Basin, a Clark County Regional Flood Control District Master Plan facility. As a portion of that work, an HEC-1 rainfall-runoff computer model was developed. The purpose of this report is to obtain written review of that HEC-1 model and the methodologies used in its development.

Two critical factors needed for pre-design of the Gowan Detention Basin are the volumes and peak discharges of design flood events. In the Las Vegas area, flood volumes and peak discharges must typically be obtained from rainfall-runoff models. The scope of work in the January 22, 1988, Agreement between the City and G. C. Wallace, Inc., establishes the following guideline for development of the rainfall-runoff model: "Develop existing and proposed conditions by utilizing hydrology methodologies which were developed by the Los Angeles District Corps of Engineers (LAD Corps) for the study of the Clark County area utilizing their HEC-1 computer model."

The HEC-1 model which G. C. Wallace, Inc., developed to estimate flood volumes and peak discharges for the Gowan Detention Basin Project uses a combination of Corps and Soil Conservation Service (SCS) methodologies:

1) Point precipitation (Corps' Las Vegas methodology)
2) Storm distribution (Corps' Las Vegas methodology)
3) Precipitation Loss Rate (SCS curve number methodology)
4) Overland runoff (SCS unit hydrograph methodology)
5) Channel Routing (Corps' Las Vegas methodology)

G. C. Wallace, Inc., recommends adoption of the above described HEC-1 model for use in preparation of the Pre-design Report for the Gowan Detention Basin.

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I. INTRODUCTION

A. PROJECT DESCRIPTION

The Gowan Detention Basin Project is a Clark County Regional Flood Control District (CCRFCD) Master Plan facility. The primary objective of the project is to reduce peak flood flows in the upper portion of the central Las Vegas Valley hydrographic area, thereby protecting water courses, watersheds, public highways, lives and properties situated downstream.

The Gowan Detention Basin project consists of four main elements, as shown in Figure No. 1 and listed below:

1) New Angel Park Outlet from the existing Angel Park Detention Basin. CCRFCD Master Plan No. 1030.

2) Angel Park Outfall Channel. CCRFCD Master Plan No.'s 1100, 1142, and 1144.

3) Gowan Detention Basin, consisting of two separate basins connected hydraulically. CCRFCD Master Plan No. 1160 (No. 1160 also includes a portion of the Gowan Outfall Channel, No. 4 below).

4) Gowan Outfall Channel. It is anticipated that major portions of the "Channel" will be in underground storm drain. CCRFCD Master Plan Nos. 1160, 2009, 2010, and 2011 (No. 1160 also includes Gowan Detention Basin, No. 3 above).

B. PRE-DESIGN SERVICES

The scope of the pre-design services is to perform engineering analyses and evaluations, and prepare a report with recommendations addressing the locations, alignments, approximate size, costs and phasing that will enhance the Gowan Detention Basin Project. The pre-design report is to be filed with the CCRFCD as an Amendment to the Master Plan.

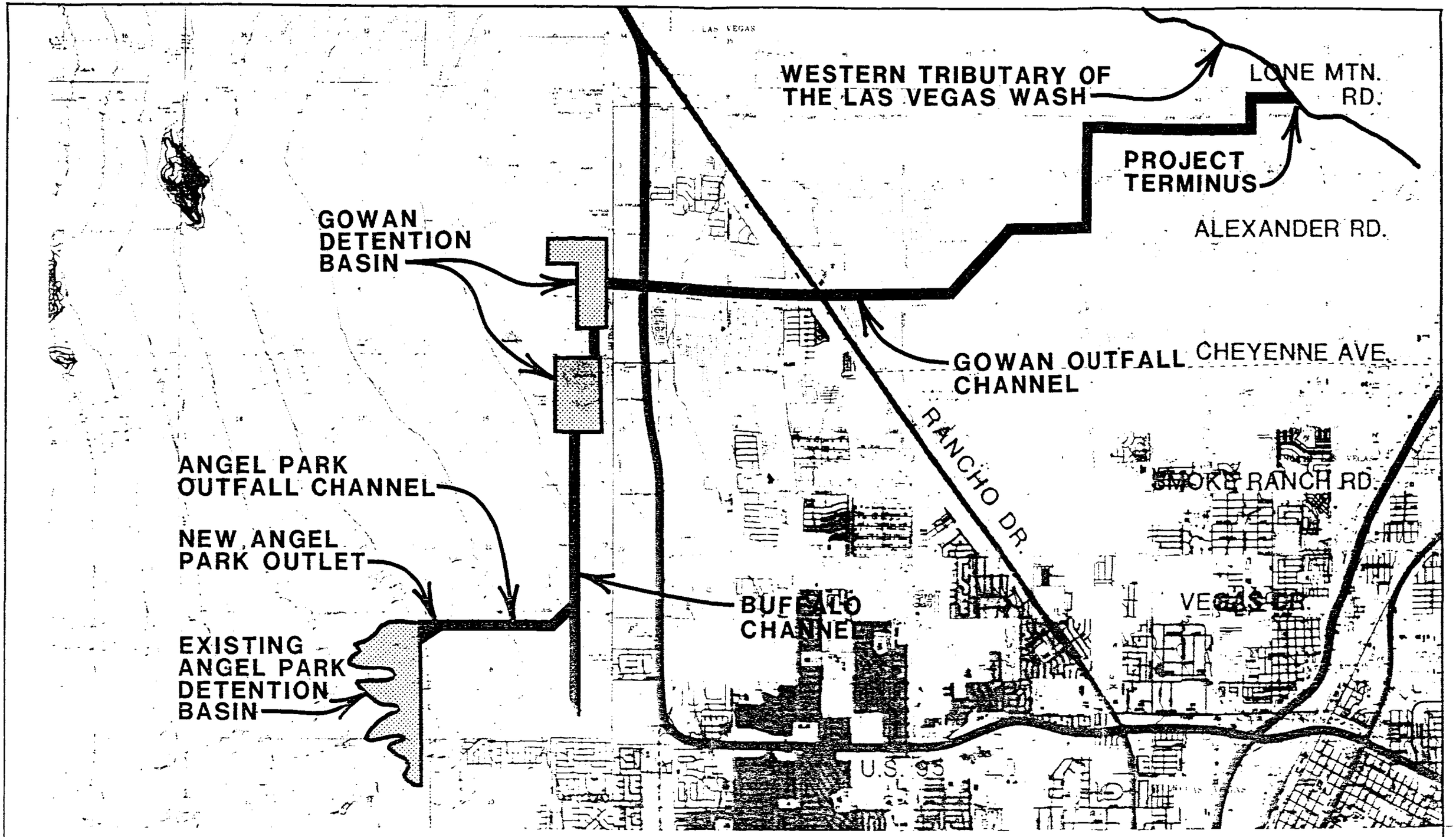
C. PURPOSE AND SCOPE OF HYDROLOGY REPORT

Purpose

This report presents the methodologies used in development of the HEC-1 rainfall-runoff model for the Gowan Detention Basin Pre-Design Services. It was prepared to obtain review of the HEC-1 model so that revisions, if any, can be made before the model is used in the analysis of project alternatives.

Scope

This report includes a brief background of hydrologic records and models which have been used in the Las Vegas Valley; a summary of the hydrologic methodologies employed in the Gowan pre-design model and the reasons for their selection; a brief discussion of the HEC-1 future conditions model including assumptions for future development and future facilities; preliminary results and a comparison with results from the Corps' Kinematic wave model and with results published in the CCRFCD Master



PROPOSED GOWAN ROAD
DETENTION BASIN FACILITIES

G.C. WALLACE, INC.
Engineering/Architecture

FIGURE
NO. 1

Plan; conclusions and recommendations; and printouts of HEC-1 model computer runs and a subbasin map for the HEC-1 runs.

D. LAS VEGAS VALLEY HYDROLOGY BACKGROUND

Records

Stream flow gage records for the Las Vegas Valley and vicinity are sparse and of short duration. There are five recording gages with record lengths from seventeen to twenty-nine years and thirteen nonrecording gages with record lengths of fifteen to twenty-five years. Precipitation records are somewhat longer, ranging from thirty-four to forty-five years for Las Vegas, Nevada; Searchlight, Nevada; Baker, California; and Needles, California.

In view of this sparse data, rainfall-runoff modeling is the only feasible means for predicting flood flow runoff for most areas of the Las Vegas Valley. Gowan Detention Basin is an area requiring rainfall-runoff modeling.

Previous Studies

There have been numerous rainfall-runoff models and methodologies used for studies in the Las Vegas Valley. Recent studies have evaluated National Oceanic and Atmospheric Administration (NOAA) Atlas 2 point precipitation values and have generally found them to be too low due to lack of record and/or excessive smoothing of data. Several studies have, therefore, multiplied the NOAA Atlas 2 point precipitation values by the ratio between point precipitation values derived from analysis of local rainfall gages and the NOAA Atlas data. For the 100-year rainfall, the NOAA point precipitation values are multiplied by a factor of approximately 1.43. A list of recent studies is included on the next page.

Another trend in recent studies has been to use depth-area relationships which are more appropriate for this desert southwest region rather than the NOAA Atlas 2 relationship which is general to the continental United States. National Weather Service (NWS) Hydro-40 is the depth area relationship most frequently selected.

For the Las Vegas Valley, rainfall-runoff models used most often have been the Soil Conservation Service (SCS) TR-20 model and the U.S. Army Corps of Engineers' HEC-1 model. Both of these models can accommodate any precipitation and storm distribution data. The TR-20 model uses SCS curve number methodology for precipitation loss rates and the SCS dimensionless unit hydrograph for overland runoff computations. The HEC-1 model can use the above listed SCS methodologies as well as constant or exponential precipitation loss rates and kinematic wave overland runoff computations.

Listed below are several studies which illustrate the different models and methodologies which have been used in the Las Vegas area in the recent past.

III. HEC-1 MODEL

A. EXISTING CONDITIONS

Figure 7 shows the major drainage areas and diversions for existing conditions. Figure G-1 in the jacket at the back of this report shows subbasins used in the model.

The HEC-1 "existing conditions" model assumes the diversion "C" Channel north of the Angel Park Detention Basin is in place. It also assumes diversions west of Charleston which route flow from the Peccole development into the Angel Park Detention Basin are operative. Construction of those diversions is considered to be imminent.

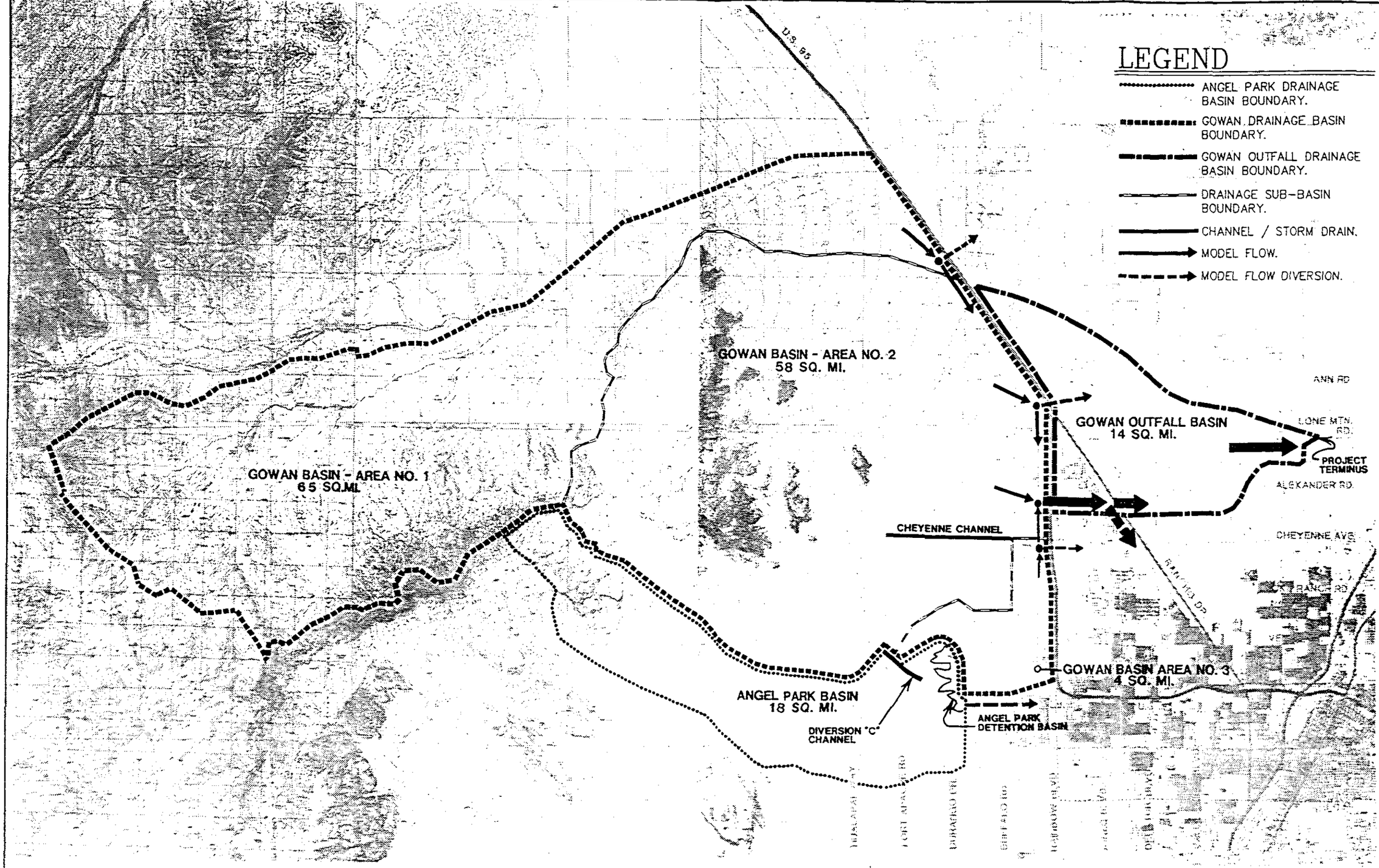
The model has three major drainage basins:
1) Angel Park, 18 square miles,
2) Gowan, 127 square miles, and
2) Gowan Outfall, 14 square miles

Under existing conditions the Angel Park drainage basin does not drain into the Gowan Drainage Basin. Outlet flows from the Angel Park Detention Basin are conveyed easterly down Westcliff Drive to converge with Las Vegas Creek flows in the east bound channel adjacent to the Oran Gragson Expressway. Flow from spillway 1 is conveyed down Westcliff Drive. Flows from spillways 2 and 3 reach the Oran Gragson Expressway north of Rainbow Boulevard where they flow through culverts to the east.

There are several major diversions from the Gowan drainage basin across U.S. 95 between the Kyle Canyon Road and Alexander Boulevard. Flow on the western side of U.S. 95 is limited to channel capacity. The capacity of the channel varies but is generally about 1000 to 1500 cfs before significant flows overtop the crown of the highway and are routed out of the model's eastern boundary. Culvert capacities are also included in these diversions. Due to the diversions, the contribution from the 65 square mile Gowan Basin Area 1 is so low that it was not included in the Hydro-40 depth-area adjustment for inflows to Gowan Detention Basin (depth area adjustment was based on 4 + 58 = 62 square miles).

Flow from the Gowan drainage basin passes into the Gowan Outfall drainage basin as surface flow in Gowan Road at the Oran Gragson Expressway overpass. The flow continues along Gowan Road or adjacent areas to the north until it reaches Rancho Drive. At Rancho Drive the flows from Gowan Road combine with diversion flows which crossed the Oran Gragson Expressway at Craig Road and at Alexander Boulevard.

At Gowan Road and Rancho Drive a flow split occurs. About 70% of the flow is diverted south along the west side of Rancho Drive. The remainder overtops Rancho Drive and proceeds west along Gowan Road. This flow combines with runoff from the Gowan Outfall drainage basin and with runoff diverted across U.S. 95 at Centennial Parkway and at the Painted Desert Golf Course (Lone Mountain). The combined flows converge at the Western Tributary of the Las Vegas Wash, the project terminus.



HYDROLOGIC BASIN BOUNDARY
EXISTING CONDITIONS

G.C. WALLACE, INC.
Engineering, Architecture 1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

FIGURE NO. 7

B. FUTURE CONDITIONS

Overview

Ultimate development for future conditions was per land developer master plans, where available, or per CCRFCD Master Plan where more specific data was not available. Future facilities used in this report are all per the CCRFCD Master Plan and the Husite Master Drainage Plan.

During alternatives analysis, the Gowan Detention Basin stage-storage relationships will be refined, using topographic mapping which has just been completed, though not used for this hydrology report. The Angel Park stage-storage relationship used for this analysis is based on the new mapping.

Drainage Basins and Model Flow Diversions

Figure 8 shows the basic model configuration for future development and future facilities. Figure G-2 in the jacket at the back of this report shows subbasins used in the model.

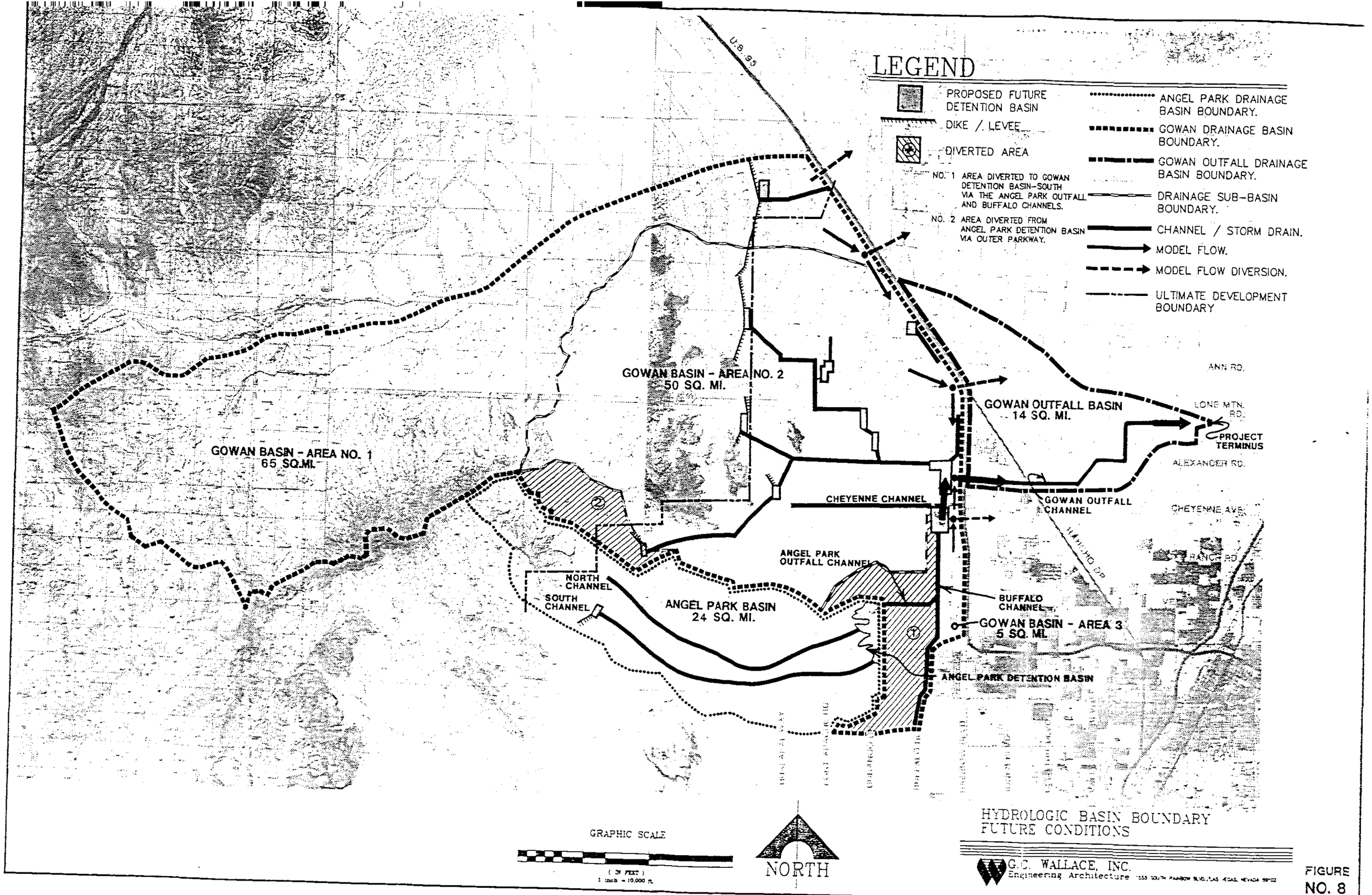
This model has three major drainage basins:

1) Angel Park, 24 square miles
2) Gowan, 120 square miles, and
3) Gowan outfall, 14 square miles

The Angel Park Drainage Basin is larger for future conditions than for existing conditions. Future roads and channels will divert runoff from a five square mile northerly area into the existing Angel Park Detention Basin. Flows outlet from the Angel Park Detention Basin are conveyed to the Gowan Detention Basin via the Angel Park Outfall Channel. All runoff from the Gowan drainage basin is routed to the Gowan Detention Basin except for the diversions shown.

As with the existing conditions model, major diversions occur across US 95. Due to these diversions, the contribution from the 65 square mile Gowan Basin Area 1 is very low and the area was not included in the Hydro-40 depth-area adjustment for inflows to Gowan Detention Basin (depth-area adjustment was based on 24 + 5 + 50 = 79 square miles).

Outlet flows from the Gowan Detention Basin are conveyed easterly in the Gowan Outfall Channel. Flow in the outfall channel combines with runoff from the Gowan Outfall drainage basin and with a diversion from the Tonopah Highway detention basin and a diversion across U.S. 95 at the Painted Desert Golf Course (Lone Mountain). Final discharge of these combined flows occurs at the confluence with the Western Tributary of the Las Vegas Wash near the Craig Road Golf Course.



HYDROLOGIC BASIN BOUNDARY
FUTURE CONDITIONS

G.C. WALLACE, INC.
Engineering Architecture 1555 SOUTH RAINBOW BLVD., LAS VEGAS, NEVADA 89102

FIGURE
NO. 8

Upstream Facilities

Major detention basins and channel configurations upstream of Gowan Detention Basin are per CCRFCD Master Plan, except for the Cheyenne Channel which is currently under construction. In addition to the Master Plan detention basin AP-1A above the Angel Park south channel, the model includes several small onsite detention facilities within the proposed Summerlin Project. These onsite detention facilities were taken from the "Husite Master Drainage Plan," April 1987 by G. C. Wallace, Inc.

Detention basin AP-1A detains flows only from drainage subbasin AP-1F, as in the Husite Master Plan. (See Figure G-2 in the jacket at the back of this report.) In the CCRFCD Master Plan, detention basin AP-1F retained runoff from drainage subbasins AP-1F, AP-5F, AP-6AF and AP-6BF. Runoff from AP-5F, AP-6AF and AP-6BF is detained in onsite detention basins in this Gowan Pre-Design Model, as in the Husite Master Plan.

CCRFCD Master Plan detention basin CAM-04 detains runoff from drainage subbasin GD-1A as in the CCRFCD Master Plan. The outlet from detention basin CAM-04 is routed to detention basin GD-10. This routing is per the Husite Master Plan which routed flow from drainage subbasin GD-1A to detention basin GD-10. The Husite Master Plan did not include the CCRFCD Master Plan detention basin CAM-04. The CCRFCD Master Plan routed flows from detention basin CAM-04 to the Angle Park Detention Basin.

These changes to CCRFCD Master Plan routing and detention basins reflect recent/ongoing construction and follow the model of the Husite Master Drainage Plan which has been previously reviewed and accepted by the City of Las Vegas.

IV. RESULTS AND COMPARISON WITH OTHER STUDIES

The results listed below are provided for evaluation of the methodology selected for this HEC-1 model and for comparisons to other models. Future facilities are taken from the CCRFCD Master Plan and allow comparisons with the CCRFCD Master Plan and Corps model runs. Discharges from future detention basins will vary with alternatives considered. Future regulated flows should not be considered as indicative of results which will be obtained for this study. Flows for existing conditions and unregulated future flows do represent model performance and are not expected to vary significantly in subsequent model runs.

The design return period for collection of local drainage into regional facilities has not been established and may be less than the 100-year return period. The Gowan Basin Area 3 and the Gowan Outfall Basin both contain areas of local drainage which will be collected into the regional facilities.

Comparison to other models is made only for future development conditions because those are the only results available.

A. RESULTS

Table 1 contains a summary of Gowan pre-design HEC-1 model results. Table 2 compares those results with results from other models. Figures 9 through 13 provide comparisons of hydrographs from the GCW - Gowan predesign model with hydrographs from other models. The HEC-1 printouts for existing conditions and future conditions with upstream detention are located in Appendices A through F. Subbasin boundary maps are in the jacket at the end of this report.

Angel Park Detention Basin

Using hydrology developed for this study, the Angel Park Detention Basin peak stage for existing conditions is 2619.7 feet, 1.2 feet above the crest elevation for the three spillways. The future conditions run with an additional 8' x 8' outlet at elevation 2598 feet resulted in a peak stage of 2619.1 feet, also above the spillway elevation of 2618.5 feet. The performance of the Angel Park Detention Basin with different outlets and in concert with Gowan and other proposed CCRFCD Master Plan detention will be evaluated in the Gowan Road Detention Basin Pre-Design Report.

B. COMPARISON WITH THE CORPS MODEL

To better compare the Gowan pre-design model results with the Corps Kinematic Wave HEC-1 model results, G. C. Wallace, Inc., developed and ran a model using the Corps kinematic wave methodology. That model is labeled "GCW - CORPS/KINEMATIC MODEL" in Table 2. It differs from the Gowan pre-design model in two major aspects:

1) Constant precipitation loss rate is set to 0.35 and initial loss is set to zero, and

2) Overland runoff is computed using the kinematic wave method

TABLE NO. 1
GCW-GOWAN PREDESIGN HEC-1 MODEL RESULTS

100-YEAR RUNOFF G.C. WALLACE, INC. AUGUST 12, 1988	DRAINAGE AREA (sq.mi.)	TOTAL VOLUME (ac.ft.)	PEAK DISCHARGE (cfs)
EXISTING CONDITIONS			
INFLOW TO ANGEL PARK DETENTION BASIN	18.0	1,259	5,083
INFLOW TO GOWAN ROAD AT EXPRESSWAY (1)	62.0	1,961	6,379
INFLOW AT CONFLUENCE WITH WESTERN TRIBUTARY OF LAS VEGAS WASH (1)	76.0	2,372	5,182
FUTURE CONDITIONS			
INFLOW TO ANGEL PARK DETENTION BASIN	24.0	1,578	6,713
INFLOW TO GOWAN ROAD DETENTION BASIN (1)(2)	79.0	2,871	5,692
INFLOW AT CONFLUENCE WITH WESTERN TRIBUTARY OF LAS VEGAS WASH (1)(2)	93.0	3,394	2,409

(1)Drainage area does not include 65 sq.mi. Kyle Canyon Area. Most of the runoff generated in this area is diverted east of Highway 95 and does not significantly impact the concentration point at Gowan Road.
(2)Total Volumes listed are different from volumes in the HEC-1 printout in the appendix. The volumes in the appendix have truncated hydrographs. The volumes in this table were derived from additional HEC-1 runs with a larger time tabulation interval.

TABLE NO. 2
GOWAN PRE-DESIGN HEC-1 MODEL RESULTS AND COMPARISON WITH OTHER MODELS

100-YEAR RUNOFF FOR FUTURE DEVELOPMENT CONDITIONS G.C. WALLACE, INC. AUGUST 12, 1988	AREA (sq.mi.)	RUNOFF VOLUME			PEAK DISCHARGE			
		VOLUME (ac.ft.)	UNIT VOLUME (ac.ft.)/ (sq.mi)	% DIFFERENCE FROM PRE-DESIGN MODEL	EXPECTED PROBABILITY (cfs)	COMPUTED PROBABILITY (cfs) (1),(2),(3)	UNIT COMPUTED PROBABILITY (cfs/sq.mi.)	% DIFFERENCE FROM PRE-DESIGN MODEL
ANGEL PARK INFLOW								
With Upstream Detention								
GCW-GOWAN PREDESIGN MODEL	24	1,578	66	---	---	6,713	280	---
GCW-CORPS/KINEMATIC MODEL	24	1,523	63	-5	7,955	---	---	---
JMM-CCRFCD MP MODEL (4)(6)	28	1,300	46	-30	---	9,402	336	20
Without Upstream Detention								
GCW-GOWAN PREDESIGN MODEL	24	1,663	69	---	---	9,961	415	---
GCW-CORPS/KINEMATIC MODEL	24	1,625	68	-1	13,143	9,145	381	-8
CORPS-SCS/KINEMATIC MODEL (4)	22	1,541	70	1	12,600	8,770	399	-4
JMM-CCRFCD MP MODEL (4)(6)	15	790	53	-24	---	7,216	481	16
GOWAN ROAD AT EXPRESSWAY								
With Upstream Detention								
GCW-GOWAN PREDESIGN MODEL (7)	79	2,871	36	---	---	5,692	72	---
GCW-CORPS/KINEMATIC MODEL (7)	79	2,874	36	0	6,432	---	---	---
JMM-CCRFCD MP MODEL (4)(6)	73	2,960	41	14	---	14,380	197	174
Without Upstream Detention (5)								
GCW-GOWAN PREDESIGN MODEL (7)	55	2,068	38	---	---	8,435	153	---
GCW-CORPS/KINEMATIC MODEL (7)	55	2,334	42	13	13,713	9,680	176	15
CORPS-SCS/KINEMATIC MODEL (7)	66	2,281	35	-8	17,722	12,450	189	24
JMM-CCRFCD MP MODEL (4)	52	---	---	---	---	23,410	450	194
CONFLUENCE WITH WESTERN TRIBUTARY OF L. V. WASH								
With Upstream Detention								
GCW-GOWAN PREDESIGN MODEL (7)	93	3,394	36	---	---	2,409	26	---
GCW-CORPS/KINEMATIC MODEL (7)	93	3,615	39	7	3,358	---	---	---
JMM-CCRFCD MP MODEL (4)(5)(6)	73	---	---	---	---	680	9	-65

(1)Models not calibrated to expected probability peak discharges are assumed to give computed probability peak discharges.
(2)Regulated flows were not adjusted from expected to computed probability.
(3)Expected probability adjusted to computed probability using Bulletin #17B adjustments for N=20 years.
(4)Development and Facilities modeled are similar but not identical to Gowan Pre-Design Model.
(5)JMM-CCRFCD MP model does not include runoff downstream of Gowan Detention Basin.
(6)Depth-Area for 3-hour storm based on 150 square mile basin area rather than area at concentration point. (All other models are based on a 6-hour storm with Corps Distribution.)
(7)Drainage area does not include 65 sq.mi. Kyle Canyon Area. Most of the runoff generated in this area is diverted east of Highway 95 and does not impact the concentration points at Gowan Road, or the project terminus.

FIGURE NO. 9 HYDROGRAPH COMPARISONS

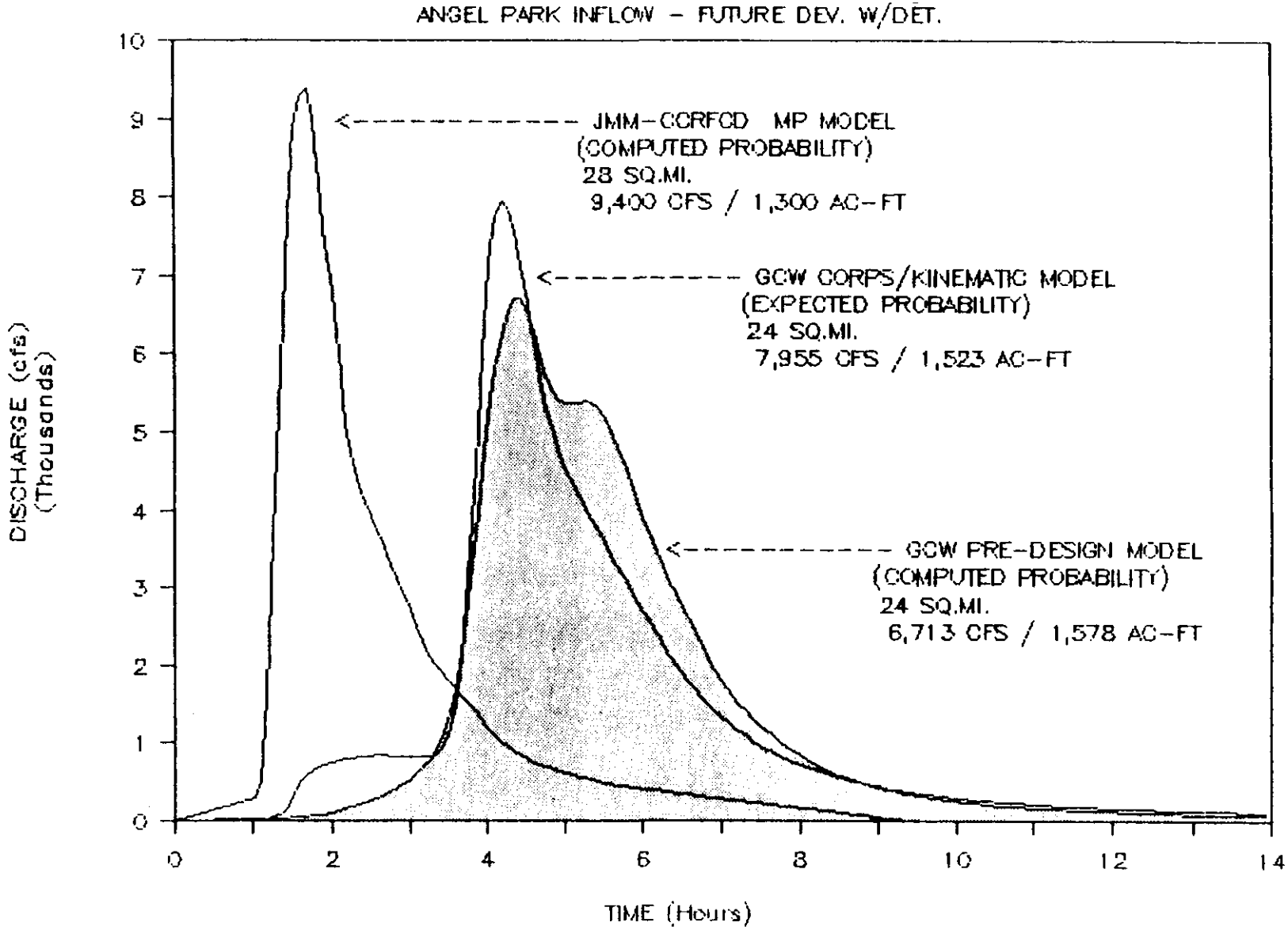


FIGURE NO.10 HYDROGRAPH COMPARISONS

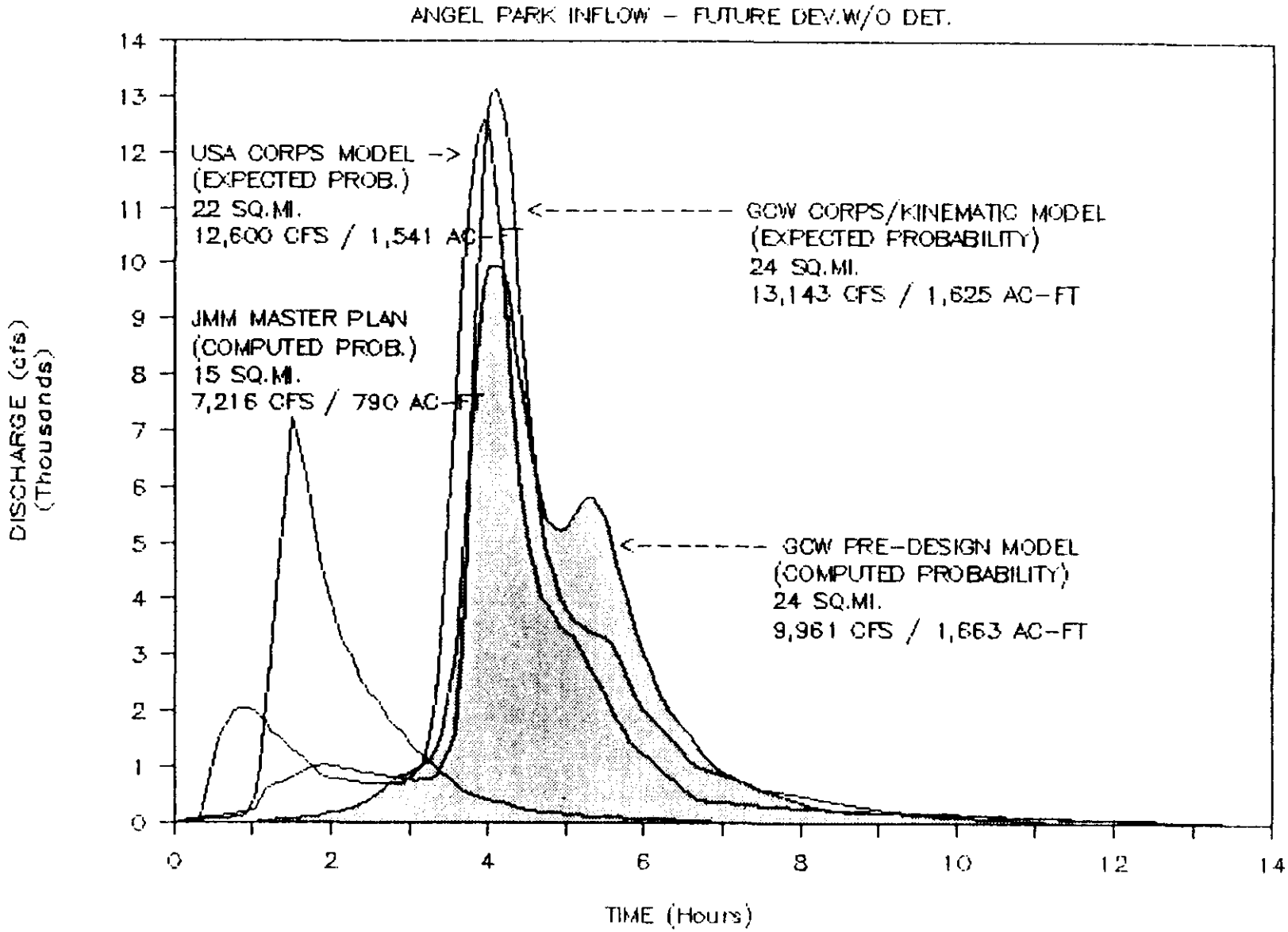


FIGURE NO.11 HYDROGRAPH COMPARISONS

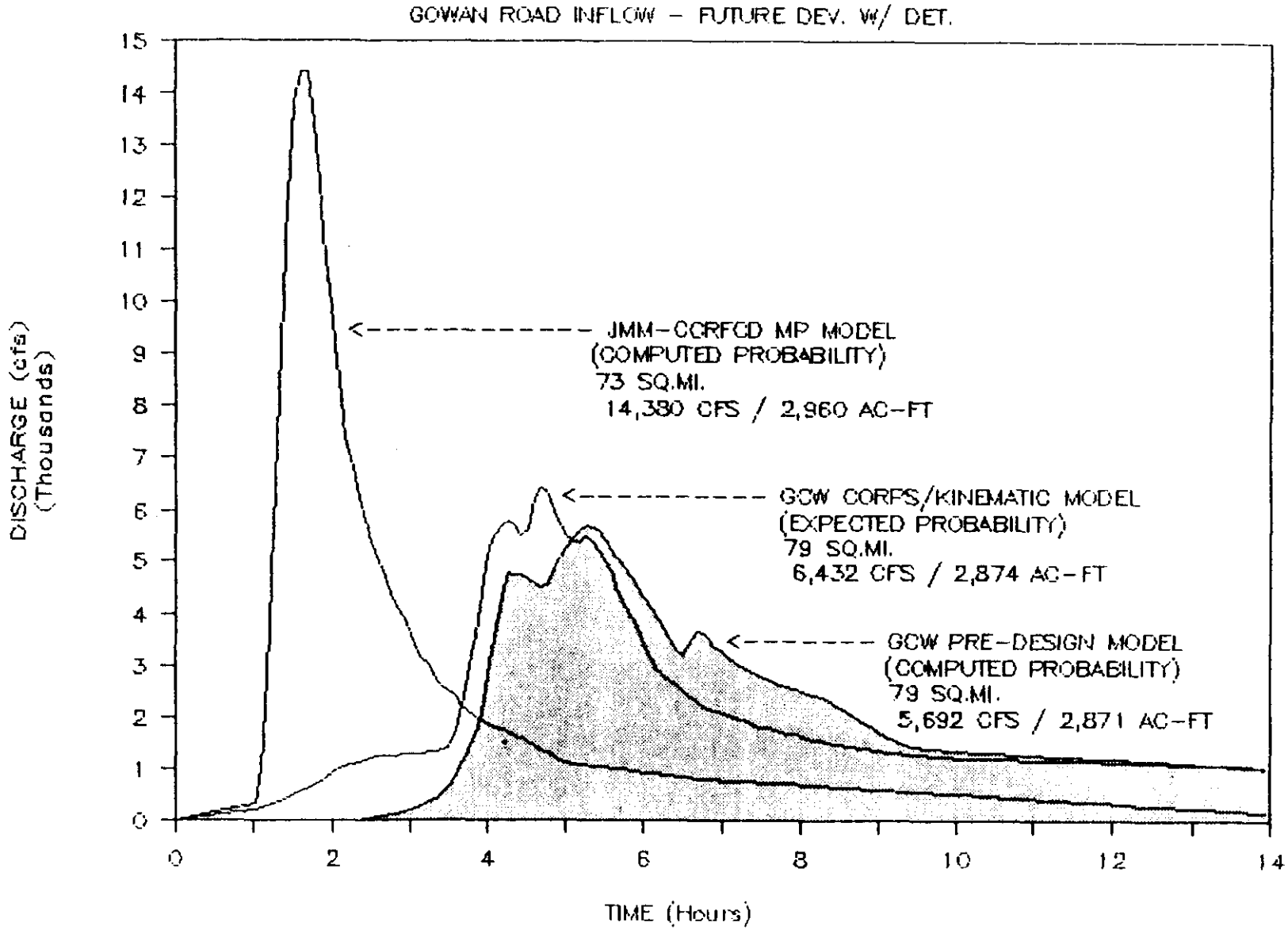


FIGURE NO.12 HYDROGRAPH COMPARISONS

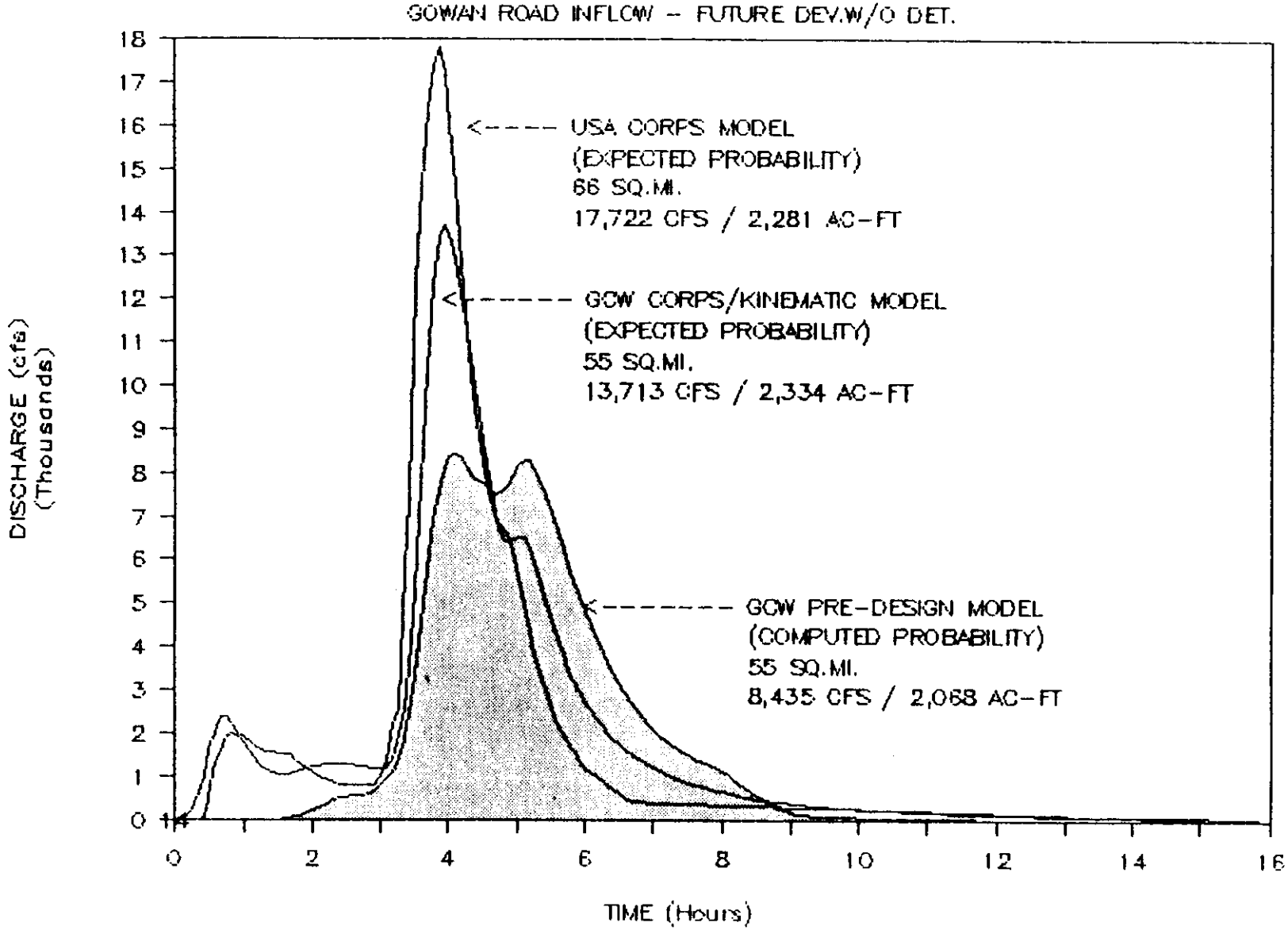
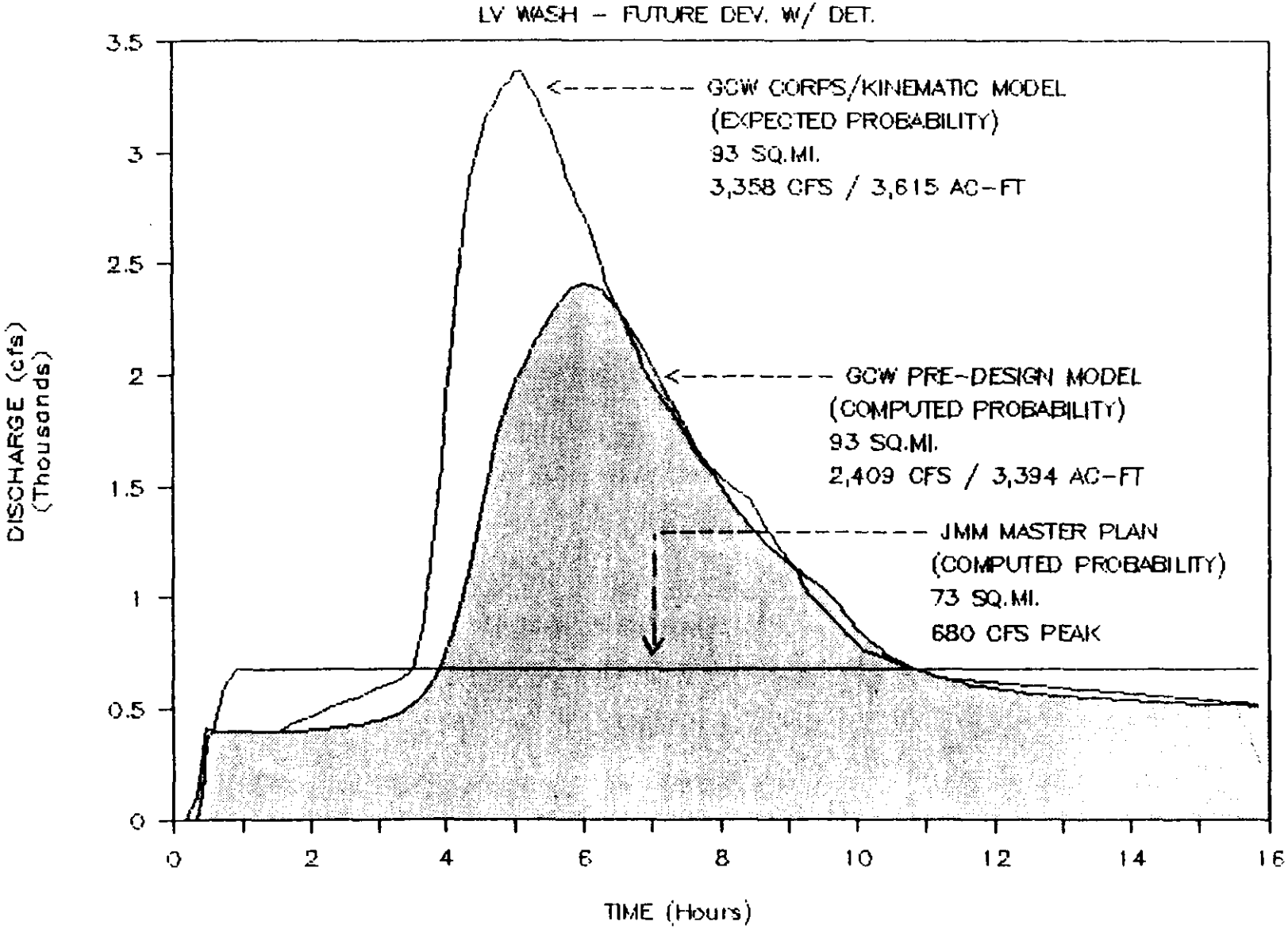


FIGURE NO.13 HYDROGRAPH COMPARISONS



Future development and facilities are the same for both models. Since the Corps calibrated their model to expected probability regional peak discharges, output from their model is listed in the "EXPECTED PROBABILITY" column in Table 2. Unregulated flows were developed for both models by making runs with detention removed from the models. For the GCW-CORPS KINEMATIC MODEL and the CORPS-SCS/KINEMATIC MODEL, computed probability peak discharges were calculated from the expected probability model values using the procedure in Bulletin #17B and regional relationships developed by the Corps. Output from the Gowan pre-design model and from the "JMM-CCRFCD MP MODEL" are assumed to be computed probability for comparison purposes in Table 2.

Peak unit discharges from the GCW-Corps/Kinematic model, adjusted to computed probability values, compare closely with the peaks from the GCW - Gowan Pre-Design model (-8% and +15%). Unit volumes from the GCW - Corps/Kinematic model were not adjusted. They also compared closely with volumes from the GCW - Gowan Pre-Design model (-5% to +13%).

Peak unit discharges from unpublished runs of the CORPS-SCS/Kinematic model, adjusted to computed probability values, are 4% less and 24% more than the peaks from the GCW-Gowan Pre-Design model. Unit volumes from the Corps unpublished runs are 1% more and 8% less than from the GCW model. Both peak discharges and volumes are considered to compare reasonably closely considering that the layout of subbasins and routing is not identical.

C. COMPARISON WITH THE CCRFCD MASTER PLAN MODEL

Results from the JMM-CCRFCD model tended to have unit peak discharges which were considerably larger than the GCW - Gowan predesign model (from 16% to 194% greater). The JMM-CCRFCD model unit volumes were smaller for the Angel Park Drainage Basin. For the larger Gowan Drainage Basin, the Master Plan unit volumes were greater.

One exception to higher peak discharges in the CCRFCD Master Plan is at the confluence with the Western Tributary of the Las Vegas Wash with future facilities. For these conditions, the CCRFCD Master Plan peak 100-year discharge is 65% less than that of the Gowan pre-design model because the JMM-CCRFCD Master Plan model does not include flows from drainage areas downstream of the Gowan Road Detention Basin.

GCW did a sensitivity analysis to determine how the Gowan Pre-Design model responded to input parameters similiar to those used in the CCRFCD Master Plan model. Table 3 presents the results of that analysis.

Peak Discharges

Using the 3-hour storm, as in the Master Plan, caused the Gowan Pre-Design model to give even smaller unit discharges (the differences in the models become greater). Master Plan precipitation loss rates, kinematic wave overload runoff computation and routing all increase peak discharges. All of these changes taken together resulted in Gowan Pre-Design model unit peak discharges which are 21% greater than the Master Plan model at Angel Park and 10% greater at Gowan Road and the Expressway. The largest single factor affecting peak discharge in the sensitivity analysis was the precipitation loss rate. The next most significant factor was precipitation.

TABLE NO. 3
COMPUTER RUNS ILLUSTRATING DIFFERENCES
BETWEEN THE GOWAN PREDESIGN MODEL & THE CCRFCD MODEL

100-YEAR RUNOFF FOR FUTURE DEVELOPMENT CONDITIONS G.C. WALLACE, INC. AUGUST 12, 1988		RUNOFF VOLUME			PEAK DISCHARGE		
	AREA (sq.mi.)	VOLUME (ac.ft.)	UNIT VOLUME (ac.ft. / sq.mi)	% DIFFERENCE FROM JHH MODEL	DISCHARGE (cfs)	UNIT DISCHARGE (cfs/sq.mi.)	% DIFFERENCE FROM JHH MODEL
ANGEL PARK INFLOW							
Without Detention							
GCW-GOWAN PREDESIGN MODEL	24	1,663	69	30	9,961	415	-14
W/3HR PRECIP. & DIST.	24	884	37	-30	5,395	225	-53
ADD JHH CONSTANT PRECIP. LOSS	24	1,508	63	19	11,473	478	-1
ADD KINEMATIC OVERLAND RUNOFF	24	1,498	62	17	13,834	576	20
ADD JHH ROUTING (3)	24	1,427	59	11	13,996	583	21
JHH-CCRFCD MP MODEL	15	790	53	---	7,216	481	---
GOWAN ROAD AT EXPRESSWAY (1)							
Without Detention							
GCW-GOWAN PREDESIGN MODEL	55	2,068	38	-19	8,435	153	-66
W/3HR PRECIP. & DIST.	55	1,166	21	-55	6,379	116	-74
ADD JHH CONSTANT PRECIP. LOSS	55	3,183	58	23	19,579	356	-21
ADD KINEMATIC OVERLAND RUNOFF	55	3,073	56	19	23,401	425	-6
ADD JHH ROUTING (2)	55	3,116	57	21	27,337	497	10
JHH-CCRFCD MP MODEL (3)	52	---	47	---	23,410	450	---

(1) For GCW Model Area does not include the 65 sq.mi. Kyle Canyon.
(2) This run has total precipitation, storm distribution, overland runoff & routing which are similar to that used for the JHH-CCRFCD Master Plan Model. Subbasins remain as in the Gowan Pre-design Model.
(3) Unit Volume assumed approx.= to JHH run w/ detention plus 15%. (For the JHH Angel Park runs, unit volume without detention is 15% larger than volume with detention.)

Hydrograph Volumes

Inputting the Master Plans' 3-hour precipitation and storm distribution significantly reduced volumes for both the Angel Park and the Gowan Drainage Basins. The Master Plan precipitation loss rates increased volumes considerably. The kinematic wave overland runoff method decreased volumes. Kinematic wave channel routing similar to that used in the Master Plan decreased volume for Angel Park and increased the volume at Gowan Road. The Gowan Pre-Design model with Master Plan precipitation, loss rate, kinematic wave overland runoff and kinematic wave channel routing produced volumes which were 11% and 21% greater than those of the Master Plan.

The precipitation input to the model for this sensitivity analysis included Hydro 40 depth-area adjustments. Inputting Master Plan precipitation to the Gowan Pre-Design model for the Angel Park Drainage Basin changed the unit volume from greater than the Master Plan volume to less than the Master Plan volume. This is largely attributed to the Master Plan Angel Park precipitation including a depth-area adjustment based on approximately 150 square miles while the pre-design model depth-area adjustment is based on only 24 square miles.

The two largest factors affecting volumes in the sensitivity analysis were precipitation and precipitation loss rate.

Sensitivity Analysis Summary

The two largest factors identified as impacting both volume and peak discharge differences between the Master Plan model and the predesign model were:

1) Precipitation and storm distribution, and
2) Precipitation loss rate.

Inputting the 3-hour precipitation and storm distribution from the Master Plan model reduced peak discharges and volumes. Inputting the Master Plan constant precipitation loss values increased peak discharges and volumes.

Unaccounted for differences are attributed to differences in the layout of drainage subbasins and diversions, and to the Master Plan type data input being only an approximation of actual values used in the Master Plan. Average Master Plan input values were typically used.

D. COMPARISON WITH THE HUSITE MASTER DRAINAGE PLAN AND MODEL

The Husite Master Drainage Plan states, on page 5: "The modeling for the 'north' channel includes a number of small onsite detention basins. The purpose of the onsite detention facilities is to limit the 100-year peak flow to 3000 cfs under ultimate development conditions."

Although not specifically stated in the Husite Master Plan, it is our understanding that the 3000 cfs limit was equal to the capacity of a proposed 12' x 12' box culvert under Summerlin Parkway. Subsequently, a 14' x 14' box culvert has been installed. The capacity of the 14' x 14' box culvert is 4000 cfs if headwater is limited to an elevation below the bottom of a pedestrian underpass which also crosses beneath the Parkway.

Under future development conditions, the peak 100-year discharge at the culvert is 3914 cfs per the Gown pre-design model. This flow is less than the capacity of the culvert and thus meets the intent of the Husite Master Drainage Plan. The difference in peak flows between the Husite model and the Gown pre-design model is attributed to the differences in precipitation and storm distribution. The Husite model used a 3-hour, 100-year storm while the Gowan model used a 6-hour, 100-year storm.

The Gowan model uses the same detention basins and routing as the Husite model. However, due to the differences in storms input to the models, the total peak storage used in the detention basins for the 100-year storm is 29% more for the Gowan model than for the Husite model.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

- Peak unit discharges from the Gowan Pre-Design model compare reasonably closely with those from the Corps' SCS/kinematic wave model when the Corps' model output is adjusted to computed probability.

- Unit hydrograph volumes from the Gowan Pre-Design model compare reasonably closely with those from the Corps SCS/kinematic wave model.

- Peak unit discharges from the Gowan Pre-Design model typically are significantly lower than peak unit discharges from the CCRFCD Master Plan model.

- Unit volumes from the Gowan Pre-Design model are larger than those from the CCRFCD Master Plan model for the small drainage basins (24 square miles±). For the larger drainage basin (55 square miles±), pre-design model unit volumes are smaller.

- The most significant factors contributing to differences between the Gowan Pre-Design model and the CCRFCD Master Plan model are precipitation and storm distribution, and precipitation loss rate. Differences in drainage areas used for depth-area adjustments exacerbate differences due to precipitation for small drainage basins (24 square miles ±).

- Peak 100-year discharge in the north channel of the Angle Park Detention Basin under ultimate development conditions is greater with the Gowan Pre-design Model than in the Husite Master Drainage Plan. However, the existing 14' x 14' culvert under Summerlin Parkway has sufficient capacity for the increased flow.

- Using FEMA Flood Insurance Study channel depth equations for undeveloped alluvial fans as a basis for developing kinematic wave channel configurations results in reasonable alluvial fan channel velocities.

- Under existing conditions, Angel Park Detention Basin overtops the spillways for the 100-year, 6-hour storm event.

B. RECOMMENDATION

- The Gowan pre-design HEC-1 model developed by G. C. Wallace, Inc., should be used for all hydrologic modeling during preparation of the Gowan Detention Basin Pre-Design Report.

Gowan Detention Basin Pre-Design, Volume III - Alternatives Evaluation

Included in this section:

Excerpts from *Gowan Detention Basin Pre-Design, Volume III - Alternatives Evaluation*, March 1989, G.C. Wallace, Inc.

412.320

City of Las Vegas

GOWAN DETENTION BASIN PRE-DESIGN

VOLUME III
ALTERNATIVES EVALUATION

MARCH 31, 1989

J M Montgomery Consulting Engrs., Inc.

ROUTING SLIP

☑ TO IRVINE FOR HYDROLOGY ☐

☑ TO LAS VEGAS FOR ALTERNATIVE DEVELOPMENT ☐

SPECIAL INSTRUCTIONS:

1. _____ ☐

2. _____ ☐

3. _____ ☐

RETURN TO: CLV

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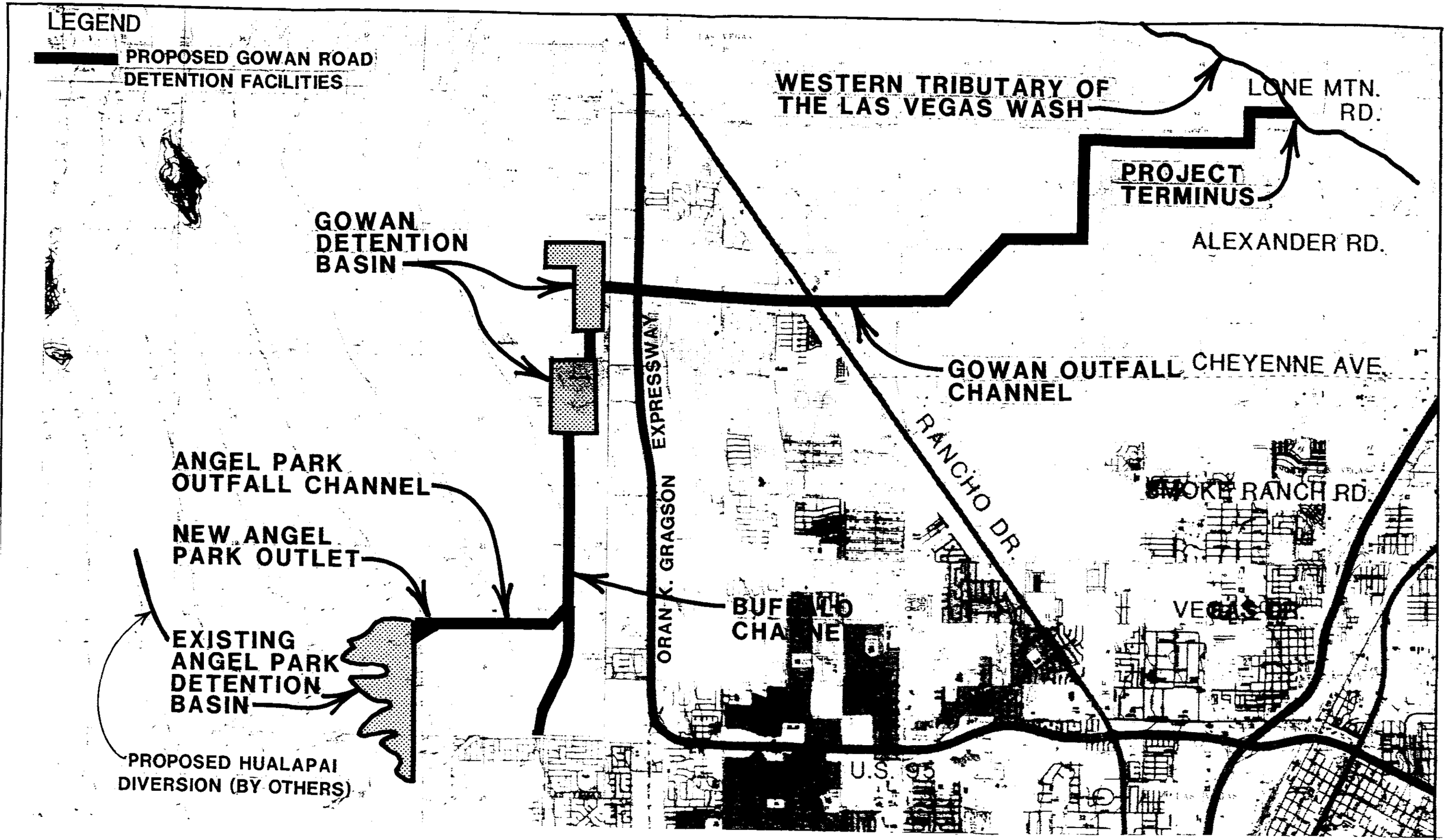
1.0 INTRODUCTION

1.1 GENERAL

This report presents the engineering analysis and evaluations that were made to determine the location, alignments, approximate size, costs and phasing for the Gowan Detention Basin project. The project consists of outlets from Angel Park Detention Basin, conveyance to Gowan South Detention Basin, Gowan South Detention Basin, conveyance to Gowan North Detention Basin, Gowan North Detention Basin, and outlets and outfall from the Gowan Basins to Las Vegas Wash (Western Tributary) as shown in Figure 1.1. The report may be filed with the Clark County Regional Flood Control District (CCRFCD) as an Amendment to the existing Master Plan developed in 1986 or considered in an updating study for the Master Plan.

This is the third report prepared as part of the Gowan Road Detention Basin Predesign project. The first report entitled, "Hydrology Report: Methodologies and HEC-1 Model for Predesign of the Gowan Detention Basin, August 19, 1988" outlined the methods and procedures used to calculate flow to the existing Angel Park Detention Basin and proposed Gowan Detention basins under existing and future conditions. Future conditions assumed facilities as identified in the 1986 CCRFCD Master Plan and the "Husite Master Drainage Plan, April 1987" which has been approved by the City of Las Vegas. The second report "Predesign Report for the Gowan Detention Basin: Volume II - Recommended Improvement for an Interim Project, September 21, 1988" focused on facilities to convey flow from the Angel Park Detention Basin to the proposed Gowan Detention Basin. The report concluded



PROPOSED GOWAN ROAD
DETENTION BASIN FACILITIES

G.C. WALLACE, INC.
Engineering/Architecture

FIGURE
NO. 1.1

that flow would overtop the spillway at Angel Park for the 100-year, 6 hour storm under existing conditions (an Angel Park volume of 820 acre-ft. below the spillways) and rather large (twin 8 ft. by 8 ft.) box culverts would be required to outlet flows to prevent overtopping and resulting damaging flows downstream of the facility.

Work was stopped on the Gowan Detention Basin project in October while the City of Las Vegas investigated the impact of enlarging Angel Park by continued excavation for gravel extraction. In January, 1989, the City concluded analyses and determined that the detention volume (increased to 1070 acre-ft. by January 1989) of Angel Park would be further increased to 1400 acre-ft. between elevation 2576 ft. (outlet invert) and elevation 2618.5 ft (spillway crest) by December 1989. The City, in conjunction with G.C. Wallace, Inc., also explored the detention time (how long water is allowed to remain in the basin) and determined that 72-hours from start of storm until outlet flow was 10 cfs would minimize outlet pipe size without significantly increasing risks due to consecutive storms, safety of berms, or vector and nuisance conditions. A geotechnical investigation subsequently determined that the Angel Park Detention Basin "embankment system has the ability to safely retain runoff for a minimum of 72 hours ". (Results of Geotechnical Evaluation, Angel Park Detention Basin, Las Vegas, Nevada, March 1, 1989, by Western Technologies, Inc.)

With this determination and City selection of routing from Angel Park to Gowan South, pre-design could proceed on the Gowan South Detention Basin. The basin would be sized to handle peak flows from Buffalo

Channel and Cheyenne Channel with outlet sized based on the same considerations made for Angel Park.

Sizing and pre-design of the Gowan North Detention Basin was more complex. A variety of detention basin and pipe/channel conveyance alternatives are possible upstream from this basin which, if constructed, would dramatically alter peak flows and volumes reaching the basin. Some 16 alternative facility arrangements were explored by G.C. Wallace with 7 alternatives presented to the City of Las Vegas in a screening analysis on January 20, 1989. The City selected four of the presented alternatives for more detailed analysis in this report.

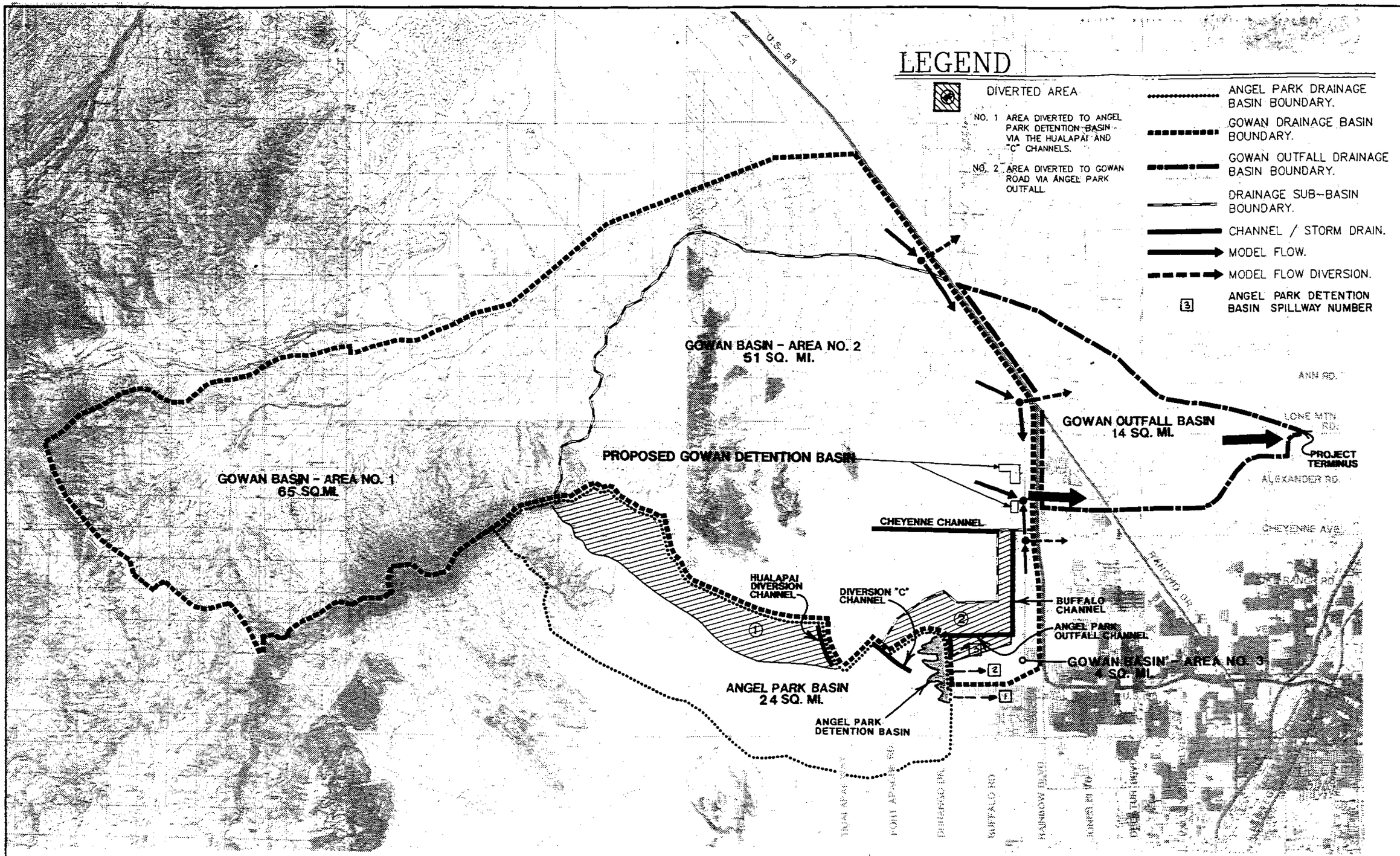
Sizing and pre-design of the Gowan outfall to Las Vegas Wash could also proceed. A route was selected and facilities sized not only to transfer Gowan Detention Basin outflow to Las Vegas Wash, but also to collect contributary drainage along the route. The City of North Las Vegas has proposed a different routing which should be considered further in final design.

This report summarizes evaluations made considering the above factors. Chapter 2 discusses project components and decisions made relative to location and routing, general design criteria, and methodology for economic evaluations. Chapter 3 presents the design hydrology used to size facilities and the impacts of other flows. Chapter 4 presents the pre-design evaluations for the Angel Park Outfall and Conveyance System for the City of Las Vegas selected route. Chapter 5 presents pre-design evaluations for the Gowan South

Detention Basin and outfall to Gowan North Detention Basin. Chapter 6 describes the Gowan North Detention Basin. Chapter 7 describes the Gowan Outfall Conveyance system. Chapter 8 details the overall project alternatives and analysis for the City of Las Vegas selected alternatives. Chapter 9 provides details on facilities, costs, and impacts of the recommended project. Chapter 10 presents conclusions and recommendations including recommended project phasing.

1.2 STUDY AREA

The study area for this project includes the hydrologic basins that influence flow to or are impacted by flow from the Angel Park and Gowan Detention Basins. Figure 1.2 shows the hydrologic basin boundaries under existing conditions. Gowan Basin Area No. 1 drains through Kyle Canyon. US95 causes diversion of portions of flood flows from this area to Gowan Basin Area No. 2. Gowan Basin Area 2 includes drainages from the Spring Mountains to the proposed Gowan Detention Basin sites. The Angel Park Basin area includes natural drainage to the Angel park Detention Basin from the Spring Mountains and areas diverted from Gowan Basin Area No. 2 by the Hualapai (soon to be constructed) and C diversion channels. Gowan Basin Area 3 includes the area downstream of the Angel Park Detention Basin that can flow to the Gowan Detention Basins. The Gowan Outfall basin includes all areas that naturally drain to the Red Coach Channel to Las Vegas Wash and can be influenced by diversions across US95 from Gowan Basin Area No. 2. Areas east of US95 that do not influence the Gowan Outfall Basin are not included in the study area even through proposed facilities may reduce flows to those areas.



GRAPHIC SCALE

(IN FEET)
1 inch = 10,000 ft.

NORTH

HYDROLOGIC BASIN BOUNDARY EXISTING CONDITIONS

G.C. WALLACE, INC.
Engineering/Architecture 5555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

FIGURE NO. 1.2

1.3 SCOPE OF ANALYSIS

G.C. Wallace, Inc. entered into an agreement with the City of Las Vegas on February 9, 1988, to prepare a pre-design study for the Angel Park/Gowan Detention Basin project. The Gowan Detention Basin Project is a Clark County Regional Flood Control District (CCRFCD) Master Plan facility. Facilities included in the scope of work were:

1. Angel Park Outflow Structure. CCRFCD Master Plan Facility 1030.
2. Angel Park/Gowan Detention Basin Conveyance System connecting Angel Park to Gowan. CCRFCD Master Plan Facilities 1100, 1142, and 1144.
3. Gowan Detention Basin including outlet structures and spillways for two separate basins connected hydraulically. CCRFCD Master Plan Facility 1160.
4. Gowan Outfall Channel/Storm Drain from the Gowan outlet structure to the Red Coach Channel near the northeast corner of Craig Road Golf Course. CCRFCD Master Plan Facilities 1160, 2009, 2010 and 2011.

The scope of services for the project can be summarized as follows:

1. Develop design flows using hydrology methods developed by the Corps of Engineers to update the hydrology used in the CCRFCD Master Plan. This includes developing inflow and outflow hydrographs for detention basins considering where flows would enter and exit the basins, stage versus discharge curves, stage versus storage curves, stage versus surface area curves.

2. Develop an alternative analysis for the project including schematic layouts, sketches, and conceptual design criteria and comparative costs. The 100-year flood impacts are to be assessed with facility sizing based on 100-year flows.

3. Prepare general plan, profile, and cross-section of facilities for one alternative selected by the City of Las Vegas in consultation with other agencies for detailed analysis. This includes general descriptions of lands, right-of-way, easements, and property to be acquired; costs for the project including construction, land, legal, administrative, and engineering; costs for offsite work including road improvements. The analysis is to satisfy NRS Chapter 543.580 evaluation criteria for cost of the project versus relocation of facilities in the flood plain. The impacts of 10, 25, 50, and 100-year floods are to be assessed for the recommended project.

4. Prepare an implementation program including detailed cost estimates and project phasing.

5. Provide survey and elevation contour for the Angel Park and Gowan Basins and selected routes for the Angel Park and Gowan Outfall Conveyance systems.

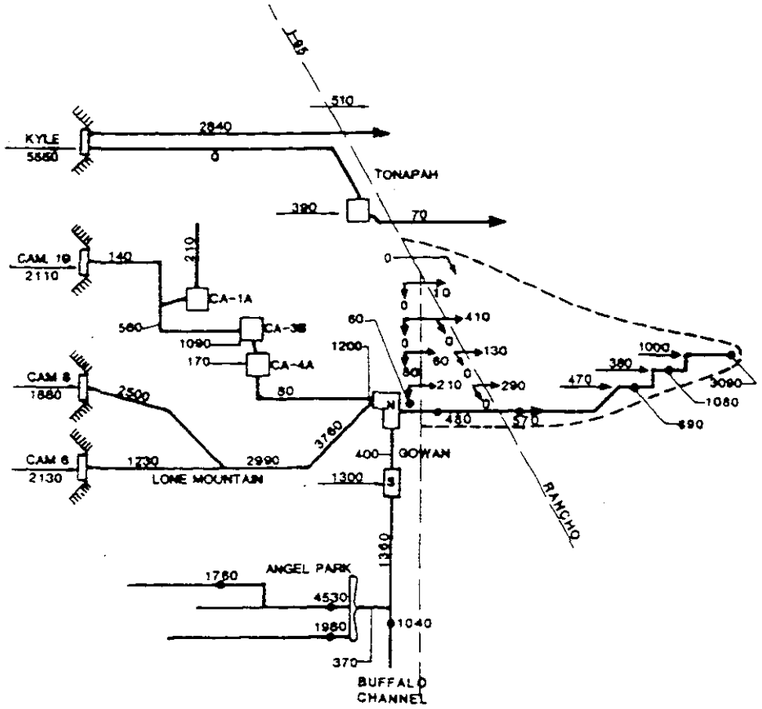
6. Provide geotechnical investigations for soil conditions, geologic hazards, excavatability, embankment and slope criteria, seepage control, erosion protection, and foundations for the basins and selected routes for conveyance.

7. Prepare right-of-way and easements maps for the selected alternative.

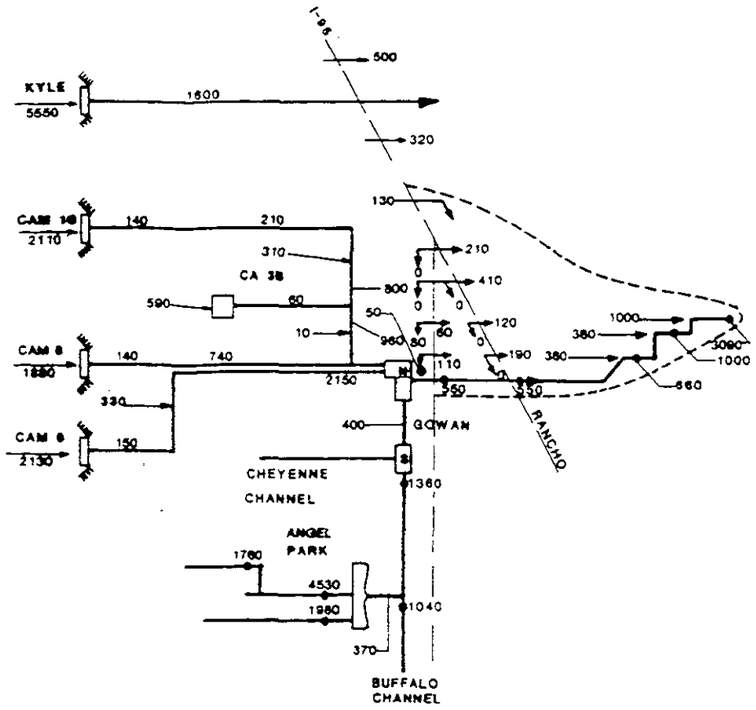
8. Confer and coordinate project efforts of the City of Las Vegas and G.C. Wallace, Inc. with local, state, and Federal agencies including the Nevada Division of Water Resources for dam permits and NRS 543.580 Compliance, the Federal Emergency Management Agency (FEMA) relative to levee and freeboard policy, CCRFCD for Master Plan requirements, Clark County for facility design requirements and City of North Las Vegas for Gowan Outfall analysis.

1.4 PROJECT OBJECTIVES

The primary objective of the pre-design report is to identify facilities that should be designed and constructed to reduce peak flows and flood damage in the upper portion of the Central Las Vegas Valley hydrographic area. A secondary objective is to amend the existing CCRFCD Master Plan for the area based on a more detailed analysis of hydrology, locations, alignments, size, costs, and phasing.



ALTERNATIVE 1 MASTER PLAN

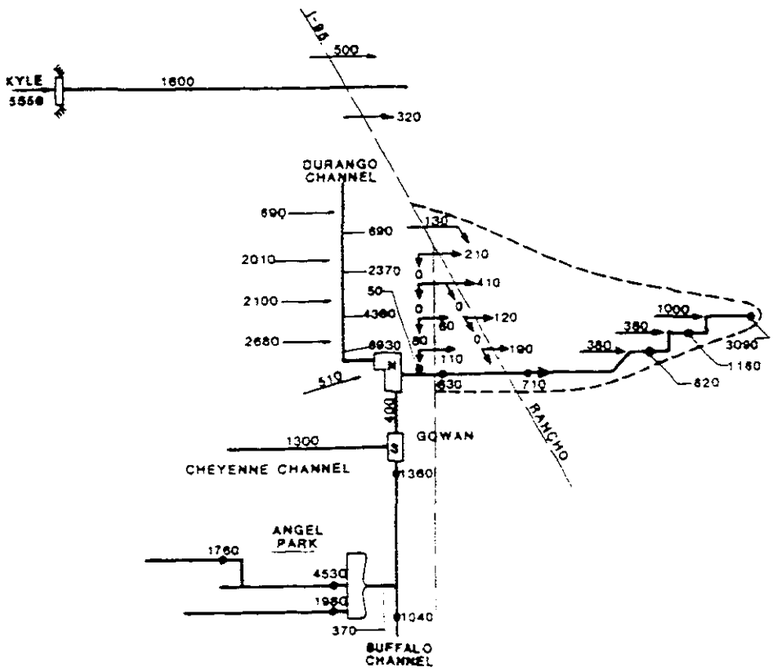


ALTERNATIVE 2 MODIFIED MASTER PLAN

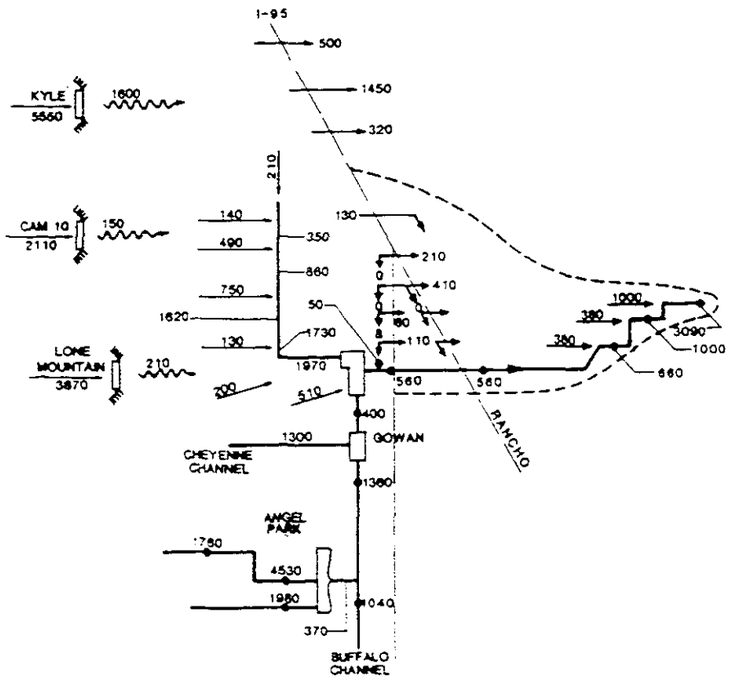
LEGEND

DETENTION BASIN

3840 PIPE OR CHANNEL 100-YEAR DESIGN FLOW (cfs)



ALTERNATIVE 4 KYLE CANYON



ALTERNATIVE 6 LIMITED OUTFALLS

NOTE: DESIGN FLOWS SHOWN ARE 100-YEAR PEAKS FOR CRITICALLY CENTERED STORMS FOR THE ASSOCIATED FACILITY.
FIVE STORM CENTERINGS WERE USED: PROJECT TERMINUS (90 SQ. MI.), GOWAN NORTH (66 SQ. MI.), GOWAN SOUTH (37 SQ. MI.) ANGEL PARK (24SQ. MI.) AND GOWAN OUTFALL (14 SQ. MI.)

FIGURE 2.2 FACILITIES AND FLOWS FOR ALTERNATIVES

TABLE 2.1

DESIGN STANDARDS

GOWAN DETENTION BASIN PRE-DESIGN

I. Hydrology

Model - HEC-1, 6-hour n-year storm, SCS curve number precipitation loss rate, SCS unit hydrograph, kinematic wave channel routing (Ref. Gowan Hydrology Report with refinements to diversions overtopping US95 and Rancho Boulevard per HEC-2 analysis for "City of North Las Vegas, Nevada, Decatur Boulevard Street Improvement Project, Drainage Study" December 16, 1988 by GCW).

Design Hydrology

Facility	Design Storm
Angel Park Detention Basin and Vegas Drive Outfall	Angel Park centered storm, existing development, Hualapai Diversion
Buffalo Channel	Buffalo Channel centered storm, future development and facilities
Gowan South Detention Basin & Outfall	Gowan South centered storm, future development and facilities
Gowan North Detention Basin	Gowan North centered storm, future development and facilities
Durango Channel	Durango Channel centered storm, future development and facilities.
Gowan North Outfall to the Western Tributary of the Las Vegas Wash	Maximum of Gowan Outfall centered storm, i.e., local runoff, or regionally centered storm; future development and facilities

Spillway Design (PMF Corps Methodology)

Angel Park - There will be no spillway redesign or PMF analysis. In discussions with Nevada Dam Safety, it was agreed that, under PMF flows, the Hualapai and Channel C diversions will be overtopped and will not significantly increase flows to Angel Park. Therefore, PMF flows will remain essentially the same as they were when the spillways were originally designed. No further PMF or spillway analysis is required.

Gowan South and Gowan North - PMF for basins with berms, drainage area does not include areas diverted by channels or dikes to the basin. Nevada Dam Safety verbal agreement.

No spillway design hydrology for basins without berms.

II. Hydraulics

Closed conduits/pressure flow/Manning equation
Minimum freeboard in manholes and catchbasins = 1 foot. (Hydraulic grade line to street grade).

Open Channels/Manning Equation
Freeboard above superelevated water-surface
Supercritical Flow:
$H_{FB} = 2.0 + 0.025V\,(d)^{1/3}$
Where H_{FB} = freeboard height (feet)
V = velocity (fps)
d = depth (feet)
Subcritical flow: $H_{FB} = 1 + V^2/2g$
Where right-of-way constraints warrant, freeboard may be reduced to not less than one foot.

Superelevation = $s = \frac{v^2 b}{gr}$

Where v = velocity in feet/second
b = width at water surface in feet.
g = acceleration of gravity in feet per second per second.
r = radius to center of channel in feet.

Friction loss
Manning formula

n = 0.012	RCP
n = 0.024	CMP
n = 0.012	concrete lined CMP
n = 0.015	concrete lined channel
n = 0.012	RCB
n = 0.025	unlined channel

Minor losses ($kv^2/2g$)

where k = loss coefficient
v = velocity in feet per second
g = acceleration of gravity in feet per second squared
use 'k' values below or other accepted norms
k = 0 manholes, pipe greater than or equal to 4 feet diameter
k = .05 manholes, pipe < 4 feet diameter
k = .2 90-degree bends
k = .14 45-degree bends
Manhole spacing - 900' based on existing Vactor with 500' of hose in CLV Sanitary Department and Vactor on order for CLV Street Department.

TABLE 2.1 (con't)

Detention Basins

100-Year freeboard below spillway - 0.5 feet
Note: Freeboard provides additional storage for precipitation occurring before or after the design storm, sediment deposition, wind set up, and safety margin for potential differences between field conditions and design. Freeboard does not account for wave action.

PMF freeboard below top of berm - Angel Park - not considered because the spillways were already designed and upstream diversions will not significantly affect the PMF, Nevada Dam Safety verbal agreement.

Gowan South and Gowan North - Top of berm for PMF per Nevada Dam Safety verbal communication.

No emergency spillway for detention basins without berms.

Detention Times

Definition: The time from start of storm until the discharge from a detention basin is 10 cfs or less.

Small basins (±100 AF) 24-hour maximum
Regional Basins - 3 day to 5 day maximum to balance detention cost versus outfall costs.
Angel Park - 3 day maximum.
Gowan North and South - 3 day maximum as target.

III. Construction Materials

Earthwork

Maximum permanent cut slope,
native material = 2:1*
Maximum temporary cut slope,
sands and gravels = 1:1*
clays and silts = ½:1*
Backfill material for trenches,
CMP = per Clark County Standard Specifications
RCP = per Clark County Standard Specifications

Pipe Materials and Loading

RCP - specify d-loads (not pipe class)
CMP - consider for alternative bid item

Embankments

Minimum 10 feet wide crest *
Detention Basin embankment material,
granular native material compacted to 90 to 95% ASTM D-1557*
Slope protection - riprap or concrete near inlets and outlets.

TABLE 2.1 (con't)

Maximum permanent embankment slope,
compacted native = 2:1*

Structural Loads

Traffic Loading - H 20 where applicable.
Earth Loading - weight of compacted fill - 145 pcf*
Earthquake - peak acceleration = 0.1g*

Concrete and Rebar

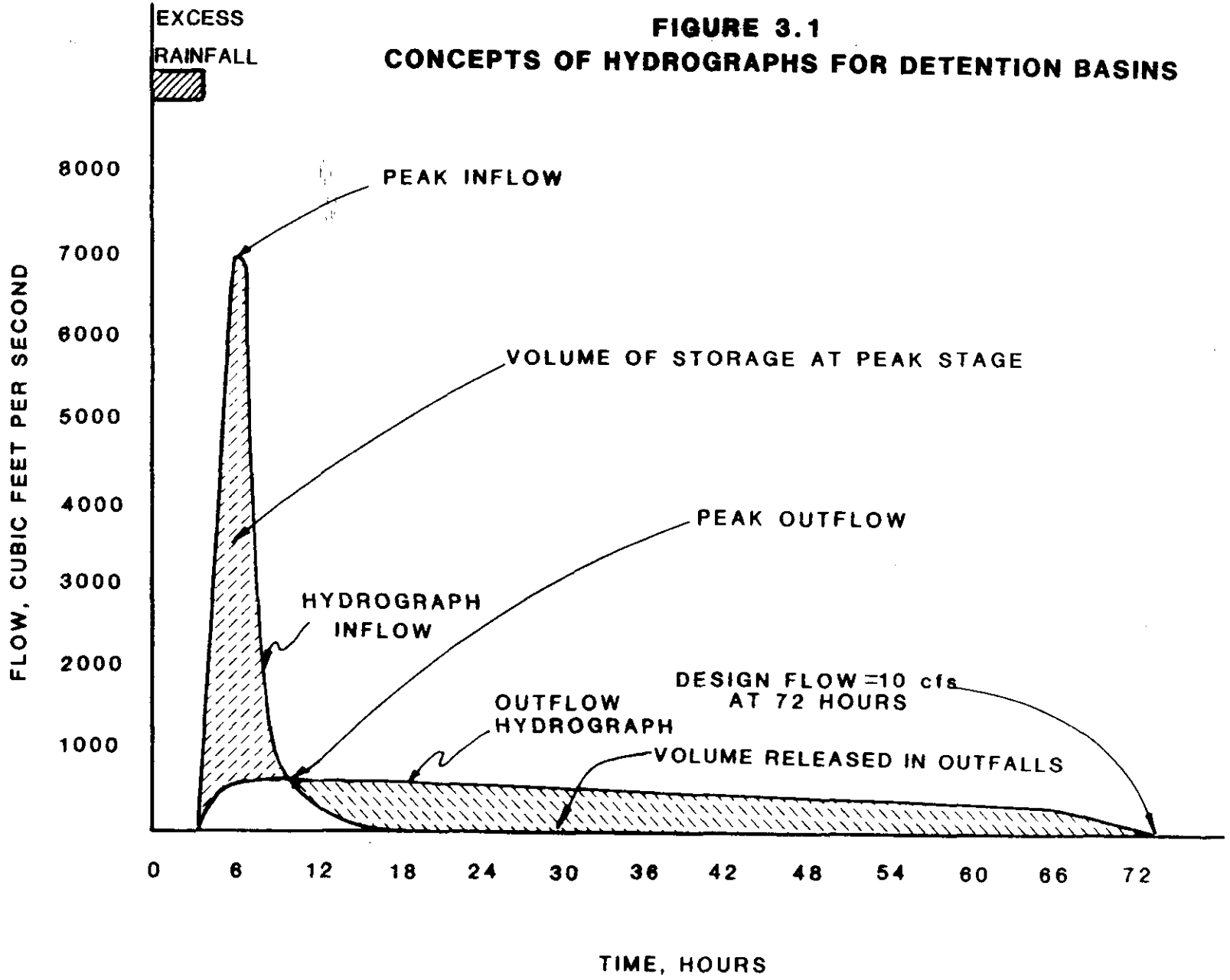
Concrete: Type V cement, 3,000 psi*
Rebar: Grade 60

IV. Traffic Control

Cost estimates will assume daytime construction and one 12 foot lane in each direction maintained at all times for Gowan Road, Tenaya Way and the Rancho Boulevard crossing.

* For additional information, see Soils Report.

FIGURE 3.1
CONCEPTS OF HYDROGRAPHS FOR DETENTION BASINS



3.3.3 Outflow From Gowan South Detention Basin

a. Detention Basin Size - The Gowan South Detention Basin is sized for the 6-hour 100-year storm centered over the Angel Park, Buffalo Channel and Cheyenne Channel areas. The inflow hydrograph for this area has a peak flow of 2150 cfs and a 72-hour volume of 1860 acre-feet, a large portion of which (about 1400 acre-feet) is due to the sustained outflow from Angel Park. The size of the Gowan South Detention Basin will be minimized if the outfall hydrograph crosses the inflow hydrograph prior to the sustained flows. A preliminary inflow-outflow hydrograph with peak outflow occurring at 10 hours was developed. It was also necessary to do a pre-design on basin configuration to establish a stage volume curve and a pre-design on the basin outfall to create a stage discharge curve for the Gowan South Basin. The preliminary evaluations indicated a basin size of about 450 acre-feet would be required.

b. Release Rate - The release rate from the Gowan South Basin needs to exceed the inflow from Angel Park or additional basin volume would be required for the difference in flow times its duration. A target release rate to empty the basin to 10 cfs in 72 hours was tested with the pre-design basin configuration and outfall by various HEC-1 runs. Because of the larger storm area for Gowan South versus Angel Park only, a smaller peak flow and runoff volume would flow into Angel Park for the 6-hour 100-year event. Facilities sized for the Angel Park centered storm would result in Angel Park emptying in less than 72 hours

providing some flexibility in selecting a release rate to match inflow and outflow volumes for Gowan South. The evaluations were refined to create the stage-volume and stage-discharge data presented in Table 3.3.

TABLE 3.3

GOWAN SOUTH DETENTION BASIN STAGE DISCHARGE, STAGE VOLUME

Elevation	Outlet Head (ft)	Outlet(1) Proposed 60" RCP (cfs)	Spillway Head (ft)	Spillway Discharge (cfs)	Total Discharge (cfs)	Storage Volume Acre-feet
2332	0	0	0	0	0	0
2334	2	144	0	0	144	9
2336	4	220	0	0	220	17
2338	6	270	0	0	270	73
2340	8	312	0	0	312	128
2342	10	348	0	0	348	260
2344	12	381	0	0	381	350
2346	14	412	0	0	412	494
2347	15	427	0	0	427	566
2348	16	441	1	3360	3801	642
2350	18	468	3	17460	17928	783
2352	20	493	5	37570	38063	933
2354	22	517	7	62230	62747	1083

(1) Based on 60" pipe discharging to Gowan North under inlet control conditions

(2) Based on 1050 feet spillway for a PMF of 39,000 cfs, Discharge = $3.2\ LH^{1.5}$, where L = spillway length and H = spillway head

c. Outflow Hydrograph - The stage-discharge and stage-volume curves of Table 3.3 were entered into the HEC-1 model for Gowan South design hydrology conditions to develop the outflow hydrograph. The inflow and outflow hydrographs for design hydrology conditions for Gowan South are shown on Figure 3.3 for the selected outfall.

GOWAN SOUTH DETENTION BASIN

INFLOW / OUTFLOW HYD.– DESIGN HYDROLOGY

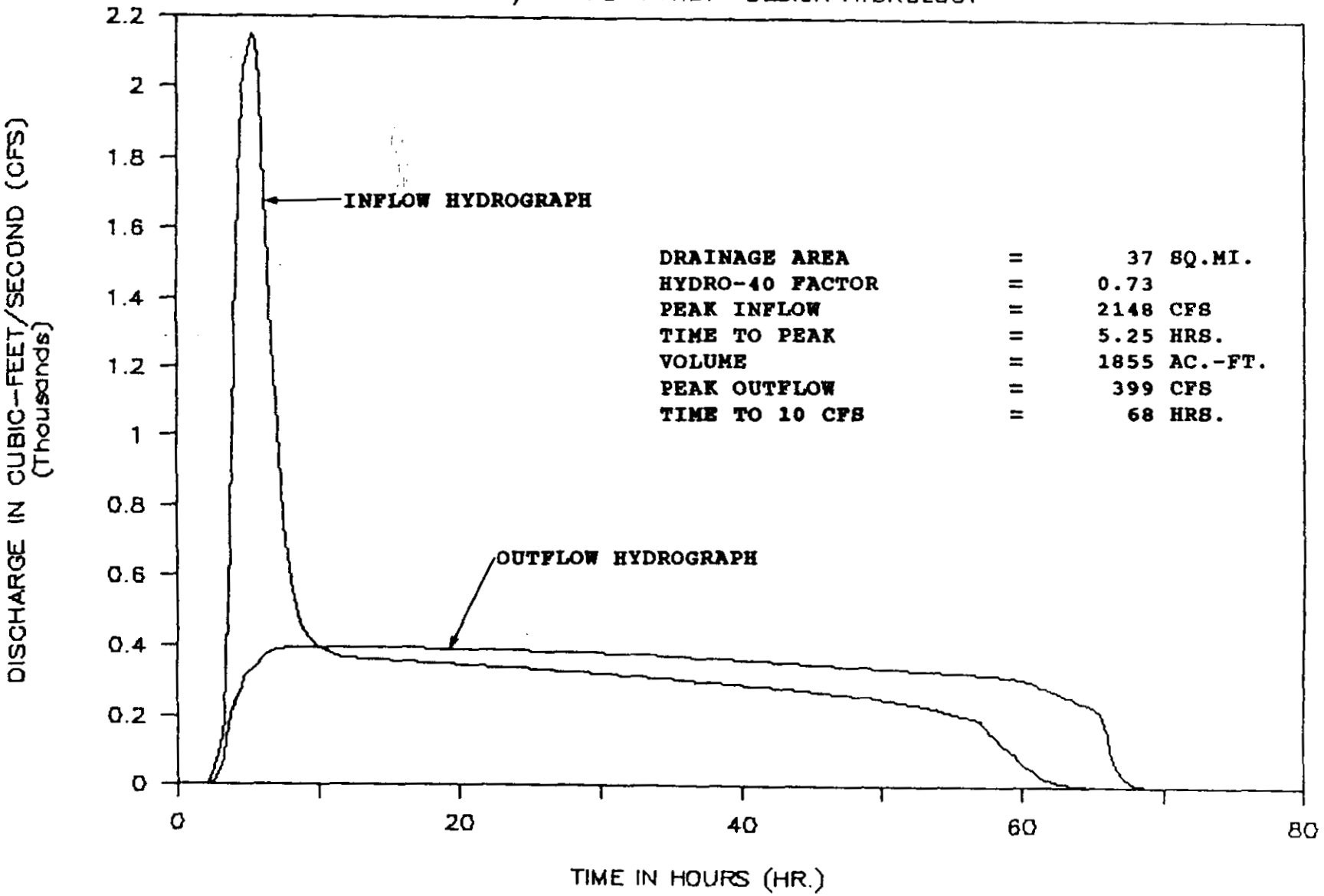


FIGURE 3.3

3.3.4 Probable Maximum Flood

The undiverted drainage areas reaching the Gowan South Detention Basin is about 14 square miles. A HEC-1 model was developed to route the probably maximum precipitation through this watershed to the site. The peak flow at the basin was estimated at 39,000 cfs with a runoff volume of 6410 acre-feet The spillway design criteria are to pass this flow without overtopping the berm (zero freeboard).

3.4 GOWAN NORTH DETENTION BASIN

The Gowan North Detention Basin is proposed to reduce peak flows reaching it from Gowan Drainage Area No. 2 and to convey the outflow from Gowan South Detention Basin (without significantly altering the peak). Under existing conditions flow is diverted by U.S. 95 from the Kyle Canyon area of Gowan Drainage Area No. 1 to Area No. 2. Design conditions for the Gowan North Detention Basin assume that Kyle Canyon Detention Basin is constructed and that future land use has occurred. Other upstream detention basins (future facilities) are a function of the alternative analysis and separate HEC-1 runs were made for each alternative (Figure 2.2 shows the alternatives and their peak flows). Future conditions represent design conditions for the selected alternative when all facilities are constructed.

3.4.1 Inflow to Gowan North

a. Existing Conditions - Under existing conditions about 7.5 square miles drain to the Gowan North Detention Basin area. The peak flow is 1400 cfs with a volume of 390 acre-feet for a 6-hour 100-year storm. The flows that could be directed

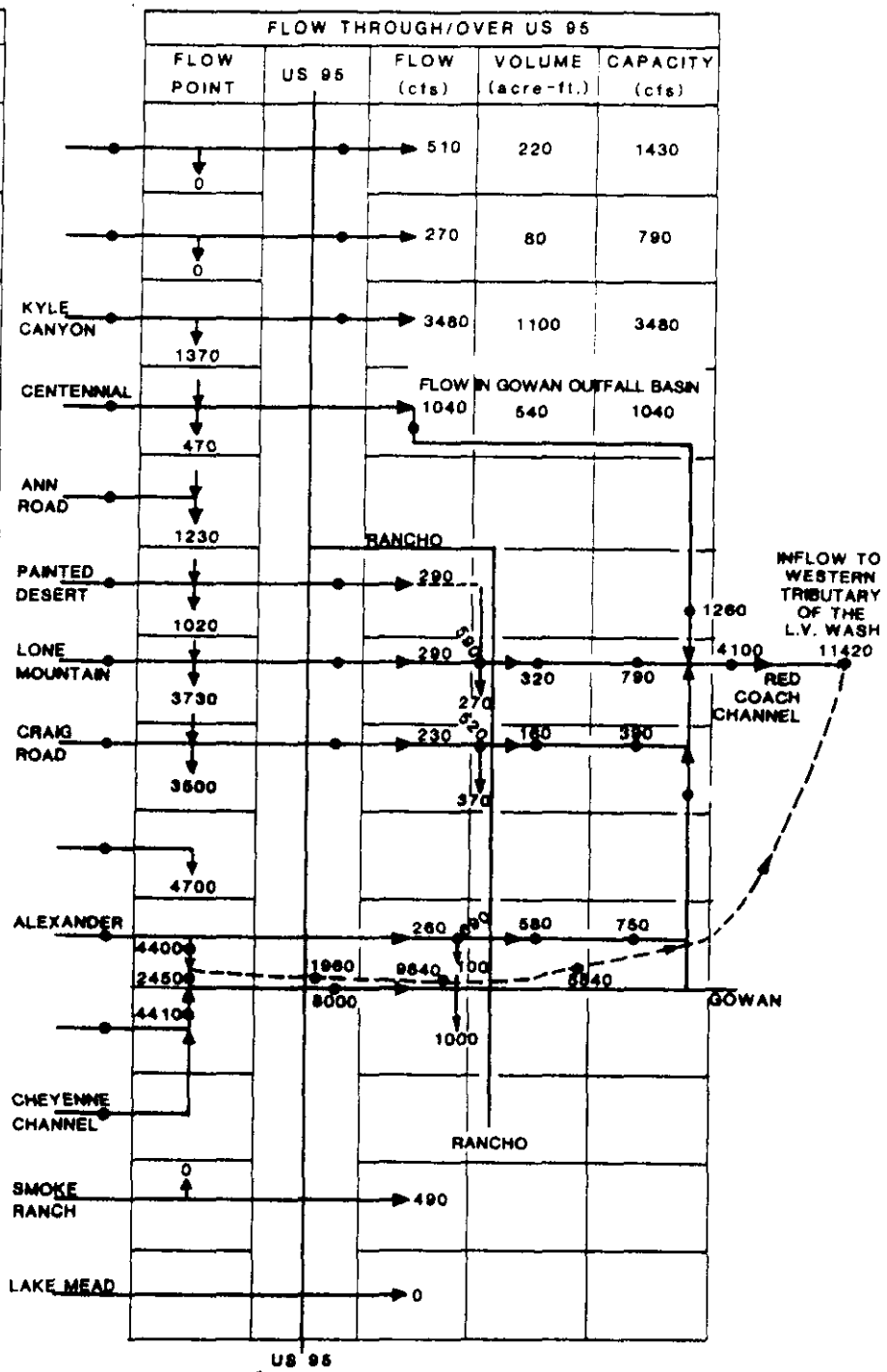
to the basin area are more important for consideration in this analysis. Figure 3.4 is a schematic of the existing flow conditions in the Gowan system. Flows from the west pass unimpeded by channels or detention basins until they reach U.S. 95. U.S. 95 acts as a long berm which channels flow that cannot pass through culverts or over low spots in the road toward Gowan Road. Flows reaching Gowan Road are conveyed through the Gowan Road underpass.

Flows north of Centennial that flow across U.S. 95 follow streets and drainage paths toward Las Vegas Wash. Flows south of this point flow into the Gowan Outfall Basin with ultimate discharge to the Red Coach Channel on the western tributary to the Las Vegas Wash. Flows across U.S. 95 south of the Painted Desert Golf Course are further impeded in their eastward path by Rancho Road. The total flow along Gowan Road east of U.S. 95 is estimated at 9840 cfs with a volume of 2630 acre-feet.

b. Design Conditions - Several detention basins and outfall channels were proposed in the CCRFCD Master Plan that would reduce the flows to U.S. 95 shown on Figure 3.4 Table 3.4 shows the size of the facilities as shown in the Master Plan and the approximate flows for the outlets based on the hydrology of this report. This is Alternative 1 as further described in Chapter 8. The outlet flows are channelized to the Las Vegas Wash or to a downstream detention basin. The flows are reduced to such an extent that some of the facilities identified in the CCRFCD Master Plan would

FIGURE 3.4 EXISTING FLOWS IN GOWAN SYSTEM

FLOW TO US 95		
DRAINAGE BASIN	FLOW (cfs)	VOLUME (acre-ft.)
GD 33	510	220
GD 32	270	80
GD 30,31	4650	1720
GD 28	140	50
GD 25,26,27	780	190
GD 29,PDGG	110	30
GD 21-24	2100	540
GD 18-20	1440	360
GD 15-17	1230	340
GD 12-14	1300	360
GD 9-11	1400	390
GD 1-8	3000	780
GD 34,35	490	130
ANGEL PARK	NOT IN EXIST. GOWAN SYSTEM	



*FLOWS ARE BASED ON GOWAN STORM CENTERING (66 SQ. MI.)

appear to no longer be needed. For this reason various basins were eliminated to create Alternative 2 Modified Master Plan.

TABLE 3.4

CCRFCD DETENTION BASINS UNDER DESIGN CONDITIONS FOR GOWAN NORTH

Detention Basin	Size (Ac.Feet)	Outflow (cfs)	Impact On Existing Gowan System Flows *
Kyle Canyon	1500	1600	Would remove GD21, GD25, GD30 and upper portions of GD31, 32, and 33 from Gowan North contributing area. All flow from Gowan Basin Area No. 1 (Figure 1.2) would flow under U.S. 95 north of Centennial.
Cam 10	350	100	Would reduce flows from GD18, and upper portions of GD22 and 23 significantly reducing flows to U.S. 95 along Lone Mountain and Craig roads.
Cam 8	100	200	Would reduce flows from GD15 and upper portions of GD13 and GD16 significantly reducing flows to U.S. 95 between Craig Road and Alexander Road.
Cam 6	200	150	Would reduce flows from GD12, GD9, V21 and part of GD13 significantly reducing flow to U.S. 95 between Alexander Road and Cheyenne Avenue.
Cam 4	180	100	Would reduce flows from GD1 to Cheyenne Channel (with Hualapai Diversion this would reduce inflow to Angel Park and not affect Gowan North).
CA1A	100	100	Would reduce flows from GD19 and portions of GD22 and 23 below CAM 10.
CA3B	250	200	Would reduce flows from GD16 below CAM 8.
CA4A	180	250	Would reduce flows from GD13 and GD14 below CAM 6 and CAM 8.
Tonopah GD28	400		Would reduce flows along U.S. 95 from below Kyle.

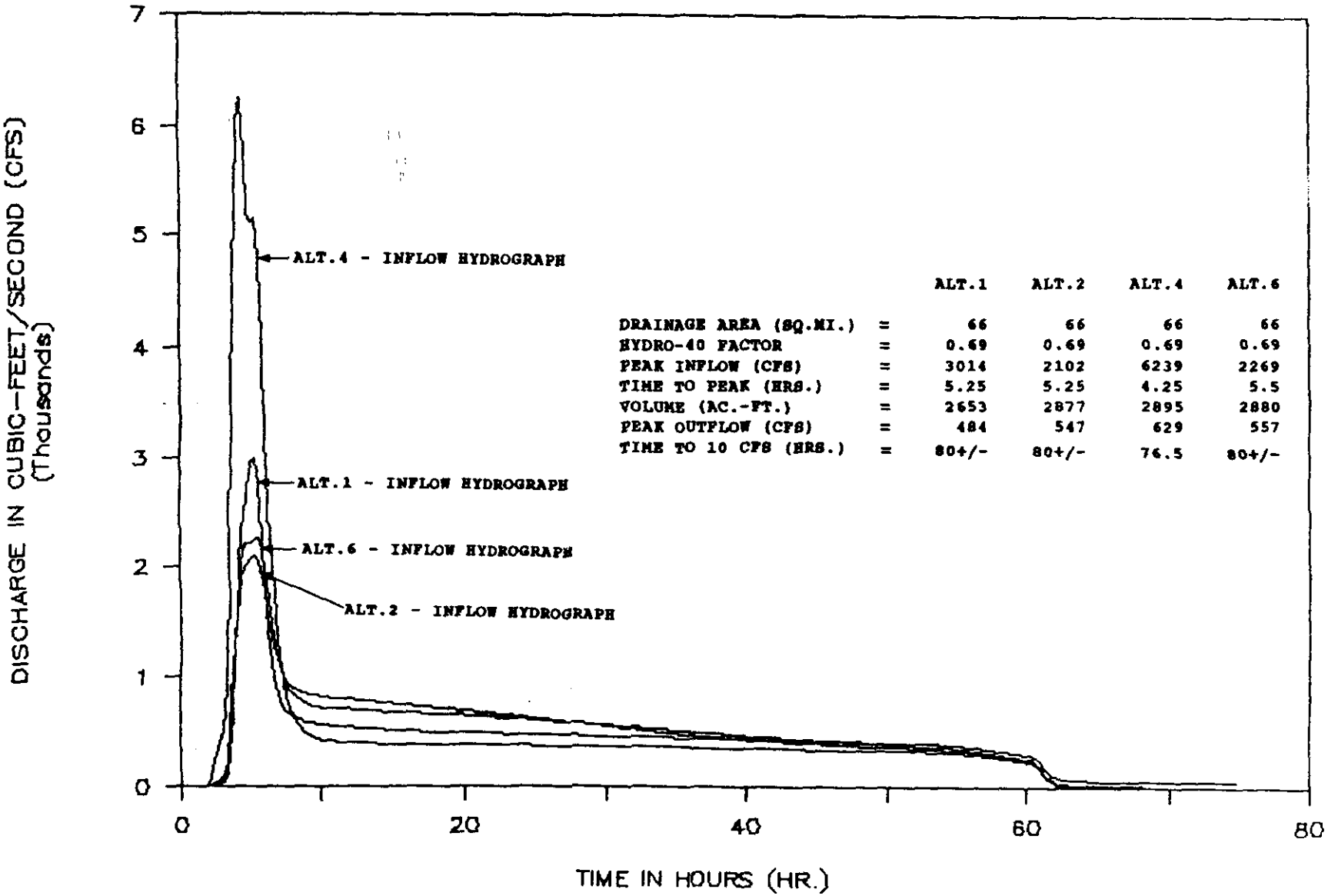
* Refer to Plate 1 in the end jacket for drainage sub-basins.

Alternative 2, the modified master plan includes facilities that are not expected to be constructed in the next 10 to 15 years. Therefore, other alternatives were developed which include only facilities which are expected to be built within a 10 to 15 year time frame. Alternative 4 collects undetained flows in the proposed Durango Channel for flow reduction in Gowan North (no detention north/west of Gowan North except for the Kyle Canyon Detention Basin). Analysis of CCRFCD Master Plan facilities and costs disclosed that a significant portion of the costs were due to the channels interconnecting the various detention basins. Alternative 6 was developed to determine if constructing basins without channel outlets in the near future would reduce the size and cost of Gowan North and Durango Channel so they could be built for the same cost as Alternative 4 (outlets could be added or flow could be diverted along streets in the far future). Figure 3.5 is the inflow hydrographs to the Gowan North Detention Basin for the four alternatives. Figure 3.6 shows how flows would be reduced at U.S. 95 under the various alternatives. The facilities required to achieve these flows are described in Chapter 8. Flows through U.S. 95 that are south of Centennial are further discussed in Section 3.5.

c. Future Conditions - The future conditions for Gowan North includes the facilities selected in the alternative analysis and flows would be the same as design conditions for that model.

GOWAN NORTH DETENTION BASIN

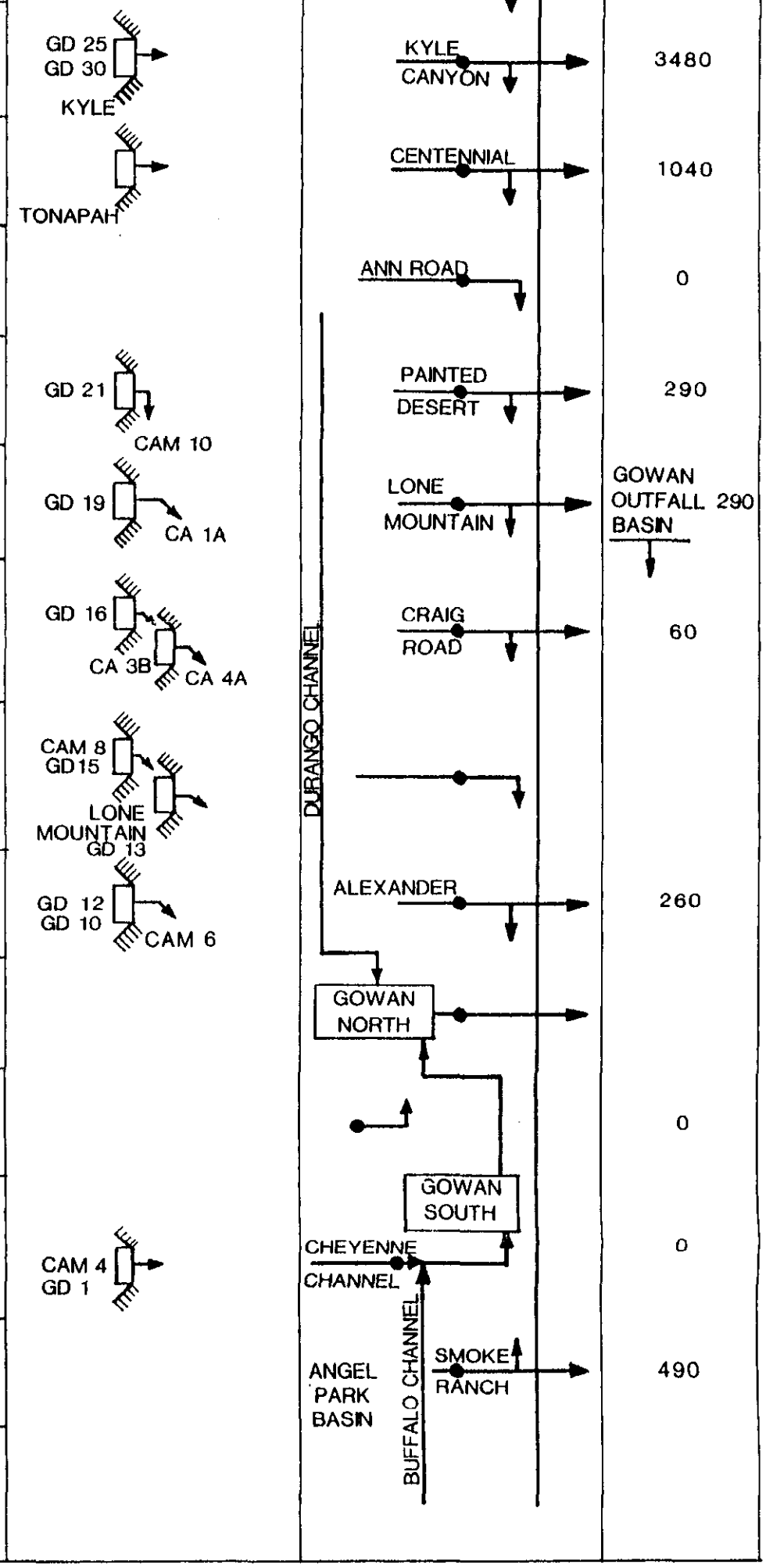
INFLOW HYDROGRAPHS FOR ALTERNATIVES



		ALT.1	ALT.2	ALT.4	ALT.6
DRAINAGE AREA (SQ.MI.)	=	66	66	66	66
HYDRO-40 FACTOR	=	0.69	0.69	0.69	0.69
PEAK INFLOW (CFS)	=	3014	2102	6239	2269
TIME TO PEAK (HRS.)	=	5.25	5.25	4.25	5.5
VOLUME (AC.-FT.)	=	2653	2877	2895	2880
PEAK OUTFLOW (CFS)	=	484	547	629	557
TIME TO 10 CFS (HRS.)	=	80+/-	80+/-	76.5	80+/-

FIGURE 3.5

BASINS	ALTERNATIVE 1	2	4	6	EXISTING
	100 YR. FLOWS (cfs) D/S OF DET. BASINS				
GD 33	500	500	500	500	510
GD 32	320	320	320	320	270
GD 30,31	2840	1600	1600	1600	4850
GD 28	130	130	130	130	140
GD 25,26,27	120	120	120	120	780
GD 29,PDGC	100	100	100	100	110
GD 21-24	40	40	40	40	2100
GD 18-20	200	200	200	200	1440
GD 15-17	40	40	40	40	1230
GD 12-14	60	50	50	50	1300
GOWAN IN NORTH	3010	2100	6240	2270	8000
GOWAN OUT NORTH	480	550	630	580	8000
GD 9-11	510	510	510	510	1400
GD 1-8	1300	1300	1300	1300	3000
GD 34,35	130	130	130	130	490
ANGEL PARK	400	400	400	400	NOT IN EXIST. GOWAN SYSTEM



NOTE: WHERE FLOW TO US 95 EXCEEDS CAPACITY TO CROSS, THE FLOWS WOULD BE DIVERTED ALONG US 95 TOWARD GOWAN ROAD.

FLOWS ARE BASED ON CRITICALLY CENTERED STORM FOR THE ASSOCIATED FACILITY. FOUR STORM CENTERINGS WERE USED: PROJECT TERMINUS (90 SQ. MI.), GOWAN NORTH (66 SQ. MI.), GOWAN SOUTH (37 SQ. MI.), AND ANGEL PARK (24 SQ. MI.). THE GOWAN NORTH CENTERING (66 SQ. MI.) WAS USED FOR ALL EXISTING FLOWS.

FIGURE 3.6
DESIGN HYDROLOGY FOR THE ALTERNATIVES

6.4 DETENTION BASIN OPTIONS

6.4.1 Detention Basin Size

The detention volume below spillway for the alternatives ranges from 544 AF to 1125 AF. Earthwork calculations were made to determine that these volumes could not be created on the site to balance cut and fill without creating an exceedingly high berm. A basin with berm at elevation 2333 ft. elevation and spillway of 2328 ft. was evaluated for all alternatives with volume created by excavation. This would create a berm with a maximum height of 14 feet along Tenaya Way. The site layout as shown schematically in Figure 6.2 was used to determine the volume of Cut and fill for the various alternatives. Results are shown in Table 6.6. Figure 2.2 is a schematic of the alternatives.

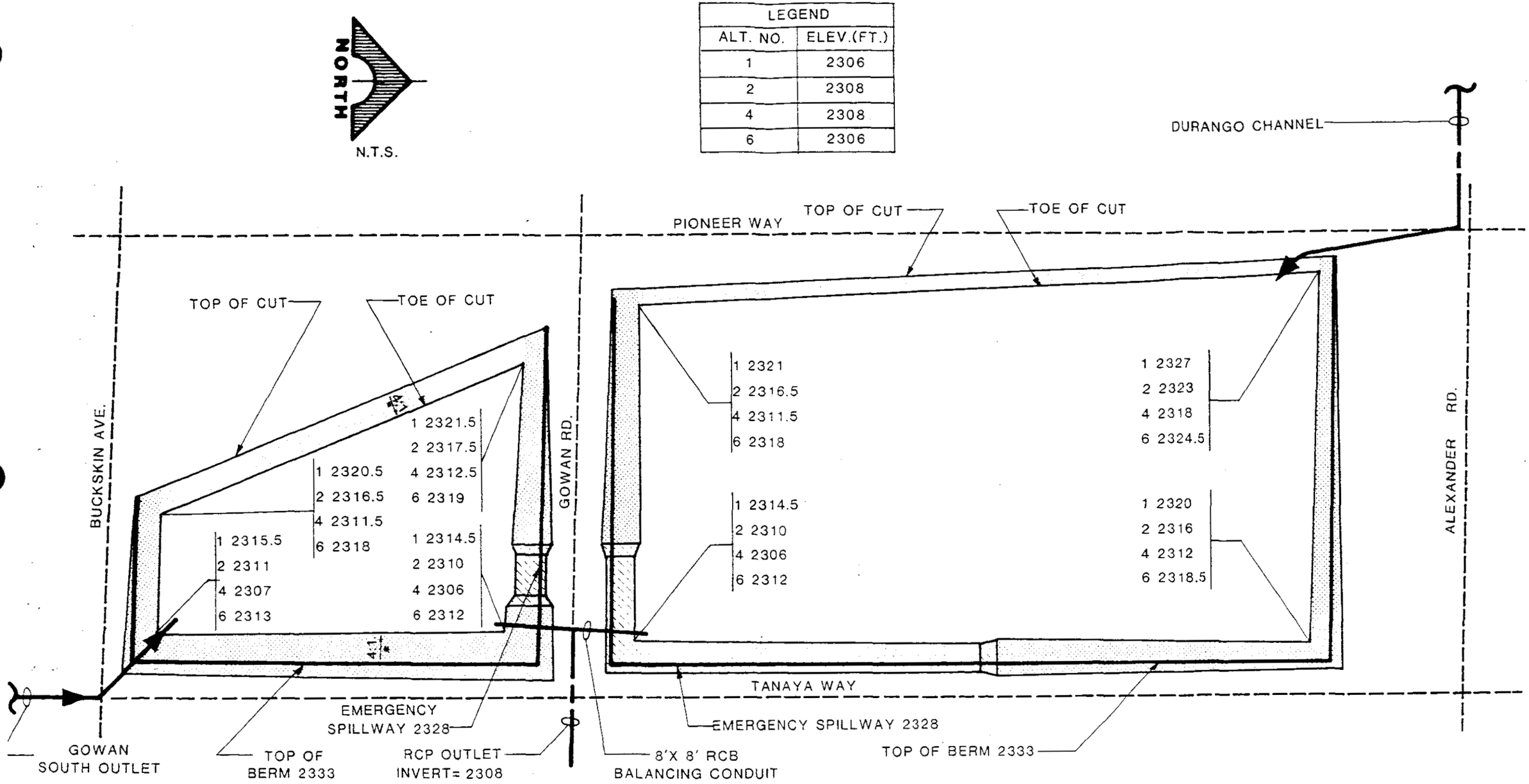
TABLE 6.6

GOWAN NORTH DETENTION BASIN ALTERNATIVES
CUT, FILL AND STORAGE QUANTITIES

	Alternative			
	1	2	4	6
	Volume			
North Basin				
Cut	353,000 cy	702,000 cy	1,046,000 cy	553,000 cy
Fill	85,000 cy	85,000 cy	85,000 cy	85,000 cy
Storage	380 AF	605 AF	818 AF	513AF
South Basin				
Cut	196,000 cy	274,000 cy	412,000 cy	260,000 cy
Fill	45,000 cy	45,000 cy	45,000 cy	45,000 cy
Storage	185 AF	235 AF	320 AF	226 AF
Total Storage	565 AF	840 AF	1,138 AF	739 AF

Note: The volume of the basins below elevation 2328 (spillway crest) and above natural ground is 105,000 cu. yd. (65 AF) for the South Basin and 274,000 cy (170 AF) for the North Basin. Adding the cut volumes to these values approximates storage in the basins below spillway crest.

LEGEND	
ALT. NO.	ELEV.(FT.)
1	2306
2	2308
4	2308
6	2306



* SLOPES FOR UPSTREAM & DOWNSTREAM FACES OF ALL BERM & ALL CUTS FOR BOTH BASINS ARE 4:1

ALT. NO.	VOLUME (AC/FT)
1	544
2	838
4	1125
6	714

FIGURE 6.2 GOWAN NORTH DETENTION BASIN ALTERNATIVES

The required detention volume for some alternatives could be obtained by using only the North Basin thus freeing the South Basin area for other public purposes.

6.4.2 Outflow Alternatives

The outlet piping from the basins would go through the berms to a common pipeline (or box culvert) in Gowan Road and form the first segment of the Gowan Outfall. The invert elevation of the pipelines on the detention basin side of the berm for the alternatives is given below:

	Alternative			
	1	2	4	6
	Invert Elevations (Feet)			
Invert North Basin	2315	2310	2306	2312
Invert South Basin	2315	2310	2306	2312

Approximately 300 feet of outlet piping from each basin is required to the common pipe in Gowan Road. The size of pipeline in Gowan Road was used as the control section for discharge from the basins. The outlet piping would be configured to provide hydraulic connection between the basins to equalize water surface levels. It was determined that approximately 600 feet of 72" pipeline would dissipate sufficient energy to allow gravity flow without surcharging manholes downstream.

6.4.3 Emergency Spillway

Emergency spillway cross-sectional configuration and unit costs are the same as described for Gowan South.

6.4.4 Economic Analysis

The unit costs for earth excavation and fill from Appendix 3 with 3000 feet haul were used for Gowan North Detention Basin to estimate costs for excess cut disposal. These costs are $2.37/cu. yd. for cut and $2.99/cu. yd. for fill. The spillway costs were based on $286/ft. or $286,000 for any alternative. Although there would be some difference amoung the alternatives, the cost of 1100 feet of 72" pipe with average depth of 12 feet in 1:1 trenches was used to estimate outlet piping for a total of $317,000 for any alternative.

The cost of using both basins for the alternatives was computed based on these factors and is shown in Table 6.7.

TABLE 6.7

ESTIMATED CONSTRUCTION COSTS FOR THE GOWAN NORTH DETENTION BASIN ALTERNATIVES*

	Alternative			
	1	2	4	6
North Basin	$1,315,000	$1,918,000	$2,733,000	$1,565,000
South Basin	687,000	784,000	1,111,000	751,000
Spillway	286,000	286,000	286,000	286,000
Outlet Piping	317,000	317,000	317,000	317,000
Total	$1,739,000	$3,305,000	$4,447,000	$3,119,000

* Costs are for the two basin option for all alternatives.

The cost of using the North Basin only was computed for Alternative 6. This would require a cut of 888,000 cy and fill of 85,000 cy for a 720 AF basin resulting in a cost of $3,162,000 compared to $3,119,000 above. The required outfall from Gowan South would be increased by 1140 feet for a cost of $302,000. This combined cost of $3,464,000 is $345,000 more than the two basin option.

6.5 RECOMMENDED FACILITIES

The Durango Channel alignment is recommended to serve as the collector channel to divert flows to Gowan North. The use of pipe/box culvert over channels in Segment 1 is recommended for all alternatives. Pipe/box is recommended in Segment 2 for Alternatives 2 and 6. Segments 3, 4 and 5 are recommended to be channel for all alternatives. Refer to Figure 6.1 for a schematic showing segment locations.

The two basin configuration is required for Alternatives 2 and 4 to provide required storage volumes and maintain reasonable berm height. For Alternatives 1 and 6, a one basin configuration could provide lands for other public purposes for the relatively low cost of about $10,000 per acre. However, the one basin alternative would not provide much flexibility should the City of Las Vegas elect to build the detention basin to a larger size in the event "free" excavation is available in exchange for allowing the soils to be used as fill for other projects.

The two basin configuration is recommended for all alternatives. As discussed above, it is required for Alternatives 2 and 4 to provide required storage. For Alternatives 1 and 6, it is recommended because of lower construction costs and to provide flexibility should a larger storage volume be desired during the interim when the Gowan facilities are constructed but upstream detention facilities are not yet constructed.

The total cost of Durango Channel and Gowan North Detention Basin for these recommendations is provided in Table 6.8.

TABLE 6.8

ESTIMATED CONSTRUCTION COSTS FOR THE
GOWAN NORTH DETENTION BASIN WITH THE DURANGO CHANNEL

Alternative	Construction Cost
1	$ 1,739,000 (w/o Durango Channel)
2	8,334,000
4	11,537,000
6	7,748,000

9.0 CITY OF LAS VEGAS SELECTED PROJECT

9.1 GENERAL

At a meeting held February 17, 1989, representatives of the City of Las Vegas, Clark County Regional Flood Control District, City of North Las Vegas and Clark County selected Alternative 6 with the following additions:

1. Outfalls from the upstream detention basins should be included as future facilities (outfalls from Kyle Canyon Detention Basin, CAM10 Detention Basin and Lone Mountain Detention Basin).
2. To aid in phasing of construction, the Gowan North Detention Basin could be built to a larger size, as in Alternative 4 (1125 acre-feet). This option would be particularly advantageous if the City manages to acquire free excavation in exchange for using soils from the site for fill in other projects.

The selection made at the February 17, 1989 meeting was based on the following data provided by GCW:

1. HEC-1 runs for the four alternatives.
2. Cost estimates for the four alternatives.
3. Recommendation for Alternative 6.

Pre-design was performed for the selected Alternative 6. This chapter summarizes the pre-design effort which included preparation of preliminary plan profile, detention basin layout, and cost estimate.

9.2 DESCRIPTION OF PHYSICAL FACILITIES

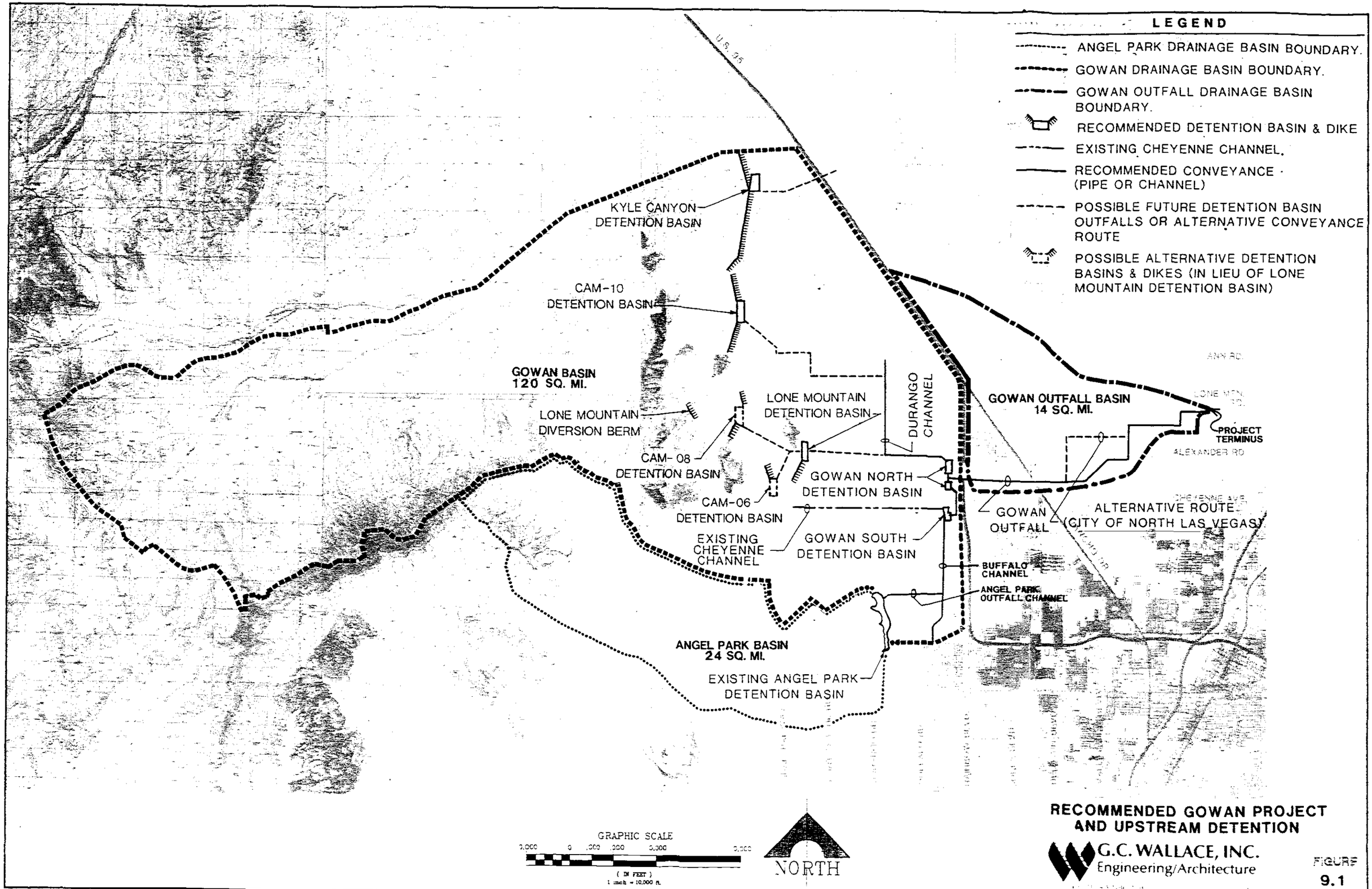
9.2.1 General Plan and Profile

The recommended Gowan project and related upstream detention facilities are shown in Figure 9.1. The design hydrology for this project includes the Kyle Canyon Detention Basin, the CAM10 Detention Basin, and Lone Mountain Detention Basin and diversion berm. An alternative to the Lone Mountain Detention Basin is Detention Basin CAM06 and Detention Basin CAM08. Outfalls from Kyle Canyon, CAM10, and the Lone Mountain Detention Basin are included as possible future facilities as is an alternative Gowan Outfall route proposed by the City of North Las Vegas.

The facilities which are recommended to be constructed as the Gowan project are shown schematically in Figure 9.2 (the Gowan facilities do not include future upstream detention basins but they do include the Durango Channel). Figures 9.3 through 9.11 are plan and profile for the outfalls; plan views of Gowan South and Gowan North Detention Basins; and stage-storage, stage-discharge and stage-surface area curves for Gowan South and North Detention Basins (these figures are at the end of the report).

9.2.2 Facility Sizing for Pre-design

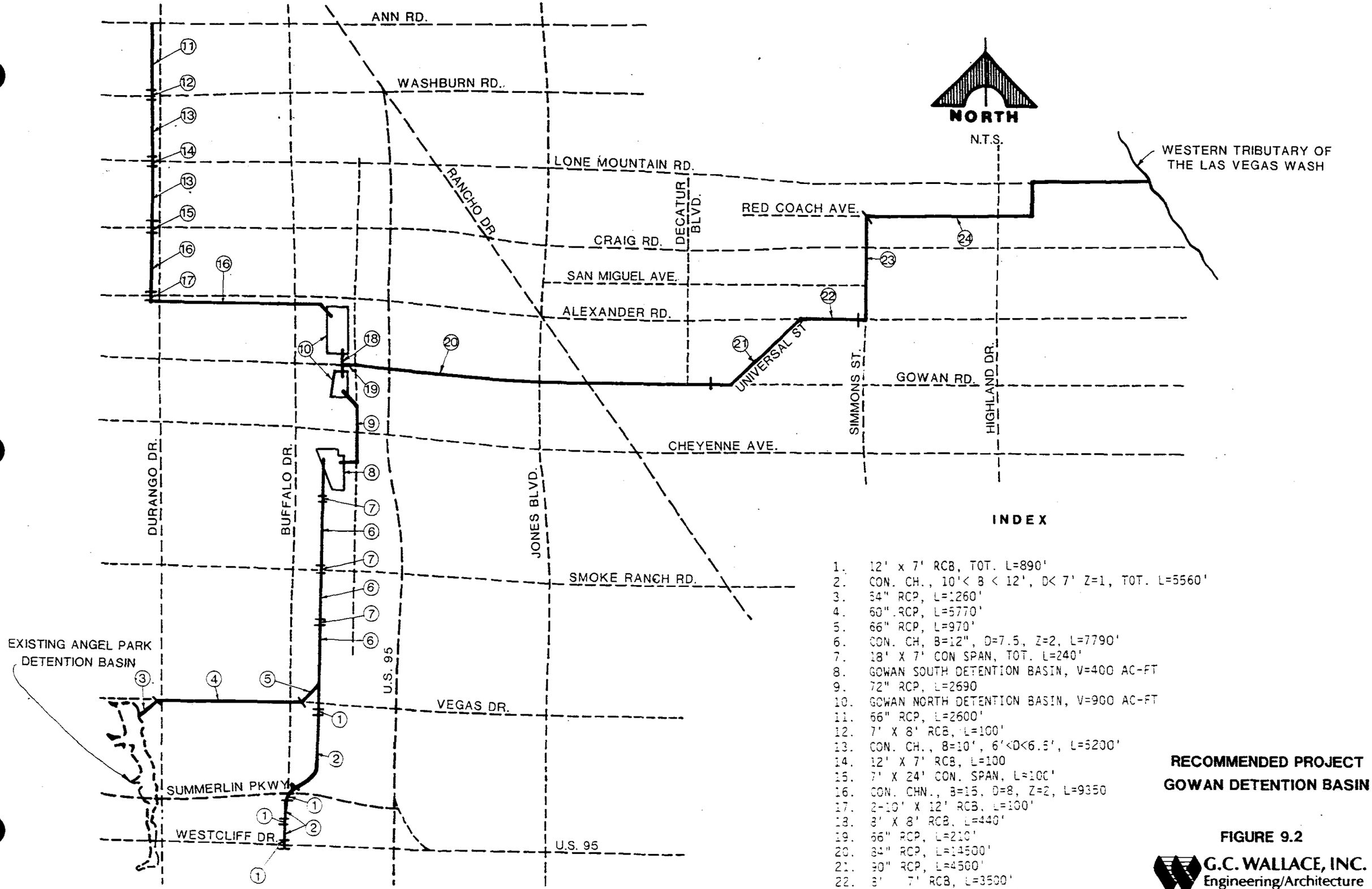
The sizes of detention basins, channels, and pipes vary to some extent from those shown for Alternative 6 in the alternatives analysis. The differences are due to a detailed analysis of facilities for the selected alternative. The changes are:



RECOMMENDED GOWAN PROJECT AND UPSTREAM DETENTION

G.C. WALLACE, INC.
Engineering/Architecture

FIGURE
9.1



INDEX

1. 12' x 7' RCB, TOT. L=890'
2. CON. CH., 10'< B < 12', D< 7' Z=1, TOT. L=5560'
3. 84" RCP, L=1260'
4. 60" RCP, L=5770'
5. 66" RCP, L=970'
6. CON. CH, B=12", D=7.5, Z=2, L=7790'
7. 18' X 7' CON SPAN, TOT. L=240'
8. GOWAN SOUTH DETENTION BASIN, V=400 AC-FT
9. 72" RCP, L=2690
10. GOWAN NORTH DETENTION BASIN, V=900 AC-FT
11. 66" RCP, L=2600'
12. 7' X 8' RCB, L=100'
13. CON. CH., B=10', 6'<D<6.5', L=5200'
14. 12' X 7' RCB, L=100
15. 7' X 24' CON. SPAN, L=100'
16. CON. CHN., B=15, D=8, Z=2, L=9350
17. 2-10' X 12' RCB, L=100'
18. 8' X 8' RCB, L=440'
19. 66" RCP, L=210'
20. 84" RCP, L=14500'
21. 90" RCP, L=4500'
22. 8' 7' RCB, L=3500'
23. 10' X 7' RCB, L=4380'
24. CON. CH, B=12', D<9', Z=2, L=10,940'

RECOMMENDED PROJECT
GOWAN DETENTION BASIN

FIGURE 9.2

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10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 GENERAL

This chapter presents conclusions and recommendations regarding project design hydrology, facilities to be constructed, project cost and phasing, and considerations for future studies.

10.2 DESIGN HYDROLOGY

The hydrology used for pre-design assumes that upstream detention facilities would be constructed within a ten to fifteen year time frame. It is recommended that this hydrology be used for design of facilities that are constructed in the next three to four years. When final design proceeds with phases of the project that are constructed further in the future, the hydrology should be updated to include the latest planning or construction of upstream detention facilities which will impact flows to the project.

Storm centering (Hydro 40 adjustment factors) used in the model significantly affect design flows and volumes. Critical storm centering for the various components was found to be:

Angel Park Detention Basin - Angel Park Centered Storm (0.76)

Gowan South Detention Basin - Cheyenne Channel plus Angel Park Centered Storm (0.73)

Gowan North Detention Basin - Gowan North Centered Storm including Gowan South and Angel Park (0.69)

Gowan Outfall:

Gowan North to Red Coach - Regional Storm over Gowan North plus Gowan Outfall Basin (0.65)

Western Tributary of the Las Vegas Wash - Local Centered Storm on the Gowan Outfall Basin (0.81)

10.3 GOWAN AND UPSTREAM FACILITIES

Subject to final design, it is recommended that the Gowan project facilities be as shown schematically on Figure 9.2. The Alternative Gowan Outfall route suggested by the City of North Las Vegas should be investigated prior to outfall design to determine if this route is more or less costly, and to evaluate the potential benefit of intercepting additional local drainage.

The upstream detention facilities as shown on Figure 9.1 should be adopted as part of the Clark County Regional Flood Control District Master Plan, including the future outfalls. If phasing proves necessary, the upstream detention basins should be constructed prior to their outfalls. Alternatives to the Lone Mountain Detention Basin are shown. Additional analysis should be performed to further evaluate the feasibility of the the Lone Mountain site. Special considerations include land acquisition and a more detailed cost comparison of the Lone Mountain Detention Basin versus CAM06 and CAM08.

If free excavation for the Gowan North Detention Basin proves feasible. consideration should be given to increasing the storage volume of the detention basin thereby allowing better performance or the detention basin during the interim between its construction and construction of upstream detention facilities. If freeboard criteria as presented in this pre-design report are used for final design of the Durango Channel, it would have considerable additional capacity to convey these unregulated flows during the interim

10.4 PROJECT COSTS AND PHASING

The Gowan Detention Basin project will have to be phased unless additional funding sources become available. Funding may be increased if the CCRFCD obtains bonding capacity.

In general, it is desirable to build detention prior to downstream conveyance. The detention will reduce peak downstream flows and increase their duration. For example, peak flows at the Western Tributary of the Las Vegas Wash will be reduced by approximately 70 percent, from 11,400 cfs to 3,100 cfs by construction of the Gowan Detention Basin system. Therefore, constructing the conveyance system first would mean that either the system would have to be designed for flows that are four times larger than needed once the detention basins are constructed, or the system would be greatly undersized should a 100-year flood event occur before the detention basins are built. On the other hand, construction of the detention basins first would significantly reduce the peak flows downstream. It should be noted that the duration of these flows would increase from approximately 24 hours to 80 hours. However, this would

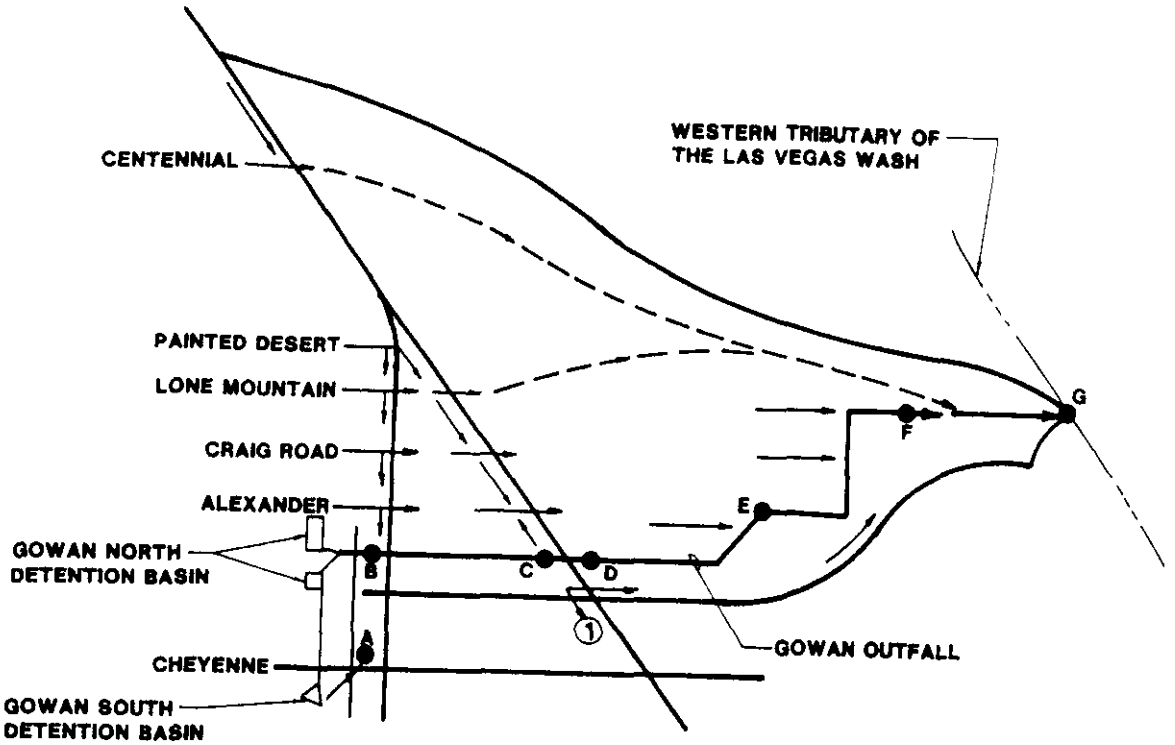
probably be less damaging than the higher peak flows.

The recommended phasing is to construct upstream detention initially. To limit sustained flows along the Gowan outfall route, the outfall should not be extended across Rancho Drive until the outfall is completed to the project terminus (Western Tributary of the Las Vegas Wash).

As shown in Figure 10.1, peak runoff is reduced as the various phases of the project are completed. The 100-year level of flood protection is not achieved until all phases of the project are completed and the upstream Kyle Canyon, CAM-10 and Lone Mountain Detention Basins are constructed (the upstream detention basins are not a part of the Gowan Project but they are needed for the Gown Project to achieve its full flood reducing potential).

Figure 9.12 shows areas where flooding will be reduced by the Gowan Project. Peak flows will be reduced and duration of flooding will be increased in reaches A & C as each Phase is constructed. However, flooding to the south of Gowan (reaches B, D & E on Figure 9.12) will not be reduced until the Gowan outfall is completed (Phase 5). As phases 1 through 4 are completed, peak flows to reaches B, D & E will remain the same but duration of flooding will increase. Table 10.1 shows the reductions in depth and width of flooding at a cross section in reaches A and C as the phases of the Gowan Project are constructed.

FIGURE NO. 10.1 RUNOFF DURING GOWAN PROJECT PHASING



	LOCATION	100-YEAR RUNOFF — PEAK(cfs.) MEAN(cfs.) DURATION(hrs.) *						
		EXIST.	UPON COMPLETION OF PHASE * *					
			1	2	3	3'	4	5&6
A	U.S. 95 AT CHEYENNE	3010	1920	6	6	6	6	6
		450	340	–	–	–	–	–
		21	59	–	–	–	–	–
B	GOWAN AT U.S. 95	7990	6750	6390	2980	1600	530	530
		970	640	560	440	430	410	410
		29	61	63	80	80	80	80
C	GOWAN WEST OF RANCHO	9810	9040	6420	3040	1730	530	530
		1060	720	570	440	430	420	420
		30	60	63	80	80	80	80
1	RANCHO SOUTH OF GOWAN (FLOW OUT OF SYSTEM)	1000	1000	1000	1000	1000	290	0
		290	240	230	220	210	200	0
		24	58	62	80	80	80	–
D	GOWAN EAST OF RANCHO	8810	8040	5420	2040	730	240	530
		1040	500	340	220	210	200	420
		24	58	62	80	80	80	80
E	ALEXANDER AT ALLEN	8900	8120	5370	2130	860	370	630
		1060	510	350	230	220	200	430
		24	58	62	80	80	80	80
F	RED COACH CHANNEL	9590	8810	6320	3490	2750	2750	2750
		920	550	460	320	300	500	500
		34	64	63	80	80	80	80
G	PROJECT TERMINUS (UPSTREAM OF WASH)	11420	10920	6440	3740	3090	3090	3090
		1040	790	480	330	310	530	530
		45	66	63	80	80	80	80

* BASED ON GOWAN NORTH STORM CENTERING (66 SQ.MI.), EXCEPT FOR LOCATIONS F & G FOR PHASES 3'- 6 HAVE PEAKS PER LOCAL STORM CENTERING (14 SQ. MI.).

* * PHASES AND ASSUMED UPSTREAM DETENTION BASIN:

PHASE 1 - ANGEL PARK OUTLET & OUTFALL TO GOWAN SOUTH WITH NO UPSTREAM DETENTION BASINS.

2 - GOWAN SOUTH & OUTFALL WITH KYLE DETENTION BASIN

3 - GOWAN NORTH AND OUTFALL TO THE WEST SIDE OF RANCHO WITH KYLE DETENTION BASIN

3' - ADD CAM-10 & LONE MOUNTAIN DETENTION BASINS.

4 - ADD DURANGO CHANNEL

5 - ADD GOWAN OUTFALL FROM PROJECT TERMINUS TO RANCHO.

6 - ADD BUFFALO CHANNEL FROM WESTCLIFF TO VEGAS DRIVE.

TABLE 10.1
NORMAL DEPTHS OF FLOODING FOR PHASED CONSTRUCTION
OF GOWAN PROJECT

LOCATION	NORMAL DEPTHS FOR 100-YEAR PEAK FLOWS *			DEPTH (FEET)/ TOP WIDTH (FEET)		
		UPON COMPLETION OF PHASE				
	EXISTING	1	2	3	3'	4
GOWAN RD. APPROX.	2.99 **	2.88 **	2.5 **	1.72	1.26	0
2000'EAST OF U.S.95	700+	700+	700+	630	519	0
ALEXANDER @ ALLEN	2.91 **	2.82 **	2.36 **	2.2	1.73	1.26
	1200+	1200+	540	525	346	252

* See Figure 10.1 for Phased Construction Assumptions and Storm Centering Used for 100-Year Peak Flow Calculations.

** Sections have been Extended.

The following phasing recommendation is based on engineering judgement and the above flow data. It does not consider overall Las Vegas Valley flooding protection requirements as they relate to the Gowan Project and limited funding. Nor does the recommendation consider future variables such as the potential for free excavation (which should be utilized if possible, and when possible). In summary, the recommendation is made to guide the effected entities as to which phases of the Gowan project provide the most flood protection initially. Changes to any phasing scheme are to be expected as priorities and funding sources vary.

It is recommended that phasing of the Gowan Detention Basin system be as follows:

1. Angel Park Outlet and outfall to the Gowan South Detention Basin Site.
2. Construction of the Gowan South Detention Basin and outfall.
3. Construction of the Gowan North Detention Basin and outfall from the detention basin to the west side of Rancho Drive.
4. The Durango Channel
5. Construction of the Gowan Outfall starting downstream at the Western Tributary of Las Vegas Wash and working upstream to Rancho Drive.
6. The Buffalo Channel from Westcliff Drive to Vegas Drive.

It is recommended that needed right-of-way be acquired as soon as possible, especially for the Durango Channel and, of course, the Angel Park Outlet (it is our understanding that the City of Las Vegas

is in the process of acquiring right-of-way for the Angel Park Outfall).

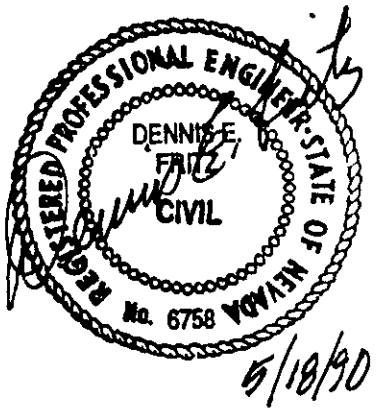
At meetings held on March 17 and March 23, 1989, the review committee (staff from City of Las Vegas, CCRFCD, City of North Las Vegas and Clark County Public Works) reviewed the G.C. Wallace, Inc. recommended Gowan project phasing and backup data. At these meetings, the review committee discussed the risks and advantages associated with various phasing scenarios for the Gowan project but did not reach agreement on a specific phasing plan. Further meetings between the affected entities are scheduled so that details of the Gowan project phasing can be refined concurrently with development of each entities 10-year construction plan.

Design Report for the Gowan Detention Basin Outfall Structure

Included in this section:

Excerpts from *Design Report for the Gowan Detention Basin Outfall Structure*, May 1990 by VTN Nevada.

DESIGN REPORT
FOR THE
GOWAN DETENTION BASIN
OUTFALL STRUCTURE



Prepared for the
City of North Las Vegas, Nevada
May 1990

VTN W.O. 3900

vtn nevada

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1.0 OVERVIEW

On October 25, 1989 VTN Nevada was retained by the City of North Las Vegas (NLV) to provide predesign and design services for the Gowan Detention Basin Outfall Structure. The initial services of this contract includes an alignment study for the Gowan Detention Basin Outfall Structure from the Gowan North Detention Basin to the Western Tributary of the Las Vegas Wash (within both the City of Las Vegas (CLV) and the NLV). The Predesign Services including existing utility research, geotechnical investigation, existing right-of-way research, aerial photography/field topographic mapping, and this design report applies only for the portion of the structure located in the NLV.

On January 23, 1990, VTN presented nine possible alternatives for the Gowan Outfall Alignment to the NLV, CLV, and Clark County Regional Flood Control District (CCRFCD). Included in this presentation was a preliminary hydrology analysis that incorporated the pertinent information provided in drainage studies for new land development projects and the Gowan Detention Basin Predesign Report (ref. 14) in putting together the HEC-1 Hydrology Model for the Lower Gowan Outfall Basin. The presentation included four storm centerings which are discussed in detail in

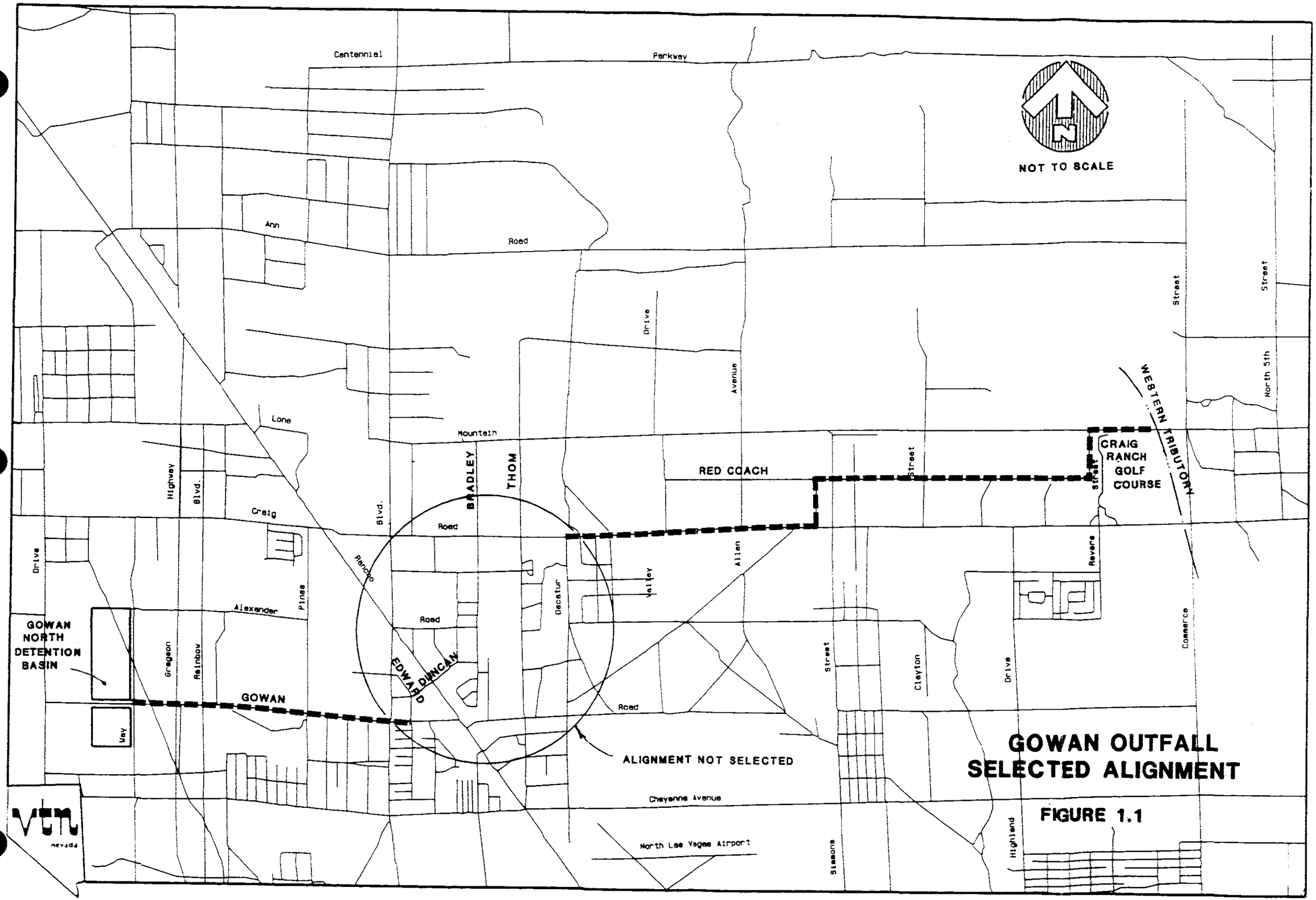
Section [illegible] this report. Based on a hydrologic and alignment analysis prepared by VTN Nevada, a large portion of the Gowan Outfall Structure alignment was selected at this meeting. A short segment of the alignment located between the Gowan/Edwards Intersection and the Decatur/Craig Intersection was identified as having three possible options that would require further consideration. The alignment is shown on Figure 1.1.

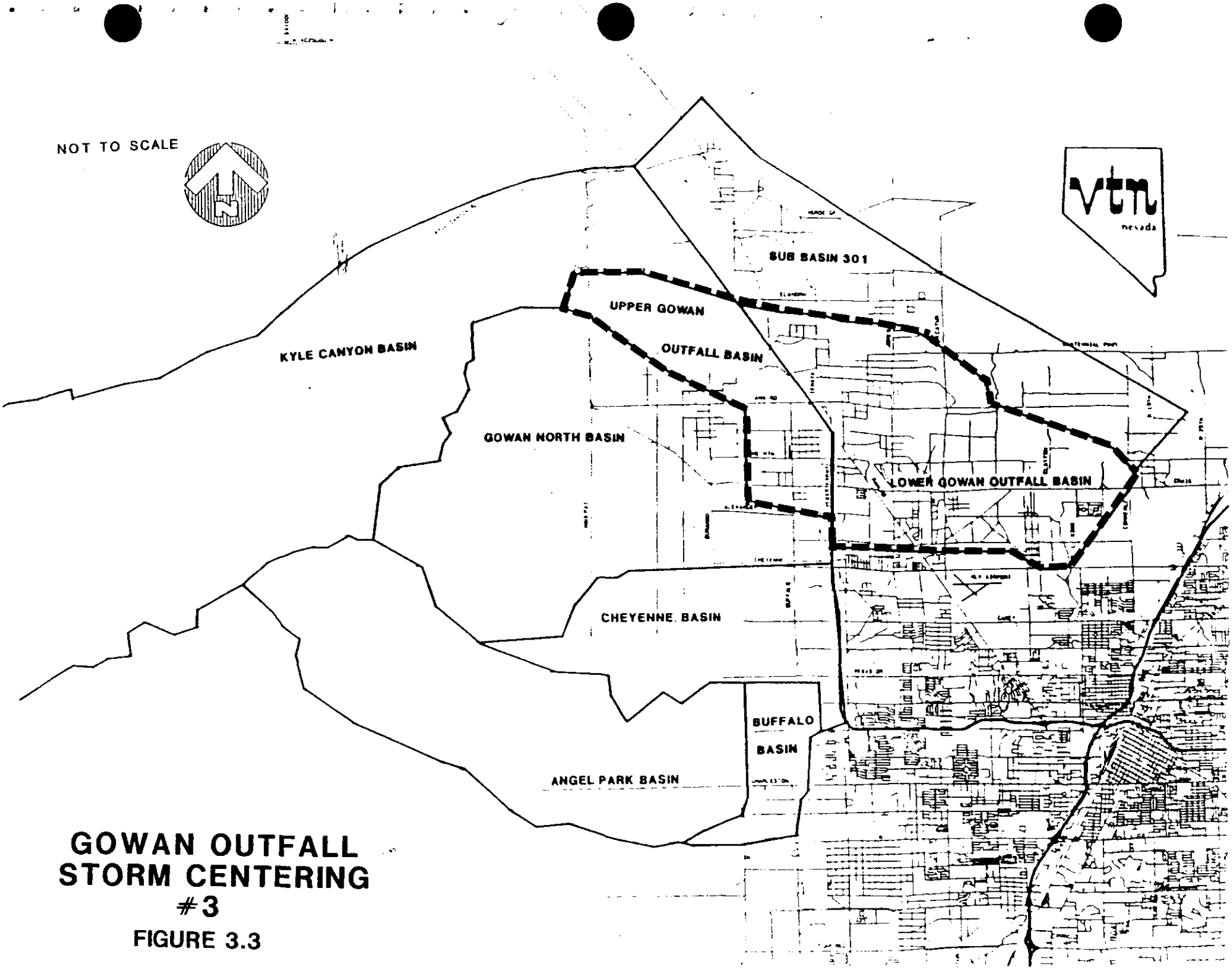
VTN Nevada analyzed three possible alternative alignments for the Gowan Outfall Conveyance Structure between the Gowan/Edwards Intersection and Craig/Decatur Intersection and the results were submitted to the City of North Las Vegas in the Draft Predesign Report and Alignment Study for the Gowan Detention Basin Outfall Structure on March 16, 1990. These three alignments were referred to as the Decatur, the Duncan, and the Thom Alignments. These alignments were analyzed using Storm Centerings 3 and 4 as discussed in Section 3.4. This analysis included a preliminary right-of-way review (Figure 4.1), preliminary existing utility research, and a preliminary opinion of probable construction costs comparison. It was assumed that Ann Road, east of the in-

tersection of Decatur Boulevard, will be graded to intercept runoff from the north and will convey those flows easterly to the Western Tributary thus cutting off flows from the north.

A meeting was held on April 6, 1990 with the CLV, NLV, CCRFCD, and VTN to select the undefined segment of the proposed Gowan Outfall Structure alignment. The Decatur Alignment as shown in this report and in the Draft Predesign Report and Alignment Study for the Gowan Detention Basin Outfall Structure was selected as the proposed alignment. VTN was then instructed to finish the predesign services for the Decatur Alignment.

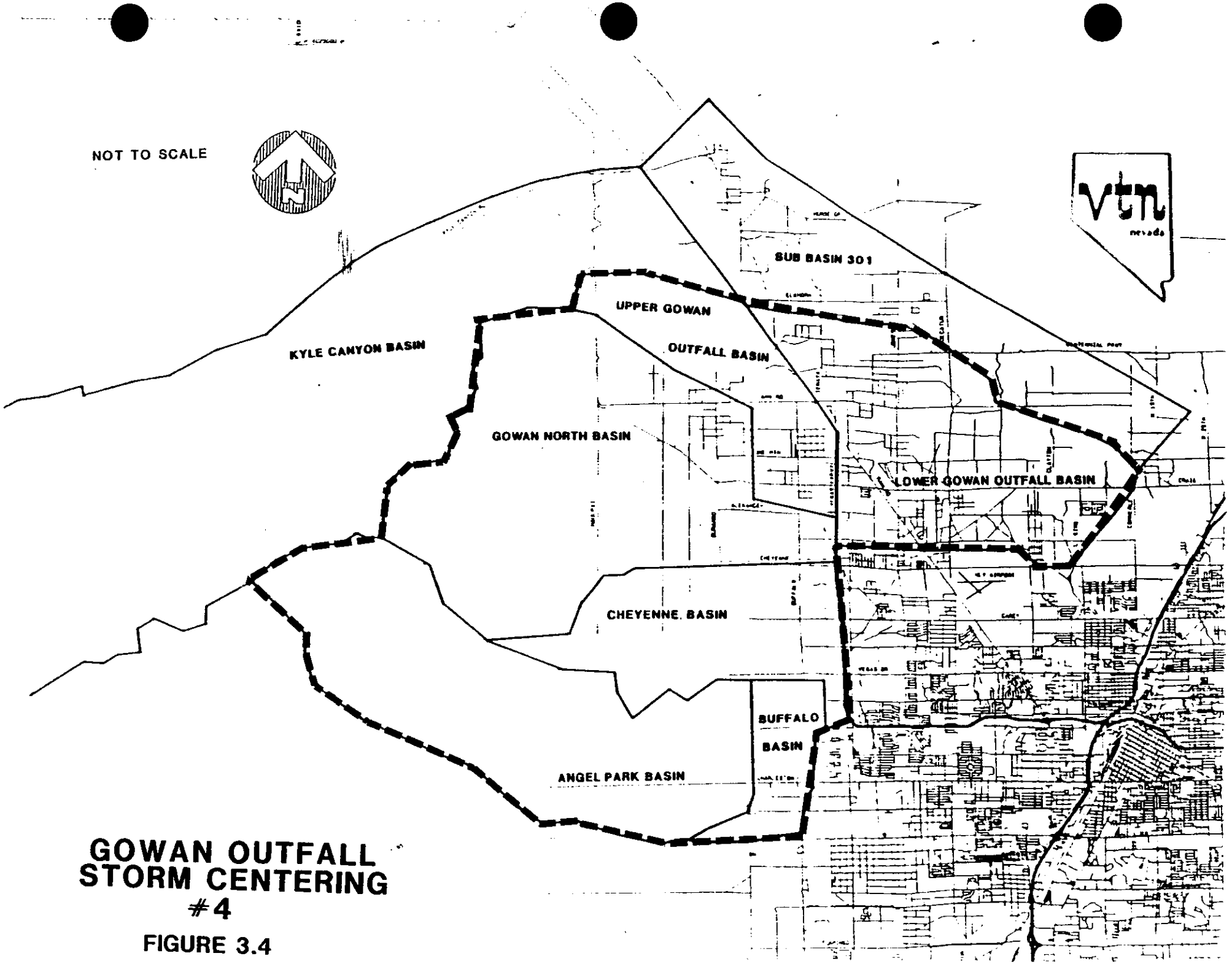
This report is the Design Report for the Gowan Detention Basin Outfall Structure. This report includes a hydrology analysis, preliminary structure sizes, a preliminary opinion of the probable construction costs, and a construction phasing plan of the Decatur Alignment.


NOT TO SCALE
Centennial
Parkway
Ann
Road
Lone
Mountain
Craig
Road
Alexander
Road
Road
Cheyenne Avenue
North Las Vegas Airport
Drive
Avenue
Street
Street
North 5th
Street
Street
Street
Street
Street
Drive
Commerce
Highland
Highway
Blvd.
Blvd.
Drive
Pines
Gregson
Rainbow
Way
Rancho
Decatur
Valley
Allen
Revere
Clayton
Simmons
RED COACH
WESTERN TRIBUTARY
CRAIG RANCH GOLF COURSE
BRADLEY
THOM
EDWARD DUNCAN
GOWAN
GOWAN NORTH DETENTION BASIN
ALIGNMENT NOT SELECTED
GOWAN OUTFALL
SELECTED ALIGNMENT
FIGURE 1.1
VTN
nevada



GOWAN OUTFALL STORM CENTERING #3

FIGURE 3.3



GOWAN OUTFALL STORM CENTERING #4

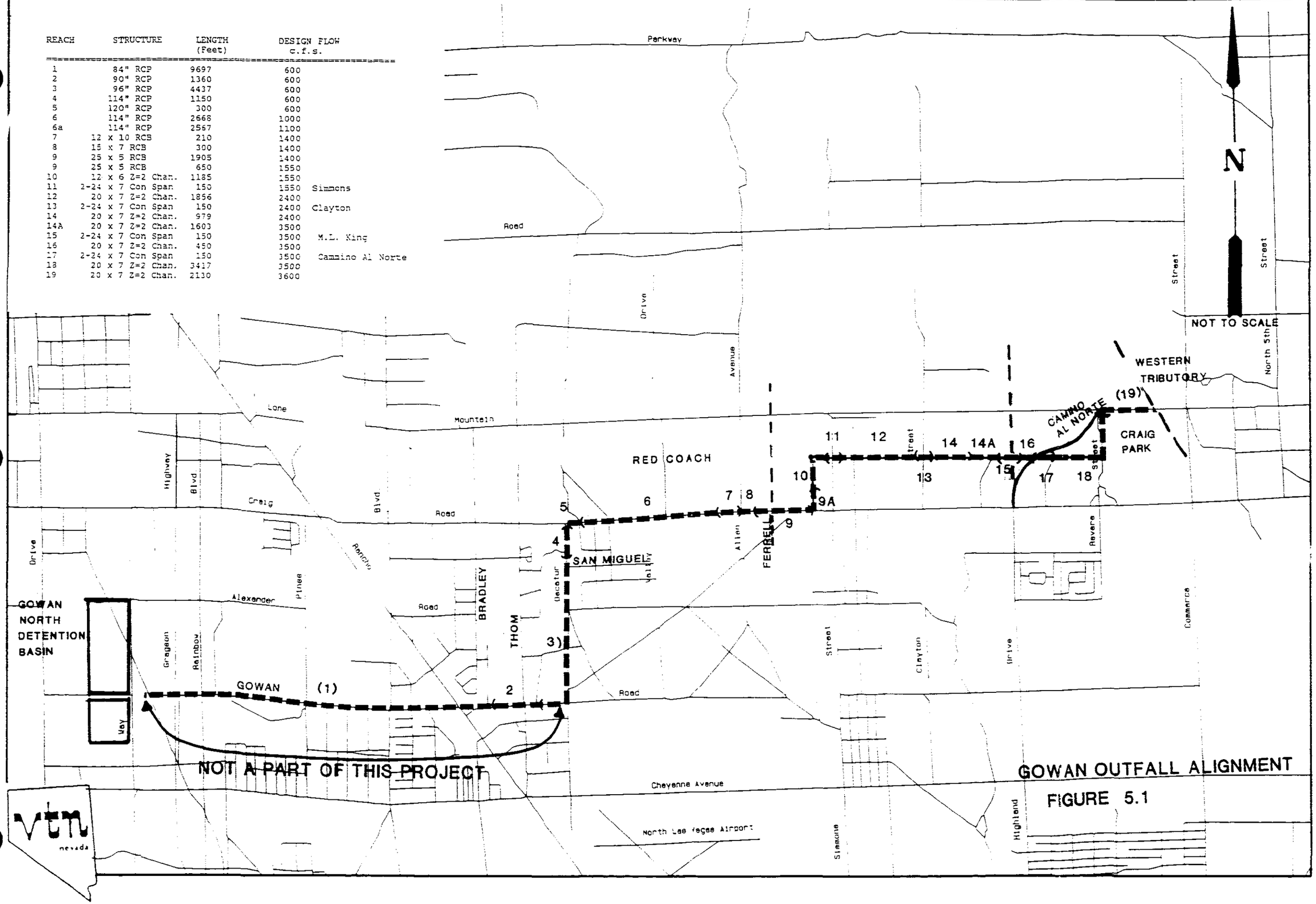
FIGURE 3.4

4.0 SELECTED OUTFALL ALIGNMENT

The Decatur Alignment was selected to be the Gowan Outfall Structure Alignment at the April 6, 1990 meeting with NLV, CLV, CCRFCD and VTN Nevada. This alignment is approximately 7 miles in length with approximately 5 miles in the NLV and the remaining 2 miles in the CLV. As shown in Figure 5.1, the Gowan Outfall Alignment follows Gowan Road from the Gowan North Detention Basin to the Decatur/Gowan Intersection. The alignment will turn north in Decatur Boulevard from the Gowan/Decatur Intersection to the Decatur/Craig Intersection and continues east along Craig Road where it turns north, approximately 450 feet west of the Craig/Simmons Intersection. The alignment then continues north to Red Coach Lane, easterly to the Craig Ranch Golf Course, north to Lone Mountain Road, and easterly to the Western Tributary.

Decatur Boulevard between Rancho Road and Craig Road has roadway improvements under design at the present time under the direction of the NLV. The Drainage Study Addendum for the Decatur Boulevard Street Improvement Project (ref. 7) was prepared using RTC design criteria which requires two 12 ft dry lanes during a 10-year 3-hour storm. This analysis for Decatur Boulevard

REACH	STRUCTURE	LENGTH (Feet)	DESIGN FLOW c.f.s.	
1	84" RCP	9697	600	
2	90" RCP	1360	600	
3	96" RCP	4437	600	
4	114" RCP	1150	600	
5	120" RCP	300	600	
6	114" RCP	2668	1000	
6a	114" RCP	2567	1100	
7	12 x 10 RCB	210	1400	
8	15 x 7 RCB	300	1400	
9	25 x 5 RCB	1905	1400	
9	25 x 5 RCB	650	1550	
10	12 x 6 Z=2 Chan.	1185	1550	
11	2-24 x 7 Con Span	150	1550	Simmons
12	20 x 7 Z=2 Chan.	1856	2400	
13	2-24 x 7 Con Span	150	2400	Clayton
14	20 x 7 Z=2 Chan.	979	2400	
14A	20 x 7 Z=2 Chan.	1603	3500	
15	2-24 x 7 Con Span	150	3500	M.L. King
16	20 x 7 Z=2 Chan.	450	3500	
17	2-24 x 7 Con Span	150	3500	Cammino Al Norte
18	20 x 7 Z=2 Chan.	3417	3500	
19	20 x 7 Z=2 Chan.	2130	3600	



GOWAN OUTFALL ALIGNMENT

FIGURE 5.1

resulted in the proposal of two separate storm drain systems. One system extends from Ricky Road to Gowan Road and has a discharge point on Gowan Road located approximately 800 ft east of Decatur Boulevard. The other system would extend from Alexander Road to Craig Road and has a discharge point located approximately 1000 ft east of Decatur Boulevard. The Gowan Outfall Structure would oversize the proposed Decatur Boulevard storm drain facilities from Alexander Road to Craig Road and the 1000 ft portion along Craig Road for conveyance of the Gowan Outfall flows. In addition, the RTC facilities in Decatur Boulevard from Ricky Road to Gowan Road could be redesigned to discharge into the Gowan Outfall Structure. This would eliminate the need for an 800 ft 24 inch storm drain in Gowan Road that is needed to discharge that segment of the proposed Decatur Boulevard storm drain. Table 2 summarizes the drainage facilities recommended in the addendum for the Decatur Boulevard street improvement project.

4.1 HYDROLOGY

A hydrology model was prepared for the selected Gowan Outfall Structure Alignment (Decatur Alignment) using Storm Centerings 3 and 4 (See Figures 3.3 and 3.4) to determine the 100-year design peak flows and to determine approximate drainage facilities sizes for the Gowan Outfall Structure. Table 3 is a summary of that analysis (See Figure 5.1).

TABLE 3
DECATUR ALIGNMENT
100-YEAR 6-HOUR PEAK FLOW (c.f.s.)

Location	Storm Centering 3 26 mi^2	Storm Centering 4 92 mi^2
Gowan/Torrey Pines * [1]	115	488
Gowan/Jones * [1]	129	488
Gowan/Rancho * [1]	253	488
Decatur/Alexander * [1]	269	488
Decatur/San Miguel * [1]	540	579
Craig/Jones	239	161
Craig/Decatur *	1020	879
Craig/Valley *	1057	895
Craig/Allen *	1117	925

TABLE 3 (cont.)
DECATUR ALIGNMENT
100-YEAR 6-HOUR PEAK FLOW (c.f.s.)

Location	Storm Centering [3] 26 mi^2	Storm Centering [4] 92 mi^2
Craig/Ferrell *	1201	968
Craig/Simmons *	1404	1078
Red Coach/Allen	98	68
Red Coach/Simmons *	1546	1149
Red Coach/Clayton *	2382	1683
Red Coach/M.L. King *	3517	2396
Red Coach/Golf *	3544	2421
Lone MTN/Jones	169	101
Lone MTN/Decatur	633	422
Lone MTN/Valley	662	440
Lone MTN/Outfall *	3540	2423
Lone MTN/Revere * (Outlet)	3614	2489
Combined Flow in Wash at Outlet	4235	2946
San Miguel/Valley	39	26
San Miguel/Allen	82	56
San Miguel/Simmons	193	130
Alexander/Torrey Pines	223	102

TABLE 3 (cont.)
DECATUR ALIGNMENT
100-YEAR 6-HOUR PEAK FLOW

Location	Storm Centering 3 26 mi^2	4 92 mi^2
Alexander/Rancho	227	105
Alexander/Valley	65	70
Alexander/Simmons	169	115
Ann/Decatur	254	174
Ann/Allen	521	360
Valley/Washburn	988	637

1) The peak discharge from the Gowan North Detention Basin (600 c.f.s.) will be used for the design of the Gowan Outfall Structure in this segment.

Asterisk (*) denotes the peak flow calculated along the proposed alignment of the Gowan Outfall Structure.

7.0 SUMMARY

The following is a summary for the Gowan Outfall Structure.

- The alignment for the Gowan Outfall Structure within the City of North Las Vegas (east of Decatur Boulevard) was determined at the January 23, 1990 meeting.

- The alignment for the Gowan Outfall Structure within the City of Las Vegas (west of Decatur Boulevard) was determined only from the detention basin to the Rancho/Edwards Intersection at the January 23, 1990 meeting.

- The entire alignment for the Gowan Outfall Structure was selected as the Decatur Alignment at the April 6, 1990 meeting.

- The Decatur Alignment would oversize proposed RTC drainage structures in Decatur Boulevard between Craig Road and Alexander Road. The Decatur Alignment is likely to receive funding from the RTC in accordance with RTC Policies and Procedures.

- The Outfall Structure will utilize the draft CCRFCD Hydrologic Criteria and Drainage Design Manual as a basis for design.

- This project can be broken up into three phase as shown on Figure 6.1. The construction of Phases 1 and Phase 2 would provide a functional system that discharges the intercepted runoff in to the existing Red Coach Wash.

- The 100-year peak flows generated in this report are based up on the assumption that the CCRFCD drainage facilities west of the Oran K. Gragson Highway (Gowan Detention Basins and conveyance facilities) and the Kyle Canyon facilities are constructed. When this facilities and all three phases of the Gowan Outfall in the NLV and CLV portion are constructed, the 100-year level protection proposed in his report will be achieved.

Construction plans for *Gowan Detention Basin*

Included in this section:

Construction plans for *Gowan Detention Basin*, January 1992, prepared by Paggemeyer Design Group.

DEPARTMENT OF PUBLIC WORKS

Mayor:
JAN LAVERTY JONES

Councilmen:
BOB NOLEN
ARNIE ADAMSEN
SCOTT HIGGINSON
FRANK HAWKINS, JR.

City Manager:
WIILLIAM J. NOONAN

Director of Public Works:
RICHARD D. GOECKE

City Engineer:
DENNIS ANDERSON, P.E.

GOWAN DETENTION BASINS

APPROVALS

City Engineer, CLV	Date
Clark County Regional Flood Control District	Date 4/3/92
Nevada State Division of Water Resources (Dam Safety)	Date
Central Telephone Company	Date
Las Vegas Valley Water District	Date
Nevada Power Company	Date
Southwest Gas Company	Date
Prime Cable Company	Date

WILLIAM E. HUNTER III

ENGINEERING DESIGN DIVISION
BID NO. 92.1730.03

FUNDED BY:

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
CITY OF LAS VEGAS

STAMP

JANUARY, 1992

DWG. NO.
731-53A

RECORD DRAWINGS

GENERAL NOTES

GENERAL REQUIREMENTS

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA NEVADA", *LATEST ISSUE*; THE "UNIFORM STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION, CLARK COUNTY AREA NEVADA", LATEST ISSUE; ANY OTHER APPLICABLE APPROVED STANDARDS ISSUED BY THE CONTROLLING AGENCY; THE UNIFORM BUILDING CODE; AND ALL APPLICABLE LOCAL CITY CODES AND ORDINANCES.
2. THE CONTRACTOR SHALL EXAMINE THE DRAWINGS BEFORE PROCEEDING WITH WORK. HE SHALL INFORM THE ENGINEER OF ANY OMISSIONS OR *CONFLICTS* DISCOVERED BEFORE PROCEEDING WITH ANY AFFECTED WORK.
3. PRECAUTIONS SHALL BE TAKEN TO PROTECT THE DESERT TORTOISE AND OTHER PROTECTED WILDLIFE AS PRESCRIBED IN THE SPECIFICATIONS ANS REQUIRED BY THE U.S. FISH AND WILDLIFE SERVICE.
4. AT LEAST 72 HOURS PRIOR TO BEGINNING CONSTRUCTION ON THE HOUSINGS AND STRUCTURES FOR THE WEATHER MONITORING EQUIPMENT CONTACT DAN HITCH, U.S.G.S., 1500 E. TROPICANA AVENUE, SUITE 201, LAS VEGAS, NEVADA 89119 - TELEPHONE: (702) 295-1770, AND TIMOTHY SUTKO, C.C.R.F.D., 301 E. CLARK, SUITE 300, LAS VEGAS, NEVADA, 89101 - TELEPHONE: (702) 455-3139.
5. THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON THESE PLANS ARE APPROXIMATE AND ARE OBTAINED FROM EXISTING PLANS AND INFORMATION PROVIDED BY THE RESPECTIVE UTILITY PROVIDERS. THE ENGINEER ASSUMES NO LIABILITY FOR THEIR ACCURACY OR FOR ANY UTILITIES NOT SHOWN ON THE PLANS. THE CONTRACTOR IS REQUIRED TO TAKE PRECAUTIONARY MEASURES TO PROTECT THE UTILITY LINES SHOWN AND ANY OTHER LINES NOT OF RECORD OR NOT SHOWN ON THESE DRAWINGS. EXISTING UTILITIES ARE LOCATED ON PLANS ONLY FOR THE CONVENIENCE OF THE CONTRACTOR. EXISTING SERVICE LATERALS MAY NOT BE SHOWN ON THE PLANS.
6. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING IMPROVEMENTS WHICH ARE TO REMAIN IN PLACE, FROM DAMAGE, AND ALL SUCH IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR RECONSTRUCTED SATISFACTORY TO THE OWNER AT THE EXPENSE OF THE CONTRACTOR.
7. THE CONTRACTOR SHALL NOT BACKFILL ANY TRENCHES IN WHICH WATER LINES HAVE BEEN UNCOVERED UNTIL THE WATER LINES HAVE BEEN INSPECTED BY THE LAS VEGAS VALLEY WATER DISTRICT. THE WATER DISTRICT SHALL BE NOTIFIED 48 HOURS IN ADVANCE OF CONSTRUCTION IN THE VICINITY OF WATER LINES.
8. ALL CONSTRUCTION SHALL BE AS SHOWN ON THESE PLANS, ANY ALTERATIONS SHALL HAVE THE PRIOR WRITTEN APPROVAL OF *THE CITY ENGINEER*.
9. TYPE V CEMENT SHALL BE USED IN ALL ON-SITE CONCRETE WORK. MIX DESIGN TO BE APPROVED BY THE ENGINEER PRIOR TO USE ON THE PROJECT.
10. THE CONTRACTOR SHALL, AT HIS EXPENSE, LOCATE ALL OVERHEAD INTERFERENCES WHICH MAY AFFECT HIS OPERATION DURING CONSTRUCTION AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO SAME. *THE CONTRACTOR SHALL USE* EXTREME CAUTION WHEN WORKING NEAR OVERHEAD OR UNDERGROUND POWER AND/OR TELEPHONE FACILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT, AND SHALL BE RESPONSIBLE FOR ALL COSTS AND LIABILITY IN CONNECTION THEREWITH.
11. PERMITS ARE REQUIRED FOR ANY WORK IN THE PUBLIC RIGHT-OF-WAY. THE CONTRACTOR SHALL SECURE ALL PERMITS AND INSPECTIONS REQUIRED FOR THIS CONSTRUCTION AT HIS EXPENSE.
12. AC PAVEMENT TO BE 1/2" ABOVE LIP OF ALL GUTTERS & VALLEY GUTTERS AFTER COMPACTION.
13. APPLY FOG SEAL ONLY AFTER ALL CORRECTIONS AND ADJUSTMENT HAVE BEEN MADE.
14. CURB & GUTTER WITH A *GRADE OF LESS THAN FOUR TENTHS OF ONE PERCENT* SHALL BE CONSTRUCTED BY FORMING. EACH JOINT SHALL BE CHECKED FOR GRADE PRIOR TO CONSTRUCTION AND WATER TESTED AS SOON AS POSSIBLE AFTER CONSTRUCTION.
15. CONTRACTOR SHALL PROVIDE ALL NECESSARY HORIZONTAL AND VERTICAL TRANSITIONS BETWEEN NEW CONSTRUCTION AND EXISTING SURFACES TO PROVIDE FOR PROPER DRAINAGE AND FOR INGRESS AND *EGRESS TO NEW CONSTRUCTION*. THE EXTENT OF TRANSITIONS TO BE AS SHOWN ON PLANS, OR AS DESIGNATED IN THE FIELD BY A CITY INSPECTOR.
16. EXACT LOCATION OF ALL SAW CUT LINES MAY BE DETERMINED IN THE FIELD BY A CITY OF LAS VEGAS INSPECTOR IF LOCATION ON THE PLAN IS NOT CLEARLY SHOWN, OR EXISTING PAVEMENT CONDITIONS REQUIRES RELOCATION.
17. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS. ANY MONUMENTS DISTURBED SHALL BE REPLACED AND ADJUSTED PER AVAILABLE RECORDS IN ACCORDANCE WITH N.R.S. STATUTE NO. 625.550.
18. UTILITY COMPANY METER BOXES, MANHOLE LIDS, VALVE COVERS, ETC. SHALL BE LOCATED *OUT OF DRIVEWAYS*, DRIVEWAY APRONS, FLOWLINES, AND VALLEY GUTTERS UNLESS WRITTEN APPROVAL IS GRANTED BY THE UTILITY COMPANY.
19. ALL UTILITY COMPANIES SHALL BE NOTIFIED BY THE CONTRACTOR AT LEAST 48 (FORTY-EIGHT) HOURS PRIOR TO COMMENCEMENT OF CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATION OF THE WORK WITH ALL OF THE UTILITY COMPANIES SO AS TO AVOID DELAYS OR DISRUPTIONS OF THE WORK.
20. THE SOUTHWEST GAS COMPANY SHALL *BE RESPONSIBLE FOR THE REMOVAL AND RELOCATION* OF ALL GAS LINES AND APPURTENANCES THAT INTERFERE WITH THE REQUIRED IMPROVEMENTS AS SHOWN ON THE CONTRACT DRAWINGS.
21. THE CENTRAL TELEPHONE COMPANY SHALL BE RESPONSIBLE FOR THE REMOVAL AND RELOCATION OF ALL TELEPHONE LINES AND APPURTENANCES THAT INTERFERE WITH THE REQUIRED IMPROVEMENTS AS SHOWN ON THE CONTRACT DRAWINGS.
22. THE NEVADA POWER COMPANY *SHALL BE RESPONSIBLE FOR THE REMOVAL AND RELOCATION* OF POWER LINES AND APPURTENANCES THAT INTERFERE WITH THE REQUIRED IMPROVEMENTS AS SHOWN ON THE CONTRACT DRAWINGS.
23. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ADJUSTMENT OR RELOCATION OF ALL LAS VEGAS VALLEY WATER DISTRICT FACILITIES AS INDICATED ON THE CONTRACT DRAWINGS OR IN THE SPECIAL PROVISIONS.
24. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ADJUSTMENTS OR RELOCATION OF ALL EXISTING CITY OF LAS VEGAS SEWER MANHOLES AND PIPING AS INDICATED ON THE CONTRACT DRAWINGS OR IN THE SPECIAL PROVISIONS.
25. THE CONTRACTOR SHALL BE *RESPONSIBLE FOR THE PROTECTION OF EXISTING* UTILITIES AND EXISTING STRUCTURES DURING CONSTRUCTION.
26. THE CONTRACTOR SHALL OBTAIN APPROVAL FROM THE CITY OF LAS VEGAS FOR DISPOSAL SITES AND HAUL ROUTES.
27. CONTRACTOR TO NOTIFY PROPERTY OWNERS 24 HOURS PRIOR TO INTERUPTION OF WATER SERVICE. INTERUPTION OF SERVICE SHALL ONLY OCCUR WITH THE APPROVAL OF LAS VEGAS VALLEY WATER DISTRICT.
28. THE CONTRACTOR WILL BE RESPONSIBLE FOR OBTAINING CONSTRUCTION AND TEMPORARY EASEMENTS OUTSIDE OF THE EXISTING RIGHT-OF-WAY FOR THE CONSTRUCTION OF THIS JOB.
29. ALL BARRICADING AND TEMPORARY TRAFFIC CONTROL DEVICES OR METHODS USED DURING CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD SPECIFICATIONS *FOR PUBLIC WORKS*" CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA, 1988", AND "STATE OF NEVADA TRAFFIC CONTROL MANUAL", DATED 1980 AND "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES", 1988 EDITION, AND THE NEVADA DEPARTMENT OF TRANSPORTATION REGULATIONS.

WATER NOTES

LAS VEGAS VALLEY WATER DISTRICT NOTES

1. NO WORK SHALL BEGIN ON WATER PLANS UNTIL THEY HAVE BEEN RELEASED FOR CONSTRUCTION BY THE LVVWD. FOLLOWING APPROVAL OF THE PLANS, NOTICE SHALL BE GIVEN TO THE LVVWD CUSTOMER SERVICE DEPARTMENT (670-4194) 48 HOURS PRIOR TO ACTUAL CONSTRUCTION, AND 24 HOURS PRIOR TO INSPECTION.
2. CALL BEFORE YOU DIG 1-800-227-2600.
3. ALL WORK SHALL CONFORM TO LVVWD LATEST STANDARD PLATES, DRAWINGS, AND SPECIFICATIONS.
4. ALL WORK, EXCEPT AS MODIFIED HEREON OR BY NOTE 3, SHALL BE DONE IN ACCORDANCE WITH THE MOST CURRENT DRAFT OR ADOPTION OF THE UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFFSITE *IMPROVEMENTS, CLARK COUNTY AREA*.
5. DISTRICT APPROVED SERVICE SADDLES OR TAPPED COLLARS SHALL BE REQUIRED ON ALL 3/4" AND 1" SERVICE LATERALS. SERVICE SADDLES ONLY SHALL BE PERMITTED ON 1-1/2" AND 2" SERVICE LATERALS. DOUBLE TAPPED COLLARS ARE NOT PERMITTED.
6. COPPER SERVICE *LATERALS: ALL 3/4" TO 2" SERVICE LATERALS SHALL BE OF* COPPER TUBING IN ACCORDANCE WITH THE DISTRICT'S SPECIFICATIONS AND STANDARD PLATES.
7. THE MAXIMUM ALLOWABLE JOINT DEFLECTION FOR ACP AND DUCTILE IRON PIPE SHALL BE AS FOLLOWS:

PIPE SIZES	ACP	DUCTILE IRON SLIP JOINT	DUCTILE IRON MECHANICAL JOINT
8 INCH	2.5 DEGREES	2.5 DEGREES	3.5 DEGREES
8 - 12 INCH	2.5 DEGREES	2.5 DEGREES	2.5 DEGREES
14 - 16 INCH	2 DEGREES	1.5 DEGREES	1.5 DEGREES
18 - 24 INCH	N/A	1.5 DEGREES	1.5 DEGREES

ON PVC PIPE, THE MAXIMUM OFFSET FOR A 20' LENGTH OF FACTORY BELLED PIPE SHALL BE 16 INCHES FOR 6" PIPE, 12 INCHES FOR 8" PIPE, AND 9 INCHES FOR 10" AND 12" PIPE.

IF THESE OFFSETS CONFLICT WITH THE PIPE MANUFACTURERS RECOMMENDATION, THE MORE STRINGENT REQUIREMENT SHALL APPLY.

8. ALL WATER METER BOXES SHALL BE LOCATED OUTSIDE OF DRIVEWAY AREAS.
9. ALL VALVES SHALL BE LOCATED OUTSIDE OF DRIVEWAYS AND VALLEY GUTTERS.
10. DETECTOR TAPE SHALL BE REQUIRED IN ACCORDANCE WITH STANDARD PLATE NO. 27 WHERE INDICATED, AND AS FOLLOWS:
    A. OVER ALL MAINS NOT INSTALLED 6 FEET FROM BACK OF CURB.
    B. OVER ALL SERVICE LATERALS NOT INSTALLED AT RIGHT ANGLES TO MAIN.
11. ALL WATER MAINS SHALL BE PRESSURE TESTED AT 200 P.S.I. FOR A CONTINUOUS TWO HOUR PERIOD, IN ACCORDANCE WITH DISTRICT STANDARDS.
12. ALL WATER MAINS SHALL BE DISINFECTED, FLUSHED, AND AN ACCEPTABLE HEALTH SAMPLE OBTAINED, PRIOR TO THE CONNECTION OF THE WATER MAIN(S) AND/OR LATERAL(S) TO THE DISTRICTS' SYSTEM.
13. CONTRACTOR TO OBTAIN ALL METERS 2" AND SMALLER FROM LVVWD CENTRAL STORES. TELEPHONE 258-3152 FORTY-EIGHT (48) HOURS PRIOR TO PICKUP.
14. ALL VALVES TO BE ABANDONDED SHALL BE ABANDONDED IN THE CLOSED POSITION, UNLESS SHOWN OTHERWISE, BY REMOVING A MINIMUM OF THE TOP 12 INCHES OF THE VALVE BOX AND THEN FILLING THE REMAINING PORTION OF THE VALVE BOX WITH *CONCRETE HAVING A COMPRESSIVE STRENGTH OF AT LEAST 2,000 PSI.* THE CONTRACTOR SHALL CUT THE EXISTING PIPE 3'± BEYOND THE ABANDONDED VALVE AND INSTALL A CAP. WHERE A JOINT OR COUPLING IN THE EXISTING PIPE IS UNCOVERED AT THE CUT AND CAP LOCATIONS, THE INSTALLATION OF A PLUG MAY BY PERMITTED, WITH DISTRICT APPROVAL. THE CONTRACTOR SHALL INSTALL A CONCRETE THRUST BLOCK IN ACCORDANCE WITH THE PROVISIONS OF THE DISTRICT'S STANDARD PLATE NO. 5 AT ALL CAP OR PLUG LOCATIONS.
15. ALL SERVICE LATERALS 2" AND SMALLER MAY BE EXTENDED PROVIDED THE FOLLOWING CRITERIA IS MET:
    A. LATERAL CAN ONLY BE EXTENDED IF CONNECTING TO COPPER.
    B. LATERAL MUST BE INSTALLED AT 90 DEGREES TO MAIN.
    C. USE ONLY DISTRICT APPROVED CONNECTIONS.

LVVWD — 2-11-93 DATE

SEWER NOTES

CITY OF LAS VEGAS SANITARY SEWER NOTES

1. ALL SANITARY SEWER INSTALLATIONS SHALL CONFORM TO THE STANDARD DETAILS AND SPECIFICATIONS OF THE CITY OF LAS VEGAS, AND SHALL ALSO CONFORM TO "THE UNIFORM STANDARD SPECIFICATIONS FOR *PUBLIC WORKS CONSTRUCTION OF* OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA LATEST EDITION," UNLESS OTHERWISE NOTED.
2. CHISEL "S" OR "G" IN CURBS WHERE SEWER OR GAS LATERALS PASS UNDER THE CURB.
3. POLYVINYL CHLORIDE (PVC) SEWER PIPE SHALL MEET ASTM D-3034 SDR 35 SPECIFICATIONS, AND INSTALLED WITH SAND BEDDING AND BACKFILL OR TYPE II GRAVEL.
4. ALL MANHOLES IN PAVED STREETS 80' R/W AND LARGER, SHALL HAVE CONCRETE COLLARS.
5. TEE SADDLES SHALL BE USED TO CONNECT SEWER LATERALS TO EXISTING MAIN LINES UP TO 12" DIAMETER SIZE. CONNECTIONS TO 15" OR LARGER MAINS SHALL *REQUIRE SPECIAL PROCEDURES*.
6. A SEWER MAIN CROSSING OVER A WATER MAIN OR LESS THAN 18" UNDER A WATER MAIN MUST BE REINFORCED CONCRETE ENCASED PIPE FOR A DISTANCE NOT LESS THAN TEN FEET (10) TO EACH SIDE OF THE CENTERLINE OF THE WATER MAIN.

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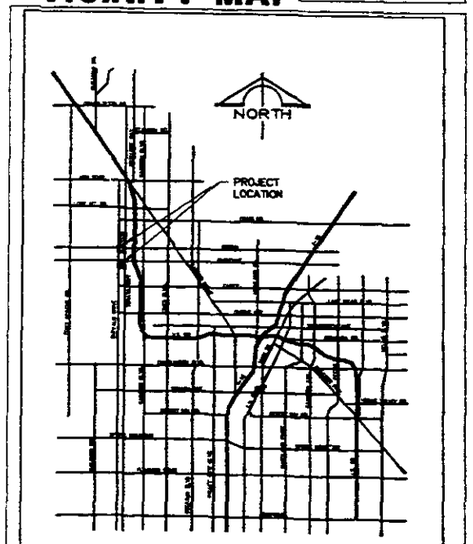
IR-9 IRRIGATION DETAILS

LEGEND

- M.H. — EXISTING MANHOLE
- F.H. — EXISTING FIRE HYDRANT
- EXISTING SIGN
- P.P. — EXISTING POWER POLE
- W — EXISTING WATER LINE
- G — EXISTING GAS LINE
- EOH — EXISTING OVERHEAD ELECTRICAL LINE
- SS — EXISTING SANITARY SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- T — EXISTING UNDERGROUND TELEPHONE
- EUG — EXIST. UNDERGROUND ELECTRICAL
- XX — EXISTING CONTOUR
- X — X — EXISTING CHAIN-LINK FENCE
- (XX.XX) — EXISTING ELEVATION
- CENTERLINE
- EDGE OF EXISTING PAVEMENT
- PROPERTY LINE OR RIGHT-OF-WAY
- M.H. — PROPOSED MANHOLE
- W — PROPOSED WATER LINE
- SS — PROPOSED SANITARY SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- XX.XX — PROPOSED ELEVATION

VICINITY MAP



REVISIONS | DATE

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ENGINEERS PLANNERS SURVEYORS
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GENERAL NOTES

GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH/TP
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92
SHEET NUMBER	CA-2
	2 OF 80

DWG. NO. 731-53A

RECORD DRAWINGS

GOWAN DRAINAGE BASIN
38 SQ MI

ANGEL PARK DRAINAGE BASIN
24 SQ MI

EXIST. ANGEL PARK BASIN

UPPER NORTH BASIN

LOWER NORTH BASIN

SOUTH BASIN

FLOYD R LAMB STATE PARK

NORTH LAS VEGAS AIR TERMINAL

North Las Vegas

LAS VEGAS VALLEY

Grassy Canyon

Goodwin Canyon

Canyon

Springs

Mountain Rd

Rock

Wash

Gravel Pit

1" = 4000'

N

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ADMISSION

DATE

POGGEMEYER DESIGN GROUP
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DRAINAGE BASIN MAP

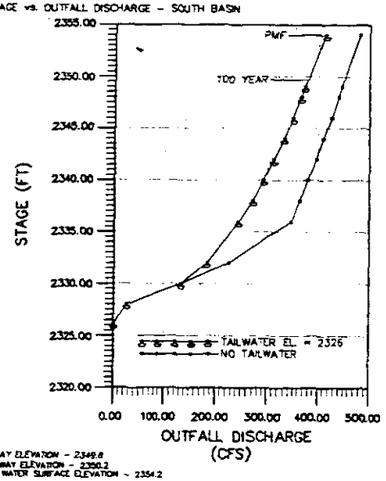
GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	MB
CHECKED BY	WH / TEP
DATE	1-17-92
SHEET NUMBER	CB-1 3 of 8?

DWG. NO. 731-53A

RECORD DRAWINGS

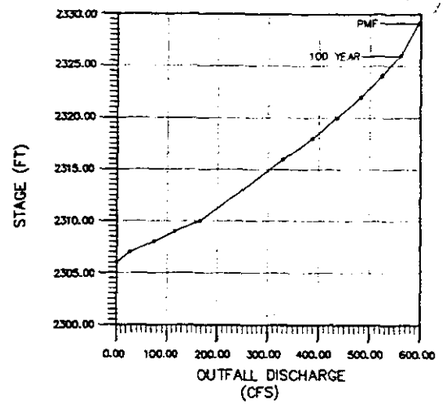
FIGURE #1 STAGE vs. OUTFALL DISCHARGE – SOUTH BASIN



NOTCHED SPILLWAY ELEVATION = 2349.6
STANDARD SPILLWAY ELEVATION = 2350.2
PROJECTED PMF WATER SURFACE ELEVATION = 2354.2

PROJECTED DISCHARGE AT = 2349.6 (NO TAILWATER) = 455 CFS
PROJECTED DISCHARGE AT = 2349.6 (TAILWATER EL = 2326.0) = 375 CFS

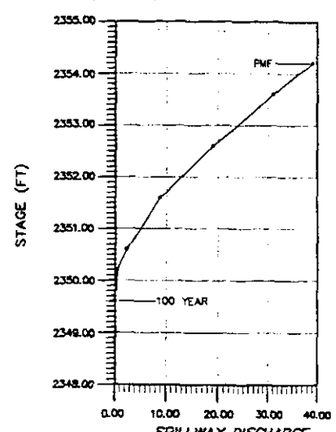
FIGURE #2 NORTH BASINS – STAGE vs. OUTFALL DISCHARGE



NOTCHED SPILLWAY ELEVATION = 2326.0
STANDARD SPILLWAY ELEVATION = 2328.4
PROJECTED PMF WATER SURFACE ELEVATION = 2329.1

PROJECTED DISCHARGE AT 2326.0 = 560 CFS

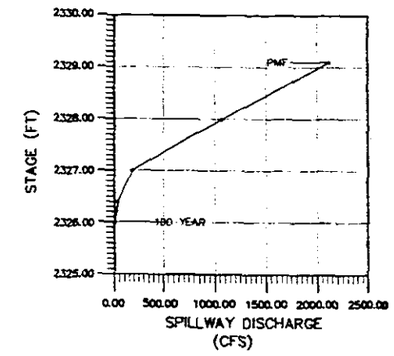
FIGURE #3 SOUTH BASIN – STAGE vs. SPILLWAY DISCHARGE



NOTCHED SPILLWAY ELEVATION = 2348.8
STANDARD SPILLWAY ELEVATION = 2350.2
PROJECTED PMF WATER SURFACE ELEVATION = 2354.2

PROJECTED DISCHARGE AT 2350.2 = 300 CFS
PROJECTED DISCHARGE AT 2354.2 = 38,030 CFS

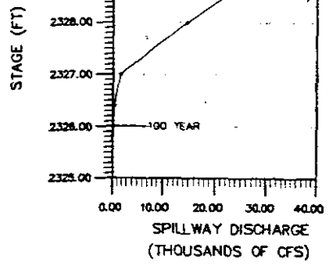
FIGURE #4 LOWER NORTH BASIN – STAGE vs. SPILLWAY DISCHARGE



NOTCHED SPILLWAY ELEVATION = 2326.0
STANDARD SPILLWAY ELEVATION = 2328.4
PROJECTED PMF WATER SURFACE ELEVATION = 2329.1

PROJECTED DISCHARGE AT 2328.4 = 68 CFS
PROJECTED DISCHARGE AT 2329.1 = 2,250 CFS

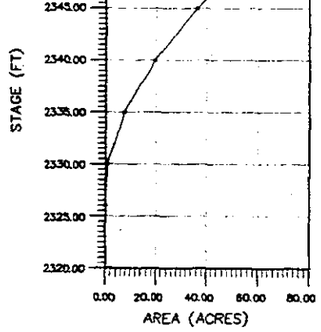
FIGURE #5 UPPER NORTH BASIN – STAGE vs. SPILLWAY DISCHARGE



NOTCHED SPILLWAY ELEVATION = 2328.0
STANDARD SPILLWAY ELEVATION = 2328.4
PROJECTED PMF WATER SURFACE ELEVATION = 2329.1

PROJECTED DISCHARGE AT = 2328.4 = 192 CFS
PROJECTED DISCHARGE AT = 2329.1 = 30,780 CFS

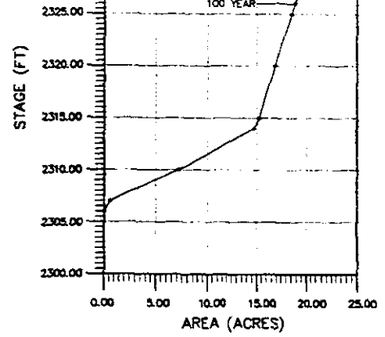
FIGURE #6 SOUTH BASIN – STAGE vs. WATER SURFACE AREA



OUTFALL INVERT ELEVATION = 2326.0
NOTCHED SPILLWAY ELEVATION = 2348.6

WATER SURFACE AREA AT = 2349.6 = 33.6 ACRES

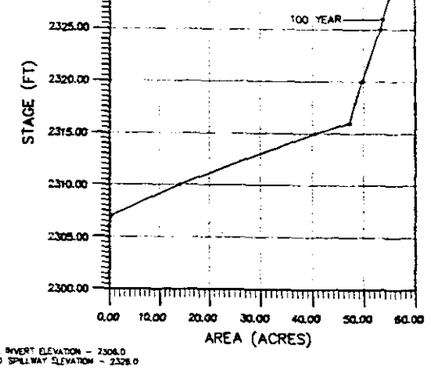
FIGURE #7 LOWER NORTH BASIN – STAGE vs. WATER SURFACE AREA



OUTFALL INVERT ELEVATION = 2306.0
NOTCHED SPILLWAY ELEVATION = 2326.0

WATER SURFACE AREA AT = 2326.0 = 18.9 ACRES

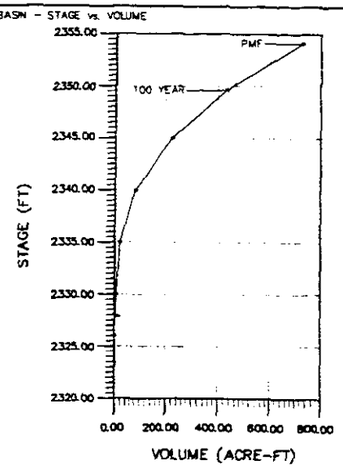
FIGURE #8 UPPER NORTH BASIN – STAGE vs. WATER SURFACE AREA



OUTFALL INVERT ELEVATION = 2306.0
NOTCHED SPILLWAY ELEVATION = 2328.0

WATER SURFACE AREA AT = 2328.0 = 53.8 ACRES

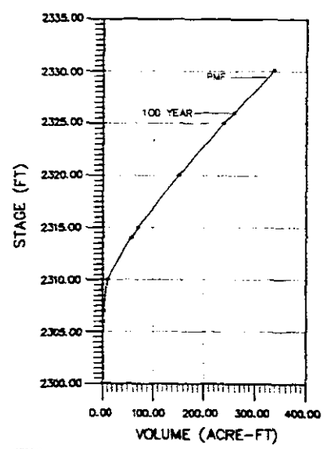
FIGURE #9 SOUTH BASIN – STAGE vs. VOLUME



OUTFALL INVERT ELEVATION = 2328.0
NOTCHED SPILLWAY ELEVATION = 2349.6

VOLUME AT = 2349.6 = 430 ACRE-FEET

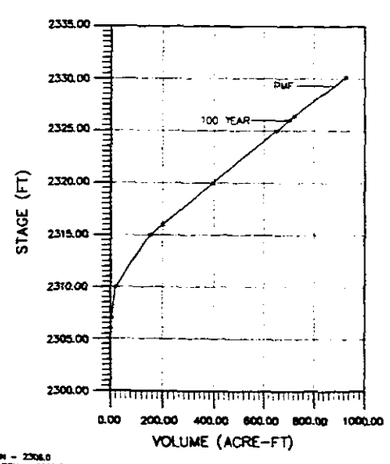
FIGURE #10 LOWER NORTH BASIN – STAGE vs. VOLUME



OUTFALL INVERT ELEVATION = 2306.0
NOTCHED SPILLWAY ELEVATION = 2326.0

VOLUME AT = 2326.0 = 258 ACRE-FEET

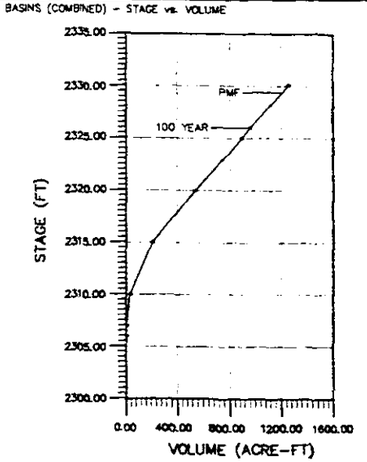
FIGURE #11 UPPER NORTH BASIN – STAGE vs. VOLUME



OUTFALL INVERT ELEVATION = 2306.0
NOTCHED SPILLWAY ELEVATION = 2328.0

VOLUME AT = 2328.0 = 704 ACRE-FEET

FIGURE #12 NORTH BASINS (COMBINED) – STAGE vs. VOLUME



OUTFALL INVERT ELEVATION = 2306.0
NOTCHED SPILLWAY ELEVATION = 2328.0

VOLUME OF NORTH BASINS (COMBINED) AT 2328.0 = 928 ACRE-FEET

REVISION | DATE

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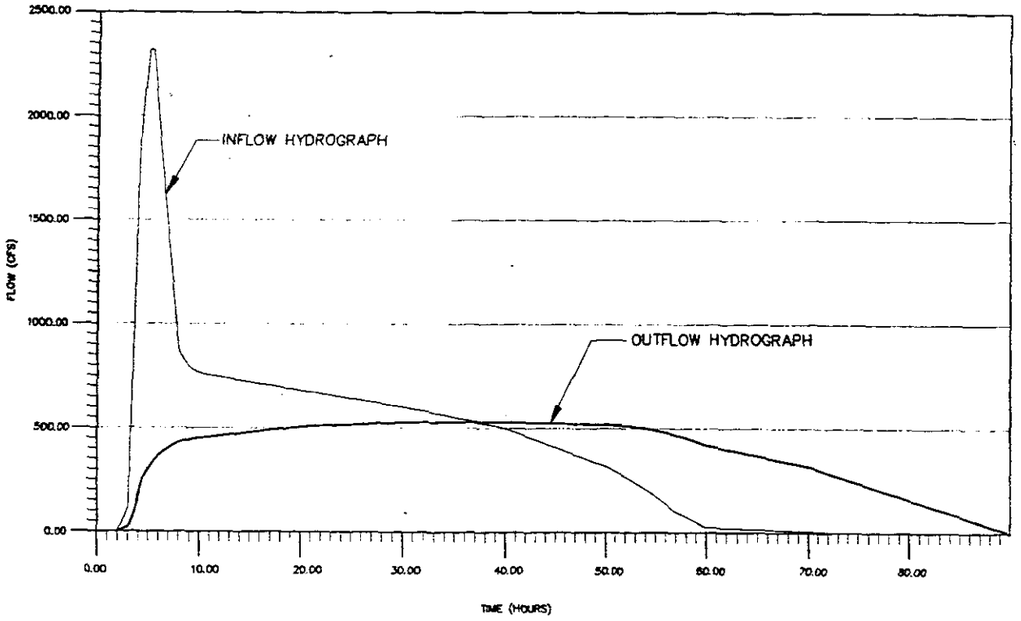
STAGE RELATIONSHIPS

GOWAN DETENTION BASINS

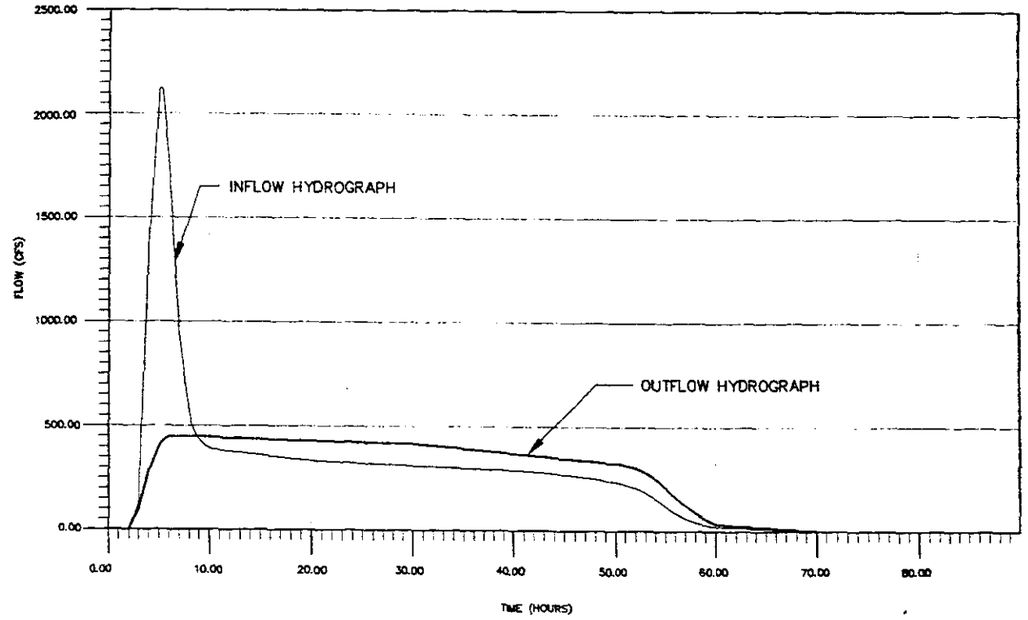
JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	RS
CHECKED BY	WH/TP
DATE	1-17-92
SHEET NUMBER	CB-2
	4 of 80

DWG. NO. 731-53A

RECORD DRAWINGS



NORTH BASINS



SOUTH BASIN

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NO.	REVISION	DATE

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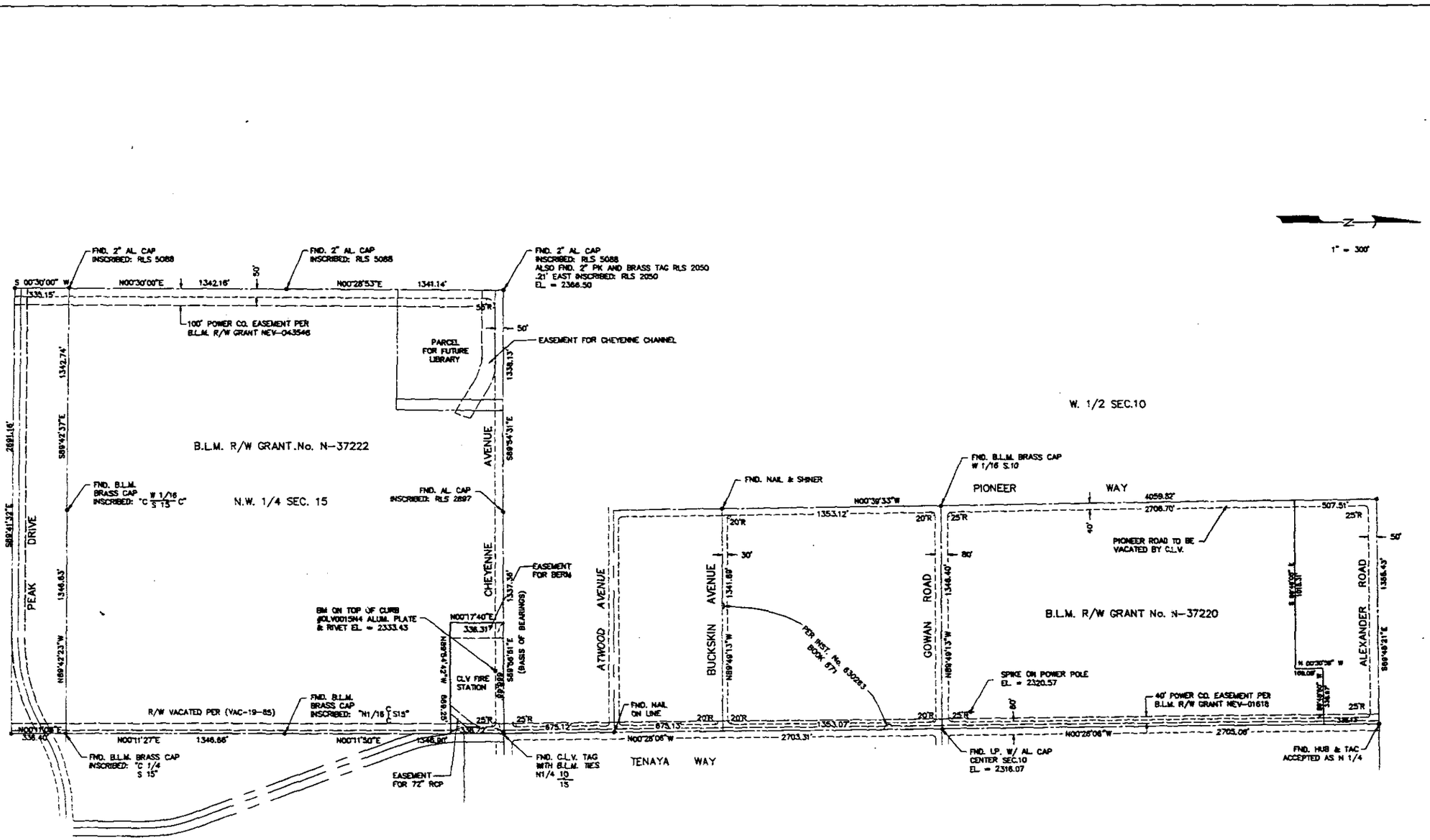
INFLOW/OUTFLOW HYDROGRAPHS
100 YEAR STORM
GOWAN
DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	EC
CHECKED BY	WH/TP
DATE	1-17-92
SHEET NUMBER	CB-3
	5 of 80

RECORD DRAWINGS



1" = 300'

REFERENCE MAPS:

ROS	FILE 41	PAGE 62
ROS	FILE 42	PAGE 33
ROS	FILE 31	PAGE 88
PM	FILE 50	PAGE 41
PM	FILE 54	PAGE 60
PM	FILE 31	PAGE 94
PM	FILE 52	PAGE 13
PM	FILE 36	PAGE 67
PM	FILE 25	PAGE 16
PM	FILE 42	PAGE 02
PLAT MAP	BOOK 38	PAGE 91

BASIS OF BEARINGS:

S89°56'51"E - BEING THE SOUTH LINE OF THE S.E. 1/4 OF THE S.W. 1/4 OF SECTION 10, T.20S.,R.60E., M.D.B.& M. PM FILE 41, PAGE 62 OF RECORD OF SURVEYS, AS RECORDED WITH THE CLARK COUNTY, NEVADA RECORDER.

BENCHMARK:

7C00-11C4 - SET DRIVE RIVET IN A 2"X2" ALUMINUM PLATE, IN DRILLED HOLE WITH EPOXY GLUE, IN TOP OF CURB, NORTHWEST CORNER OF GOWAN ROAD & TORREY PINES DRIVE. ELEVATION: 2284.34

LEGEND:

•	FOUND POINT AS NOTED
○	COMPUTED POINT
R/W	RIGHT-OF-WAY
----------	RIGHT-OF-WAY LINE
———·———	SECTION LINE / CENTERLINE
– – – – –	EASEMENT LINE
———·———	PROPERTY LINE

REVISION | DATE

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HORIZONTAL AND VERTICAL CONTROL MAP

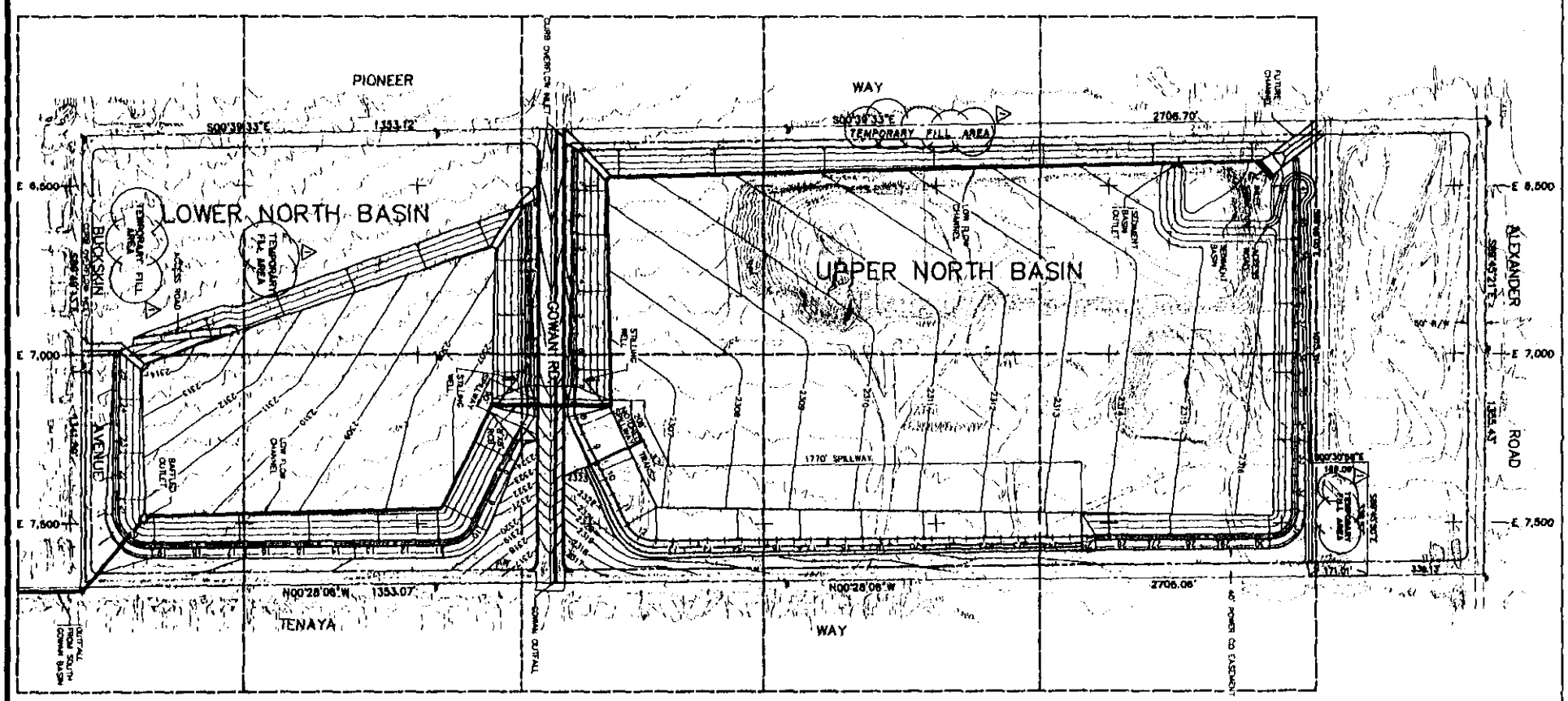
GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	DR/PC
DRAWN BY	PC
CHECKED BY	PC/TEP
DATE	1-17-92
SHEET NUMBER	CE-1 6 OF 80

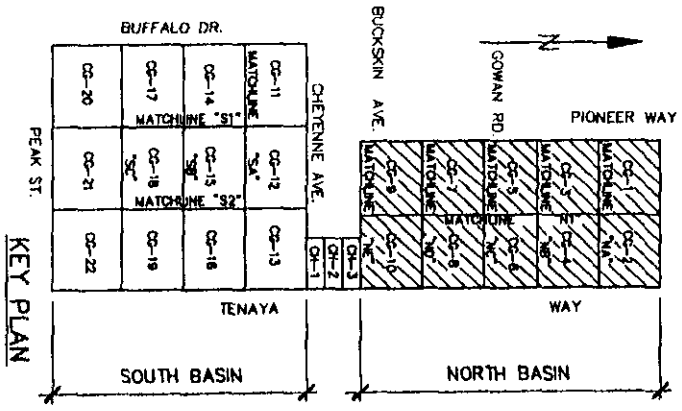
DWG. NO. 731-53A

RECORD DRAWINGS

N 14,000 — N 14,500 — N 15,000 — N 15,500 — N 16,000 — N 16,500 — N 17,000 — N 17,500 — N 18,000



N 14,000 — N 14,500 — N 15,000 — N 15,500 — N 16,000 — N 16,500 — N 17,000 — N 17,500 — N 18,000



SCALE: 1"=200'

N

SITE PLAN – NORTH BASIN

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

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DATE	REVISION
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JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92

CF-1

7 of 80

RECORD DRAWINGS

DWG. NO. 731-53A

BY: RECORD DRAWING
DATE: 6/15/93

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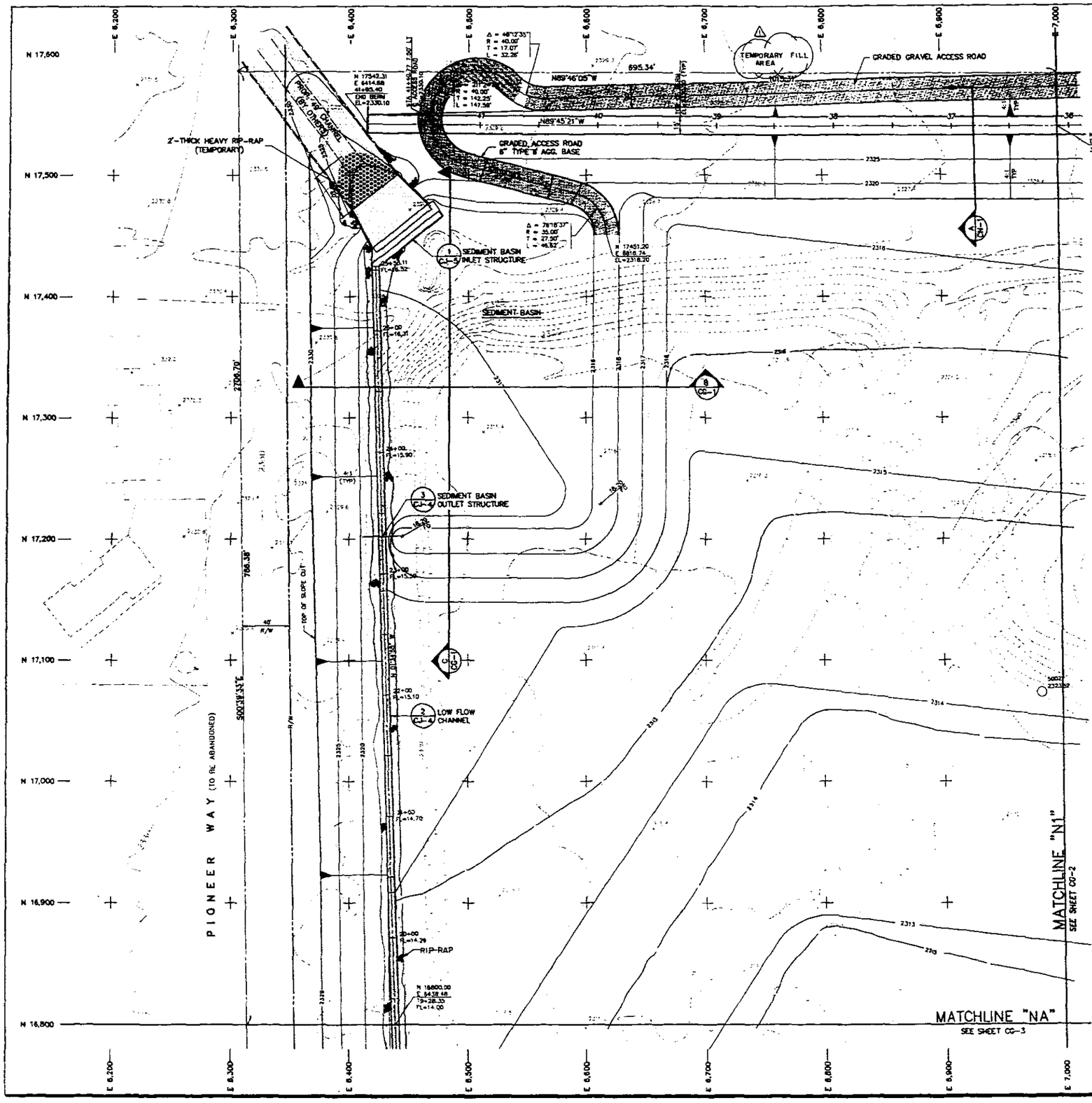
SITE PLAN – SOUTH BASIN

GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92
SHEET NUMBER	CF-2
	8 of 80

DWG. NO. 731-53A

RECORD DRAWINGS



REVISION
DATE
6/14/93
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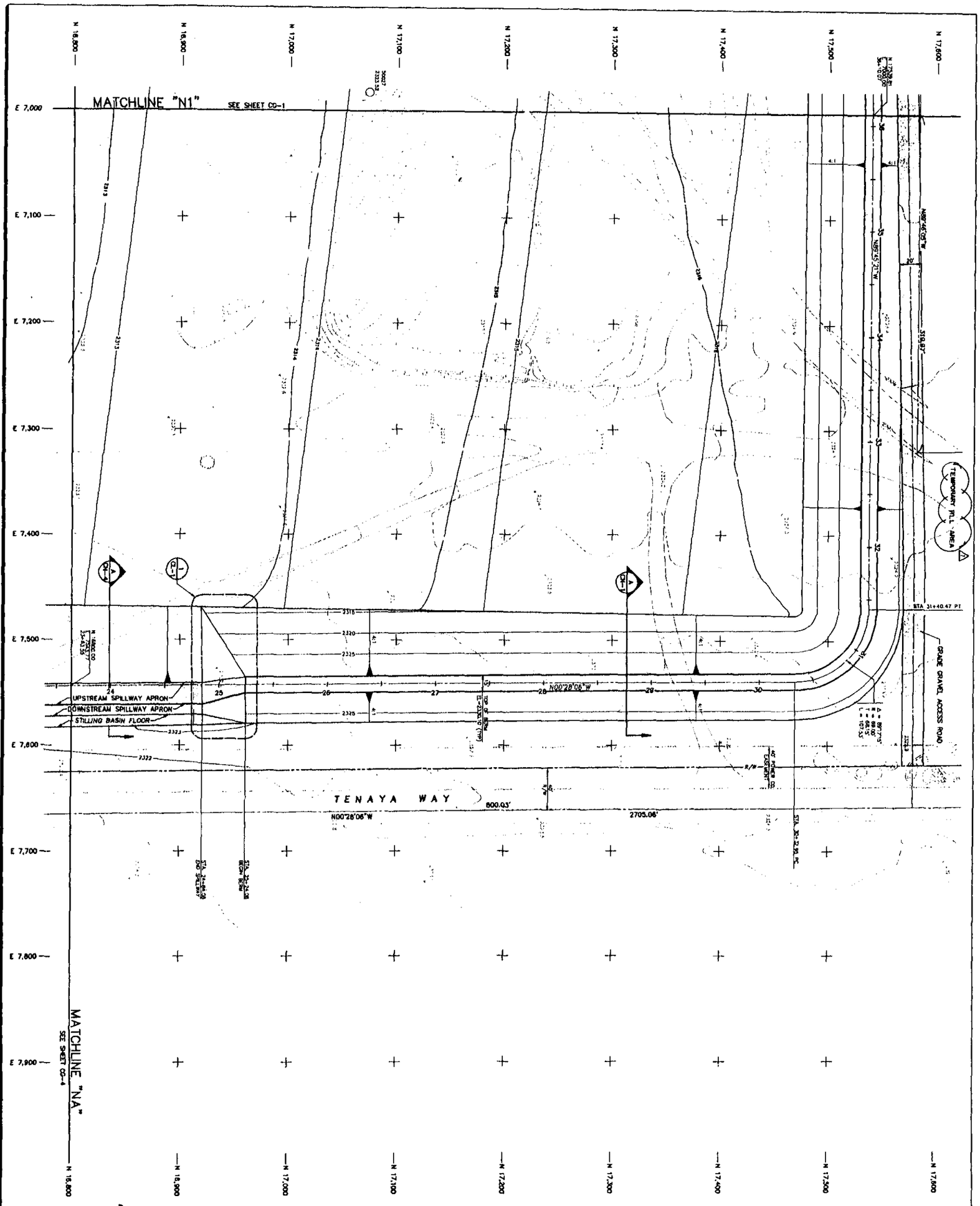
GRADING PLAN -- NORTH BASINS

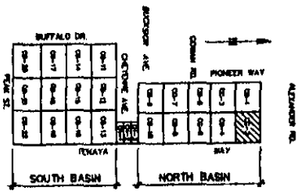
GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92
SHEET NUMBER	CG-1
	9 OF 80

RECORD DRAWINGS



KEY PLAN



1" = 40'

GRADING PLAN – NORTH BASINS

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

1140 ALMOND TREE LANE, SUITE 306 LAS VEGAS, NEVADA 89104 (702) 735-5108

DATE	REVISION
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SHEET NUMBER: CG-2 10 of 80

DATE: 1-17-92

DRAWN BY: WH/TP

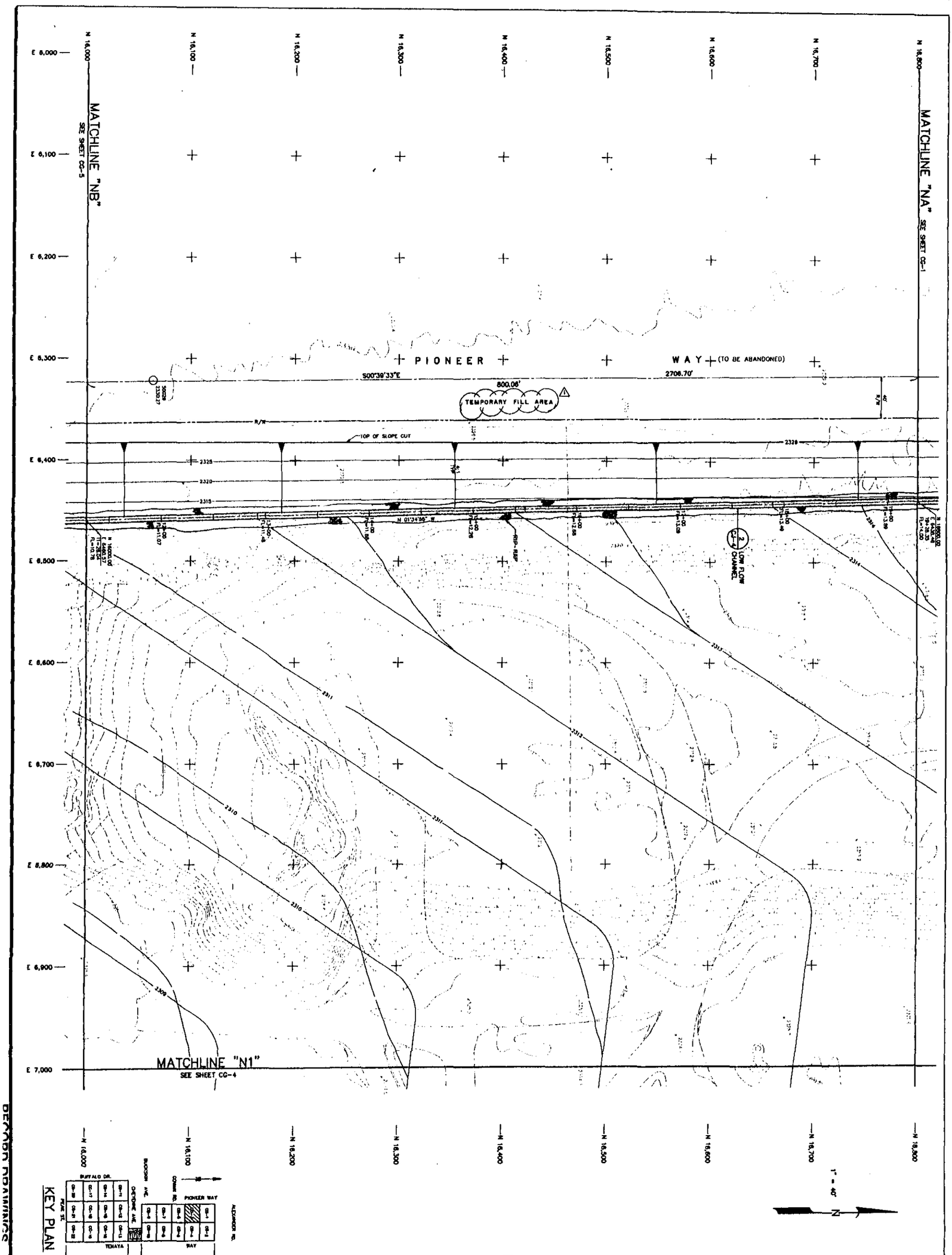
CHECKED BY: PA

DESIGNED BY: WH

JOB NUMBER: 90001

DWG. NO. 731-53A

RECORD DRAWINGS



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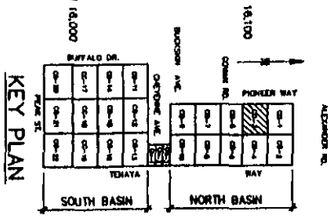

GRADING PLAN – NORTH BASINS

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP
ENGINEERS PLANNERS SURVEYORS
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DATE	REVISION
6/14/93	⚠ RECORD DRAWING

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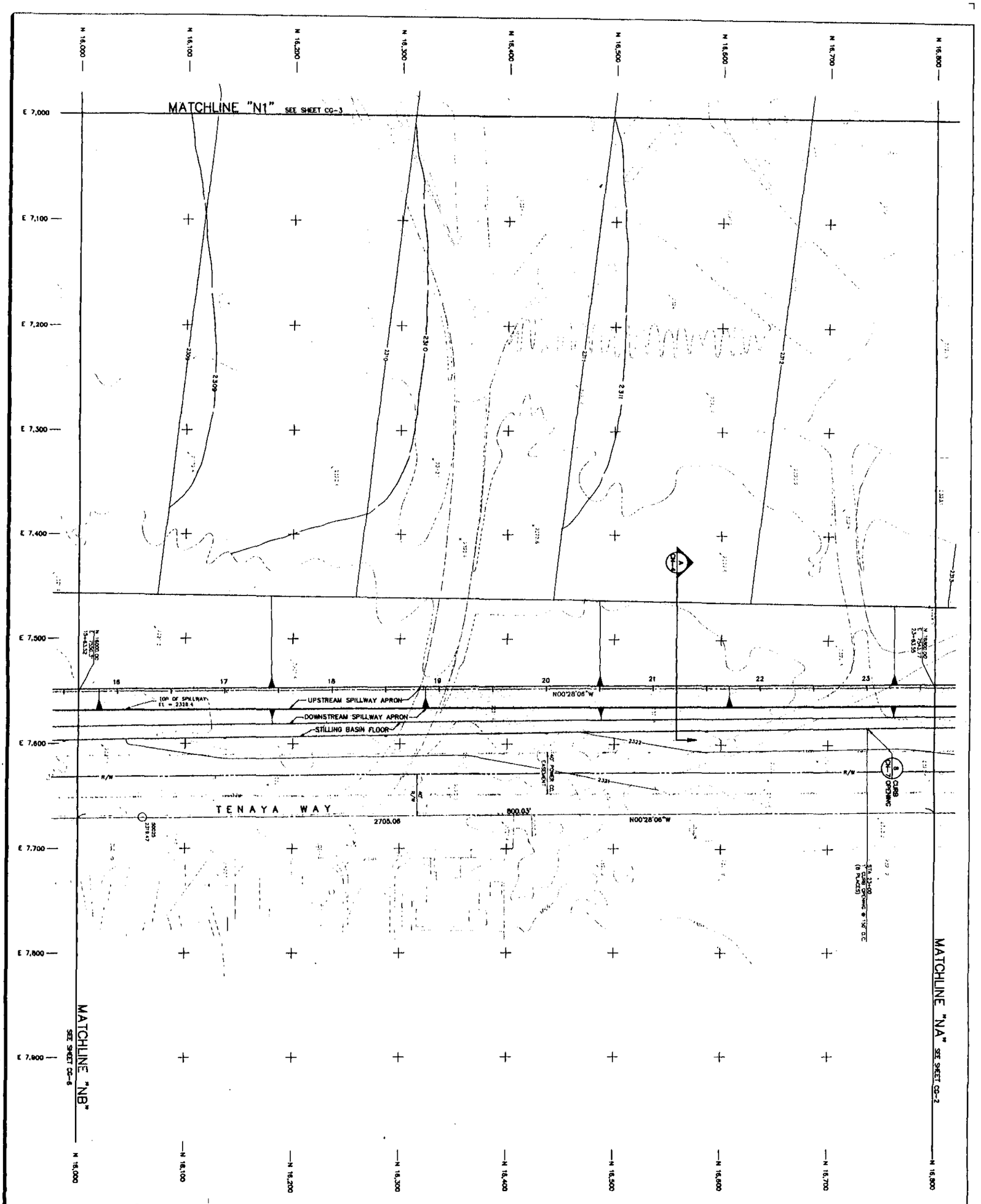
SHEET NUMBER	DATE	DRAWN BY	CHECKED BY	DESIGNED BY	JOB NUMBER
CG-3	1-17-92	PA	WH/TP	WH	90001

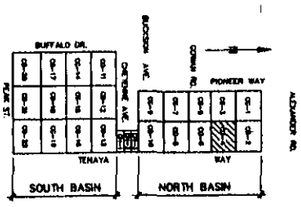
11 of 80

DWG. NO. 731-53A

BENCH MARKS



KEY PLAN



GRADING PLAN – NORTH BASINS

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

1140 ALMONO TREE LANE, SUITE 306 LAS VEGAS, NEVADA 89104 (702) 735-5108

DATE	REVISION
8/14/93	RECORD DRAWING

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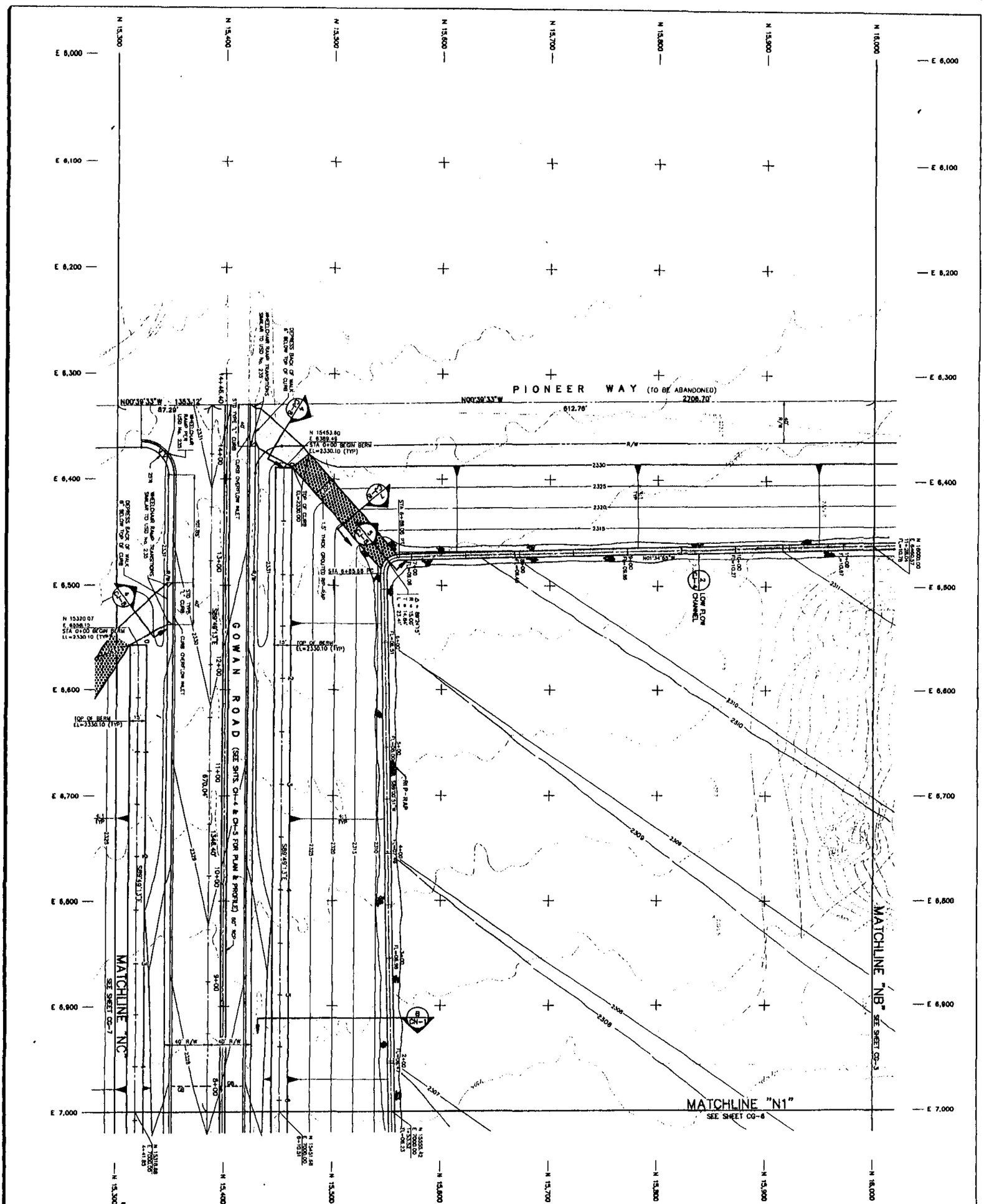
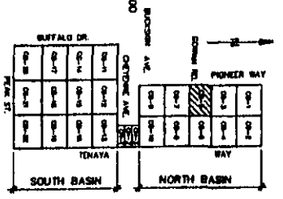
SHEET NUMBER	DATE	DRAWN BY	CHECKED BY	JOB NUMBER
CG-4 12 of 80	1-17-92	WH/TP	PA	WH 90001

RECORD DRAWINGS

DWG. NO. 731-53A



KEY PLAN



GRADING PLAN – NORTH BASINS

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

1140 ALMOND TREE LANE, SUITE 308 LAS VEGAS, NEVADA 89104 (702) 735-5108

DATE	REVISION
6/14/93	RECORD DRAWING

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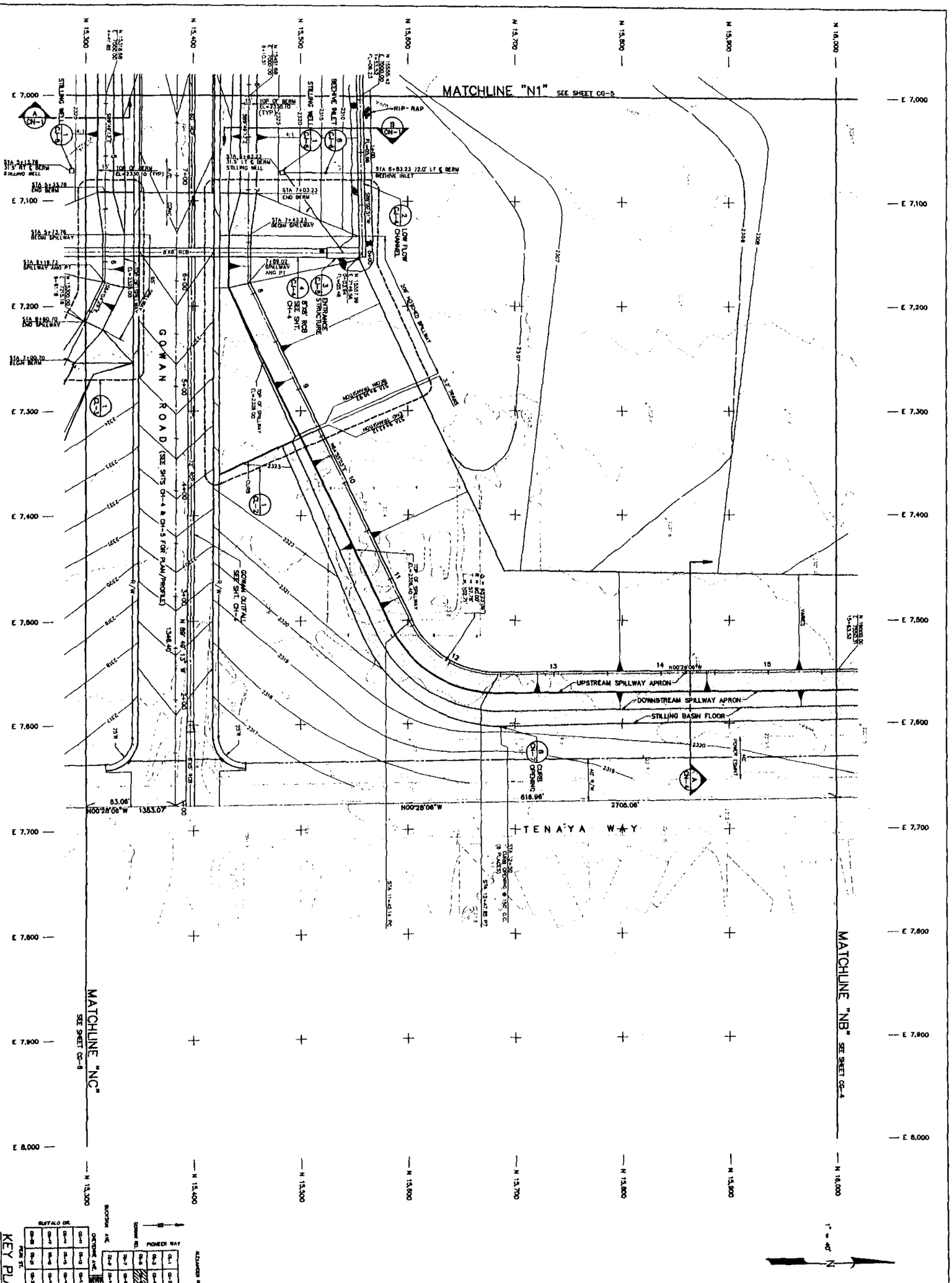
SHEET NUMBER	DATE	DRAWN BY	CHECKED BY	JOB NUMBER
CG-5 13 of 80	1-17-92	WH/JP	PA	WH 90001

RECORD DRAWINGS

DWG. NO. 731-53A



KEY PLAN

SOUTH BASIN

NORTH BASIN

GRADING PLAN – NORTH BASINS

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

1140 ALMOND TREE LANE, SUITE 308 LAS VEGAS, NEVADA 89104 (702) 735-5108

DATE	REVISION
6/19/95	RECORD DRAWING

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SHEET NUMBER	DATE	DESIGNED BY	DRAWN BY	CHECKED BY	JOB NUMBER
CG-6 14 OF 50	1-17-92	WH/TP	PA	WH	90001

SIGNATURE RECORD DRAWINGS

DWG. NO. 731-53A

MATCHLINE "NC"
SEE SHEET CG-5

MATCHLINE "ND"
SEE SHEET CG-9

MATCHLINE "N1"
SEE SHEET CG-6

PIONEER WAY
800.00'
N00°39'33"W
1353.13'

S89°49'13"E

TOP OF BERM
EL=2330.10

TOP OF CURB
EL=2329.50

1.5' THICK GROUTED RIP-RAP

10'

50022
2333.38

50023
2328.30

TEMPORARY FILL AREA

N 15,300
N 15,200
N 15,100
N 15,000
N 14,900
N 14,800
N 14,700
N 14,600
N 14,500

N 6,000
N 6,100
N 6,200
N 6,300
N 6,400
N 6,500
N 6,600
N 6,700
N 6,800
N 6,900
N 7,000

N

1" = 40'

KEY PLAN

ALEXANDER RD.
POWER WAY
COWAN RD.
BUCKSKIN AVE.
CHEYENNE AVE.
BUFFALO DR.
TORAYA
PEAK ST.
NORTH BASIN
SOUTH BASIN

DATE	REVISION
6/14/93	RECORD DRAWING

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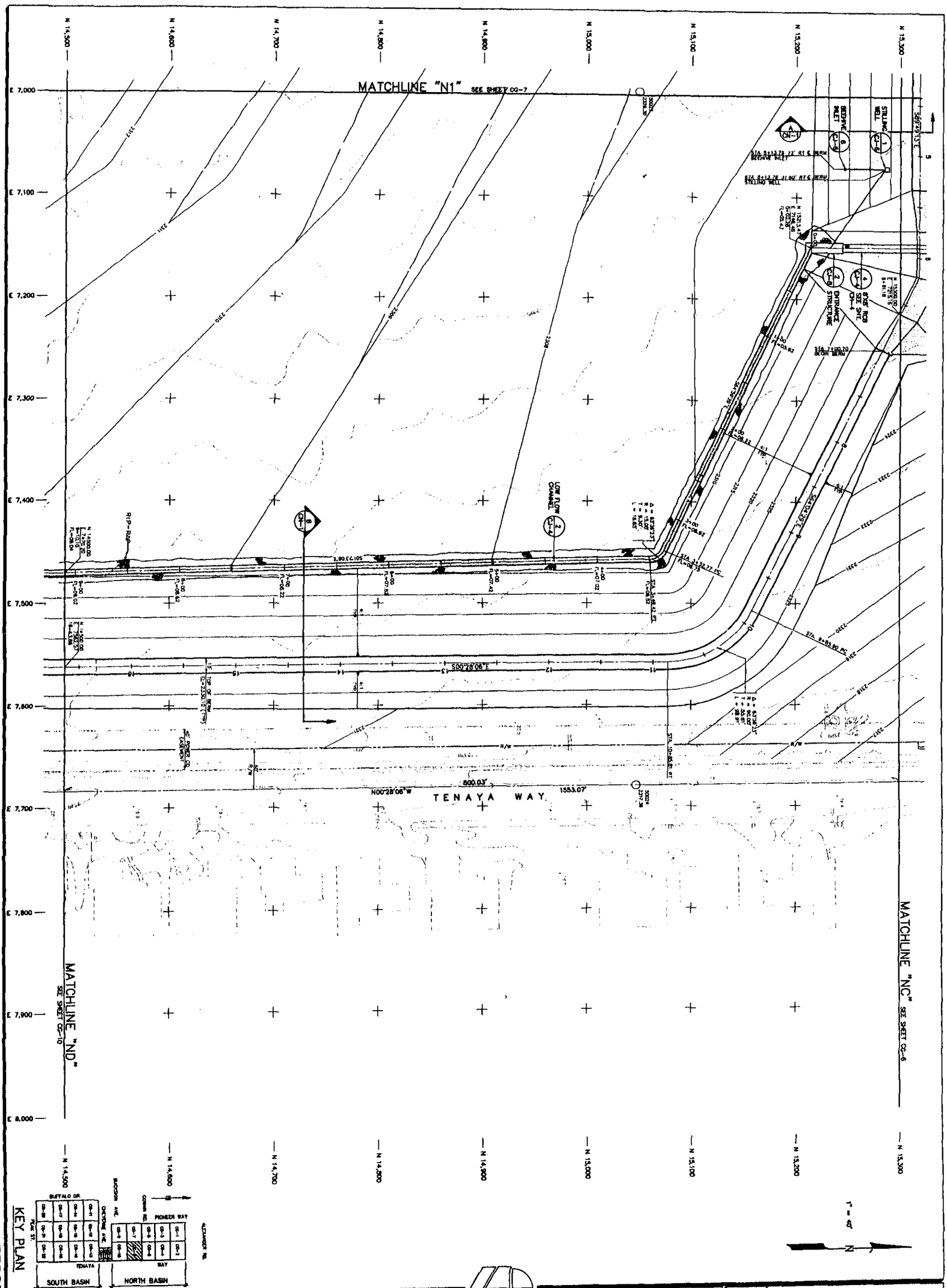
POGGEMEYER DESIGN GROUP
ENGINEERS PLANNERS SURVEYORS
1140 ALMOND TREE LANE, SUITE 305 LAS VEGAS, NEVADA 89104 (702) 733-9100

GRADING PLAN NORTH BASINS

GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92
SHEET NUMBER	CG-7
	15 of 80

RECORD DRAWINGS



GRADING PLAN — NORTH BASINS

GOWAN DETENTION BASINS

CG-8

DATE	CHECKED BY	DRAWN BY	DESIGNED BY	JOB NUMBER
1-17-92	WH/TP	PA	WH	90001

DWG. NO. 731-53A

POGGEMEYER DESIGN GROUP
ENGINEERS PLANNERS SURVEYORS
1140 ALMOND TREE LANE, SUITE 308 LAS VEGAS, NEVADA 89104 (702) 735-5108

DATE	REVISION
6/14/93	RECORD DRAWING

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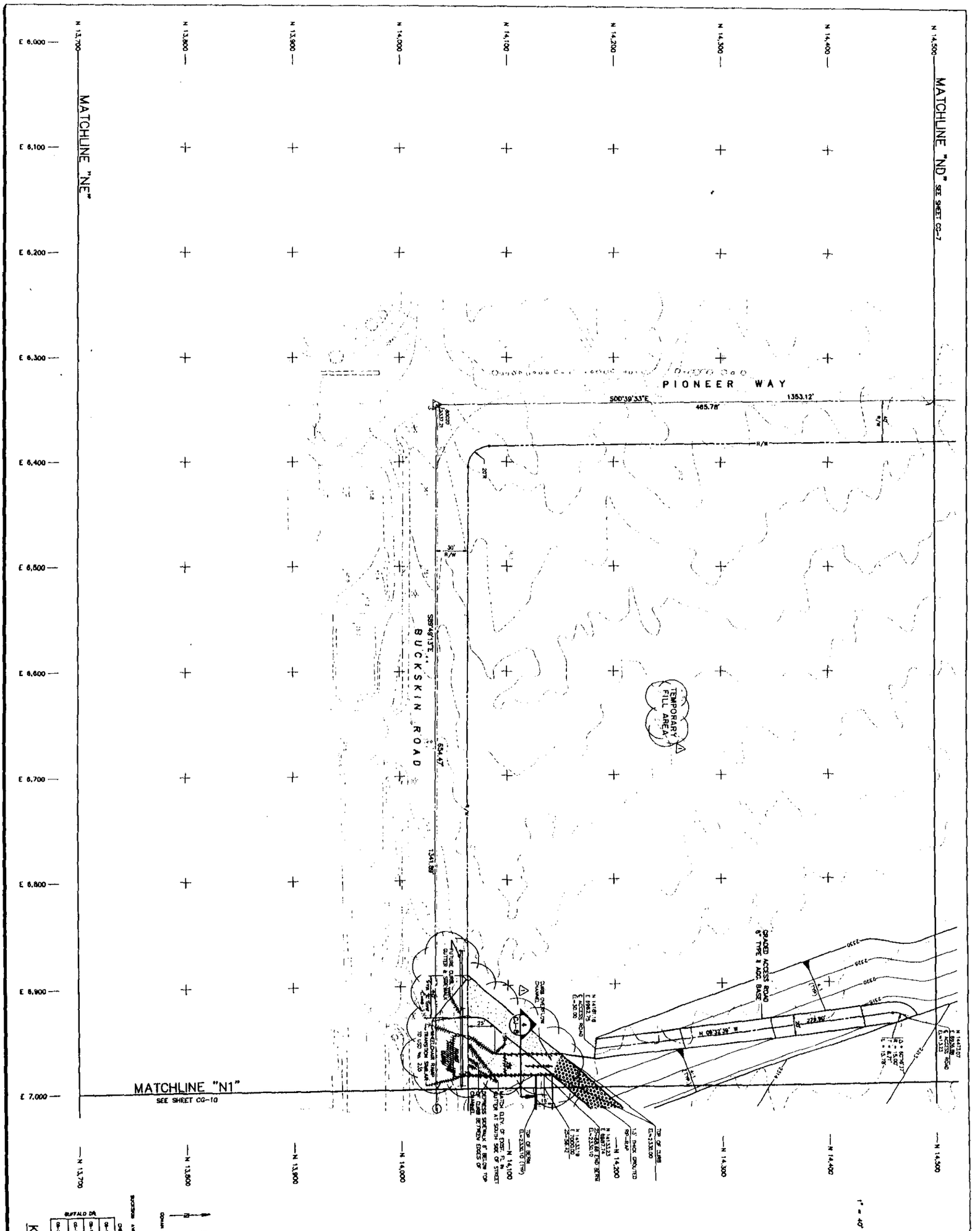
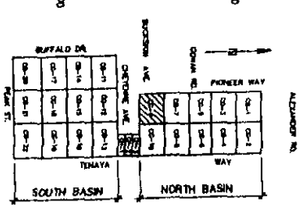


KEY PLAN



GRADING PLAN – NORTH BASINS

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

3140 ALMOND TREE LANE, SUITE 308 LAS VEGAS, NEVADA 89104 (702) 735-5108

DATE	REVISION
6/09/93	RECORD DRAWING

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SHEET NUMBER	DRAWN BY	CHECKED BY	DATE	JOB NUMBER
CG-9	PA	WH/TP	1-17-92	90001

17 of 80

RECORD DRAWINGS

MATCHLINE "ND" SEE SHEET CG-8

MATCHLINE "N1" SEE SHEET CG-9

MATCHLINE "NE"

BUCKSKIN ROAD

TENAYA WAY

CURB OVERFLOW CHANNEL (SEE SHT. CG-9)

LOW FLOW CHANNEL

BAFFLED OUTLET

RIP-RAP

1.5' THICK GROUTED RIP-RAP

40' POWER CO. EASEMENT

72" RCP

KEY PLAN

ALEXANDER RD.
PIONEER WAY
GOWAN RD.
BUCKSKIN AVE.
CHEYENNE AVE.
BUFFALO DR.
TONOPA
PECOS ST.
NORTH BASIN
SOUTH BASIN

DATE	REVISION
6/14/93	RECORD DRAWING

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POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

1140 ALMOND TREE LANE, SUITE 309 LAS VEGAS, NEVADA 89104 (702) 735-5108

GRADING PLAN – NORTH BASIN

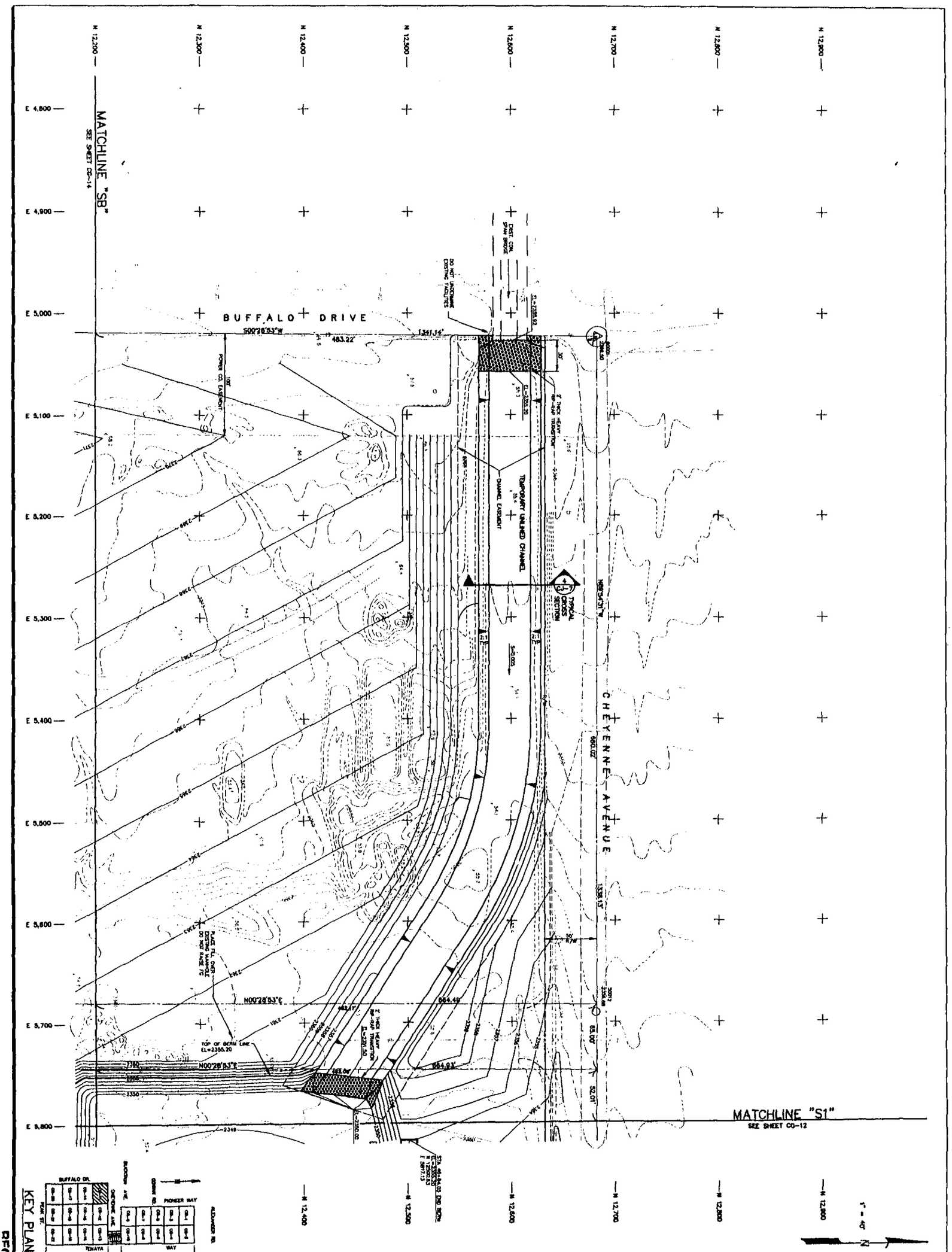
GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92

SHEET NUMBER CG-10 18 of 80

DWG. NO. 731-53A

RECORD DRAWINGS



RECORD DRAWINGS

GRADING PLAN – SOUTH BASIN

GOWAN DETENTION BASIN

CG-11

SHEET NUMBER

DATE 1-17-92

DESIGNED BY WH/TP

DRAWN BY P.A.

CHECKED BY WH

JOB NUMBER 90001

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

1140 ALMOND TREE LANE, SUITE 308 LAS VEGAS, NEVADA 89104 (702) 735-5108

DATE	REVISION

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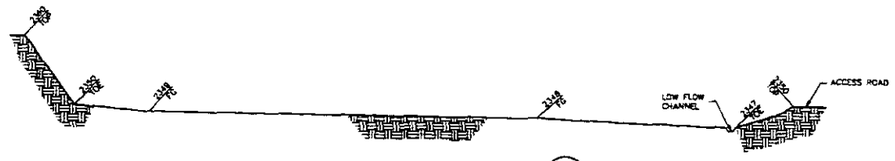
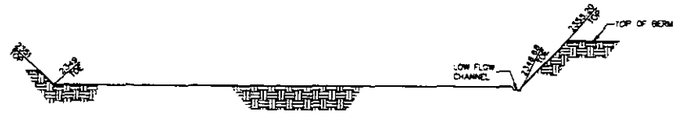
DWG. NO. 731-53A

MATCHLINE "SA"



SEDIMENT BASIN CROSS SECT (B)
NO SCALE



SEDIMENT BASIN CROSS SECT (C)
NO SCALE

MATCHLINE "S1" SEE SHEET CG-11

CHEYENNE

SEDIMENT BASIN

MATCHLINE "SB" SEE SHEET CG-15

MATCHLINE "N1" SEE SHEET CG-9

1.5' THICK GROUTED RIP-RAP

RIP-RAP

CURB OVERFLOW CHANNEL (SEE SHT. CG-9)

LOW FLOW CHANNEL

SEDIMENT BASIN OUTLET

20 0 80

RECORD DRAWINGS

MATCHLINE "S2" SEE SHEET CG-12

MATCHLINE "SA" SEE SHEET CG-2

MATCHLINE "SB" SEE SHEET CG-16

CHEYENNE AVENUE

TENAYA WAY

EXIST. FIRE STATION

EASEMENT FOR 72" RCP

60' POWER CO. EASEMENT

72" RCP REF. STM. DR. PLAN

UNLINED LOW FLOW CHANNEL

EASEMENT FOR BDW

KEY PLAN

ALEXANDER RD.

PIONEER WAY

BUCKSKIN AVE.

CHEYENNE AVE.

BUFFALO DR.

PEAK ST.

NORTH BASIN

SOUTH BASIN

1" = 40'

N

N 13,000

N 12,900

N 12,800

N 12,700

N 12,600

N 12,500

N 12,400

N 12,300

N 12,200

E 6,900

E 7,000

E 7,100

E 7,200

E 7,300

E 7,400

E 7,500

E 7,600

E 7,700

E 7,800

E 7,900

E 8,000

DATE

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GRADING PLAN – SOUTH BASIN

GOWAN DETENTION BASINS

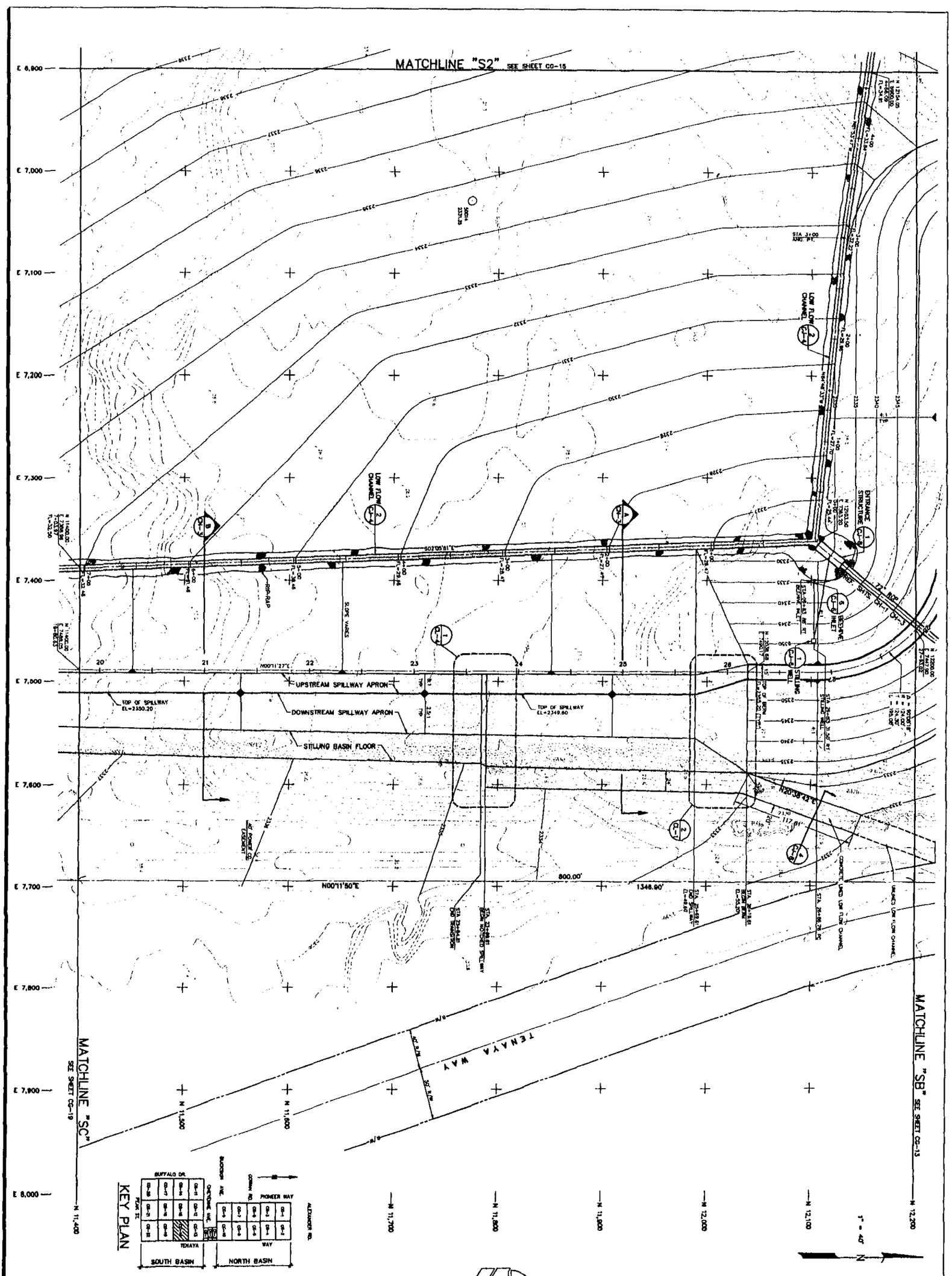
JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92

CG-13

21 OF 80

DWG. NO. 731-53A

RECORD DRAWINGS



GRADING PLAN – SOUTH BASIN

GOWAN
DETENTION BASINS

CG-16
24 of 80

DATE	REVISION
6/18/93	RECORD DRAWING

POGGEMEYER DESIGN GROUP
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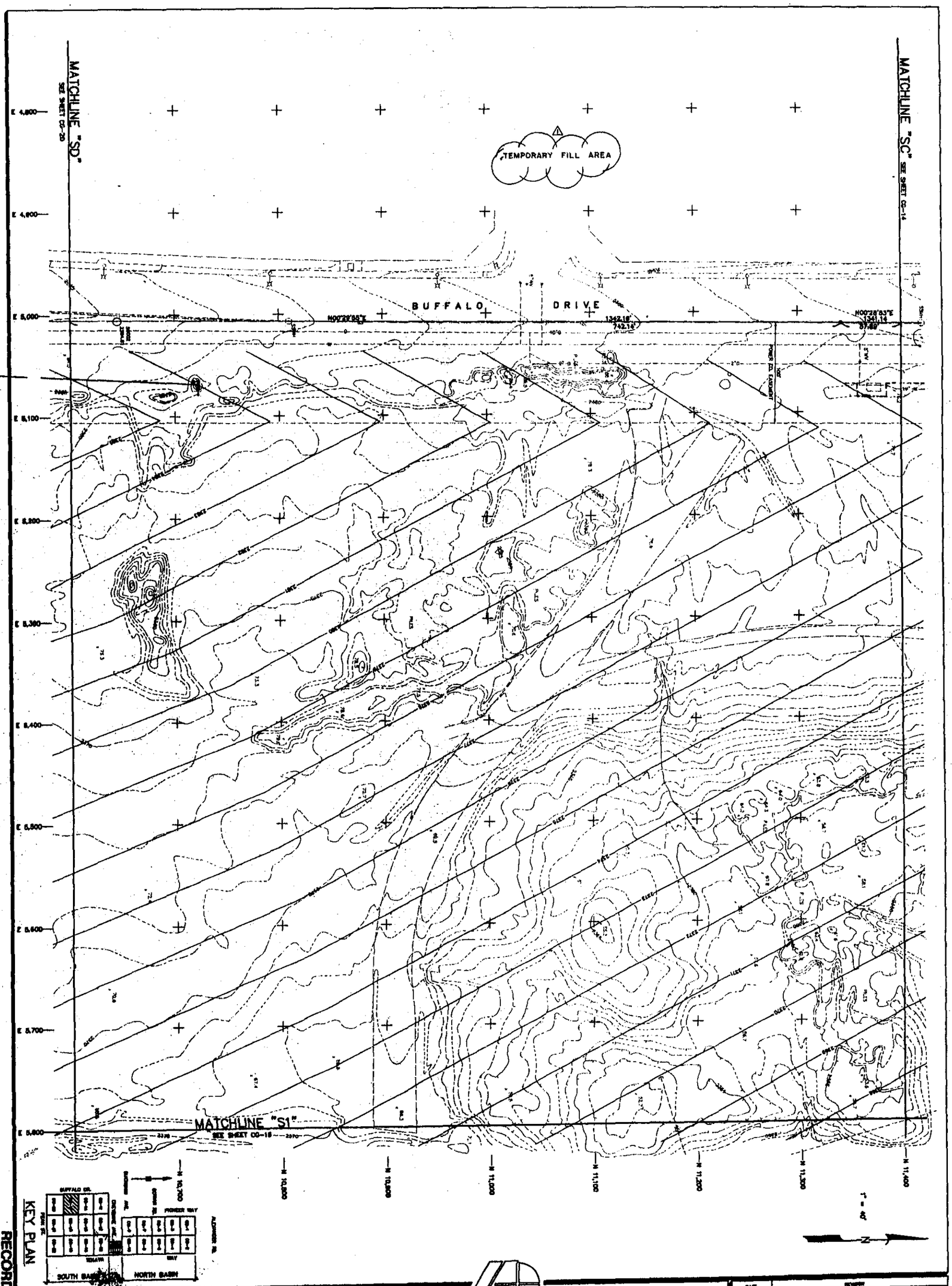
DATE 1-17-92 | DRAWN BY WH/TP | CHECKED BY PA | DESIGNED BY WH | JOB NUMBER 90001

RECORD DRAWINGS

DWG. NO. 731-53A



RECORD DRAWINGS

CG-17
25 of 60

GRADING PLAN – SOUTH BASIN

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP
ENGINEERS PLANNERS SURVEYORS
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DATE	REVISIONS
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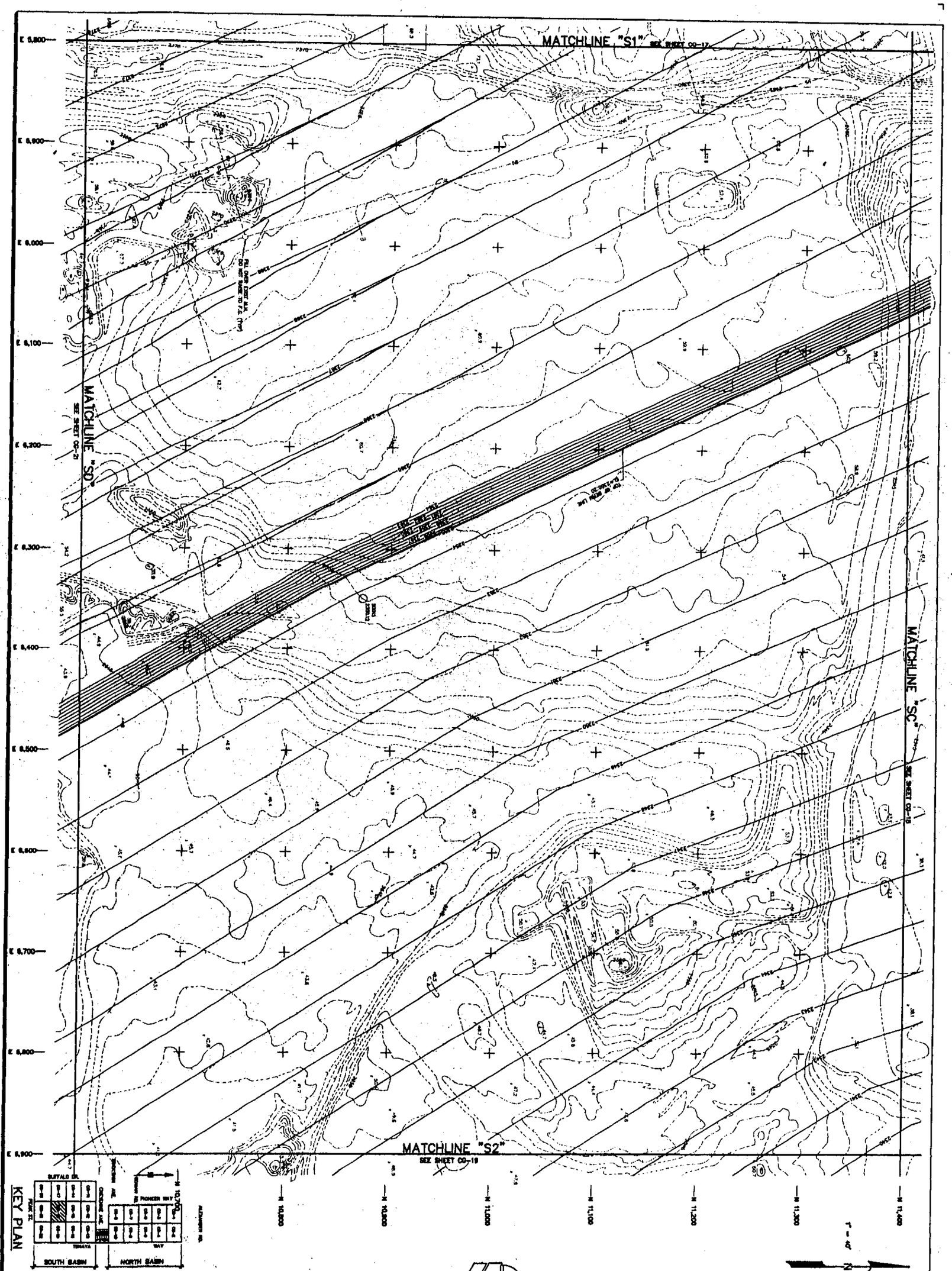
1-17-02

DWG. NO. 7315-98A



KEY PLAN

RECORD DRAWINGS

CG-18
28 of 80

GRADING PLAN – SOUTH BASIN

GOWAN DETENTION BASINS

DATE	REVISION
6/15/93	RECORD DRAWING

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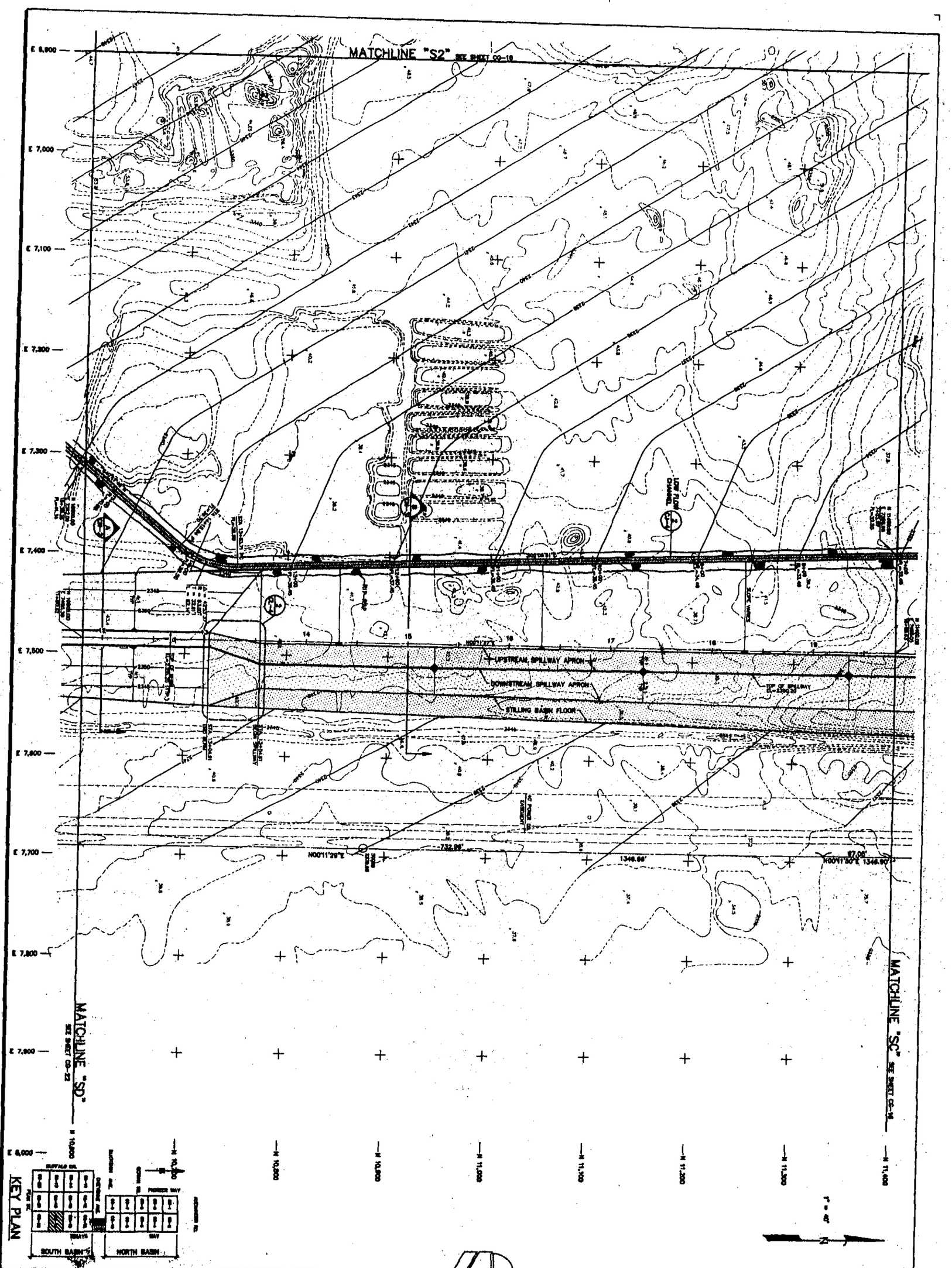
DWG. NO. 731-53A



KEY PLAN

1" = 4'

RECORD DRAWINGS

CG-19

GRADING PLAN – SOUTH BASIN

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

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DATE	REVISION
6/19/92	RECORD DRAWING

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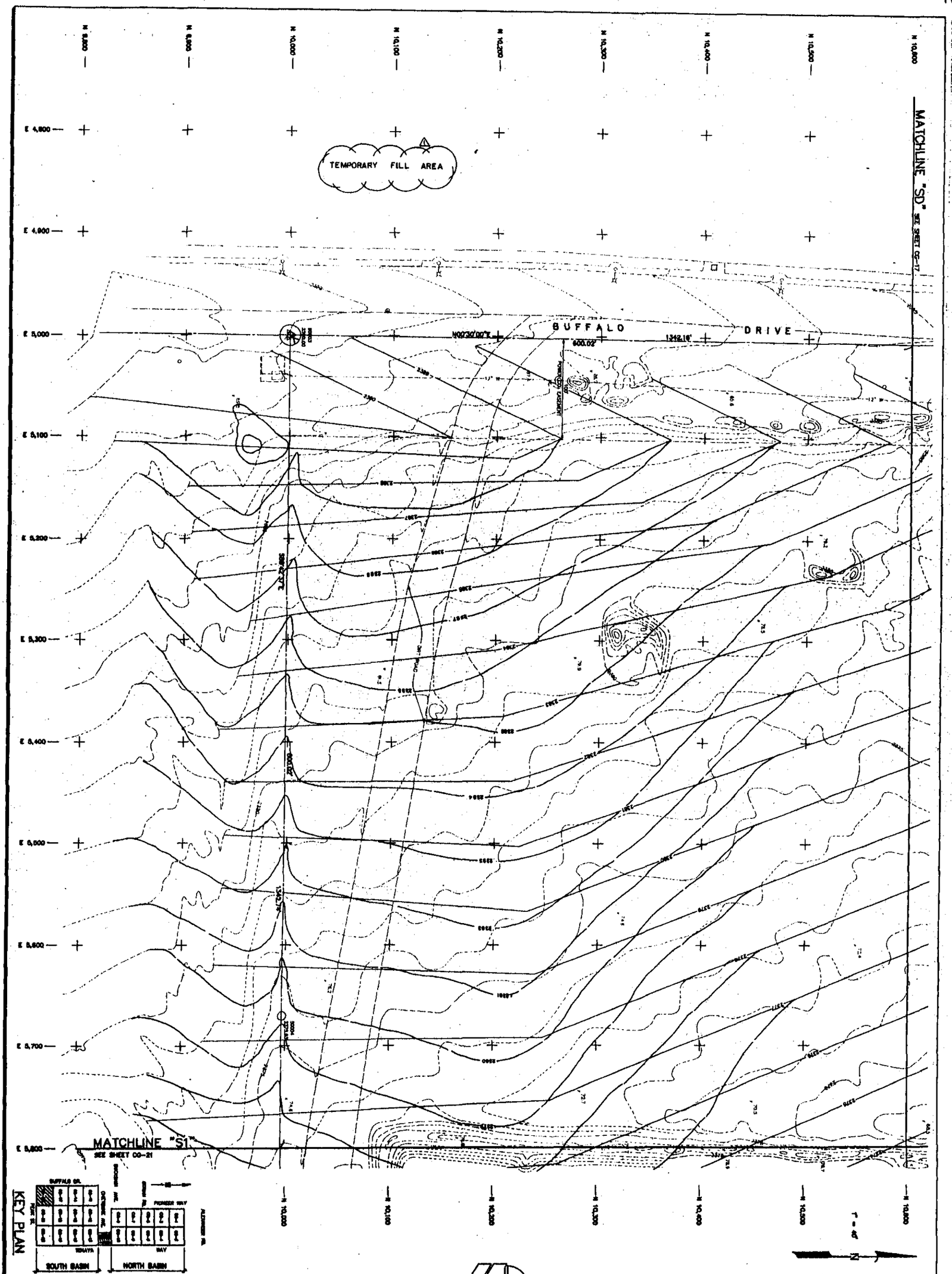
DWG. NO. 731-53A



GRADING PLAN – SOUTH BASIN

GOWAN DETENTION BASINS

CG-20

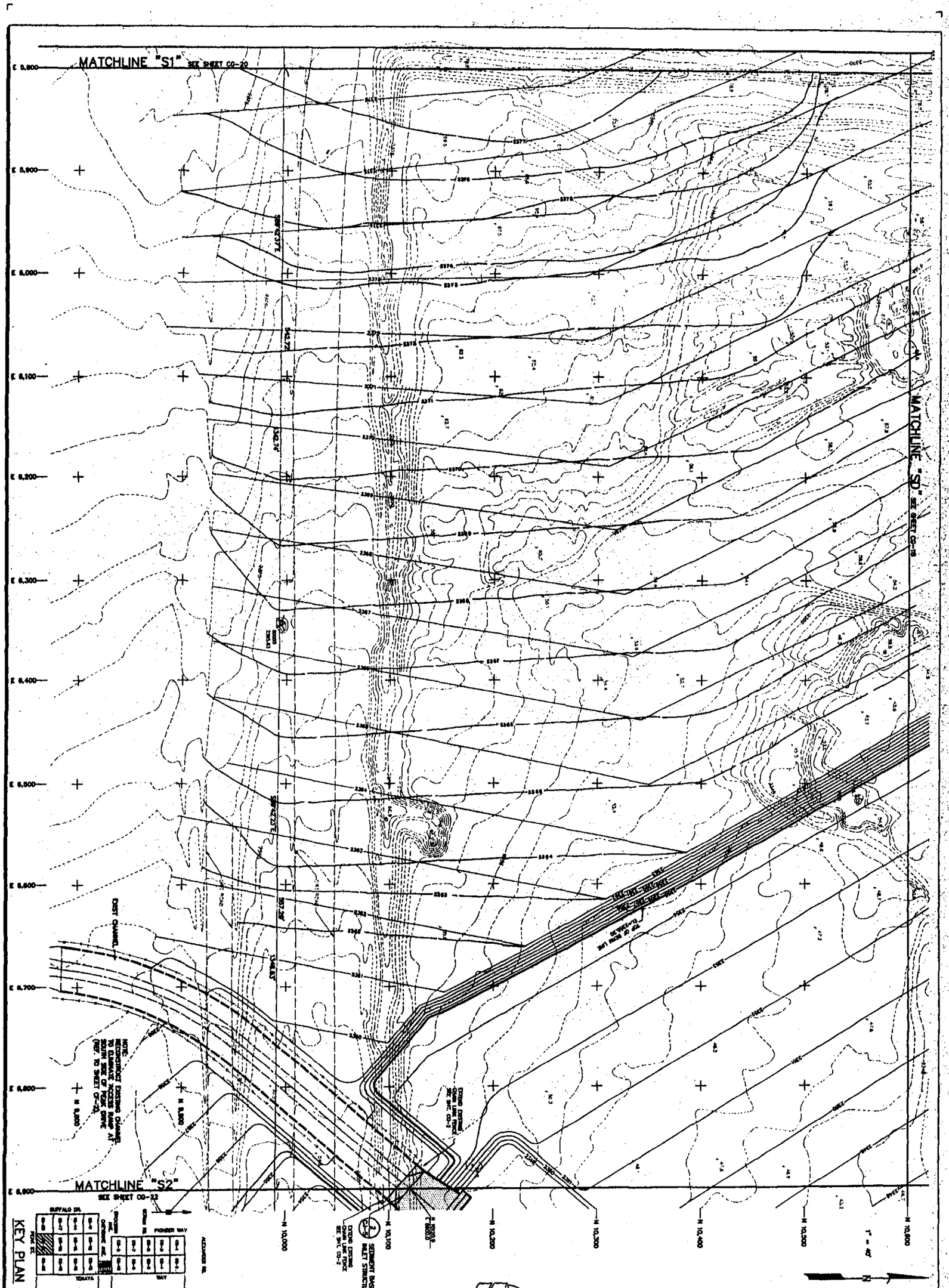
DWG. NO. 731-53A

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

1140 ALMOND TREE LANE, SUITE 300 LAS VEGAS, NEVADA 89704 (702) 735-6100

DATE	REVISION
6/19/98	RECORD DRAWING



KEY PLAN

GRADING PLAN – SOUTH BASIN

GOWAN
DETENTION BASINS

POGGEMEYER DESIGN GROUP
ENGINEERS PLANNERS SURVEYORS
1140 ALMOND TREE LANE, SUITE 306 LAS VEGAS, NEVADA 89104 (702) 735-8108

DATE	REVISION
6/15/95	RECORD DRAWING

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JOB NUMBER	DRAWING NO.	SHEET NO.
90001	CG-21	21 of 80

DESIGNED BY	DRAWN BY	CHECKED BY	DATE
WH	PA	WH/TP	1-17-92

DWG. NO. 731-53A

MATCHLINE "SB" SEE SHEET CG-11

MATCHLINE "SC" SEE SHEET CG-17

MATCHLINE "S1" SEE SHEET CG-15

N 12,200 — N 12,100 — N 12,000 — N 11,900 — N 11,800 — N 11,700 — N 11,600 — N 11,500 — N 11,400

E 4,700 — E 4,800 — E 4,900 — E 5,000 — E 5,100 — E 5,200 — E 5,300 — E 5,400 — E 5,500 — E 5,600 — E 5,700 — E 5,800

DRIVE

BUFFALO

660.00'

S89°31'07"E

725.00'

65.00'

N00°28'53"E

182.32'

182.07'

664.48'

664.93'

176.78'

1341.14'

823.28'

100' POWER CO. EASEMENT

TOP OF BERM LINE EL=2359.20

FILL OVER EXISTING MANHOLE DO NOT RAISE TO FG (TYP.)

1" = 40'

N

KEY PLAN

ALEXANDER RD.

PIONEER WAY

GOWAN RD.

CHEYENNE AVE.

BUFFALO DR.

TENAYA WAY

PEAK ST.

NORTH BASIN

SOUTH BASIN

REVISION

DATE

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ENGINEERS PLANNERS SURVEYORS

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GRADING PLAN — SOUTH BASIN

GOWAN DETENTION BASINS

JOB NUMBER 90001

DESIGNED BY WH

DRAWN BY PA

CHECKED BY WH/TP

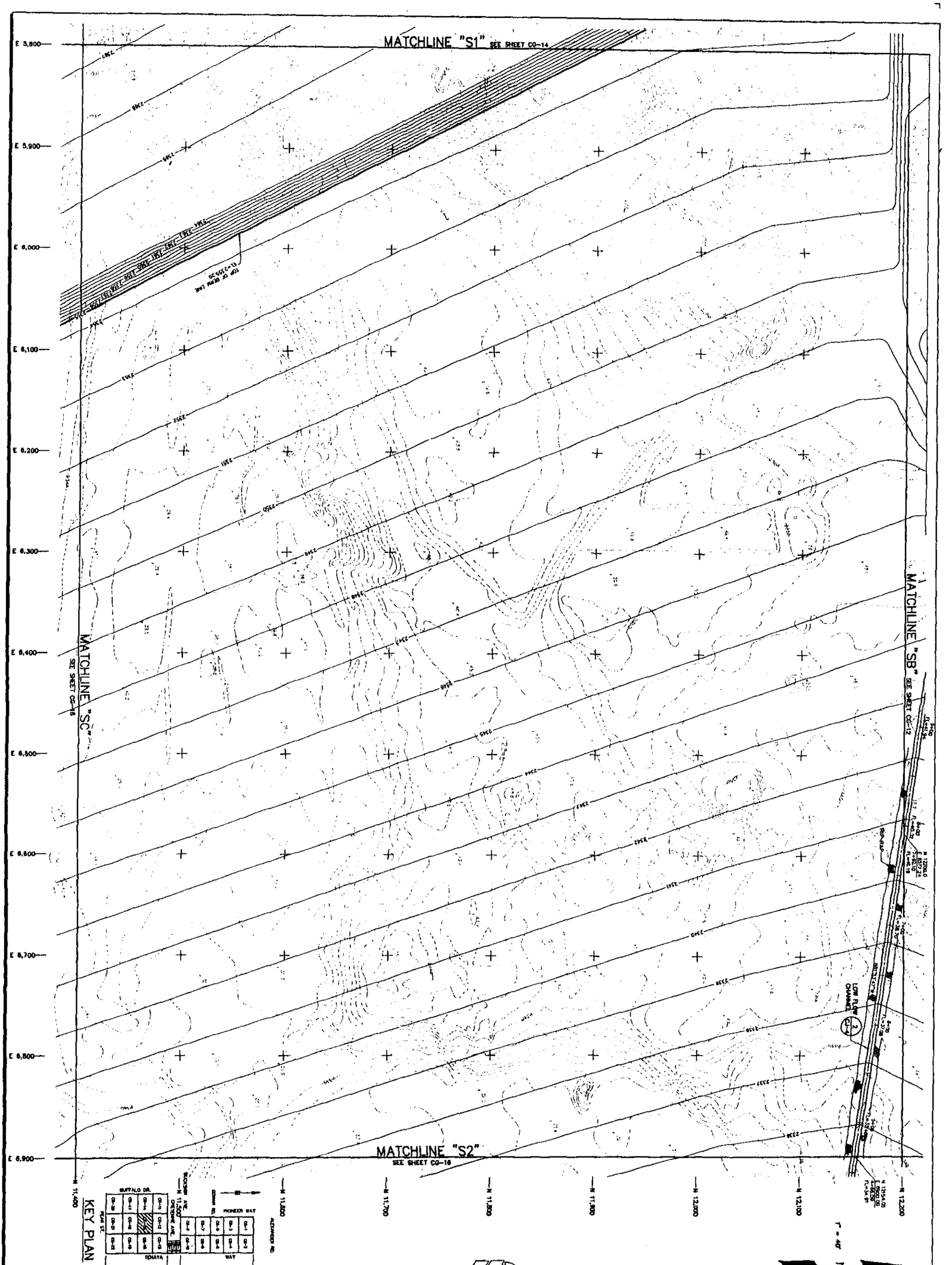
DATE 1-17-92

SHEET NUMBER CG-14

22 OF 80

DWG. NO. 731-53A

RECORD DRAWINGS



GRADING PLAN – SOUTH BASIN

GOWAN
DETENTION BASINS

POGGEMEYER DESIGN GROUP
ENGINEERS PLANNERS SURVEYORS
1140 ALMOND TREE LANE, SUITE 308 LAS VEGAS, NEVADA 89104 (702) 735-5108

DATE	REVISION
6/14/93	RECORD DRAWING

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SHEET NO. **CG-15** 23 of 80

DATE	CHECKED BY	DRAWN BY	DESIGNED BY	JOB NUMBER
1-12-92	WH/TP	PA	WH	90001

RECORD DRAWINGS

DWG. NO. 731-53A

MATCHLINE "SD" SEE SHEET CG-19

N 10,600

N 10,500

N 10,100

N 10,000

N 9,900

N 9,800

E 6,900 | E 7,000 | E 7,100 | E 7,200 | E 7,300 | E 7,400 | E 7,500 | E 7,600 | E 7,700 | E 7,800 | E 7,900 | E 8,000

MATCHLINE "S2" SEE SHEET CG-21

SEDIMENT BASIN OUTLET STRUCTURE

SEDIMENT BASIN INLET STRUCTURE

SEDIMENT BASIN

LOW FLOW CHANNEL

EXTEND EXISTING CHAIN LINK FENCE SEE SHT. CG-21

S89°42'23"E 768.34' 1346.83'

STA. 5+10.62 PT

STA. 4+37.88 PC

FUTURE PEAK DRIVE

90' POWER CO. EASEMENT

DIRT ROAD

N00°11'34"E 802.83'

N00°11'34"E

SEDIMENT BASIN CROSS SECT (B)

NO SCALE

SEDIMENT BASIN CROSS SECT (C)

NO SCALE

KEY PLAN

ALEXANDER RD.

GOWAN RD.

BUFFALO DR.

PEAK ST.

PIONEER WAY

CHEYENNE AVE.

TENAYA WAY

NORTH BASIN

SOUTH BASIN

1" = 40'

N

RECORD DRAWINGS

DATE 6/15/92

RECORD DRAWINGS

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

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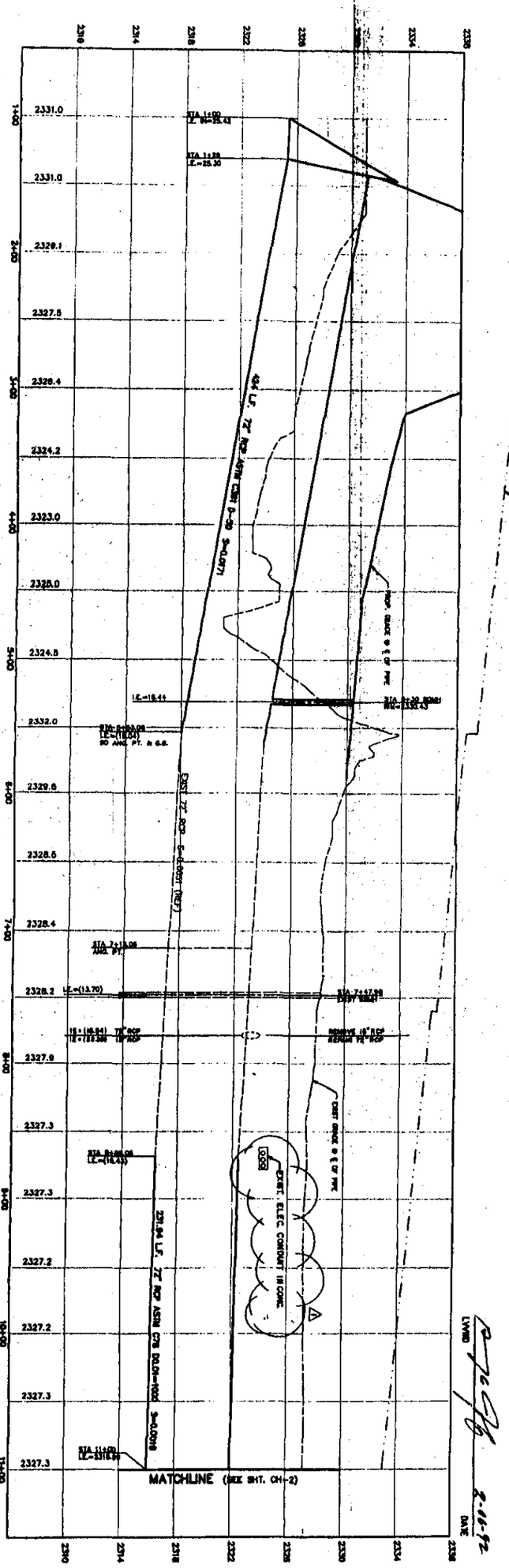
GRADING PLAN – SOUTH BASIN

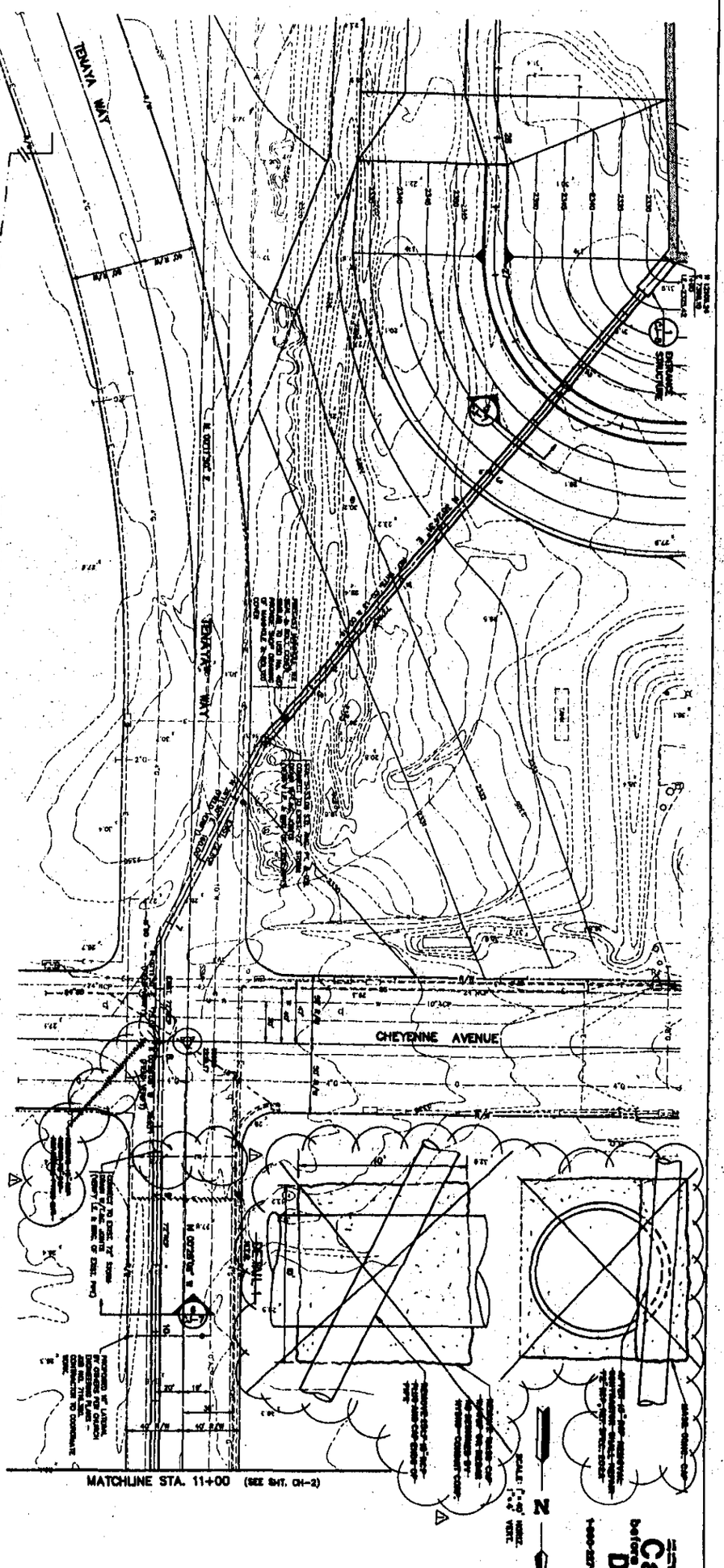
GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92

SHEET NUMBER CG-22 30 of 80

DWG. NO. 731-53A





Call before you dig.

RECORD DRAWING

CH-1	1-17-02	WI/TP	PA	WI/PA	90001

PLAN AND PROFILE-72" OUTFALL

GOWAN DETENTION BASINS

POGGEMEYER DESIGN GROUP

ENGINEERS PLANNERS SURVEYORS

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DATE	REVISION
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DWG. NO. 731-53A

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N

SCALE: 1"=40' HORIZ.
1"=4' VERT.

MATCHLINE STA. 11+00 (SEE SHT. CH-1)

ATWOOD

SUNBURY CIRCLE

TENAYA WAY

DRIVEWAY

DALEGROVE

MATCHLINE STA. 21+00 (SEE SHT. CH-3)

RELOCATE EXIST 8" WATERLINE

PROPOSED CANAL BY GREEN-ROE CHURCH (EXISTING FLOW 228 MIN. 7THL.3RD. CONTRACTOR TO COORDINATE WORK.)

PRECAST MANHOLE YZ SEAL & BOLT COVER SIMILAR TO UNI-TEX 407 PRIMER, SHOP DRAWING OF MANHOLE & BOLTED COVER

RELOCATE EXIST SEWER & WATER LINES REF. SHT. CH-3

2-16-92
LVWD DATE

MATCHLINE (SEE SHT. CH-1)

EXIST. CENTEL LINES

EXIST. GAS LINE

HGL FOR 100 YR STORM

DIST GRADE ℄ OF PIPE

RELOCATE EXIST 8" WATERLINE

824.52 L.F. 72" RCP ASTM C76 DO.01=1000 S=0.0019

372.7 L.F. 8" SAN. SEWER PVC

S=.0069

RELOCATE EXIST SEWER LINE (SEE SHT. CH-3 FOR NEW PROFILE)

RELOCATE EXIST WATER LINES (SEE SHT. CH-3)

NEW STRM

175.48 L.F. 72" RCP ASTM C76 DO.01=1000 S=0.0024

MATCHLINE (SEE SHT. CH-3)

2334 2330 2326 2322 2318 2314 2310

11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00

REVISIONS

DATE	REVISIONS
8/10/93	RECORD DRAWING

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PLAN AND PROFILE-72" OUTFALL

GOWAN
DETENTION BASINS

JOB NO.	90001
DESIGNED BY	WH/PA
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92

CH-2
32 OF 80

DWG. NO. 731-53A

RECORD DRAWINGS

GOWAN DETENTION BASINS

PLAN AND PROFILE-72" OUTFALL

CH-3

1-19-92

RECORD DRAWINGS

POGGEMEYER DESIGN GROUP

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RECORD DRAWING 6/10/93

Call before you Dig. 1-800-227-8600

2.16.93 DATE

LAS VEGAS VALLEY WATER DISTRICT

SCALE 1"=40' HORIZ. 1"=4' VERT.

N

ABANDON VALVE AND CUT AND CAP WITHIN RIGHT-OF-WAY

ALL VALVES TO BE ABANDONED SHALL BE APPROVED BY THE CLOSED POSITION, UNLESS SHOWN OTHERWISE ON THE PLANS. ALL VALVES SHALL BE TURNED A MINIMUM OF TEN (10) TURNS AND THEN PLUG THE REMAINING PORTION OF PVC VALVE BOX WITH CONCRETE HAVING A COMPRESSIVE STRENGTH OF AT LEAST 2,000 PSI.

THE CONTRACTOR SHALL CUT THE EXISTING PIPE WITHIN THE RIGHT-OF-WAY OR EASEMENT AS SHOWN ON THE PLANS AND CAP WITH A CONCRETE PLUG. THE CUT AND CAP LOCATION SHALL BE APPROVED AT THE TIME OF CONSTRUCTION. THE INSTALLATION OF A CLASS 150 PVC PIPE IS PERMITTED, WITH INSPECTOR APPROVAL. THE CONTRACTOR SHALL INSTALL A CONCRETE PLUG AT THE END OF THE PIPE AS DIRECTED BY THE INSPECTOR OF THE DISTRICT'S STANDARD PLATE NO. 9 AT ALL CAP OR PLUG LOCATIONS.

NOTE: RECONNECT EXISTING SEWER LATERALS TO NEW SEWER LINES PER CLV STDS.

DALEGROVE

TENAYA WAY

REMOVE AND RELOCATE DIST SIGN

RELOCATE EXISTING 18" MAILBOX

REMOVE DIST. SIGN

RELOCATE DIST WATER LINES

DIST. 8" PVC TO BE REMOVED

DIST. GRADE @ ℄

8" PVC

STA 1+50 ℄ OF 68MH

STA 0+00 ℄ OF 60MH

INVERT ELEV. = 2319.39

LOW FLOW CHANNEL

BAFFLED OUTLET

BUCKSKIN ROAD

MATCHLINE STA 21+00 (SEE SHT. CH-2)

SANITARY SEWER PROFILE

72" OUTFALL PROFILE

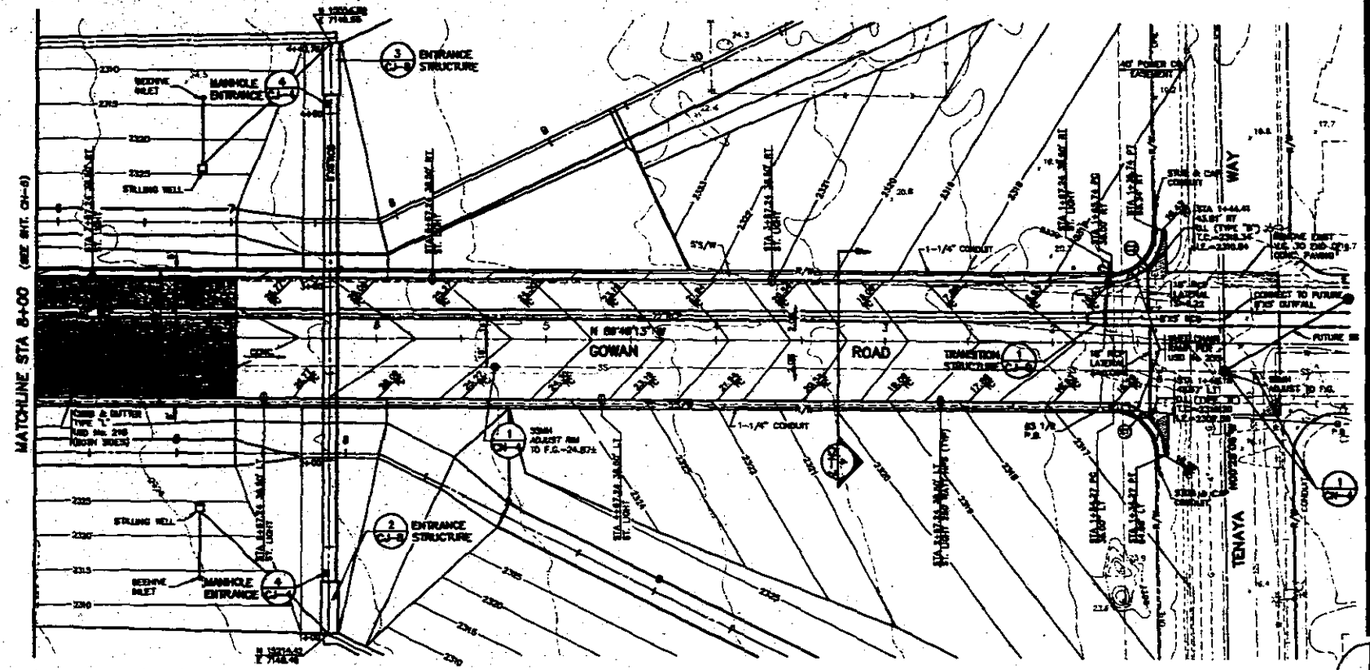
2' MIN. COVER

BAFFLED OUTLET

MATCHLINE (SEE SHT. CH-3)

RECORD DRAWINGS

Call before you Dig.
1-800-227-2600

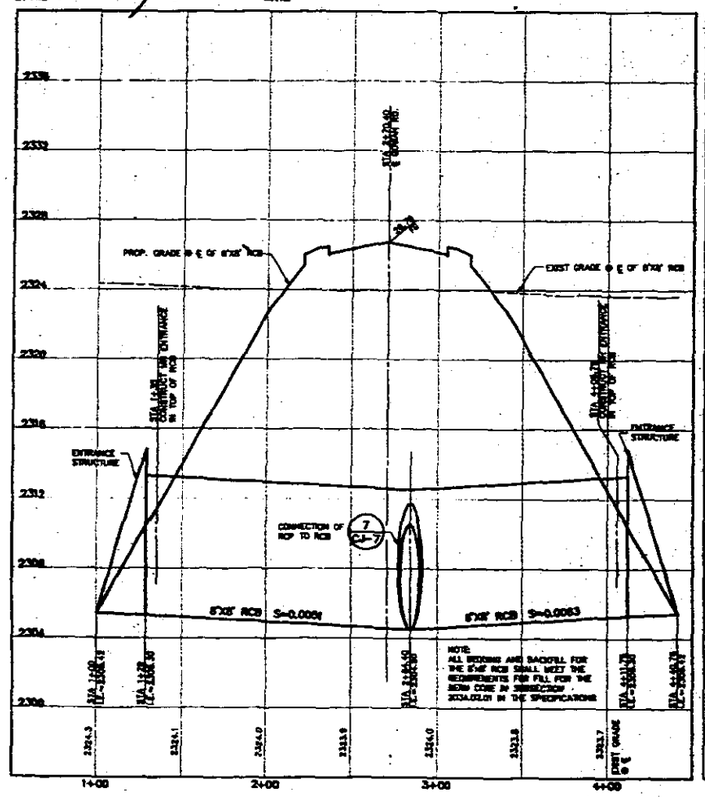


N

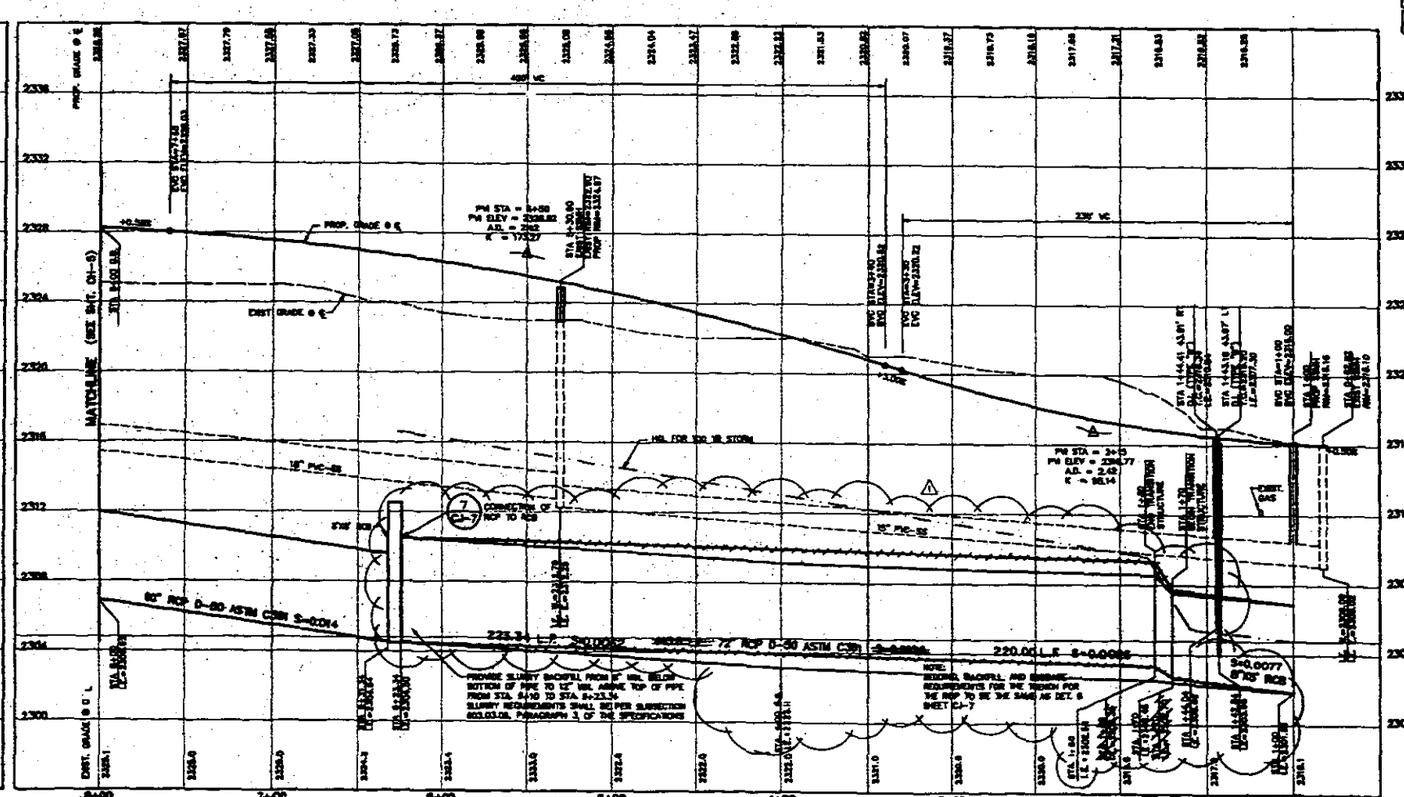
SCALE: 1"=40' HORIZ.
1"=4' VERT.

CURVE DATA				
CURVE	RADIUS	LENGTH	TANGENT	DELTA
C1	30.00'	46.78'	29.68'	89°21'07"
C2	30.00'	47.46'	30.34'	90°38'53"

LYVRD 2/06/92
DATE



NOTE:
ALL BEDDING AND BACKFILL FOR THE 8'X8' RCB SHALL MEET THE REQUIREMENTS FOR FILL FOR THE BOX CORE IN SUBSECTION 203.03.01.01 IN THE SPECIFICATIONS



PROVIDE SLURRY BACKFILL FROM 6" MIN. BELOW BOTTOM OF PIPE TO 12" MIN. ABOVE TOP OF PIPE FROM STA. 8+10 TO STA. 8+23.34
SLURRY REQUIREMENTS SHALL BE PER SUBSECTION 203.03.01.01, PARAGRAPH 3, OF THE SPECIFICATIONS

NOTE:
BEDDING, BACKFILL AND EMBANKMENT REQUIREMENTS FOR THE TRENCH FOR THE RCP TO BE THE SAME AS DET. 6 SHEET CH-7

DATE	REVISIONS
6/11/93	△ RECORD DRAWINGS

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PLAN AND PROFILE~GOWAN ROAD

GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH/PA
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92

CH-4
34 of 80

DWG. NO. 731-53A

RECORD DRAWINGS

L.V.W.D. 2-01-92 DATE

Call before you Dig. 1-800-227-2600

DATE	REVISION
6/11/93	RECORD DRAWING

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PLAN AND PROFILE—GOWAN ROAD

GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH/PA
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92
SHEET NUMBER	CH-5
	35 of 80

DWG. NO. 731-53A

RECORD DRAWINGS

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NO.	DATE	REVISION
1	6/11/92	RECORD DRAWING

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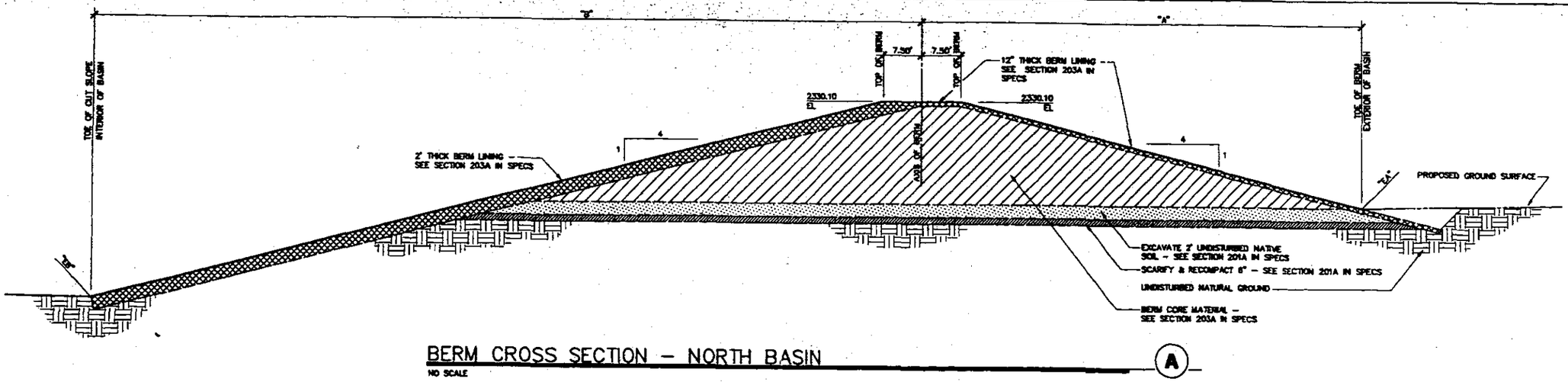
PLAN AND PROFILE—36" STORM DRAIN

GOWAN DETENTION BASINS

JOB NUMBER	90001
DESIGNED BY	WH/PA
DRAWN BY	PA
CHECKED BY	WH/TP
DATE	1-17-92
SHEET NUMBER	CH-6
	36 of 80

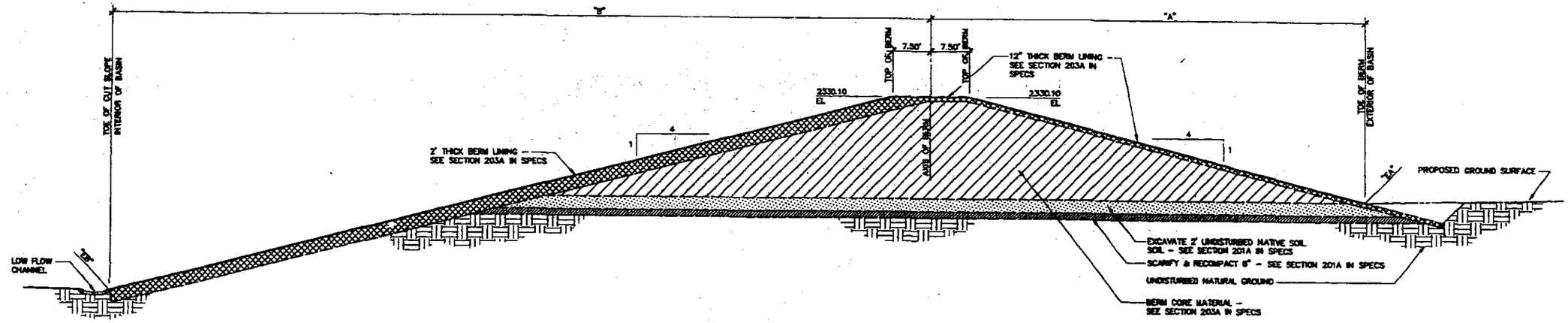
DWG. NO. 731-53A

RECORD DRAWINGS



BERM CROSS SECTION – NORTH BASIN (A)

NO SCALE



BERM CROSS SECTION – NORTH BASIN (B)

NO SCALE

UPPER NORTH BASIN – BERM SCHEDULE				
STATION	"A"	"EA"	"B"	"EB"
0+00	7.50'	2330.10	–	–
0+98.10	7.50'	2330.10	90.32'	2309.40
1+00	7.50'	2330.010	90.35'	2309.39
2+00	7.50'	2330.10	92.39'	2308.88
3+00	7.50'	2330.10	94.42'	2308.37
4+00	7.50'	2330.10	96.46'	2307.86
4+20.81	7.50'	2330.10	96.86'	2307.75
5+00	12.47'	2328.86	98.50'	2307.35
6+00	14.96'	2328.24	100.53'	2306.84
7+00	18.53'	2327.34	102.58'	2306.33
7+03.23	18.68'	2327.41	102.63'	2306.32
25+00	–	–	73.38'	2313.63
25+24.08	36.70'	2322.80	72.85'	2313.76
26+00	38.56'	2322.83	71.04'	2314.21
27+00	38.42'	2322.87	68.87'	2314.76
28+00	38.27'	2322.91	66.70'	2315.30
29+00	38.11'	2322.95	64.54'	2315.84
30+00	35.95'	2322.99	62.54'	2316.34
30+32.95	35.90'	2323.00	61.90'	2316.50
31+00	33.18'	2323.68	89.40'	2316.50
31+40.47	31.90'	2324.00	61.90'	2316.50
32+00	31.33'	2324.14	61.75'	2316.54
33+00	29.07'	2324.71	61.51'	2316.60
34+00	26.81'	2325.27	61.26'	2316.66
35+00	24.54'	2325.84	61.01'	2316.72
36+00	22.56'	2326.33	60.77'	2316.78

UPPER NORTH BASIN – BERM SCHEDULE				
STATION	"A"	"EA"	"B"	"EB"
37+00	20.74'	2328.79	60.52'	2316.84
38+00	18.25'	2327.41	60.26'	2316.91
39+00	15.36'	2328.14	60.03'	2316.97
40+00	13.00'	2328.72	–	–
41+00	10.46'	2329.36	–	–
41+95.40	7.91'	2330.00	–	–

LOWER NORTH BASIN – BERM SCHEDULE				
STATION	"A"	"EA"	"B"	"EB"
0+00	7.50'	2330.10	–	–
1+00	7.50'	2330.10	–	–
1+38.27	7.50'	2330.10	94.75'	2308.29
2+00	7.50'	2330.10	95.98'	2307.98
2+31.74	7.50'	2330.10	97.01'	2307.72
3+00	11.25'	2329.16	97.98'	2307.48
4+00	14.18'	2328.43	99.96'	2306.98
5+00	16.99'	2327.73	101.96'	2306.48
5+33.76	18.88'	2327.41	102.86'	2306.31
7+00.70	27.90'	2325.00	102.98'	2306.23
8+00	32.75'	2323.79	101.40'	2306.63
9+00	40.47'	2321.86	99.80'	2307.03
9+69.46	43.90'	2321.00	98.88'	2307.30
9+85.90	43.90'	2321.00	–	–
10+00	43.90'	2321.00	–	–
10+85.81	43.90'	2321.00	–	–
11+00	43.90'	2321.00	–	–
11+02.25	43.90'	2321.00	98.33'	2307.38
12+00	43.90'	2321.00	96.76'	2307.78
13+00	43.90'	2321.00	95.16'	2308.18
14+00	43.20'	2321.18	93.56'	2308.58
15+00	41.92'	2321.48	91.96'	2308.98
16+00	40.65'	2321.18	90.36'	2309.38
17+00	39.28'	2322.15	88.76'	2309.78
18+00	37.80'	2322.53	87.16'	2310.18

LOWER NORTH BASIN – BERM SCHEDULE				
STATION	"A"	"EA"	"B"	"EB"
19+00	36.31'	2322.90	85.56'	2310.58
19+37.18	36.19'	2322.93	–	–
20+00	34.02'	2323.47	–	–
20+85.90	27.90'	2325.00	–	–
21+00	27.37'	2325.13	–	–
22+00	23.40'	2326.13	81.56'	2311.58
23+00	18.26'	2327.41	78.29'	2312.40
24+00	14.19'	2328.43	75.02'	2313.22
25+00	10.35'	2329.39	71.75'	2314.04
25+10.56	9.98'	2329.48	71.40'	2314.13
25+68.68	7.50'	2330.10	–	–

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BERM CROSS SECTION – NORTH BASIN

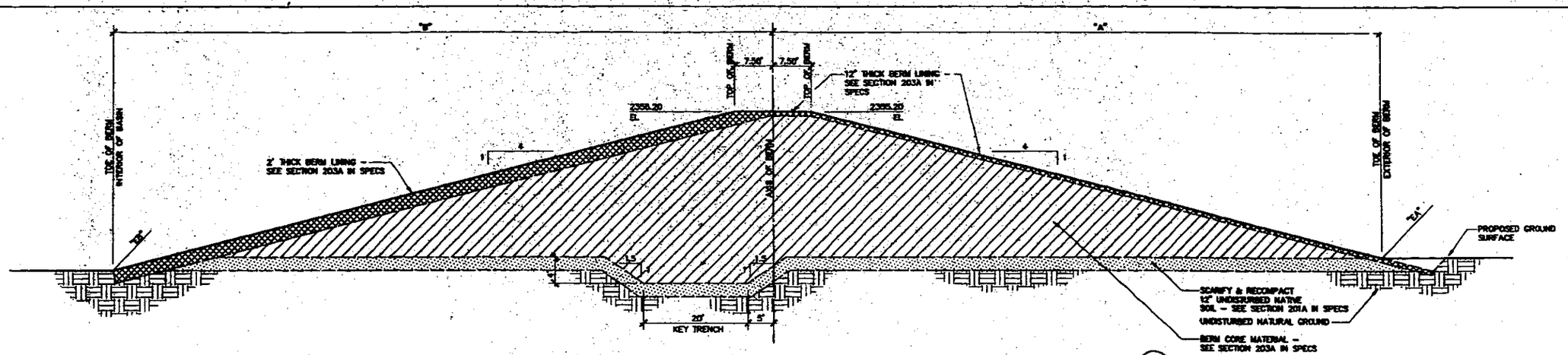
GOWAN DETENTION BASINS

90001
WH
CPG/PA
WH/TP
1-17-92

CN-1
50 of 80

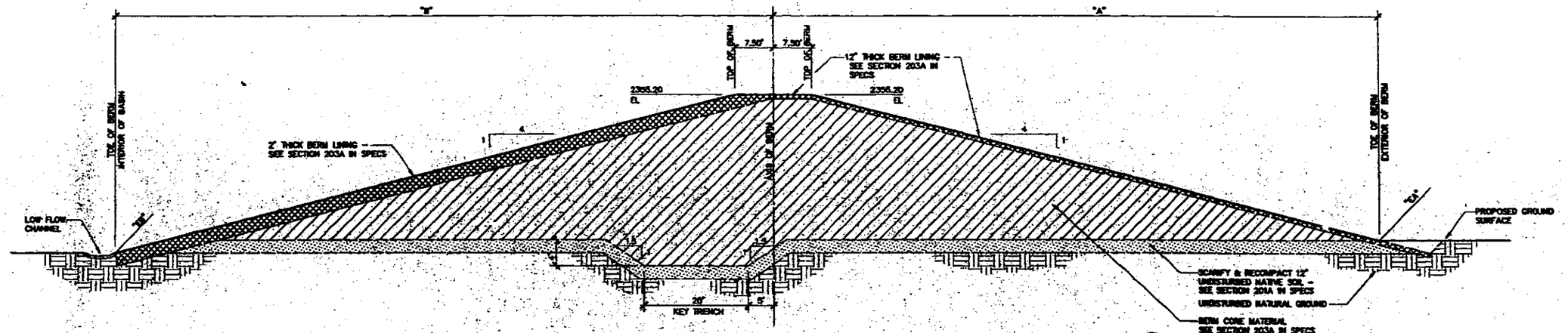
DWG. NO. 731-53A

RECORD DRAWINGS



BERM CROSS SECTION — SOUTH BASIN (A)

NO SCALE



BERM CROSS SECTION — SOUTH BASIN (B)

NO SCALE

SOUTH BASIN — BERM SCHEDULE

STATION	"A"	"EA"	"B"	"EB"
0+00	8.34'	2354.99	8.38'	2354.98
1+00	12.90'	2353.85	14.38'	2353.48
2+00	17.46'	2352.71	18.51'	2352.45
3+00	22.02'	2351.57	22.63'	2351.42
4+00	26.58'	2350.43	26.75'	2350.38
4+37.59	28.30'	2350.00	28.30'	2350.22
5+00	35.35'	2348.24	28.30'	2350.03
5+10.62	38.30'	2348.00	28.30'	2350.00
6+00	39.28'	2347.26	33.58'	2348.69
7+00	42.58'	2346.43	38.58'	2347.18
8+00	45.88'	2345.60	43.63'	2345.67
9+00	49.38'	2344.73	50.83'	2344.37
10+00	53.25'	2343.78	55.38'	2343.23
11+00	57.14'	2342.79	59.98'	2342.10
12+00	61.03'	2341.82	64.44'	2340.97
13+00	64.92'	2340.84	68.86'	2339.85
13+94.81	65.10'	2340.80	69.08'	2339.81
25+00	—	—	128.34'	2328.87
26+19.81	98.30'	2332.50	128.63'	2328.87
26+85.76	100.30'	2332.00	—	—
27+00	98.58'	2332.43	—	—
28+00	82.30'	2334.00	—	—
28+81.84	82.30'	2334.00	—	—
29+00	80.69'	2334.43	122.88'	2328.40

SOUTH BASIN — BERM SCHEDULE

STATION	"A"	"EA"	"B"	"EB"
30+00	61.19'	2338.78	113.70'	2328.65
31+00	71.66'	2338.18	104.71'	2330.90
31+28.94	68.30'	2334.00	102.11'	2331.55
31+66.83	—	—	98.70'	2332.40
32+00	68.30'	2340.00	90.00'	2334.57
32+27.40	—	—	86.30'	2335.50
32+85.29	68.30'	2340.00	85.29'	2335.75
33+00	70.32'	2338.50	84.36'	2335.99
33+68.47	74.09'	2338.55	80.79'	2336.89
34+00	75.74'	2338.14	—	—
34+10.80	76.30'	2338.00	—	—
34+83.95	80.30'	2337.00	—	—
35+00	79.83'	2337.17	—	—
35+28.29	78.52'	2337.44	80.30'	2337.00
36+00	75.39'	2338.23	77.62'	2337.67
37+00	70.95'	2338.34	72.48'	2338.98
38+00	65.08'	2340.80	67.28'	2340.28
39+00	57.58'	2342.88	61.71'	2341.65
40+00	50.08'	2344.56	56.15'	2343.04
41+00	42.55'	2348.44	50.80'	2344.43
42+00	35.02'	2348.32	44.19'	2346.03
43+00	27.78'	2350.14	37.19'	2347.78
44+00	22.21'	2351.52	28.64'	2348.91
45+00	18.30'	2353.00	20.30'	2352.00
46+00	11.75'	2354.14	20.30'	2352.00
46+84.03	8.34'	2354.99	20.30'	2352.00

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REVISION | DATE

POGGEMEYER DESIGN GROUP
ENGINEERS PLANNERS SURVEYORS
1140 ALMOND TREE LANE, SUITE 300 LAS VEGAS, NEVADA 89104 (702) 739-9100

BERM CROSS SECTION — SOUTH BASIN

GOWAN DETENTION BASIN

JOB NUMBER	90001
DESIGNED BY	WH
DRAWN BY	CPG/PA
CHECKED BY	WH/TP
DATE	1-17-92
SHEET NUMBER	CN-2 51 of 80

DWG. NO. 731-63A

RECORD DRAWINGS

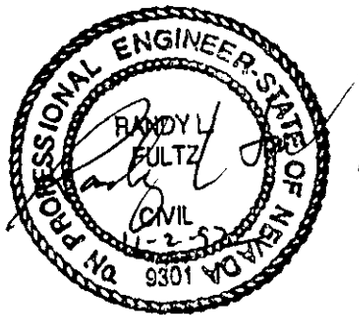
Section 6
Craig Road Storm Drain System

Hydrology Study for Craig Road Between U.S. 95 and Decatur Boulevard

Included in this section:

Excerpts from *Hydrology Study for Craig Road Between U.S. 95 and Decatur Boulevard*, November, 1992, prepared by City of Las Vegas.

HYDROLOGY STUDY
FOR
CRAIG ROAD BETWEEN U.S.95 AND DECATUR BOULEVARD



PREPARED BY:

CITY OF LAS VEGAS
DEPARTMENT OF PUBLIC WORKS
FLOOD CONTROL SECTION
LAS VEGAS, NV 89128
229-6276

November 2, 1992

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APPENDIX B	HEC-1 Model Future Conditions
APPENDIX C	VTN Gowan Outfall Report Information
APPENDIX D	3'x7' Culvert Analysis At the Rancho/Craig Intersection
APPENDIS E	Hydraulic Grade Line Analysis

CRAIG ROAD DRAINAGE STUDY

PURPOSE

The purpose of this study is to present hydrology and design assumptions for the Craig Road Street Improvement Project. The design adequacy will be evaluated based on (1) the Regional Transportation Commission (RTC) design criteria to collect and convey the 10-year stormwater flow as outlined in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (2) its ability to reduce flooding along Rancho Drive and (3) does it perpetuate the historical flow thereby not adversely impacting other areas.

BACKGROUND

The RTC Craig Road Project extends from U.S. 95 to Decatur Boulevard. The design was started and largely finished by Hefner Engineering. However, it became necessary for the City of Las Vegas (CLV) to finish the design and bid the project. Final CLV review resulted in concerns regarding drainage design and are listed below:

- Diverting the majority of the stormwater flows south along Rancho Drive at Craig Road would perpetuate existing flooding problems along Rancho Drive at the two intersections south of Craig Road at Alexander Road and Jones Boulevard.

- Is the most direct or efficient route to the Gowan Outfall being implemented?

- Why collect the Q10 flow and discharge the majority of it south along Rancho Boulevard when the original undeveloped contours conveyed runoff in a predominately west to east direction?

- Why was the 50-year frequency flow being intercepted at U.S.95 instead of the 10-year frequency and why was the Gowan North Channel assumed to be in-place?

- A Q10 stormwater diversion at Lone Mountain Road and Jones Boulevard of 120 cfs (Q100 = 240 cfs) was not included in the stormwater design.

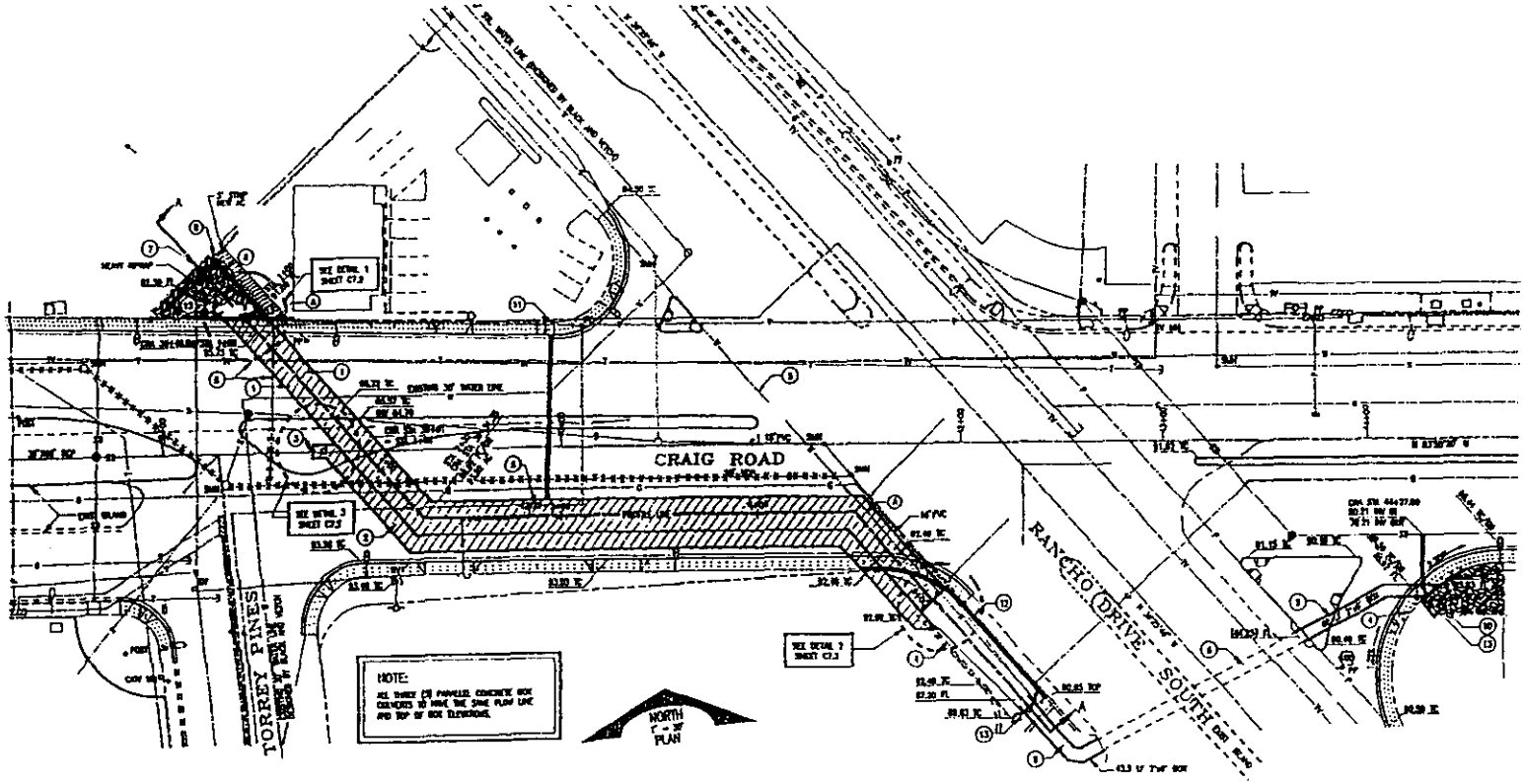
- The culvert diversions along Rancho Drive did not allow for a lower backwater elevation for the 10-year flows. Therefore, significantly less stormwater runoff would be reaching the Rancho/Craig intersection.

- How will the 78 cfs that is conveyed across Rancho Drive draining along Craig Road be handled in the future?

The Hefner design required about 400 LF of 3-3'x7' box culverts at the Rancho/Craig intersection to discharge 468 cfs south into Rancho Drive (See Figure 1). The majority of the stormwater flows at the intersection of Rancho Drive and Craig Road are presently diverted south along Rancho Drive. Howver, about 78 cfs was conveyed across Rancho Drive in a existing 2'x6' RCB and discharged along the south side of Craig Road in a ditch. As the area develops this flow will remain in the street. As a minimum, this flow should have been piped east in Craig Road to Decatur Boulevard into the Gowan Outfall system.

Prior to construction of Rancho Drive, the flow direction along Craig Road was west to east across Rancho Drive. However, when Rancho Drive was constructed a low point or sump area was created forcing stormwater flows south along Rancho Drive.

Near the time the 7-11 Store was constructed, on the northwest corner of the Craig/Rancho intersection, the sump area in Craig Road created by Rancho Drive was moved to the west about 150 feet from Rancho Drive. This sump area was required in Craig Road because the 7-11 site was filled to a level that cut off the historical flow path on the west side of Rancho Drive across the 7-11 Store property. It was understood that Hefner Engineering approached NDOT with the proposal to extend the Craig Road drainage system north along the west side of Rancho Drive to intercept the flows that were conveyed along Rancho Drive prior to construction of the 7-11 Store. We understand that NDOT would not allow a storm sewer in Rancho Drive.



Hefner Design at the Rancho/Craig Intersection

FIGURE 1

Since the flows in the undeveloped area were originally west to east, it is believed most of the flow would have been conveyed across Rancho Drive prior to construction. It is believed a similar portion of the 100-year flow (Q100) should be conveyed across Rancho Drive with a underground piping system into the Gowan Outfall at Decatur Boulevard. The proposed design will convey the 10-year flow (Q10) across Rancho Drive.

This would relieve the flooding problems south of Craig Road at the two intersections of (1) Rancho Drive and Alexander Road and (2) Jones Boulevard and Rancho Drive. Both of these intersections will need significant future RTC funds for flood control improvements to alleviate flooding if the Craig Road Project does not convey a portion of the flow east.

Previous studies in the project area include the following:

- August 1988 G.C. Wallace Inc., Gowan Detention Basin Predesign Report.
- December 1988 G.C. Wallace Inc., Decatur Boulevard Street Improvement Project Design Report.
- 1989 G.C. Wallace Inc., Drainage Study for U.S.95 Interchanges Between Smoke Ranch and Lone Mountain.
- May 1990 VTN-Nevada, Design Report for Gowan Detention Basin Outfall Structure.
- November 1990 Hefner Engineering, Design Report for Craig Road Between Decatur and U.S. 95.

The November 1990 Hefner Engineering Report used information presented in the above studies to design the storm sewer system for Craig Road from U.S.95 to Decatur Boulevard. The RTC criteria allows for funding drainage improvements for the 10-year flow with a 12-foot dry lane in each direction and 6-inch depth (curb height) at major intersections.

OBJECTIVES

This study will prepare hydrology and hydraulic calculations for design whcih convey the 10-year flow in Craig easterly across Rancho Drive. A hydrologic analysis for the 10 and 100-year frequency events for existing and future conditions will be prepared. The hydraulic characteristics through culverts along U.S.95 and Rancho Drive were modified to reflect lower backwater elevations for a 10-year frequency. The results of this analysis will be compared to the Hefner Engineering Design Report.

HYDROLOGIC ANALYSIS

This section presents the criteria, methodology and results of the hydrologic analysis of the study. The hydrologic analysis was divided into two alternatives: (1) Existing Conditions and (2) Future Conditions With the Gowan North Channel In-place. The drainage areas west of U.S. 95 are shown of Figure 2 and east of U.S.95 on Figure 3.

The basis for the HEC-1 Model was the G.C. Wallace Decatur Drainage Study with the following changes:

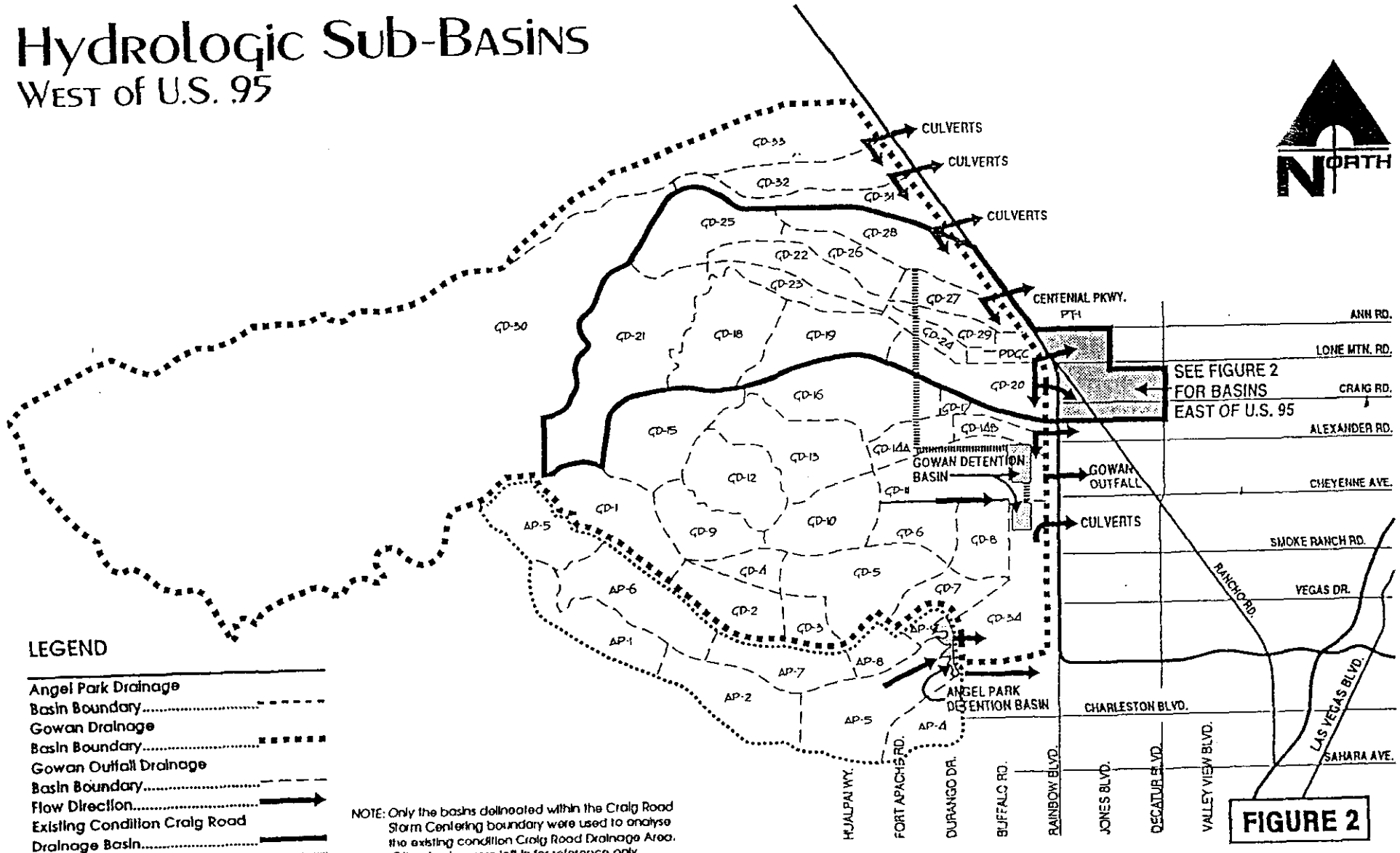
- Culvert analysis modified to allow for the lower backwater elevations.
- The storm centering was modified for the smaller drainage areas and is dicsussed below.
- Future value CN values were modified to allow for greater percentage of drought tolerant landscaping.

Existing Conditions

Both the 10 and 100 year 6-hour storms were analyzed for the Existing Condition Alternative. This alternative assumed the Q10 portion of the Q100 was conveyed east across Rancho Drive. This assumption would allow for the reduction in flooding problems at (1) Alexander Road and Rancho Drive and (2) Jones Boulevard and Rancho Drive. The remainder of the Q100 flow would be directed across Craig Road and south along Rancho Drive through two 3'x7' RCB's similar to the design originally proposed by the Hefner Design. Hydraulic calculations are contained in Appendix D.

The VTN Gowan Outfall Report provided a more refined storm centering analysis to the terminus of this project at Craig Road and Decatur Boulevard and this was incorporated into the HEC-1 Model. The VTN Gowan Outfall Report evaluated several storm centering alternatives for the Gowan Outfall. Storm Centering 3 for a 66 square mile area (see Figure 2 for storm centering delineation) yielded the highest Q100 stormwater runoff at the Craig Road and Decatur Boulevard intersection of 1020 cfs. This same storm centering using a DARF of 0.67 was used for the existing condition analysis. For future conditions with the Gowan Outfall the DARF was reduced to 0.765.

Hydrologic Sub-Basins
West of U.S. 95



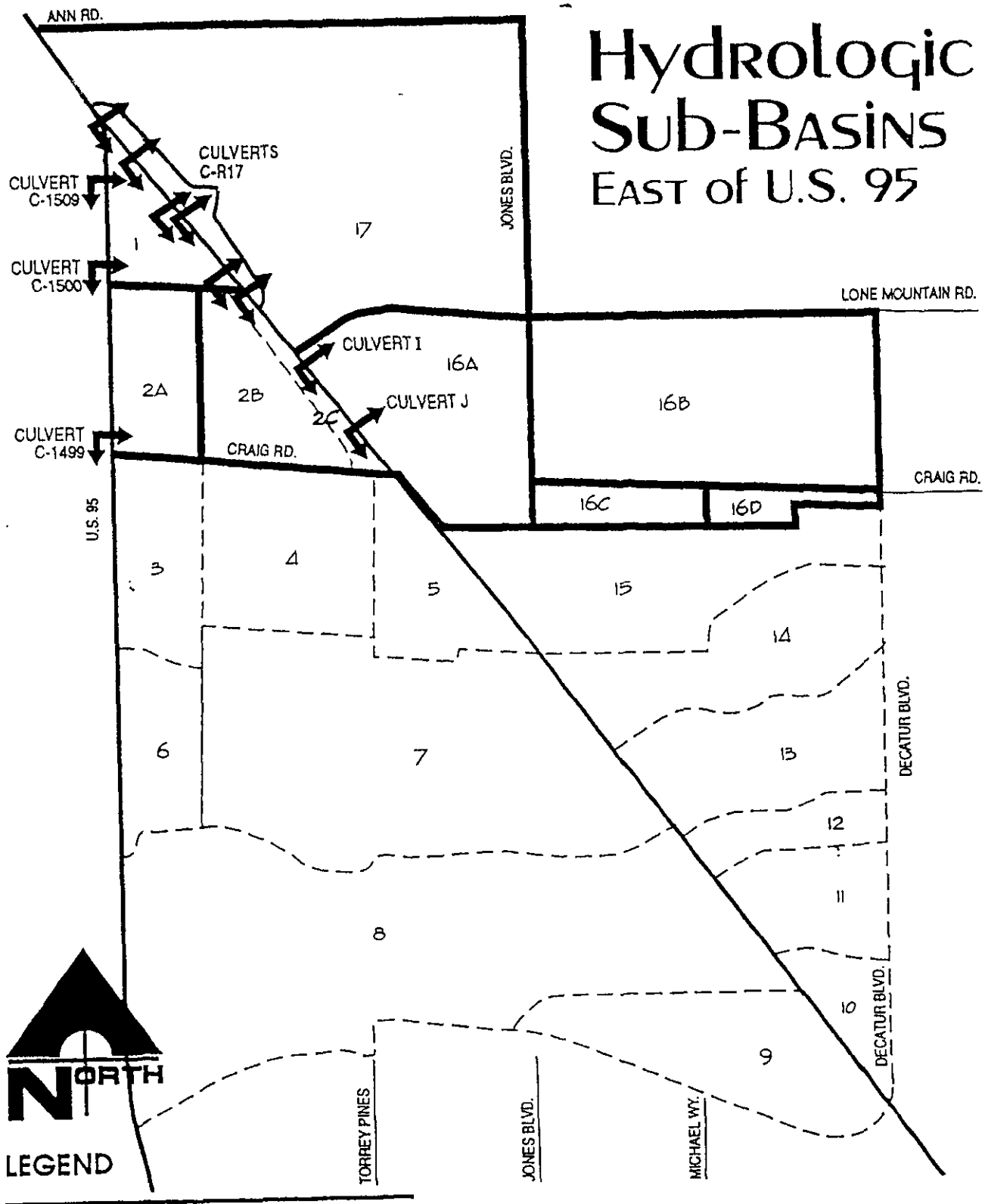
LEGEND

- Angel Park Drainage Basin Boundary
- Gowan Drainage Basin Boundary
- Gowan Outfall Drainage Basin Boundary
- Flow Direction
- Existing Condition Craig Road Drainage Basin
- Gowan North Channel

NOTE: Only the basins delineated within the Craig Road Storm Centering boundary were used to analyse the existing condition Craig Road Drainage Area. Other basins were left in for reference only.

FIGURE 2

Hydrologic Sub-Basins East of U.S. 95



LEGEND

Gowan Outfall Drainage Basin Boundary.....

Flow Direction.....

Craig Road Drainage Basin.....

*NOTE: Basins 1, 2A, 2B, 2C, 16A, 16B, 16C, 16D and 17 were deliniated in the Decatur Boulevard Street Improvement Drainage Study and were the only basins used in the Craig Road Drainage Study.

FIGURE 3

The storm drain system for the Existing Condition Alternative was analyzed taking the Q10 flow of 223 cfs across Rancho Drive and conveying the Q100 cross flow from Rancho Drive across Craig Road and south along Rancho Drive as shown on Figure 4. It is necessary to convey the Q100 Rancho Drive cross flow of 359 cfs because the adjacent property to the 7-11 Store is in a FEMA A zone and the Craig Road project is raising the street grade approximately 2-feet. Thus, a backwater condition on the property would be caused on the FEMA A zone property if not properly conveyed.

The Q100 flow of 359 cfs is collected behind the 7-11 Store. The Q10 portion of 140 cfs will be directed into the Craig Road 10-year storm drainage system. The remaining 219 cfs (359 cfs minus 140 cfs) not collected in the Q10 system will be conveyed in a concrete lined channel into 2-3'x7' concrete boxes that extend across Craig Road into the drainageway along the west side of Rancho Drive. This is similar to the Hefner Design. However, since a 54-inch pipe extends across Craig Road, one less 3'x7' box will be required. Hydraulic calculations for the two 3'x7' culverts are contained in Appendix D.

A flow split north of Craig Road at Lone Mountain and Jones Boulevard occurs and diverts a Q10 of 120 cfs and Q100 of 240 cfs into the Craig Road system. This diversion area was part of the VTN design for the Gowan Outfall Project and must be intercepted.

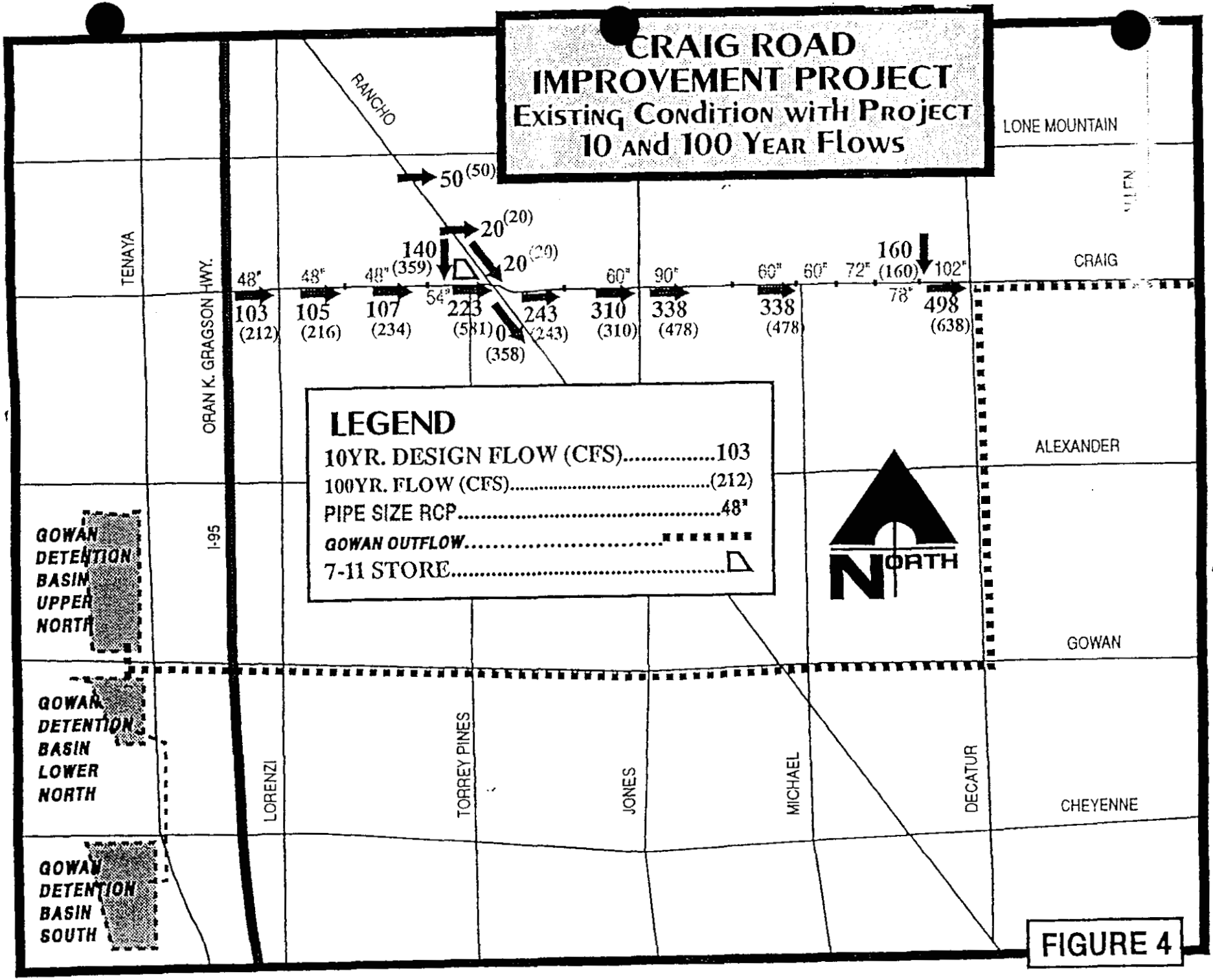
Approximately 800 LF west of Decatur Boulevard, the Rancho Alta Mira Development has a 66-inch storm sewer that discharges approximately 160 cfs into the Craig Road storm sewer system. This is a reduced Q100 peak flow following detention in Rancho Alta Mira. This flow was added directly to the peak flow in Craig Road for both the 10 and 100-year frequency analyses.

Future Conditions With Gowan North Channel

The design flows with the Gowan North Channel are shown on Figure 6. This Regional Flood Control Facility is not on the City of Las Vegas 10-Year Plan and it is not known when it will be scheduled for construction. The HEC-1 Model was modified to allow for the reduction in area from 66 square miles to 26 square miles. The DARF was increased from 0.67 to 0.765.

Hydrologic Analysis Summary

A summary of the results of the flow analyses and pipe sizes is presented on Table 1 and is graphically shown on Figures 4 and 5 along with the Hefner Engineering design information on Figure 6 for comparison.


CRAIG ROAD
IMPROVEMENT PROJECT
EXISTING CONDITION WITH PROJECT
10 AND 100 YEAR FLOWS
RANCHO
LONE MOUNTAIN
CRAIG
ALEXANDER
GOWAN
CHEYENNE
TENAYA
ORAN K. GRAGSON HWY.
I-95
LORENZI
TORREY PINES
JONES
MICHAEL
DECATUR
50 (50)
20 (20)
140 (359)
20 (20)
160 (160)
48"
48"
48"
54"
60"
90"
60"
60"
72"
78"
102"
103 (212)
105 (216)
107 (234)
223 (581)
0 (358)
243 (243)
310 (310)
338 (478)
338 (478)
498 (638)
LEGEND
10YR. DESIGN FLOW (CFS).....103
100YR. FLOW (CFS).....(212)
PIPE SIZE RCP.....48"
GOWAN OUTFLOW.....
7-11 STORE.....
NORTH
GOWAN DETENTION BASIN UPPER NORTH
GOWAN DETENTION BASIN LOWER NORTH
GOWAN DETENTION BASIN SOUTH
FIGURE 4

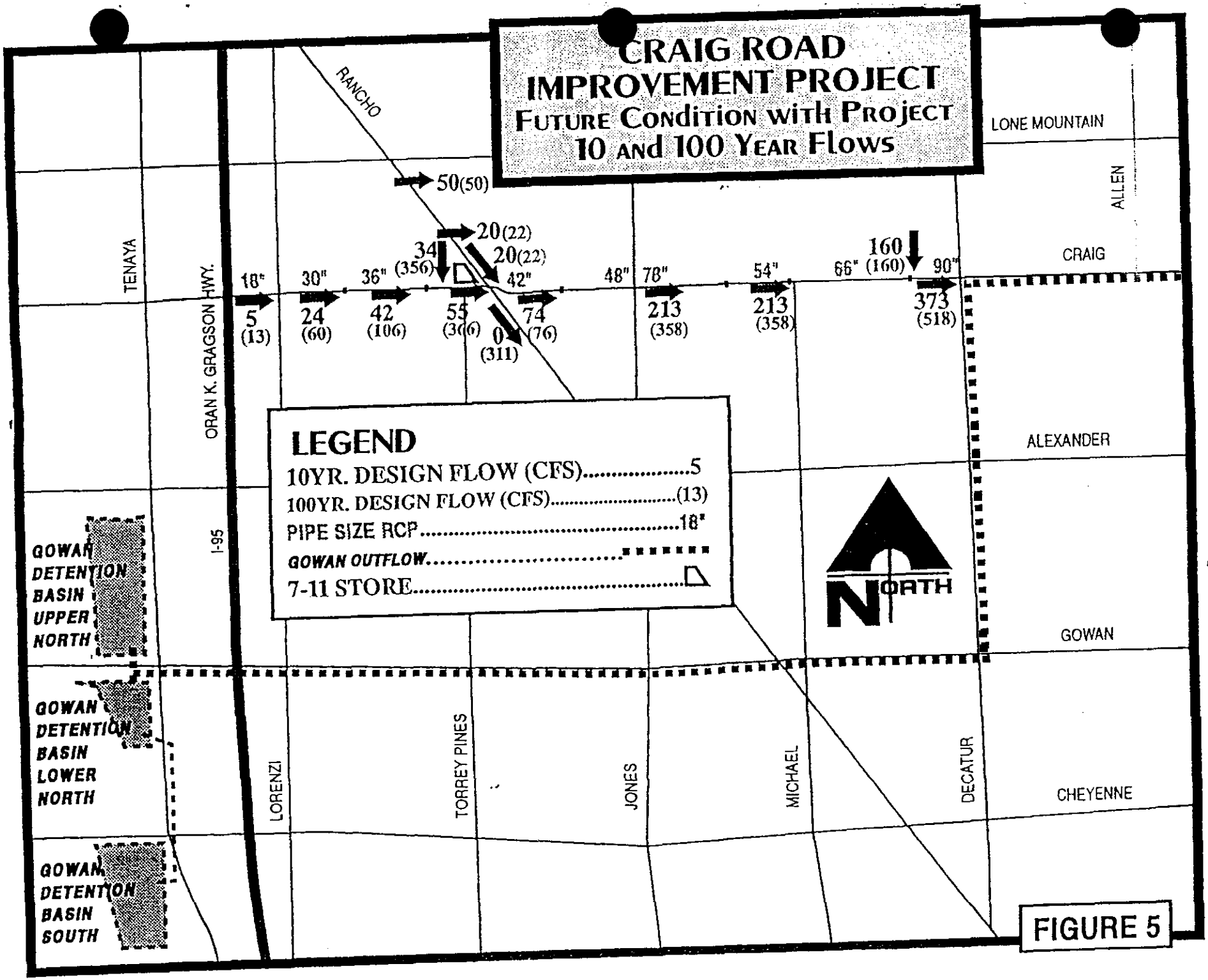
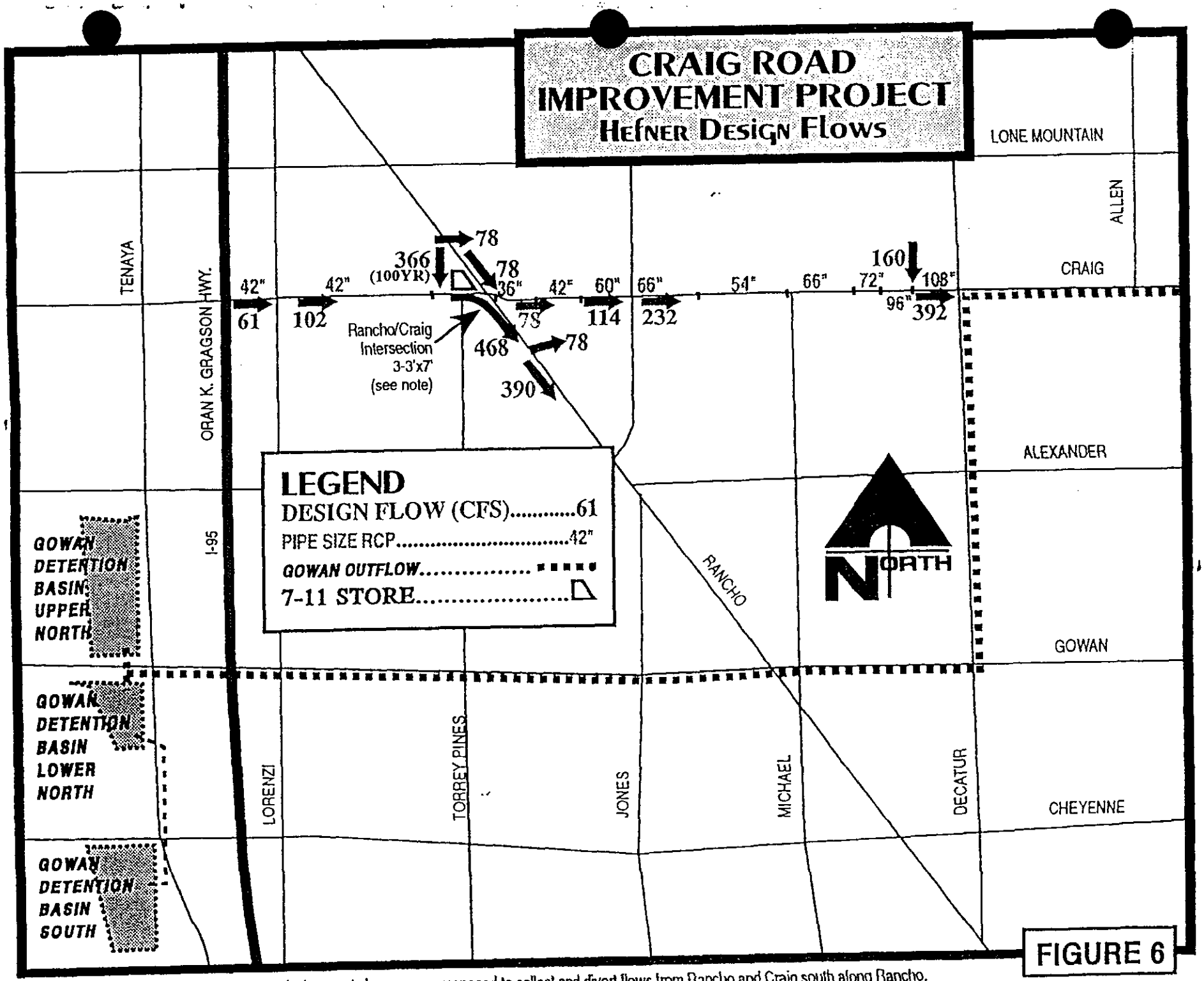

CRAIG ROAD
IMPROVEMENT PROJECT
FUTURE CONDITION WITH PROJECT
10 AND 100 YEAR FLOWS
RANCHO
LONE MOUNTAIN
ALLEN
CRAIG
ALEXANDER
GOWAN
CHEYENNE
TENAYA
ORAN K. GRAGSON HWY.
I-95
LORENZI
TORREY PINES
JONES
MICHAEL
DECATUR
50(50)
20(22)
20(22)
34
(356)
160
(160)
18"
30"
36"
42"
48"
78"
54"
66"
90"
5
(13)
24
(60)
42
(106)
55
(306)
0
(311)
74
(76)
213
(358)
213
(358)
373
(518)
LEGEND
10YR. DESIGN FLOW (CFS).....5
100YR. DESIGN FLOW (CFS).....(13)
PIPE SIZE RCP.....18"
GOWAN OUTFLOW.....
7-11 STORE.....
NORTH
GOWAN DETENTION BASIN UPPER NORTH
GOWAN DETENTION BASIN LOWER NORTH
GOWAN DETENTION BASIN SOUTH

FIGURE 5



NOTE: At the Rancho/Craig intersection, 3-7'x3' concrete boxes were proposed to collect and divert flows from Rancho and Craig south along Rancho.

TABLE 1
STORMWATER FLOW SUMMARY

LOCATION	Existing 10-yr (cfs)	Existing 100-yr (cfs)	Future 10-yr (cfs)	Future 100-yr (cfs)	Hefner Design (cfs)
Craig and US 95	103	212	5	13	61
Craig and Torrey Pines	140	359	34	356	366
Craig and Rancho	223	581	55	366	468
Craig and Jones	338	478	213	358	232
Craig and Rancho Alta Mira	498	638	373	518	392
Craig and Decatur	498	638	373	518	392

Following this hydrologic analysis it is believed weaknesses in the Hefner Engineering design existed in the following areas:

- Allowing only 78 cfs to cross Rancho Drive in a pipe during a 100-year event. The historical flow path was predominately west to east in Craig Road.

- The input for the diversions across Rancho Drive north of Craig Road were taken from the Decatur Drainage Study for a 100-year event. For a 10-year event the backwater conditions in the culverts would be significantly lower. With lower backwater conditions, less stormwater would be passed through the culverts and more stormwater would be conveyed south on the west side of Rancho Drive to the intersection of Craig Road and Rancho Drive.

- The Hefner Engineering report assumed the Gowan North Channel was in place. Since this project is not on the CLV 10-Year Regional Flood Control Plan, it is believed the stormwater system should be designed as though it was not in place. Also, the Hefner Design Report used the 50-year frequency flow crossing U.S. 95 rather than a 10-year frequency.

- A flow diversion occurs at Lone Mountain and Jones Boulevard that presently diverts a Q10 of 120 cfs and Q100 of 240 cfs into the Craig Road system.

COST SUMMARY

Pipe sizes were determined based on normal depth calculations using Manning's Equation and are presented in Table 2. A cost comparison was prepared using the Q10 flow for the existing and future condition alternatives and comparing the relative pipe conveyance cost differences to the Hefner Design. This cost estimate is not a detailed construction cost estimate since it does not include the inlet and lateral collection system costs. The inlet and lateral system cost differences were considered significant to the cost of the storm sewer system.

These costs provide a relative idea as to the cost-effectiveness of the alternatives. The Cost Summary of the Existing Condition 10-Year Design, Hefner Design and Future Conditions with the Gowan North Channel is shown on Table 3. The Existing Condition 10-Year Design Alternative is approximately $144,100 or 5.5 percent more expensive than the original Hefner Design. This represents about 2.4 percent of the total cost for the Craig Road project estimated at $6,000,000. The Future Condition Alternative is about $410,000 or 16 percent less than the Hefner Design.

TABLE 2
Craig Road Stormwater
Normal Depth Pipe Analysis

Pipe Segment	Station	Flow (cfs)	Slope (%)	Pipe Size (in) *
	166+39 (Decatur Blvd.)	485	0.37 %	
1				102
	114+72	485	0.25 %	
2				102
	106+71	325	0.42 %	
3				78
	97+65 (Lake Tahoe)	325	0.58 %	
4				72
	88+30	325	0.63 %	
5				72
	84+00	325	1.60 %	
6				60
	79+41	325	1.92 %	
7				60
	70+97	325	0.41 %	
8				78
	67+00	325	0.57 %	
9				78
	61+57 (Jones Blvd.)	297	1.79 %	
10				60
	55+46	230	2.75 %	
11				54
	50+83	230	1.91 %	
12				54
	47+23	230	1.67 %	
13				54
	43+63 (Rancho Road)	210	2.26 %	
14				54 **
	38+75	210	0.56 %	
15				54 **
	38+32 (Torrey Pines)	94	0.56 %	
16				54 **
	32+84.38	94	0.68 %	
17				48
	29+01.30	94	0.56 %	
18				48
	25+18.22	92	0.56 %	
19				48
	13+00 (Rainbow Blvd.)	90	0.56 %	
20				48
	06+65 (U.S. 95)	90	1.23 %	
21				48

* – Pipes sized based on normal depth calculations
Manning's equation (n=0.013)
** – or equivalent low head pipe

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TABLE 4
Craig Road Stormwater
Recommended Pipe Sizes

Pipe Segment	Station	Flow (cfs)	Slope (%)	Pipe Size (in) *
	166+39 (Decatur Blvd.)	485		
1	Existing Pipe		0.37 %	84
	114+72	485		
2			0.50 %	84
	107+67	325		
3			0.37%	72
	97+65 (Lake Tahoe)	325		
4			0.35%	72
	92+98	325		
5			0.75%	66 **
	84+00	325		
6			1.86 %	60
	70+97	325		
7			0.41 %	60
	67+00	325		
8			0.57 %	60
	61+57 (Jones Blvd.)	297		
9			1.79 %	60
	55+46	230		
10			3.19%	60
	50+83	230		
11			0.87%	60
	47+23	230		
12			0.87%	60
	43+63 (Rancho Road)	210		
13			0.56 %	60
	38+75 (Torrey Pines)	210		
14			0.55 %	48
	20+18	92		
15			0.55 %	42
	13+00 (Rainbow Blvd.)	90		
16			0.55 %	42
	06+65 (U.S. 95)	90		
17				42

* – Pipes sized based on normal depth calculations
Manning's equation (n=0.013)
** – or equivalent low head pipe

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Construction Plans for
Craig Road

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Included in this section:

Construction plans for *Craig Road*, November, 1991, prepared by Hefner Engineering.

CULVERT INLET SECTION

OPEN CHANNEL SECTION

CRAIG ROAD

RANCHO DRIVE SOUTH

TORREY PINE

CRA STA 36+15.00

CRA STA 45+20.00

CONSTRUCT 4' WIDE FLOOR GRATE MEGHAN # R-4877-4 (or equal)

HEAVY RIPRAP

STA 1+00 CRA STA 38+41.87 65' RT. 91.00 FL

RELOCATE EXIST 16" WATERLINE TO 6'-0" FROM BACK OF CURB SEE SHEET C3.4.2 FOR ADDITIONAL CONST. NOTES

SEE DETAIL 4 SHEET C7.2

INSTALL 16" 90° BEND AND CONC THRUST BLOCK PER LVVWD STDS

EXISTING 30" WATER LINE

54" RCP STORM DRAIN

EXIST. ISLAND

REFER TO SHEETS C1.4 & C1.5 FOR INFORMATION THIS AREA

INSTALL 16" 45° BEND AND CONC THRUST BLOCK PER LVVWD STANDARDS FOR LOCATIONS

STA 2+43.44 CRA STA 39+38.87 40.6' RT. 88.92 FL/GB

STA 4+48.40 CRA STA 41+43.83 40.6' RT. 87.84 FL

STORM DRAIN MANHOLE # 109A

STA 44+50, 48' RT STORM DRAIN MH # 109B

24" RCP OUT INV. 2285.81

24" RCP STORM DRAIN 87 LF @ 1.50% - TYP.

STA 5+06 RAH STA 50+35.6 83.38' RT., END BOX 87.55 FL

BOX CULVERT OUTLET SECTION SEE SHT. C7.1 DETAIL # 1

GABIONS SEE SHEET C7.2 - DETAIL # 3

JUNCTION BOX SEE SHEET C7.2 - DETAIL # 2

EXIST. HEADWALL INV. FL. 87.40

NOTE (A)

ANY WATERLINE THAT DOES NOT HAVE AN 18" CLEARANCE ABOVE ANY SANITARY OR STORM SEWER, THE SEWER LINES MUST BE ENCASED WITH 4" OF CONCRETE 10' EACH SIDE OF THE WATERLINES. EXISTING WATERLINES WHICH ARE DIRECTLY IN LINE WITH ANY PROPOSED SEWER LINES MUST BE RELOCATED. THE UTILIZING ALL BENDS AND THRUST BLOCKS. ANY SAN = STORM DRAIN. A WATERLINE SHALL BE ABOVE.

NOTE (B)

WINGWALL TO BE CONSTRUCTED WITH A LEVEL TOP-OF-WALL ELEVATION. CONTRACTOR TO CONNECT WINGWALL TO EXISTING BLOCK WALL.

NOTE (C)

REFER TO SHEETS C3.4 & C3.5 FOR ADDITIONAL STORM DRAINAGE INFORMATION

NORTH 1" = 30' PLAN

NOTE: EXACT LOCATION & EXISTING UTILITY AND ITS VARIATION SHALL BE FIELD VERIFIED BY CONTRACTOR TO PIPE HOLE AND VERIFY HORIZONTAL AND VERTICAL UTILITY LOCATIONS BEFORE CONSTRUCTION.

CONCRETE BARRIER WITH TYPE 'A' STD. CURB & GUTTER

NEW AC PAVEMENT

MEDIAN

TRIM AC PAVEMENT

HEAVY RIPRAP 91.00 FL

143.44 LF S= -1.49%

259.56 LF S=0.50%

87.84 FL

87.55 FL

48" RCP INV. 2286.08

EXISTING WATER LINE

PROFILE ALIGNMENT & GRADES BASED ON CENTERLINE STAGGERING BETWEEN THE 2 - 3' X 7' BOX CULVERTS

HORIZONTAL 1" = 30' VERTICAL 1" = 5'

CONSTRUCTION NOTES

1. INSTALL 3'x 7' PRECAST BOX CULVERT AS PER DETAIL ON SHEET C7.1.
2. RELOCATE EXISTING UTILITY LINES WHICH CONFLICT WITH NEW BOX CULVERT.
3. CONTRACTOR TO CLEAN AND CLEAR ALL DEBRIS IN EXISTING BOX CULVERT.
4. LIMIT OF CONSTRUCTION.
5. CONSTRUCT TYPE 1 HEADWALL AS PER NDOT STD. SHEET NO. 8-20.1.5 (502).

NOTE

FOR HEADWALLS WITH NDOT'S LESS THAN ANY SHOWN IN THE NDOT STD. TABLES, USE THE NDOT GREATER SIZE HEADWALL CONCRETE AND REINFORCEMENT. MAKE NECESSARY CHANGES IN BAR LENGTHS AND QUANTITIES.

REVISIONS PREFORMED TO EXISTING DRAWINGS BY THE CITY OF LAS VEGAS ENGINEERING DIVISION
ORIGINAL HEFNER ENGINEERING DESIGN DRAWINGS ON FILE AT THE CITY OF LAS VEGAS

REVISIONS ONLY

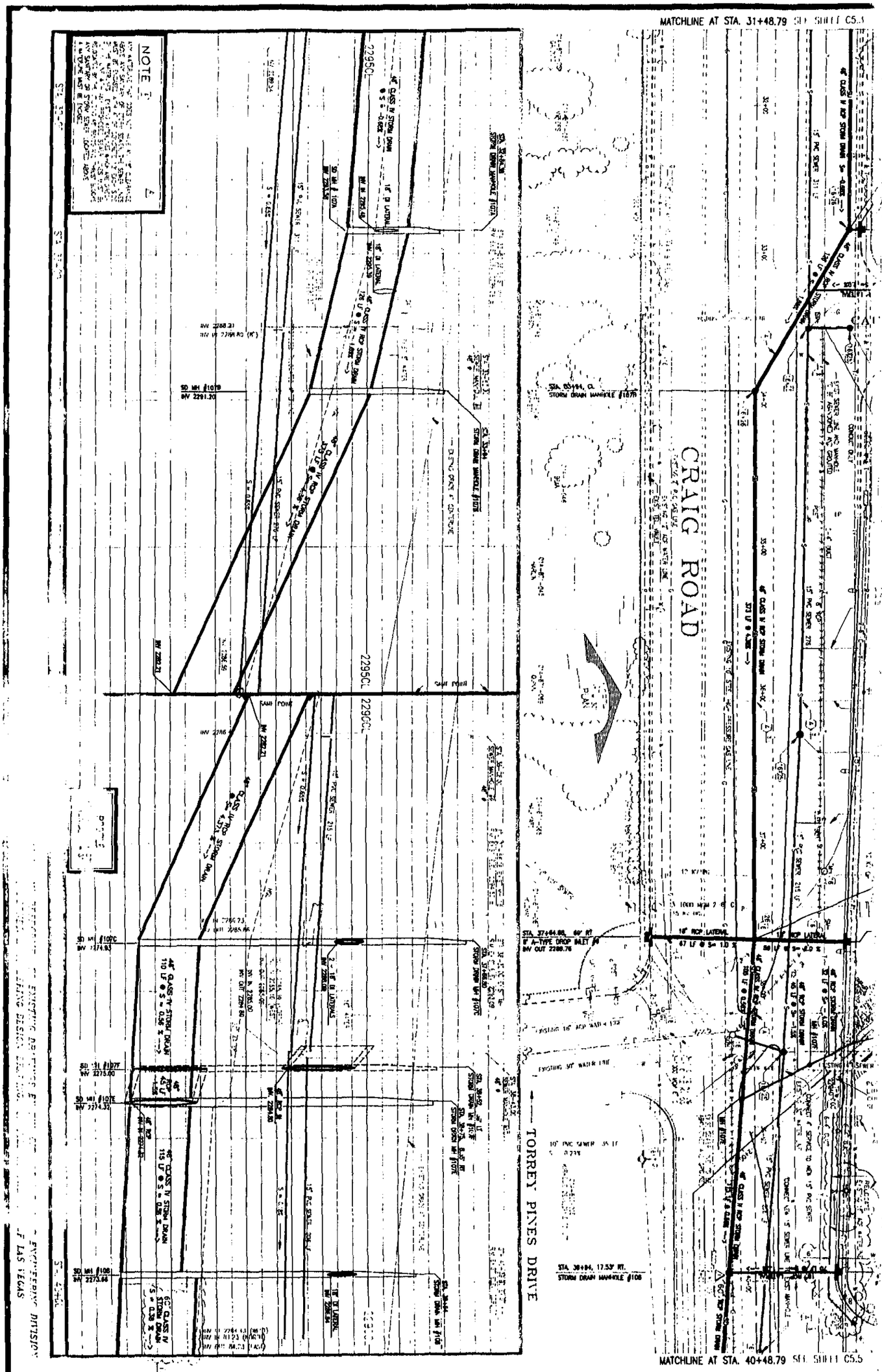
DATE	REVISION
9/92	CITY OF LAS VEGAS ENGINEERING DESIGN. DRAINAGE DESIGN REVISED ALONG WITH VARIOUS OTHER MINOR REVISIONS

HEFNER ENGINEERING
CIVIL ENGINEERING DESIGN
LAND PLANNING & DEVELOPMENT
4121 South Pecos Avenue Las Vegas, Nevada 89121
Phone (702) 795-1920

CRAIG ROAD
UTILITY PLAN AND PROFILE
STATION 31+48.79 TO STATION 40+48.79

SHEET NO.
C6.BX

SHT. 53/63



CRAIG ROAD

UTILITY PLAN AND PROFILE

STATION 31+48.79 TO STATION 40+48.79

SHEET NO. C5.4.2

HEFNER ENGINEERING

CIVIL ENGINEERING DESIGN
LAND PLANNING & DEVELOPMENT
4441 South Pecos Avenue, Las Vegas, Nevada 89103
Phone (702) 798-1900

REVISIONS ONLY

DATE	
9/93	A
9/93	B
10 JUNE 1994	A

ENGINEERING DIVISION
OF LAS VEGAS

MATCHLINE AT STA. 40+48.79 SEE SHEET C5.4

MATCHLINE AT STA. 49+48.79 SEE SHEET C5.6

CRAIG ROAD

EXISTING 16" ACP WATERLINE

EXISTING 8" PVC SEWER

EXISTING 4" PE GAS LINE

EXISTING 10" STEEL HIGH PRESSURE GAS LINE

EXISTING 15" PVC SEWER

EXIST. 10" VCP SEWER TO BE REMOVED

EXISTING 10" STEEL GAS LINE

60" CLASS IV RCP STORM DRAIN
367 LF @ Sm = 0.56%

STA 44+50, 46' RT
STORM DRAIN MH # 1098A

60" RCP STORM DRAIN
84 LF @ Sm = 0.87%

24" RCP STORM DRAIN
91 LF @ Sm = 13.08

60" CLASS IV RCP STORM DRAIN
270 LF @ Sm = 0.87 %

60" CLASS IV RCP STORM DRAIN
383 LF @ Sm = 0.87 %

24" CLASS IV RCP LATERAL
136 LF @ 33.5 %

24" CLASS IV RCP LATERAL
96 LF @ -3.5 %

STA 47+23 – 46' RT
STORM DRAIN MANHOLE #110

SEE SHEET C6.5X FOR BOX CULVERT DESIGN IN THIS AREA

NORTH
1" = 10' PLAN

EXIST GRADE AT CENTERLINE

8" WATER INV. 2289.65

EXIST 16" ACP WATER LINE

SAWE POINT

4" CONDUIT

DI #10A
INV. 2281.18

24" CLASS IV RCP LATERAL
96 LF @ 3.5 %

60" RCP
84 LF
S = 0.87%

24" RCP DRAIN IN
INV. 2273.85

60" CLASS IV STORM DRAIN
270 LF @ Sm = 0.87 %

16" DI LATERAL
INV. 2271.95

24" DI LATERAL
INV. 2271.45

60" CLASS IV STORM DRAIN
383 LF @ Sm = 0.87 % -->

60" CLASS IV STORM DRAIN
367 LF @ Sm = 0.56 % -->

INV. 2271.27

INV. 36" IN
2273.59

NOTE ④

ANY WATERLINE THAT DOES NOT HAVE AN 18" CLEARANCE ABOVE ANY SANITARY OR STORM SEWER, THE SEWER LINES MUST BE ENCASED WITH 4" OF CONCRETE 10' EACH SIDE OF THE WATERLINES. EXISTING WATERLINES WHICH ARE DIRECTLY IN LINE WITH ANY PROPOSED SEWER LINES MUST BE RELOCATED BY THE UTILIZING AGENCY. BENDS AND THRUST BLOCKS ANY SANITARY OR STORM SEWER LOCATED ABOVE A WATERLINE MUST BE ENCASED

PROFILE
HORIZONTAL 1" = 30'
VERTICAL 1" = 3'

ENGINEERING DIVISION

REVISIONS ONLY

DATE 9/82 5/83 11/84

CRAIG ROAD
UTILITY PLAN AND PROFILE
STATION 40+48.79 TO STATION 49+48.79

SHEET NO.
C5.5.1

SHT. 44/66

MATCHLINE AT STA. 40+48.79 SEE SHEET C1.4

MATCHLINE AT STA. 49+48.79 SEE SHEET C1.6

RANCHO DRIVE

CRAIG ROAD

TONOPAH-CRAIG ROAD CO.

EXIST. NEVADA POWER BOX

EXIST 2' L-CURB
EXIST 6' SIDEWALK

CUT EXIST ISLAND BACK AS SHOWN

REFER TO SHEETS C2.2 & C6.8X FOR INFORMATION IN THIS AREA

REFER TO SHEETS C6.8X FOR INFO. IN THIS AREA

NORTH
PLAN

PROPOSED GRADE AT CENTERLINE
EXIST GRADE AT CENTERLINE
PROPOSED ISLAND GRADE AT CENTERLINE
PROPOSED AC GRADE AT CENTERLINE
EXIST GRADE AT NORTH FLOWLINE
EXIST GRADE AT SOUTH FLOWLINE
PROPOSED SOUTH TOP OF CURB
SAME POINT

2285CL 2285N 2285S
2280CL 2280N 2280S

BENCHMARK BASIS

HEPNER ENGINEERING
CIVIL ENGINEERING - DESIGN
LAND PLANNING & DEVELOPMENT
4441 South Pecos Avenue, Las Vegas, Nevada 89103
Phone (702) 361-1900

CRAIG ROAD
PLAN AND PROFILE
STATION 40+48.79 TO STATION 49+48.79

CARIBOU WAY

CRAIG ROAD

TORREY PINES DRIVE

MATCHLINE AT STA. 31+48.79 SEE SHEET C1.3

MATCHLINE AT STA. 40+48.79 SEE SHEET C1.5

NORTH
1" = 30'
PLAN

SLOPE TO MATCH EXISTING GRADE AT 4:1 MAXIMUM

EXIST 7' L-CURB
EXIST 6' SIDEWALK

EXIST ISLAND TO BE REMOVED

EXIST 6' SIDEWALK
EXIST 7' L-CURB

EXIST. TEL. VAULT

EXIST. NEVADA POWER BOX

CATV

POST

EXIST 6' SIDEWALK
EXIST 6' CURB

01A-841-028 FLEMING

01A-841-026 MAPES-ET

01A-871-050 MEYERS

01A-871-049 LOWE

01A-871-048 SAMPSON

01A-871-047 SAMPSON

01A-871-045 HARLIN

01A-871-069 QUINN

01A-871-068 HAYWARD

01A-871-067 WILEMAN

01A-872-045 BEAN

01A-830-007 SOUTHLAND CORP.

01A-830-005 ARNELE DEVELOPMENTS LTD

BIG WEST DEVELOPMENT

CRA STA 33+50.63
100.34 FG

CRA STA 50+08
TOR

CRA STA 37+27.80
94.40 AC

CRA STA 44+27.80
94.40 AC

CENTER OF 32' DRIVEWAY

CENTER OF 24' DRIVEWAY

CUL PLANTER BACK 3'

PROFILE

3.27 FG

EXIST GRADE AT CENTERLINE

S = 1.40%

S = 1.06%

PROPOSED ISLAND GRADE AT CENTERLINE

97.25 FG/GB

2295CL

2290CL

MATCH EXISTING

98.79 TC

PROPOSED NORTH TOP OF CURB

S = 0.36%

EXIST GRADE AT NORTH FLOWLINE

2295N

2290N

EXIST GRADE AT SOUTH FLOWLINE

S = 0.56%

S = 1.27%

S=1.68%

S=1.03%

PROPOSED AC GRADE AT CENTERLINE

93.81 AC

EXISTING GRADE AT CENTERLINE

S=2.71%

PROPOSED SOUTH TOP OF CURB

S = 0.42%

92.92 TC

STA 42+00

HEFNER ENGINEERING

CIVIL ENGINEERING - DESIGN
LAND DEVELOPMENT
4141 South Pecos Avenue, Las Vegas, Nevada 89103
Phone (702) 798-1800

CRAIG ROAD

PLAN AND PROFILE

STATION 31+48.79 TO STATION 40+48.79

Section 7
Las Vegas Valley FIS Hydrology Report by JMM, 1991

Las Vegas Valley FIS Hydrology Report

N:\930017\ADMIN\17-094RP.WP5

Included in this section:

Excerpts from *Las Vegas Valley FIS Hydrology Report*, by JMM, 1991

Serving the World's
Environmental Needs

3916 West Charleston Boulevard
Suite 10 Las Vegas
Nevada 89102

#1758.0113

JMM

October 4, 1991

Mr. Gale Fraser
Clark County Regional Flood Control District
301 E. Clark Avenue, Suite 301
Las Vegas, NV 89101

SUBJECT: Las Vegas Valley Flood Insurance Study Hydrology Report

Dear Gale:

Enclosed are three copies of the final Las Vegas Valley Flood Insurance Study Hydrology Report. This final report incorporates comments of the District, Clark County Department of Public Works, and the City of Henderson. To date, no comments have been received from the Cities of Las Vegas or North Las Vegas.

Our contract calls for delivery of 10 copies of the FIS Hydrology Report. These early copies have been provided now so you can forward two copies to FEMA in order to initiate their review process. In addition, we will be providing one hard copy of the Technical Appendix as well as computer files on disks. The remaining reports and the Technical Appendix will be submitted next week.

Please do not hesitate to contact me if you have any questions.

Very truly yours,

James M. Montgomery,
Consulting Engineers, Inc.

Chip Paulson

Chip Paulson
Project Engineer

Encls.

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CHAPTER 1
INTRODUCTION

CHAPTER 1

INTRODUCTION

STUDY PURPOSE

This report presents the results of a hydrologic analysis to determine peak discharges appropriate for use in Flood Insurance Studies (FIS) in Las Vegas Valley, Nevada. The hydrologic analysis was conducted by James M. Montgomery, Consulting Engineers, Inc. (JMM), under contract to Clark County Regional Flood Control District (CCRFCD), dated April 1990. Work was performed in conjunction with a Flood Control Master Plan Update for Las Vegas Valley. Peak discharges generated in this study will be used in future hydraulic analyses to update floodplain mapping for Las Vegas Valley.

Proposed FIS study reaches, as developed by CCRFCD and the local entities, are depicted in Figure 1-1. This figure also identifies concentration points at which FIS discharges will be required.

In conformance with guidelines for FIS hydrology, the analyses performed in this study are based on existing development conditions with existing flood control improvements. In specific cases, flood control improvements scheduled for construction in the near future (i.e., within the next two years) have been incorporated as "existing facilities".

Because of the large number of previous hydrologic studies throughout Las Vegas Valley, it was not the intent of this FIS hydrologic analysis to "reinvent the wheel". Rather, the philosophy was to determine the best available model of existing hydrologic conditions and to update it as necessary to conform to the criteria presented in the CCRFCD "Hydrologic Criteria and Drainage Design Manual" (1990). Further, it was the objective of the study to develop FIS discharges which agree as closely as possible with the "regulatory discharges" adopted by CCRFCD for planning and design purposes.

REPORT ORGANIZATION

This report has been assembled from preliminary draft reports prepared for each major watershed in Las Vegas Valley. Each chapter of the report represents a stand-alone summary of FIS hydrology for one of the following major watersheds:

Range Wash
Northern Las Vegas Wash
Gowan Area
Central Basin
Flamingo/Tropicana Wash
Duck Creek/Blue Diamond Wash
Pittman Wash
C-1 Channel
Lower Las Vegas Wash

The Introduction chapter presents background information pertaining to all of the study areas. Results and specific modeling assumptions for each study area are described in the associated

chapter. A separately bound Technical Appendix contains HEC-1 routing diagrams and [illegible] for 100-year flood simulations.

BASIC DATA AND ASSUMPTIONS

The key previous studies referenced in this work which affect the overall Las Vegas Valley study area are:

Hydrologic Documentation for Feasibility Study, Las Vegas Wash and Tributaries, U.S. Army Corps of Engineers, Los Angeles District, 1986
Clark County Flood Insurance Study (draft), JMM, 1985
Clark County Flood Control Master Plan, JMM, 1986
Special Flood Hazard Study, Las Vegas Wash and Tributaries, U.S. Army Corps of Engineers, Los Angeles District, 1988

The Master Plan utilized hydrologic modeling data from the FIS in drainage areas beyond the anticipated development boundary. The Corps of Engineers (COE) Special Flood Hazard Study, which was prepared as a supplement to the Feasibility Study for Las Vegas Wash and Tributaries, incorporated much of the Master Plan modeling information.

Existing land use information was based on digitized land use data provided by Clark County Comprehensive Planning (1986), supplemented by information obtained from an April 1990 aerial photograph. Thus land use conditions are considered accurate as of April 1990. Soils data were obtained from the SCS Soil Survey for Las Vegas Valley (1985). Subbasin boundaries were adopted from previous studies to the greatest extent possible; where necessary, additional subbasins were delineated based on 7.5 minute USGS maps, recent drainage studies, and aerial photos.

Modeling methods were selected to be consistent with the CCRFCD manual. Design storms were 6-hour events with depths as given in the manual. Storm distributions were SDN #3 (for areas under 10 square miles) and SDN #5 (for areas over 10 square miles), as developed by the COE. Point precipitation was reduced by depth-area reduction factors (DARF's) given in the CCRFCD Manual. Unique DARF's were computed for each concentration point of interest based on contributing drainage area or assumed upstream storm area. Hydrographs were computed from rainfall excess using the SCS unit hydrograph method, except in subbasins where kinematic runoff parameters were already available. The Muskingum routing method was used for channel routing except where improved channels were involved, in which case the kinematic method was used. Losses were computed using the SCS curve number (CN) method, based on standard CN tables provided in the CCRFCD manual.

HEC-1 models were executed using the 1988 version of the program. Although this program version is provisional and contains some "bugs" associated with use of the kinematic routing routine (although not in the kinematic algorithm itself), it was selected because it was the most recent version of the program being distributed and because it gives results which should agree better with the recently released 1990 HEC-1 version than would the 1985 version.

Because the new FIS modeling was based primarily on the COE existing conditions analysis, and because local entities generally accept the COE results, one of the objectives of the new analysis was to produce results consistent with the COE flows at common points of interest. The CCRFCD has adopted 100-year COE flows for Las Vegas Wash, Range Wash, Flamingo Wash, Tropicana Wash, Duck Creek, Blue Diamond Wash, Pittman Wash, and C-1 Channel

as official "regulatory discharges" (see Appendix A). Certain COE flows for Range Wash, [illegible]licana Wash, Blue Diamond Wash, Pittman Wash and C-1 Channel were identified as "interim discharges" due to concerns over their accuracy. It was hoped that conversion of the uniform loss rate method used by the COE to the curve number method recommended by CCRFCD, and other necessary model modifications, would produce results directly consistent with the COE discharges. At most model concentration points this was the case. At the remaining concentration points, model parameters (e.g., curve numbers and routing parameters) had to be adjusted within an acceptable range of values in order to better reproduce the COE flows. Thus, FIS flows were "calibrated" to the COE flows in order to assure reasonableness. Comparison within 10 percent was considered acceptable, although reasonable efforts were made to gain agreement to within 5 percent. It was felt that agreement of FIS flows at concentration points common to the COE study would allow discharges at non-COE concentration points to be computed which would be consistent with the COE flood frequency results. At the direction of CCRFCD, if modeled flows agree with regulatory discharges to within 10 percent, then the regulatory discharges will be adopted as FIS discharges.

The aggressive program of CCRFCD and each of the local agencies to design and construct major flood control facilities in Las Vegas Valley has lead to a "moving target" situation with regard to the definition of existing facilities. The proposed projects included in this FIS Hydrology study are based on information available in early 1991. When actual floodplain mapping is performed for FIS purposes, it will be important to assure that the assumed "existing conditions" in this hydrology study are correct; if not, the hydrology models will have to be revised accordingly.

In the remainder of this report, the terms "FIS Hydrology" and "FIS Model" refer to the flows and modeling developed for the present study, rather than to the 1985 draft Clark County Flood Insurance Study. Any differences in this terminology are clearly identified.

CHAPTER 3
NORTHERN LAS VEGAS WASH
FIS HYDROLOGY

CHAPTER 3

NORTHERN LAS VEGAS WASH FIS HYDROLOGY

INTRODUCTION

This chapter summarizes the existing conditions/facilities analysis of Northern Las Vegas Wash conducted for the new FIS Hydrology study for Las Vegas Valley. The purpose of the analysis was to develop acceptable discharges for use in future Flood Insurance Studies for Northern Las Vegas Wash. In addition, results could be used to assess the adequacy of existing facilities to handle existing flood discharges. "Northern Las Vegas Wash" is defined as the Las Vegas Wash watershed upstream of the Pecos/Lake Mead bridge. Major drainage features include the Main Branch of Las Vegas Wash (N Channel) and the Western Tributary to Las Vegas Wash (A Channel).

The bases of the hydrologic analysis were the HEC-1 models developed by Black and Veatch (B&V) for the "Flood Control Facilities Plan for the Northern Las Vegas Wash" for the City of North Las Vegas, August 1989. Previous hydrologic studies of the watershed also include the CCRFCD Master Plan; the Corps of Engineers' (COE) Special Flood Hazard Study; the "Hydrology Report - Methodologies and HEC-1 Model for Pre-Design of the Gowan Detention Basin" by G.C. Wallace, Inc., for the City of Las Vegas, August 1988; and the "Design Report for the Gowan Detention Basin Outfall Structure" by VTN for the City of North Las Vegas, May 1990. The HEC-1 data files from the B&V study were used as the primary source of basic subarea area, curve number, lag time, and kinematic runoff parameters for the Sheep Mountain and Spring Mountain Storm models. The VTN and Wallace models were used to supplement the B&V study with additional subareas and recommended drainage facilities. Chapter 4 describes the hydrologic analysis of the Gowan watershed.

JMM's modeling revisions have involved three separate areas. First, the B&V Spring Mountain Storm HEC-1 model was used as the basis for JMM's modeling of flows and calibration to the COE Special Flood Hazard Study flows at the A Channel Inlet. Second, the B&V Sheep Mountain Storm HEC-1 model was used as the basis of the analysis of the calibration flows at the upstream end of the Main Channel of Las Vegas Wash. Third, the B&V Lower Central Valley Storm was used to determine discharges associated with a storm occurring below existing and proposed detention basins.

In each case, the 10-, 50-, and 100-year existing conditions, existing facilities flows were modeled. 500-year discharges were determined through extrapolation. The major revisions to the B&V HEC-1 data files are described below. A subarea map is shown in Figure 3.1; this map was adapted from the B&V report. In addition, Northern Las Vegas Wash subareas are shown in Figure S-2 (Appendix B). Figure 3-2 shows the assumed areal coverage for the Sheep Mountain, Spring Mountain and Lower Central Valley storms.

For FIS purposes, three proposed flood control projects have been considered "existing facilities". These are the Upper Las Vegas Wash Detention Basin under design by Black & Veatch, modifications to the existing North Las Vegas Detention Basin proposed by B&V, and the West Range Wash Diversion Dike under design by Boyle. An initial set of model runs were made without these proposed facilities to allow for calibration to previous COE and B&V discharges. The proposed facilities were then introduced to the models to generate FIS flows.

MODIFICATIONS TO EXISTING CONDITIONS MODEL FROM BLACK & VEATCH

The following changes were made by JMM to the B&V existing conditions/existing facilities model.

1. Previous HEC-1 runs for the B&V analyses were made using the 1985 version of the program. FIS Hydrology runs were made using the 1988 version.

2. Kinematic routing computations in upland, natural channel reaches were changed to the Muskingum routing method (RM cards) to assure compatibility with the 1988 version of the HEC-1 program. In addition, this method is consistent with the District's Hydrology Manual. Routing computations for regularly-shaped, improved channels were left as kinematic wave method (RK cards). In cases where data files would not run using the 1988 version of the program due to conflicts with kinematic wave routing, routing steps were either subdivided, combined with adjacent routing steps, or replaced by Muskingum routing.

3. Where a diversion (DI and DQ cards) is immediately followed by a kinematic wave routing step, the 1988 version of the program often gives zero flow or translates the full flow without attenuation. There appears to be no predictable pattern as to when this will occur. To eliminate this problem, kinematic wave routing steps immediately downstream of a diversion were replaced by Muskingum routing.

4. Where the recall of a diversion (DR cards) was followed immediately with kinematic routing, the 1988 version of the program terminates with a "divide by zero" error. To eliminate this problem, dummy subbasins with near-zero (0.001 sq mi) areas were introduced at the diversion recall location so the program would continue to process through this step.

5. Depth-area reduction factors (DARF's) used by B&V were based on Hydro 40. These have been changed to the CCRFCD Manual DARF's and applied to B&V's precipitation depths. The revised DARF's for the three design storm models are lower than those used by B&V resulting in lower design precipitation depths.

Depth-Area Reduction Factors

	B&V	FIS
Spring Mountain Storm	0.62	0.51-0.56
Sheep Mountain Storm	0.62	0.54
Lower Central Valley Storm	0.62	0.53-0.66

6. For the Sheep Mountain and Spring Mountain Storm models, the DARF's appropriate for the total drainage/storm areas were modeled (169 and 200 sq mi, respectively). These storm centerings were selected because the B&V study determined that they produced critical flows for the respective branches of Las Vegas Wash. Additionally, for the Spring Mountain Storm models, a second run with a DARF for 136 sq mi was modeled for the West Tributary and Gowan area concentration points.

7. Curve numbers (CN) in the B&V modeling were accepted for the current modeling. The curve numbers used by B&V were consistently higher (by 1 unit) than those used by Wallace and VTN for the same subareas. Where subareas were taken from the Wallace

[illegible] studies, the curve numbers were adjusted to be consistent with the B&V modeling.

8. For the Sheep Mountain Storm and Lower Central Valley Storm models, the King Charles Channel and related facilities were included as existing drainage facilities. These were not in the B&V model. The Upper Las Vegas Wash Detention Basin was not included in the model for calibration runs.

9. For the Sheep Mountain Storm models, 250 hydrograph ordinates were used for the 10- and 100-year runs; 180 hydrograph ordinates were used for the 50-year run. The original B&V runs used 300 ordinates (the maximum number). The changes to the number of hydrograph ordinates were made to eliminate kinematic wave (RK) routing problems with the new (1988) version of HEC-1. The output was reviewed to ensure all of the peak flows were occurring within the specified modeling period.

10. Upper Las Vegas Wash Detention Basin was modeled for FIS production runs using storage-outflow data provided by B&V based on final design criteria. It is noted that the final selected site is lower in the watershed than the site recommended in the original B&V report; the final site is modeled in the FIS simulations.

11. West Range Wash Diversion Dike was considered as an existing facility. This facility will direct a portion of the Range Wash watershed into the North Las Vegas Detention Basin. Hydrologic evaluations of various storm centerings by B&V determined that storms centered over Range Wash or a combination of Range and Las Vegas Washes would not produce higher discharges in lower Las Vegas Wash than storms centered in Las Vegas Wash alone. Thus, this diversion facility was not modeled for the Las Vegas Wash FIS study.

12. B&V has proposed that the North Las Vegas Wash Detention Basin be modified by closing one of the five outlet pipes. This modification was included in the FIS production runs (but not the calibration runs) using storage-outflow data provided by B&V.

SUMMARY OF RESULTS

Table 3-1 presents a summary of the simulated 100-year discharges for existing land use conditions at key points in the Upper Las Vegas Wash watershed. These flows do not include effects of the proposed detention basin improvements. Where available, a comparison between the preliminary flows modeled by the FIS Hydrology and those modeled by B&V and the COE are presented. Notes on the table provide partial explanations for the differences between the flows generated in the different studies.

The objective of the modeling was to develop discharges consistent with the CCRFCD adopted regulatory discharges from the COE Special Flood Hazard Study. For Northern Las Vegas Wash, flows were adopted at the UPRR and downstream of Las Vegas Blvd (CP 6 and CP 7). Table 3-1 shows that for both of these locations, simulated 100-year flows agree to within 5 percent of the COE flows.

Conversion from the 1985 to the 1988 version of HEC-1 and from kinematic to Muskingum channel routing has unusually complex effects on the simulated discharges. A detailed evaluation of model comparisons using the Range Wash HEC-1 data file yielded the following key conclusions:

1. The 1988 Kinematic routing gives much less attenuation than the 1985 kinematic routing. The 1988 program results are more consistent with the kinematic routing theory, which suggests that hydrographs should be translated but only minimally attenuated by this procedure.

2. Muskingum routing generally results in less peak attenuation than kinematic routing in the 1985 program, and more peak attenuation than kinematic routing in the 1988 program. This is due to the differences in the kinematic methods, not in the Muskingum methods.

As a result of the above effects, it is possible for conversion from 1985 kinematic routing to 1988 Muskingum routing to produce higher discharges in some locations. This helps explain why the FIS Hydrology 100-year discharge is lower than the B&V discharge at node 125, but is higher than the B&V discharge at node WTRIBUS.

Based on the "calibrated" results shown in Table 3-1 for the 100-year flood, HEC-1 models were developed for the 10- and 50-year floods. These models utilize the same curve number and lag time parameters as the 100-year model. Results are summarized in Table 3-2 for existing conditions at the same key points as Table 3-1 in the Upper Las Vegas Wash watershed. It is seen that at both CP 6 and CP 7, the 10- and 50-year discharges do not compare as well with the COE computed probability flows as the 100-year discharges. This is due in part to the fact that the COE analysis utilized higher uniform loss rates for the more frequent events, whereas the District Manual allows for use of the same curve numbers for all of the storms analyzed for this study.

Table 3-2 presents discharges based on the COE regional discharge-frequency relationship developed for the Feasibility Study. This is the relationship used to calibrate the COE HEC-1 models, and was used by the COE in conjunction with the model results to select discharges for the study. It can be seen that in some cases, there are considerable differences between the regional values and the COE-adopted values, as well as between the regional values and the FIS Hydrology model results. Nonetheless, in general, there is good agreement between the model output and the COE regional frequency values. Of the 15 comparisons between the two approaches, six are within ten percent and 10 are within 20 percent. It is seen that the slope of the frequency curve for the COE regional frequency discharges is steeper than that for the model output; this was the justification for the COE to use higher loss rates for the more frequent floods in its hydrologic analysis.

The rationale used by the COE to determine recommended flows involved hydrologic judgement and experience, and is not documented specifically in the Hydrologic Documentation Report for every concentration point; thus it is not possible to apply this identical strategy to the FIS discharge analysis.

After the "calibration" modeling summarized in Tables 3-1 and 3-2 had been completed, CCRFCD agreed with a recommendation of the City of North Las Vegas that Upper Las Vegas Wash Detention Basin and North Las Vegas Wash Detention Basin improvements should be added to the "existing conditions" analysis. These modeling changes were made based on the assumptions discussed in the previous section. Results of the B&V hydrologic analysis for the Upper Las Vegas Wash Detention Basin Predesign indicated that peak discharges in N Channel are generated by the Spring Mountain Storm (routed through the two Las Vegas Wash detention basins). The same analysis showed that peak flows in A Channel are generated by the Lower Central Valley Storm which is centered downstream of the detention basins. Thus FIS flows were generated using these two storm centerings. It is noted that the Lower Central

Valley Storm covers a portion of the Gowan watershed. Chapter 4 describes the existing conditions assumptions for this area, which include consideration of the proposed Gowan Detention Basin. This differs from the B&V existing conditions assumptions in this area. Use of the Lower Central Valley Storm produces different (more critical) discharges than the upper storms in lower N Channel, lower A Channel, and Las Vegas Wash below the confluence of these two channels.

Table 3-3 presents results of the 10-, 50-, and 100-year FIS modeling and recommended FIS discharges for Northern Las Vegas Wash study reaches. Due to the major facility differences between this FIS modeling and the modeling used to produce the CCRFCD regulatory discharges, the new model results are recommended as adopted FIS discharges.

Discharges for the 500-year flood were determined graphically by extrapolating the discharges for the lower three storms. Flood frequency plots used to perform the extrapolations are shown in Figures 3-3 and 3-4.

The HEC-1 routing diagrams and 100-year input/output files are included in the Technical Appendix for reference.

TABLE 3-1

COMPARISON OF EXISTING CONDITION 100-YEAR DISCHARGES FOR NORTHERN LAS VEGAS WASH FIS HYDROLOGY

FIS Hydrology				B&V Facility Study				COE Computed Probability					
CP/Node	Area*	DARF	Flow	CP/Node	Area*	DARF	Flow	CP/Node	Area	DARF	Flow	Note	Description
Sheep Mtn Storm: Main Las Vegas Wash													
125	163.7	0.535	11730	125	163.7	0.62	14719	-	-	-	-	1	Upper Las Vegas Det. Basin site
101	168.7	0.535	11412	101	168.7	0.62	14895	-	-	-	-	1,6	*u/s of NLV Det. Basin Diversion*
DIVDIKE	168.7	0.535	2065	DIVDIKE	168.7	0.62	4574	-	-	-	-	2	Divert flow fr/NLV Det. Basin
DIVDIKE(.)	168.7	0.535	9347	DIVDIKE(.)	168.7	0.62	10321	-	-	-	-	3	Remaining flow into NLV Det. Basin
NLVDET	168.7	0.535	5167	NLVDET	168.7	0.62	5248	-	-	-	-	4	Outflow fr/NLV Det. Bas.
303	168.7	0.535	5414	303	168.7	0.62	5262	-	-	-	-	4	N Channel at UPRR
NCHANNL	168.7	0.535	5400	NCHANNL	168.7	0.62	5247	-	-	-	-	4	N Channel u/s of Confluence
Spring Mtn Storm: Western Tributary to Las Vegas Wash													
WTRIBUS	136.3	0.56	14628	WTRIBUS	136.3	0.62	13132	-	-	-	-	3	*u/s end of W. Tributary*
GOWANDIV	0	0.56	3064	GOWANDIV	0	0.62	4321	-	-	-	-	7	all flows diverted fr/Gowan Area
GOWANDIV(.)	136.3	0.56	17626	GOWANDIV(.)	136.3	0.62	17363	-	-	-	-	4	combine W.Trib+Gowan Diversions
SNIC	198.2	0.51	14919	SNIC	198.2	0.62	14227	6**	733	-	14500	4,5,6	at SNIC
ACHANNL	198.2	0.51	15681	ACHANNL	198.2	0.62	14982	7**	735	-	15000	4,5	A Channel
LKMEAD	198.2	0.51	15643	LKMEAD	198.2	0.62	14948	7**	735	-	15000	4,5	*Lake Mead Blvd.*

* = Area of storm; may be smaller than total drainage area ** = location of CCRFCD regulatory discharge from COE study

Notes:

General - FIS hydrology based on new (1988) HEC-1, conversion to Muskingum routing in upland areas, and CCRFCD DARF's
B&V hydrology based on 1985 HEC-1, kinematic routing in all locations, and Hydro 40 DARF's
Simulations do not include Upper Las Vegas Wash Detention Basin and Interception Berm

1. FIS Q lower than B&V Q due to lower DARF and kinematic-to-Muskingum routing conversions
2. High flow difference due to diversion statement sensitive to inflow (only diverts Q over 8200 cfs)
3. FIS and B&V flows agree within 10%
4. FIS and B&V flows agree within 5%
5. FIS Q calibrates to COE flow within 5%; adopt CCRFCD regulatory flow
6. FIS Q lower than u/s node because storm centering has no rain over subareas low in watershed
7. Large flow difference due to rating curves for Rancho Rd culverts which are sensitive to inflow

TABLE 3-2

CALIBRATED NORTHERN LAS VEGAS WASH FIS DISCHARGES

Node	Area (sq mi)	10-Year Peak Discharge COE Reg Q	COE SFHS Q	Model Output	Calibrated Flow	50-Year Peak Discharge COE Reg Q	COE SFHS Q	Model Output	Calibrated Flow	100-Year Peak Discharge COE Reg Q	COE SFHS Q	Model Output	Calibrated Flow	500-Year Peak Discharge COE SFHS Q	Model Extrap	Calibrated Flow
Sheep Mtn Storm:																
125	163.7	2627	-	2858	2900	8803	-	9214	9200	13489	-	11730	11700	-	26000	26000
101	168.7	2832	-	2761	2800	9322	-	8964	9000	14195	-	11412	11400	-	25000	25000
DIVDIKE	168.7	-	-	0	0	-	-	444	400	-	-	2065	2100	-	11000	11000
DIVDIKE(.)	168.7	-	-	2761	2800	-	-	8521	8500	-	-	9347	9300	-	14000	14000
NLVDET	168.7	-	-	1651	1700	-	-	3915	3900	-	-	5167	5200	-	9400	9400
303	168.7	-	-	1637	1600	-	-	3901	3900	-	-	5414	5400	-	11000	11000
NCHANNL	168.7	-	-	1636	1600	-	-	3900	3900	-	-	5400	5400	-	11000	11000
Spring Mtn Storm:																
WTRIBUS	136.3	2341	-	3429	3400	7984	-	10229	10200	12312	-	14628	14600	-	30500	30500
GOWANDIV	0	-	-	694	700	-	-	2060	2100	-	-	3064	3100	-	7000	7000
GOWANDIV(.)	136.3	-	-	4043	4000	-	-	12256	12300	-	-	17626	17600	-	38000	38000
SNIC	198.2	2472	1900	3207	3200	8355	8500	10317	10300	12814	14500	14919	14500	39000	40000	39000
ACHANNL	198.2	3054	2000	3312	3300	9699	8600	10887	10900	14586	15000	15681	15000	40000	42000	40000
LKMEAD	198.2	3821*	2000	3305	3300	11712*	8600	10856	10900	17392*	15000	15643	15000	40000	42000	40000

Node	Location
125	Upper Las Vegas Detention Basin site
101	u/s of NLV Detention Basin Diversion
DIVDIKE	Divert flow fr/NLV Detention Basin
DIVDIKE(.)	Remaining flow into NLV Detention Basin
NLVDET	Outflow fr/NLV Detention Basin
303	N Channel at UPRR
NCHANNL	N Channel u/s of confluence with A Channel
LVWASH	d/s end of Gowan Area
WTRIBUS	u/s end of Western Tributary
GOWANDIV	all flows diverted fr/Gowan Area
GOWANDIV(.)	combine Western Tributary + Gowan Diversions
SNIC	at SNIC
ACHANNL	A Channel
LKMEAD	Lake Mead Blvd.

COE Reg Q = Corps of Engineers Regional Discharge-Frequency Relationship
COE SFHS Q = Corps of Engineers Special Flood Hazard Study
Model Output = FIS HEC-1 Model Output
Adopted Flow = Adopted Flow for FIS Purposes
Model Extrap = Extrapolation of Q10, Q50, and Q100 Flows from HEC-1 Model Output

Area = Area of storm coverage only; not necessarily the total drainage area
* = Does not account for regulation by NLV Detention Basin
= FIS concentration point

Note: Calibration simulations do not include Upper Las Vegas Wash Detention Basin

TABLE 3-3

PROPOSED NORTHERN LAS VEGAS WASH FIS DISCHARGES

Node	Storm	Area (sq mi)	DARF	10-Yr Peak Discharge (cfs) Model Output	10-Yr Peak Discharge (cfs) Adopted Flow	50-Yr Peak Discharge (cfs) Model Output	50-Yr Peak Discharge (cfs) Adopted Flow	100-Yr Peak Discharge (cfs) Model Output	100-Yr Peak Discharge (cfs) Adopted Flow	500-Yr Peak Discha (cfs) Model Extrap	500-Yr Peak Discha (cfs) Adopt Flow
RRBRIDGE	Spring Mountain	136.3	0.56	1444	1440	2598	2600	3052	3050	4626	[illegible]
NC5	Spring Mountain	136.3	0.56	288	288	520	520	618	618	940	
304	Lower Central Valley	64.5	0.66	1187	1190	2559	2560	3515	3520	6103	6
ACHANNL	Lower Central Valley	111.6	0.59	2159	2160	5122	5120	6734	6730	12447	12400
NCHANNL	Lower Central Valley	172.2	0.53	1668	2160	4372	5120	5850	6730	11595	12400

Node	Location
RRBRIDGE	Total flow at RR bridge (before diversion along RR to A Channel - equivalent to node 303)
NC5	Outflow from NLV Det. Basin routed through N Channel (below King Charles Channel diversion)
304	Route subbasin 301, Gowan Outfall, and diverted Gowan Area flow through subbasin 304 to Craig Rd
ACHANNL	*Upstream end of A Channel*
NCHANNL	*Intersection of N Channel and A Channel*

Notes:

Area =	Area of storm coverage only; not necessarily the total drainage area
Model Output =	FIS HEC-1 Model Output
Adopted Flow =	Adopted Flow for FIS Purposes
Model Extrap =	Extrapolation of Q10, Q50, and Q100 Flows from HEC-1 Model Output
Adopt Extrap =	Extrapolation of Adopted Flows for Q10, Q50, and Q100

FIS Hydrology includes Upper Las Vegas Wash Detention Basin and Interception Berm, Gowan Detention Basin and other Gowan Area facilities (see Chapter 4), and West Range Wash Diversion Dike

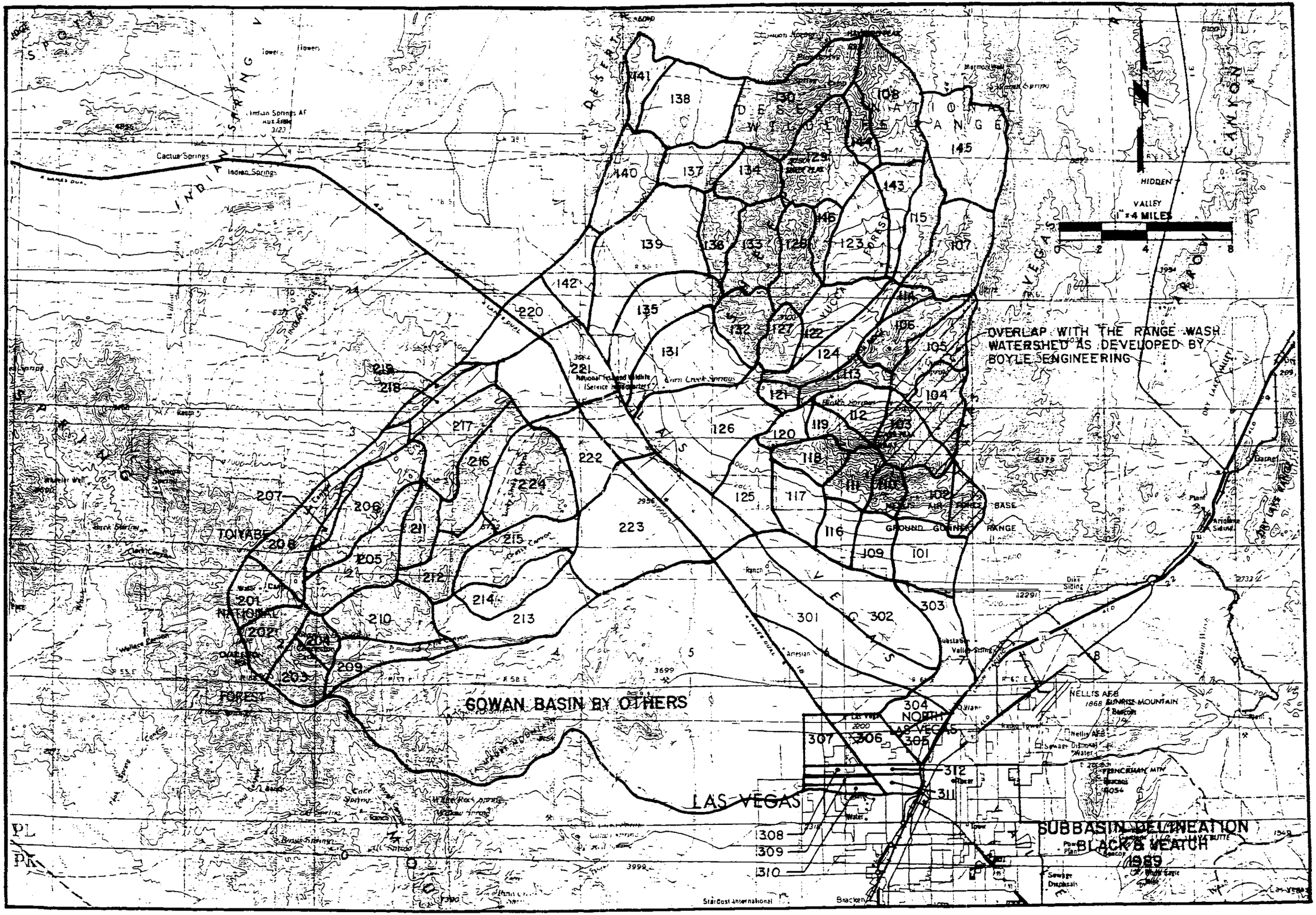

INDIAN SPRING
DESERT
CANYON
VEGAS
Indian Springs AF
Cactus Springs
Indian Springs
HIDDEN
VALLEY
1" = 4 MILES
OVERLAP WITH THE RANGE WASH WATERSHED AS DEVELOPED BY BOYLE ENGINEERING
TOIYABE
NATIONAL
FOREST
GOWAN BASIN BY OTHERS
LAS VEGAS
NORTH LAS VEGAS
NELLIS AFB
BASE
RANGE
SUBBASIN DELINEATION
BLACK & VEATCH
1989

FIGURE 3-1

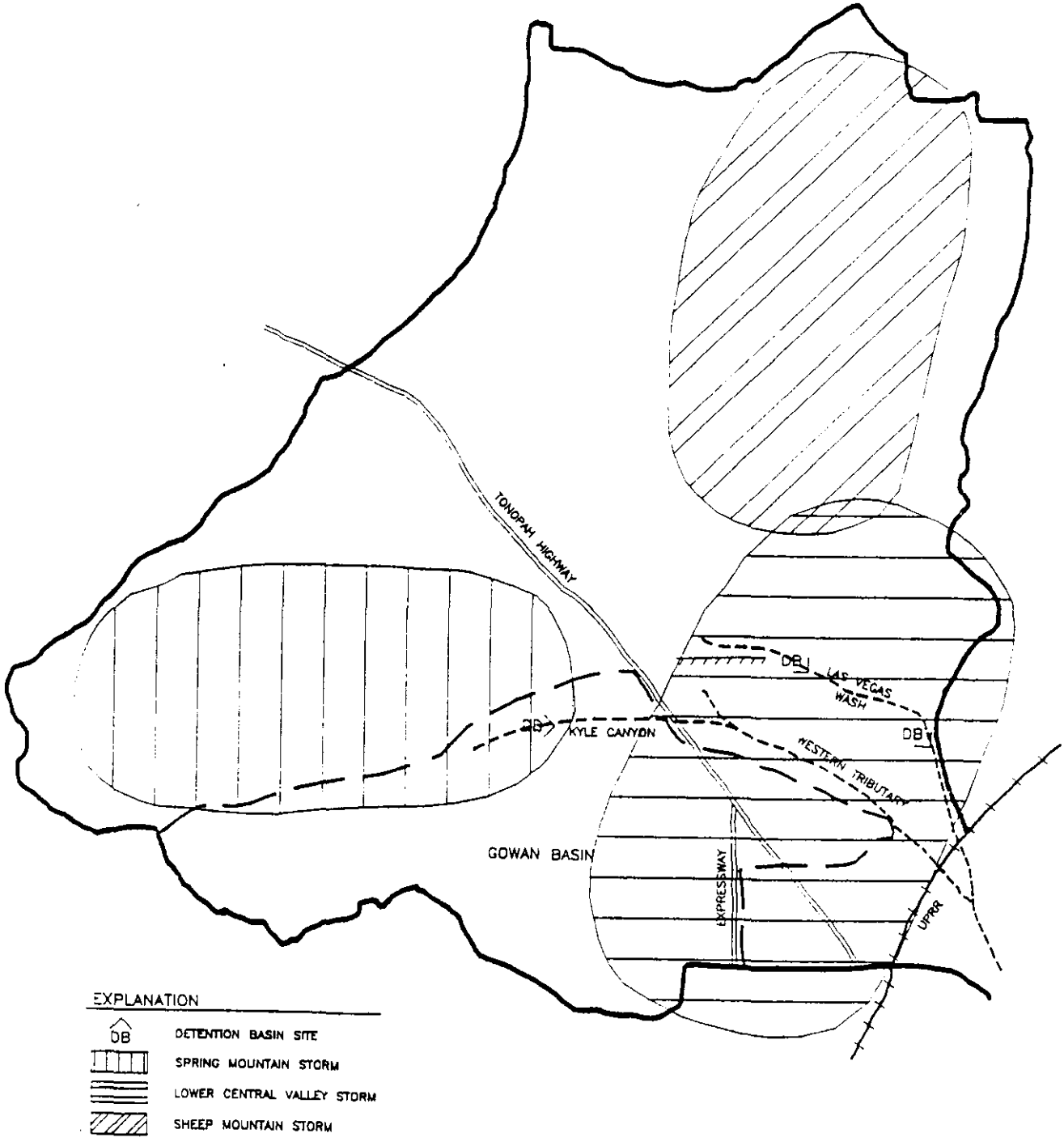


FIGURE 3-2

CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE

NORTHERN LAS VEGAS WASH STORM CENTERINGS

FIGURE 3-3
NORTHERN LAS VEGAS WASH FIS DISCHARGES
(PLOT #1)

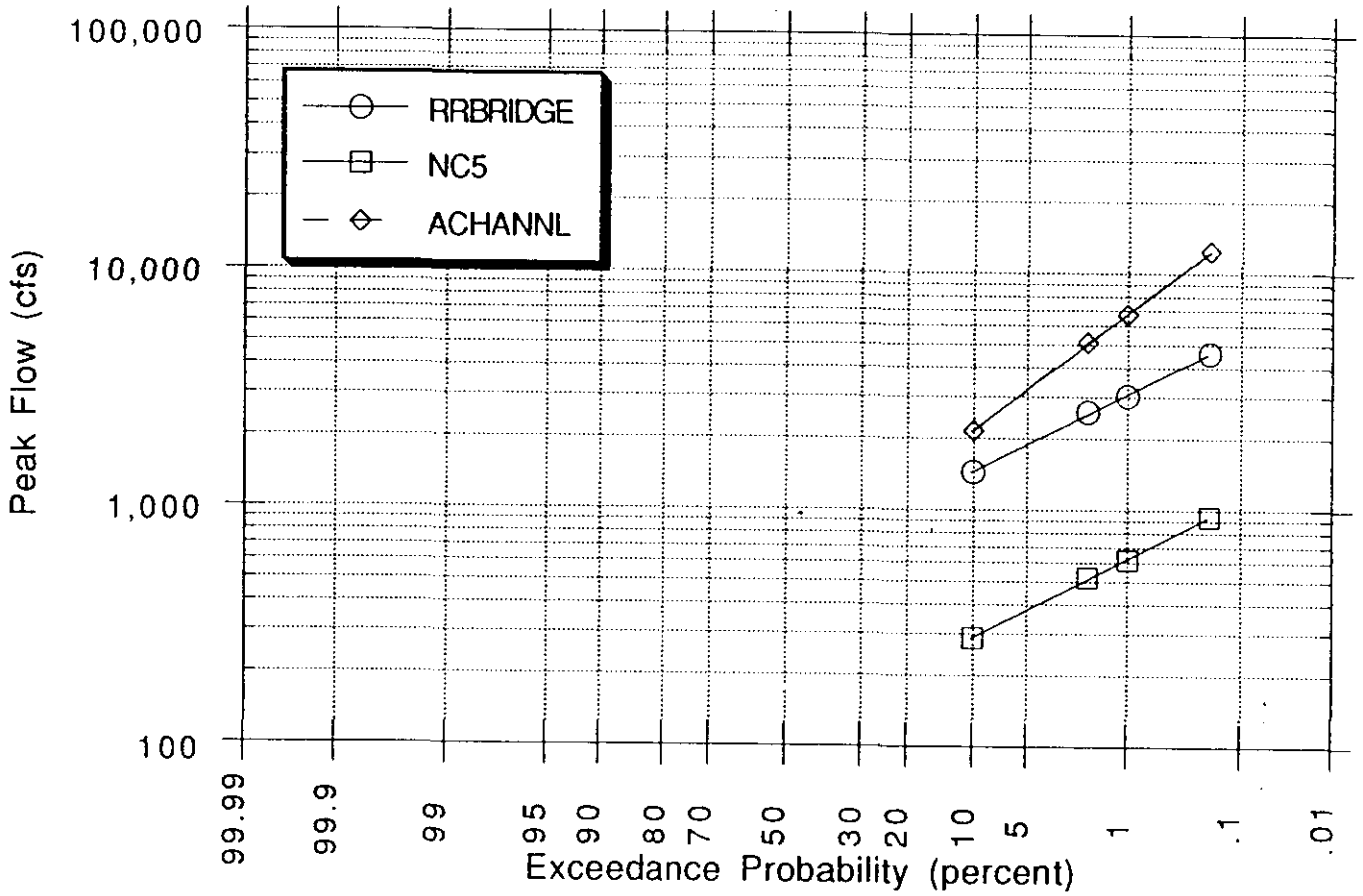
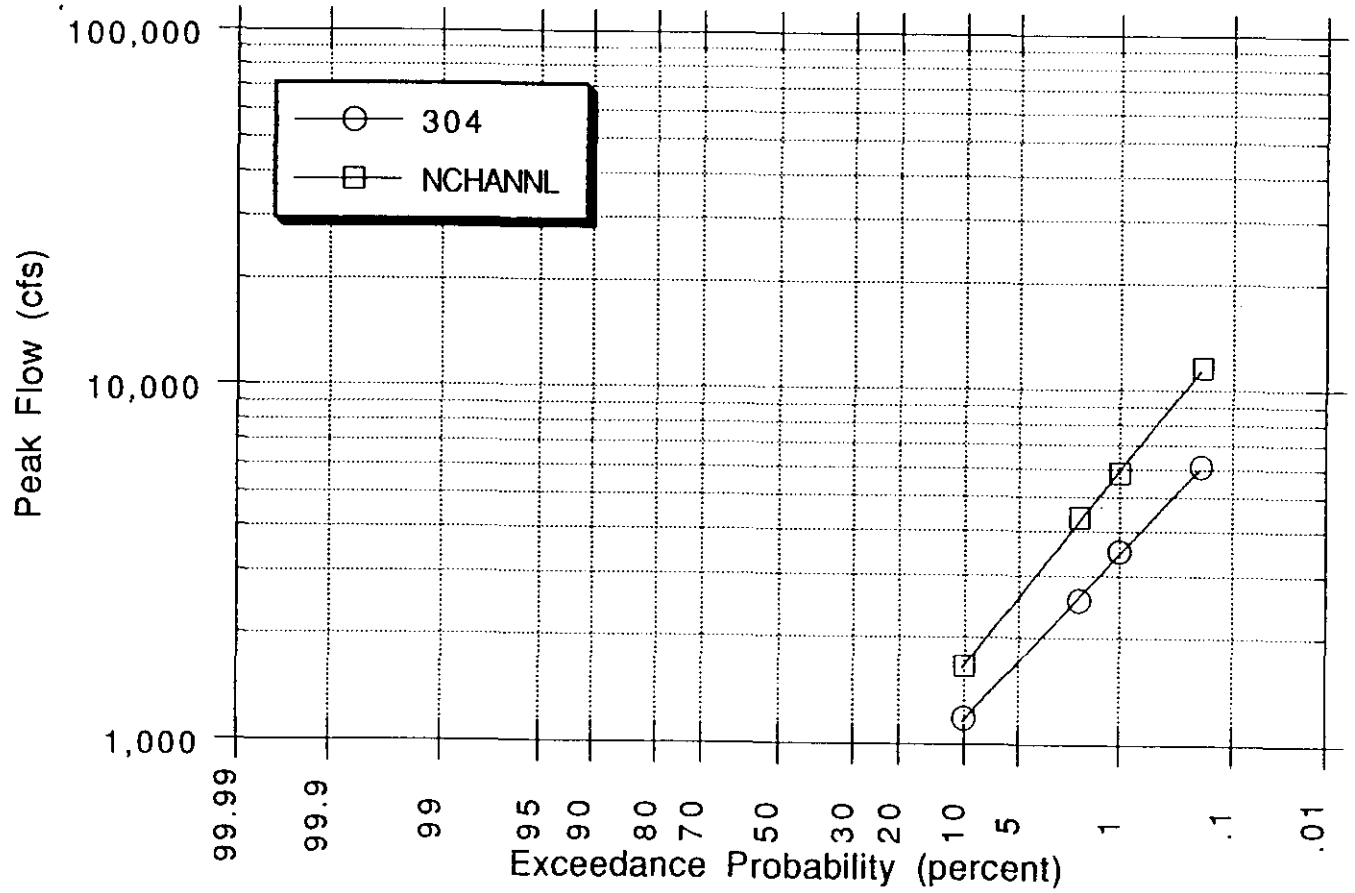


FIGURE 3-4
NORTHERN LAS VEGAS WASH FIS DISCHARGES
(PLOT #2)



CHAPTER 4
GOWAN AREA FIS HYDROLOGY

CHAPTER 4

GOWAN AREA FIS HYDROLOGY

INTRODUCTION

This chapter summarizes the existing conditions/facilities analysis of the Gowan Area conducted for the new FIS Hydrology study for Las Vegas Valley. The purpose of the analysis was to develop acceptable discharges for use in future Flood Insurance Studies for the Gowan Area. In addition, results could be used to assess the adequacy of existing facilities to handle existing conditions flood discharges.

For the purposes of this report, the Gowan Area is defined as the watershed generally limited by the Angel Park Detention Basin tributary area on the south; the Kyle Canyon drainage area on the north; and Tonopah Highway and the Gowan Outfall tributary area on the east.

The bases of the hydrologic analysis were the HEC-1 models developed by Black and Veatch (B&V) for the "Flood Control Facilities Plan for the Northern Las Vegas Wash" for the City of North Las Vegas, August 1989. Previous hydrologic studies of the watershed also include the CCRFCD Master Plan; the Corps of Engineers' (COE) Special Flood Hazard Study; the "Hydrology Report - Methodologies and HEC-1 Model for Pre-Design of the Gowan Detention Basin" by G.C. Wallace, Inc., for the City of Las Vegas, August 1988; the "Gowan Detention Basin Pre-Design" by G.C. Wallace, Inc., for the City of Las Vegas, March 1989; the "Design Report for the Gowan Detention Basin Outfall Structure" by VTN for the City of North Las Vegas, May 1990; and the "Summerlin Stormwater Management Plan - Hydrology Report of Existing Conditions" by Boyle Engineering Corporation (Boyle), July 1990. The HEC-1 data files for the Lower Central Valley Storm from the B&V study were used as the primary source of basic subarea area, curve number, lag time, and kinematic routing parameters. The VTN, Wallace, and Boyle models were used to supplement the B&V study with additional subareas, curve numbers, and recommended drainage facilities.

The previous chapter describes the hydrologic analysis of Northern Las Vegas Wash, to which the Gowan Area is tributary.

For the Gowan Area, the 10-, 50-, and 100-year existing conditions, existing facilities flows were modeled. 500-year discharges were determined through extrapolation. The major revisions to the B&V data files are described below. The subarea delineations are the same as depicted in the Wallace report. These are shown in Figure S-2 (Appendix B).

REVIEW OF PAST STUDIES

The relationships among these past studies are complex, in that they borrowed extensively from each other and yet all were developed to analyze a different set of conditions. The basic assumptions and objectives of each of the recent predesign studies are briefly summarized below.

Gowan Detention Basin Predesign/Wallace - This was the first post-Master Plan detailed hydrology study in the Gowan Area. Subarea boundaries did not follow those used in the Master Plan. Two conditions were modeled - existing land use/existing facilities and ultimate land use/ultimate facilities. Problems with certain model parameters (e.g., subarea

precipitation, and recommended alternatives were corrected in the March 1989 update to the original report. Facility recommendations included an enlarged Angel Park Detention Basin, Gowan-North and Gowan-South Detention Basins, and Angel Park Outfall and Buffalo Channel connecting the Angel Park and Gowan Detention Basins, the Gowan Outfall Channel, and a series of detention basins and channels in the upper Gowan area watershed.

Upper Las Vegas Wash Facility Study/B&V - B&V included the Gowan Area in the hydrologic analysis of Upper Las Vegas Wash, but was only interested in results at Las Vegas Wash itself. B&V utilized the Wallace subareas, with small modifications, for the area west of Highway 95. B&V increased the Wallace curve numbers by 1.0 unit, and further adjusted curve numbers and lag times for certain key subareas in order to "calibrate" the model to the 1975 storm. Precipitation depths agreed with the 1989 Wallace study. Flow divisions at culverts in Highway 95 and Rancho Rd agreed with the Wallace study for Highway 95 north of Rancho Rd, but were revised for the culverts below the intersection of these two roadways. The B&V model shows more flow crossing Highway 95 rather than being routed south into the Gowan Detention Basin area under existing conditions. B&V modeled existing land use/existing facilities and ultimate land use/ultimate facilities. The proposed improvements in the Gowan Area were taken from the Wallace study recommendations. The B&V model yields similar results to the Wallace model, except in the area downstream of the Highway 95 and Rancho Rd culverts.

Gowan Outfall Structure Design/VTN - This study used the basic Wallace subareas in the area upstream of the Gowan Detention Basins, and developed a much more detailed subarea system in the drainage area tributary to the Gowan Outfall Channel itself. VTN made changes to the Wallace model in the lower Gowan Area (i.e., east of Highway 95) to include the effects of new developments. In addition, VTN further revised the flow splits at the Highway 95 and Rancho Rd culverts; in general the VTN model limits flow across these roadways to the culvert capacities (i.e., no flow over the roadway is assumed). The Gowan Outfall Structure study analyzed only ultimate land use with proposed improvements. In the upper Gowan Area this included the proposed diversions, channels and detention basins recommended in the Wallace study. Because the VTN project only considered ultimate conditions, it is not pertinent to the FIS hydrologic analysis.

Summerlin Stormwater Management Plan/Boyle - This study covered the Summerlin development area only, which includes the Angel Park Detention Basin drainage area and the southwestern portion of the Gowan-South Detention Basin drainage area. The hydrologic model terminated at the eastern edge of the proposed development, which is west of Highway 95. The Boyle study used a much more detailed subarea definition than past studies (e.g., it subdivides the Angel Park drainage area into 30 subbasins compared to the 12 subbasins used by Wallace), and subarea comparison with past studies is not straightforward. Boyle investigated soil types in the area, and as a result revised curve numbers compared to past modeling studies. Further, Boyle computed subarea lag times for large subbasins using the USBR lag formula rather than the upland method, and generally selected shorter lag times for the alluvial fan subareas and slightly longer lag times for the mountain subareas. Results of the Boyle existing conditions modeling are about 15% higher than results from previous studies. It is noted that the Summerlin report was received by JMM after initial model development had been completed in the Gowan Area.

Based on review of the above reports, it was concluded that the B&V modeling was the most appropriate starting point for development of an existing conditions model for FIS hydrology which would meet the guidelines of the CCRFCD Hydrology Manual.

MODIFICATIONS TO EXISTING CONDITIONS MODEL FROM BLACK & VEATCH

The following changes were made by JMM to the B&V existing conditions/existing facilities HEC-1 model.

1. Previous HEC-1 runs for the B&V analyses were made using the 1985 version of the program. FIS Hydrology runs were made using the 1988 version.

2. Kinematic routing computations in upland, natural channel reaches were changed to the Muskingum routing method (RM cards) to assure compatibility with the 1988 version of the HEC-1 program. In addition, this method is consistent with the District's Hydrology Manual. Routing computations for regularly-shaped, improved channels were left as kinematic wave method (RK cards). In cases where data files would not run using the 1988 version of the program due to conflicts with kinematic wave routing, routing steps were either subdivided, combined with adjacent routing steps, or replaced by Muskingum routing, or the total simulation period was shortened.

3. Where a diversion (DI and DQ cards) is immediately followed by a kinematic wave routing step, the 1988 version of the program often gives zero flow or translates the full flow without attenuation. There appears to be no predictable pattern as to when this will occur. To eliminate this problem, all kinematic wave routing steps immediately downstream of a diversion were replaced by Muskingum routing.

4. Depth-area reduction factors (DARF's) used by B&V were based on Hydro 40. These have been changed to the CCRFCD Manual DARF's and applied to B&V's point precipitation depths. The revised DARF's for concentration points of interest in the Lower Central Valley Storm model vary from 0.554 to 0.909 (depending on specific storm centering), compared to the single overall value of 0.62 used by B&V.

5. Separate storm centerings were simulated using appropriate DARF's for each control point where FIS flows are required. A total of seven different DARF's were modeled based largely on the storm centerings which VTN reported to have produced the largest peak discharges at the control points, and supplemented with storm centerings representing the total tributary area at the point of interest. The storm sizes ranged from 4.2 sq mi for the small upland alluvial fan areas to 158 sq mi for the control point at the Gowan Area outfall at Las Vegas Wash. Averaged DARF's were used for similar sized storms in order to keep the required simulations to a manageable number. For each storm centering, precipitation was modeled only for those subareas within the storm area.

6. In general, curve numbers (CN) in the B&V modeling were accepted for the current modeling. The curve numbers used by B&V were consistently higher (by 1 unit) than those used by Wallace and VTN for the same subareas. Where subareas were taken from the Wallace or VTN studies, the curve numbers were adjusted to be consistent with the B&V modeling.

   CN's in the area covered by Boyle's Summerlin analysis were revised based on the detailed hydrologic soils analysis from the Boyle study. New CN's were determined for the B&V/Wallace subareas based on the Boyle soils data and have been incorporated into the HEC-1 modeling. The revised CN's are generally slightly lower than those used by B&V.

7. For the Gowan Area model, there are several drainage improvements for which construction is either complete or will be complete by the time the FIS flows are used. These include the Gowan-North and Gowan-South Detention Basins and the Outfall Channel to Las Vegas Wash; Cheyenne Channel into the Gowan-South Detention Basin from the west; Angel Park Detention Basin expansion and Outfall Channel; the Hualapai Diversion into the Angel Park Detention Basin; and Buffalo Channel connecting the Angel Park Outfall Channel and Gowan-South Detention Basin. Each of these improvements was considered to be an "existing facility" for the purposes of the FIS Hydrology modeling. Existing condition subarea boundaries were not revised in these areas (although proposed facilities would have minor impacts on existing drainage patterns), but were brought into the improved facilities at the nearest existing node.

   The input data (storage rating curves) for the Gowan-North and Gowan-South Detention Basins were taken from the VTN model (3900EX4.DAT). This model is more recent (January 1990) than the Wallace modeling (August 1988) which combined the Gowan-North and Gowan-South basins into a single rating curve; the VTN model also included "refined Gowan S. and N. Stage Storage Curves." It is noted that final design of the Gowan Detention Basins, currently underway by Poggemeyer Design Group, could modify this data. The input data for the Angel Park Detention Basin was taken from the recommended improvements model in the Wallace report. This remains the proposed final configuration for Angel Park.

8. For those subareas located downstream of Highway 95 and north of the Angel Park Detention Basin, subarea designations from the Wallace existing conditions model were adopted (EPT.XX and GD.XX, respectively). Although the VTN analysis incorporated a more detailed subarea network, particularly downstream of Highway 95, this analysis only considered ultimate land use conditions and thus was not valid for FIS hydrology.

9. At each FIS control point, the critical storm for the 100-year recurrence interval was determined. Table 4-1 compares peak discharges generated by the different storm centerings at each control point of concern. The critical storm is that which produces the maximum peak discharge at the point of interest. The 100-year critical storm centering was also used for the 10- and 50-year model runs.

10. A slightly shortened modeling period (reduced number of hydrograph ordinates) was used for certain 10- and 50-year model runs. The original B&V runs used 300 ordinates (the maximum number). The changes to the number of hydrograph ordinates were required to eliminate RK routing problems with the new version of HEC-1. The output was reviewed to ensure that all of the peak flows were occurring within the specified modeling period.

11. As was stated previously, the Boyle modeling for Summerlin modified subarea lag times based on the recommendation of the CCRFCD Hydrology Manual. In order to test the sensitivity of this adjustment, lag times for the FIS Hydrology subbasins tributary to Angel Park Detention Basin were recomputed using the USBR lag formula, and a new Angel Park inflow was computed. (It is noted that the Boyle curve number revisions were already included in the FIS Hydrology model.) The results are compared below.

	Angel Park 100-year Inflow	Gowan-North 100-year Outflow
FIS Hydrology model	6,760 cfs	2,450 cfs
FIS Hydrology model with USBR lags	7,130 cfs	2,480 cfs
Boyle Summerlin model	7,830 cfs	Not Computed

These results indicate that the lag adjustments only increase the peak discharge by 5 percent. This magnitude of change was not considered significant enough to make lag adjustments to all of the Wallace/B&V subareas utilized in the FIS Hydrology analysis. (It is noted that similar changes would have to be made in the Gowan Area HEC-1 models prepared for Northern Las Vegas Wash.) It appears that the Boyle model is yielding higher results than the previous modeling efforts due to a combination of different curve numbers, shorter lag times, possible channel routing differences, and the use of a larger number of smaller subareas.

12. An in-depth investigation was performed of possible assumptions for flow routing and diversions at the Highway 95 and Rancho Rd culverts. As described in a previous section, the past studies arrive at different flow splits at these culverts. In addition to the past predesign studies listed previously, several other studies have modeled or made assumptions regarding these flow splits. These include: Preliminary Design Report for Upper Mendenhall and Southern Nevada Industrial Center Channels by JMM (October 1987); Paradiso Drainage Report Addendum by Summit Engineers (August 1989); Revised Hydrology Study for High Country Estates by ESI (December 1986); and drainage studies for Rainbow Vista Units 11 and 12. Based on this investigation, it was concluded that the flow split diversions in the Black & Veatch model were reasonable representations of the current physical conditions, and were more representative than the diversions in either the Wallace or VTN models.

SUMMARY OF RESULTS

Table 4-2 presents a summary of the simulated 100-year discharges for existing conditions at key points in the Gowan Area watershed. A comparison between the preliminary flows modeled by the FIS Hydrology and those modeled by Wallace and Boyle are presented for the few locations where subbasins and facility assumptions agree. Comparisons of flows cannot be made for nodes downstream of Angel Park because the existing conditions Wallace analysis did not include diversions and channel improvements which were incorporated as "existing" facilities in the FIS modeling; and the Boyle study only covers the Summerlin area. Notes on the table provide partial explanations for the differences between the flows generated in the different studies. Comparisons cannot be made between the FIS Hydrology results and the results of the VTN study because it only modeled future conditions/future facilities.

An objective of the hydrologic modeling for the FIS Hydrology study is to develop discharges consistent with the CCRFCD adopted regulatory discharges from the COE Special Flood Hazard Study. However, for the Gowan Area, no COE Special Flood Hazard Study flows are available. Therefore, the "adopted" flows are based on the FIS Hydrology modeled flows.

Conversion from the 1985 to the 1988 version of HEC-1 and from kinematic to Muskingum channel routing has unusually complex effects on the simulated discharges. A detailed

[illegible] model comparisons using the Range Wash HEC-1 data file yielded the following key conclusions:

1. The 1988 kinematic routing gives much less attenuation than the 1985 kinematic routing. The 1988 program results are more consistent with the kinematic routing theory, which suggests that hydrographs should be translated but only minimally attenuated by this procedure.

2. Muskingum routing generally results in less peak attenuation than kinematic routing in the 1985 program, and more peak attenuation than kinematic routing in the 1988 program. This is due to the differences in the kinematic methods, not in the Muskingum methods.

As a result of the above effects, it is possible for conversion from 1985 kinematic routing to 1988 Muskingum routing to produce higher discharges in some locations. This helps explain why the FIS Hydrology 100-year discharge is higher than the Wallace discharge at nodes GD.14B(.), PDGC(.), and ANGEL.PK.

Based on the results shown in Table 4-2 for the 100-year flood, HEC-1 models were developed for the 10- and 50-year floods. These models utilize the same curve number and lag time parameters as the 100-year model. Results are summarized in Table 4-3 for existing conditions at the same key points as Table 4-2 in the Gowan Area.

Table 4-3 presents discharges based on the COE regional discharge-frequency relationship developed for the Feasibility Study. This is the relationship used to calibrate the COE HEC-1 models, and was used by the COE in conjunction with the model results to select discharges for the study. It can be seen that in some cases, there are considerable differences between the regional values and the FIS Hydrology model results. However, these differences are due in part to the fact that the COE regional discharge-frequency analysis does not account for regulation by the Angel Park, Gowan-North, and Gowan-South Detention Basins.

Due to the lack of COE Special Flood Hazard Study flows for the Gowan Area and the presence of the two major detention basins, the "adopted" flows for FIS purposes were selected based on the HEC-1 modeling results with little concern for differences between COE regional flows.

Modeling results indicate that both the Angel Park and Gowan Detention Basins are subject to overflow during the 100-year flood under existing conditions (note that "existing conditions" includes improvements to Angel Park and construction of the proposed Buffalo Channel connecting Angel Park with the proposed Gowan-South Detention Basin). The 100-year peak stage in Angel Park is 2618.7 compared to a spillway crest elevation of 2618.5. The Angel Park overflow (600 cfs) will be directed to the Gowan-South Detention Basin by the Angel Park Outfall and Buffalo Channel. The Gowan-North Detention Basin experiences a 100-year peak stage of 2325.7 compared to a spillway crest elevation of 2325.5. Future construction of proposed detention basins in the Gowan area watershed will eliminate this overflow under ultimate conditions.

Discharges for the 500-year flood were determined graphically by extrapolating the discharges for the lower three storms. In the case of nodes R.G-UPS and DET.GN, the effect of the Gowan-North Detention Basin regulation is such that the 10-year and 50-year flows are contained in the basin while the 100-year flood overtops the basin. This results in a very nonlinear frequency curve at these locations. Because the 100-year discharges for these two nodes below the basin incorporated overflows, it was considered reasonable to extrapolate to

the 500-year peak flow using the 100-year model discharge and the slope of the frequency plot for node LVWASH (the downstream study limit). Flood frequency plots used to perform the extrapolations are shown in Figures 4-1 to 4-4.

The HEC-1 routing diagrams and 100-year input/output files are included in the Technical Appendix.

TABLE 4-1

GOWAN AREA - SUMMARY OF CRITICAL STORMS

Location / Node No.	Storm*	Storm Area (sq mi)	CCRFCD DARF	Q100 (cfs)	Critical Storm
Downstream terminus at Las Vegas Wash					
Node LVWASH (all subareas)	VTN Storm 3	26	0.76	2710	
Node LVWASH (all subareas)	Entire drainage area	158	0.544	4592	X
Node EPT.5(.) (all subareas except EPT.2)	VTN Storm 3	26	0.76	2584	
Node EPT.5(.) (all subareas except EPT.2)	Entire drainage area	158	0.544	4573	X
Gowan Outfall Channel at Rancho Road					
Node R.G-UPS. (route basin outflow d/s)	VTN Storm 4	92	0.613	2312	
Node R.G-UPS. (route basin outflow d/s)	Tributary area	144	0.556	2405	X
Gowan-North and South Detention Basins					
DET.GN (Outflow from Gowan-North)	VTN Storm 4	92	0.613	2359	
DET.GN (Outflow from Gowan-North)	Tributary area	144	0.556	2454	X
GN_IN (total inflow to Gowan-North)	VTN Storm 4	92	0.613	4465	X
GN_IN (total inflow to Gowan-North)	Tributary area	144	0.556	4063	
Rancho Road at Hwy 95					
Node PDGC(.) (Painted Desert Golf Course)	Tributary area	67	0.652	1518	X
Inflow to Angel Park Detention Basin					
Node ANGEL.PK	Tributary area	24	0.770	6762	X
Alluvial Fan Apexes					
Node GD.1	Tributary area	4.2	0.909	2522	X
Node GD.21	Tributary area	4.2	0.909	4531	X
Node GD.18	Tributary area	4.2	0.909	4096	X

Either VTN Storm # or area covered by storm

TABLE 4-2

COMPARISON OF EXISTING CONDITION 100-YEAR DISCHARGES FOR GOWAN AREA FIS HYDROLOGY

FIS Hydrology				Wallace Study				Boyle Summerlin Hydrology						
CP/Node	Area*	DARF	Flow	CP/Node	Area	DARF	Flow	CP/Node	Area	DARF	Flow	Note	Description	Adopted Discharge
LVWASH	157.9	0.544	4592	-	-	-	-	-	-	-	-	1,2	d/s terminus at LV Wash	4600
EPT.5(.)	156.4	0.544	4573	-	-	-	-	-	-	-	-	1,2	all Gowan Subareas except EPT.2	4600
R.G-UPS.	143.9	0.556	2405	-	-	-	-	-	-	-	-	1,2	Gowan Outfall Chnl @ Rancho Rd	2400
DET.GN	143.9	0.556	2454	-	-	-	-	-	-	-	-	1,2	Outflow fr/Gowan-No. Det. Bas.	2450
GN_IN	143.9	0.613	4465	-	-	-	-	-	-	-	-	1,2	Inflow to Gowan-No. Det. Bas.	4500
GD.14B(.)	100.1	0.613	2991	GD.14(.)	100.1	0.62	2785	-	-	-	-	2,4	Inflow to Gowan-No. fr/north	3000
PDGC(.)	67.2	0.652	1518	PDGC(.)	67.2	0.62	1337	-	-	-	-	5	Rancho Road at Hwy 95 (PDGC)	1500
ANGELPK	24.1	0.77	6762	ANGELPK	24.1	0.765	6730	ANGELP	24.5	0.77	7830	3,4,6	Inflow to Angel Pk Det. Bas.	6800
GD.1	3.0	0.909	2522	-	-	-	-	3A	2.6	0.93	2420	7,8	Alluvial Fan Apex (GD.1)	2500
GD.21	6.0	0.909	4531	-	-	-	-	-	-	-	-	2,7	Alluvial Fan Apex (GD.21)	4500
GD.18	3.4	0.909	4096	-	-	-	-	-	-	-	-	2,7	Alluvial Fan Apex (GD.18)	4100

* = Total drainage area; may be different than storm area ** = location of CCRFCD regulatory discharge from COE study

Notes:

General - FIS hydrology based on new (1988) HEC-1, conversion to Muskingum routing in upland areas, and CCRFCD DARF's
Wallace study based on 1985 HEC-1, kinematic routing in all locations, and Hydro 40 DARF's
Boyle study based on 1985 HEC-1, Muskingum routing in all locations, and CCRFCD DARF's

1. FIS Q cannot be compared to Wallace Q since Wallace "existing" analysis did not include Hualapai and Durango Diversions and "ultimate" analysis includes proposed detention basins
2. Not covered by Boyle analysis
3. Wallace Q reflects future conditions (existing conditions do not include Hualapai or Durango Diversions)
4. FIS and Wallace Q's agree within 10%
5. FIS and Wallace Q's agree within 15%
6. FIS and Boyle Q's agree within 15%
7. FIS Q cannot be compared to Wallace Q since DARF's based on different storm areas were used
8. Boyle analysis used larger DARF and different lag time computation
9. FIS Q's include Gowan-North and Gowan-South Detention Basins and Outfall to Las Vegas Wash; Cheyenne Channel into Gowan-South Detention Basin; Angel Park Detention Basin Expansion; Hualpai Diversion to Angel Park; and Buffalo Channel connecting Angel Park and Gowan-South Basin

TABLE 4-3

PROPOSED GOWAN AREA FIS DISCHARGES

Node	Area (sq mi)	10-Year Peak Discharge COE Reg Q	COE SFHS Q	Model Output	Adopted Flow	50-Year Peak Discharge COE Reg Q	COE SFHS Q	Model Output	Adopted Flow	100-Year Peak Discharge COE Reg Q	COE SFHS Q	Model Output	Adopted Flow	500-Year Peak Discharge COE SFHS Q	Adopt Extrap	Adopted Flow
LVWASH	157.9	2133*	-	1432	**1400**	7275*	-	2937	**2940**	11218*	-	4592	**4600**	-	8500	**8200**
EPT.5(.)	156.4	-	-	1415	**1400**	-	-	2864	**2900**	-	-	4573	**4600**	-	7800	**7800**
R.G-UPS.	143.9	-	-	343	**340**	-	-	533	**530**	-	-	2405	**2400**	-	4100	**4100**
DET.GN	143.9	-	-	343	**340**	-	-	533	**530**	-	-	2454	**2450**	-	4500	**4500**
GN_IN	143.9	-	-	1785	**1800**	-	-	4018	**4000**	-	-	4465	**4500**	-	8000	**8000**
GD.14B(.)	100.1	1758**	-	1069	**1100**	6212**	-	2735	**2700**	9700**	-	2991	**3000**	-	3500	**3500**
PDGC(.)	67.2	-	-	518	**520**	-	-	1201	**1200**	-	-	1518	**1500**	-	3000	**3000**
ANGEL.PK	24.1	885	-	3040	**3000**	3478	-	5798	**5800**	5640	-	6762	**6800**	-	10700	**10700**
GD.1	3.0	269	-	1183	**1200**	1241	-	2145	**2100**	2130	-	2522	**2500**	-	4000	**4000**
GD.21	6.0	434	-	2181	**2200**	1865	-	4035	**4000**	3120	-	4531	**4500**	-	7000	**7000**
GD.18	3.4	292	-	1911	**1900**	1348	-	3329	**3300**	2312	-	4096	**4100**	-	6100	**6100**

Node	Location
LVWASH	d/s terminus of Gowan Area at LV Wash
EPT.5(.)	all Gowan subareas except EPT.2
R.G-UPS.	Gowan Outfall Channel at Rancho Road
DET.GN	Outflow from Gowan-North Detention Basin
GN_IN	Inflow to Gowan-North Detention Basin
PDGC(.)	Rancho Road at Hwy 95 (PDGC)
ANGEL.PK	Inflow to Angel Park Detention Basin
GD.1	Alluvial Fan Apex (at GD.1)
GD.21	Alluvial Fan Apex (at GD.21)
GD.18	Alluvial Fan Apex (at GD.18)

COE Reg Q = Corps of Engineers Regional Discharge-Frequency Relationship
COE SFHS Q = Corps of Engineers Special Flood Hazard Study
Model Output = FIS Hydrology HEC-1 Model Output
Adopted Flow = Adopted Flow for FIS Purposes
Model Extrap = Extrapolation of Q10, Q50, and Q100 Flows from HEC-1 Model Output
Adopt Extrap = Extrapolation of Adopted Flows for Q10, Q50 and Q100

Area = Total drainage area
* = Does not account for regulation by Angel Park, Gowan-North, or Gowan-South Detention Basins
** = Does not account for regulation by Angel Park Detention Basin
Bold = FIS concentration point

Note: FIS Q's include Gowan-North and Gowan-South Detention Basins and Outfall to Las Vegas Wash; Cheyenne Channel into Gowan-South Basin Angel Park Detention Basin Expansion; Hualpai Diversion to Angel Park, and Buffalo Channel connecting Angel Park to Gowan-South Basin

FIGURE 4-1
GOWAN PLOT AREA FIS DISCHARGES
(PLOT #1)

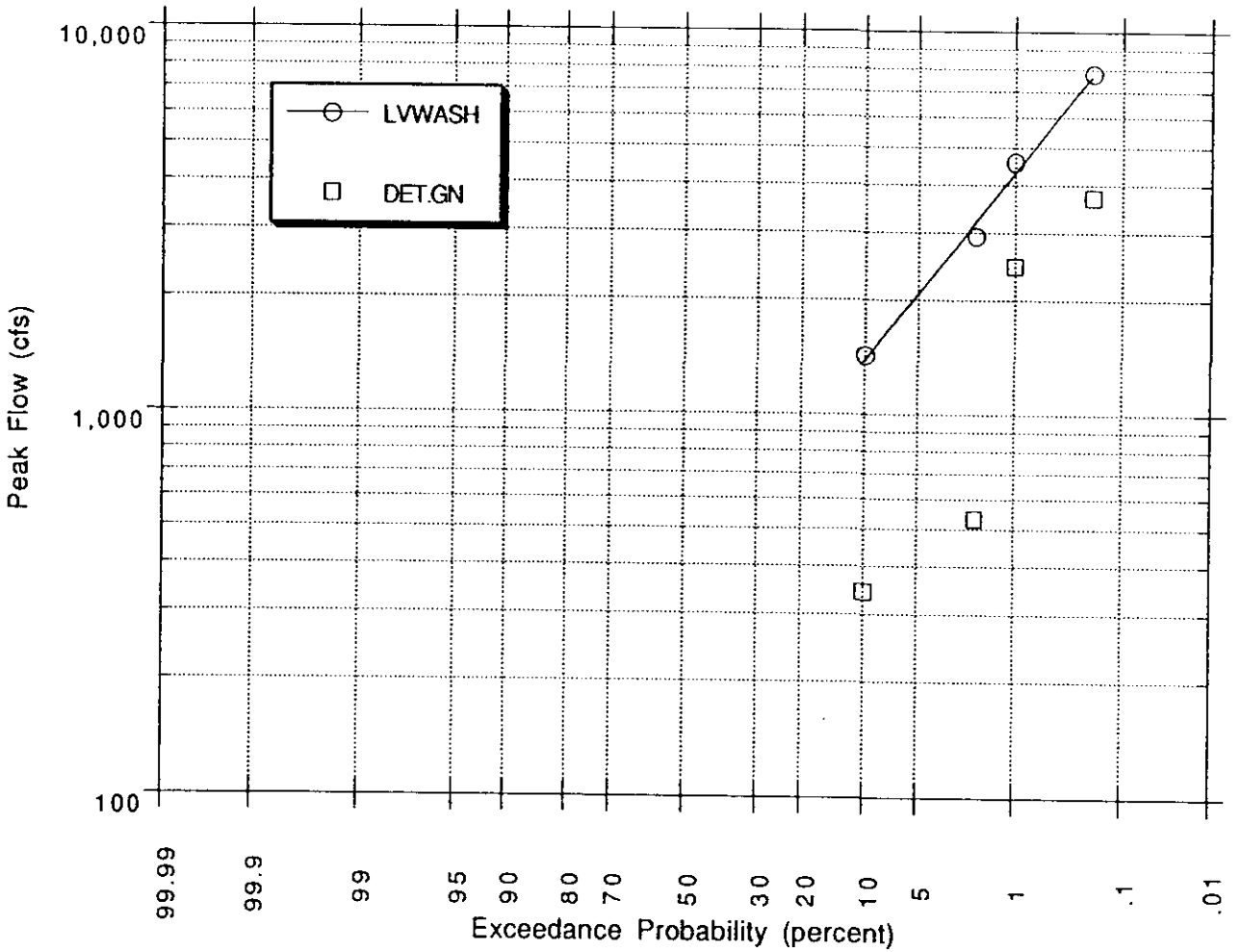


FIGURE 4-2
GOWAN AREA FIS DISCHARGES
(PLOT #2)

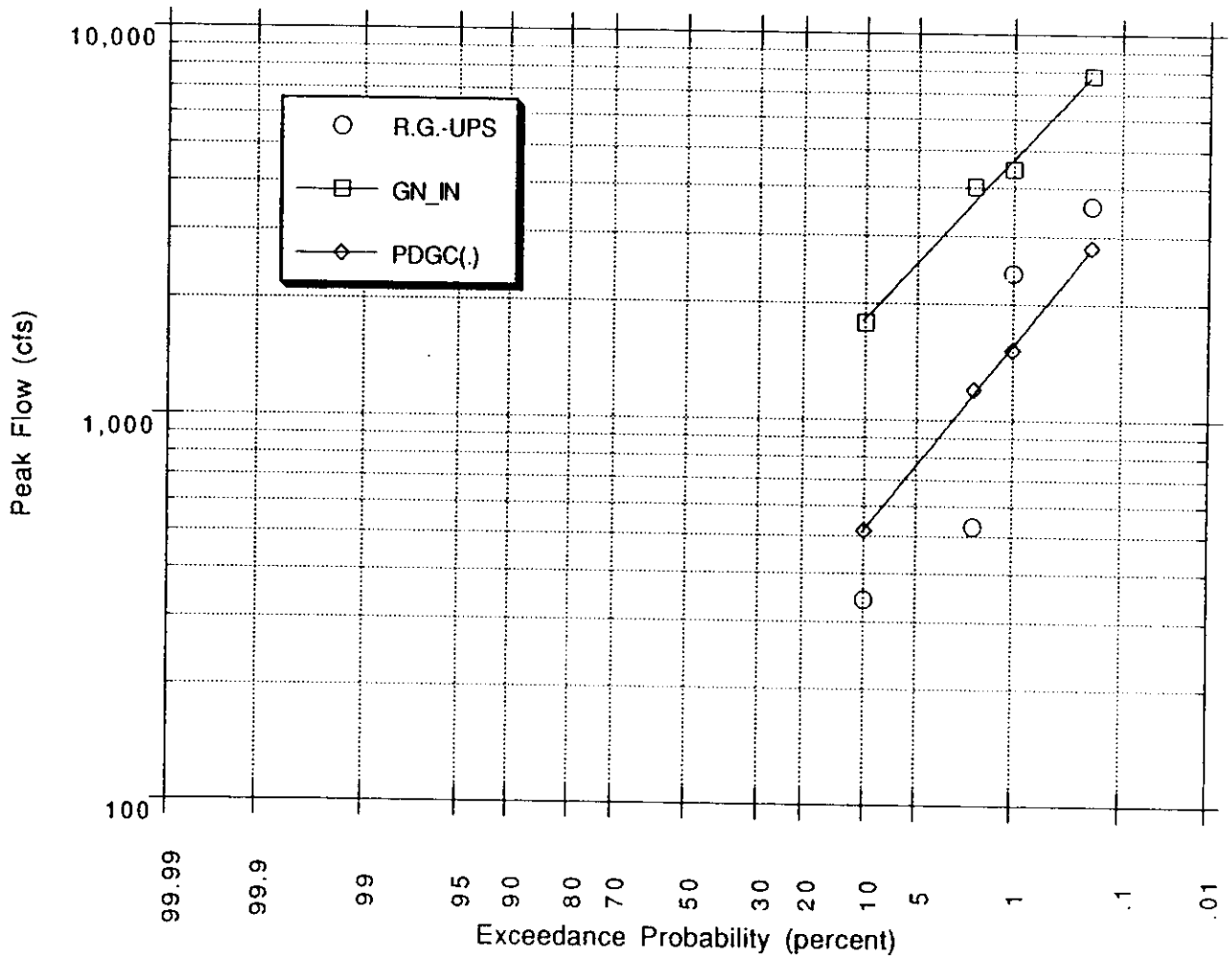


FIGURE 4-3
GOWAN AREA FIS DISCHARGES
(PLOT #3)

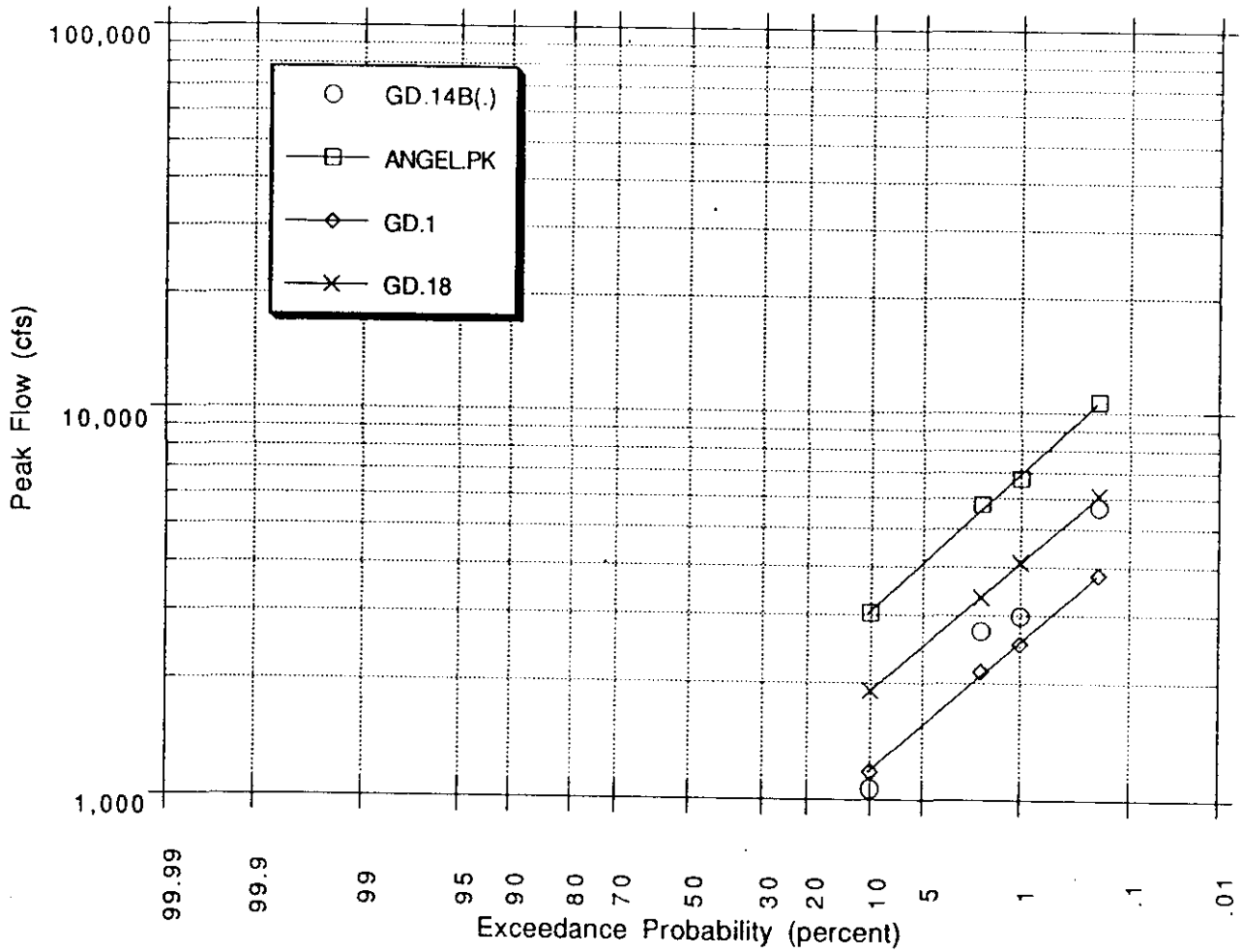
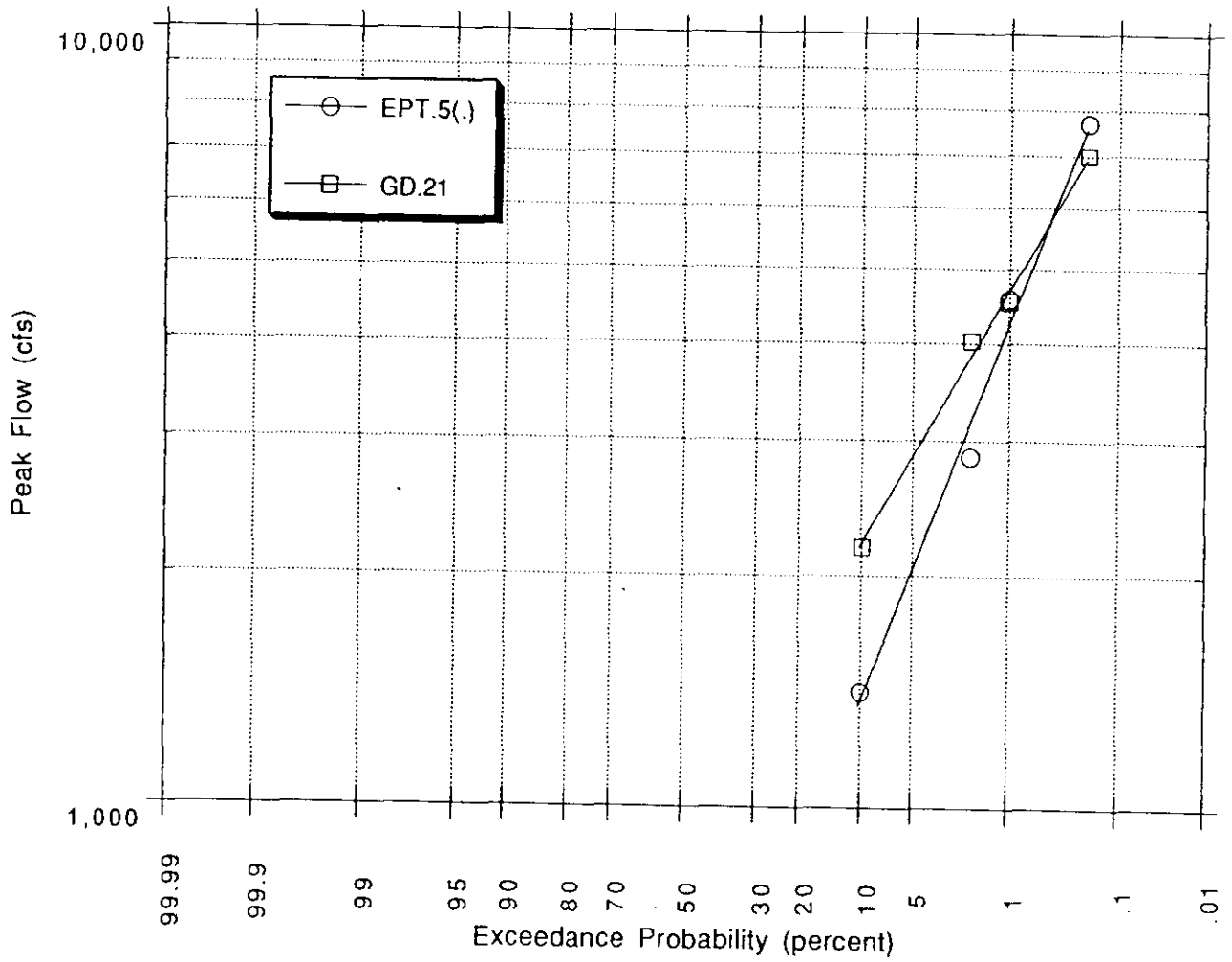


FIGURE 4-4
GOWAN AREA FIS DISCHARGES
(PLOT #4)



CHAPTER 5
CENTRAL BASIN FIS HYDROLOGY

CHAPTER 5

CENTRAL BASIN FIS HYDROLOGY

INTRODUCTION

This report summarizes the existing conditions/existing facilities analysis of the Central Basin drainage area conducted for the new FIS Hydrology study for Las Vegas Valley. The purpose of the analysis was to develop acceptable discharges for use in future flood insurance studies for Las Vegas Creek. In addition, results could be used to assess the adequacy of existing facilities to handle existing condition flood discharges. The Central Basin study area includes all of the area tributary to Las Vegas Creek (Washington Avenue Channel) at Las Vegas Wash; the area tributary to the Freeway Channel; and most of the area between Washington Avenue Channel and Flamingo Wash. However, the only designated FIS flooding source in Central Basin is Las Vegas Creek from Meadows Detention Basin to Las Vegas Wash.

The basis of the hydrologic analysis was the group of HEC-1 models developed by MEA Engineers for the preliminary design analysis of Washington Avenue Channel. These are described in the report "Washington Avenue Channel Improvements, Predesign Report, Hydrology Study" (1990). The MEA hydrology study divided the Las Vegas Creek Watershed into several subwatersheds to compute design flows at critical locations. The study analyzed only assumed ultimate development conditions, but the majority of the existing drainage area is very close to buildout development. The MEA study also assumed construction of all proposed regional drainage facilities in the watershed; the FIS study had to modify this to reflect existing drainage improvements only. Previous studies in this watershed also include the CCRFCD Master Plan and the COE Special Flood Hazard Study which were used as references in modifying the MEA models to simulate existing condition land use and flow routing.

Peak discharges have been computed for proposed Las Vegas Creek FIS concentration points (Figure 1-1) for 10-, 50-, 100-, and 500-year return periods. The three lower floods were analyzed using HEC-1 models; the 500-year peak discharges were determined by graphical extrapolation.

Subareas used for the modeling are shown in Figures 5-1A, 5-1B, and 5-1C, which are reproduced from the MEA report.

ASSUMPTIONS FOR THE FIS HYDROLOGIC ANALYSIS

The FIS hydrologic analysis is based on existing land use conditions, and drainage improvements which are existing or scheduled for construction in the near future (e.g., the next two years). The following assumptions are made for the FIS hydrology analysis for the Central Basin.

- While Vegas Drive will be the northern drainage boundary west of Jones Boulevard when future proposed facilities are in place, the northern boundary for existing condition FIS flows is the boundary from the November 1990 MEA report on Washington Avenue Channel Improvements. This excludes the area roughly bounded by Jones Boulevard, Vegas Drive, Buffalo Road, and Washington Avenue from the Las Vegas Creek drainage area (see Figure 5-1A).

- The Lake Mead Storm Drain System and the Carey/Lake Mead Detention Basin are considered in place.

- The Oakey Detention Basin was proposed but not funded at the time of the analysis, and thus is not considered in place. It is noted that this project is now programmed for funding.

- The I-15 Conveyance System, which will convey flows northward along I-15 from Desert Inn Road to the Expressway, is not funded and thus is not considered in place.

- The Gowan Detention Basin and Outfall System are designed and funded, and thus are considered in place.

- The Durango Storm Drain System feeding into the Angel Park Detention Basin is considered in place on Durango Road from the detention basin to the first street south of Charleston.

- The Angel Park Outfall System including the Buffalo Channel north of Vegas Drive is considered in place. This connects the Angel Park and Gowan Detention Basins, and diverts a significant portion of the original Las Vegas Creek drainage area into the Gowan Basin.

- The capacity of the Freeway Channel south of Lake Mead Blvd is 584 cfs as described in the Final Hydrology Study for the Lake Mead Boulevard Storm Drain system (VTN, October 1989). This report indicates that 584 cfs capacity is available in the Freeway Channel for those areas south of the Lake Mead Storm Drain Drainage Basin which would otherwise drain to the Washington Avenue Channel and Las Vegas Creek drainage area. The Carey/Lake Mead Detention Basin and the Lake Mead Storm Drain System have been designed and sized to meet the capacity of the Freeway Channel north of Lake Mead Blvd.

- Flow originating north of the Expressway stays on the north side of the Expressway west of the UPRR and I-15.

MODIFICATIONS TO MEA HYDROLOGIC MODELS

The following paragraphs discuss the significant changes made to the MEA HEC-1 models in order to simulate assumed FIS conditions.

1. The MEA curve numbers, which reflect future proposed conditions, were replaced by existing condition curve numbers.

2. Subareas W3A, W3B, W4A and W4B were routed along the north side of the Expressway to the UPRR and I-15, where they encountered the flow split between the Freeway Channel and the Washington Avenue drainage areas.

3. Subareas W1A and W1B were added to the model, as was a flow split at the existing Buffalo Channel between Charleston Boulevard and Westcliff Drive.

4. Subareas below Charleston Boulevard and subarea CE-7C2 were not considered to contribute to Las Vegas Creek in existing conditions, and were removed from the model. Runoff from these subareas is intercepted and "detained" in the Charleston Underpass flooding area, from which it flows easterly away from Las Vegas Creek.

5. Separate simulation runs were made for storm distribution numbers (SDN) 3 and 5 to correctly simulate flows at concentration points in the upper and lower basin areas, respectively. The upper and lower basins were separated by the I-15 freeway. Results of the SDN 3 simulations were used for cumulative drainage areas less than 10 square miles; SDN 5 simulations were used for cumulative areas larger than10 square miles.

6. MEA developed separate models for the northern, southern and eastern drainage basins. These were linked together by JMM into one FIS model.

7. A flow split was taken from the COE model and added to the MEA model to simulate existing conditions at Rancho Road on Las Vegas Creek.

8. A flow split and diversion were added to the MEA model at the entrance to the Las Vegas Creek RCB structure at the UPRR to simulate the existing flow constriction at this location due to the limited RCB capacity Flow split data was taken from the COE model.

SUMMARY OF RESULTS

Table 5-1 presents a summary of the simulated 100-year discharges for existing conditions at key points in the Las Vegas Creek watershed. A comparison between the flows modeled by the FIS Hydrology and those modeled for the COE Special Flood Hazard Study is presented. Comparison of flows cannot be made between the FIS Hydrology and the MEA study because the MEA model simulates only future conditions. Notes in Table 5-1 provide partial explanations for the differences between the flows generated and the two studies compared.

In the lower portion of Washington Avenue Channel, breakouts from the main flow in the main flow path has been limited to the bankfull capacity of Washington Avenue Channel and the existing road crossings. It is possible that surcharging could occur in the channel, increasing the effective flow capacity. This situation should be investigated as part of the future hydraulic analysis and floodplain mapping for Las Vegas Creek.

An objective of the overall hydrologic modeling for the FIS Hydology study is to develop discharges consistent with the CCRFCD adopted regulatory discharges from the COE Special Flood Hazard Study. For Las Vegas Creek, the COE flows were not adopted as regulatory discharges due to concerns over the COE analysis, and thus were subject to future confirmation studies. In the Las Vegas Creek watershed construction of the Angel Park Detention Basin outfall channel to Gowan Detention Basin, considered as an existing facility, results in a substantial change from the COE model. This facility greatly reduces the effective drainage area tributary to the Las Vegas Creek FIS study reach. In addition, the COE analysis was performed prior to construction of the Meadows Detention Basin and also did not include the Carey/Lake Mead Detention Basin. The FIS Hydrology model discharges, therefore, must be considered more up to date information which will supersede the COE model flows. Thus, the adopted flows for FIS purposes are based on the new model results.

HEC-1 models were developed for the 10- and 50-year floods, utilizing the same curve number and lag time parameters as the 100-year model. Results are summarized and included in Table 5-2 for existing conditions at the same key locations as the 100-year flow values reported in Table 5-1.

[illegible] were extrapolated by statistical and graphical methods from the 10-, 50- and 100-year values (Figures 5-2, 5-3 and 5-4), except in certain cases. These exceptions result from anomalies in the extrapolation results due to effects of Meadows Detention Basin on the lower return period peak flow values, and to channel breakouts and diversions. These factors influence the 10-year flows more significantly than the 100-year flows, creating artificially steep frequency curves at some concentration points. Extrapolated 500-year flows were adjusted for consistency at the following locations:

- The 500-year flow for station RETMED was set at the upstream station flow of 2,470/cfs. The Meadows Detention Basin is assumed to have no impact on the 500-year flow.

- The 500-year flow for stations DIV1 and W2C was based on straight-line interpolation between the flow values for stations RETMED and UPRR. The extrapolation for the UPRR station was considered to be accurate, while the 500-year extrapolated flows for the upstream stations were subject to reduction to be consistent with the UPRR 500-year flow.

- The 500-year flow values for stations UPRR and DIVWA were extrapolated from the lower recurrence flow values.

- Flow values increase for the 10-, 50- and 100-year recurrence intervals for stations BRUCE and PECOS (.). The capacity of the Washington Avenue Channel, however, has more of an effect on higher flow values as it has a limited capacity. The lower flow values, therefore, fluctuate to a much greater extent causing the slope of the extrapolation line to flatten out for those stations. For this reason, the extrapolated 500-year flows decrease rather than increase at those two stations. It was decided to retain the upstream 500-year flow of 2,800 cfs for those two stations.

HEC-1 routing diagrams and 100-year input/output files are included in the Technical Appendix.

TABLE 5-1

COMPARISON OF EXISTING CONDITION 100-YEAR DISCHARGES FOR CENTRAL BASIN FIS HYDROLOGY

	FIS Hydrology			COE Special Flood Hazard Study						Adopted
CP/Node	Area	DARF	Flow	CP/Node	Area	DARF	Flow	Note	Description	Discharge
LVWASH	17.6	0.81	1000	35	26.81		1200	1	d/s terminus at LV Wash	1000
DPECOS	17.4	0.81	1000	30	26.2		1000	5,6	Washington Ave Channel d.s. of Pecos	1000
PECOS (.)	17.4	0.81	1411	30	26.2		11000	2,3,4	Washington Ave Channel u.s. of Pecos	1410
BRUCE	11.4	0.85	1318	33	24.04		4000	3,4	Washington Ave Channel at Bruce	1320
DIVWA	7.5	0.89	1181	43	23.29		3800	3,4,6	Las Vegas Creek d.s. of UPRR box	1180
UPRR	7.5	0.89	1350	43	23.29		5500	3,4	Las Vegas Creek u.s. of UPRR box	1350
DIV1	6.8	0.89	1311	40	19.46		4800	3,4,6	Las Vegas Creek d.s. of I-15	1310
W2C	6.8	0.89	1311	40	19.46		6200	3,4	Las Vegas Creek u.s. of I-15	1310
RETMED	5.9	0.89	1096	39	18.57		6000	3,4	Outflow from Meadows Detention Basin	1100
MEDOWS	5.9	0.89	1581	-	-		-		Inflow to Meadows Detention Basin	1580
W2A	3.0	0.92	641	38	17.62		5800	3,4	Alta at Michael Way	640

Notes:

General - FIS hydrology based on new (1988) HEC-1, conversion to SCS loss rates, and CCRFCD DARF's
COE study based on 1985 HEC-1, and kinematic routing in all locations
All discharges are in cfs

1. FIS and COE Q's agree within 20%
2. Flows do not agree because FIS considers an upgrade to Lake Mead Blvd structure at Freeway Channel, which modifies breakout
3. Flows do not agree because FIS includes Meadows Det. Basin
4. Areas and flows do not agree because FIS considers Angel Park Outfall Channel to Gowan Basin an existing facility
5. Flow is limited by bankfull channel capacity; subject to verification by future detailed hydraulic analyses
6. Reduction in flow compared to upstream concentration point due to breakout

TABLE 5-2

PROPOSED CENTRAL BASIN FIS DISCHARGES

Node	Area (sq mi)	10-Year Peak Discharge				50-Year Peak Discharge				100-Year Peak Discharge				500-Year Peak Disc		
		COE Reg Q	COE SFHS Q*	Model Output	Adopted Flow	COE Reg Q	COE SFHS Q*	Model Output	Adopted Flow	COE Reg Q	COE SFHS Q*	Model Output	Adopted Flow	COE SFHS Q*	Model Extrap	Ad d F
LVWASH	17.6		1000	441	460		1100	996	1000		1200	1000	1000	1800	1000	1
DPECOS	17.4		1000	436	460		1000	1000	1000		1000	1000	1000	1000	1000	1
PECOS (.)	17.4		1100	457	460		8500	1111	1110		11000	1411	1410	14500	2650	2
BRUCE	11.4		1050	436	440		2600	1040	1040		4000	1318	1320	7300	2440	2800
DIVWA	7.5		880	241	240		2600	815	820		3800	1181	1180	7000	2800	2800
UPRR	7.5		1050	276	280		3500	932	930		5500	1350	1350	12000	3200	3200
DIV1	6.8		500	198	200		1800	918	920		4800	1311	1310	11000	3860	3090
W2C	6.8		500	198	200		1800	918	920		6200	1311	1310	18000	3860	3090
RETMED	5.9		450	116	120		1500	767	770		6000	1096	1100	18000	4120	2470
MEDOWS	5.9		-	713	710		-	1344	1340		-	1581	1580	-	2470	2470
W2A	3.0		350	280	280		1400	530	530		5800	641	640	17000	1000	1000

Node	Location
LVWASH	d/s terminus at LV Wash
DPECOS	*Washington Ave. Channel d.s. of Pecos*
PECOS (.)	Washington Ave. Channel u.s. of Pecos
BRUCE	Washington Ave. Channel at Bruce
DIVWA	L V Creek d.s. of UPRR box
UPRR	L V Creek u.s. of UPRR box
DIV1	L V Creek d.s. of I-15
W2C	L V Creek u.s. of I-15
RETMED	Outflow from Meadows Det. Basin u.s. of Rancho Rd
MEDOWS	Inflow to Meadows Detention Basin
W2A	Alta at Michael Way

COE Reg Q = Corps of Engineers Regional Discharge-Frequency Relationship
COE SFHS Q = Corps of Engineers Special Flood Hazard Study
Model Output = FIS HEC-1 Model Output
Adopted Flow = Adopted Flow for FIS Purposes
Model Extrap = Extrapolation of Q10, Q50, and Q100 Flows from HEC-1 Model Output
All discharges in cfs

Area = Total drainage area
* = Does not account for regulation by Angel Park Outfall

Note: Flows include effects of proposed Carey/Lake Mead Detention Basin and Gowan Area improvements (see Chapter 4).
Flows at DPECOS and LVWASH limited by bankfull channel capacity; subject to verification in future hydraulic analyses.

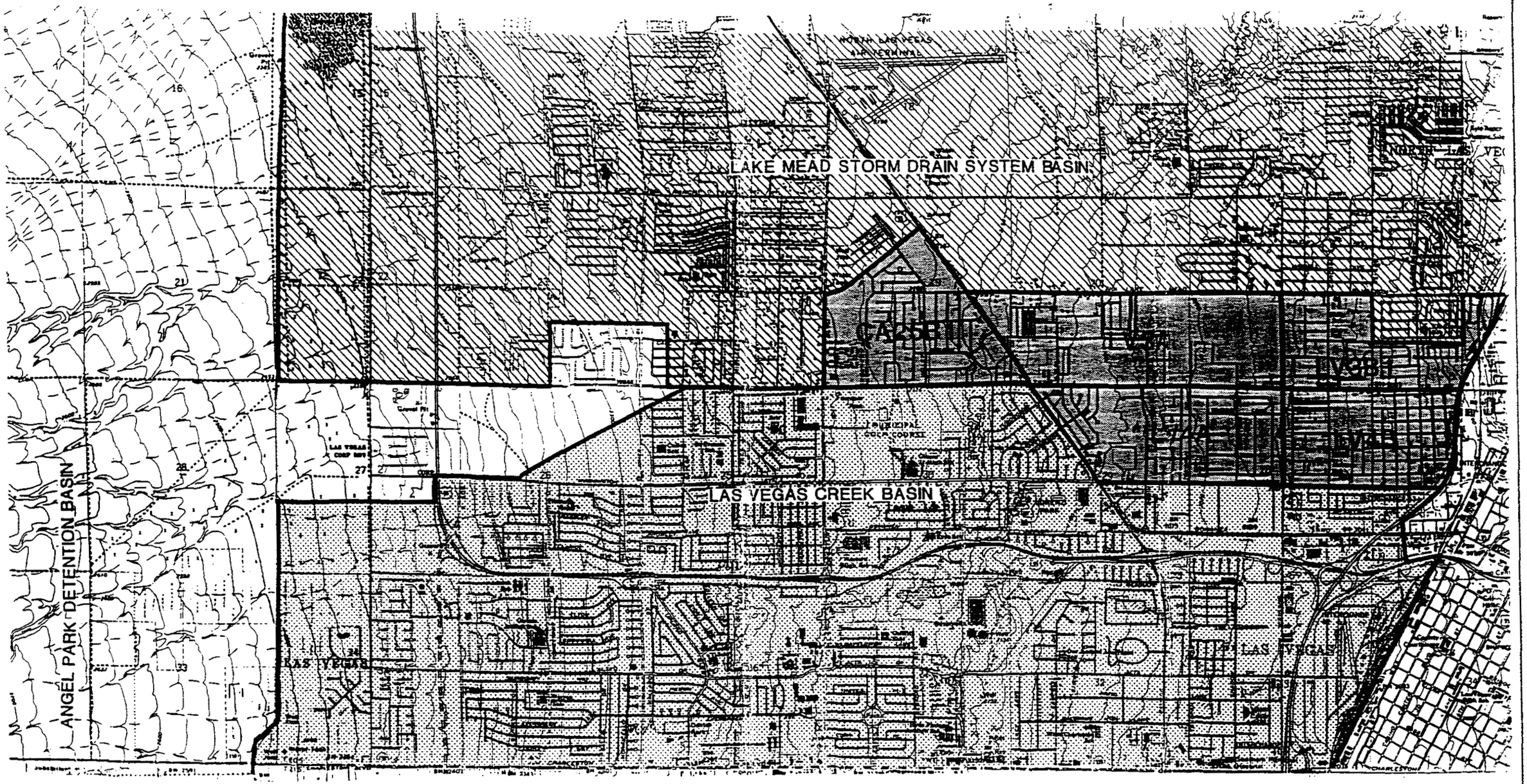


FIGURE 5-1A

WASHINGTON AVENUE CHANNEL IMPROVEMENTS

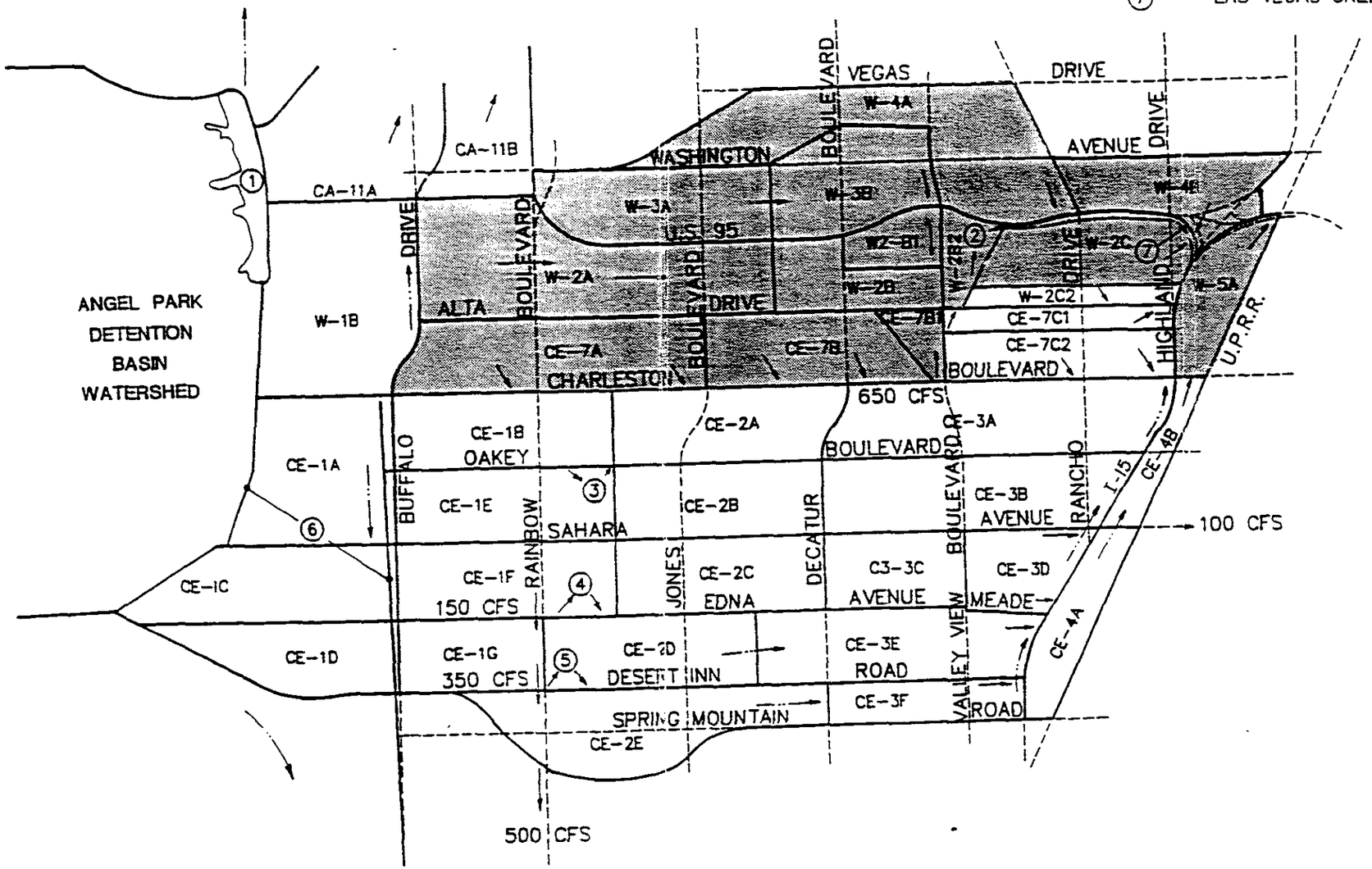
PREDESIGN REPORT I-15 FREEWAY CHANNEL BASIN

MEA CONSULTING ENGINEERS

N.T.S.

LEGEND

1. ANGEL PARK DETENTION BASIN
2. MEADOWS DETENTION BASIN
3. OAKEY DETENTION BASIN
4. EDNA DETENTION BASIN
5. DESERT INN / RAINBOW DETENTION BASIN
6. COLLECTION SYSTEM
7. LAS VEGAS CREEK



WASHINGTON AVENUE CHANNEL IMPROVEMENTS

PREDESIGN REPORT LAS VEGAS CREEK WATERSHED (NORTHERN BASIN)

CONSULTING ENGINEERS

FIGURE 5-1B

N.T.S.

SUB-BASIN BOUNDARIES

WASHINGTON AVENUE CHANNEL IMPROVEMENTS

PREDESIGN REPORT ADJACENT DRAINAGE AREA

MEA CONSULTING ENGINEERS

FIGURE 5-1C

FIGURE 5-2
CENTRAL BASIN FIS DISCHARGES
(PLOT #1)

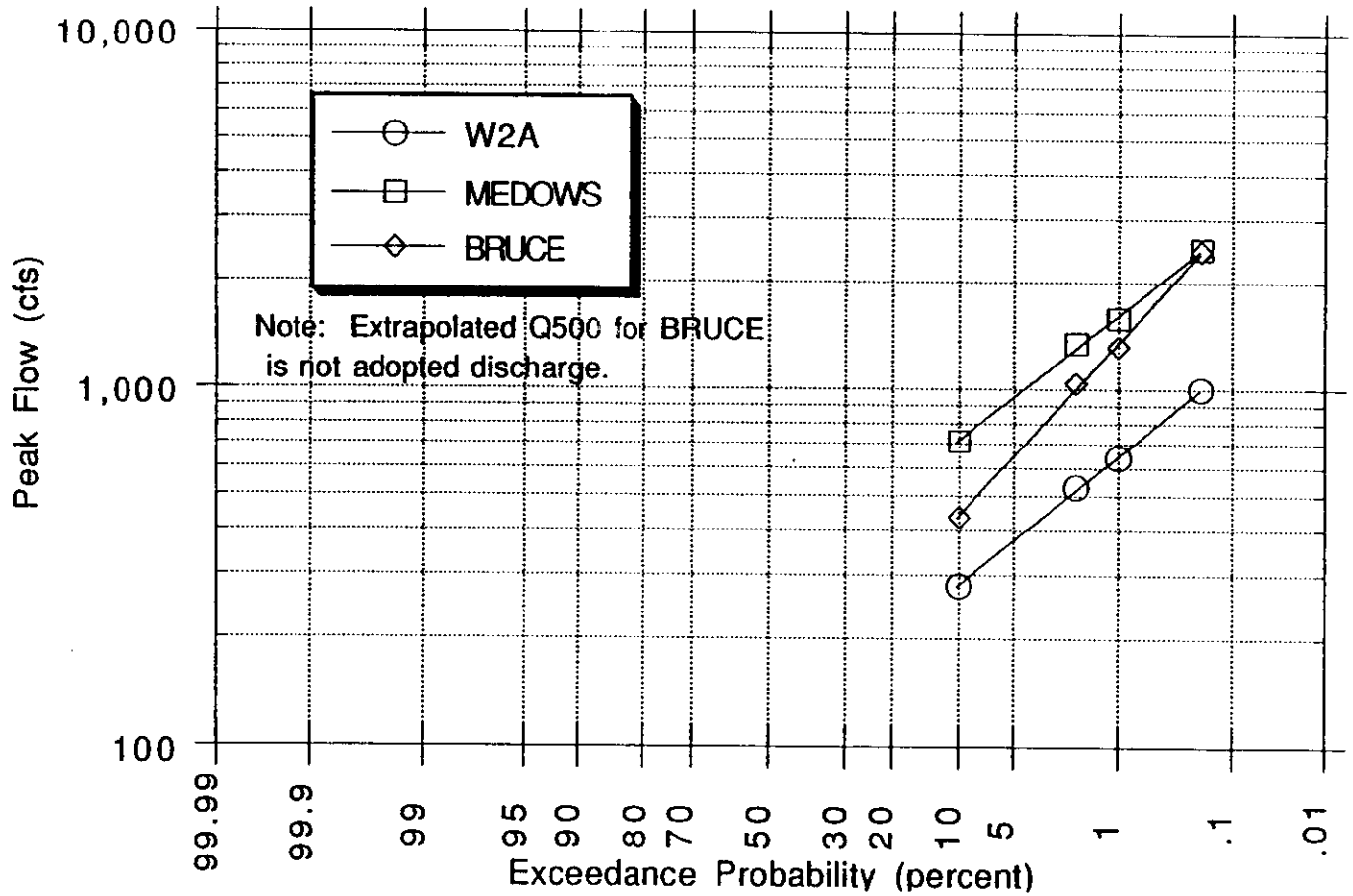


FIGURE 5-3
CENTRAL BASIN FIS DISCHARGES
(PLOT #2)

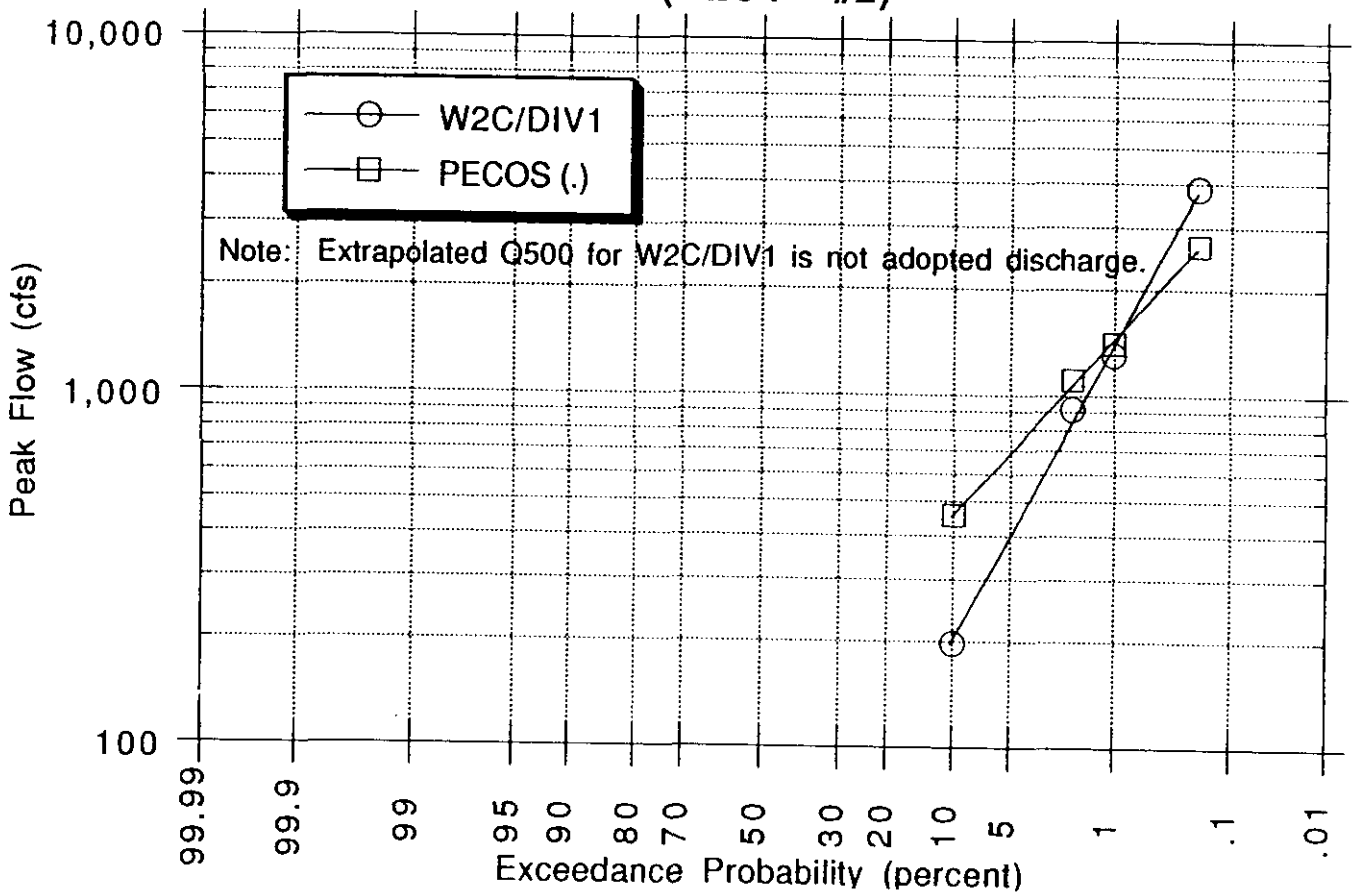
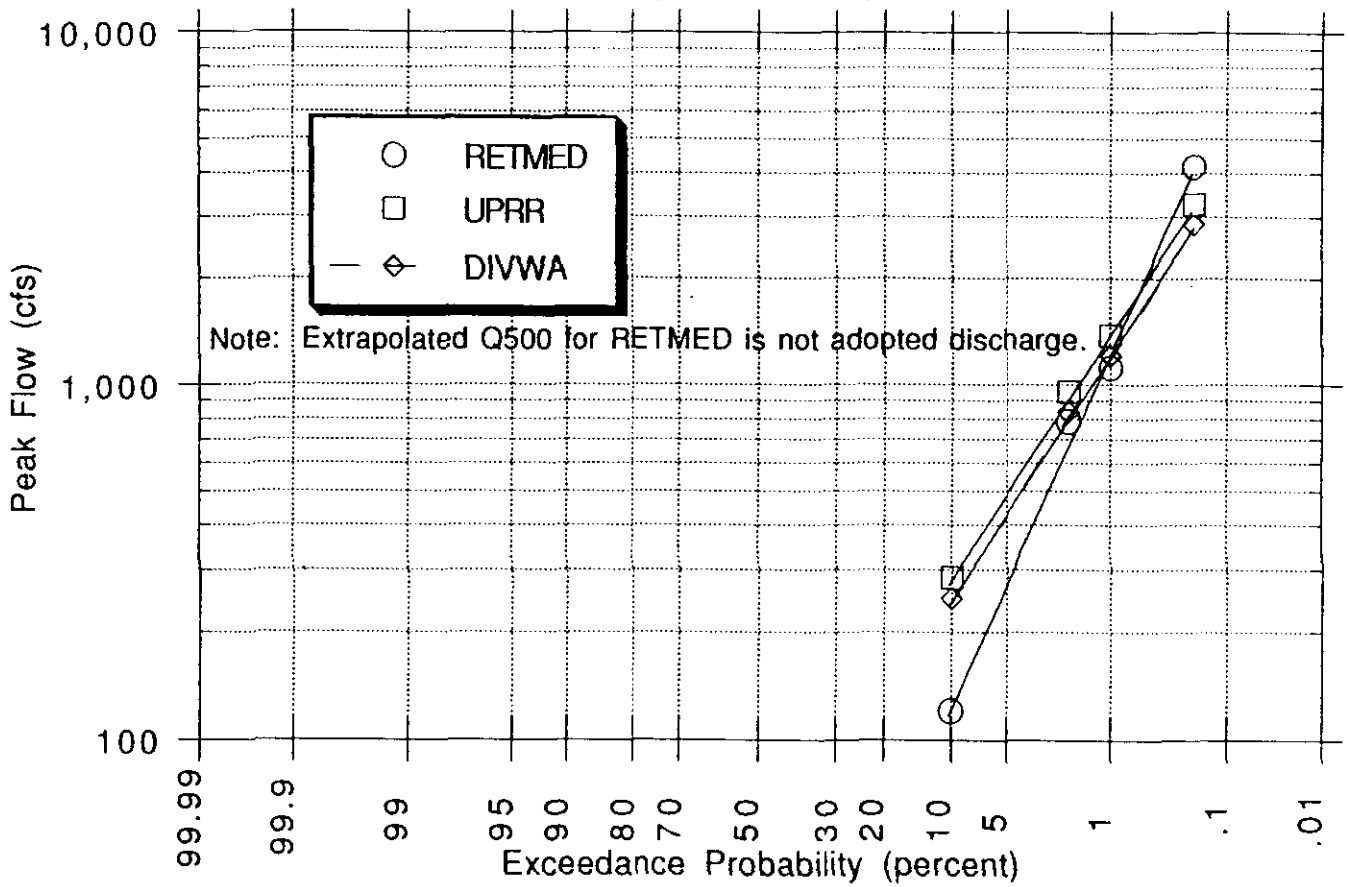


FIGURE 5-4
CENTRAL BASIN FIS DISCHARGES
(PLOT #3)



CHAPTER 10
LOWER LAS VEGAS WASH
FIS HYDROLOGY

CHAPTER 10

LOWER LAS VEGAS WASH FIS HYDROLOGY

INTRODUCTION

This chapter summarizes the existing conditions/existing facilities analysis of Lower Las Vegas Wash conducted for the new FIS Hydrology study for Las Vegas Valley. The purpose of the analysis was to develop acceptable discharges for use in future Flood Insurance Studies for Lower Las Vegas Wash. In addition, results could be used to assess the adequacy of existing facilities to handle existing conditions flood discharges. For purposes of this study, Lower Las Vegas Wash is defined as the main Las Vegas Wash Channel from the Pecos/Lake Mead bridge crossing in North Las Vegas downstream to the Lake Las Vegas intake structure.

The key previous hydrologic analysis of Lower Las Vegas Wash is the Corps of Engineers Special Flood Hazard Study. This study presents existing conditions, computed probability discharges for Lower Las Vegas Wash based on conditions at the time of the analysis (1988). Other previous studies include the CCRFCD Master Plan (1986) and the Clark County Flood Insurance Restudy (1985), both prepared by JMM. The COE study utilized information from each of these analyses. There are no recent feasibility or preliminary design level studies for Lower Las Vegas Wash.

METHOD OF ANALYSIS

The Lower Las Vegas Wash drainage area varies from 735 square miles at Pecos/Lake Mead to 1460 square miles at Telephone Line Road.

Inflows to the study reach consist of six major tributary confluences, and minor local tributary drainages. The major confluences are:

Las Vegas Creek (Washington Ave. Channel)	27	square miles
Range Wash	151	square miles
Flamingo Wash	145	square miles
Duck Creek	234*	square miles
Pittman Wash	118	square miles
C-1 Channel	39	square miles

*Including total Upper Blue Diamond watershed

Due to the large drainage area of Las Vegas Wash compared to the typical storm area of about 200 square miles, previous studies have estimated peak flows in Lower Las Vegas Wash based on the peak inflows from the various major tributaries. Past analyses by JMM and COE found that a general storm covering the entire drainage area would not generate critical peak discharges. The selected approach has been to begin at the upstream end of the study reach and move downstream, adopting the largest peak tributary inflows as Las Vegas Wash peak flows. This approach is conservative in that it does not account for channel routing effects in the Las Vegas Wash floodplain. In addition it does not consider the possibility of concurrent 100-year storms over more than one major tributary; an occurrence of an event of this type would have a return period exceeding 100 years.

Although there are no recent or pending improvements on Lower Las Vegas Wash which would affect peak discharges, the recommended approach accounts for facilities constructed or proposed for construction on each of the major tributaries. Facilities thus incorporated into the "existing conditions" analysis include:

West Range Wash Diversion Dike
North Las Vegas Detention Basin Modifications
Upper Las Vegas Wash Detention Basin and Collection Dike
Gowan Detention Basin and Outfall
Angel Park Detention Basin Modifications
Cheyenne Channel, Buffalo Channel, and Hualpai Diversion
Upper Flamingo Detention Basin

SUMMARY OF RESULTS

Table 10-1 and Figure 10-1 present a summary of existing conditions peak discharges for Lower Las Vegas Wash. Table 10-1 also shows currently adopted regulatory discharges based on the COE Special Flood Hazard Study. It is seen that the FIS Hydrology flows are all significantly lower than the COE flows. This is attributed to the major future detention facilities assumed in the FIS analysis which reduce the peak flows tributary to Las Vegas Wash at most key inflow points. These detention facilities also invalidate flows based on the COE regional regression equations, which do not account for regulation in the tributary watershed. As a result, the FIS Hydrology flows are recommended for use in future FIS studies.

Table 10-2 presents recommended FIS discharges for 10-, 50-, 100-, and 500-year return periods. FIS flows for all recurrence intervals were taken from model results or adopted flows for the major tributaries to Las Vegas Wash, as summarized in Figure 10-1. Although there is excellent agreement between the COE computed probability flows (regulatory discharges) and the FIS flows for the 10-year event, differences become progressively larger for the more severe events. In all cases the FIS flows have been selected as the adopted flows because they account for existing and pending flood control improvements.

TABLE 10-1

COMPARISON OF EXISTING CONDITION 100-YEAR DISCHARGES FOR LOWER LAS VEGAS WASH FIS HYDROLOGY

FIS Hydrology					COE Computed Probability						
CP/Node	Total Area	Storm Area	DARF	Flow	CP/Node	Total Area	DARF	Flow	Notes	Description	Adopted Discharge
L1	735	112	0.59	6730	CP7	735	-	15000	1,4	@ Pecos/Lake Mead	6730
L2	768	112	0.59	6730	CP9	768	-	15000	1,4	D/S of Las Vegas Creek	6730
					CP10	800	-	15000	4	@ Nellis Blvd	
L3	1011	145	0.57	7100					2	D/S of Flamingo Wash	7100
L4	1113	145	0.57	7100	CP3	1100	-	15000	2,4	@ Vegas Valley Dr	7100
L5	1473	164	0.54	11500	CP19	1460	-	16000	3	D/S of Duck Cr	11500

Notes:

General: FIS flows based on largest of upstream tributary inflows to Las Vegas Wash.
FIS flows include effects of pending flood control projects on all tributaries (Upper Las Vegas Wash Detention Basin, West Range Wash Diversion, Gowan Detention Basin, Angel Park Outfall, Upper Flamingo Detention Basin).

1. FIS flow from Northern Las Vegas Wash/Western Tributary drainage area.
2. FIS flow from Flamingo/Tropicana drainage area.
3. FIS flow from Duck/Blue Diamond drainage area.
4. COE flow from Northern Las Vegas Wash

TABLE 10-2

PROPOSED LOWER LAS VEGAS WASH FIS DISCHARGES

Node	Total Area (sq mi)	10-Year Peak Discharge				50-Year Peak Discharge				100-Year Peak Discharge				500-Year Peak Discharge		
		COE Reg Q	COE SFHS Q	Model Output	Adopted Flow	COE Reg Q	COE SFHS Q	Model Output	Adopted Flow	COE Reg Q	COE SFHS Q	Model Output	Adopted Flow	COE SFHS Q	Adopt Extrap	Adopted Flow
L1	735	3600	2000	2160	2200	10900	8600	5120	5100	16200	15000	6730	6700	40000	11600	11600
L2	768	3700	2100	2160	2200	11200	8600	5120	5100	16500	15000	6730	6700	40000	11600	11600
L3	1011	3900	2600	2500	2500	11700	9200	5500	5500	17200	15000	7100	7100	40000	14300	14300
L4	1113	3900	2600	2500	2500	11700	9200	5500	5500	17300	15000	7100	7100	40000	14300	14300
L5	1473	4100	3000	3000	3000	12100	10000	8500	8500	17700	16000	11500	11500	41000	24000	24000

Node	Location
L1	@ Pecos/Lake Mead
L2	D/S of Las Vegas Creek
L3	D/S of Flamingo Wash
L4	@ Vegas Valley Dr
L5	D/S of Duck Cr

COE Reg Q =	Corps of Engineers Regional Discharge-Frequency Relationship
COE SFHS Q =	Corps of Engineers Special Flood Hazard Study
Model Output =	FIS Hydrology HEC-1 Model Output
Adopted Flow =	Adopted Flow for FIS Purposes
Area =	Drainage Area from FIS Hydrology

Note: FIS flows include effects of pending flood control projects on all tributaries (Upper Las Vegas Wash Detention Basin, West Range Wash Diversion, Gowan Detention Basin, Angel Park Outfall, Upper Flamingo Detention Basin).

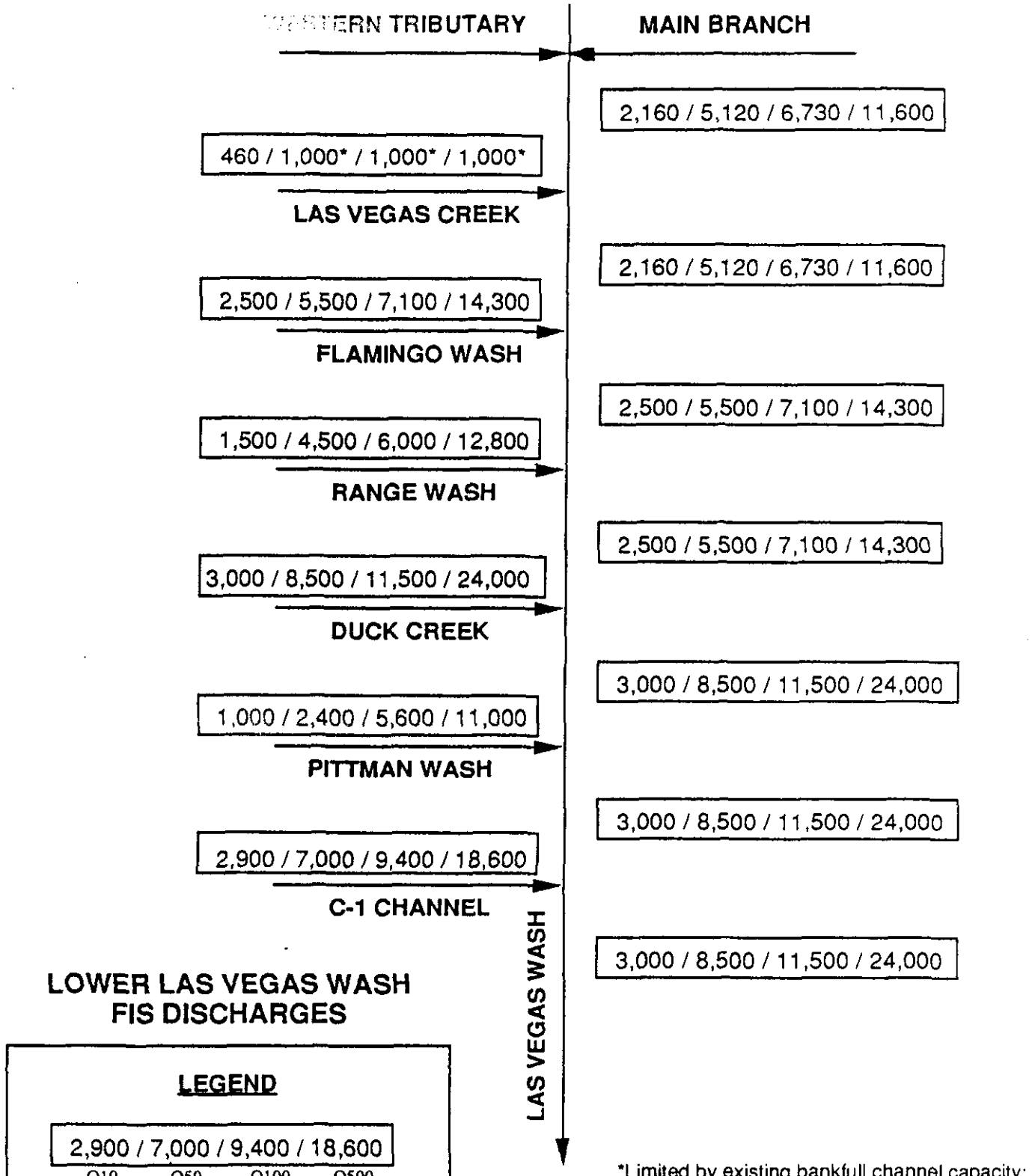


FIGURE 10-1

JMM

APPENDIX A

APPENDIX A

CCRFCD REGULATORY AND INTERIM DISCHARGES

REGIONAL FLOOD CONTROL DISTRICT
OF
CLARK COUNTY

AGENDA ITEM

Subject: REGULATORY DISCHARGES
Petitioner: VIRGINIA BAX-VALENTINE, P.E., GENERAL MANAGER/CHIEF ENGINEER
Recommendation: THAT THE BOARD ADOPT THE DISCHARGES FOR FLOOD INSURANCE PURPOSES ALONG WITH THE STRATEGY TO EVALUATE THE INTERIM DISCHARGE VALUES AND AMEND THE UNIFORM REGULATIONS TO INCLUDE THE INTERIM DISCHARGES

Fiscal Impact:
None

Background:

The U.S. Army Corps of Engineers (COE), Los Angeles District, prepared a report entitled "Special Flood Hazard Study, Las Vegas Wash and Tributaries, Clark County, Nevada," dated July, 1988. This Study was prepared by the COE to provide the District with computed probability discharges for regulatory purposes.

The District distributed copies of this Study to local public and private engineers with a solicitation for comments. Subsequent to the distribution of this study, meetings were held with representatives from Consulting Engineers Council (CEC), the Floodplain Management Committee and the Technical Advisory Committee. A strategy of adopting and examining discharge values in further detail evolved. Common to all the meetings held was the recognization of the need to adopt a single set of discharge values for flood insurance purposes.

Continued.....

T.C. AGENDA	FCD AGENDA
ITEM # 3	ITEM # 3
Date:	Date:
12-29-88	1-12-89

On December 8, 1988, representatives of CEC met with a subcommittee of the Floodplain Management Committee to discuss and review the COE's computed probability values. At its December 13, 1988 meeting, the Floodplain Management Committee recommended that the Technical Advisory Committee adopt the recommendations agreed upon at the December 8, 1988 meeting. The Floodplain Management Committee's recommendations are included in your backup.

STAFF RECOMMENDATION:

Staff recommends that the Board adopt items 1 through 5 and Enclosures A through C, as developed with the Floodplain Management Committee and recommended for approval by the Citizens Advisory Committee and Technical Advisory Committee.

Respectfully submitted,

VIRGINIA BAX-VALENTINE, P.E.
General Manager/Chief Engineer

T.C. AGENDA	FCD AGENDA
ITEM # 3	ITEM # 3
Date:	Date:
12-29-88	1-12-89

FLOODPLAIN MANAGEMENT COMMITTEE RECOMMENDATION

The Floodplain Management Committee, recognizing the need to adopt a single set of discharge values for Flood Insurance purposes, recommends that the Technical Advisory Committee:

1. Adopt the U.S. Army Corps of Engineers (COE), July 1988, Special Flood Hazard Study discharge values that were determined to be reasonable by representatives of the Consulting Engineers Council (CEC) and a subcommittee of the Floodplain Management Committee.

   Reasonableness was determined based upon a qualitative review of the following hydrologic parameters utilized by the COE.

   a. COE's regional approach appears appropriate for larger watersheds.
   b. COE's calibration of their hydrologic model was applied to USGS gaging stations with large watersheds.
   c. COE's loss rates utilized in their hydrologic model appear appropriate for their regional analysis of the larger watersheds.
   d. The rainfall depth-area factors do not differ greatly for storm areal extent of 100 square miles or greater (i.e. large watersheds).

   For flood insurance purposes the discharge values determined to be reasonable are the COE's 100-year return interval computed probability discharges values determined for existing conditions as identified on Enclosure A.

2. Request that staff direct the COE to restudy the Las Vegas Creek system. The restudy will incorporate the physical changes to the Angel Park Detention Basin and include the Meadows Detention Basin.

3. Request that staff proceed with the strategy to review the hydrologic parameters and adopt Flood Insurance discharge values for the drainage system not stated in item 1 above. Enclosure B presents the strategy.

4. Adopt, in the interim, the 100-year return interval COE's computed probability discharge values for existing conditions as identified in Enclosure C, for the District and it's entities.

5. Recognize that hydrologic analyses performed with site specific data and detailed hydrologic parameters may be proven to be more appropriate Flood Insurance discharge values than the COE's discharge values.

ENCLOSURE 1

DISCHARGE VALUES FOR FLOOD INSURANCE PURPOSES
RECOMMENDED FOR ADOPTION **13-Dec-88**

CONCENTRATION POINTS		DRAINAGE AREA (sq.mi.)	100-YEAR DISCHARGE (cfs)
CCRFCD MASTER PLAN (1)	CORPS OF ENGINEERS SPECIAL FLOOD HAZARD STUDY (COE)		
DUCK CREEK :			
#10 (FIG B11)	CP 10 BELOW LAS VEGAS BLVD	130.21	10,500
#12 (FIG B11)	CP 12 PARADISE RD	137.45	11,000
#14 (FIG B11)	CP 14 UNION PACIFIC RAILROAD	205.77	11,500
#57 (FIG B8)	CP 57 SUNSET ROAD	214.36	11,500
#8 (FIG B9)	CP 8 BOULDER HWY	226.31	11,500
RANGE WASH :			
#9 (FIG B-6)	CP 9 OWENS AVENUE	114.30	8,000
#1 (FIG B-9)	CP 1 u.s. of VEGAS VALLEY DRIVE	156.35	8,000
LAS VEGAS WASH :			
#6 (FIG B-5)	CP 6 UNION PACIFIC RAILROAD	733.00	14,500
#7 (FIG B-5)	CP 7 ds. of LAS VEGAS BOULEVARD	735.00	15,000
#9 (FIG B-5)	CP 9 HARRIS and MARION AVENUES	768.00	15,000
#10 (FIG B-5)	CP 10 NELLIS BLVD	800.00	15,000
#3 (FIG B-9)	CP 3 VEGAS VALLEY DRIVE	1100.00	15,000
#19 (FIG B-9)	CP 19 TELEPHONE LINE ROAD	1460.00	16,000
TROPICANA WASH :			
#10 (FIG B-8)	CP 10 I-15	12.34	4,800
#29 (FIG B-8)	CP 29 KOVAL LANE	13.43	4,800
#30 (FIG B-8)	CP 30 us. of FLAMINGO WASH	20.34	4,800
FLAMINGO WASH :			
#35 (FIG B-8)	CP 35 SPENCER STREET	127.76	8,800
#40 (FIG B-8)	CP 40 BOULDER HWY	135.43	9,000

Source: "Special Flood Hazard Study, Las Vegas Wash and Tributaries, Clark County, Nevada" U.S. Army Corps of Engineers, Los Angeles District, July, 1988. Values listed are for present conditions and computed probability.

(1) Clark County Regional Flood Control District - Flood Control Master Plan (October 1986), by James M. Montogomery, Inc.

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DISCHARGE VALUES FOR FLOOD INSURANCE PURPOSES
RECOMMENDED TO BE UTILIZED AS INTERIM VALUES

13-Dec-88

CONCENTRATION POINTS		DRAINAGE AREA (sq.mi.)	100-YEAR DISCHARGE (cfs)
CCRFCD MASTER PLAN (1)	CORPS OF ENGINEERS SPECIAL FLOOD HAZARD STUDY (COE)		
HENDERSON C-1 CHANNEL :			
#46 FIG B-12	CP 46 @ UPRR	7.81	3,800
#42 FIG B-12	CP 42 d.s. of BOULDER HWY	14.00	5,800
#40 FIG B-12	CP 40 BASIC HIGH SCHOOL	21.77	6,400
#27 FIG B-12	CP 27 Major Ave.	29.22	7,600
#23 FIG B-12	CP 23 Apache Place	34.37	8,800
DUCK CREEK :			
#6 FIG B11	CP 4 BLUE DIAMOND @ PARADISE RD.	66.18	8,300
RANGE WASH :			
#8 FIG B-2	CP 8 I-15	53.94	7,000
#12 FIG B-5	CP 12 LAS VEGAS BOULEVARD	78.56	7,500
#14 FIG B-5	CP 14 CAREY AVENUE	82.18	7,500
#4 FIG B-6	CP 4 E. RANGE WASH u.s. of CAREY	59.84	5,600
TROPICANA WASH :			
#4 FIG B-8	CP 4 S. TROPICANA @ UPRR	2.79	3,000
#7 FIG B-8	CP 7 along UPRR	8.31	2,400
#9 FIG B-8	CP 9 N. TROPICANA @ UPRR	10.86	3,100
FLAMINGO WASH :			
#18 FIG B-8	CP 18 N. FLAMINGO @ I-15	7.75	1,500
#26 FIG B-7	CP 26 SPANISH TRAILS GOLF COURSE	91.86	7,000
#12 FIG B-8	CP 12 DECATUR BLVD	96.54	7,800
#13 FIG B-8	CP 13 @ UPRR	97.55	7,800
#14 FIG B-8	CP 14 @ UPRR	97.55	6,000
#16 FIG B-8	CP 16 @ I-15	98.07	6,000
PITTMAN WASH :			
#23 FIG B-11	CP 23 UPRR	86.34	10,500
#9 FIG B-9	CP 9 us. of BOULDER HIGHWAY	88.87	1,300
#10 FIG B-9	CP10 us. of LAS VEGAS WASH	89.90	1,500

Source: "Special Flood Hazard Study, Las Vegas Wash and Tributaries, Clark County, Nevada" U.S. Army Corps of Engineers, Los Angeles District, July, 1988. Values listed are for present conditions and computed probability.

(1) Clark County Regional Flood Control District - Flood Control Master Plan (October 1986), by James M. Montogomery, Inc.

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APPENDIX B

APPENDIX B

OVERALL WATERSHED SUBAREA MAPS

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

45 SUBAREA DESIGNATION

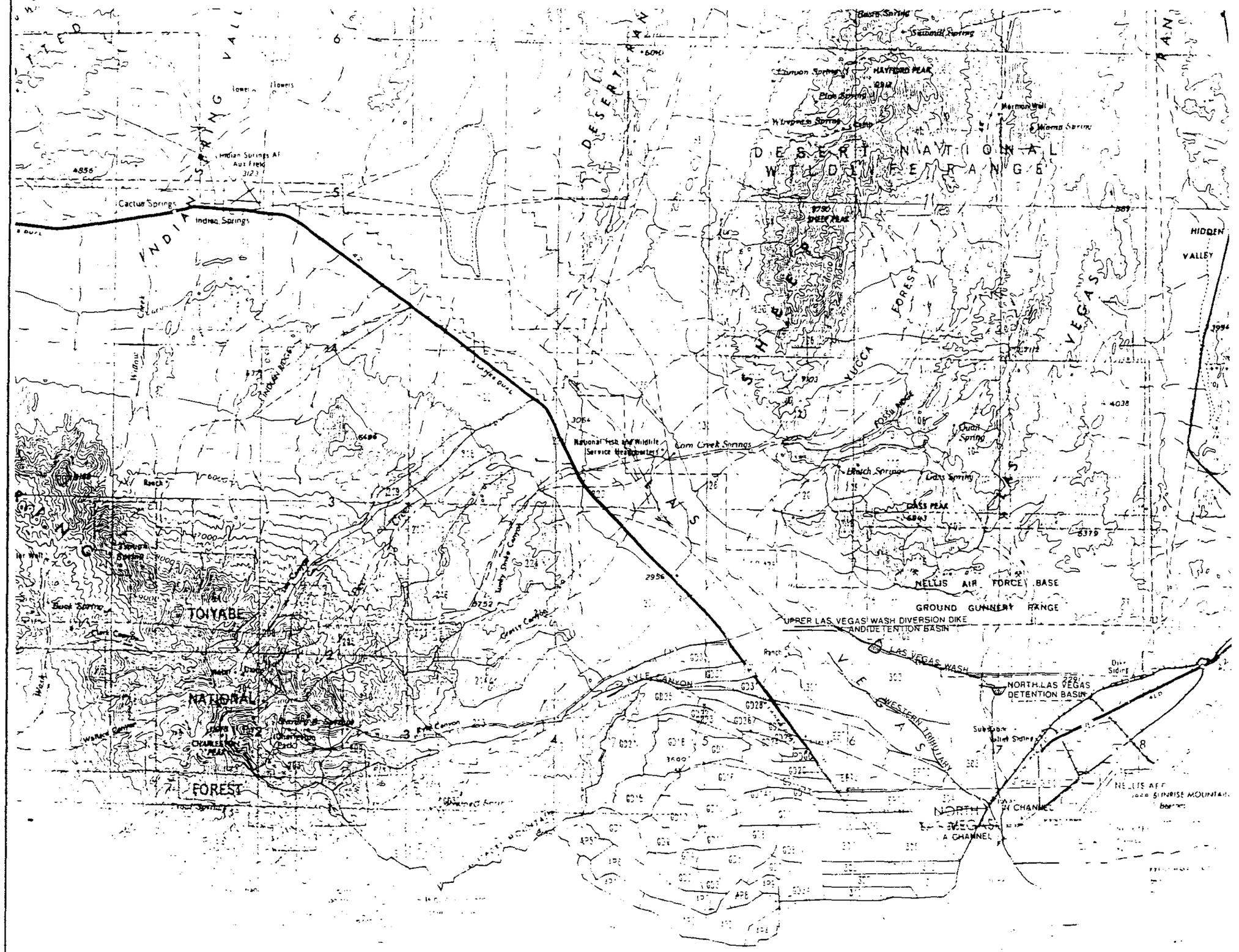
SUBAREA DELINEATION

0 7,500 15,000 22,500
(APPROXIMATE)

RANGE WASH
HYDROLOGIC SUBAREAS

FIGURE S-1

James M. Montgomery
Consulting Engineers, Inc.


INDIAN SPRING VALLEY
DESERT RANGE
DESERT NATIONAL WILDLIFE RANGE
SPRING MOUNTAINS
LAS VEGAS RANGE
HIDDEN VALLEY
Cactus Springs
Indian Springs
Indian Springs AF Aux Field
Lower
Flowers
Basin Spring
Sawmill Spring
Stinson Spring
HAYFORD PEAK
Pine Spring
Mormon Well
W Potosi Spring
E Potosi Spring
DEEP PEAK
HIGHWAY 95
LAS VEGAS
FOREST
YUCCA
Fossil Ridge
Quail Spring
Black Spring
Cats Spring
CASS PEAK
Corn Creek Springs
National Fish and Wildlife Service Headquarters
TOIYABE
NATIONAL
FOREST
CHARLESTON PEAK
NELLIS AIR FORCE BASE
GROUND GUNNERY RANGE
UPPER LAS VEGAS WASH DIVERSION DIKE AND DETENTION BASIN
LAS VEGAS WASH
NORTH LAS VEGAS DETENTION BASIN
KYLE CANYON
WESTERN TRIBUTARY
NORTH LAS VEGAS A CHANNEL
NELLIS AFB
SUNRISE MOUNTAIN
Fish Canyon
Lovell Canyon
Wilson Creek
Indian Ranch
Ranch
Dam
Tank
Well
Spring
Mine
Cabin
Camp
Diversion
Substation
Diversion Structure
Diversion Channel
Detention Basin
Levee
Dike
Siding
Pipeline
Transmission Line
Road
Trail
Creek
Canyon
Wash
Mountain
Peak
Ridge
Valley
Forest
Range
Basin
Lake
Reservoir
Airport
Airfield
Runway
Building
Tower
Antenna
Fence
Gate
Bridge
Culvert
Pump
Well
Spring
Tank
Dam
Levee
Channel
Diversion
Detention
Substation
Pipeline
Transmission

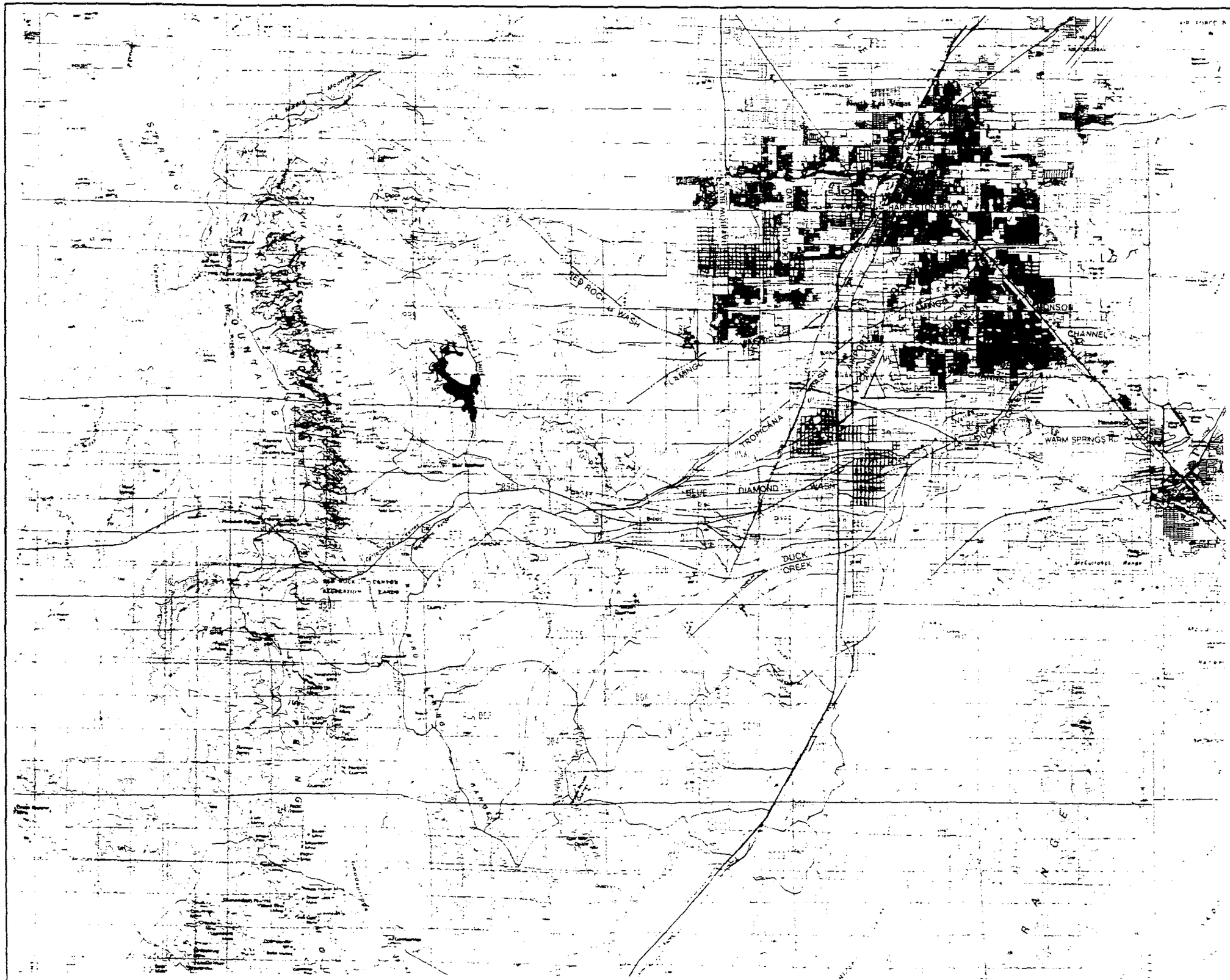
CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

45 SUBAREA DESIGNATION

SUBAREA DELINEATION



(APPROXIMATE)

SOUTHWEST BASIN
HYDROLOGIC SUBAREAS

FIGURE S-4

James M. Montgomery
Consulting Engineers, Inc.

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

45 SUBAREA DESIGNATION

SUBAREA DELINEATION

5,000' 10,000' 15,000'
(APPROXIMATE)

HENDERSON BASIN HYDROLOGIC SUBAREAS

FIGURE S-5

James M. Montgomery
Consulting Engineers, Inc.

NORTHWEST FLOOD STUDY_C

NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY

Clark County, Nevada

Technical Data Notebook Appendix III
Supporting Technical Data for Hydrologic Analyses

Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

CVL CONSULTANTS, INC., 6655 W. SAHARA, SUITE A-200, LAS VEGAS, NV 89103 (702) 368-3008
PENTACORE ENGINEERING, INC., 6763 W. CHARLESTON BLVD., LAS VEGAS, NV 89102 (702) 258-0115

Northwest Las Vegas Flood Insurance Study Restudy
Clark County, Nevada

Technical Data Notebook
Appendix III - Supporting Technical Data for Hydrologic Analyses

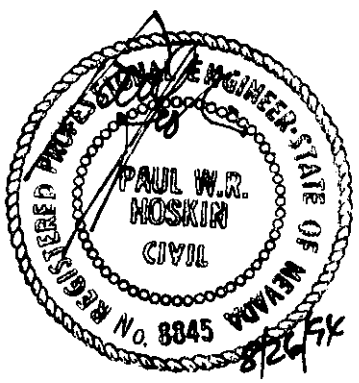
Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

301 East Clark Avenue, Suite 300
Las Vegas, Nevada 89101

August 26, 1994



CVL CONSULTANTS, INC., 6655 W. SAHARA, SUITE A-200, LAS VEGAS, NV 89103 (702) 368-3008
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Flood Insurance Study Restudy
for
Northwest Las Vegas

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- Wash.dat
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Northwest Las Vegas

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Section 1
FEMA Forms

Form 2
Certification by Registered Professional Engineer

FEDERAL EMERGENCY MANAGEMENT AGENCY
CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in civil hydrology and hydraulics
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 14 years experience in the expertise listed above.
4. I have ☒ prepared ☐ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Hydrologic, hydraulic & floodplain analyses
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☐ Examined plans and specifications and compared with completed projects.
   d. ☒ Other Compiled and reviewed plans and design reports
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Paul W.R. Hoskin, P.E.
(please print or type)

Title: Vice President
(please print or type)

Registration No. 8845

Expiration Date:

State Nevada

Type of License Civil

Signature

8/26/94
Date

Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

Form 3
Hydrologic Analysis

FEDERAL EMERGENCY MANAGEMENT AGENCY **HYDROLOGIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.67 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada

Flooding Source: Kyle Canyon
(One form for each flooding source)

Project Name/Identifier: Northwest Las Vegas Flood Insurance Study Restudy

1. HYDROLOGIC ANALYSIS IN FIS

☐ Approximate study stream (Zone A)

☒ Detailed study stream (briefly explain methodology) HEC-1 computer model (kyle.dat)

2. REASON FOR NEW HYDROLOGIC ANALYSIS

☐ No existing analysis

☐ Improved data *(see data revision on page 3)*

☒ Changed physical conditions of watershed *(explain)* Kyle Canyon detention basin has been constructed.

☐ Alternative methodology *(justify why the revised model is better than model used in the effective FIS)*

☐ Evaluation of proposed conditions (CLOMRs only) (explain)

☐ Other

If a computer program/model was used in revising the hydrologic analysis, please provide a diskette with the input files for the 10-, 50-, 100- and 500-year recurrence intervals.

Only the 100-year recurrence interval need be included for SFHAs designated as Zone A.

3. APPROVAL OF ANALYSIS

☒ Approval of the hydrologic analysis, including the resulting peak discharge value(s) has been provided by the appropriate local, state, or Federal Agency. (i.e., Clark County Regional Flood Control District (Refer to Community Concurrence Letter)

Attach evidence of approval.

☐ Approval of the hydrologic analysis is not required by any local, State or Federal Agency.

4. REVIEW OF RESULTS

Stream: Kyle Canyon

Comparison of 100-year Discharges

Location:	Drainage area (Sq. mi.)	FIS (cfs):	Revised (cfs):
Kyle Canyon Detention Basin Inflow	58	n/a	13,427
Kyle Canyon Detention Basin Outflow			360

Note: When revised discharges are not significantly different than FIS discharges, FEMA may require a confidence limits analysis on attachment D at a later date to complete the review.

As is often the case with revision requests, only a portion of a stream may actually be revised or be affected by a revision. Therefore, transition to the unrevised portion is important to maintain the continuity of the study. NFIP regulations stipulate that such a transition must be assured. What is the transition from the proposed discharges to the effective discharges? Please explain how the transition was made *(attach separate sheet if necessary)*.

ATTACH A COMPLETED REVIEW OF RESULTS PAGE FOR EACH FLOODING SOURCE.

Is the new hydrologic analysis being developed solely to revise the flow values presented in the FIS *(i.e. no changed hydraulic conditions)?* ☐ Yes ☒ No

If yes, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

FEMA does not normally revise NFIP maps solely due to insignificant flow changes where changes in 100-year water surface elevation are less than 1.0 foot.

5. HISTORICAL FLOODING INFORMATION

Is historical data available for the flooding source? ☐ Yes ☒ No

If yes, provide the following:

Location along flooding source: _____

Maximum peak discharge: _____ cfs

Second highest peak discharge: _____ cfs

Source of information: _____

6. GAGE RECORD INFORMATION

Location of nearest gage to project site *(along flooding source or similar watershed; specify)*

None

Gaging Station: _____

Drainage area at gage: _____ mi^2

Number of years of data: _____

7. DATA REVISION

Please use the following table to list all the data and/or parameters affected by this request and identify them as new data *(New)* or as revising existing data *(Revised)*. *(If necessary, attach a separate sheet.)*

Data Parameter	New	Revised	Data Source
Subbasin Areas	☐	☒	U.S.G.S.
Lag Time	☐	☒	U.S.G.S. CCRFCD Manual
Depth-Area Reduction Factor	☐	☒	CCRFCD Manual
Rainfall Distribution	☐	☒	CCRFCD Manual
	☐	☐	

- Data source can be from a Federal, State, or local government agency, or from a private source. Some State and local governments may have less strict data requirements than Federal agencies, in which case the hydrologic data may not be accepted by FEMA unless it is demonstrated that the data give a better estimate of the flood discharge.
- Attach documentation corroborating each data source *(i.e., certified statement, report, bibliographical reference to a published document)*. In the case of a published document or a government report, providing copies of the cover and pertinent pages may be helpful.

8. METHODOLOGY FOR NEW ANALYSIS

☐ Statistical Analysis of Gage Records *(use Attachment A)*

☐ Regional Regression Equations *(use Attachment B)*

☒ Precipitation/Runoff Model *(use Attachment C)*

☐ Other *(specify; attach backup computations and supporting data)* _____

_____

ATTACHMENT A: STATISTICAL ANALYSIS OF GAGE RECORDS

Gaging Station: n/a

Gage Location (latitude and longitude): _____

		FIS:	Revised:
1.	Number of years of data	_____	_____
	Systematic	_____	_____
	Historical	_____	_____
2.	Homogeneous data	☐ Yes ☐ No	☐ Yes ☐ No
3.	Data adjustments	☐ Yes ☐ No	☐ Yes ☐ No
4.	Number of high outliers	_____	_____
	Low outliers	_____	_____
	Zero events	_____	_____
5.	Generalized skew	_____	_____
6.	Station skew	_____	_____
7.	Adopted skew	_____	_____
8.	Probability distribution used (justify if log-Pearson *III* was not used)	_____	_____
9.	Transfer equations to ungaged sites.		☐ Yes ☐ No
	If yes, specify method		

_____

_____

_____

10. Expected probability* ☐ Yes ☐ No

11. Comparison of results with other analyses. ☐ Yes ☐ No

If yes, describe comparison

_____

_____

_____

* FEMA does not accept expected probability analyses for the purpose of reflecting flood hazard information in a FIS.

If any data is not available, indicate by N/A.

Attach analysis including plot of flood frequency curve.

FEDERAL EMERGENCY MANAGEMENT AGENCY **HYDROLOGIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.67 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada

Flooding Source: Gowan Area and North Las Vegas Valley
(One form for each flooding source)

Project Name/Identifier: Northwest Las Vegas Flood Insurance Study Restudy

1. HYDROLOGIC ANALYSIS IN FIS

☐ *Approximate study stream (Zone A)*

☒ Detailed study stream (briefly explain methodology) HEC-1 computer model (CAREY-F.DAT)

2. REASON FOR NEW HYDROLOGIC ANALYSIS

☐ No existing analysis

☐ Improved data *(see data revision on page 3)*

☒ Changed physical conditions of watershed *(explain)* Gowan north and south detention basin, Angel Park detention basin, Buffalo Channel, and Carey/Lake Mead detention basin have been constructed.

☐ Alternative methodology *(justify why the revised model is better than model used in the effective FIS)*

☐ Evaluation of proposed conditions (CLOMRs only) (explain)

☐ Other

If a computer program/model was used in revising the hydrologic analysis, please provide a diskette with the input files for the 10-, 50-, 100- and 500-year recurrence intervals.

Only the 100-year recurrence interval need be included for SFHAs designated as Zone A.

3. APPROVAL OF ANALYSIS

☒ Approval of the hydrologic analysis, including the resulting peak discharge value(s) has been provided by the appropriate local, state, or Federal Agency. (i.e., Clark County Regional Flood Control District (Refer to Community Concurrence Letter)
Attach evidence of approval.

☐ Approval of the hydrologic analysis is not required by any local, State or Federal Agency.

4. REVIEW OF RESULTS

Stream: _____

Comparison of 100-year Discharges

Location:	Drainage area (Sq. mi.)	FIS (cfs):	Revised (cfs):
Gowan North Detention Basin Inflow	52	n/a	3,925
Highway 95 and Rancho Dr. Intersection	4	n/a	437
Highway 95 and Gowan Rd. Intersection	19	n/a	2,829
Rancho Dr. and Washington Ave. Intersection	3	n/a	537
Carey/Lake Mead Detention Basin Inflow	8	n/a	2,236

Note: When revised discharges are not significantly different than FIS discharges, FEMA may require a confidence limits analysis on attachment D at a later date to complete the review.

As is often the case with revision requests, only a portion of a stream may actually be revised or be affected by a revision. Therefore, transition to the unrevised portion is important to maintain the continuity of the study. NFIP regulations stipulate that such a transition must be assured. What is the transition from the proposed discharges to the effective discharges? Please explain how the transition was made *(attach separate sheet if necessary)*.

ATTACH A COMPLETED REVIEW OF RESULTS PAGE FOR EACH FLOODING SOURCE.

Is the new hydrologic analysis being developed solely to revise the flow values presented in the FIS *(i.e. no changed hydraulic conditions)?* ☐ Yes ☒ No

If yes, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

FEMA does not normally revise NFIP maps solely due to insignificant flow changes where changes in 100-year water surface elevation are less than 1.0 foot.

5. HISTORICAL FLOODING INFORMATION

Is historical data available for the flooding source? ☐ Yes ☒ No

If yes, provide the following:

Location along flooding source: _____

Maximum peak discharge: _____ cfs

Second highest peak discharge: _____ cfs

Source of information: _____

6. GAGE RECORD INFORMATION

Location of nearest gage to project site *(along flooding source or similar watershed; specify)*

None

Gaging Station: _____

Drainage area at gage: _____ mi^2

Number of years of data: _____

7. DATA REVISION

Please use the following table to list all the data and/or parameters affected by this request and identify them as new data *(New)* or as revising existing data *(Revised)*. *(If necessary, attach a separate sheet.)*

Data Parameter	New	Revised	Data Source
Subbasin Areas	☐	☒	U.S.G.S.
Lag Time	☐	☒	U.S.G.S, CCRFCD Manual
Depth-Area Reduction Factor	☐	☒	CCRFCD Manual
Rainfall Distribution	☐	☒	CCRFCD Manual
	☐	☐	

- Data source can be from a Federal, State, or local government agency, or from a private source. Some State and local governments may have less strict data requirements than Federal agencies, in which case the hydrologic data may not be accepted by FEMA unless it is demonstrated that the data give a better estimate of the flood discharge.
- Attach documentation corroborating each data source *(i.e., certified statement, report, bibliographical reference to a published document)*. In the case of a published document or a government report, providing copies of the cover and pertinent pages may be helpful.

8. METHODOLOGY FOR NEW ANALYSIS

☐ Statistical Analysis of Gage Records *(use Attachment A)*

☐ Regional Regression Equations *(use Attachment B)*

☒ Precipitation/Runoff Model *(use Attachment C)*

☐ Other *(specify; attach backup computations and supporting data)* _____

_____

ATTACHMENT A: STATISTICAL ANALYSIS OF GAGE RECORDS

Gaging Station: n/a

Gage Location (latitude and longitude): _____

		FIS:	Revised:
1.	Number of years of data	_____	_____
	Systematic	_____	_____
	Historical	_____	_____
2.	Homogeneous data	☐ Yes ☐ No	☐ Yes ☐ No
3.	Data adjustments	☐ Yes ☐ No	☐ Yes ☐ No
4.	Number of high outliers	_____	_____
	Low outliers	_____	_____
	Zero events	_____	_____
5.	Generalized skew	_____	_____
6.	Station skew	_____	_____
7.	Adopted skew	_____	_____
8.	Probability distribution used (justify if log-Pearson III was not used)	_____	_____
9.	Transfer equations to ungaged sites.		☐ Yes ☐ No
	If yes, specify method		

_____

_____

_____

10.	Expected probability*	☐ Yes ☐ No
11.	Comparison of results with other analyses.	☐ Yes ☐ No
	If yes, describe comparison	

_____

_____

_____

* FEMA does not accept expected probability analyses for the purpose of reflecting flood hazard information in a FIS.

If any data is not available, indicate by N/A.

ach analysis including plot of flood frequency curve.

ATTACHMENT B: REGIONAL REGRESSION EQUATIONS

1. *Bibliographical Reference:*

N/A

(Attach a copy of title page, table of contents, and pertinent pages including equations.)

2. Gaged or ungaged stream: _____

3. Hydrologic region(s): _____
Attach backup map.

4. Provide parameters, values, and source of data used to define parameters.

		FIS:	Revised:
5.	Urbanized conditions calculations	☐ Yes ☐ No	☐ Yes ☐ No
6.	Percent of watershed urbanization	_____	_____
7.	Is the watershed controlled?	☐ Yes ☐ No	☐ Yes ☐ No
8.	Comparison with other analyses	☐ Yes ☐ No	☐ Yes ☐ No

If the answer to 5, 7, or 8 is yes, explain methodology in Comments.

If data is not available, indicate by N/A.

Comments

Attach computation and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT C: PRECIPITATION/RUNOFF MODEL

		FIS:	Revised:
1.	Method or model used:		HEC-1
	Version:		4.0
	Date:		9/90
2.	Source of rainfall depth:		NOAA Atlas 2
3.	Source of rainfall distribution:		CCRFCD Manual
4.	Rainfall duration:		6 hours
5.	Areal adjustment to precipitation (%):		CCRFCD Manual
6.	Hydrograph development method:		CCRFCD Manual
7.	Loss rate method:		SCS curve number
	Source of soils information:		SCS soils map
	Source of land use information:		
8.	Channel routing method:		Muskingum & Kinematic Wave
9.	Reservoir routing:	☐ Yes ☐ No	☒ Yes ☐ No
10.	Baseflow considerations:	☐ Yes ☐ No	☐ Yes ☒ No

If yes, explain how baseflow was determined:

N/A

11.	Snowmelt considerations:	☐ Yes ☐ No	☐ Yes ☒ No
12.	Model calibration:	☐ Yes ☐ No	☐ Yes ☒ No

If yes, explain how calibration was performed

13.	Future land use condition:	☐ Yes ☒ No

If yes, explain why:

Note: FEMA policy is to base flooding on existing conditions.

If data is not available, indicate by N/A.

Attach precipitation/runoff model, hydrologic model schematic, curve number calculations, time of concentration calculations, and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT D: CONFIDENCE LIMITS EVALUATION

Stream: N/A

Select one location for Confidence Limits Evaluation *(describe location):* _____

_____

Discharges for selected location:

Exceedance Probability	FIS		Revised	
10% (10-year)	_____	cfs	_____	cfs
2% (50-year)	_____	cfs	_____	cfs
1% (100-year)	_____	cfs	_____	cfs
0.2% (500-year)	_____	cfs	_____	cfs

1% (100-year) Flood Confidence Intervals

90% Confidence Interval:
5% limit _____ cfs
95% limit _____ cfs

50% Confidence Interval:
25% limit _____ cfs
75% limit _____ cfs

If the value of the 100-year frequency flood in the FIS is beyond the 50% confidence interval but within the 90% confidence interval, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

An example of confidence limits analysis can be found in Appendix 9 of Bulletin 17B.

Attach Confidence Limits Analysis.

ATTACHMENT C: PRECIPITATION/RUNOFF MODEL

		FIS:	Revised:
1.	Method or model used:	n/a	HEC-1
	Version:		4.0
	Date:		9/90
2.	Source of rainfall depth:		NOAA Atlas 2
3.	Source of rainfall distribution:		CCRFCD Manual
4.	Rainfall duration:		6 hours
5.	Areal adjustment to precipitation (%):		CCRFCD Manual
6.	Hydrograph development method:		CCRFCD Manual
7.	Loss rate method:		SCS curve number
	Source of soils information:		SCS soils map
	Source of land use information:		
8.	Channel routing method:		Muskingum & Kinematic Wave
9.	Reservoir routing:	☐ Yes ☐ No	☒ Yes ☐ No
10.	Baseflow considerations:	☐ Yes ☐ No	☐ Yes ☒ No
	If yes, explain how baseflow was determined:		
	N/A		
11.	Snowmelt considerations:	☐ Yes ☐ No	☐ Yes ☒ No
12.	Model calibration:	☐ Yes ☐ No	☐ Yes ☒ No
	If yes, explain how calibration was performed		
13.	Future land use condition:		☐ Yes ☒ No
	If yes, explain why:		

Note: FEMA policy is to base flooding on existing conditions.

If data is not available, indicate by N/A.

h precipitation/runoff model, hydrologic model schematic, curve number calculations, time of concentration calculations, and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT D: CONFIDENCE LIMITS EVALUATION

Stream: N/A

Select one location for Confidence Limits Evaluation *(describe location):* _____

_____

Discharges for selected location:

Exceedance Probability	FIS		Revised	
10% (10-year)	_____	cfs	_____	cfs
2% (50-year)	_____	cfs	_____	cfs
1% (100-year)	_____	cfs	_____	cfs
0.2% (500-year)	_____	cfs	_____	cfs

1% (100-year) Flood Confidence Intervals

90% Confidence Interval:
5% limit _____ cfs
95% limit _____ cfs

50% Confidence Interval:
25% limit _____ cfs
75% limit _____ cfs

If the value of the 100-year frequency flood in the FIS is beyond the 50% confidence interval but within the 90% confidence interval, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

An example of confidence limits analysis can be found in Appendix 9 of Bulletin 17B.

Attach Confidence Limits Analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **HYDROLOGIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.67 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada

Flooding Source: Carey/Lake Mead Area
(One form for each flooding source)

Project Name/Identifier: Northwest Las Vegas Flood Insurance Study Restudy

1. HYDROLOGIC ANALYSIS IN FIS

☐ Approximate study stream (Zone A)

☒ Detailed study stream (briefly explain methodology) HEC-1 computer model (WASH.DAT)

2. REASON FOR NEW HYDROLOGIC ANALYSIS

☐ No existing analysis

☐ Improved data *(see data revision on page 3)*

☒ Changed physical conditions of watershed *(explain)* Carey/Lake Mead detention basin have been constructed.

☐ Alternative methodology *(justify why the revised model is better than model used in the effective FIS)*

☐ Evaluation of proposed conditions (CLOMRs only) (explain)

☐ Other

If a computer program/model was used in revising the hydrologic analysis, please provide a diskette with the input files for the 10-, 50-, 100- and 500-year recurrence intervals.

Only the 100-year recurrence interval need be included for SFHAs designated as Zone A.

3. APPROVAL OF ANALYSIS

☒ Approval of the hydrologic analysis, including the resulting peak discharge value(s) has been provided by the appropriate local, state, or Federal Agency. (i.e., Clark County Regional Flood Control District (Refer to Community Concurrence Letter))
Attach evidence of approval.

☐ Approval of the hydrologic analysis is not required by any local, State or Federal Agency.

4. REVIEW OF RESULTS

Stream: _____

Comparison of 100-year Discharges

Location:	Drainage area (Sq. mi.)	FIS (cfs):	Revised (cfs):
Rancho Drive & Vegas Drive Intersection	1	n/a	364
Highland and Balzar Intersection	2	n/a	598
Rancho Drive and Washington Ave. Intersection	3	n/a	537
Carey/Lake Mead Retention Basin Inflow	8	n/a	2,236
Below Carey/Lake Mead Detention Basin	8	n/a	310

Note: When revised discharges are not significantly different than FIS discharges, FEMA may require a confidence limits analysis on attachment D at a later date to complete the review.

As is often the case with revision requests, only a portion of a stream may actually be revised or be affected by a revision. Therefore, transition to the unrevised portion is important to maintain the continuity of the study. NFIP regulations stipulate that such a transition must be assured. What is the transition from the proposed discharges to the effective discharges? Please explain how the transition was made *(attach separate sheet if necessary)*.

ATTACH A COMPLETED REVIEW OF RESULTS PAGE FOR EACH FLOODING SOURCE.

Is the new hydrologic analysis being developed solely to revise the flow values presented in the FIS *(i.e. no changed hydraulic conditions)?* ☐ Yes ☒ No

If yes, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

FEMA does not normally revise NFIP maps solely due to insignificant flow changes where changes in 100-year water surface elevation are less than 1.0 foot.

5. HISTORICAL FLOODING INFORMATION

Is historical data available for the flooding source? ☐ Yes ☒ No

If yes, provide the following:

Location along flooding source: _____

Maximum peak discharge: _____ cfs

Second highest peak discharge: _____ cfs

Source of information: _____

6. GAGE RECORD INFORMATION

Location of nearest gage to project site *(along flooding source or similar watershed; specify)*

None

Gaging Station: _____

Drainage area at gage: _____ mi^2

Number of years of data: _____

7. DATA REVISION

Please use the following table to list all the data and/or parameters affected by this request and identify them as new data *(New)* or as revising existing data *(Revised)*. *(If necessary, attach a separate sheet.)*

Data Parameter	New	Revised	Data Source
Subbasin Areas	☐	☒	U.S.G.S.
Lag Time	☐	☒	U.S.G.S, CCRFCD Manual
Depth-Area Reduction Factor	☐	☒	CCRFCD Manual
Rainfall Distribution	☐	☒	CCRFCD Manual
	☐	☐	

- Data source can be from a Federal, State, or local government agency, or from a private source. Some State and local governments may have less strict data requirements than Federal agencies, in which case the hydrologic data may not be accepted by FEMA unless it is demonstrated that the data give a better estimate of the flood discharge.
- Attach documentation corroborating each data source *(i.e., certified statement, report, bibliographical reference to a published document)*. In the case of a published document or a government report, providing copies of the cover and pertinent pages may be helpful.

8. METHODOLOGY FOR NEW ANALYSIS

☐ Statistical Analysis of Gage Records *(use Attachment A)*

☐ Regional Regression Equations *(use Attachment B)*

☒ Precipitation/Runoff Model *(use Attachment C)*

☐ Other *(specify; attach backup computations and supporting data)* _____

_____

ATTACHMENT A: STATISTICAL ANALYSIS OF GAGE RECORDS

Gaging Station: N/A

Gage Location (latitude and longitude): _____

		FIS:	Revised:
1.	Number of years of data	_____	_____
	Systematic	_____	_____
	Historical	_____	_____
2.	Homogeneous data	☐ Yes ☐ No	☐ Yes ☐ No
3.	Data adjustments	☐ Yes ☐ No	☐ Yes ☐ No
4.	Number of high outliers	_____	_____
	Low outliers	_____	_____
	Zero events	_____	_____
5.	Generalized skew	_____	_____
6.	Station skew	_____	_____
7.	Adopted skew	_____	_____
8.	Probability distribution used (justify if log-Pearson III was not used)	_____	_____
9.	Transfer equations to ungaged sites.		☐ Yes ☐ No
	If yes, specify method		
10.	Expected probability*		☐ Yes ☐ No
11.	Comparison of results with other analyses.		☐ Yes ☐ No
	If yes, describe comparison		

* FEMA does not accept expected probability analyses for the purpose of reflecting flood hazard information in a FIS.

If any data is not available, indicate by N/A.

Attach analysis including plot of flood frequency curve.

1. Bibliographical Reference:

N/A

(Attach a copy of title page, table of contents, and pertinent pages including equations.)

2. Gaged or ungaged stream: _____

3. Hydrologic region(s): _____
Attach backup map.

4. Provide parameters, values, and source of data used to define parameters.

		FIS:	Revised:
5.	Urbanized conditions calculations	☐ Yes ☐ No	☐ Yes ☐ No
6.	Percent of watershed urbanization	_____	_____
7.	Is the watershed controlled?	☐ Yes ☐ No	☐ Yes ☐ No
8.	Comparison with other analyses	☐ Yes ☐ No	☐ Yes ☐ No

If the answer to 5, 7, or 8 is yes, explain methodology in Comments.

If data is not available, indicate by N/A.

Comments

Attach computation and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT B: REGIONAL REGRESSION EQUATIONS

1. Bibliographical Reference:

N/A

(Attach a copy of title page, table of contents, and pertinent pages including equations.)

2. Gaged or ungaged stream: _____

3. Hydrologic region(s): _____
Attach backup map.

4. Provide parameters, values, and source of data used to define parameters.

		FIS:	Revised:
5.	Urbanized conditions calculations	☐ Yes ☐ No	☐ Yes ☐ No
6.	Percent of watershed urbanization	_____	_____
7.	Is the watershed controlled?	☐ Yes ☐ No	☐ Yes ☐ No
8.	Comparison with other analyses	☐ Yes ☐ No	☐ Yes ☐ No

If the answer to 5, 7, or 8 is yes, explain methodology in Comments.

If data is not available, indicate by N/A.

Comments

Attach computation and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT C: PRECIPITATION/RUNOFF MODEL

		FIS:	Revised:
1.	Method or model used:		HEC-1
	Version:		4.0
	Date:		9/90
2.	Source of rainfall depth:		NOAA Atlas 2
3.	Source of rainfall distribution:		CCRFCD Manual
4.	*Rainfall duration:*		*6 hours*
5.	Areal adjustment to precipitation (%):		CCRFCD Manual
6.	Hydrograph development method:		CCRFCD Manual
7.	Loss rate method:		SCS curve number
	Source of soils information:		SCS soils map
	Source of land use information:		
8.	Channel routing method:		Muskingum & Kinematic Wave
9.	Reservoir routing:	☐ Yes ☐ No	☒ Yes ☐ No
10.	Baseflow considerations:	☐ Yes ☐ No	☐ Yes ☒ No
	If yes, explain how baseflow was determined:		
	N/A		
11.	Snowmelt considerations:	☐ Yes ☐ No	☐ Yes ☒ No
12.	Model calibration:	☐ Yes ☐ No	☐ Yes ☒ No
	If yes, explain how calibration was performed		
13.	Future land use condition:		☐ Yes ☒ No
	If yes, explain why:		

Note: FEMA policy is to base flooding on existing conditions.

If data is not available, indicate by N/A.

Attach precipitation/runoff model, hydrologic model schematic, curve number calculations, time of concentration calculations, and supporting maps, delineating the watershed boundary and drainage area divides.

Stream: N/A

Select one location for Confidence Limits Evaluation *(describe location):* _____

_____

Discharges for selected location:

Exceedance Probability	FIS		Revised	
10% (10-year)	_____	cfs	_____	cfs
2% (50-year)	_____	cfs	_____	cfs
1% (100-year)	_____	cfs	_____	cfs
0.2% (500-year)	_____	cfs	_____	cfs

1% (100-year) Flood Confidence Intervals

90% Confidence Interval:
5% limit _____ cfs
95% limit _____ cfs

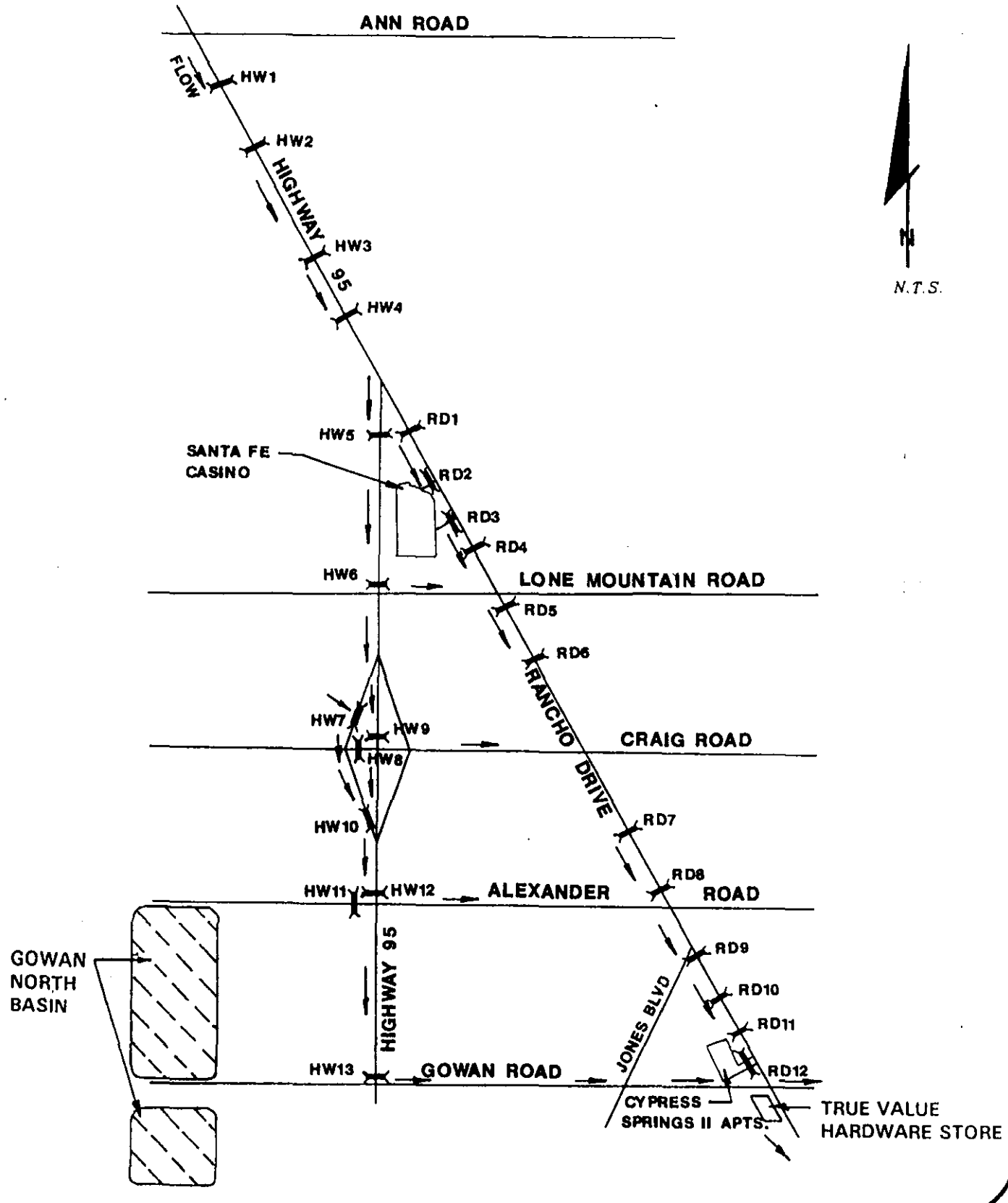
50% Confidence Interval:
25% limit _____ cfs
75% limit _____ cfs

If the value of the 100-year frequency flood in the FIS is beyond the 50% confidence interval but within the 90% confidence interval, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

An example of confidence limits analysis can be found in Appendix 9 of Bulletin 17B.

Attach Confidence Limits Analysis.

Form 7
Bridge/Culvert



COE & VAN LOO
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LANDSCAPE ARCHITECTURE

FIGURE 12
EXISTING STRUCTURE INDEX MAP

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert HW1

3. This revision reflects *(check one of the following)*:

- [X] New bridge/culvert not modeled in the FIS
- [ ] Modified bridge/culvert previously modeled in the FIS
- [ ] New analysis of bridge/culvert previously modeled in the FIS

(Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One - 24" CMP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wingwalls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson pipe culvert analysis computer program based on hydraulic design of highway culverts HDS #5

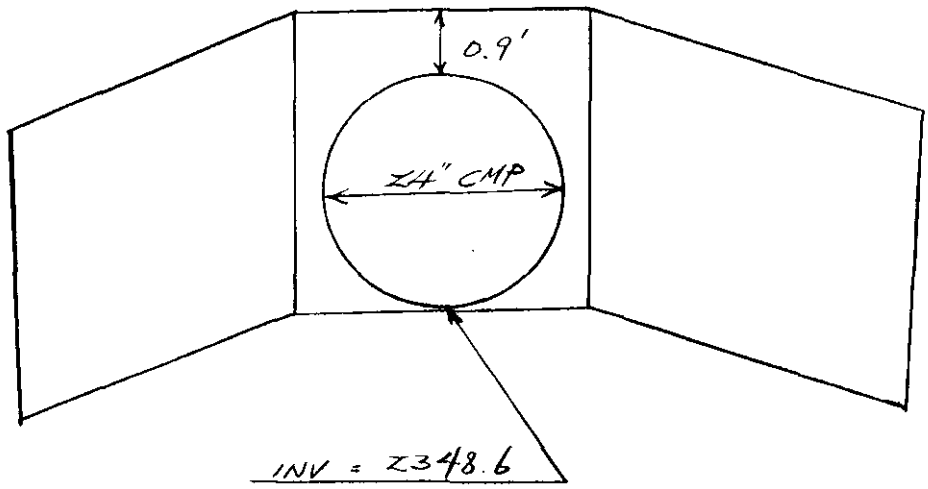
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

Culvert structure is perpendicular to the stream.

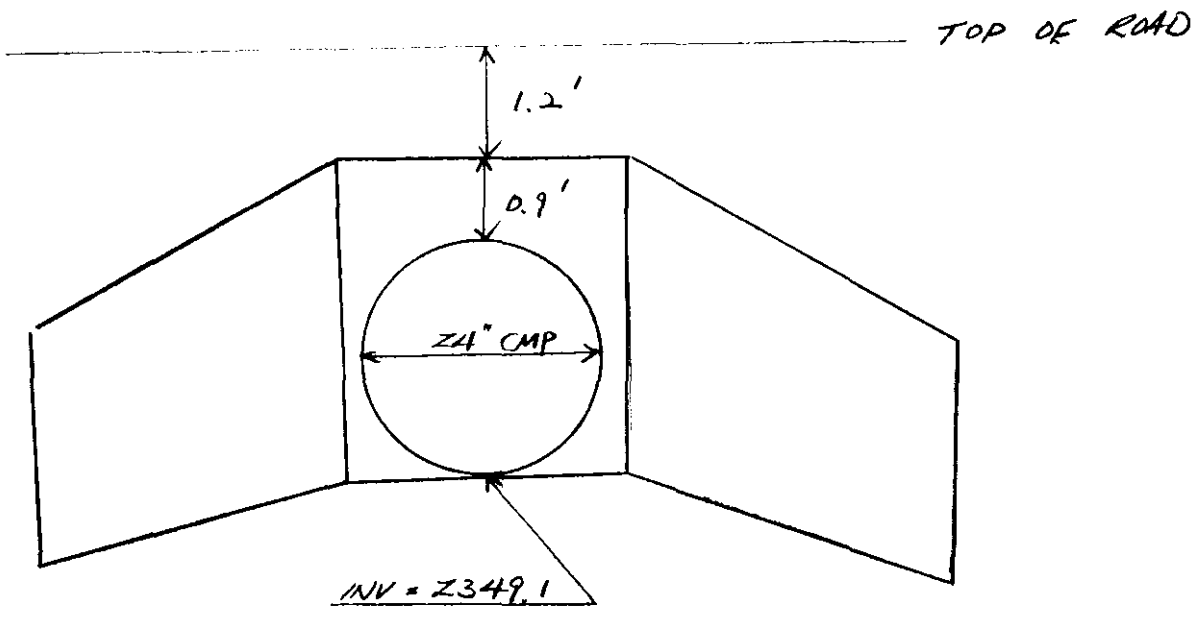
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

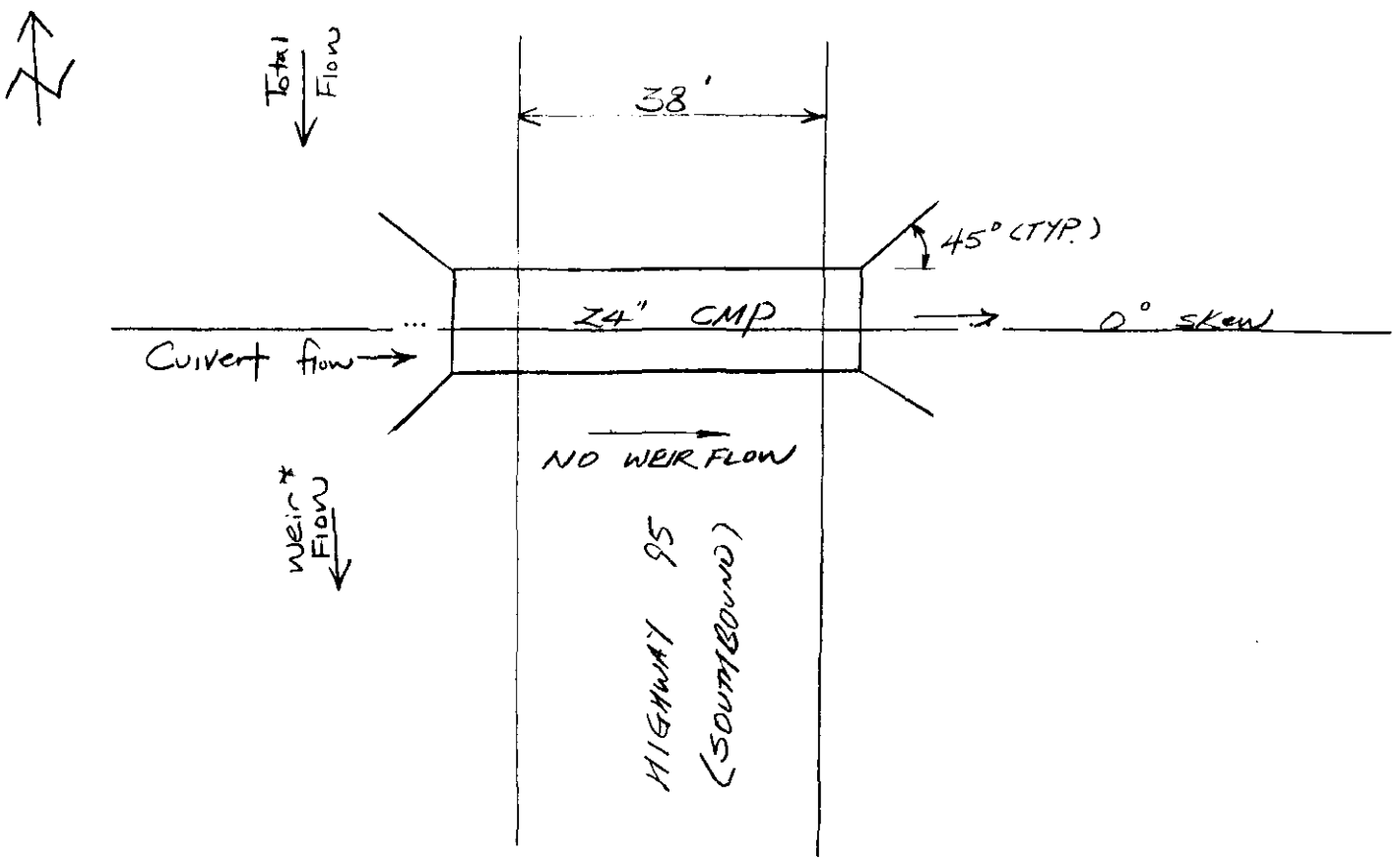
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow continues south along Highway 95

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	60
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	3.14
Total culvert/bridge area (ft^2)	3.14

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2353.2	2353.2
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2352.9	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s)		26 (culvert flow to east)	528 (weir flow to south)	554

The maximum depth of flow over the roadway/railroad (ft.) . . . . . n/a

Weir length (ft.) . . . . . Refer to Section 4 - Diversion Calculations

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.5
Manning's "n" value assigned to the structure(s)	0.024
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.7
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert HW2

3. This revision reflects *(check one of the following)*:

   [X] *New bridge/culvert not modeled in the FIS*

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One - 24" CMP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wingwalls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson pipe culvert analysis computer program based on hydraulic design of highway culverts HDS #5

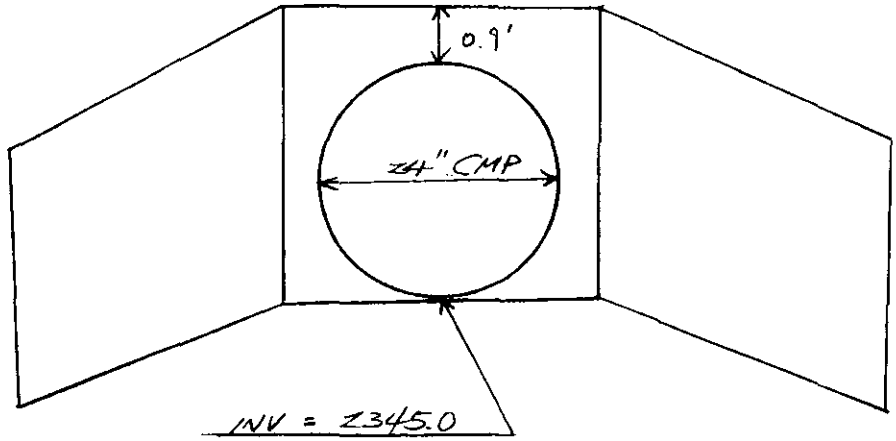
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

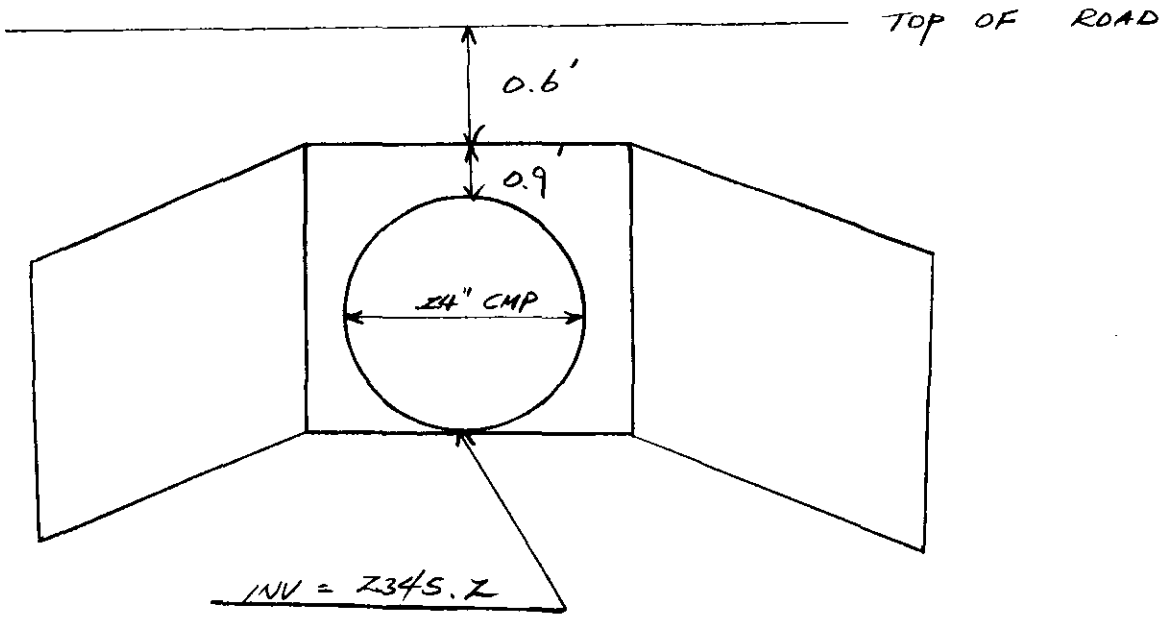
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

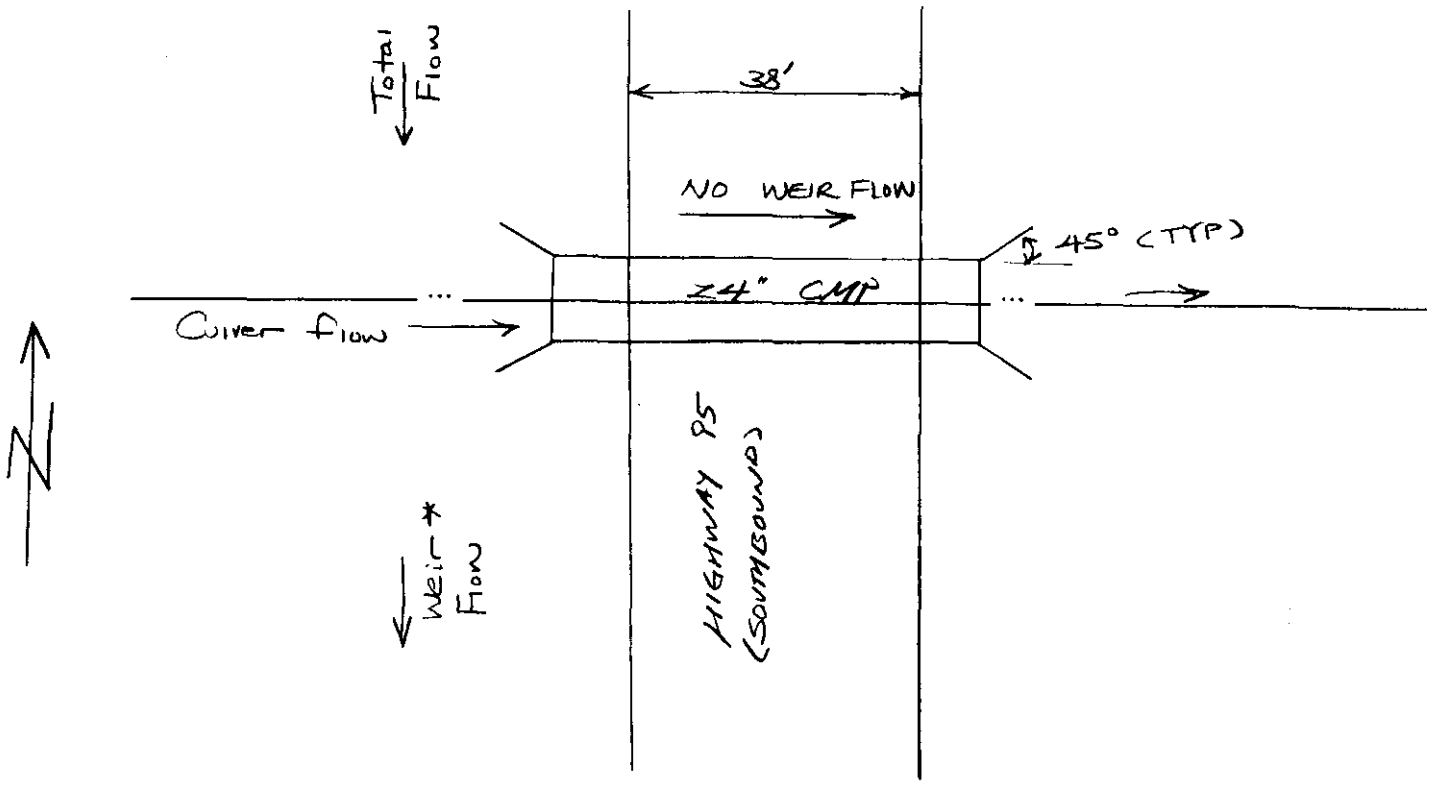
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow continues south along Highway 95

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	60
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	3.14
Total culvert/bridge area (ft^2)	3.14

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2348.7	2348.7
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2347	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s)		29 (culvert flow to east)	498 (weir flow to south)	527

The maximum depth of flow over the roadway/railroad (ft.)	n/a
Weir length (ft.)	Refer to Section 4 - Diversion Calculations

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.5
Manning's "n" value assigned to the structure(s)	0.024
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.7
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☒ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier):

   Culvert HW3

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One 10' x 3.1' RCB

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with wingwalls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson box culvert analysis computer program based on hydraulic design of highway culverts HDS #5

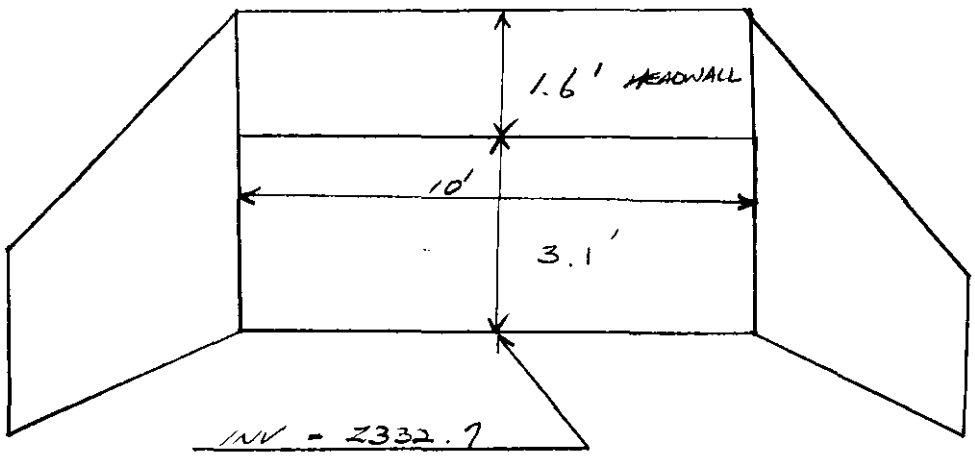
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

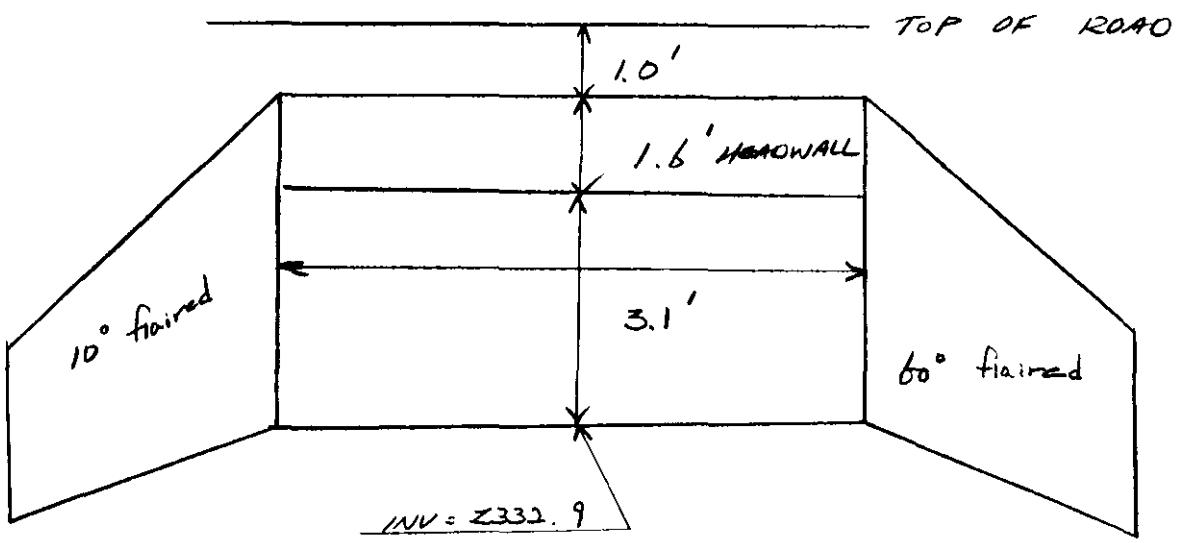
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

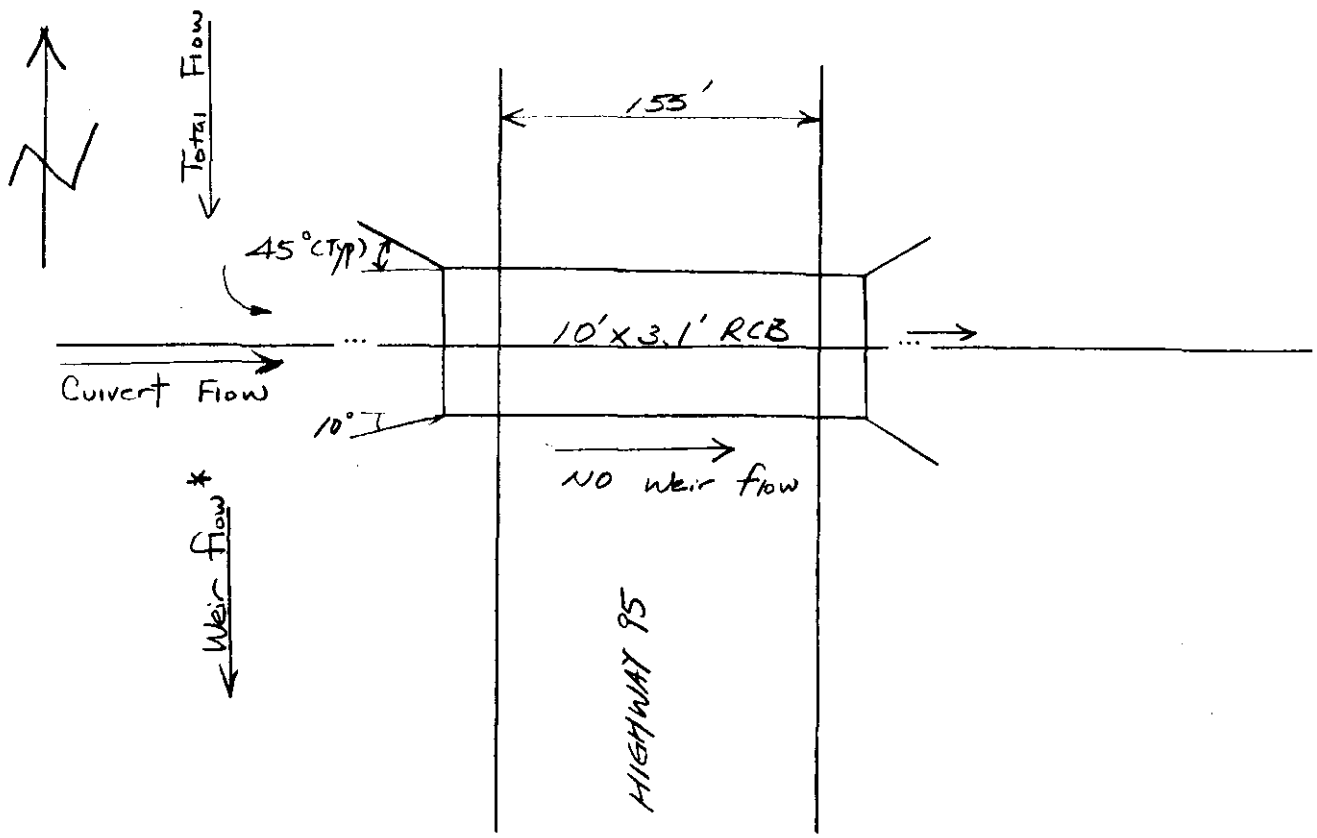
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow continues south along Highway 95

Attach plans of the structure(s) certified by a registered Professional Engineer. – NOT AVAILABLE

Culvert length or bridge width (ft.)	230
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	31
Total culvert/bridge area (ft^2)	31

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2338.6	2338.6
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2338.2	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		298 (culvert flow to east)	467 (weir flow to south)	765
The maximum depth of flow over the roadway/railroad (ft.)			n/a	
Weir length (ft.)			Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.7
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier):

   Culvert HW4

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One - 24" RCP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Pipe end section

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson pipe culvert analysis computer program based on hydraulic design of highway culverts HDS #5

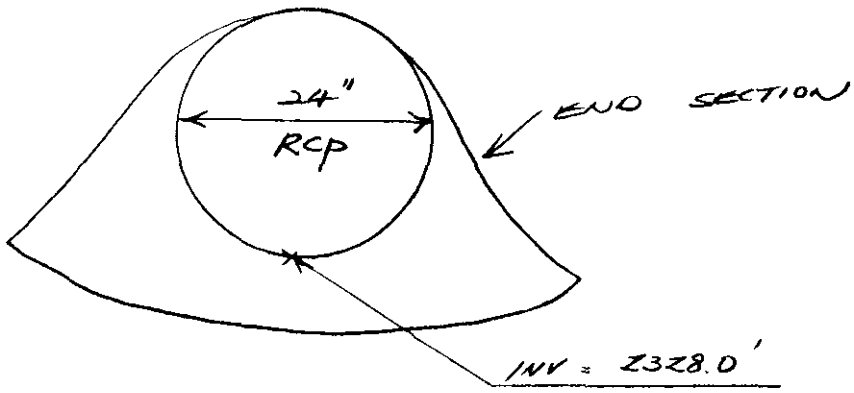
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

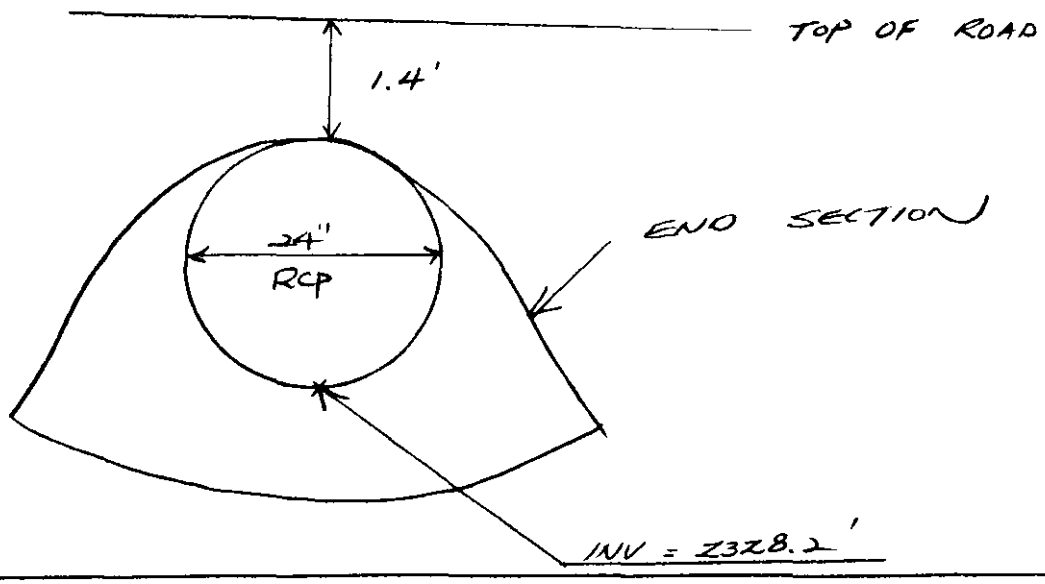
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

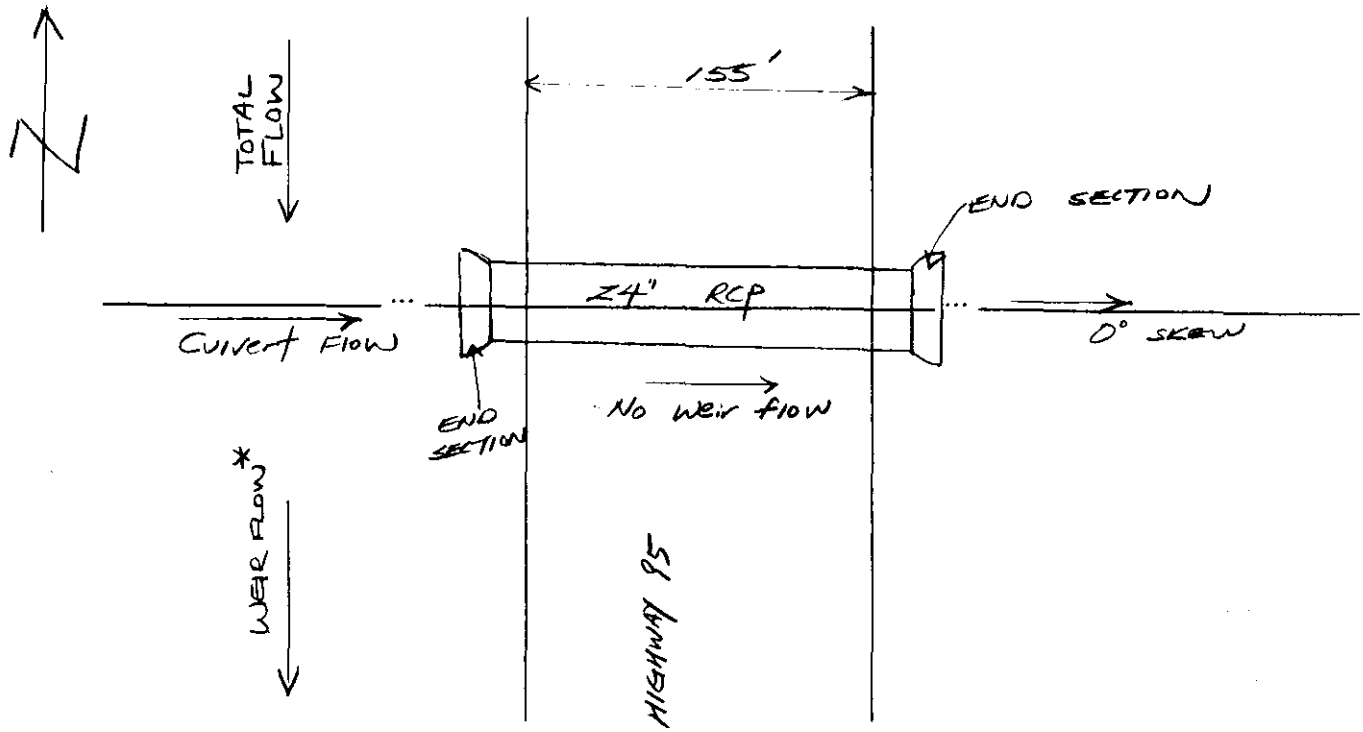
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow continues south along Highway 95

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	270
Calculated culvert/bridge (ft²) by the hydraulic model, if applicable	3.14
Total culvert/bridge area (ft²)	3.14

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2331.6	2331.6
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2331.6	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		26 (culvert flow to east)	441 (weir flow to south)	467
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.7
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. *Is there any indication from historical records that sediment transport (including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

5. FLOODWAY ANALYSIS (Cont'd)

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert HW5

3. This revision reflects *(check one of the following)*:

- [X] New bridge/culvert not modeled in the FIS
- [ ] Modified bridge/culvert previously modeled in the FIS
- [ ] New analysis of bridge/culvert previously modeled in the FIS

(Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Two - 6' x 2' RCB

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wingwalls. Beveled top edge.

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson box culvert analysis computer program based on hydraulic design of highway culverts HDS #5

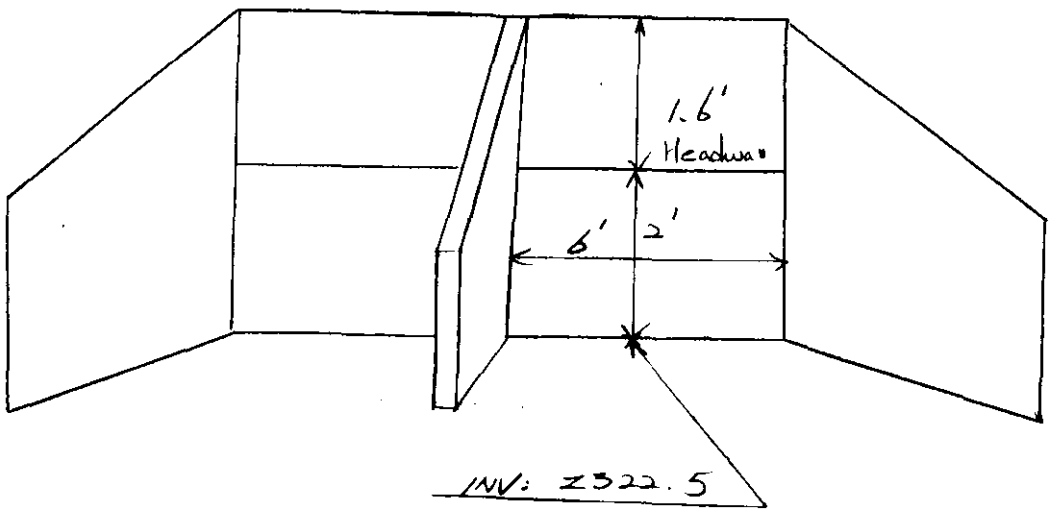
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

Culvert structure is perpendicular to the stream.

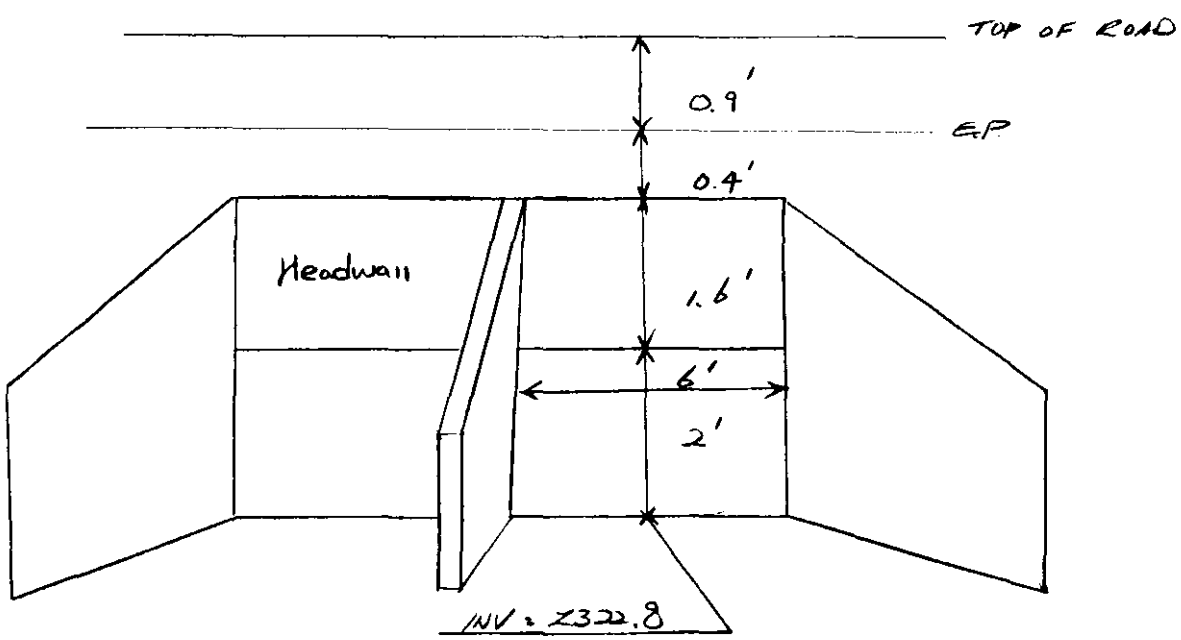
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

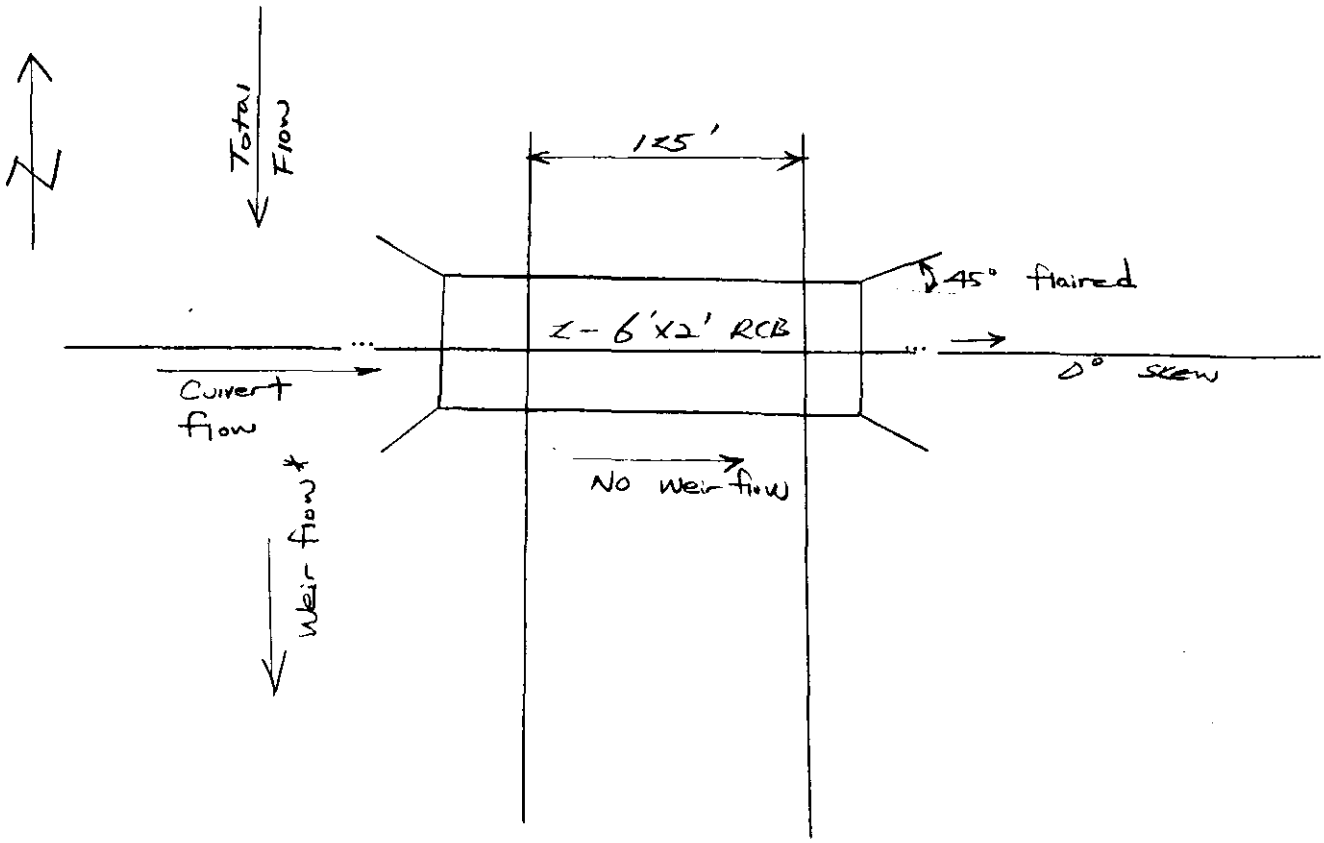
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow Continues South along Highway 95

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	170
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	24
Total culvert/bridge area (ft^2)	24

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2327.7	2327.7
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2327.47	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		213 (culvert flow to east)	224 (weir flow to south)	437
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.7
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95
2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert HW6
3. This revision reflects *(check one of the following)*:

- [X] New bridge/culvert not modeled in the FIS
- [ ] Modified bridge/culvert previously modeled in the FIS
- [ ] New analysis of bridge/culvert previously modeled in the FIS

(Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Two - 6' x 2' RCB
2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wingwalls. Beveled top edge.
3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson box culvert analysis computer program based on hydraulic design of highway culverts HDS #5

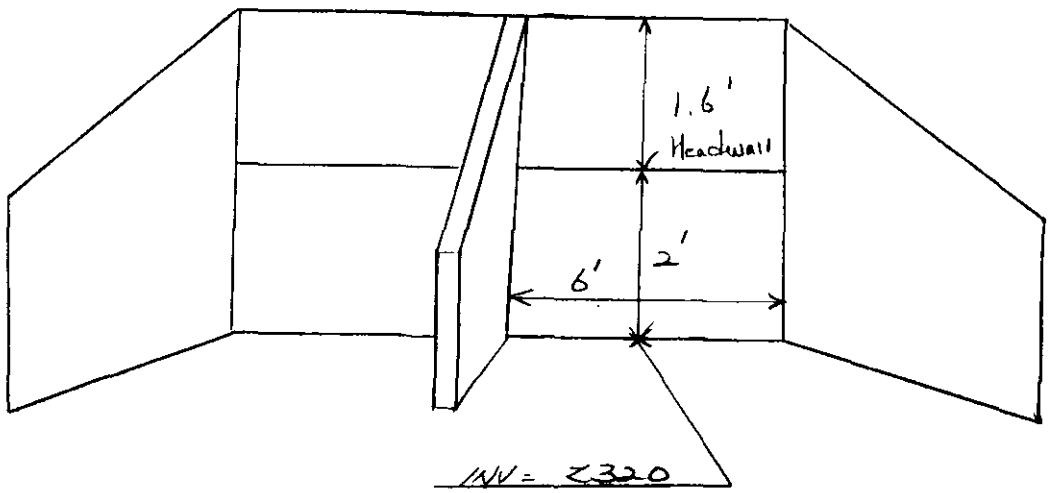
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

Culvert structure is perpendicular to the stream.

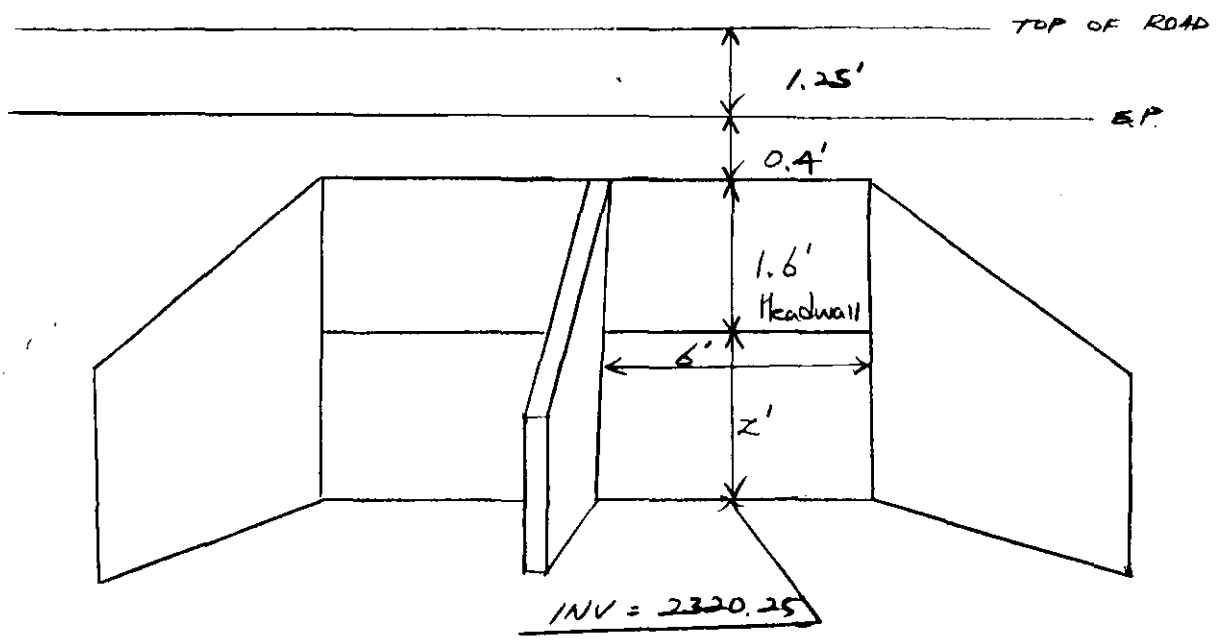
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

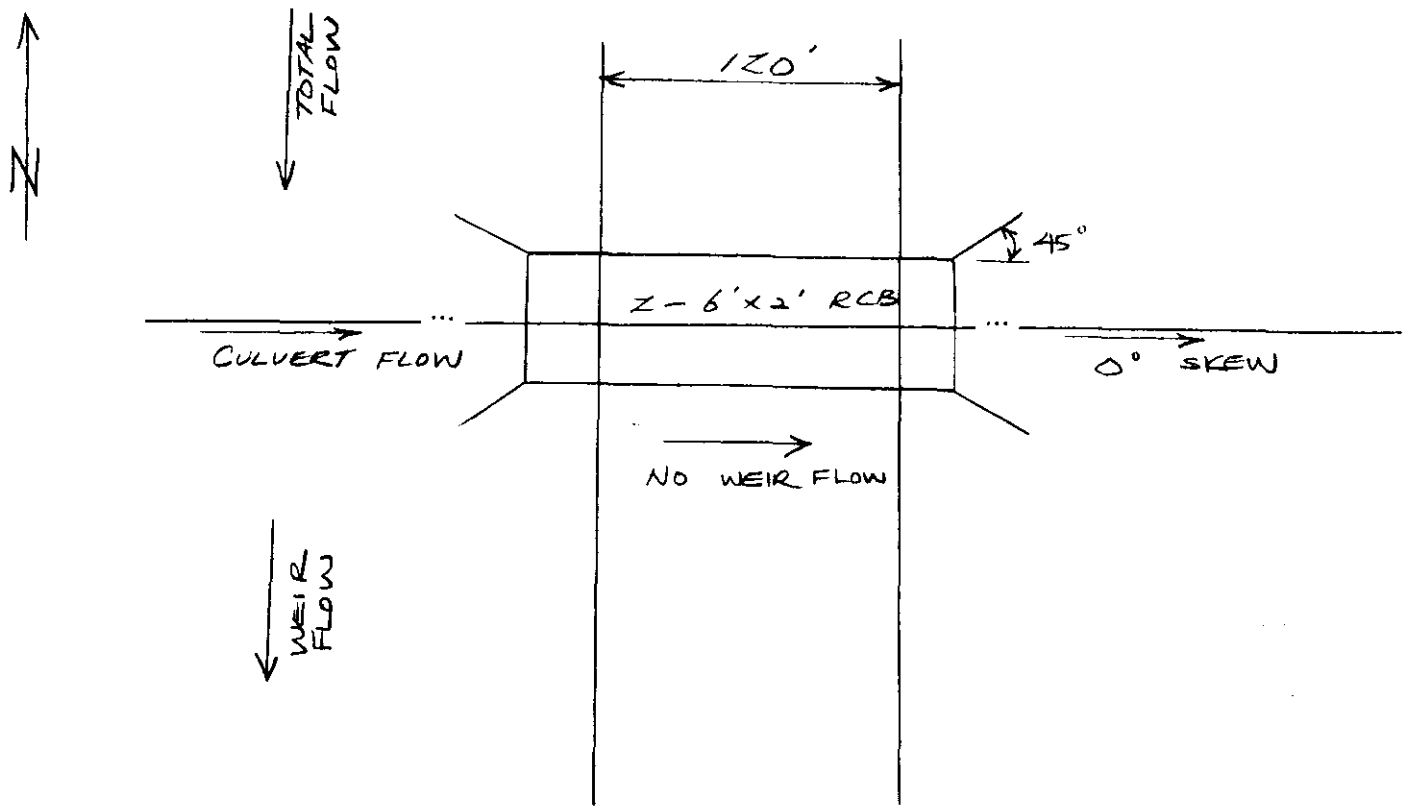
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow continues south along Highway 95

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	160
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	24
Total culvert/bridge area (ft^2)	24

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2325.5	2325.5
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2323.45	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		153 (culvert flow to east)	72 (weir flow to south)	225
The maximum depth of flow over the roadway/railroad (ft.)			n/a	
Weir length (ft.)			Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.7
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

5. FLOODWAY ANALYSIS (Cont'd)

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier):

   Culvert HW7

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Six 8' x 3.1' RCB

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wingwalls. Beveled top edge.

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson box culvert analysis computer program based on hydraulic design of highway culverts HDS #5

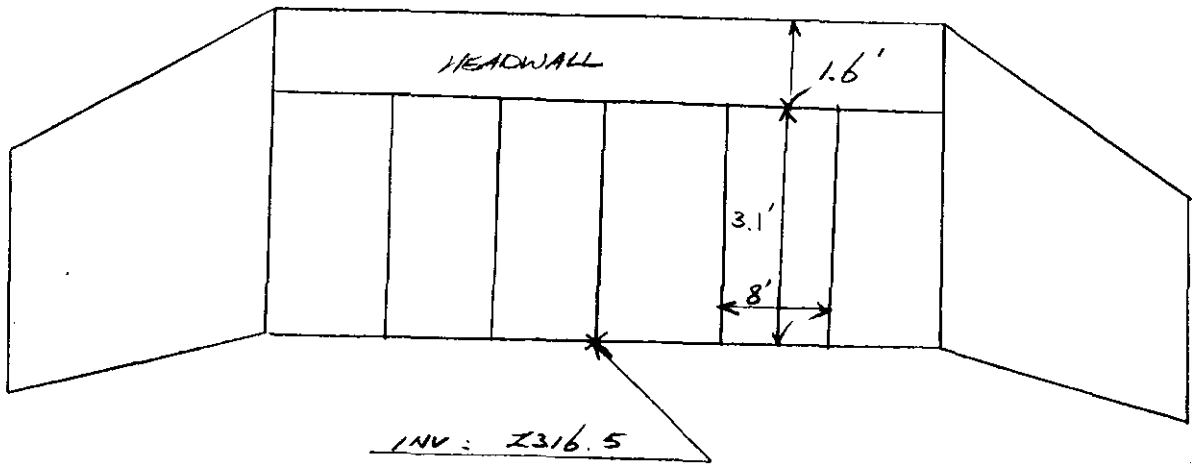
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

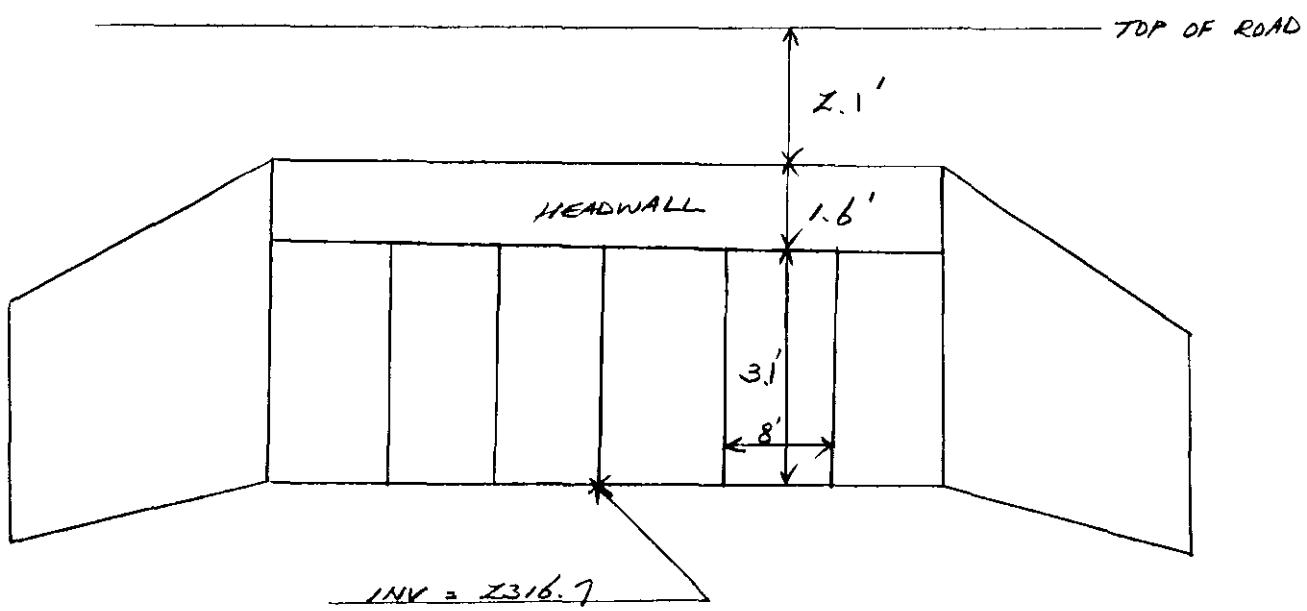
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

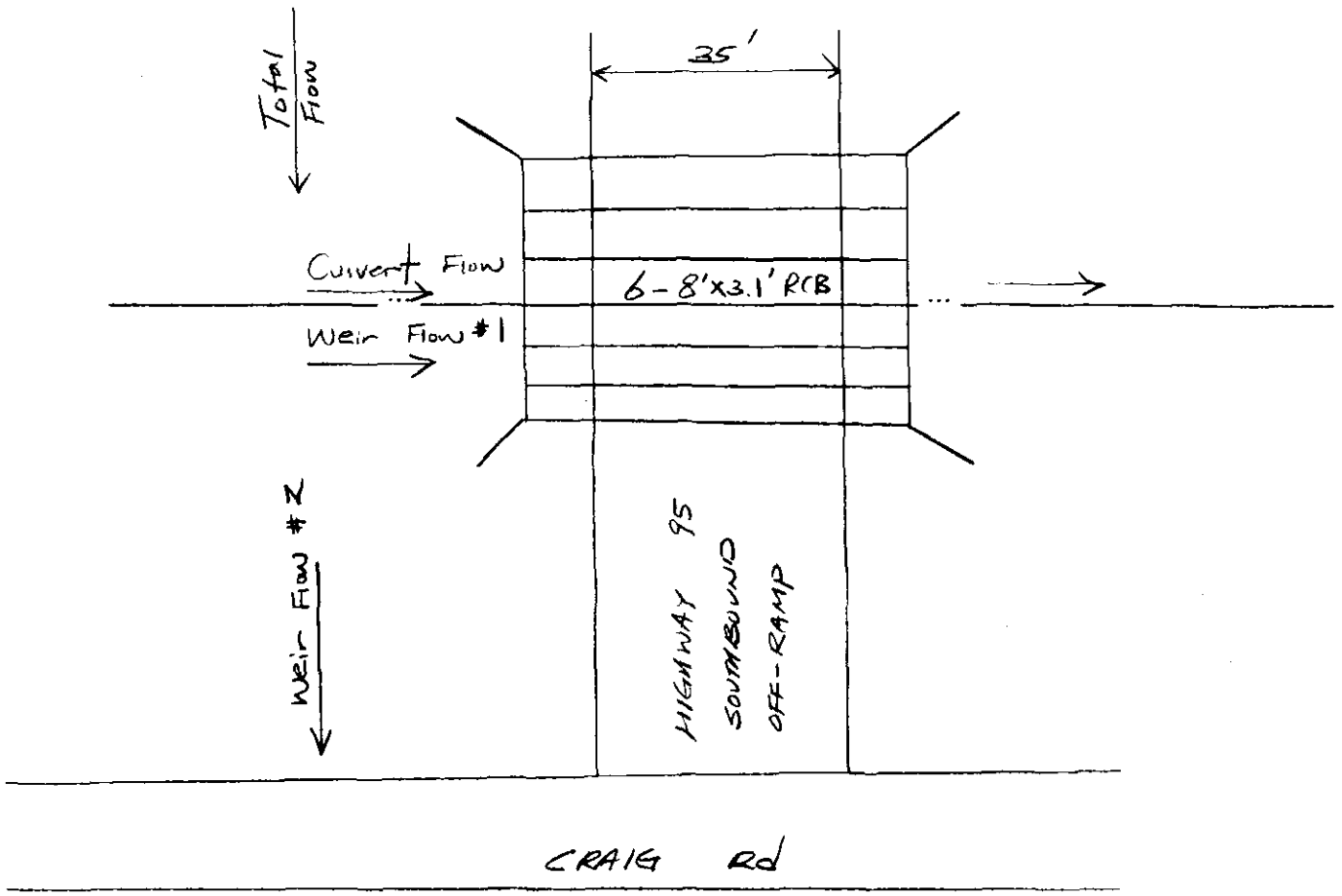
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	100
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	148.8
Total culvert/bridge area (ft^2)	148.8

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2323.5	2323.5
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2322.3	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		1330	Weir #1 = 350 Weir #2 = 1265	2945
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	3.0
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

5. FLOODWAY ANALYSIS (Cont'd)

Comments (explain any unusual situations):

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culverts HW8 and HW9

3. This revision reflects *(check one of the following)*:

- [X] New bridge/culvert not modeled in the FIS
- [ ] Modified bridge/culvert previously modeled in the FIS
- [ ] New analysis of bridge/culvert previously modeled in the FIS

(Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Four 10' x 4' RCB (HW8) and two 6' x 2' RCB (HW9)

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wingwalls. Beveled top edge.

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson box culvert analysis computer program based on hydraulic design of highway culverts HDS #5

   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   HEC-2 cannot compute WSEL accurately when culvert flow and channel flow exist at the same location.

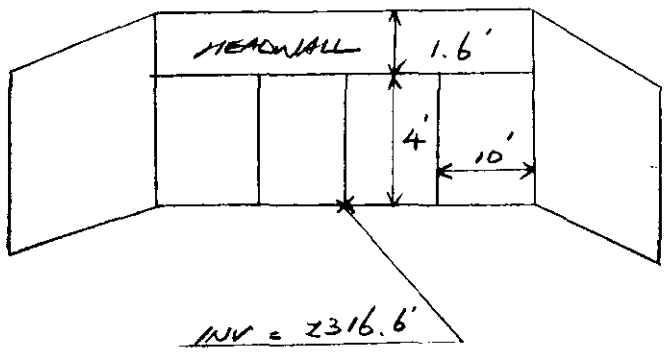
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.

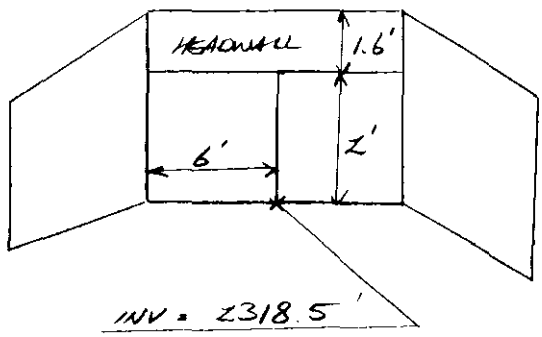
CULVERT HW8

4 – 10' x 4' RCB



CULVERT HW9

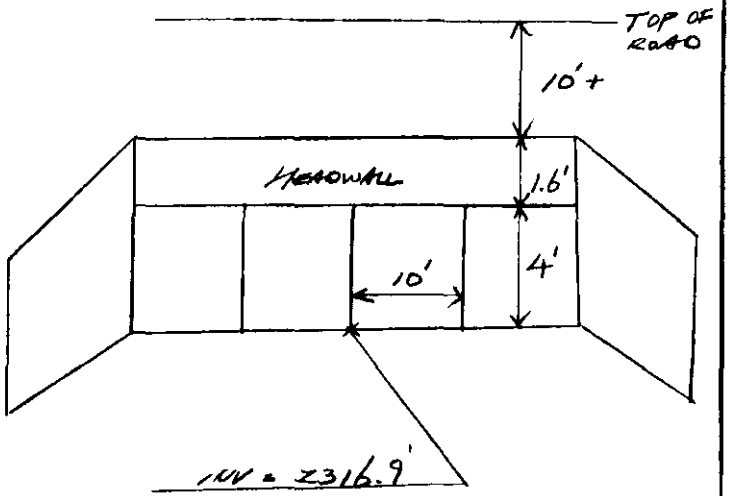
2 – 6' x 2' RCB



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.

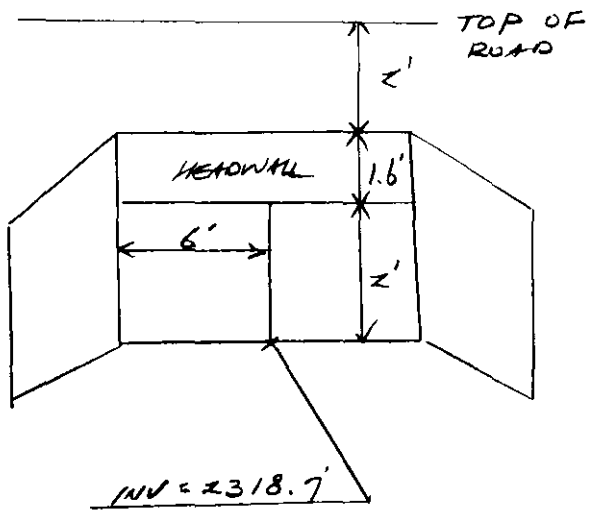
CULVERT HW8

4 – 10' x 4' RCB

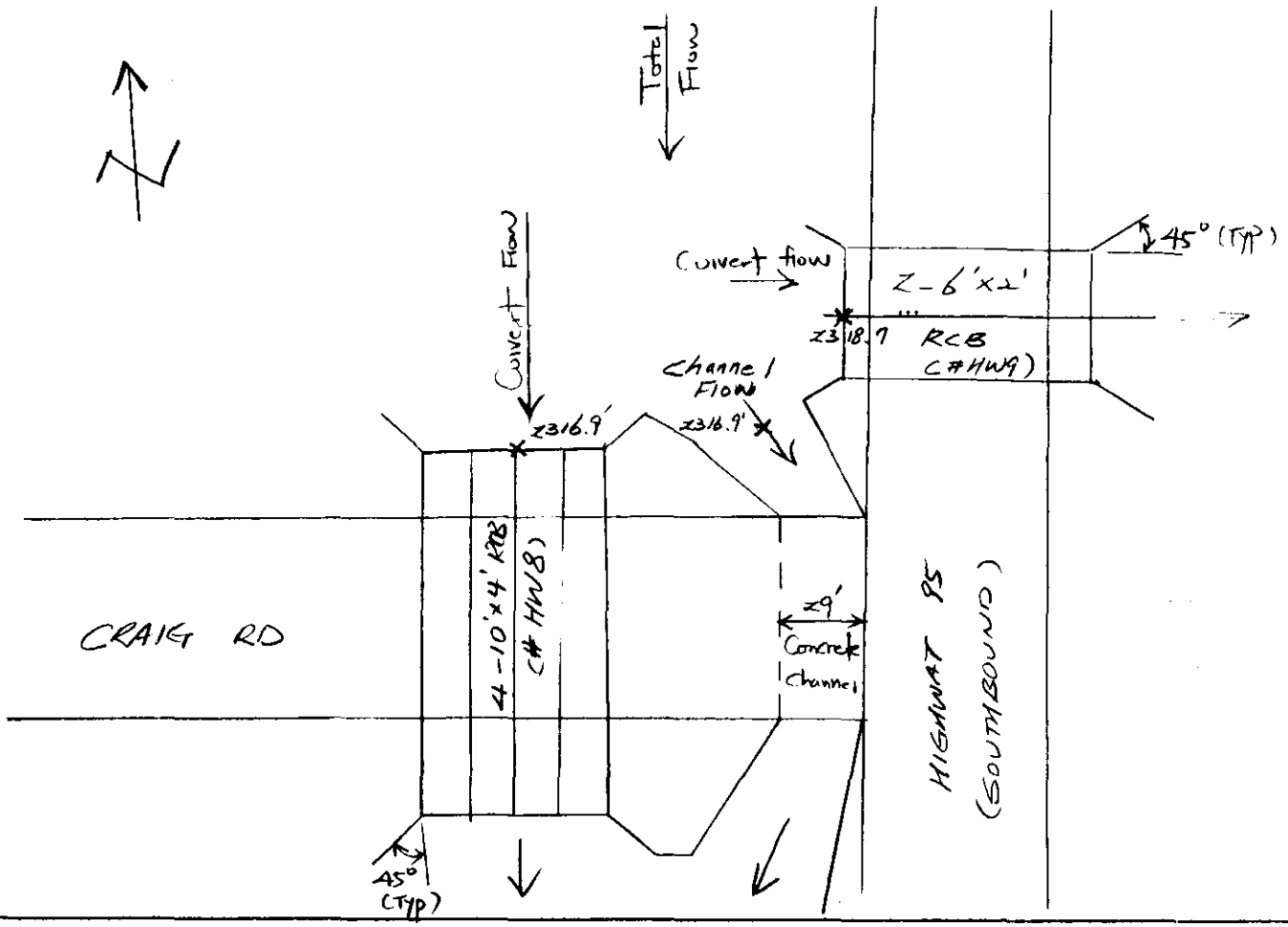


CULVERT HW9

2 – 6' x 2' RCB



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



Attach plans of the structure(s) certified by a registered Professional Engineer. – NOT AVAILABLE

	HW8	HW9
Culvert length or bridge width (ft.)	226	160
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	160	24
Total culvert/bridge area (ft^2)	160	24

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

		Left Overbank	Right Overbank
Upstream face	Culvert HW8	2338	2338
	Culvert HW9	2324.3	2324.3
Downstream face		n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2319.95	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)	Culvert HW8 Culvert HW9	600 50	No weir flow (channel flow = 1,030)	1680
The maximum depth of flow over the roadway/railroad (ft.)			n/a	
Weir length (ft.)			Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

3. ANALYSIS (Cont'd)

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (*e.g.*, bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	n/a
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ *cfs (attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier):

   Culvert HW10

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. *Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway)* Six 8' x 3' RCB

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with wingwalls.

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson box culvert analysis computer program based on hydraulic design of highway culverts HDS #5

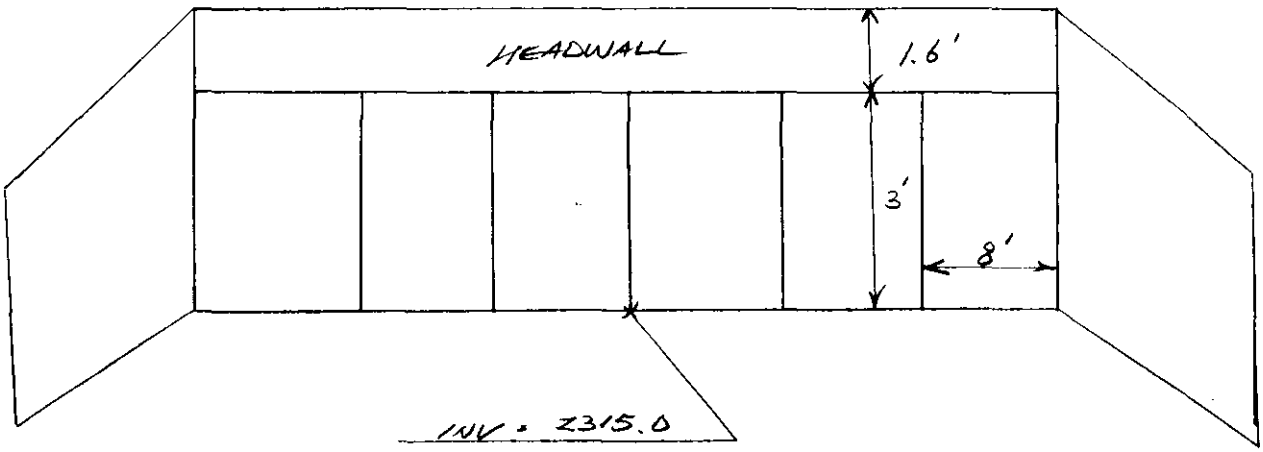
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

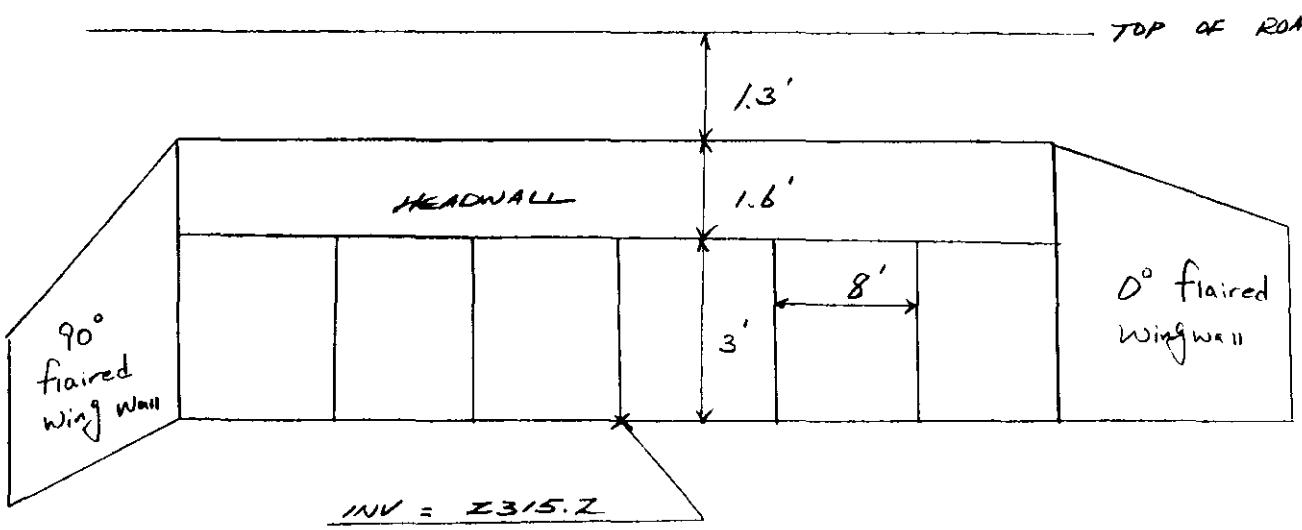
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

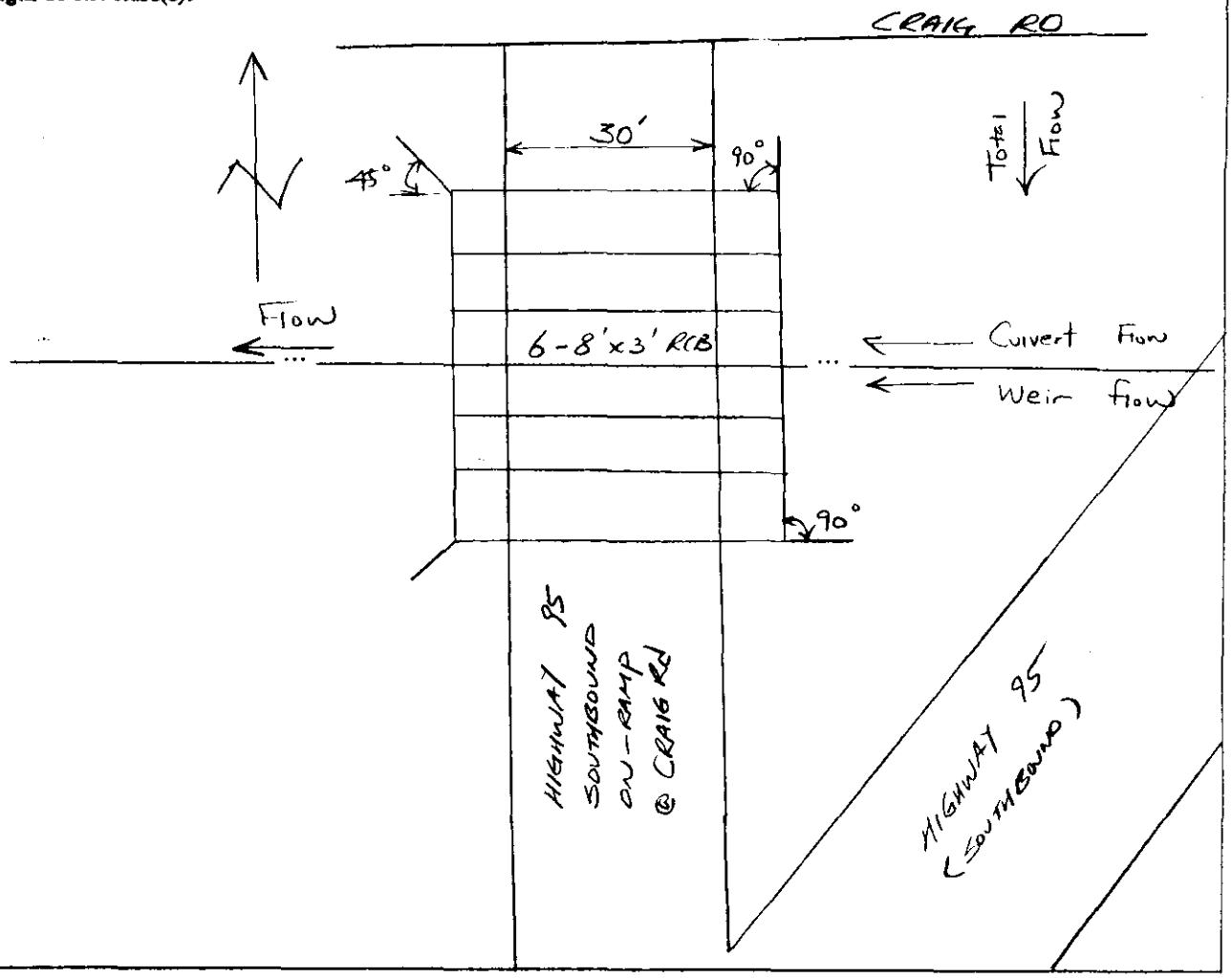
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



Attach plans of the structure(s) certified by a registered Professional Engineer. – NOT AVAILABLE

Culvert length or bridge width (ft.)	124
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	144
Total culvert/bridge area (ft^2)	144

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2321.1	2321.1
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2320.48	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		275	0	275
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	3.0
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95
2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culverts HW11 and HW12
3. This revision reflects *(check one of the following)*:

- [X] New bridge/culvert not modeled in the FIS
- [ ] Modified bridge/culvert previously modeled in the FIS
- [ ] New analysis of bridge/culvert previously modeled in the FIS

(Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Four 10' x 4' RCB (HW11) and two 6' x 2' RCB (HW12)
2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wingwalls. Beveled top edge.
3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson box culvert analysis computer program based on hydraulic design of highway culverts HDS #5

If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

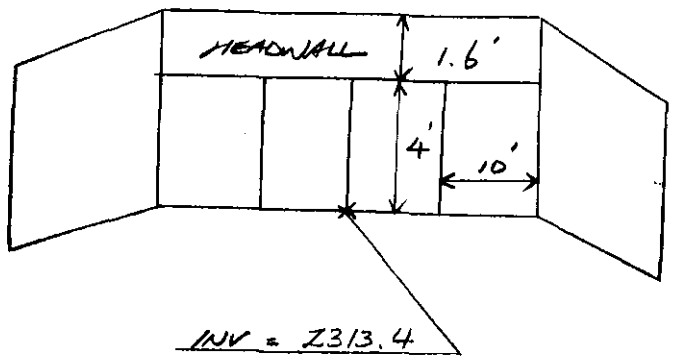
HEC-2 cannot compute WSEL accurately when culvert flow and channel flow exist at the same location.

Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

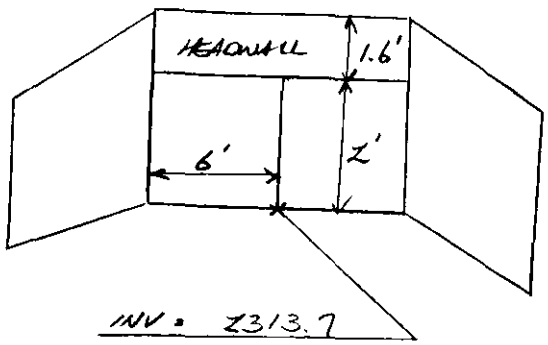
*One form per new/revised bridge/culvert

Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.

Culvert HW11
4 – 10' x 4' RCB

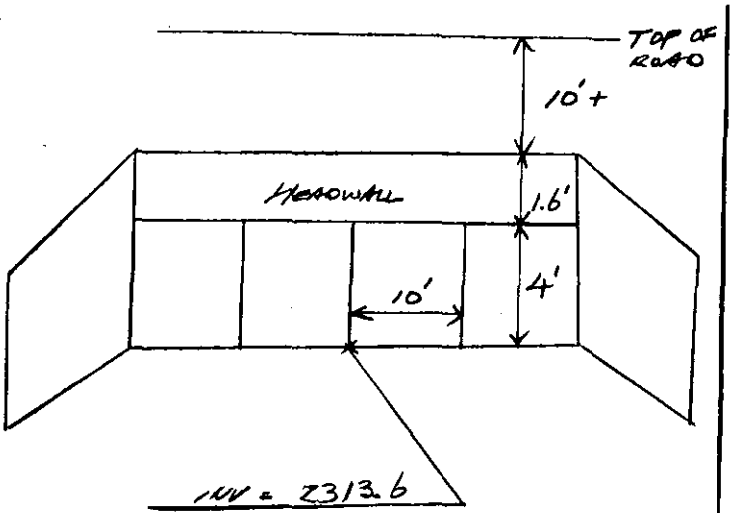


Culvert HW12
2 – 6' x 2' RCB

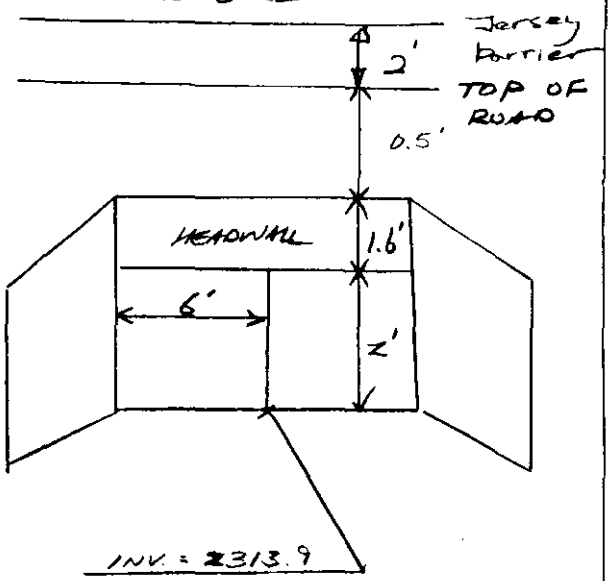


Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.

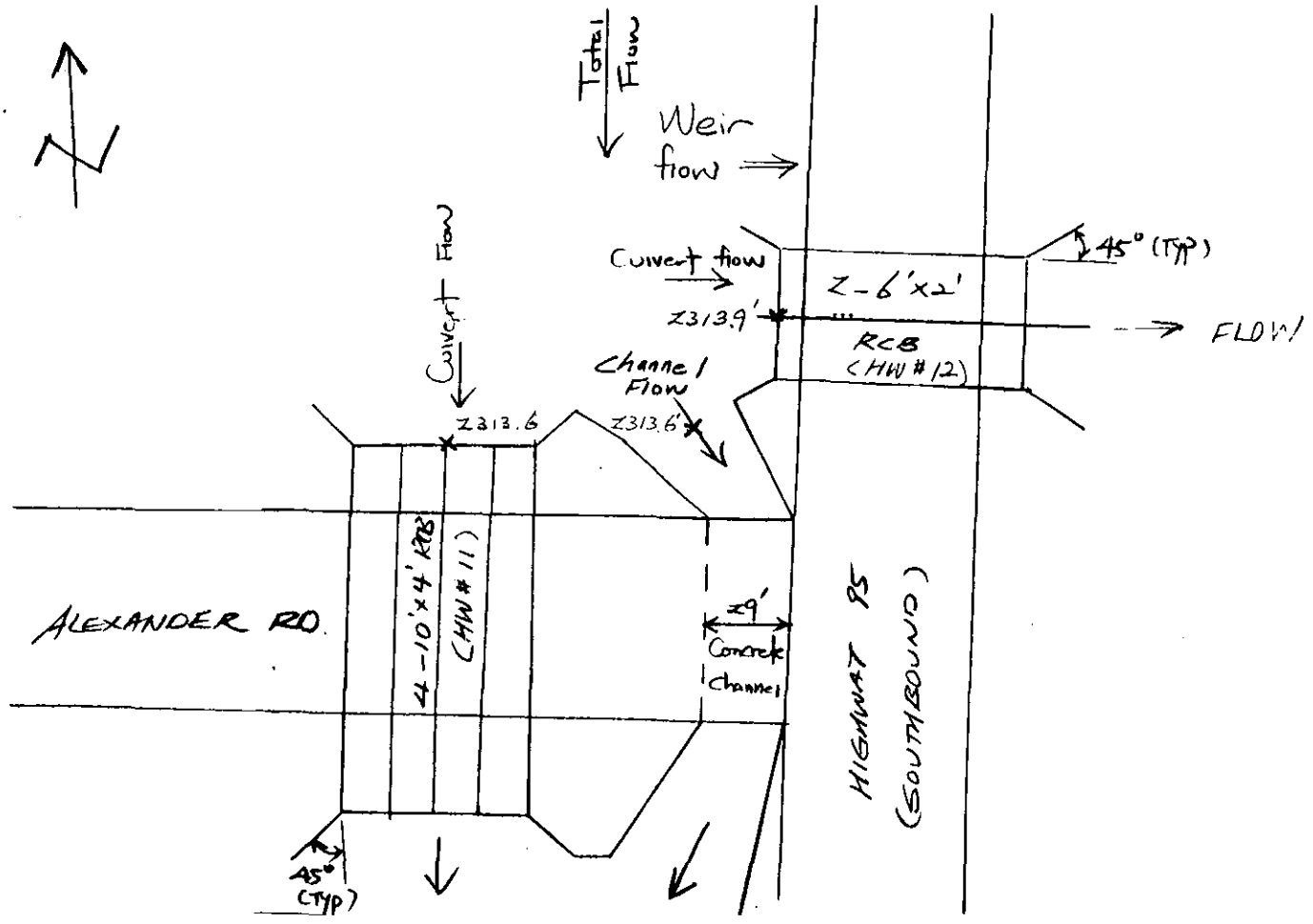
Culvert HW11
4 – 10' x 4' RCB



Culvert HW12
2 – 6' x 2' RCB



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

	HW11	HW12
Culvert length or bridge width (ft.)	127	160
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	160	24
Total culvert/bridge area (ft^2)	160	24

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

		Left Overbank	Right Overbank
Upstream face	Culvert HW11	2330	2330
	Culvert HW12	2320	2320
Downstream face		n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2319.4	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)	Culvert HW11 Culvert HW12	1090 193	weir flow = 297 channel flow = 1,750	3330
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .		n/a	
Weir length (ft.)	. . . . .		Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	3.0
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Highway 95

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert HW13

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Two 9' x 2.2' RCB

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with wingwalls.

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson box culvert analysis computer program based on hydraulic design of highway culverts HDS #5

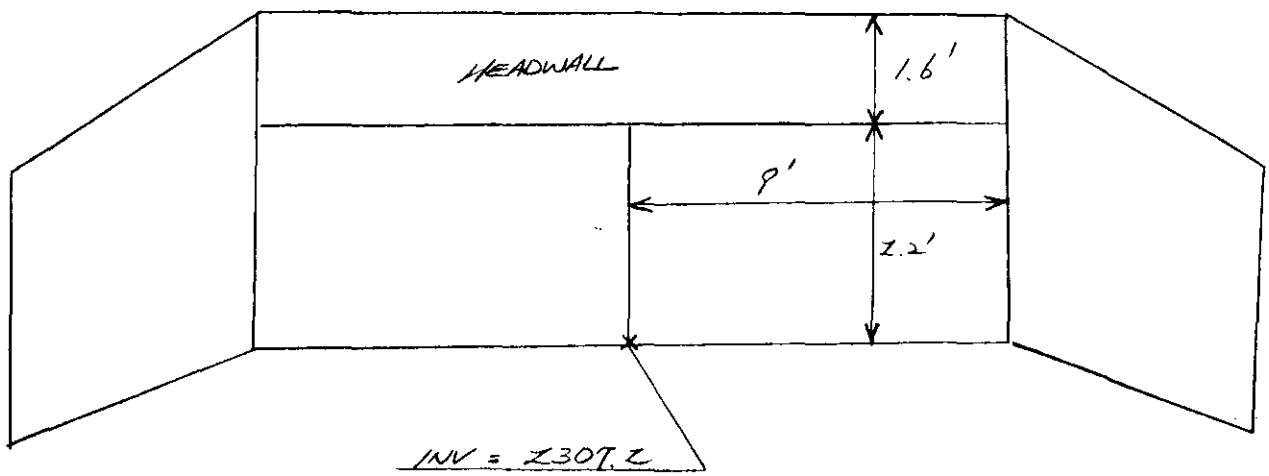
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

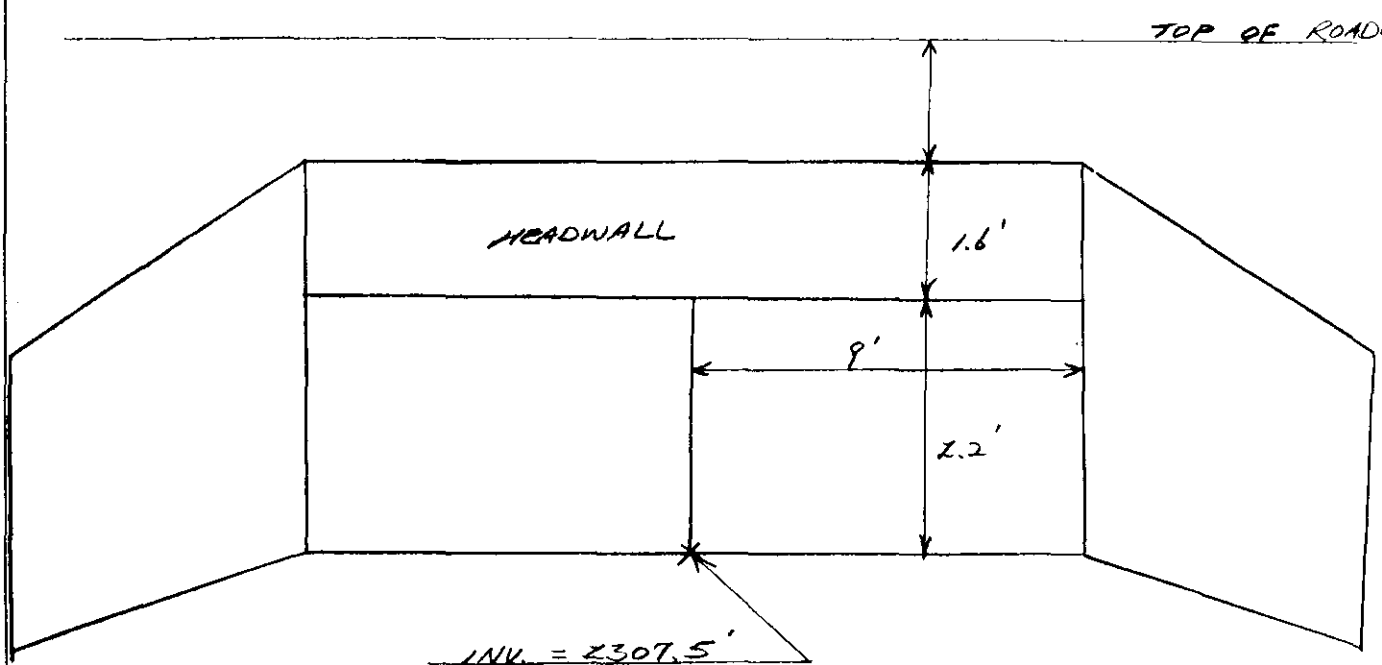
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

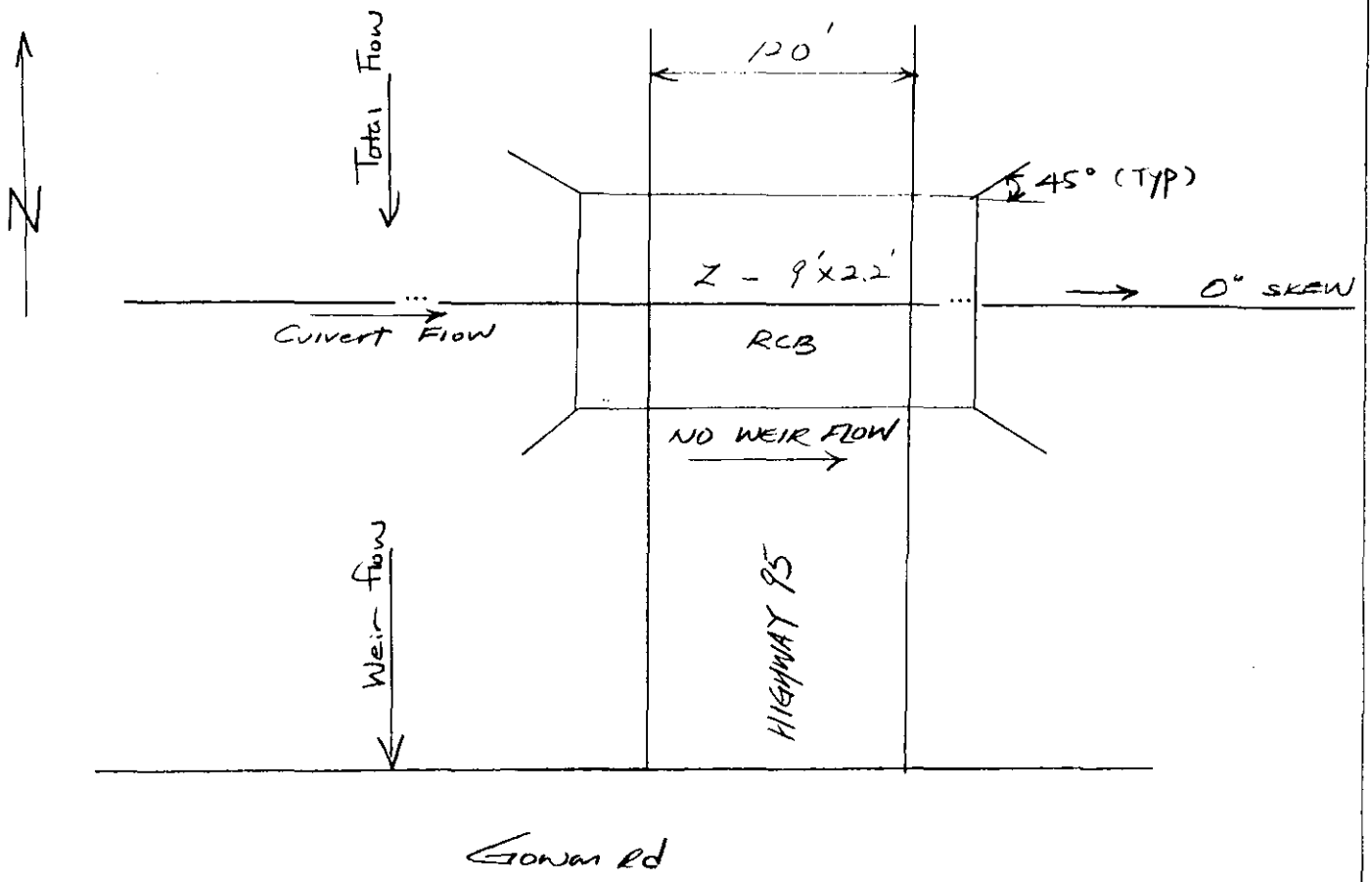
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	230
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	39.6
Total culvert/bridge area (ft^2)	39.6

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2324	2324
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2314.13	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		440	2389	2829

The maximum depth of flow over the roadway/railroad (ft.) . . . . . n/a

Weir length (ft.) . . . . . Refer to Section 4 - Diversion Calculations

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.8
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Northwest Las Vegas, Clark County

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier):

   Culvert RD1

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One 36" CMP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Headwall - no wing wall

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson Pipe Culvert Analysis computer program based on Hydraulic Design of Highway Culverts HDS #5

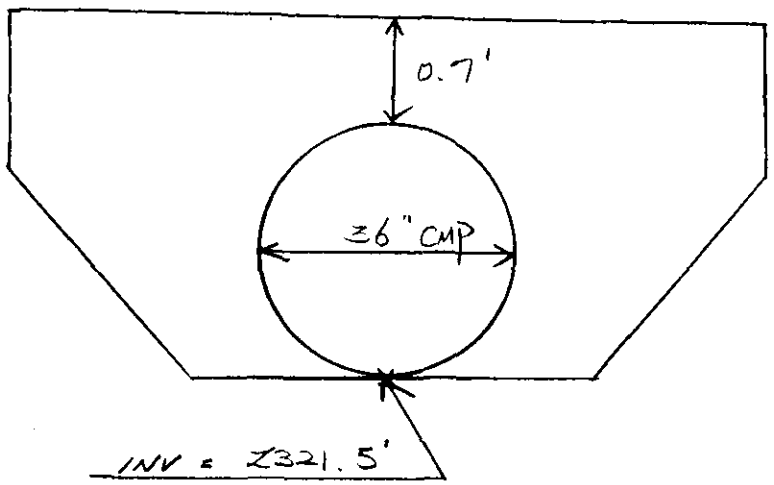
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

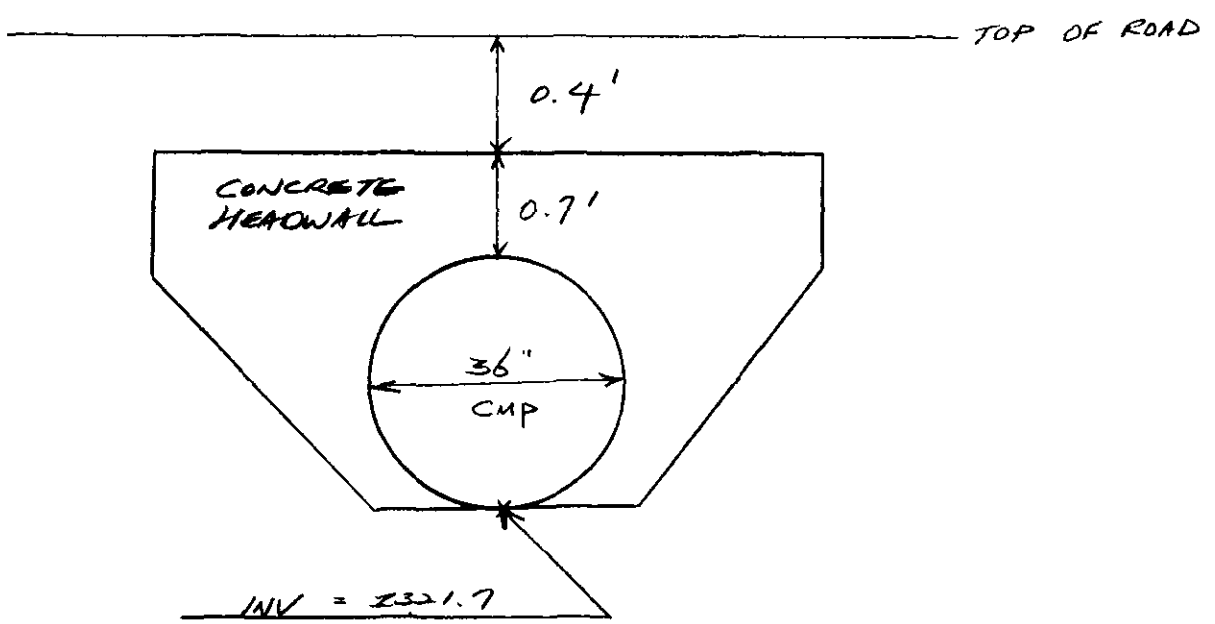
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

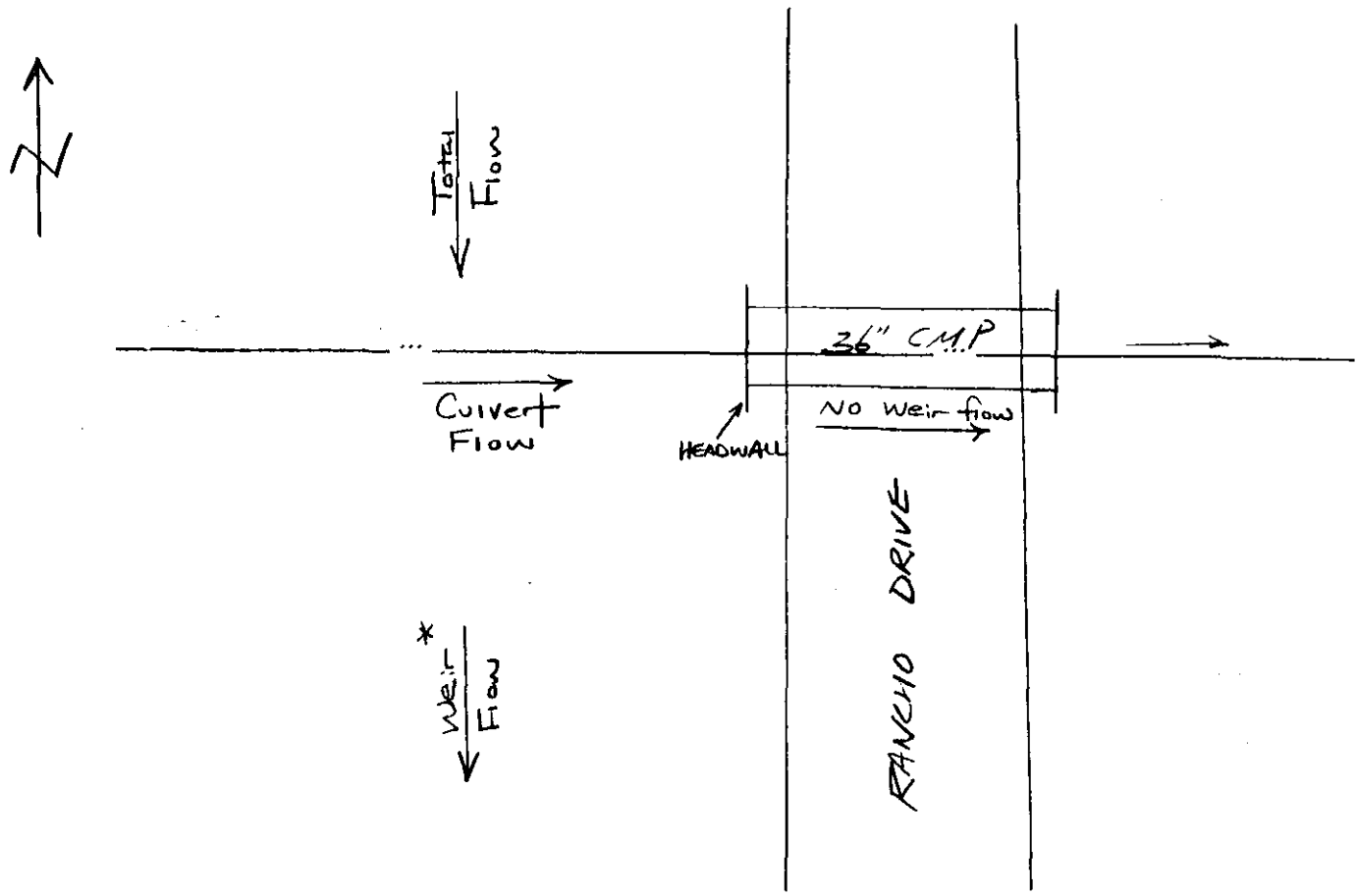
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow Continues south along Rancho Drive

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	60
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	7
Total culvert/bridge area (ft^2)	7

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2325.8	2325.8
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2324.64	n/a
Downstream face	n/a	n/a

Discharge	*Low Flow*	*Pressure Flow*	*Weir Flow*	*Total Flow*
Amount of flow through/over the structure(s) (cfs)		35 (culvert flow to east)	178 (weir flow to south)	213
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.5
Manning's "n" value assigned to the structure(s)	0.024
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.7
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. *Name of roadway, railroad, etc.:* Rancho Drive
2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert RD2
3. This revision reflects *(check one of the following)*:

   [X] *New bridge/culvert not modeled in the FIS*

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

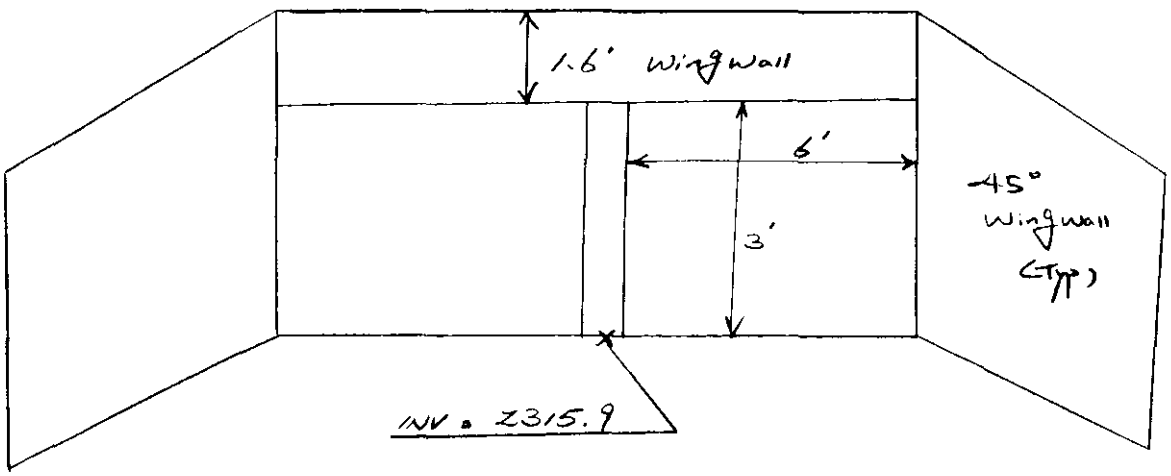
1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Two 6' x 3' RCB
2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wing walls
3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* HEC-2 with special culvert routine

   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

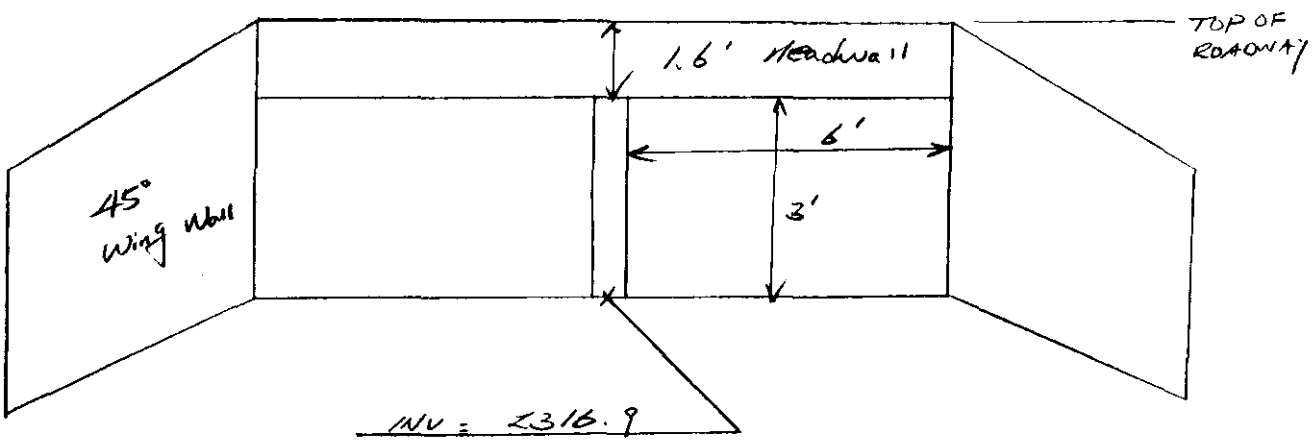
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

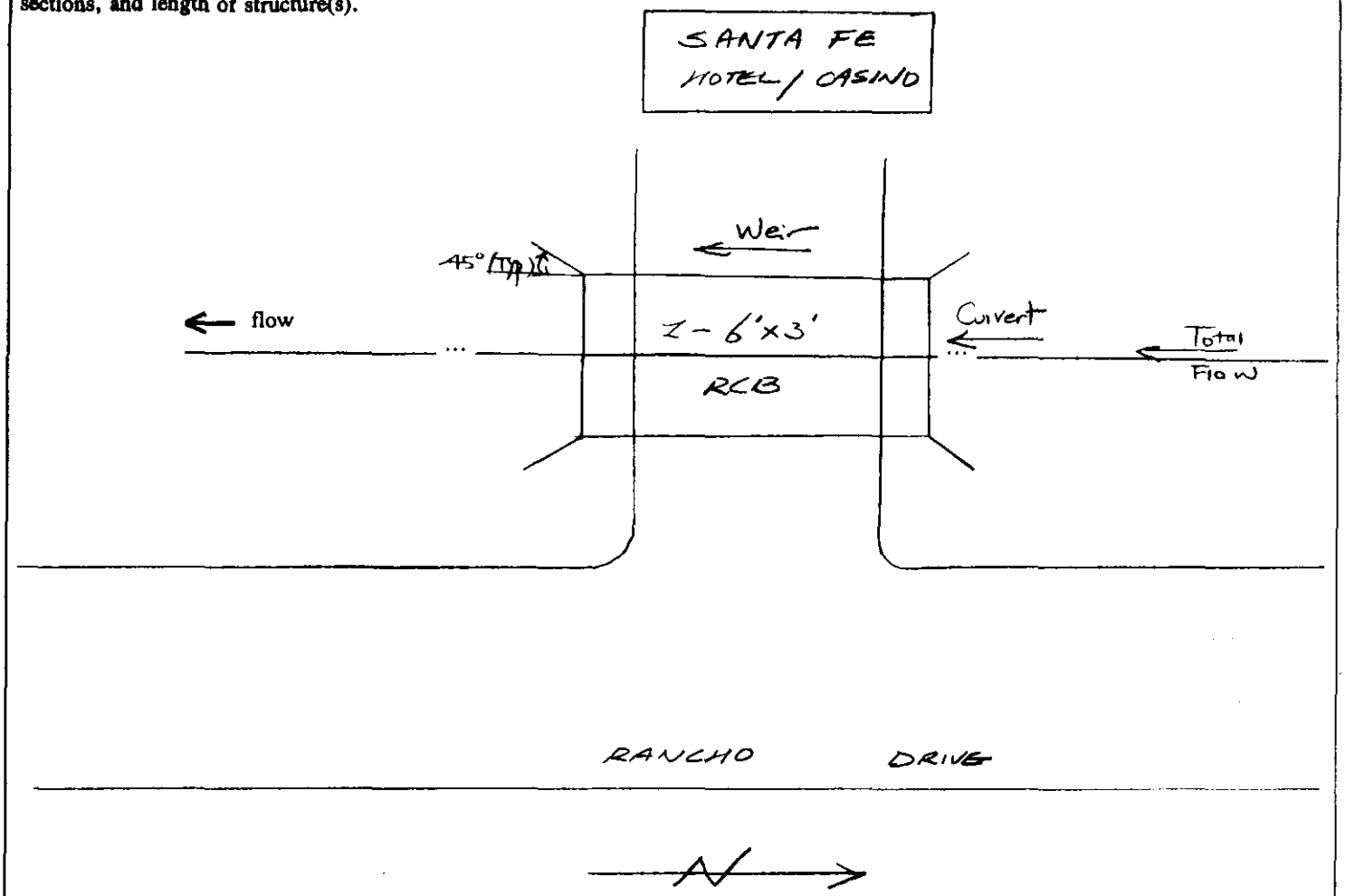
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



Attach plans of the structure(s) certified by a registered Professional Engineer. – NOT AVAILABLE

Culvert length or bridge width (ft.)	150
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	36
Total culvert/bridge area (ft^2)	36

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2321.5	2321.5
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2319.99	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		180	0	180
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	223	n/a
Downstream face	24	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.9
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier):

   Culvert RD3

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Two 6' x 3' RCB

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wing walls

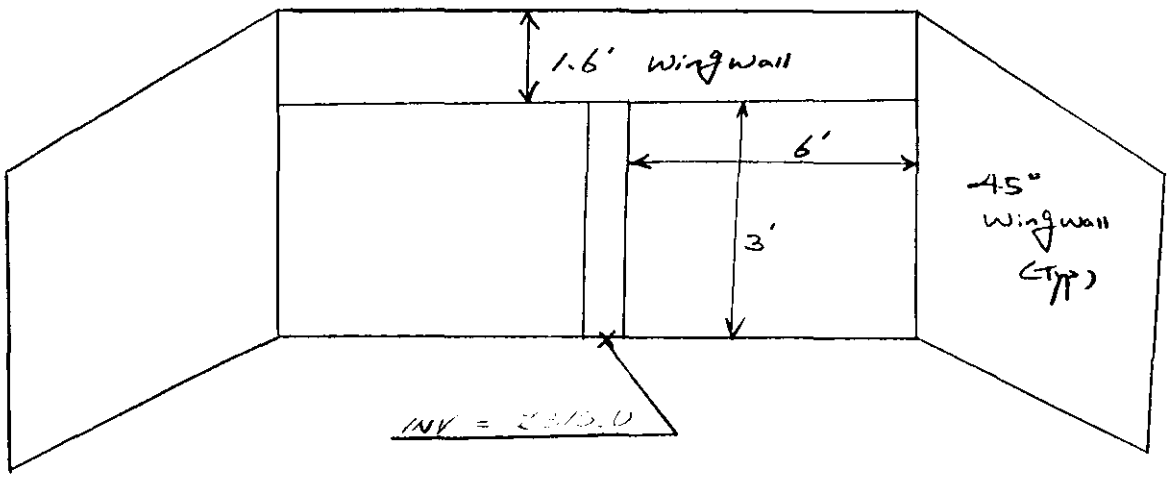
3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* HEC-2 with special culvert routine

   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

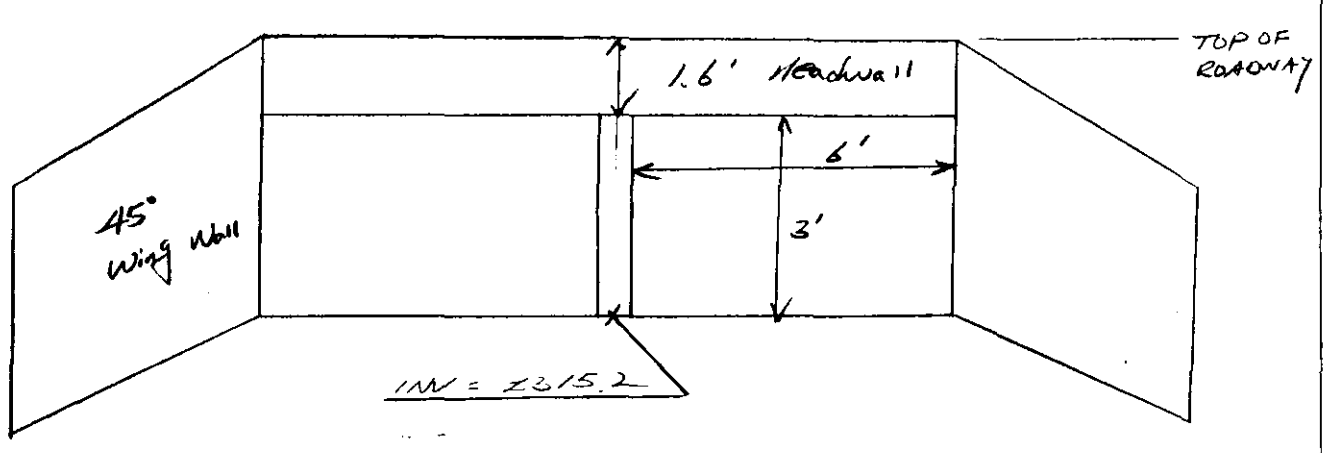
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

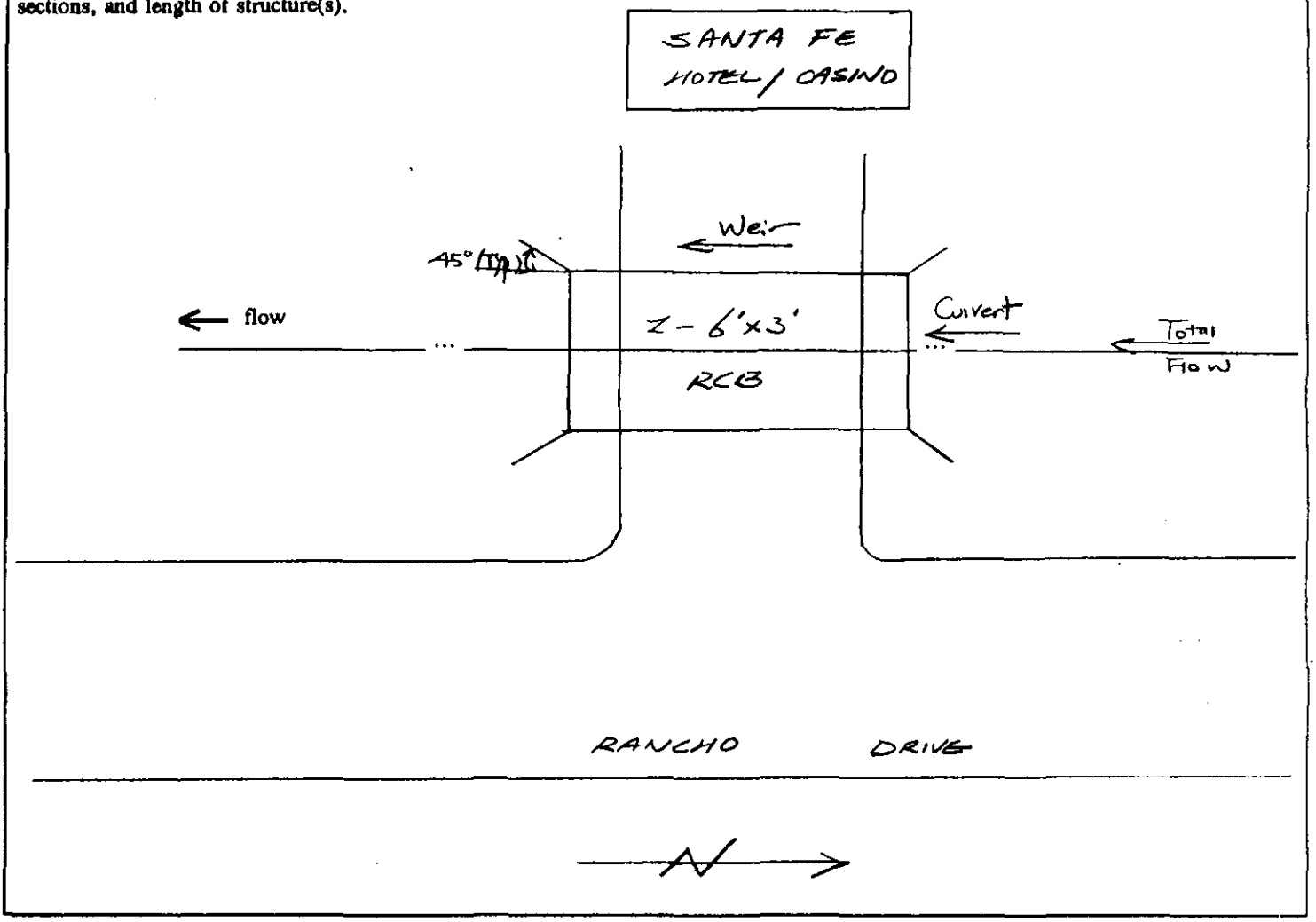
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	65
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	36
Total culvert/bridge area (ft^2)	36

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2319.8	2319.8
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2318.27	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		180	0	180
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	32	n/a
Downstream face	12	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.9
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert RD4

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Two 24" CMP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with no wing walls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson Pipe Culvert Analysis computer program based on Hydraulic Design of Highway Culverts HDS #5

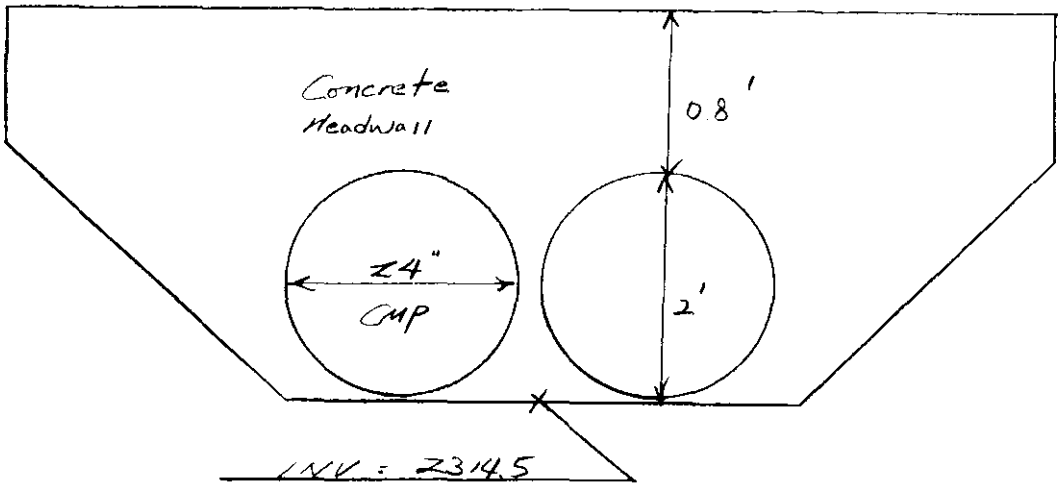
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

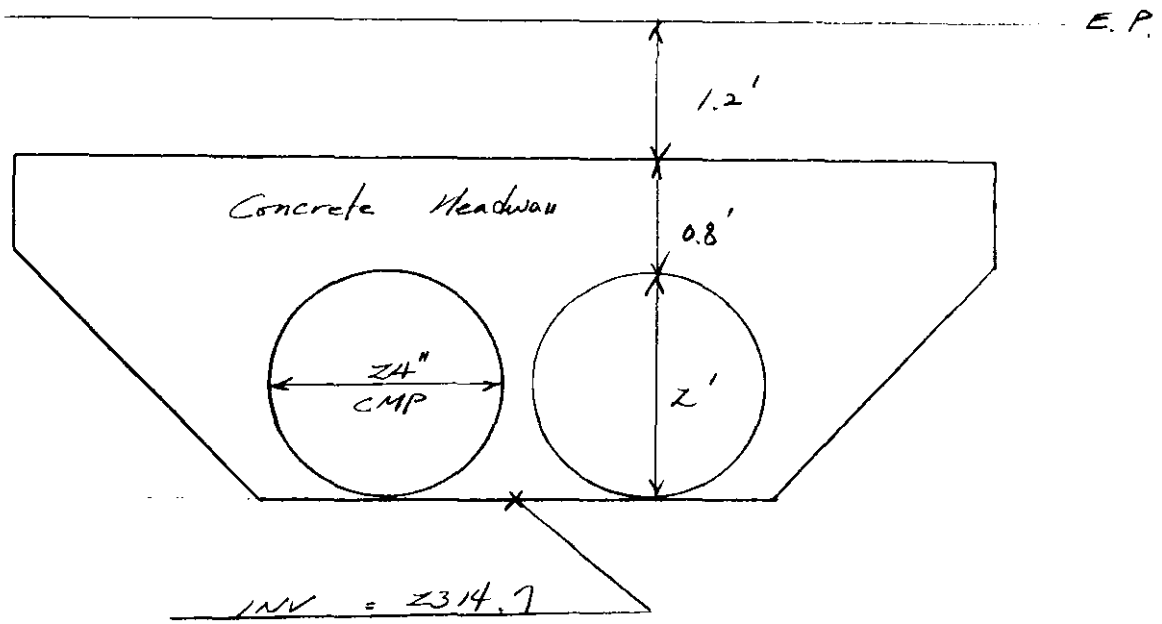
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

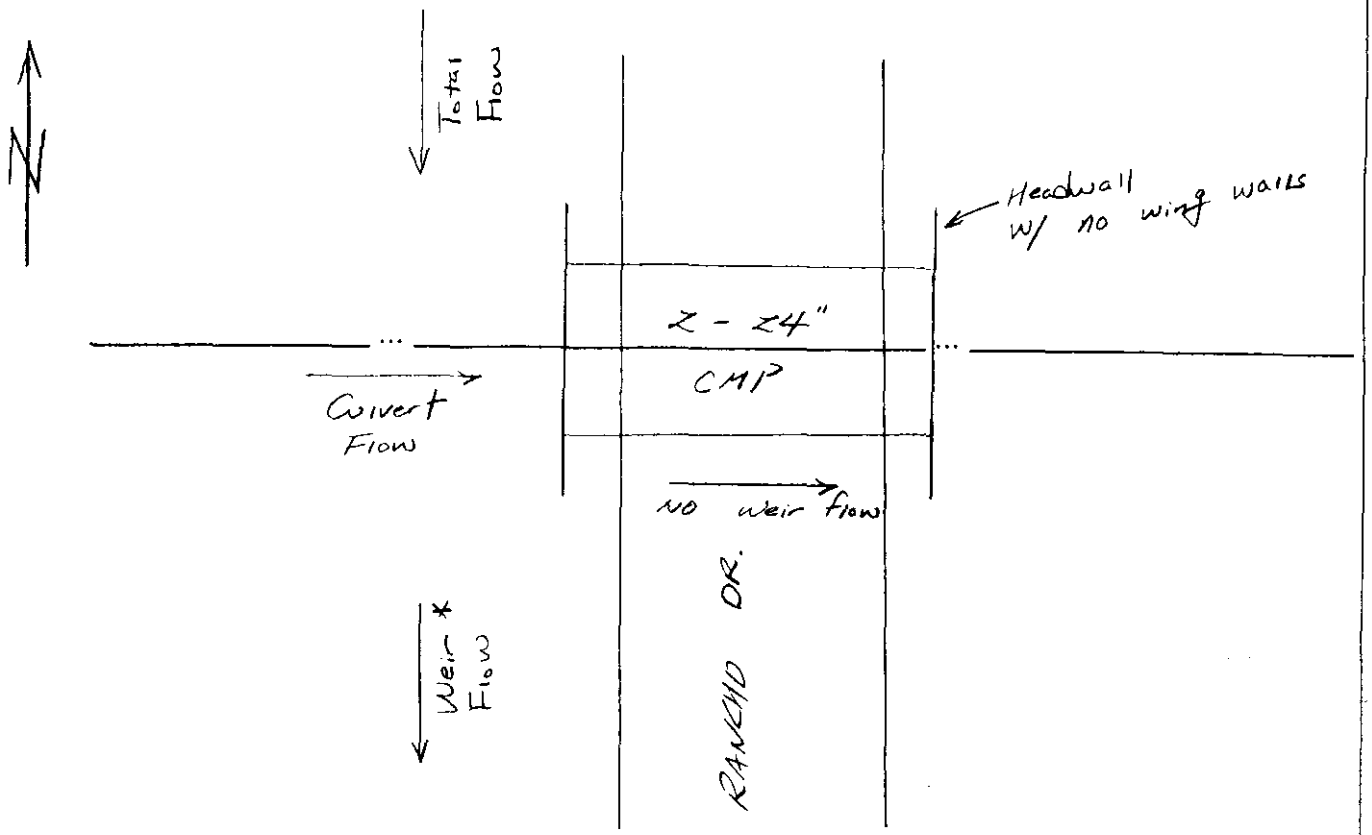
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow continues south along Rancho Dr.

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	115
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	6.3
Total culvert/bridge area (ft^2)	6.3

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2318.7	2318.7
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2316.96	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		30 (culvert flow to east)	150 (weir flow to south)	180
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.5
Manning's "n" value assigned to the structure(s)	0.024
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.7
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert RD5

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One 30" CMP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with no wing walls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson Pipe Culvert Analysis computer program based on Hydraulic Design of Highway Culverts HDS #5

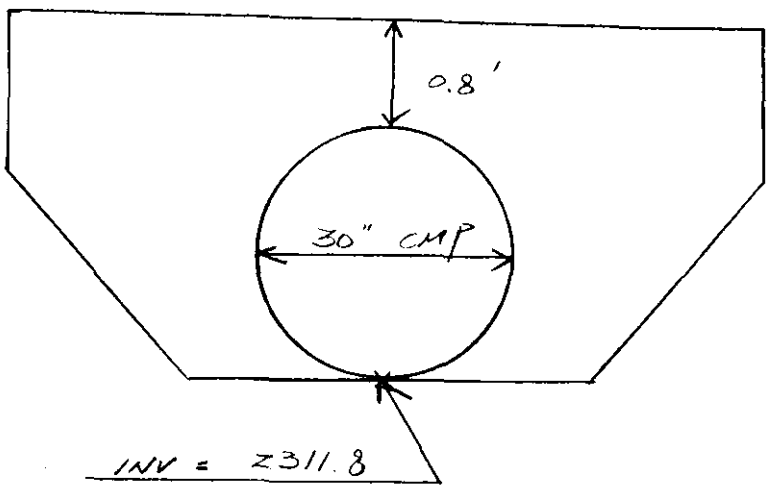
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

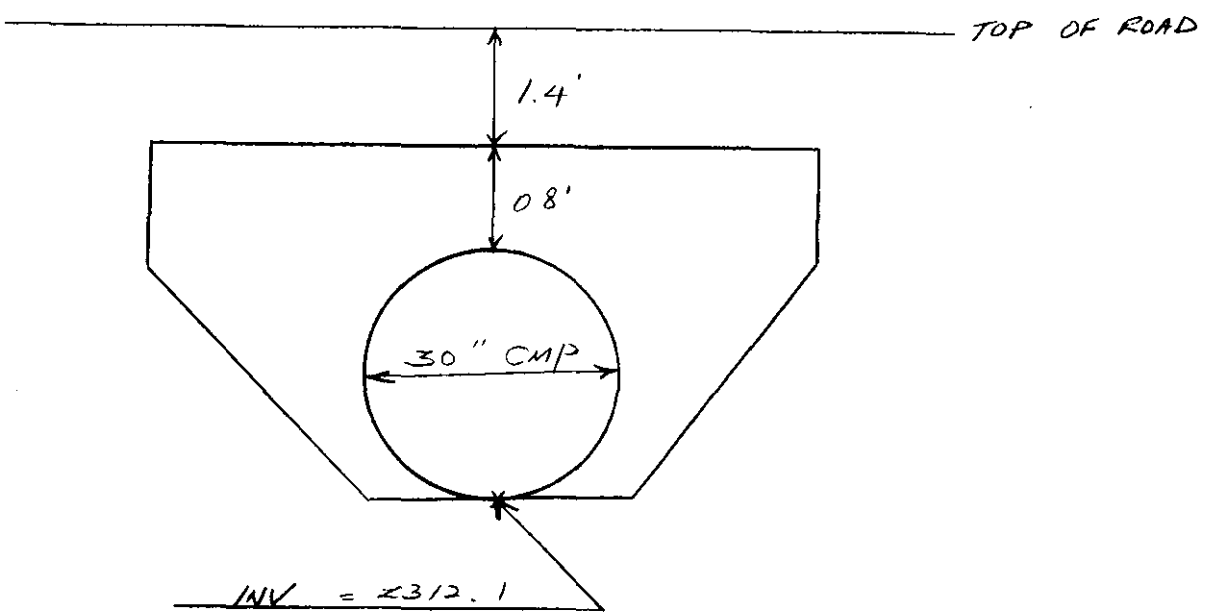
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

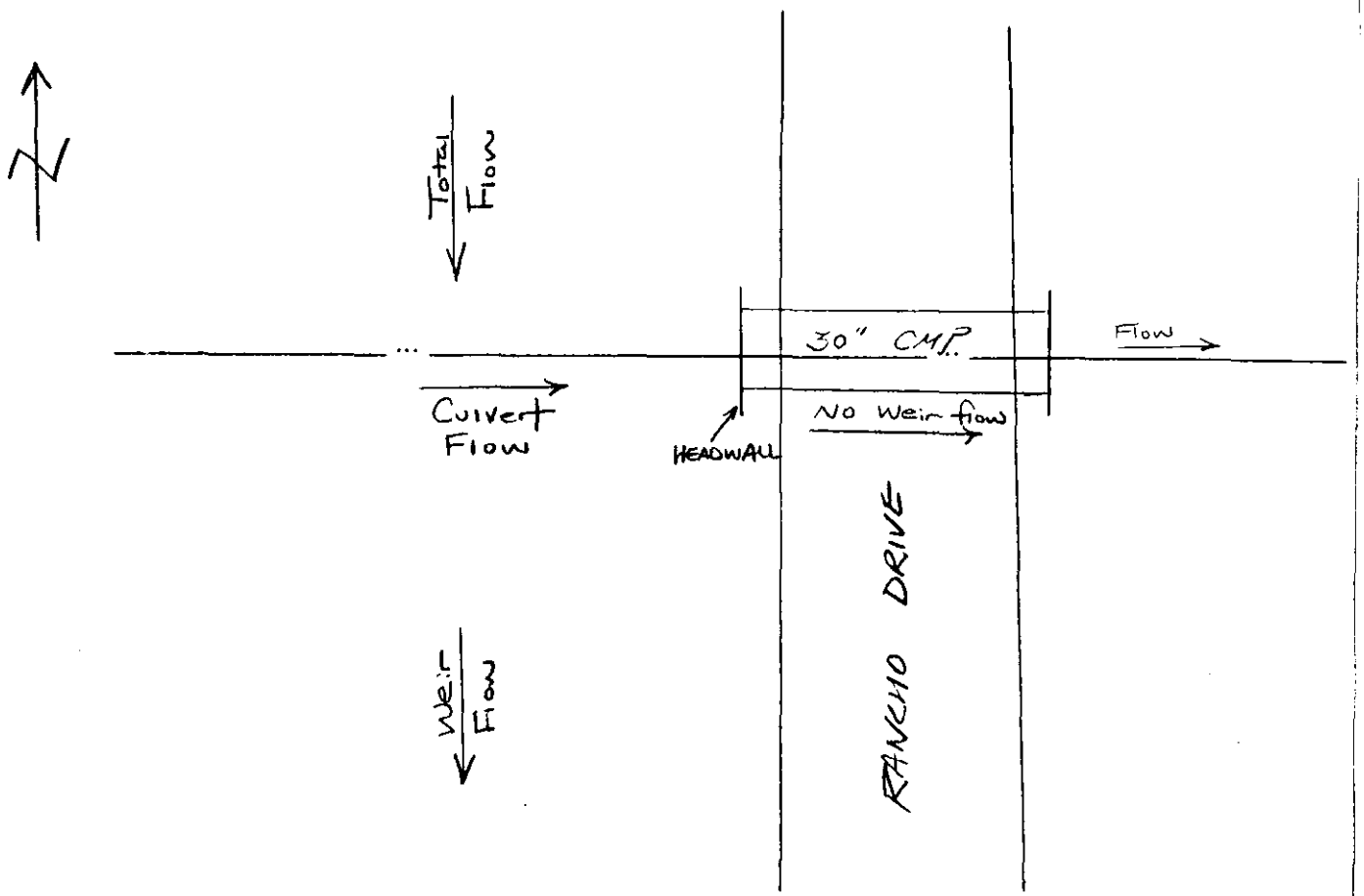
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow Continues South along Rancho Drive

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	120
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	4.9
Total culvert/bridge area (ft^2)	4.9

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2316.8	2316.8
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2316.6	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		51 (culvert flow to east)	248 (weir flow to south)	299
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.5
Manning's "n" value assigned to the structure(s)	0.024
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.8
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert RD6

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One 36" CMP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with no wing walls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson Pipe Culvert Analysis computer program based on Hydraulic Design of Highway Culverts HDS #5

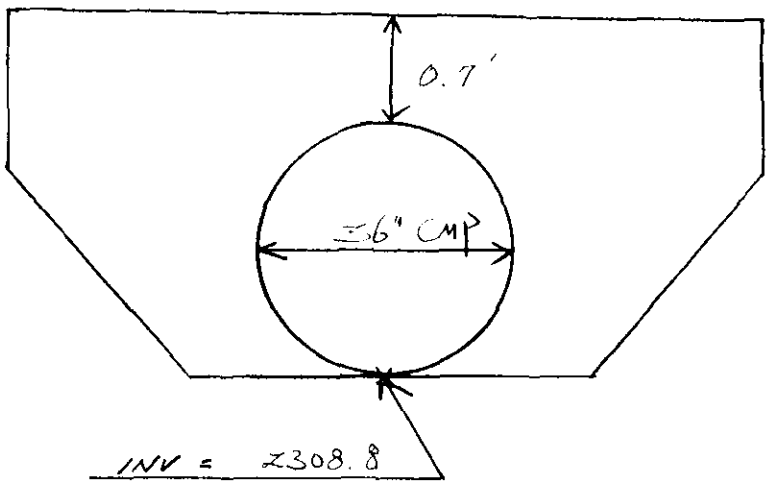
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

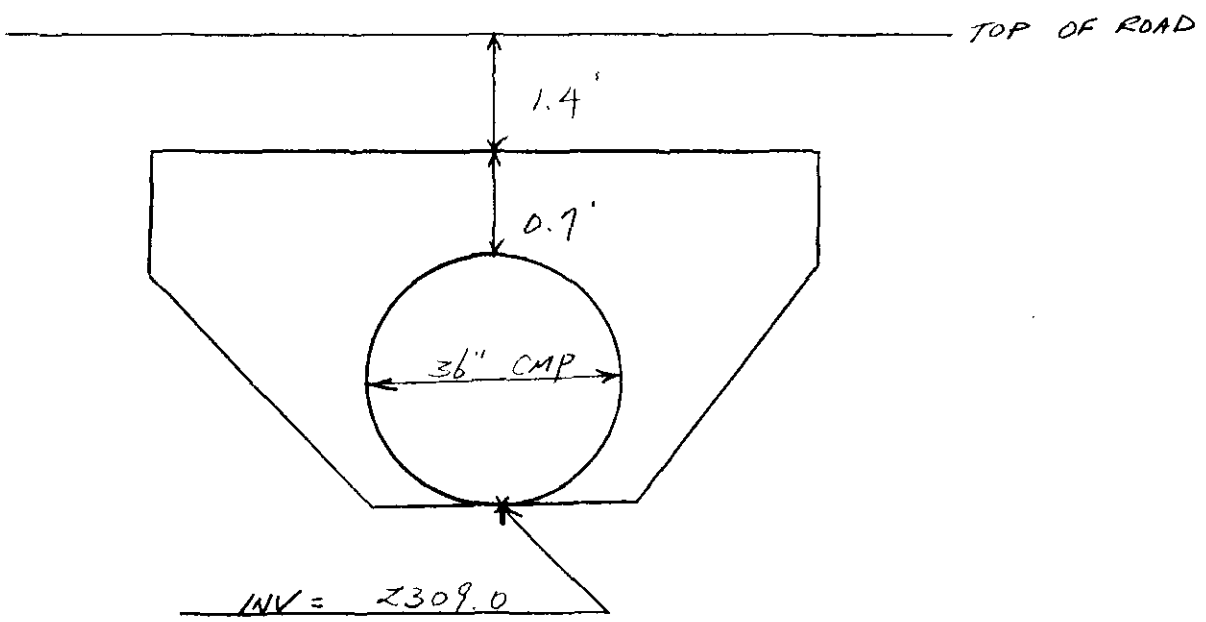
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

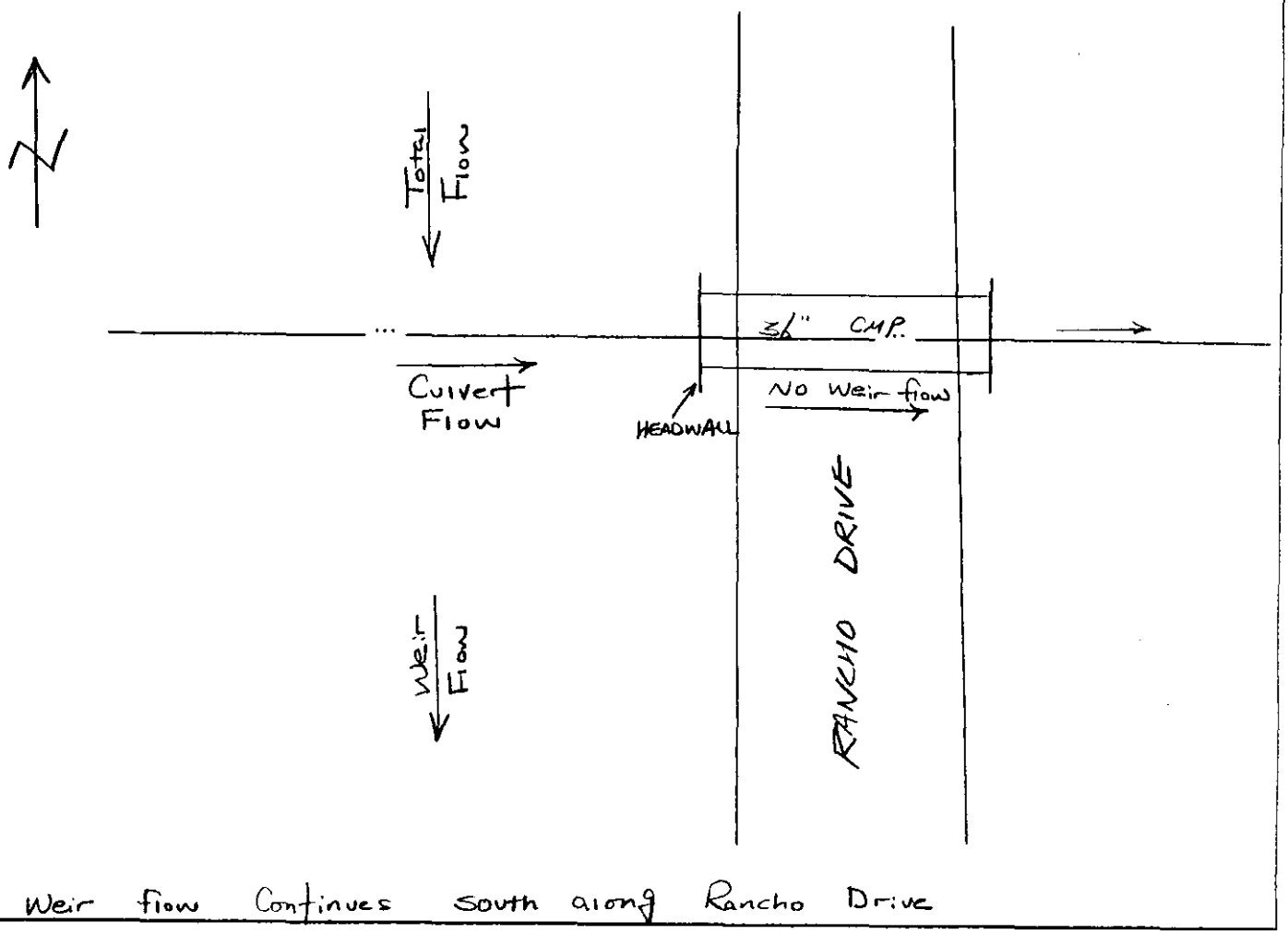
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow Continues south along Rancho Drive

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	120
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	7
Total culvert/bridge area (ft^2)	7

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2314.1	2314.1
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2312.3	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		40 (to east)	210 (to south)	250
The maximum depth of flow over the roadway/railroad (ft.)			n/a	
Weir length (ft.)			Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.5
Manning's "n" value assigned to the structure(s)	0.024
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.8
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert RD7

3. This revision reflects *(check one of the following)*:

- [X] New bridge/culvert not modeled in the FIS
- [ ] Modified bridge/culvert previously modeled in the FIS
- [ ] New analysis of bridge/culvert previously modeled in the FIS

(Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One 6' x 3' RCB

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with beveled top edge, 45° wing walls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson Box Culvert Analysis computer program based on Hydraulic Design of Highway Culverts HDS #5

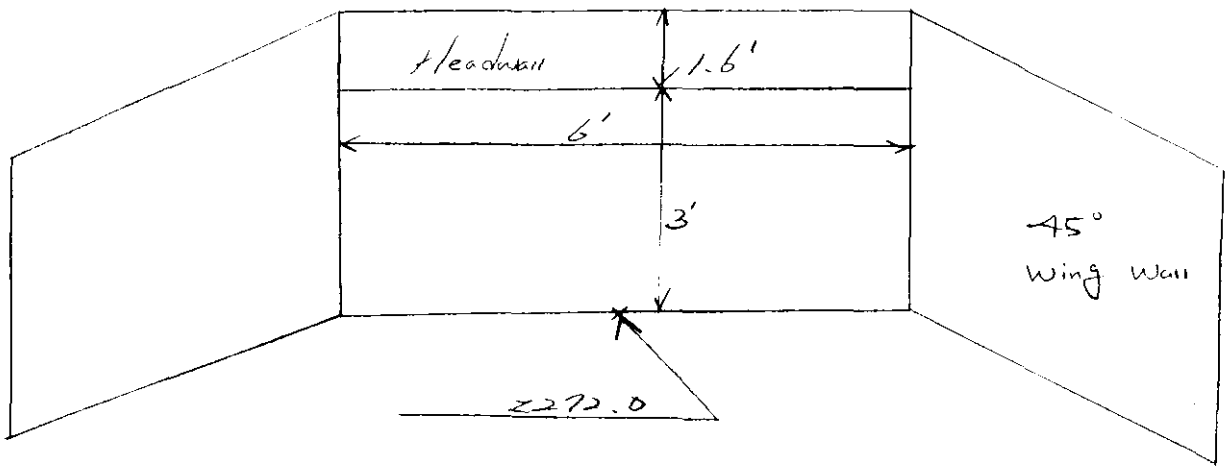
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

Culvert structure is perpendicular to the stream.

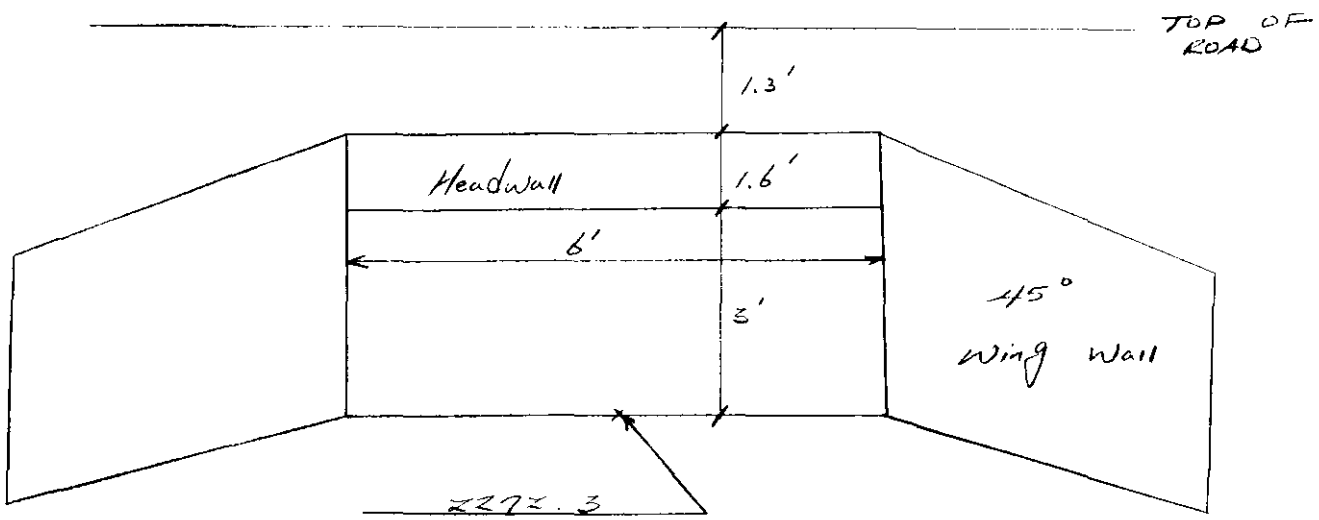
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

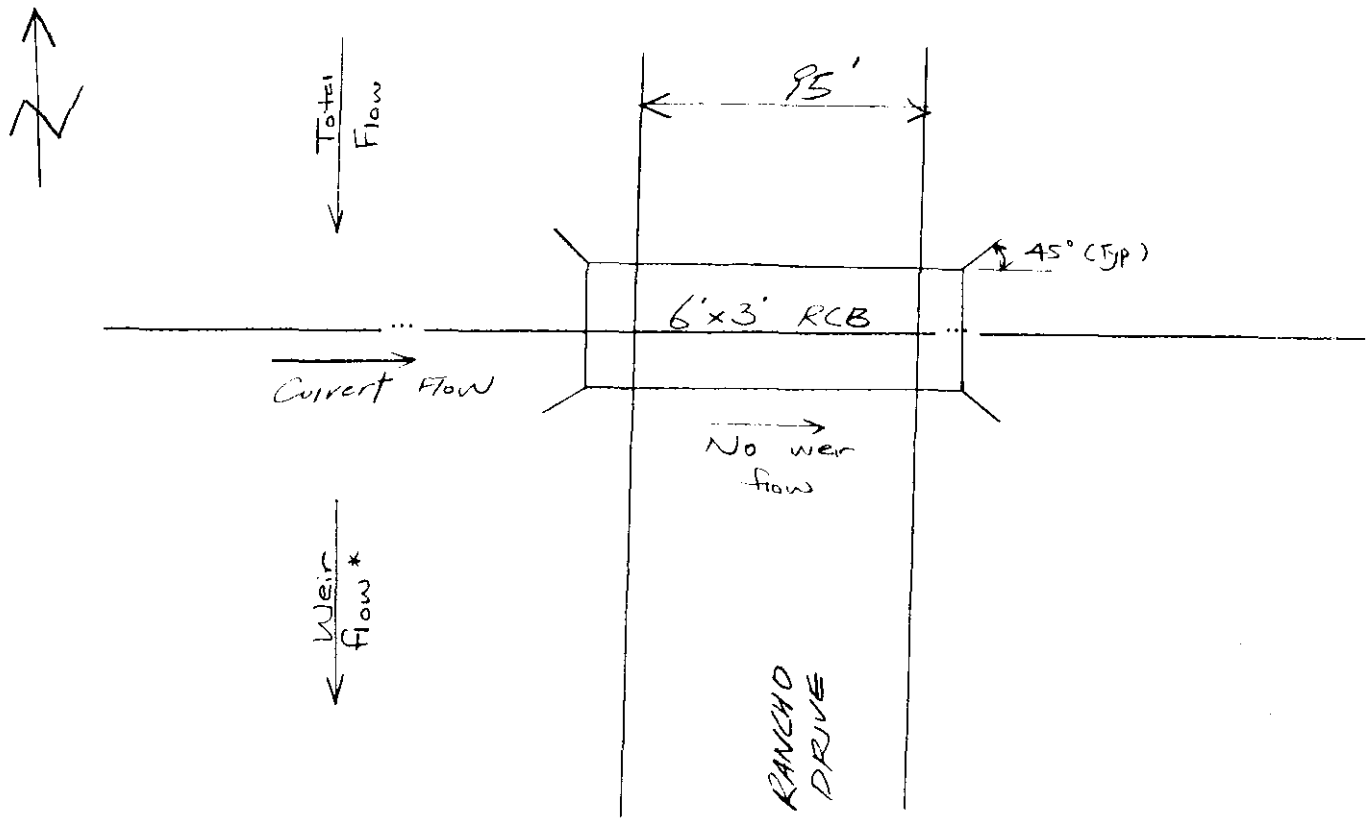
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow Continues South along Rancho Drive

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	120
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	18
Total culvert/bridge area (ft^2)	18

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2278.2	2278.2
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)	0	0	0	0

The maximum depth of flow over the roadway/railroad (ft.) . . . . . n/a

Weir length (ft.) . . . . . Refer to Section 4 - Diversion Calculations

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.8
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert RD8

3. This revision reflects *(check one of the following)*:

- [X] New bridge/culvert not modeled in the FIS
- [ ] Modified bridge/culvert previously modeled in the FIS
- [ ] New analysis of bridge/culvert previously modeled in the FIS

(Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One 6' x 3' RCB

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wing walls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson Box Culvert Analysis computer program based on Hydraulic Design of Highway Culverts HDS #5

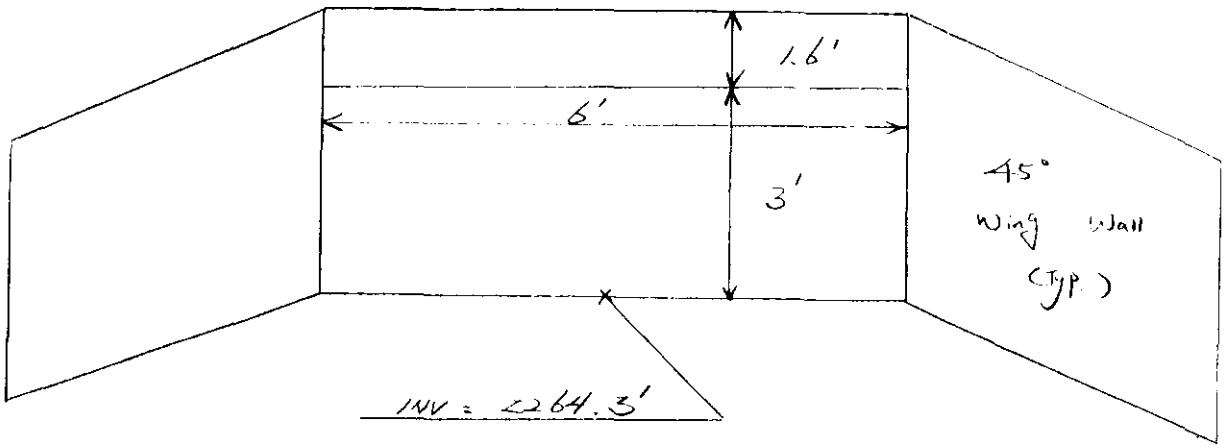
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

Culvert structure is perpendicular to the stream.

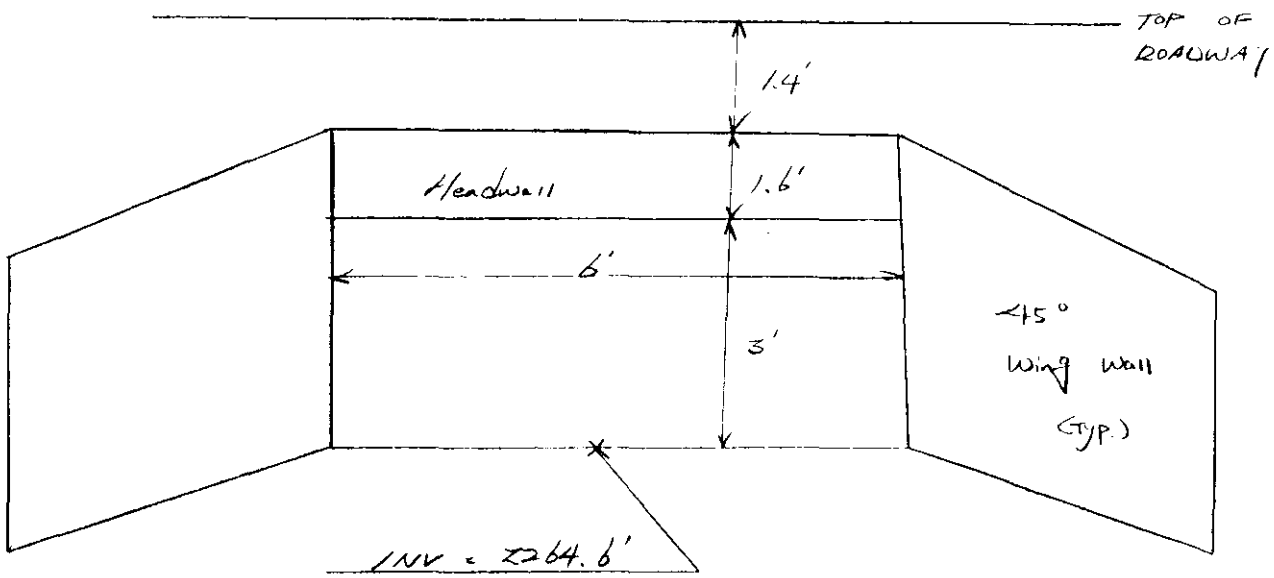
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

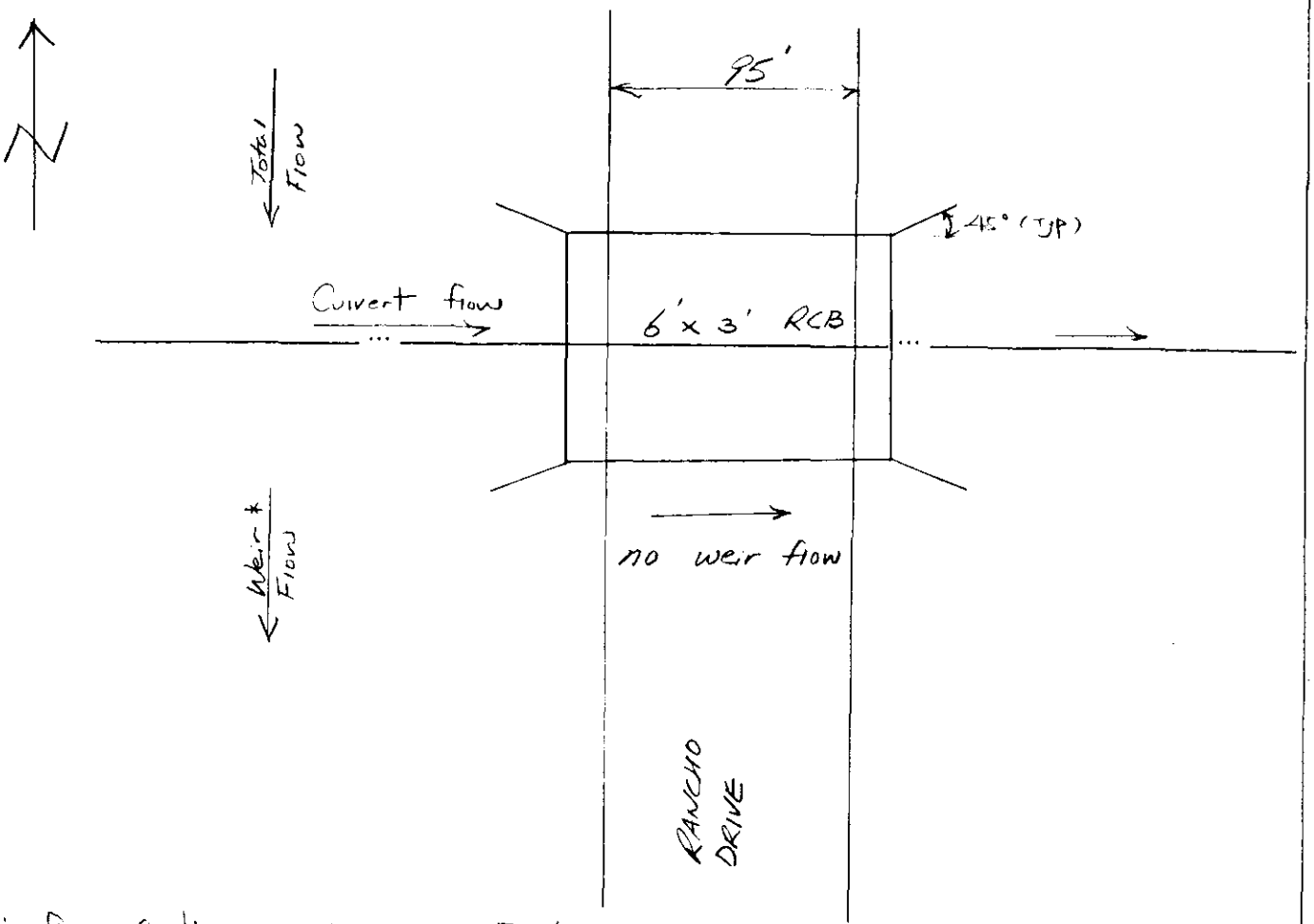
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



*Weir flow continues south along Rancho Drive

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	120
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	18
Total culvert/bridge area (ft^2)	18

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2270.6	2270.6
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)	0	0	0	0

The maximum depth of flow over the roadway/railroad (ft.) . . . . . n/a

Weir length (ft.) . . . . . Refer to Section 4 - Diversion Calculations

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.8
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier):
   Culvert RD9

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One 30" CMP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with no wing walls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson Pipe Culvert Analysis computer program based on Hydraulic Design of Highway Culverts HDS #5

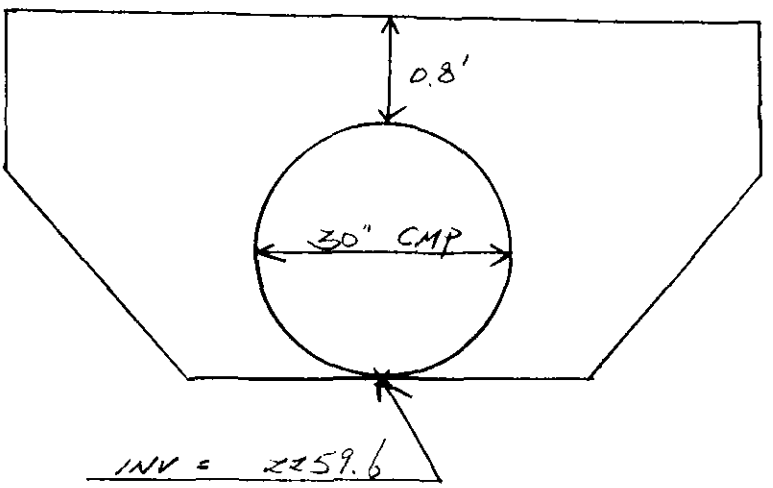
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

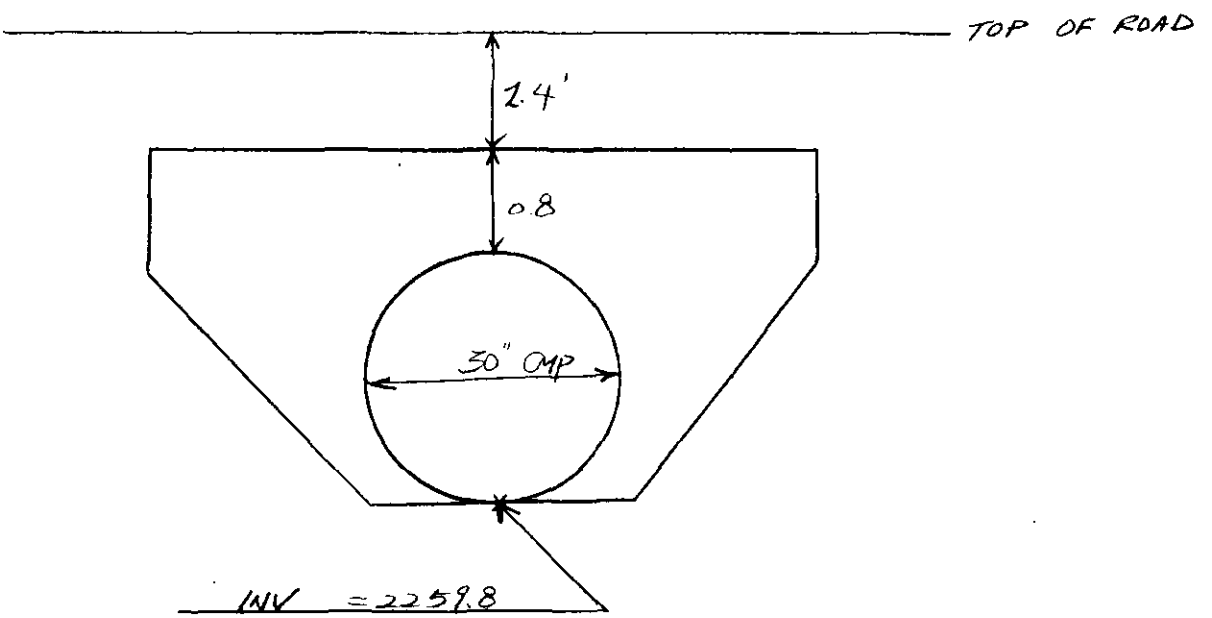
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

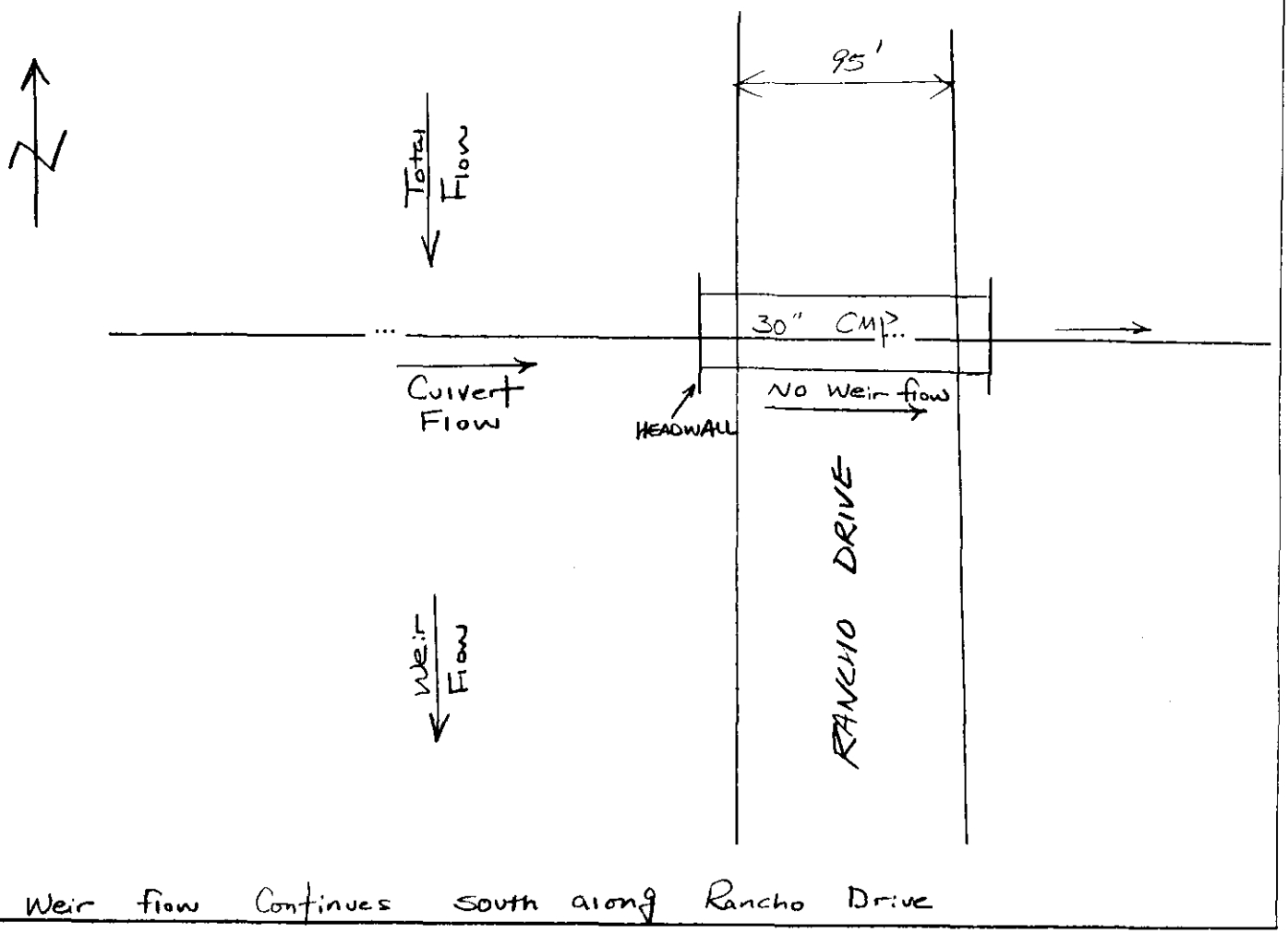
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow Continues South along Rancho Drive

Attach plans of the structure(s) certified by a registered Professional Engineer. – NOT AVAILABLE

Culvert length or bridge width (ft.)	120
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	4.9
Total culvert/bridge area (ft^2)	4.9

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2265.5	2265.5
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2265.0	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		100 (to east)	480 (to south)	580
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.5
Manning's "n" value assigned to the structure(s)	0.024
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.8
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert RD10

3. This revision reflects *(check one of the following)*:

   [X] *New bridge/culvert not modeled in the FIS*

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) One 6' x 2' RCB

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with 45° wing walls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson Box Culvert Analysis computer program based on Hydraulic Design of Highway Culverts HDS #5

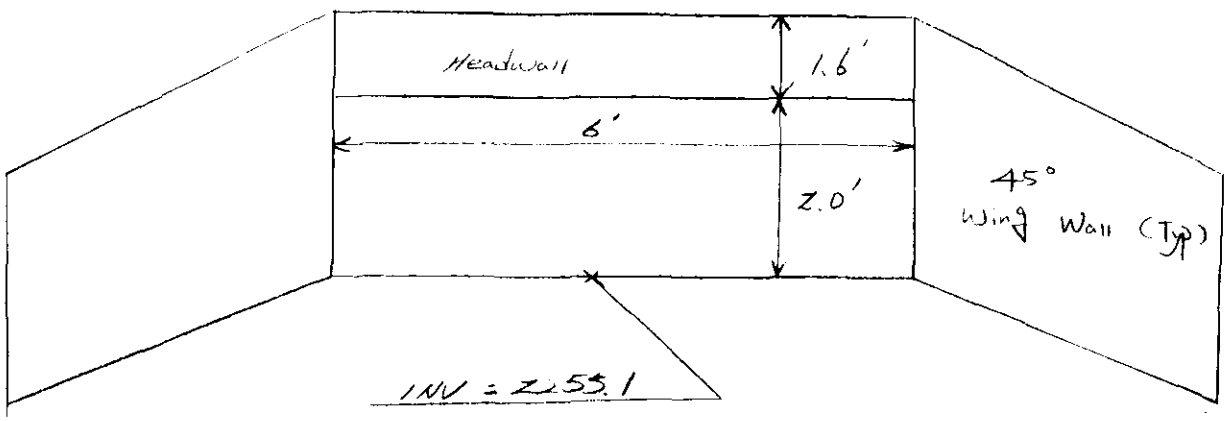
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

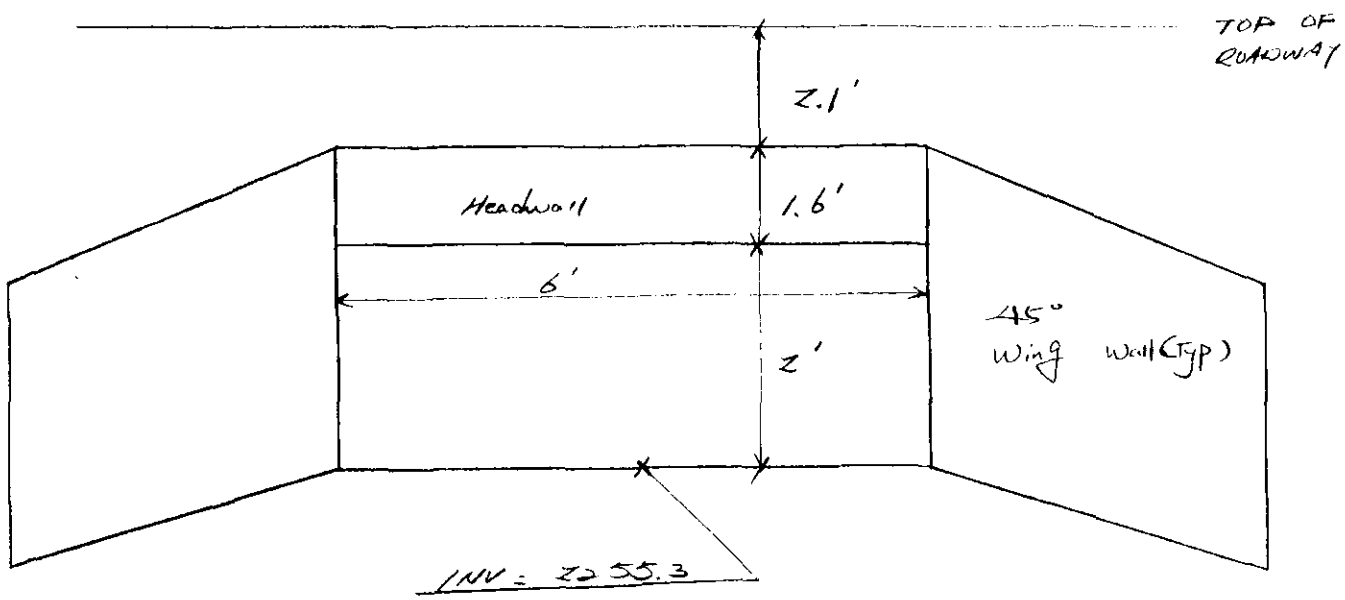
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

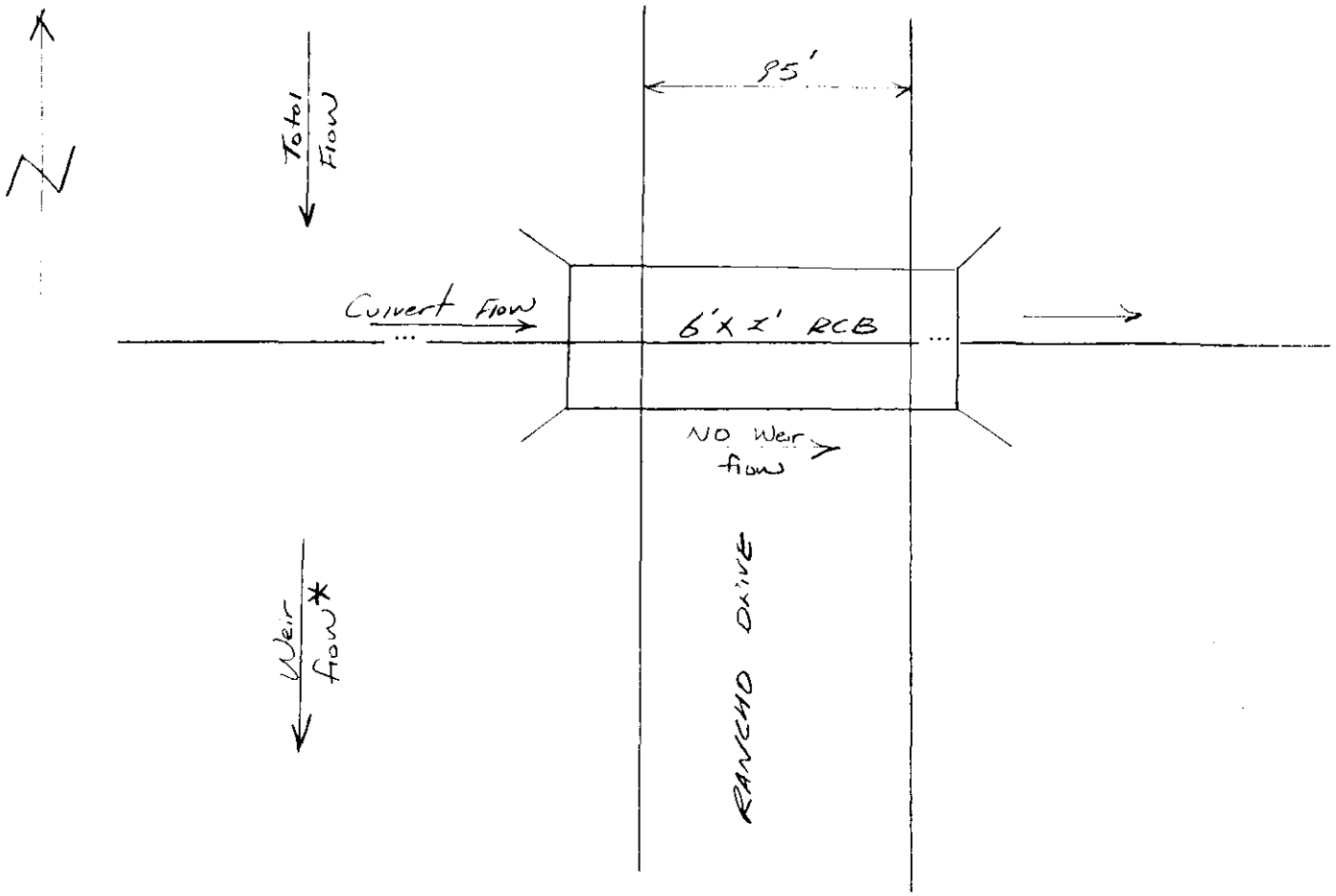
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow continues south along Rancho Drive

Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	120
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	12
Total culvert/bridge area (ft^2)	12

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2261	2261
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2260.77	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		120 (to east)	426 (to south)	546
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.2
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.8
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment (floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert RD11

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] Modified bridge/culvert previously modeled in the FIS

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of *two 3-foot diameter circular piers; 40-foot wide ogee shape spillway)* One 24" CMP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Concrete headwall with no wing walls

3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* Dodson Pipe Culvert Analysis computer program based on Hydraulic Design of Highway Culverts HDS #5

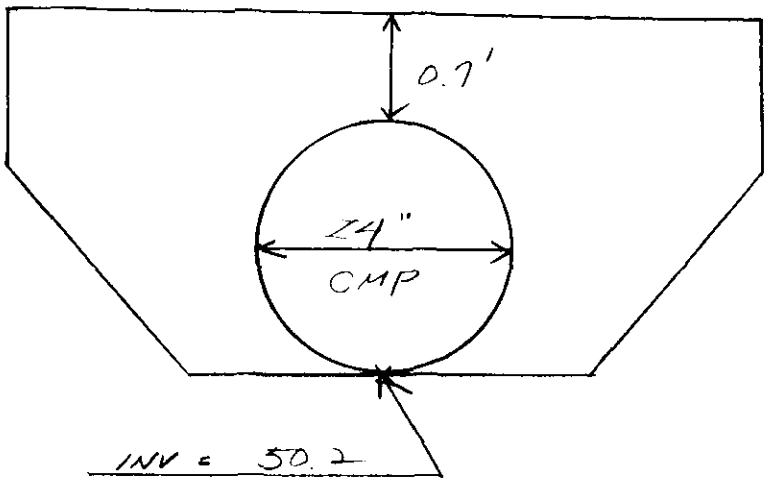
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

   Culvert structure is perpendicular to the stream.

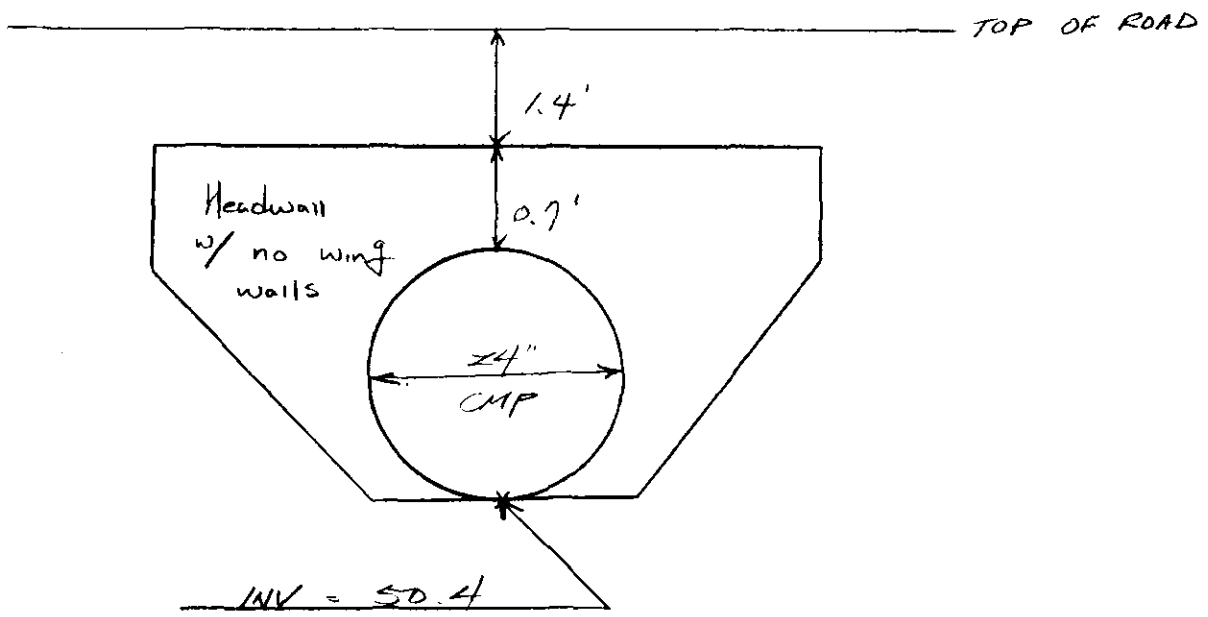
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

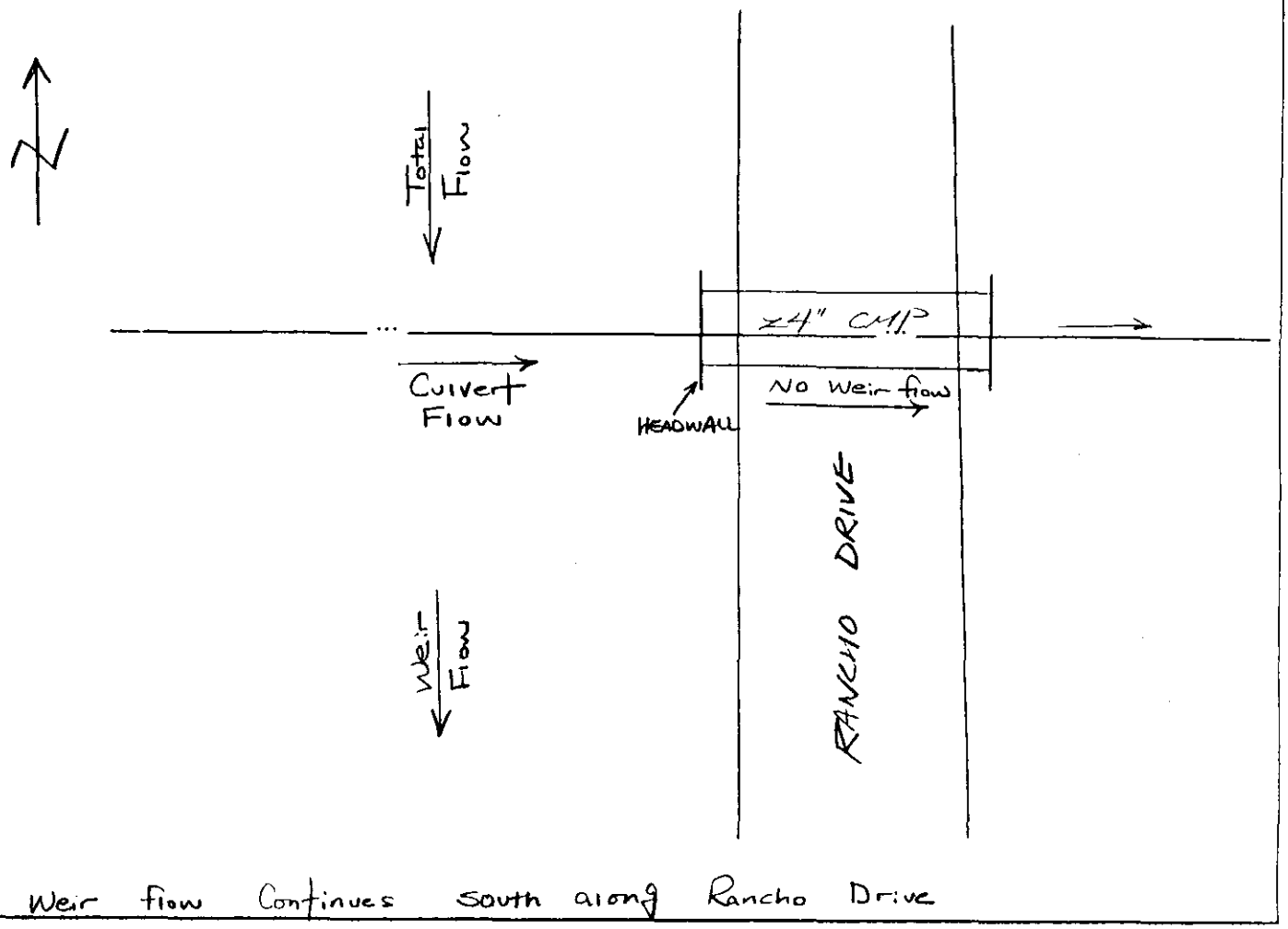
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



* Weir flow Continues south along Rancho Drive

Attach plans of the structure(s) certified by a registered Professional Engineer. – NOT AVAILABLE

Culvert length or bridge width (ft.)	120
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	3.1
Total culvert/bridge area (ft^2)	3.1

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2254.5	2254.5
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2254.0	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		24 (to east)	319 (to south)	343
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.5
Manning's "n" value assigned to the structure(s)	0.024
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.8
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the *100-year water surface elevations?* . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Northwest Las Vegas, Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. IDENTIFIER

1. *Name of roadway, railroad, etc.:* Rancho Drive

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): Culvert RD12

3. This revision reflects *(check one of the following)*:

   [X] New bridge/culvert not modeled in the FIS

   [ ] *Modified bridge/culvert previously modeled in the FIS*

   [ ] New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3-foot diameter circular piers; 40-foot wide ogee shape spillway) Two 48" CMP

2. Entrance geometry of culvert/type of bridge opening (e.g. 30°-75° wing walls with square top edge, sloping embankments and vertical abutments) Projecting from fill

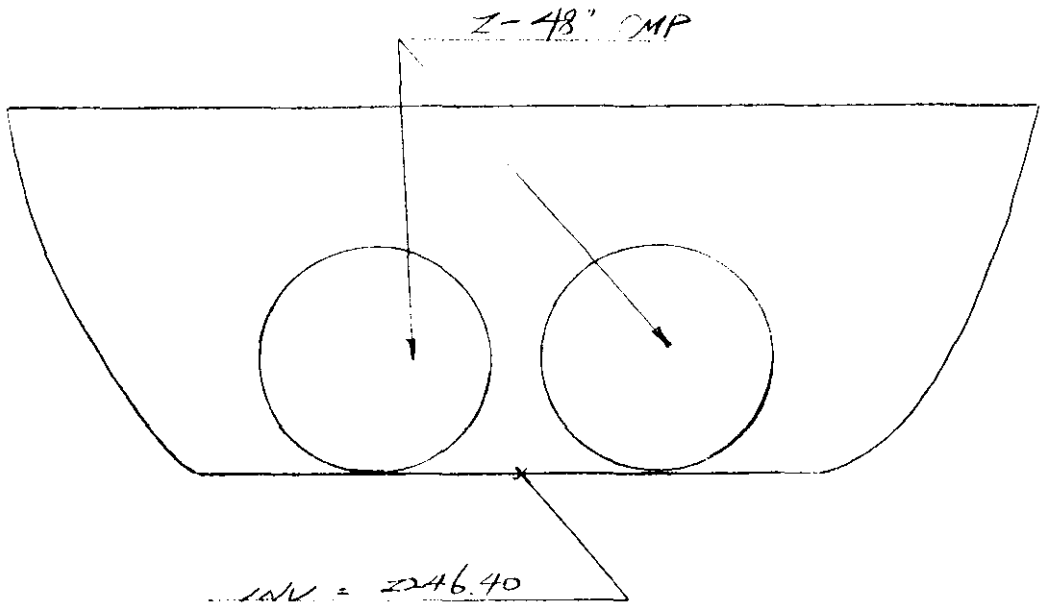
3. *Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8)* HEC-2 with special culvert routine

   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

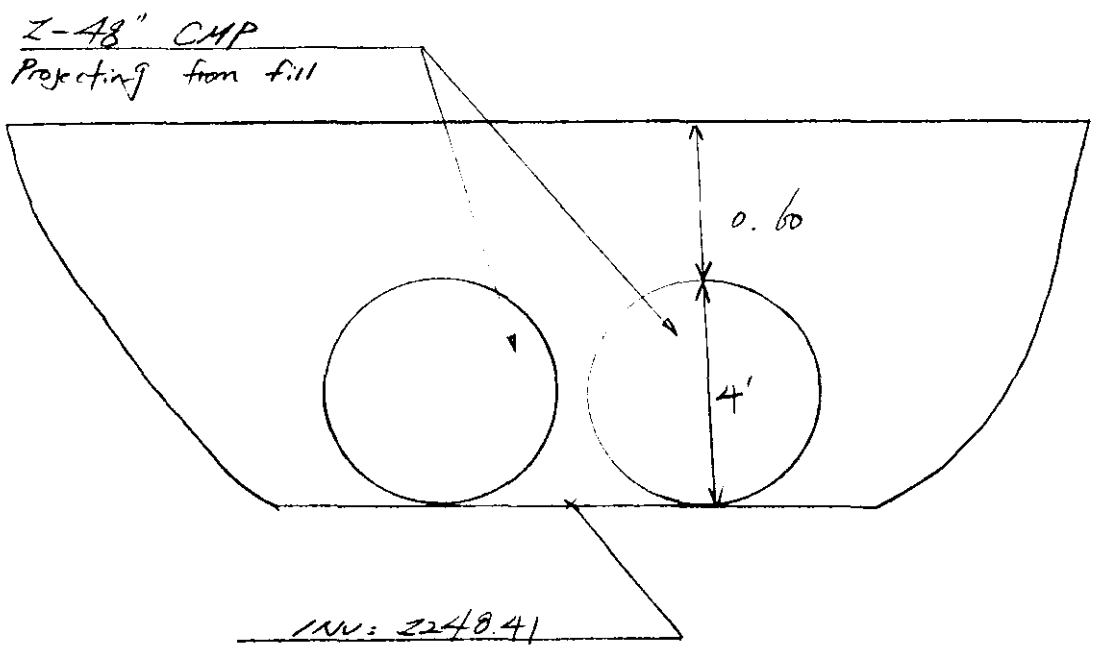
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

*One form per new/revised bridge/culvert

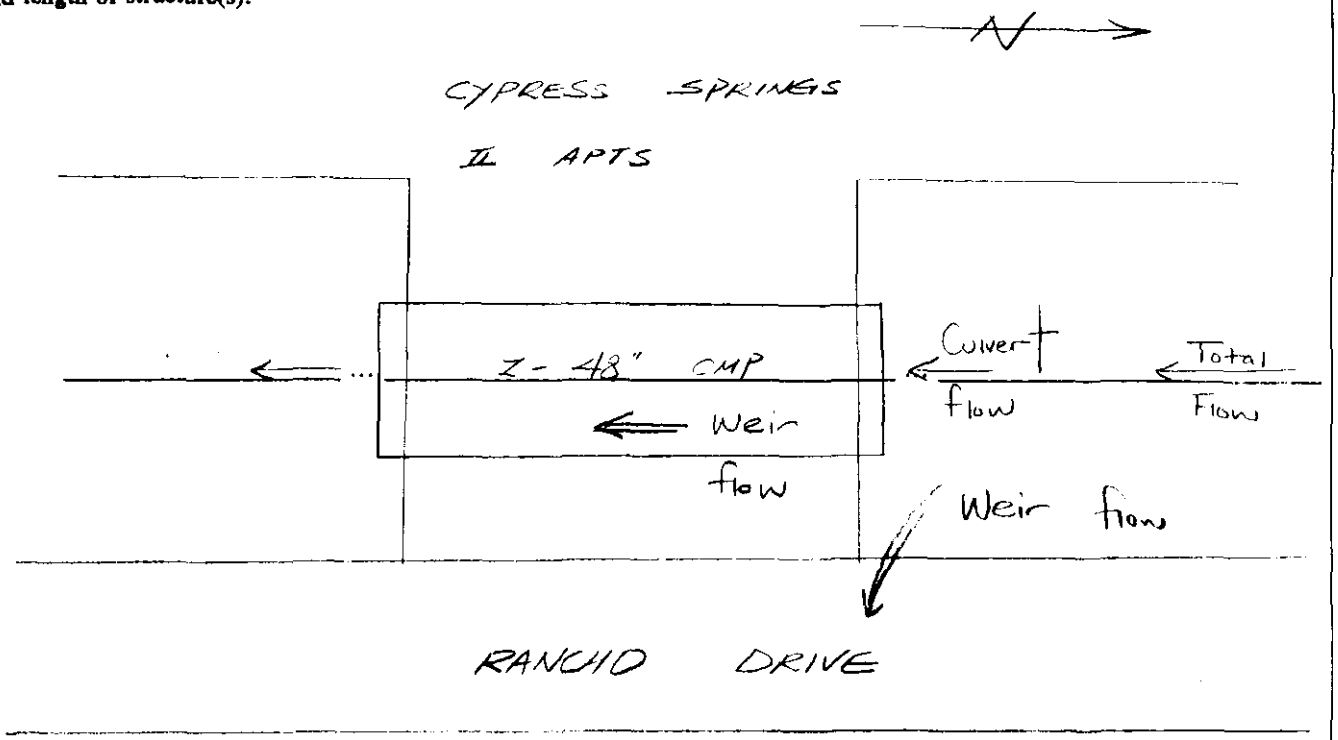
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).



Attach plans of the structure(s) certified by a registered Professional Engineer. — NOT AVAILABLE

Culvert length or bridge width (ft.)	402
Calculated culvert/bridge (ft^2) by the hydraulic model, if applicable	25.12
Total culvert/bridge area (ft^2)	25.12

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	*Right Overbank*
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	2253.6	2253.6
Downstream face	n/a	n/a

100-Year Elevations

	Water-Surface Elevations	Energy Gradient Elevations
Upstream face	2254.08	n/a
Downstream face	n/a	n/a

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)		59 (to south)	261 (to south & east)	320
The maximum depth of flow over the roadway/railroad (ft.)	. . . . .	. . . . .	n/a	
Weir length (ft.)	. . . . .	. . . . .	Refer to Section 4 - Diversion Calculations	

Top Widths

	Floodplain	Floodway
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Top Widths

	Effective Flow	Effective and Ineffective Flow
Upstream face	n/a	n/a
Downstream face	n/a	n/a

Loss Coefficients

Entrance loss coefficient	0.8
Manning's "n" value assigned to the structure(s)	0.024
Friction loss coefficient through structure(s)	n/a
Other loss coefficients (e.g., bend, manhole, etc.)	n/a
Total loss coefficient	n/a
Weir coefficient	2.9
Pier coefficient	n/a
Contraction loss coefficient	n/a
Expansion loss coefficient	n/a

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?

   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment

(floodway run) n/a

Comments *(explain any unusual situations)*:

n/a

Attach analysis.

Section 2
HEC-1 Models

Kyle.dat

KYLE.DAT

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*          SEPTEMBER 1990               *
*            VERSION 4.0                *
*                                       *
*  RUN DATE  06/08/1994  TIME  10:31:52 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```


```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
   1      ID
   2      ID
   3      ID       NORTHWEST LAS VEGAS FIS RESTUDY                DATE: JUNE 1994
   4      ID       BY COE & VAN LOO ASSOCIATES                    JOB # 930017
   5      ID       Kyles Canyon Detention basin area              File: Kyle.dat
   6      ID
   7      ID     6-HOUR RAINFALL, 6 MINUTE TIME INTERVAL
   8      ID     RAINFALL DISTRIBUTION = SDN5
   9      ID     SCS UNIT HYDROGRAPH METHOD
  10      ID     EXISTING CONDITIONS
  11      ID
  12      ID
  13      ID  ************************************************************************
  14      ID       This HEC-1 model is modified from VTN Nevadas HEC-1 model for Kyle
  15      ID       Canyon Detention Basin , Jan. 1993
  16      ID
  17      ID
  18      ID
  19      ID       Rainfall depth values replaced w/ 3.65 by CVL
  20      ID
  21      ID
  22      ID
  23      ID
  24      ID
  25      ID  ************************************************************************
  26      ID       KYLE CANYON DETENTION BASIN WATERSHED AREA = 58 SQ. MI.
  27      ID
  28      ID
  29      ID                    ***ADJUSTMENT RATIOS***
  30      ID       PT OF INTEREST      AREA    DARF
  31      ID       @ Kyle Canyon         58   0.667
  32      ID
  33      ID
  34      ID
  35      ID  ************************************************************************
  36      ID
  37      ID
          *DIAGRAM
  38      IT       6       0       0     300
  39      IO       5       0       0
  40      IN       5       0       0
  41      JR    PREC   0.667
          *
          * REFER TO KYLE CANYON DETENTION BASIN BY VTN NEVADA
          * HEC-1 MODEL - KYLE1.DAT
          *

  42      KK  GD30.5
  43      KM   Total for basins; GD 30.5 THRU GD 30.11
  44      KM  LARGE FORESTED AREA EXTENDING TO MT. CHARLESTON
  45      BA   28.60
          * NOAA Point Rainfall = 2.55, Adjusted rainfall = 2.55 x 1.43 = 3.65
  46      PB    3.65
  47      PC    .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
  48      PC    .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  49      PC    .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
  50      PC    .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
  51      PC    .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
  52      PC    .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
  53      PC    .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
  54      PC    .997    .999   1.00
  55      LS       0   83.6
  56      UD    1.04

  57      KK     RT1
  58      KM    Route flows to CP at GD 30.4
  59      RS       5    FLOW      -1       0
  60      RC    0.06    0.04    0.06   21950  0.0349
  61      RX       0       1      26      27     177     178     203     204
  62      RY      10       3       3       0       0       3       3      10
  63      RL       0       0       2

  64      KK  GD30.4
  65      KM   Runoff from basin GD 30.4
  66      BA    6.89
  67      LS       0    82.3
  68      UD    0.60

  69      KK    CMB1
  70      KM   Combine hydrographs at cp GD 30.4
  71      HC       2

  72      KK     RT2
  73      KM   Route flows to CP at GD 30.3
  74      RS       1    FLOW      -1       0
  75      RC    0.06    0.04    0.06    2075  0.0386
  76      RX       0       1      26      27     177     178     203     204
  77      RY      10       3       3       0       0       3       3      10
  78      RL       0       0       2

  79      KK  GD30.3
  80      KM   Runoff from basin GD 30.3
  81      BA    9.43
  82      LS       0    86.9
  83      UD    0.96

  84      KK    CMB2
  85      KM   Combine hydrographs at cp GD 30.3
  86      HC       2

  87      KK     RT3
  88      KM   Route flows to CP at GD 30.1
  89      RS       4    FLOW      -1       0
  90      RC    0.06    0.04    0.06   18000  0.0383
  91      RX       0       1      26      27     177     178     203     204
  92      RY      10       3       3       0       0       3       3      10
  93      RL       0       0       2
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  94      KK  GD30.2
  95      KM   Runoff from basin GD 30.2
  96      BA    0.85
  97      LS       0      77
  98      UD    0.41

  99      KK     RT4
 100      KM   Route flows to CP at GD 30.1
 101      RS       3    FLOW      -1       0
 102      RC    0.06    0.04    0.06    4800  0.0323
 103      RX       0       1      26      27     177     178     203     204
 104      RY      10       3       3       0       0       3       3      10
 105      RL       0       0       2

 106      KK  GD30.1
 107      KM   Runoff from basin GD 30.1
 108      BA    2.61
 109      LS       0    83.1
 110      UD    0.85

 111      KK    CMB3
 112      KM   Combine hydrographs at cp GD 30.1
 113      HC       3

 114      KK     RT5
 115      KM   Route flows to CP at GD 25-3
 116      RS       2    FLOW      -1       0
 117      RC    0.06    0.04    0.06   10000  0.0390
 118      RX       0       1      26      27     177     178     203     204
 119      RY      10       3       3       0       0       3       3      10
 120      RL       0       0       2

 121      KK    GD25
 122      KM   Runoff from basin GD 25-3
 123      BA    2.34
 124      LS       0    79.3
 125      UD    0.38

 126      KK    GD21
 127      KM   Runoff from basin GD 21
 128      BA    6.79
 129      LS       0    83.9
 130      UD    0.86

 131      KK     RT6
 132      KM   Route flows from GD 21 to CP at GD 25-3
 133      RS       5    FLOW      -1       0
 134      RC    0.06    0.04    0.06   10500  0.0438
 135      RX       0       1      26      27     177     178     203     204
 136      RY      10       3       3       0       0       3       3      10
 137      RL       0       0       2
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  138     KK    CMB4
  139     KM   Combine hydrographs at CP GD 30.3
  140     HC       3

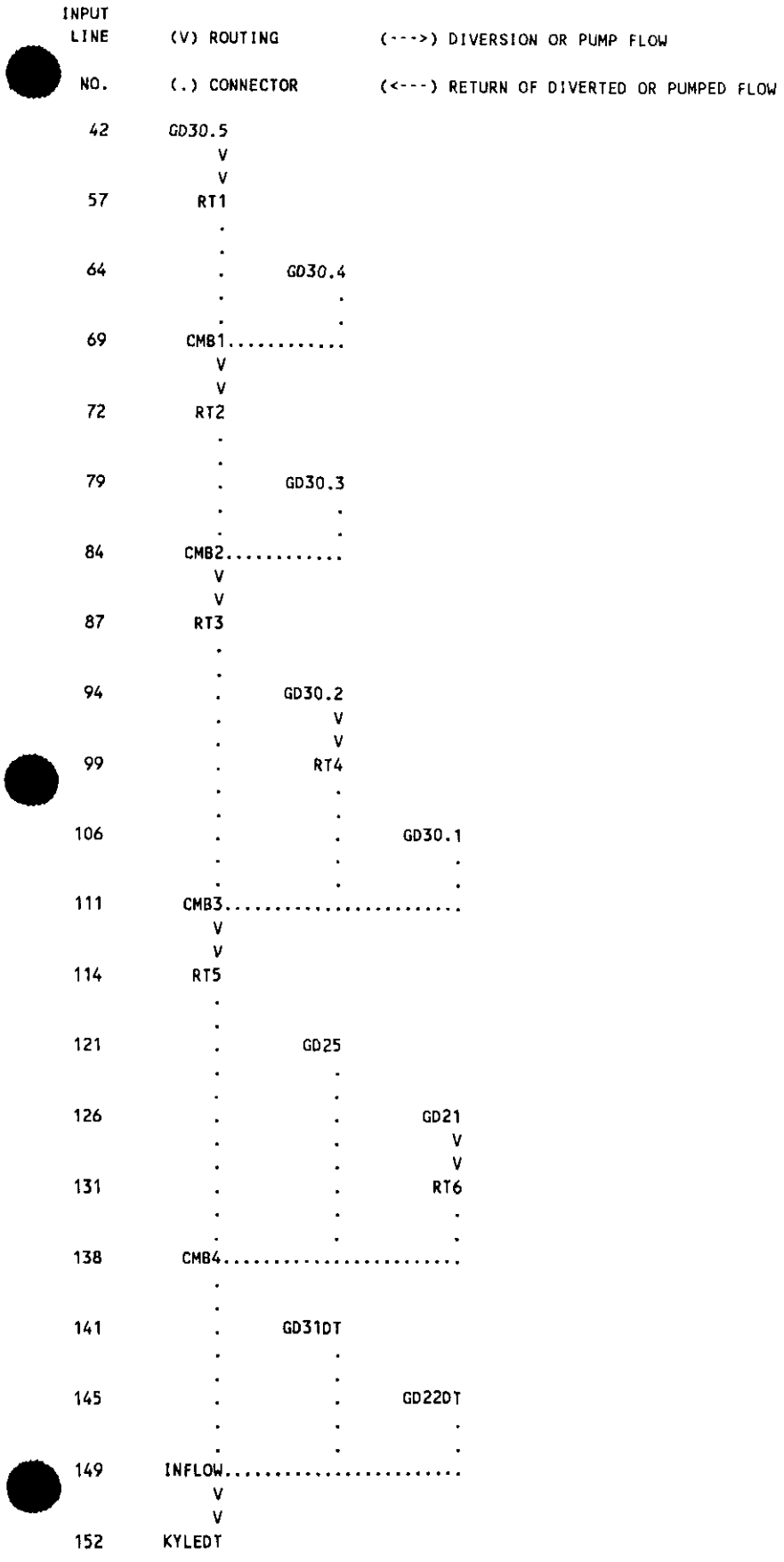
  141     KK  GD31DT
  142     BA    0.22
  143     LS       0    79.3
  144     UD     0.4

  145     KK  GD22DT
  146     BA    0.42
  147     LS       0      86
  148     UD    0.38
          * ************************
          * * PEAK INFLOW TO BASIN *
          * ************************

  149     KK  INFLOW
  150     KO       1
  151     HC       3

  152     KK  KYLEDT
  153     KM   Route flows through Kyle Canyon Detention Basin
  154     KO       1
  155     RS       1    STOR      -1
  156     SV       0      11     205     769    1738    3059    4320
  157     SE    3235    3240    3250    3260    3270    3281    3290
  158     SQ       0      27      40      50     301     343     369     390
  159     SE    3235    3245    3255    3265    3266    3275    3281    3290
          *
          * Outflow hydrograph @ this point will be inputed into
          * HEC-1 model for areas east of US 95.
          * carey-f.dat
  160     ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  06/08/1994  TIME  10:31:52 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


NORTHWEST LAS VEGAS FIS RESTUDY — DATE: JUNE 1994
BY COE & VAN LOO ASSOCIATES — JOB # 930017
Kyles Canyon Detention basin area — File: Kyle.dat

6-HOUR RAINFALL, 6 MINUTE TIME INTERVAL
RAINFALL DISTRIBUTION = SDNS
SCS UNIT HYDROGRAPH METHOD
EXISTING CONDITIONS

****

This HEC-1 model is modified from VTN Nevadas HEC-1 model for Kyle Canyon Detention Basin , Jan. 1993

Rainfall depth values replaced w/ 3.65 by CVL

****

KYLE CANYON DETENTION BASIN WATERSHED AREA = 58 SQ. MI.

ADJUSTMENT RATIOS

PT OF INTEREST	AREA	DARF
@ Kyle Canyon	58	0.667

****

39 IO — OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT — HYDROGRAPH TIME DATA

NMIN		6	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	0	ENDING DATE
NDTIME		0554	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .10 HOURS
TOTAL TIME BASE 29.90 HOURS

```
      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT

JP         MULTI-PLAN OPTION
                NPLAN          1  NUMBER OF PLANS

JR         MULTI-RATIO OPTION
               RATIOS OF PRECIPITATION
               .67

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
149 KK    *    INFLOW  *
          *            *
          **************

150 KO         OUTPUT CONTROL VARIABLES
                    IPRNT          1  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

151 HC         HYDROGRAPH COMBINATION
                    ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***
```

****

HYDROGRAPH AT STATION INFLOW
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .67

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0730	76	2637.	1		1500	151	0.	1		2230	226	0.
1		0006	2	0.	1		0736	77	2373.	1		1506	152	0.	1		2236	227	0.
1		0012	3	0.	1		0742	78	2150.	1		1512	153	0.	1		2242	228	0.
1		0018	4	0.	1		0748	79	1916.	1		1518	154	0.	1		2248	229	0.
1		0024	5	0.	1		0754	80	1685.	1		1524	155	0.	1		2254	230	0.
1		0030	6	0.	1		0800	81	1471.	1		1530	156	0.	1		2300	231	0.
1		0036	7	0.	1		0806	82	1286.	1		1536	157	0.	1		2306	232	0.
1		0042	8	1.	1		0812	83	1147.	1		1542	158	0.	1		2312	233	0.
1		0048	9	2.	1		0818	84	1063.	1		1548	159	0.	1		2318	234	0.
1		0054	10	2.	1		0824	85	974.	1		1554	160	0.	1		2324	235	0.
1		0100	11	3.	1		0830	86	880.	1		1600	161	0.	1		2330	236	0.
1		0106	12	4.	1		0836	87	782.	1		1606	162	0.	1		2336	237	0.
1		0112	13	4.	1		0842	88	682.	1		1612	163	0.	1		2342	238	0.
1		0118	14	4.	1		0848	89	585.	1		1618	164	0.	1		2348	239	0.
1		0124	15	5.	1		0854	90	495.	1		1624	165	0.	1		2354	240	0.
1		0130	16	7.	1		0900	91	417.	1		1630	166	0.	2		0000	241	0.
1		0136	17	10.	1		0906	92	358.	1		1636	167	0.	2		0006	242	0.
1		0142	18	14.	1		0912	93	330.	1		1642	168	0.	2		0012	243	0.
1		0148	19	20.	1		0918	94	311.	1		1648	169	0.	2		0018	244	0.
1		0154	20	27.	1		0924	95	293.	1		1654	170	0.	2		0024	245	0.
1		0200	21	35.	1		0930	96	274.	1		1700	171	0.	2		0030	246	0.

1	0206	22	45.	*	1	0936	97	255.	*	1	1706	172	0.	*	2	0036	247	0.
1	0212	23	55.	*	1	0942	98	236.	*	1	1712	173	0.	*	2	0042	248	0.
1	0218	24	60.	*	1	0948	99	217.	*	1	1718	174	0.	*	2	0048	249	0.
1	0224	25	61.	*	1	0954	100	197.	•	1	1724	175	0.	*	2	0054	250	0.
1	0230	26	58.	*	1	1000	101	177.	*	1	1730	176	0.	*	2	0100	251	0.
1	0236	27	67.	*	1	1006	102	156.	*	1	1736	177	0.	*	2	0106	252	0.
1	0242	28	82.	*	1	1012	103	135.	*	1	1742	178	0.	*	2	0112	253	0.
1	0248	29	105.	*	1	1018	104	113.	*	1	1748	179	0.	*	2	0118	254	0.
1	0254	30	137.	*	1	1024	105	92.	*	1	1754	180	0.	•	2	0124	255	0.
1	0300	31	190.	*	1	1030	106	70.	*	1	1800	181	0.	*	2	0130	256	0.
1	0306	32	272.	*	1	1036	107	48.	*	1	1806	182	0.	*	2	0136	257	0.
1	0312	33	382.	*	1	1042	108	28.	*	1	1812	183	0.	*	2	0142	258	0.
1	0318	34	525.	*	1	1048	109	10.	*	1	1818	184	0.	*	2	0148	259	0.
1	0324	35	722.	*	1	1054	110	0.	*	1	1824	185	0.	*	2	0154	260	0.
1	0330	36	1000.	*	1	1100	111	0.	*	1	1830	186	0.	*	2	0200	261	0.
1	0336	37	1355.	*	1	1106	112	0.	*	1	1836	187	0.	*	2	0206	262	0.
1	0342	38	1848.	*	1	1112	113	0.	*	1	1842	188	0.	*	2	0212	263	0.
1	0348	39	2476.	*	1	1118	114	0.	*	1	1848	189	0.	•	2	0218	264	0.
1	0354	40	3435.	*	1	1124	115	0.	*	1	1854	190	0.	*	2	0224	265	0.
1	0400	41	4599.	•	1	1130	116	0.	*	1	1900	191	0.	*	2	0230	266	0.
1	0406	42	6111.	*	1	1136	117	0.	*	1	1906	192	0.	*	2	0236	267	0.
1	0412	43	7719.	*	1	1142	118	0.	*	1	1912	193	0.	*	2	0242	268	0.
1	0418	44	9034.	*	1	1148	119	0.	*	1	1918	194	0.	*	2	0248	269	0.
1	0424	45	10119.	*	1	1154	120	0.	*	1	1924	195	0.	*	2	0254	270	0.
1	0430	46	11045.	*	1	1200	121	0.	*	1	1930	196	0.	*	2	0300	271	0.
1	0436	47	11867.	*	1	1206	122	0.	*	1	1936	197	0.	*	2	0306	272	0.
1	0442	48	12600.	*	1	1212	123	0.	*	1	1942	198	0.	*	2	0312	273	0.
1	0448	49	13078.	*	1	1218	124	0.	*	1	1948	199	0.	•	2	0318	274	0.
1	0454	50	13334.	*	1	1224	125	0.	*	1	1954	200	0.	*	2	0324	275	0.
1	0500	51	13427.	*	1	1230	126	0.	*	1	2000	201	0.	*	2	0330	276	0.
1	0506	52	13398.	*	1	1236	127	0.	*	1	2006	202	0.	*	2	0336	277	0.
1	0512	53	13287.	*	1	1242	128	0.	*	1	2012	203	0.	*	2	0342	278	0.
1	0518	54	13131.	*	1	1248	129	0.	*	1	2018	204	0.	*	2	0348	279	0.
1	0524	55	12933.	*	1	1254	130	0.	*	1	2024	205	0.	*	2	0354	280	0.
1	0530	56	12686.	*	1	1300	131	0.	*	1	2030	206	0.	*	2	0400	281	0.
1	0536	57	12372.	•	1	1306	132	0.	*	1	2036	207	0.	*	2	0406	282	0.
1	0542	58	11980.	*	1	1312	133	0.	*	1	2042	208	0.	*	2	0412	283	0.
1	0548	59	11532.	*	1	1318	134	0.	*	1	2048	209	0.	*	2	0418	284	0.
1	0554	60	11072.	*	1	1324	135	0.	*	1	2054	210	0.	*	2	0424	285	0.
1	0600	61	10600.	*	1	1330	136	0.	*	1	2100	211	0.	*	2	0430	286	0.
1	0606	62	10057.	*	1	1336	137	0.	*	1	2106	212	0.	*	2	0436	287	0.
1	0612	63	9445.	*	1	1342	138	0.	•	1	2112	213	0.	*	2	0442	288	0.
1	0618	64	8794.	*	1	1348	139	0.	*	1	2118	214	0.	*	2	0448	289	0.
1	0624	65	8121.	*	1	1354	140	0.	*	1	2124	215	0.	*	2	0454	290	0.
1	0630	66	7433.	*	1	1400	141	0.	*	1	2130	216	0.	*	2	0500	291	0.
1	0636	67	6761.	*	1	1406	142	0.	•	1	2136	217	0.	*	2	0506	292	0.
1	0642	68	6118.	*	1	1412	143	0.	*	1	2142	218	0.	*	2	0512	293	0.
1	0648	69	5537.	*	1	1418	144	0.	*	1	2148	219	0.	*	2	0518	294	0.
1	0654	70	5017.	*	1	1424	145	0.	*	1	2154	220	0.	*	2	0524	295	0.
1	0700	71	4520.	•	1	1430	146	0.	*	1	2200	221	0.	*	2	0530	296	0.
1	0706	72	4075.	*	1	1436	147	0.	*	1	2206	222	0.	*	2	0536	297	0.
1	0712	73	3709.	*	1	1442	148	0.	*	1	2212	223	0.	*	2	0542	298	0.
1	0718	74	3336.	*	1	1448	149	0.	*	1	2218	224	0.	*	2	0548	299	0.
1	0724	75	2968.	*	1	1454	150	0.	*	1	2224	225	0.	*	2	0554	300	0.
				*					*					*				

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.90-HR
13427.	5.00	(CFS)	5907.	1494.	1200.	1200.
		(INCHES)	.945	.956	.956	.956
		(AC-FT)	2929.	2964.	2964.	2964.

CUMULATIVE AREA = 58.15 SQ MI

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          **************
          *            *
152 KK    *   KYLEDT   *
          *            *
          **************

154 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

               HYDROGRAPH ROUTING DATA

137 RL          ROUTING LOSSES
                     QLOSS        .00  INITIAL LOSS
                     CLOSS        .00  ADDITIONAL FRACTION LOST

155 RS          STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       STOR  TYPE OF INITIAL CONDITION
                     RSVRIC      -1.00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

156 SV            STORAGE          .0       11.0      205.0      769.0     1738.0     3059.0     4320.0

157 SE          ELEVATION     3235.00    3240.00    3250.00    3260.00    3270.00    3281.00    3290.00

158 SQ          DISCHARGE          0.       27.        40.        50.       301.       343.       369.       390.

159 SE          ELEVATION     3235.00    3245.00    3255.00    3265.00    3266.00    3275.00    3281.00    3290.00

                                                      ***

                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       11.00      108.00      205.00      487.00      769.00     1253.50     1350.40     1738.00     2338.45
          OUTFLOW        .00       13.50       27.00       33.50       40.00       45.00       50.00      301.00      319.67      343.00
        ELEVATION    3235.00    3240.00    3245.00    3250.00    3255.00    3260.00    3265.00    3266.00    3270.00    3275.00

          STORAGE    3059.00    4320.00
          OUTFLOW     369.00     390.00
        ELEVATION    3281.00    3290.00

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                                                HYDROGRAPH AT STATION   KYLEDT
                                                   PLAN 1,   RATIO =   .67

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                                                  *                                                  *
DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE  *  DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE  *  DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE
                                                  *                                                  *
 1   0000   1       0.        .0  3235.0  *   1    1000  101      360.   2816.3  3279.0  *   1    2000  201      350.   2528.9  3276.6
 1   0006   2       0.        .0  3235.0  *   1    1006  102      360.   2814.7  3279.0  *   1    2006  202      350.   2526.0  3276.6
 1   0012   3       0.        .0  3235.0  *   1    1012  103      360.   2812.9  3279.0  *   1    2012  203      350.   2523.1  3276.5
 1   0018   4       0.        .0  3235.0  *   1    1018  104      360.   2810.9  3278.9  *   1    2018  204      350.   2520.2  3276.5
 1   0024   5       0.        .0  3235.0  *   1    1024  105      360.   2808.8  3278.9  *   1    2024  205      349.   2517.3  3276.5
 1   0030   6       0.        .0  3235.0  *   1    1030  106      360.   2806.5  3278.9  *   1    2030  206      349.   2514.4  3276.5
 1   0036   7       0.        .0  3235.0  *   1    1036  107      360.   2804.0  3278.9  *   1    2036  207      349.   2511.6  3276.4
 1   0042   8       0.        .0  3235.0  *   1    1042  108      360.   2801.4  3278.9  *   1    2042  208      349.   2508.7  3276.4
 1   0048   9       0.        .0  3235.0  *   1    1048  109      360.   2798.5  3278.8  *   1    2048  209      349.   2505.8  3276.4
 1   0054  10       0.        .0  3235.0  *   1    1054  110      359.   2795.6  3278.8  *   1    2054  210      349.   2502.9  3276.4
 1   0100  11       0.        .1  3235.0  *   1    1100  111      359.   2792.6  3278.8  *   1    2100  211      349.   2500.0  3276.3
 1   0106  12       0.        .1  3235.0  *   1    1106  112      359.   2789.7  3278.8  *   1    2106  212      349.   2497.1  3276.3
 1   0112  13       0.        .1  3235.1  *   1    1112  113      359.   2786.7  3278.7  *   1    2112  213      349.   2494.3  3276.3
 1   0118  14       0.        .1  3235.1  *   1    1118  114      359.   2783.7  3278.7  *   1    2118  214      349.   2491.4  3276.3
 1   0124  15       0.        .2  3235.1  *   1    1124  115      359.   2780.8  3278.7  *   1    2124  215      348.   2488.5  3276.2
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1	0130	16	0.	.2	3235.1	*	1	1130	116	359.	2777.8	3278.7	*	1	2130	216	348.	2485.6	3276.2
1	0136	17	0.	.3	3235.1	*	1	1136	117	359.	2774.8	3278.6	*	1	2136	217	348.	2482.7	3276.2
1	0142	18	0.	.4	3235.2	•	1	1142	118	359.	2771.9	3278.6	*	1	2142	218	348.	2479.9	3276.2
1	0148	19	1.	.5	3235.2	*	1	1148	119	359.	2768.9	3278.6	*	1	2148	219	348.	2477.0	3276.2
1	0154	20	1.	.7	3235.3	*	1	1154	120	358.	2766.0	3278.6	•	1	2154	220	348.	2474.1	3276.1
1	0200	21	1.	1.0	3235.4	*	1	1200	121	358.	2763.0	3278.5	*	1	2200	221	348.	2471.2	3276.1
1	0206	22	2.	1.3	3235.6	*	1	1206	122	358.	2760.0	3278.5	•	1	2206	222	348.	2468.4	3276.1
1	0212	23	2.	1.7	3235.8	*	1	1212	123	358.	2757.1	3278.5	*	1	2212	223	348.	2465.5	3276.1
1	0218	24	3.	2.1	3236.0	*	1	1218	124	358.	2754.1	3278.5	*	1	2218	224	347.	2462.6	3276.0
1	0224	25	3.	2.6	3236.2	*	1	1224	125	358.	2751.2	3278.4	*	1	2224	225	347.	2459.7	3276.0
1	0230	26	4.	3.1	3236.4	•	1	1230	126	358.	2748.2	3278.4	*	1	2230	226	347.	2456.9	3276.0
1	0236	27	4.	3.6	3236.6	*	1	1236	127	358.	2745.2	3278.4	*	1	2236	227	347.	2454.0	3276.0
1	0242	28	5.	4.1	3236.9	•	1	1242	128	358.	2742.3	3278.4	*	1	2242	228	347.	2451.1	3275.9
1	0248	29	6.	4.9	3237.2	•	1	1248	129	357.	2739.3	3278.3	*	1	2248	229	347.	2448.3	3275.9
1	0254	30	7.	5.8	3237.6	*	1	1254	130	357.	2736.4	3278.3	*	1	2254	230	347.	2445.4	3275.9
1	0300	31	9.	7.1	3238.2	•	1	1300	131	357.	2733.4	3278.3	•	1	2300	231	347.	2442.5	3275.9
1	0306	32	11.	8.9	3239.1	*	1	1306	132	357.	2730.5	3278.3	*	1	2306	232	347.	2439.7	3275.8
1	0312	33	14.	11.5	3240.0	*	1	1312	133	357.	2727.5	3278.2	*	1	2312	233	347.	2436.8	3275.8
1	0318	34	14.	15.2	3240.2	*	1	1318	134	357.	2724.6	3278.2	*	1	2318	234	346.	2433.9	3275.8
1	0324	35	15.	20.2	3240.5	*	1	1324	135	357.	2721.6	3278.2	*	1	2324	235	346.	2431.1	3275.8
1	0330	36	16.	27.2	3240.8	*	1	1330	136	357.	2718.7	3278.2	*	1	2330	236	346.	2428.2	3275.7
1	0336	37	17.	36.8	3241.3	*	1	1336	137	357.	2715.7	3278.1	*	1	2336	237	346.	2425.3	3275.7
1	0342	38	19.	49.9	3242.0	*	1	1342	138	357.	2712.8	3278.1	*	1	2342	238	346.	2422.5	3275.7
1	0348	39	21.	67.6	3242.9	*	1	1348	139	356.	2709.8	3278.1	*	1	2348	239	346.	2419.6	3275.7
1	0354	40	25.	91.8	3244.2	•	1	1354	140	356.	2706.9	3278.1	*	1	2354	240	346.	2416.8	3275.7
1	0400	41	28.	124.8	3245.9	*	1	1400	141	356.	2703.9	3278.0	*	2	0000	241	346.	2413.9	3275.6
1	0406	42	31.	168.8	3248.1	*	1	1406	142	356.	2701.0	3278.0	*	2	0006	242	346.	2411.1	3275.6
1	0412	43	34.	225.7	3250.4	*	1	1412	143	356.	2698.1	3278.0	*	2	0012	243	346.	2408.2	3275.6
1	0418	44	36.	294.6	3251.6	•	1	1418	144	356.	2695.1	3278.0	*	2	0018	244	345.	2405.3	3275.6
1	0424	45	37.	373.5	3253.0	•	1	1424	145	356.	2692.2	3277.9	*	2	0024	245	345.	2402.5	3275.5
1	0430	46	39.	460.6	3254.5	•	1	1430	146	356.	2689.2	3277.9	*	2	0030	246	345.	2399.6	3275.5
1	0436	47	41.	554.9	3256.2	*	1	1436	147	356.	2686.3	3277.9	*	2	0036	247	345.	2396.8	3275.5
1	0442	48	43.	655.7	3258.0	*	1	1442	148	355.	2683.4	3277.9	*	2	0042	248	345.	2393.9	3275.5
1	0448	49	45.	761.4	3259.9	•	1	1448	149	355.	2680.4	3277.8	*	2	0048	249	345.	2391.1	3275.4
1	0454	50	46.	870.2	3261.0	*	1	1454	150	355.	2677.5	3277.8	*	2	0054	250	345.	2388.2	3275.4
1	0500	51	47.	980.4	3262.2	*	1	1500	151	355.	2674.5	3277.8	*	2	0100	251	345.	2385.4	3275.4
1	0506	52	48.	1090.9	3263.3	*	1	1506	152	355.	2671.6	3277.8	*	2	0106	252	345.	2382.5	3275.4
1	0512	53	49.	1200.7	3264.5	*	1	1512	153	355.	2668.7	3277.7	*	2	0112	253	344.	2379.7	3275.3
1	0518	54	193.	1308.9	3265.6	*	1	1518	154	355.	2665.7	3277.7	*	2	0118	254	344.	2376.8	3275.3
1	0524	55	304.	1414.5	3266.7	*	1	1524	155	355.	2662.8	3277.7	*	2	0124	255	344.	2374.0	3275.3
1	0530	56	309.	1517.9	3267.7	*	1	1530	156	355.	2659.9	3277.7	*	2	0130	256	344.	2371.2	3275.3
1	0536	57	314.	1618.8	3268.8	*	1	1536	157	354.	2657.0	3277.7	*	2	0136	257	344.	2368.3	3275.2
1	0542	58	319.	1716.9	3269.8	*	1	1542	158	354.	2654.0	3277.6	*	2	0142	258	344.	2365.5	3275.2
1	0548	59	323.	1811.4	3270.6	*	1	1548	159	354.	2651.1	3277.6	*	2	0148	259	344.	2362.6	3275.2
1	0554	60	326.	1902.1	3271.4	*	1	1554	160	354.	2648.2	3277.6	*	2	0154	260	344.	2359.8	3275.2
1	0600	61	329.	1988.9	3272.1	*	1	1600	161	354.	2645.2	3277.6	*	2	0200	261	344.	2356.9	3275.2
1	0606	62	333.	2071.6	3272.8	*	1	1606	162	354.	2642.3	3277.5	*	2	0206	262	344.	2354.1	3275.1
1	0612	63	336.	2149.4	3273.4	*	1	1612	163	354.	2639.4	3277.5	*	2	0212	263	343.	2351.3	3275.1
1	0618	64	338.	2222.0	3274.0	*	1	1618	164	354.	2636.5	3277.5	*	2	0218	264	343.	2348.4	3275.1
1	0624	65	341.	2289.1	3274.6	*	1	1624	165	354.	2633.5	3277.5	*	2	0224	265	343.	2345.6	3275.1
1	0630	66	343.	2350.5	3275.1	*	1	1630	166	354.	2630.6	3277.4	*	2	0230	266	343.	2342.7	3275.0
1	0636	67	345.	2406.3	3275.6	*	1	1636	167	353.	2627.7	3277.4	*	2	0236	267	343.	2339.9	3275.0
1	0642	68	347.	2456.7	3276.0	*	1	1642	168	353.	2624.8	3277.4	*	2	0242	268	343.	2337.1	3275.0
1	0648	69	349.	2502.0	3276.4	*	1	1648	169	353.	2621.9	3277.4	*	2	0248	269	343.	2334.2	3275.0
1	0654	70	350.	2542.7	3276.7	*	1	1654	170	353.	2618.9	3277.3	*	2	0254	270	343.	2331.4	3274.9
1	0700	71	352.	2579.2	3277.0	*	1	1700	171	353.	2616.0	3277.3	*	2	0300	271	343.	2328.6	3274.9
1	0706	72	353.	2611.8	3277.3	*	1	1706	172	353.	2613.1	3277.3	*	2	0306	272	343.	2325.7	3274.9
1	0712	73	354.	2641.0	3277.5	*	1	1712	173	353.	2610.2	3277.3	*	2	0312	273	342.	2322.9	3274.9
1	0718	74	355.	2667.2	3277.7	*	1	1718	174	353.	2607.3	3277.2	*	2	0318	274	342.	2320.1	3274.8
1	0724	75	356.	2690.3	3277.9	*	1	1724	175	353.	2604.4	3277.2	*	2	0324	275	342.	2317.3	3274.8
1	0730	76	356.	2710.6	3278.1	*	1	1730	176	352.	2601.4	3277.2	*	2	0330	276	342.	2314.4	3274.8
1	0736	77	357.	2728.3	3278.2	*	1	1736	177	352.	2598.5	3277.2	*	2	0336	277	342.	2311.6	3274.8
1	0742	78	358.	2744.1	3278.4	*	1	1742	178	352.	2595.6	3277.1	*	2	0342	278	342.	2308.8	3274.8
1	0748	79	358.	2757.9	3278.5	*	1	1748	179	352.	2592.7	3277.1	*	2	0348	279	342.	2306.0	3274.7
1	0754	80	359.	2769.8	3278.6	*	1	1754	180	352.	2589.8	3277.1	*	2	0354	280	342.	2303.1	3274.7
1	0800	81	359.	2779.9	3278.7	*	1	1800	181	352.	2586.9	3277.1	*	2	0400	281	342.	2300.3	3274.7
1	0806	82	359.	2788.3	3278.7	*	1	1806	182	352.	2584.0	3277.0	*	2	0406	282	341.	2297.5	3274.7
1	0812	83	359.	2795.4	3278.8	*	1	1812	183	352.	2581.1	3277.0	*	2	0412	283	341.	2294.7	3274.6
1	0818	84	360.	2801.6	3278.9	*	1	1818	184	352.	2578.2	3277.0	*	2	0418	284	341.	2291.8	3274.6

1	0824	85	360.	2807.0	3278.9	*	1	1824	185	352.	2575.3	3277.0	*	2	0424	285	341.	2289.0	3274.6
1	0830	86	360.	2811.7	3278.9	*	1	1830	186	351.	2572.4	3276.9	*	2	0430	286	341.	2286.2	3274.6
1	0836	87	360.	2815.6	3279.0	*	1	1836	187	351.	2569.5	3276.9	*	2	0436	287	341.	2283.4	3274.5
1	0842	88	360.	2818.6	3279.0	*	1	1842	188	351.	2566.5	3276.9	*	2	0442	288	341.	2280.6	3274.5
1	0848	89	360.	2820.9	3279.0	*	1	1848	189	351.	2563.6	3276.9	*	2	0448	289	341.	2277.8	3274.5
1	0854	90	360.	2822.4	3279.0	*	1	1854	190	351.	2560.7	3276.9	*	2	0454	290	341.	2274.9	3274.5
1	0900	91	360.	2823.2	3279.0	*	1	1900	191	351.	2557.8	3276.8	*	2	0500	291	340.	2272.1	3274.4
1	0906	92	360.	2823.4	3279.0	*	1	1906	192	351.	2554.9	3276.8	*	2	0506	292	340.	2269.3	3274.4
1	0912	93	360.	2823.3	3279.0	*	1	1912	193	351.	2552.0	3276.8	*	2	0512	293	340.	2266.5	3274.4
1	0918	94	360.	2822.9	3279.0	*	1	1918	194	351.	2549.1	3276.8	*	2	0518	294	340.	2263.7	3274.4
1	0924	95	360.	2822.4	3279.0	*	1	1924	195	350.	2546.3	3276.7	*	2	0524	295	340.	2260.9	3274.4
1	0930	96	360.	2821.8	3279.0	*	1	1930	196	350.	2543.4	3276.7	*	2	0530	296	340.	2258.1	3274.3
1	0936	97	360.	2821.0	3279.0	*	1	1936	197	350.	2540.5	3276.7	*	2	0536	297	340.	2255.3	3274.3
1	0942	98	360.	2820.1	3279.0	*	1	1942	198	350.	2537.6	3276.7	•	2	0542	298	340.	2252.5	3274.3
1	0948	99	360.	2819.0	3279.0	•	1	1948	199	350.	2534.7	3276.6	*	2	0548	299	340.	2249.7	3274.3
1	0954	100	360.	2817.7	3279.0	*	1	1954	200	350.	2531.8	3276.6	*	2	0554	300	339.	2246.8	3274.2
						*							•						

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
(CFS)	(HR)		6-HR	24-HR	72-HR	29.90-HR
360.	9.10	(CFS)	359.	351.	290.	290.
		(INCHES)	.057	.224	.231	.231
		(AC-FT)	178.	696.	717.	717.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
(AC-FT)	(HR)	6-HR	24-HR	72-HR	29.90-HR
2823.	9.10	2783.	2551.	2110.	2110.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
(FEET)	(HR)	6-HR	24-HR	72-HR	29.90-HR
3279.04	9.10	3278.70	3276.77	3270.42	3270.42

CUMULATIVE AREA = 58.15 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1
					.67
HYDROGRAPH AT	GD30.5	28.60	1	FLOW	7198.
				TIME	4.50
ROUTED TO	RT1	28.60	1	FLOW	6947.
				TIME	4.80
			** PEAK STAGES IN FEET **		
			1	STAGE	3.15
				TIME	4.80
HYDROGRAPH AT	GD30.4	6.89	1	FLOW	2194.
				TIME	4.00
2 COMBINED AT	CMB1	35.49	1	FLOW	8304.
				TIME	4.90
ROUTED TO	RT2	35.49	1	FLOW	8290.
				TIME	5.00
			** PEAK STAGES IN FEET **		
			1	STAGE	3.38
				TIME	5.00
HYDROGRAPH AT	GD30.3	9.43	1	FLOW	2962.
				TIME	4.40
2 COMBINED AT	CMB2	44.92	1	FLOW	10848.
				TIME	4.80
ROUTED TO	RT3	44.92	1	FLOW	10689.
				TIME	5.00
			** PEAK STAGES IN FEET **		
			1	STAGE	3.91
				TIME	5.00
HYDROGRAPH AT	GD30.2	.85	1	FLOW	234.
				TIME	3.80
ROUTED TO	RT4	.85	1	FLOW	176.
				TIME	4.20
			** PEAK STAGES IN FEET **		
			1	STAGE	.29
				TIME	4.20
HYDROGRAPH AT	GD30.1	2.61	1	FLOW	719.
				TIME	4.30
3 COMBINED AT	CMB3	48.38	1	FLOW	11345.
				TIME	5.00
ROUTED TO	RT5	48.38	1	FLOW	11254.
				TIME	5.10
			** PEAK STAGES IN FEET **		
			1	STAGE	4.01
				TIME	5.10

HYDROGRAPH AT	GD25	2.34	1	FLOW	776.
				TIME	3.80
HYDROGRAPH AT	GD21	6.79	1	FLOW	1942.
				TIME	4.30
ROUTED TO	RT6	6.79	1	FLOW	1852.
				TIME	4.50

** PEAK STAGES IN FEET **

1	STAGE	1.31
	TIME	4.50

3 COMBINED AT	CMB4	57.51	1	FLOW	13259.
				TIME	5.00
HYDROGRAPH AT	GD31DT	.22	1	FLOW	72.
				TIME	3.80
HYDROGRAPH AT	GD22DT	.42	1	FLOW	202.
				TIME	3.80
3 COMBINED AT	INFLOW	58.15	1	FLOW	13427.
				TIME	5.00
ROUTED TO	KYLEDT	58.15	1	FLOW	360.
				TIME	9.10

** PEAK STAGES IN FEET **

1	STAGE	3279.04
	TIME	9.10

*** NORMAL END OF HEC-1 ***

Carey-F.dat

CAREY-F.DAT

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*           SEPTEMBER 1990              *
*            VERSION 4.0                *
*                                       *
*  RUN DATE  08/16/1994  TIME  11:18:17 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*        (916) 756-1104                 *
*                                       *
*****************************************
```

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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
    1     ID
    2     ID
    3     ID
    4     ID                                                    CAREY-F.DAT
    5     ID        NORTHWEST LAS VEGAS FIS RESTUDY             DATE: JUNE 1994
    6     ID        BY COE & VAN LOO CONSULTANTS, INC           JOB # 930017
    7     ID        PREPARED FOR CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
    8     ID
    9     ID      6-HOUR RAINFALL, 6 MINUTE TIME INTERVAL
   10     ID      RAINFALL DISTRIBUTION = SDN5
   11     ID      SCS UNIT HYDROGRAPH METHOD
   12     ID      EXISTING CONDITIONS
   13     ID
   14     ID
   15     ID
   16     ID        INFORMATION USED IN THIS HEC-1 MODEL IS BASED ON FIS HYDROLOGY REPORT
   17     ID        BY JAMES M. MONTGOMERY, FINAL HYDROLOGY STUDY - LAKE MEAD BOULEVARD
   18     ID        PHASE 1A BY VTN NEVADA, AND REVISED TECHNICAL HYDROLOGY STUDY FOR
   19     ID        THE LAS BRISAS NORTE RESIDENTIAL SUBBASIN BY CHURCH ENGINEERING.
   20     ID
   21     ID        MOST KINEMATIC WAVE ROUTINGS IN THIS HEC-1 MODEL
   22     ID        HAVE BEEN REPLACED WITH MUSKINGUM ROUTING METHOD
   23     ID
   24     ID
   25     ID        DIVERSION CARDS ALONG US 95 BETWEEN ANN RD & GOWAN RD.,
   26     ID        RANCHO DR. BETWEEN ANN RD. AND WASHINGTON HAVE BEEN REVISED BY CVL
   27     ID        CONSULTANTS, INC.
   28     ID
   29     ID
   30     ID
   31     ID
   32     ID
   33     ID        RAINFALL VALUES HAVE BEEN REPALCED W/ THREE CENTROID RAINFALL DEPTHS
   34     ID
   35     ID        McCARRAN AIRPORT AREA = 2.77"
   36     ID        GOWAN DETENTION AREA =  2.25" X 1.43 = 3.21"
   37     ID        NORTH OF GOWAN AREA = 2.2" X 1.43 = 3.15"
   38     ID
   39     ID
   40     ID
   41     ID
   42     ID
   43     ID
   44     ID
          *DIAGRAM
   45     IT       6        0        0      300
   46     IO       5        0        0
   47     IN       5        0        0
          *
          * ************************************************************************
          *       PT OF INTEREST       AREA            DARF
          *
          *
          *       GOWAN DET. BASIN     51.6            0.68
          *
          *       US 95 & RANCHO        3.8            0.91
          *       US 95 & CRAIG        14.8            0.83
          *       US 95 & GOWAN        18.6            0.80
          *
          *       GOWAN OUTFALL        80.5            0.63
          *       CAREY DETEN.                         0.63
          *       RANCHO & WASH.                       0.63
          * ************************************************************************
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  48      JR    PREC    0.91    0.83    0.80    0.68    0.63    0.75

  49      KK   AP1
  50      KM   ************************************************************************
  51      KM   BEGIN DATA FOR AREA 1 FROM FIS. THE INFORMATION USED IN DEVELOPING
  52      KM   THE FIS IS FROM VARIOUS SOURCES. THESE SOURCES ARE NOTED AS SHOWN IN
  53      KM   THE FIS MODEL.
  54      KM   ************************************************************************
  55      KM   BEGIN SUBAREAS TRIBUTARY TO GOWAN SOUTH DETENTION BASIN
  56      KM   BEGIN SUBAREAS TRIBUTARY TO ANGEL PARK DETENTION BASIN
  57      KM   FROM WALLACE ANGEL PARK MODEL
  58      BA    1.94
          * ****************************************************
          * NOAA RAINFALL FOR GOWAN AREA = 2.25"
          * ADJUSTED RAINFALL DEPTH = 2.25" X 1.43 = 3.21"
          * ****************************************************
  59      PB    3.21
  60      PC    .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
  61      PC    .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
  62      PC    .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
  63      PC    .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
  64      PC    .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
  65      PC    .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
  66      PC    .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
  67      PC    .997    .999    1.00
  68      LS      0      88
  69      UD    0.62

  70      KK      V
  71      KM   ROUTE AP1
  72      RM      7    0.67    0.15

  73      KK   AP2
  74      KM   FROM WALLACE ANGEL PARK MODEL
  75      KM   CURVE NUMBER FROM BOYLE SUMMERLIN ANALYSIS
  76      BA    2.56
  77      LS      0      84
  78      UD    1.09

  79      KK      .
  80      KM   COMBINE AP1 AND AP2
  81      HC      2

  82      KK      V
  83      RM     11    1.06    0.15

  84      KK   AP3
  85      KM   CURVE NUMBER TAKEN FROM BOYLES SUMMERLIN ANALYSIS
  86      BA    3.62
  87      LS      0      86
  88      UD    2.41
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  89      KK   AP4
  90      KM   FROM WALLACE ANGEL PARK MODEL
  91      KM   CURVE NUMBER TAKEN FROM BOYLES SUMMERLIN ANALYSIS
  92      BA    1.16
  93      LS       0      86
  94      UD    1.03

  95      KK       .
  96      KM   COMBINE AP1, AP2, AP3, AND AP4
  97      HC       3

  98      KK   AP5
  99      KM   FROM WALLACE ANGEL PARK MODEL
 100      BA    2.27
 101      LS       0      90
 102      UD    0.39

 103      KK       V
 104      KM   ROUTE AP5
 105      RM       8    0.82    0.15

 106      KK   AP6
 107      BA    3.28
 108      LS       0      88
 109      UD    0.75

 110      KK       .
 111      KM   COMBINE AP5 AND AP6
 112      HC       2

 113      KK       V
 114      KM   ROUTE AP5 AND AP6
 115      RM       7    0.66    0.15

 116      KK   AP7
 117      KM   CURVE NUMBER TAKEN FROM BOYLE SUMMERLIN ANALYSIS
 118      BA    2.03
 119      LS       0      82
 120      UD    1.18

 121      KK   N_CHN
 122      KM   COMBINE NORTH CHANNEL FLOWS
 123      HC       2

 124      KK   GD1
 125      KM   BEGIN SUBAREAS TRIBUTARY TO HUALPAI DIVERSION
 126      KM   FROM VTN (PB AND CN FROM BLACK AND VEATCH LA MADRE)
 127      BA    2.98
 128      LS       0      88
 129      UD    0.62
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  130     KK       V
  131     KM   ROUTE GD1
  132     RM       2    0.24    0.15

  133     KK       V
  134     KM   ROUTE CONTINUED
  135     RM       3    0.27    0.15

  136     KK    GD2
  137     KM   FROM VTN
  138     KM   CURVE NUMBER FROM BOYLE SUMMERLIN ANALYSIS
  139     BA   1.875
  140     LS       0      86
  141     UD    0.83

  142     KK       .
  143     KM   COMBINE GD1 AND GD2
  144     HC       2

  145     KK   TO_DIV
  146     KM   ROUTE GD1 AND GD2 TO HUALPAI DIVERSION
  147     RM       3    0.34    0.15

  148     KK    GD3 (=AP12)
  149     KM   FROM VTN
  150     KM   CURVE NUMBER FROM BOYLE SUMMERLIN ANALYSIS
  151     BA    0.80
  152     LS       0      84
  153     UD    0.32

  154     KK  HUALPAI
  155     KM   COMBINE SUBAREAS TRIBUTARY TO HUALPAI DIVERSION GD1-3
  156     HC       2

  157     KK  HUA&NO.CH
  158     KM   COMBINE NO.CH FLOWS W/HUALPAI DIVERTED FLOWS (AP SUBAREAS + DIV.GD SUBAREAS)
  159     HC       2

  160     KK       V
  161     KM   ROUTE COMBINED FLOWS
  162     RK    5500    .023    0.04       0    TRAP     100       2

  163     KK       V
  164     KM   ROUTE CONTINUED
  165     RK    4500    .004    .030       0    TRAP      30       4

  166     KK    AP8
  167     KM   CURVE NUMBER FROM BOYLE SUMMERLIN ANALYSIS
  168     BA    0.93
  169     LS       0      86
  170     UD    0.62
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  171     KK    BOX
  172     KM   SUMMERLIN PKWY CULVERT
  173     HC       2

  174     KK       V
  175     KM   ROUTE TO ANGEL PARK DETENTION BASIN
  176     RK    3000    .027    0.04       0    TRAP     100       2

  177     KK    AP9
  178     KM   CURVE NUMBER FROM BOYLE SUMMERLIN ANALYSIS
  179     BA    0.68
  180     LS       0      86
  181     UD    0.83

  182     KK   N_CHAN
  183     KM   INTERIM TOTAL AT ANGEL PARK DUE TO HUALPAI DIVERSION
  184     HC       2

  185     KK  ANGEL.PK
  186     KM   EXISTING TOTAL AT ANGEL PARK DETENTION BASIN AP1-9, GD1-3
  187     HC       2

  188     KK   DET.AP
  189     KM   ANGEL PARK DETENTION BASIN: (1) 24" EXIT & (1) 54" PROP. OUTLET
          *  REVISED BY COE & VAN LOO CONSULTANTS, INC. TO REFLECT EXIST. COND.
          *  RATHER THEN DESIGN CAPACITY.
  190     RS       1    STOR      -1
  191     SV       0   141.6   239.5   640.3   927.9  1141.2  1173.8  1206.4  1239.1
  192     SE    2576    2595    2600    2610    2615  2618.5    2619  2619.5    2620
  193     SQ       0     285     316     370     388     407    1852    4491    7909
          *

  194     KK  AP.OUTANGEL PARK SOUTH BASIN OVERSPILL
  195     DT   SOUTH
  196     DI       0      89     194     232     285     316     343     370     392     405
  197     DI     407    1852    4491    7909
  198     DQ       0       0       0       0      22      26      29      32      33      33
  199     DQ      33     842    2321    4237

  200     KK  AP_TWO_VEGAS/PIONEER
          *  ROUTE TO ANGEL PARK DETENTION BASIN OUTFALL TO VEGAS/PIONEER VIA VEGAS DRIVE
          *  FROM VTN
  201     RK    7500    .030   0.012       0    CIRC       5       0

  202     KK  BUFFALO_1
  203     KM   ROUTE FLOWS FROM VEGAS/PIONEER IN BUFFALO CHANNEL (FROM VTN)
  204     RK    1500    .020    0.03       0    TRAP      20       4

  205     KK     GD7
  206     KM   INTERSECTION OF LAKE MEAD AND BUFFALO
  207     KM   CURVE NUMBER TAKEN FROM BOYLE SUMMERLIN ANALYSIS
  208     BA    1.13
  209     LS       0      86
  210     UD    1.38
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  211     KK    GD34
  212     BA    1.56
  213     LS       0      84
  214     UD    0.46
          *

  215     KK    GD35
          *       FROM WALLACE STUDY
  216     BA     1.9
  217     LS       0      88
  218     UD    1.22

  219     KK  RT BUF         ROUTE TO BUFF1
  220     RK    6000   0.015   0.015        0    TRAP      10        2
          *

  221     KK  CB LKM         COMBINE GD7, GD34 & GD35
  222     HC       3
          *
          *

  223     KK   BUFF1
  224     KM  BUFFALO CHANNEL NEAR  LAKE MEAD
  225     HC       2

  226     KK  BUFFALO_2
  227     KM   ROUTE FLOWS TO GOWAN SOUTH DETENTION BASIN (FROM VTN)
  228     RK    5000    .005   0.025        0    TRAP      30        4

  229     KK     GD8
  230     KM   RA HOMES DESERT SHORES
  231     KM   CURVE NUMBER TAKEN FROM BOYLE SUMMERLIN ANALYSIS
  232     BA    1.97
  233     LS       0      81
  234     UD    1.11

  235     KK   BUFF2
  236     KM  BUFFALO CHANNEL NEAR SOUTH GOWAN BASIN
  237     HC       2

  238     KK     GD4
  239     KM   FROM BLACK AND VEATCH LA MADRE
  240     KM   CURVE NUMBER TAKEN FROM BOYLE SUMMERLIN ANALYSIS
  241     BA    0.80
  242     LS       0      84
  243     UD    0.62

  244     KK       V
  245     KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
  246     RM       7     .74    0.15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 247      KK    GD5
 248      KM   CURVE NUMBER TAKEN FROM BOYLE SUMMERLIN ANALYSIS
 249      BA    3.31
 250      LS       0      83
 251      UD    1.38

 252      KK       .
 253      KM   COMBINE GD4 AND GD5 AT INSECTION OF RAMPART AND LAKE MEAD
 254      HC       2

 255      KK       V
 256      KM   ROUTE NORTH ALONG RAMPART
 257      RM       4     .43    0.15

 258      KK    GD6
 259      KM   DEL WEBB SUN CITY SUMMERLIN
 260      KM   CURVE NUMBER TAKEN FROM BOYLE SUMMERLIN ANALYSIS
 261      BA    1.60
 262      LS       0      83
 263      UD    0.96

 264      KK       .
 265      KM   COMBINE GD4 THROUGH GD6 AT INTERSECTION OF RAMPART AND CHEYENNE
 266      HC       2

 267      KK       V
 268      KM  ROUTE TO GOWAN SOUTH BASIN
 269      RK    5500    .015   0.015       0    TRAP      20       2

 270      KK  GOWAN SOUTH
 271      KM   TOTAL INFLOW TO GOWAN SOUTH DETENTION BASIN
 272      HC       2

 273      KK   DETGS
 274      KM   GOWAN SOUTH DETENTION BASIN DATA FROM VTN
 275      RS       1    STOR      -1
 276      SV       0     9.8     113     435     454     680
 277      SE    2326    2330    2340  2349.6    2350    2354
 278      SQ       0     112     328     455     459   30700

 279      KK   RGSOUT
 280      KM   ROUTE GOWAN SOUTH OUTFLOW TO GOWAN NORTH DETENTION BASIN
 281      RK    3200    .007   0.012       0    CIRC       5       0

 282      KK    GD9
 283      KM   BEGIN SUBAREAS TRIBUTARY TO GOWAN NORTH DETENTION BASIN
 284      KM   FROM BLACK AND VEATCH LA MADRE
 285      KM   CURVE NUMBER TAKEN FROM BOYLE SUMMERLIN ANALYSIS
 286      BA    2.00
 287      LS       0      88
 288      UD    0.30
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  289     KK       V
  290     RM       5     .52     .15

  291     KK    GD10
  292     KM    FROM BLACK AND VEATCH LA MADRE
  293     KM    CURVE NUMBER TAKEN FROM BOYLE SUMMERLIN ANALYSIS
  294     BA    2.27
  295     LS       0      84
  296     UD    0.90

  297     KK       .
  298     KM    COMBINE GD9 AND GD10
  299     HC       2

  300     KK       V
  301     KM    ROUTE EAST TO GOWAN NORTH DETENTION BASIN
  302     RM       6     .61     .15

  303     KK       V
  304     KM    ROUTE CONTINUED
  305     RM       7     .74     .15

  306     KK    GD11
  307     KM    FROM BLACK AND VEATCH LA MADRE
  308     BA    3.17
  309     LS       0      85
  310     UD    2.44

  311     KK       .
  312     KM    INFLOW FROM WEST INTO GOWAN NORTH GD9-11
  313     HC       2

  314     KK    GD12
  315     KM    FROM WALLACE
  316     BA    2.27
  317     LS       0      89
  318     UD    0.30

  319     KK       V
  320     RM       4    0.42    0.15

  321     KK    GD13
  322     KM    FROM WALLACE
  323     BA    3.15
  324     LS       0      86
  325     UD    1.10

  326     KK       .
  327     KM    COMBINE GD12 AND 13
  328     HC       2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 329      KK      V
 330      KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
 331      RM      4    0.43    0.15

 332      KK      V
 333      KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
 334      RM     11    1.06    0.15

 335      KK   GD14A
 336      KM    FROM WALLACE
 337      BA    1.71
 338      LS       0      81
 339      UD    0.88

 340      KK      .
 341      KM   COMBINE GD12 - 14A
 342      HC      2

 343      KK      V
 344      KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
 345      RM      5    0.53    0.15

 346      KK   GD14B
 347      KM    FROM WALLACE
 348      BA    0.68
 349      LS       0      83
 350      UD    1.67

 351      KK      .
 352      KM   COMBINE GD9 - GD11 WITH GD12 - GD17
 353      HC      3

 354      KK   GN_IN
 355      KM   TOTAL INFLOW TO GOWAN NORTH INCLUDING GOWAN SOUTH OUTFALL
 356      HC      2

 357      KK   DET.GN
 358      KM   ROUTE FLOW THROUGH GOWAN NORTH DETENTION BASIN: 72" RCP OUTLET
 359      KM   FROM VTN
 360      RS      1   STOR      -1
 361      SV      0     28      46     113     774     885    1163
 362      SE   2308   2311    2312    2314    2324  2325.5    2329
 363      SQ      0      0     126     251     519     539   35800
          *
          *
          *
          * DIVERT GOWAN OUTFALL FLOW THRU GOWAN OUTFALL PIPE TO OUTFALL CHANNEL

 364      KK  OUTFALL
 365      DT  DV DTG
 366      DI      0    200     400     600    2000
 367      DQ      0    200     400     600     600
          *
          *
          *
          *
          * ********************************************
          * REFER TO CHURCH ENGINEERING HYDROLOGY STUDY
          * FOR THE LAS BRISAS NORTE RESIDENTIAL SUBBASIN
          * ********************************************
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  368     KK    GD33
  369     KM   FROM WALLACE EPT.H1
  370     BA    4.85
          *
          * NOAA RAINFALL DEPTH = 2.2"
          * ADJUSTED RAINFALL DEPTH = 2.2" X 1.43 = 3.146"
          *
          *
  371     PB    3.15
  372     LS       0      89
  373     UD    3.50

  374     KK  RANCHO
  375     KM   DIVERT CHANNEL EXCESS AND CULVERT CAPACITIES WEST
  376     KM   FROM WALLACE
  377     DT   CULV1
  378     DI       0    1545    3129    4000    8000
  379     DQ       0    1545    1545    2416    6416

  380     KK       V
  381     KM    ROUTE SOUTH ALONG WEST SIDE OF U.S. 95
  382     KM    CONVERT FROM KINEMATIC WAVE TO MUSKINGUM ROUTING TO AVOID ZERO FLOW
  383     RM       2     .15     .15

  384     KK    GD32
  385     KM   FROM WALLACE
  386     BA    2.35
  387     LS       0      86
  388     UD    1.74

  389     KK       .
  390     KM   COMBINE GD32 AND GD33
  391     HC       2

  392     KK  RANCHO
  393     KM   DIVERT CHANNEL EXCESS AND CULVERT CAPACITIES WEST
  394     KM   FROM WALLACE
  395     DT   CULV2
  396     DI       0     900    2484    4000    8000
  397     DQ       0     900     900    2416    6416

  398     KK       V
  399     KM    ROUTE SOUTH ALONG WEST SIDE OF U.S. 95
  400     KM    CONVERT FROM KINEMATIC WAVE TO MUSKINGUM ROUTING TO AVOID ZERO FLOW
  401     RM       1     .14     .15

  402     KK    GD31
  403     KM   FROM WALLACE
  404     BA    1.55
  405     LS       0      81
  406     UD    2.19
          *
          * REFER TO KYLES CANYON DETENTION BASIN HEC-1 MODEL BY  CVL CONSULTANTS, INC.
          * HEC-1 MODEL - KYLE.DAT
          *
          * INPUT KYLE CANYON DETENTION BASIN OUTFLOW HYDROGRAPH
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 407      KK    KYLE        OUTFLOW HYDROGRAPH
 408      BA   0.001
 409      QI       0       0       0       0       0       0       0       0       0       0
 410      QI       0       0       0       0       0       0       0       0       1       1
 411      QI       1       2       2       3       3       4       4       5       6       7
 412      QI       9      11      14      14      15      16      17      19      21      25
 413      QI      28      31      34      36      37      39      41      43      45      46
 414      QI      47      48      49     193     304     309     314     319     323     326
 415      QI     329     333     336     338     341     343     345     347     349     350
 416      QI     352     353     354     355     356     356     357     358     358     359
 417      QI     359     359     359     360     360     360     360     360     360     360
 418      QI     360     360     360     360     360     360     360     360     360     360
 419      QI     360     360     360     360     360     360     360     360     360     359
 420      QI     359     359     359     359     359     359     359     359     359     358
 421      QI     358     358     358     358     358     358     358     358     357     357
 422      QI     357     357     357     357     357     357     357     357     356     356
 423      QI     356     356     356     356     356     356     356     355     355     355
 424      QI     355     355     355     355     355     355     354     354     354     354
 425      QI     354     354     354     354     354     354     353     353     353     353
 426      QI     353     353     353     353     353     352     352     352     352     352
 427      QI     352     352     352     352     352     351     351     351     351     351
 428      QI     351     351     351     351     350     350     350     350     350     350
 429      QI     350     350     350     350     349     349     349     349     349     349
 430      QI     349     349     349     349     348     348     348     348     348     348
 431      QI     348     348     348     347     347     347     347     347     347     347
 432      QI     347     347     347     346     346     346     346     346     346     346
 433      QI     346     346     346     345     345     345     345     345     345     345
 434      QI     345     345     344     344     344     344     344     344     344     344
 435      QI     344     344     343     343     343     343     343     343     343     343
 436      QI     343     343     342     342     342     342     342     342     342     342
 437      QI     342     341     341     341     341     341     341     341     341     341
 438      QI     340     340     340     340     340     340     340     340     340     339

 439      KK       V
 440      KM    ROUTE WEST TO RANCHO (U.S. 95)
 441      RM      12    1.23     .15

 442      KK       .
 443      KM        COMBINE KYLE CANYON OUTFLOW W/ GD33 - GD31
 444      HC       3

 445      KK  RANCHO
 446      KM   DIVERT CHANNEL EXCESS AND CULVERT CAPACITIES WEST
 447      DT   CULV3
 448      DI       0     520    1889    4000    8000
 449      DQ       0     520     520    2631    6631

 450      KK       V
 451      KM    ROUTE SOUTH ALONG WEST SIDE OF U.S. 95
 452      KM    CONVERT FROM KINEMATIC WAVE TO MUSKINGUM ROUTING TO AVOID ZERO FLOW
 453      RM       1     .14     .15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  454     KK    GD28
  455     KM   FROM WALLACE
  456     BA    2.88
  457     LS       0      77
  458     UD    2.52

  459     KK       .
  460     HC       2

  461     KK  RANCHO
  462     KM   DIVERT CHANNEL EXCESS AND CULVERT CAPACITIES WEST
  463     DT  CENTNL
  464     DI       0    1040    5456    8000
  465     DQ       0    1040    1040    3585

  466     KK       V
  467     KM    ROUTE SOUTH ALONG WEST SIDE OF U.S. 95
  468     KM    CONVERT FROM KINEMATIC WAVE TO MUSKINGUM ROUTING TO AVOID ZERO FLOW
  469     RM       1     .07     .15

  470     KK    GD26
  471     KM   FROM WALLACE
  472     BA    1.41
  473     LS       0      78
  474     UD    1.23

  475     KK       V
  476     KM    ROUTE WEST TO ANN RD AND U.S. 95
  477     KM    ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
  478     RM       4    0.43     .15

  479     KK       V
  480     KM    ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
  481     RM       5    0.49     .15

  482     KK    GD27
  483     KM   FROM WALLACE
  484     BA    1.13
  485     LS       0      78
  486     UD    1.61

  487     KK  CB ANN
  488     KM   COMBINE GD25 - GD28 AND GD30 - 33 AT INTERSECTION OF ANN RD AND HWY 95
  489     HC       3

  490     KK       V
  491     KM    ROUTE SOUTH ALONG WEST SIDE OF U.S.95
  492     RM       1     0.1    0.25
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

493       KK  DV ANN        DIVERSION THRU 24" CMP UNDER US 95 NEAR ANN ROAD
494       DT     HW1
495       DI       0      13      42      99     183     302     443     629
496       DQ       0      13      20      21      22      23      25      26

497       KK       V
498       RM       1     0.1    0.25

499       KK  DV PNT        DIVERSION THRU 24" CMP UNDER US 95 NEAR PAINTED MIRAGE ROAD
500       DT     HW2
501       DI       0      10      22      92     219     382     576
502       DQ       0      10      22      24      26      28      30

503       KK    GD29
504       KM   FROM WALLACE
505       BA    0.76
506       LS       0      77
507       UD    1.49

508       KK       V
509       RM       3     0.3    0.25

510       KK    PDGC
511       KM    FROM WALLACE PAINTED DESERT GOLF COURSE
512       BA    0.53
513       LS       0      80
514       UD    1.20

515       KK       .
516       KM   COMBINE GD25 - 33 AND PDGC AT THE SOUTH SIDE OF PAINTED DESERT AND HWY 95
517       HC       3

518       KK  DV10X3        DIVERSION THRU 10'X3.1' RCB UNDER US 95
519       DT     HW3
520       DI       0     240     345     453     595
521       DQ       0     240     263     274     285

522       KK  DV INT        DIVERSION THRU 24"RCP UNDER US 95 NEAR THE INTERSECTION
523       KM                OF US 95 & RANCHO DR.
524       DT     HW4
525       DI       0      14      49      96     177     292
526       DQ       0      14      19      21      23      24

527       KK  RT RAN
528       KM   ROUTE SOUTH ALONG WEST SIDE OF U.S.95
529       KM   CONVERT FROM KINEMATIC WAVE ROUTING TO MUSKINGUM ROUTING TO AVOID ZERO FLOW
530       RM       1    0.14    0.15

531       KK  DV 6X2        DIVERSION THRU 2- 6'X2'RCB NEAR THE INTERSECTION
532       KM                OF US 95 & RANCHO DR.
533       DT     HW5
534       DI       0      80     132     191     337     449     589
535       DQ       0      80     132     167     200     214     227
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  536     KK  DV LNE        DIVERSION THRU 2 - 6'X2' RCB NEAR LONE MOUNTAIN RD
  537     DT    HW6
  538     DI      0     120     198     572    1338
  539     DQ      0     120     152     169     186

  540     KK   GD22
  541     KM   FROM WALLACE
  542     BA   1.23
  543     LS      0      86
  544     UD   1.12

  545     KK   GD23
  546     KM   FROM WALLACE
  547     BA   1.01
  548     LS      0      86
  549     UD   1.41

  550     KK      .
  551     KM  COMBINE GD22 & GD23
  552     HC      2

  553     KK      V
  554     KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
  555     RM      7   0.65    0.15

  556     KK   GD24
  557     KM   FROM WALLACE
  558     BA   0.64
  559     LS      0      77
  560     UD   1.20

  561     KK      .
  562     KM   COMBINE GD21 - 24
  563     HC      2

  564     KK      V
  565     KM   ROUTE WEST TO HWY 95
  566     KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
  567     RM      7   0.65    0.15

  568     KK   GD18
  569     KM   FROM WALLACE
  570     BA   3.42
  571     LS      0      89
  572     UD   0.31

  573     KK      V
  574     RM      6   0.62    0.15
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

575       KK    GD19
576       KM    FROM WALLACE
577       BA    2.41
578       LS       0      82
579       UD    1.24

580       KK       .
581       KM    COMBINE GD18 AND 19
582       HC       2

583       KK       V
584       KM    ROUTE WEST TO HWY 95 AND CRAIG RD
585       KM    ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
586       RM       9    0.88    0.15

587       KK    GD20
588       KM    FROM WALLACE
589       BA    2.35
590       LS       0      82
591       UD    2.51

592       KK  CB CRG
593       KM    COMBINE GD18 - 33 AND PDGC AT INTERSECTION OF CRAIG ROAD AND HWY 95
594       HC       4

595       KK    HWY95
596       KM         DIVERSION THRU 2 - 6'X2'RCB UNDER US95 NEAR CRAIG RD & US 95 INT
597       DT    CRAIG
598       DI       0    1046    1718    2269    3224    4954
599       DQ       0      13      21      33      55     109

600       KK       V
601       KM    ROUTE SOUTH ALONG WEST SIDE OF U.S. 95 TO ALEXANDER RD
602       KM    CONVERT KINEMATIC WAVE TO MUSKINGUM ROUTING TO AVOID ZERO FLOW
603       RM       1    0.07    0.15

604       KK    GD15
605       KM    FROM WALLACE
606       BA    3.28
607       LS       0      88
608       UD    0.48
          *
          * ROUTE THRU BOX CANYON - REFER TO " ANALYSIS OF THE KYLE CANYON
          * DETENTION BASIN OUTLET DIVERSION, BY MONTGOMERY , SEPT 1993."
          *

609       KK  RT G15
610       RS       1    FLOW      -1
611       SV       0     100    1000   10000
612       SQ       0       1       1       1
          *
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  613     KK       V
  614     RM       7    0.74    0.15

  615     KK    GD16
  616     KM    FROM WALLACE
  617     BA    3.76
  618     LS       0      82
  619     UD    1.63

  620     KK       .
  621     HC       2

  622     KK       V
  623     KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
  624     RM      10    1.01    0.15

  625     KK    GD17
  626     KM    FROM WALLACE
  627     BA    0.56
  628     LS       0      80
  629     UD    2.00

  630     KK       .
  631     KM   COMBINE GD15 - 17
  632     HC       3

  633     KK   ALEX1        WEIR FLOW OVER HIGHWAY 95 NORTH OF ALEX. AND US95 INT.
  634     DT   AWEIR
  635     DI       0    1000    2000    3330    5000
  636     DQ       0       0     187     297     563

  637     KK   ALEX2        DIVERSION THRU 2 - 6'X2' RCB NEAR  ALEXANDER & US 95 INT.
  638     DT    A6X2
  639     DI       0     439    1166    1887    2363    3083    4166
  640     DQ       0      30      96     141     164     195     238

  641     KK  RT GWN
  642     KM   ROUTE SOUTH ALONG WEST SIDE OF ORAN GRAGSON TO GOWAN RD
  643     KM   CONVERT FROM KINEMATIC WAVE TO MUSKINGUM ROUTING TO AVOID ZERO FLOW
  644     RM       1    0.11    0.15

  645     KK  DV GOW        DIVERSION THRU 42" PIPE TO GOWAN OUTFALL PIPE
          * FLOW INTERCEPTED BY 48" PIPE ENTERS GOWAN OUTFALL PIPE
          * & COMBINE WITH BASIN OUTFALL "DET.G"  - BY CVL CONSULTANTS, INC.
  646     DT  GOW 42
  647     DI       0      93     192     511    1279    2652    4322
  648     DQ       0      93     112     127     150     158     163

  649     KK  RT JON
  650     KM        ROUTE FLOWS FROM US95/GOWAN INTER. TO JONES/GOWAN INT
  651     RM       1    0.09     0.4
  652     KM   ************************************************************
  653     KM   *** BEGIN DATA FOR GENERAL AREA 2 LOCATED BETWEEN US 95 AND *
  654     KM   *** RANCHO ROAD NORTH OF GOWAN ROAD FROM WALLACE DECATUR ****
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 655      KM   *** BOULEVARD STREET IMPROVEMENT PROJECT DRAINAGE ***********
 656      KM   *** STUDY 12/16/88 *****************************************

 657      KK   JONESBL
 658      KM   ****************************************
 659      KM   FROM VTN NEVADA SILVER MESA STUDY (1989)
 660      KM   ****************************************
 661      KM   FLOWS SEPARATE AT JONES BOULEVARD
 662      KM   CONCENTRATIONS IN GOWAN AND MORRO BAY LANE
 663      KM   SHEET FLOW NORTH OF GOWAN
 664      DT  MORBAY
 665      DI       0     100     500    1000    2000    3000    4000    5500
 666      DQ       0       0     116     253     592     948    1308    1859

 667      KK   SPLIT
 668      KM   *********************************
 669      KM   PER VTN SILVER MESA STUDY (1989)
 670      KM  EDITED BY CVL CONSULTANTS, INC.
 671      KM   *********************************
 672      KM   FLOW IN GOWAN SPLITS AT THIS LOCATION
 673      KM   SPLIT FLOW DRAINS SOUTH, WEST OF TRUE VALUE HARDWARE
 674      KM   REMAINING FLOW CONTINUES EAST TO RANCHO DR
 675      DT  TRUVAL
 676      DI       0     519    1840    3000
 677      DQ       0     245    1040    1753
          *
          * SUBBASINS AREA1 - AREA 7 - FROM CHURCH ENGINEERING STUDY
          *

 678      KK   2-6X2         RETRIEVE DIVERSION "2-6X2"
 679      DR     HW5

 680      KK   DV R1         DIVERSION THRU 36" CMP NEARRANCHO & US 95 INT.
 681      DT     RD1
 682      DI       0      20      35     100     200     500
 683      DQ       0      20      35      35      35      35

 684      KK  RTCBL1         ROUTE TO LONE MOUNTAIN RD
 685      RM       6     0.6    0.25

 686      KK  AREA.1
 687      KM   UNDEVELOPED
 688      BA   .1067
          * ****************************************
          * McCARRAN AIRPORT AREA PRECIPITATION = 2.77"
          * ****************************************
 689      PB    2.77
 690      LS       0      81
 691      UD     0.5
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

692       KK   CB L1       COMBINE AREA 1 @ LONE MOUNTAIN
693       HC      2
694       KK   DV R4       DIVERSION THRU 2 - 24" CMP NEAR LONE MOUNTAIN
695       DT    RD4
696       DI      0     13      23      55     129     254
697       DQ      0     10      14      20      28      34
          *
698       KK    LONE       RETRIEVE DIVERSION "LONE"
699       DR     HW6
700       KK   CB L2       COMBINE DIVERSION "LONE" W/ AREA 1
701       HC      2
702       KK   DV R5       DIVERSION THRU 30" CMP UNDER RANCHONEAR LONE MOUNTAIN
703       DT    RD5
704       DI      0     25      51      91     122     160
705       DQ      0     25      37      40      42      44
706       KK   DV R6       DIVERSION THRU 36" CMP NEAR PAINTED DESERT DR.
707       DT    RD6
708       DI      0     10      71     145     350
709       DQ      0     10      38      39      40
710       KK  RTCBC1       ROUTE TO CRAIG RD
711       RM      7    0.7    0.25
712       KK  AREA.2
713       KM   FROM WALLACE DECATUR STUDY
714       BA   .3090
715       LS      0     82
716       UD    1.0
717       KK   CB C1       COMBINE AREA 1 & AREA 2
718       HC      2
719       KK   DV DI       DIVERSION THRU DROP INLET
720       DT     DI
721       DI      3     26      55     101     161
722       DQ      0      0       5      15      27
723       KK   CRAIG       COMBINE DIVERSION "CRAIG" W/ AREA 1&2
724       DR   CRAIG
725       KK  DV CS1       CRAIG RD STORM DRAIN
726       DT   CRSD1
727       DI      0     50     100     200
728       DQ      0     50     100     100
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

729       KK   CB C2
730       HC      2

731       KK  DV CS2        DIVERSION THRU CRAIG RD STORM DRAIN SYSTEM
          *
          * REFER TO THE UTILITY PLAN AND PROFILES FOR CRAIG ROAD BY
          * BY HEFNER ENGINEERING
          *
732       DT   CRSD2
733       DI       0      50     103     166     310     454
734       DQ       0      50     103     126     155     180

735       KK  DV CS3
          * DIVERSION THRU 6' X 2' RCB AND 24" RCP STORM DRAIN PIPE
736       DT   CRSD3
737       DI       0      47      88     150     500
738       DQ       0      47      60      60      60

739       KK   DV R7        DIVERSION THRU 6' X 3' RCB BETWEEN CRAIG & ALEXANDER
740       DT     RD7
741       DI       0      38      70     133     220
742       DQ       0      38      48      55      62

743       KK   DV R8        DIVERSION THRU 6' X 3' RCB NEAR ALEXANDER RD
744       DT     RD8
745       DI       0      44      67      98     127     174
746       DQ       0      44      62      82      93     115

747       KK  RTCBA1        ROUTE TO ALEXANDER RD.
748       RM       6     0.6    0.25

749       KK  AREA.3
750       KM   FROM WALLACE DECATUR STUDY
751       BA   .1630
752       LS       0      82
753       UD   0.667

754       KK   RALX1
755       DR   AWEIR

756       KK   RALX2
757       DR    A6X2

758       KK       .
759       KM        COMBINE  AREA  3 & DIVERSION ALEX
760       HC       3

761       KK       V
762       KM   FROM WALLACE DECATUR STUDY
763       KM
764       RM       1     0.1     0.3
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  765     KK  AREA.4
  766     KM   FROM WALLACE DECATUR STUDY
  767     BA   .2480
  768     LS        0       85
  769     UD   0.833

  770     KK        .
  771     HC        2

  772     KK        V
  773     KM   FROM WALLACE DECATUR STUDY
  774     KM    ROUTE FLOWS TO RANCHO AND ALEXANDER INTERSECTION
  775     RM        1     0.1      0.3

  776     KK  AREA.5
  777     KM   FROM WALLACE DECATUR STUDY
  778     BA   .1520
  779     LS        0       82
  780     UD   0.783

  781     KK   CB A1
  782     HC        3

  783     KK   DV R9         DIVERSION THRU 30" CMP NEAR JONES & RANCHO
  784     DT     RD9
  785     DI        0       46       71       99      116      146      200      264
  786     DQ        0       46       60       65       69       72       76       80

  787     KK  AREA7A
  788     KM   FROM WALLACE DECATUR STUDY
  789     KM  REVISED BY CVL
  790     BA   0.423
  791     LS        0       85
  792     UD   2.183

  793     KK   CB A2COMBINE AREA1-AREA7A
  794     HC        2

  795     KK  DV R10         DIVERSION THRU 6' X 2' RCB BETWEEN JONES & DUNCAN
  796     DT    RD10
  797     DI        0       88      114      151      202      256      337
  798     DQ        0       88       98      102      105      109      112

  799     KK  RTCBG1         ROUTE TO GOWAN RD
  800     RM        7     0.7     0.25

  801     KK  DV DUN         WEIR FLOW OVER RANCHO NEAR DUNCAN DR.
  802     DT  DUNCAN
  803     DI        0      300      422      700
  804     DQ        0       68      145      322
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 805      KK  AREA7B
 806      KM   FROM WALLACE DECATUR STUDY
 807      KM  REVISED BY CVL
 808      BA   0.423
 809      LS      0      85
 810      UD   2.183

 811      KK   CB G1COMBINE  AREA1 - AREA7B
 812      HC      2

 813      KK  DV R11        DIVERSION THRU 24" CMP NEAR DUNCAN DR
 814      DT    RD11
 815      DI      0      13      29      65     126     217     344
 816      DQ      0      10      13      16      19      22      24

 817      KK   CB G2
 818      KM   COMBINE RUNOFF FROM BASINS WEST OF U.S. 95 (GD15 - 33) WITH
 819      KM   BASIN AREAS 1 THROUGH 7 AT GOWAN AND RANCHO
 820      HC      2
          *
          * DIVERSION THRU 4' X 4' RCB @ GOWAN & RANCHO INTERSECTION
          * BY CVL

 821      KK  DV 4X4
 822      DT    4X4
 823      DI      0     170     699    1453    2528
 824      DQ      0     170     189     195     202
          * DIVERSION @ GOWAN & RANCHO INTERSECTION - REVISED BY CVL CONSULTANTS, INC.
          * DIVERTED FLOWS FLOW ALONG WEST SIDE OF RANCHO DRIVE

 825      KK  DV GWN
 826      DT   GOWAN
 827      DI      0     510    1258    2326
 828      DQ      0     117     221     344

 829      KK   RT GB        ROUTE TO CP GB
 830      RM     18    1.76    0.15

 831      KK  R24"-1        RETRIEVE DIVERSION 24"-1
 832      DR    HW1

 833      KK  R24"-2        RETRIEVE DIVERSION 24"-2
 834      DR    HW2

 835      KK   R10X3        RETRIEVE DIVERSION 10X3
 836      DR    HW3

 837      KK  R24RCP        RETRIEVE DIVERSION 24RCP
 838      DR    HW4
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

839       KK  CB DIV        COMBINE DIVERSIONS
840       HC       4

841       KK       V
842       KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
843       RM      20    2.03    0.15

844       KK   EPT.3
845       BA   4.391
846       LS       0      88
847       UD    3.67

848       KK       .
849       KM   Combine EPT.1, EPT.3 & flows diverted at P. Desert & Centenial
850       HC       2

851       KK      R1        RETRIEVE DIVERSION R1
852       DR     RD1

853       KK      R4        RETRIEVE DIVERSION R4
854       DR     RD4

855       KK      R5        RETRIEVE DIVERSION R5
856       DR     RD5

857       KK      R6        RETRIEVE DIVERSION R6
858       DR     RD6

859       KK      DI        RETRIEVE DIVERSION DI
860       DR      DI

861       KK       .        COMBINE DIVERSIONS R1,R4,R5,R6,DI
862       HC       5

863       KK  RTEPT3Route through EPT3
864       RM      21    2.07    0.15
          *

865       KK       .
866       HC       2

867       KK   EPT.4
          * AREA & LAG TIME CHANGED BY CVL
868       BA    0.48
869       LS       0      89
870       UD    0.92

871       KK      R7        RETRIEVE DIVERSION R9
872       DR     RD7
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

873       KK      R8        RETRIEVE DIVERSION R10
874       DR     RD8
875       KK  CB DIV        COMBINE DIVERSIONS
876       HC       2
877       KK  RTEPT4        ROUTE THRU EPT4
878       RM      15     1.5    0.15
879       KK      CB        COMBINE EPT4 & R9&R10
880       HC       2
881       KK   RT GA        ROUTE TO  CP GA
882       RM       9     0.9    0.15
883       KK  GOW 42        RETRIEVE DIVERSION GOW 42
884       DR  GOW 42
885       KK  R.G.UP.       ROUTE GOWAN NORTH DETENTION OUTFLOW TO GOWAN
886       RM       1     0.1     0.5
887       KK     4X4        RETRIEVE DIVERSION 4X4
888       DR     4X4
889       KK      CB        COMBINE W/ 4X4
890       HC       2
891       KK   RT GA        ROUTE TO GOWAN OUTFALL CHANNEL
892       RM       2     0.2    0.45
          *
893       KK  RC CS1        RECALL DIVERSION CRSD1
894       DR   CRSD1
895       KK  RC CS2        RECALL DIVERSION CRSD2
896       DR   CRSD2
897       KK  RC CS3        RECALL DIVERSION CRSD3
898       DR   CRSD3
899       KK  CB DIV        COMBINE TWO  DIVERSIONS
900       HC       3
901       KK   RT GA        ROUTE CRAIG RD. STORM DRAIN TO CP GA
902       RM       2     0.2    0.45
          *
903       KK   CP GA        COMBINE FLOWS @ CP GA - GOWAN OUTFALL PIPE OUTLET
904       HC       4
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 905      KK   R DTG
 906      KM        RECALL GOWAN DETENTION BASIN OUTFALL
 907      DR   DV DTG
          *
          *
          *

 908      KK   RT GA         ROUTE GOWAN OUTFALL TO CP GA
 909      RM       3     0.3    0.45

 910      KK   CB GA         COMBINE ALL FLOWS @ GOWAN OUTFALL PIPE OUTLET
 911      KM   Gowan Outfall Channel
 912      HC       2

 913      KK   RT GB         ROUTE TO CP GB
 914      RM       2     0.2    0.45

 915      KK   EPT.5
          * AREA & LAG TIME REVISED BY CVL
 916      BA    2.38
 917      LS       0      87
 918      UD    0.64

 919      KK      R9         RETRIEVE DIVERSION R11
 920      DR     RD9

 921      KK     R10         RETRIEVE DIVERSION R12
 922      DR    RD10

 923      KK   R DUN         RETRIEVE DIVERSION DUNCAN
 924      DR   DUNCAN

 925      KK     R11         RETRIEVE DIVERSION R13
 926      DR    RD11

 927      KK   CB DIV         COMBINE DIVERSIONS RD9 THRU RD11
 928      HC       4

 929      KK   RTEPT5Route through EPT5
 930      RM      18    1.76    0.15

 931      KK       .Combine hydrographs
 932      HC       2

 933      KK       V
 934      RM       1     0.1     0.4

 935      KK   CENTNL
 936      KM    Recall flow diverted at Centenial
 937      DR   CENTNL
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

938       KK  RTEPT1
939       KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
940       RM      20    2.03    0.15
          * ********************************************
          * REFER TO MONTGOMERY FIS HYDROLOGY - GOWAN AREA
          * ********************************************

941       KK   EPT.1
942       BA    3.76
943       LS       0      85
944       UD    3.36

945       KK       .
946       KM   Combine EPT.1 & flow diverted at Centenial
947       HC       2

948       KK       V
949       KM   ALLUVIAL FAN BRAIDED CHANNEL ROUTING (FEMA)
950       RM       8    0.76    0.15

951       KK   EPT.2
952       BA   1.492
953       LS       0      85
954       UD    2.51
          * 100-YEAR DISCHARGE MAY BE UNDERESTIMATED.
          * INFLOWS FROM WESTERN TRIBUTARY NOT INCLUDED.

955       KK   CP GB
956       KM        COMBINE ALL FLOWS @ CP GB
957       HC       5
          * ************************** END GOWAN MODEL ********************************
          *  KKRT 304
          *  KM ROUTE SUBBASIN 301 & GOWAN OUTFALL THRU SUBBASIN 304 TO CRAIG ROAD
          *  RM     3    0.28    0.15
          *  KK  SNIC        COMBINE SNIC & LBC
          *  KM ROUTE SUBBASIN 301 & GOWAN OUTFALL THRU THE SOUTHERN NEVADA INDUSTRIAL CEN
          *  KM FLOOD CONTROL CHANNEL FROM CRAIG ROAD TO ALEXANDER
          *  KM ROUTE SUBBASIN 301 & GOWAN OUTFALL THRU THE LOSEE BRIDGE CHANNEL
          *  KM FROM ALEXANDER TO THE BEGINNING OF THE "A" CHANNEL
          *  RM     1     0.1     0.4

958       KK     304
959       KM   RUNOFF FROM SUBBASIN 304
960       BA   2.903
961       LS       0      86
962       UD    1.98

963       KK     305
964       KM   RUNOFF FROM SUBBASIN 305
          * area edited - VTN model
965       BA    2.81
966       LS       0      87
967       UD    1.49
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

968       KK       .
969       KM   COMBINE SUBBASINS 304 & 305 AT THE "A" CHANNEL
970       HC       2
          *  KKCOMBINE ALL FLOWS @ "A" CHANNEL
          *  HC     2
          *
          * ********************************************************
          * *  REFER TO VTN NEVADAS LAKE MEAD/ CAREY LAKE         *
          * *  DETENTION BASIN ALTERNATIVE 2A.A HEC-1 MODE        *
          * *  WATERSHEDS FN10A, FN10B, R, A4, AND W REVISED BY CVL
          * ********************************************************

971       KK      X4
972       BA    0.81
973       LS       0      91
974       UD     1.9

975       KK      X3B
976       BA     .16
977       LS       0      88
978       UD    0.54

979       KK     CUL4
          * ROUTE THRU 2-6 X 4 689+30
980       RS       1    ELEV    13.5
981       SV       0     .32      18
982       SE    13.5      15      18
983       SQ       0      60     245

984       KK      X3A
985       BA     .12
986       LS       0      88
987       UD    0.49

988       KK     CUL8
          *    24"  674+06
989       RS       1    ELEV    18.5
990       SV       0     1.1     3.6
991       SE    18.5    20.5    22.5
992       SQ       0      15      28

993       KK      CX3
          * COMBINE X3A &  X3B
994       HC       2

995       KK    RK3AB
          * ROUTE TO JONES
996       RM      10     1.0      .3
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 997      KK       +
 998      HC       2

 999      KK   DEVX4
          * DIVORT 100 CFS TO CHEYNNE
1000      DT   DEVX4
1001      DI       0      50     100     200     500    1000    5000
1002      DQ       0      25      50     100     100     100     100

1003      KK     RK4
          *  ROUTE K4 SOUTH ON MICHAEL TO LOW POINT
          * THEN TO RANCHO
1004      RM       2     0.2     0.4

1005      KK     X3C
1006      BA     .48
1007      LS       0      81
1008      UD    1.52

1009      KK    SD1A
          *   DROP   INLET  @  BROOKS / JONES
1010      DT    SD1A
1011      DI       0      50      93     285     500
1012      DQ       0       5      13      21      21

1013      KK    RK3C
          *  ROUTE TO RANCHO
1014      RM       2     0.2    0.45

1015      KK      X3
1016      BA    0.34
1017      LS       0      92
1018      UD    0.71

1019      KK     CX3
          * COMBINE X3 X4 TO X3#
1020      HC       3

1021      KK    DTX4
          * RET. DIVORT FLOW X4
1022      DR   DEVX4

1023      KK    RDEX
          * ROUTE TO CHEYENNE
1024      RM       1     0.1    0.45

1025      KK    BSX5
1026      BA     0.1
1027      LS       0      92
1028      UD    0.42
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1029      KK     CX5
          * COMBINE X5 & DEVX4
1030      HC       2

1031      KK  TRUVAL        RETRIEVE DIVERSION TRUVAL
1032      DR  TRUVAL

1033      KK   GOWAN        RETRIEVE DIVERSION GOWAN
1034      DR   GOWAN

1035      KK  CB DV1        COMBINE TRUVAL AND GOWAN
1036      HC       2

1037      KK  MORBAY        RETRIEVE DIVERSION MORBAY
1038      DR  MORBAY

1039      KK  CB DV2        COMBINE CB DV1 & MORRO BAY SPLIT
1040      HC       2

1041      KK  RT CHY        ROUTE TO CHEYENNE/RANCHO
1042      RM       3    0.32    0.15

1043      KK  CB CX5        COMBINE W/ CX5
1044      HC       2
          *

1045      KK   DVWR1
          * OVERFLOW CHEYENNE/RANCHO INTERSECTION
1046      DT  DVSTR1
1047      DI       0     167     261     622    1272
1048      DQ       0       0      36     180     455

1049      KK   DVWR2
          * 24" PIPE RANCHO
1050      DT  DVSTR2
1051      DI       0      10      20      30      37     100     500
1052      DQ       0      10      20      30      37      37      37

1053      KK     RX5
          * ROUTE TO 6 X 3 RCB
1054      RM       1     0.1     0.3

1055      KK   CX4X3
          * COMBINE X4 TO X3
1056      HC       2

1057      KK   DVBOX
          * ROUTE FLOW THRU 6 X 3 BOX (MEA)
1058      DT   DVBOX
1059      DI       0      50     100     170     210     700    5000
1060      DQ       0      50     100     170     210     210     210
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1061      KK    RX34
          * ROUTE TO X3 43 X 27 CMP
1062      RM       1     0.1    0.25

1063      KK      X2
1064      BA    0.20
1065      LS       0      91
1066      UD    0.40

1067      KK    CUL5
          * 36" 633+05
1068      RS       1    ELEV    33.5
1069      SV       0    0.95      10
1070      SE    33.5      35      39
1071      SQ       0      20      73

1072      KK     X1D
1073      BA    0.07
1074      LS       0      88
1075      UD    0.45

1076      KK    CUL9
          * 24" 644+60
1077      RS       1    ELEV      28
1078      SV       0     1.4     6.5
1079      SE      28      30      33
1080      SQ       0      15      33

1081      KK     X1C
1082      BA    0.08
1083      LS       0      88
1084      UD    0.46

1085      KK   CUL10
          * 30" 650+20
1086      RS       1    ELEV      25
1087      SV       0    0.84    11.6
1088      SE      25      27    30.5
1089      SQ       0      18      53

1090      KK     X1B
1091      BA    0.07
1092      LS       0      88
1093      UD    0.47

1094      KK    CUL6
          * 24" 660+00
1095      RS       1    ELEV      22
1096      SV       0       4      10
1097      SE      22      25      27
1098      SQ       0      20      34
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1099      KK     X1A
1100      BA    0.04
1101      LS       0      88
1102      UD    0.49

1103      KK    CUL7
          * 24"663+80
1104      RS       1    ELEV    21.5
1105      SV       0     0.5       2
1106      SE    21.5    23.5    25.5
1107      SQ       0      15      28

1108      KK     X12
          * X1# TO X2
1109      HC       5

1110      KK     RX2
          * ROUTE TO JONES
1111      RM       3     0.3    0.35

1112      KK     X1E
1113      BA    0.46
1114      LS       0      81
          * SCS UNIT HYDROGRAPH
1115      UD    1.38

1116      KK    CX1E
          * COMBINE X1#
1117      HC       2

1118      KK    SD1B
          *DROP INLET @ PEAK/JONES
1119      DT    SD1B
1120      DI       0      50     100     212     500
1121      DQ       0       2       6      12      12

1122      KK     RX1
          * ROUTE TO RANCHO
1123      RM       2     0.2    0.35

1124      KK      X1
1125      BA    0.17
1126      LS       0      92
          * SCS UNIT HYDROGRAPH
1127      UD    0.80

1128      KK     CX1
          * COMBINE X
1129      HC       2
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1130      KK   CX1X4
          * COMBINE X1 W/ROUTE FLOW ALONG RANCHO
1131      HC       2

1132      KK  DVFLAT
          * ROUTE FLOW THRU 43 X 27 CMP (MEA)
1133      DT  DVFLAT
1134      DI       0      10      15      20     100     700    5000
1135      DQ       0      10      15      20      20      20      20

1136      KK    RX34
          * ROUTE TO X1 TO N2 36"
1137      RM       1     0.1     0.3

1138      KK      N2
1139      BA    0.20
1140      LS       0      92
          * SCS UNIT HYDROGRAPH
1141      UD    0.97

1142      KK     CN2
          * COMBINE N2 TO X3
1143      HC       2

1144      KK   DVCUL1
          * 36"RCP
1145      DT  DVCUL1
1146      DI       0       5      10      15      20      35     100     700    5000
1147      DQ       0       5      10      15      20      35      35      35      35

1148      KK     RN2
          * ROUTE TO N2 TO N1 36"
1149      RM       1     0.1    0.25

1150      KK      N1
1151      BA    0.23
1152      LS       0      92
          * SCS UNIT HYDROGRAPH
1153      UD     1.0

1154      KK     CN1
          * COMBINE N1 TO N2
1155      HC       2

1156      KK   DVCUL2
          * 36" RCP
1157      DT  DVCUL2
1158      DI       0       5      10      15      20      35     100     700    5000
1159      DQ       0       5      10      15      20      35      35      35      35
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1160      KK     RN1
          * ROUTE TO N1 TO K
1161      RM       1     0.1    0.25

1162      KK     PSM
          * ******************************************
          * * FLOW ROUTED THROUGH 18" X 29" CMAP      *
          * *    HEADWALL = 4.5'                      *
          * *       OUTLET TO PIPE IS 6 X 3 RCB       *
          * *      NDOT STATION 65+75                 *
          * ******************************************
1163      DT    PSM1
1164      DI       0     100     200     261     300     400     500     800    5000
1165      DQ       0     100     200     261     261     261     261     261     261

1166      KK      K3
1167      BA   0.119
1168      LS       0      92
          * SCS UNIT HYDROGRAPH
1169      UD    0.40

1170      KK    CUL2
1171      KM   ROUTE6 X 4 RCB 624+000
1172      RS       1    ELEV      40
1173      SV       0    0.20     7.5
1174      SE      40      41      45
1175      SQ       0      17     170
          * FLOW EAST OF OK HIGHWAY

1176      KK     RK3
          * ROUTE K3 TO K2
1177      RM       2     0.2     0.3

1178      KK      K2
1179      BA   0.195
1180      LS       0      77
          * SCS UNIT HYDROGRAPH
1181      UD    0.71

1182      KK    CK23
1183      KM   COMBINE K3 &  K2
1184      HC       2
          * PEAK FLOW @ TORREY PINES ON SMOKE RANCH

1185      KK     RK2
1186      KM   ROUTE K2 & K3 TO K2A
1187      RM       1     0.1     0.4

1188      KK     K2A
1189      BA    0.22
1190      LS       0      85
          * SCS UNIT HYDROGRAPH
1191      UD    0.98
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1192      KK    CK2A
          * PEAK FLOW @ SMOKE RANCH/JONES
1193      HC       2

1194      KK    DSD1
          * ******************************************
          * *  SMOKE RANCH CLARK COUNTY SID NO. 39    *
          * *  DROP INLET NO.1 L=21', NO.2 L=14'      *
          * *    NO.3 L=7', NO.4-8 & 12  L=14'        *
          * *     6 EX DI                             *
          * ******************************************
1195      DT     SD1
1196      DI       0      25      50      75     100     135     150     185     250
1197      DQ       0      25      50      75     100     135     135     135     135
          *   RK2A
          *
          * ROUTE TO RANCH STREET DRAINAGE        - TAKEN OUT BECAUSE Q AT DSD1 = 0
          *   7100     .01    .016            TRAP      80      10

1198      KK   BASK1
1199      BA    0.33
1200      LS       0      85
          * SCS UNIT  HYDROGRAPH
1201      UD    1.49

1202      KK     CK1
1203      KM   COMBINE K3, K2 & K1
          * PEAK FLOW  @ RANCHO
1204      HC       2

1205      KK    DSD2
          * ******************************************
          * *     SMOKE RANCH CLARK COUNTY SID NO. 39 *
          * *      DROP INLETS NO. 9-10  L=4'         *
          * *      2 EI DI                            *
          * ******************************************
1206      DT     SD2
1207      DI       0      10      20      25      30      50     100     150
1208      DQ       0      10      20      25      25      25      25      25

1209      KK     CXK
          * COMBINE PEAK FLOW @ RANCHO
1210      HC       2

1211      KK    DSD3
          * ******************************************
          * *  SMOKE RANCH CLARK COUNTY SID NO. 39    *
          * *  DROP INLET NO.11 L=4' MOD "A"          *
          * *  1 EX DI - PLUS GRADE @ ISLAND          *
          * ******************************************
1212      DT     SD3
1213      DI       0      10      20      30      40      50     100     200     600    5000
1214      DQ       0      10      20      30      40      50      50      50      50      50
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1215      KK    RXLM
          * ROUTE TO LAKE MEAD
1216      RM       1     0.1     0.3
          * ************************************
          * * LAKE MEAD WEST OF DECATUR        *
          * ************************************
          * ****************************
          * * G, B, & P BASINS          *
          * ****************************

1217      KK    SUBW
1218      BA    0.26
1219      LS       0      92
          * SCS UNIT HYDROGRAPH
1220      UD   0.27

1221      KK    RTLO
1222      KM   ROUTE SUBW H- GRAPH  TO LORENZI
1223      RM       1     0.1     0.4

1224      KK   SUBS1
1225      BA     .07
1226      LS       0      89
1227      UD    .208

1228      KK   SUBN1
1229      BA    .005
1230      LS       0      89
1231      UD    .076

1232      KK   COMLO
1233      KM   COMBINE H-GRAPH AT LORENZI
1234      HC       3

1235      KK    RTBL
1236      KM   ROUTE FLOWS TO BILBRAY
1237      RM       1     0.1     0.4

1238      KK   SUBS2
1239      BA     .12
1240      LS       0      77
1241      UD     .24

1242      KK   SUBN2
1243      BA    .009
1244      LS       0      77
1245      UD    .107

1246      KK   COMBL
1247      KM   COMBINE H-GRAPH AT BILBRAY
1248      HC       3
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1249      KK   RTTP
1250      KM   ROUTE FLOWS TO TORREY PINES
1251      RM      1     0.1     0.4

1252      KK   SUBS3
1253      BA    .12
1254      LS      0      77
1255      UD    .310

1256      KK   SUBN3
1257      BA    .02
1258      LS      0      77
1259      UD    .138

1260      KK   COMTP
1261      KM   COMBINE H-GRAPH AT TORREY PINE
1262      HC      3

1263      KK   RTL1
1264      KM   ROUTE FLOWS TO LIRO
1265      RM      1     0.1     0.4

1266      KK   SUBS4
1267      BA    .02
1268      LS      0      77
1269      UD    .115

1270      KK   SUBN4
1271      BA   .006
1272      LS      0      77
1273      UD     .1

1274      KK   COMLI
1275      KM   COMBINE H-GRAPH AT LIRO
1276      HC      3

1277      KK   RTAR
1278      KM   ROUTE FLOWS TO ARPA
1279      RM      1     0.1     0.4

1280      KK   SUBS5
1281      BA    .06
1282      LS      0      77
1283      UD    .26

1284      KK   COMAR
1285      KM   COMBINE H-GRAPHS AT ARPA
1286      HC      2
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1287      KK   RTSAN
1288      KM   ROUTE FLOWS TO SAN SIMEON
1289      RM      1     0.1     0.4

1290      KK   SUBN5
1291      BA    .04
1292      LS      0      77
1293      UD    .143

1294      KK   COMSS
1295      KM   COMBINE FLOWSAT SAN SIMEON
1296      HC      2

1297      KK    RTJN
1298      KM   ROUTE TO JONES
1299      RM      1     0.1     0.4

1300      KK   SUBS6
1301      BA    .02
1302      LS      0      92
1303      UD    .132

1304      KK   SUBN6
1305      BA    .006
1306      LS      0      92
1307      UD    .09

1308      KK   COMJN
1309      KM   COMBINE H-GRAPHS AT JONES
1310      HC      3

1311      KK    RTSA
1312      KM   ROUTE TO SAYLOR
1313      RM      1     0.1     0.4

1314      KK   SUBS7
1315      BA    .05
1316      LS      0      77
1317      UD    .18

1318      KK   SUBN7
1319      BA    .03
1320      LS      0      77
1321      UD    .14

1322      KK   COMSA
1323      KM   COMBINE FLOWS AT SAYLOR
1324      HC      3
          * ********************************************
          * *     END OF G, B, & P BASINS              *
          * ********************************************
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1325      KK    RM2A
          * ROUTE TO SMITH
1326      RM       1     0.1     0.4
          * ********************************************
          * *          SEA BASINS                      *
          * ********************************************

1327      KK   AREAU
1328      BA    .026
1329      LS       0      87
1330      UD  .03536

1331      KK   SMITH
          * PEAK FLOW SMITH
1332      HC       2

1333      KK    ROUT
          * ROUTE TO SHADOW
1334      RM       1     0.1     0.4

1335      KK   AREAT
1336      BA   .0463
1337      LS       0      87
1338      UD   .5868

1339      KK   AREAB1
1340      BA   .0048
1341      LS       0      87
1342      UD   .0867

1343      KK    SHAD
          * PEAK FLOW SHADOW
1344      HC       3

1345      KK    ROUT
          * ROUTE TO JEANNE
1346      RM       1     0.1     0.4

1347      KK   AREAB
1348      BA   .0347
1349      LS       0      87
1350      UD   .3721

1351      KK    JEAN
          * PEAK FLOW JEANNE
1352      HC       2

1353      KK    ROUT
          * ROUTE TO MICHAEL
1354      RM       1     0.1     0.4
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1355      KK   AREAC
1356      BA   .0064
1357      LS      0      90
1358      UD   .3095

1359      KK   AREAS
1360      BA   .0315
1361      LS      0      87
1362      UD   .6399

1363      KK    MICH
          * PEAK FLOW MICHAEL
1364      HC      3

1365      KK    ROUT
          * ROUTE TO TEQUESTA
1366      RM      1     0.1     0.3

1367      KK   AREAR
1368      BA    .025
1369      LS      0      87
1370      UD   .3555

1371      KK     TEQ
          * PEAK FLOW TEQUESTA
1372      HC      2

1373      KK    ROUT
          * ROUTE TO LEONARLD
1374      RM      1     0.1     0.3

1375      KK   AREAD
1376      BA   .0303
1377      LS      0      87
1378      UD   .4224

1379      KK   AREAQ
1380      BA   .0729
1381      LS      0      87
1382      UD   .5705

1383      KK    LEON
          * PEAK FLOW LEONARLD
1384      HC      3

1385      KK    ROUT
          * ROUTE  TO DECATUR
1386      RM      1     0.1     0.4
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1387      KK   AREAE
1388      BA   .0486
1389      LS      0      87
1390      UD  0.6821

1391      KK   AREAP
1392      BA  0.0986
1393      LS      0      87
1394      UD   .5845

1395      KK  AREADS
1396      BA    .005
1397      LS      0      98
1398      UD   .2619

1399      KK  AREADN
1400      BA   .0032
1401      LS      0      98
1402      UD    .083

1403      KK     DEC
1404      HC       5
          * PEAK FLOW @ DECATAUR/LAKE MEAD
          * ************************************
          * *  END SEA BASINS                  *
          * ************************************
          *

1405      KK     RM1
          * ROUTE TO LAKE MEAD/RANCHO
1406      RM       1     0.1     0.3

1407      KK   BASLJ
1408      BA     0.4
1409      LS       0      89
          * SCS UNIT HYDROGRAPH
1410      UD    1.42

1411      KK       +
          * PEAK FLOW ON LAKE MEAD
1412      HC       2

1413      KK   DV SD        DIVERSION THRU LAKE MEAD DR. STORM DRAIN
1414      KM        FROM VTN NEVADAS FINAL HYDROLOGY STUDY FOR LAKE MEAD BOULEVARD PHASE 1B
1415      KM        WEST SIDE OF RANCHO DR. STORM DRAIN CAPACITY = 573 CFS
1416      DT   LMSD1
1417      DI       0     200     400     573    1000
1418      DQ       0     200     400     573     573
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1419      KK  CB MED
          * PEAK FLOW AT LAKE MEAD/RANCHO INTERSECTION
1420      HC       2
          *
          * DIVERT THRU 5' X 4' RCB TO LAKE MEAD STORM DRAIN

1421      KK  DV 5X4
1422      DT     5X4
1423      DI       0     100     200     500    1000    3000
1424      DQ       0     100     200     200     200     200
          *
          * DIVERSION @ LAKE MEAD & RANCHO DR. INTERSECTION

1425      KK  DV MED
1426      DT    MEAD
1427      DI       0     200    1000    3000
1428      DQ       0     200    1000    3000
          *
          *
          * ************************************
          * *  ROUTE TO DENTENTION BASIN 2A    *
          * ************************************

1429      KK      RR
1430      RM       1     0.1    0.45
          * ************************************
          * *  RUNOFF ALONG LAKE MEAD BLVD     *
          * ************************************

1431      KK    BASI
1432      BA    0.05
          * REVISED DUE TO ROADWAY ALIGNMENT
1433      LS       0      92
1434      UD     .43

1435      KK       +
1436      HC       2

1437      KK     RT1
          * ROUTE BASIN I
1438      RM       1     0.1     0.4

1439      KK    BASH
1440      BA    0.13
          * REVISED DUE TO ROADWAY ALIGNMENT
1441      LS       0      91
1442      UD     .60

1443      KK      HI
          * COMBINE I AND H
1444      HC       2
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1445      KK   LMSD1        RETRIEVE DIVERSION LMSD1
1446      DR   LMSD1

1447      KK     5X4        RETRIEVE DIVERSION 5X4
1448      DR     5X4

1449      KK  CB DIV        COMBINE DIVERSIONS
1450      HC       2

1451      KK  RT DET        ROUTE TO CAREY DETENTION BASIN
1452      RM       1     0.1     0.5

1453      KK  DVLM36        LOW FLOW DIVERSION THRU 36" PIPE
1454      DT    LM36
1455      DI       0      50     100     500    1500
1456      DQ       0      50      50      50      50

1457      KK    CMB1
1458      HC       2
          * ************************************
          * *  NLV AIRPORT DRAINAGE            *
          * *  REFERENCE MEA STUDY &           *
          * *  G.C. WALLACE STUDY              *
          * ************************************
          * ************************************
          * *  FLOW WEST SIDE AIRPORT          *
          * ************************************

1459      KK     B1A
1460      BA   .0516
          * MEA NLV AIRPORT CARD SOUTH SIDE
1461      LS       0      83      80
1462      UK     600    .005      .1     100
1463      RK    1500    .004    .012            TRAP      10       0      NO

1464      KK  DVFLAT
1465      DR  DVFLAT

1466      KK  DVCUL1
1467      DR  DVCUL1

1468      KK   B1A+C
1469      HC       3

1470      KK     B1B
          * COMPUTE RUNOFF FROM THE EAST MOST PAVED AREA
1471      BA   .0144
1472      LS       0      83      80
1473      UK     700    .005      .1     100
1474      RK    1500    .006    .012            TRAP      10       0
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1475      KK   CB AB        COMBINE B1A & B1B
1476      HC       2

1477      KK    ROUT
1478      RM       1     0.1    0.25

1479      KK      B2
1480      BA    .106
1481      UK    1200     .01     0.1     100
1482      RK    3400   0.008    0.02            TRAP       2       1

1483      KK   B1+B2
1484      HC       2
          * ************************************
          * * REMOVE MEA SECOND DET. BASIN     *
          * ************************************

1485      KK   RBAS2
          * ROUTE FLOW TO B4
1486      RM       1     0.1     0.4

1487      KK   DVCUL2
1488      DR  DVCUL2

1489      KK    PSM1
1490      DR    PSM1

1491      KK       +
1492      HC       2

1493      KK       R
          * ROUTE FLOW TO B4
1494      RM       1     0.1     0.4

1495      KK      B4
1496      BA     .11
1497      LS       0      92
1498      UO     .52

1499      KK     CB4
1500      HC       3

1501      KK     RB4
          * ROUTE TO B3 BASIN ( ALLEN)
1502      RM       1     0.1     0.3

1503      KK    DSD4
          * ****************************
          * *  INLET TO STORM DRAIN    *
          * *  CAREY AVENUE AT ALLEN   *
          * *  30" RCP STA 80+16       *
          * ****************************
1504      DT     SD4
1505      DI       0      20     100     200     700
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1506      DQ       0      20      20      20      20

1507      KK     RB3
1508      RM       1     0.1    0.25
          * ****************************
          * *  RET FLOW IN CAREY SD    *
          * ****************************

1509      KK    SD1A
1510      DR    SD1A
          * FLOW IN JONES STORM @ BROOK

1511      KK       R
1512      RM       1     0.1     0.5

1513      KK    SD1B
1514      DR    SD1B

1515      KK       +
          * FLOW IN JONES SD @ PEAK
1516      HC       2

1517      KK       R
1518      RM       1     0.1     0.5
          * FLOW CARTIER AND MADRE MESA @ JONES

1519      KK      R1
1520      RM       1     0.1     0.3

1521      KK     SD1
          * INTERCEPTED FLOW FROM JONES TO DECATUR ON SMOKE RANCH
1522      DR     SD1

1523      KK       +
1524      HC       2

1525      KK      R1        COMBINE R1 & R2
1526      RM       1     0.1     0.5

1527      KK     SD2
          * FLOW INTERCEPTED BETWEEN DECATUR AND RANCH ON SMOKE RANCH
1528      DR     SD2

1529      KK       +
1530      HC       2

1531      KK      R3
1532      RM       1     0.1     0.5

1533      KK     SD3
1534      DR     SD3
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1535      KK       +
          * FLOW IN SMOKE RANCH STORM DRAIN @ RANCHO
1536      HC       2

1537      KK     RK1        COMBINE RK1, RK1A, & RK1B
          * 54" RCP, 60" RCP, & 54" RCP
1538      RM       1     0.1     0.5

1539      KK     SD4
1540      DR     SD4

1541      KK       +
1542      HC       2

1543      KK     RSD
          * ****************************
          * *  ROUTE SD FLOW TO ALLEN  *
          * ****************************
1544      RM       1     0.1     0.5

1545      KK       +
          * FLOW FROM AIRPORT AND CAREY STORM DRAIN
1546      HC       2

1547      KK      RR
1548      RM       1     0.1    0.45
          *

1549      KK     B1A
1550      BA   .0516
          * MEA NLV AIRPORT CARD SOUTH SIDE
1551      LS       0      83      80
1552      UK     600    .005      .1     100
1553      RK    1500    .004    .012            TRAP      10       0      NO
          *
          *
          *
          *

1554      KK  CB CRY        COMBINE TWO HYDROGRAPHS AT CAREY/ LAKE MEAD DETENTION BASIN
1555      HC       3
          * ****************************
          * *  EAST SIDE AIRPORT       *
          * ****************************

1556      KK  DVSTR1
          * OVERFLOW @ CHEYENNE RANCH
1557      DR  DVSTR1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1558      KK  DVSTR2
          * FLOW FROM 24"
1559      DR  DVSTR2

1560      KK      CD
          * COMBINE DIV FLOWS
1561      HC       2

1562      KK    R-AB
          * MEA
1563      RM       1     0.1     0.3
          *

1564      KK      N1
          * MEA
1565      BA    .097
1566      LS       0      87
1567      UD    .273

1568      KK    STR1
          * MEA STREET RUNOFF RANCHO TO DECATUR
1569      BA   .0049
1570      LS       0      98
1571      UD      .1

1572      KK     AB+
1573      HC       3

1574      KK    DAV+
1575      DT    DAV+
1576      DI       0      10      25     100     200
1577      DQ       0       0       0      75     175

1578      KK    ROUT
          * ROUTE RUNOFF SOUTH IN NEW DECATUR TO A LOW POINT
1579      RM       1     0.1    0.25

1580      KK      A1
          * MEA
1581      BA    .042
1582      LS       0      81
1583      UD     .11

1584      KK   DVBOX
1585      DR   DVBOX

1586      KK       +
1587      HC       3
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1588      KK      A2
1589      BA     .15
1590      LS       0      81       1
1591      UD     .44

1592      KK     A2+
1593      HC       2

1594      KK    ROUT
1595      RM       1     0.1     0.4

1596      KK    DAV+
1597      DR    DAV+

1598      KK   AA-BB
          * ROUTE FLOW NOT DIVERTED SOUTH ON DECATUR
1599      RM       1     0.1     0.4

1600      KK     FN2
1601      BA     .13
1602      LS       0      92
1603      UD     .54

1604      KK    STR2
          * STREET RUNOFF DECATUR TO VALLEY DR.
1605      BA   .0107
1606      LS       0      98
1607      UD     .22

1608      KK    HYD+
          * COMBINE FN2 + STR2
1609      HC       2

1610      KK     FN4
1611      BA     .14
1612      LS       0      92
1613      UD     .61

1614      KK   BA-BB
1615      RM       1     0.1     0.4

1616      KK     BB+
1617      HC       3

1618      KK     DBB
1619      DT     DBB
1620      DI       0      80     212     300
1621      DQ       0      80      80      80
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1622      KK    ROUT
          * ROUT THE OVERFLOW FROM CHEYENNE/VALLEY SOUTH TO AIRPORT CHANNEL
1623      RM       1     0.1    0.25

1624      KK       +
          * COMBINE THE OVERFLOW WITH WATER IN THE AIRORT CHANNEL
1625      HC       2

1626      KK    R"W"
          * ROUTE THE AIRPORT CHANNEL TO THE EAST OF EXISTING RUNWAY
1627      RM       1     0.1     0.4

1628      KK      A3
1629      BA     .15
1630      LS       0      81       1
1631      UD     .44

1632      KK       +
          * COMBINE A3 WITH AIRPORT CHANNEL
1633      HC       2

1634      KK     DBB
1635      DR     DBB

1636      KK   BB-CB
1637      RM       1     0.1     0.5

1638      KK      N9
1639      BA     .15
1640      LS       0      91
1641      UD     .77

1642      KK   N9-CA
1643      RM       1     0.1    0.35

1644      KK     FN6
1645      BA     .13
1646      LS       0      91
1647      UD     .74

1648      KK     CA+
1649      HC       2

1650      KK   CA-CB
1651      RM       1     0.1    0.35

1652      KK     FN5
1653      BA     .12
1654      LS       0      91
1655      UD     .79
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1656      KK    STA3
          * STREET RUNOFF VALLEY DR TO ALLEN LN
1657      BA   .0095
1658      LS      0      98
1659      UD    .173

1660      KK    HYD+
1661      HC       3

1662      KK     CB+
1663      HC       2

1664      KK   ALLEN
1665      DT   ALLEN
1666      DI       0      50     100     200     500
1667      DQ       0      50     100     181     181

1668      KK    R"Y"
          * ROUTE THE OVERFLOW FROM CHEYENNE/ALLEN TO AIRPORT CHANNEL
1669      RM       1     0.1     0.3

1670      KK    HYD+
1671      HC       2

1672      KK    R"Z"
          * ROUTE THE AIRPORT CHANNEL TO DETETNION BASIN
1673      RM       1     0.1     0.3
          * REMOVE MEA AIRPORT DET BASIN

1674      KK   ALLEN
1675      DR   ALLEN

1676      KK  CB-LOW
1677      RM       1     0.1     0.5

1678      KK    ROUT
1679      RM       1     0.1    0.35

1680      KK      +F
1681      HC       2

1682      KK   RBAS1
1683      RM       1     0.1     0.4

1684      KK      B3
1685      BA    .313
1686      LS       0      90
1687      UD     .81
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1688      KK     CB3
          * COMBINE OUTFLOW WITH B3
1689      HC       2

1690      KK  CB LMD
          * INFLOW TO DETENTION BASIN 2A
1691      HC       2
          * ****************************
          * CAREY / LAKE MEAD          *
          * DETENTION BASIN            *
          * EDITED BY                  *
          * CVL CONSULTANTS, INC       *
          * SPILLWAY ELEV = 18.5'      *
          * ****************************

1692      KK      2A
1693      RS       1    FLOW      -1
1694      SV       0      10      50     125     220     350     486     533     588
1695      SE      92      98     102     106     110     114     118     119     121
1696      SQ       0      60     100     123     150     213     370    1390   11026

1697      KK   RLM36        RETRIEVE DIVERSION LM36
1698      DR    LM36

1699      KK   CB SD        COMBINE LOW FLOW DIVERSION W/CAREY DETENTION  BASIN OUTFLOW
1700      HC       2

1701      KK    RTIH
1702      RM       1     0.1    0.45

1703      KK   BASF1
1704      BA    0.09
1705      LS       0      85
1706      UD     .56

1707      KK     RF1
          * KINEMATIC WAVE ROUTING
1708      RM       2     0.2    0.45

1709      KK   BASF2
1710      BA   0.06
1711      LS       0      85
          * SCS UNIT HYDROGRAPH
1712      UD      .7

1713      KK    CMB2
          * COMBINE F1, F2
1714      HC       2
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1715      KK   FLOW1
1716      HC      2

1717      KK   RTF1H
          * ROUTE COMBINE HYDROGRAPH
1718      RM      1     0.1    0.45

1719      KK    BASD
1720      BA   0.064
1721      LS      0      85
          * SCS UNIT HYDROGRAPH
1722      UD    1.02

1723      KK    BASE
1724      BA   0.016
1725      LS      0      85
          * SCS UNIT HYDROGRAPH
1726      UD    0.23

1727      KK    CMB3
          * COMBINE D,E
1728      HC      2

1729      KK   FLOW2
1730      HC      2

1731      KK   RDEFIH
          * ROUTE DEFIH BASINS
1732      RM      1     0.1    0.35

1733      KK    BASC
1734      BA    0.04
1735      LS      0      86
          * SCS UNIT HYDROGRAPH
1736      UD     0.7

1737      KK   FLOW3
          * COMBINE BASIN C WITH MAIN HYDROGRAPH
1738      HC      2

1739      KK     RTC
          * ROUTE C AND MAIN HYDROGRAPH
1740      RM      1     0.1     0.3

1741      KK    BASB
1742      BA    0.01
1743      LS      0      85
1744      UD    0.31
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1745      KK   BASB1
1746      BA   0.015
1747      LS      0      90
          * SCS UNIT HYDROGRAPH
1748      UD    0.57

1749      KK    CMB5
          * COMBINE B, B1
1750      HC       2

1751      KK   FLOW4
1752      HC       2

1753      KK     RTB
          * ROUTE MAIN HYDROGRAPH
1754      RM       1     0.1     0.3

1755      KK    BASA
1756      BA    0.01
1757      LS       0      90
          * SCS UNIT HYDROGRAPH
1758      UD    0.23

1759      KK    BASG
1760      BA   0.073
1761      LS       0      90
          * SCS UNIT HYDROGRAPH
1762      UD     .42

1763      KK    CMB6
          * COMBINE A, G
1764      HC       2

1765      KK   FLOW5
          *  ********************************
          *  * PEAK FLOW AT LOSEE           *
          *  ********************************
1766      HC       2

1767      KK  RT CRY        ROUTE TO CAREY/LOSEE
1768      RM       1     0.1    0.35
          * ****************************
          * * RUNOFF CAREY AVENUE      *
          *
          * ****************************

1769      KK    F10A
1770      BA    0.08
1771      LS       0      91
1772      UD   0.498
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1773      KK  RTF10B        ROUTE TO FN10B
1774      RM       1     0.1      0.2

1775      KK   FN10B
1776      BA    0.05
1777      LS       0      91
1778      UD    0.33

1779      KK  CB F10        COMBINE FN10A & FN10B
1780      HC       2

1781      KK   RT A4        ROUTE TO A4
1782      RM       2     0.2      0.2

1783      KK       A4
1784      BA    0.08
1785      LS       0      81       1
1786      UD     0.2

1787      KK   CB A4        COMBINE FN10A, FN10B, AND A4
1788      HC       2

1789      KK    RT W        ROUTE TO W
1790      RM       2     0.2      0.2

1791      KK        W
1792      BA    0.24
1793      LS       0      90
1794      UD    0.57

1795      KK    CB W        COMBINE FN10A &B, A4, AND W
1796      HC       2

1797      KK   RT W1        ROUTE TO HIGHLAND
1798      RM       5     0.5      0.2
          *

1799      KK    BASR
1800      BA    0.22
1801      LS       0      90
1802      UD    0.47

1803      KK   RT R1        ROUTE TO R1
1804      RM       2     0.2      0.2

1805      KK       R1
1806      BA      0.2
1807      LS       0      89
1808      UD      .53
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1809      KK   CB R1        COMBINE R1 & R
1810      HC       2

1811      KK   RT R2        ROUTE TO R2
1812      RM       1     0.1     0.2

1813      KK      R2
1814      BA      .2
1815      LS       8      88
1816      UD     .55

1817      KK   CB R2        COMBINE R, R1 & R2
          * **********************
          * *   CLAYTON         *
          * **********************
1818      HC       2

1819      KK    DSD5
1820      DT     SD5
          * STORM DRAIN IN CAREY
1821      DI       0      50      70     100     700
1822      DQ       0      50      70      70      70

1823      KK      RR
          * ROUTE TO HIGHLAND
1824      RM       2     0.2    0.25
          *

1825      KK      W1
1826      BA     .38
1827      LS       0      85
1828      UD    1.25

1829      KK   CB W1        COMBINE 3 HYDROGRAPHS @ HIGHLAND
1830      HC       3

1831      KK   RT W2
1832      RM       4     0.4     0.2

1833      KK       S
          * **********************
          * *     HIGHLAND     *
          * **********************
1834      BA     .49
1835      LS       0      88
1836      UD     .93

1837      KK   DSD62
1838      DT    SD62
          * STORM DRAIN IN CAREY
1839      DI       0      50      76     100     230     500
1840      DQ       0      50      76      79      96     107
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1841      KK      RS
          * ROUTE TO LEXINGTON
1842      RM       1     0.1    0.25

1843      KK    DSD7
1844      DT     SD7
          * STORM IN CAREY
1845      DI       0      25      50     100     300     500
1846      DQ       0      13      14      16      22      29

1847      KK    ROUT
1848      RM       4     0.4     0.2

1849      KK      W2
1850      BA     .45
1851      LS       0      88
1852      UD    1.15
          * *******************************
          * *  PEAK FLOW AT I-15 CHANNEL*
          * *******************************

1853      KK       +
1854      HC       3

1855      KK     DWC
1856      DT     DWC
1857      DI       0     100     300     600    1000    3000
1858      DQ       0     100     300     600    1000    3000

1859      KK      S1
          * *********************
          * *  REVERSE (H ST)  *
          * *********************
1860      BA     .18
1861      LS       0      89
1862      UD     .89

1863      KK    DSD8
1864      DT     SD8
          * STORM DRAIN IN CAREY
1865      DI       0      25      50     100     200
1866      DQ       0       9      18      29      35

1867      KK      RS
          * ROUTE TO COMMERCE
1868      RM       1     0.1    0.45

1869      KK   DSD91
1870      DT    SD91
          * STORM DRAIN IN CAREY
1871      DI       0      25      60     100     200
1872      DQ       0      18      43      51      62
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1873      KK       V
          * ********************
          * *   COMMERCE       *
          * ********************
1874      BA    0.13
1875      LS       0      88
1876      UD     .37

1877      KK   DSD92
          * STORM DRAIN IN CAREY
1878      DT    SD92
1879      DI       0      25      75      95     200
1880      DQ       0       5      12      15      18

1881      KK    CB V        COMBINE S1 & V
          * PEAK SURFACE FLOW AT COMMERCE
1882      HC       2

1883      KK  RT CRY        ROUTE TO CAREY/LOSEE
1884      RM       1     0.1    0.35

1885      KK  CB LOS        COMBINE W/ W2
1886      HC       2

1887      KK     SD5
1888      DR     SD5

1889      KK      RR
          * ROUTE TO HIGHLAND
1890      RM       1     0.1    0.45

1891      KK    SD62
1892      DR    SD62

1893      KK       +
1894      HC       2

1895      KK      RS
          * ROUTE TO LEXINGTON
1896      RM       1     0.1    0.35

1897      KK     SD7
1898      DR     SD7

1899      KK       +
1900      HC       2

1901      KK      RS
          * ROUTE TO REVERE (H ST)
1902      RM       1     0.1    0.35
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1903      KK     SD8
1904      DR     SD8

1905      KK       +
1906      HC       2

1907      KK      RS
          * ROUTE TO COMMERCE
1908      RM       1     0.1    0.35

1909      KK    SD91
1910      DR    SD91

1911      KK    SD92
1912      DR    SD92

1913      KK       +
          * PEAK FLOW IN STORM DRAIN
1914      HC       3

1915      KK    DWC1
1916      DR     DWC
          * PEAK SURFACE

1917      KK       +
          * PEAK FLOW AT CHANNEL
1918      HC       2
          *
          * ******************************************
          * *     END OF VTN NEVADAS CAREY/LAKE ME    *
          * *     DETENTION BASIN                     *
          * ******************************************
          *
          *

1919      KK  CB LOS        COMBINE 4 HYDROGRAPHS @ CAREY/LOSEE
1920      HC       3
          *
          *  KKRT CHA        ROUTE TO CHANNEL "A"
          *  RM     2     0.2    0.25
          *  KKCB CHA        COMBINE HYDROGRAPHS @ CHANNEL "A"
          *  HC     2
          *
          *
          *
          *
          *

1921      KK    MEAD        RETRIEVE DIVERSION MEAD
1922      DR    MEAD
          *
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1923      KK  DV 6X3       DIVERSION THRU 6' X 3' RCB
1924      DT   1-6X3
1925      DI        0      91     318     705    1303    2570
1926      DQ        0      48      86     117     148     173
          *

1927      KK  DV26X3       DIVERSION THRU 6' X 3' RCB
1928      DT   2-6X3
1929      DI        0      48     180     416     757    1208    1776
1930      DQ        0      48      86     117     148     173     196
          *

1931      KK  DV 24"         24" CMP
1932      DT   24CMP
1933      DI        0      27     100    1000
1934      DQ        0      27      27      27
          *

1935      KK       J2
          * FROM VTN LAKE MEAD HYDROLOGY STUDY
1936      BA     0.22
1937      LS        0      89
1938      UD     0.70

1939      KK   CB J2       COMBINE DIVERSION MEAD W/ J2
1940      HC        2

1941      KK  DV COR       DIVERSION @ CORAN & RANCHO
1942      DT   CORAN
1943      DI        0     100     281    1217    2997    5802
1944      DQ        0       0      13     205     732    1695
          *

1945      KK  RT VGS       ROUTE TO VEGAS DR.
1946      RM        3     0.3    0.35

1947      KK       J3
1948      BA     0.37
1949      LS        0      89
1950      UD      0.5

1951      KK  CB VEG       COMBINE J2 & J3
1952      HC        2

1953      KK  DV VGS       DIVERSION @ VEGAS & RANCHO
1954      DT   VEGAS
1955      DI        0      45     260    1428    3684    7222
1956      DQ        0      20     117     640    1639    3179
          *
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1957      KK  RT WAS        ROUTE TO WASHINGTON AVE.
1958      RM       3     0.3    0.35
          *
          * ******************************************
          * REFER TO MONTGOMERY FIS HYDROLOGY
          * FOR NORTH LAS VEGAS AREA.
          * ******************************************

1959      KK    309W
1960      KM   RUNOFF FROM WESTERN PORTION OF SUBBASIN 309
1961      BA    1.35
1962      LS       0      71       0       0      70
1963      UK     150    0.01     0.3      22
1964      UK     300  0.0144    0.25      78
1965      RK    1000   0.007    0.02   0.013    TRAP      51       0
1966      RK    2600   0.007    0.02    0.20    TRAP      80       0
1967      RK   12000  0.0144    0.02       0    TRAP     100       0

1968      KK   R309W
1969      KM   ROUTE FROM 309W TO 309E
1970      RM      10       1    0.35

1971      KK    309E
1972      KM   RUNOFF FROM EASTERN PORTION OF SUBBASIN 309
1973      BA    1.19
1974      LS       0      87       0       0      80
1975      UK     150    0.01     0.3      52
1976      UK     300  0.0144    0.25      48
1977      RK    1000   0.007    0.02   0.019    TRAP      51       0
1978      RK    2600   0.007    0.02    0.30    TRAP      80       0
1979      RK   21000  0.0144    0.02       0    TRAP     100       0

1980      KK  DV CUL
          * DIVERSION THRU CULVERT UNDER WASHINGTON AVE.
          * DIVERTED DISCHARGES CONTINUE SOUTH IN A CHANNEL TO BONANZA RD., AND FLOW THRU
          * 48" RCP UNDER BONANZA RD. TO THE BOX CULVERT UNDER I-95.
1981      DT  CULVRT
1982      DI       0     100     158     300     500    1000
1983      DQ       0     100     158     158     158     158

1984      KK    309E
1985      KM   COMBINE ROUTED 309W WITH 309E
1986      HC       2
          *

1987      KK  CB WAS        COMBINE FLOWS FROM VEGAS W/ WS 309
1988      HC       2
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1989      KK  DV WAS        DIVERSION @ WASHINGTON & RANCHO DR.
1990      DT    WASH
1991      DI       0      83     471    2670    7373
1992      DQ       0      23     132     750    2070
          *

1993      KK  RT 310        ROUTE TO 310E
1994      RM       3     0.3    0.35

1995      KK    310W
1996      KM   RUNOFF FROM WESTERN PORTION OF SUBBASIN 310
1997      BA    1.08
1998      LS       0      87       0       0      87
1999      UK     150   0.010     0.3      38
2000      UK     300   0.015    0.25      62
2001      RK    1000  0.0075    0.02   0.013    TRAP      51       0
2002      RK    2600  0.0075    0.02     0.2    TRAP      80       0
2003      RK   12000  0.0150    0.02       0    TRAP     100       0

2004      KK   R310W
2005      KM   ROUTE RUNOFF FROM 310W TO 310E
2006      RM       3    0.32    0.35

2007      KK    310E
2008      KM   RUNOFF FROM EASTERN PORTION OF SUBBASIN 310
          * TOTAL AREA = 1.238 - 0.266 = 0.972
          *
          * RUNOFF FROM AREAS SOUTH OF BONANZA RD. BETWEEN MICHAEL WAY AND VALLEY VEIW
          * RD. DRAINS INTO A DROP INLET LOCATED NEAR THE ON-RAMP TO I-95 WESTBOUND.
          * THIS AREA IS TAKEN OUT OF BASIN 310E.
          *
2009      BA   0.972
2010      LS       0      86       0       0      83
2011      UK     150    0.01     0.3      46
2012      UK     300   0.015    0.25      54
2013      RK    1000  0.0075    0.02   0.019    TRAP      51       0
2014      RK    2000  0.0075    0.02    0.31    TRAP      80       0
2015      RK   10500   0.015    0.02       0    TRAP     100       0

2016      KK    310E
2017      KM   COMBINE ROUTED 310W WITH 310E
2018      HC       2

2019      KK  CB 310        COMBINE FLOWS FROM WASHINGTON W/ 310
2020      HC       2
          *

2021      KK  DV BON
          *
          * AT INTERSECTION OF RANCHO DR. AND BONANZA ROAD, FLOW SPLITS INTO TWO
          * DIRECTIONS.
          * SPLIT FLOW CONTINUES SOUTH ALONG WEST SIDE OF RANCHO DR.
          *
2022      DT   BONAN
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

2023      DI        0     172     333     558     840    1174    1558
2024      DQ        0     159     259     379     515     666     831
          *

2025      KK  RT311W        ROUTE TO WS 311W
2026      RM        5     0.5    0.35
          *

2027      KK   VEGAS        RETRIEVE DIVERSION VEGAS
2028      DR   VEGAS

2029      KK    WASH        RETRIEVE DIVERSION VEGAS
2030      DR    WASH

2031      KK  CB DIV        COMBINE DIVERSIONS
2032      HC        2

2033      KK  RT311W        ROUTE TO 311W
2034      RM        5     0.5    0.35

2035      KK    311W
2036      KM   RUNOFF FROM WESTERN PORTION OF SUBBASIN 311
          * TOTAL AREA OF BASIN 311W FROM JMM HEC-1 MODEL = 0.96
          * RUNOFF FROM AREAS SOUTH OF BONANZA RD. BETWEEN HIGHLAND AND RANCHO
          * GETS DIVERTED SOUTH @ INTERSECTION OF I-95AND HIGHLAND.
          * THIS AREA IS TAKEN OUT OF BASIN 311W.
          * AREA = 0.96 - 0.075 = 0.88
2037      BA     0.88
2038      LS        0      85       0       0      83
2039      UK      150   0.010     0.3      60
2040      UK      300  0.0132    0.25      40
2041      RK      650  0.0065    0.02    0.01    TRAP      51       0
2042      RK     2200  0.0065    0.02    0.14    TRAP      80       0
2043      RK     5300  0.0132    0.02       0    TRAP     100       0

2044      KK    311W
2045      KM  COMBINE 310, 309 & ROUTED 311W
2046      HC        3

2047      KK  RT311E
2048      KM   ROUTE FROM 311W TO 311E
2049      RM        2     0.2    0.35

2050      KK    311E
2051      KM   RUNOFF FROM EASTERN PORTION OF SUBBASIN 311
2052      BA     0.77
2053      LS        0      75       0       0      72
2054      UK      150    0.01     0.3      75
2055      UK      300  0.0132    0.25      25
2056      RK      650  0.0065    0.02   0.008    TRAP      51
2057      RK     2200  0.0065    0.02    0.11    TRAP      80       0
2058      RK     7500  0.0132    0.02       0    TRAP     100       0
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

2059      KK    311ECOMBINE 309,310,&311
2060      HC       2
          *   KKRT312E        ROUTE FROM 311E TO 312E (LAKE MEAD)
          *   RM     2     0.2     0.3
          *
          *
          *

2061      KK   1-6X3         RETRIEVE DIVERSION 1-6X3
2062      DR   1-6X3

2063      KK   2-6X3         RETRIEVE DIVERSION 2-6X3
2064      DR   2-6X3

2065      KK   24CMP         RETRIEVE 24CMP
2066      DR   24CMP

2067      KK   CORAN         RETRIEVE DIVERSION @ CORAN
2068      DR   CORAN
          *
          *

2069      KK  CB DIV         COMBINE DIVERSIONS
2070      HC       4
          *

2071      KK  RT312W         ROUTE TO WS 312W
2072      RM       6     0.6    0.35
          *

2073      KK    312W
2074      KM   RUNOFF FROM WESTERN PORTION OF SUBBBASIN 312
2075      KM   ROUTE SUBBASINS 307 & 308 THRU SUBBASIN 312
          *       AREA REVISED TO INCORPORATE CHANGES BY VTN NEVADAS HEC-1
2076      BA    0.87
2077      LS       0      81       0       0      80
2078      UK     150    0.01     0.3      20
2079      UK     300  0.0132    0.25      80
2080      RK    1000  0.0065    0.02   0.012    TRAP      51       0
2081      RK    2600  0.0065    0.02   0.175    TRAP      80       0
2082      RK    6100  0.0132    0.02       0    TRAP     100       0

2083      KK    312W
2084      KM        COMBINE DIVERSIONS W/ 312W
2085      HC       2

2086      KK   R312W
2087      KM   ROUTE FROM 312W TO 312E
2088      RM       1    0.11    0.35
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

2089      KK   312E
2090      KM   RUNOFF FROM EASTERN PORTION OF SUBBASIN 312
          *      AREA REVISED TO INCORPORATE CHANGES BY VTN NEVADAS HEC-1
2091      BA    0.62
2092      LS       0      79       0       0      76
2093      UK     150   0.010     0.3      50
2094      UK     300  0.0132    0.25      50
2095      RK     500  0.0065    0.02   0.012    TRAP      51       0
2096      RK    2600  0.0065    0.02   0.175    TRAP      80       0
2097      RK    6100  0.0132    0.02       0    TRAP     100       0

2098      KK    312E
2099      KM   COMBINE ROUTED 312W WITH 312E
2100      HC       2
          *   KKCB312E        COMBINE W/ 309,310,&311
          *   HC     2
          *   KKRTCARY
          *   KM       ROUTE FROM 312E TO CAREY/LOSEE
          *   RM     1     0.1     0.4
          *   KKRT CHA         ROUTE TO CHANNEL "A"
          *   RM     2     0.2    0.25
          *   KKCB CHA
          *   HC     2
          *
          *
          *
          *

2101      KK   CULV1
2102      KM        RECALL DIVERSION CULV1
2103      DR   CULV1

2104      KK   CULV2
2105      KM        RETREIVE DIVERSION CULV2
2106      DR   CULV2

2107      KK   CULV3
2108      KM        RETREIVE DIVERSION CULV3
2109      DR   CULV3

2110      KK  CB DIV         COMBINE DIVERSIONS CULV1 TO CULV3
2111      HC       3

2112      KK  RT 301
2113      KM        ROUTE DIVERTED GOWAN FLOW THRU SUBBASIN 301
2114      RM      22    2.17    0.15

2115      KK     301
2116      KM        RUNOFF FROM SUBBASIN 301
2117      BA  18.616
2118      LS       0      85
2119      UD     4.3
```

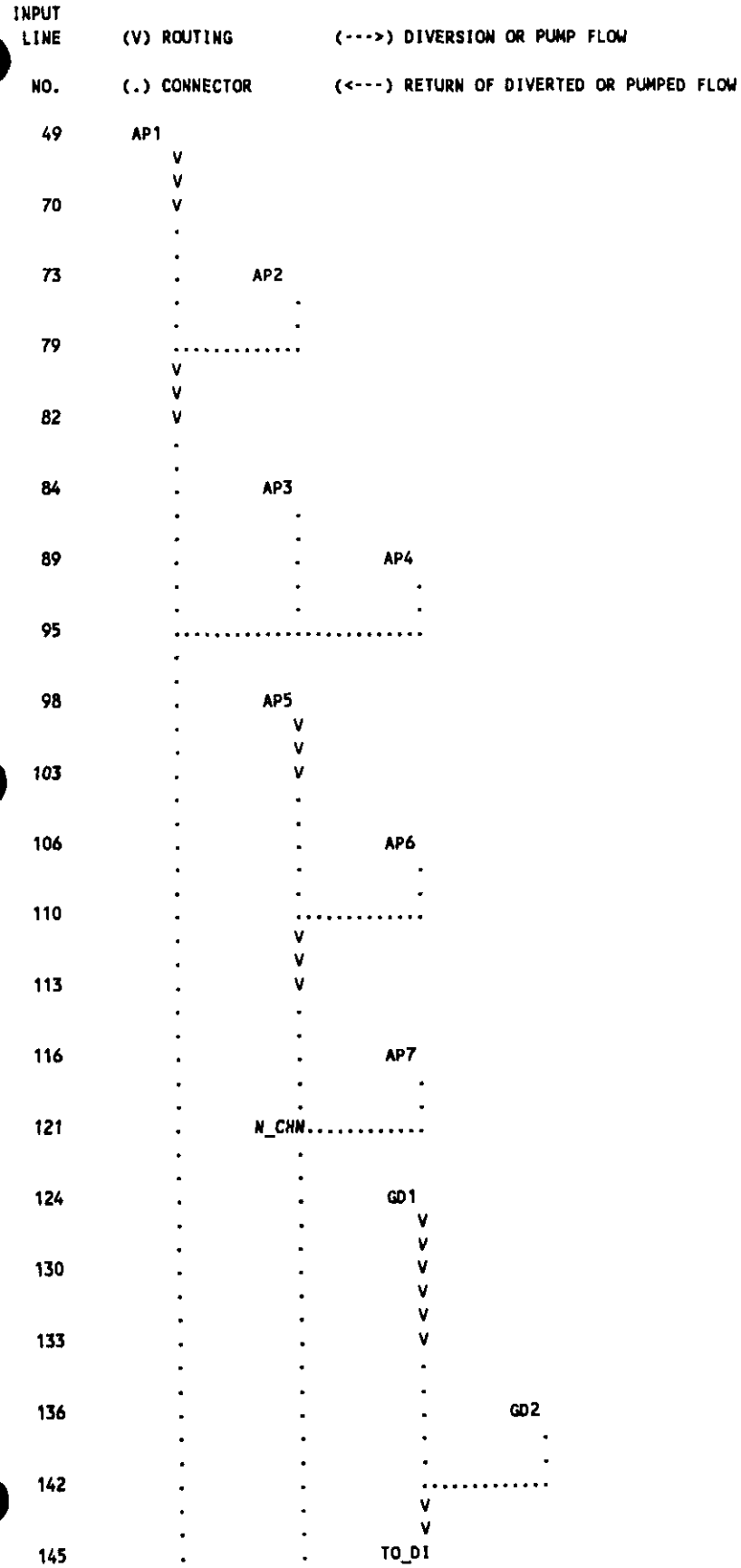
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

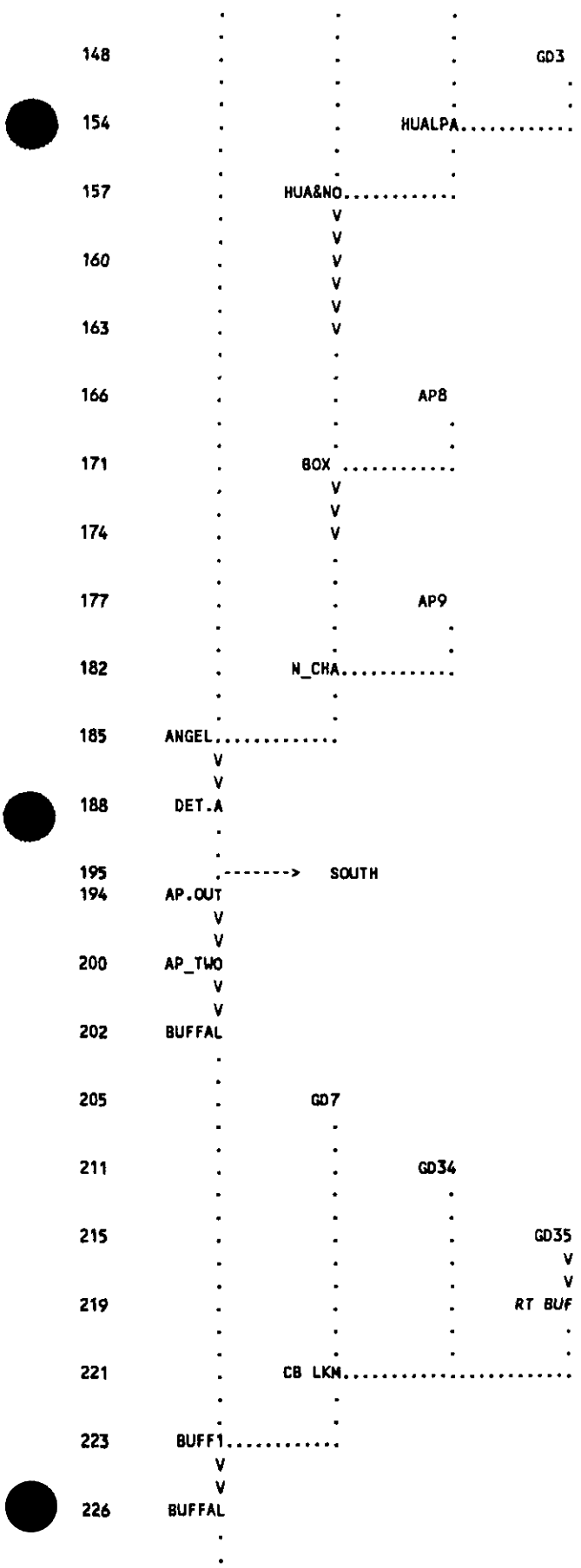
2120      KK   WTRIB
2121      KM        COMBINE SUBBASIN 301 & DIVERTED GOWAN FLOW
2122      HC       2
          *
          *
          *
          *  KK   302
          *  KM       RUNOFF SUBBASIN 302
          * AREA EDITED BY CVL CONSULTANTS, INC - SUBTRACT AREAS DIVERTED
          * BY DIVERSION DIKE
          *  BA  11.0
          *  LS     0      86
          *  UD   3.1
          *  KKRT 303
          *  KM       ROUTE SUNBASIN 301 THRU 303
          *  RM     8    0.83    0.15
          *  KK   303
          *  KM       RUNOFF FROM 303
          *  BA10.217
          *  LS     0      84
          *  UD  4.24
          *  KKCB 303
          *  KM       COMBINE FLOW FROM SUBBASINS 302 & 303
          *  HC     2
          *

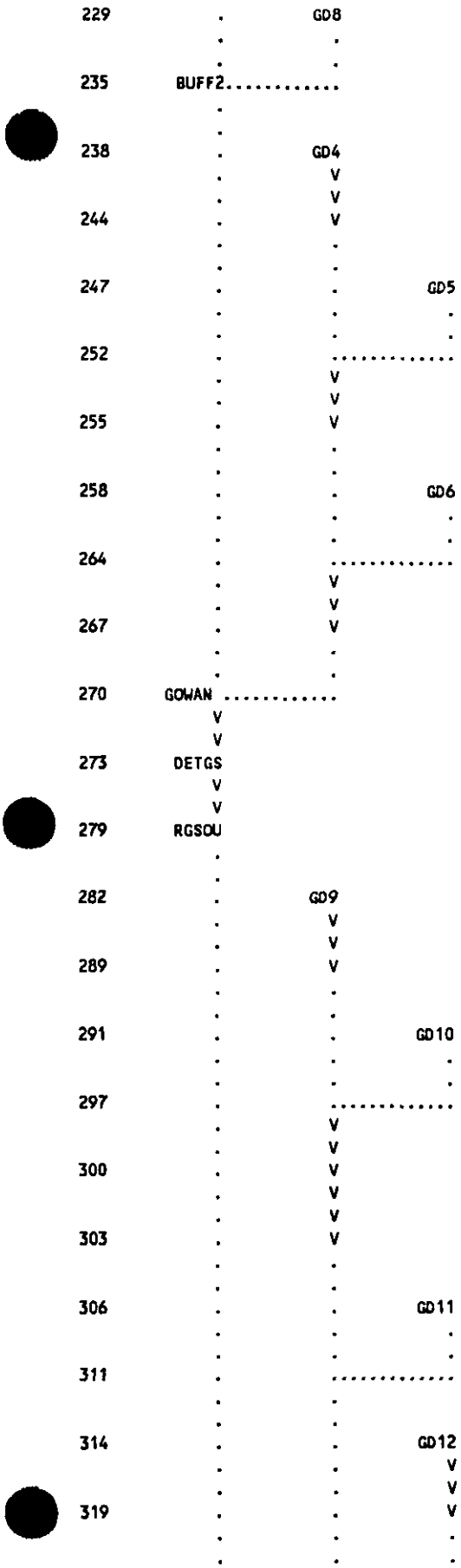
2123      KK   BONAN         RETRIEVE DIVERSION "BONAN"
2124      DR   BONAN
          *

2125      KK  DV RAN
          * FLOW SPLITS OCCUR IN TWO DIRECTIONS @ INTERSECTION OF RANCH DR. & I-95.
          * SPLIT FLOW CONTINUES SOUTH ON RANCHO DR.. THE REMAINING FLOW OVERTOPS
          * RANCHO DR. & FLOW EAST TO THE INTERSECTION OF HIGHLAND DR. AND I-95
          * AND CONTINUE SOUTH ALONG HIGHLAND DR.
2126      DT  RANCHO
2127      DI       0     107     318     642    1039    1502
2128      DQ       0      31      75     177     309     470
          *
2129      ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK




148
GD3
154
HUALPA
157
HUA&NO
160
163
166
AP8
171
BOX
174
177
AP9
182
N_CHA
185
ANGEL
188
DET.A
195
SOUTH
194
AP.OUT
200
AP_TWO
202
BUFFAL
205
GD7
211
GD34
215
GD35
219
RT BUF
221
CB LKN
223
BUFF1
226
BUFFAL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GD8
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BUFF2
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GD4
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247
GD5
252
255
258
GD6
264
267
270
GOWAN
273
DETGS
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RGSOU
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GD9
289
291
GD10
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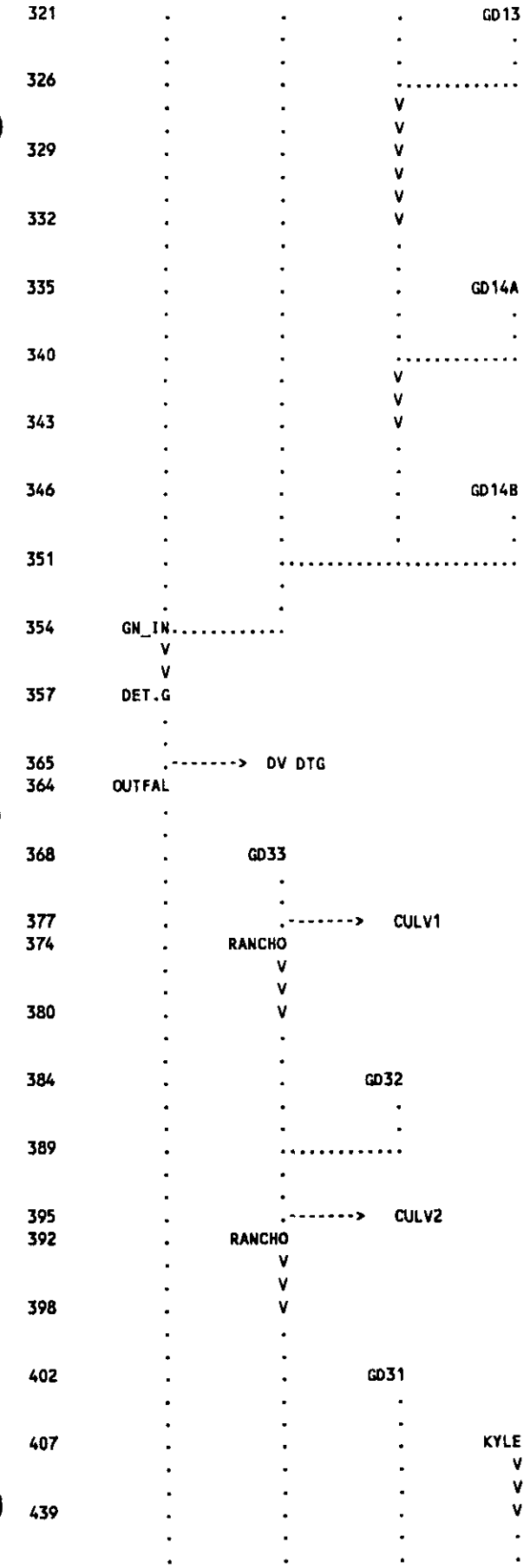
300
303
306
GD11
311
314
GD12
319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GD13
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329
332
335
GD14A
340
343
346
GD14B
351
354
GN_IN
357
DET.G
365
DV DTG
364
OUTFAL
368
GD33
377
CULV1
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RANCHO
380
384
GD32
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395
CULV2
392
RANCHO
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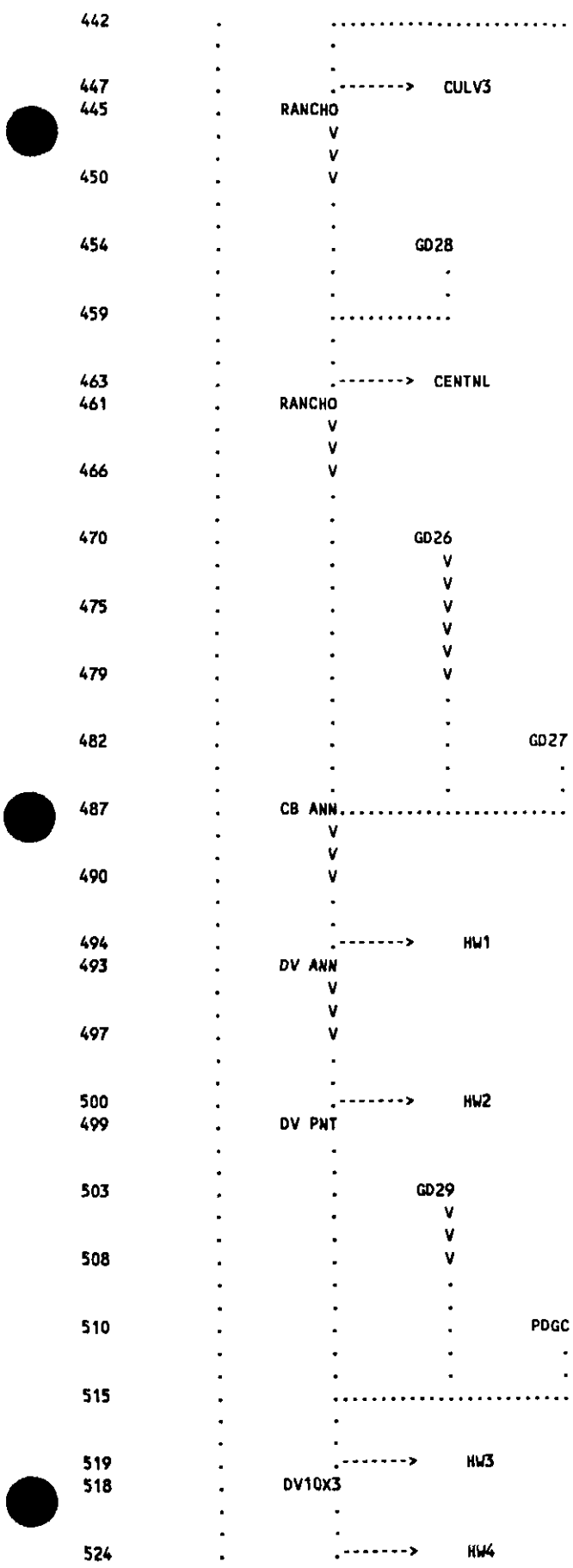
402
GD31
407
KYLE
439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445
RANCHO
450
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GD28
459
463
CENTNL
461
RANCHO
466
470
GD26
475
479
482
GD27
487
CB ANN
490
494
HW1
493
DV ANN
497
500
HW2
499
DV PNT
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GD29
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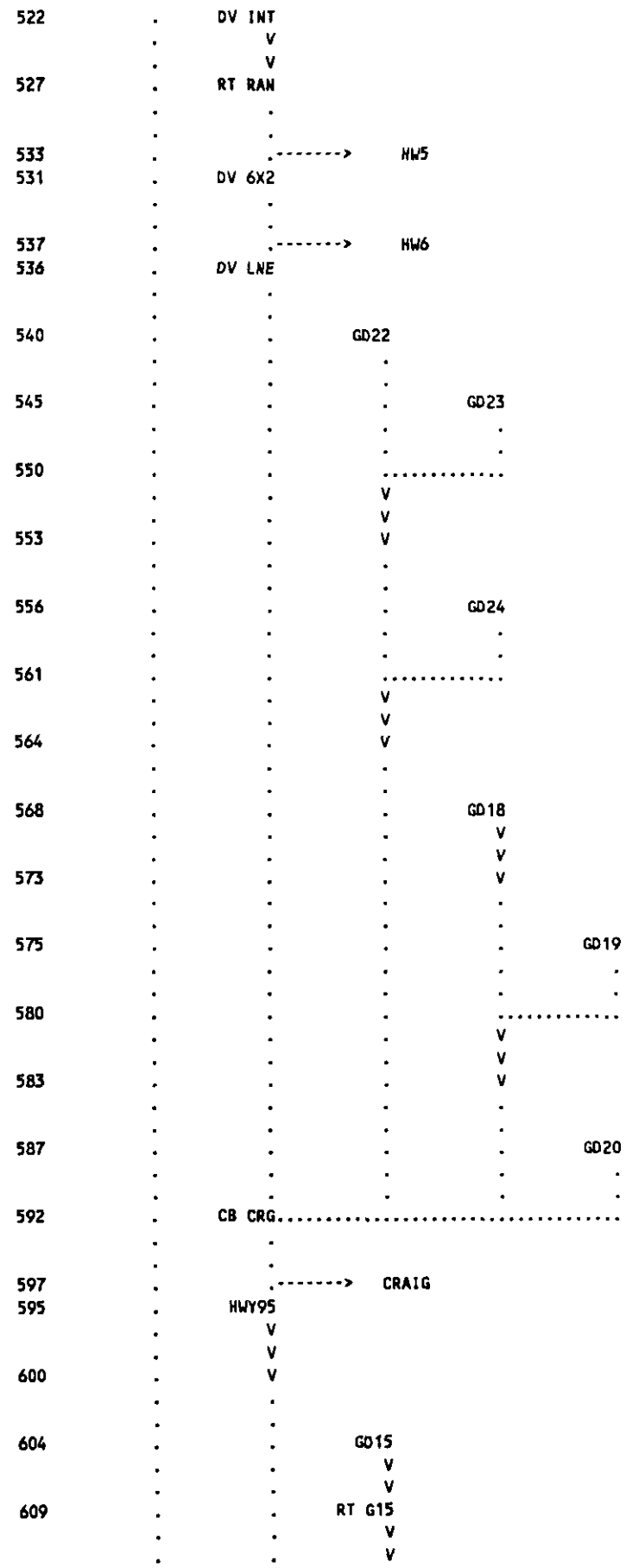
PDGC
515
519
HW3
518
DV10X3
524
HW4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DV INT
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RT RAN
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HW5
531
DV 6X2
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HW6
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DV LNE
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GD22
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GD23
550
553
556
GD24
561
564
568
GD18
573
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GD19
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583
587
GD20
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CB CRG
597
CRAIG
595
HWY95
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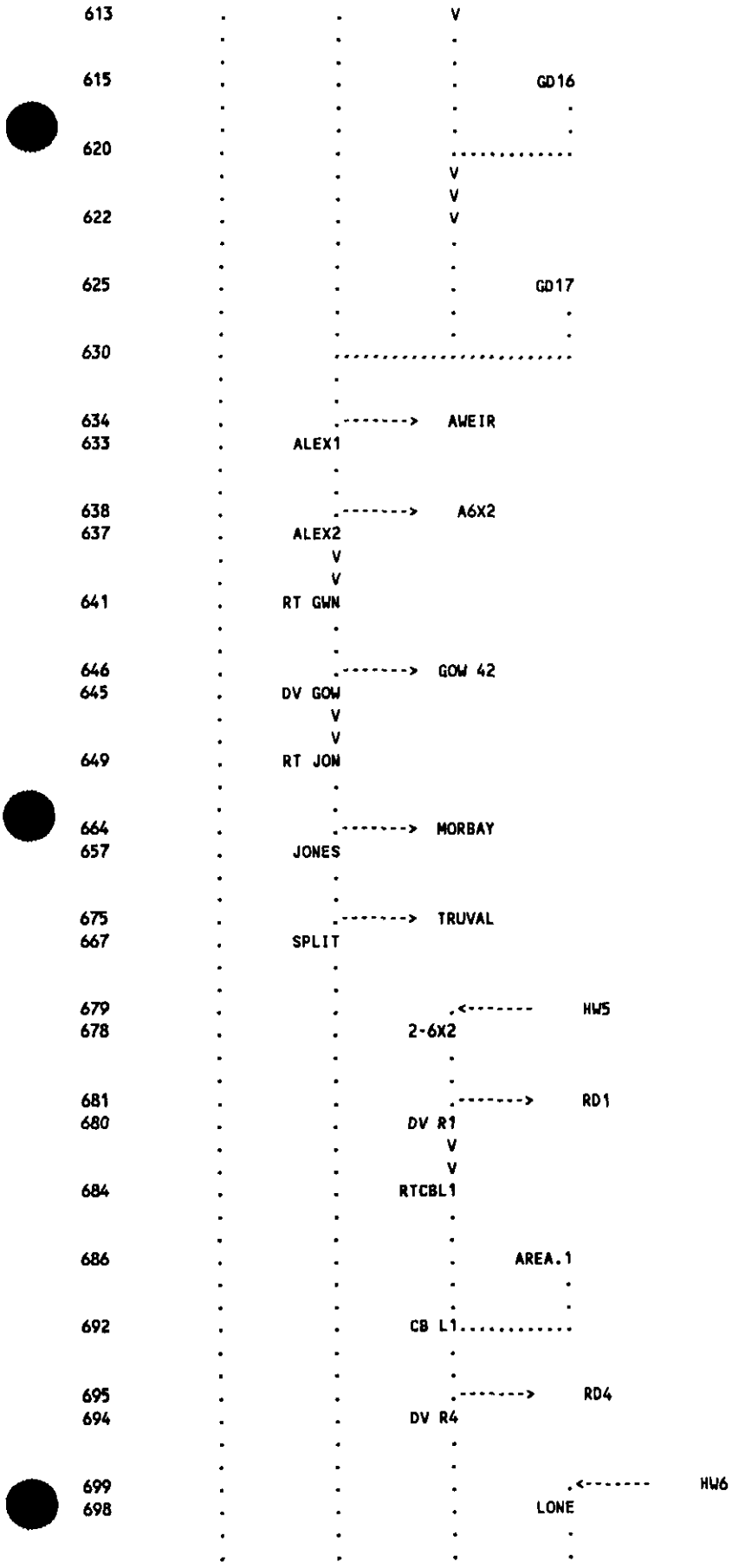
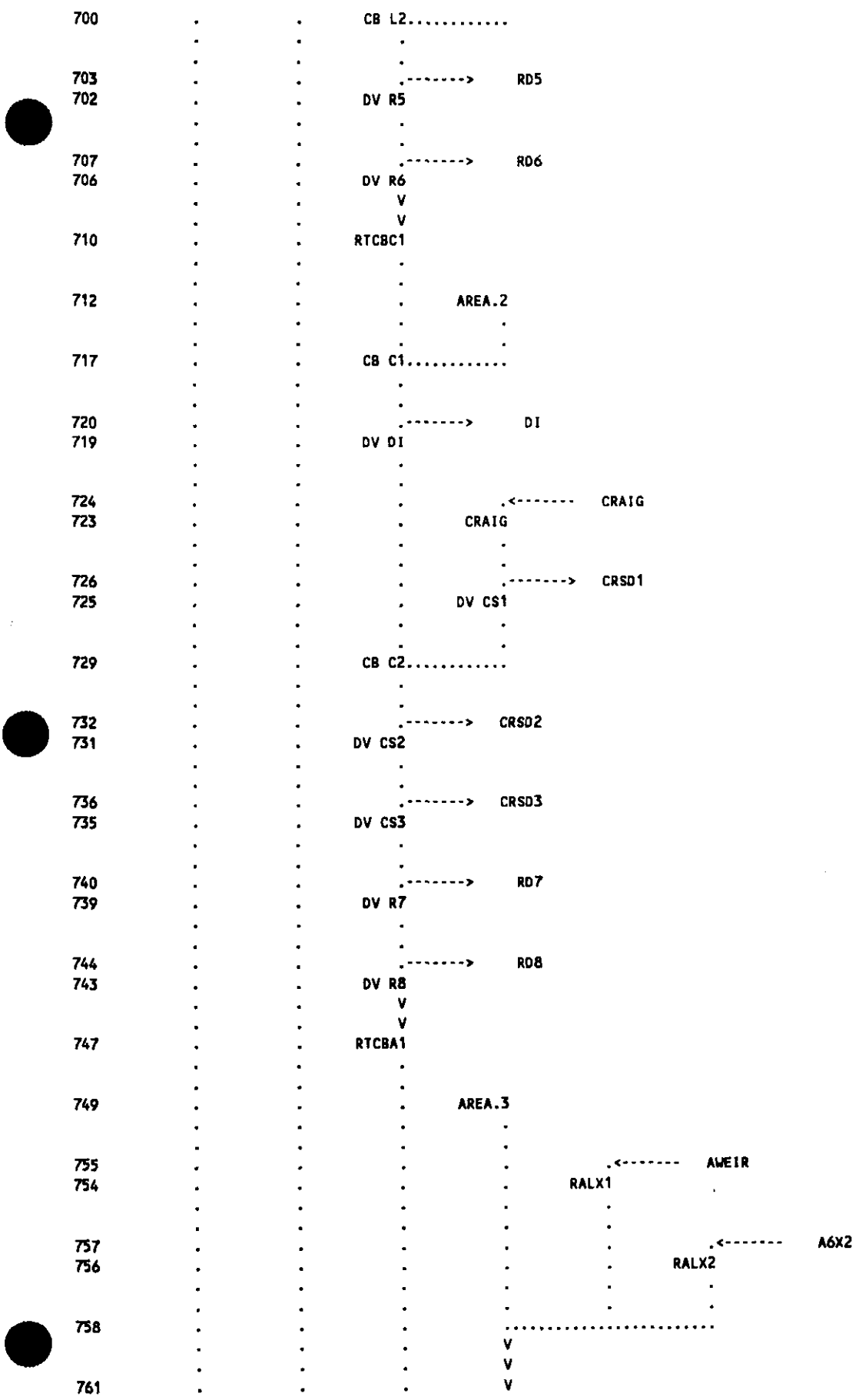
604
GD15
609
RT G15


613
615
GD16
620
622
625
GD17
630
634
AWEIR
633
ALEX1
638
A6X2
637
ALEX2
641
RT GWN
646
GOW 42
645
DV GOW
649
RT JON
664
MORBAY
657
JONES
675
TRUVAL
667
SPLIT
679
HW5
678
2-6X2
681
RD1
680
DV R1
684
RTCBL1
686
AREA.1
692
CB L1
695
RD4
694
DV R4
699
HW6
698
LONE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CB L2
703
RD5
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DV R5
707
RD6
706
DV R6
710
RTCBC1
712
AREA.2
717
CB C1
720
DI
719
DV DI
724
CRAIG
723
CRAIG
726
CRSD1
725
DV CS1
729
CB C2
732
CRSD2
731
DV CS2
736
CRSD3
735
DV CS3
740
RD7
739
DV R7
744
RD8
743
DV R8
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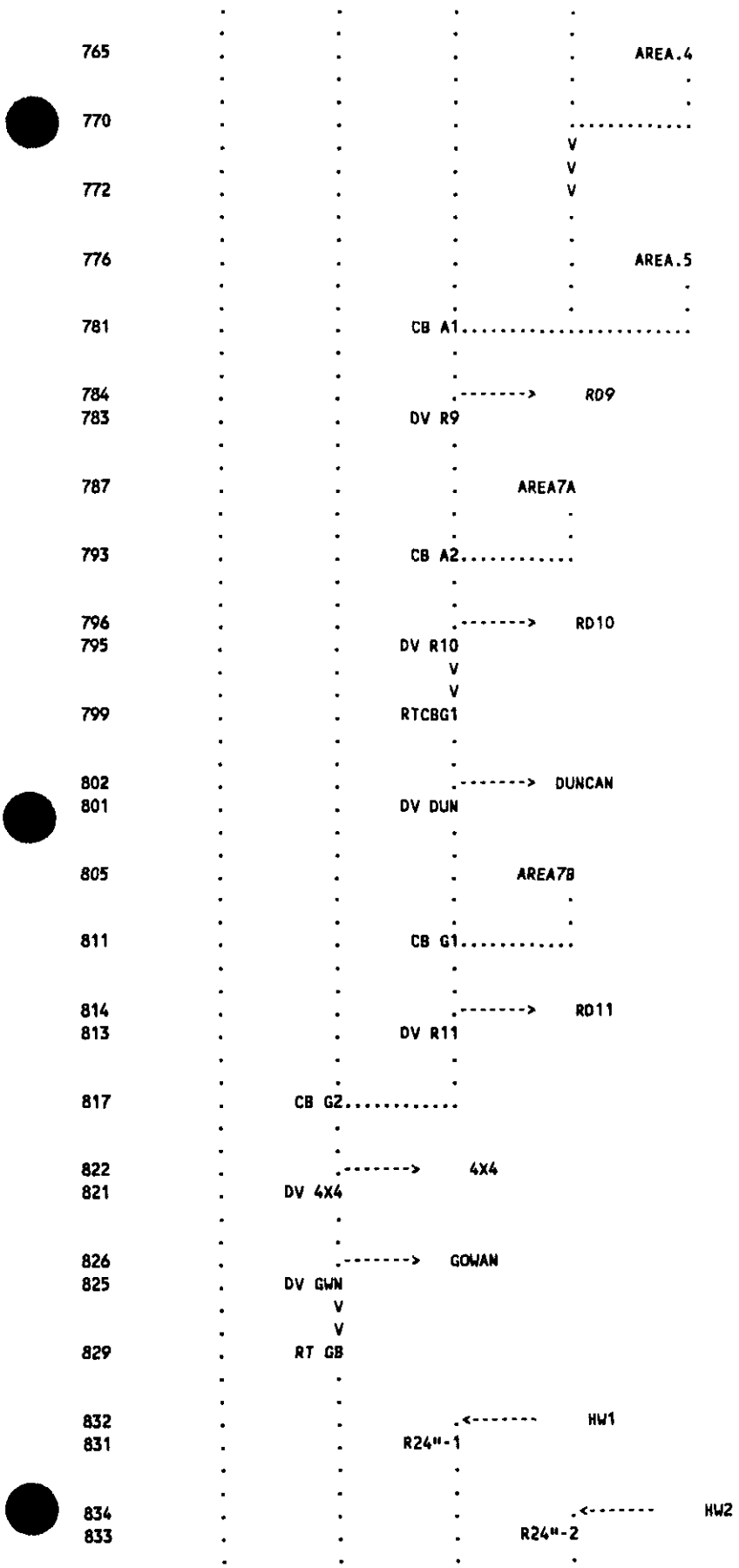
RTCBA1
749
AREA.3
755
AWEIR
754
RALX1
757
A6X2
756
RALX2
758
761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AREA.4
770
772
776
AREA.5
781
CB A1
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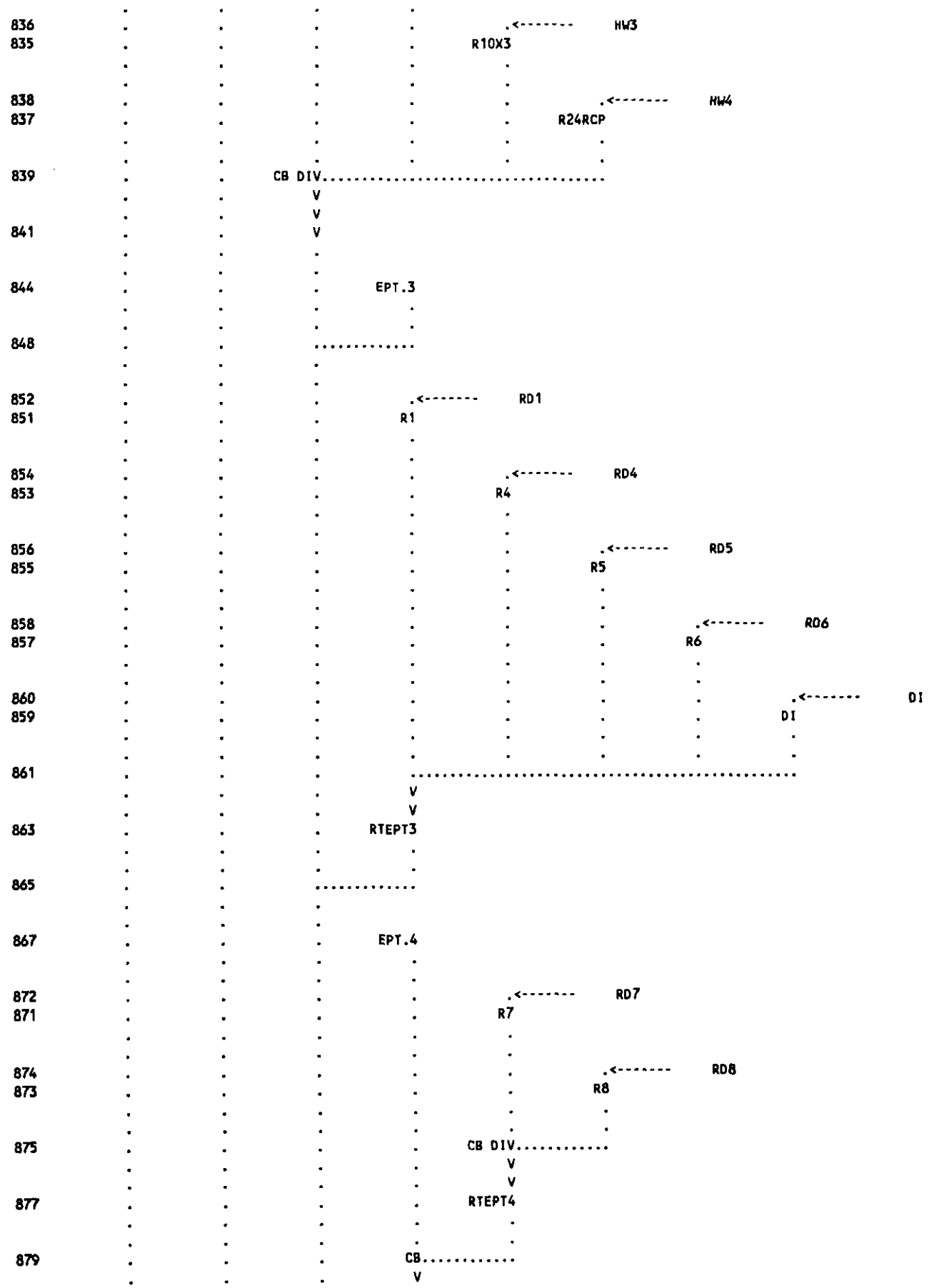
RD9
783
DV R9
787
AREA7A
793
CB A2
796
RD10
795
DV R10
799
RTCBG1
802
DUNCAN
801
DV DUN
805
AREA7B
811
CB G1
814
RD11
813
DV R11
817
CB G2
822
4X4
821
DV 4X4
826
GOWAN
825
DV GWN
829
RT GB
832
HW1
831
R24"-1
834
HW2
833
R24"-2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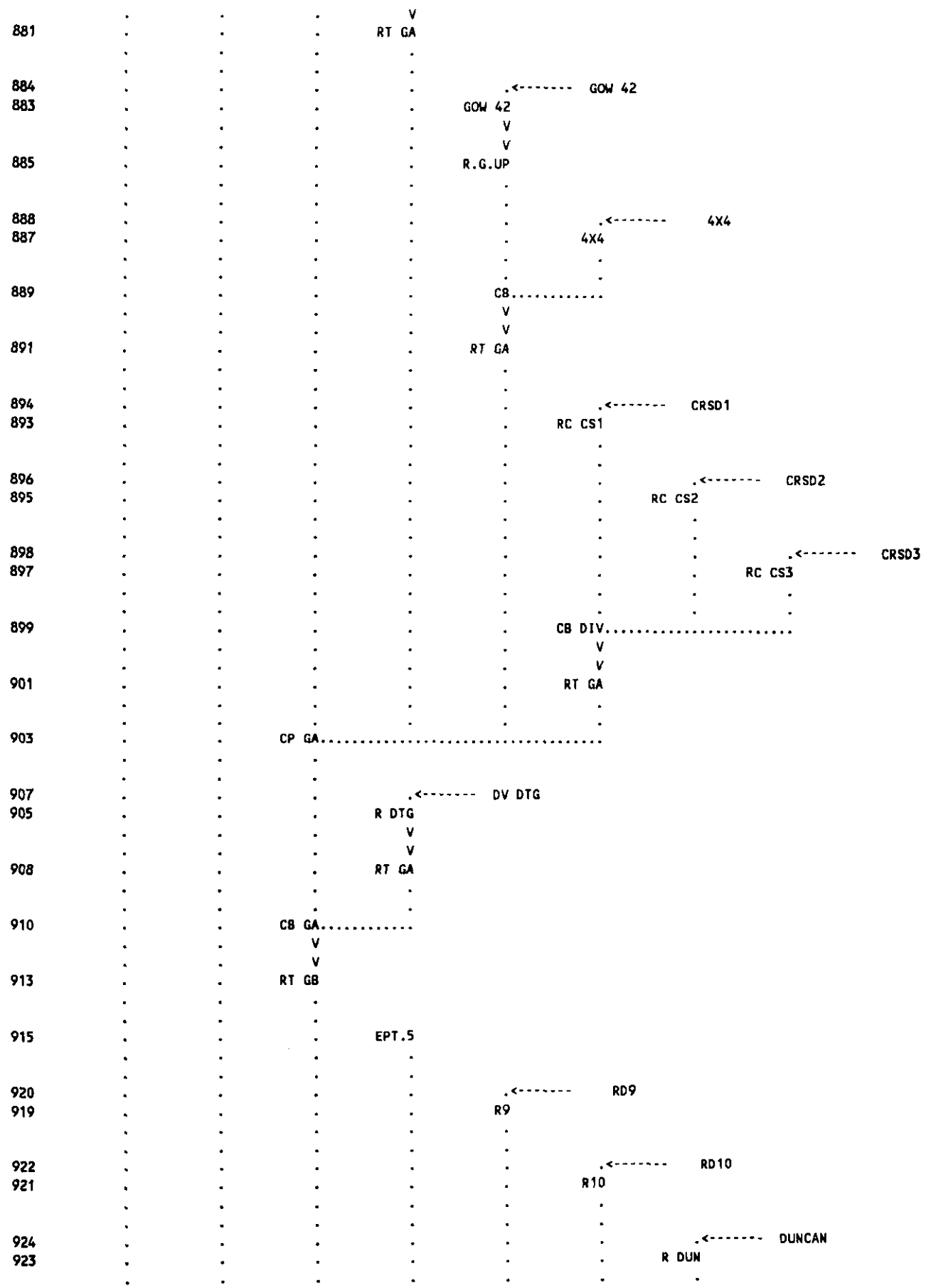
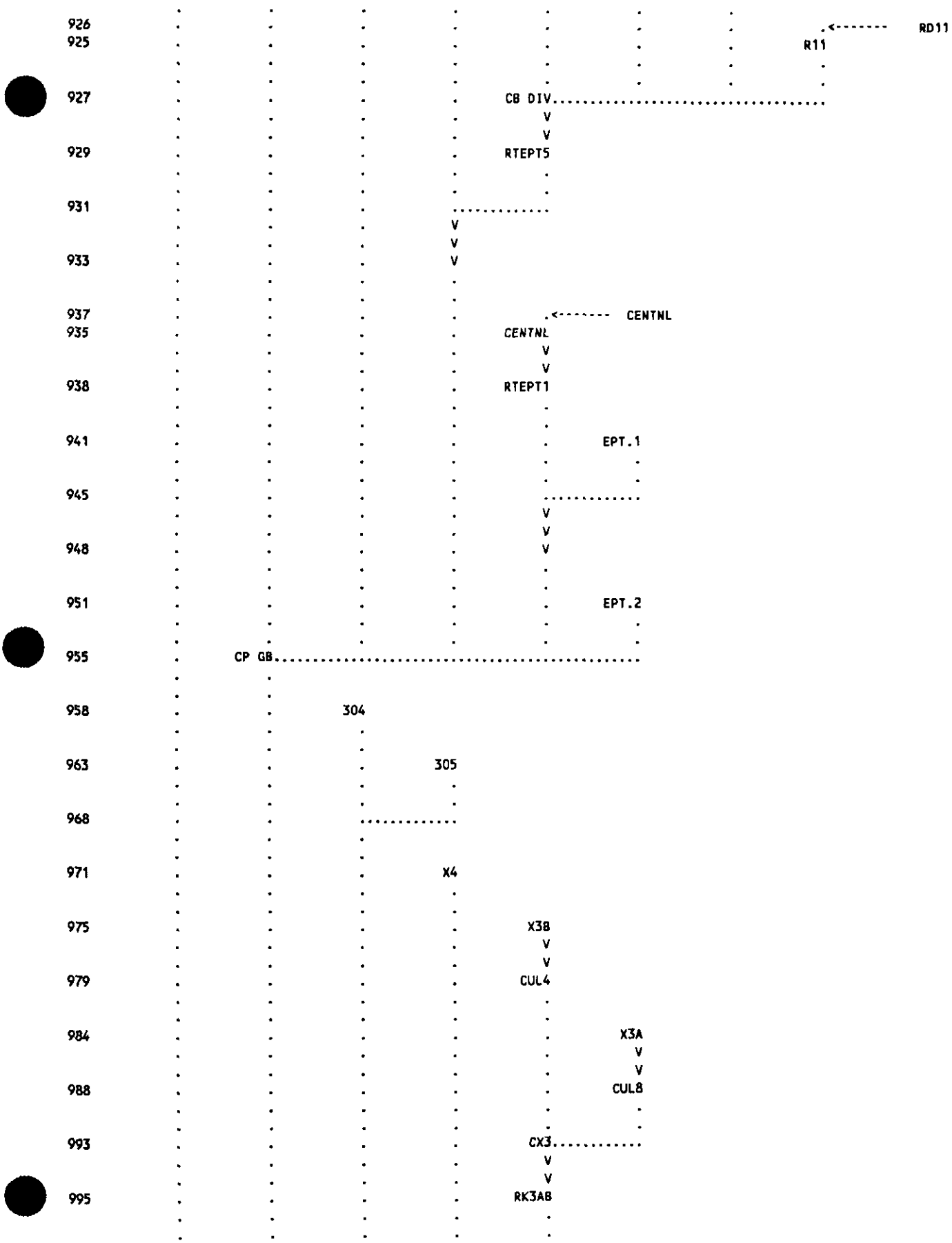
863
865
867
872
871
874
873
875
877
879
HW3
R10X3
HW4
R24RCP
CB DIV
EPT.3
RD1
R1
RD4
R4
RD5
R5
RD6
R6
DI
DI
RTEPT3
EPT.4
RD7
R7
RD8
R8
CB DIV
RTEPT4
CB


V
881 RT GA
884 .<------- GOW 42
883 GOW 42
V
V
885 R.G.UP
888 .<------- 4X4
887 4X4
889 CB.....
V
V
891 RT GA
894 .<------- CRSD1
893 RC CS1
896 .<------- CRSD2
895 RC CS2
898 .<------- CRSD3
897 RC CS3
899 CB DIV.....
V
V
901 RT GA
903 CP GA.....
907 .<------- DV DTG
905 R DTG
V
V
908 RT GA
910 CB GA.....
V
V
913 RT GB
915 EPT.5
920 .<------- RD9
919 R9
922 .<------- RD10
921 R10
924 .<------- DUNCAN
923 R DUN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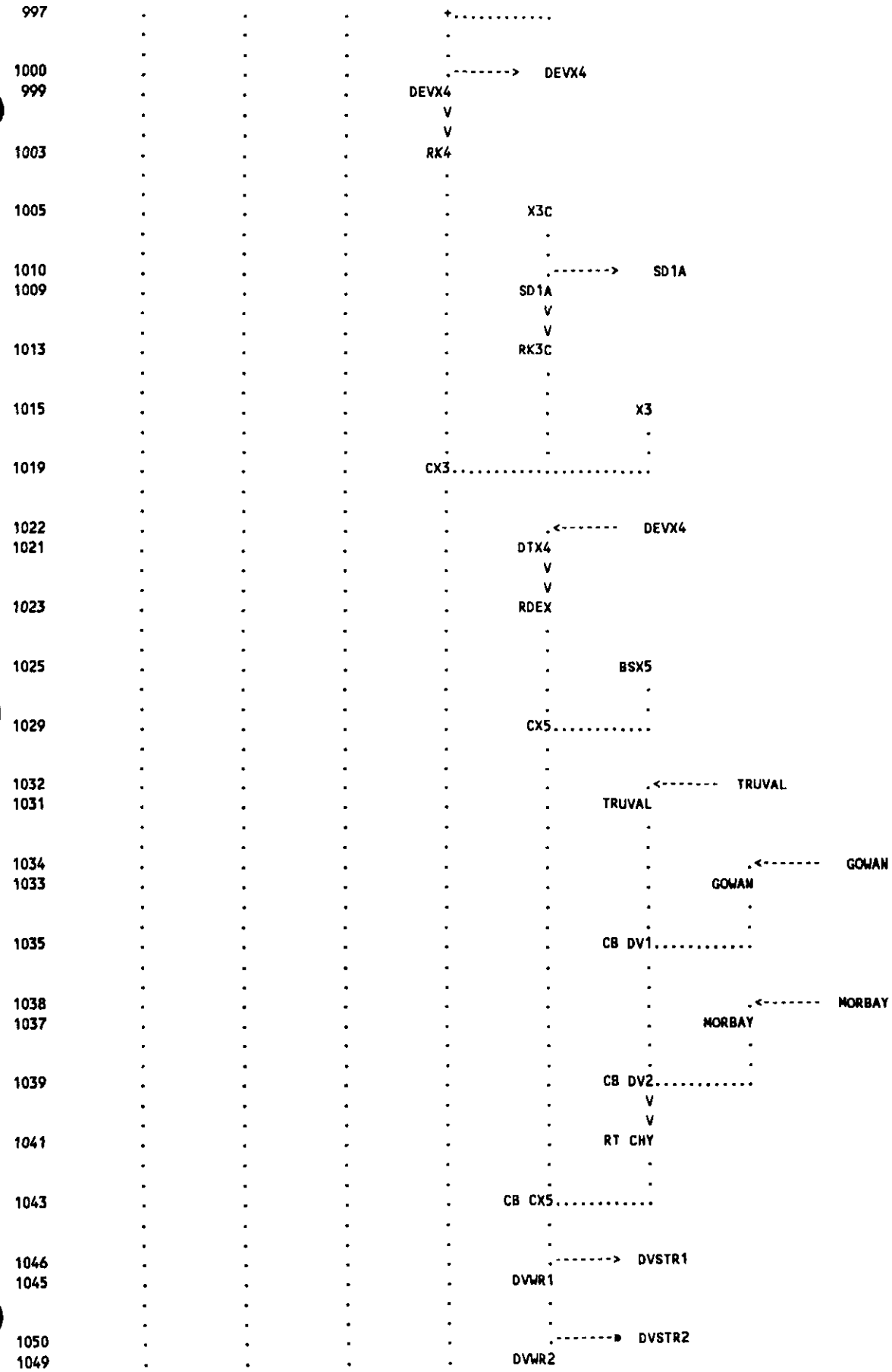
963
968
971
975
979
984
988
993
995
RD11
R11
CB DIV
RTEPT5
CENTNL
CENTNL
RTEPT1
EPT.1
EPT.2
CP GB
304
305
X4
X3B
CUL4
X3A
CUL8
CX3
RK3AB


997
1000
999
1003
1005
1010
1009
1013
1015
1019
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1021
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1025
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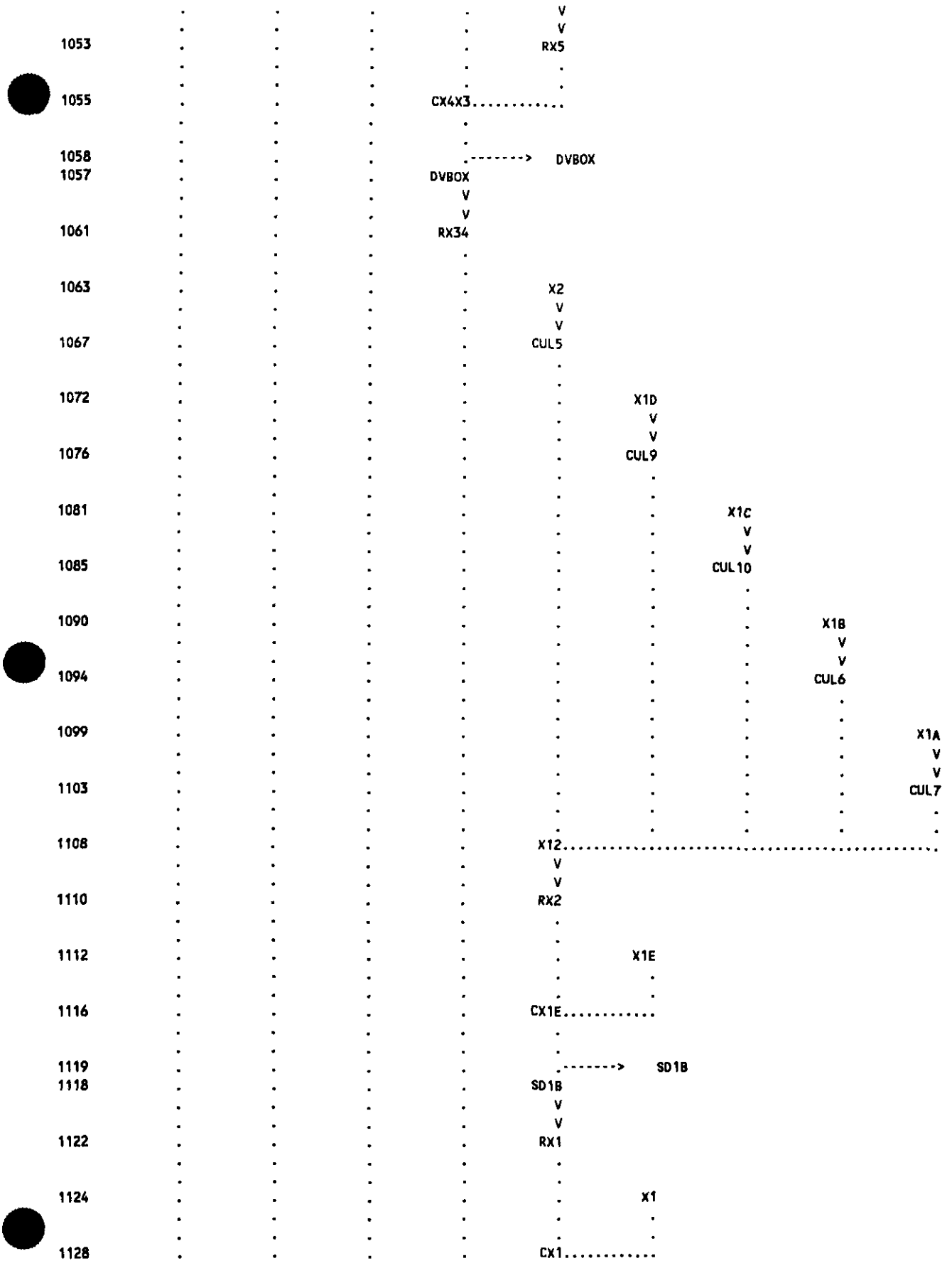
1032
1031
1034
1033
1035
1038
1037
1039
1041
1043
1046
1045
1050
1049
DEVX4
DEVX4
RK4
X3C
SD1A
SD1A
RK3C
X3
CX3
DEVX4
DTX4
RDEX
BSX5
CX5
TRUVAL
TRUVAL
GOWAN
GOWAN
CB DV1
MORBAY
MORBAY
CB DV2
RT CHY
CB CX5
DVSTR1
DVWR1
DVSTR2
DVWR2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CX4X3
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DVBOX
DVBOX
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RX34
1063
X2
1067
CUL5
1072
X1D
1076
CUL9
1081
X1C
1085
CUL10
1090
X1B
1094
CUL6
1099
X1A
1103
CUL7
1108
X12
1110
RX2
1112
X1E
1116
CX1E
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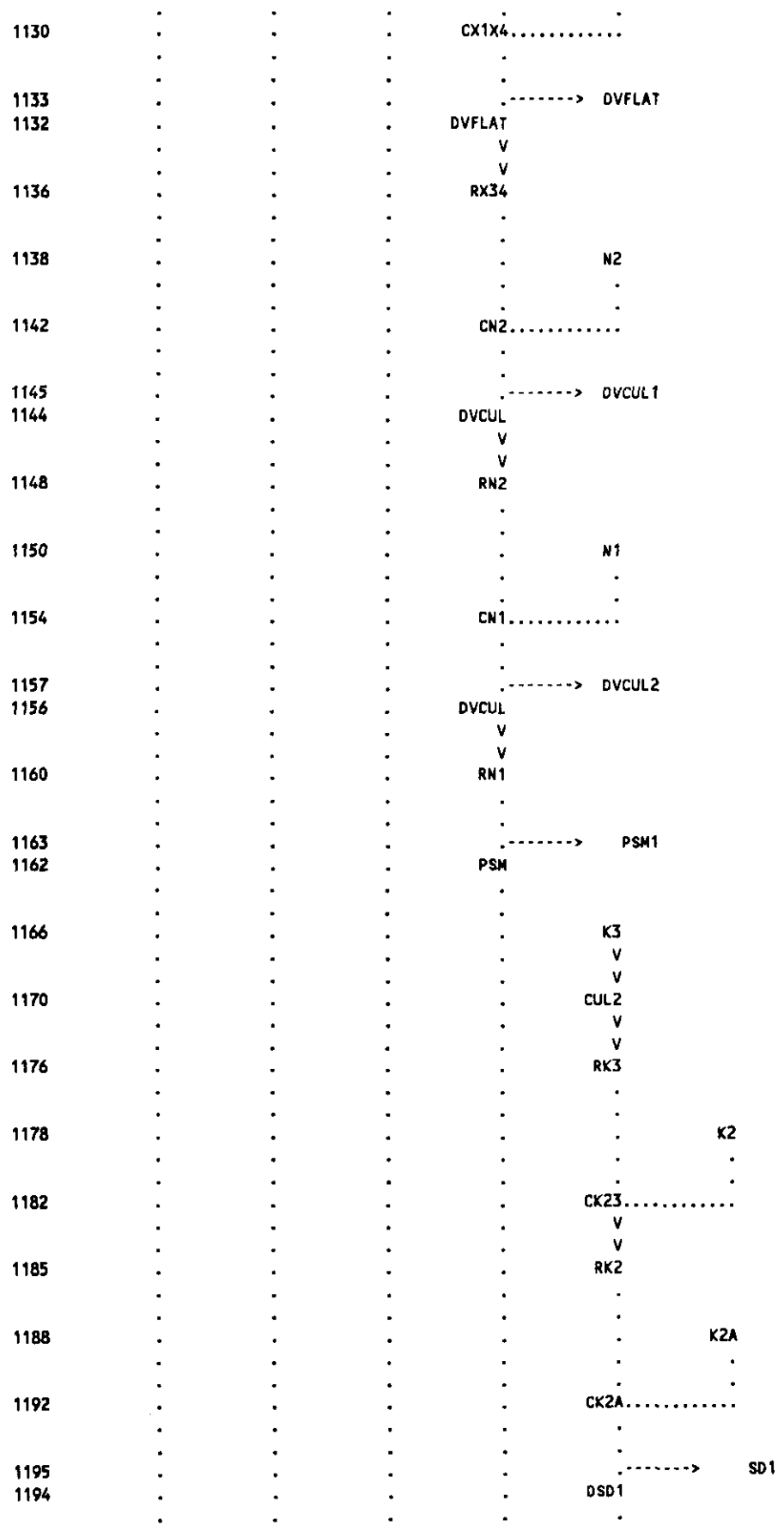
SD1B
1118
SD1B
1122
RX1
1124
X1
1128
CX1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DVFLAT
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DVFLAT
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RX34
1138
N2
1142
CN2
1145
DVCUL1
1144
DVCUL
1148
RN2
1150
N1
1154
CN1
1157
DVCUL2
1156
DVCUL
1160
RN1
1163
PSM1
1162
PSM
1166
K3
1170
CUL2
1176
RK3
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K2
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CK23
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RK2
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K2A
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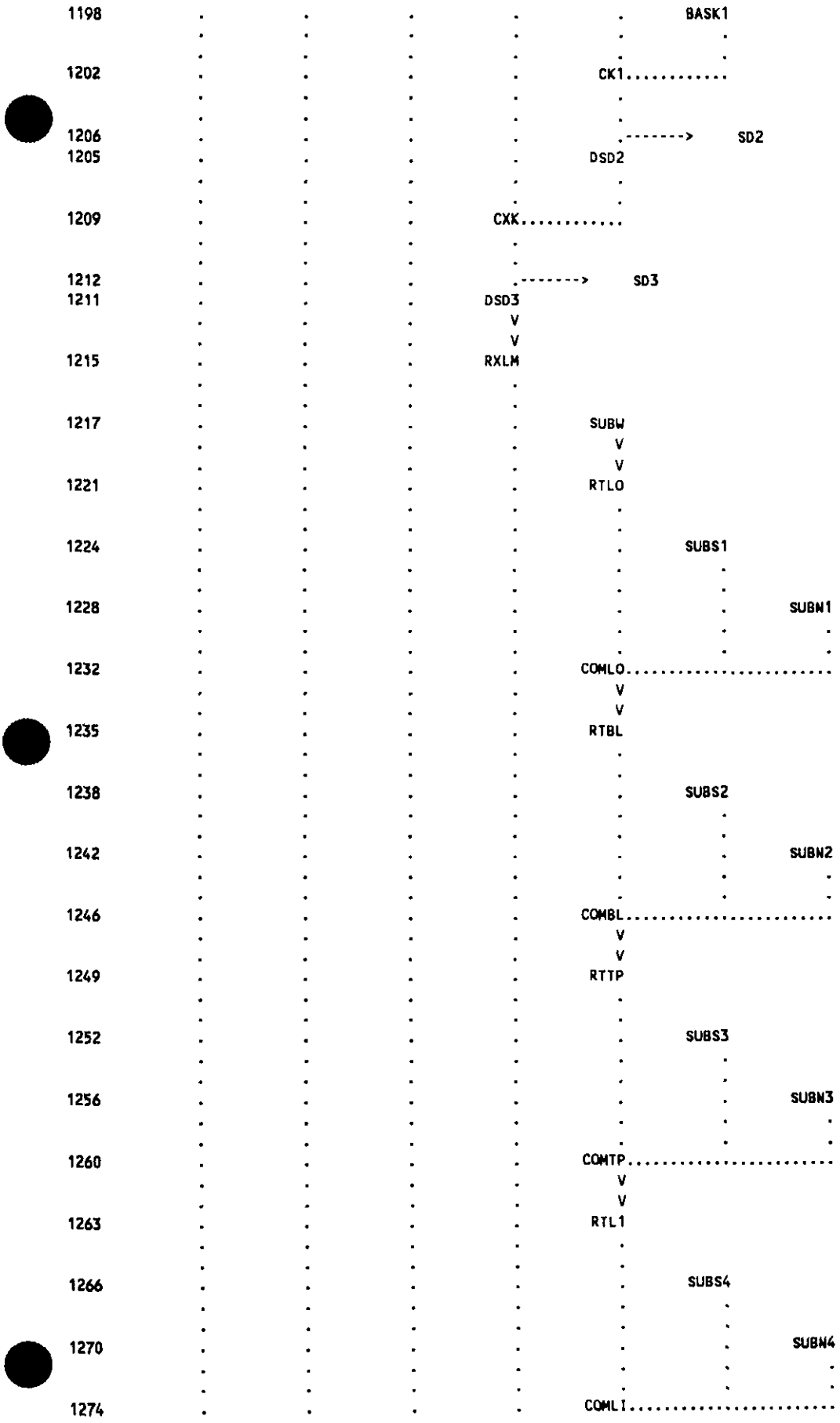
CK2A
1195
SD1
1194
DSD1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CK1
1206
SD2
1205
DSD2
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CXK
1212
SD3
1211
DSD3
1215
RXLM
1217
SUBW
1221
RTLO
1224
SUBS1
1228
SUBN1
1232
COMLO
1235
RTBL
1238
SUBS2
1242
SUBN2
1246
COMBL
1249
RTTP
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SUBS3
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SUBN3
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RTL1
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SUBS4
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SUBN4
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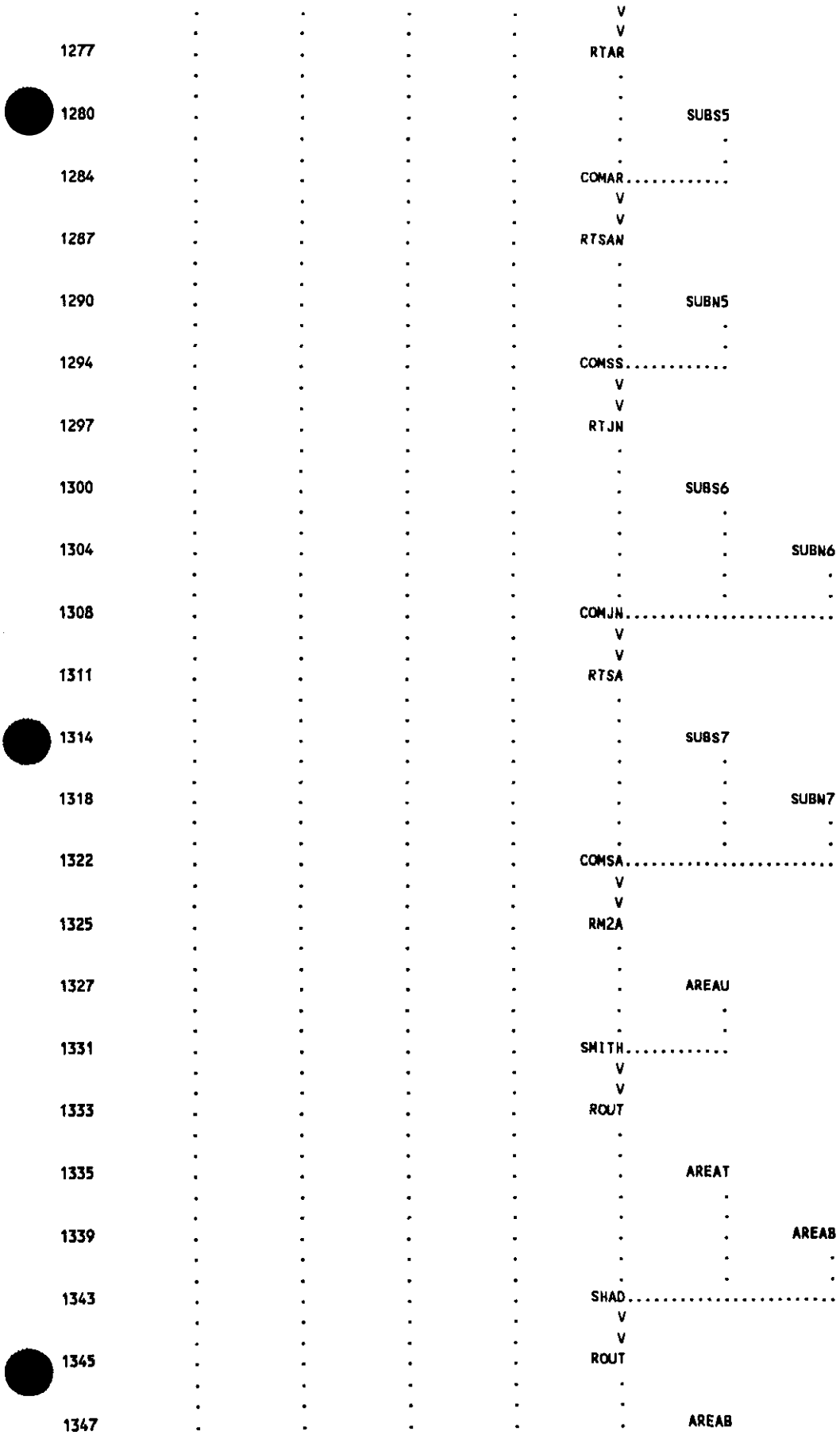
COMLI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RTAR
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SUBS5
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COMAR
1287
RTSAN
1290
SUBN5
1294
COMSS
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RTJN
1300
SUBS6
1304
SUBN6
1308
COMJN
1311
RTSA
1314
SUBS7
1318
SUBN7
1322
COMSA
1325
RM2A
1327
AREAU
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SMITH
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AREAT
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AREAB
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SHAD
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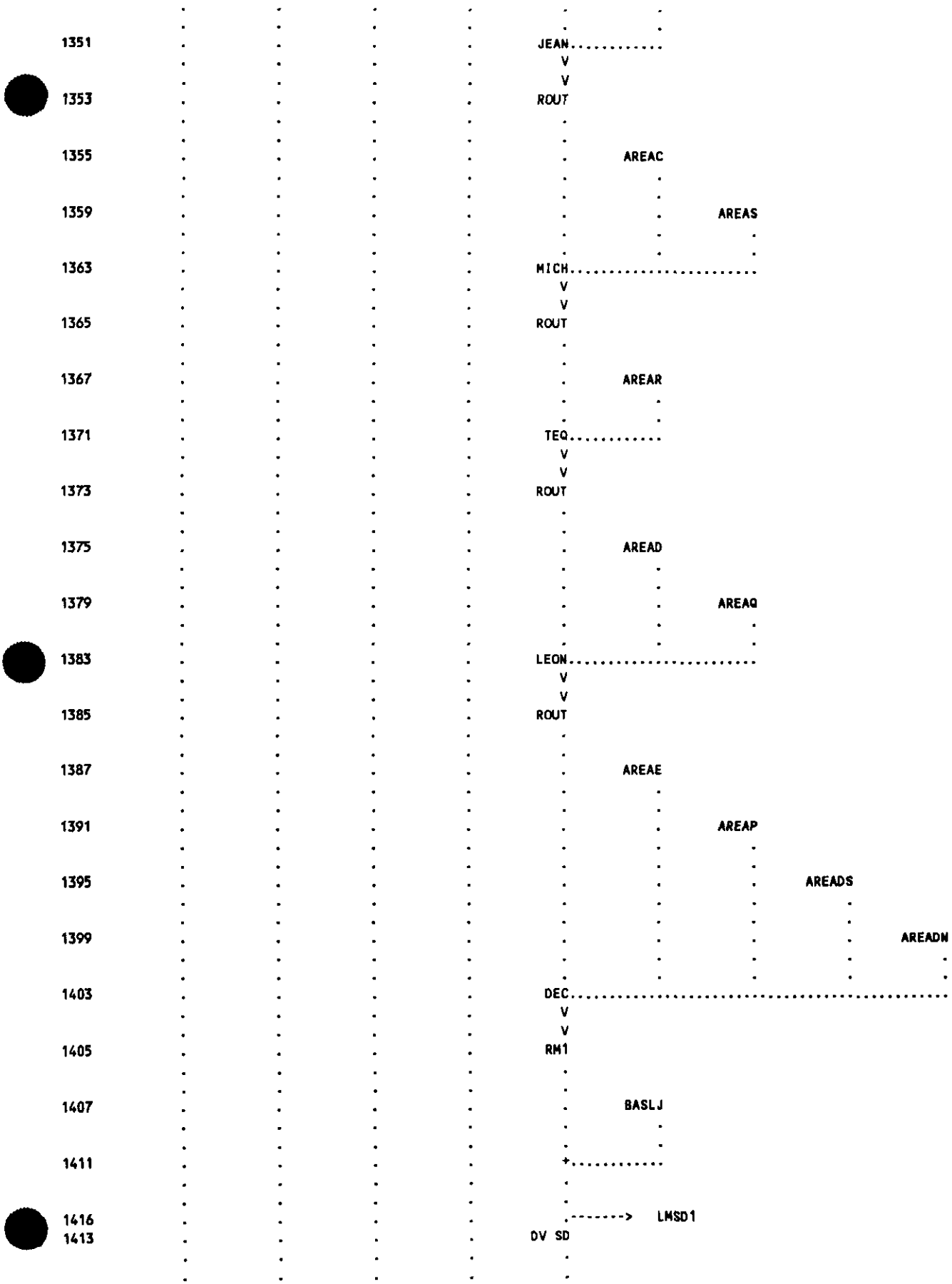
ROUT
1347
AREAB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JEAN
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ROUT
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AREAC
1359
AREAS
1363
MICH
1365
ROUT
1367
AREAR
1371
TEQ
1373
ROUT
1375
AREAD
1379
AREAQ
1383
LEON
1385
ROUT
1387
AREAE
1391
AREAP
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AREADS
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AREADN
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RM1
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BASLJ
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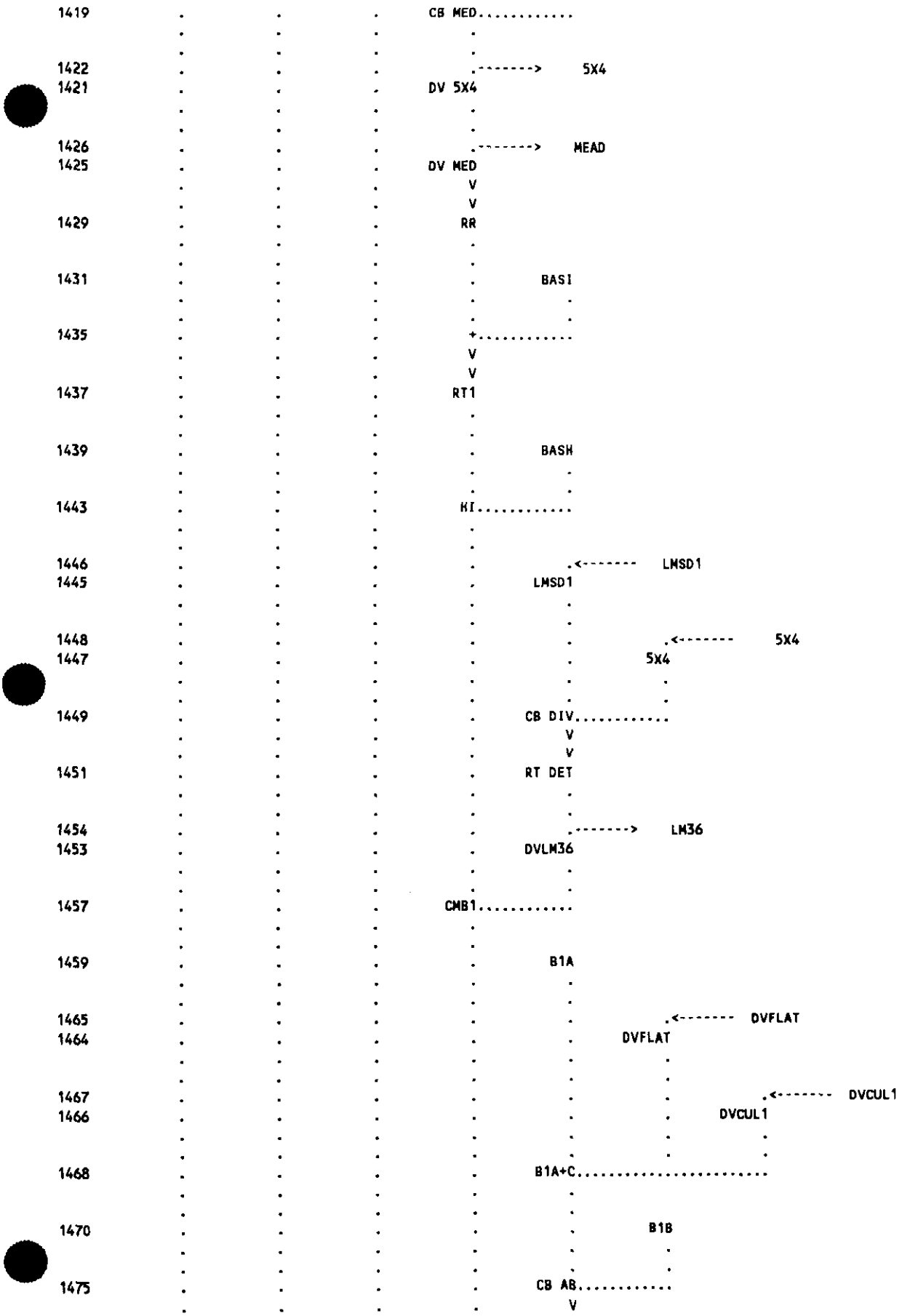
LMSD1
1413
DV SD


1419
CB MED
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5X4
1421
DV 5X4
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MEAD
1425
DV MED
1429
RR
1431
BASI
1435
1437
RT1
1439
BASH
1443
HI
1446
LMSD1
1445
LMSD1
1448
5X4
1447
5X4
1449
CB DIV
1451
RT DET
1454
LM36
1453
DVLM36
1457
CMB1
1459
B1A
1465
DVFLAT
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DVFLAT
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DVCUL1
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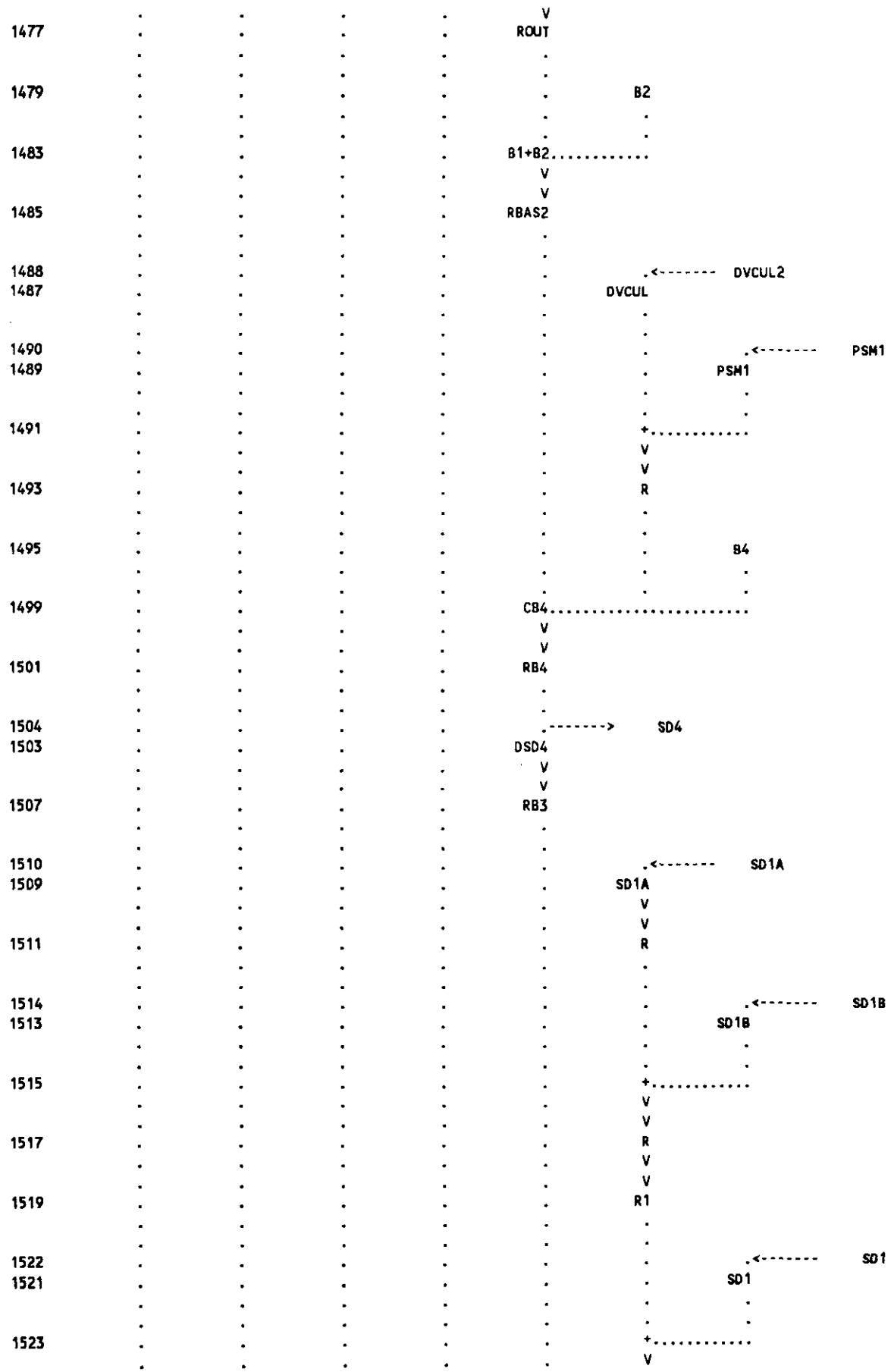
B1A+C
1470
B1B
1475
CB AB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ROUT
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B2
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B1+B2
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RBAS2
1488
DVCUL2
1487
DVCUL
1490
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1489
PSM1
1491
1493
R
1495
B4
1499
CB4
1501
RB4
1504
SD4
1503
DSD4
1507
RB3
1510
SD1A
1509
SD1A
1511
R
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SD1B
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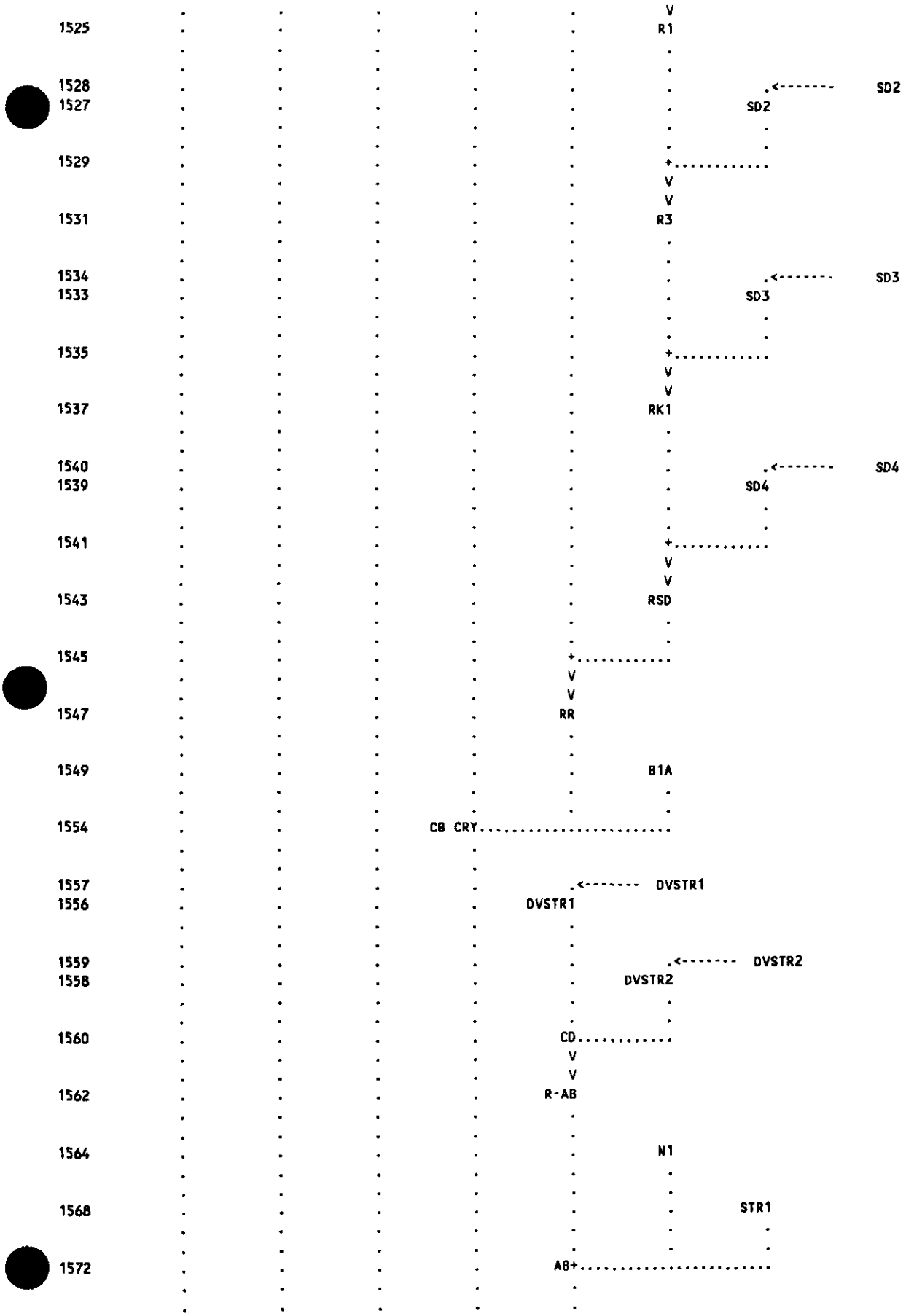
SD1B
1515
1517
R
1519
R1
1522
SD1
1521
SD1
1523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R1
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1527
SD2
SD2
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R3
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SD3
SD3
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RK1
1540
1539
SD4
SD4
1541
1543
RSD
1545
1547
RR
1549
B1A
1554
CB CRY
1557
DVSTR1
DVSTR1
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DVSTR2
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DVSTR2
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CD
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R-AB
1564
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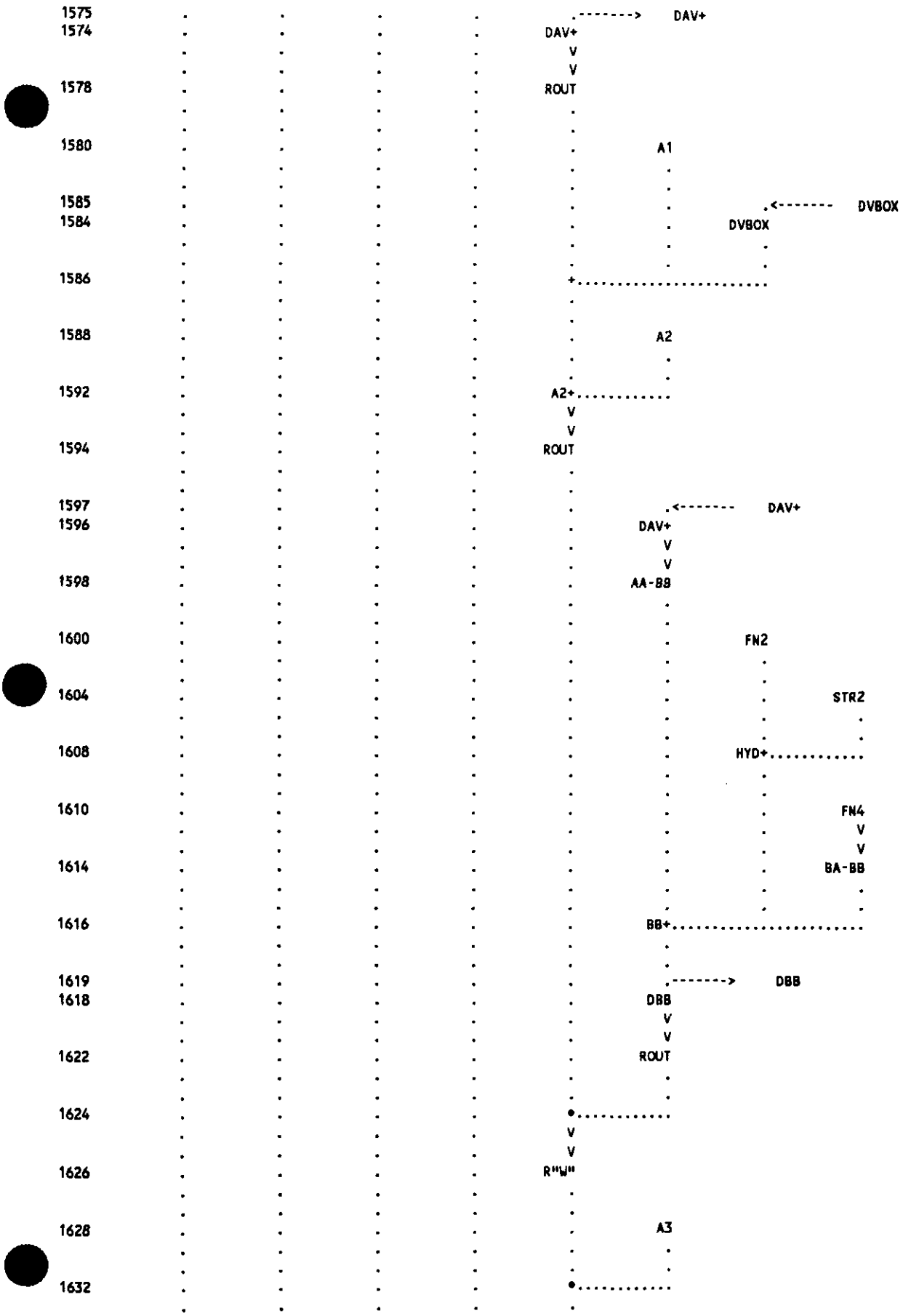
1568
STR1
1572
AB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1600
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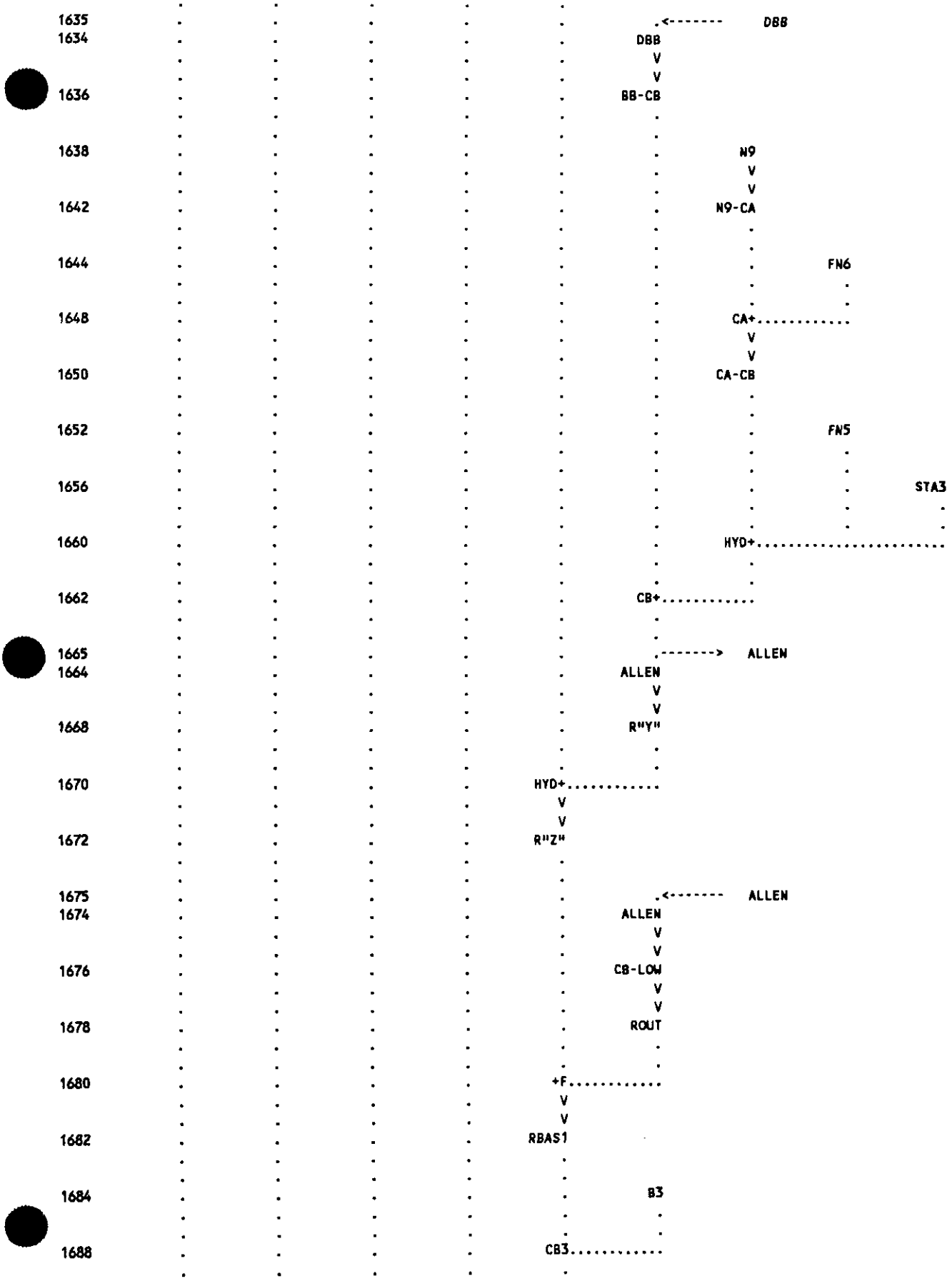
1610
1614
1616
1619
1618
1622
1624
1626
1628
1632
DAV+
DAV+
V
V
ROUT
A1
DVBOX
DVBOX
A2
A2+
V
V
ROUT
DAV+
DAV+
V
V
AA-BB
FN2
STR2
HYD+
FN4
V
V
BA-BB
BB+
DBB
DBB
V
V
ROUT
R"W"
A3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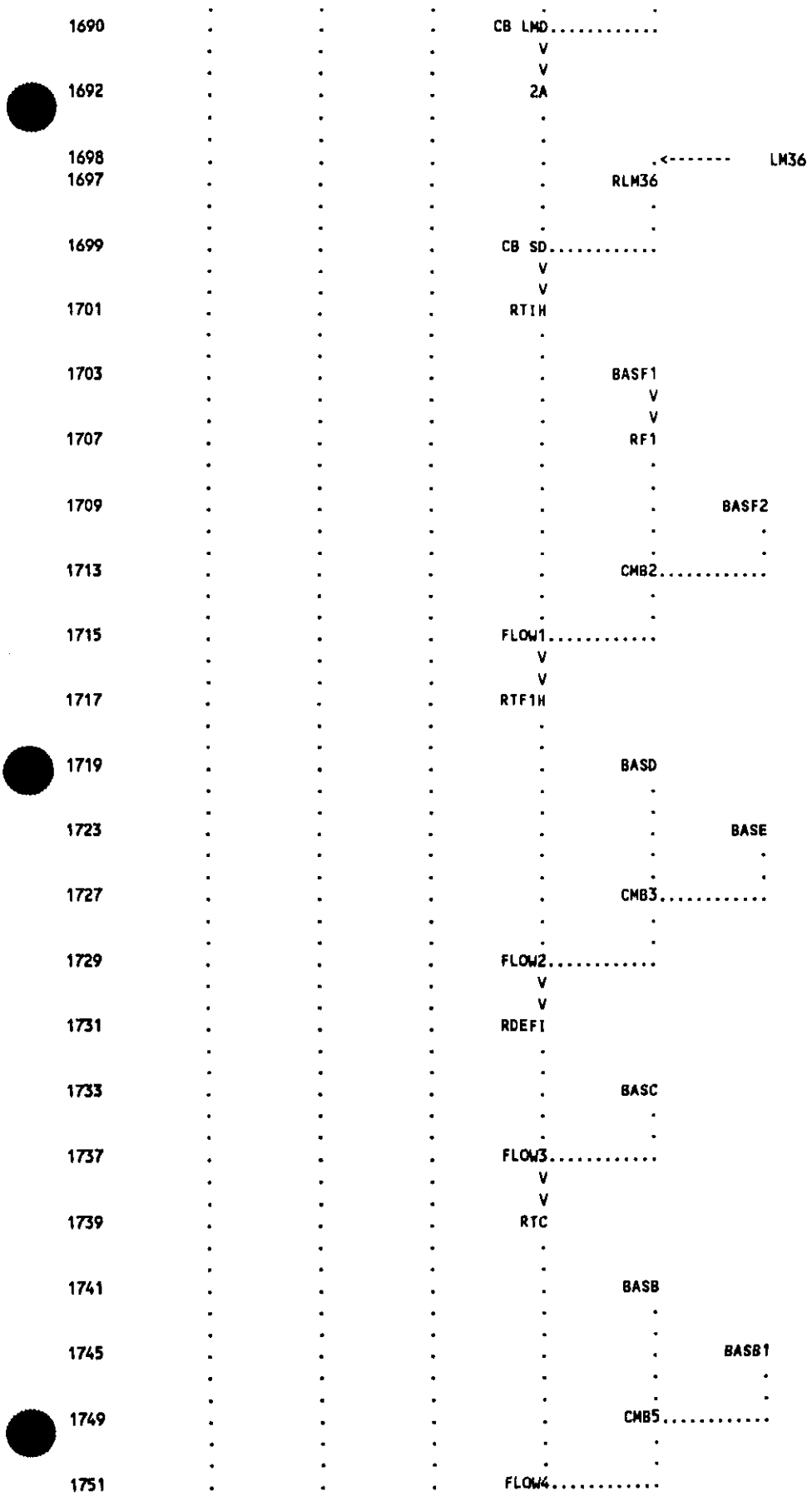
1670
1672
1675
1674
1676
1678
1680
1682
1684
1688
.<-------
DBB
DBB
V
V
BB-CB
N9
V
V
N9-CA
FN6
CA+.....
V
V
CA-CB
FN5
STA3
HYD+.....
CB+.....
.------->
ALLEN
ALLEN
V
V
R"Y"
HYD+.....
V
V
R"Z"
.<-------
ALLEN
ALLEN
V
V
CB-LOW
V
V
ROUT
+F.....
V
V
RBAS1
B3
CB3.....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2A
1698
1697
LM36
RLM36
1699
CB SD
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RTIH
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BASF1
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RF1
1709
BASF2
1713
CMB2
1715
FLOW1
1717
RTF1H
1719
BASD
1723
BASE
1727
CMB3
1729
FLOW2
1731
RDEFI
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BASC
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FLOW3
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RTC
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BASB
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BASB1
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CMB5
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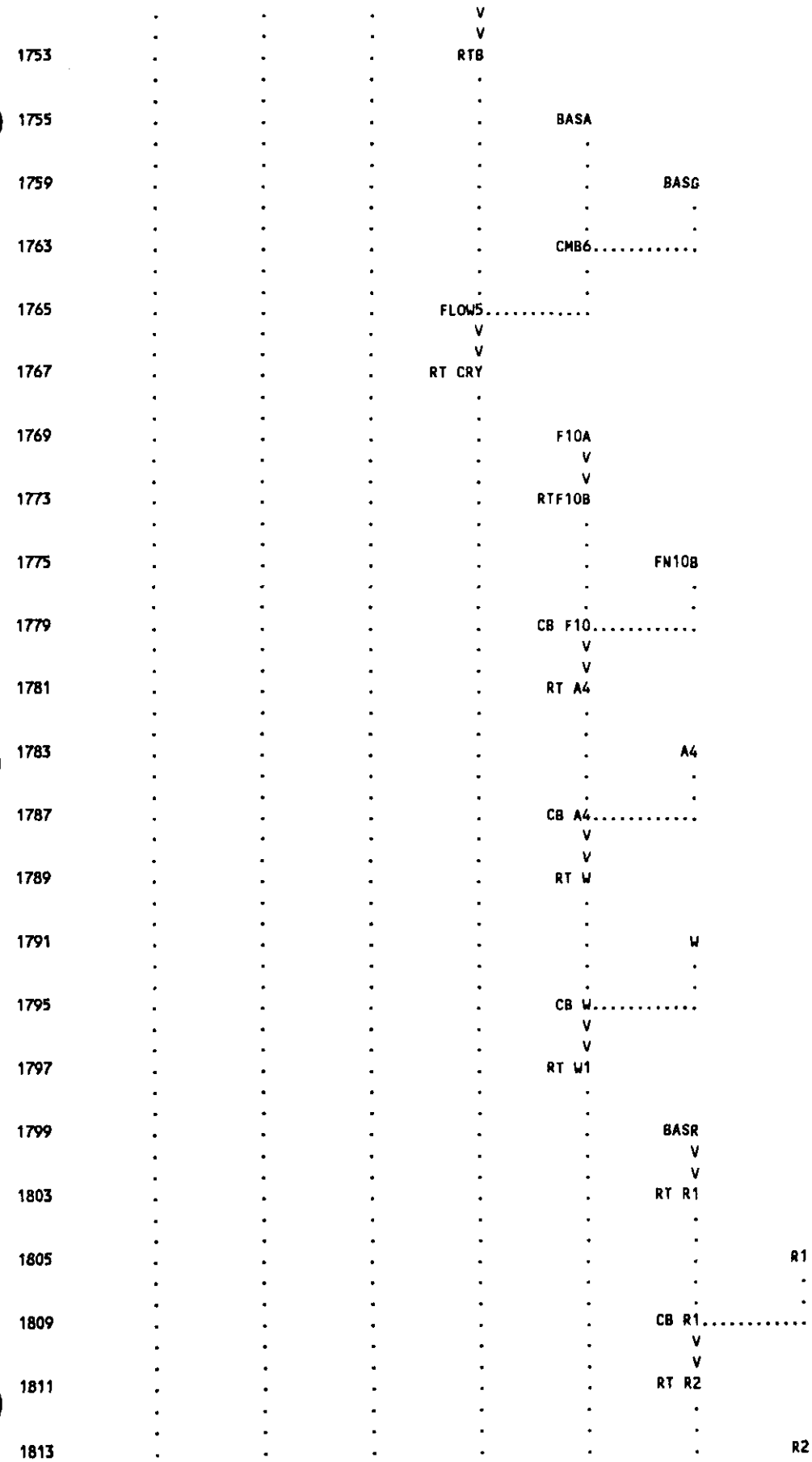
FLOW4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RTB
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BASA
1759
BASG
1763
CMB6
1765
FLOW5
1767
RT CRY
1769
F10A
1773
RTF10B
1775
FN10B
1779
CB F10
1781
RT A4
1783
A4
1787
CB A4
1789
RT W
1791
W
1795
CB W
1797
RT W1
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BASR
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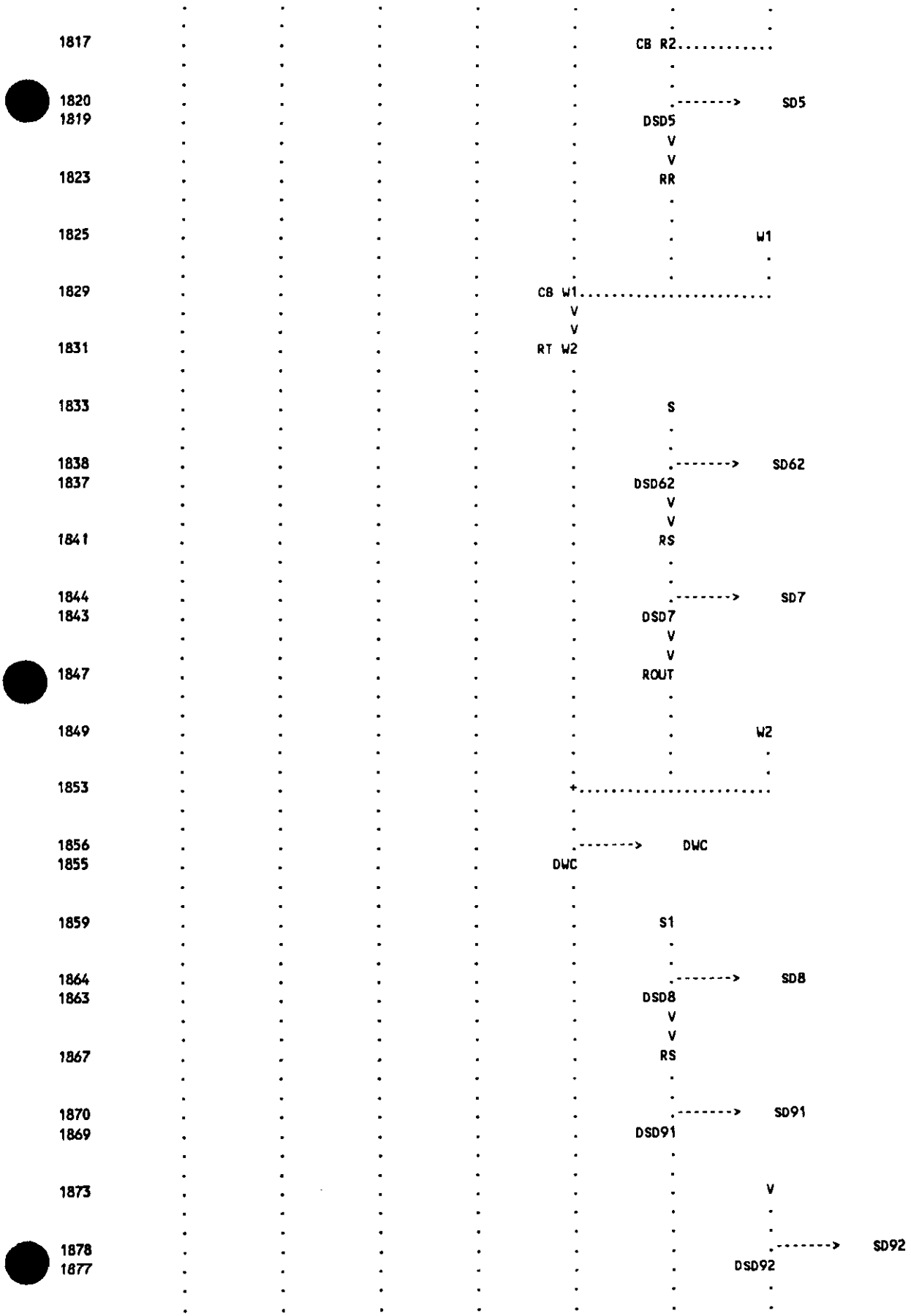
RT R1
1805
R1
1809
CB R1
1811
RT R2
1813
R2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1838
SD62
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DSD62
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SD7
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DSD7
1847
ROUT
1849
W2
1853
1856
DWC
1855
DWC
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S1
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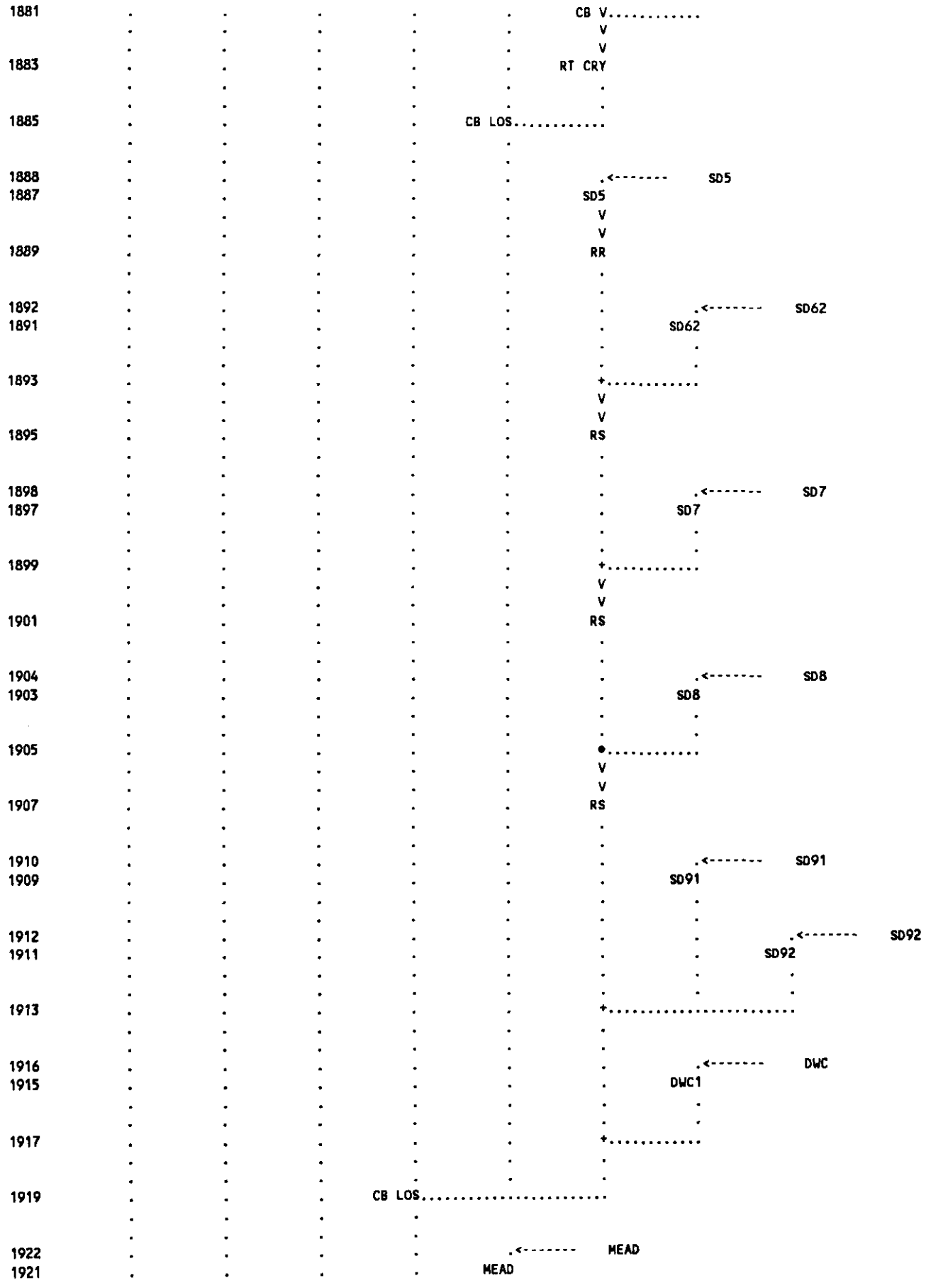
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SD91
1909
SD91
1912
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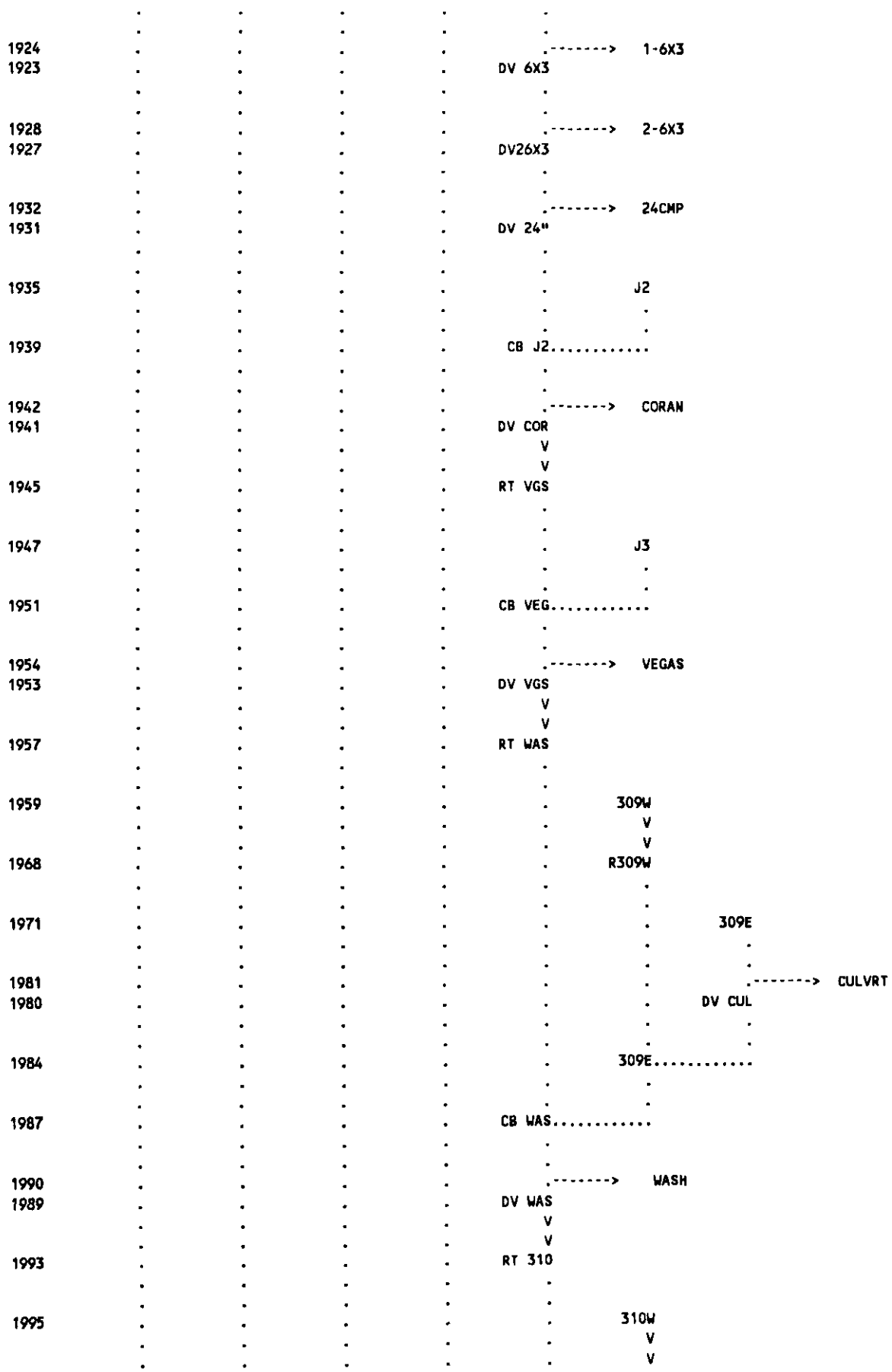
1915
DWC1
1917
1919
CB LOS
1922
MEAD
1921
MEAD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1923
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1927
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1932
1931
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1935
J2
1939
CB J2
1942
1941
DV COR
CORAN
1945
RT VGS
1947
J3
1951
CB VEG
1954
1953
DV VGS
VEGAS
1957
RT WAS
1959
309W
1968
R309W
1971
309E
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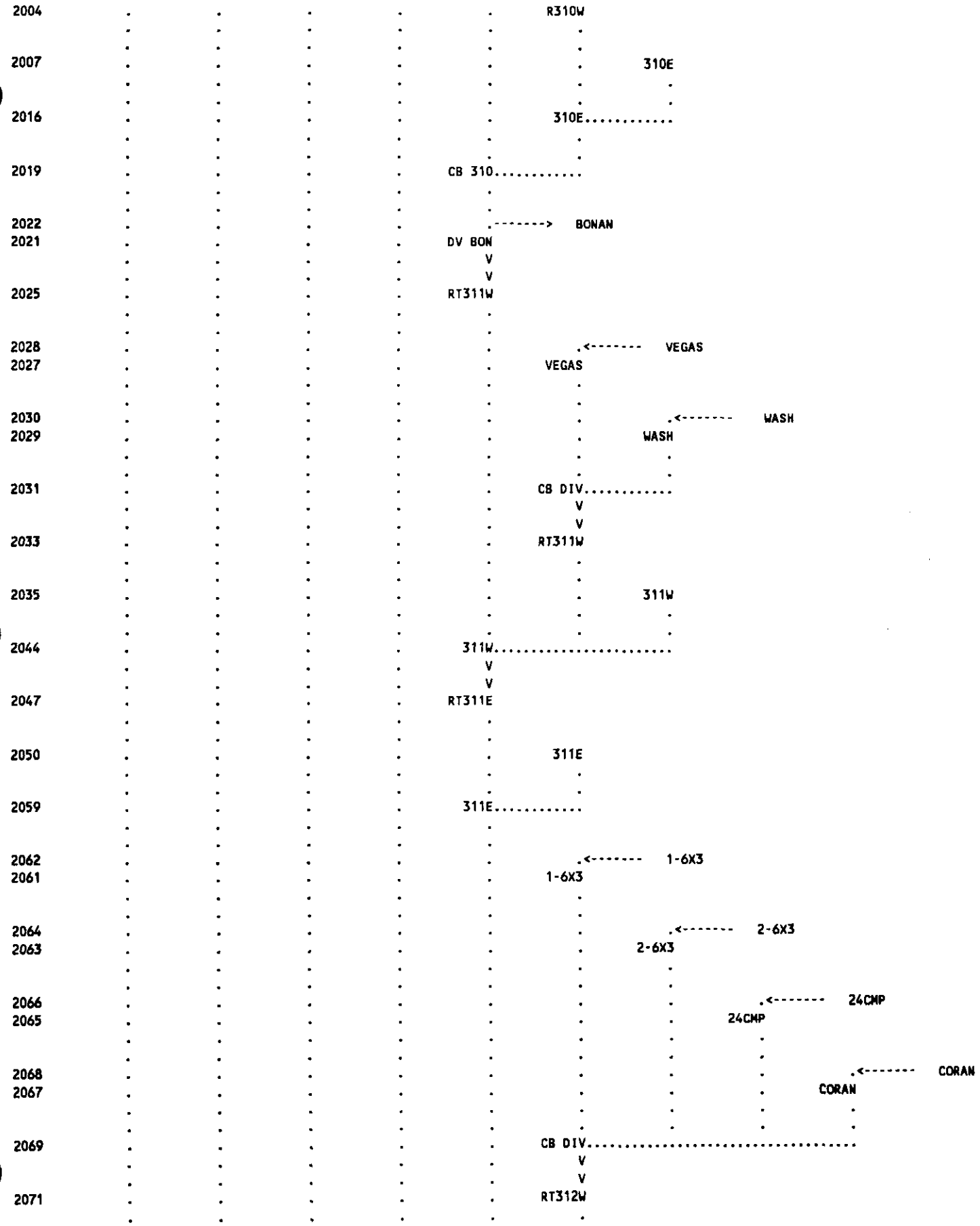
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310E
2016
310E
2019
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2022
BONAN
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2027
VEGAS
2030
WASH
2029
WASH
2031
CB DIV
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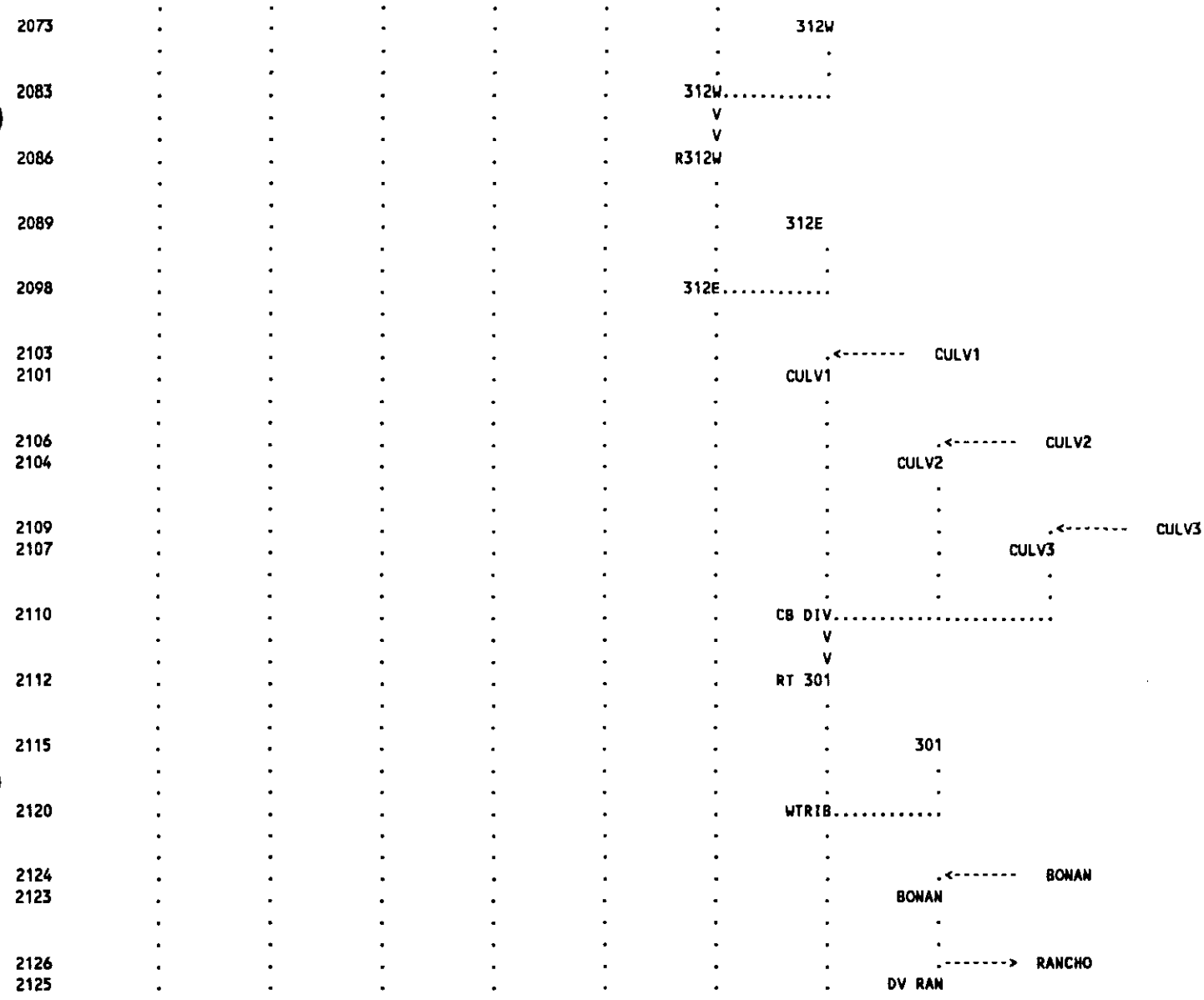

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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**********                                    **********
*        *                                    *        *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)          *  U.S. ARMY CORPS OF ENGINEERS  *
*        *       SEPTEMBER 1990               *  HYDROLOGIC ENGINEERING CENTER *
*        *        VERSION 4.0                 *       609 SECOND STREET        *
*        *                                    *    DAVIS, CALIFORNIA 95616     *
*  RUN DATE  08/16/1994  TIME  11:18:17       *       (916) 756-1104           *
*        *                                    *        *
**********                                    **********
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CAREY-F.DAT
NORTHWEST LAS VEGAS FIS RESTUDY — DATE: JUNE 1994
BY COE & VAN LOO CONSULTANTS, INC — JOB # 930017
PREPARED FOR CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

6-HOUR RAINFALL, 6 MINUTE TIME INTERVAL
RAINFALL DISTRIBUTION = SDN5
SCS UNIT HYDROGRAPH METHOD
EXISTING CONDITIONS

INFORMATION USED IN THIS HEC-1 MODEL IS BASED ON FIS HYDROLOGY REPORT BY JAMES M. MONTGOMERY, FINAL HYDROLOGY STUDY - LAKE MEAD BOULEVARD PHASE 1A BY VTN NEVADA, AND REVISED TECHNICAL HYDROLOGY STUDY FOR THE LAS BRISAS NORTE RESIDENTIAL SUBBASIN BY CHURCH ENGINEERING.

MOST KINEMATIC WAVE ROUTINGS IN THIS HEC-1 MODEL HAVE BEEN REPLACED WITH MUSKINGUM ROUTING METHOD

DIVERSION CARDS ALONG US 95 BETWEEN ANN RD & GOWAN RD., RANCHO DR. BETWEEN ANN RD. AND WASHINGTON HAVE BEEN REVISED BY CVL CONSULTANTS, INC.

RAINFALL VALUES HAVE BEEN REPALCED W/ THREE CENTROID RAINFALL DEPTHS

McCARRAN AIRPORT AREA = 2.77"
GOWAN DETENTION AREA = 2.25" X 1.43 = 3.21"
NORTH OF GOWAN AREA = 2.2" X 1.43 = 3.15"

```
46 10        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                  NMIN           6  MINUTES IN COMPUTATION INTERVAL
                  IDATE      1   0  STARTING DATE
                  ITIME       0000  STARTING TIME
```

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                NQ          300  NUMBER OF HYDROGRAPH ORDINATES
             NDDATE        2    0  ENDING DATE
             NDTIME          0554  ENDING TIME
             ICENT            19  CENTURY MARK

          COMPUTATION INTERVAL      .10 HOURS
              TOTAL TIME BASE    29.90 HOURS

   ENGLISH UNITS
        DRAINAGE AREA          SQUARE MILES
        PRECIPITATION DEPTH    INCHES
        LENGTH, ELEVATION      FEET
        FLOW                   CUBIC FEET PER SECOND
        STORAGE VOLUME         ACRE-FEET
        SURFACE AREA           ACRES
        TEMPERATURE            DEGREES FAHRENHEIT

JP        MULTI-PLAN OPTION
             NPLAN            1  NUMBER OF PLANS

JR        MULTI-RATIO OPTION
            RATIOS OF PRECIPITATION
            .91       .83       .80       .68       .63       .75

   *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

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   *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

   *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1

   *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1

   *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  2

   *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  2
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*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .91	RATIO 2 .83	RATIO 3 .80	RATIO 4 .68	RATIO 5 .63	RATIO 6 .75
HYDROGRAPH AT	AP1	1.94	1	FLOW	1068.	936.	887.	692.	613.	805.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	V	1.94	1	FLOW	975.	854.	809.	632.	559.	735.
				TIME	4.70	4.70	4.70	4.70	4.70	4.70
HYDROGRAPH AT	AP2	2.56	1	FLOW	868.	747.	702.	528.	458.	629.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
2 COMBINED AT	.	4.50	1	FLOW	1832.	1594.	1505.	1157.	1016.	1359.
				TIME	4.70	4.70	4.70	4.70	4.70	4.70
ROUTED TO	V	4.50	1	FLOW	1709.	1487.	1405.	1080.	949.	1268.
				TIME	5.80	5.80	5.80	5.80	5.80	5.80
HYDROGRAPH AT	AP3	3.62	1	FLOW	907.	789.	746.	576.	507.	674.
				TIME	6.20	6.30	6.30	6.30	6.30	6.30
HYDROGRAPH AT	AP4	1.16	1	FLOW	443.	385.	363.	278.	244.	328.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
3 COMBINED AT	.	9.28	1	FLOW	2880.	2507.	2368.	1824.	1603.	2139.
				TIME	5.80	5.80	5.80	5.80	5.80	5.80
HYDROGRAPH AT	AP5	2.27	1	FLOW	1664.	1473.	1401.	1117.	999.	1283.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	V	2.27	1	FLOW	1384.	1224.	1164.	926.	827.	1064.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	AP6	3.28	1	FLOW	1629.	1426.	1350.	1055.	934.	1226.
				TIME	4.10	4.10	4.10	4.20	4.20	4.20
2 COMBINED AT	.	5.55	1	FLOW	2734.	2406.	2284.	1800.	1603.	2081.
				TIME	4.40	4.40	4.40	4.50	4.50	4.40
ROUTED TO	V	5.55	1	FLOW	2601.	2290.	2174.	1714.	1525.	1982.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10
HYDROGRAPH AT	AP7	2.03	1	FLOW	603.	514.	481.	356.	306.	428.
				TIME	4.70	4.80	4.80	4.80	4.90	4.80
2 COMBINED AT	N_CHN	7.58	1	FLOW	3183.	2791.	2644.	2067.	1830.	2402.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10
HYDROGRAPH AT	GD1	2.98	1	FLOW	1641.	1438.	1362.	1064.	941.	1237.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	V	2.98	1	FLOW	1563.	1371.	1299.	1016.	900.	1181.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	V	2.98	1	FLOW	1516.	1328.	1258.	981.	868.	1142.
				TIME	4.50	4.50	4.50	4.50	4.60	4.50
HYDROGRAPH AT	GD2	1.88	1	FLOW	812.	705.	665.	509.	446.	599.
				TIME	4.20	4.20	4.20	4.30	4.30	4.20
2 COMBINED AT	.	4.86	1	FLOW	2261.	1977.	1872.	1455.	1285.	1697.

				TIME	4.50	4.50	4.50	4.50	4.50	4.50
ROUTED TO	TO_DI	4.86	1	FLOW	2181.	1906.	1803.	1399.	1235.	1634.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	GD3	.80	1	FLOW	513.	442.	416.	313.	272.	373.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	HUALPA	5.66	1	FLOW	2441.	2138.	2025.	1579.	1397.	1838.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
2 COMBINED AT	HUA&NO	13.24	1	FLOW	5546.	4859.	4603.	3591.	3178.	4178.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00
ROUTED TO	V	13.24	1	FLOW	5539.	4848.	4591.	3574.	3162.	4164.
				TIME	5.00	5.00	5.00	5.00	5.10	5.00
ROUTED TO	V	13.24	1	FLOW	5516.	4834.	4579.	3572.	3160.	4157.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10
HYDROGRAPH AT	AP8	.93	1	FLOW	472.	410.	387.	297.	260.	349.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	BOX	14.17	1	FLOW	5814.	5097.	4830.	3771.	3337.	4386.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10
ROUTED TO	V	14.17	1	FLOW	5807.	5087.	4818.	3755.	3325.	4373.
				TIME	5.10	5.10	5.10	5.10	5.20	5.10
HYDROGRAPH AT	AP9	.68	1	FLOW	295.	256.	241.	185.	162.	217.
				TIME	4.20	4.20	4.20	4.30	4.30	4.20
2 COMBINED AT	N_CHA	14.85	1	FLOW	6021.	5275.	4997.	3896.	3451.	4535.
				TIME	5.10	5.10	5.10	5.10	5.20	5.10
2 COMBINED AT	ANGEL.	24.13	1	FLOW	8297.	7262.	6878.	5357.	4736.	6240.
				TIME	5.20	5.30	5.30	5.30	5.30	5.30
ROUTED TO	DET.A	24.13	1	FLOW	6456.	4710.	3997.	406.	393.	2681.
				TIME	6.20	6.60	6.70	8.70	8.60	7.10
			** PEAK STAGES IN FEET **							
			1	STAGE	2619.79	2619.53	2619.41	2618.31	2615.85	2619.16
				TIME	6.20	6.60	6.70	8.70	8.60	7.10
DIVERSION TO	SOUTH	24.13	1	FLOW	3423.	2444.	2044.	33.	33.	1306.
				TIME	6.20	6.60	6.70	6.80	8.10	7.10
HYDROGRAPH AT	AP.OUT	24.13	1	FLOW	3034.	2266.	1953.	373.	360.	1374.
				TIME	6.20	6.60	6.70	8.70	8.60	7.10
ROUTED TO	AP_TWO	24.13	1	FLOW	3013.	2260.	1946.	373.	360.	1360.
				TIME	6.20	6.60	6.80	8.70	8.70	7.20
ROUTED TO	BUFFAL	24.13	1	FLOW	3003.	2251.	1943.	373.	360.	1359.
				TIME	6.30	6.60	6.80	8.80	8.70	7.20
HYDROGRAPH AT	GD7	1.13	1	FLOW	373.	324.	306.	236.	208.	276.
				TIME	5.00	5.00	5.00	5.10	5.20	5.10
HYDROGRAPH AT	GD34	1.56	1	FLOW	838.	721.	678.	510.	443.	606.
				TIME	3.80	3.80	3.80	3.90	3.90	3.80
HYDROGRAPH AT	GD35	1.90	1	FLOW	719.	630.	596.	466.	413.	541.
				TIME	4.70	4.70	4.70	4.80	4.80	4.70
ROUTED TO	RT BUF	1.90	1	FLOW	718.	629.	596.	466.	412.	541.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80

3 COMBINED AT	CB LKM	4.59	1	FLOW	1574.	1380.	1308.	1025.	910.	1189.
				TIME	5.00	5.00	5.00	5.10	5.10	5.10
2 COMBINED AT	BUFF1	28.72	1	FLOW	3787.	2739.	2316.	1330.	1208.	1576.
				TIME	6.20	6.60	6.70	5.10	5.10	7.20
ROUTED TO	BUFFAL	28.72	1	FLOW	3764.	2713.	2315.	1325.	1204.	1574.
				TIME	6.30	6.60	6.80	5.20	5.20	7.20
HYDROGRAPH AT	GD8	1.97	1	FLOW	575.	487.	455.	332.	284.	403.
				TIME	4.60	4.60	4.70	4.70	4.70	4.70
2 COMBINED AT	BUFF2	30.68	1	FLOW	4071.	2902.	2456.	1648.	1482.	1887.
				TIME	6.30	6.60	6.80	5.10	5.20	5.10
HYDROGRAPH AT	GD4	.80	1	FLOW	373.	321.	301.	226.	196.	270.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	V	.80	1	FLOW	334.	288.	271.	204.	177.	242.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	GD5	3.31	1	FLOW	961.	826.	777.	586.	510.	696.
				TIME	5.10	5.20	5.20	5.30	5.30	5.20
2 COMBINED AT	.	4.11	1	FLOW	1281.	1099.	1032.	771.	668.	922.
				TIME	4.90	4.90	4.90	5.00	5.00	4.90
ROUTED TO	V	4.11	1	FLOW	1256.	1079.	1014.	759.	658.	906.
				TIME	5.40	5.40	5.40	5.40	5.50	5.40
HYDROGRAPH AT	GD6	1.60	1	FLOW	559.	478.	449.	333.	287.	400.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	.	5.71	1	FLOW	1710.	1472.	1385.	1045.	909.	1241.
				TIME	5.30	5.30	5.30	5.40	5.40	5.40
ROUTED TO	V	5.71	1	FLOW	1707.	1471.	1384.	1044.	907.	1241.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
2 COMBINED AT	GOWAN	36.40	1	FLOW	5402.	3852.	3413.	2665.	2363.	3098.
				TIME	6.20	6.60	5.20	5.20	5.20	5.20
ROUTED TO	DETGS	36.40	1	FLOW	5286.	3774.	3169.	1338.	458.	2221.
				TIME	6.30	6.70	6.90	6.90	8.80	6.20
			** PEAK STAGES IN FEET **							
			1	STAGE	2350.64	2350.44	2350.36	2350.12	2349.90	2350.23
				TIME	6.30	6.70	6.90	6.90	8.80	6.20
ROUTED TO	RGSOU	36.40	1	FLOW	5277.	3758.	3163.	1327.	458.	2216.
				TIME	6.40	6.70	6.90	6.90	8.80	6.30
HYDROGRAPH AT	GD9	2.00	1	FLOW	1537.	1350.	1280.	1004.	890.	1164.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
ROUTED TO	V	2.00	1	FLOW	1281.	1123.	1065.	832.	737.	967.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
HYDROGRAPH AT	GD10	2.27	1	FLOW	861.	740.	696.	522.	453.	622.
				TIME	4.30	4.30	4.30	4.40	4.40	4.30
2 COMBINED AT	.	4.27	1	FLOW	2126.	1848.	1745.	1341.	1176.	1575.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	V	4.27	1	FLOW	1933.	1682.	1589.	1223.	1074.	1435.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
ROUTED TO	V	4.27	1	FLOW	1785.	1552.	1465.	1125.	987.	1322.
				TIME	5.60	5.60	5.60	5.60	5.60	5.60

HYDROGRAPH AT	GD11	3.17	1	FLOW	757.	656.	619.	474.	415.	558.
				TIME	6.30	6.30	6.30	6.40	6.40	6.30
2 COMBINED AT	.	7.44	1	FLOW	2476.	2149.	2028.	1553.	1361.	1828.
				TIME	5.70	5.70	5.70	5.70	5.70	5.70
HYDROGRAPH AT	GD12	2.27	1	FLOW	1809.	1595.	1516.	1198.	1068.	1383.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
ROUTED TO	V	2.27	1	FLOW	1548.	1363.	1295.	1022.	909.	1180.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	GD13	3.15	1	FLOW	1159.	1007.	950.	728.	638.	857.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
2 COMBINED AT	.	5.42	1	FLOW	2524.	2207.	2089.	1624.	1435.	1894.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	V	5.42	1	FLOW	2366.	2067.	1956.	1518.	1339.	1772.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
ROUTED TO	V	5.42	1	FLOW	2155.	1884.	1783.	1386.	1224.	1616.
				TIME	5.80	5.80	5.80	5.80	5.80	5.80
HYDROGRAPH AT	GD14A	1.71	1	FLOW	571.	483.	451.	328.	280.	399.
				TIME	4.30	4.30	4.30	4.40	4.40	4.30
2 COMBINED AT	.	7.13	1	FLOW	2533.	2211.	2091.	1619.	1427.	1893.
				TIME	5.70	5.70	5.70	5.70	5.70	5.70
ROUTED TO	V	7.13	1	FLOW	2439.	2128.	2013.	1560.	1376.	1823.
				TIME	6.20	6.20	6.30	6.30	6.30	6.30
HYDROGRAPH AT	GD14B	.68	1	FLOW	184.	158.	149.	112.	98.	133.
				TIME	5.60	5.60	5.60	5.60	5.70	5.60
3 COMBINED AT	.	15.25	1	FLOW	4813.	4194.	3964.	3060.	2693.	3584.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
2 COMBINED AT	GN_IN	51.65	1	FLOW	9963.	7507.	6702.	3925.	3108.	5747.
				TIME	6.30	6.70	6.00	6.90	6.20	6.30
ROUTED TO	DET.G	51.65	1	FLOW	9589.	7108.	6073.	539.	500.	4159.
				TIME	6.50	6.90	7.10	10.50	11.10	7.50
			** PEAK STAGES IN FEET **							
			1	STAGE	2326.40	2326.15	2326.05	2325.47	2323.29	2325.86
				TIME	6.50	6.90	7.10	10.50	11.00	7.50
DIVERSION TO	DV DTG	51.65	1	FLOW	600.	600.	600.	539.	500.	600.
				TIME	6.20	6.60	6.80	10.50	11.10	7.30
HYDROGRAPH AT	OUTFAL	51.65	1	FLOW	8989.	6508.	5473.	0.	0.	3559.
				TIME	6.50	6.90	7.10	.10	.10	7.50
HYDROGRAPH AT	GD33	4.85	1	FLOW	1028.	903.	856.	673.	598.	779.
				TIME	7.20	7.20	7.20	7.30	7.30	7.20
DIVERSION TO	CULV1	4.85	1	FLOW	1028.	903.	856.	673.	598.	779.
				TIME	7.20	7.20	7.20	7.30	7.30	7.20
HYDROGRAPH AT	RANCHO	4.85	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
ROUTED TO	V	4.85	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	GD32	2.35	1	FLOW	684.	596.	563.	435.	383.	509.

				TIME	5.60	5.60	5.60	5.70	5.70	5.60
2 COMBINED AT	.	7.20	1	FLOW	684.	596.	563.	435.	383.	509.
				TIME	5.60	5.60	5.60	5.70	5.70	5.60
DIVERSION TO	CULV2	7.20	1	FLOW	684.	596.	563.	435.	383.	509.
				TIME	5.60	5.60	5.60	5.70	5.70	5.60
HYDROGRAPH AT	RANCHO	7.20	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
ROUTED TO	V	7.20	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	GD31	1.55	1	FLOW	323.	275.	258.	190.	163.	229.
				TIME	6.10	6.10	6.20	6.20	6.20	6.20
HYDROGRAPH AT	KYLE	.00	1	FLOW	360.	360.	360.	360.	360.	360.
				TIME	7.00	7.00	7.00	7.00	7.00	7.00
ROUTED TO	V	.00	1	FLOW	360.	360.	360.	360.	360.	360.
				TIME	9.20	9.20	9.20	9.20	9.20	9.20
3 COMBINED AT	.	8.75	1	FLOW	648.	602.	585.	521.	496.	558.
				TIME	6.40	6.50	6.50	6.50	6.60	6.50
DIVERSION TO	CULV3	8.75	1	FLOW	520.	520.	520.	520.	496.	520.
				TIME	5.80	5.90	5.90	6.50	6.60	6.10
HYDROGRAPH AT	RANCHO	8.75	1	FLOW	128.	82.	65.	1.	0.	38.
				TIME	6.40	6.50	6.50	6.50	.10	6.50
ROUTED TO	V	8.75	1	FLOW	125.	80.	64.	1.	0.	36.
				TIME	6.60	6.60	6.60	6.60	.10	6.60
HYDROGRAPH AT	GD28	2.88	1	FLOW	451.	377.	350.	247.	207.	306.
				TIME	6.50	6.50	6.50	6.60	6.60	6.60
2 COMBINED AT	.	11.63	1	FLOW	576.	457.	413.	248.	207.	342.
				TIME	6.50	6.60	6.60	6.60	6.60	6.60
DIVERSION TO	CENTNL	11.63	1	FLOW	576.	457.	413.	248.	207.	342.
				TIME	6.50	6.60	6.60	6.60	6.60	6.60
HYDROGRAPH AT	RANCHO	11.63	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
ROUTED TO	V	11.63	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	GD26	1.41	1	FLOW	326.	273.	254.	183.	155.	224.
				TIME	5.00	5.10	5.10	5.30	5.40	5.20
ROUTED TO	V	1.41	1	FLOW	324.	272.	253.	182.	154.	222.
				TIME	5.50	5.50	5.60	5.70	5.80	5.60
ROUTED TO	V	1.41	1	FLOW	321.	270.	251.	180.	153.	221.
				TIME	6.00	6.00	6.10	6.20	6.20	6.10
HYDROGRAPH AT	GD27	1.13	1	FLOW	240.	202.	188.	135.	115.	165.
				TIME	5.60	5.60	5.60	5.70	5.70	5.70
3 COMBINED AT	CB ANN	14.17	1	FLOW	555.	466.	433.	309.	261.	380.
				TIME	5.80	5.80	5.80	5.90	5.90	5.80
ROUTED TO	V	14.17	1	FLOW	554.	465.	432.	309.	261.	379.
				TIME	5.90	5.90	5.90	6.00	6.00	5.90
DIVERSION TO	HW1	14.17	1	FLOW	26.	25.	25.	23.	23.	24.

				TIME	5.90	5.90	5.90	6.00	6.00	5.90
HYDROGRAPH AT	DV ANN	14.17	1	FLOW	528.	440.	407.	286.	238.	355.
				TIME	5.90	5.90	5.90	6.00	6.00	5.90
ROUTED TO	V	14.17	1	FLOW	527.	439.	407.	285.	238.	355.
				TIME	6.00	6.00	6.00	6.10	6.10	6.10
DIVERSION TO	HW2	14.17	1	FLOW	29.	29.	28.	27.	26.	28.
				TIME	6.00	6.00	6.00	6.10	6.10	6.00
HYDROGRAPH AT	DV PNT	14.17	1	FLOW	498.	410.	378.	258.	211.	327.
				TIME	6.00	6.00	6.00	6.10	6.10	6.10
HYDROGRAPH AT	GD29	.76	1	FLOW	158.	133.	123.	88.	74.	108.
				TIME	5.50	5.50	5.50	5.60	5.60	5.60
ROUTED TO	V	.76	1	FLOW	157.	132.	123.	87.	73.	107.
				TIME	5.80	5.80	5.80	5.90	5.90	5.80
HYDROGRAPH AT	PDGC	.53	1	FLOW	137.	116.	108.	78.	67.	95.
				TIME	4.80	4.80	4.90	5.10	5.20	4.90
3 COMBINED AT	.	15.46	1	FLOW	765.	635.	588.	409.	339.	512.
				TIME	5.80	5.90	5.90	5.90	6.00	5.90
DIVERSION TO	HW3	15.46	1	FLOW	298.	288.	284.	270.	262.	279.
				TIME	5.80	5.90	5.90	5.90	6.00	5.90
HYDROGRAPH AT	DV10X3	15.46	1	FLOW	467.	347.	304.	140.	77.	233.
				TIME	5.80	5.90	5.90	5.90	6.00	5.90
DIVERSION TO	HW4	15.46	1	FLOW	26.	24.	24.	22.	20.	23.
				TIME	5.80	5.90	5.90	5.90	6.00	5.90
HYDROGRAPH AT	DV INT	15.46	1	FLOW	441.	323.	280.	117.	57.	210.
				TIME	5.80	5.90	5.90	5.90	6.00	5.90
ROUTED TO	RT RAN	15.46	1	FLOW	437.	320.	277.	115.	56.	207.
				TIME	6.00	6.00	6.00	6.10	6.10	6.00
DIVERSION TO	HW5	15.46	1	FLOW	213.	196.	186.	115.	56.	171.
				TIME	6.00	6.00	6.00	6.10	6.10	6.00
HYDROGRAPH AT	DV 6X2	15.46	1	FLOW	225.	124.	90.	0.	0.	36.
				TIME	6.00	6.00	6.00	.10	.10	6.00
DIVERSION TO	HW6	15.46	1	FLOW	153.	122.	90.	0.	0.	36.
				TIME	6.00	6.00	6.00	.10	.10	6.00
HYDROGRAPH AT	DV LNE	15.46	1	FLOW	72.	2.	0.	0.	0.	0.
				TIME	6.00	6.00	.10	.10	.10	.10
HYDROGRAPH AT	GD22	1.23	1	FLOW	436.	378.	357.	273.	239.	321.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	GD23	1.01	1	FLOW	321.	279.	263.	203.	178.	238.
				TIME	5.00	5.10	5.10	5.20	5.30	5.20
2 COMBINED AT	.	2.24	1	FLOW	740.	642.	605.	464.	407.	546.
				TIME	4.70	4.80	4.80	4.90	4.90	4.80
ROUTED TO	V	2.24	1	FLOW	729.	633.	598.	459.	403.	539.
				TIME	5.50	5.50	5.50	5.60	5.60	5.50
HYDROGRAPH AT	GD24	.64	1	FLOW	142.	118.	110.	78.	66.	96.
				TIME	4.90	5.10	5.10	5.30	5.40	5.20
2 COMBINED AT	.	2.88	1	FLOW	865.	748.	705.	536.	469.	634.

				TIME	5.40	5.50	5.50	5.50	5.60	5.50
ROUTED TO	V	2.88	1	FLOW	853.	738.	696.	530.	463.	626.
				TIME	6.10	6.20	6.20	6.20	6.30	6.20
HYDROGRAPH AT	GD18	3.42	1	FLOW	2633.	2319.	2202.	1737.	1546.	2008.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
ROUTED TO	V	3.42	1	FLOW	2149.	1891.	1795.	1413.	1256.	1635.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	GD19	2.41	1	FLOW	677.	577.	541.	400.	346.	481.
				TIME	4.80	4.90	4.90	5.10	5.20	4.90
2 COMBINED AT	.	5.83	1	FLOW	2724.	2375.	2246.	1736.	1530.	2032.
				TIME	4.30	4.30	4.30	4.30	4.40	4.30
ROUTED TO	V	5.83	1	FLOW	2417.	2109.	1994.	1543.	1359.	1804.
				TIME	5.30	5.30	5.30	5.30	5.30	5.30
HYDROGRAPH AT	GD20	2.35	1	FLOW	470.	402.	377.	280.	242.	336.
				TIME	6.40	6.40	6.40	6.50	6.50	6.50
4 COMBINED AT	CB CRG	26.52	1	FLOW	3417.	2943.	2773.	2112.	1845.	2494.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
DIVERSION TO	CRAIG	26.52	1	FLOW	61.	49.	45.	30.	24.	38.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
HYDROGRAPH AT	HWY95	26.52	1	FLOW	3356.	2894.	2729.	2082.	1822.	2456.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
ROUTED TO	V	26.52	1	FLOW	3343.	2884.	2718.	2073.	1814.	2446.
				TIME	5.50	5.40	5.40	5.50	5.50	5.40
HYDROGRAPH AT	GD15	3.28	1	FLOW	1981.	1737.	1646.	1286.	1138.	1495.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	RT G15	3.28	1	FLOW	1.	1.	1.	1.	1.	1.
				TIME	3.80	3.90	4.00	4.30	4.50	4.10
ROUTED TO	V	3.28	1	FLOW	1.	1.	1.	1.	1.	1.
				TIME	5.40	5.50	5.40	5.80	6.20	5.60
HYDROGRAPH AT	GD16	3.76	1	FLOW	953.	817.	767.	573.	495.	685.
				TIME	5.50	5.60	5.60	5.60	5.60	5.60
2 COMBINED AT	.	7.04	1	FLOW	954.	818.	768.	574.	496.	686.
				TIME	5.50	5.60	5.60	5.60	5.60	5.60
ROUTED TO	V	7.04	1	FLOW	936.	801.	752.	561.	485.	671.
				TIME	6.50	6.50	6.50	6.60	6.60	6.60
HYDROGRAPH AT	GD17	.56	1	FLOW	117.	100.	93.	68.	58.	83.
				TIME	6.00	6.00	6.00	6.00	6.10	6.00
3 COMBINED AT	.	34.12	1	FLOW	4140.	3540.	3330.	2514.	2204.	2985.
				TIME	5.60	5.60	5.60	5.60	6.40	5.60
DIVERSION TO	AWEIR	34.12	1	FLOW	426.	330.	297.	229.	204.	268.
				TIME	5.60	5.60	5.60	5.60	6.40	5.60
HYDROGRAPH AT	ALEX1	34.12	1	FLOW	3714.	3209.	3033.	2284.	2000.	2717.
				TIME	5.60	5.60	5.60	5.60	6.40	5.60
DIVERSION TO	A6X2	34.12	1	FLOW	220.	200.	193.	160.	146.	179.
				TIME	5.60	5.60	5.60	5.60	6.40	5.60
HYDROGRAPH AT	ALEX2	34.12	1	FLOW	3494.	3009.	2840.	2124.	1854.	2537.

				TIME	5.60	5.60	5.60	5.60	6.40	5.60
ROUTED TO	RT GWN	34.12	1	FLOW	3481.	2999.	2829.	2118.	1849.	2527.
				TIME	5.70	5.70	5.70	6.40	6.40	5.70
DIVERSION TO	GOW 42	34.12	1	FLOW	160.	159.	159.	155.	153.	157.
				TIME	5.70	5.70	5.70	6.40	6.40	5.70
HYDROGRAPH AT	DV GOW	34.12	1	FLOW	3321.	2840.	2671.	1964.	1695.	2370.
				TIME	5.70	5.70	5.70	6.40	6.40	5.70
ROUTED TO	RT JON	34.12	1	FLOW	3319.	2838.	2669.	1963.	1695.	2369.
				TIME	5.80	5.80	5.80	6.50	6.50	5.80
DIVERSION TO	MORBAY	34.12	1	FLOW	1063.	890.	830.	579.	489.	723.
				TIME	5.80	5.80	5.80	6.50	6.50	5.80
HYDROGRAPH AT	JONES	34.12	1	FLOW	2256.	1947.	1839.	1383.	1206.	1645.
				TIME	5.80	5.80	5.80	6.50	6.50	5.80
DIVERSION TO	TRUVAL	34.12	1	FLOW	1296.	1106.	1039.	765.	659.	923.
				TIME	5.80	5.80	5.80	6.50	6.50	5.80
HYDROGRAPH AT	SPLIT	34.12	1	FLOW	960.	841.	799.	618.	548.	723.
				TIME	5.80	5.80	5.80	6.50	6.50	5.80
HYDROGRAPH AT	2-6X2	.00	1	FLOW	213.	196.	186.	115.	56.	171.
				TIME	6.00	6.00	6.00	6.10	6.10	6.00
DIVERSION TO	RD1	.00	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	4.60	4.70	4.80	5.30	5.70	5.00
HYDROGRAPH AT	DV R1	.00	1	FLOW	178.	161.	151.	80.	21.	136.
				TIME	6.00	6.00	6.00	6.10	6.10	6.00
ROUTED TO	RTCBL1	.00	1	FLOW	177.	160.	150.	76.	18.	134.
				TIME	6.60	6.60	6.60	6.70	6.70	6.70
HYDROGRAPH AT	AREA.1	.11	1	FLOW	37.	31.	29.	20.	17.	25.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	CB L1	.11	1	FLOW	179.	161.	151.	77.	19.	135.
				TIME	6.50	6.60	6.60	6.70	6.70	6.60
DIVERSION TO	RD4	.11	1	FLOW	30.	30.	29.	22.	12.	28.
				TIME	6.50	6.60	6.60	6.70	6.70	6.60
HYDROGRAPH AT	DV R4	.11	1	FLOW	148.	132.	122.	55.	6.	107.
				TIME	6.50	6.60	6.60	6.70	6.70	6.60
HYDROGRAPH AT	LONE	.00	1	FLOW	153.	122.	90.	0.	0.	36.
				TIME	6.00	6.00	6.00	.10	.10	6.00
2 COMBINED AT	CB L2	.11	1	FLOW	299.	243.	201.	55.	6.	127.
				TIME	6.30	6.20	6.20	6.70	6.70	6.30
DIVERSION TO	RD5	.11	1	FLOW	51.	48.	46.	37.	6.	42.
				TIME	6.30	6.20	6.20	6.70	6.70	6.30
HYDROGRAPH AT	DV R5	.11	1	FLOW	248.	194.	155.	17.	0.	84.
				TIME	6.30	6.20	6.20	6.70	.10	6.30
DIVERSION TO	RD6	.11	1	FLOW	40.	39.	39.	13.	0.	38.
				TIME	6.30	6.10	6.20	6.70	.10	6.30
HYDROGRAPH AT	DV R6	.11	1	FLOW	209.	155.	115.	4.	0.	46.
				TIME	6.30	6.20	6.20	6.70	.10	6.30
ROUTED TO	RTCBC1	.11	1	FLOW	204.	148.	108.	3.	0.	42.

				TIME	6.90	6.90	6.90	7.40	.10	7.00
HYDROGRAPH AT	AREA.2	.31	1	FLOW	77.	65.	61.	43.	37.	53.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
2 COMBINED AT	CB C1	.42	1	FLOW	221.	163.	121.	43.	37.	53.
				TIME	6.80	6.80	6.80	4.50	4.50	4.50
DIVERSION TO	DI	.42	1	FLOW	39.	27.	19.	3.	2.	5.
				TIME	6.80	6.80	6.80	4.50	4.50	4.50
HYDROGRAPH AT	DV DI	.42	1	FLOW	182.	136.	102.	40.	35.	49.
				TIME	6.80	6.80	6.80	4.50	4.50	4.50
HYDROGRAPH AT	CRAIG	.00	1	FLOW	61.	49.	45.	30.	24.	38.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
DIVERSION TO	CRSD1	.00	1	FLOW	61.	49.	45.	30.	24.	38.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
HYDROGRAPH AT	DV CS1	.00	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
2 COMBINED AT	CB C2	.42	1	FLOW	182.	136.	102.	40.	35.	49.
				TIME	6.80	6.80	6.80	4.50	4.50	4.50
DIVERSION TO	CRSD2	.42	1	FLOW	129.	115.	102.	40.	35.	49.
				TIME	6.80	6.80	6.80	4.50	4.50	4.50
HYDROGRAPH AT	DV CS2	.42	1	FLOW	53.	21.	0.	0.	0.	0.
				TIME	6.80	6.80	.10	.10	.10	.10
DIVERSION TO	CRSD3	.42	1	FLOW	49.	21.	0.	0.	0.	0.
				TIME	6.80	6.80	.10	.10	.10	.10
HYDROGRAPH AT	DV CS3	.42	1	FLOW	4.	0.	0.	0.	0.	0.
				TIME	6.80	.10	.10	.10	.10	.10
DIVERSION TO	RD7	.42	1	FLOW	4.	0.	0.	0.	0.	0.
				TIME	6.80	.10	.10	.10	.10	.10
HYDROGRAPH AT	DV R7	.42	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
DIVERSION TO	RD8	.42	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	DV R8	.42	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
ROUTED TO	RTCBA1	.42	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	AREA.3	.16	1	FLOW	51.	43.	40.	29.	24.	35.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	RALX1	.00	1	FLOW	426.	330.	297.	229.	204.	268.
				TIME	5.60	5.60	5.60	5.60	6.40	5.60
HYDROGRAPH AT	RALX2	.00	1	FLOW	220.	200.	193.	160.	146.	179.
				TIME	5.60	5.60	5.60	5.60	6.40	5.60
3 COMBINED AT	.	.16	1	FLOW	675.	557.	515.	409.	365.	470.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
ROUTED TO	V	.16	1	FLOW	673.	555.	514.	408.	364.	469.
				TIME	5.60	5.60	5.60	5.60	5.60	5.60
HYDROGRAPH AT	AREA.4	.25	1	FLOW	81.	69.	65.	48.	42.	58.

				TIME	4.30	4.30	4.30	4.30	4.30	4.30
2 COMBINED AT	.	.41	1	FLOW	726.	602.	558.	442.	394.	510.
				TIME	5.60	5.60	5.60	5.60	5.60	5.60
ROUTED TO	V	.41	1	FLOW	724.	600.	557.	441.	393.	508.
				TIME	5.70	5.70	5.70	5.70	5.70	5.70
HYDROGRAPH AT	AREA.5	.15	1	FLOW	44.	37.	34.	25.	21.	30.
				TIME	4.20	4.20	4.20	4.30	4.30	4.20
3 COMBINED AT	CB A1	.98	1	FLOW	750.	623.	580.	458.	408.	529.
				TIME	5.70	5.70	5.60	5.60	5.70	5.60
DIVERSION TO	RD9	.98	1	FLOW	110.	102.	100.	92.	89.	97.
				TIME	5.70	5.70	5.60	5.60	5.70	5.60
HYDROGRAPH AT	DV R9	.98	1	FLOW	640.	521.	480.	366.	319.	432.
				TIME	5.70	5.70	5.60	5.60	5.70	5.60
HYDROGRAPH AT	AREA7A	.42	1	FLOW	86.	74.	70.	52.	46.	62.
				TIME	6.10	6.10	6.10	6.10	6.20	6.10
2 COMBINED AT	CB A2	1.40	1	FLOW	723.	592.	546.	415.	362.	491.
				TIME	5.70	5.70	5.70	5.70	5.70	5.70
DIVERSION TO	RD10	1.40	1	FLOW	126.	121.	120.	115.	113.	118.
				TIME	5.70	5.70	5.70	5.70	5.70	5.70
HYDROGRAPH AT	DV R10	1.40	1	FLOW	597.	470.	426.	300.	249.	373.
				TIME	5.70	5.70	5.70	5.70	5.70	5.70
ROUTED TO	RTCBG1	1.40	1	FLOW	580.	457.	416.	292.	240.	364.
				TIME	6.50	6.40	6.40	6.40	6.50	6.40
DIVERSION TO	DUNCAN	1.40	1	FLOW	246.	167.	141.	66.	54.	108.
				TIME	6.50	6.40	6.40	6.40	6.50	6.40
HYDROGRAPH AT	DV DUN	1.40	1	FLOW	334.	290.	275.	225.	186.	255.
				TIME	6.50	6.40	6.40	6.40	6.50	6.40
HYDROGRAPH AT	AREA7B	.42	1	FLOW	86.	74.	70.	52.	46.	62.
				TIME	6.10	6.10	6.10	6.10	6.20	6.10
2 COMBINED AT	CB G1	1.82	1	FLOW	418.	362.	343.	277.	230.	316.
				TIME	6.40	6.40	6.40	6.40	6.40	6.40
DIVERSION TO	RD11	1.82	1	FLOW	25.	24.	24.	23.	22.	24.
				TIME	6.40	6.40	6.40	6.40	6.40	6.40
HYDROGRAPH AT	DV R11	1.82	1	FLOW	393.	338.	319.	254.	208.	293.
				TIME	6.40	6.40	6.40	6.40	6.40	6.40
2 COMBINED AT	CB G2	35.95	1	FLOW	1341.	1168.	1108.	871.	755.	1009.
				TIME	6.40	6.40	6.40	6.50	6.50	6.40
DIVERSION TO	4X4	35.95	1	FLOW	194.	193.	192.	190.	189.	191.
				TIME	6.40	6.40	6.40	6.50	6.50	6.40
HYDROGRAPH AT	DV 4X4	35.95	1	FLOW	1147.	975.	916.	681.	566.	818.
				TIME	6.40	6.40	6.40	6.50	6.50	6.40
DIVERSION TO	GOWAN	35.95	1	FLOW	206.	182.	173.	141.	125.	160.
				TIME	6.40	6.40	6.40	6.50	6.50	6.40
HYDROGRAPH AT	DV GWN	35.95	1	FLOW	942.	793.	742.	540.	441.	658.
				TIME	6.40	6.40	6.40	6.50	6.50	6.40
ROUTED TO	RT GB	35.95	1	FLOW	916.	772.	722.	514.	417.	637.

				TIME	8.10	8.10	8.10	8.20	8.20	8.10
HYDROGRAPH AT	R24"-1	.00	1	FLOW	26.	25.	25.	23.	23.	24.
				TIME	5.90	5.90	5.90	6.00	6.00	5.90
HYDROGRAPH AT	R24"-2	.00	1	FLOW	29.	29.	28.	27.	26.	28.
				TIME	6.00	6.00	6.00	6.10	6.10	6.00
HYDROGRAPH AT	R10X3	.00	1	FLOW	298.	288.	284.	270.	262.	279.
				TIME	5.80	5.90	5.90	5.90	6.00	5.90
HYDROGRAPH AT	R24RCP	.00	1	FLOW	26.	24.	24.	22.	20.	23.
				TIME	5.80	5.90	5.90	5.90	6.00	5.90
4 COMBINED AT	CB DIV	.00	1	FLOW	379.	366.	362.	341.	331.	354.
				TIME	5.80	5.90	5.90	5.90	6.00	5.90
ROUTED TO	V	.00	1	FLOW	375.	363.	358.	338.	325.	351.
				TIME	7.90	7.90	8.00	8.00	8.10	8.00
HYDROGRAPH AT	EPT.3	4.39	1	FLOW	714.	621.	587.	452.	398.	530.
				TIME	7.40	7.40	7.40	7.50	7.50	7.50
2 COMBINED AT	.	4.39	1	FLOW	1084.	979.	940.	783.	715.	875.
				TIME	7.50	7.50	7.60	7.70	7.80	7.60
HYDROGRAPH AT	R1	.00	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	4.60	4.70	4.80	5.30	5.70	5.00
HYDROGRAPH AT	R4	.00	1	FLOW	30.	30.	29.	22.	12.	28.
				TIME	6.50	6.60	6.60	6.70	6.70	6.60
HYDROGRAPH AT	R5	.00	1	FLOW	51.	48.	46.	37.	6.	42.
				TIME	6.30	6.20	6.20	6.70	6.70	6.30
HYDROGRAPH AT	R6	.00	1	FLOW	40.	39.	39.	13.	0.	38.
				TIME	6.30	6.10	6.20	6.70	.10	6.30
HYDROGRAPH AT	DI	.00	1	FLOW	39.	27.	19.	3.	2.	5.
				TIME	6.80	6.80	6.80	4.50	4.50	4.50
5 COMBINED AT	.	.00	1	FLOW	194.	176.	164.	108.	52.	146.
				TIME	6.60	6.70	6.70	6.70	6.60	6.70
ROUTED TO	RTEPT3	.00	1	FLOW	189.	170.	159.	93.	41.	140.
				TIME	8.70	8.70	8.70	8.70	8.30	8.60
2 COMBINED AT	.	4.39	1	FLOW	1240.	1116.	1068.	841.	750.	981.
				TIME	7.80	7.90	7.90	8.10	7.90	8.00
HYDROGRAPH AT	EPT.4	.48	1	FLOW	180.	157.	149.	115.	102.	135.
				TIME	4.30	4.30	4.30	4.30	4.40	4.30
HYDROGRAPH AT	R7	.00	1	FLOW	4.	0.	0.	0.	0.	0.
				TIME	6.80	.10	.10	.10	.10	.10
HYDROGRAPH AT	R8	.00	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
2 COMBINED AT	CB DIV	.00	1	FLOW	4.	0.	0.	0.	0.	0.
				TIME	6.80	.10	.10	.10	.10	.10
ROUTED TO	RTEPT4	.00	1	FLOW	2.	0.	0.	0.	0.	0.
				TIME	8.20	.10	.10	.10	.10	.10
2 COMBINED AT	CB	.48	1	FLOW	180.	157.	149.	115.	102.	135.
				TIME	4.30	4.30	4.30	4.30	4.40	4.30
ROUTED TO	RT GA	.48	1	FLOW	168.	147.	139.	108.	96.	126.

				TIME	5.30	5.30	5.30	5.30	5.30	5.30
HYDROGRAPH AT	GOW 42	.00	1	FLOW	160.	159.	159.	155.	153.	157.
				TIME	5.70	5.70	5.70	6.40	6.40	5.70
ROUTED TO	R.G.UP	.00	1	FLOW	160.	159.	159.	155.	153.	157.
				TIME	5.80	5.80	5.80	6.50	6.50	5.80
HYDROGRAPH AT	4X4	.00	1	FLOW	194.	193.	192.	190.	189.	191.
				TIME	6.40	6.40	6.40	6.50	6.50	6.40
2 COMBINED AT	CB	.00	1	FLOW	354.	352.	351.	345.	343.	349.
				TIME	6.40	6.40	6.40	6.50	6.50	6.50
ROUTED TO	RT GA	.00	1	FLOW	354.	352.	351.	345.	343.	349.
				TIME	6.60	6.60	6.60	6.70	6.70	6.70
HYDROGRAPH AT	RC CS1	.00	1	FLOW	61.	49.	45.	30.	24.	38.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
HYDROGRAPH AT	RC CS2	.00	1	FLOW	129.	115.	102.	40.	35.	49.
				TIME	6.80	6.80	6.80	4.50	4.50	4.50
HYDROGRAPH AT	RC CS3	.00	1	FLOW	49.	21.	0.	0.	0.	0.
				TIME	6.80	6.80	.10	.10	.10	.10
3 COMBINED AT	CB DIV	.00	1	FLOW	224.	168.	131.	68.	57.	83.
				TIME	6.50	6.70	6.80	5.40	5.40	5.30
ROUTED TO	RT GA	.00	1	FLOW	223.	167.	130.	67.	57.	83.
				TIME	6.70	6.90	7.00	5.60	5.60	5.50
4 COMBINED AT	CP GA	4.87	1	FLOW	1815.	1613.	1524.	1213.	1112.	1382.
				TIME	7.30	7.30	7.30	7.50	7.60	7.50
HYDROGRAPH AT	R DTG	.00	1	FLOW	600.	600.	600.	539.	500.	600.
				TIME	6.20	6.60	6.80	10.50	11.10	7.30
ROUTED TO	RT GA	.00	1	FLOW	600.	600.	600.	539.	500.	600.
				TIME	6.90	7.30	7.50	10.80	11.40	8.00
2 COMBINED AT	CB GA	4.87	1	FLOW	2415.	2213.	2124.	1709.	1556.	1980.
				TIME	7.30	7.30	7.30	8.00	7.80	7.70
ROUTED TO	RT GB	4.87	1	FLOW	2414.	2213.	2124.	1709.	1556.	1979.
				TIME	7.50	7.50	7.50	8.20	8.00	7.90
HYDROGRAPH AT	EPT.5	2.38	1	FLOW	991.	857.	808.	614.	537.	726.
				TIME	4.00	4.00	4.00	4.10	4.10	4.00
HYDROGRAPH AT	R9	.00	1	FLOW	110.	102.	100.	92.	89.	97.
				TIME	5.70	5.70	5.60	5.60	5.70	5.60
HYDROGRAPH AT	R10	.00	1	FLOW	126.	121.	120.	115.	113.	118.
				TIME	5.70	5.70	5.70	5.70	5.70	5.70
HYDROGRAPH AT	R DUN	.00	1	FLOW	246.	167.	141.	66.	54.	108.
				TIME	6.50	6.40	6.40	6.40	6.50	6.40
HYDROGRAPH AT	R11	.00	1	FLOW	25.	24.	24.	23.	22.	24.
				TIME	6.40	6.40	6.40	6.40	6.40	6.40
4 COMBINED AT	CB DIV	.00	1	FLOW	500.	409.	379.	292.	275.	341.
				TIME	6.40	6.40	6.40	6.40	6.40	6.40
ROUTED TO	RTEPT5	.00	1	FLOW	477.	390.	363.	286.	269.	327.
				TIME	8.30	8.30	8.30	8.30	8.30	8.30
2 COMBINED AT	.	2.38	1	FLOW	1009.	870.	818.	620.	540.	734.

				TIME	4.00	4.00	4.00	4.10	4.10	4.10
ROUTED TO	V	2.38	1	FLOW	1005.	866.	815.	617.	538.	731.
				TIME	4.10	4.10	4.20	4.20	4.20	4.20
HYDROGRAPH AT	CENTNL	.00	1	FLOW	576.	457.	413.	248.	207.	342.
				TIME	6.50	6.60	6.60	6.60	6.60	6.60
ROUTED TO	RTEPT1	.00	1	FLOW	542.	428.	387.	239.	201.	321.
				TIME	8.60	8.60	8.60	8.60	8.70	8.60
HYDROGRAPH AT	EPT.1	3.76	1	FLOW	567.	487.	457.	343.	297.	409.
				TIME	7.20	7.20	7.20	7.20	7.30	7.20
2 COMBINED AT	.	3.76	1	FLOW	1005.	829.	765.	537.	459.	664.
				TIME	8.30	8.30	8.30	8.10	8.10	8.20
ROUTED TO	V	3.76	1	FLOW	995.	821.	759.	534.	456.	659.
				TIME	9.00	9.00	9.00	8.80	8.80	8.90
HYDROGRAPH AT	EPT.2	1.49	1	FLOW	278.	239.	224.	169.	147.	201.
				TIME	6.40	6.40	6.40	6.50	6.50	6.40
5 COMBINED AT	CP GB	48.45	1	FLOW	4753.	4186.	3985.	3113.	2755.	3662.
				TIME	8.00	8.10	8.10	8.20	8.20	8.20
HYDROGRAPH AT	304	2.90	1	FLOW	653.	565.	532.	405.	354.	479.
				TIME	5.90	5.90	5.90	5.90	5.90	5.90
HYDROGRAPH AT	305	2.81	1	FLOW	751.	652.	616.	473.	416.	555.
				TIME	5.20	5.30	5.30	5.40	5.40	5.30
2 COMBINED AT	.	5.71	1	FLOW	1373.	1190.	1123.	860.	753.	1012.
				TIME	5.50	5.60	5.60	5.60	5.60	5.60
HYDROGRAPH AT	X4	.81	1	FLOW	230.	203.	193.	154.	138.	177.
				TIME	5.70	5.70	5.70	5.70	5.80	5.70
HYDROGRAPH AT	X3B	.16	1	FLOW	76.	66.	63.	48.	42.	57.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	CUL4	.16	1	FLOW	64.	61.	60.	48.	42.	56.
				TIME	4.20	4.10	4.00	4.00	4.00	4.00
			** PEAK STAGES IN FEET **							
			1	STAGE	15.07	15.02	15.00	14.69	14.55	14.90
				TIME	4.20	4.10	4.00	4.00	4.00	4.00
HYDROGRAPH AT	X3A	.12	1	FLOW	60.	52.	49.	38.	33.	45.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	CUL8	.12	1	FLOW	27.	24.	23.	19.	18.	22.
				TIME	5.40	5.40	5.40	5.30	5.30	5.40
			** PEAK STAGES IN FEET **							
			1	STAGE	22.38	21.94	21.78	21.15	20.89	21.51
				TIME	5.40	5.40	5.40	5.30	5.30	5.40
2 COMBINED AT	CX3	.28	1	FLOW	88.	83.	80.	64.	57.	74.
				TIME	4.30	4.20	4.10	4.00	4.00	4.00
ROUTED TO	RK3AB	.28	1	FLOW	86.	79.	75.	60.	53.	69.
				TIME	5.30	5.10	5.10	5.10	5.10	5.10
2 COMBINED AT	+	1.09	1	FLOW	311.	272.	257.	204.	182.	235.
				TIME	5.40	5.30	5.30	5.30	5.30	5.30
DIVERSION TO	DEVX4	1.09	1	FLOW	100.	100.	100.	100.	91.	100.
				TIME	4.50	4.60	4.70	5.20	5.30	4.80

HYDROGRAPH AT	DEVX4	1.09	1	FLOW	211.	172.	157.	104.	91.	135.
				TIME	5.40	5.30	5.30	5.30	5.30	5.30
ROUTED TO	RK4	1.09	1	FLOW	211.	172.	157.	103.	91.	134.
				TIME	5.60	5.50	5.50	5.50	5.60	5.50
HYDROGRAPH AT	X3C	.48	1	FLOW	96.	81.	76.	55.	47.	67.
				TIME	5.50	5.50	5.50	5.60	5.60	5.50
DIVERSION TO	SD1A	.48	1	FLOW	13.	11.	10.	6.	5.	8.
				TIME	5.50	5.50	5.50	5.60	5.60	5.50
HYDROGRAPH AT	SD1A	.48	1	FLOW	83.	70.	66.	49.	42.	59.
				TIME	5.50	5.50	5.50	5.60	5.60	5.50
ROUTED TO	RK3C	.48	1	FLOW	83.	70.	66.	49.	42.	59.
				TIME	5.70	5.70	5.70	5.80	5.80	5.70
HYDROGRAPH AT	X3	.34	1	FLOW	167.	148.	141.	113.	101.	129.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
3 COMBINED AT	CX3	1.91	1	FLOW	383.	326.	304.	218.	193.	268.
				TIME	5.40	5.40	5.30	5.30	5.30	5.40
HYDROGRAPH AT	DTX4	.00	1	FLOW	100.	100.	100.	100.	91.	100.
				TIME	4.50	4.60	4.70	5.20	5.30	4.80
ROUTED TO	RDEX	.00	1	FLOW	100.	100.	100.	100.	91.	100.
				TIME	4.80	5.00	5.00	5.40	5.40	5.10
HYDROGRAPH AT	BSX5	.10	1	FLOW	64.	56.	54.	43.	39.	49.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	CX5	.10	1	FLOW	133.	130.	129.	121.	108.	127.
				TIME	5.00	5.00	5.00	5.20	5.20	5.00
HYDROGRAPH AT	TRUVAL	.00	1	FLOW	1296.	1106.	1039.	765.	659.	923.
				TIME	5.80	5.80	5.80	6.50	6.50	5.80
HYDROGRAPH AT	GOWAN	.00	1	FLOW	206.	182.	173.	141.	125.	160.
				TIME	6.40	6.40	6.40	6.50	6.50	6.40
2 COMBINED AT	CB DV1	.00	1	FLOW	1494.	1282.	1207.	906.	783.	1075.
				TIME	5.80	5.80	5.80	6.50	6.50	6.50
HYDROGRAPH AT	MORBAY	.00	1	FLOW	1063.	890.	830.	579.	489.	723.
				TIME	5.80	5.80	5.80	6.50	6.50	5.80
2 COMBINED AT	CB DV2	.00	1	FLOW	2557.	2173.	2037.	1485.	1272.	1797.
				TIME	5.80	5.80	5.80	6.50	6.50	5.80
ROUTED TO	RT CHY	.00	1	FLOW	2541.	2153.	2018.	1477.	1264.	1785.
				TIME	6.30	6.20	6.20	6.80	6.80	6.70
2 COMBINED AT	CB CX5	.10	1	FLOW	2644.	2257.	2121.	1560.	1335.	1886.
				TIME	6.30	6.20	6.20	6.30	6.70	6.30
DIVERSION TO	DVSTR1	.10	1	FLOW	1035.	872.	814.	577.	482.	715.
				TIME	6.30	6.20	6.20	6.30	6.70	6.30
HYDROGRAPH AT	DVWR1	.10	1	FLOW	1608.	1385.	1307.	983.	853.	1171.
				TIME	6.30	6.20	6.20	6.30	6.70	6.30
DIVERSION TO	DVSTR2	.10	1	FLOW	37.	37.	37.	37.	37.	37.
				TIME	2.90	3.10	3.20	3.40	3.50	3.30
HYDROGRAPH AT	DVWR2	.10	1	FLOW	1571.	1348.	1270.	946.	816.	1134.
				TIME	6.30	6.20	6.20	6.30	6.70	6.30

ROUTED TO	RX5	.10	1	FLOW	1571.	1347.	1269.	946.	816.	1134.
				TIME	6.40	6.30	6.30	6.40	6.80	6.40
2 COMBINED AT	CX4X3	2.01	1	FLOW	1862.	1594.	1499.	1107.	953.	1333.
				TIME	6.20	6.20	6.20	6.20	6.30	6.20
DIVERSION TO	DVBOX	2.01	1	FLOW	210.	210.	210.	210.	210.	210.
				TIME	3.60	3.70	3.80	4.10	4.50	3.90
HYDROGRAPH AT	DVBOX	2.01	1	FLOW	1652.	1384.	1289.	897.	743.	1123.
				TIME	6.20	6.20	6.20	6.20	6.30	6.20
ROUTED TO	RX34	2.01	1	FLOW	1649.	1381.	1286.	895.	742.	1121.
				TIME	6.30	6.30	6.30	6.40	6.40	6.30
HYDROGRAPH AT	X2	.20	1	FLOW	125.	110.	105.	83.	74.	96.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	CUL5	.20	1	FLOW	52.	46.	44.	37.	34.	41.
				TIME	5.30	5.30	5.30	5.30	5.30	5.30
			** PEAK STAGES IN FEET **							
			1	STAGE	37.38	36.99	36.84	36.26	36.02	36.60
				TIME	5.30	5.30	5.30	5.30	5.30	5.30
HYDROGRAPH AT	X1D	.07	1	FLOW	36.	32.	30.	23.	20.	27.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	CUL9	.07	1	FLOW	17.	16.	15.	12.	11.	14.
				TIME	5.30	5.30	5.30	5.30	5.30	5.30
			** PEAK STAGES IN FEET **							
			1	STAGE	30.30	30.09	30.02	29.60	29.42	29.86
				TIME	5.30	5.30	5.30	5.30	5.30	5.30
HYDROGRAPH AT	X1C	.08	1	FLOW	41.	36.	34.	26.	23.	30.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	CUL10	.08	1	FLOW	21.	20.	19.	18.	16.	19.
				TIME	5.30	4.40	4.40	4.20	4.20	4.30
			** PEAK STAGES IN FEET **							
			1	STAGE	27.26	27.15	27.12	26.99	26.75	27.06
				TIME	5.30	4.40	4.40	4.20	4.20	4.30
HYDROGRAPH AT	X1B	.07	1	FLOW	35.	31.	29.	22.	20.	26.
				TIME	3.80	3.80	3.80	3.90	3.90	3.90
ROUTED TO	CUL6	.07	1	FLOW	14.	12.	11.	9.	8.	10.
				TIME	5.40	5.40	5.40	5.50	5.50	5.40
			** PEAK STAGES IN FEET **							
			1	STAGE	24.06	23.80	23.70	23.31	23.16	23.54
				TIME	5.40	5.40	5.40	5.50	5.50	5.50
HYDROGRAPH AT	X1A	.04	1	FLOW	20.	17.	16.	13.	11.	15.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	CUL7	.04	1	FLOW	15.	14.	13.	10.	9.	12.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
			** PEAK STAGES IN FEET **							
			1	STAGE	23.53	23.31	23.21	22.82	22.66	23.05
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
5 COMBINED AT	X12	.46	1	FLOW	114.	103.	99.	81.	73.	92.
				TIME	5.30	5.30	5.30	4.30	4.30	5.30

ROUTED TO	RX2	.46	1	FLOW	113.	103.	99.	81.	72.	91.
				TIME	5.60	5.60	5.60	4.60	4.60	5.50
HYDROGRAPH AT	X1E	.46	1	FLOW	95.	80.	75.	54.	46.	66.
				TIME	5.30	5.30	5.40	5.40	5.50	5.40
2 COMBINED AT	CX1E	.92	1	FLOW	207.	182.	173.	134.	118.	157.
				TIME	5.40	5.50	5.50	5.50	5.50	5.50
DIVERSION TO	SD1B	.92	1	FLOW	12.	10.	10.	8.	7.	9.
				TIME	5.40	5.50	5.50	5.50	5.50	5.50
HYDROGRAPH AT	SD1B	.92	1	FLOW	195.	171.	163.	126.	111.	148.
				TIME	5.40	5.50	5.50	5.50	5.50	5.50
ROUTED TO	RX1	.92	1	FLOW	195.	171.	163.	125.	110.	148.
				TIME	5.60	5.60	5.70	5.70	5.70	5.70
HYDROGRAPH AT	X1	.17	1	FLOW	78.	69.	66.	53.	47.	61.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
2 COMBINED AT	CX1	1.09	1	FLOW	244.	215.	204.	158.	140.	186.
				TIME	5.20	5.20	5.20	5.20	5.30	5.30
2 COMBINED AT	CX1X4	3.10	1	FLOW	1836.	1547.	1441.	1014.	846.	1259.
				TIME	6.20	6.20	6.20	6.30	6.30	6.20
DIVERSION TO	DVFLAT	3.10	1	FLOW	20.	20.	20.	20.	20.	20.
				TIME	2.10	2.30	2.40	2.90	3.20	2.60
HYDROGRAPH AT	DVFLAT	3.10	1	FLOW	1816.	1527.	1421.	994.	826.	1239.
				TIME	6.20	6.20	6.20	6.30	6.30	6.20
ROUTED TO	RX34	3.10	1	FLOW	1813.	1524.	1418.	992.	824.	1237.
				TIME	6.40	6.30	6.30	6.40	6.40	6.40
HYDROGRAPH AT	N2	.20	1	FLOW	83.	73.	70.	56.	50.	64.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	CN2	3.30	1	FLOW	1841.	1549.	1443.	1010.	840.	1259.
				TIME	6.30	6.30	6.30	6.30	6.40	6.30
DIVERSION TO	DVCUL1	3.30	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	2.90	3.30	3.40	3.60	3.70	3.50
HYDROGRAPH AT	DVCUL	3.30	1	FLOW	1806.	1514.	1408.	975.	805.	1224.
				TIME	6.30	6.30	6.30	6.30	6.40	6.30
ROUTED TO	RN2	3.30	1	FLOW	1802.	1510.	1404.	972.	804.	1221.
				TIME	6.40	6.40	6.40	6.50	6.50	6.40
HYDROGRAPH AT	N1	.23	1	FLOW	93.	83.	79.	63.	56.	72.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	CN1	3.53	1	FLOW	1832.	1538.	1430.	994.	822.	1245.
				TIME	6.40	6.40	6.40	6.40	6.40	6.40
DIVERSION TO	DVCUL2	3.53	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	3.40	3.50	3.60	3.70	3.80	3.60
HYDROGRAPH AT	DVCUL	3.53	1	FLOW	1797.	1503.	1395.	959.	787.	1210.
				TIME	6.40	6.40	6.40	6.40	6.40	6.40
ROUTED TO	RN1	3.53	1	FLOW	1794.	1499.	1391.	956.	785.	1207.
				TIME	6.50	6.50	6.50	6.50	6.50	6.50
DIVERSION TO	PSM1	3.53	1	FLOW	261.	261.	261.	261.	261.	261.
				TIME	4.20	4.30	4.40	5.00	5.30	4.50

HYDROGRAPH AT	PSM	3.53	1	FLOW	1533.	1238.	1130.	695.	524.	946.
				TIME	6.50	6.50	6.50	6.50	6.50	6.50
HYDROGRAPH AT	K3	.12	1	FLOW	77.	68.	65.	52.	47.	60.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	CUL2	.12	1	FLOW	53.	47.	45.	37.	33.	41.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
			** PEAK STAGES IN FEET **							
			1	STAGE	41.93	41.79	41.73	41.51	41.42	41.64
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
ROUTED TO	RK3	.12	1	FLOW	52.	46.	44.	36.	33.	41.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	K2	.19	1	FLOW	44.	36.	33.	22.	17.	28.
				TIME	4.20	4.20	4.20	4.20	5.30	4.20
2 COMBINED AT	CK23	.31	1	FLOW	95.	81.	77.	58.	50.	68.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	RK2	.31	1	FLOW	94.	81.	76.	57.	50.	68.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	K2A	.22	1	FLOW	65.	56.	53.	39.	34.	47.
				TIME	4.40	4.40	4.40	4.50	4.50	4.40
2 COMBINED AT	CK2A	.53	1	FLOW	160.	137.	129.	96.	84.	115.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
DIVERSION TO	SD1	.53	1	FLOW	135.	135.	129.	96.	84.	115.
				TIME	4.10	4.30	4.40	4.40	4.40	4.40
HYDROGRAPH AT	DSD1	.53	1	FLOW	25.	2.	0.	0.	0.	0.
				TIME	4.40	4.40	.10	.10	.10	.10
HYDROGRAPH AT	BASK1	.33	1	FLOW	80.	69.	65.	49.	43.	58.
				TIME	5.30	5.40	5.40	5.40	5.50	5.40
2 COMBINED AT	CK1	.86	1	FLOW	88.	69.	65.	49.	43.	58.
				TIME	4.50	5.40	5.40	5.40	5.50	5.40
DIVERSION TO	SD2	.86	1	FLOW	25.	25.	25.	25.	25.	25.
				TIME	3.80	3.90	4.00	4.20	4.30	4.00
HYDROGRAPH AT	DSD2	.86	1	FLOW	63.	44.	40.	24.	18.	33.
				TIME	4.50	5.40	5.40	5.40	5.50	5.40
2 COMBINED AT	CXK	4.39	1	FLOW	1562.	1260.	1150.	704.	529.	961.
				TIME	6.50	6.50	6.50	6.50	6.50	6.50
DIVERSION TO	SD3	4.39	1	FLOW	50.	50.	50.	50.	50.	50.
				TIME	4.20	4.30	4.40	5.10	5.40	4.60
HYDROGRAPH AT	DSD3	4.39	1	FLOW	1512.	1210.	1100.	654.	479.	911.
				TIME	6.50	6.50	6.50	6.50	6.50	6.50
ROUTED TO	RXLM	4.39	1	FLOW	1509.	1207.	1097.	652.	478.	909.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
HYDROGRAPH AT	SUBW	.26	1	FLOW	197.	174.	166.	133.	119.	152.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
ROUTED TO	RTLO	.26	1	FLOW	193.	172.	163.	131.	117.	150.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	SUBS1	.07	1	FLOW	53.	47.	44.	35.	31.	40.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60

HYDROGRAPH AT	SUBN1	.00	1	FLOW	5.	4.	4.	3.	3.	4.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	COMLO	.33	1	FLOW	240.	213.	203.	162.	145.	186.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
ROUTED TO	RTBL	.33	1	FLOW	237.	210.	200.	159.	143.	183.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	SUBS2	.12	1	FLOW	45.	37.	34.	22.	18.	29.
				TIME	3.60	3.60	3.60	3.60	3.70	3.60
HYDROGRAPH AT	SUBN2	.01	1	FLOW	5.	4.	3.	2.	2.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	COMBL	.46	1	FLOW	275.	241.	229.	179.	159.	208.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	RTTP	.46	1	FLOW	272.	239.	226.	177.	157.	206.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	SUBS3	.12	1	FLOW	41.	33.	31.	20.	16.	26.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	SUBN3	.02	1	FLOW	9.	7.	7.	5.	4.	6.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMTP	.60	1	FLOW	310.	270.	255.	197.	173.	231.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	RTL1	.60	1	FLOW	307.	267.	253.	195.	171.	228.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	SUBS4	.02	1	FLOW	10.	8.	7.	5.	4.	6.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	SUBN4	.01	1	FLOW	3.	3.	2.	2.	1.	2.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	COMLI	.63	1	FLOW	311.	271.	256.	197.	173.	231.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RTAR	.63	1	FLOW	308.	268.	253.	195.	171.	229.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	SUBS5	.06	1	FLOW	22.	18.	16.	11.	9.	14.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMAR	.69	1	FLOW	319.	278.	262.	201.	177.	236.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
ROUTED TO	RTSAN	.69	1	FLOW	317.	275.	260.	199.	175.	234.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
HYDROGRAPH AT	SUBN5	.04	1	FLOW	18.	15.	14.	9.	8.	12.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMSS	.73	1	FLOW	321.	278.	263.	202.	177.	237.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	RTJN	.73	1	FLOW	318.	276.	261.	200.	175.	235.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	SUBS6	.02	1	FLOW	19.	17.	16.	13.	12.	15.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	SUBN6	.01	1	FLOW	6.	6.	6.	4.	4.	5.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50

3 COMBINED AT	COMJN	.76	1	FLOW	322.	280.	264.	202.	178.	238.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	RTSA	.76	1	FLOW	320.	278.	262.	201.	176.	236.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	SUBS7	.05	1	FLOW	22.	18.	16.	11.	9.	14.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SUBN7	.03	1	FLOW	13.	11.	10.	7.	6.	9.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMSA	.84	1	FLOW	327.	284.	268.	205.	180.	241.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
ROUTED TO	RM2A	.84	1	FLOW	325.	282.	266.	204.	179.	240.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	AREAU	.03	1	FLOW	27.	23.	22.	17.	15.	20.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	SMITH	.86	1	FLOW	332.	288.	272.	208.	183.	245.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
ROUTED TO	ROUT	.86	1	FLOW	330.	286.	270.	207.	181.	244.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	AREAT	.05	1	FLOW	20.	17.	16.	13.	11.	15.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	AREAB	.00	1	FLOW	4.	4.	4.	3.	2.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	SHAD	.91	1	FLOW	343.	298.	281.	216.	189.	254.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
ROUTED TO	ROUT	.91	1	FLOW	342.	296.	280.	214.	188.	252.
				TIME	4.70	4.70	4.70	4.70	4.70	4.70
HYDROGRAPH AT	AREAB	.03	1	FLOW	19.	16.	15.	12.	10.	14.
				TIME	3.70	3.70	3.70	3.80	3.80	3.70
2 COMBINED AT	JEAN	.95	1	FLOW	349.	303.	286.	219.	192.	258.
				TIME	4.70	4.70	4.70	4.70	4.70	4.70
ROUTED TO	ROUT	.95	1	FLOW	347.	302.	285.	218.	191.	257.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	AREAC	.01	1	FLOW	4.	4.	4.	3.	3.	3.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	AREAS	.03	1	FLOW	13.	11.	11.	8.	7.	10.
				TIME	4.00	4.00	4.00	4.10	4.10	4.00
3 COMBINED AT	MICH	.99	1	FLOW	357.	310.	293.	224.	197.	264.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80
ROUTED TO	ROUT	.99	1	FLOW	354.	307.	290.	222.	195.	262.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
HYDROGRAPH AT	AREAR	.03	1	FLOW	14.	12.	11.	9.	7.	10.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	TEQ	1.01	1	FLOW	361.	314.	296.	227.	199.	267.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
ROUTED TO	ROUT	1.01	1	FLOW	358.	311.	294.	225.	198.	265.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00

HYDROGRAPH AT	AREAD	.03	1	FLOW	16.	13.	13.	10.	8.	11.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	AREAQ	.07	1	FLOW	32.	28.	26.	20.	17.	24.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
3 COMBINED AT	LEON	1.11	1	FLOW	387.	336.	317.	244.	214.	287.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00
ROUTED TO	ROUT	1.11	1	FLOW	385.	335.	316.	243.	213.	285.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10
HYDROGRAPH AT	AREAE	.05	1	FLOW	20.	17.	16.	12.	11.	14.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	AREAP	.10	1	FLOW	43.	37.	35.	27.	23.	32.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	AREADS	.00	1	FLOW	5.	4.	4.	3.	3.	4.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	AREADN	.00	1	FLOW	4.	4.	4.	3.	3.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
5 COMBINED AT	DEC	1.27	1	FLOW	427.	372.	351.	271.	238.	317.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10
ROUTED TO	RM1	1.27	1	FLOW	424.	369.	349.	269.	236.	315.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	BASLJ	.40	1	FLOW	119.	104.	99.	77.	68.	90.
				TIME	5.00	5.00	5.10	5.10	5.20	5.10
2 COMBINED AT	+	1.67	1	FLOW	542.	473.	447.	346.	305.	405.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
DIVERSION TO	LMSD1	1.67	1	FLOW	542.	473.	447.	346.	305.	405.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	DV SD	1.67	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
2 COMBINED AT	CB MED	6.06	1	FLOW	1509.	1207.	1097.	652.	478.	909.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
DIVERSION TO	5X4	6.06	1	FLOW	200.	200.	200.	200.	200.	200.
				TIME	4.50	5.00	5.20	5.70	5.80	5.40
HYDROGRAPH AT	DV 5X4	6.06	1	FLOW	1309.	1007.	897.	452.	278.	709.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
DIVERSION TO	*MEAD*	*6.06*	*1*	*FLOW*	*1309.*	*1007.*	*897.*	*452.*	*278.*	*709.*
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
HYDROGRAPH AT	DV MED	6.06	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
ROUTED TO	RR	6.06	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	BASI	.05	1	FLOW	31.	28.	27.	21.	19.	24.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	+	6.11	1	FLOW	31.	28.	27.	21.	19.	24.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	RT1	6.11	1	FLOW	31.	28.	26.	21.	19.	24.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90

HYDROGRAPH AT	BASH	.13	1	FLOW	67.	59.	56.	45.	40.	51.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	HI	6.24	1	FLOW	97.	86.	82.	65.	58.	75.
				TIME	3.90	3.90	3.90	3.90	4.00	3.90
HYDROGRAPH AT	LMSD1	.00	1	FLOW	542.	473.	447.	346.	305.	405.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	5X4	.00	1	FLOW	200.	200.	200.	200.	200.	200.
				TIME	4.50	5.00	5.20	5.70	5.80	5.40
2 COMBINED AT	CB DIV	.00	1	FLOW	742.	673.	647.	480.	408.	581.
				TIME	5.20	5.20	5.20	5.60	5.80	5.40
ROUTED TO	RT DET	.00	1	FLOW	742.	673.	647.	480.	408.	581.
				TIME	5.30	5.30	5.30	5.70	5.90	5.50
DIVERSION TO	LM36	.00	1	FLOW	50.	50.	50.	50.	50.	50.
				TIME	2.50	3.10	3.20	3.50	3.60	3.30
HYDROGRAPH AT	DVLM36	.00	1	FLOW	692.	623.	597.	430.	358.	531.
				TIME	5.30	5.30	5.30	5.70	5.90	5.50
2 COMBINED AT	CMB1	6.24	1	FLOW	745.	670.	642.	450.	370.	564.
				TIME	5.30	5.30	5.30	5.70	5.90	5.50
HYDROGRAPH AT	B1A	.05	1	FLOW	35.	31.	29.	23.	21.	27.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	DVFLAT	.00	1	FLOW	20.	20.	20.	20.	20.	20.
				TIME	2.10	2.30	2.40	2.90	3.20	2.60
HYDROGRAPH AT	DVCUL1	.00	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	2.90	3.30	3.40	3.60	3.70	3.50
3 COMBINED AT	B1A+C	.05	1	FLOW	90.	86.	84.	78.	76.	82.
				TIME	3.60	3.60	3.60	3.60	3.70	3.60
HYDROGRAPH AT	B1B	.01	1	FLOW	9.	8.	8.	6.	5.	7.
				TIME	3.70	3.70	3.70	3.80	3.80	3.70
2 COMBINED AT	CB AB	.07	1	FLOW	99.	94.	92.	84.	81.	89.
				TIME	3.60	3.60	3.60	3.60	3.70	3.70
ROUTED TO	ROUT	.07	1	FLOW	98.	93.	91.	84.	81.	88.
				TIME	3.70	3.80	3.80	3.80	3.90	3.80
HYDROGRAPH AT	B2	.11	1	FLOW	62.	54.	52.	41.	37.	47.
				TIME	3.70	3.80	3.80	3.80	3.90	3.80
2 COMBINED AT	B1+B2	.17	1	FLOW	160.	147.	143.	125.	118.	135.
				TIME	3.70	3.80	3.80	3.80	3.90	3.80
ROUTED TO	RBAS2	.17	1	FLOW	160.	147.	143.	125.	117.	135.
				TIME	3.80	3.90	3.90	3.90	4.00	3.90
HYDROGRAPH AT	DVCUL	.00	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	3.40	3.50	3.60	3.70	3.80	3.60
HYDROGRAPH AT	PSM1	.00	1	FLOW	261.	261.	261.	261.	261.	261.
				TIME	4.20	4.30	4.40	5.00	5.30	4.50
2 COMBINED AT	+	.00	1	FLOW	296.	296.	296.	296.	296.	296.
				TIME	4.20	4.30	4.40	5.00	5.30	4.50
ROUTED TO	R	.00	1	FLOW	296.	296.	296.	296.	296.	296.
				TIME	4.60	4.80	4.80	5.50	5.80	5.00

HYDROGRAPH AT	B4	.11	1	FLOW	63.	56.	53.	43.	38.	49.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
3 COMBINED AT	CB4	.28	1	FLOW	473.	440.	428.	414.	396.	423.
				TIME	4.20	4.40	4.50	5.10	5.40	5.00
ROUTED TO	RB4	.28	1	FLOW	464.	435.	427.	411.	392.	422.
				TIME	4.30	4.50	5.10	5.30	5.50	5.10
DIVERSION TO	SD4	.28	1	FLOW	20.	20.	20.	20.	20.	20.
				TIME	.90	1.00	1.00	1.40	1.50	1.10
HYDROGRAPH AT	DSD4	.28	1	FLOW	444.	415.	407.	391.	372.	402.
				TIME	4.30	4.50	5.10	5.30	5.50	5.10
ROUTED TO	RB3	.28	1	FLOW	438.	411.	407.	390.	370.	402.
				TIME	4.50	4.60	5.20	5.40	5.70	5.20
HYDROGRAPH AT	SD1A	.00	1	FLOW	13.	11.	10.	6.	5.	8.
				TIME	5.50	5.50	5.50	5.60	5.60	5.50
ROUTED TO	R	.00	1	FLOW	13.	11.	10.	6.	5.	8.
				TIME	5.60	5.60	5.60	5.70	5.70	5.60
HYDROGRAPH AT	SD1B	.00	1	FLOW	12.	10.	10.	8.	7.	9.
				TIME	5.40	5.50	5.50	5.50	5.50	5.50
2 COMBINED AT	+	.00	1	FLOW	25.	21.	20.	14.	12.	17.
				TIME	5.50	5.50	5.60	5.60	5.60	5.60
ROUTED TO	R	.00	1	FLOW	25.	21.	20.	14.	12.	17.
				TIME	5.60	5.60	5.70	5.70	5.70	5.70
ROUTED TO	R1	.00	1	FLOW	25.	21.	20.	14.	12.	17.
				TIME	5.70	5.70	5.80	5.80	5.80	5.80
HYDROGRAPH AT	SD1	.00	1	FLOW	135.	135.	129.	96.	84.	115.
				TIME	4.10	4.30	4.40	4.40	4.40	4.40
2 COMBINED AT	+	.00	1	FLOW	155.	148.	140.	104.	90.	125.
				TIME	4.80	4.50	4.40	4.50	4.50	4.40
ROUTED TO	R1	.00	1	FLOW	155.	148.	140.	104.	90.	125.
				TIME	4.90	4.60	4.50	4.60	4.60	4.50
HYDROGRAPH AT	SD2	.00	1	FLOW	25.	25.	25.	25.	25.	25.
				TIME	3.80	3.90	4.00	4.20	4.30	4.00
2 COMBINED AT	+	.00	1	FLOW	180.	173.	165.	129.	115.	150.
				TIME	4.90	4.60	4.50	4.60	4.60	4.50
ROUTED TO	R3	.00	1	FLOW	180.	173.	165.	129.	115.	150.
				TIME	5.00	4.70	4.60	4.70	4.70	4.60
HYDROGRAPH AT	SD3	.00	1	FLOW	50.	50.	50.	50.	50.	50.
				TIME	4.20	4.30	4.40	5.10	5.40	4.60
2 COMBINED AT	+	.00	1	FLOW	230.	223.	215.	169.	158.	200.
				TIME	5.00	4.70	4.60	5.50	5.60	4.60
ROUTED TO	RK1	.00	1	FLOW	230.	223.	215.	169.	158.	200.
				TIME	5.10	4.80	4.70	5.60	5.70	4.70
HYDROGRAPH AT	SD4	.00	1	FLOW	20.	20.	20.	20.	20.	20.
				TIME	.90	1.00	1.00	1.40	1.50	1.10
2 COMBINED AT	+	.00	1	FLOW	250.	243.	235.	189.	178.	220.
				TIME	5.10	4.80	4.70	5.60	5.70	4.70

ROUTED TO	RSD	.00	1	FLOW	250.	243.	235.	189.	178.	220.
				TIME	5.20	4.90	4.80	5.70	5.80	4.80
2 COMBINED AT	+	.28	1	FLOW	677.	650.	637.	577.	548.	614.
				TIME	4.50	4.70	4.80	5.40	5.70	5.00
ROUTED TO	RR	.28	1	FLOW	676.	650.	637.	577.	548.	614.
				TIME	4.60	4.80	4.90	5.50	5.80	5.10
HYDROGRAPH AT	B1A	.05	1	FLOW	35.	31.	29.	23.	21.	27.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	CB CRY	6.58	1	FLOW	1424.	1322.	1282.	1025.	919.	1179.
				TIME	5.30	5.20	5.30	5.70	5.90	5.40
HYDROGRAPH AT	DVSTR1	.00	1	FLOW	1035.	872.	814.	577.	482.	715.
				TIME	6.30	6.20	6.20	6.30	6.70	6.30
HYDROGRAPH AT	DVSTR2	.00	1	FLOW	37.	37.	37.	37.	37.	37.
				TIME	2.90	3.10	3.20	3.40	3.50	3.30
2 COMBINED AT	CD	.00	1	FLOW	1072.	909.	851.	614.	519.	752.
				TIME	6.30	6.20	6.20	6.30	6.70	6.30
ROUTED TO	R-AB	.00	1	FLOW	1072.	908.	850.	614.	518.	751.
				TIME	6.40	6.30	6.30	6.40	6.80	6.40
HYDROGRAPH AT	N1	.10	1	FLOW	59.	51.	48.	37.	32.	44.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	STR1	.00	1	FLOW	6.	5.	5.	4.	4.	5.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	AB+	.10	1	FLOW	1073.	909.	852.	614.	518.	752.
				TIME	6.40	6.30	6.30	6.40	6.80	6.40
DIVERSION TO	DAV+	.10	1	FLOW	1048.	884.	827.	589.	493.	727.
				TIME	6.40	6.30	6.30	6.40	6.80	6.40
HYDROGRAPH AT	DAV+	.10	1	FLOW	25.	25.	25.	25.	25.	25.
				TIME	2.20	2.90	2.90	3.10	3.20	3.00
ROUTED TO	ROUT	.10	1	FLOW	25.	25.	25.	25.	25.	25.
				TIME	2.70	3.70	3.40	3.80	3.90	3.50
HYDROGRAPH AT	A1	.04	1	FLOW	26.	22.	21.	15.	12.	18.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	DVBOX	.00	1	FLOW	210.	210.	210.	210.	210.	210.
				TIME	3.60	3.70	3.80	4.10	4.50	3.90
3 COMBINED AT	+	.14	1	FLOW	257.	247.	246.	244.	243.	245.
				TIME	3.60	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	A2	.15	1	FLOW	56.	47.	43.	31.	26.	38.
				TIME	3.80	3.80	3.80	3.90	3.90	3.80
2 COMBINED AT	A2+	.29	1	FLOW	301.	291.	287.	265.	260.	280.
				TIME	3.80	3.80	3.80	4.10	4.90	3.90
ROUTED TO	ROUT	.29	1	FLOW	301.	290.	286.	264.	259.	279.
				TIME	3.90	3.90	3.90	4.20	5.00	4.00
HYDROGRAPH AT	DAV+	.00	1	FLOW	1048.	884.	827.	589.	493.	727.
				TIME	6.40	6.30	6.30	6.40	6.80	6.40
ROUTED TO	AA-BB	.00	1	FLOW	1048.	883.	826.	589.	493.	727.
				TIME	6.50	6.40	6.40	6.50	6.90	6.50

HYDROGRAPH AT	FN2	.13	1	FLOW	73.	65.	62.	50.	45.	57.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	STR2	.01	1	FLOW	11.	10.	9.	8.	7.	9.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	HYD+	.14	1	FLOW	79.	70.	67.	54.	48.	61.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	FN4	.14	1	FLOW	74.	66.	63.	50.	45.	58.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	BA-BB	.14	1	FLOW	74.	66.	63.	50.	45.	57.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
3 COMBINED AT	BB+	.28	1	FLOW	1061.	896.	838.	599.	498.	738.
				TIME	6.40	6.40	6.40	6.40	6.50	6.40
DIVERSION TO	DBB	.28	1	FLOW	80.	80.	80.	80.	80.	80.
				TIME	3.30	3.40	3.40	3.50	3.60	3.50
HYDROGRAPH AT	DBB	.28	1	FLOW	981.	816.	758.	519.	418.	658.
				TIME	6.40	6.40	6.40	6.40	6.50	6.40
ROUTED TO	ROUT	.28	1	FLOW	980.	815.	757.	518.	418.	657.
				TIME	6.50	6.50	6.50	6.50	6.60	6.50
2 COMBINED AT	+	.57	1	FLOW	1218.	1053.	995.	755.	654.	894.
				TIME	6.50	6.50	6.50	6.50	6.60	6.50
ROUTED TO	R"W"	.57	1	FLOW	1218.	1052.	995.	754.	654.	894.
				TIME	6.60	6.60	6.60	6.60	6.70	6.60
HYDROGRAPH AT	A3	.15	1	FLOW	56.	47.	43.	31.	26.	38.
				TIME	3.80	3.80	3.80	3.90	3.90	3.80
2 COMBINED AT	+	.72	1	FLOW	1219.	1054.	996.	756.	655.	895.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
HYDROGRAPH AT	DBB	.00	1	FLOW	80.	80.	80.	80.	80.	80.
				TIME	3.30	3.40	3.40	3.50	3.60	3.50
ROUTED TO	BB-CB	.00	1	FLOW	80.	80.	80.	80.	80.	80.
				TIME	3.40	3.50	3.50	3.60	3.70	3.60
HYDROGRAPH AT	N9	.15	1	FLOW	68.	60.	57.	45.	40.	52.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	N9-CA	.15	1	FLOW	67.	59.	56.	45.	40.	52.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	FN6	.13	1	FLOW	60.	53.	50.	40.	36.	46.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
2 COMBINED AT	CA+	.28	1	FLOW	127.	112.	106.	84.	75.	97.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	CA-CB	.28	1	FLOW	126.	111.	106.	84.	75.	96.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	FN5	.12	1	FLOW	53.	47.	45.	36.	32.	41.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
HYDROGRAPH AT	STA3	.01	1	FLOW	10.	9.	9.	7.	7.	8.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	HYD+	.41	1	FLOW	180.	159.	151.	120.	107.	138.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30

2 COMBINED AT	CB+	.41	1	FLOW	260.	239.	231.	200.	187.	218.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
DIVERSION TO	ALLEN	.41	1	FLOW	181.	181.	181.	181.	170.	181.
				TIME	3.80	3.90	4.00	4.30	4.30	4.00
HYDROGRAPH AT	ALLEN	.41	1	FLOW	79.	58.	50.	19.	17.	37.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	R"Y"	.41	1	FLOW	78.	57.	49.	19.	16.	36.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	HYD+	1.13	1	FLOW	1222.	1056.	998.	756.	655.	896.
				TIME	6.60	6.50	6.60	6.60	6.60	6.60
ROUTED TO	R"Z"	1.13	1	FLOW	1221.	1055.	997.	755.	655.	895.
				TIME	6.70	6.70	6.70	6.70	6.70	6.70
HYDROGRAPH AT	ALLEN	.00	1	FLOW	181.	181.	181.	181.	170.	181.
				TIME	3.80	3.90	4.00	4.30	4.30	4.00
ROUTED TO	CB-LOW	.00	1	FLOW	181.	181.	181.	181.	170.	181.
				TIME	3.90	4.00	4.10	4.40	4.40	4.10
ROUTED TO	ROUT	.00	1	FLOW	181.	181.	181.	180.	170.	181.
				TIME	4.40	4.50	4.50	4.50	4.50	4.60
2 COMBINED AT	+F	1.13	1	FLOW	1334.	1166.	1106.	859.	756.	1002.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
ROUTED TO	RBAS1	1.13	1	FLOW	1333.	1165.	1105.	859.	755.	1002.
				TIME	6.70	6.70	6.70	6.70	6.70	6.70
HYDROGRAPH AT	B3	.31	1	FLOW	132.	116.	110.	86.	76.	100.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
2 COMBINED AT	CB3	1.45	1	FLOW	1350.	1180.	1120.	871.	766.	1015.
				TIME	6.70	6.70	6.70	6.70	6.70	6.70
2 COMBINED AT	CB LMD	8.02	1	FLOW	2330.	2115.	2035.	1714.	1583.	1899.
				TIME	6.40	6.40	6.40	6.40	6.40	6.40
ROUTED TO	2A	8.02	1	FLOW	2011.	1621.	1367.	708.	349.	1150.
				TIME	7.30	7.90	8.30	9.10	9.50	8.60
			** PEAK STAGES IN FEET **							
			1	STAGE	119.13	119.05	118.98	118.33	117.46	118.77
				TIME	7.30	7.90	8.30	9.10	9.50	8.60
HYDROGRAPH AT	RLM36	.00	1	FLOW	50.	50.	50.	50.	50.	50.
				TIME	2.50	3.10	3.20	3.50	3.60	3.30
2 COMBINED AT	CB SD	8.02	1	FLOW	2061.	1671.	1417.	712.	363.	1200.
				TIME	7.30	7.90	8.30	9.10	8.40	8.60
ROUTED TO	RTIH	8.02	1	FLOW	2058.	1667.	1416.	711.	362.	1200.
				TIME	7.40	8.00	8.40	9.20	8.50	8.70
HYDROGRAPH AT	BASF1	.09	1	FLOW	36.	31.	29.	22.	19.	26.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RF1	.09	1	FLOW	36.	31.	29.	22.	19.	26.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
HYDROGRAPH AT	BASF2	.06	1	FLOW	22.	19.	17.	13.	11.	15.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
2 COMBINED AT	CMB2	.15	1	FLOW	58.	49.	46.	35.	30.	41.

				TIME	4.10	4.20	4.20	4.20	4.20	4.20
2 COMBINED AT	FLOW1	8.17	1	FLOW	2059.	1667.	1416.	711.	362.	1200.
				TIME	7.40	8.00	8.40	9.20	8.50	8.70
ROUTED TO	RTF1H	8.17	1	FLOW	2056.	1662.	1416.	711.	360.	1199.
				TIME	7.50	8.10	8.50	9.30	8.60	8.80
HYDROGRAPH AT	BASD	.06	1	FLOW	19.	16.	15.	11.	10.	13.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	BASE	.02	1	FLOW	10.	8.	8.	6.	5.	7.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	CMB3	.08	1	FLOW	22.	19.	18.	14.	12.	16.
				TIME	4.80	4.80	4.80	4.90	4.90	4.90
2 COMBINED AT	FLOW2	8.25	1	FLOW	2058.	1663.	1416.	711.	360.	1199.
				TIME	7.50	8.10	8.50	9.30	8.60	8.80
ROUTED TO	RDEFI	8.25	1	FLOW	2045.	1650.	1415.	709.	357.	1197.
				TIME	7.60	8.20	8.60	9.40	8.70	8.90
HYDROGRAPH AT	BASC	.04	1	FLOW	15.	13.	12.	9.	8.	11.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
2 COMBINED AT	FLOW3	8.29	1	FLOW	2045.	1650.	1415.	709.	357.	1197.
				TIME	7.60	8.20	8.60	9.40	8.70	8.90
ROUTED TO	RTC	8.29	1	FLOW	2030.	1635.	1413.	707.	355.	1194.
				TIME	7.80	8.30	8.70	9.50	8.70	9.00
HYDROGRAPH AT	BASB	.01	1	FLOW	5.	5.	4.	3.	3.	4.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	BASB1	.01	1	FLOW	8.	7.	6.	5.	4.	6.
				TIME	3.90	3.90	3.90	4.00	4.00	4.00
2 COMBINED AT	CMB5	.02	1	FLOW	12.	11.	10.	8.	7.	9.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	FLOW4	8.32	1	FLOW	2030.	1635.	1413.	707.	355.	1194.
				TIME	7.80	8.30	8.70	9.50	8.70	9.00
ROUTED TO	RTB	8.32	1	FLOW	2023.	1622.	1411.	705.	354.	1191.
				TIME	7.90	8.40	8.80	9.60	8.80	9.10
HYDROGRAPH AT	BASA	.01	1	FLOW	8.	7.	6.	5.	4.	6.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	BASG	.07	1	FLOW	43.	38.	36.	28.	25.	33.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	CMB6	.08	1	FLOW	48.	42.	40.	32.	28.	37.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	FLOW5	8.40	1	FLOW	2023.	1622.	1411.	705.	354.	1191.
				TIME	7.90	8.40	8.80	9.60	8.80	9.10
ROUTED TO	RT CRY	8.40	1	FLOW	2017.	1614.	1410.	704.	353.	1189.
				TIME	8.00	8.60	8.90	9.70	8.90	9.20
HYDROGRAPH AT	F10A	.08	1	FLOW	45.	40.	38.	30.	27.	35.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	RTF10B	.08	1	FLOW	44.	39.	37.	30.	26.	34.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	FN10B	.05	1	FLOW	34.	30.	29.	23.	20.	26.

				TIME	3.70	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	CB F10	.13	1	FLOW	72.	63.	60.	48.	43.	55.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	RT A4	.13	1	FLOW	69.	61.	58.	46.	41.	53.
				TIME	4.00	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	A4	.08	1	FLOW	43.	36.	34.	24.	20.	29.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	CB A4	.21	1	FLOW	89.	78.	74.	58.	51.	67.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RT W	.21	1	FLOW	87.	76.	72.	56.	49.	65.
				TIME	4.10	4.10	4.20	4.20	4.20	4.20
HYDROGRAPH AT	W	.24	1	FLOW	121.	106.	101.	79.	70.	92.
				TIME	3.90	3.90	3.90	4.00	4.00	4.00
2 COMBINED AT	CB W	.45	1	FLOW	205.	180.	170.	132.	117.	154.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RT W1	.45	1	FLOW	194.	170.	161.	125.	111.	146.
				TIME	4.50	4.50	4.50	4.50	4.60	4.50
HYDROGRAPH AT	BASR	.22	1	FLOW	122.	107.	102.	80.	71.	92.
				TIME	3.80	3.80	3.80	3.80	3.90	3.80
ROUTED TO	RT R1	.22	1	FLOW	117.	103.	97.	77.	68.	89.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	R1	.20	1	FLOW	101.	88.	83.	65.	57.	76.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	CB R1	.42	1	FLOW	215.	189.	179.	140.	124.	162.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RT R2	.42	1	FLOW	211.	186.	176.	137.	122.	160.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	R2	.20	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
2 COMBINED AT	CB R2	.62	1	FLOW	211.	186.	176.	137.	122.	160.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
DIVERSION TO	SD5	.62	1	FLOW	70.	70.	70.	70.	70.	70.
				TIME	3.50	3.60	3.60	3.70	3.70	3.60
HYDROGRAPH AT	DSD5	.62	1	FLOW	141.	116.	106.	67.	52.	90.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
ROUTED TO	RR	.62	1	FLOW	136.	111.	101.	64.	49.	86.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	W1	.38	1	FLOW	99.	85.	80.	60.	52.	71.
				TIME	4.80	4.90	4.90	5.00	5.10	4.90
3 COMBINED AT	CB W1	1.45	1	FLOW	411.	349.	326.	235.	198.	287.
				TIME	4.40	4.40	4.40	4.40	4.50	4.40
ROUTED TO	RT W2	1.45	1	FLOW	392.	332.	310.	224.	189.	274.
				TIME	4.80	4.90	4.90	4.90	4.90	4.90
HYDROGRAPH AT	S	.49	1	FLOW	174.	151.	143.	110.	96.	129.
				TIME	4.30	4.30	4.40	4.40	4.40	4.40
DIVERSION TO	SD62	.49	1	FLOW	89.	86.	85.	80.	79.	83.

				TIME	4.30	4.30	4.40	4.40	4.40	4.40
HYDROGRAPH AT	DSD62	.49	1	FLOW	85.	66.	58.	30.	18.	46.
				TIME	4.30	4.30	4.40	4.40	4.40	4.40
ROUTED TO	RS	.49	1	FLOW	84.	65.	58.	29.	17.	46.
				TIME	4.40	4.50	4.50	4.50	4.50	4.50
DIVERSION TO	SD7	.49	1	FLOW	15.	15.	14.	13.	9.	14.
				TIME	4.40	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	DSD7	.49	1	FLOW	69.	50.	43.	16.	8.	32.
				TIME	4.40	4.50	4.50	4.50	4.50	4.50
ROUTED TO	ROUT	.49	1	FLOW	65.	47.	40.	14.	7.	29.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
HYDROGRAPH AT	W2	.45	1	FLOW	142.	123.	116.	89.	79.	105.
				TIME	4.60	4.60	4.60	4.70	4.70	4.60
3 COMBINED AT	+	2.39	1	FLOW	596.	500.	464.	326.	274.	406.
				TIME	4.80	4.80	4.80	4.90	4.90	4.80
DIVERSION TO	DWC	2.39	1	FLOW	596.	500.	464.	326.	274.	406.
				TIME	4.80	4.80	4.80	4.90	4.90	4.80
HYDROGRAPH AT	DWC	2.39	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	S1	.18	1	FLOW	69.	60.	57.	44.	39.	52.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
DIVERSION TO	SD8	.18	1	FLOW	22.	20.	20.	16.	14.	18.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	DSD8	.18	1	FLOW	47.	40.	37.	28.	25.	33.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	RS	.18	1	FLOW	47.	40.	37.	28.	25.	33.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
DIVERSION TO	SD91	.18	1	FLOW	33.	29.	27.	20.	18.	24.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	DSD91	.18	1	FLOW	13.	11.	11.	8.	7.	9.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	V	.13	1	FLOW	74.	64.	60.	46.	41.	55.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
DIVERSION TO	SD92	.13	1	FLOW	12.	10.	10.	8.	7.	9.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	DSD92	.13	1	FLOW	62.	54.	50.	38.	34.	45.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	CB V	.31	1	FLOW	68.	59.	56.	43.	37.	50.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	RT CRY	.31	1	FLOW	67.	58.	55.	42.	37.	50.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	CB LOS	2.70	1	FLOW	67.	58.	55.	42.	37.	50.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	SD5	.00	1	FLOW	70.	70.	70.	70.	70.	70.
				TIME	3.50	3.60	3.60	3.70	3.70	3.60
ROUTED TO	RR	.00	1	FLOW	70.	70.	70.	70.	70.	70.

				TIME	3.90	3.90	3.90	4.00	4.10	4.00
HYDROGRAPH AT	SD62	.00	1	FLOW	89.	86.	85.	80.	79.	83.
				TIME	4.30	4.30	4.40	4.40	4.40	4.40
2 COMBINED AT	+	.00	1	FLOW	159.	156.	155.	150.	149.	153.
				TIME	4.30	4.30	4.40	4.40	4.40	4.40
ROUTED TO	RS	.00	1	FLOW	159.	156.	155.	150.	149.	153.
				TIME	4.40	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	SD7	.00	1	FLOW	15.	15.	14.	13.	9.	14.
				TIME	4.40	4.50	4.50	4.50	4.50	4.50
2 COMBINED AT	+	.00	1	FLOW	174.	170.	169.	163.	158.	167.
				TIME	4.40	4.50	4.50	4.50	4.50	4.50
ROUTED TO	RS	.00	1	FLOW	174.	170.	169.	163.	157.	166.
				TIME	4.50	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	SD8	.00	1	FLOW	22.	20.	20.	16.	14.	18.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
2 COMBINED AT	+	.00	1	FLOW	195.	190.	188.	179.	171.	184.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
ROUTED TO	RS	.00	1	FLOW	195.	190.	188.	178.	170.	184.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	SD91	.00	1	FLOW	33.	29.	27.	20.	18.	24.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	SD92	.00	1	FLOW	12.	10.	10.	8.	7.	9.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
3 COMBINED AT	+	.00	1	FLOW	233.	222.	218.	201.	191.	211.
				TIME	4.50	4.50	4.50	4.50	4.60	4.50
HYDROGRAPH AT	DWC1	.00	1	FLOW	596.	500.	464.	326.	274.	406.
				TIME	4.80	4.80	4.80	4.90	4.90	4.80
2 COMBINED AT	+	.00	1	FLOW	824.	718.	679.	524.	461.	614.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80
3 COMBINED AT	CB LOS	11.10	1	FLOW	2055.	1628.	1418.	770.	691.	1193.
				TIME	8.00	8.50	8.90	4.90	4.90	9.20
HYDROGRAPH AT	MEAD	.00	1	FLOW	1309.	1007.	897.	452.	278.	709.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
DIVERSION TO	1-6X3	.00	1	FLOW	148.	133.	127.	97.	79.	117.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
HYDROGRAPH AT	DV 6X3	.00	1	FLOW	1160.	874.	770.	356.	199.	591.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
DIVERSION TO	2-6X3	.00	1	FLOW	170.	155.	149.	109.	88.	133.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
HYDROGRAPH AT	DV26X3	.00	1	FLOW	990.	720.	621.	247.	110.	458.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
DIVERSION TO	24CMP	.00	1	FLOW	27.	27.	27.	27.	27.	27.
				TIME	4.90	5.40	5.50	5.90	6.10	5.60
HYDROGRAPH AT	DV 24"	.00	1	FLOW	963.	693.	594.	220.	83.	431.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
HYDROGRAPH AT	J2	.22	1	FLOW	96.	84.	79.	62.	55.	72.

				TIME	4.10	4.10	4.10	4.10	4.10	4.10
2 COMBINED AT	CB J2	.22	1	FLOW	973.	702.	603.	226.	89.	439.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
DIVERSION TO	CORAN	.22	1	FLOW	155.	99.	79.	9.	0.	45.
				TIME	6.60	6.60	6.60	6.60	.10	6.60
HYDROGRAPH AT	DV COR	.22	1	FLOW	818.	603.	524.	217.	89.	394.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
ROUTED TO	RT VGS	.22	1	FLOW	813.	598.	520.	214.	87.	390.
				TIME	6.90	6.90	6.90	6.90	6.90	6.90
HYDROGRAPH AT	J3	.37	1	FLOW	192.	168.	159.	123.	109.	144.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	CB VEG	.59	1	FLOW	816.	601.	522.	216.	142.	393.
				TIME	6.90	6.90	6.90	6.90	4.00	6.90
DIVERSION TO	VEGAS	.59	1	FLOW	366.	270.	234.	97.	64.	176.
				TIME	6.90	6.90	6.90	6.90	4.00	6.90
HYDROGRAPH AT	DV VGS	.59	1	FLOW	450.	331.	288.	119.	78.	216.
				TIME	6.90	6.90	6.90	6.90	4.00	6.90
ROUTED TO	RT WAS	.59	1	FLOW	448.	329.	286.	117.	77.	215.
				TIME	7.20	7.20	7.20	7.20	4.30	7.20
HYDROGRAPH AT	309W	1.35	1	FLOW	169.	134.	120.	67.	47.	97.
				TIME	5.30	5.40	5.50	5.90	6.30	5.60
ROUTED TO	R309W	1.35	1	FLOW	165.	129.	116.	64.	45.	94.
				TIME	6.30	6.50	6.50	7.00	7.30	6.70
HYDROGRAPH AT	309E	1.19	1	FLOW	378.	303.	272.	180.	153.	230.
				TIME	4.30	4.40	4.50	4.80	5.10	4.60
DIVERSION TO	CULVRT	1.19	1	FLOW	158.	158.	158.	158.	153.	158.
				TIME	3.90	4.00	4.10	4.60	5.10	4.30
HYDROGRAPH AT	DV CUL	1.19	1	FLOW	220.	145.	114.	22.	0.	72.
				TIME	4.30	4.40	4.50	4.80	.10	4.60
2 COMBINED AT	309E	2.54	1	FLOW	220.	145.	116.	64.	45.	94.
				TIME	4.30	4.40	6.50	7.00	7.30	6.70
2 COMBINED AT	CB WAS	3.13	1	FLOW	560.	426.	376.	179.	92.	295.
				TIME	7.00	7.10	7.10	7.20	7.20	7.10
DIVERSION TO	WASH	3.13	1	FLOW	157.	119.	105.	50.	26.	83.
				TIME	7.00	7.10	7.10	7.20	7.20	7.10
HYDROGRAPH AT	DV WAS	3.13	1	FLOW	403.	306.	271.	129.	67.	212.
				TIME	7.00	7.10	7.10	7.20	7.20	7.10
ROUTED TO	RT 310	3.13	1	FLOW	401.	305.	269.	128.	66.	211.
				TIME	7.30	7.40	7.40	7.50	7.50	7.40
HYDROGRAPH AT	310W	1.08	1	FLOW	502.	411.	385.	262.	220.	326.
				TIME	4.00	4.10	4.10	4.20	4.30	4.10
ROUTED TO	R310W	1.08	1	FLOW	477.	396.	368.	253.	211.	315.
				TIME	4.30	4.40	4.40	4.60	4.70	4.50
HYDROGRAPH AT	310E	.97	1	FLOW	394.	315.	290.	192.	155.	245.
				TIME	4.00	4.10	4.10	4.20	4.30	4.10
2 COMBINED AT	310E	2.05	1	FLOW	775.	649.	598.	412.	346.	516.

				TIME	4.30	4.30	4.30	4.50	4.60	4.40
2 COMBINED AT	CB 310	5.18	1	FLOW	939.	753.	688.	472.	401.	582.
				TIME	4.40	4.40	4.40	4.50	4.60	4.40
DIVERSION TO	BONAN	5.18	1	FLOW	560.	473.	442.	333.	295.	391.
				TIME	4.40	4.40	4.40	4.50	4.60	4.40
HYDROGRAPH AT	DV BON	5.18	1	FLOW	379.	280.	246.	139.	106.	192.
				TIME	4.40	4.40	4.40	4.50	4.60	4.40
ROUTED TO	RT311W	5.18	1	FLOW	365.	270.	239.	132.	100.	186.
				TIME	4.90	4.90	5.00	5.10	5.20	5.00
HYDROGRAPH AT	VEGAS	.00	1	FLOW	366.	270.	234.	97.	64.	176.
				TIME	6.90	6.90	6.90	6.90	4.00	6.90
HYDROGRAPH AT	WASH	.00	1	FLOW	157.	119.	105.	50.	26.	83.
				TIME	7.00	7.10	7.10	7.20	7.20	7.10
2 COMBINED AT	CB DIV	.00	1	FLOW	522.	387.	338.	144.	82.	257.
				TIME	6.90	6.90	6.90	7.00	4.10	6.90
ROUTED TO	RT311W	.00	1	FLOW	517.	383.	334.	141.	80.	253.
				TIME	7.40	7.40	7.40	7.50	4.60	7.50
HYDROGRAPH AT	311W	.88	1	FLOW	375.	299.	277.	185.	148.	237.
				TIME	3.90	4.00	4.00	4.10	4.20	4.00
3 COMBINED AT	311W	6.06	1	FLOW	738.	590.	538.	344.	284.	445.
				TIME	4.90	5.00	5.00	5.10	5.10	5.00
ROUTED TO	RT311E	6.06	1	FLOW	733.	586.	534.	341.	282.	443.
				TIME	5.10	5.20	5.20	5.30	5.30	5.20
HYDROGRAPH AT	311E	.77	1	FLOW	130.	102.	94.	63.	50.	80.
				TIME	4.40	5.30	5.30	5.40	5.50	5.30
2 COMBINED AT	311E	6.83	1	FLOW	851.	687.	627.	403.	329.	523.
				TIME	5.10	5.20	5.20	5.30	5.40	5.30
HYDROGRAPH AT	1-6X3	.00	1	FLOW	148.	133.	127.	97.	79.	117.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
HYDROGRAPH AT	2-6X3	.00	1	FLOW	170.	155.	149.	109.	88.	133.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
HYDROGRAPH AT	24CMP	.00	1	FLOW	27.	27.	27.	27.	27.	27.
				TIME	4.90	5.40	5.50	5.90	6.10	5.60
HYDROGRAPH AT	CORAN	.00	1	FLOW	155.	99.	79.	9.	0.	45.
				TIME	6.60	6.60	6.60	6.60	.10	6.60
4 COMBINED AT	CB DIV	.00	1	FLOW	500.	414.	382.	242.	195.	323.
				TIME	6.60	6.60	6.60	6.60	6.60	6.60
ROUTED TO	RT312W	.00	1	FLOW	497.	410.	378.	240.	193.	319.
				TIME	7.20	7.20	7.20	7.20	7.20	7.20
HYDROGRAPH AT	312W	.87	1	FLOW	252.	195.	177.	108.	93.	145.
				TIME	4.10	4.20	4.30	5.20	5.20	4.40
2 COMBINED AT	312W	.87	1	FLOW	527.	439.	406.	265.	217.	346.
				TIME	7.10	7.10	7.10	7.10	7.20	7.10
ROUTED TO	R312W	.87	1	FLOW	526.	438.	405.	265.	216.	345.
				TIME	7.20	7.20	7.30	7.20	7.30	7.30
HYDROGRAPH AT	312E	.62	1	FLOW	145.	110.	97.	65.	55.	80.

				TIME	4.10	4.30	4.30	5.20	5.30	5.20
2 COMBINED AT	312E	1.49	1	FLOW	544.	455.	422.	280.	230.	361.
				TIME	7.20	7.20	7.20	7.20	7.20	7.20
HYDROGRAPH AT	CULV1	.00	1	FLOW	1028.	903.	856.	673.	598.	779.
				TIME	7.20	7.20	7.20	7.30	7.30	7.20
HYDROGRAPH AT	CULV2	.00	1	FLOW	684.	596.	563.	435.	383.	509.
				TIME	5.60	5.60	5.60	5.70	5.70	5.60
HYDROGRAPH AT	CULV3	.00	1	FLOW	520.	520.	520.	520.	496.	520.
				TIME	5.80	5.90	5.90	6.50	6.60	6.10
3 COMBINED AT	CB DIV	.00	1	FLOW	2015.	1827.	1758.	1483.	1348.	1643.
				TIME	6.20	6.30	6.30	6.40	6.50	6.30
ROUTED TO	RT 301	.00	1	FLOW	1984.	1798.	1729.	1450.	1318.	1614.
				TIME	8.60	8.60	8.60	8.70	8.80	8.70
HYDROGRAPH AT	301	18.62	1	FLOW	2300.	1972.	1851.	1384.	1198.	1653.
				TIME	8.10	8.10	8.10	8.20	8.20	8.10
2 COMBINED AT	WTRIB	18.62	1	FLOW	4256.	3742.	3552.	2806.	2491.	3238.
				TIME	8.30	8.40	8.40	8.50	8.60	8.50
HYDROGRAPH AT	BONAN	.00	1	FLOW	560.	473.	442.	333.	295.	391.
				TIME	4.40	4.40	4.40	4.50	4.60	4.40
DIVERSION TO	RANCHO	.00	1	FLOW	151.	124.	114.	80.	70.	98.
				TIME	4.40	4.40	4.40	4.50	4.60	4.40
HYDROGRAPH AT	DV RAN	.00	1	FLOW	409.	349.	328.	253.	225.	293.
				TIME	4.40	4.40	4.40	4.50	4.60	4.40

Wash.dat

WASH.DAT

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*          SEPTEMBER 1990               *
*           VERSION 4.0                 *
*                                       *
*  RUN DATE  08/16/1994  TIME  11:23:43 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*         (916) 756-1104                *
*                                       *
*****************************************
```


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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1     ID
    2     ID                                                  DATE: JUNE 1994
    3     ID      NORTHWEST LAS VEGAS FIS RESTUDY             FILE NAME: WASH.DAT
    4     ID      BY COE & VAN LOO CONSULTANTS, INC           JOB # 930017
    5     ID      PREPARED FOR CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
    6     ID
    7     ID    6-HOUR RAINFALL, 6 MINUTE TIME INTERVAL
    8     ID    RAINFALL DISTRIBUTION = SDN3
    9     ID    SCS UNIT HYDROGRAPH METHOD
   10     ID    EXISTING CONDITIONS
   11     ID
   12     ID
   13     ID
   14     ID      INFORMATION USED IN THIS HEC-1 MODEL IS BASED ON FIS HYDROLOGY REPORT
   15     ID      BY JAMES M. MONTGOMERY AND FINAL HYDROLOGY STUDY - LAKE MEAD BOULEVARD
   16     ID      PHASE 1A BY VTN NEVADA,
   17     ID
   18     ID
   19     ID      MOST KINEMATIC WAVE ROUTINGS IN THIS HEC-1 MODEL
   20     ID      HAVE BEEN REPLACED WITH MUSKINGUM ROUTING METHOD
   21     ID
   22     ID
   23     ID
   24     ID
   25     ID
   26     ID
          *DIAGRAM
   27     IT      6       0       0     300
   28     IO      5       0       0
   29     IN      5       0       0
          *
          * ************************************************************************
          *       PT OF INTEREST                              AREA          DARF
          *
          *       @ CAREY/ LAKE MEAD DETENTION BASIN          8.02          0.88
          *       @ HIGHLAND & BALZAR INTER.                  1.45          0.95
          *       @ RANCHO & VEGAS INTER.                     0.59          0.98
          *       @ RANCHO & WASHINGTON INTER.                3.13          0.92
          *       @ RANCHO & US 95 INTER.                     5.45          0.90
          *       @ WASHINGTON & HIGHLAND INTER.              6.41          0.90
          *       @ I - 15 & OWENS INTER.                     7.18          0.89
          *
          *
          * ************************************************************************
          *
   30     JR    PREC    0.98    0.95    0.92    0.90    0.89    0.88
          *
          * ********************************************************
          * *  REFER TO VTN NEVADAS LAKE MEAD/ CAREY LAKE         *
          * *  DETENTION BASIN ALTERNATIVE 2A.A HEC-1 MODE        *
          * *  WATERSHEDS FN10A, FN10B, R, A4, AND W REVISED BY CVL
          * ********************************************************
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  31      KK      X4
  32      BA    0.81
          * McCARRAN AIRPORT RAINFALL VALUE = 2.77
  33      PB    2.77
          * DISTRIBUTION TYPE SDN3
  34      PC    .000    .020    .057     .07    .087    .108    .124    .130    .130    .130
  35      PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
  36      PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
  37      PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
  38      PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
  39      PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
  40      PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
  41      PC    .998    .999     1.0
  42      LS       0      91
  43      UD     1.9

  44      KK     X3B
  45      BA     .16
  46      LS       0      88
  47      UD    0.54

  48      KK    CUL4
          * ROUTE THRU 2-6 X 4 689+30
  49      RS       1    ELEV    13.5
  50      SV       0     .32      18
  51      SE    13.5      15      18
  52      SQ       0      60     245

  53      KK     X3A
  54      BA     .12
  55      LS       0      88
  56      UD    0.49

  57      KK    CUL8
          *    24"  674+06
  58      RS       1    ELEV    18.5
  59      SV       0     1.1     3.6
  60      SE    18.5    20.5    22.5
  61      SQ       0      15      28

  62      KK     CX3
          * COMBINE X3A &  X3B
  63      HC       2

  64      KK   RK3AB
          * ROUTE TO JONES
  65      RM      10     1.0      .3

  66      KK       +
  67      HC       2
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  68      KK   DEVX4
          * DIVORT 100 CFS TO CHEYNNE
  69      DT   DEVX4
  70      DI      0      50     100     200     500    1000    5000
  71      DQ      0      25      50     100     100     100     100

  72      KK     RK4
          *  ROUTE K4 SOUTH ON MICHAEL TO LOW POINT
          * THEN TO RANCHO
  73      RM      2     0.2     0.4

  74      KK     X3C
  75      BA     .48
  76      LS      0      81
  77      UD    1.52

  78      KK    SD1A
          *   DROP   INLET  @  BROOKS / JONES
  79      DT    SD1A
  80      DI      0      50      93     285     500
  81      DQ      0       5      13      21      21

  82      KK    RK3C
          *  ROUTE TO RANCHO
  83      RM      2     0.2    0.45

  84      KK      X3
  85      BA    0.34
  86      LS      0      92
  87      UD    0.71

  88      KK     CX3
          * COMBINE X3 X4 TO X3#
  89      HC      3

  90      KK    DTX4
          * RET. DIVORT FLOW X4
  91      DR   DEVX4

  92      KK    RDEX
          * ROUTE TO CHEYENNE
  93      RM      1     0.1    0.45

  94      KK    BSX5
  95      BA     0.1
  96      LS      0      92
  97      UD    0.42

  98      KK     CX5
          * COMBINE X5 & DEVX4
  99      HC      2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

100       KK   DVWR1
          * OVERFLOW CHEYENNE/RANCHO INTERSECTION
101       DT  DVSTR1
102       DI       0     167     261     622    1272
103       DQ       0       0      36     180     455

104       KK   DVWR2
          * 24" PIPE RANCHO
105       DT  DVSTR2
106       DI       0      10      20      30      37     100     500
107       DQ       0      10      20      30      37      37      37

108       KK     RX5
          * ROUTE TO 6 X 3 RCB
109       RM       1     0.1     0.3

110       KK   CX4X3
          * COMBINE X4 TO X3
111       HC       2

112       KK   DVBOX
          * ROUTE FLOW THRU 6 X 3 BOX (MEA)
113       DT   DVBOX
114       DI       0      50     100     170     210     700    5000
115       DQ       0      50     100     170     210     210     210

116       KK    RX34
          * ROUTE TO X3 43 X 27 CMP
117       RM       1     0.1    0.25

118       KK      X2
119       BA    0.20
120       LS       0      91
121       UD    0.40

122       KK    CUL5
          * 36" 633+05
123       RS       1    ELEV    33.5
124       SV       0    0.95      10
125       SE    33.5      35      39
126       SQ       0      20      73

127       KK     X1D
128       BA    0.07
129       LS       0      88
130       UD    0.45

131       KK    CUL9
          * 24" 644+60
132       RS       1    ELEV      28
133       SV       0     1.4     6.5
134       SE      28      30      33
135       SQ       0      15      33
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  136     KK     X1C
  137     BA    0.08
  138     LS       0      88
  139     UD    0.46

  140     KK   CUL10
          * 30" 650+20
  141     RS       1    ELEV      25
  142     SV       0    0.84    11.6
  143     SE      25      27    30.5
  144     SQ       0      18      53

  145     KK     X1B
  146     BA    0.07
  147     LS       0      88
  148     UD    0.47

  149     KK    CUL6
          * 24" 660+00
  150     RS       1    ELEV      22
  151     SV       0       4      10
  152     SE      22      25      27
  153     SQ       0      20      34

  154     KK     X1A
  155     BA    0.04
  156     LS       0      88
  157     UD    0.49

  158     KK    CUL7
          * 24"663+80
  159     RS       1    ELEV    21.5
  160     SV       0     0.5       2
  161     SE    21.5    23.5    25.5
  162     SQ       0      15      28

  163     KK     X12
          * X1# TO X2
  164     HC       5

  165     KK     RX2
          * ROUTE TO JONES
  166     RM       3     0.3    0.35

  167     KK     X1E
  168     BA    0.46
  169     LS       0      81
          * SCS UNIT HYDROGRAPH
  170     UD    1.38
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  171     KK    CX1E
          * COMBINE X1#
  172     HC       2

  173     KK    SD18
          *DROP INLET @ PEAK/JONES
  174     DT    SD18
  175     DI       0      50     100     212     500
  176     DQ       0       2       6      12      12

  177     KK     RX1
          * ROUTE TO RANCHO
  178     RM       2     0.2    0.35

  179     KK      X1
  180     BA    0.17
  181     LS       0      92
          * SCS UNIT HYDROGRAPH
  182     UD    0.80

  183     KK     CX1
          * COMBINE X
  184     HC       2

  185     KK   CX1X4
          * COMBINE X1 W/ROUTE FLOW ALONG RANCHO
  186     HC       2

  187     KK  DVFLAT
          * ROUTE FLOW THRU 43 X 27 CMP (MEA)
  188     DT  DVFLAT
  189     DI       0      10      15      20     100     700    5000
  190     DQ       0      10      15      20      20      20      20

  191     KK    RX34
          * ROUTE TO X1 TO N2 36"
  192     RM       1     0.1     0.3

  193     KK      N2
  194     BA    0.20
  195     LS       0      92
          * SCS UNIT HYDROGRAPH
  196     UD    0.97

  197     KK     CN2
          * COMBINE N2 TO X3
  198     HC       2

  199     KK   DVCUL1
          * 36"RCP
  200     DT  DVCUL1
  201     DI       0       5      10      15      20      35     100     700    5000
  202     DQ       0       5      10      15      20      35      35      35      35
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 203      KK     RN2
          * ROUTE TO N2 TO N1 36"
 204      RM       1     0.1    0.25

 205      KK      N1
 206      BA    0.23
 207      LS       0      92
          * SCS UNIT HYDROGRAPH
 208      UD     1.0

 209      KK     CN1
          * COMBINE N1 TO N2
 210      HC       2

 211      KK   DVCUL2
          * 36" RCP
 212      DT  DVCUL2
 213      DI       0       5      10      15      20      35     100     700    5000
 214      DQ       0       5      10      15      20      35      35      35      35

 215      KK     RN1
          * ROUTE TO N1 TO K
 216      RM       1     0.1    0.25

 217      KK     PSM
          * ******************************************
          * * FLOW ROUTED THROUGH 18" X 29" CMAP      *
          * *    HEADWALL = 4.5'                      *
          * *      OUTLET TO PIPE IS 6 X 3 RCB        *
          * *      NDOT STATION 65+75                 *
          * ******************************************
 218      DT    PSM1
 219      DI       0     100     200     261     300     400     500     800    5000
 220      DQ       0     100     200     261     261     261     261     261     261

 221      KK      K3
 222      BA   0.119
 223      LS       0      92
          * SCS UNIT HYDROGRAPH
 224      UD    0.40

 225      KK    CUL2
 226      KM   ROUTE6 X 4 RCB 624+000
 227      RS       1    ELEV      40
 228      SV       0    0.20     7.5
 229      SE      40      41      45
 230      SQ       0      17     170
          * FLOW EAST OF OK HIGHWAY
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

231       KK     RK3
          * ROUTE K3 TO K2
232       RM       2     0.2     0.3

233       KK      K2
234       BA   0.195
235       LS       0      77
          * SCS UNIT HYDROGRAPH
236       UD    0.71

237       KK    CK23
238       KM   COMBINE K3 &  K2
239       HC       2
          * PEAK FLOW @ TORREY PINES ON SMOKE RANCH

240       KK     RK2
241       KM   ROUTE K2 & K3 TO K2A
242       RM       1     0.1     0.4

243       KK     K2A
244       BA    0.22
245       LS       0      85
          * SCS UNIT HYDROGRAPH
246       UD    0.98

247       KK    CK2A
          * PEAK FLOW @ SMOKE RANCH/JONES
248       HC       2

249       KK    DSD1
          * ****************************************
          * *  SMOKE RANCH CLARK COUNTY SID NO. 39    *
          * *  DROP INLET NO.1 L=21', NO.2 L=14'      *
          * *    NO.3 L=7', NO.4-8 & 12  L=14'        *
          * *     6 EX DI                             *
          * ****************************************
250       DT     SD1
251       DI       0      25      50      75     100     135     150     185     250
252       DQ       0      25      50      75     100     135     135     135     135
          *   RK2A
          *
          * ROUTE TO RANCH STREET DRAINAGE        - TAKEN OUT BECAUSE Q AT DSDI = 0
          *   7100     .01    .016            TRAP      80      10

253       KK   BASK1
254       BA    0.33
255       LS       0      85
          * SCS UNIT  HYDROGRAPH
256       UD    1.49
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  257     KK     CK1
  258     KM   COMBINE K3, K2 & K1
          * PEAK FLOW  @ RANCHO
  259     HC       2

  260     KK    DSD2
          * ******************************************
          * *     SMOKE RANCH CLARK COUNTY SID NO. 39 *
          * *      DROP INLETS NO. 9-10  L=4'         *
          * *      2 EI DI                            *
          * ******************************************
  261     DT     SD2
  262     DI       0      10      20      25      30      50     100     150
  263     DQ       0      10      20      25      25      25      25      25

  264     KK     CXK
          * COMBINE PEAK FLOW @ RANCH
  265     HC       2

  266     KK    DSD3
          * ******************************************
          * *  SMOKE RANCH CLARK COUNTY SID NO. 39    *
          * *  DROP INLET NO.11 L=4' MOD "A"          *
          * *  1 EX DI - PLUS GRADE @ ISLAND          *
          * ******************************************
  267     DT     SD3
  268     DI       0      10      20      30      40      50     100     200     600    5000
  269     DQ       0      10      20      30      40      50      50      50      50      50

  270     KK    RXLM
          * ROUTE TO LAKE MEAD
  271     RM       1     0.1     0.3
          * ************************************
          * * LAKE MEAD WEST OF DECATUR        *
          * ************************************
          * ******************************
          * * G, B, & P BASINS             *
          * ******************************

  272     KK    SUBW
  273     BA    0.26
  274     LS       0      92
          * SCS UNIT HYDROGRAPH
  275     UD   0.27

  276     KK    RTLO
  277     KM   ROUTE SUBW H- GRAPH  TO LORENZI
  278     RM       1     0.1     0.4
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  279     KK   SUBS1
  280     BA    .07
  281     LS      0      89
  282     UD    .208

  283     KK   SUBN1
  284     BA    .005
  285     LS      0      89
  286     UD    .076

  287     KK   COMLO
  288     KM   COMBINE H-GRAPH AT LORENZI
  289     HC      3

  290     KK    RTBL
  291     KM   ROUTE FLOWS TO BILBRAY
  292     RM      1     0.1     0.4

  293     KK   SUBS2
  294     BA    .12
  295     LS      0      77
  296     UD    .24

  297     KK   SUBN2
  298     BA    .009
  299     LS      0      77
  300     UD    .107

  301     KK   COMBL
  302     KM   COMBINE H-GRAPH AT BILBRAY
  303     HC      3

  304     KK    RTTP
  305     KM   ROUTE FLOWS TO TORREY PINES
  306     RM      1     0.1     0.4

  307     KK   SUBS3
  308     BA    .12
  309     LS      0      77
  310     UD    .310

  311     KK   SUBN3
  312     BA    .02
  313     LS      0      77
  314     UD    .138

  315     KK   COMTP
  316     KM   COMBINE H-GRAPH AT TORREY PINE
  317     HC      3
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  318     KK    RTL1
  319     KM    ROUTE FLOWS TO LIRO
  320     RM       1     0.1     0.4

  321     KK    SUBS4
  322     BA      .02
  323     LS        0      77
  324     UD     .115

  325     KK    SUBN4
  326     BA     .006
  327     LS        0      77
  328     UD       .1

  329     KK    COMLI
  330     KM    COMBINE H-GRAPH AT LIRO
  331     HC        3

  332     KK    RTAR
  333     KM    ROUTE FLOWS TO ARPA
  334     RM       1     0.1     0.4

  335     KK    SUBS5
  336     BA      .06
  337     LS        0      77
  338     UD      .26

  339     KK    COMAR
  340     KM    COMBINE H-GRAPHS AT ARPA
  341     HC        2

  342     KK    RTSAN
  343     KM    ROUTE FLOWS TO SAN SIMEON
  344     RM       1     0.1     0.4

  345     KK    SUBN5
  346     BA      .04
  347     LS        0      77
  348     UD     .143

  349     KK    COMSS
  350     KM    COMBINE FLOWSAT SAN SIMEON
  351     HC        2

  352     KK    RTJN
  353     KM    ROUTE TO JONES
  354     RM       1     0.1     0.4

  355     KK    SUBS6
  356     BA      .02
  357     LS        0      92
  358     UD     .132
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 359      KK   SUBN6
 360      BA    .006
 361      LS      0      92
 362      UD    .09

 363      KK   COMJN
 364      KM   COMBINE H-GRAPHS AT JONES
 365      HC      3

 366      KK    RTSA
 367      KM   ROUTE TO SAYLOR
 368      RM      1     0.1     0.4

 369      KK   SUBS7
 370      BA    .05
 371      LS      0      77
 372      UD    .18

 373      KK   SUBN7
 374      BA    .03
 375      LS      0      77
 376      UD    .14

 377      KK   COMSA
 378      KM   COMBINE FLOWS AT SAYLOR
 379      HC      3
          * ****************************************
          * *     END OF G, B, & P BASINS          *
          * ****************************************

 380      KK    RM2A
          * ROUTE TO SMITH
 381      RM      1     0.1     0.4
          * ****************************************
          * *          SEA BASINS                  *
          * ****************************************

 382      KK   AREAU
 383      BA    .026
 384      LS      0      87
 385      UD  .03536

 386      KK   SMITH
          * PEAK FLOW SMITH
 387      HC      2

 388      KK    ROUT
          * ROUTE TO SHADOW
 389      RM      1     0.1     0.4
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 390      KK   AREAT
 391      BA   .0463
 392      LS      0      87
 393      UD   .5868

 394      KK   AREAB1
 395      BA   .0048
 396      LS      0      87
 397      UD   .0867

 398      KK    SHAD
          * PEAK FLOW SHADOW
 399      HC      3

 400      KK    ROUT
          * ROUTE TO JEANNE
 401      RM      1     0.1     0.4

 402      KK   AREAB
 403      BA   .0347
 404      LS      0      87
 405      UD   .3721

 406      KK    JEAN
          * PEAK FLOW JEANNE
 407      HC      2

 408      KK    ROUT
          * ROUTE TO MICHAEL
 409      RM      1     0.1     0.4

 410      KK   AREAC
 411      BA   .0064
 412      LS      0      90
 413      UD   .3095

 414      KK   AREAS
 415      BA   .0315
 416      LS      0      87
 417      UD   .6399

 418      KK    MICH
          * PEAK FLOW MICHAEL
 419      HC      3

 420      KK    ROUT
          * ROUTE TO TEQUESTA
 421      RM      1     0.1     0.3
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 422      KK   AREAR
 423      BA    .025
 424      LS       0      87
 425      UD   .3555

 426      KK     TEQ
          * PEAK FLOW TEQUESTA
 427      HC       2

 428      KK    ROUT
          * ROUTE TO LEONARLD
 429      RM       1     0.1     0.3

 430      KK   AREAD
 431      BA   .0303
 432      LS       0      87
 433      UD   .4224

 434      KK   AREAQ
 435      BA   .0729
 436      LS       0      87
 437      UD   .5705

 438      KK    LEON
          * PEAK FLOW LEONARLD
 439      HC       3

 440      KK    ROUT
          * ROUTE  TO DECATUR
 441      RM       1     0.1     0.4

 442      KK   AREAE
 443      BA   .0486
 444      LS       0      87
 445      UD  0.6821

 446      KK   AREAP
 447      BA  0.0986
 448      LS       0      87
 449      UD   .5845

 450      KK  AREADS
 451      BA    .005
 452      LS       0      98
 453      UD   .2619

 454      KK  AREADN
 455      BA   .0032
 456      LS       0      98
 457      UD    .083
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

458       KK     DEC
459       HC       5
          * PEAK FLOW @ DECATAUR/LAKE MEAD
          * ************************************
          * *  END SEA BASINS                  *
          * ************************************
          *

460       KK     RM1
          * ROUTE TO LAKE MEAD/RANCHO
461       RM       1     0.1     0.3

462       KK   BASLJ
463       BA     0.4
464       LS       0      89
          * SCS UNIT HYDROGRAPH
465       UD    1.42

466       KK       +
          * PEAK FLOW ON LAKE MEAD
467       HC       2

468       KK   DV SD        DIVERSION THRU LAKE MEAD DR. STORM DRAIN
469       KM        FROM VTN NEVADAS FINAL HYDROLOGY STUDY FOR LAKE MEAD BOULEVARD PHASE 1B
470       KM        WEST SIDE OF RANCHO DR. STORM DRAIN CAPACITY = 573 CFS
471       DT   LMSD1
472       DI       0     200     400     573    1000
473       DQ       0     200     400     573     573

474       KK  CB MED
          * PEAK FLOW AT LAKE MEAD/RANCHO INTERSECTION
475       HC       2
          *
          * DIVERT THRU 5' X 4' RCB TO LAKE MEAD STORM DRAIN

476       KK  DV 5X4
477       DT     5X4
478       DI       0     100     200     500    1000    3000
479       DQ       0     100     200     200     200     200
          *
          * DIVERSION @ LAKE MEAD & RANCHO DR. INTERSECTION

480       KK  DV MED
481       DT    MEAD
482       DI       0     200    1000    3000
483       DQ       0     200    1000    3000
          *
          *
          * ************************************
          * *  ROUTE TO DENTENTION BASIN 2A    *
          * ************************************
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 484      KK      RR
 485      RM       1     0.1    0.45
          * ************************************
          * *  RUNOFF ALONG LAKE MEAD BLVD     *
          * ************************************

 486      KK    BASI
 487      BA    0.05
          * REVISED DUE TO ROADWAY ALIGNMENT
 488      LS       0      92
 489      UD     .43

 490      KK       +
 491      HC       2

 492      KK     RT1
          * ROUTE BASIN I
 493      RM       1     0.1     0.4

 494      KK    BASH
 495      BA    0.13
          * REVISED DUE TO ROADWAY ALIGNMENT
 496      LS       0      91
 497      UD     .60

 498      KK      HI
          * COMBINE I AND H
 499      HC       2

 500      KK   LMSD1        RETRIEVE DIVERSION LMSD1
 501      DR   LMSD1

 502      KK     5X4        RETRIEVE DIVERSION 5X4
 503      DR     5X4

 504      KK  CB DIV        COMBINE DIVERSIONS
 505      HC       2

 506      KK  RT DET        ROUTE TO CAREY DETENTION BASIN
 507      RM       1     0.1     0.5

 508      KK  DVLM36        LOW FLOW DIVERSION THRU 36" PIPE
 509      DT    LM36
 510      DI       0      50     100     500    1500
 511      DQ       0      50      50      50      50

 512      KK    CMB1
 513      HC       2
          * ************************************
          * *  NLV AIRPORT DRAINAGE            *
          * *  REFERENCE MEA STUDY &           *
          * *  G.C. WALLACE STUDY              *
          * ************************************
          * ************************************
          * *  FLOW WEST SIDE AIRPORT          *
          * ************************************
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

514       KK     B1A
515       BA   .0516
          * MEA NLV AIRPORT CARD SOUTH SIDE
516       LS      0      83      80
517       UK    600    .005      .1     100
518       RK   1500    .004    .012            TRAP      10       0      NO

519       KK  DVFLAT
520       DR  DVFLAT

521       KK  DVCUL1
522       DR  DVCUL1

523       KK   B1A+C
524       HC       3

525       KK     B1B
          * COMPUTE RUNOFF FROM THE EAST MOST PAVED AREA
526       BA   .0144
527       LS      0      83      80
528       UK    700    .005      .1     100
529       RK   1500    .006    .012            TRAP      10       0

530       KK   CB AB         COMBINE B1A & B1B
531       HC       2

532       KK    ROUT
533       RM       1     0.1    0.25

534       KK      B2
535       BA    .106
536       UK    1200     .01     0.1     100
537       RK    3400   0.008    0.02            TRAP       2       1

538       KK   B1+B2
539       HC       2
          * ************************************
          * * REMOVE MEA SECOND DET. BASIN     *
          * ************************************

540       KK   RBAS2
          * ROUTE FLOW TO B4
541       RM       1     0.1     0.4

542       KK   DVCUL2
543       DR  DVCUL2

544       KK    PSM1
545       DR    PSM1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

546       KK       +
547       HC       2

548       KK       R
          * ROUTE FLOW TO B4
549       RM       1     0.1     0.4

550       KK      B4
551       BA     .11
552       LS       0      92
553       UD     .52

554       KK     CB4
555       HC       3

556       KK     RB4
          * ROUTE TO B3 BASIN ( ALLEN)
557       RM       1     0.1     0.3

558       KK    DSD4
          * ******************************
          * *  INLET TO STORM DRAIN     *
          * *  CAREY AVENUE AT ALLEN    *
          * *  30" RCP STA 80+16        *
          * ******************************
559       DT     SD4
560       DI       0      20     100     200     700
561       DQ       0      20      20      20      20

562       KK     RB3
563       RM       1     0.1    0.25
          * ******************************
          * *  RET FLOW IN CAREY SD     *
          * ******************************

564       KK    SD1A
565       DR    SD1A
          * FLOW IN JONES STORM @ BROOK

566       KK       R
567       RM       1     0.1     0.5

568       KK    SD1B
569       DR    SD1B

570       KK       +
          * FLOW IN JONES SD @ PEAK
571       HC       2
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LINE      ID.,.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

572       KK       R
573       RM       1     0.1     0.5
          * FLOW CARTIER AND MADRE MESA @ JONES

574       KK      R1
575       RM       1     0.1     0.3

576       KK     SD1
          * INTERCEPTED FLOW FROM JONES TO DECATUR ON SMOKE RANCH
577       DR     SD1

578       KK       +
579       HC       2

580       KK      R1        COMBINE R1 & R2
581       RM       1     0.1     0.5

582       KK     SD2
          * FLOW INTERCEPTED BETWEEN DECATUR AND RANCH ON SMOKE RANCH
583       DR     SD2

584       KK       +
585       HC       2

586       KK      R3
587       RM       1     0.1     0.5

588       KK     SD3
589       DR     SD3

590       KK       +
          * FLOW IN SMOKE RANCH STORM DRAIN @ RANCHO
591       HC       2

592       KK     RK1        COMBINE RK1, RK1A, & RK1B
          * 54" RCP, 60" RCP, & 54" RCP
593       RM       1     0.1     0.5

594       KK     SD4      *
595       DR     SD4

596       KK       +
597       HC       2

598       KK     RSD
          * ****************************
          * *  ROUTE SD FLOW TO ALLEN  *
          * ****************************
599       RM       1     0.1     0.5
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

600       KK       +
          * FLOW FROM AIRPORT AND CAREY STORM DRAIN
601       HC       2

602       KK      RR
603       RM       1     0.1    0.45
          *

604       KK     B1A
605       BA   .0516
          * MEA NLV AIRPORT CARD SOUTH SIDE
606       LS       0      83      80
607       UK     600    .005      .1     100
608       RK    1500    .004    .012            TRAP      10       0      NO
          *
          *
          *
          *

609       KK  CB CRY        COMBINE TWO HYDROGRAPHS AT CAREY/ LAKE MEAD DETENTION BASIN
610       HC       3
          * ****************************
          * *  EAST SIDE AIRPORT       *
          * ****************************

611       KK  DVSTR1
          * OVERFLOW @ CHEYENNE RANCH
612       DR  DVSTR1

613       KK  DVSTR2
          * FLOW FROM 24"
614       DR  DVSTR2

615       KK      CD
          * COMBINE DIV FLOWS
616       HC       2

617       KK    R-AB
          * MEA
618       RM       1     0.1     0.3
          *

619       KK      N1
          * MEA
620       BA    .097
621       LS       0      87
622       UD    .273

623       KK    STR1
          * MEA STREET RUNOFF RANCHO TO DECATUR
624       BA   .0049
625       LS       0      98
626       UD      .1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 627      KK     AB+
 628      HC       3

 629      KK    DAV+
 630      DT    DAV+
 631      DI       0      10      25     100     200
 632      DQ       0       0       0      75     175

 633      KK    ROUT
          * ROUTE RUNOFF SOUTH IN NEW DECATUR TO A LOW POINT
 634      RM       1     0.1    0.25

 635      KK      A1
          * MEA
 636      BA    .042
 637      LS       0      81
 638      UD     .11

 639      KK   DVBOX
 640      DR   DVBOX

 641      KK       +
 642      HC       3

 643      KK      A2
 644      BA     .15
 645      LS       0      81       1
 646      UD     .44

 647      KK     A2+
 648      HC       2

 649      KK    ROUT
 650      RM       1     0.1     0.4

 651      KK    DAV+
 652      DR    DAV+

 653      KK   AA-BB
          * ROUTE FLOW NOT DIVERTED SOUTH ON DECATUR
 654      RM       1     0.1     0.4

 655      KK     FN2
 656      BA     .13
 657      LS       0      92
 658      UD     .54

 659      KK    STR2
          * STREET RUNOFF DECATUR TO VALLEY DR.
 660      BA   .0107
 661      LS       0      98
 662      UD     .22
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

663       KK    HYD+
          * COMBINE FN2 + STR2
664       HC       2

665       KK     FN4
666       BA     .14
667       LS       0      92
668       UD     .61

669       KK   BA-BB
670       RM       1     0.1     0.4

671       KK     BB+
672       HC       3

673       KK     DBB
674       DT     DBB
675       DI       0      80     212     300
676       DQ       0      80      80      80

677       KK    ROUT
          * ROUT THE OVERFLOW FROM CHEYENNE/VALLEY SOUTH TO AIRPORT CHANNEL
678       RM       1     0.1    0.25

679       KK       +
          * COMBINE THE OVERFLOW WITH WATER IN THE AIRORT CHANNEL
680       HC       2

681       KK    R"W"
          * ROUTE THE AIRPORT CHANNEL TO THE EAST OF EXISTING RUNWAY
682       RM       1     0.1     0.4

683       KK      A3
684       BA     .15
685       LS       0      81       1
686       UD     .44

687       KK       +
          * COMBINE A3 WITH AIRPORT CHANNEL
688       HC       2

689       KK     DBB
690       DR     DBB

691       KK   BB-CB
692       RM       1     0.1     0.5

693       KK      N9
694       BA     .15
695       LS       0      91
696       UD     .77
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  697     KK   N9-CA
  698     RM      1     0.1    0.35

  699     KK     FN6
  700     BA     .13
  701     LS       0      91
  702     UD     .74

  703     KK     CA+
  704     HC       2

  705     KK   CA-CB
  706     RM      1     0.1    0.35

  707     KK     FN5
  708     BA     .12
  709     LS       0      91
  710     UD     .79

  711     KK    STA3
          * STREET RUNOFF VALLEY DR TO ALLEN LN
  712     BA   .0095
  713     LS       0      98
  714     UD    .173

  715     KK    HYD+
  716     HC       3

  717     KK     CB+
  718     HC       2

  719     KK   ALLEN
  720     DT   ALLEN
  721     DI       0      50     100     200     500
  722     DQ       0      50     100     181     181

  723     KK    R"Y"
          * ROUTE THE OVERFLOW FROM CHEYENNE/ALLEN TO AIRPORT CHANNEL
  724     RM       1     0.1     0.3

  725     KK    HYD+
  726     HC       2

  727     KK    R"Z"
          * ROUTE THE AIRPORT CHANNEL TO DETETNION BASIN
  728     RM       1     0.1     0.3
          * REMOVE MEA AIRPORT DET BASIN

  729     KK   ALLEN
  730     DR   ALLEN
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

731       KK  CB-LOW
732       RM       1     0.1     0.5

733       KK    ROUT
734       RM       1     0.1    0.35

735       KK      +F
736       HC       2

737       KK   RBAS1
738       RM       1     0.1     0.4

739       KK      B3
740       BA    .313
741       LS       0      90
742       UD     .81

743       KK     CB3
          * COMBINE OUTFLOW WITH B3
744       HC       2

745       KK  CB LMD
          * INFLOW TO DETENTION BASIN 2A
746       HC       2
          * ****************************
          * CAREY / LAKE MEAD          *
          * DETENTION BASIN            *
          * EDITED BY                  *
          * CVL CONSULTANTS, INC       *
          * SPILLWAY ELEV = 18.5'      *
          * ****************************

747       KK      2A
748       RS       1    FLOW      -1
749       SV       0      10      50     125     220     350     486     533     588
750       SE      92      98     102     106     110     114     118     119     121
751       SQ       0      60     100     123     150     213     370    1390   11026

752       KK   RLM36        RETRIEVE DIVERSION LM36
753       DR    LM36

754       KK   CB SD        COMBINE LOW FLOW DIVERSION W/CAREY DETENTION  BASIN OUTFLOW
755       HC       2

756       KK    RTIH
757       RM       1     0.1    0.45

758       KK   BASF1
759       BA    0.09
760       LS       0      85
761       UD     .56
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

762       KK     RF1
          * KINEMATIC WAVE ROUTING
763       RM       2     0.2    0.45

764       KK   BASF2
765       BA   0.06
766       LS       0      85
          * SCS UNIT HYDROGRAPH
767       UD      .7

768       KK    CMB2
          * COMBINE F1, F2
769       HC       2

770       KK   FLOW1
771       HC       2

772       KK   RTF1H
          * ROUTE COMBINE HYDROGRAPH
773       RM       1     0.1    0.45

774       KK    BASD
775       BA   0.064
776       LS       0      85
          * SCS UNIT HYDROGRAPH
777       UD    1.02

778       KK    BASE
779       BA   0.016
780       LS       0      85
          * SCS UNIT HYDROGRAPH
781       UD    0.23

782       KK    CMB3
          * COMBINE D,E
783       HC       2

784       KK   FLOW2
785       HC       2

786       KK   RDEFIH
          * ROUTE DEFIH BASINS
787       RM       1     0.1    0.35

788       KK    BASC
789       BA    0.04
790       LS       0      86
          * SCS UNIT HYDROGRAPH
791       UD     0.7
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

792       KK   FLOW3
          * COMBINE BASIN C WITH MAIN HYDROGRAPH
793       HC       2

794       KK     RTC
          * ROUTE C AND MAIN HYDROGRAPH
795       RM       1     0.1     0.3

796       KK    BASB
797       BA    0.01
798       LS       0      85
799       UD    0.31

800       KK   BASB1
801       BA   0.015
802       LS       0      90
          * SCS UNIT HYDROGRAPH
803       UD    0.57

804       KK    CMB5
          * COMBINE B, B1
805       HC       2

806       KK   FLOW4
807       HC       2

808       KK     RTB
          * ROUTE MAIN HYDROGRAPH
809       RM       1     0.1     0.3

810       KK    BASA
811       BA    0.01
812       LS       0      90
          * SCS UNIT HYDROGRAPH
813       UD    0.23

814       KK    BASG
815       BA   0.073
816       LS       0      90
          * SCS UNIT HYDROGRAPH
817       UD     .42

818       KK    CMB6
          * COMBINE A, G
819       HC       2

820       KK   FLOW5
          *  ********************************
          *  * PEAK FLOW AT LOSEE            *
          *  ********************************
821       HC       2
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 822      KK  RT CRY        ROUTE TO CAREY/LOSEE
 823      RM       1     0.1    0.35
          * ******************************
          * * RUNOFF CAREY AVENUE      *
          *
          * ****************************

 824      KK    F10A
 825      BA    0.08
 826      LS       0      91
 827      UD   0.498

 828      KK  RTF10B        ROUTE TO FN10B
 829      RM       1     0.1     0.2

 830      KK   FN10B
 831      BA    0.05
 832      LS       0      91
 833      UD    0.33

 834      KK  CB F10        COMBINE FN10A & FN10B
 835      HC       2

 836      KK   RT A4        ROUTE TO A4
 837      RM       2     0.2     0.2

 838      KK      A4
 839      BA    0.08
 840      LS       0      81       1
 841      UD     0.2

 842      KK   CB A4        COMBINE FN10A, FN10B, AND A4
 843      HC       2

 844      KK    RT W        ROUTE TO W
 845      RM       2     0.2     0.2

 846      KK       W
 847      BA    0.24
 848      LS       0      90
 849      UD    0.57

 850      KK    CB W        COMBINE FN10A &B, A4, AND W
 851      HC       2

 852      KK   RT W1        ROUTE TO HIGHLAND
 853      RM       5     0.5     0.2
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 854      KK    BASR
 855      BA    0.22
 856      LS       0      90
 857      UD    0.47

 858      KK   RT R1         ROUTE TO R1
 859      RM       2     0.2     0.2

 860      KK      R1
 861      BA     0.2
 862      LS       0      89
 863      UD     .53

 864      KK   CB R1         COMBINE R1 & R
 865      HC       2

 866      KK   RT R2         ROUTE TO R2
 867      RM       1     0.1     0.2

 868      KK      R2
 869      BA      .2
 870      LS       8      88
 871      UD     .55

 872      KK   CB R2         COMBINE R, R1 & R2
          * **********************
          * *   CLAYTON         *
          * **********************
 873      HC       2

 874      KK    DSD5
 875      DT     SD5
          * STORM DRAIN IN CAREY
 876      D1       0      50      70      100      700
 877      DQ       0      50      70       70       70

 878      KK      RR
          * ROUTE TO HIGHLAND
 879      RM       2     0.2    0.25
          *

 880      KK      W1
 881      BA     .38
 882      LS       0      85
 883      UD    1.25

 884      KK   CB W1         COMBINE 3 HYDROGRAPHS @  HIGHLAND
 885      HC       3
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

886       KK   RT W2
887       RM       4     0.4     0.2

888       KK       S
          * **********************
          * *     HIGHLAND     *
          * **********************
889       BA     .49
890       LS       0      88
891       UD     .93

892       KK   DSD62
893       DT    SD62
          * STORM DRAIN IN CAREY
894       DI       0      50      76     100     230     500
895       DQ       0      50      76      79      96     107

896       KK      RS
          * ROUTE TO LEXINGTON
897       RM       1     0.1    0.25

898       KK    DSD7
899       DT     SD7
          * STORM IN CAREY
900       DI       0      25      50     100     300     500
901       DQ       0      13      14      16      22      29

902       KK    ROUT
903       RM       4     0.4     0.2

904       KK      W2
905       BA     .45
906       LS       0      88
907       UD    1.15
          * ******************************
          * *  PEAK FLOW AT I-15 CHANNEL*
          * ******************************

908       KK       +
909       HC       3

910       KK     DWC
911       DT     DWC
912       DI       0     100     300     600    1000    3000
913       DQ       0     100     300     600    1000    3000

914       KK      S1
          * **********************
          * *  REVERSE (H ST)  *
          * **********************
915       BA     .18
916       LS       0      89
917       UD     .89
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 918      KK    DSD8
 919      DT     SD8
          * STORM DRAIN IN CAREY
 920      DI       0      25      50     100     200
 921      DQ       0       9      18      29      35

 922      KK      RS
          * ROUTE TO COMMERCE
 923      RM       1     0.1    0.45

 924      KK   DSD91
 925      DT    SD91
          * STORM DRAIN IN CAREY
 926      DI       0      25      60     100     200
 927      DQ       0      18      43      51      62

 928      KK       V
          * **********************
          * *   COMMERCE        *
          * **********************
 929      BA    0.13
 930      LS       0      88
 931      UD     .37

 932      KK   DSD92
          * STORM DRAIN IN CAREY
 933      DT    SD92
 934      DI       0      25      75      95     200
 935      DQ       0       5      12      15      18

 936      KK    CB V        COMBINE S1 & V
          * PEAK SURFACE FLOW AT COMMERCE
 937      HC       2

 938      KK  RT CRY        ROUTE TO CAREY/LOSEE
 939      RM       1     0.1    0.35

 940      KK  CB LOS        COMBINE W/ W2
 941      HC       2

 942      KK     SD5
 943      DR     SD5

 944      KK      RR
          * ROUTE TO HIGHLAND
 945      RM       1     0.1    0.45

 946      KK    SD62
 947      DR    SD62
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

948       KK       +
949       HC       2

950       KK      RS
          * ROUTE TO LEXINGTON
951       RM       1     0.1    0.35

952       KK     SD7
953       DR     SD7

954       KK       +
955       HC       2

956       KK      RS
          * ROUTE TO REVERE (H ST)
957       RM       1     0.1    0.35

958       KK     SD8
959       DR     SD8

960       KK       +
961       HC       2

962       KK      RS
          * ROUTE TO COMMERCE
963       RM       1     0.1    0.35

964       KK    SD91
965       DR    SD91

966       KK    SD92
967       DR    SD92

968       KK       +
          * PEAK FLOW IN STORM DRAIN
969       HC       3

970       KK    DWC1
971       DR     DWC
          * PEAK SURFACE

972       KK       +
          * PEAK FLOW AT CHANNEL
973       HC       2
          *
          * ********************************************
          * *     END OF VTN NEVADAS CAREY/LAKE ME     *
          * *     DETENTION BASIN                      *
          * ********************************************
          *
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 974      KK  CB LOS        COMBINE 4 HYDROGRAPHS @ CAREY/LOSEE
 975      HC       3
          *
          *

 976      KK    MEAD        RETRIEVE DIVERSION MEAD
 977      DR    MEAD
          *

 978      KK  DV 6X3        DIVERSION THRU 6' X 3' RCB
 979      DT   1-6X3
 980      DI       0      91     318     705    1303    2570
 981      DQ       0      48      86     117     148     173
          *

 982      KK  DV26X3        DIVERSION THRU 6' X 3' RCB
 983      DT   2-6X3
 984      DI       0      48     180     416     757    1208    1776
 985      DQ       0      48      86     117     148     173     196
          *

 986      KK  DV 24"          24" CMP
 987      DT   24CMP
 988      DI       0      27     100    1000
 989      DQ       0      27      27      27
          *

 990      KK      J2
          * FROM VTN LAKE MEAD HYDROLOGY STUDY
 991      BA    0.22
 992      LS       0      89
 993      UD    0.70

 994      KK   CB J2        COMBINE DIVERSION MEAD W/ J2
 995      HC       2

 996      KK  DV COR        DIVERSION @ CORAN & RANCHO
 997      DT   CORAN
 998      DI       0     100     281    1217    2997    5802
 999      DQ       0       0      13     205     732    1695
          *

1000      KK  RT VGS        ROUTE TO VEGAS DR.
1001      RM       3     0.3    0.35

1002      KK      J3
1003      BA    0.37
1004      LS       0      89
1005      UD     0.5
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1006      KK  CB VEG        COMBINE J2 & J3
1007      HC       2
1008      KK  DV VGS        DIVERSION @ VEGAS & RANCHO
1009      DT   VEGAS
1010      DI       0      45     260    1428    3684    7222
1011      DQ       0      20     117     640    1639    3179
          *
1012      KK  RT WAS        ROUTE TO WASHINGTON AVE.
1013      RM       3     0.3    0.35
          *
          * ****************************************
          * REFER TO MONTGOMERY FIS HYDROLOGY
          * FOR NORTH LAS VEGAS AREA.
          * ****************************************

1014      KK    309W
1015      KM   RUNOFF FROM WESTERN PORTION OF SUBBASIN 309
1016      BA    1.35
1017      LS       0      71       0       0      70
1018      UK     150    0.01     0.3      22
1019      UK     300  0.0144    0.25      78
1020      RK    1000   0.007    0.02   0.013    TRAP      51       0
1021      RK    2600   0.007    0.02    0.20    TRAP      80       0
1022      RK   12000  0.0144    0.02       0    TRAP     100       0

1023      KK   R309W
1024      KM   ROUTE FROM 309W TO 309E
1025      RM      10       1    0.35

1026      KK    309E
1027      KM   RUNOFF FROM EASTERN PORTION OF SUBBASIN 309
1028      BA    1.19
1029      LS       0      87       0       0      80
1030      UK     150    0.01     0.3      52
1031      UK     300  0.0144    0.25      48
1032      RK    1000   0.007    0.02   0.019    TRAP      51       0
1033      RK    2600   0.007    0.02    0.30    TRAP      80       0
1034      RK   21000  0.0144    0.02       0    TRAP     100       0

1035      KK  DV CUL
          * DIVERSION THRU CULVERT UNDER WASHINGTON AVE.
          * DIVERTED DISCHARGES CONTINUE SOUTH IN A CHANNEL TO BONANZA RD., AND FLOW THRU
          * 48" RCP UNDER BONANZA RD. TO THE BOX CULVERT UNDER I-95.
1036      DT  CULVRT
1037      DI       0     100     158     300     500    1000
1038      DQ       0     100     158     158     158     158
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1039      KK    309E
1040      KM    COMBINE ROUTED 309W WITH 309E
1041      HC       2
          *

1042      KK  CB WAS        COMBINE FLOWS FROM VEGAS W/ WS 309
1043      HC       2
          *

1044      KK  DV WAS        DIVERSION @ WASHINGTON & RANCHO DR.
1045      DT    WASH
1046      DI       0      83     471    2670    7373
1047      DQ       0      23     132     750    2070
          *

1048      KK  RT 310        ROUTE TO 310E
1049      RM       3     0.3    0.35

1050      KK    310W
1051      KM    RUNOFF FROM WESTERN PORTION OF SUBBASIN 310
1052      BA    1.08
1053      LS       0      87       0       0      87
1054      UK     150   0.010     0.3      38
1055      UK     300   0.015    0.25      62
1056      RK    1000  0.0075    0.02   0.013    TRAP      51       0
1057      RK    2600  0.0075    0.02     0.2    TRAP      80       0
1058      RK   12000  0.0150    0.02       0    TRAP     100       0

1059      KK    R310W
1060      KM    ROUTE RUNOFF FROM 310W TO 310E
1061      RM       3    0.32    0.35

1062      KK    310E
1063      KM    RUNOFF FROM EASTERN PORTION OF SUBBASIN 310
          *
          * TOTAL AREA = 1.238 - 0.266 = 0.972
          *
          * RUNOFF FROM AREAS SOUTH OF BONANZA RD. BETWEEN MICHAEL WAY AND VALLEY VIEW
          * RD. DRAINS INTO A DROP INLET LOCATED NEAR THE ON-RAMP TOI-95 WESTBOUND.
          * THIS AREA IS TAKEN OUT OF BASIN 310E.
          *
1064      BA   0.972
1065      LS       0      86       0       0      83
1066      UK     150    0.01     0.3      46
1067      UK     300   0.015    0.25      54
1068      RK    1000  0.0075    0.02   0.019    TRAP      51       0
1069      RK    2000  0.0075    0.02    0.31    TRAP      80       0
1070      RK   10500   0.015    0.02       0    TRAP     100       0
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1071      KK    310E
1072      KM   COMBINE ROUTED 310W WITH 310E
1073      HC       2

1074      KK  CB 310        COMBINE FLOWS FROM WASHINGTON W/ 310
1075      HC       2

1076      KK  DV BON
          *
          * AT INTERSECTION OF RANCHO DR. AND BONANZA ROAD, FLOW SPLITS INTO TWO
          * DIRECTIONS.
          * SPLIT FLOW CONTINUES SOUTH ALONG WEST SIDE OF RANCHO DR.
          *
1077      DT   BONAN
1078      DI       0     172     333     558     840    1174    1558
1079      DQ       0     159     259     379     515     666     831
          *
          *

1080      KK  RT311W        ROUTE TO WS 311W
1081      RM       5     0.5    0.35
          *

1082      KK   VEGAS        RETRIEVE DIVERSION VEGAS
1083      DR   VEGAS

1084      KK    WASH        RETRIEVE DIVERSION VEGAS
1085      DR    WASH

1086      KK  CB DIV        COMBINE DIVERSIONS
1087      HC       2

1088      KK  RT311W        ROUTE TO 311W
1089      RM       5     0.5    0.35

1090      KK    311W
1091      KM   RUNOFF FROM WESTERN PORTION OF SUBBASIN 311
          * TOTAL AREA OF BASIN 311W FROM JMM HEC-1 MODEL =  0.96
          * RUNOFF FROM AREAS SOUTH OF BONANZA RD. BETWEEN HIGHLAND AND RANCHO
          * GETS DIVERTED SOUTH @ INTERSECTION OF I-95 AND HIGHLAND.
          * THIS AREA IS TAKEN OUT OF BASIN 311W.
          * AREA  = 0.96 - 0.075 = 0.88
1092      BA     .88
1093      LS       0      85       0       0      83
1094      UK     150   0.010     0.3      60
1095      UK     300  0.0132    0.25      40
1096      RK     650  0.0065    0.02    0.01    TRAP      51       0
1097      RK    2200  0.0065    0.02    0.14    TRAP      80       0
1098      RK    5300  0.0132    0.02       0    TRAP     100       0
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1099      KK   311W
1100      KM  COMBINE 310, 309 & ROUTED 311W
1101      HC       3

1102      KK  RT311E
1103      KM   ROUTE FROM 311W TO 311E
1104      RM       2     0.2    0.35

1105      KK   311E
1106      KM   RUNOFF FROM EASTERN PORTION OF SUBBASIN 311
1107      BA    0.77
1108      LS       0      75       0       0      72
1109      UK     150    0.01     0.3      75
1110      UK     300  0.0132    0.25      25
1111      RK     650  0.0065    0.02   0.008    TRAP      51
1112      RK    2200  0.0065    0.02    0.11    TRAP      80       0
1113      RK    7500  0.0132    0.02       0    TRAP     100       0

1114      KK   311ECOMBINE 309,310,&311
1115      HC       2
          *
          *   SOME SPLIT FLOW MAY OCCUR @ THIS LOCATION.
          *   KKRT312E        ROUTE FROM 311E TO 312E (LAKE MEAD)
          *   RM     2     0.2     0.3
          *
          *
          *

1116      KK   1-6X3        RETRIEVE DIVERSION 1-6X3
1117      DR   1-6X3

1118      KK   2-6X3        RETRIEVE DIVERSION 2-6X3
1119      DR   2-6X3

1120      KK   24CMP        RETRIEVE 24CMP
1121      DR   24CMP

1122      KK   CORAN        RETRIEVE DIVERSION @ CORAN
1123      DR   CORAN
          *
          *

1124      KK  CB DIV        COMBINE DIVERSIONS
1125      HC       4
          *

1126      KK  RT312W        ROUTE TO WS 312W
1127      RM       6     0.6    0.35
          *
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1128      KK   312W
1129      KM   RUNOFF FROM WESTERN PORTION OF SUBBBASIN 312
1130      KM   ROUTE SUBBASINS 307 & 308 THRU SUBBASIN 312
          *      AREA REVISED TO INCORPORATE CHANGES BY VTN NEVADAS HEC-1
1131      BA   0.87
1132      LS      0      81       0       0      80
1133      UK    150    0.01     0.3      20
1134      UK    300  0.0132    0.25      80
1135      RK   1000  0.0065    0.02   0.012    TRAP      51       0
1136      RK   2600  0.0065    0.02   0.175    TRAP      80       0
1137      RK   6100  0.0132    0.02       0    TRAP     100       0

1138      KK   312W
1139      KM       COMBINE DIVERSIONS W/ 312W
1140      HC     2

1141      KK   R312W
1142      KM   ROUTE FROM 312W TO 312E
1143      RM      1    0.11    0.35

1144      KK   312E
1145      KM   RUNOFF FROM EASTERN PORTION OF SUBBASIN 312
          *      AREA REVISED TO INCORPORATE CHANGES BY VTN NEVADAS HEC-1
1146      BA   0.62
1147      LS      0      79       0       0      76
1148      UK    150   0.010     0.3      50
1149      UK    300  0.0132    0.25      50
1150      RK    500  0.0065    0.02   0.012    TRAP      51       0
1151      RK   2600  0.0065    0.02   0.175    TRAP      80       0
1152      RK   6100  0.0132    0.02       0    TRAP     100       0

1153      KK   312E
1154      KM   COMBINE ROUTED 312W WITH 312E
1155      HC     2
          *   KKCB312E        COMBINE W/ 309,310,&311
          *   HC     2
          *   KKRTCARY
          *   KM      ROUTE FROM 312E TO CAREY/LOSEE
          *   RM     1     0.1     0.4
          *   KKRT CHA        ROUTE TO CHANNEL "A"
          *   RM     2     0.2    0.25
          *   KKCB CHA
          *   HC     2
          *

1156      KK   BONAN        RETRIEVE DIVERSION "BONAN"
1157      DR   BONAN
          *
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1158      KK  DV RAN
          * FLOW SPLITS OCCUR IN TWO DIRECTIONS @ INTERSECTION OF RANCHO DR & I-95.
          * SPLIT FLOW CONTINUES SOUTH ON RANCHO DR..  THE REMAINING FLOW OVERTOPS
          * RANCHO DR. & FLOW EAST TO THE INTERSECTION OF HIGHLAND DR. AND I-95
          * AND CONTINUE SOUTH ALONG HIGHLAND DR.
1159      DT  RANCHO
1160      DI       0     107     318     642    1039    1502
1161      DQ       0      31      75     177     309     470
          •
          *
          •
1162      ZZ
```
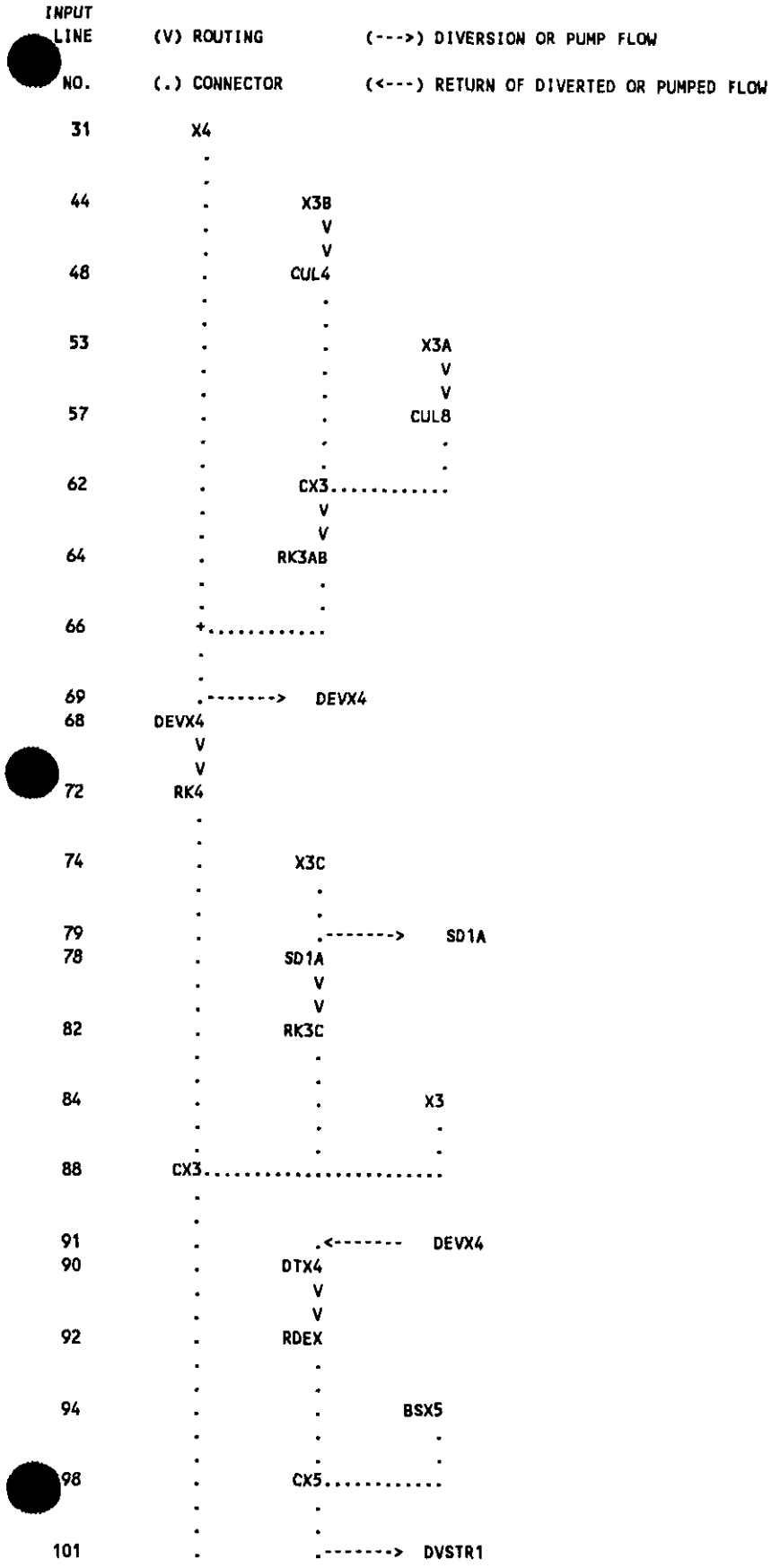
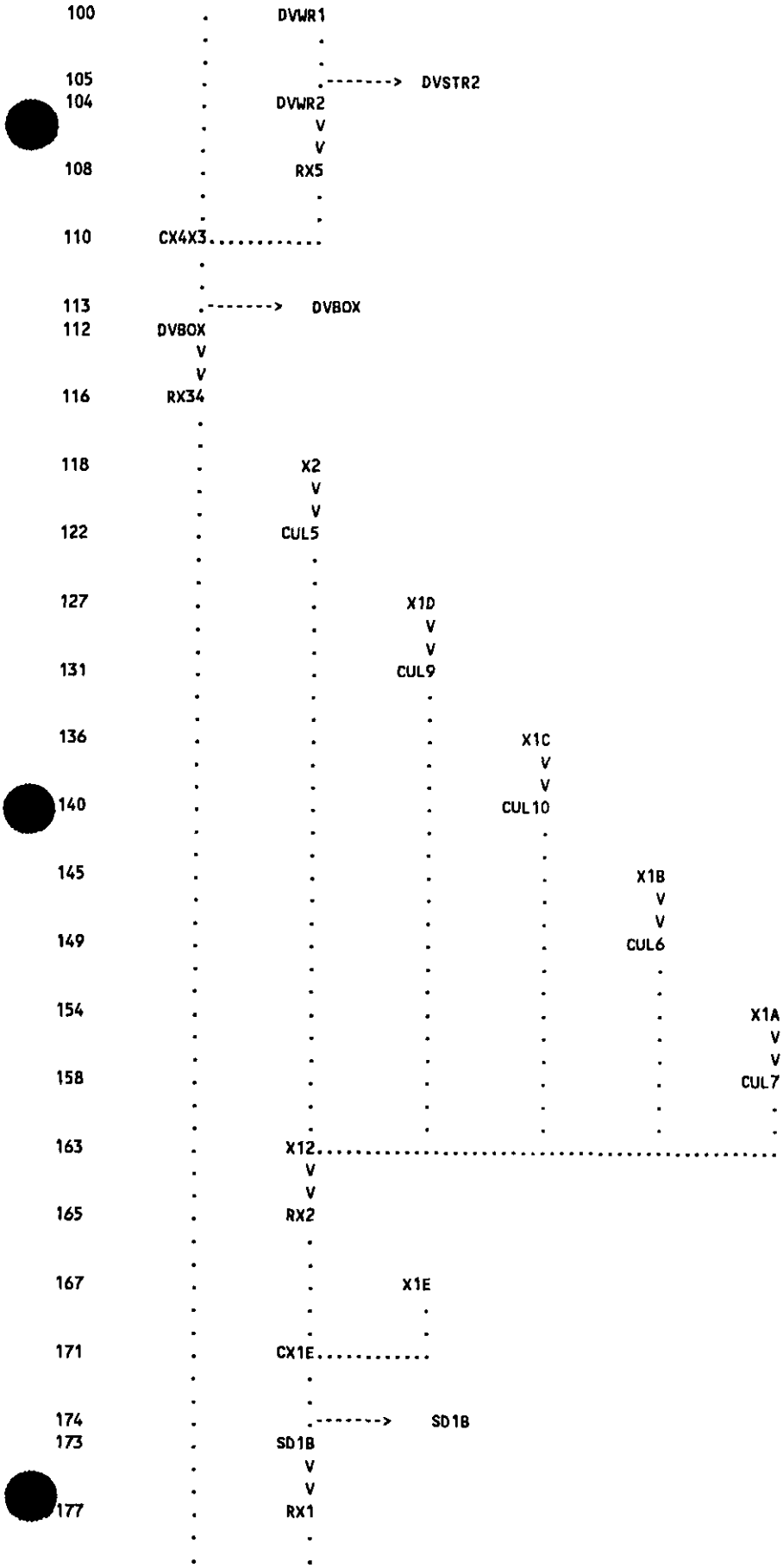

SCHEMATIC DIAGRAM OF STREAM NETWORK

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122
CUL5
127
X1D
131
CUL9
136
X1C
140
CUL10
145
X1B
149
CUL6
154
X1A
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SD1B
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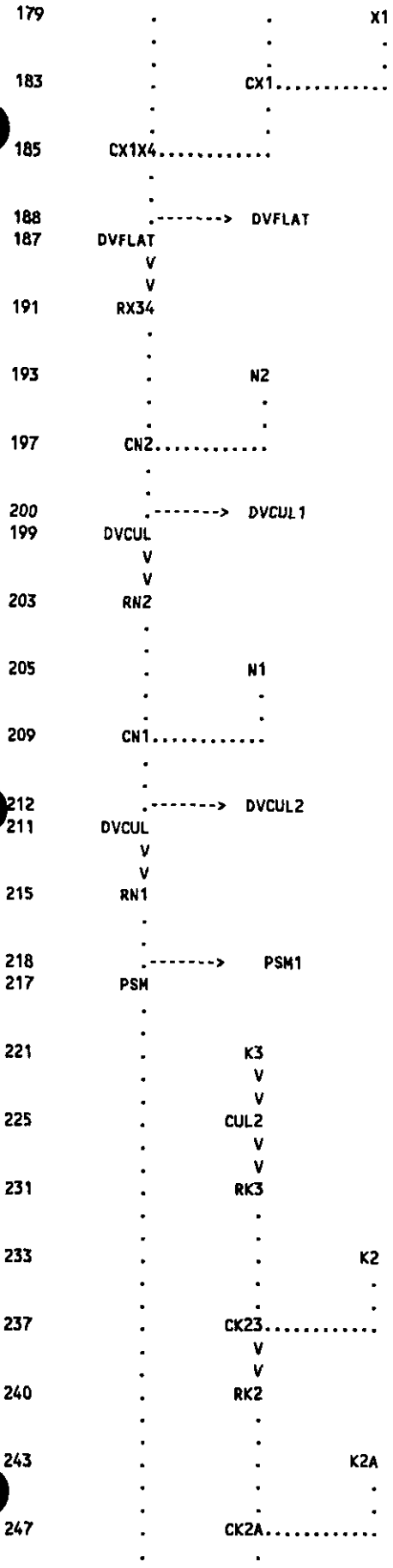
RX1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RN2
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PSM1
217
PSM
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CK23
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K2A
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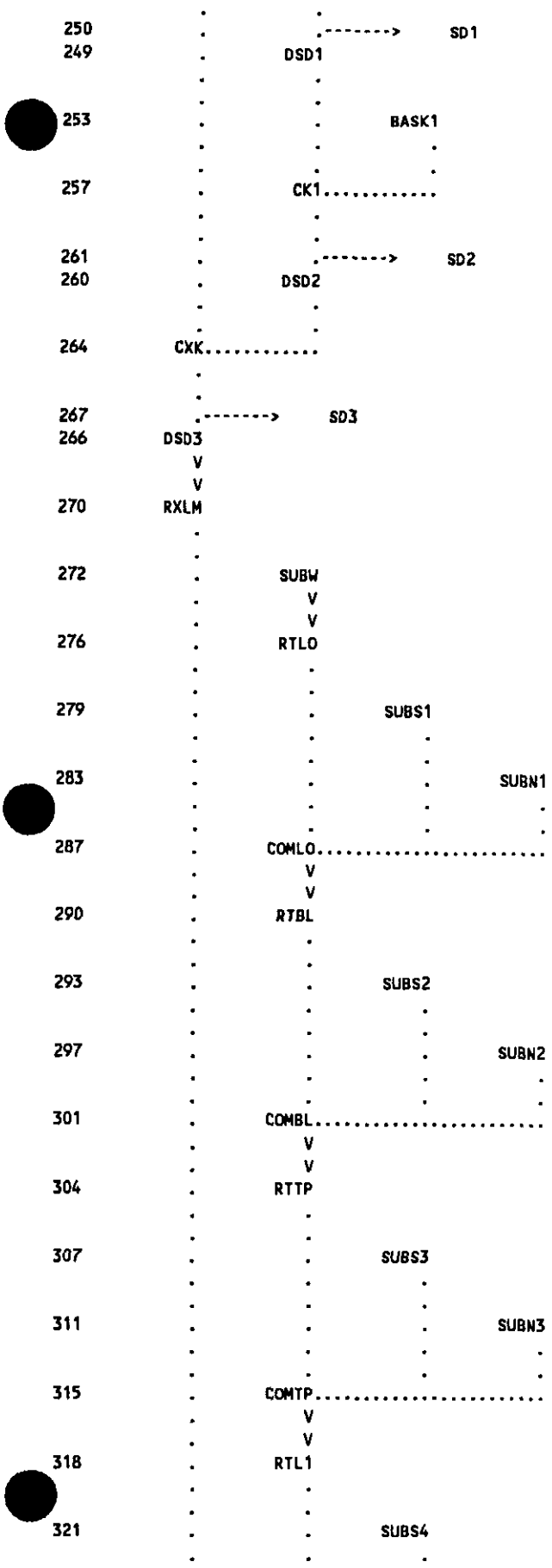
CK2A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DSD3
270
RXLM
272
SUBW
276
RTLO
279
SUBS1
283
SUBN1
287
COMLO
290
RTBL
293
SUBS2
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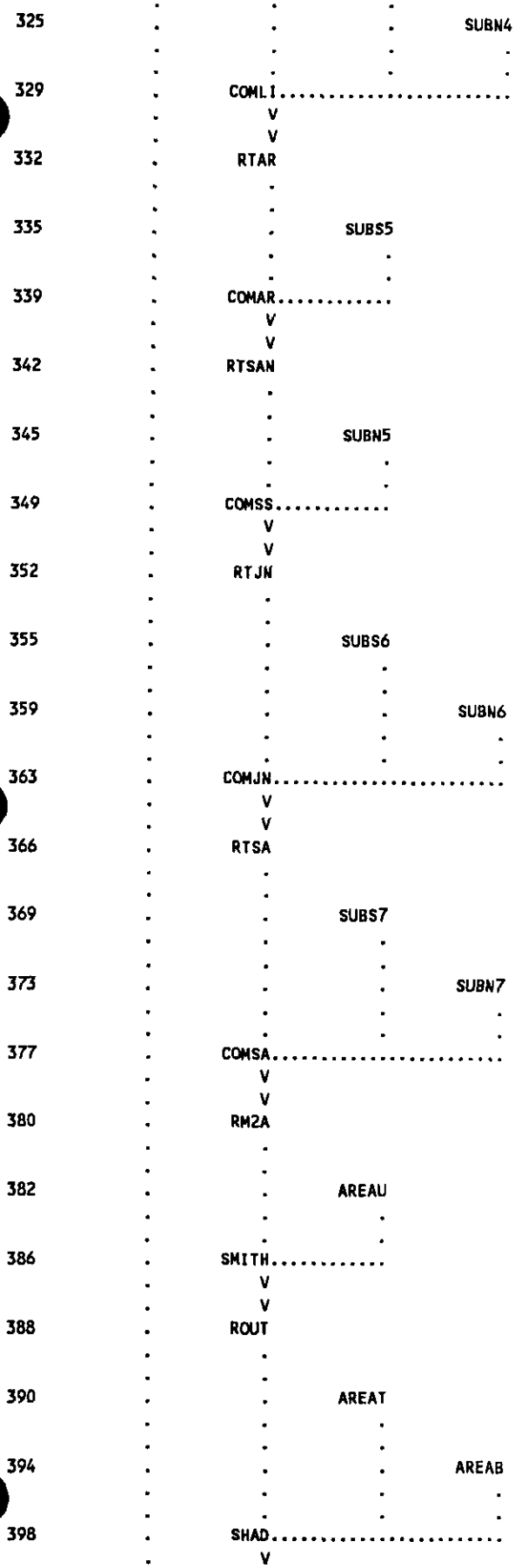
SUBS4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SUBS5
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RTJN
355
SUBS6
359
SUBN6
363
COMJN
366
RTSA
369
SUBS7
373
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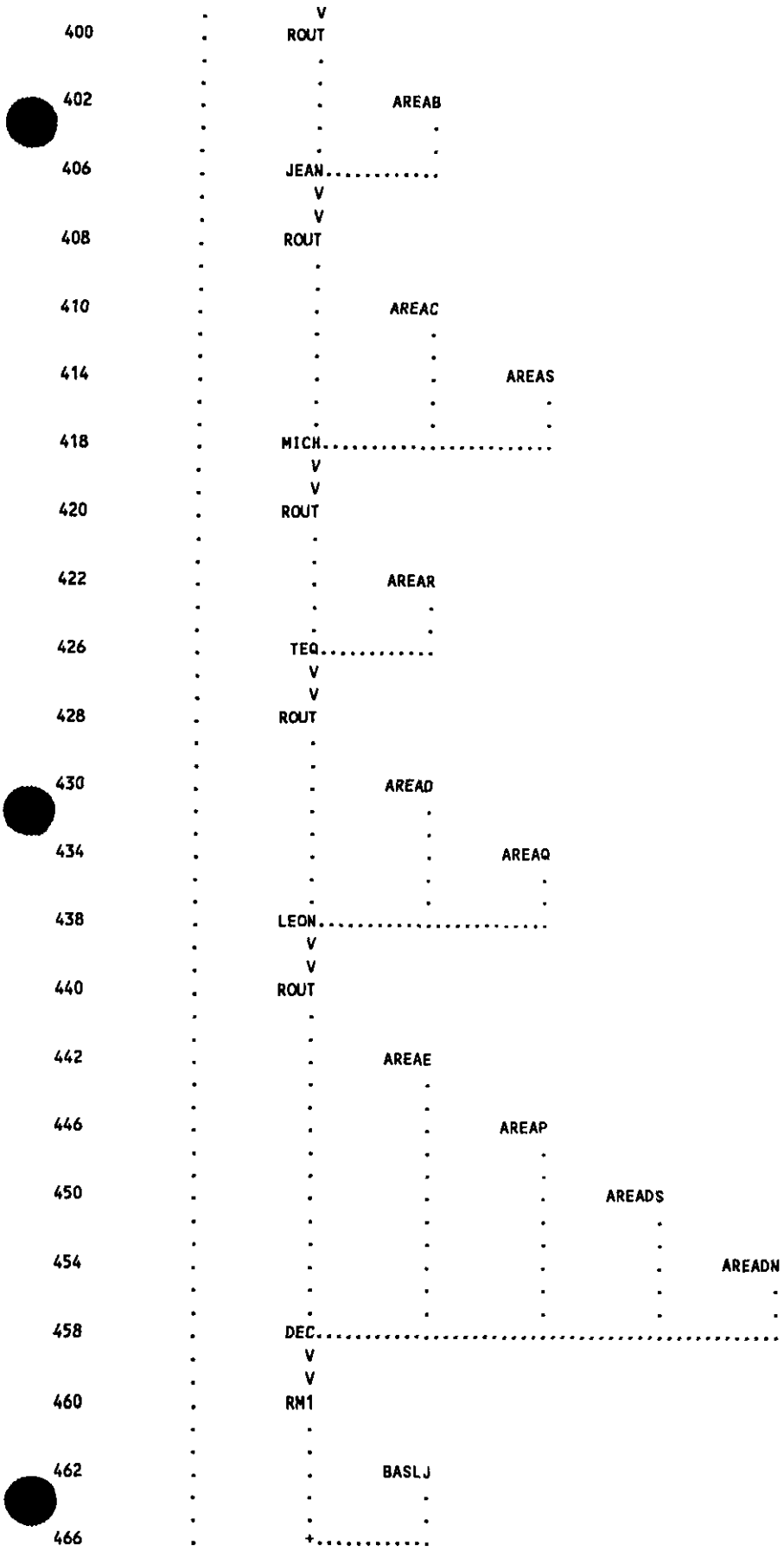
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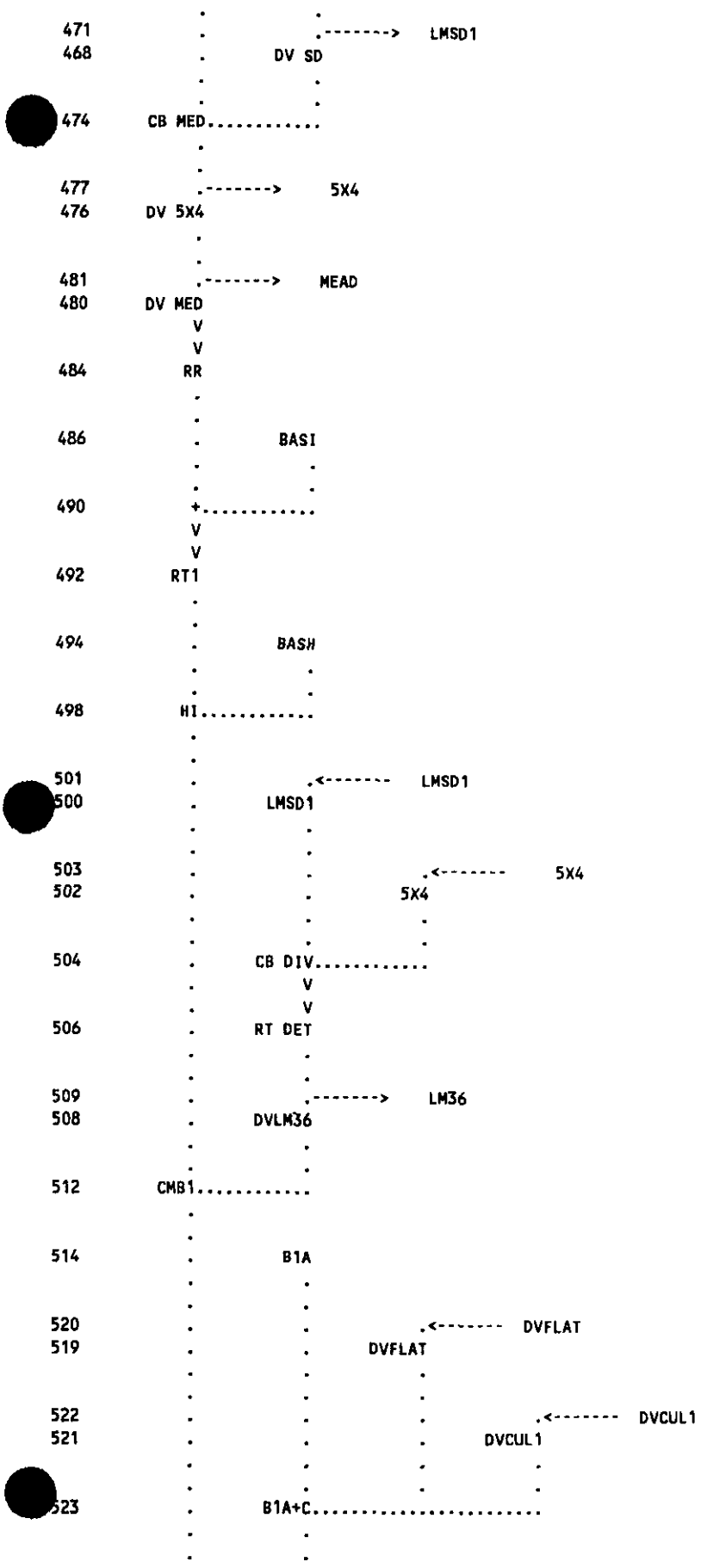
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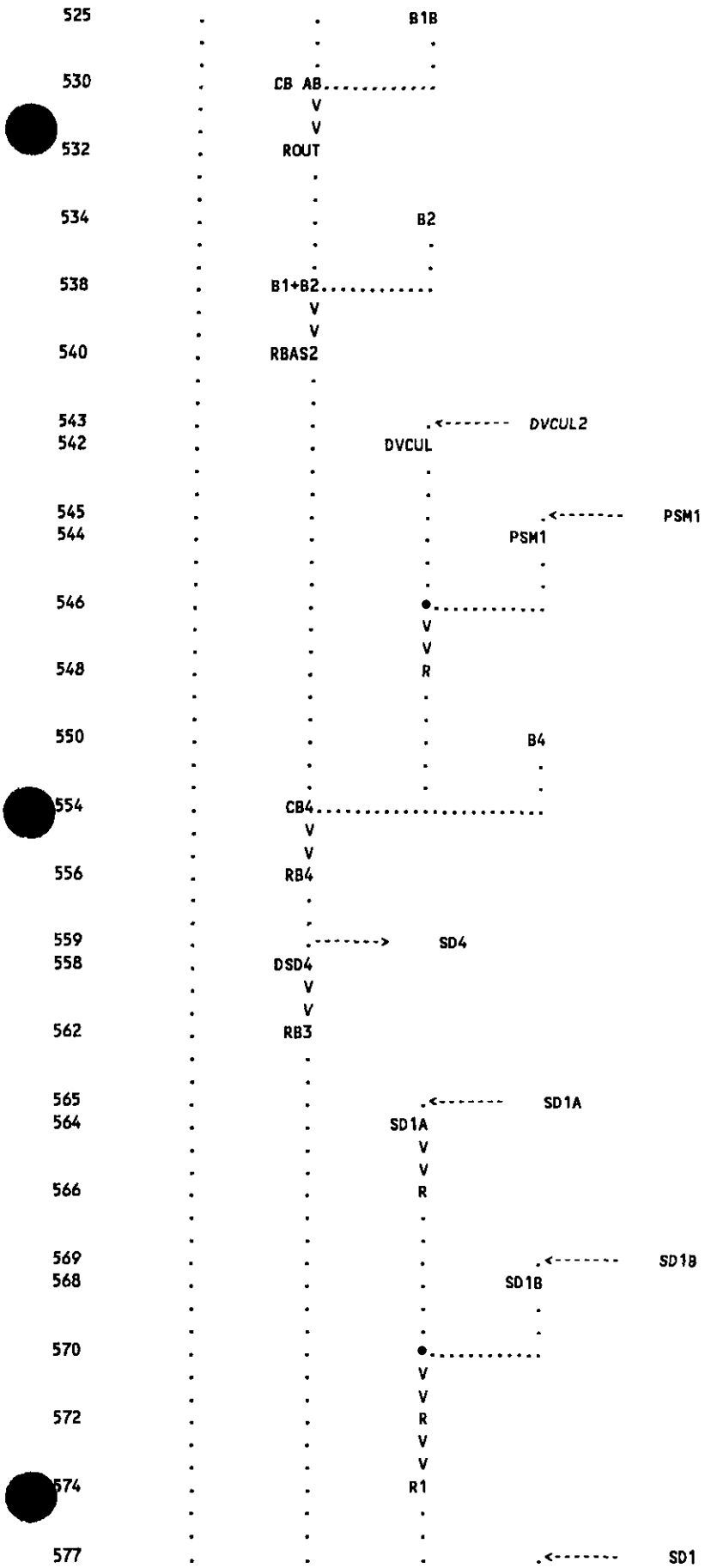
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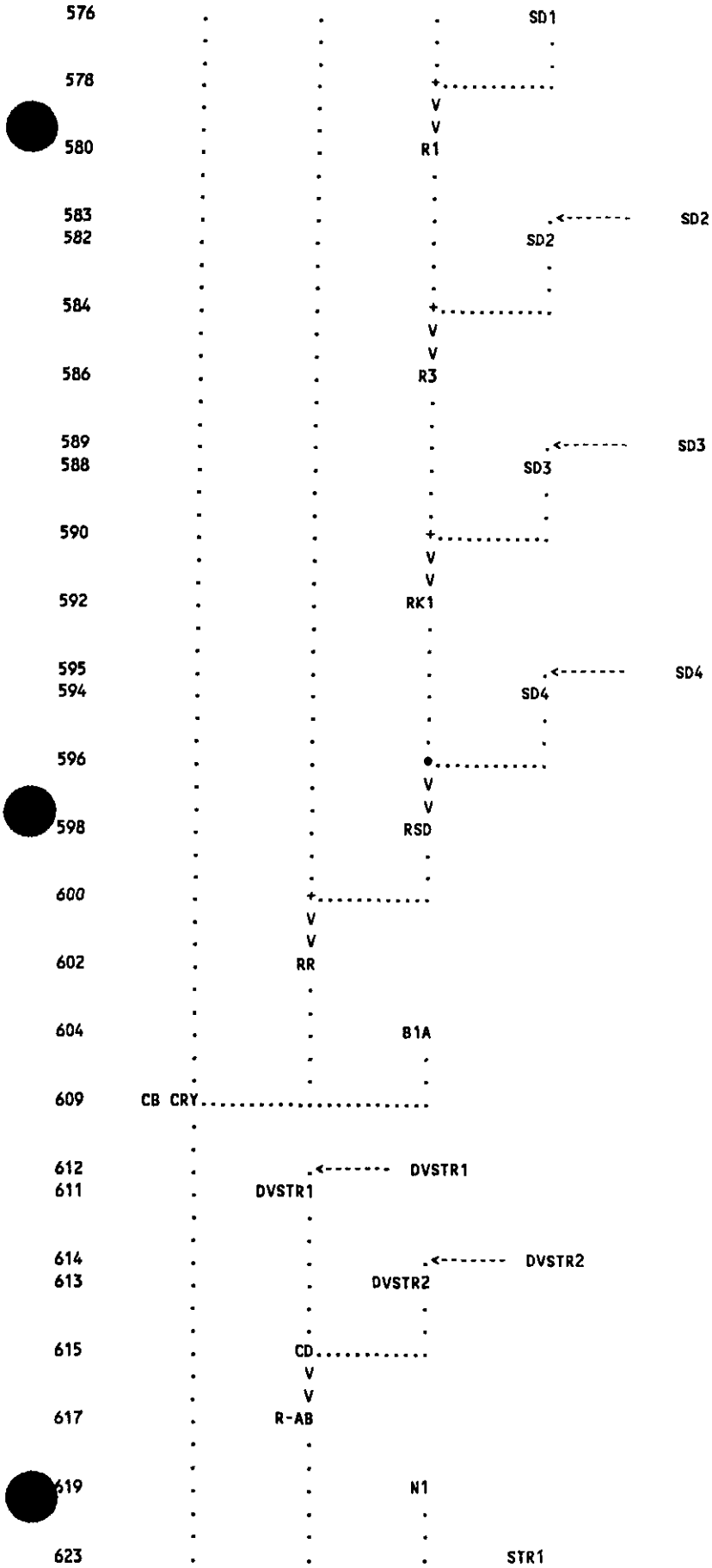
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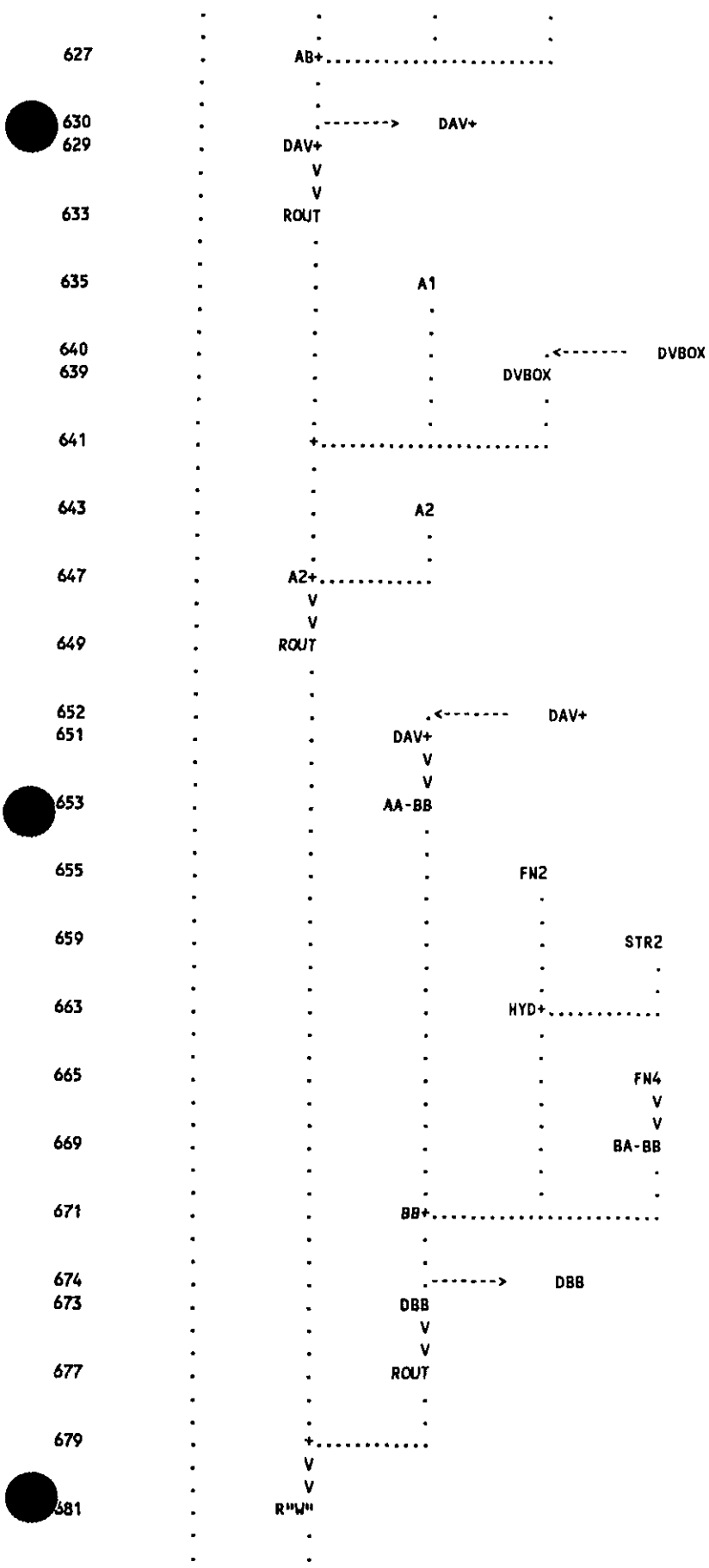
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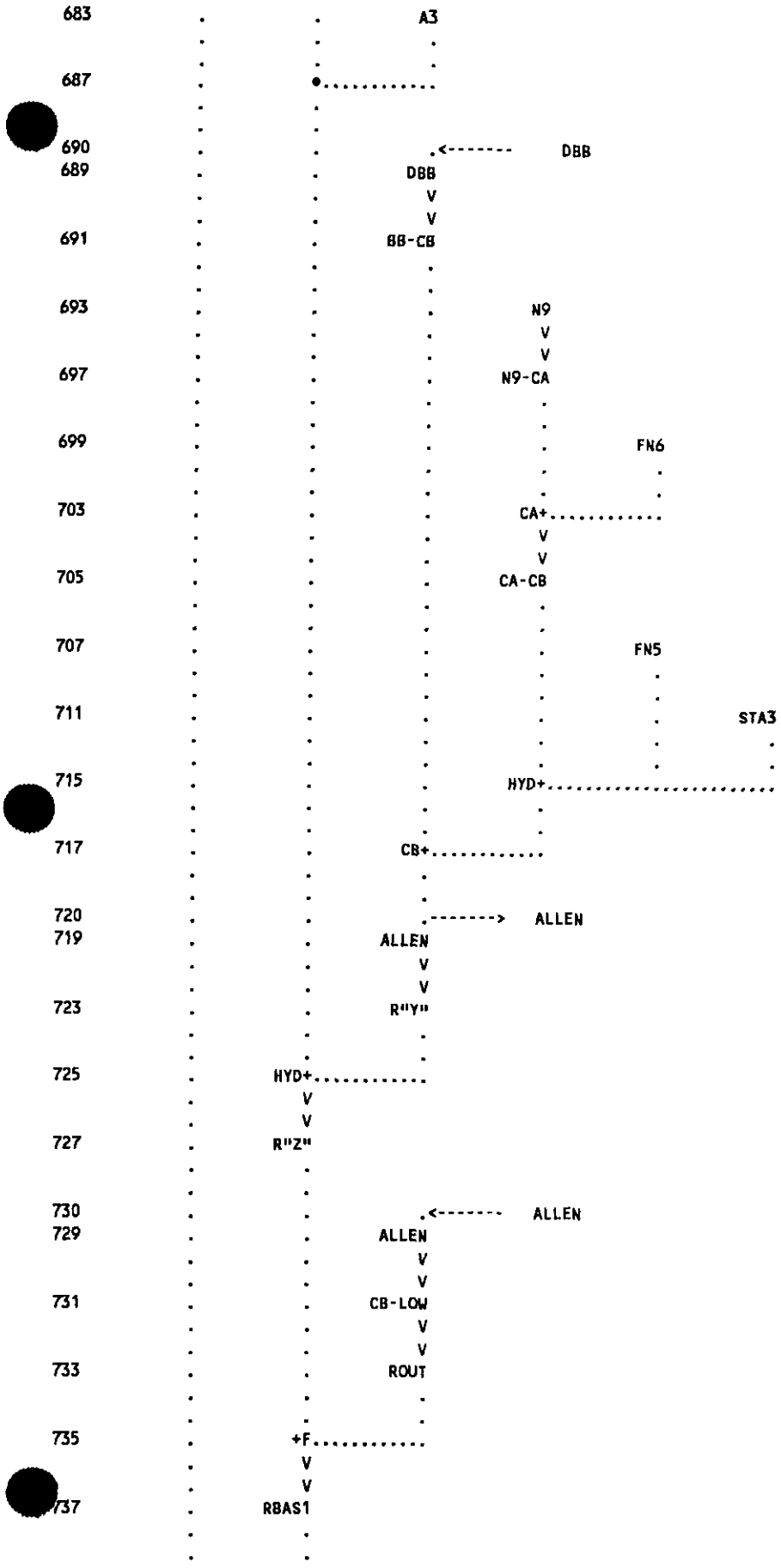
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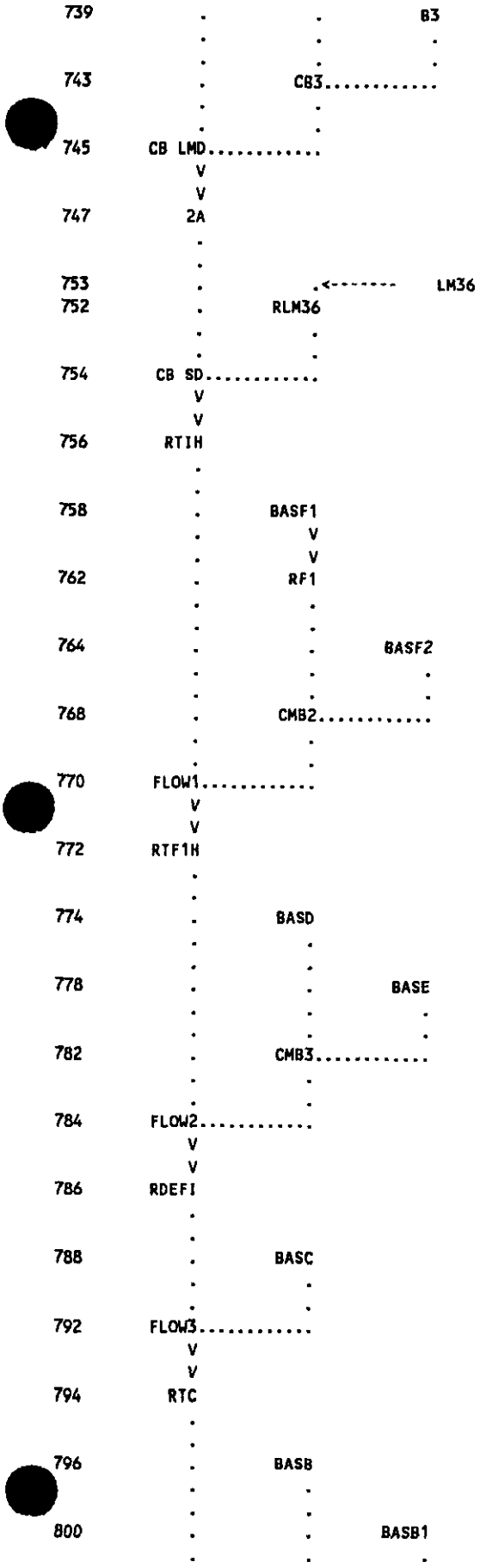
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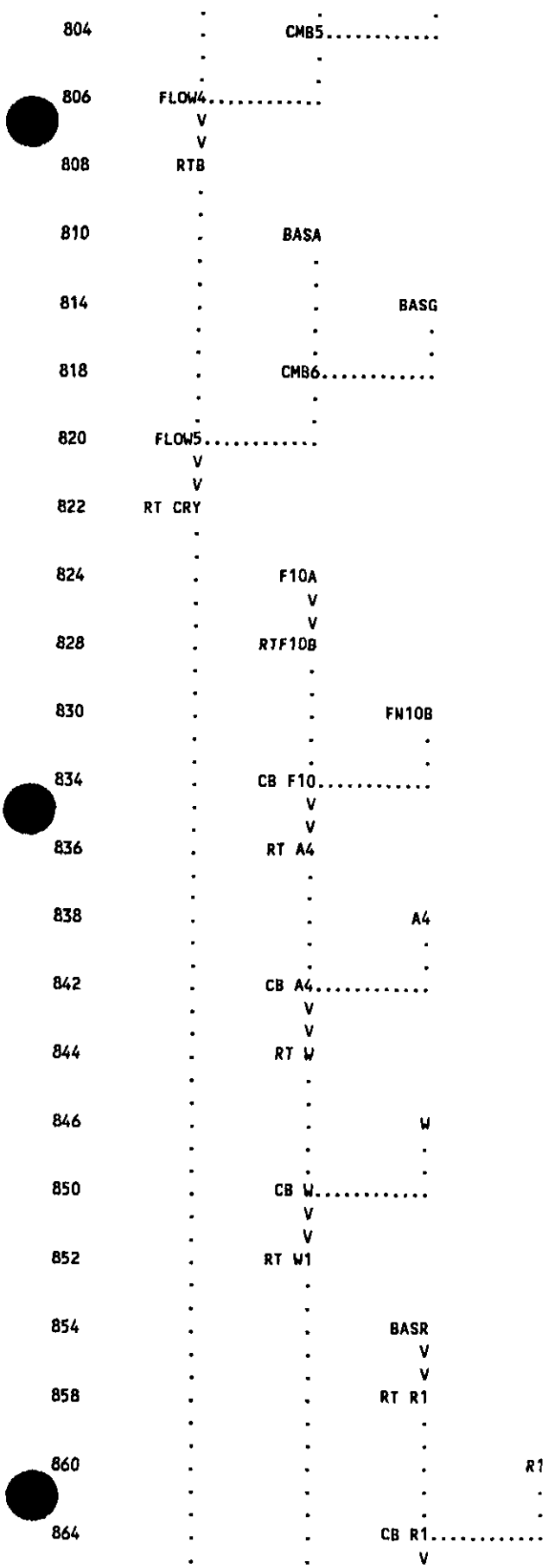
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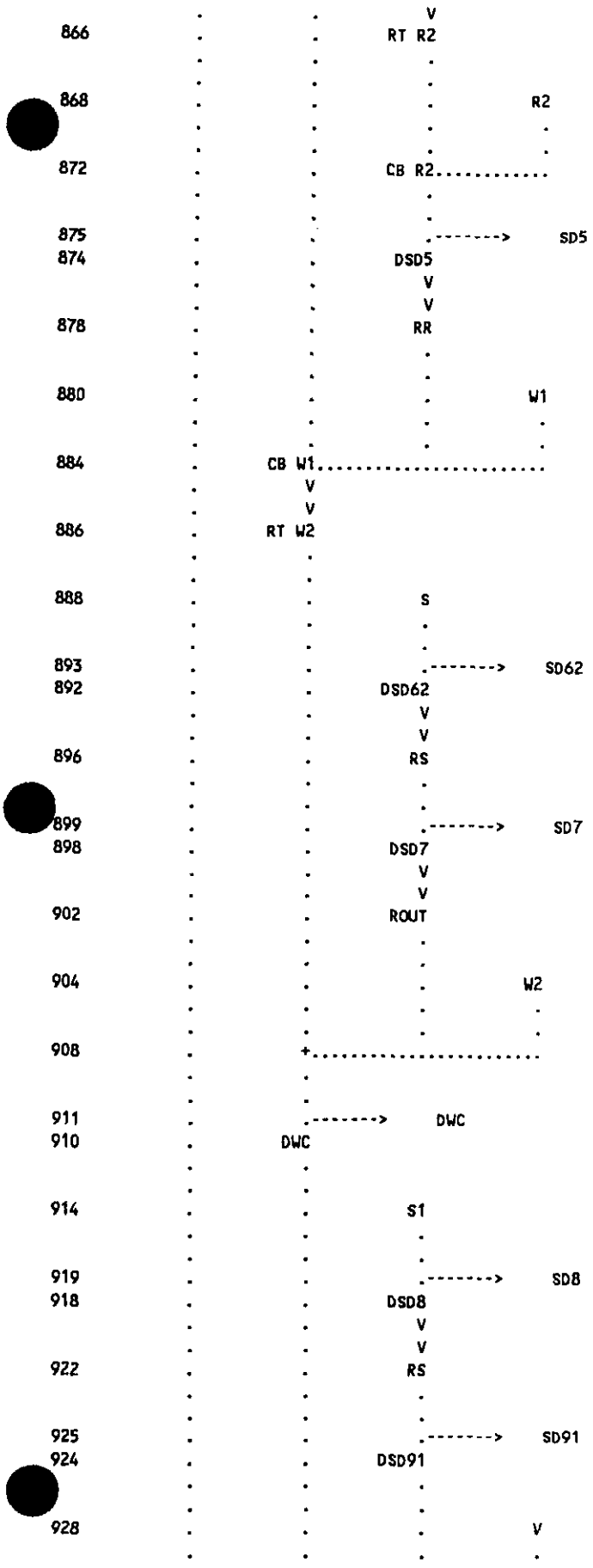
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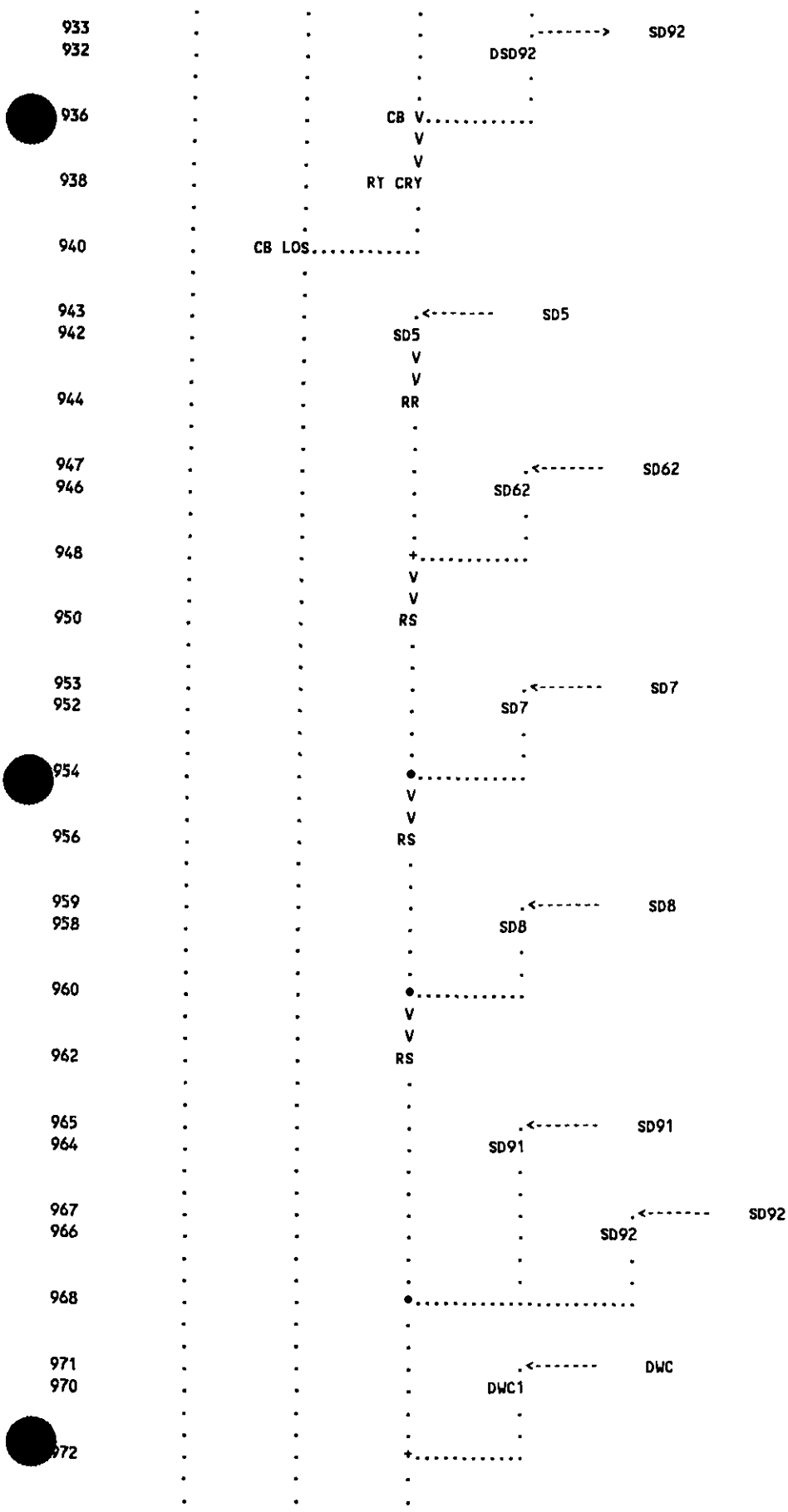
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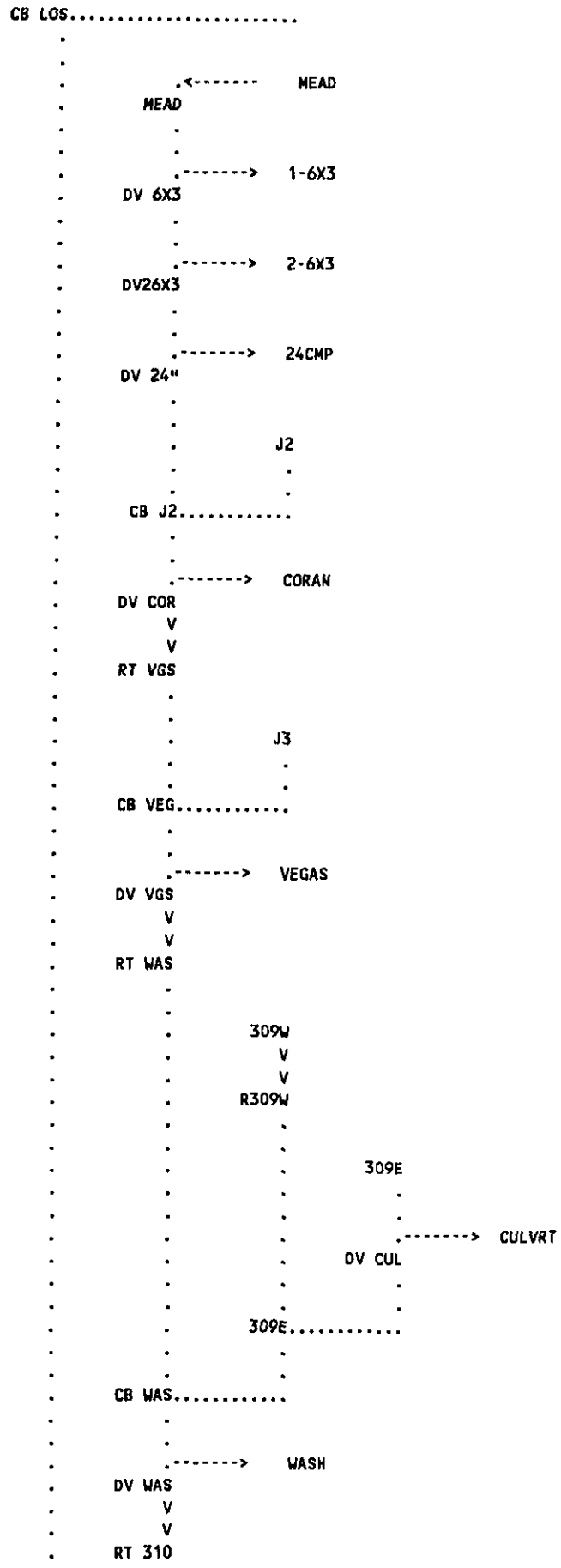
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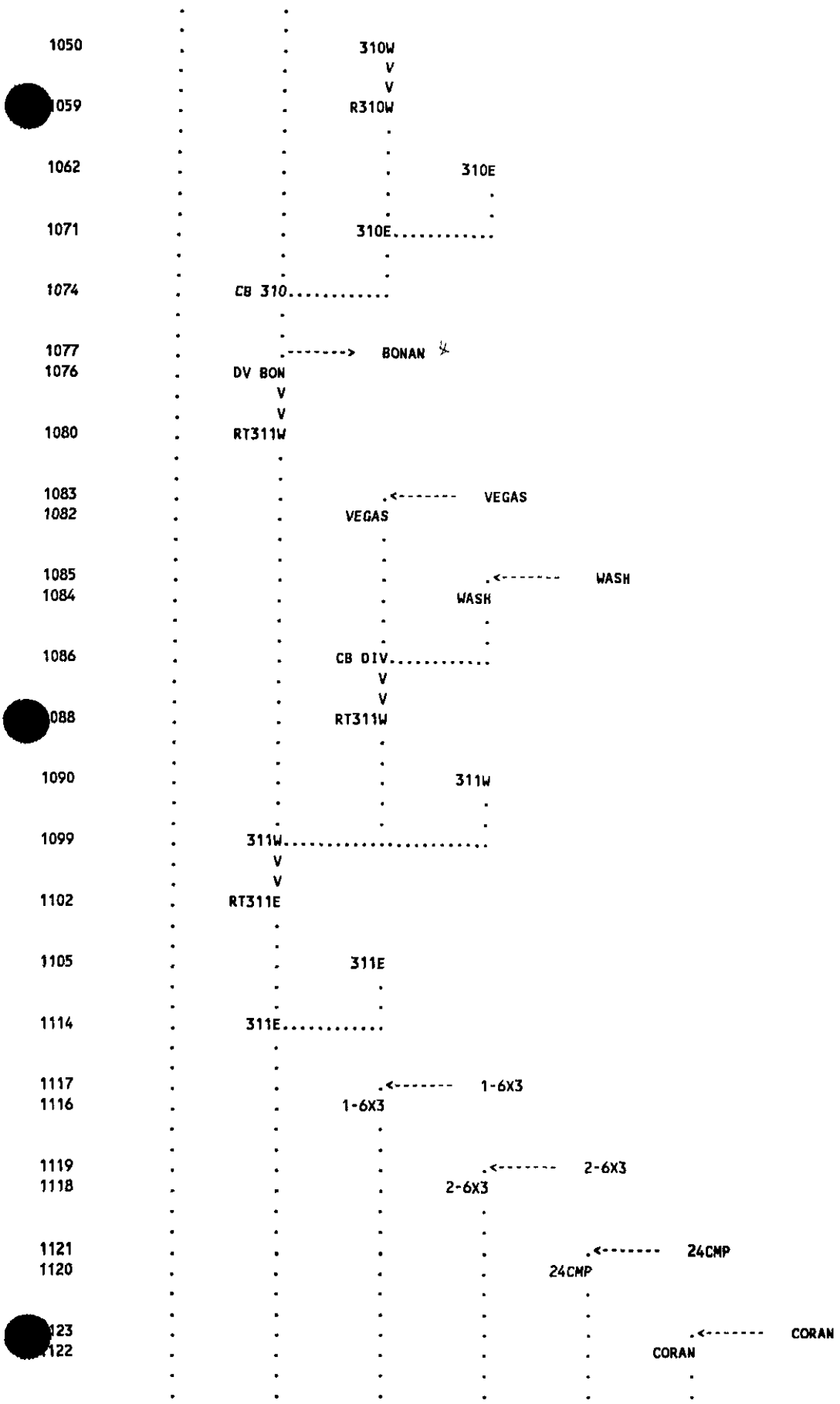
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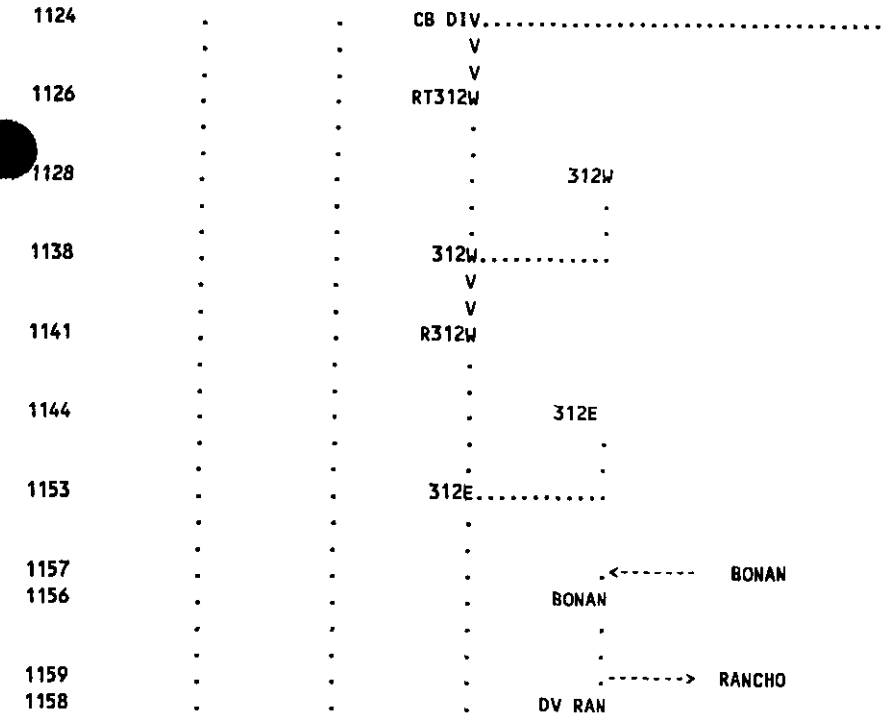

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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*                                            *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)        *
*          SEPTEMBER 1990                    *
*           VERSION 4.0                      *
*                                            *
*  RUN DATE  08/16/1994  TIME  11:23:43      *
*                                            *
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```
**********************************************
*                                            *
*    U.S. ARMY CORPS OF ENGINEERS            *
*    HYDROLOGIC ENGINEERING CENTER           *
*         609 SECOND STREET                  *
*       DAVIS, CALIFORNIA 95616              *
*          (916) 756-1104                    *
*                                            *
**********************************************
```


DATE: JUNE 1994

NORTHWEST LAS VEGAS FIS RESTUDY
BY COE & VAN LOO CONSULTANTS, INC
PREPARED FOR CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

FILE NAME: WASH.DAT
JOB # 930017

6-HOUR RAINFALL, 6 MINUTE TIME INTERVAL
RAINFALL DISTRIBUTION = SDN3
SCS UNIT HYDROGRAPH METHOD
EXISTING CONDITIONS

INFORMATION USED IN THIS HEC-1 MODEL IS BASED ON FIS HYDROLOGY REPORT
BY JAMES M. MONTGOMERY AND FINAL HYDROLOGY STUDY - LAKE MEAD BOULEVARD
PHASE 1A BY VTN NEVADA,

MOST KINEMATIC WAVE ROUTINGS IN THIS HEC-1 MODEL
HAVE BEEN REPLACED WITH MUSKINGUM ROUTING METHOD

```
28 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                     NMIN          6  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      2   0  ENDING DATE
                   NDTIME       0554  ENDING TIME
                    ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL      .10 HOURS
                      TOTAL TIME BASE    29.90 HOURS

       ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT

   JP          MULTI-PLAN OPTION
```

```
                    NPLAN          1  NUMBER OF PLANS

      JR          MULTI-RATIO OPTION
                      RATIOS OF PRECIPITATION
                       .98       .95       .92       .90       .89       .88

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*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

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PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .98	RATIO 2 .95	RATIO 3 .92	RATIO 4 .90	RATIO 5 .89	RATIO 6 .88
HYDROGRAPH AT	X4	.81	1	FLOW	290.	278.	266.	258.	254.	250.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
HYDROGRAPH AT	X3B	.16	1	FLOW	116.	110.	105.	102.	100.	98.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	CUL4	.16	1	FLOW	78.	76.	74.	73.	72.	72.
				TIME	4.40	4.40	4.30	4.30	4.30	4.30
			** PEAK STAGES IN FEET **							
			1	STAGE	15.30	15.26	15.23	15.21	15.20	15.19
				TIME	4.40	4.40	4.30	4.30	4.30	4.30
HYDROGRAPH AT	X3A	.12	1	FLOW	91.	87.	83.	81.	79.	78.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	CUL8	.12	1	FLOW	33.	32.	30.	30.	29.	29.
				TIME	4.80	4.70	4.70	4.70	4.70	4.70
			** PEAK STAGES IN FEET **							
			1	STAGE	23.24	23.06	22.87	22.74	22.68	22.62
				TIME	4.80	4.70	4.70	4.70	4.70	4.70
2 COMBINED AT	CX3	.28	1	FLOW	110.	107.	104.	101.	100.	99.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
ROUTED TO	RK3AB	.28	1	FLOW	108.	104.	101.	99.	98.	97.
				TIME	5.50	5.50	5.50	5.40	5.40	5.40
2 COMBINED AT	+	1.09	1	FLOW	397.	382.	367.	357.	352.	347.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
DIVERSION TO	DEVX4	1.09	1	FLOW	100.	100.	100.	100.	100.	100.
				TIME	4.50	4.50	4.50	4.50	4.60	4.60
HYDROGRAPH AT	DEVX4	1.09	1	FLOW	297.	282.	267.	257.	252.	247.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
ROUTED TO	RK4	1.09	1	FLOW	297.	282.	267.	257.	252.	247.
				TIME	5.70	5.70	5.70	5.70	5.70	5.70
HYDROGRAPH AT	X3C	.48	1	FLOW	125.	118.	111.	107.	105.	102.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
DIVERSION TO	SD1A	.48	1	FLOW	14.	14.	14.	14.	13.	13.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	SD1A	.48	1	FLOW	111.	104.	98.	93.	91.	89.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
ROUTED TO	RK3C	.48	1	FLOW	111.	104.	98.	93.	91.	89.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
HYDROGRAPH AT	X3	.34	1	FLOW	243.	234.	224.	218.	215.	211.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
3 COMBINED AT	CX3	1.91	1	FLOW	484.	460.	436.	420.	412.	404.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40

HYDROGRAPH AT	DTX4	.00	1	FLOW	100.	100.	100.	100.	100.	100.
				TIME	4.50	4.50	4.50	4.50	4.60	4.60
ROUTED TO	RDEX	.00	1	FLOW	100.	100.	100.	100.	100.	100.
				TIME	4.80	4.80	4.90	4.90	4.90	4.90
HYDROGRAPH AT	BSX5	.10	1	FLOW	97.	93.	89.	87.	86.	84.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	CX5	.10	1	FLOW	135.	129.	127.	126.	125.	125.
				TIME	3.90	3.90	4.60	4.60	4.60	4.90
DIVERSION TO	DVSTR1	.10	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	DVWR1	.10	1	FLOW	135.	129.	127.	126.	125.	125.
				TIME	3.90	3.90	4.60	4.60	4.60	4.90
DIVERSION TO	DVSTR2	.10	1	FLOW	37.	37.	37.	37.	37.	37.
				TIME	3.40	3.40	3.40	3.40	3.40	3.40
HYDROGRAPH AT	DVWR2	.10	1	FLOW	98.	92.	90.	89.	88.	88.
				TIME	3.90	3.90	4.60	4.60	4.60	4.90
ROUTED TO	RX5	.10	1	FLOW	97.	91.	89.	88.	88.	88.
				TIME	4.00	4.00	5.00	5.00	5.00	5.00
2 COMBINED AT	CX4X3	2.01	1	FLOW	567.	542.	518.	501.	493.	485.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
DIVERSION TO	DVBOX	2.01	1	FLOW	210.	210.	210.	210.	210.	210.
				TIME	3.70	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	DVBOX	2.01	1	FLOW	357.	332.	308.	291.	283.	275.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
ROUTED TO	RX34	2.01	1	FLOW	356.	331.	306.	290.	282.	274.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
HYDROGRAPH AT	X2	.20	1	FLOW	193.	185.	177.	172.	170.	167.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	CUL5	.20	1	FLOW	65.	62.	60.	59.	58.	57.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
			** PEAK STAGES IN FEET **							
			1	STAGE	38.38	38.21	38.03	37.92	37.86	37.80
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	X1D	.07	1	FLOW	56.	54.	51.	50.	49.	48.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	CUL9	.07	1	FLOW	19.	19.	18.	18.	18.	18.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
			** PEAK STAGES IN FEET **							
			1	STAGE	30.74	30.65	30.57	30.51	30.49	30.46
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	X1C	.08	1	FLOW	63.	61.	58.	56.	55.	54.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	CUL10	.08	1	FLOW	24.	23.	23.	22.	22.	22.
				TIME	4.60	4.60	4.50	4.50	4.50	4.50
			** PEAK STAGES IN FEET **							
			1	STAGE	27.59	27.53	27.48	27.45	27.43	27.41
				TIME	4.60	4.60	4.50	4.50	4.50	4.50

HYDROGRAPH AT	X1B	.07	1	FLOW	55.	52.	50.	48.	47.	47.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	CUL6	.07	1	FLOW	16.	16.	15.	14.	14.	14.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
			** PEAK STAGES IN FEET **							
			1	STAGE	24.45	24.34	24.23	24.16	24.12	24.08
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	X1A	.04	1	FLOW	30.	29.	28.	27.	26.	26.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	CUL7	.04	1	FLOW	18.	18.	17.	17.	17.	17.
				TIME	4.40	4.30	4.30	4.30	4.30	4.30
			** PEAK STAGES IN FEET **							
			1	STAGE	24.01	23.93	23.86	23.81	23.79	23.77
				TIME	4.40	4.30	4.30	4.30	4.30	4.30
5 COMBINED AT	X12	.46	1	FLOW	142.	137.	133.	130.	128.	127.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
ROUTED TO	RX2	.46	1	FLOW	141.	137.	132.	129.	128.	126.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	X1E	.46	1	FLOW	127.	120.	113.	109.	106.	104.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00
2 COMBINED AT	CX1E	.92	1	FLOW	268.	256.	245.	237.	233.	229.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00
DIVERSION TO	SD1B	.92	1	FLOW	12.	12.	12.	12.	12.	12.
				TIME	4.40	4.40	4.50	4.50	4.60	4.60
HYDROGRAPH AT	SD1B	.92	1	FLOW	256.	244.	233.	225.	221.	217.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00
ROUTED TO	RX1	.92	1	FLOW	255.	244.	232.	224.	221.	217.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	X1	.17	1	FLOW	113.	108.	104.	101.	99.	98.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
2 COMBINED AT	CX1	1.09	1	FLOW	316.	302.	288.	279.	275.	270.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
2 COMBINED AT	CX1X4	3.10	1	FLOW	656.	618.	580.	555.	543.	530.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
DIVERSION TO	DVFLAT	3.10	1	FLOW	20.	20.	20.	20.	20.	20.
				TIME	2.70	2.80	2.90	2.90	3.00	3.00
HYDROGRAPH AT	DVFLAT	3.10	1	FLOW	636.	598.	560.	535.	523.	510.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
ROUTED TO	RX34	3.10	1	FLOW	635.	597.	559.	534.	521.	509.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
HYDROGRAPH AT	N2	.20	1	FLOW	116.	112.	107.	104.	103.	101.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	CN2	3.30	1	FLOW	699.	659.	618.	592.	578.	565.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
DIVERSION TO	DVCUL1	3.30	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	3.40	3.50	3.50	3.50	3.50	3.50

HYDROGRAPH AT	DVCUL	3.30	1	FLOW	664.	624.	583.	557.	543.	530.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
ROUTED TO	RN2	3.30	1	FLOW	662.	622.	582.	555.	542.	528.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
HYDROGRAPH AT	N1	.23	1	FLOW	131.	126.	121.	117.	116.	114.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
2 COMBINED AT	CN1	3.53	1	FLOW	735.	692.	649.	621.	606.	592.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
DIVERSION TO	DVCUL2	3.53	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	DVCUL	3.53	1	FLOW	700.	657.	614.	586.	571.	557.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
ROUTED TO	RN1	3.53	1	FLOW	699.	656.	613.	584.	570.	556.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
DIVERSION TO	PSM1	3.53	1	FLOW	261.	261.	261.	261.	261.	261.
				TIME	4.20	4.20	4.20	4.20	4.30	4.30
HYDROGRAPH AT	PSM	3.53	1	FLOW	438.	395.	352.	323.	309.	295.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
HYDROGRAPH AT	K3	.12	1	FLOW	119.	115.	110.	107.	105.	104.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	CUL2	.12	1	FLOW	75.	72.	70.	68.	67.	66.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
			** PEAK STAGES IN FEET **							
			1	STAGE	42.52	42.45	42.37	42.32	42.30	42.28
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	RK3	.12	1	FLOW	74.	71.	69.	67.	66.	65.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	K2	.19	1	FLOW	67.	63.	58.	56.	54.	53.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
2 COMBINED AT	CK23	.31	1	FLOW	139.	132.	126.	121.	119.	117.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	RK2	.31	1	FLOW	139.	132.	125.	121.	118.	116.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	K2A	.22	1	FLOW	94.	89.	85.	81.	80.	78.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
2 COMBINED AT	CK2A	.53	1	FLOW	232.	220.	209.	201.	198.	194.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
DIVERSION TO	SD1	.53	1	FLOW	135.	135.	135.	135.	135.	135.
				TIME	4.00	4.00	4.00	4.00	4.10	4.10
HYDROGRAPH AT	DSD1	.53	1	FLOW	97.	85.	74.	66.	63.	59.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	BASK1	.33	1	FLOW	106.	101.	96.	93.	91.	89.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10
2 COMBINED AT	CK1	.86	1	FLOW	180.	165.	149.	139.	134.	128.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
DIVERSION TO	SD2	.86	1	FLOW	25.	25.	25.	25.	25.	25.
				TIME	3.80	3.90	3.90	3.90	3.90	3.90

HYDROGRAPH AT	DSD2	.86	1	FLOW	155.	140.	124.	114.	109.	103.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
2 COMBINED AT	CXK	4.39	1	FLOW	529.	473.	418.	386.	371.	355.
				TIME	4.80	4.80	5.50	5.50	5.50	5.50
DIVERSION TO	SD3	4.39	1	FLOW	50.	50.	50.	50.	50.	50.
				TIME	4.10	4.10	4.10	4.20	4.20	4.20
HYDROGRAPH AT	DSD3	4.39	1	FLOW	479.	423.	368.	336.	321.	305.
				TIME	4.80	4.80	5.50	5.50	5.50	5.50
ROUTED TO	RXLM	4.39	1	FLOW	477.	421.	367.	335.	319.	304.
				TIME	4.90	4.90	5.60	5.60	5.60	5.60
HYDROGRAPH AT	SUBW	.26	1	FLOW	313.	301.	289.	281.	277.	273.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
ROUTED TO	RTLO	.26	1	FLOW	308.	296.	284.	276.	272.	268.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	SUBS1	.07	1	FLOW	83.	80.	76.	74.	73.	71.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SUBN1	.00	1	FLOW	8.	8.	7.	7.	7.	7.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	COMLO	.33	1	FLOW	374.	359.	344.	335.	330.	325.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	RTBL	.33	1	FLOW	369.	354.	340.	330.	325.	321.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	SUBS2	.12	1	FLOW	74.	69.	65.	62.	60.	59.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	SUBN2	.01	1	FLOW	7.	7.	6.	6.	6.	6.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	COMBL	.46	1	FLOW	434.	415.	397.	384.	378.	372.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	RTTP	.46	1	FLOW	428.	410.	391.	379.	373.	367.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	SUBS3	.12	1	FLOW	66.	62.	58.	55.	54.	52.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	SUBN3	.02	1	FLOW	15.	14.	13.	13.	12.	12.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMTP	.60	1	FLOW	494.	471.	449.	434.	427.	419.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	RTL1	.60	1	FLOW	488.	466.	443.	429.	421.	414.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	SUBS4	.02	1	FLOW	15.	14.	13.	13.	12.	12.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SUBN4	.01	1	FLOW	5.	5.	4.	4.	4.	4.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	COML1	.63	1	FLOW	493.	471.	448.	434.	426.	419.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RTAR	.63	1	FLOW	488.	465.	443.	428.	421.	414.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10

HYDROGRAPH AT	SUBS5	.06	1	FLOW	36.	33.	31.	30.	29.	28.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMAR	.69	1	FLOW	505.	482.	459.	443.	436.	428.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
ROUTED TO	RTSAN	.69	1	FLOW	500.	477.	454.	439.	431.	423.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
HYDROGRAPH AT	SUBN5	.04	1	FLOW	30.	28.	26.	25.	25.	24.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMSS	.73	1	FLOW	505.	481.	458.	443.	435.	428.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	RTJN	.73	1	FLOW	500.	477.	454.	438.	431.	423.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	SUBS6	.02	1	FLOW	30.	29.	27.	27.	26.	26.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SUBN6	.01	1	FLOW	10.	10.	9.	9.	9.	9.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	COMJN	.76	1	FLOW	503.	480.	457.	442.	434.	426.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	RTSA	.76	1	FLOW	499.	476.	453.	438.	430.	422.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	SUBS7	.05	1	FLOW	35.	32.	30.	29.	28.	27.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SUBN7	.03	1	FLOW	23.	21.	20.	19.	18.	18.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMSA	.84	1	FLOW	507.	484.	460.	445.	437.	430.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
ROUTED TO	RM2A	.84	1	FLOW	503.	480.	457.	441.	434.	426.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	AREAU	.03	1	FLOW	43.	41.	39.	38.	37.	36.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	SMITH	.86	1	FLOW	511.	487.	464.	448.	441.	433.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
ROUTED TO	ROUT	.86	1	FLOW	507.	483.	460.	444.	437.	429.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	AREAT	.05	1	FLOW	30.	29.	28.	27.	26.	26.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	AREAB	.00	1	FLOW	7.	7.	6.	6.	6.	6.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	SHAD	.91	1	FLOW	524.	500.	476.	460.	452.	444.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
ROUTED TO	ROUT	.91	1	FLOW	520.	496.	472.	456.	449.	441.
				TIME	4.70	4.70	4.70	4.70	4.70	4.70
HYDROGRAPH AT	AREAB	.03	1	FLOW	29.	28.	27.	26.	25.	25.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	JEAN	.95	1	FLOW	528.	504.	480.	464.	456.	448.
				TIME	4.70	4.70	4.70	4.70	4.70	4.70

ROUTED TO	ROUT	.95	1	FLOW	524.	500.	476.	460.	452.	444.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	AREAC	.01	1	FLOW	7.	6.	6.	6.	6.	6.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	AREAS	.03	1	FLOW	20.	19.	18.	17.	17.	17.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
3 COMBINED AT	MICH	.99	1	FLOW	536.	511.	487.	470.	462.	454.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80
ROUTED TO	ROUT	.99	1	FLOW	529.	504.	480.	464.	456.	448.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
HYDROGRAPH AT	AREAR	.03	1	FLOW	22.	21.	20.	19.	19.	18.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	TEQ	1.01	1	FLOW	535.	510.	486.	470.	461.	453.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
ROUTED TO	ROUT	1.01	1	FLOW	528.	504.	480.	464.	456.	448.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00
HYDROGRAPH AT	AREAD	.03	1	FLOW	24.	23.	22.	21.	21.	20.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	AREAQ	.07	1	FLOW	49.	46.	44.	43.	42.	41.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
3 COMBINED AT	LEON	1.11	1	FLOW	555.	530.	504.	488.	479.	471.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00
ROUTED TO	ROUT	1.11	1	FLOW	552.	527.	501.	485.	476.	468.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10
HYDROGRAPH AT	AREAE	.05	1	FLOW	29.	28.	26.	25.	25.	25.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	AREAP	.10	1	FLOW	65.	62.	59.	57.	56.	55.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	AREADS	.00	1	FLOW	7.	7.	7.	7.	6.	6.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	AREADN	.00	1	FLOW	7.	6.	6.	6.	6.	6.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
5 COMBINED AT	DEC	1.27	1	FLOW	593.	566.	539.	521.	512.	503.
				TIME	5.10	5.10	5.10	5.10	5.10	5.10
ROUTED TO	RM1	1.27	1	FLOW	586.	560.	533.	515.	507.	498.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	BASLJ	.40	1	FLOW	159.	153.	146.	141.	139.	137.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00
2 COMBINED AT	+	1.67	1	FLOW	742.	709.	676.	654.	643.	632.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
DIVERSION TO	LMSD1	1.67	1	FLOW	573.	573.	573.	573.	573.	573.
				TIME	4.80	4.90	4.90	5.00	5.00	5.00
HYDROGRAPH AT	DV SD	1.67	1	FLOW	169.	136.	103.	81.	70.	59.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
2 COMBINED AT	CB MED	6.06	1	FLOW	634.	546.	458.	400.	371.	342.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20

DIVERSION TO	5X4	6.06	1	FLOW	200.	200.	200.	200.	200.	200.
				TIME	4.40	4.40	4.50	4.50	4.60	4.60
HYDROGRAPH AT	DV 5X4	6.06	1	FLOW	434.	346.	258.	200.	171.	142.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
DIVERSION TO	MEAD	6.06	1	FLOW	434.	346.	258.	200.	171.	142.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	DV MED	6.06	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
ROUTED TO	RR	6.06	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	BASI	.05	1	FLOW	48.	46.	44.	43.	42.	42.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	+	6.11	1	FLOW	48.	46.	44.	43.	42.	42.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	RT1	6.11	1	FLOW	47.	46.	44.	42.	42.	41.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	BASH	.13	1	FLOW	100.	96.	92.	89.	87.	86.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	HI	6.24	1	FLOW	147.	141.	135.	131.	129.	127.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	LMSD1	.00	1	FLOW	573.	573.	573.	573.	573.	573.
				TIME	4.80	4.90	4.90	5.00	5.00	5.00
HYDROGRAPH AT	5X4	.00	1	FLOW	200.	200.	200.	200.	200.	200.
				TIME	4.40	4.40	4.50	4.50	4.60	4.60
2 COMBINED AT	CB DIV	.00	1	FLOW	773.	773.	773.	773.	773.	773.
				TIME	4.80	4.90	4.90	5.00	5.00	5.00
ROUTED TO	RT DET	.00	1	FLOW	773.	773.	773.	773.	773.	773.
				TIME	4.90	5.00	5.00	5.10	5.10	5.10
DIVERSION TO	LM36	.00	1	FLOW	50.	50.	50.	50.	50.	50.
				TIME	3.30	3.30	3.40	3.40	3.40	3.40
HYDROGRAPH AT	DVLM36	.00	1	FLOW	723.	723.	723.	723.	723.	723.
				TIME	4.90	5.00	5.00	5.10	5.10	5.10
2 COMBINED AT	CMB1	6.24	1	FLOW	778.	775.	773.	770.	769.	769.
				TIME	4.90	5.00	5.00	5.10	5.10	5.10
HYDROGRAPH AT	B1A	.05	1	FLOW	58.	57.	54.	52.	51.	50.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	DVFLAT	.00	1	FLOW	20.	20.	20.	20.	20.	20.
				TIME	2.70	2.80	2.90	2.90	3.00	3.00
HYDROGRAPH AT	DVCUL1	.00	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	3.40	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	B1A+C	.05	1	FLOW	113.	112.	109.	107.	106.	105.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	B1B	.01	1	FLOW	15.	14.	14.	13.	13.	13.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	CB A8	.07	1	FLOW	128.	126.	123.	120.	119.	118.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70

ROUTED TO	ROUT	.07	1	FLOW	126.	124.	121.	118.	117.	116.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	B2	.11	1	FLOW	101.	96.	92.	90.	88.	87.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	B1+B2	.17	1	FLOW	227.	221.	214.	209.	206.	203.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	RBAS2	.17	1	FLOW	225.	219.	212.	207.	204.	202.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	DVCUL	.00	1	FLOW	35.	35.	35.	35.	35.	35.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	PSM1	.00	1	FLOW	261.	261.	261.	261.	261.	261.
				TIME	4.20	4.20	4.20	4.20	4.30	4.30
2 COMBINED AT	+	.00	1	FLOW	296.	296.	296.	296.	296.	296.
				TIME	4.20	4.20	4.20	4.20	4.30	4.30
ROUTED TO	R	.00	1	FLOW	296.	296.	296.	296.	296.	296.
				TIME	4.70	4.70	4.70	4.70	4.70	4.80
HYDROGRAPH AT	B4	.11	1	FLOW	95.	91.	87.	85.	84.	82.
				TIME	3.90	3.90	4.00	4.00	4.00	4.00
3 COMBINED AT	CB4	.28	1	FLOW	516.	505.	500.	495.	486.	475.
				TIME	4.20	4.30	4.30	4.30	4.30	4.30
ROUTED TO	RB4	.28	1	FLOW	509.	498.	491.	485.	477.	468.
				TIME	4.30	4.40	4.40	4.40	4.40	4.40
DIVERSION TO	SD4	.28	1	FLOW	20.	20.	20.	20.	20.	20.
				TIME	1.20	1.30	1.40	1.40	1.50	1.50
HYDROGRAPH AT	DSD4	.28	1	FLOW	489.	478.	471.	465.	457.	448.
				TIME	4.30	4.40	4.40	4.40	4.40	4.40
ROUTED TO	RB3	.28	1	FLOW	482.	472.	463.	456.	450.	445.
				TIME	4.40	4.50	4.50	4.50	4.50	4.60
HYDROGRAPH AT	SD1A	.00	1	FLOW	14.	14.	14.	14.	13.	13.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
ROUTED TO	R	.00	1	FLOW	14.	14.	14.	14.	13.	13.
				TIME	5.30	5.30	5.30	5.30	5.30	5.30
HYDROGRAPH AT	SD1B	.00	1	FLOW	12.	12.	12.	12.	12.	12.
				TIME	4.40	4.40	4.50	4.50	4.60	4.60
2 COMBINED AT	+	.00	1	FLOW	26.	26.	26.	26.	25.	25.
				TIME	5.30	5.30	5.30	5.30	5.30	5.30
ROUTED TO	R	.00	1	FLOW	26.	26.	26.	26.	25.	25.
				TIME	5.40	5.40	5.40	5.40	5.40	5.40
ROUTED TO	R1	.00	1	FLOW	26.	26.	26.	26.	25.	25.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
HYDROGRAPH AT	SD1	.00	1	FLOW	135.	135.	135.	135.	135.	135.
				TIME	4.00	4.00	4.00	4.00	4.10	4.10
2 COMBINED AT	+	.00	1	FLOW	161.	161.	161.	160.	160.	160.
				TIME	5.40	5.30	5.20	5.10	5.10	5.10
ROUTED TO	R1	.00	1	FLOW	161.	161.	161.	160.	160.	160.
				TIME	5.50	5.40	5.30	5.20	5.20	5.20

HYDROGRAPH AT	SD2	.00	1	FLOW	25.	25.	25.	25.	25.	25.
				TIME	3.80	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	+	.00	1	FLOW	186.	186.	186.	185.	185.	185.
				TIME	5.50	5.40	5.30	5.20	5.20	5.20
ROUTED TO	R3	.00	1	FLOW	186.	186.	186.	185.	185.	185.
				TIME	5.60	5.50	5.40	5.30	5.30	5.30
HYDROGRAPH AT	SD3	.00	1	FLOW	50.	50.	50.	50.	50.	50.
				TIME	4.10	4.10	4.10	4.20	4.20	4.20
2 COMBINED AT	+	.00	1	FLOW	236.	236.	236.	235.	235.	235.
				TIME	5.60	5.50	5.40	5.30	5.30	5.30
ROUTED TO	RK1	.00	1	FLOW	236.	236.	236.	235.	235.	235.
				TIME	5.70	5.60	5.50	5.40	5.40	5.40
HYDROGRAPH AT	SD4	.00	1	FLOW	20.	20.	20.	20.	20.	20.
				TIME	1.20	1.30	1.40	1.40	1.50	1.50
2 COMBINED AT	+	.00	1	FLOW	256.	256.	256.	255.	255.	255.
				TIME	5.70	5.60	5.50	5.40	5.40	5.40
ROUTED TO	RSD	.00	1	FLOW	256.	256.	256.	255.	255.	255.
				TIME	5.80	5.70	5.60	5.50	5.50	5.50
2 COMBINED AT	+	.28	1	FLOW	720.	710.	700.	693.	687.	683.
				TIME	4.50	4.50	4.50	4.50	4.60	4.60
ROUTED TO	RR	.28	1	FLOW	719.	709.	699.	692.	686.	683.
				TIME	4.60	4.60	4.60	4.60	4.70	4.70
HYDROGRAPH AT	B1A	.05	1	FLOW	58.	57.	54.	52.	51.	50.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
3 COMBINED AT	CB CRY	6.58	1	FLOW	1487.	1462.	1452.	1443.	1440.	1438.
				TIME	4.60	4.90	5.00	5.10	5.10	5.10
HYDROGRAPH AT	DVSTR1	.00	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	DVSTR2	.00	1	FLOW	37.	37.	37.	37.	37.	37.
				TIME	3.40	3.40	3.40	3.40	3.40	3.40
2 COMBINED AT	CD	.00	1	FLOW	37.	37.	37.	37.	37.	37.
				TIME	3.40	3.40	3.40	3.40	3.40	3.40
ROUTED TO	R-AB	.00	1	FLOW	37.	37.	37.	37.	37.	37.
				TIME	3.90	3.90	3.90	4.10	4.10	4.10
HYDROGRAPH AT	N1	.10	1	FLOW	95.	91.	87.	84.	82.	81.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	STR1	.00	1	FLOW	9.	9.	9.	9.	9.	8.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	AB+	.10	1	FLOW	137.	133.	128.	125.	124.	122.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
DIVERSION TO	DAV+	.10	1	FLOW	112.	108.	103.	100.	99.	97.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	DAV+	.10	1	FLOW	25.	25.	25.	25.	25.	25.
				TIME	3.00	3.10	3.10	3.20	3.20	3.20
ROUTED TO	ROUT	.10	1	FLOW	25.	25.	25.	25.	25.	25.
				TIME	3.40	3.60	3.60	3.70	3.70	3.70

HYDROGRAPH AT	A1	.04	1	FLOW	41.	38.	36.	35.	34.	33.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	DVBOX	.00	1	FLOW	210.	210.	210.	210.	210.	210.
				TIME	3.70	3.80	3.80	3.80	3.80	3.80
3 COMBINED AT	+	.14	1	FLOW	262.	259.	253.	252.	252.	252.
				TIME	3.70	3.70	3.80	3.80	3.80	3.80
HYDROGRAPH AT	A2	.15	1	FLOW	88.	83.	78.	75.	73.	72.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	A2+	.29	1	FLOW	338.	332.	327.	323.	321.	319.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	ROUT	.29	1	FLOW	337.	331.	325.	321.	319.	317.
				TIME	3.90	3.90	3.90	4.00	4.00	4.00
HYDROGRAPH AT	DAV+	.00	1	FLOW	112.	108.	103.	100.	99.	97.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
ROUTED TO	AA-BB	.00	1	FLOW	111.	106.	102.	99.	97.	96.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	FN2	.13	1	FLOW	110.	106.	102.	99.	97.	96.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	STR2	.01	1	FLOW	17.	16.	16.	15.	15.	15.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	HYD+	.14	1	FLOW	118.	113.	109.	106.	104.	103.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	FN4	.14	1	FLOW	110.	106.	102.	99.	97.	96.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	BA-BB	.14	1	FLOW	109.	105.	101.	98.	97.	95.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
3 COMBINED AT	BB+	.28	1	FLOW	310.	298.	286.	278.	274.	270.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
DIVERSION TO	DBB	.28	1	FLOW	80.	80.	80.	80.	80.	80.
				TIME	3.40	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	DBB	.28	1	FLOW	230.	218.	206.	198.	194.	190.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	ROUT	.28	1	FLOW	225.	213.	201.	193.	189.	185.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	+	.57	1	FLOW	560.	543.	525.	514.	508.	502.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	R"W"	.57	1	FLOW	558.	540.	523.	511.	505.	500.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	A3	.15	1	FLOW	88.	83.	78.	75.	73.	72.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	+	.72	1	FLOW	632.	611.	590.	576.	568.	561.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	DBB	.00	1	FLOW	80.	80.	80.	80.	80.	80.
				TIME	3.40	3.50	3.50	3.50	3.50	3.50
ROUTED TO	BB-CB	.00	1	FLOW	80.	80.	80.	80.	80.	80.
				TIME	3.50	3.60	3.60	3.60	3.60	3.60

HYDROGRAPH AT	N9	.15	1	FLOW	98.	94.	90.	88.	86.	85.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	N9-CA	.15	1	FLOW	98.	94.	90.	87.	86.	85.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	FN6	.13	1	FLOW	87.	84.	80.	78.	77.	76.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
2 COMBINED AT	CA+	.28	1	FLOW	183.	175.	168.	163.	161.	158.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	CA-CB	.28	1	FLOW	182.	174.	167.	162.	160.	157.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	FN5	.12	1	FLOW	77.	74.	71.	69.	68.	67.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
HYDROGRAPH AT	STA3	.01	1	FLOW	16.	16.	15.	15.	15.	14.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	HYD+	.41	1	FLOW	260.	249.	239.	232.	228.	225.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
2 COMBINED AT	CB+	.41	1	FLOW	340.	329.	319.	312.	308.	305.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
DIVERSION TO	ALLEN	.41	1	FLOW	181.	181.	181.	181.	181.	181.
				TIME	3.80	3.80	3.80	3.80	3.80	3.90
HYDROGRAPH AT	ALLEN	.41	1	FLOW	159.	148.	138.	131.	127.	124.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	R"Y"	.41	1	FLOW	157.	146.	136.	129.	126.	122.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	HYD+	1.13	1	FLOW	745.	715.	686.	666.	657.	647.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	R"Z"	1.13	1	FLOW	739.	710.	681.	661.	651.	642.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	ALLEN	.00	1	FLOW	181.	181.	181.	181.	181.	181.
				TIME	3.80	3.80	3.80	3.80	3.80	3.90
ROUTED TO	CB-LOW	.00	1	FLOW	181.	181.	181.	181.	181.	181.
				TIME	3.90	3.90	3.90	3.90	3.90	4.00
ROUTED TO	ROUT	.00	1	FLOW	181.	181.	181.	181.	181.	181.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	+F	1.13	1	FLOW	920.	891.	862.	842.	832.	823.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
ROUTED TO	RBAS1	1.13	1	FLOW	918.	888.	859.	840.	830.	820.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	B3	.31	1	FLOW	190.	182.	174.	169.	166.	163.
				TIME	4.30	4.30	4.30	4.30	4.30	4.30
2 COMBINED AT	CB3	1.45	1	FLOW	1102.	1065.	1028.	1003.	991.	979.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	CB LMD	8.02	1	FLOW	2559.	2476.	2367.	2318.	2281.	2236.
				TIME	4.50	4.50	4.60	4.60	4.60	4.60
ROUTED TO	2A	8.02	1	FLOW	367.	351.	334.	322.	316.	310.
				TIME	8.00	7.90	7.90	7.90	7.90	7.90

** PEAK STAGES IN FEET **

			1	STAGE	117.92	117.51	117.08	116.78	116.62	116.47
				TIME	8.00	7.90	7.90	7.90	7.90	7.90
[redacted]DROGRAPH AT	RLM36	.00	1	FLOW	50.	50.	50.	50.	50.	50.
				TIME	3.30	3.30	3.40	3.40	3.40	3.40
2 COMBINED AT	CB SD	8.02	1	FLOW	412.	395.	377.	366.	360.	354.
				TIME	7.50	7.50	7.40	7.40	7.40	7.40
ROUTED TO	RT1H	8.02	1	FLOW	411.	394.	377.	366.	360.	354.
				TIME	7.60	7.60	7.50	7.50	7.50	7.50
HYDROGRAPH AT	BASF1	.09	1	FLOW	55.	53.	50.	48.	47.	46.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RF1	.09	1	FLOW	55.	52.	50.	48.	47.	46.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
HYDROGRAPH AT	BASF2	.06	1	FLOW	32.	31.	29.	28.	27.	27.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
2 COMBINED AT	CMB2	.15	1	FLOW	87.	83.	79.	76.	74.	73.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
2 COMBINED AT	FLOW1	8.17	1	FLOW	412.	395.	378.	366.	360.	354.
				TIME	7.60	7.60	7.50	7.50	7.50	7.50
ROUTED TO	RTF1H	8.17	1	FLOW	411.	395.	377.	366.	360.	354.
				TIME	7.70	7.70	7.60	7.60	7.60	7.60
HYDROGRAPH AT	BASD	.06	1	FLOW	27.	25.	24.	23.	23.	22.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
[redacted]ROGRAPH AT	BASE	.02	1	FLOW	15.	14.	14.	13.	13.	13.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	CMB3	.08	1	FLOW	30.	28.	27.	26.	25.	25.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
2 COMBINED AT	FLOW2	8.25	1	FLOW	413.	396.	379.	367.	361.	355.
				TIME	7.70	7.70	7.60	7.60	7.60	7.60
ROUTED TO	RDEF1	8.25	1	FLOW	412.	395.	378.	366.	360.	354.
				TIME	7.80	7.80	7.70	7.70	7.70	7.70
HYDROGRAPH AT	BASC	.04	1	FLOW	22.	21.	20.	20.	19.	19.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
2 COMBINED AT	FLOW3	8.29	1	FLOW	412.	395.	378.	366.	360.	354.
				TIME	7.80	7.80	7.70	7.70	7.70	7.70
ROUTED TO	RTC	8.29	1	FLOW	411.	395.	378.	366.	360.	353.
				TIME	7.90	7.80	7.80	7.80	7.80	7.80
HYDROGRAPH AT	BASB	.01	1	FLOW	8.	8.	8.	7.	7.	7.
				TIME	3.70	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	BASB1	.01	1	FLOW	11.	11.	10.	10.	10.	10.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	CMB5	.02	1	FLOW	18.	17.	17.	16.	16.	16.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
[redacted]COMBINED AT	FLOW4	8.32	1	FLOW	411.	395.	378.	366.	360.	353.
				TIME	7.90	7.80	7.80	7.80	7.80	7.80
ROUTED TO	RTB	8.32	1	FLOW	410.	394.	377.	365.	359.	353.

				TIME	8.00	7.90	7.90	7.90	7.90	7.90
HYDROGRAPH AT	BASA	.01	1	FLOW	12.	11.	11.	10.	10.	10.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
DROGRAPH AT	BASG	.07	1	FLOW	65.	63.	60.	58.	57.	56.
				TIME	3.80	3.80	3.90	3.90	3.90	3.90
2 COMBINED AT	CMB6	.08	1	FLOW	75.	72.	69.	67.	66.	65.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	FLOW5	8.40	1	FLOW	410.	394.	377.	365.	359.	353.
				TIME	8.00	7.90	7.90	7.90	7.90	7.90
ROUTED TO	RT CRY	8.40	1	FLOW	410.	394.	377.	365.	359.	352.
				TIME	8.10	8.00	8.00	8.00	8.00	8.00
HYDROGRAPH AT	F10A	.08	1	FLOW	68.	66.	63.	61.	60.	59.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	RTF10B	.08	1	FLOW	67.	64.	61.	60.	59.	58.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	FN10B	.05	1	FLOW	52.	50.	48.	47.	46.	45.
				TIME	3.70	3.70	3.70	3.80	3.80	3.80
2 COMBINED AT	CB F10	.13	1	FLOW	109.	104.	100.	97.	96.	94.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	RT A4	.13	1	FLOW	104.	100.	96.	93.	92.	90.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	A4	.08	1	FLOW	67.	63.	60.	57.	56.	55.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
COMBINED AT	CB A4	.21	1	FLOW	129.	124.	118.	115.	113.	111.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RT W	.21	1	FLOW	127.	121.	116.	112.	110.	109.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
HYDROGRAPH AT	W	.24	1	FLOW	183.	175.	167.	162.	160.	157.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	CB W	.45	1	FLOW	304.	291.	278.	269.	265.	261.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
ROUTED TO	RT W1	.45	1	FLOW	284.	272.	260.	252.	247.	243.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	BASR	.22	1	FLOW	187.	179.	171.	166.	164.	161.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
ROUTED TO	RT R1	.22	1	FLOW	178.	171.	163.	158.	156.	153.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	R1	.20	1	FLOW	152.	146.	139.	135.	133.	130.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	CB R1	.42	1	FLOW	322.	309.	295.	286.	282.	277.
				TIME	4.10	4.10	4.10	4.10	4.10	4.10
ROUTED TO	RT R2	.42	1	FLOW	316.	303.	289.	281.	276.	272.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROGRAPH AT	R2	.20	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
2 COMBINED AT	CB R2	.62	1	FLOW	316.	303.	289.	281.	276.	272.

				TIME	4.20	4.20	4.20	4.20	4.20	4.20
DIVERSION TO	SD5	.62	1	FLOW	70.	70.	70.	70.	70.	70.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
DROGRAPH AT	DSD5	.62	1	FLOW	246.	233.	219.	211.	206.	202.
				TIME	4.20	4.20	4.20	4.20	4.20	4.20
ROUTED TO	RR	.62	1	FLOW	236.	223.	211.	202.	198.	193.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	W1	.38	1	FLOW	137.	131.	124.	119.	117.	115.
				TIME	4.80	4.80	4.80	4.80	4.80	4.80
3 COMBINED AT	CB W1	1.45	1	FLOW	629.	598.	568.	547.	537.	527.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
ROUTED TO	RT W2	1.45	1	FLOW	597.	568.	538.	519.	509.	499.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
HYDROGRAPH AT	S	.49	1	FLOW	249.	238.	227.	219.	216.	212.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
DIVERSION TO	SD62	.49	1	FLOW	97.	96.	96.	95.	94.	94.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	DSD62	.49	1	FLOW	152.	142.	131.	125.	122.	118.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
ROUTED TO	RS	.49	1	FLOW	151.	140.	130.	123.	120.	117.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
DIVERSION TO	SD7	.49	1	FLOW	18.	17.	17.	17.	17.	17.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
DROGRAPH AT	DSD7	.49	1	FLOW	133.	123.	113.	107.	104.	101.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
ROUTED TO	ROUT	.49	1	FLOW	126.	116.	107.	101.	98.	95.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
HYDROGRAPH AT	W2	.45	1	FLOW	197.	189.	180.	174.	171.	168.
				TIME	4.70	4.70	4.70	4.70	4.70	4.70
3 COMBINED AT	+	2.39	1	FLOW	912.	865.	818.	787.	771.	756.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
DIVERSION TO	DWC	2.39	1	FLOW	912.	865.	818.	787.	771.	756.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
HYDROGRAPH AT	DWC	2.39	1	FLOW	0.	0.	0.	0.	0.	0.
				TIME	.10	.10	.10	.10	.10	.10
HYDROGRAPH AT	S1	.18	1	FLOW	98.	94.	90.	87.	85.	84.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
DIVERSION TO	SD8	.18	1	FLOW	29.	28.	27.	26.	26.	25.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	DSD8	.18	1	FLOW	70.	66.	63.	61.	60.	59.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
ROUTED TO	RS	.18	1	FLOW	69.	66.	63.	61.	60.	58.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
VERSION TO	SD91	.18	1	FLOW	45.	44.	44.	43.	43.	42.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	DSD91	.18	1	FLOW	25.	22.	19.	18.	17.	17.

				TIME	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	V	.13	1	FLOW	116.	110.	105.	102.	100.	98.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
VERSION TO	SD92	.13	1	FLOW	16.	15.	15.	15.	15.	15.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	DSD92	.13	1	FLOW	100.	95.	90.	87.	85.	83.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	CB V	.31	1	FLOW	107.	102.	96.	93.	91.	89.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
ROUTED TO	RT CRY	.31	1	FLOW	105.	100.	95.	91.	90.	88.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	CB LOS	2.70	1	FLOW	105.	100.	95.	91.	90.	88.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	SD5	.00	1	FLOW	70.	70.	70.	70.	70.	70.
				TIME	3.60	3.60	3.60	3.60	3.60	3.60
ROUTED TO	RR	.00	1	FLOW	70.	70.	70.	70.	70.	70.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	SD62	.00	1	FLOW	97.	96.	96.	95.	94.	94.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	+	.00	1	FLOW	167.	166.	166.	165.	164.	164.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
ROUTED TO	RS	.00	1	FLOW	167.	166.	165.	164.	164.	164.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
DROGRAPH AT	SD7	.00	1	FLOW	18.	17.	17.	17.	17.	17.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
2 COMBINED AT	+	.00	1	FLOW	184.	183.	182.	181.	181.	180.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
ROUTED TO	RS	.00	1	FLOW	184.	183.	182.	181.	180.	180.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	SD8	.00	1	FLOW	29.	28.	27.	26.	26.	25.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
2 COMBINED AT	+	.00	1	FLOW	212.	210.	208.	206.	205.	204.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
ROUTED TO	RS	.00	1	FLOW	212.	210.	208.	206.	205.	204.
				TIME	4.60	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	SD91	.00	1	FLOW	45.	44.	44.	43.	43.	42.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	SD92	.00	1	FLOW	16.	15.	15.	15.	15.	15.
				TIME	3.80	3.80	3.80	3.80	3.80	3.80
3 COMBINED AT	+	.00	1	FLOW	262.	259.	256.	254.	252.	251.
				TIME	4.50	4.60	4.60	4.50	4.50	4.50
HYDROGRAPH AT	DWC1	.00	1	FLOW	912.	865.	818.	787.	771.	756.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
COMBINED AT	+	.00	1	FLOW	1165.	1113.	1062.	1028.	1011.	994.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
3 COMBINED AT	CB LOS	11.10	1	FLOW	1526.	1463.	1401.	1360.	1340.	1320.

				TIME	4.90	4.90	4.90	4.90	4.90	4.90
HYDROGRAPH AT	MEAD	.00	1	FLOW	434.	346.	258.	200.	171.	142.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
[redacted]VERSION TO	1-6X3	.00	1	FLOW	95.	88.	76.	66.	61.	57.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	DV 6X3	.00	1	FLOW	339.	258.	182.	133.	109.	86.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
DIVERSION TO	2-6X3	.00	1	FLOW	107.	96.	86.	73.	66.	59.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	DV26X3	.00	1	FLOW	232.	161.	96.	61.	44.	27.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
DIVERSION TO	24CMP	.00	1	FLOW	27.	27.	27.	27.	27.	27.
				TIME	4.50	4.60	4.80	5.00	5.10	5.20
HYDROGRAPH AT	DV 24"	.00	1	FLOW	205.	134.	69.	34.	17.	0.
				TIME	5.20	5.20	5.20	5.20	5.20	.10
HYDROGRAPH AT	J2	.22	1	FLOW	141.	135.	129.	125.	123.	121.
				TIME	4.10	4.10	4.20	4.20	4.20	4.20
2 COMBINED AT	CB J2	.22	1	FLOW	267.	194.	129.	125.	123.	121.
				TIME	5.20	5.20	4.20	4.20	4.20	4.20
DIVERSION TO	CORAN	.22	1	FLOW	12.	7.	2.	2.	2.	1.
				TIME	5.20	5.20	4.20	4.20	4.20	4.20
HYDROGRAPH AT	DV COR	.22	1	FLOW	255.	187.	127.	123.	121.	119.
				TIME	5.20	5.20	4.20	4.20	4.20	4.20
[redacted]UTED TO	RT VGS	.22	1	FLOW	246.	179.	124.	121.	119.	117.
				TIME	5.50	5.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	J3	.37	1	FLOW	291.	278.	265.	257.	253.	249.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	CB VEG	.59	1	FLOW	364.	349.	333.	322.	317.	312.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
DIVERSION TO	VEGAS	.59	1	FLOW	164.	157.	150.	145.	142.	140.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	DV VGS	.59	1	FLOW	201.	192.	183.	177.	174.	172.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RT WAS	.59	1	FLOW	196.	188.	180.	174.	171.	168.
				TIME	4.40	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	309W	1.35	1	FLOW	229.	205.	184.	170.	165.	159.
				TIME	4.60	4.70	4.80	4.90	4.90	4.90
ROUTED TO	R309W	1.35	1	FLOW	212.	193.	175.	164.	158.	153.
				TIME	5.70	5.80	5.90	6.00	6.00	6.00
HYDROGRAPH AT	309E	1.19	1	FLOW	601.	553.	516.	486.	477.	463.
				TIME	4.20	4.20	4.30	4.30	4.30	4.30
DIVERSION TO	CULVRT	1.19	1	FLOW	158.	158.	158.	158.	158.	158.
				TIME	3.80	3.90	3.90	3.90	3.90	3.90
[redacted]ROGRAPH AT	DV CUL	1.19	1	FLOW	443.	395.	358.	328.	319.	305.
				TIME	4.20	4.20	4.30	4.30	4.30	4.30
2 COMBINED AT	309E	2.54	1	FLOW	443.	395.	358.	328.	319.	305.

				TIME	4.20	4.20	4.30	4.30	4.30	4.30
2 COMBINED AT	CB WAS	3.13	1	FLOW	629.	575.	537.	501.	490.	472.
				TIME	4.20	4.30	4.30	4.30	4.30	4.30
[illegible]IVERSION TO	WASH	3.13	1	FLOW	176.	161.	151.	141.	137.	132.
				TIME	4.20	4.30	4.30	4.30	4.30	4.30
HYDROGRAPH AT	DV WAS	3.13	1	FLOW	453.	413.	387.	361.	353.	340.
				TIME	4.20	4.30	4.30	4.30	4.30	4.30
ROUTED TO	RT 310	3.13	1	FLOW	426.	396.	366.	341.	332.	319.
				TIME	4.50	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	310W	1.08	1	FLOW	820.	777.	731.	689.	677.	658.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	R310W	1.08	1	FLOW	764.	717.	663.	629.	618.	604.
				TIME	4.30	4.30	4.30	4.40	4.40	4.40
HYDROGRAPH AT	310E	.97	1	FLOW	654.	602.	566.	537.	525.	509.
				TIME	3.90	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	310E	2.05	1	FLOW	1184.	1112.	1044.	992.	974.	951.
				TIME	4.20	4.30	4.30	4.30	4.30	4.30
2 COMBINED AT	CB 310	5.18	1	FLOW	1458.	1358.	1264.	1199.	1172.	1140.
				TIME	4.30	4.40	4.40	4.40	4.40	4.40
DIVERSION TO	*BONAN*	5.18	1	*FLOW*	*788.*	*745.*	*705.*	*677.*	*665.*	*650.*
				TIME	4.30	4.40	4.40	4.40	4.40	4.40
HYDROGRAPH AT	DV BON	5.18	1	FLOW	670.	613.	559.	522.	507.	489.
				TIME	4.30	4.40	4.40	4.40	4.40	4.40
[illegible]UTED TO	RT311W	5.18	1	FLOW	632.	584.	532.	496.	482.	465.
				TIME	4.90	4.90	4.90	4.90	4.90	4.90
HYDROGRAPH AT	VEGAS	.00	1	FLOW	164.	157.	150.	145.	142.	140.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	WASH	.00	1	FLOW	176.	161.	151.	141.	137.	132.
				TIME	4.20	4.30	4.30	4.30	4.30	4.30
2 COMBINED AT	CB DIV	.00	1	FLOW	333.	311.	285.	270.	265.	258.
				TIME	4.20	4.20	4.20	4.30	4.30	4.30
ROUTED TO	RT311W	.00	1	FLOW	314.	292.	271.	257.	252.	245.
				TIME	4.70	4.70	4.80	4.80	4.80	4.80
HYDROGRAPH AT	311W	.88	1	FLOW	631.	589.	549.	526.	513.	494.
				TIME	3.90	3.90	3.90	3.90	3.90	3.90
3 COMBINED AT	311W	6.06	1	FLOW	1131.	1050.	969.	914.	893.	869.
				TIME	4.80	4.80	4.80	4.90	4.90	4.90
ROUTED TO	RT311E	6.06	1	FLOW	1115.	1036.	956.	903.	883.	859.
				TIME	5.00	5.00	5.00	5.10	5.10	5.10
HYDROGRAPH AT	311E	.77	1	FLOW	225.	200.	182.	170.	159.	155.
				TIME	4.20	4.30	4.30	4.30	4.40	4.40
2 COMBINED AT	311E	6.83	1	FLOW	1239.	1155.	1068.	1009.	987.	961.
				TIME	5.00	5.00	5.00	5.10	5.10	5.10
[illegible]DROGRAPH AT	1-6X3	.00	1	FLOW	95.	88.	76.	66.	61.	57.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	2-6X3	.00	1	FLOW	107.	96.	86.	73.	66.	59.

				TIME	5.20	5.20	5.20	5.20	5.20	5.20
HYDROGRAPH AT	24CMP	.00	1	FLOW	27.	27.	27.	27.	27.	27.
				TIME	4.50	4.60	4.80	5.00	5.10	5.20
[redacted]DROGRAPH AT	CORAN	.00	1	FLOW	12.	7.	2.	2.	2.	1.
				TIME	5.20	5.20	4.20	4.20	4.20	4.20
4 COMBINED AT	CB DIV	.00	1	FLOW	241.	218.	191.	166.	154.	142.
				TIME	5.20	5.20	5.20	5.20	5.20	5.20
ROUTED TO	RT312W	.00	1	FLOW	235.	212.	183.	158.	145.	127.
				TIME	5.80	5.80	5.80	5.80	5.80	5.80
HYDROGRAPH AT	312W	.87	1	FLOW	417.	386.	351.	328.	316.	306.
				TIME	4.10	4.10	4.10	4.10	4.10	4.20
2 COMBINED AT	312W	.87	1	FLOW	417.	386.	351.	328.	316.	306.
				TIME	4.10	4.10	4.10	4.10	4.10	4.20
ROUTED TO	R312W	.87	1	FLOW	408.	375.	337.	319.	310.	300.
				TIME	4.20	4.20	4.20	4.30	4.30	4.30
HYDROGRAPH AT	312E	.62	1	FLOW	245.	226.	201.	186.	180.	175.
				TIME	4.10	4.10	4.10	4.20	4.20	4.20
2 COMBINED AT	312E	1.49	1	FLOW	633.	587.	533.	499.	480.	464.
				TIME	4.20	4.20	4.20	4.20	4.20	4.30
HYDROGRAPH AT	BONAN	.00	1	FLOW	788.	745.	705.	677.	665.	650.
				TIME	4.30	4.40	4.40	4.40	4.40	4.40
DIVERSION TO	RANCHO	.00	1	FLOW	226.	211.	198.	189.	185.	180.
				TIME	4.30	4.40	4.40	4.40	4.40	4.40
[redacted]DROGRAPH AT	DV RAN	.00	1	FLOW	562.	534.	507.	488.	480.	471.
				TIME	4.30	4.40	4.40	4.40	4.40	4.40

BUFFALO.DAT

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*         SEPTEMBER 1990                *
*          VERSION 4.0                  *
*                                       *
*  RUN DATE  07/12/1994  TIME  16:29:13 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*         (916) 756-1104                *
*                                       *
*****************************************
```


```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1       ID
  2       ID                                                    DATE: JULY, 1994
  3       ID       NORTHWEST LAS VEGAS FIS RESTUDY              FILE NAME: BUFFALO.DAT
  4       ID       BY COE & VAN LOO CONSULTANTS, INC            JOB # 930017
  5       ID       PREPARED FOR CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
  6       ID
  7       ID     6-HOUR RAINFALL, 6 MINUTE TIME INTERVAL
  8       ID     RAINFALL DISTRIBUTION = SDN3
  9       ID     SCS UNIT HYDROGRAPH METHOD
 10       ID     EXISTING CONDITIONS
 11       ID
 12       ID     THIS HEC-1 MODEL IS TO ESTIMATE Q100 IN BUFFALO CHANNEL NEAR
 13       ID     LAKE MEAD BLVD.  THIS AREA IS ALSO MODELED IN CAREY-F.DAT.
 14       ID     Q100S FROM BOTH MODELS WILL BE COMPARED AND THE HIGHER Q100 WILL BE
 15       ID     CHOSEN TO REFLECT THE WORST CASE.
 16       ID
          *DIAGRAM
 17       IT       6       0       0     300
 18       IO       5       0       0
 19       IN       5       0       0
          *
          *
          *
 20       JR    PREC    0.91

 21       KK     GD7
 22       KM   INTERSECTION OF LAKE MEAD AND BUFFALO
 23       KM   CURVE NUMBER TAKEN FROM BOYLE SUMMERLIN ANALYSIS
 24       BA    1.13
          *
          *   NOAA RAINFALL VALUE = 2.05"
          *   2.05" X 1.43 = 2.93
 25       PB    2.93
          * DISTRIBUTION TYPE SDN3
 26       PC    .000    .020    .057     .07    .087    .108    .124    .130    .130    .130
 27       PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
 28       PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
 29       PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
 30       PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
 31       PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
 32       PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
 33       PC    .998    .999     1.0
 34       LS       0      86
 35       UD    1.38

 36       KK    GD34
 37       BA    1.56
 38       LS       0      84
 39       UD    0.46
          *
```

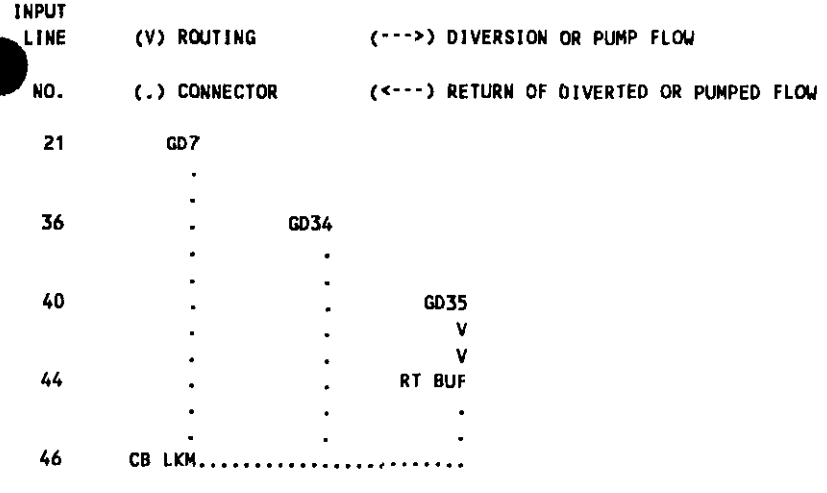
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  40      KK    GD35
          *       FROM WALLACE STUDY
  41      BA     1.9
  42      LS       0      88
  43      UD    1.22

  44      KK  RT BUF         ROUTE TO BUFF1
  45      RK    6000   0.015   0.015       0    TRAP       10        2

  46      KK  CB LKM         COMBINE GD7, GD34, AND GD35 @ BUFFALO CHANNEL NEAR LAKE MEAD
  47      HC       3
  48      ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  07/12/1994  TIME  16:29:13 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


DATE: JULY, 1994
NORTHWEST LAS VEGAS FIS RESTUDY — FILE NAME: BUFFALO.DAT
BY COE & VAN LOO CONSULTANTS, INC — JOB # 930017
PREPARED FOR CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

6-HOUR RAINFALL, 6 MINUTE TIME INTERVAL
RAINFALL DISTRIBUTION = SDN3
SCS UNIT HYDROGRAPH METHOD
EXISTING CONDITIONS

THIS HEC-1 MODEL IS TO ESTIMATE Q100 IN BUFFALO CHANNEL NEAR
LAKE MEAD BLVD. THIS AREA IS ALSO MODELED IN CAREY-F.DAT.
Q100S FROM BOTH MODELS WILL BE COMPARED AND THE HIGHER Q100 WILL BE
CHOSEN TO REFLECT THE WORST CASE.

```
18 IO        OUTPUT CONTROL VARIABLES
                 IPRNT          5  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                 NMIN           6  MINUTES IN COMPUTATION INTERVAL
                 IDATE      1   0  STARTING DATE
                 ITIME        0000  STARTING TIME
                    NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE     2   0  ENDING DATE
                 NDTIME       0554  ENDING TIME
                 ICENT          19  CENTURY MARK

               COMPUTATION INTERVAL      .10 HOURS
                   TOTAL TIME BASE    29.90 HOURS

     ENGLISH UNITS
          DRAINAGE AREA          SQUARE MILES
          PRECIPITATION DEPTH    INCHES
          LENGTH, ELEVATION      FEET
          FLOW                   CUBIC FEET PER SECOND
          STORAGE VOLUME         ACRE-FEET
          SURFACE AREA           ACRES
          TEMPERATURE            DEGREES FAHRENHEIT

   JP        MULTI-PLAN OPTION
                 NPLAN          1  NUMBER OF PLANS

   JR        MULTI-RATIO OPTION
             RATIOS OF PRECIPITATION
             .91
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .91
HYDROGRAPH AT	GD7	1.13	1	FLOW	390.
				TIME	5.00
HYDROGRAPH AT	GD34	1.56	1	FLOW	995.
				TIME	3.90
HYDROGRAPH AT	GD35	1.90	1	FLOW	780.
				TIME	4.70
ROUTED TO	RT BUF	1.90	1	FLOW	780.
				TIME	4.80
3 COMBINED AT	CB LKM	4.59	1	FLOW	1542.
				TIME	4.10

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO=		.91							
RT BUF	MANE	1.42	779.84	285.30	1.53	6.00	779.58	288.00	1.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1545E+03 EXCESS= .0000E+00 OUTFLOW= .1545E+03 BASIN STORAGE= .1304E-04 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

Diskette

Section 3
Watershed Maps from Previous Studies

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

45 SUBAREA DESIGNATION

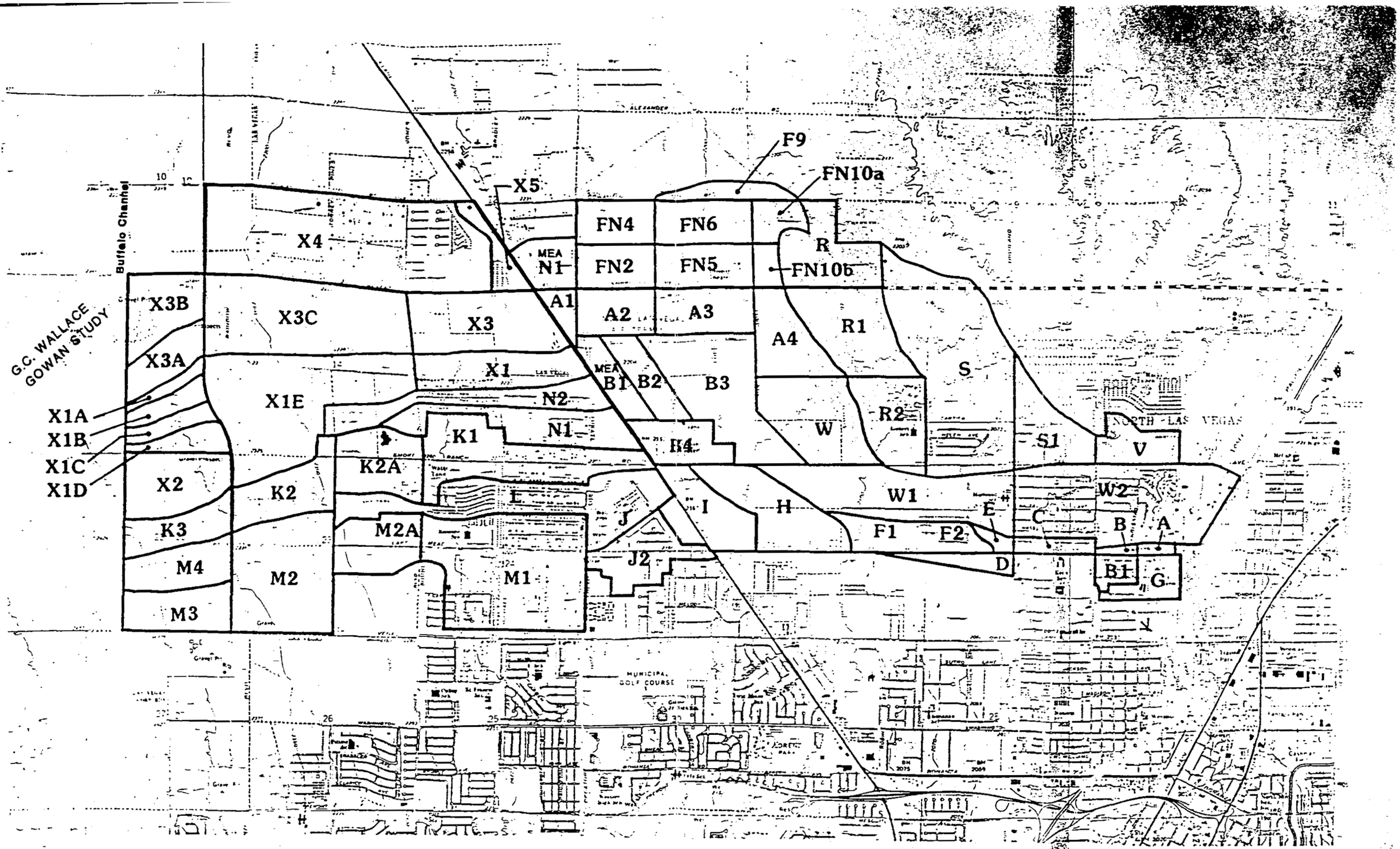
SUBAREA DELINEATION

0 10,000 20,000 30,000
(APPROXIMATE)

NORTHERN LAS VEGAS WASH HYDROLOGIC SUBAREAS

FIGURE S-2

JMM James M. Montgomery
Consulting Engineers, Inc.
Las Vegas, Nevada



DRAINAGE BASIN MAP
LAKE MEAD PHASE 1A

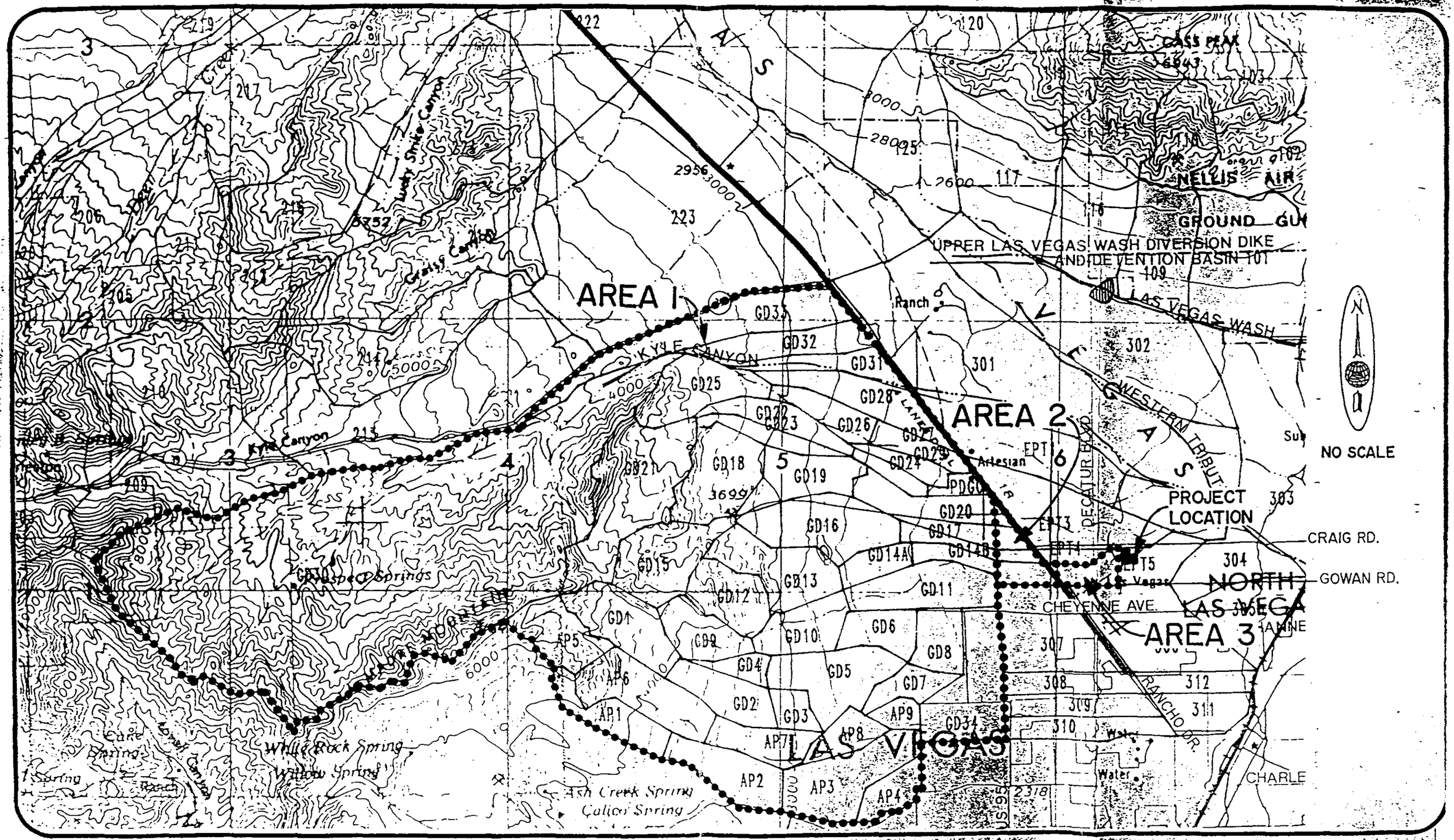
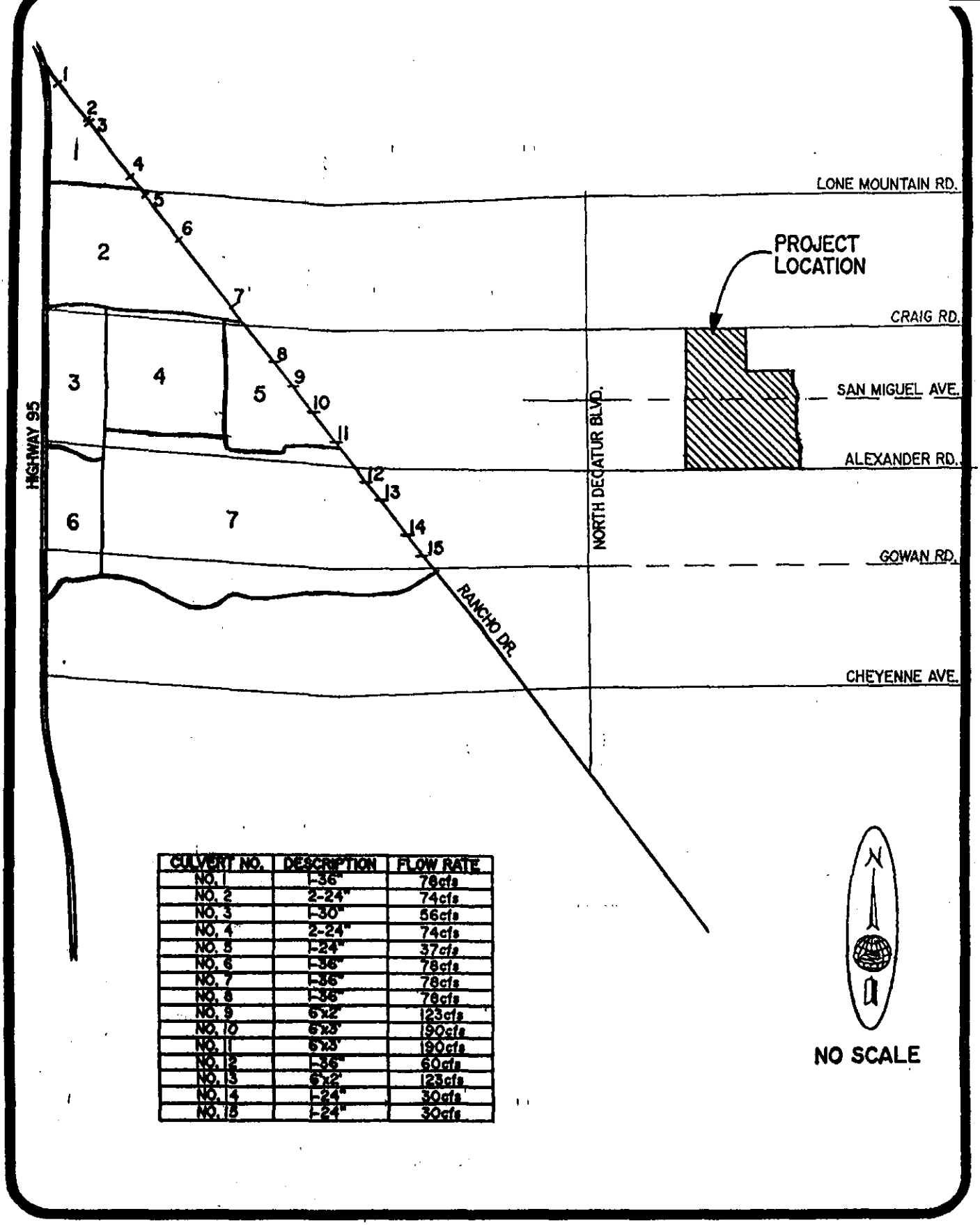


FIGURE 6

THREE GENERAL WATERSHEDS THAT CONTRIBUTE STORMWATER TO SITE UNDER EXISTING CONDITIONS



CULVERT NO.	DESCRIPTION	FLOW RATE
NO. 1	1-36"	78cfs
NO. 2	2-24"	74cfs
NO. 3	1-30"	56cfs
NO. 4	2-24"	74cfs
NO. 5	1-24"	37cfs
NO. 6	1-36"	78cfs
NO. 7	1-36"	78cfs
NO. 8	1-36"	78cfs
NO. 9	6'x2'	123cfs
NO. 10	6'x3'	190cfs
NO. 11	6'x3'	190cfs
NO. 12	1-36"	60cfs
NO. 13	6'x2'	123cfs
NO. 14	1-24"	30cfs
NO. 15	1-24"	30cfs

FIGURE 7

AREA 2 DRAINAGE BASINS

FROM G.C.W.(1988)

Section 4
Hand Calculations

Subbasin Parameters

COE & VAN LOO
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project _____

Project No. 8017

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

WS GD34.

$A = 2.0 \ mi^2$

$T_{Lag} = 0.6\ t_c$

$T_{Lag} = 20\ K_n\ (LL_c / S^{0.5})^{0.33}$

$= 20\ (0.025)\ (3.5\ (1.9) / 71^{0.5})^{0.33}$

$= 0.46.$

$K_n = 0.025$

$L = 3.5$ miles

$L_c = 1.90$

$S = 71$ ft/mi

COE & VAN LOO
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project WILDFIRE
Project No 8017
Sheet No. ____ of ____
Calculated by YS Date 7/25/18
Checked by ____ Date ____

Watershed EPT 4

A_{area} = 0.48 mi^2

L_g = 0.6 t_c

t_c = t_i + t_t

t_i = 1.8 (1.1 − K) $L_o^{1/2} / S^{1/3}$

K = 0.0132 CN − 0.39 , CN = 89 − From Montgomery Fig
= 0.78

L_o = 500

S = $\frac{90}{10,000}$ = 0.9 %

t_i = 13 min.

t_t, L = 9500

S = 0.009

V = 2 ft/s — from Figure 602 — Design manual

t_t = 79 min.

t_c = 1.54 hr.

L_g = 0.92 hr.

COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

Project: NWLVFIS

Project No. 930017

Sheet No. _____ of _____

Calculated by MC Date 9/30/93

Checked by _____ Date _____

Watershed EPT 5

$A = 2.38$

$L_{ag} = 0.6\ t_c$

$T_{Lag} = 20\ K_n\ (LL_n / S^{0.5})^{0.33}$

$K_n = 0.03$

$L = 21,600' = 4.1$ mi

$L_c = 1.95$ mi

$S = 43$ ft/mile

$T_{Lag} = 0.64$

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LANDSCAPE ARCHITECTURE

Project WALVFIC
Project No. 830017
Sheet No. _____ of _____
Calculated by JS Date 9/30/98
Checked by _____ Date _____

Watershed J3

A = 0.37

CN = 89 ⇒ Same as WS J2 in VTNS Report

$L_{ag} = 0.6\ t_c$, $t_c = t_i + t_t$

$t_i = 1.8(1.1 - K) L_o^{1/2} / S^{1/2}$

$K = 0.0132\,CN - 0.39 = 0.78$

$L_o = 500$

$S = \frac{6}{350}(100) = 1.7\%$

$= 11.5$ min

t_t, $L = 500'$

$V = 2.5$ ft/s — Figure 602, Design manual

$t_t = .35$ min

$L_{ag} = 0.5$ hr.

Routing Conversions

MEMORANDUM/TRANSMITTAL

Northwest Las Vegas Flood Insurance Study Restudy

DATE: October 19, 1993 TIME: _____

FAX NO.: _____ OTHER _____

TO: Jack Moody FROM Dean Rasmuson

RE: Angel Park Detention Basin North

COMMENTS: I have completed the storage calculations for the detention basin and have verified the results using a variety of methods. The following is the stage-storage tabulation:

Elev.	Storage (Ac-Ft)	North	Total	
2595	137.8	3.75	141.6	✓
2600	214.3	25.16	239.5	✓
2610	518.1	122.19	640.3	✓
2615	728.3	199.64	927.9	✓
2618.5	872.6	268.6	1141.2	✓
2620	936.6	302.53	1239.1	✓

Also attached is calculation for Angel Park Detention Basin South provided to us by the City of Las Vegas

CVL DISTRIBUTION:

cc:
- ☐ Mike Koizumi
- ☐ Paul Hoskin
- ☐ Doug Bahnsider
- ■ Other Jack Moody

PENTACORE DISTRIBUTION:
- ☐ Gary Spinhirnik
- ☐ Dean Rasmuson
- ☐ Other _____

COMMITTEE DISTRIBUTION:
- ☐ Gale Fraser - CCRFCD
- ☐ Kevin Bubanks - CCRFCD
- ☐ Mark Sorensen - CLV
- ☐ Bob Marmaso - NLV
- ☐ Phil Simpson - CCCD
- ☐ Bill Brandt - CCFWD
- ☐ Other _____

SHEET 1 OF _

GOWAN DETENTION BASIN PREDESIGN

HYDRAULIC AND COST ESTIMATE CALCS. & SUPPORTING DATA

G.C. WALLACE, INC.
Engineering/Architecture

DATE 1/89

CLIENT CLV JOB NO 412 BOAC CALC. BY MNK

DESCRIPTION ANGEL PARK — SOUTH BASIN CHECKED BY

ANGEL PARK DETENTION : SOUTH BASIN — COMPUTE

#	STAGE	AREA AC	STORAGE AC-FT.		STAGE	AREA AC.	STORAGE AC-FT.
1.	2590	0	0	15	2622	27.17	353.2
2.	2595	2.39	3.75	16	2622.5	28.08	367.01
3.	2600	6.50	25.16	-	2623	29.05	381.25
4.	2605	9.56	65.06				
5.	2610	13.40	122.19				
6.	2615	17.68	199.64				
7.	2618	21.17	257.83				
8.	2618.5	21.75	268.6				
9.	2619	22.34	279.62				
10.	2619.5	22.92	290.93				
11.	2620	23.5	302.53				
12.	26205	24.12	314.51				
13.	2621	25.33	326.95				
14.	2621.5	26.25	339.85				

NOTE: SEE ADJUSTED STAGE - STORAGE CURVE & DATA SHEET 3 & 4.

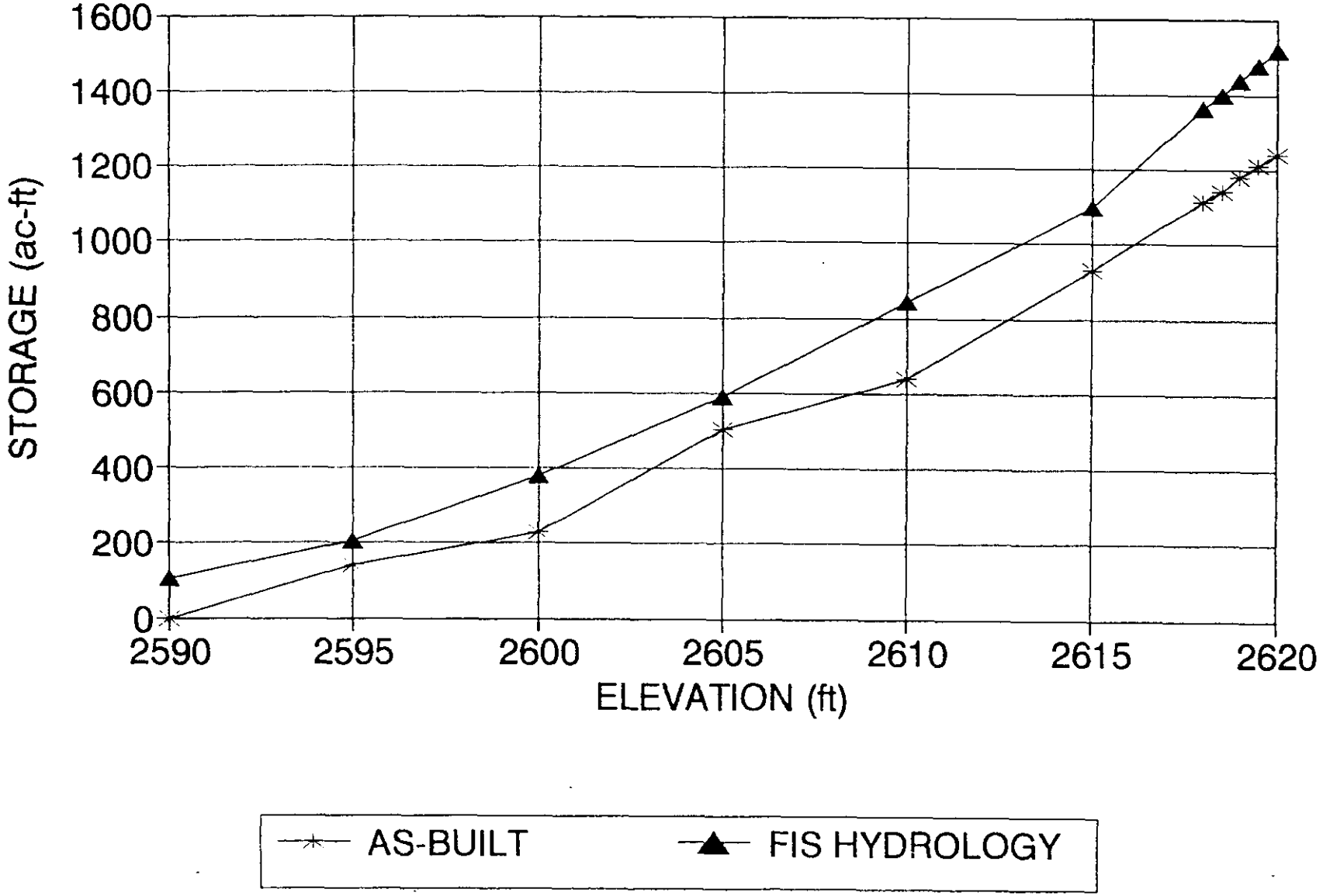
SHEET 1 OF 4

EN-3-N 3/88

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

ANGEL PARK DETENTION BASIN

STAGE STORAGE CURVE



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LANDSCAPE ARCHITECTURE

Project NWLVFL
Project No. 5017
Sheet No. _____ of _____
Calculated by YS Date 9/27/95
Checked by _____ Date _____

Route from Gowan Rd & US 95 to Jones/Gowan intersection

Convert

RK	5000	0.005	0.025	0	Trap	40	0

to Muskingum Method.

$L = 5000'$
$V = 10$
$V_w = 15$ ft/s

$t_t = 5.6$ min
$K = 0.09$
NSTPS = 1
$X = 0.4$

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

September 27, 1993
ROUTING CHANNEL FROM US95/GOWAN TO JONES/GOWAN

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0050
Manning's Roughness Coefficient (n-value).....	0.0250
Channel Side Slope - Left Side (horizontal/vertical)....	0.00
Channel Side Slope - Right Side (horizontal/vertical)...	0.00
Channel Bottom Width (feet).....	40.0

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
1.0	162.7	4.07	0.717	0.257	1.257	40.0	40.0
2.0	500.9	6.26	0.780	0.609	2.609	80.0	40.0
3.0	955.8	7.96	0.810	0.985	3.985	120.0	40.0
4.0	1500.6	9.38	0.826	1.366	5.366	160.0	40.0
2053 5.0	2118.2	10.59	0.835	1.742	6.742	200.0	40.0
6.0	2796.3	11.65	0.838	2.108	8.108	240.0	40.0
7.0	3525.6	12.59	0.839	2.462	9.462	280.0	40.0
8.0	4298.9	13.43	0.837	2.802	10.802	320.0	40.0

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986 Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092 (713) 895-8322. A manual with equations & flow chart is available.

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Project VALLEY

Project No. 8-20017

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

— Route from Jones / Gavan Intersection to near True Value hardware store.

L = 1500', S = 0.01 ft/ft

V = 2 ft/s. — Figure 602

Vw = 3 ft/s

t_t = 0.13 hr.

K = 0.1

NoTps = 1

X = 0.4

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[illegible]

Project _____

Project No. 92-019

Sheet No. _____ of _____

Calculated by JS Date _____

Checked by _____ Date _____

Split flows: ① MONEY ② TRUVAL ③ CREADY } Combine them @ Javan & Rancho. Then Route to Cheyenn & Rancho Drive.

Muskingum Routing Method

$L = 3,500'$, $S = 0.0075$ ft/ft .

$V = 2$ ft/s — from Figure 602 (C.C. design manual)

$V_w = 1.5V = 3$ ft/s.

$t_c = 19$ min

$K = 0.32$

$X = 0.15$

NSTPS = 3 steps.

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Project NWLVFIS
Project No. 83017
Sheet No. _____ of _____
Calculated by _____ Date 12/7/83
Checked by _____ Date _____

Muskingum Routing Method

— Route from Rancho & US 95 Intersection
to Lone mountain & Rancho Int.

L = 3000', S = 0.002.
V = 1 ft/s — From Figure 602, NEM-4
Vw = 1.5 ft/s

tt = 0.55 hr
K = 0.6
NSTPS = 6
X = 0.25

— Route from Lone Mountain & Rancho
to Craig & Rancho

L = 3600' S = 0.007 ft/ft

V = 1 ft/s — Figure 602, NEM-4
Vw = 1.5 ft/s

tt = 0.67 ft/s
K = 0.7
NSTPS = 7
X = 0.25

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LANDSCAPE ARCHITECTURE

Project MWLWF I=
Project No. 23017
Sheet No. ____ of ____
Calculated by YS Date 12/9/93
Checked by ____ Date ____

Muskingum Routing Method

— Route from Craig Rd to Alexander Rd along Rancho

L = 3300' S = 0.008

V = 1 ft/s
Vw = 1.5 ft/s — Figure 602, MCM-4

K = 0.6
NSTP = 6
X = 0.25

— Route from Alexander Rd to Gowan along Rancho Dr.

L = 3800 S = 0.004

V = 1 ft/s
Vw = 1.5 ft/s

K = 0.7
NSTP = 7
X = 0.25

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LANDSCAPE ARCHITECTURE

Project WILVFIS

Project No. 80017

Sheet No. _____ of _____

Calculated by _____ Date 9/16/18

Checked by _____ Date _____

Route C-R17 & C-R16 through EPT. 2
- Muskingum Routing Method

$L = 21,400'$, $S_{avg} = 0.008$

$V = 2$ ft/s. (Figure 602), NEH-4

$V_w = 3$ ft/s

$t_2 = 2.07$ hr.

NSTPS = 21

$X = 0.15$

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LANDSCAPE ARCHITECTURE

Project INVLVFIS
Project No. 830017
Sheet No. _____ of _____
Calculated by YS Date 9/16/93
Checked by _____ Date _____

Route C-R15 through EPT4 & EPT3.

Muskingum Routing Method.

L = 16,400'

S = 0.009 ft/ft

V = 2 ft/s — Figure 602

V_W = 3 ft/s.

t_b = 1.5

NSTPS = 15

X = 0.15

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LANDSCAPE ARCHITECTURE

Project: NKLVFIS
Project No. 92017-01
Sheet No. _____ of _____
Calculated by: YS Date: 9/16/93
Checked by _____ Date _____

Route C-R14 & C-R13 thru EPT 5

Muskingum Routing Method

L = 19000 S = 0.009 ft/ft

V = 2 ft/s — figure 602, Drainage design manual.

Vw = 3 ft/s

tt = 1.76

NSTPS = 18

X = 0.15

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LANDSCAPE ARCHITECTURE

Project NWLV FLS

Project No. 12017

Sheet No. _____ of _____

Calculated by JS Date 9/30/93

Checked by _____ Date _____

Route WS J2 & WS J3 thru WS 312W.

L = 7000

S = 0.01

V = 2

V_w = 3

t_c = 39 min

K = 0.65

NSTPS = 6

X = 0.35

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Project CAVE CK
Project No. 2017
Sheet No. _____ of _____
Calculated by XS Date 2/30/18
Checked by _____ Date _____

Rock WS 310 & WS 309 thru
WS 311W

From Montgomery FIS

L = 5300'
S = 0.013
N = 0.02
Trap Chan.
b = 100
SS = 0

V = 2
Vw = 3

t_t = 29 min

K = 0.5
NSTP = 5
X = 0.35

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LANDSCAPE ARCHITECTURE

Project INVERT
Project No. 2907
Sheet No. _____ of _____
Calculated by YC Date 10/6/93
Checked by _____ Date _____

- Route from Coran to Vegas along Rancho Drive

$L = 5200'$
$S = 0.01$

$V = 2$ ft/s — from Figure 602, design manual, CCRFCD

$V_w = 3$ ft/s

NSTP = 3
K = 0.3
X = 0.35

- Route from Vegas to Washington along Rancho Dr

$L = 3400'$
$S = 0.01$

$V = 2$ ft/s — from Figure 602, design manual, CCRFCD
$V_w = 3$ ft/s

NSTPS = 3
K = 0.3
X = 0.35

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Project NWLVFLS

Project No. 82017

Sheet No. _____ of _____

Calculated by JS Date 2/11/83

Checked by _____ Date _____

Route from 311E to 312E (Lake Mead)

L = 3000

S = 0.017

V = 2.5

Vw = 3.75

t_c = 13 min.

K = 0.2

NST/B = 2

X = 0.3

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Project NWLVFIS
Project No. 23017
Sheet No. ____ of ____
Calculated by JS Date 9/28/92
Checked by ____ Date ____

- Route from Lake Mead / Losee to Carey / Losee

L = 3100'
S = 0.0012

From Montgomery FIS.
Routing Channel section - Trap. b = 20'
ss = 1.5
n = 0.016

V = 5 ft/s
Vw = 7.5 ft/s

tt = 6.8 min

K = 0.11
NSTP = 1
X = 0.4.

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Project NWLVFIS
Project No. 80017
Sheet No. _____ of _____
Calculated by _____ Date _____
Checked by _____ Date _____

Route from Simmon/Carey to Highland/Carey

L = 5300'
S = 0.01

V = 2 ft/s
V_w = 3 ft/s

K = 0.5
NSTP = 5
X = 0.2

Route from Highland/Carey to Lasea/Carey

L = 6800
S = 0.017

V = 3 ft/s
V_w = 4.5 ft/s

K = 0.4
NSTPs = 4
X = 0.2

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LANDSCAPE ARCHITECTURE

Project WHITE

Project No. 20017

Sheet No. _____ of _____

Calculated by JS Date 9-8-92

Checked by _____ Date _____

Route from Commerce to Losee / Carey

L = 1500
S = 0.03
V = 3.5 ft/s
Vw = 5.25 ft/s.

t_t = 4.76

K = 0.08
NSTPS = 1
X = 0.4

} RM Card

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Project [illegible]
Project No [illegible]
Sheet No ____ of ____
Calculated by ____ Date ____
Checked by ____ Date ____

Route from Carey / Losee to Chan "4" thru the Freeway Channel

L = 10,000.

S = 0.0011
N = 0.016
Trap chan
b = 20
side slope = 1.5
} from FIS by Montgomery

V = 8 ft/s

Vw = 12 ft/s

tt = 1/4 min

K = 0.23
NSTPS = 2
X = 0.25

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LANDSCAPE ARCHITECTURE

Project NAVAJO
Project No. 830017
Sheet No. _____ of _____
Calculated by JS Date 10/4/93
Checked by _____ Date _____

CONVERT KINAMATIC WAVE ROUTING TO MUSKINGUM ROUTING

-V, Route South along West side of us. 95

L = 3000
n = 0.025
S = 0.009
Trap
b = 50
S.S = 3.
} From FIS

V = 6 ft/s, V_w = 9 ft/s Q = 300
t_t = 5.6 min
K = 0.1
NSTPS = 1
X = 0.25

-V, Route South along westside of us. 95

L = 3000
n = 0.022
S = 0.004
Trap
b = 25
S.S = 8
} From FIS

V = 5 ft/s Q = 300
V_w = 7.5 ft/s
t_t = 6.7 min.
K = 0.11
NSTPS = 1
X = 0.25

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NDSC.

Project _____
Project No. 82017
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CONVERT (CONTINUED)

- V, Route GO 29 to PDEC

L = 8000
n = 0.025
S = 0.01
Trap
b = 20
S.S = 8.

} From FIS

V = 4.5 ft/s
Vw = 6.75 ft/s.

Q = 100

t_t = 20 min

NSTPS = 3
K = 0.33
X = 0.25

- V, Route flows to Rancho and Alexander Intersection

L = 2500
n = 0.025
S = 0.005
Trap
b = 0
SS = 4

} From CHURCH

Q = 300

V = 6 ft/s
Vw = 9 ft/s
t_t = 4.6 min

K = 0.1
NSTPS = 1
X = 0.3

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Project _____

Project No. _____

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CONVERSION (CONT'D)

- V, Route Flow East to Rancho / Gowan Intersection

L = 7000
S = 0.005
n = 0.025
Trap
b = 40
S.S = 4

} From Church Eng.

Q = 300

V = 5 ft/s
Vw = 7.5 ft/s

t_t = 16 min

NSTPS = 3
K = 0.3
X = 0.25

- SNIC, Flood Control Channel from Craig Rd to Alexander Rd.

L = 3850
n = 0.016
S = 0.013
Trap
b = 20
S.S. = 2

} from FIS

Q = 4600

V = 25 ft/s
t_t = 1.7 min

NSTPS = 0
K = 0.03
X = 0.4

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Project _____
Project No. _____
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Calculated by _____ Date _____
Checked by _____ Date _____

CONVERSION CONT'D

LBC, FROM ALEXANDER TO "A" CHANNEL

L = 2000
n = 0.016
S = 0.002
Trap
b = 80
S.S = 2

From FIS

Q = 500

V = 11 ft/s
Vw = 16.5 ft/s

t_t = 2.8 min

K = 0.047
NSTPs = 0
X = 0.04

— Combine w/ SWC, use K = 0.1, NSTPs = 1, X = 0.4

RK4, Rock K4 south on michael to Low Point then to Rancho

L = 1400
n = 0.016
S = 0.0052
Trap
b = 50
S.S. = 10

From VTN

L = 2000
n = 0.02
S = 0.0086
Trap
b = 50
S.S = 10

Q = 150
V = 4 ft/s, Vw = .6 ft/s.
t_t = 3.9 min,

V = 4, Vw = 6
t_t = 5.6.

use K = 0.2
NSTPs = 2
X = 0.4

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Project _____

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Checked by _____ Date _____

(CONVERSION CONT'D)

- RK3C, Rouk to Rancho.

L = 4700
n = 0.016
S = 0.01
Trap
b = 50
S.S = 10

} From VTN

Q = 60

V = 4 ft/s
Vw = 6 ft/s
t_t = 13 min.

K = 0.2
X = 0.45
NSTPs = 2

- RDEX, Rouk to Cheyenne

L = 1350'
n = 0.016
S = 0.0087
Trap
b = 60
S.S 10

Q = 100

V = 4 ft/s
Vw = 6 ft/s
t_t = 3.75 min.
K = 0.1
NSTPS = 1
X = 0.45

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Project _____

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(Conversion Cont'd)

RX2, Rock to Jones.

L = 6300'
n = 0.02
S = 0.01
Trap
b = 40
S.S = 10

from VTN

Q = 100

V = 4.5 ft/s
Vw = 6.75 ft/s
t_t = 16 min
K = 0.26
NSTPs = 2
X = 0.35

RX1, Rock to Rancho

L = 5900
S = 0.01
n = 0.02
Trap
b = 40
S.S = 10

From VTN

Q = 150

V = 5
Vw = 7.5
t_t = 12 min

K = 0.2
NSTPs = 2
X = 0.35

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LANDSCAPE ARCHITECTURE

Project _____

Project No. _____

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CONVERT CONT'D

— RK3 , Route K3 to K—

L = 350
n = 0.03
S = 0.016
Trap
b = 0
ss = 2.0
} From VTN

Q = 20

V = 3 ft/s
Vw = 4.5 ft/s

tt = 12 min
K = 0.2
NSTP = 2
X = 0.3

— RK2 , Route K2 & K to KA

L = 2700
S = 0.01
n = 0.016
Trap
b = 80
ss = 10
} From VTN

Q = 70

V = 3.5 ft/s
Vw = 5.25 ft/s

tt = 8.6 min.
NSTP = 1
K = 0.14
X = 0.4

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PLANNING • ENGINEERING

Project _____

Project No. _____

Sheet No. _____ of _____

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Checked by _____ Date _____

CONVERSION CONT'D

- RXLM, Route to Lake Head

L = 1050'
S = 0.0052 } From VTN
n = 0.025
Trap
b = 80'
SS = 10

Q = 1600

V = 6.5 ft/s
Vw = 9.75 ft/s
tt = 1.8 min.

NSTP = 0
K = 0.03
X = 0.3

- RTLD, Route Subbn H- Graph to Lorenzi.

L = 1200	VTN	L = 500
S = 0.017		S = 0.013
n = 0.017		n = 0.017
Trap		Trap
b = 45		b = 45
SS = 0.		SS = 0

Q = 150

V = 6.5 ft/s
Vw = 9.75 ft/s
tt = .9 min.

NSTP = 0
K = 0.04
X = 0.4

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Project _____

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CONVERSION CONT'D

- RTBL, Route from Eilray

L = 1358
S = 0.014
n = 0.017
Trap
b = 45
S.S = 0

from VTN

Q = 200

V = 7, Vw = 10.5 ft/s
t_t = 2 min

NSTPS = 0
K = 0.04
X = 0.4

- RTTP, Route from to Torrey Pines

VTN, L = 1362'
S = 0.01X
n = 0.017
Trap
b = 45
S.S = 0

Q = 200

V = 7, Vw = 10.5 ft/s

NSTP = 0
K = 0.04
X = 0.4

- RTL1, Route from to LIRO

VTN, L = 825'
S = 0.0104
n = 0.017
Trap
b = 45
S.S = 0.

Q = 250.

V = 7
Vw = 10.5 ft/s
NSTPS = 0
K = 0.02
X = 0.4

- RTN4, Route N4 H- Graph to LIRO

VTN, L = 250
S = 0.0104
n = 0.017
Trap
b = 45
S.S = 0

Q = 2

Figure

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LANDSCAPE ARCHITECTURE

Project _____

Project No. _____

Sheet No. _____ of _____

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CONVERSION CONT'D

— RTAR, Rock flows to ARPA

VTN, L = 801'
S = 0.0156
n = 0.017
Trap
b = 90
SS = 0.

Q = 250

V = 6, Vw = 9 ft/s
tt = 1.5 min
NSTP = 0
K = 0.02
X = 0.4

— RTSAN Rock flows to San Simeon

VTN, L = 170
S = 0.0134
n = 0.017
Trap
b = 90
SS = 0.

Q = 250

V = 6 Vw = 9 ft/s
tt = 0.3 min
NSTPs = 0
K = 0.005
X = 0.4

— RTJN, Rock to Jones

VTN, L = 810'
S = 0.0134
n = 0.017
Trap
b = 90
S.S. 0.

Q = 250

V = 6, Vw = 9 ft/s
tt = 1.5 min
NSTPs = 0
K = 0.025
X = 0.4

— RTSA, Rock to Sylar

VTN,
L = 1187'
S = 0.0147
n = 0.017
Trap
b = 90
SS = 0

Q = 300,

V = 6.5 ft/s
Vw = 9.75 ft/s
tt = 2 min
NSTP = 0
K = 0.03
X = 0.4

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LANDSCAPE ARCHITECTURE

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CONVERSION / COUT'E

— RM24 , Route to Smith

VTN, L = 450'
S = 0.01
n = 0.016
Trap
b = 100
S.S = 10

Q = 350

V = 6 ft/s , V_w = 9 ft/s
t_T = 0.8 min
NSTP = 0
K = 0.01
X = 0.4

— ROUT, Route to Shadow

VTN, L = 450'
S = 0.01
n = 0.016
Trap
b = 100
S.S. = 10

Q = 350

V = 6 ft/s
NSTP = 0
K = 0.01
X = 0.4

— ROUT, Route to Jeanne

VTN, L = 140
S = 0.01
n = 0.016
Trap
b = 100
S.S = 10

V = 6 ft/s
NTSP = 0
K = 0.004
X = 0.4

— ROUT , Route to Micheal

VTN, L = 260
S = 0.01
n = 0.016
Trap
b = 100
S.S = 10

V = 6 ft/s
NTSP = 0
K = 0.008
X = 0.4

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_ROUT, Route to Decatur

VTN, L = 1300' Q = 350. V = 6 Vw = 9 ft/s

S = 0.01

n = 0.016

Trap

b = 100'

SS = 10.

NSTP = 0

K = 0.04

X = 0.4

_RR, Route to Detention Basin 2A

VTN, L = 1000' Q = 100. V = 7.5 ft/s

S = 0.01 Vw = 11 ft/s

n = 0.013

Trap

b = 20

S.S = 3

NSTP = 0

K = 0.03

X = 0.45

_RT1, Route Basin I

VTN, L = 2700 Q = 100 V = 5 ft/s

S = 0.009 Vw = 7.5 ft/s

n = 0.016

Trap

b = 30

S.S = 10

NSTPs = 1

K = 0.1

X = 0.4

_RBASE, Route Flow to B4

VTN, L = 1600 Q = 150 V = 5 ft/s

S = 0.01 Vw = 7.5 ft/s

n = 0.02 NSTP = 1

Trap K = 0.1

b = 0 X = 0.4

S.S = 20

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(Convert corrid)

R, link flow to B4

VTN, L = 1600
S = 0.01
N = 0.02
Trap
b = 0
SS = 20

Q = 200

V = 6 ft/s
Vw = 9 ft/s

NSTPS = 1
K = 0.1
X = 0.4

R,

VTN, L = 1400
S = 0.003
n = 0.013
Circ
d = 2

Q = 10

V = 4 ft/s
Vw = 6 ft/s

NSTPS = 1
K = 0.1
X = 0.5

R,

VTN, L = 1309'
S = 0.003
n = 0.013
Circ
d = 4.5

Q = 170

V = 5 ft/s
Vw = 7.5 ft/s
NSTPS = 0
K = 0.05
X = 0.5

R1

VTN, L = 2835'
S = 0.01
n = 0.013
Circ 1
d = 4.5

Q = 170

V = 13 ft/s
Vw = 20 ft/s
NSTPS = 0
K = 0.04
X = 0.5

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Convert Cont'd

R2,
VTN, L = 2462'
S = 0.01
n = 0.013
Circ
d = 5'

Q = 170

V = 13
Vw = 20
NSTP = 0
K = 0.03
X = 0.5

R3,
VTN, L = 1881'
S = 0.01
n = 0.013
Circ
d = 5

Q = 150

V = 14
Vw = 21
NSTPS = 0
K = 0.02
X = 0.5

RK1, 54" RCP
VTN, L = 592'
S = 0.0115
n = 0.013
Circ
d = 4.5

Q = 200

V = 15
Vw = 23
NSTPS = 0
K = 0.007
X = 0.5

RK1B, 60" RCP
VTN,
L = 1184'
S = 0.0187
n = 0.013
Circ
d = 4.5

Q = 200

V = 19
Vw = 29
NSTPS = 0
K = 0.01
X = 0.5

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Convert Conf.

- RSD, Route 2c flow to Filer.

VTN, L = 3105'
S = 0.0131
n = 0.013
Circ
d. 1.5

Q = 200

V = 16
Vw = 24 ft/s
NSTP = 0
K = 0.04
X = 0.5

- RR,

VTN, L = 1000, Route flow from Airport and Caney storm drain.
S = 0.01
n = 0.015
Trap
b = 20'
S.S. = 3

Q = 600

V = 14 ft/s
Vw = 21 ft/s
NSTP = 0
K = 0.006
X = 0.45

- AA-B13, Route flow not diverted South on Decatur

VTN, L = 2984
S = 0.068
n = 0.02
Trap
b = 100
S.S = 0

Q = 1200

V = 16 ft/s
Vw = 24 ft/s

NSTP = 0
K = 0.03
X = 0.4

- BA - BE,

VTN, L = 1250'
S = 0.009
n = 0.02
Trap
b = 80
S. 0.

Q = 60

V = 3 ft/s
Vw = 4.5 ft/s

NSTP = 1
K = 0.1
X = 0.4

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PLANNING • ENGINEERING
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Concept Cor-3

- R"N", Route the Airport channel to the east of existing Runway

VTN, L = 2900 , Q = 14ks , V = 14 ft/s
S = 0.007 , Vw = 21 ft/s
n = 0.02
Trap
b = 15
S.S. = 0
NSTPs = 0
K = 0.04
X = 0.4

- BB - CB

VTN, L = 448 , L = 2191 , L_{total} = 2639'
S = 0.006 , S = 0.004 , V = 5 ft/s
n = 0.013 , n = 0.013 , Vw = 7.5 ft/s
Circ , Circ , NSTP = 1
d = 2.5 , d = 2.5 , K = 0.1
X = 0.5

- N9 - CA

VTN, L = 1350 , Q = 20 , V = 2 ft/s
S = 0.004 , Vw = 3 ft/s
n = 0.02 , NSTPs = 1
Trap , K = 0.12
b = 80 , X = 0.35
S.S. = 0

- CA - CB

VTN, L = 1250 , Q = 120 , V = 3 ft/s
S = 0.004 , Vw = 4.5 ft/s
n = 0.02 , NSTPs = 1
Trap , K = 0.1
b = 80 , X = 0.35
S.S. = 0

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Conversion Con't'd

CB-LOW
VTN, L = 1700'
S = 0.004
n = 0.013
Circ
d = 4
Q = 18,
V = 10 ft/s
Vw = 15 ft/s
NSTP = 0
K = 0.02
X = 0.5

DC-LOW
VTN, L = 900'
S = 0.004
n = 002
Trap
b = 50
Q = 30,
V = 2 ft/s
Vw = 3 ft/s
NSTP = 1
K = 0.1
X = 0.35

ROUT
VTN, L = 1800
S = 0.004
n = 0.025
Trap
b = 20
S.S = 2
Q = 300
V = 6 ft/s
Vw = 9 ft/s
NSTP = 1
K = 0.1
X = 0.35

REAS 1
VTN, L = 5800'
S = 0.0087
n = 0.02
Trap
b = 10
S.S = 3
Q = 1500
V = 13 ft/s
Vw = 20 ft/s
NSTP = 1
K = 0.1
X = 0.4

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Conversion Config

- RKCA, Route to detention Basin 24
VTN, L = 14450'
S = 0.01
n = 0.013
Trap
b = 20'
S.S. = 3
Q = [illegible]
V = 7 ft/s
Vw = 11 ft/s
NSTPS = 0
K = 0.04
X = 0.45

- RTIM, Route Basins 11 and I
VTN, L = 4450'
S = 0.01
n = 0.016
Trap
b = 30'
S.S = 10
Q = 1500
V = 13 ft/s
Vw = 19.5 ft/s
NSTP = 1
K = 0.1
X = 0.45

- RF1, Kinematic Wave Routing
VTN, L = 2600
S = 0.007
n = 0.016
Trap
b = 40
S.S = 10
Q = 30,
V = 3 ft/s
Vw = 4.5 ft/s
NSTPS = 2
K = 0.2
X = 0.45

- RTFIM, Route Combined hydrograph.
VTN,
L = 350
S = 0.007
n = 0.016
Trap
b = 40
S.S = 10
Q = 1800
V = 12 ft/s
Vw = 18 ft/s
NSTP = 0
K = 0.01
X = 0.45

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Convert Cont'd

— Rout,
VTN, L = 3700'
S = 0.0121
n = 0.025
Trap
b = 30
S.S = 3
Q =
V = 4 ft/s
Vw = 6 ft/s
NSTP = 1
K = 0.15
X = 0.3

- ROUT, To Miller
VTN, L = 13900' Q = 30
S = 0.0075
n = 0.016
Trap
b = 80'
S.S = 10
V = 3 ft/s
Vw = 4.5 ft/s
NSTP = 8
K = 0.85
X = 0.45

- RW1, Rock W to W1
VTN, L = 8200' Q = 70,
S = 0.0127
n = 0.016
Trap
b = 60'
S.S = 10
V = 5 ft/s
Vw = 7.5 ft/s
NSTP = 3
K = 0.3
X = 0.45

— RS, Rock to Commerce
VTN,
L = 2405'
S = 0.0273
n = 0.016
Trap
b = 80'
S.S = 10
Q = 30,
V = 4 ft/s
Vw = 6 ft/s
NSTP = 1
K = 0.11
X = 0.45

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Convert Conf'd

- RK, Rock to Highland

VTN, L = 2600'
S = 0.007
n = 0.015
Trap
b = 80
SS = 10

Q = 70

V = 4 ft/s
Vw = 6 ft/s
NSTP = 1
K = 0.12
X = 0.45

- R310W, Rock Runoff from 310W to 310E

FIS, L = 10,500'
S = 0.015
n = 0.02
Trap
b = 100
SS = 0

Q = 200

V = 6 ft/s
Vw = 9 ft/s
NSTP = 3
K = 0.32
X = 0.35

- R309W, Rock from 309W to 309E

FIS, L = 21000
S = 0.01UK
n = 0.02
Trap
b = 100
SS = 0

Q = 100

V = 4 ft/s
Vw = 6 ft/s
NSTP = 10
K = 1
X = 0.35

- RT311E, Rock from 311W to 311E

FIS, L = 7500'
S = 0.0132
n = 0.02
Trap
b = 100
SS = 0

Q = 800

V = 8 ft/s
Vw = 13.5 ft/s
NSTP = 1
K = 0.15
X = 0.35

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Convert Conf'd

R3/2W, Route from 3/2W to 2/1E

(FIS) L = 6100'
S = 0.0132
n = 0.02
Trap
b = 100
S.S = 0

Q = 1500

V = 10 ft/s
Vw = 15 ft/s
NSTP = 1
K = 0.11
X = 0.35

R.G. Ups., Route Gowan North Detention outflow to Gowan Outfall Channel.

(FIS)
L = 9000'
S = 0.005
n = 0.013
Circ
d = 6

Q = 500

V = 12 ft/s
Vw = 18 ft/s
NSTP = 1
K = 0.13
X = 0.5

RT CH, Route to Gowan Outfall Channel.

L = 17,650', 90" RCP to 2 - 8'x8' RCB
S = 0.005
n = 0.013

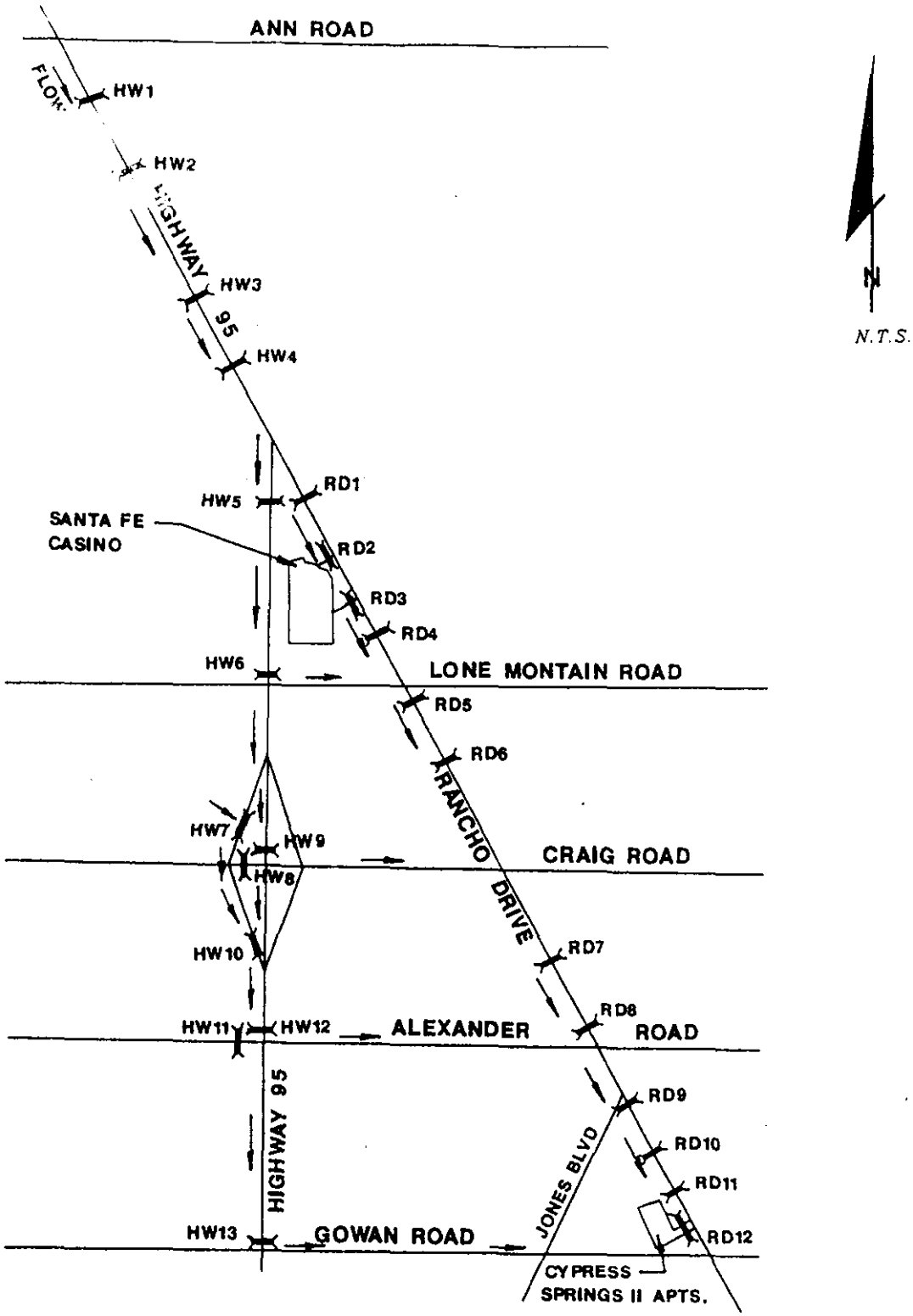
V = 18 ft/s
Vw = 27 ft/s
NSTP = 2
K = 0.2
X = 0.5

RTCHA Route to Channel "A"

L = 25000
S = 0.01
n = 0.013
Trap
b = 20
S.S = 2

V = 14 ft/s
Vw = 21 ft/s
NSTP = 3
K = 0.33
X = 0.5

Diversion Calculations



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LANDSCAPE ARCHITECTURE

EXISTING STRUCTURE INDEX MAP

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NDSCAPE ARCHITECTURE

Project NWLVFIS
Project No. 83017
Sheet No. ____ of ____
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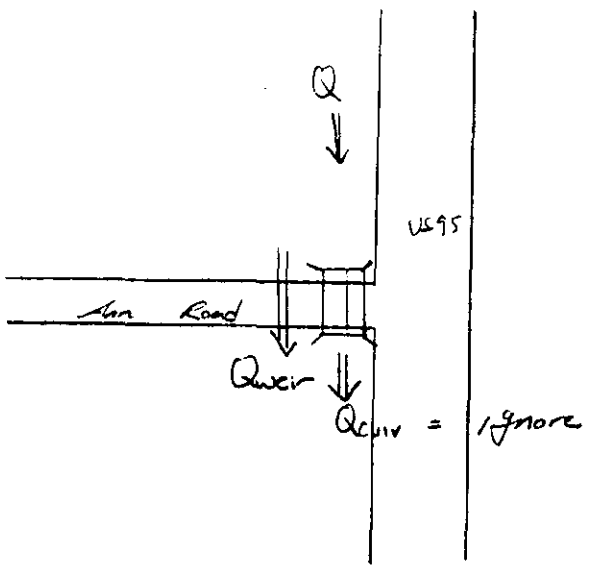
#1

@ Ann Road & US 95 (2 – 36" x 24" RCAP)
└(Clogged – Ignore)



Weir Section.

56.4/1000, 56/1025, 54/1085, 53/1100, 54/1120

56/1140, 58/1045

C = 3

$Q = CLH^{3/2}$

Elev	Top width	Avg Depth	Area	$Q = CLH^{3/2}$
2556.4	141	1.55	218	817
2556.0	115	1.46	168	607

Qweir > Q

No split flow @ Ann Road
Stay in West side of US 95

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PLANNING • [illegible]
LANDSCAPE A[illegible]

Project NWLVFIS

Project No. 930017

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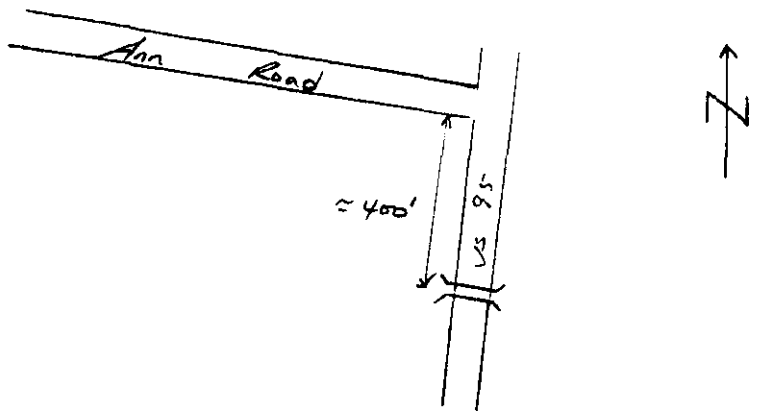
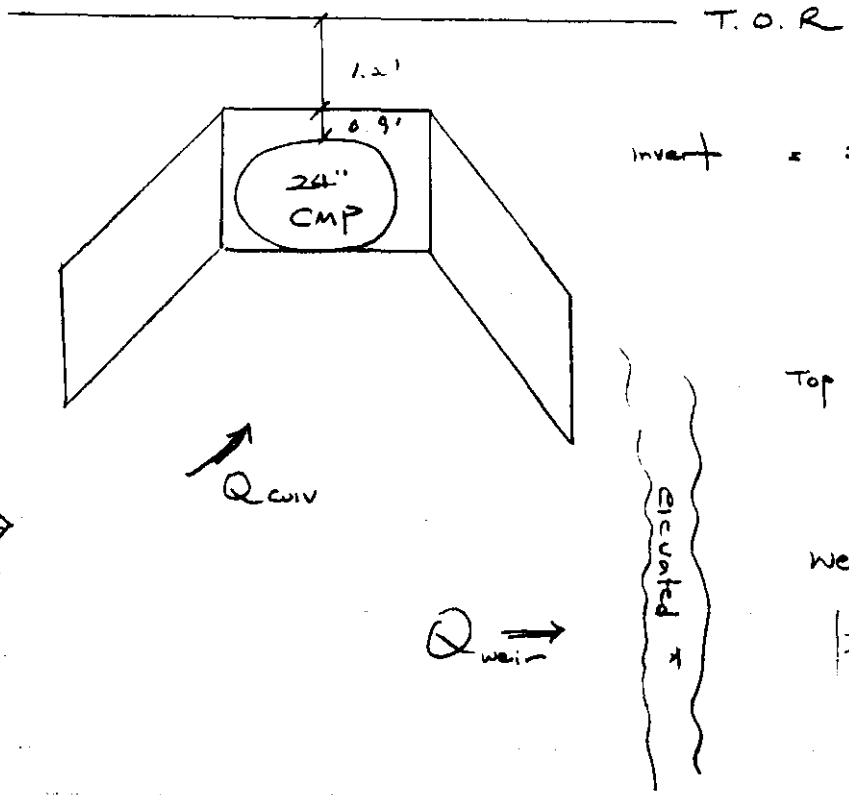
HW1

24" CMP @ US 95 ±





Invert = 3349.1'

Top of elevated area ≈ 2.6' from Invert

Weir Coef.

53	52	51.7	52	54
1000	1050	1100	1150	1180

C =

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LANDSCAPE ARCHITECTURE

Project NWLVFIS

Project No. 830017

Sheet No. 2 of

Calculated by YS Date 8/21/8

Checked by Date

Rating Curve

	Elev.	Q culv <DQ>	Q weir	Q total <DI>
INV.	2349.1	0	0	0
	2351.1	13	0	13
	2352	20	22	42
	52.2	21	78	99
	52.4	22	161	183
	52.6	23	279	302
	52.8	25	418	443
	53.0	26	603	629

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LANDSCAPE ARCHITECTURE

Project NWLVF 1 S
Project No. 83017
Sheet No. 3 of
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Checked by Date

Weir sect.

53.7/1000, 52/1050, 51.7/1140, 52/1250, 54/1480.

C = 2.7

$Q = CLH^{3/2}$

Elev	Top width	Avg depth	A	Q
53.0	317.9	0.79	250	702
52.8	282.4	0.67	189.9	418
52.6	246.8	0.58	137.0	279
52.4	211.2	0.43	91.2	161
52.2	175.6	0.30	52.6	78
52.0	140.0	0.15	21.0	22

Project_____
Project No._____
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UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: *FILENAME:* ann1.SEC

No. of Cross Section Points:	5	Bed Slope:	0.00500	Max Elev:	54.0
Bank Stations.....Left:	1000.0	Right....:	1480.0	Min Elev:	51.7
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	53.7	1000.0	2)	52.0	1090.0	3)	51.7	1140.0	4)	52.0	1230.0
5)	54.0	1480.0									

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
52.80	510.7	2.7	0.578	0.030	0.7	282.4	189.9	282.4
52.60	324.2	2.4	0.560	0.030	0.6	246.8	137.0	246.8
52.40	182.6	2.0	0.537	0.030	0.4	211.2	91.2	211.2
52.20	82.4	1.6	0.505	0.030	0.3	175.6	52.6	175.6
52.00	20.8	1.0	0.450	0.030	0.1	140.0	21.0	140.0
51.80	1.1	0.5	0.375	0.030	0.0	46.7	2.3	46.7

NOTES:

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 23, 1993
24" CMP W/ HEADWALL & WINGWALL
US 95 NEAR ANN ROAD

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	2.00
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	60.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	2.00	1.67	-0.37	0.83	1.13	0.83	8.09
12.0	2.00	1.89	-0.09	0.93	1.24	0.93	8.41
14.0	2.00	2.10	0.24	1.01	1.35	1.01	8.77
16.0	2.00	2.36	0.62	1.10	1.44	1.10	9.04
18.0	2.00	2.62	1.05	1.18	1.53	1.18	9.30
20.0	2.00	2.91	1.53	1.27	1.61	1.27	9.52
22.0	2.00	3.24	2.07	1.36	1.67	1.36	9.70
24.0	2.00	3.59	2.65	1.45	1.73	1.45	9.84
26.0	2.00	3.97	3.28	1.55	1.79	1.55	9.95
28.0	2.00	4.39	3.97	1.68	1.83	1.68	9.92
30.0	2.00	4.83	4.70	2.00	1.86	2.00	9.55
32.0	2.00	5.31	5.49	2.00	1.89	2.00	10.19
34.0	2.00	5.82	6.32	2.00	1.91	2.00	10.82
36.0	2.00	6.35	7.21	2.00	1.93	2.00	11.46

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Project VALLEY
Project No. 92017
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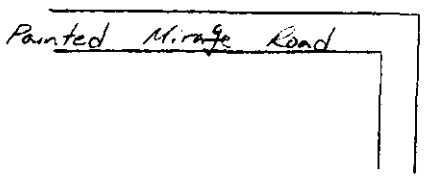
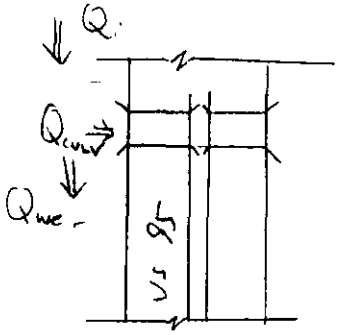
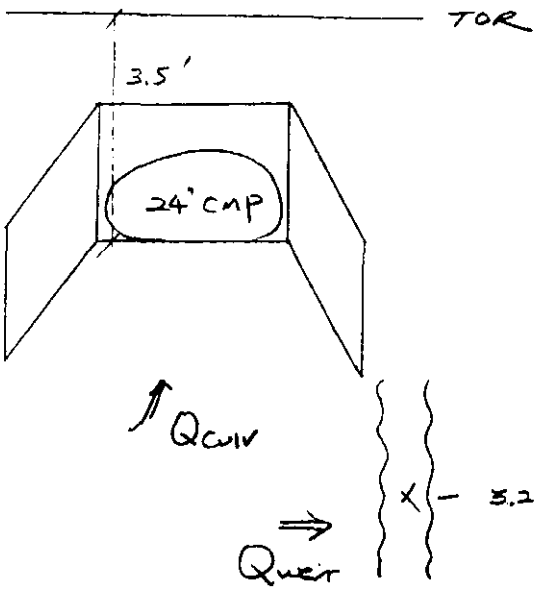
1 W 2







Headwall
Wingwall 45° flared

Weir flow (C = 2.7)

Elev.	Top width	hw depth	A	Q
3.2	100	0	0	0
3.4	100	0.2	20	24
3.6	100	0.4	40	68
4.0	100	0.8	80	193
4.4	100	1.2	120	354
4.8	100	1.6	160	546

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LANDSCAPE ARC[illegible]

Project WILLOWFIRE
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Checked by _____ Date _____

Rating Curve

	Elev.	Qculv <DQ>	Qweir	Qtotal <DI>
INV.	0	0	0	0
	1.67	10	0	10
	3.2	22	0	22
	3.6	24	68	92
	4.0	26	193	219
	4.4	28	354	382
	4.8	30	546	576

INVert = 2345.2

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 22, 1993
24" CMP near US95 & Painted Mirage Road
w/ Wingwalls & headwall

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	2.00
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	60.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	1.00	1.67	-0.80	0.83	1.13	0.83	8.09
12.0	2.00	1.89	-0.09	0.93	1.24	0.93	8.41
14.0	2.00	2.10	0.24	1.01	1.35	1.01	8.77
16.0	2.00	2.36	0.62	1.10	1.44	1.10	9.04
18.0	2.00	2.62	1.05	1.18	1.53	1.18	9.30
20.0	2.00	2.91	1.53	1.27	1.61	1.27	9.52
22.0	2.00	3.24	2.07	1.36	1.67	1.36	9.70
24.0	2.00	3.59	2.65	1.45	1.73	1.45	9.84
26.0	2.00	3.97	3.28	1.55	1.79	1.55	9.95
28.0	2.00	4.39	3.97	1.68	1.83	1.68	9.92
30.0	2.00	4.83	4.70	2.00	1.86	2.00	9.55

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Project NWLV FIS
Project No. 80017
Sheet No. ____ of ____
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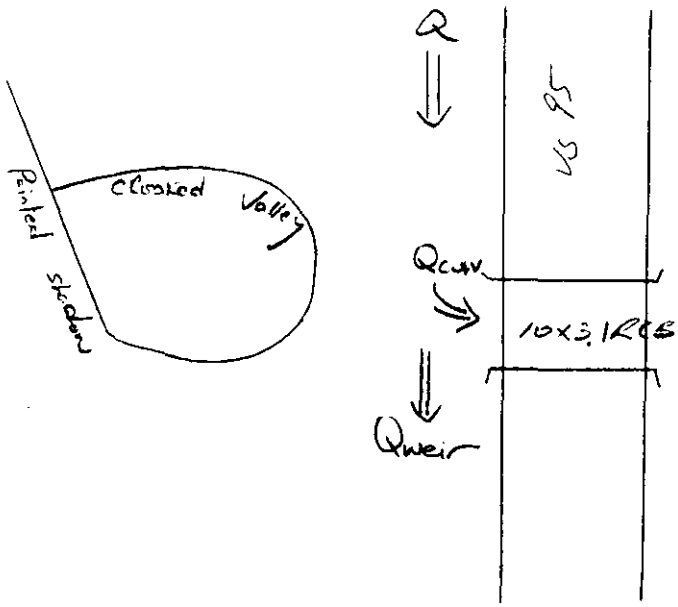
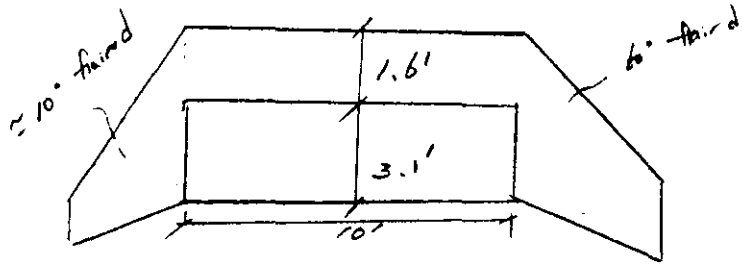
HW3





Beveled Top edge

Q → Qcurv → Qweir

x ← 12' from invert.

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Project JUNIPERS
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Rating Curve @ 10'x3.1' RCB

Elev.	<DQ> Q equiv.	Q weir	<DI> Q total
32.9	0	0	0
37.2	240	0	240
37.6	263	82	345
37.8	274	179	453
38.0	285	310	595
38.2 <38.2	296	485	781 — TSS
38.4	310	703	1013
38.6	320	947	1267

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 23, 1993
10' X 3.1' RCB ON US 95 NEAR CROOKED VALLEY
INVERT = 2332.9'
9/23/93

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	10.00
Culvert Rise (Height of Opening) (feet)	3.10
FHWA Chart Number (8,9,10,11,12 or 13)	9
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	230.0
Culvert Slope (feet per foot)	0.0200

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
100.0	2.00	2.37	-1.98	0.79	1.46	0.79	12.59
150.0	2.00	3.10	-1.33	1.03	1.91	1.03	14.56
200.0	2.00	3.77	-0.53	1.24	2.32	1.24	16.11
220.0	2.00	4.04	-0.17	1.32	2.47	1.32	16.65
240.0	2.00	4.33	0.21	1.40	2.62	1.40	17.16
260.0	2.00	4.65	0.62	1.47	2.76	1.47	17.64
280.0	2.00	5.00	1.06	1.55	2.90	1.55	18.08
300.0	2.00	5.37	1.52	1.62	3.03	1.62	18.50
320.0	2.00	5.77	1.98	1.69	3.10	1.69	18.90
340.0	2.00	6.20	2.42	1.76	3.10	1.76	19.28
360.0	2.00	6.65	2.90	1.83	3.10	1.83	19.65
380.0	2.00	7.12	3.40	1.90	3.10	1.90	20.00
400.0	2.00	7.62	3.93	1.97	3.10	1.97	20.34
420.0	2.00	8.15	4.49	2.03	3.10	2.03	20.66
440.0	2.00	8.70	5.07	2.10	3.10	2.10	20.97
460.0	3.00	9.28	5.68	2.16	3.10	2.16	21.27
480.0	3.00	9.89	6.32	2.23	3.10	2.23	21.56
500.0	3.00	10.52	6.99	2.29	3.10	2.29	21.83

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Project: NVLVFIS
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Calculated by: JKS Date: 9/23/93
Checked by: _____ Date: _____

Wet Soil.

38.2/1000, 37.1/1100, /, 37.5/1150, 38/1200

Q = 2.7

Elev	Top width	Area	Avg. depth	Q = CLy^3/2
38	x82	154	0.55	310
37.8	x44	102	0.42	179
37.6	x06	57	0.28	82
37.4	140	21	0.15	22
38.2	300	212	0.71	485
38.4	300	272	0.91	703
38.6	300	332	1.11	947

Project_____
Project No._____
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UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	4	Bed Slope:	0.00500	Max Elev:	38.2
Bank Stations.....Left:	1000.0	Right....:	1300.0	Min Elev:	37.1
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	38.2	1000.0	2)	37.1	1100.0	3)	37.5	1250.0	4)	38.0	1300.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
38.00	361.8	2.3	0.558	0.030	0.5	281.8	154.3	281.8
37.80	199.2	2.0	0.534	0.030	0.4	243.6	101.8	243.6
37.60	84.6	1.5	0.498	0.030	0.3	205.5	56.9	205.5
37.40	20.7	1.0	0.450	0.030	0.2	139.8	21.0	139.8
37.20	1.1	0.5	0.375	0.030	0.1	46.6	2.3	46.6

NOTES:

Project_____
Project No._____
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Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	4	Bed Slope:	0.00500	Max Elev:	38.2
Bank Stations.....Left:	1000.0	Right....:	1300.0	Min Elev:	37.1
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	38.2	1000.0	2)	37.1	1100.0	3)	37.5	1250.0	4)	38.0	1300.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
38.00	361.8	2.3	0.558	0.030	0.5	281.8	154.3	281.8
38.20	591.4	2.8	0.583	0.030	0.7	300.0	212.5	300.0
38.40	895.2	3.3	0.607	0.030	0.9	300.0	272.5	300.0
38.60	1247.2	3.8	0.628	0.030	1.1	300.0	332.5	300.0
38.80	1644.5	4.2	0.646	0.030	1.3	300.0	392.5	300.0
39.00	2084.4	4.6	0.661	0.030	1.5	300.0	452.5	300.0

NOTES:

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Project UNLVFIS

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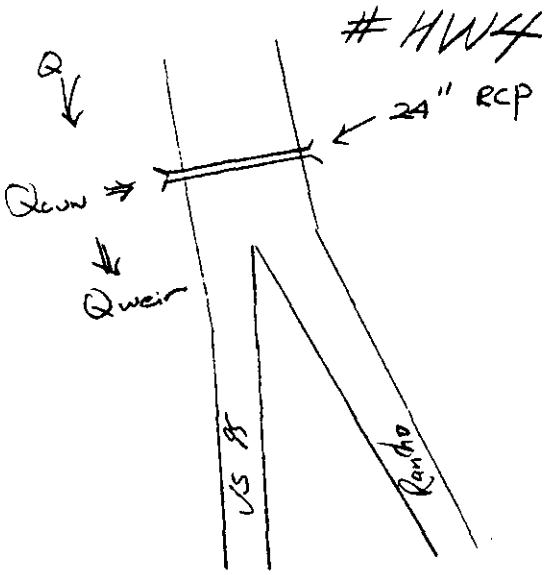
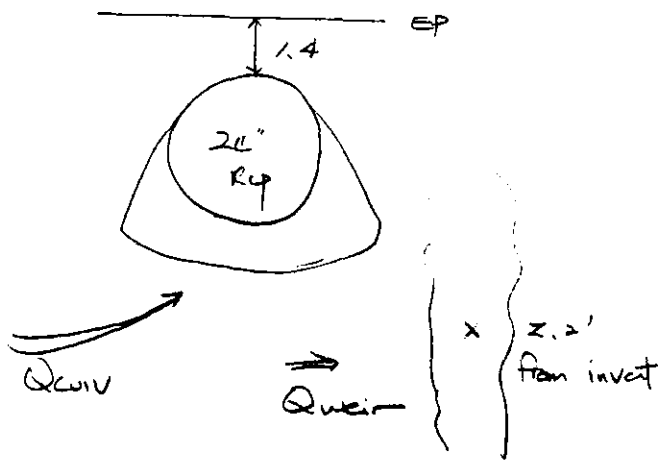
Checked by _____ Date _____





Rating Curve

Elev	Q_{curv} <DQ>	Q_{weir}	Q_{total} <DI>
invert → 2328.2	0	0	0
30.3	14	0	14
30.8	19	30	49
31.0	21	75	96
31.2	23	154	177
31.4	24	268	292
31.6	25	444	469
31.8	26	644	670

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 23, 1993
24" RCP NEAR US 95 AND RANCHO DR. INTER.
INVERT = 2328.2'

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	2.00
FHWA Chart Number (1,2 or 3)	1
Scale Number on Chart (Type of Culvert Entrance)	2
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	270.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	1.00	1.67	-11.22	0.60	1.13	0.60	12.53
14.0	2.00	2.10	-10.10	0.72	1.35	0.72	13.76
18.0	2.00	2.44	-9.19	0.83	1.53	0.83	14.70
22.0	2.00	2.91	-8.05	0.93	1.67	0.93	15.38
26.0	2.00	3.48	-6.68	1.02	1.79	1.02	16.22
30.0	2.00	4.14	-5.08	1.11	1.86	1.11	16.78
34.0	2.00	4.90	-3.25	1.20	1.91	1.20	17.26
38.0	2.00	5.75	-1.20	1.29	1.94	1.29	17.66
42.0	2.00	6.70	1.08	1.40	1.96	1.40	17.90
46.0	2.00	7.74	3.60	1.50	1.97	1.50	18.22
50.0	2.00	8.87	6.34	1.62	1.98	1.62	18.33

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Project NWLVFL
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Sheet No. _____ of _____
Calculated by YS Date 9/22/83
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Weir Section.

32/1050, 30.4/1050, 31.4/1300, C = 2.7

Elev.	Top Width	Area	Avg depth	$Q = CLH^{3/2}$
31.4	281	141	0.5	268
31.2	225	90	0.4	154
31.0	169	51	0.3	75
30.8	123	23	0.2	30
31.6	287	198	0.69	444
31.8	294	256	0.87	644

Project_____
Project No._____
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Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	3	Bed Slope:	0.00500	Max Elev:	32.0
Bank Stations.....Left:	1000.0	Right....:	1300.0	Min Elev:	30.4
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	32.0	1000.0	2)	30.4	1050.0	3)	31.4	1300.0			

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
31.40	310.3	2.2	0.550	0.030	0.5	281.3	140.6	281.3
31.20	171.1	1.9	0.530	0.030	0.4	225.0	90.0	225.0
31.00	79.5	1.6	0.505	0.030	0.3	168.8	50.6	168.8
30.80	27.0	1.2	0.472	0.030	0.2	112.5	22.5	112.5
30.60	4.2	0.8	0.421	0.030	0.1	56.3	5.6	56.3

NOTES:

Project_____
Project No._____
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Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	3	Bed Slope:	0.00500	Max Elev:	32.0
Bank Stations.....Left:	1000.0	Right....:	1300.0	Min Elev:	30.4
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	32.0	1000.0	2)	30.4	1050.0	3)	31.4	1300.0			

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
31.40	310.3	2.2	0.550	0.030	0.5	281.3	140.6	281.3
31.60	538.5	2.7	0.580	0.030	0.7	287.5	197.5	287.5
31.80	816.0	3.2	0.603	0.030	0.9	293.8	255.6	293.8
32.00	1139.7	3.6	0.622	0.030	1.1	300.0	315.0	300.0
32.20	1524.0	4.1	0.641	0.030	1.3	300.0	375.0	300.0
32.40	1951.8	4.5	0.657	0.030	1.5	300.0	435.0	300.0

NOTES:

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Project WILDFIRE

Project No 830017

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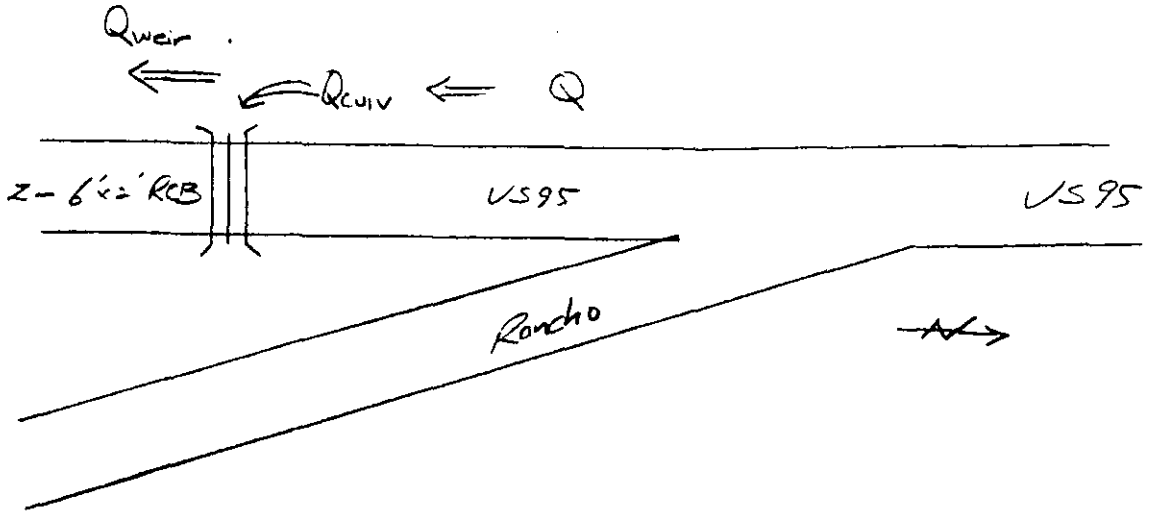
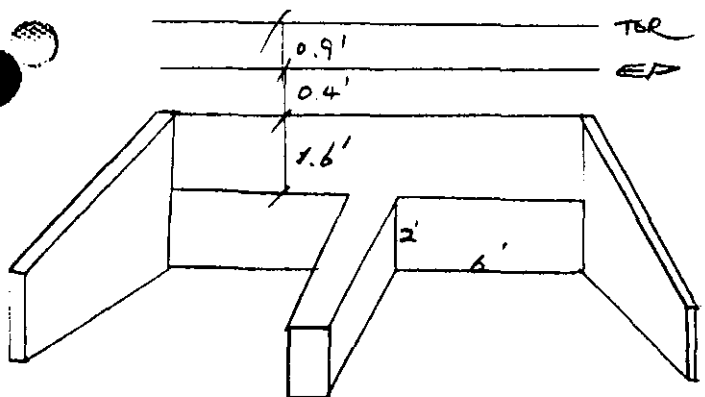
#HW5





45° Wingwall & Headwall & Beveled Top edge.

Q

Qcuiv

Qweir

2.7' from Invert

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Project: NWLVFS
Project No.: 86017
Sheet No.: _____ of _____
Calculated by: YS Date: _____
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Rating

Elev.	Q_{equiv} (CDQ)	Q_{weir}	Q_{total} (DZ)
20.3 (@invert)	0	0	0
22.1	80	0	80
23.0	132	0	132
23.8	167	24	191
24.6	200	137	337
25	214	235	449
25.4	227	362	589

True invert = 22.82'

Q_{100} = 437, WSEL = 27.47'

BOX CULVERT ANALYSIS

CALCULATION OF CULVERT PERFORMANCE CURVE

September 23, 1993

2 - 6'X2' RCB UNDER US95 NEAR THE INTERSECTION

W/ WINGWALL & HEADWALL

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	6.00
Culvert Rise (Height of Opening) (feet).....	2.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0130
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	170.0
Culvert Slope (feet per foot).....	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	2.00	1.11	0.40	0.51	0.70	0.51	6.56
40.0	2.00	1.79	0.72	0.79	1.11	0.79	8.39
60.0	2.00	2.40	1.24	1.04	1.46	1.04	9.62
80.0	2.00	3.33	1.97	1.26	1.77	1.26	10.56
100.0	2.00	4.29	2.91	1.47	2.00	1.47	11.33
120.0	2.00	5.47	4.06	1.67	2.00	1.67	11.98
140.0	2.00	6.86	5.42	1.86	2.00	1.86	12.53

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Project NWLVFIS
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Weir Section

$\frac{26}{1000}$, $\frac{24}{1036}$, $\frac{23}{1060}$, $\frac{24}{1080}$, $\frac{26}{1020}$, C = 2.7

Elev	Top Width	Area	Avg depth	$Q = CLH^{3/2}$
25.4	91	121	1.24	362
25	82	85	1.04	235
24.6	67	55	0.83	137
24.2	52	32	0.61	67
23.8	35	14	0.40	24
23.4	18	4	0.2	4

Project_____
Project No._____
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Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	5	Bed Slope:	0.00500	Max Elev:	26.0
Bank Stations.....Left:	1000.0	Right.....:	1120.0	Min Elev:	23.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	26.0	1000.0	2)	24.0	1036.0	3)	23.0	1060.0	4)	24.0	1080.0
5)	26.0	1120.0									

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
25.80	729.0	4.5	0.656	0.030	1.4	112.4	162.8	112.5
25.40	489.0	4.0	0.640	0.030	1.2	97.2	120.8	97.3
25.00	304.7	3.6	0.620	0.030	1.0	82.0	85.0	82.1
24.60	170.3	3.1	0.598	0.030	0.8	66.8	55.2	66.9
24.20	79.6	2.5	0.568	0.030	0.6	51.6	31.6	51.7
23.80	26.8	1.9	0.529	0.030	0.4	35.2	14.1	35.2

NOTES:

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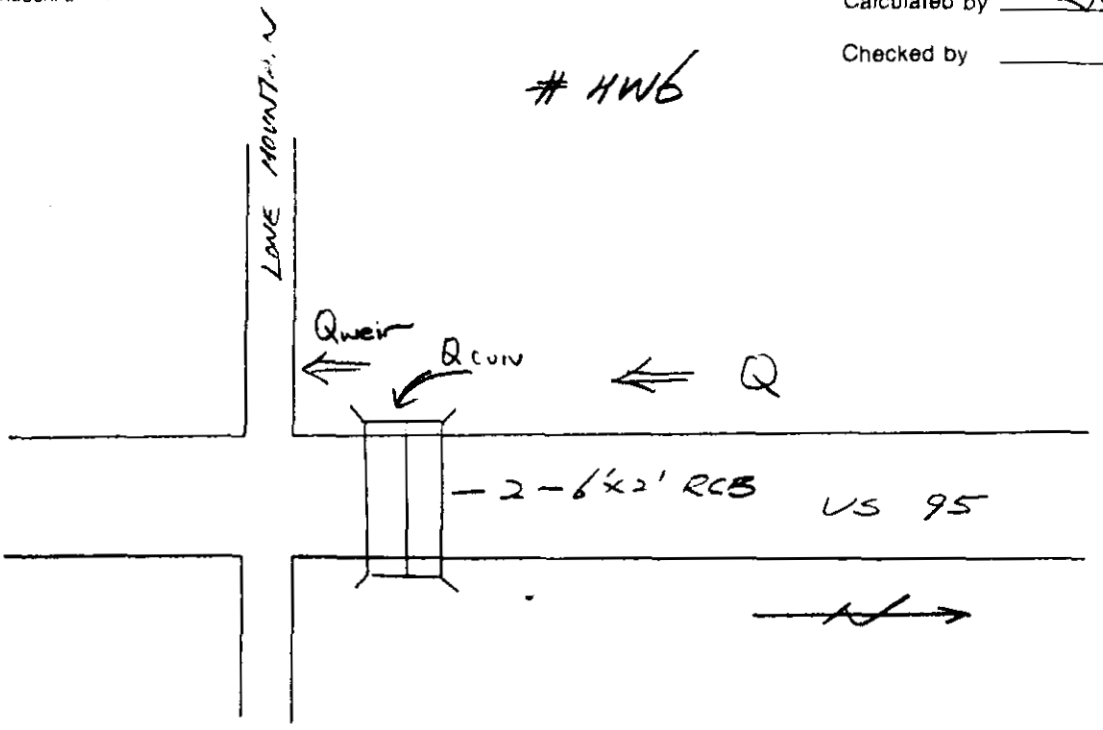
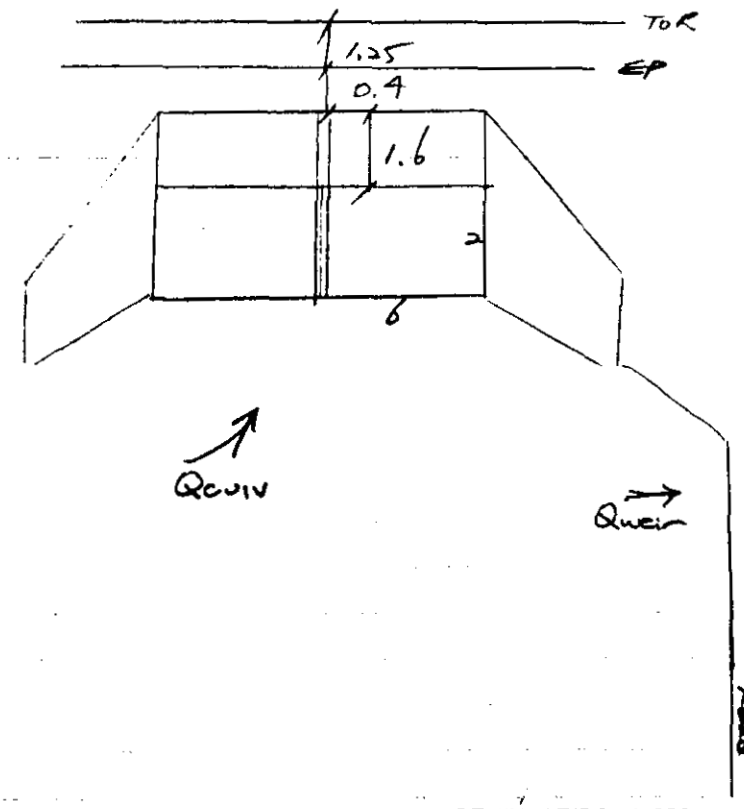
PLANNING • LANDSCAPE

Project NAVFIC
Project No. 23017
Sheet No. _____ of _____
Calculated by JS Date 5/23/83
Checked by _____ Date _____

HW6





w/ wingwalls & Headwall
Beveled Top edge

Q ⇒

5.5' from invert

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Project NVLVFIS

Project No. 23017

Sheet No. _____ of _____

Calculated by YS Date 3/25/83

Checked by _____ Date _____

Rating 9

Elev.	Qcurv <DR>	Qweir	Qtotal <DI>
20.25	0	0	0
22.65	120	0	120
23.4	152	46	198
23.8	169	402	572
24.2	186	1152	1338

BOX CULVERT ANALYSIS

COMPUTATION OF CULVERT PERFORMANCE CURVE

September 23, 1993

2 - 6' x 2' RCB UNDER US 95 NEAR LONE MOUNTAIN ROAD

W/ WINGWALLS & HEADWALL

Invert ≈ 20.25'

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	6.00
Culvert Rise (Height of Opening) (feet).....	2.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0130
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	160.0
Culvert Slope (feet per foot).....	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
60.0	2.00	2.40	1.31	1.04	1.46	1.04	9.62
80.0	2.00	3.33	2.02	1.26	1.77	1.26	10.56
100.0	2.00	4.29	2.93	1.47	2.00	1.47	11.33
120.0	2.00	5.47	4.05	1.67	2.00	1.67	11.98
140.0	2.00	6.86	5.37	1.86	2.00	1.86	12.53
160.0	2.00	8.46	6.89	2.00	2.00	2.00	13.33

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Project NWLVFIS
Project No. 92017
Sheet No. _____ of _____
Calculated by JS Date 9/23/93
Checked by _____ Date _____

River Section

25.15	24	23.75	23.5	23.1	24	25
1080	1050	1160	1300	1665	1780	2100

C = 2.7

Elev.	Top width	Area	Avg depth	$Q = CLH^{3/2}$
24.6	948	877	0.925	2277
24.2	803	527	0.656	1152
23.8	614	239	0.389	402
23.4	312	45	0.144	46

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	7	Bed Slope:	0.00500	Max Elev:	25.1
Bank Stations.....Left:	1000.0	Right....:	2100.0	Min Elev:	23.1
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	25.1	1000.0	2)	24.0	1050.0	3)	23.8	1160.0	4)	23.5	1300.0
5)	23.1	1665.0	6)	24.0	1780.0	7)	25.0	2100.0			

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	*ne*	D(ft)	TW(ft)	A(sf)	WP(ft)
25.00	5013.5	3.9	0.634	0.030	1.2	1093.5	1285.2	1093.5
24.60	2915.8	3.3	0.609	0.030	0.9	948.1	876.9	948.1
24.20	1393.3	2.6	0.575	0.030	0.7	802.7	526.8	802.7
23.80	444.6	1.9	0.527	0.030	0.4	616.4	238.9	616.4
23.40	46.3	1.0	0.450	0.030	0.1	312.1	46.8	312.1

NOTES:

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Project WILLOWS

Project No. 92017

Sheet No. _____ of _____

Calculated by JS Date 9/24/92

Checked by _____ Date _____

North Side

@ US 95 & Craig Rd Intersection

DI	0	1,046	1718	2269	3224	4954
DQ	0	13	21	33	55	109

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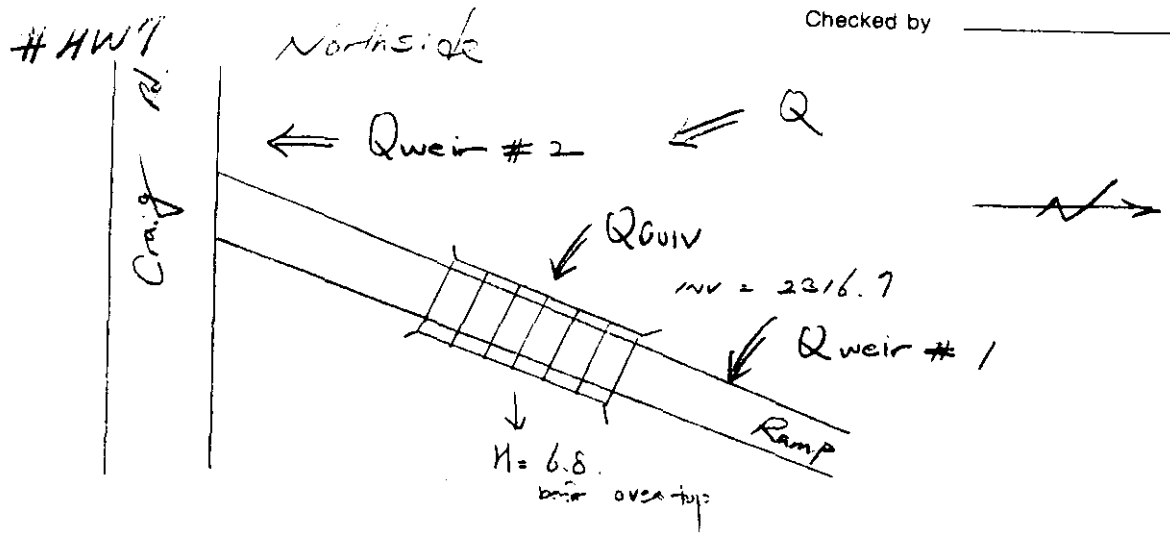
SCA

Project HWLVFL
Project No. 83017
Sheet No. ____ of ____
Calculated by YS Date 9/24/83
Checked by ____ Date ____



Elev.	Q_{CULV}	$Q_{weir\,1}$	$Q_{weir\,2}$	Q_{total}
2316.7	0			0
2320.0	792			792
2321.0	1,029	0	17	1,046
2321.8	1220	27	471	1,718
2322.0	1266	98	715	2,079
2322.4	1353	429	1442	3,224
2322.8	1440	1157	2357	4,954

Q_{weir} 1263

Q_{total} 2943

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 24, 1993
6 - 8' X 3.1' RCB UNDER OFFRAMP NEAR CRAIG RD.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	8.00
Culvert Rise (Height of Opening) (feet).....	3.10
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0130
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	100.0
Culvert Slope (feet per foot).....	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
100.0	2.00	2.72	1.81	1.17	1.69	1.17	10.70
120.0	2.00	3.09	2.10	1.32	1.91	1.32	11.37
140.0	2.00	3.44	2.41	1.46	2.12	1.46	11.97
160.0	2.00	3.97	2.76	1.60	2.32	1.60	12.49
180.0	2.00	4.54	3.13	1.73	2.51	1.73	12.97
200.0	2.00	5.01	3.53	1.86	2.69	1.86	13.41
220.0	3.00	5.54	3.98	1.99	2.86	1.99	13.81
240.0	3.00	6.12	4.43	2.11	3.03	2.11	14.19
260.0	3.00	6.74	4.87	2.24	3.10	2.24	14.54
280.0	3.00	7.42	5.31	2.36	3.10	2.36	14.86
300.0	3.00	8.14	5.79	2.47	3.10	2.47	15.16
320.0	3.00	8.92	6.30	2.59	3.10	2.59	15.45
340.0	3.00	9.75	6.84	2.70	3.10	2.70	15.72

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BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 14, 1994
6 - 8' X 3.1' RCB UNDER OFFRAMP NEAR CRAIG RD.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	8.00
Culvert Rise (Height of Opening) (feet)	3.10
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	100.0
Culvert Slope (feet per foot)	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
120.0	4.50	3.09	4.09	1.32	1.91	3.10	4.84
140.0	4.50	3.44	4.30	1.46	2.12	3.10	5.65
160.0	4.50	3.97	4.55	1.60	2.32	3.10	6.45
180.0	4.50	4.54	4.83	1.73	2.51	3.10	7.26
200.0	4.50	5.01	5.14	1.86	2.69	3.10	8.06
220.0	4.50	5.54	5.48	1.99	2.86	1.99	13.81
240.0	4.50	6.12	5.86	2.11	3.03	2.11	14.19
260.0	4.50	6.74	6.27	2.24	3.10	2.24	14.54
280.0	4.50	7.42	6.71	2.36	3.10	2.36	14.86
300.0	4.50	8.14	7.19	2.47	3.10	2.47	15.16
320.0	4.50	8.92	7.70	2.59	3.10	2.59	15.45
340.0	4.50	9.75	8.24	2.70	3.10	2.70	15.72

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Project NWLV FI-
Project No. 83001.7
Sheet No. _____ of _____
Calculated by TO Date 9/14/83
Checked by _____ Date _____

Weir sect # 1.

23/1000, 22.5/1350, 22/1665, 21.5/1790, 23/1925, 24/2010

C = 3

Elev	Top Width	Area	Avg depth	$Q = CA\sqrt{y}$
22.8	851	504.1	0.59	1157
22.4	545	226	0.41	429
22.0	260	65	0.25	98
21.8	156	23.4	0.15	27

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Weir #1 @ Craig

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	6	Bed Slope:	0.00500	Max Elev:	24.0
Bank Stations.....Left:	1000.0	Right....:	2090.0	Min Elev:	21.5
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	23.0	1000.0	2)	22.5	1350.0	3)	22.0	1665.0	4)	21.5	1790.0
5)	22.0	1925.0	6)	24.0	2090.0						

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
22.80	1245.5	2.5	0.566	0.030	0.6	851.0	504.1	851.0
22.40	440.2	1.9	0.533	0.030	0.4	545.0	226.0	545.0
22.00	90.3	1.4	0.490	0.030	0.3	260.0	65.0	260.0
21.80	23.1	1.0	0.450	0.030	0.1	156.0	23.4	156.0

NOTES:

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Project NWLVFLS
Project No. 93017
Sheet No. _____ of _____
Calculated by MS Date 8/24/95
Checked by _____ Date _____

Weir Section #1

C = 3

24 / 10230, 22 / 1255, 20.7 / 1570, 22 / 1910, 24 / 1995

Elev	Top Width	Area	Avg depth	$Q = CLH^{3/2}$
23.2	647	957	1.48	3,495
22.8	583	710.9	1.22	2,357
22.4	519	490.5	0.95	1,442
21.8	385	211.7	0.55	471
21.4	245	85.7	0.35	152
21.0	105	15.7	0.14	17
22.0	455	295.7	0.65	715

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Weir #2

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	5	Bed Slope:	0.00500	Max Elev:	24.0
Bank Stations.....Left:	1000.0	Right....:	1775.0	Min Elev:	20.7
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	*0.030*	*CHANNEL..:*	*0.030*	*ROB.....:*	*0.030*

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	24.0	1000.0	2)	22.0	1255.0	3)	20.7	1570.0	4)	22.0	1710.0
5)	24.0	1775.0									

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
22.80	2842.2	4.0	0.638	0.030	1.2	583.0	710.9	583.0
22.40	1654.8	3.4	0.611	0.030	0.9	519.0	490.5	519.0
22.00	777.3	2.6	0.574	0.030	0.6	455.0	295.7	455.0
21.80	497.9	2.4	0.559	0.030	0.5	385.0	211.7	385.0
21.40	149.2	1.7	0.518	0.030	0.3	245.0	85.7	245.0
21.00	15.6	1.0	0.450	0.030	0.1	105.0	15.7	105.0

NOTES:

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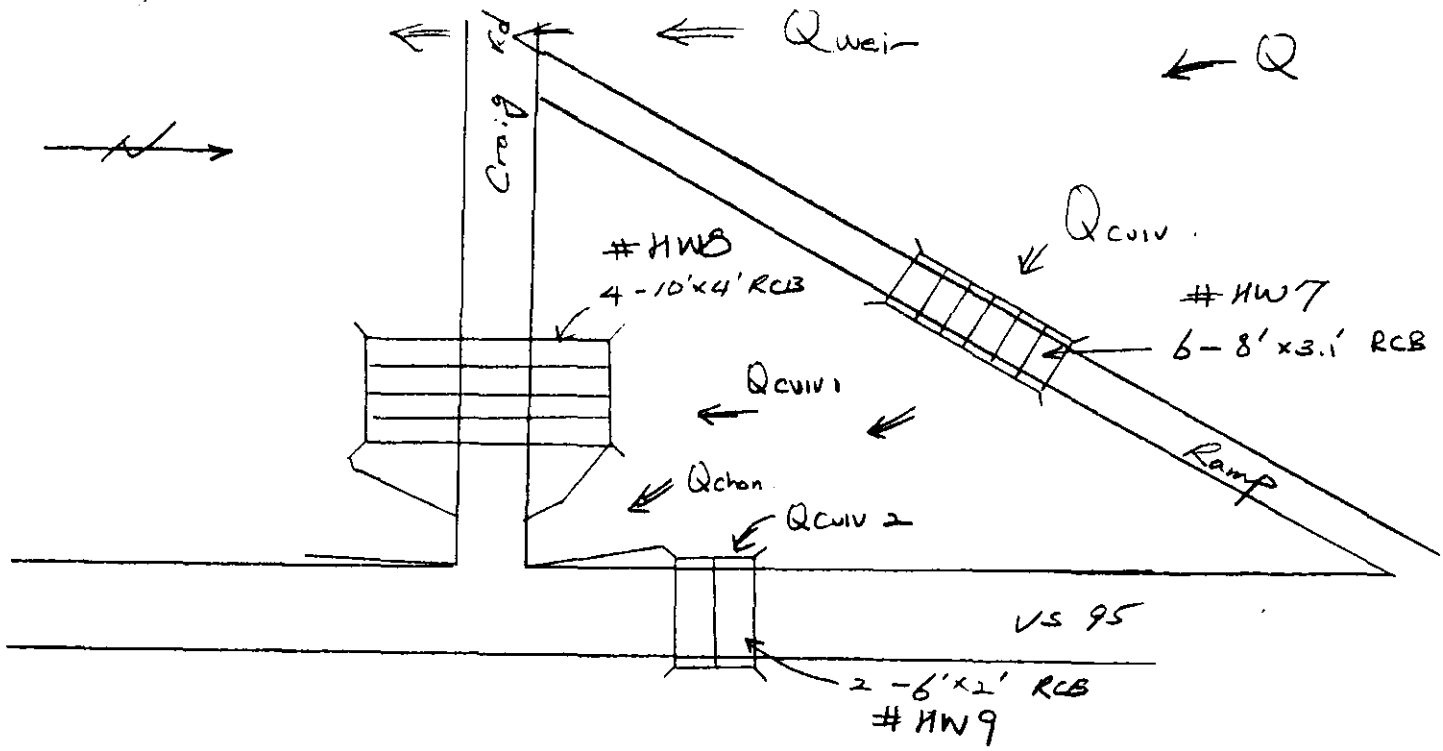
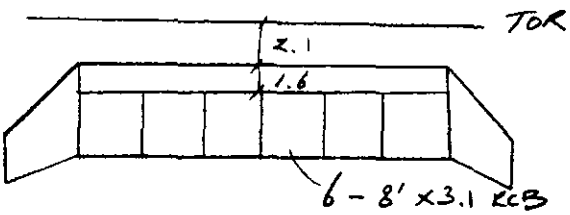
LANDSCAPE ARCHITECTURE

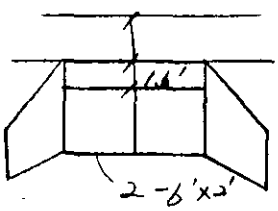
Project VALLEY VIEW
Project No. 83017
Sheet No. _____ of _____
Calculated by JS Date 8/24/83
Checked by _____ Date _____

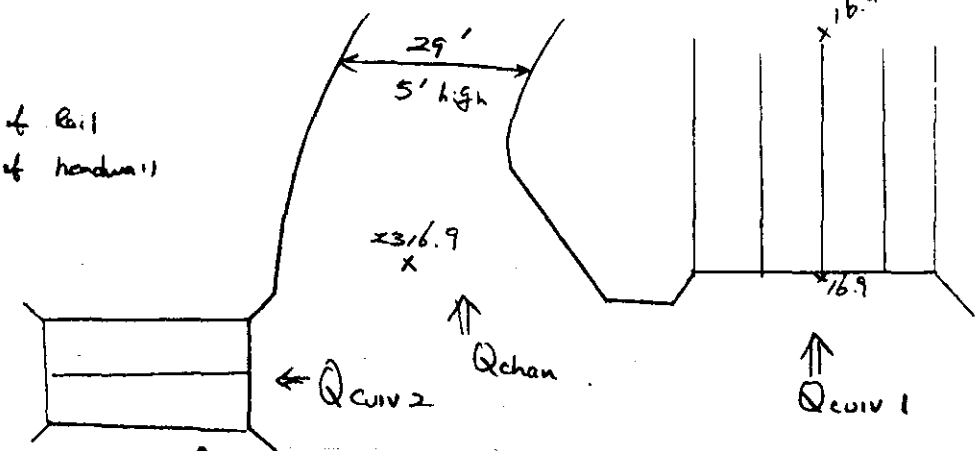
HW8
HW9

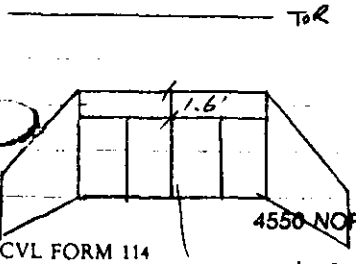




45° Wingwall
Headwall, Beveled Top edge







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LANDSCAPE ARCHITECTURE

Project WILDFIRE

Project No. 83001.7

Sheet No. _____ of _____

Calculated by YS Date 9/24/83

Checked by _____ Date _____

Elev. Invert	$Q_{CULV\,1}$ <2316.9>	<DQ> $Q_{CULV\,2}$ <2318.7>	Q_{chan} <2316.9>	<DZ> Q_{total}
2316.9	0	0	0	0
17.4				
17.8	102		149	251
18.2	172		268	440
18.6	256	0	410	666
19.0	347	10	573	930
19.4	447	20	754	1221
19.8	560	40	950	1550
20.2	670	63	1160	1893
20.6	791	81	1382	2260
21.0	917	113	1616	2646

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 24, 1993
2 - 6' X 2' RCB UNDER US 95 NEAR CRAIG RD

INV = 18.7

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	6.00
Culvert Rise (Height of Opening) (feet).....	2.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0130
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	160.0
Culvert Slope (feet per foot).....	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	2.00	1.11	0.50	0.51	0.70	0.51	6.56
40.0	2.00	1.79	0.81	0.79	1.11	0.79	8.39
60.0	2.00	2.40	1.31	1.04	1.46	1.04	9.62
80.0	2.00	3.33	2.02	1.26	1.77	1.26	10.56
100.0	2.00	4.29	2.93	1.47	2.00	1.47	11.33
120.0	2.00	5.47	4.05	1.67	2.00	1.67	11.98
140.0	2.00	6.86	5.37	1.86	2.00	1.86	12.53
160.0	2.00	8.46	6.89	2.00	2.00	2.00	13.33

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BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 24, 1993
4 - 10' X 4' RCB UNDER CRAIG RD NEAR CRAIG AND US INTER.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	10.00
Culvert Rise (Height of Opening) (feet)	4.00
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	225.0
Culvert Slope (feet per foot)	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	2.00	0.77	0.01	0.36	0.50	0.36	5.54
40.0	2.00	1.24	0.18	0.56	0.79	0.56	7.20
60.0	2.00	1.63	0.33	0.72	1.04	0.72	8.37
80.0	2.00	1.99	0.50	0.86	1.26	0.86	9.30
100.0	2.00	2.32	0.66	0.99	1.46	0.99	10.08
120.0	2.00	2.63	0.84	1.12	1.65	1.12	10.76
140.0	2.00	2.92	1.02	1.23	1.83	1.23	11.35
160.0	2.00	3.20	1.22	1.35	2.00	1.35	11.89
180.0	2.00	3.47	1.42	1.45	2.16	1.45	12.38
200.0	3.00	3.73	1.64	1.56	2.32	1.56	12.83
220.0	3.00	3.99	1.87	1.66	2.47	1.66	13.25
240.0	2.00	4.23	2.11	1.76	2.62	1.76	13.63
260.0	2.00	4.48	2.37	1.86	2.76	1.86	14.00
280.0	2.00	4.71	2.63	1.95	2.90	1.95	14.34
300.0	2.00	5.31	2.91	2.05	3.03	2.05	14.66
320.0	2.00	5.70	3.21	2.14	3.17	2.14	14.96
340.0	2.00	6.02	3.51	2.23	3.30	2.23	15.25
360.0	2.00	6.36	3.83	2.32	3.43	2.32	15.53
380.0	2.00	6.71	4.17	2.41	3.55	2.41	15.79
400.0	2.00	7.09	4.52	2.49	3.68	2.49	16.04

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TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

September 24, 1993
CONCRETE LINED CHANNEL UNDER CRAIG OVERPASS
29' WIDE @ CONTROL PT.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0030
Manning's Roughness Coefficient (n-value).....	0.0130
Channel Side Slope - Left Side (horizontal/vertical)....	0.00
Channel Side Slope - Right Side (horizontal/vertical)...	0.00
Channel Bottom Width (feet).....	29.0

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
0.2	12.3	2.12	0.836	0.070	0.270	5.8	29.0
0.6	75.4	4.34	0.986	0.292	0.892	17.4	29.0
1.0	173.7	5.99	1.055	0.557	1.557	29.0	29.0
1.4	299.2	7.37	1.097	0.843	2.243	40.6	29.0
1.8	447.3	8.57	1.126	1.140	2.940	52.2	29.0
2.2	614.9	9.64	1.145	1.443	3.643	63.8	29.0
2.6	799.7	10.61	1.159	1.747	4.347	75.4	29.0
3.0	999.5	11.49	1.169	2.050	5.050	87.0	29.0
3.4	1212.9	12.30	1.176	2.350	5.750	98.6	29.0
3.8	1438.6	13.05	1.180	2.646	6.446	110.2	29.0
4.2	1675.5	13.76	1.183	2.938	7.138	121.8	29.0
4.6	1922.4	14.41	1.184	3.225	7.825	133.4	29.0
5.0	2178.7	15.03	1.184	3.506	8.506	145.0	29.0
5.4	2443.6	15.60	1.183	3.781	9.181	156.6	29.0
5.8	2716.4	16.15	1.182	4.050	9.850	168.2	29.0
6.2	2996.5	16.67	1.180	4.313	10.513	179.8	29.0

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

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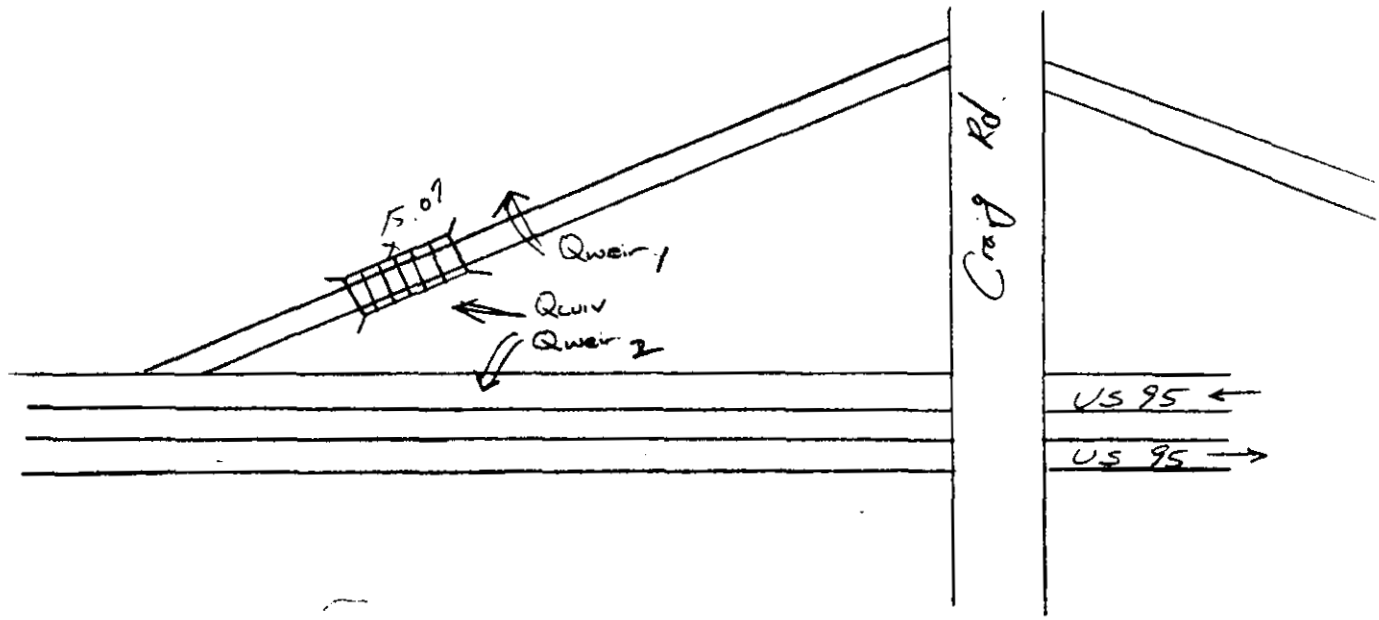
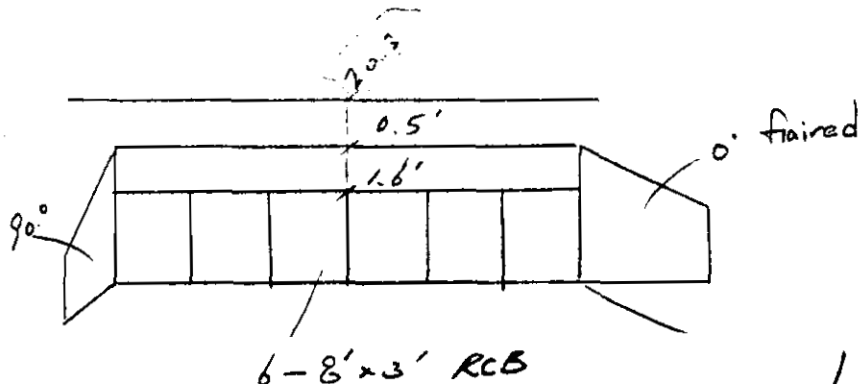
Project VALLEY
Project No. 2017
Sheet No. _____ of _____
Calculated by JS Date 9/4/12
Checked by _____ Date _____

HW10
@ Southside of Craig & US 95 Intersection





Invert = 2315.2

S = 0.001
↳ Refer to church eng.

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Project NWLVEIS
Project No. 23017
Sheet No. ____ of ____
Calculated by YS Date 9/24/98
Checked by ____ Date ____

@ Southside of Craig Rd & US 95 Intersection

Elev.	Qcuiv	Qweir 1	Qweir 2	Qtotal	<DQ> <DI>
~~2315.2~~	0	0	0	0	
2319.0	960	0	0	960	
2319.4	1,098	94	0	1192	<1405
2320.0	1,267	~~440~~	0	1,707	
2320.4	1,369	829	21	2,198	

BOX CULVERT ANALYSIS

GENERATION OF CULVERT PERFORMANCE CURVE

September 24, 1993

6 - 8' X 3' RCB UNDER RAMP NEAR CRAIG RD & US 95 INTERSECTION

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	8.00
Culvert Rise (Height of Opening) (feet).....	3.00
FHWA Chart Number (8,9,10,11,12 or 13).....	9
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0130
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	110.0
Culvert Slope (feet per foot).....	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	2.00	0.94	0.92	0.42	0.58	0.42	5.99
40.0	2.00	1.49	0.97	0.65	0.92	0.65	7.74
60.0	2.00	1.95	1.17	0.84	1.20	0.84	8.95
80.0	2.00	2.37	1.42	1.01	1.46	1.01	9.91
100.0	2.00	2.75	1.70	1.17	1.69	1.17	10.70
120.0	2.00	3.10	2.01	1.32	1.91	1.32	11.37
140.0	3.00	3.44	2.79	1.46	2.12	1.46	11.97
160.0	3.00	3.78	3.06	1.60	2.32	1.60	12.49
180.0	3.00	4.14	3.37	1.73	2.51	1.73	12.97
200.0	3.00	4.55	3.71	1.86	2.69	1.86	13.41
220.0	3.00	5.00	4.09	1.99	2.86	1.99	13.81
240.0	3.00	5.49	4.51	2.11	3.00	2.11	14.19
260.0	3.00	6.03	4.96	2.24	3.00	2.24	14.54
280.0	3.00	6.61	5.45	2.36	3.00	2.36	14.86
300.0	3.00	7.23	5.98	2.47	3.00	2.47	15.16
320.0	3.00	7.89	6.54	2.59	3.00	2.59	15.45
340.0	3.00	8.60	7.14	2.70	3.00	2.70	15.72

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Project _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Weir Section #1

$\frac{20.2}{1000}$, $\frac{20.3}{1380}$, $\frac{20}{1550}$, $\frac{18.7}{1710}$, $\frac{20}{1830}$, $\frac{22}{1990}$, $C = 3$

Elev.	Top Width	Area	depth	$Q = CLy^{3/2}$
21.2	914	1108	1.21	3,649
21.0	900	927	1.03	2,822
20.8	886	748	0.84	2,046
20.6	872	572	0.66	1,403
20.4	858	399	0.47	829
20.2	407	251	0.62	596
20.0	280	182	0.65	440
19.8	237	130	0.55	290
19.6	194	87	0.45	176
19.4	151	53	0.35	94
19.2	108	27	0.25	41

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	6	Bed Slope:	0.00500	Max Elev:	22.0
Bank Stations.....Left:	1000.0	Right....:	1970.0	Min Elev:	18.7
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	20.2	1000.0	2)	20.3	1380.0	3)	20.0	1550.0	4)	18.7	1710.0
5)	20.0	1830.0	6)	22.0	1970.0						

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
21.20	4411.4	4.0	0.637	0.030	1.2	914.0	1107.9	914.0
21.00	3308.4	3.6	0.620	0.030	1.0	900.0	926.5	900.0
20.80	2339.7	3.1	0.600	0.030	0.8	886.0	747.9	886.0
20.60	1512.9	2.6	0.575	0.030	0.7	872.0	572.1	872.0
20.40	839.2	2.1	0.543	0.030	0.5	858.0	399.1	858.0
20.20	635.5	2.5	0.569	0.030	0.6	407.3	250.7	407.3

NOTES:

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	6	Bed Slope:	0.00500	Max Elev:	22.0
Bank Stations.....Left:	1000.0	Right....:	1970.0	Min Elev:	18.7
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	20.2	1000.0	2)	20.3	1380.0	3)	20.0	1550.0	4)	18.7	1710.0
5)	20.0	1830.0	6)	22.0	1970.0						

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
20.00	478.3	2.6	0.574	0.030	0.6	280.0	182.0	280.0
19.80	306.4	2.4	0.559	0.030	0.5	236.9	130.3	236.9
19.60	179.4	2.1	0.540	0.030	0.4	193.8	87.2	193.9
19.40	91.8	1.7	0.518	0.030	0.3	150.8	52.8	150.8
19.20	37.4	1.4	0.490	0.030	0.3	107.7	26.9	107.7
19.00	9.6	1.0	0.450	0.030	0.1	64.6	9.7	64.6

NOTES:

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Project WILLVFIS

Project No. 930017

Sheet No. _____ of _____

Calculated by JS Date 1/24/93

Checked by _____ Date _____

Weir Sect #2

$\frac{20.2}{1000}$ / $\frac{20.4}{1225}$ / $\frac{20.8}{1650}$ / $\frac{21.2}{1955}$ $C = 3$

Elev	Top Width	Area	Depth	$Q = CA^{3/2}$
21.2	955	519	0.54	1,137
21.0	803	343	0.43	679
20.8	650	198	0.30	320
20.6	438	89	0.20	117
20.4	225	23	0.10	21

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	4	Bed Slope:	0.00500	Max Elev:	21.2
Bank Stations.....Left:	1000.0	Right....:	1955.0	Min Elev:	20.2
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	20.2	1000.0	2)	20.4	1225.0	3)	20.8	1650.0	4)	21.2	1955.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
21.20	1208.6	2.3	0.558	0.030	0.5	955.0	518.5	955.0
21.00	680.8	2.0	0.536	0.030	0.4	802.5	342.8	802.5
20.80	312.6	1.6	0.506	0.030	0.3	650.0	197.5	650.0
20.60	107.3	1.2	0.473	0.030	0.2	437.5	88.8	437.5
20.40	17.0	0.8	0.421	0.030	0.1	225.0	22.5	225.0
20.30	2.7	0.5	0.375	0.030	0.0	112.5	5.6	112.5

NOTES:

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Project _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Ratings for weir flow over Highway 95 to Rancho Dr.

<DI> Q_{total}	<DQ> Q_{weir}
0	0
1000	0
2000	187
3300	297
5000	563

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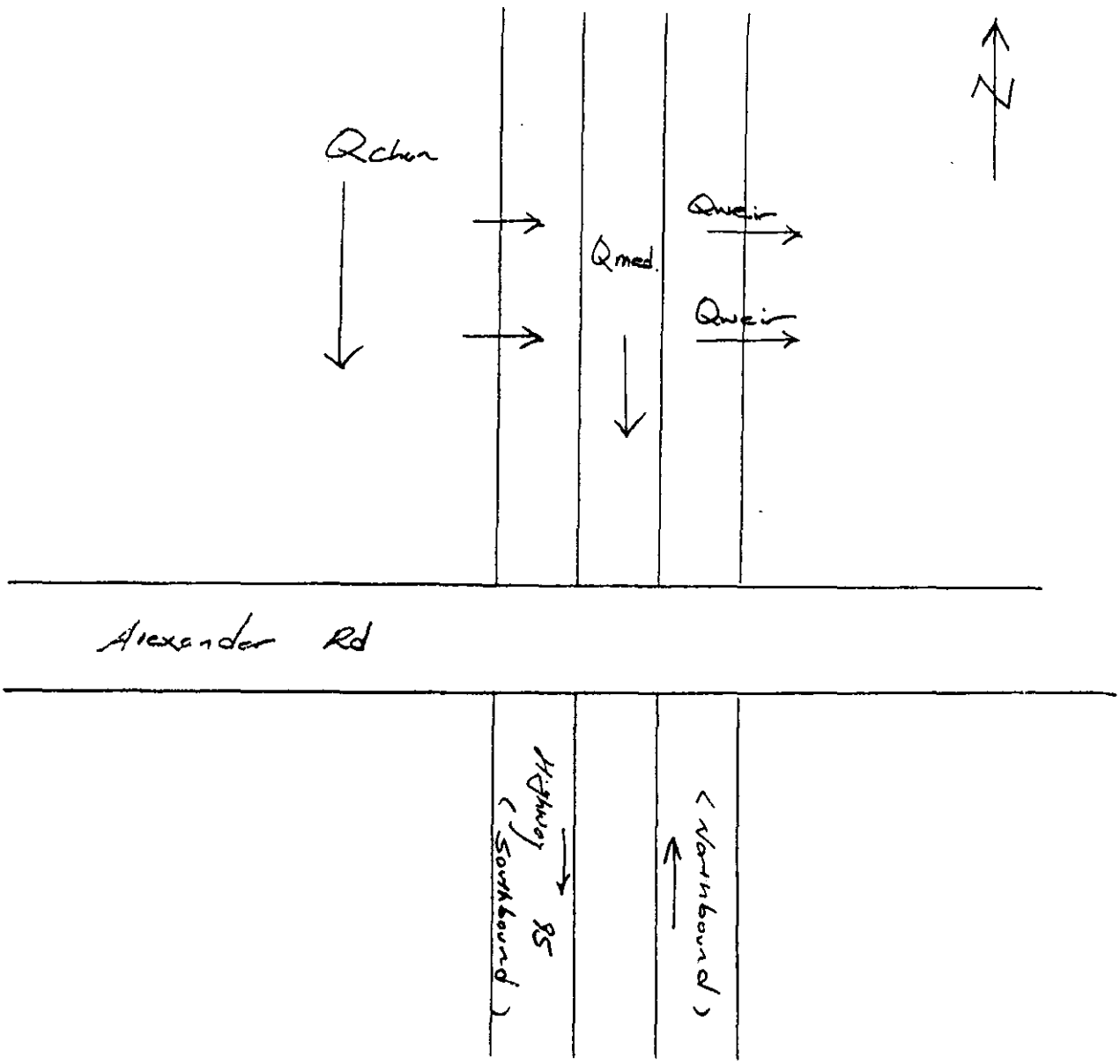
Project NWLVFIS
Project No. 83007
Sheet No. ____ of ____
Calculated by JS Date 3/28/94
Checked by ____ Date ____

At Alexander Rd and Highway .95 Intersection



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Project NWL-VFLS

Project No.

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

$Q = CLy^{3/2}$, $L = 655'$; $C = 3$

Elev.	Qmed	Qweir	Qtotal
18.1	42	0	42
18.2	51	62	113
18.4	77	323	400
18.6	107	695	802
18.8	141	1150	1291

366

Project NWLVFTS
Project No.
Sheet No. of
Calculated by Date

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Highway 95 Median area
near Alexander Rd

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	6	Bed Slope:	0.00122	Max Elev:	2318.1
Bank Stations.....Left:	9990.1	Right....:	10000.0	Min Elev:	2316.7
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.025	CHANNEL..:	0.020	ROB.....:	0.025

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2318.1	9977.5	2)	2317.0	9990.1	3)	2316.7	9994.6	4)	2317.4	10000.0
5)	2317.9	10012.9	6)	2318.1	10018.3						

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
2317.80	20.1	1.4	0.365	0.022	0.5	29.4	14.1	29.5
2318.00	32.2	1.6	0.367	0.023	0.6	37.0	20.7	37.1
2318.20	51.2	1.8	0.375	0.023	0.7	40.8	28.6	40.9
2318.40	77.0	2.1	0.388	0.023	0.9	40.8	36.8	40.9
2318.60	106.9	2.4	0.399	0.023	1.1	40.8	45.0	40.9
2318.80	140.6	2.6	0.409	0.023	1.3	40.8	53.1	40.9

NOTES:

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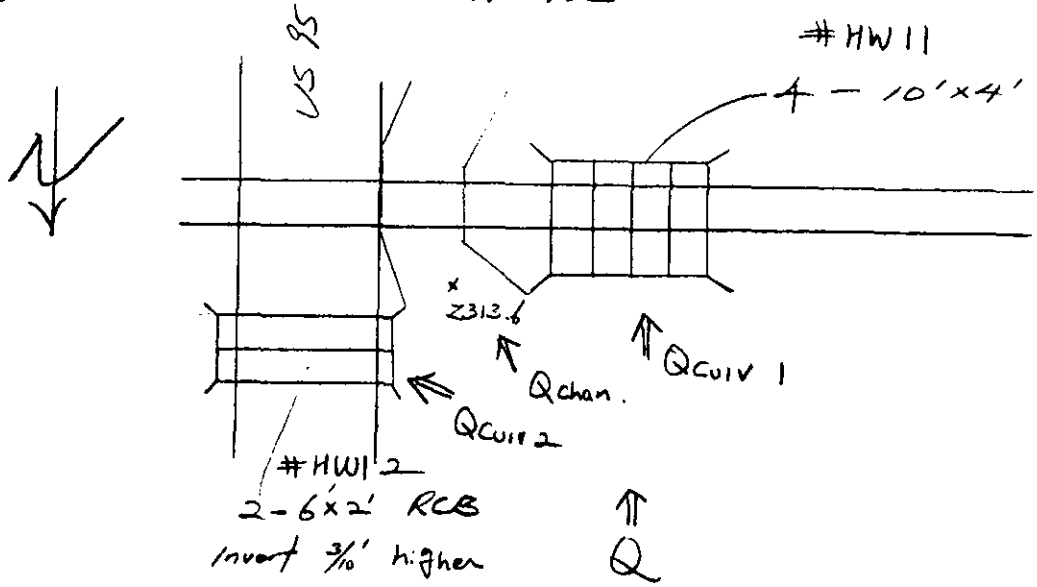
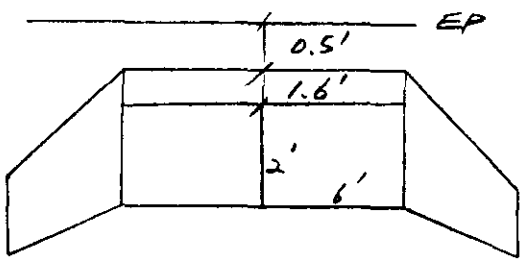
Project NWLVFLS
Project No. 83-17
Sheet No. ____ of ____
Calculated by JE Date 9/24/85
Checked by ____ Date ____

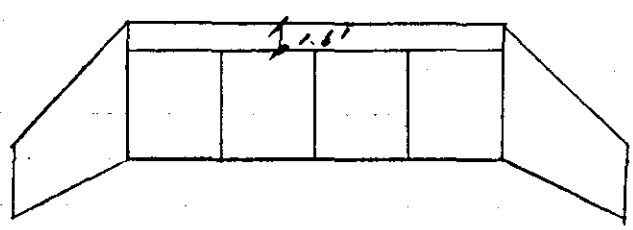
HW11
HW12



Channel, W = 29'
H = 3.8'
n = 0.018



2 – 6'x2' RCB
INVERT ≃ 2313.9
Wingwall – 45°
Headwall – Beveled Top edge
ℓ = 160'



4 – 10'x4' RCB
Wingwall – 45°
Headwall – Beveled Top edge
ℓ = 125'

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Project _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

@ Alexander Rd and US 95 Intersection

Elev.	Qculv1 (4-10x4)	Qculv2 (2-6x2) (DQ)	Qchan	Qweir	Qtotal (DI)
2313.6	0	0	0	—	0
14.84	160	30	249.	-	439
15.92	400	96	670	—	1166
16.8	640	141	1106	-	1887
17.33	800	164	1399	—	2363
18.08	1040	195	1848	—	3083
19.30	1280	238	2648	—	4166

* Culvert Ratings based on Inlet Control

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

December 16, 1993
4 - 10' X 4' RCB UNDER ALEXANDER RD
TW DEPTH = 3.3'

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	10.00
Culvert Rise (Height of Opening) (feet)	4.00
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	127.0
Culvert Slope (feet per foot)	0.0010

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
40.0	3.30	1.24	3.20	1.15	0.79	3.30	1.21
60.0	3.30	1.63	3.23	1.51	1.04	3.30	1.82
80.0	3.30	1.99	3.27	1.82	1.26	3.30	2.42
100.0	3.30	2.32	3.33	2.12	1.46	3.30	3.03
120.0	3.30	2.63	3.39	2.40	1.65	3.30	3.64
140.0	3.30	2.92	3.47	2.68	1.83	3.30	4.24
160.0	3.30	3.20	3.57	2.94	2.00	3.30	4.85
180.0	3.30	3.47	3.67	3.19	2.16	3.30	5.45
200.0	3.30	3.73	3.79	3.44	2.32	3.30	6.06
220.0	3.30	3.99	3.92	3.69	2.47	3.69	5.97
240.0	3.30	4.23	4.07	3.93	2.62	3.93	6.11
260.0	3.30	4.48	4.29	4.00	2.76	4.00	6.50
280.0	3.30	4.71	4.53	4.00	2.90	4.00	7.00
300.0	3.30	5.31	4.78	4.00	3.03	4.00	7.50
320.0	3.30	5.70	5.03	4.00	3.17	4.00	8.00
340.0	3.30	6.02	5.30	4.00	3.30	4.00	8.50
360.0	3.30	6.36	5.58	4.00	3.43	4.00	9.00
380.0	3.30	6.71	5.87	4.00	3.55	4.00	9.50
400.0	3.30	7.09	6.18	4.00	3.68	4.00	10.00

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TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

September 24, 1993
CONCRETE LINED CHANNEL @ ALEXANDER & US 95 INTER.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0030
Manning's Roughness Coefficient (n-value).....	0.0130
Channel Side Slope - Left Side (horizontal/vertical)....	0.00
Channel Side Slope - Right Side (horizontal/vertical)...	0.00
Channel Bottom Width (feet).....	29.0

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
0.2	12.3	2.12	0.836	0.070	0.270	5.8	29.0
0.6	75.4	4.34	0.986	0.292	0.892	17.4	29.0
1.0	173.7	5.99	1.055	0.557	1.557	29.0	29.0
1.4	299.2	7.37	1.097	0.843	2.243	40.6	29.0
1.8	447.3	8.57	1.126	1.140	2.940	52.2	29.0
2.2	614.9	9.64	1.145	1.443	3.643	63.8	29.0
2.6	799.7	10.61	1.159	1.747	4.347	75.4	29.0
3.0	999.5	11.49	1.169	2.050	5.050	87.0	29.0
3.4	1212.9	12.30	1.176	2.350	5.750	98.6	29.0
3.8	1438.6	13.05	1.180	2.646	6.446	110.2	29.0
4.2	1675.5	13.76	1.183	2.938	7.138	121.8	29.0
4.6	1922.4	14.41	1.184	3.225	7.825	133.4	29.0
5.0	2178.7	15.03	1.184	3.506	8.506	145.0	29.0
5.4	2443.6	15.60	1.183	3.781	9.181	156.6	29.0
5.8	2716.4	16.15	1.182	4.050	9.850	168.2	29.0
6.2	2996.5	16.67	1.180	4.313	10.513	179.8	29.0

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
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(713) 895-8322. A manual with equations & flow chart is available.

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 24, 1993
2 - 6' X 2' RCB UNDER US 95 NEAR ALEXANDER & US 95 INTERSECTION

INV = 2313.9'

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	6.00
Culvert Rise (Height of Opening) (feet)	2.00
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.013(
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	160.0
Culvert Slope (feet per foot)	0.010(

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	1.00	1.11	-0.15	0.51	0.70	0.51	6.56
40.0	2.00	1.79	0.81	0.79	1.11	0.79	8.39
60.0	2.00	2.40	1.31	1.04	1.46	1.04	9.62
80.0	2.00	3.33	2.02	1.26	1.77	1.26	10.56
100.0	2.00	4.29	2.93	1.47	2.00	1.47	11.33
120.0	2.00	5.47	4.05	1.67	2.00	1.67	11.98
140.0	2.00	6.86	5.37	1.86	2.00	1.86	12.53
160.0	2.00	8.46	6.89	2.00	2.00	2.00	13.33

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Project WILLCOX

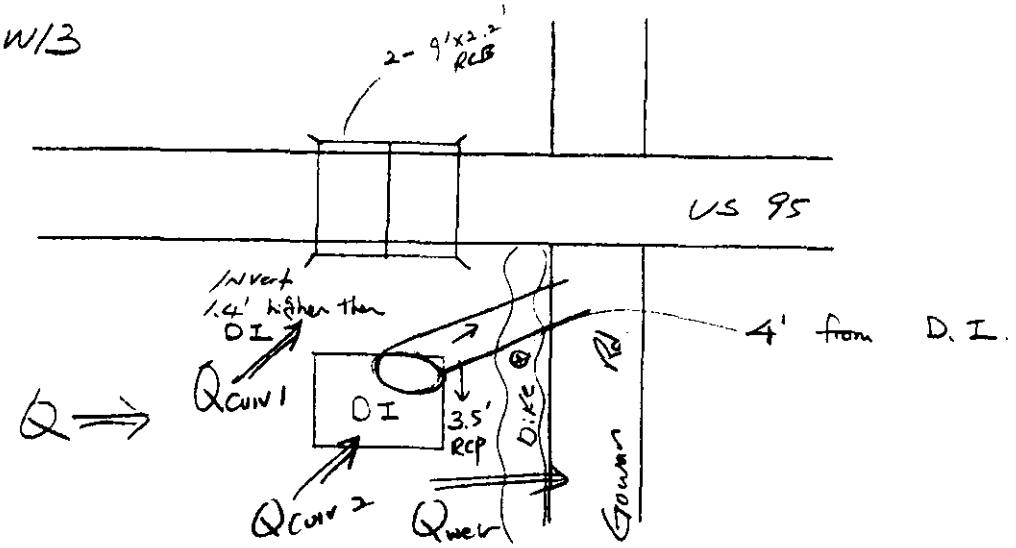
Project No. 92017

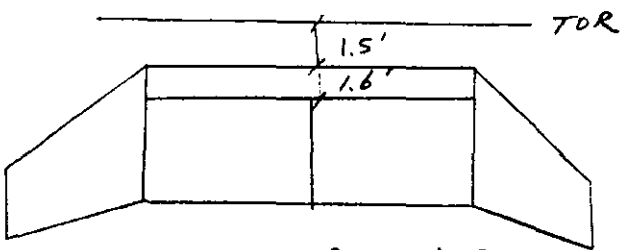
Sheet No. _____ of _____

Calculated by YS Date 8/24/92

Checked by _____ Date _____

HW13





2 — 9x 2.2' RCB

l = 230'

DI	0	93	192	511	1279	2632	4322
OL	0	93	112	127	150	158	163

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LANDSCAPE ARCHITECTURE

Project NWLVFL
Project No.
Sheet No. of
Calculated by Date
Checked by Date

@ Gowan Road & Highway 95

Elev.	Qculv1	Qweir	Qculv2	Qtotal
0	0	0	0	0
1.4	-	-	93	93
2.75	80	-	112	192
4.0	204	180	127	511
6.2	350	779	150	1279
7.0	394	2100	158	2652
7.6	424	3735	163	4322

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DSCAP[illegible]

Project NWLJFLC

Project No. 830017

Sheet No. _____ of _____

Calculated by YS Date 9-7-83

Checked by _____ Date _____

Weir flow Section

20/1000, 12/1030, W 10.5/1075, 12/1110, 14/1510, 14/1540, 12.2/1580, 10/1600, 16/1940

C = 2.8

WSEL	Top Width	Area	Avg depth	Q = CLH^3/2
14.6	712	1084	1.52	3,235
14.2	642	814	1.27	2,574
14.0	578	689	1.19	2,100
13.6	476	478	1.0	1,333
13.2	374	308	0.82	779
12.8	273	178	0.65	401
12.4	171.5	89	0.52	180

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	9	*Bed Slope:0.00500*		*Max Elev:*	*20.0*
Bank Stations.....Left:	1000.0	Right....:	1970.0	Min Elev:	11.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	20.0	1000.0	2)	12.0	1030.0	3)	11.0	1075.0	4)	12.0	1110.0
5)	14.0	1510.0	6)	14.0	1540.0	7)	12.2	1580.0	8)	14.0	1630.0
9)	16.0	1970.0									

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
14.60	5025.9	4.6	0.662	0.030	1.5	711.8	1084.3	712.2
14.20	3334.1	4.1	0.642	0.030	1.3	642.3	813.5	642.6
14.00	2710.2	3.9	0.635	0.030	1.2	577.5	688.5	577.9
13.60	1677.0	3.5	0.617	0.030	1.0	476.0	477.8	476.3
13.20	945.0	3.1	0.597	0.030	0.8	374.5	307.7	374.7
12.80	469.5	2.6	0.575	0.030	0.7	273.0	178.2	273.2

NOTES:

PIPE CULVERT ANALYSIS
[illegible] OF CULVERT PERFORMANCE CURVE

October 27, 1993
3.5' RCP NEAR GOWAN RD & US 95 INTER.
INTO GOWAN OUTFALL PIPE
ASSUMED INLET CONTROL

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	3.50
FHWA Chart Number (1,2 or 3)	1
Scale Number on Chart (Type of Culvert Entrance)	3
Manning's Roughness Coefficient (n-value)	0.0150
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	100.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
60.0	2.00	3.70	-0.66	1.33	2.43	1.33	17.89
80.0	3.00	4.60	0.59	1.56	2.79	1.56	19.29
100.0	3.00	5.84	2.11	1.76	3.07	1.76	20.58
120.0	3.00	7.34	3.88	1.98	3.25	1.98	21.32
140.0	3.00	9.12	5.92	2.20	3.35	2.20	22.01
160.0	3.00	11.18	8.25	2.42	3.41	2.42	22.58
180.0	3.00	13.51	10.86	2.67	3.44	2.67	22.89
200.0	3.00	16.11	13.78	2.96	3.46	2.96	23.07

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BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 24, 1993
2 - 9' X 2.2' RCB UNDER US 95 NEAR GOWANS & US95 INTER.

PROGRAM INPUT DATA:

DESCRIPTION	VALU
Culvert Span (Width of Opening) (feet).....	9.00
Culvert Rise (Height of Opening) (feet).....	2.20
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.013
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	230.0
Culvert Slope (feet per foot).....	0.010

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outle Velocit (fps
40.0	2.00	1.35	-0.14	0.60	0.85	0.60	7.4
60.0	2.00	1.79	0.06	0.77	1.11	0.77	8.6
80.0	2.00	2.18	0.34	0.93	1.35	0.93	9.5
100.0	2.00	2.54	0.70	1.07	1.57	1.07	10.3
120.0	2.00	3.20	1.14	1.21	1.77	1.21	11.0
140.0	2.00	3.71	1.74	1.34	1.96	1.34	11.6
160.0	2.00	4.30	2.43	1.46	2.14	1.46	12.1
180.0	2.00	4.96	3.15	1.58	2.20	1.58	12.68
200.0	2.00	5.71	3.91	1.69	2.20	1.69	13.12
220.0	2.00	6.53	4.75	1.81	2.20	1.81	13.53
240.0	2.00	7.44	5.67	1.92	2.20	1.92	13.91
260.0	2.00	8.42	6.67	2.02	2.20	2.02	14.28

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Project _____
Project No. _____
Sheet No. _____ of _____
Calculated by _____ Date _____
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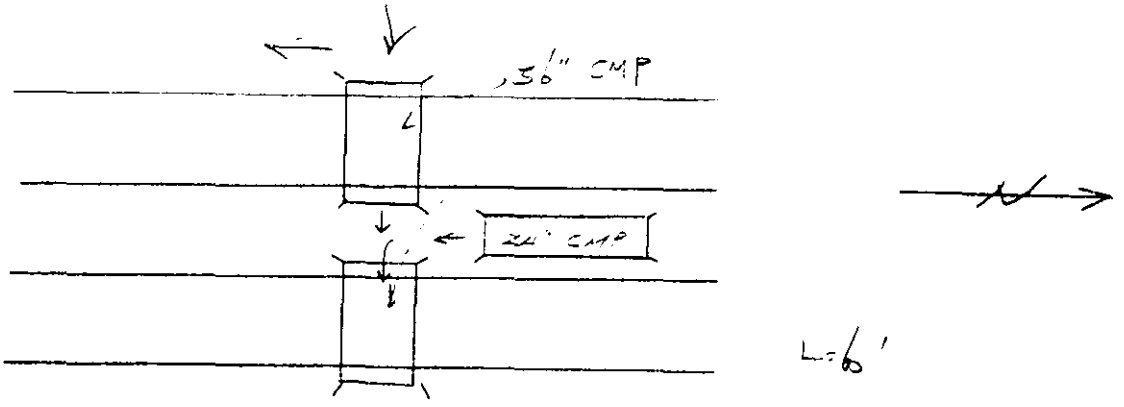
ERDI

36" CMP near Ranch @ I-10 95 Interchange



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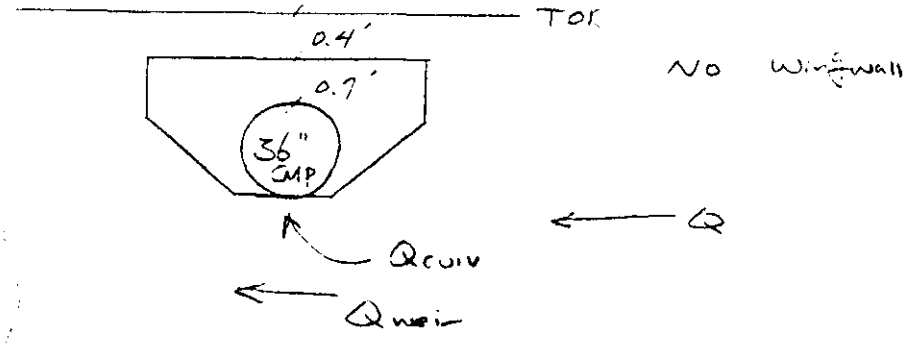
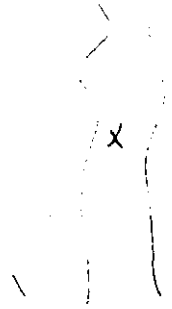


No Wingwall



INV ≈ 21.7'

Diversion Basin to NSEL

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 22, 1993
36" CMP NEAR RANCHO & US 95 INTER.
UNDER RANCHO DR.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	3.00
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	60.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	2.00	2.05	-0.41	1.02	1.43	1.02	9.46
25.0	2.00	2.35	-0.12	1.15	1.61	1.15	10.06
30.0	2.00	2.65	0.22	1.29	1.77	1.29	10.33
35.0	2.00	2.94	0.59	1.38	1.92	1.38	11.01
40.0	2.00	3.23	1.01	1.49	2.06	1.49	11.39
45.0	2.00	3.64	1.46	1.60	2.19	1.60	11.71
50.0	2.00	3.96	1.96	1.71	2.30	1.71	12.04
55.0	2.00	4.36	2.50	1.81	2.41	1.81	12.33
60.0	2.00	4.80	3.07	1.93	2.50	1.93	12.51
65.0	2.00	5.27	3.69	2.03	2.59	2.03	12.79
70.0	2.00	5.78	4.35	2.20	2.66	2.20	12.58
75.0	2.00	6.33	5.05	2.29	2.72	2.29	12.95
80.0	2.00	6.92	5.79	2.43	2.77	2.43	13.02
85.0	2.00	7.55	6.58	2.63	2.81	2.63	12.93
90.0	5.00	8.21	9.48	3.00	2.85	3.00	12.73

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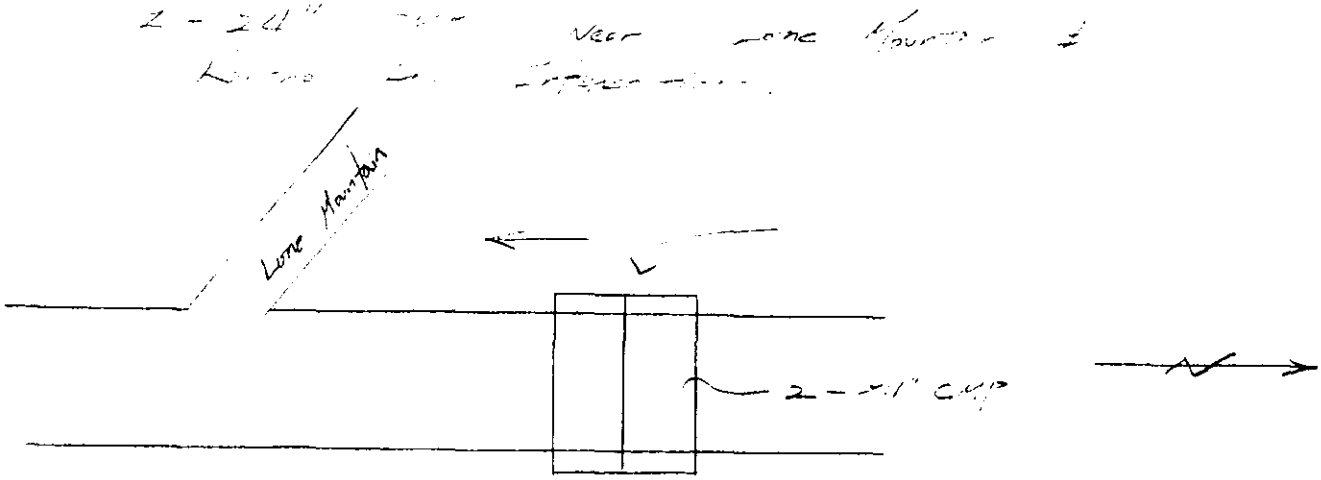
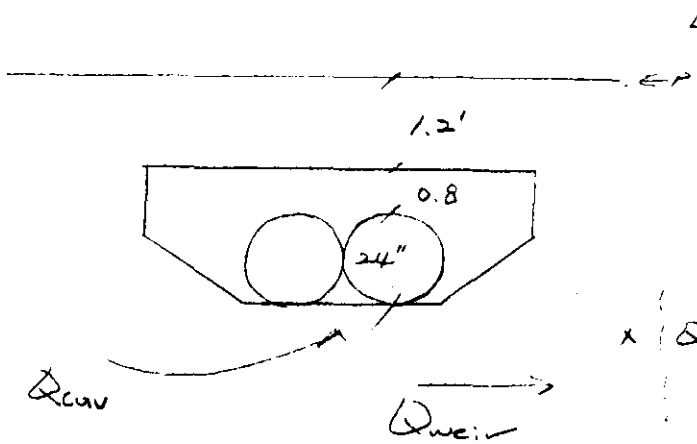
Project
Project No.
Sheet No. ____ of ____
Calculated by ____ Date ____
Checked by ____ Date ____

RD 4





x Qweir

weir starts @ elev. 7/10' higher than invert

invert ≈ 14.7'

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LANDSCAPE [illegible]

Project [illegible]

Project No. [illegible]

Sheet No. _____ of _____

Calculated by [illegible] Date [illegible]

Checked by _____ Date _____

		Q 100 yr	Q 10 yr	Q 2 yr
	Elev	E - W CMP		
Inv. =	14.7	0	0	0
	15.3	10	3	15
	16.0	14	9	23
	16.4	20	35	55
	16.8	28	101	127
	17.2	34	220	254

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 22, 1993
2 - 24" cmp under rancho dr.
near lone mountain & rancho intersection

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	2.00
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	120.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
5.0	2.00	1.10	-3.74	0.58	0.79	0.58	6.64
10.0	2.00	1.67	-2.97	0.83	1.13	0.83	8.09
15.0	2.00	2.21	-1.68	1.06	1.40	1.06	8.92
20.0	2.00	2.91	0.12	1.27	1.61	1.27	9.52
25.0	2.00	3.78	2.44	1.75	1.76	1.75	8.58
30.0	2.00	4.83	5.28	2.00	1.86	2.00	9.55
35.0	2.00	6.08	8.63	2.00	1.92	2.00	11.14
40.0	2.00	7.52	12.49	2.00	1.95	2.00	12.73

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Project _____
Project No. 93219
Sheet No. _____ of _____
Calculated by JS Date 12/2/93
Checked by _____ Date _____

Weir Section

18 16 154 16 18
1054, 1155, 1165, 1175 1200,

C = 2.7

Elev.	T.W.	Head	Depth	Q = CLH^3/2
17.6	164	153.2	0.82	397
17.2	128	84.8	0.74	220
16.8	92	50.8	0.55	101
16.4	56	21.2	0.38	35
16.0	20	6.0	0.20	9
15.8	13	2.7	0.20	3

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	5	Bed Slope:	0.00500	Max Elev:	18.0
Bank Stations.....Left:	1000.0	Right....:	1200.0	Min Elev:	15.4
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	18.0	1000.0	2)	16.0	1155.0	3)	15.4	1165.0	4)	16.0	1175.0
5)	18.0	1200.0									

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
17.60	512.5	3.3	0.610	0.030	0.9	164.0	153.2	164.1
17.20	271.7	2.9	0.587	0.030	0.7	128.0	94.8	128.1
16.80	119.7	2.4	0.559	0.030	0.6	92.0	50.8	92.1
16.40	38.8	1.8	0.525	0.030	0.4	56.0	21.2	56.1
16.00	9.4	1.6	0.504	0.030	0.3	20.0	6.0	20.0
15.80	3.2	1.2	0.471	0.030	0.2	13.3	2.7	13.4

NOTES:

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LANDSCAPE ARCHITECTURE

Project _____

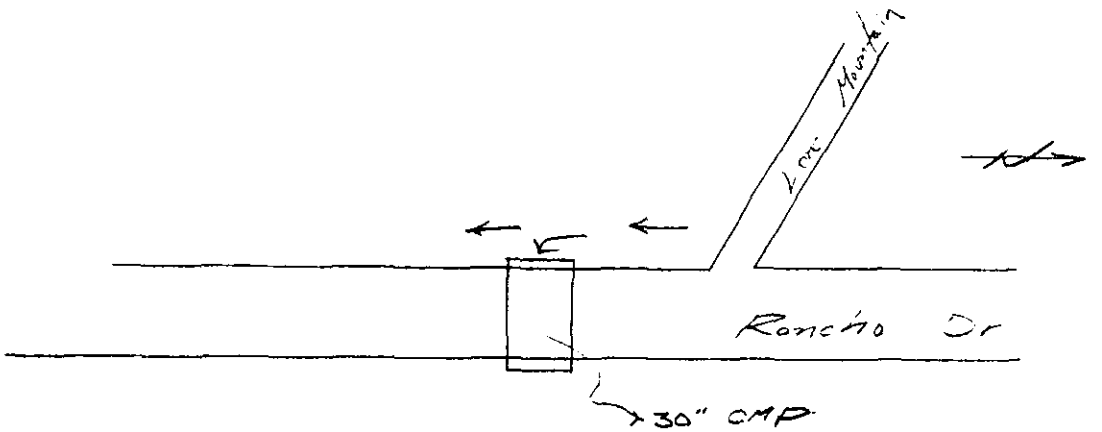
Project No. _____

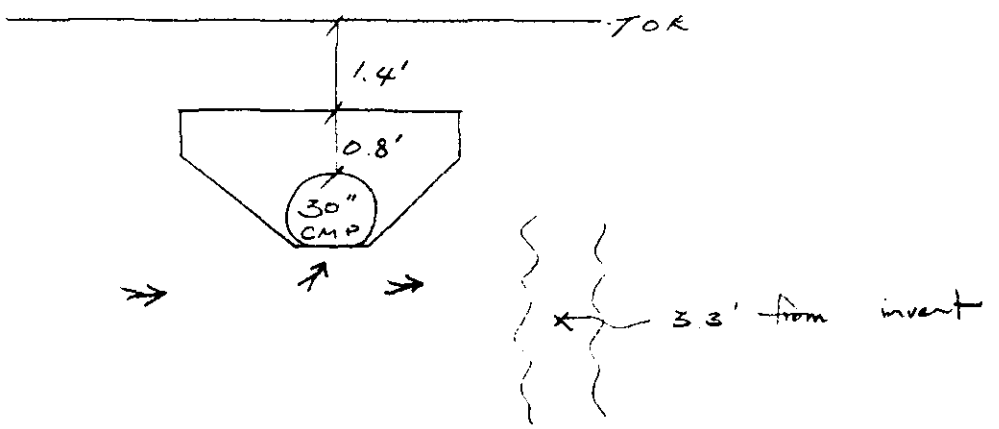
Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

R05





INV = 12.1

COE & VAN LOO
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project _____

Project No _____

Sheet No _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Elev	Q (cfs) (30" CMP)	Qlocal	Qtotal
12.1	0	0	0
14.77	25	0	25
16	37	14	51
16.4	40	51	91
16.6	42	80	122
16.8	44	116	160

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 22, 1993
30" cmp under rancho drive
near lone mountian & rancho intersection

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	2.50
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	120.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	2.00	1.48	-3.66	0.76	1.06	0.76	7.91
15.0	2.00	1.89	-3.24	0.94	1.31	0.94	8.89
20.0	2.00	2.28	-2.64	1.11	1.52	1.11	9.52
25.0	2.00	2.67	-1.78	1.25	1.70	1.25	10.16
30.0	2.00	3.18	-0.77	1.40	1.87	1.40	10.62
35.0	2.00	3.65	0.40	1.55	2.01	1.55	10.99
40.0	2.00	4.24	1.73	1.71	2.13	1.71	11.19
45.0	2.00	4.91	3.22	1.86	2.23	1.86	11.49
50.0	2.00	5.65	4.86	2.06	2.30	2.06	11.54
55.0	3.00	6.48	7.24	2.50	2.35	2.50	11.20
60.0	3.00	7.38	9.18	2.50	2.39	2.50	12.22
65.0	3.00	8.37	11.30	2.50	2.42	2.50	13.24

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LANDSCAPE ARCHITECTURE

Project: [illegible]

Project No [illegible]

Sheet No _____ of _____

Calculated by [illegible] Date [illegible]

Checked by _____ Date _____

[illegible]

[illegible] C = .8

Elev	Area	T. W.	Mid L.	A = CLW/2
17	62	70	0.89	165
16.8	48.4	66.3	0.73	116
16.6	36	57.5	0.63	80
16.4	25.4	48.8	0.52	51
16.2	16.5	40.0	0.41	29
16	9.4	31.3	0.3	14

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	4	Bed Slope:	0.00500	Max Elev:	17.0
Bank Stations.....Left:	1000.0	Right....:	1070.0	Min Elev:	15.4
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	16.8	1000.0	2)	16.0	1020.0	3)	15.4	1040.0	4)	17.0	1070.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
17.00	200.2	3.2	0.604	0.030	0.9	70.0	62.0	70.1
16.80	137.3	2.8	0.585	0.030	0.7	66.3	48.4	66.3
16.60	92.2	2.6	0.571	0.030	0.6	57.5	36.0	57.6
16.40	57.5	2.3	0.553	0.030	0.5	48.8	25.4	48.8
16.20	32.0	1.9	0.532	0.030	0.4	40.0	16.5	40.0
16.00	14.7	1.6	0.505	0.030	0.3	31.3	9.4	31.3

NOTES:

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Project _____

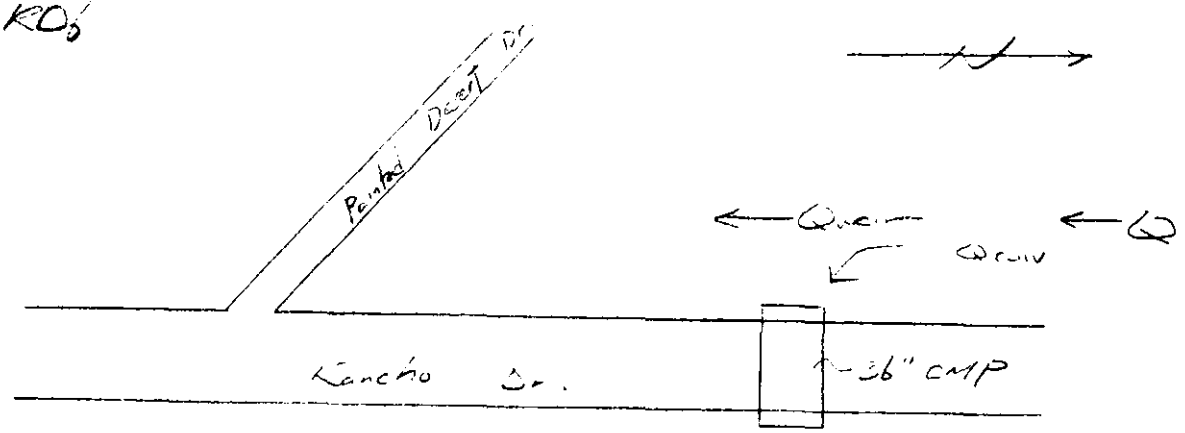
Project No _____

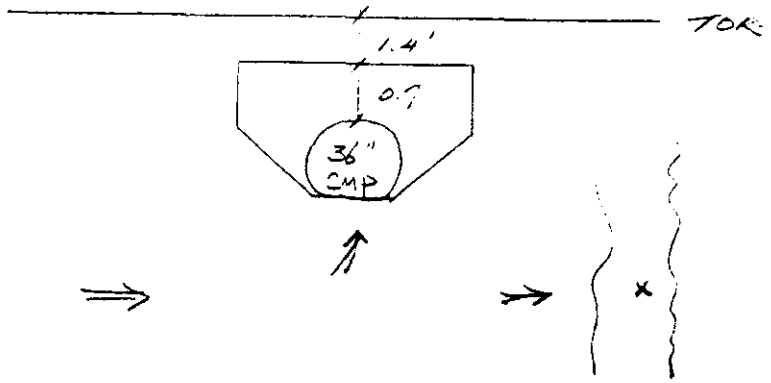
Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

KO5





INV. = 3695.0'

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Project _____

Project No. 2009

Sheet No. _____ of _____

Calculated by _____ Date 10/25/12

Checked by _____ Date _____

Zoning

Area	Zone Comp	Zone Weight	Zone Total
230' (min)	0	0	0
210.28	10	0	10
212.1	38	33	71
212.2	39	105	145
212.4	40	310	350

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 22, 1993
36" cmp under rancho dr. near painted desert dr.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	3.00
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	120.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	2.00	1.38	-3.86	0.71	1.00	0.71	7.77
15.0	2.00	1.73	-3.57	0.87	1.23	0.87	8.75
20.0	2.00	2.05	-3.23	1.02	1.43	1.02	9.46
25.0	2.00	2.35	-2.83	1.15	1.61	1.15	10.06
30.0	2.00	2.65	-2.37	1.29	1.77	1.29	10.33
35.0	2.00	2.94	-1.85	1.38	1.92	1.38	11.01
40.0	2.00	3.23	-1.26	1.49	2.06	1.49	11.39
45.0	2.00	3.64	-0.61	1.60	2.19	1.60	11.71
50.0	3.00	3.96	0.45	1.71	2.30	1.71	12.04
55.0	3.00	4.36	1.18	1.81	2.41	1.81	12.33
60.0	3.00	4.80	1.97	1.93	2.50	1.93	12.51
65.0	3.00	5.27	2.83	2.03	2.59	2.03	12.79
70.0	3.00	5.78	3.76	2.20	2.66	2.20	12.58
75.0	3.00	6.33	4.76	2.29	2.72	2.29	12.95

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Project _____

Project No. 9010

Sheet No. _____ of _____

Calculated by _____ Date 12-12-12

Checked by _____ Date _____

Water Service

$\frac{121}{1050}$, $\frac{12}{1200}$, $\frac{12}{1740}$ $\frac{12}{1790}$. C = 2.3

Elev	Pres	Area	Vel	Q = CAV
13	600	570	0.85	1,310
12.8	564	393.6	0.70	925
12.6	528	284.4	0.54	585
12.4	492	182.4	0.37	310
12.2	456	87.6	0.19	106
12.1	438	42.9	0.09	33

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	4	Bed Slope:	0.00500	Max Elev:	14.0
Bank Stations.....Left:	1000.0	Right....:	1780.0	Min Elev:	12.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	14.0	1000.0	2)	12.0	1320.0	3)	12.0	1740.0	4)	14.0	1780.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
13.00	1602.8	3.1	0.601	0.030	0.9	600.0	510.0	600.0
12.80	1084.6	2.8	0.581	0.030	0.7	564.0	393.6	564.0
12.60	659.4	2.3	0.557	0.030	0.5	528.0	284.4	528.0
12.40	329.7	1.8	0.523	0.030	0.4	492.0	182.4	492.0
12.20	102.2	1.2	0.469	0.030	0.2	456.0	87.6	456.0
12.10	31.9	0.7	0.419	0.030	0.1	438.0	42.9	438.0

NOTES:

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Project _____

Project No _____

Sheet No _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Gravel Section

2298 2298 +-76.5 2295 2.15
1200, 1200, 1200, 1275, 1300

S = 0.01
n = 0.035

into DI

Elev	Retain	Dump	Qtotal
2296.8	3	0	3
2297.—	26	0	26
2297.4	50	5	55
2297.6	86	15	101
2297.8	124	37	161

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	5	Bed Slope:	0.01000	Max Elev:	2300.0
Bank Stations.....Left:	1000.0	Right....:	1340.0	Min Elev:	2296.5
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.035	CHANNEL..:	0.035	ROB.....:	0.035

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2300.0	1000.0	2)	2298.0	1200.0	3)	2296.5	1240.0	4)	2298.0	1275.0
5)	2299.0	1340.0									

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
2296.80	2.7	1.2	0.545	0.035	0.2	15.0	2.3	15.0
2297.20	25.8	2.1	0.628	0.035	0.3	35.0	12.2	35.0
2297.40	50.4	2.5	0.655	0.035	0.4	45.0	20.2	45.0
2297.60	86.2	2.8	0.677	0.035	0.6	55.0	30.3	55.0
2297.80	134.5	3.2	0.696	0.035	0.7	65.0	42.3	65.1
2298.00	197.0	3.5	0.713	0.035	0.8	75.0	56.3	75.1

NOTES:

PIPE CULVERT ANALYSIS
[illegible] OF CULVERT PERFORMANCE CURVE

October 26, 1993
36 " CMP
DROP INLET NEAR SHOPPING CENTER

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	3.00
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	200.0
Culvert Slope (feet per foot)	0.0500

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	3.00	1.38	-6.80	0.71	1.00	0.71	7.77
15.0	3.00	1.73	-6.55	0.87	1.23	0.87	8.75
20.0	3.00	2.05	-6.20	1.02	1.43	1.02	9.46
25.0	3.00	2.35	-5.76	1.15	1.61	1.15	10.06
30.0	3.00	2.65	-5.21	1.29	1.77	1.29	10.33
35.0	3.00	2.94	-4.56	1.38	1.92	1.38	11.01
40.0	3.00	3.23	-3.82	1.49	2.06	1.49	11.39
45.0	3.00	3.64	-2.97	1.60	2.19	1.60	11.71
50.0	3.00	3.96	-2.03	1.71	2.30	1.71	12.04
55.0	3.00	4.36	-0.98	1.81	2.41	1.81	12.33
60.0	3.00	4.80	0.16	1.93	2.50	1.93	12.51
65.0	3.00	5.27	1.41	2.03	2.59	2.03	12.79
70.0	3.00	5.78	2.75	2.20	2.66	2.20	12.58
75.0	3.00	6.33	4.19	2.29	2.72	2.29	12.95
80.0	3.00	6.92	5.73	2.43	2.77	2.43	13.02
85.0	3.00	7.55	7.38	2.63	2.81	2.63	12.93

==========

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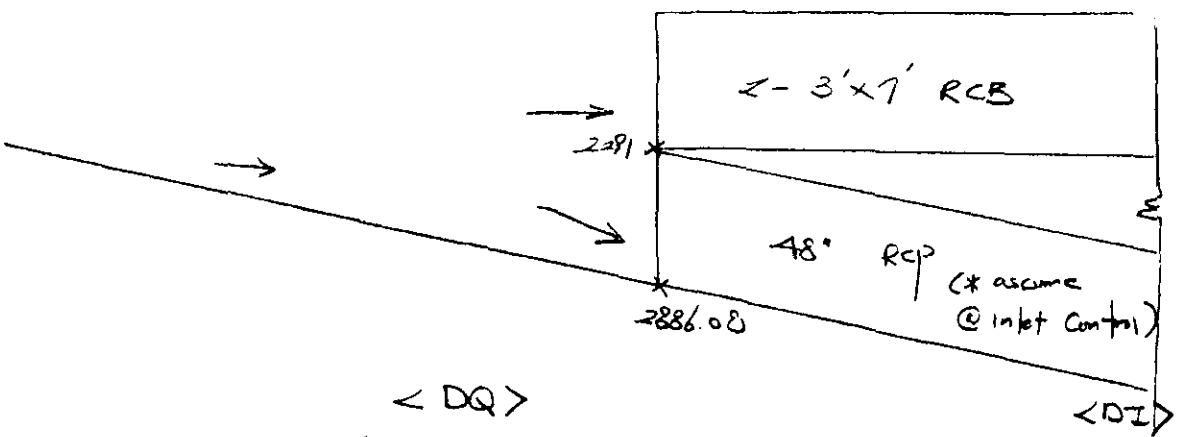
Project NICKEL
Project No. 85017
Sheet No. _____ of _____
Calculated by MC Date 3/25/14
Checked by _____ Date _____

Near Craig Rd and Rancho Dr. Intersection.



ELEV	Q 48" rcp	Q 2-3'x7' RCB	Qtotal
2286.08	0	0	0
2289.17	50	0	50
2291.0	103	0	103
2292.0	126	40	166
2293.5	155	154	310
2295.0	180	275	454

Q100	WSEL
180	2292.1

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 28, 1994
48" RCP STORM DRAIN PIPE UNDER CRAIG RD

INV = 286.08

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	4.00
FHWA Chart Number (1,2 or 3)	1
Scale Number on Chart (Type of Culvert Entrance)	2
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	200.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	2.00	1.25	-7.52	0.48	0.92	0.48	11.56
20.0	2.00	1.81	-7.26	0.68	1.32	0.68	14.23
30.0	2.00	2.27	-6.99	0.83	1.62	0.83	16.04
40.0	2.00	2.69	-6.71	0.96	1.89	0.96	17.22
50.0	2.00	3.09	-6.40	1.07	2.12	1.07	18.54
60.0	2.00	3.47	-6.06	1.17	2.33	1.17	19.57
70.0	2.00	3.85	-5.69	1.27	2.53	1.27	20.45
80.0	2.00	4.23	-5.27	1.36	2.71	1.36	21.22
90.0	2.00	4.63	-4.83	1.45	2.88	1.45	21.94
100.0	2.00	4.83	-4.34	1.53	3.03	1.53	22.58
110.0	2.00	5.19	-3.82	1.61	3.17	1.61	23.17
120.0	2.00	5.62	-3.26	1.69	3.30	1.69	23.69
130.0	2.00	6.08	-2.67	1.77	3.41	1.77	24.22
140.0	2.00	6.58	-2.04	1.85	3.51	1.85	24.71
150.0	2.00	7.12	-1.38	1.91	3.60	1.91	25.25
160.0	2.00	7.69	-0.68	1.99	3.67	1.99	25.56
170.0	2.00	8.30	0.06	2.07	3.73	2.07	25.91
180.0	2.00	8.95	0.83	2.15	3.77	2.15	26.18
190.0	2.00	9.63	1.65	2.21	3.81	2.21	26.64
200.0	2.00	10.35	2.50	2.29	3.85	2.29	26.93

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BOX CULVERT ANALYSIS

CULVERT PERFORMANCE CURVE

March 28, 1994

2 - 7' X 3' RCB UNDER CRAIG RD

INV = 291

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	7.00
Culvert Rise (Height of Opening) (feet).....	3.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0130
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	200.0
Culvert Slope (feet per foot).....	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	*Tailwater* Depth (ft)	*Headwater (ft)* Inlet Control	Outlet Control	*Normal* Depth (ft)	*Critical Depth* (ft)	*at* Outlet (ft)	*Outlet* Velocity (fps)
20.0	2.00	0.99	-7.97	0.28	0.63	0.28	10.34
40.0	2.00	1.59	-7.88	0.43	1.00	0.43	13.43
60.0	2.00	2.10	-7.57	0.55	1.32	0.55	15.58
10.0	2.00	0.62	-7.99	0.18	0.40	0.18	7.92
20.0	2.00	0.99	-7.97	0.28	0.63	0.28	10.34
30.0	2.00	1.30	-7.93	0.36	0.83	0.36	12.06
40.0	2.00	1.59	-7.88	0.43	1.00	0.43	13.43
50.0	2.00	1.85	-7.73	0.49	1.17	0.49	14.59
60.0	2.00	2.10	-7.57	0.55	1.32	0.55	15.58
70.0	2.00	2.33	-7.41	0.61	1.46	0.61	16.48
80.0	2.00	2.56	-7.23	0.66	1.59	0.66	17.29
90.0	2.00	2.78	-7.03	0.71	1.73	0.71	18.03
100.0	2.00	2.99	-6.83	0.76	1.85	0.76	18.72
110.0	2.00	3.19	-6.61	0.81	1.97	0.81	19.36
120.0	2.00	3.39	-6.38	0.86	2.09	0.86	19.96
130.0	2.00	3.68	-6.14	0.90	2.20	0.90	20.52
140.0	2.00	4.11	-5.88	0.95	2.32	0.95	21.05
150.0	2.00	4.39	-5.61	0.99	2.42	0.99	21.56

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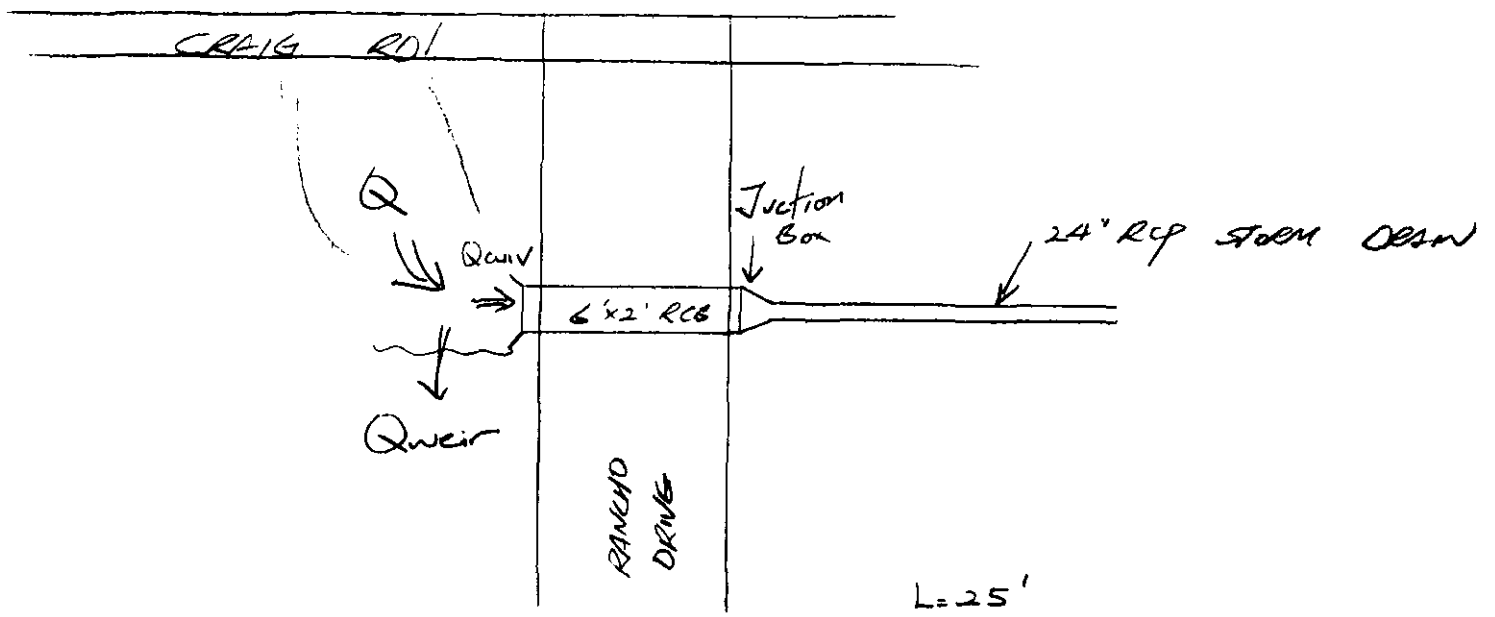
Project VINLVFIC

Project No. 83017

Sheet No. _____ of _____

Calculated by YS Date 3/3/84

Checked by _____ Date _____



L=25'
C=2.7

Elev	Qeqiv	Qweir	Qtotal
87.40	0	0	0
89.40	47	0	47
89.80	60	17	88

Assume 24" RCP can carry up to 60 cfs

DI	0	47	88	150	500
DQ	0	47	60	60	60

BOX CULVERT ANALYSIS
OF CULVERT PERFORMANCE CURVE

March 28, 1994

6' X 2' RCB UNDER RANCHO DR. NEAR CRAIG RD

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	6.00
Culvert Rise (Height of Opening) (feet).....	2.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	110.0
Culvert Slope (feet per foot).....	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	2.00	0.69	0.92	0.31	0.44	2.00	0.83
20.0	2.00	1.11	0.98	0.48	0.70	0.48	6.91
30.0	2.00	1.47	1.08	0.63	0.92	0.63	7.99
40.0	2.00	1.79	1.22	0.75	1.11	0.75	8.84
50.0	2.00	2.09	1.41	0.87	1.29	0.87	9.54
60.0	2.00	2.40	1.63	0.99	1.46	0.99	10.15
70.0	2.00	2.93	1.89	1.09	1.62	1.09	10.68
80.0	2.00	3.33	2.19	1.20	1.77	1.20	11.15
90.0	2.00	3.79	2.54	1.30	1.91	1.30	11.58
100.0	2.00	4.29	2.92	1.39	2.00	1.39	11.97
110.0	2.00	4.85	3.35	1.49	2.00	1.49	12.33
120.0	2.00	5.47	3.81	1.58	2.00	1.58	12.66
130.0	2.00	6.14	4.32	1.67	2.00	1.67	12.97
140.0	2.00	6.86	4.86	1.76	2.00	1.76	13.26
150.0	2.00	7.64	5.45	1.85	2.00	1.85	13.54

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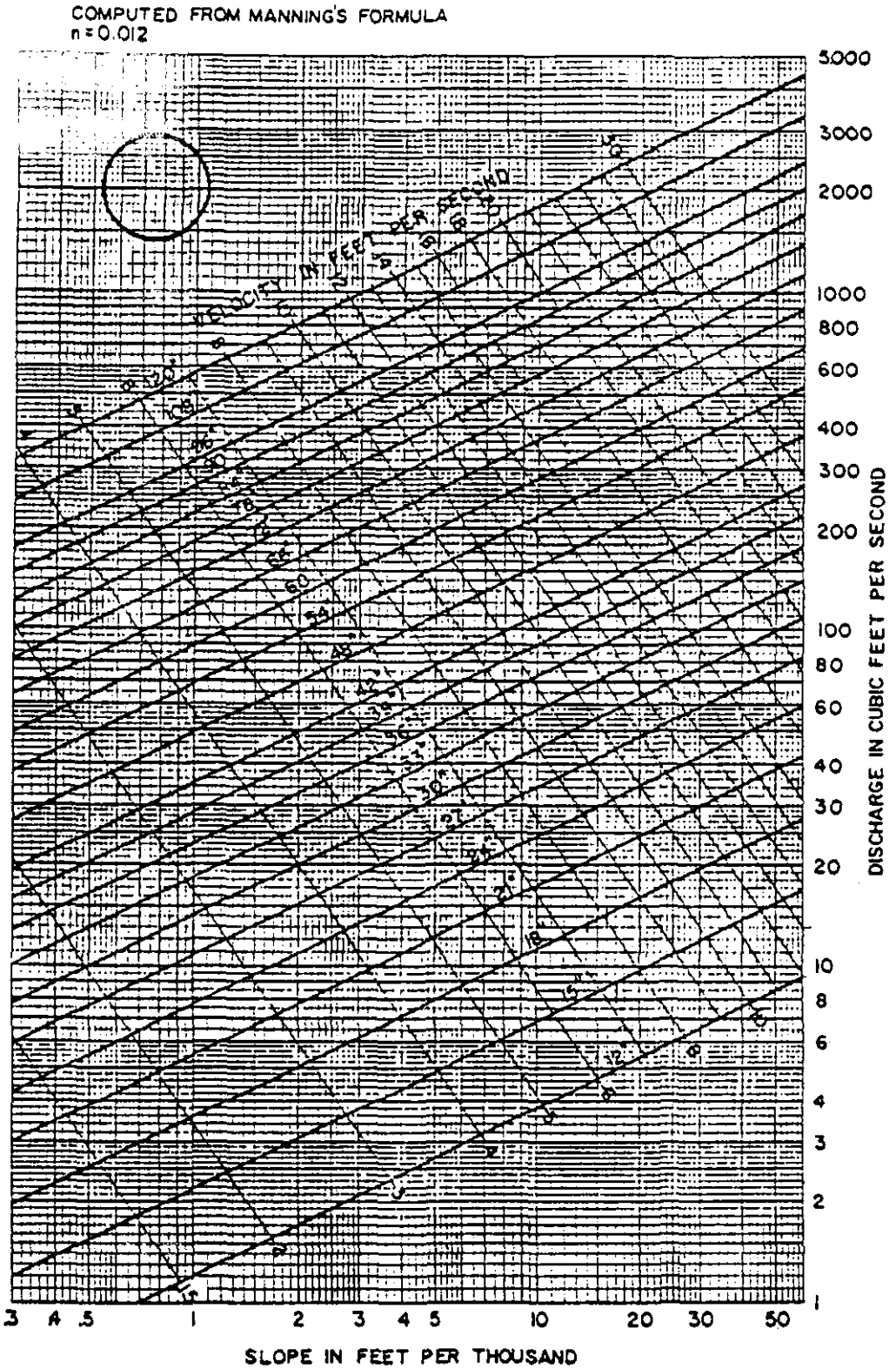

DISCHARGE CAPACITY OF CONCRETE PIPE FLOWING FULL

FIGURE 3-51

COE & VAN LOO
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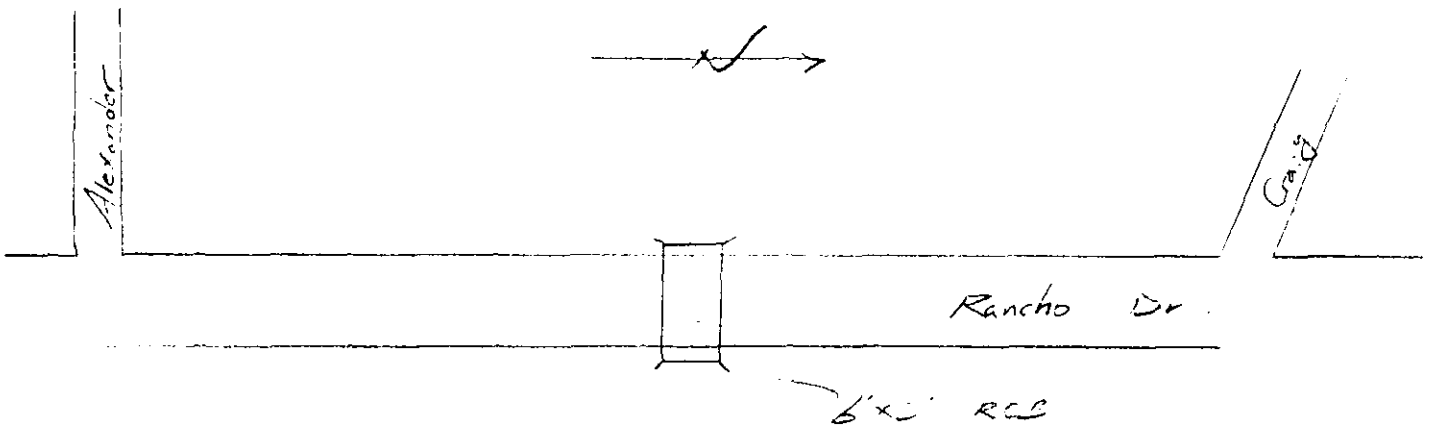
LANDSCAPE ARCHITECTURE

Project: [illegible]
Project No. [illegible]
Sheet No. _____ of _____
Calculated by [illegible] Date [illegible]
Checked by _____ Date _____

#RC7 6'x3' RCB [illegible] Crossing of Alexander.



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PLANNING • ENGINEERING
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Project _____
Project No. _____
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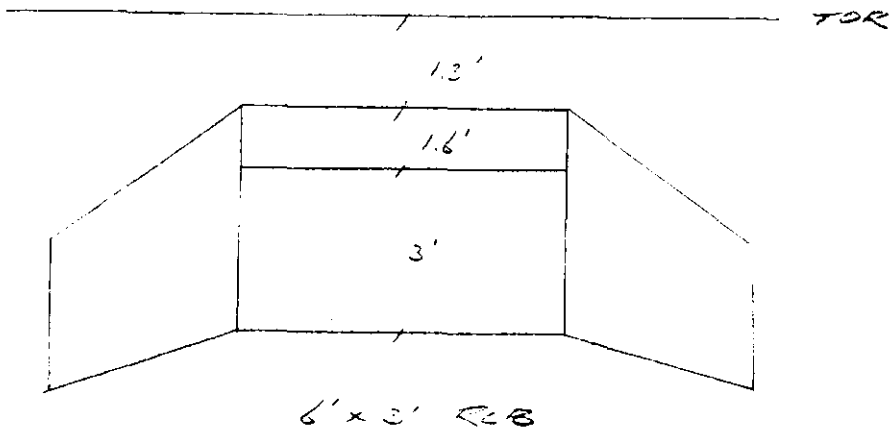
Checked by _____ Date _____



Q_{equiv}

Q_{weir}

2' from invert

	Elev	ΔQ_{equiv}	Q_{weir}	Q_{total}
TV →	2272.3	0	0	0
	2274.0	38	0	38
	2274.2	15	22	70
	2274.5	55	78	133
	2274.7	62	158	220

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 26, 1993
6' X 3' RCB
UNDER RANCHO RD

PROGRAM INPUT DATA:

DESCRIPTION	VA
Culvert Span (Width of Opening) (feet).....	6.0
Culvert Rise (Height of Opening) (feet).....	3.0
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0
Entrance Loss Coefficient of Culvert Opening.....	0.2
Culvert Length (feet).....	120.0
Culvert Slope (feet per foot).....	0.0

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Out Veloc (ft
10.0	1.00	0.69	0.53	0.33	0.44	0.33	5.
20.0	1.00	1.10	0.68	0.51	0.70	0.51	6.
30.0	1.00	1.45	0.84	0.66	0.92	0.66	7.
40.0	1.00	1.77	0.99	0.79	1.11	0.79	8.
50.0	1.00	2.06	1.16	0.92	1.29	0.92	9.
60.0	1.00	2.34	1.34	1.04	1.46	1.04	9.
70.0	2.00	2.60	1.53	1.15	1.62	1.15	10.
80.0	2.00	2.85	1.73	1.26	1.77	1.26	10.
90.0	2.00	3.09	1.95	1.37	1.91	1.37	10.
100.0	2.00	3.33	2.18	1.47	2.05	1.47	11.
110.0	2.00	3.59	2.43	1.57	2.19	1.57	11.
120.0	2.00	4.12	2.69	1.67	2.32	1.67	11.
130.0	2.00	4.44	2.97	1.77	2.44	1.77	12.
140.0	3.00	4.76	3.48	1.86	2.57	1.86	12.
150.0	3.00	5.10	3.73	1.96	2.69	1.96	12.
160.0	3.00	5.47	3.99	2.05	2.81	2.05	13.
170.0	3.00	5.86	4.28	2.14	2.92	2.14	13.
180.0	3.00	6.28	4.58	2.23	3.00	2.23	13.

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Project: [illegible]

Project No. [illegible]

Sheet No. _____ of _____

Calculated by [illegible] Date [illegible]

Checked by _____ Date _____

[illegible] Color

$C = .3$

$n = 0.015$

93	92	91	90	89	88
100	133	[illegible]	[illegible]	170	180

Elev.	T.W	Area	Hy. d.	$Q = CLy^{3/2}$
74.3	135	20.2	0.15	22
74.5	147.4	48.5	0.33	78
74.7	158.7	79.2	0.50	158
74.9	172.1	112.4	0.65	252
75.1	184.4	148.0	0.80	369
75.3	196.8	185.1	0.94	502

Project _____
Project No. _____
Sheet No. _____ of _____
Calculated by _____ Date _____

UNIFORM FLOW COMPUTATIONS

LOCATION DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	6	Bed Slope:	0.00500	Max Elev:	28.0
Bank Stations.....Left:	1000.0	Right....:	1370.0	Min Elev:	24.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	28.0	1000.0	2)	26.0	1030.0	3)	24.3	1050.0	4)	24.0	1170.0
5)	26.0	1270.0	6)	28.0	1370.0						

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
24.30	20.0	1.0	0.450	0.030	0.1	135.0	20.2	135.0
24.50	80.9	1.7	0.513	0.030	0.3	147.4	48.5	147.4
24.70	173.7	2.2	0.549	0.030	0.5	159.7	79.2	159.7
24.90	296.2	2.6	0.575	0.030	0.7	172.1	112.4	172.1
25.10	447.7	3.0	0.595	0.030	0.8	184.4	148.0	184.5
25.30	628.1	3.4	0.611	0.030	0.9	196.8	186.1	196.8

NOTES:

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Project _____

Project No. 23014

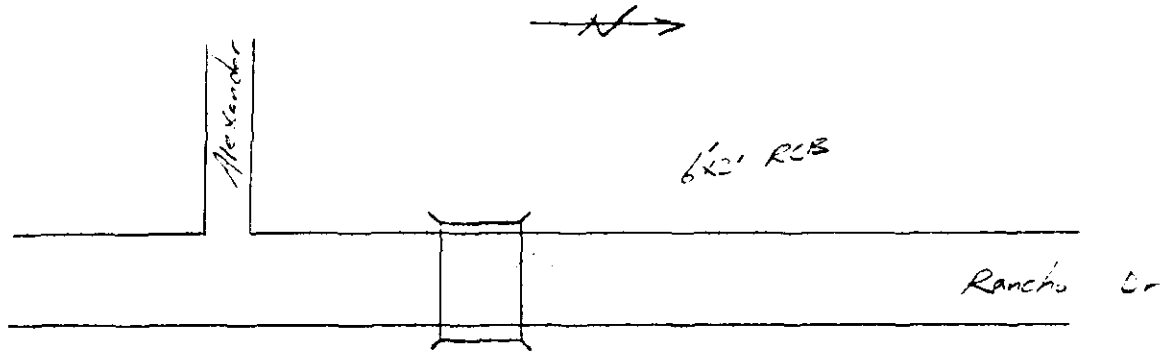
Sheet No. _____ of _____

Calculated by _____ Date 4-6-88

Checked by _____ Date _____

RD8

6'x 3' RCB Near Meriander Dr



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Project _____

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Sheet No. _____ of _____

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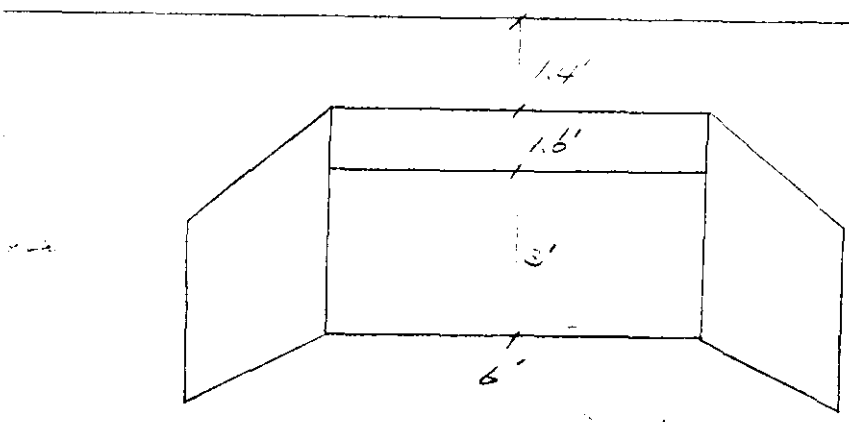
Checked by _____ Date _____



Elev	Q curv	Q weir	Q total
2264.6 (INV)	0	0	0
2266.5	44	0	44
2267	62	5	67
2267.5	82	16	98
2268	93	34	127
2268.5	115	59	174

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 26, 1993
6' X 3' RCB
UNDER RANCHO RD

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	6.00
Culvert Rise (Height of Opening) (feet).....	3.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.013C
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	120.0
Culvert Slope (feet per foot).....	0.010C

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	1.00	0.69	0.53	0.33	0.44	0.33	5.09
20.0	1.00	1.10	0.68	0.51	0.70	0.51	6.56
30.0	1.00	1.45	0.84	0.66	0.92	0.66	7.59
40.0	1.00	1.77	0.99	0.79	1.11	0.79	8.39
50.0	1.00	2.06	1.16	0.92	1.29	0.92	9.05
60.0	1.00	2.34	1.34	1.04	1.46	1.04	9.62
70.0	2.00	2.60	1.53	1.15	1.62	1.15	10.12
80.0	2.00	2.85	1.73	1.26	1.77	1.26	10.57
90.0	2.00	3.09	1.95	1.37	1.91	1.37	10.97
100.0	2.00	3.33	2.18	1.47	2.05	1.47	11.33
110.0	2.00	3.59	2.43	1.57	2.19	1.57	11.67
120.0	2.00	4.12	2.69	1.67	2.32	1.67	11.97
130.0	2.00	4.44	2.97	1.77	2.44	1.77	12.27
140.0	3.00	4.76	3.48	1.86	2.57	1.86	12.53
150.0	3.00	5.10	3.73	1.96	2.69	1.96	12.79
160.0	3.00	5.47	3.99	2.05	2.81	2.05	13.03
170.0	3.00	5.86	4.28	2.14	2.92	2.14	13.25
180.0	3.00	6.28	4.58	2.23	3.00	2.23	13.46

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Project _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

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Weir Section

70/1013, 63/917, 65.1/942, 65/1020, 70/1150

C = 3

Elev	TW	Hm	Hg S	Q cfs
67.0	6.2	2.8	0.45	5
67.5	9.6	4.7	0.70	16
68.0	13.0	10.4	0.95	34
68.5	54.8	29.3	0.53	59
69.0	96.5	67.1	0.70	153

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	5	Bed Slope:	0.00500	Max Elev:	70.0
Bank Stations.....Left:	1000.0	Right....:	1180.0	Min Elev:	66.1
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	70.0	1000.0	2)	68.0	1017.0	3)	66.1	1022.0	4)	68.0	1030.0
5)	70.0	1180.0									

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
67.00	5.5	2.0	0.525	0.030	0.5	6.2	2.8	6.4
67.50	18.0	2.7	0.565	0.030	0.7	9.6	6.7	10.0
68.00	40.6	3.3	0.595	0.030	1.0	13.0	12.4	13.6
68.50	67.1	2.3	0.552	0.030	0.5	54.8	29.3	55.4
69.00	183.7	2.7	0.578	0.030	0.7	96.5	67.1	97.1
69.50	412.4	3.3	0.606	0.030	0.9	138.3	125.8	138.9

NOTES:

COE & VAN LOO
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LANDSCAPE ARCHITECTURE

Project _____

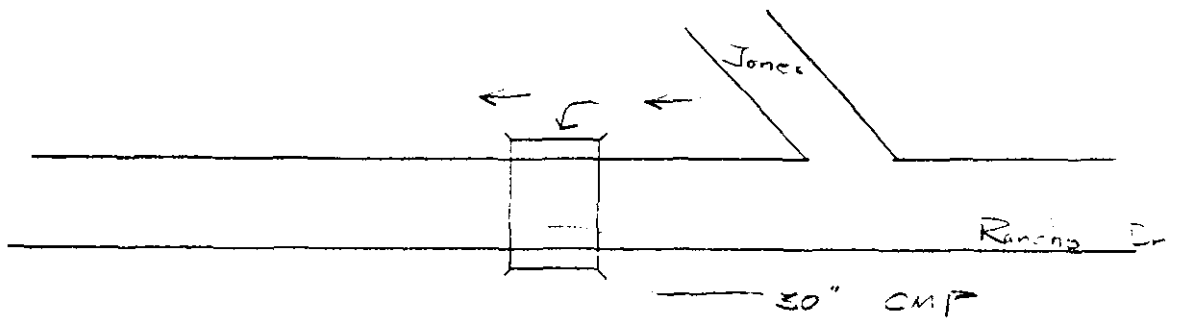
Project No. _____

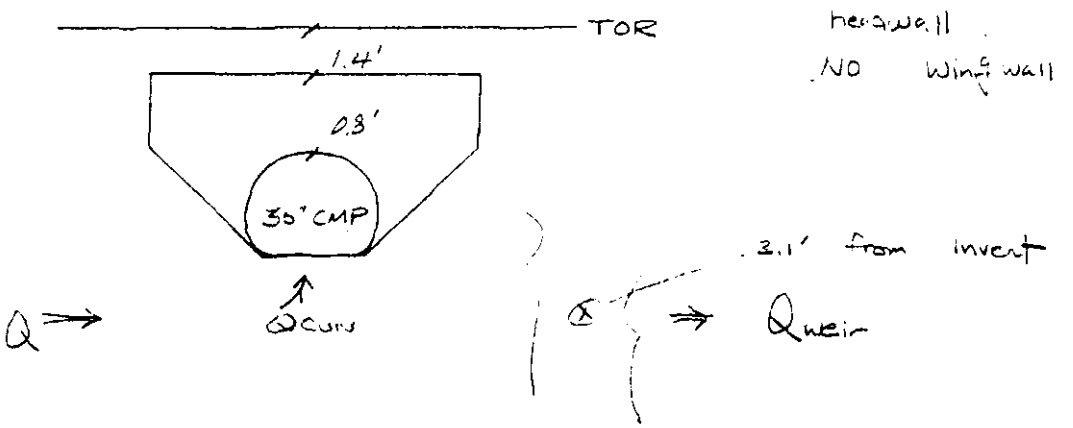
Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

#RD9 . 30" CMP [illegible] # Ranch





headwall

NO wing wall

3.1' from invert

Inv ≃ 59.5

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Project: _____

Project No. 2017

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Elev	Σ Area	Σ Vol	Q to +1
59.5 (INV)	0	0	0
63.0	46	0	43
63.6	60	11	71
64.0	65	34	99
64.2	69	47	116
64.4	72	74	146
64.6	76	124	205
64.8	80	184	264

CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 26, 1993
30 " CMP UNDER RANCHO DRIVE
NEAR JONES

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	3.50
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	120.0
Culvert Slope (feet per foot)	0.0200

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	1.00	1.31	-0.11	0.85	0.96	0.85	5.51
20.0	2.00	1.91	0.30	1.21	1.37	1.21	6.78
30.0	2.00	2.43	0.78	1.52	1.69	1.52	7.51
40.0	2.00	2.90	1.38	1.79	1.97	1.79	8.09
50.0	2.00	3.37	2.09	2.05	2.21	2.05	8.53
60.0	3.00	3.83	2.95	2.32	2.43	2.32	8.85
70.0	3.00	4.47	3.86	2.61	2.62	2.61	9.08
80.0	3.00	5.03	4.93	2.98	2.79	2.98	9.16
90.0	3.00	5.73	6.11	3.50	2.94	3.00	10.25
100.0	3.00	6.51	7.42	3.50	3.07	3.07	11.18

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Project: [illegible]

Project No. [illegible]

Sheet No. _____ of _____

Calculated by [illegible] Date [illegible]

Checked by _____ Date _____

Weir Section

64.1 64 64.9 64 65.8 C = 2.5

1000, 1040, 1080, 1120, 1160

Elev	TW	Area	Avg d	Q cu ft/s
63.6	19	6.7	0.35	11
64.0	30	16.5	0.55	34
64.2	56	25.1	0.45	47
64.4	82	33.9	0.47	74
64.6	100	57.5	0.58	124
64.8	110	78.5	0.71	184

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	5	Bed Slope:	0.00500	Max Elev:	65.8
Bank Stations.....Left:	1000.0	Right....:	1160.0	Min Elev:	62.9
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	64.5	1000.0	2)	64.0	1040.0	3)	62.9	1060.0	4)	64.0	1070.0
5)	65.8	1160.0									

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
63.60	11.6	1.7	0.517	0.030	0.3	19.1	6.7	19.1
64.00	38.7	2.3	0.558	0.030	0.5	30.0	16.5	30.1
64.20	51.4	2.0	0.539	0.030	0.4	56.0	25.1	56.1
64.40	82.8	2.1	0.545	0.030	0.5	82.0	38.9	82.1
64.60	139.2	2.4	0.562	0.030	0.6	100.0	57.5	100.1
64.80	219.4	2.8	0.583	0.030	0.7	110.0	78.5	110.1

NOTES:

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LANDSCAPE ARCHITECTURE

Project _____

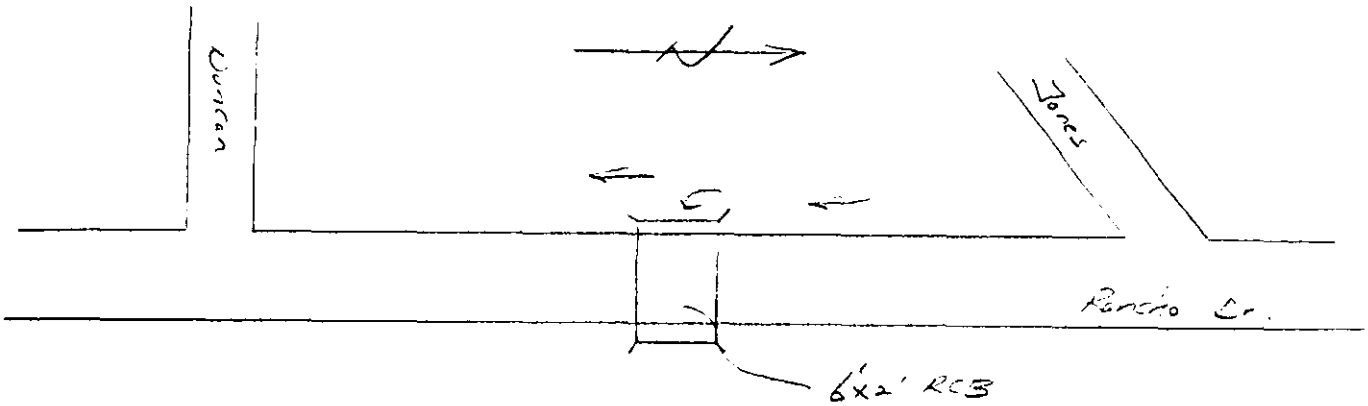
Project No _____

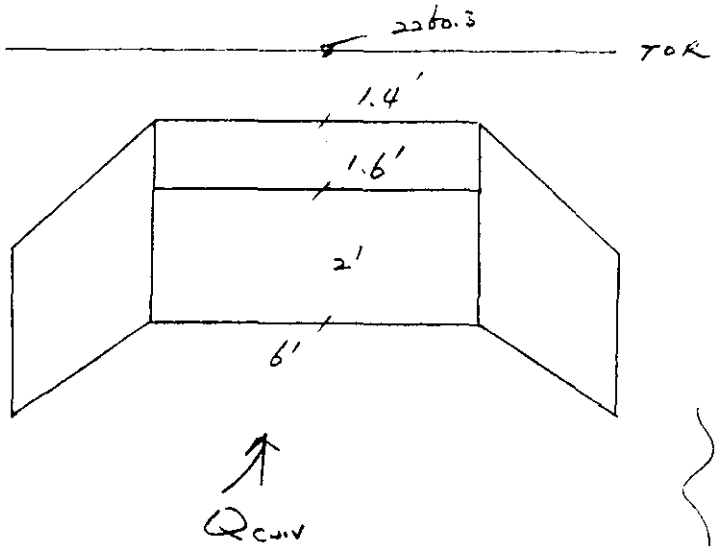
Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

#R010. 6'x2' RCB under Loma de Durian Jones and Durian





45° wingwall headwall

inv ≈ 55.3

Q_{conv}

Q_{weir}

4' from invert

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PLANNING • [illegible]
LANDSCAPE [illegible]

Project [illegible]

Project No [illegible]

Sheet No. _____ of _____

Calculated by [illegible] Date [illegible]

Checked by _____ Date _____

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0	0	0
59	85	0	55
59.5	98	16	114
59.7	102	49	151
59.9	105	99	202
60.1	109	147	255
60.3	112	225	337

BOX CULVERT ANALYSIS

COMPUTATION OF CULVERT PERFORMANCE CURVE

October 26, 1993

6' X 2' RCB UNDER RANCHO DR.

BETWEEN JONES AND DUNCAN

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	6.00
Culvert Rise (Height of Opening) (feet)	2.00
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	120.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	1.00	1.11	-4.56	0.31	0.70	0.31	10.90
40.0	1.00	1.79	-4.09	0.47	1.11	0.47	14.09
60.0	1.00	2.40	-3.47	0.61	1.46	0.61	16.31
80.0	1.00	3.33	-2.69	0.74	1.77	0.74	18.05
100.0	1.00	4.29	-1.78	0.86	2.00	0.86	19.49
120.0	1.00	5.47	-0.80	0.96	2.00	0.96	20.73
140.0	1.00	6.86	0.36	1.07	2.00	1.07	21.80
160.0	2.00	8.46	1.70	1.17	2.00	1.17	22.78
180.0	2.00	10.28	3.21	1.27	2.00	1.27	23.66
200.0	2.00	12.31	4.90	1.36	2.00	1.36	24.47

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LANDSCAPE [illegible]

Project _____
Project No. 2547
Sheet No. _____ of _____
Calculated by _____ Date _____
Checked by _____ Date _____

River Section

60.2	52	59.2	57.3	60	50.7	C = 2.3
1000	1047	1050	1110	1100	1250	

Elev	TW	Area	$R^{2/3}$ d	Q = CAR$^{2/3}$
59.5	75.7	13.6	0.18	16
59.7	91.4	30.3	0.33	49
59.9	107.1	50.1	0.47	97
60.1	148.0	74.4	0.50	147
60.3	214	110.6	0.52	225

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	6	Bed Slope:	0.00500	Max Elev:	60.5
Bank Stations.....Left:	1000.0	Right....:	1250.0	Min Elev:	59.3
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	60.3	1000.0	2)	60.0	1045.0	3)	59.3	1050.0	4)	59.3	1110.0
5)	60.0	1160.0	6)	60.5	1250.0						

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
59.50	15.1	1.1	0.463	0.030	0.2	75.7	13.6	75.7
59.70	50.8	1.7	0.513	0.030	0.3	91.4	30.3	91.5
59.90	105.8	2.1	0.544	0.030	0.5	107.1	50.1	107.2
60.10	164.7	2.2	0.550	0.030	0.5	148.0	74.4	148.1
60.30	249.4	2.3	0.553	0.030	0.5	214.0	110.6	214.1

NOTES:

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LANDSCAPE ARCHITECTURE

Project UWLVFIS

Project No.

Sheet No. _____ of _____

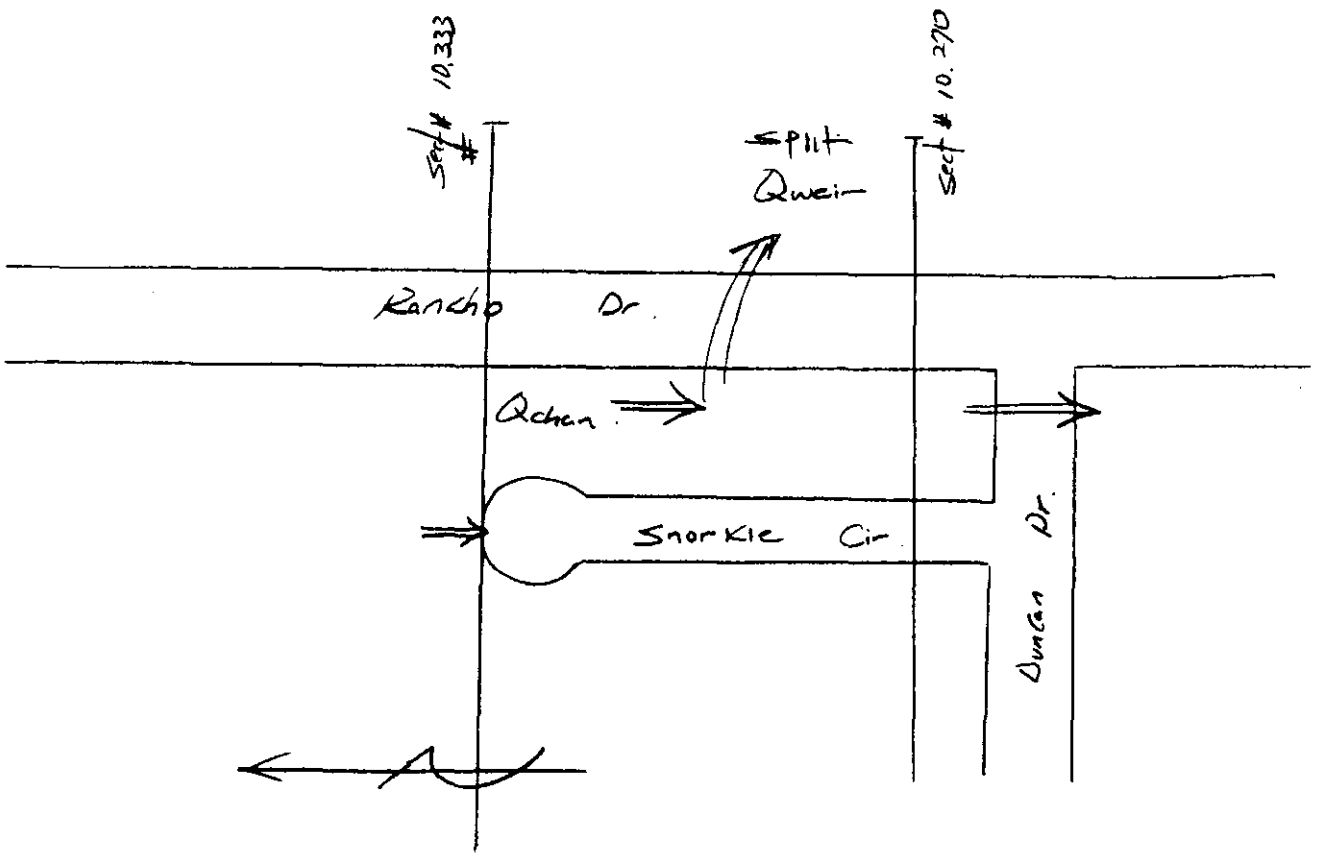
Calculated by JS Date 5/4/84

Checked by _____ Date _____

Weir flow over Rancho Dr. near Duncan Dr. and Rancho Dr.

Split rating from hec-2 model (Ranchol.dat)

DT	Duncan			
DI	0	300	422	700
DQ	0	68	145	322



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ANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project _____

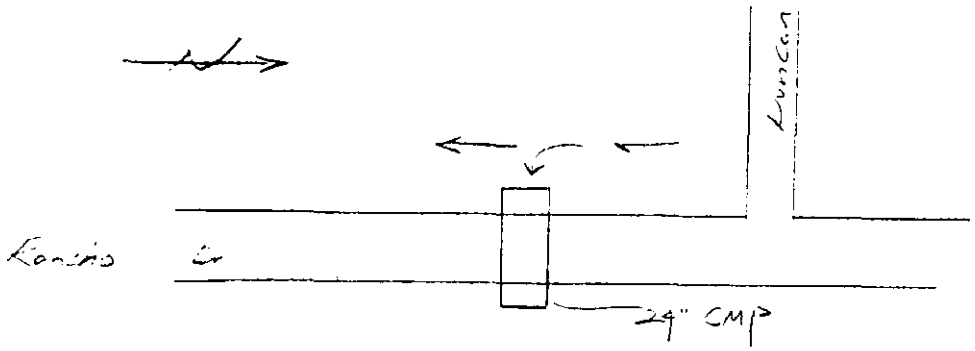
Project No. _____

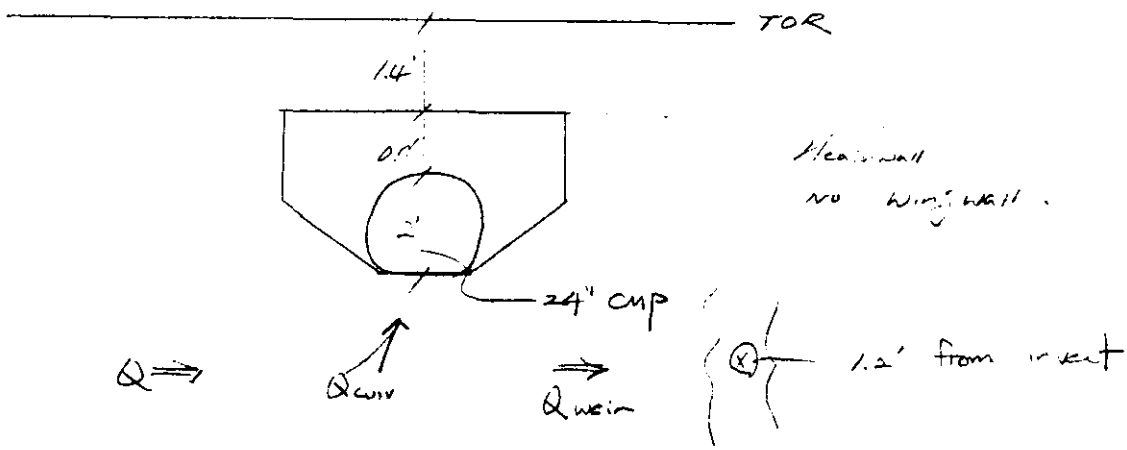
Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

#R011 24" CMP [illegible] Lucero Dr. NEar Duncan Dr





Headwall
No wing wall.

Inv. 50.4

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LANDSCAPE ARCHITECTURE

Project: _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Elev	Q equiv	Q weir	Q total
50.4 (INV)	0	0	0
52	10	3	13
52.4	13	16	29
52.8	16	49	65
53.2	19	107	126
53.6	22	185	217
54.0	24	320	344

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 27, 1993
24" CMP UNDER RANCHO DR.
W/ HEADWALL
NEAR DUNCAN

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	2.00
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	120.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	2.00	1.67	-2.97	0.83	1.13	0.83	8.09
15.0	2.00	2.21	-1.68	1.06	1.40	1.06	8.92
20.0	2.00	2.91	0.12	1.27	1.61	1.27	9.52
25.0	2.00	3.78	2.44	1.75	1.76	1.75	8.58
30.0	2.00	4.83	5.28	2.00	1.86	2.00	9.55
35.0	2.00	6.08	8.63	2.00	1.92	2.00	11.14
40.0	2.00	7.52	12.49	2.00	1.95	2.00	12.73

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Project _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Weir Section

Elev.	TW	d	d	Q. c.f.s.
52	10	2	0.2	3
52.4	27	3.4	0.35	16
52.8	46	3.6	0.54	49
53.2	61	4.0	0.73	107
53.6	78	2.4	0.93	195
54.0	95	107	1.13	320

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	7	Bed Slope:	0.00500	Max Elev:	56.0
Bank Stations.....Left:	1000.0	Right....:	1152.0	Min Elev:	51.6
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	54.5	1000.0	2)	54.0	1045.0	3)	52.0	1060.0	4)	51.6	1065.0
5)	52.0	1070.0	6)	54.0	1140.0	7)	56.0	1152.0			

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
52.00	2.4	1.2	0.471	0.030	0.2	10.0	2.0	10.0
52.40	16.3	1.7	0.517	0.030	0.3	27.0	9.4	27.1
52.80	54.5	2.3	0.556	0.030	0.5	44.0	23.6	44.1
53.20	126.6	2.8	0.585	0.030	0.7	61.0	44.6	61.1
53.60	241.0	3.3	0.609	0.030	0.9	78.0	72.4	78.2
54.00	405.2	3.8	0.629	0.030	1.1	95.0	107.0	95.2

NOTES:

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Project _____

Project No. _____

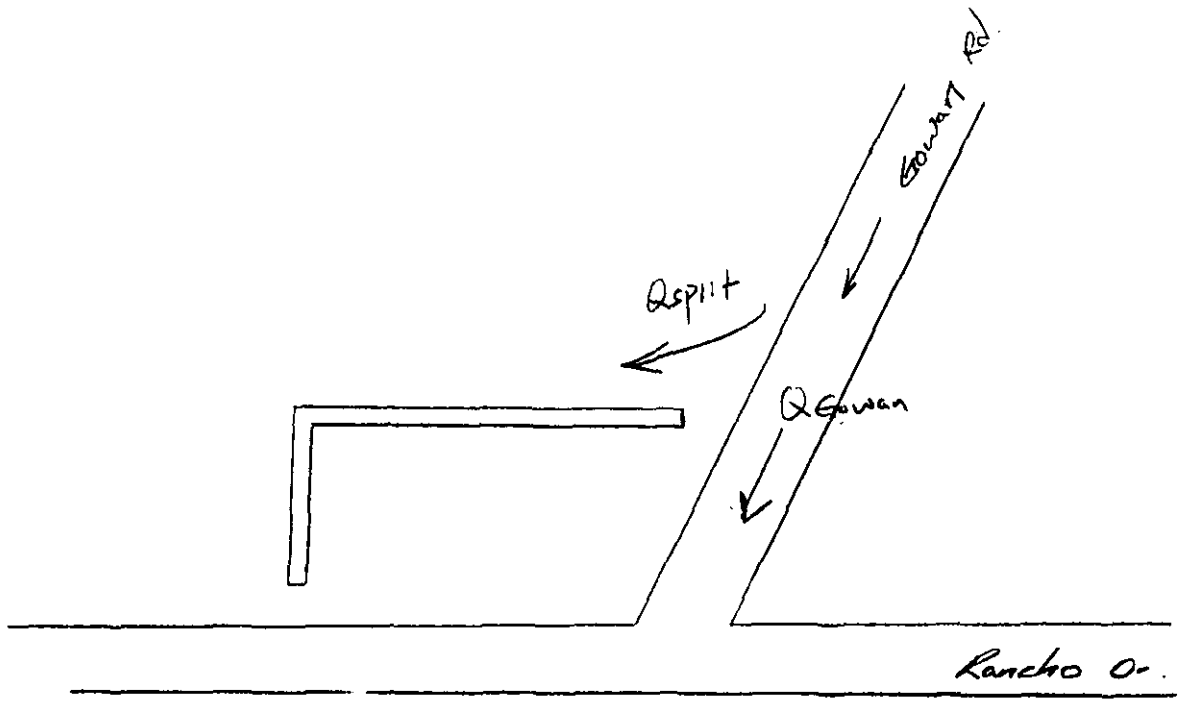
Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Split flow near Gowan & Rancho Intersection.

TRU-VALUE hardware



Qtotal	0	519	1840	3000
Qsplit	0	245	1040	1753

* Rating Curve from HEC-2 models — Rancho 3.dat
Rancho 4.dat

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Project: [illegible]

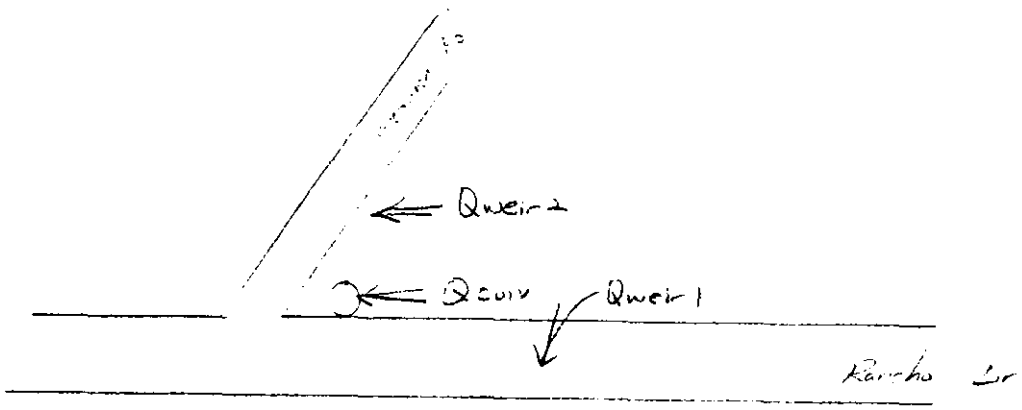
Project No. [illegible]

Sheet No. _____ of _____

Calculated by [illegible] Date [illegible]

Checked by _____ Date _____

[illegible] @ [illegible] & Rancho [illegible]



* [illegible] to hydraulics notebook

Elev	Qcuiv	Qweir 1	Qweir 2	Qtotal
~~[illegible]~~	0	0		0
52	170	0	0	170
52.[illegible]	181	—	—	—
53.0	189	393	117	699
53.4	195	1037	221	1453
53.8	202	1982	344	2528

↳ assumed inlet Control

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PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Diversion through 4'x4' RCB to Gowan Storm Drain

DI	0	170	699	1453	2528
DQ	0	170	189	195	202

Weir flow over Gowan (to South)

DI	0	510	1258	2326
DQ	0	117	221	344
EL		53.0	53.4	53.8

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 6, 1993
4'x 4' RCB @ RANCHO & GOWAN
INLET CONTROL ASSUMED

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	4.00
Culvert Rise (Height of Opening) (feet).....	4.00
FHWA Chart Number (B,9,10,11,12 or 13).....	B
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	100.0
Culvert Slope (feet per foot).....	0.0100

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
100.0	4.00	4.36	4.16	2.01	2.69	2.01	12.41
120.0	4.00	5.31	4.67	2.31	3.03	2.31	12.97
140.0	4.00	6.19	5.28	2.60	3.36	2.60	13.44
160.0	4.00	7.09	5.98	2.89	3.68	2.89	13.84
180.0	4.00	8.11	6.77	3.17	4.00	3.17	14.19
200.0	4.00	9.26	7.65	3.45	4.00	3.45	14.49
220.0	4.00	10.52	8.63	3.73	4.00	3.73	14.76

==========

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Project _____
Project No. _____
Sheet No. _____ of _____
Calculated by _____ Date _____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	6	Bed Slope:	0.00500	Max Elev:	60.0
Bank Stations.....Left:	1000.0	Right....:	1535.0	Min Elev:	54.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	54.5	1000.0	2)	54.0	1045.0	3)	54.0	1085.0	4)	56.0	1220.0
5)	58.0	1380.0	6)	60.0	1535.0						

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
59.00	9281.1	7.1	0.736	0.030	2.9	457.5	1312.5	457.5
58.00	5536.0	6.2	0.712	0.030	2.4	380.0	893.8	380.0
57.00	2918.3	5.3	0.684	0.030	1.8	300.0	553.8	300.0
56.00	1247.5	4.2	0.648	0.030	1.3	220.0	293.8	220.0
55.00	298.2	2.8	0.582	0.030	0.7	152.5	107.5	152.5
54.60	100.9	1.9	0.533	0.030	0.4	125.5	51.9	125.5

NOTES:

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

PUTATIONS

LOCATION/DESCRIPTION:

Weir over Gowan to South

Weir #2

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	3	Bed Slope:	0.00500	Max Elev:	52.5
Bank Stations.....Left:	1000.0	Right....:	1060.0	Min Elev:	52.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.020	CHANNEL..:	0.020	ROB.....:	0.020

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	52.5	1000.0	2)	52.0	1057.0	3)	52.0	1060.0			

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
52.80	120.8	3.6	0.841	0.020	0.6	60.0	33.7	60.0
53.00	200.6	4.4	0.885	0.020	0.8	60.0	45.8	60.0
53.20	295.8	5.1	0.920	0.020	1.0	60.0	57.8	60.0
53.40	405.1	5.8	0.949	0.020	1.2	60.0	69.8	60.0
53.60	527.8	6.5	0.975	0.020	1.4	60.0	81.7	60.0
53.80	663.2	7.1	0.997	0.020	1.6	60.0	93.7	60.0

NOTES:

Weir flow

$C = 2.95$

Avg d (ft)	$Q = CLH^{3/2}$
0.56	74
0.76	117
0.96	166
1.16	221
1.36	281
1.56	344

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Weir over Rancho to east

Weir #1

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	9	Bed Slope:	0.00500	Max Elev:	54.5
Bank Stations.....Left:	970.0	Right....:	1960.0	Min Elev:	52.2
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.020	CHANNEL..:	0.020	ROB.....:	0.020

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	52.5	970.0	2)	52.2	975.0	3)	52.2	1000.0	4)	52.2	1060.0
5)	52.5	1065.0	6)	52.7	1350.0	7)	53.5	1620.0	8)	54.0	1805.0
9)	54.5	1960.0									

C = 3.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	Avg d (ft)	$Q = C L y^{3/2}$
52.80	243.6	2.2	0.744	0.020	0.3	413.7	111.3	413.8	0.27	174
53.00	589.0	2.9	0.800	0.020	0.4	481.2	200.8	481.3	0.42	393
53.20	1076.0	3.5	0.839	0.020	0.6	548.8	303.8	548.8	0.55	672
53.40	1710.8	4.1	0.869	0.020	0.7	616.3	420.3	616.3	0.68	1,037
53.60	2494.7	4.5	0.892	0.020	0.8	687.0	550.4	687.0	0.80	1,474
53.80	3439.1	4.9	0.912	0.020	0.9	761.0	695.2	761.0	0.91	1,982

NOTES:

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Project NVLVFIS
Project No. 93017
Sheet No. ____ of ____
Calculated by Jong. Date 10/6/93
Checked by ____ Date ____

@ Lake Mead / Rocho Intersection

5'x4' RCB @ Lake Mead — into storm drain.
(wingwall & headwall)
Available Head = 7'

DI	DQ
0	0
100	100
200	200
500	200
1000	200
3000	200

← Diversion to Lake Mead storm drain.

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 6, 1993
5' X 4' RCB @ LAKE MEAD & RANCHO
INLET CONTROL ASSUMED

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	5.00
Culvert Rise (Height of Opening) (feet)	4.00
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0120
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	100.0
Culvert Slope (feet per foot)	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
100.0	4.00	3.73	3.72	1.63	2.32	1.63	12.27
120.0	4.00	4.23	4.04	1.86	2.62	1.86	12.92
140.0	4.00	4.71	4.42	2.08	2.90	2.08	13.47
160.0	4.00	5.70	4.85	2.29	3.17	2.29	13.95
180.0	4.00	6.36	5.34	2.50	3.43	2.50	14.38
200.0	4.00	7.09	5.89	2.71	3.68	2.71	14.75
220.0	4.00	7.90	6.50	2.92	3.92	2.92	15.09
240.0	4.00	8.78	7.17	3.12	4.00	3.12	15.40
260.0	4.00	9.75	7.89	3.32	4.00	3.32	15.68
280.0	4.00	10.79	8.67	3.51	4.00	3.51	15.94

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Project NWLVFLS

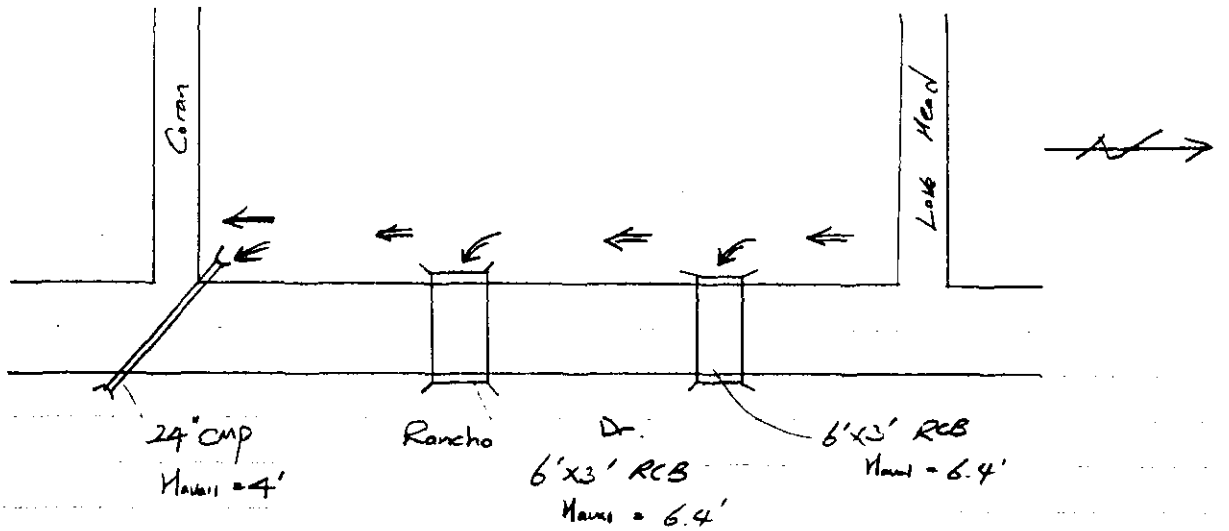
Project No. 830017

Sheet No. _____ of _____

Calculated by XS Date 10/6/15

Checked by _____ Date _____

Between Lake Mead & Coran



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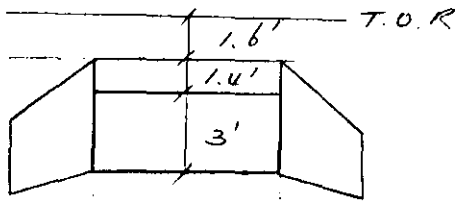
Project NWLVFC
Project No 83017
Sheet No. _____ of _____
Calculated by MKS Date 10/6/83
Checked by _____ Date _____

– 6'x 3' RCB



Weir sect.

4.2 4 2 1 2 4 6
10ft, 10ft 10ft 10ft 10ft 10ft 8ft

C = 2.7

Q ⇒ Q_{coiv} → Q_{weir} × weir 1' from invert

Elev	<DQ> Q_{coiv}	Q_{weir}	<DI> Q_{total}
0	0	0	0
2	48	43	91
3	86	232	318
4	117	588	705
5	148	1155	1303
6	173	2397	2570

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PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project WILVFI

Project No. 830017

Sheet No. _____ of _____

Calculated by MS Date 10/6/93

Checked by _____ Date _____

Weir flow

Elev.	Area	Top width	Avg depth	$Q = CLy^{3/2}$
2	22.5	45	0.5	43
3	81.3	72.5	1.12	232
4	167.5	100	1.68	588
5	356.0	245	1.45	1,155
6	653.5	350	1.86	2,397

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 6, 1993
6' X 3' RCB BETWEEN LAKE MEAD & CORAN
INLET CONTROL ASSUMED

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	6.00
Culvert Rise (Height of Opening) (feet)	3.00
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0120
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	100.0
Culvert Slope (feet per foot)	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
40.0	3.00	1.77	2.15	0.75	1.11	3.00	2.22
60.0	3.00	2.34	2.33	0.99	1.46	0.99	10.15
80.0	3.00	2.85	2.59	1.19	1.77	1.19	11.16
100.0	3.00	3.33	2.92	1.39	2.05	1.39	11.98
120.0	3.00	4.12	3.32	1.58	2.32	1.58	12.66
140.0	3.00	4.76	3.80	1.76	2.57	1.76	13.26
160.0	3.00	5.47	4.35	1.93	2.81	1.93	13.79
180.0	3.00	6.28	4.98	2.10	3.00	2.10	14.26
200.0	3.00	7.18	5.68	2.27	3.00	2.27	14.69
220.0	3.00	8.18	6.45	2.43	3.00	2.43	15.07
240.0	3.00	9.27	7.29	2.59	3.00	2.59	15.43

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Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	7	Bed Slope:	0.00500	Max Elev:	72.0
Bank Stations.....Left:	1000.0	Right....:	1350.0	Min Elev:	67.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	70.2	1000.0	2)	70.0	1040.0	3)	68.0	1060.0	4)	67.0	1080.0
5)	68.0	1105.0	6)	70.0	1140.0	7)	72.0	1350.0			

COMPUTED PARAMETERS:

	WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
	73.00	7090.7	7.1	0.735	0.030	2.9	350.0	1003.5	350.2
6	72.00	3469.3	5.3	0.685	0.030	1.9	350.0	653.5	350.2
5	71.00	1598.7	4.5	0.657	0.030	1.5	245.0	356.0	245.2
4	70.00	826.3	4.9	0.672	0.030	1.7	100.0	167.5	100.2
3	69.00	306.7	3.8	0.628	0.030	1.1	72.5	81.3	72.6
2	~~68.00~~	49.6	2.2	0.550	0.030	0.5	45.0	22.5	45.0

NOTES:

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Project WILVFI

Project No. 82017

Sheet No. _____ of _____

Calculated by Tony Date 10/7/83

Checked by _____ Date _____

2ND 6'x3' RCB

Elev.	(DQ) Q_{CULV}	Q_{weir}	(OL) Q_{total}
0	0	0	0
2	48	—	48
3	86	94	180
4	117	299	416
5	148	609	757
6	173	1035	1208
7	196	1580	1776

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Project NWLVFLS

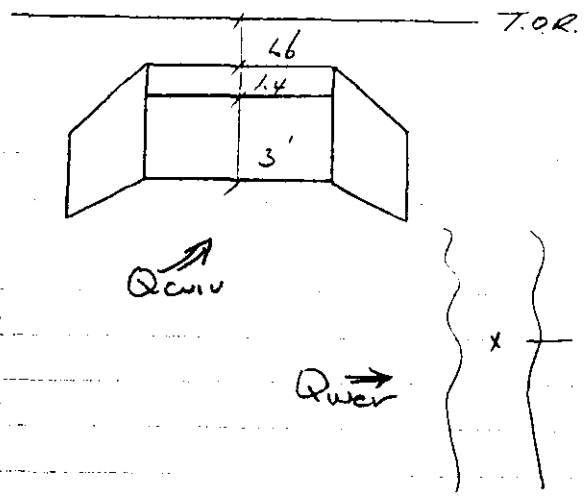
Project No. 93017

Sheet No. _____ of _____

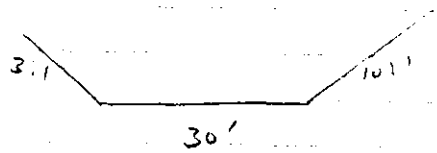
Calculated by Hong Date 10/6/93

Checked by _____ Date _____

— 6'x3' RCB



Weir section



C = 2.8

Weir Elev.	Top width	flow Area	hyd depth	$Q = CLH^{3/2}$
3	43	36.5	0.85	94
4	56	86	1.54	299
5	69	148.5	2.15	609
6	82	224	2.73	1,035
7	95	312.5	3.28	1,580

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 6, 1993
6' X 3' RCB BETWEEN LAKE MEAD & CORAN
INLET CONTROL ASSUMED

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	6.00
Culvert Rise (Height of Opening) (feet).....	3.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	100.0
Culvert Slope (feet per foot).....	0.0100

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
40.0	3.00	1.77	2.15	0.75	1.11	3.00	2.22
60.0	3.00	2.34	2.33	0.99	1.46	0.99	10.15
80.0	3.00	2.85	2.59	1.19	1.77	1.19	11.16
100.0	3.00	3.33	2.92	1.39	2.05	1.39	11.98
120.0	3.00	4.12	3.32	1.58	2.32	1.58	12.66
140.0	3.00	4.76	3.80	1.76	2.57	1.76	13.26
160.0	3.00	5.47	4.35	1.93	2.81	1.93	13.79
180.0	3.00	6.28	4.98	2.10	3.00	2.10	14.26
200.0	3.00	7.18	5.68	2.27	3.00	2.27	14.69
220.0	3.00	8.18	6.45	2.43	3.00	2.43	15.07
240.0	3.00	9.27	7.29	2.59	3.00	2.59	15.43

==========

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Project NWLVFLS

Project No. 92017

Sheet No. _____ of _____

Calculated by JLS Date 10/7/93

Checked by _____ Date _____

24" CMP @ Coran & Rancho Dr.

DI	0	27	100	1000
DQ	0	27	27	27

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 6, 1993
24" CMP @ CORAN & RANCHO DR
INLET CONTROL ASSUMED

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	2.00
FHWA Chart Number (1,2 or 3)	2
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0240
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	50.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	2.00	1.67	0.02	0.83	1.13	0.83	8.09
12.0	2.00	1.89	0.25	0.93	1.24	0.93	8.41
14.0	2.00	2.10	0.52	1.01	1.35	1.01	8.77
16.0	2.00	2.36	0.83	1.10	1.44	1.10	9.04
18.0	2.00	2.62	1.18	1.18	1.53	1.18	9.30
20.0	2.00	2.91	1.58	1.27	1.61	1.27	9.52
22.0	2.00	3.24	2.02	1.36	1.67	1.36	9.70
24.0	2.00	3.59	2.49	1.45	1.73	1.45	9.84
26.0	2.00	3.97	3.01	1.55	1.79	1.55	9.95
28.0	2.00	4.39	3.58	1.68	1.83	1.68	9.92
30.0	2.00	4.83	4.18	2.00	1.86	2.00	9.55

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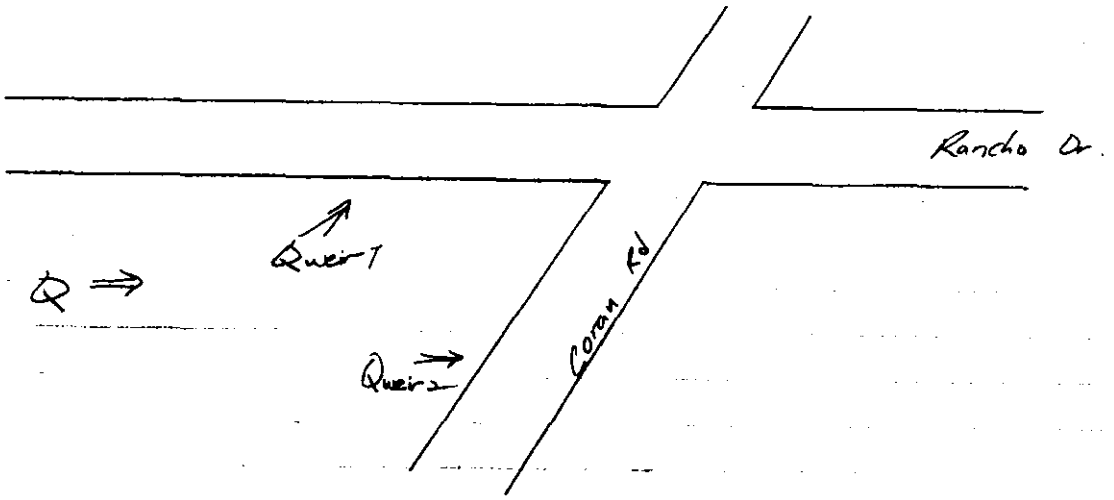
Project CANALETAS
Project No. 930017
Sheet No. _____ of _____
Calculated by YS Date 10/7/93
Checked by _____ Date _____

Split flow ratings @ Coran & Rancho Dr.



Elev	(DQ) Qweir 1	Qweir 2	(DI) Q total
59	3121	6673	
58	1695	4107	5862
57	732	2265	2997
56	205	1012	1217
55	13	268	281
54.6		99	100

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Project NWLVFLS

Project No. 930017

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Weir Section # 1

54.5 / 1000, 56 / 1105, 58 / 1240, 60 / 1420, C = 3.0

Elev.	TW	Area	Avg d	Q = CLH$^{3/2}$
59.0	330	708.8	2.15	3,121
58.0	240	423.8	1.77	1,695
57.0	172.5	217.5	1.26	732
56.0	105	78.8	0.75	205
55.0	35	8.8	0.25	13
54.6	7	0.3	0.04	

Weir Section # 2

54.5 / 1070, 54 / 1045, 54 / 1085, 56 / 1220, 58 / 1380, 60 / 1535, C = 3.0

Elev	TW	Area	Davg	Q = CLH$^{3/2}$
59	457.5	1312.5	2.87	6,673
58	380	893.8	2.35	4,107
57	300	553.8	1.85	2,265
56	220	293.8	1.33	1,012
55	152.5	107.5	0.70	268
54.6	125.5	51.9	0.41	99

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	4	Bed Slope:	0.00500	Max Elev:	60.0
Bank Stations.....Left:	1000.0	Right....:	1420.0	Min Elev:	54.5
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	54.5	1000.0	2)	56.0	1105.0	3)	58.0	1240.0	4)	60.0	1420.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
59.00	4132.1	5.8	0.701	0.030	2.1	330.0	708.8	330.0
58.00	2168.0	5.1	0.679	0.030	1.8	240.0	423.8	240.0
57.00	889.0	4.1	0.642	0.030	1.3	172.5	217.5	172.5
56.00	227.7	2.9	0.588	0.030	0.8	105.0	78.8	105.0
55.00	12.2	1.4	0.490	0.030	0.3	35.0	8.8	35.0
54.60	0.2	0.5	0.375	0.030	0.0	7.0	0.3	7.0

NOTES:

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LANDSCAPE ARCHITECTURE

Project No. 83017

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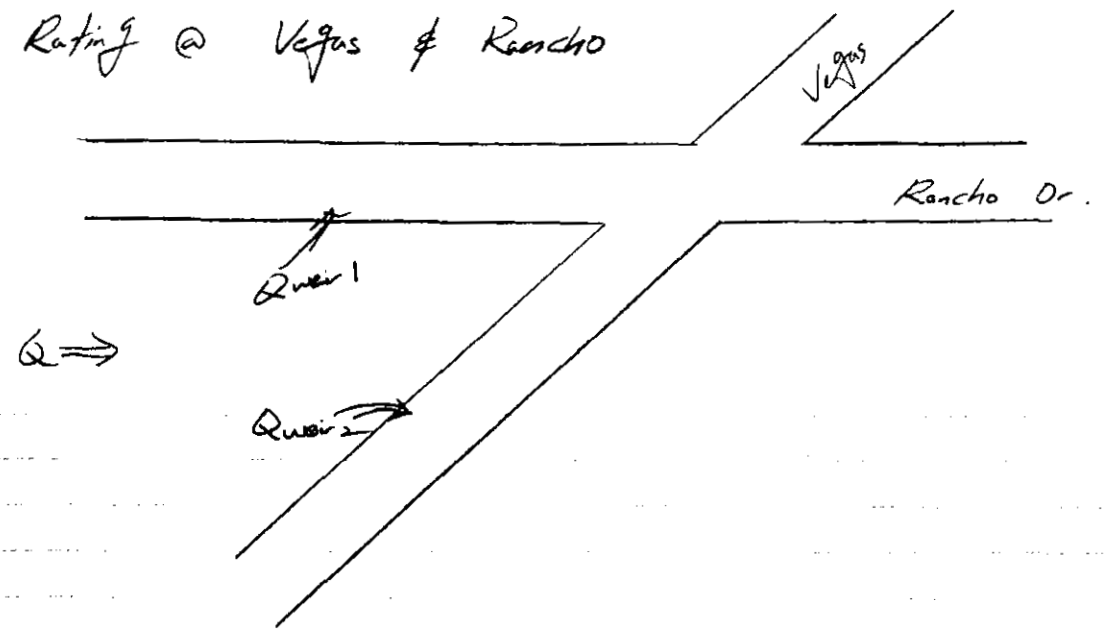
Calculated by JS Date _____

Checked by _____ Date _____

Rating @ Vegas & Rancho



	<OQ>		<DI>
ElCV.	Qweir 1	Qweir 2	Qtotal
20	5534	6942	
19	3179	4043	7,222
18	1639	2045	3,684
17	640	788	1,428
16	117	143	260
15.5	20	25	45

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Project NWLVFIS
Project No. 80017
Sheet No. _____ of _____
Calculated by YS Date 10/7/83
Checked by _____ Date _____

Weir Sect # 1

2115 / 1000, 2116 / 1110, 2118 / 1265, 2120 / 1490 C = 3

Elev.	TW	A	d	Q = CLy^3/2
20	490	1185	2.42	5,534
19	377.5	751.3	1.99	3,179
18	265	430	1.62	1639
17	187.5	203.8	1.09	640
16	110.0	55	0.5	117
15.5	55	13.8	0.25	20

Weir Sect # 2

2115 / 1000, 2116 / 1135, 2118 / 1340, 2120 / 1565, / C = 3

Elev	TW	A	d	Q = CLy^3/2
20	565	1449.5	2.56	6,942
19	452.5	938.8	2.07	4,043
18	340	542.5	1.59	2,045
17	237.5	253.8	1.07	788
16	135	67.5	0.5	143
15.5	67.5	16.9	0.25	25

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	4	Bed Slope:	0.00500	Max Elev:	20.0
Bank Stations.....Left:	1000.0	Right....:	1490.0	Min Elev:	15.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	15.0	1000.0	2)	16.0	1110.0	3)	18.0	1265.0	4)	20.0	1490.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
20.00	7477.7	6.3	0.715	0.030	2.4	490.0	1185.0	490.0
19.00	4162.9	5.5	0.692	0.030	2.0	377.5	751.3	377.5
18.00	2079.6	4.8	0.669	0.030	1.6	265.0	430.0	265.0
17.00	754.3	3.7	0.626	0.030	1.1	187.5	203.8	187.5
16.00	121.4	2.2	0.550	0.030	0.5	110.0	55.0	110.0
15.50	19.1	1.4	0.490	0.030	0.3	55.0	13.8	55.0

NOTES:

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	4	Bed Slope:	0.00500	Max Elev:	20.0
Bank Stations.....Left:	1000.0	Right....:	1565.0	Min Elev:	15.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	15.0	1000.0	2)	16.0	1135.0	3)	18.0	1340.0	4)	20.0	1565.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
20.00	9492.3	6.6	0.722	0.030	2.6	565.0	1447.5	565.0
19.00	5348.2	5.7	0.697	0.030	2.1	452.5	938.8	452.5
18.00	2594.5	4.8	0.667	0.030	1.6	340.0	542.5	340.0
17.00	928.8	3.7	0.624	0.030	1.1	237.5	253.8	237.5
16.00	148.9	2.2	0.550	0.030	0.5	135.0	67.5	135.0
15.50	23.5	1.4	0.490	0.030	0.3	67.5	16.9	67.5

NOTES:

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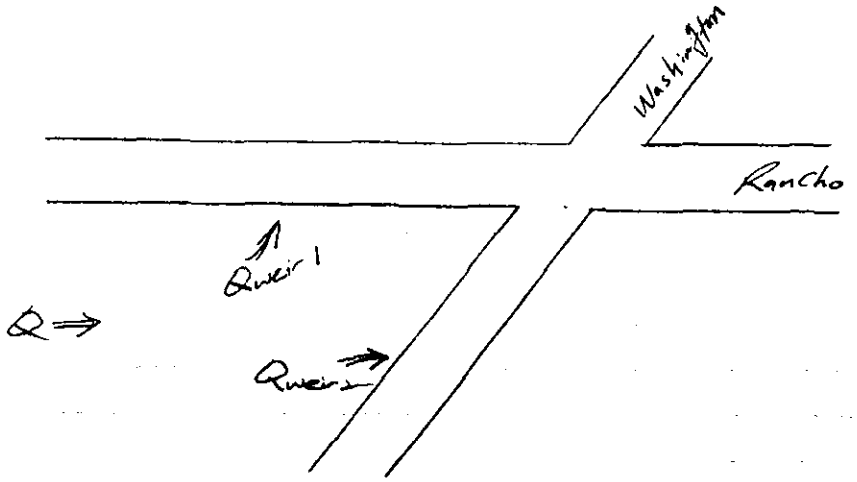
Project NVLVFIS
Project No. 830017
Sheet No. _____ of _____
Calculated by YS Date 10/2/92
Checked by _____ Date _____

Ratings @ Washington & Rancho



Elev	<OQ> Qweir 1	Qweir 2	<OI> Qtotal
100	4529		
99	2070	5,303	7,373
98	750	1920	2,670
97	132	339	471
96.5	23	60	83

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LANDSCAPE ARCHITECTURE

Project NWHVFLS

Project No. 830017

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Qweir 1

$\frac{96}{1000}$, $\frac{98}{1250}$, $\frac{100}{1600}$, C = 3.0

ELEV	TW	A	d	$Q = CLy^{3/2}$
100	620	1120	1.81	4,529
99	435	592.5	1.36	2,070
98	250	250	1.0	750
97	125	62.5	0.5	132
96.5	62.5	15.6	0.25	23

Qweir 2

$\frac{96}{1000}$, $\frac{98}{1640}$, $\frac{100}{2140}$, C = 3.0

ELEV	TW	A	d	$Q = CLy^{3/2}$
100	1140	2420	2.12	10,557
99	890	1405	1.58	5,303
98	640	640	1	1,920
97	320	160	0.5	339
96.5	160	40	0.25	60

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	3	Bed Slope:	0.00500	Max Elev:	100.0
Bank Stations.....Left:	1000.0	Right....:	1620.0	Min Elev:	96.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	96.0	1000.0	2)	98.0	1250.0	3)	100.0	1620.0			

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
100.00	5818.5	5.2	0.681	0.030	1.8	620.0	1120.0	620.0
99.00	2549.9	4.3	0.650	0.030	1.4	435.0	592.5	435.0
98.00	875.6	3.5	0.617	0.030	1.0	250.0	250.0	250.0
97.00	137.9	2.2	0.550	0.030	0.5	125.0	62.5	125.0
97.50	406.6	2.9	0.588	0.030	0.8	187.5	140.6	187.5

NOTES:

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	3	Bed Slope:	0.00500	Max Elev:	100.0
Bank Stations.....Left:	1000.0	Right....:	2140.0	Min Elev:	96.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	96.0	1000.0	2)	98.0	1640.0	3)	100.0	2140.0			

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
100.00	14000.3	5.8	0.700	0.030	2.1	1140.0	2420.0	1140.0
99.00	6671.9	4.7	0.666	0.030	1.6	890.0	1405.0	890.0
98.00	2241.6	3.5	0.617	0.030	1.0	640.0	640.0	640.0
97.00	353.0	2.2	0.550	0.030	0.5	320.0	160.0	320.0
96.50	55.6	1.4	0.490	0.030	0.3	160.0	40.0	160.0

NOTES:

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LANDSCAPE ARCHITECTURE

Project _____

Project No. 83017

Sheet No. _____ of _____

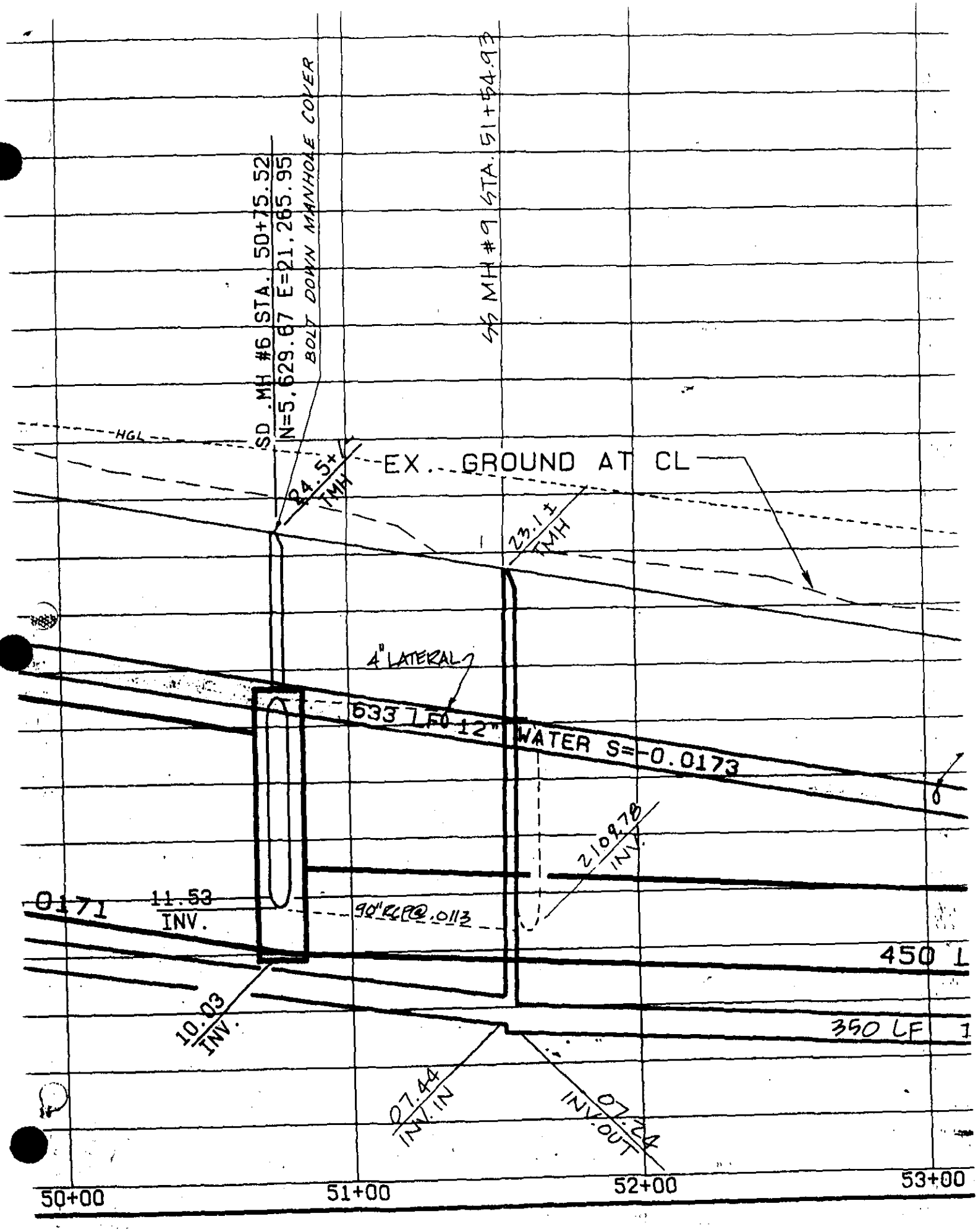
Calculated by _____ Date _____

Checked by _____ Date _____

Lake Mead storm drain low flow diversion thru 36" P.P.

DI	0	50	100	500	1500
DQ	0	50	50	50	50

4550 NORTH 12TH STREET • PHOENIX, ARIZONA 85014 • PHONE (602) 264-6831


SD. MH #6 STA. 50+75.52
N=5,629.67 E=21,265.95
BOLT DOWN MANHOLE COVER
SD MH #9 STA. 51+54.93
HGL
EX. GROUND AT CL
24.5± TMH
23.1± TMH
4" LATERAL
633 LF 12" WATER S=-0.0173
21.09 INV.
0171
11.53 INV.
90° RCP @ .0113
450 L
350 LF
10.03 INV.
07.44 INV. IN
07.24 INV. OUT
50+00
51+00
52+00
53+00

CIRCULAR CHANNEL ANALYSIS
RATING CURVE COMPUTATION

December 22, 1993
90" RCP
S = 0.017
NORMAL DEPTH CALC

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0170
Manning's Roughness Coefficient (n-value).....	0.0130
Channel Diameter (feet).....	7.50

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
5.0	784.8	25.08	2.101	9.770	14.770	31.29	7.07
6.0	978.6	25.83	1.811	10.359	16.359	37.89	6.00
6.5	1045.7	25.71	1.604	10.263	16.763	40.68	5.10
6.6	1055.4	25.63	1.554	10.202	16.802	41.18	4.87
6.7	1063.6	25.54	1.500	10.126	16.826	41.65	4.63
6.8	1070.1	25.42	1.442	10.031	16.831	42.10	4.36
6.9	1074.5	25.27	1.378	9.916	16.816	42.52	4.07
7.0	1076.8	25.09	1.306	9.777	16.777	42.91	3.74
7.1	1076.4	24.88	1.223	9.609	16.709	43.27	3.37
7.2	1072.6	24.61	1.126	9.404	16.604	43.59	2.94

CIRCULAR CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.5 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A complete program manual is available.

CIRCULAR CHANNEL ANALYSIS
RATING CURVE COMPUTATION

December 22, 1993
36" RCP
S = 0.005
NORMAL DEPTH CALC

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0050
Manning's Roughness Coefficient (n-value).....	0.0130
Channel Diameter (feet).....	3.00

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
2.5	47.8	7.60	0.798	0.897	3.397	6.29	2.24
2.6	49.3	7.57	0.747	0.890	3.490	6.51	2.04
2.7	50.3	7.50	0.685	0.874	3.574	6.70	1.80
2.8	50.7	7.39	0.608	0.847	3.647	6.87	1.50
2.9	50.4	7.20	0.498	0.805	3.705	7.00	1.08
3.0	48.3	6.84	0.267	0.726	3.716	7.07	0.35

CIRCULAR CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.5 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A complete program manual is available.

CIRCULAR CHANNEL ANALYSIS
RATING CURVE COMPUTATION

December 22, 1993
90" rcp
s = 0.011
NORMAL DEPTH CALC

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0110
Manning's Roughness Coefficient (n-value).....	0.0130
Channel Diameter (feet).....	7.50

==========

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
6.5	841.2	20.68	1.290	6.641	13.141	40.68	5.10
6.6	849.0	20.62	1.250	6.602	13.202	41.18	4.87
6.7	855.6	20.54	1.207	6.552	13.252	41.65	4.63
6.8	860.7	20.44	1.160	6.491	13.291	42.10	4.36
6.9	864.4	20.33	1.108	6.416	13.316	42.52	4.07
7.0	866.2	20.18	1.050	6.326	13.326	42.91	3.74
7.1	865.8	20.01	0.984	6.217	13.317	43.27	3.37
7.2	862.8	19.80	0.906	6.085	13.285	43.59	2.94
7.3	856.2	19.52	0.808	5.919	13.219	43.85	2.42

==========

CIRCULAR CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.5 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
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Project No. 83017

Sheet No. _____ of _____

Calculated by _____ Date _____

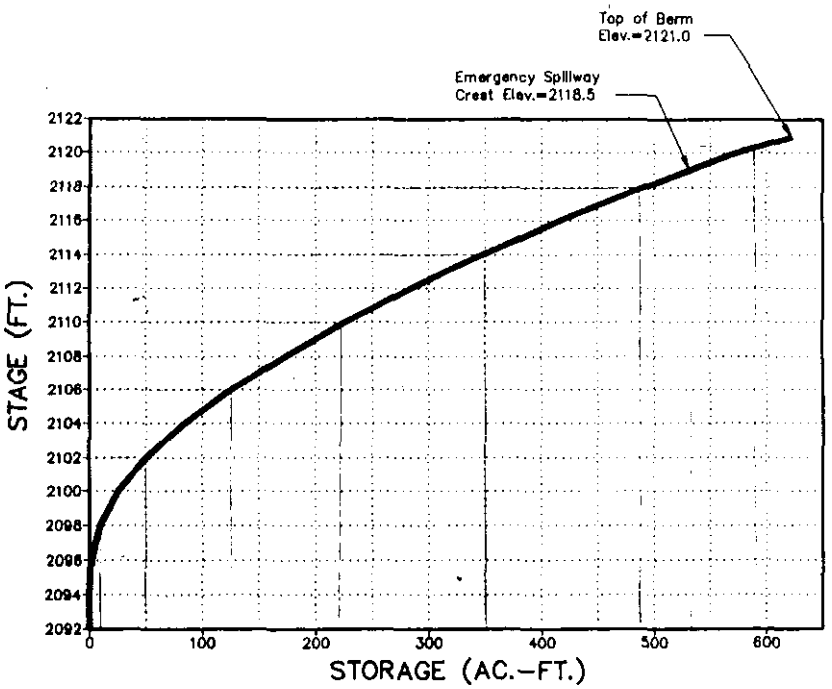
Checked by _____ Date _____

Rating @ Carey / Lake Mead Retention Basin

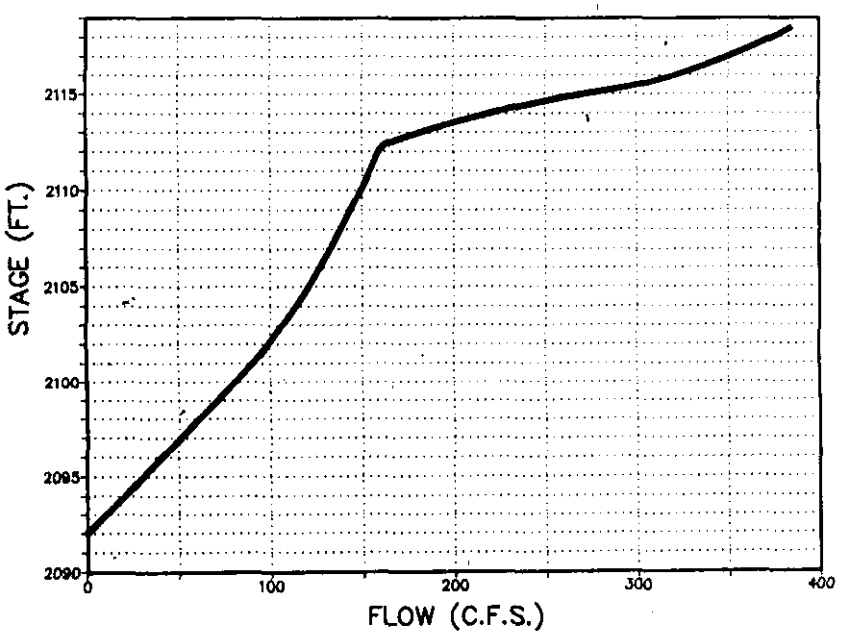
from Design Plan

Elev (ft.)	92	98	102	106	110	114	118	119	121
Volume (Ac.ft.)	0	10	50	125	220	350	486	533	588
Flow (Cfs)	0	60	100	123	150	213	370	1390	11026

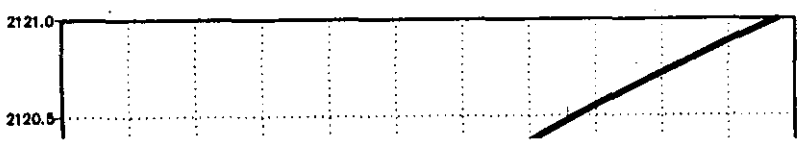
STAGE vs. STORAGE

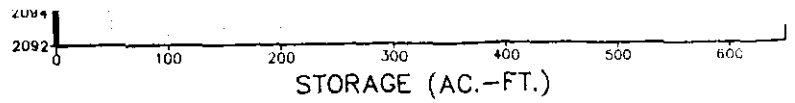


STAGE vs. DISCHARGE OUTLETS

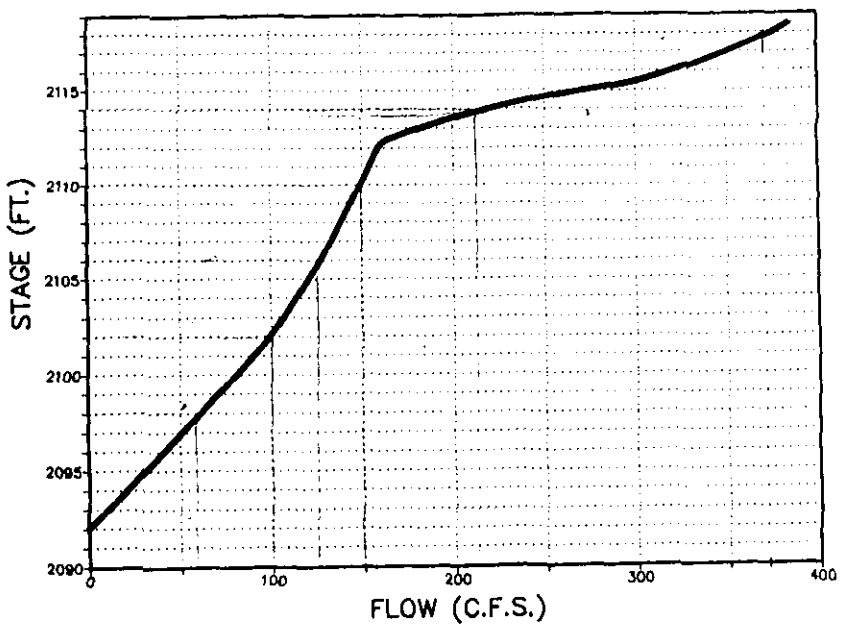


STAGE vs. DISCHARGE SPILLWAY





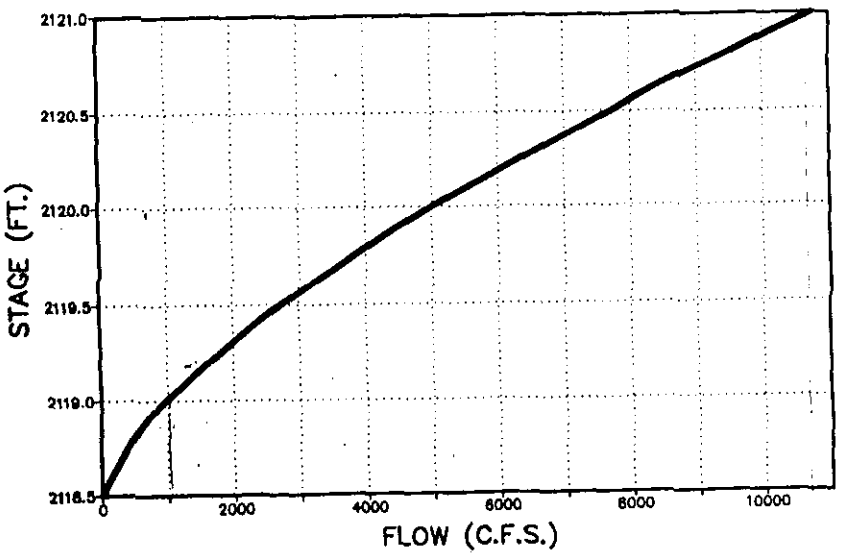
STAGE vs. DISCHARGE OUTLETS



100

2600
2400
2200
2000
1800
1600
1400
1200
100
80
60
40
20
FLOW (C.F.S.)

STAGE vs. DISCHARGE SPILLWAY



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Project NWLVFIC

Project No.

Sheet No. _____ of _____

Calculated by JS Date 8/11/82

Checked by _____ Date _____

◇ 48" RCP under Bonanza Road/ between Starks Dr. and Langtry Drive.

L = 52'

S = 0.021

Hava'i = 9.0'

Q_{100} thru pipe = 158 cfs.

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 11, 1994
Northwest Las Vegas FIS
48" rcp under bonanza rd
between starks dr. and langtry dr.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	4.00
FHWA Chart Number (1,2 or 3)	1
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	52.0
Culvert Slope (feet per foot)	0.0210

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	2.00	1.82	1.62	0.84	1.32	0.84	10.48
40.0	2.00	2.72	2.08	1.19	1.89	1.19	12.79
60.0	2.00	3.52	2.59	1.47	2.33	1.47	14.33
80.0	2.00	4.32	3.18	1.72	2.71	1.72	15.49
100.0	4.00	5.22	4.34	1.96	3.03	1.96	16.32
120.0	4.00	6.31	4.97	2.18	3.30	2.18	17.18
140.0	4.00	7.62	5.71	2.40	3.51	2.40	17.78
160.0	4.00	9.13	6.57	2.63	3.67	2.63	18.26
180.0	4.00	10.85	7.54	2.87	3.77	2.87	18.63
200.0	4.00	12.76	8.63	3.14	3.85	3.14	18.87

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PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

August 11, 1994
Northwest Las Vegas FIS
48" rcp under bonanza road.
between starks dr. and Langtry dr.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	4.00
FHWA Chart Number (1,2 or 3)	1
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	52.0
Culvert Slope (feet per foot)	0.0130

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	2.00	1.82	2.04	0.94	1.32	2.00	3.18
40.0	2.00	2.72	2.50	1.35	1.89	1.35	10.77
60.0	2.00	3.52	3.01	1.67	2.33	1.67	12.04
80.0	2.00	4.32	3.59	1.97	2.71	1.97	12.94
100.0	3.00	5.22	4.27	2.25	3.03	2.25	13.71
120.0	3.00	6.31	5.03	2.54	3.30	2.54	14.23
140.0	3.00	7.62	5.88	2.86	3.51	2.86	14.57
160.0	3.00	9.13	6.82	3.20	3.67	3.20	14.85
180.0	4.00	10.85	7.96	4.00	3.77	4.00	14.32
200.0	4.00	12.76	9.05	4.00	3.85	4.00	15.92

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LANDSCAPE ARCHITECTURE

Project _____

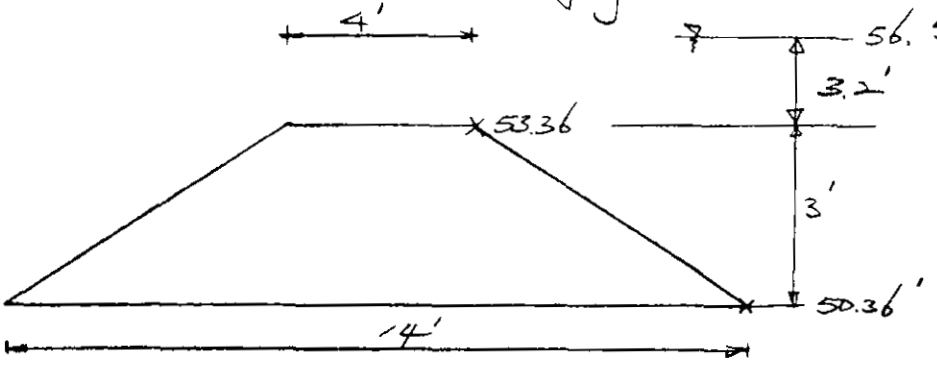
Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

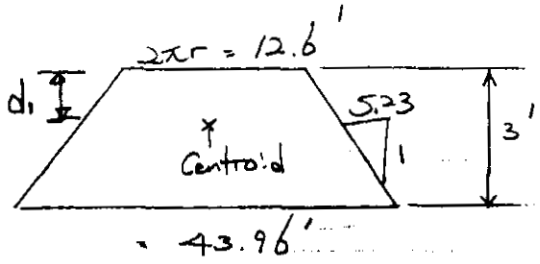
Drop Inlet near on-Ramp to I-95 westbound between Starks and Langley. assume Ponding elev.=



50 % Clogged.

Area 1 = πr^2 - $\pi (4/2)^2$ · 12.56 ft^2

Area 2 = 84.84 ft^2.



Total A. 97 ft^2 - Area of steel bar

$$48.5 = 12.6 + \frac{12.6 + (12.6 + 10.46d)}{2}(d_1)$$

$$35.9 = \frac{25.2 + 10.46d}{2}(d_1)$$

d = 1, = 17.83

d = 1.5 = 30.7 , 36, d_1 = 1.67'

d = 2, = 46.1

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PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project _____
Project No. _____
Sheet No. _____ of _____
Calculated by _____ Date _____
Checked by _____ Date _____

Total length of #4 bars

$4\ (4(2) + 8(2.25) + 12(4.08) +$

$= 4\ (75)$

$= 300$ ft

diameter of #4 steel bar = 0.5"

Length of #8 bar = 82 ft
diameter of #8 steel bar = 1"

Total open area = $97 - 300(0.04) - 82(0.08)$

$= 78$ ft²

50 % Clogged - Existing.
2 - Clogging factor.

$A = 19.6$ ft².

Avg d = 4.9', $Q = CA\sqrt{2gh}$, use $C = 0.67$.

$Q = 5.38\ A\ d^{1/2}$

$= 233$ cfs

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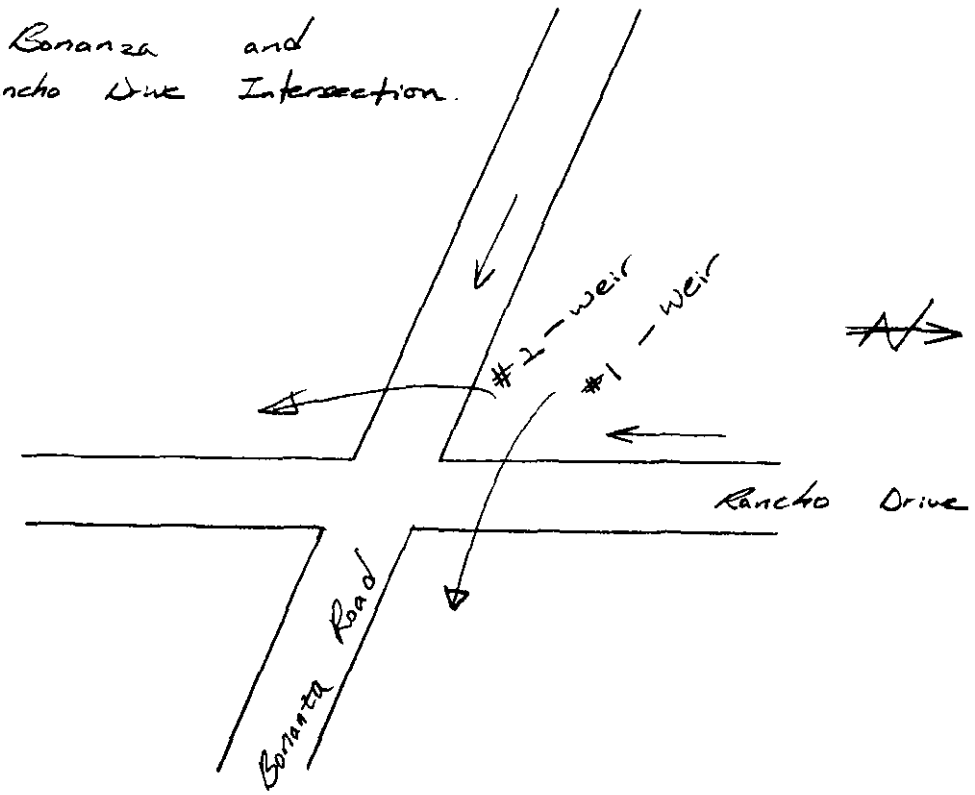
LANDSCAPE ARCHITECTURE

Project NWLVFIS
Project No. 8007-01
Sheet No. ____ of ____
Calculated by YS Date 6/6/91
Checked by ____ Date ____

At Bonanza and Rancho Drive Intersection.



WSEL	Q #1	⟨DQ⟩ Q #2	⟨DL⟩ Q Total	
83.6	13	159	172	
83.8	74	259	333	
84.0	179	379	558	
84.2	325	515	840	
84.4	508	666	1174	
84.6	727	831	1558	
	413	587	1000	0.52
	673	790	1463	0.25

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

WEIR FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: BONAN1.SEC

No. of Cross Section Points: 4 Bed Slope:0.00500 Max Elev.: 86.00
Bank Stations.....Left: 1000.0 Right....: 1440.0 Min Elev.: 83.50
Encroachment Stations..Left: Right....: Weir Coef: 3.000

CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	86.00	1000.00	2)	84.00	1205.00	3)	83.50	1316.00
4)	83.50	1440.00						

COMPUTED PARAMETERS:

WSEL(ft)	Q(cfs)	H:max(ft)	H:ave(ft)	TW(ft)	A(sf)
83.60	12.6	0.10	0.09	146.2	13.5
83.80	74.3	0.30	0.25	190.6	47.2
84.00	178.6	0.50	0.38	235.0	89.8
84.20	324.5	0.70	0.54	255.5	138.8
84.40	507.8	0.90	0.70	276.0	192.0
84.60	727.3	1.10	0.84	296.5	249.2

NOTES:

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

WEIR FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: BONAN2.SEC

No. of Cross Section Points:	4	Bed Slope:	0.00500	Max Elev.:	83.68
Bank Stations.....Left:	1000.0	Right....:	1170.0	Min Elev.:	82.70
Encroachment Stations..Left:	1000.0	Right....:	1170.0	Weir Coef:	2.800

CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	83.50	1000.00	2)	82.70	1050.00	3)	83.68	1170.00
4)	84.00	1210.00						

COMPUTED PARAMETERS:

WSEL(ft)	Q(cfs)	H:max(ft)	H:ave(ft)	TW(ft)	A(sf)
83.60	159.0	3.90	0.47	160.2	74.6
83.80	258.7	0.90	0.64	170.0	108.2
84.00	378.8	1.10	0.84	170.0	142.2
84.20	515.4	1.30	1.04	170.0	176.2
84.40	666.4	1.50	1.24	170.0	210.2
84.60	830.6	1.70	1.44	170.0	244.2

NOTES:

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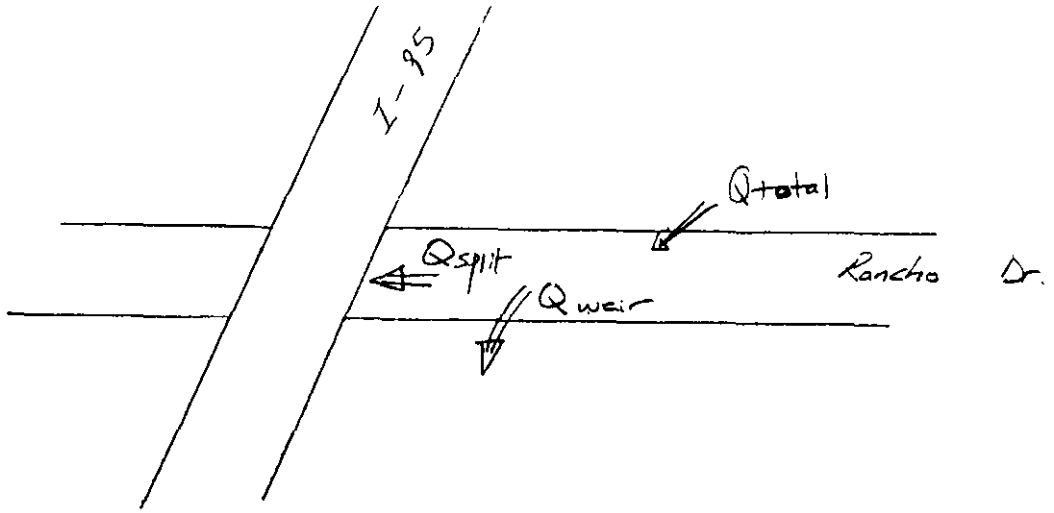
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project [illegible]
Project No. 93017
Sheet No. _____ of _____
Calculated by [illegible] Date 2/15/
Checked by _____ Date _____

Rancho Dr. & I-95 Int. (South)



	<DQ>		<DI>
Elev.	Qsplit	Q weir	Qtotal
80.2	31	76	107
80.4	75	243	318
80.6	171	465	642
80.8	309	730	1,039
81.0	470	1032	1,502

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LANDSCAPE ARCHITECTURE

Project _____

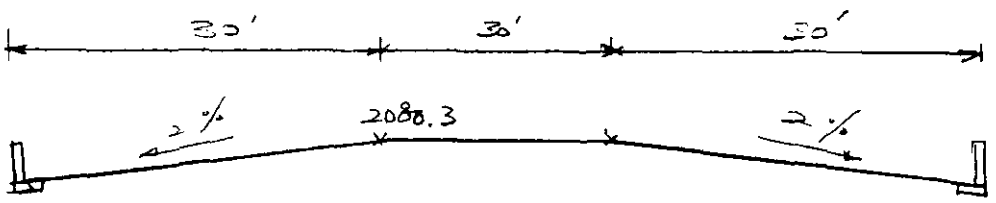
Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Rancho Dr.



assume 4" curb.

$\frac{79.7}{1000}$, $\frac{80.3}{1030}$, $\frac{80.3}{1060}$, $\frac{79.7}{1080}$.

$n = 0.016$

$S = 0.0045$

Assume Weir length ≈ 360'

@ elev = 80.03

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: RANCHO1.SEC

No. of Cross Section Points:	4	Bed Slope:	0.00450	Max Elev.:	80.30
Bank Stations.....Left:	1000.0	Right....:	1090.0	Min Elev.:	79.70
Encroachment Stations..Left:	1000.0	Right....:	1090.0		
Manning-n Values.....LOB:	0.016	CHANNEL..:	0.016	ROB.....:	0.016

CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	79.70	1000.00	2)	80.30	1030.00	3)	80.30	1060.00
4)	79.70	1090.00						

COMPUTED PARAMETERS:

WSEL(ft)	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	CRWS(ft)
80.00	7.9	1.8	0.80	0.016	0.2	30.0	4.5	30.0	79.98
80.20	30.9	2.5	0.87	0.016	0.3	50.0	12.5	50.0	80.18
80.40	75.4	2.8	0.90	0.016	0.3	90.0	27.0	90.0	80.38
80.60	176.6	3.9	0.98	0.016	0.5	90.0	45.0	90.0	80.60
80.80	309.4	4.9	1.03	0.016	0.7	90.0	63.0	90.0	80.81
81.00	470.4	5.8	1.08	0.016	0.9	90.0	81.0	90.0	81.04

NOTES:

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

WEIR FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points: 3 Bed Slope:0.00500 Max Elev.: 80.03
Bank Stations.....Left: 1000.0 Right....: 1360.0 Min Elev.: 80.03
Encroachment Stations..Left: 1000.0 Right....: 1360.0 Weir Coef: 3.000

CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	80.03	1000.00	2)	80.03	1200.00	3)	80.03	1360.00

COMPUTED PARAMETERS:

WSEL(ft)	Q(cfs)	H:max(ft)	H:ave(ft)	TW(ft)	A(sf)
80.20	75.7	0.17	0.17	360.0	61.2
80.40	243.1	0.37	0.37	360.0	133.2
80.60	464.8	0.57	0.57	360.0	205.2
80.80	729.7	0.77	0.77	360.0	277.2
81.00	1031.8	0.97	0.97	360.0	349.2

NOTES:

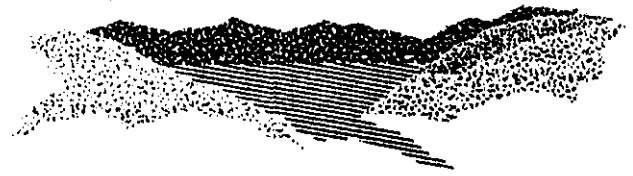
Northwest Las Vegas Flood Insurance Study Restudy
Clark County, Nevada

Technical Data Notebook
Appendix IV - Supporting Technical Data for Detailed Study Area Hydraulic Analyses

Prepared for:

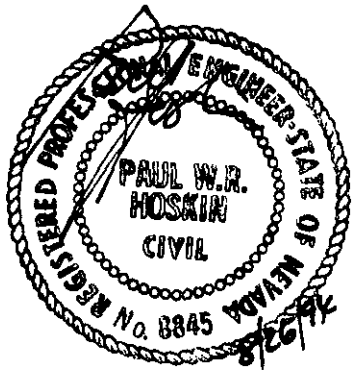
CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT



301 East Clark Avenue, Suite 300
Las Vegas, Nevada 89101

August 26, 1994



CVL CONSULTANTS, INC., 6655 W. SAHARA, SUITE A-200, LAS VEGAS, NV 89103 (702) 368-3008
PENTACORE ENGINEERING, INC., 6763 W. CHARLESTON BLVD., LAS VEGAS NV 89102 (702) 258-0115

Flood Insurance Study Restudy
for
Northwest Las Vegas

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Appendix IV - Supporting Technical Data for Detailed Study Area Hydraulic Analyses

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- Form 1 - Revision Requester and Community Official
- Form 2 - Certification by Registered Professional Engineer
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Section 1
FEMA Forms

Form 1
Revision Requester and Community Official

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*

- [X] Physical change
  - [X] Existing
  - [ ] Proposed
- [X] Improved methodology
- [ ] Improved data
- [ ] Floodway revision
- [X] Other Flood Insurance Study
  Explain Area studied for flood hazard determination and mapping

2. Flooding Source: Highway 95 and Rancho Drive

3. Project Name/Identifier: Northwest Las Vegas FIS Restudy

4. FEMA zone designations affected: Zone A
(example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)

5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	325276	City of Las Vegas	Clark	NV	325276	0015C	10/18/83
	320003	City of Las Vegas	Clark	NV	320003	1000B	9/29/89

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding
- [X] Riverine
- [ ] Coastal
- [ ] Alluvial Fan
- [X] Shallow Flooding *(e.g. Zones AO and AH)*
- [ ] Lakes

Affected by wind/wave action
- [ ] Yes
- [X] No

- [ ] Other *(describe)* _____

Structures
- [ ] Channelization
- [ ] Levee/Floodwall
- [X] Bridge/Culvert
- [ ] Dam
- [ ] Coastal
- [ ] Fill
- [ ] Pump Station
- [ ] None
- [ ] Channel Relocation
- [ ] Excavation
- [ ] Other *(describe)* _____

Disciplines*
- [X] Water Resources
  - [X] Hydrology
  - [X] Hydraulics
  - [ ] Sediment Transport
  - [ ] Interior Drainage
- [ ] Structural
- [ ] Geotechnical
- [ ] Land Surveying
- [ ] Other *(describe)* _____

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? [ ] Yes [X] No

8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? [ ] Yes [X] No
If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

☐ Yes ☒ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☐ Yes ☐ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☐ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☐ Yes ☐ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? ☐ Yes ☐ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)?

☐ Yes ☒ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by _____ (entity) _____ with a maximum interval of _____ months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by _____ (entity) to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☐ has ☐ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☐ performing ☐ overseeing compliance with the maintenance and operation plans of the _____
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. *After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments* to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. 1, Parts 60, 65, and 72)*.

____b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

__X__c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

17. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	☒ Hydrologic Analysis Form (Form 3) - Refer to Technical Data Notebook - Appendix III
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☒ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☒ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☒ Bridge/Culvert Form (Form 7) - Refer to Technical Data Notebook - Appendix III
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☐ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☐ Yes ☒ No

Initial fee amount: $ EXEMPT

METHOD OF PAYMENT (Check one box)

☐ PAYMENT ENCLOSED ☐ VISA ☐ MASTERCARD CARD NUMBER

Check or money order only.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☒ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Signature of Revision Requestor

Paul W.R. Hoskin, P.E., Vice President
Printed Name and Title of Revision Requestor

Coe & Van Loo Consultants, Inc.
Company Name

8/26/94
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

Signature of Community Official

Kevin Eubanks, P.E., Assistant General Manager
Printed Name and Title of Community Official

Clark County Regional Flood Control District
Community Name

Date

Does this request impact any other communities? ☒ Yes ☐ No

Request is endorsed by: Clark County Regional Flood Control District
City of Las Vegas

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

Form 2
Certification by Registered Professional Engineer

FEDERAL EMERGENCY MANAGEMENT AGENCY
CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

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1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in hydrology and hydraulics
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 14 years experience in the expertise listed above.
4. I have ☒ prepared ☐ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Hydrologic, hydraulic & floodplain analyses
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☐ Examined plans and specifications and compared with completed projects.
   d. ☒ Other Compiled and reviewed plans and design reports
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Paul W.R. Hoskin, P.E.
(please print or type)

Title: Vice President
(please print or type)

Registration No. 8845

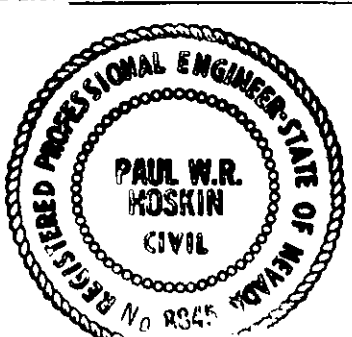
Expiration Date: _____

State Nevada

Type of License Civil

Signature

8/26/94
Date



Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

Form 4
Riverine Hydraulic Analysis

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE HYDRAULIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Clark County, Nevada

Flooding Source: Highway 95
(One form for each flooding source)

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. REACH TO BE REVISED

Downstream limit: Gowan Road

Upstream limit: Ann Road

2. EFFECTIVE FIS

[X] Not studied

[ ] Studied by approximate methods
- Downstream limit of study _____
- Upstream limit of study _____

[ ] Studied by detailed methods
- Downstream limit of study _____
- Upstream limit of study _____

[ ] Floodway delineated
- Downstream limit of Floodway _____
- Upstream limit of Floodway _____

3. HYDRAULIC ANALYSIS

Why is the hydraulic analysis different from that used to develop the FIRM? *(Check all that apply)*

[X] Not studied in FIS

[ ] Improved hydrologic data/analysis. Explain: _____

[ ] Improved hydraulic analysis. Explain: _____

[ ] Flood control structure. Explain: _____

[ ] Other. Explain: _____

3. RIVERINE HYDRAULIC ANALYSIS FORM
Models Submitted

Full input and output listings along with files on diskette *(if available)* for each of the models listed below and summary of the source of input parameters used in the models must be provided. The summary must include a complete description of any changes made from model to model *(e.g. duplicate effective model to corrected effective model)*. Only the Duplicate Effective and the Revised or Post-Project Conditions models must be submitted. See instructions for directions on when other models may be required. Only the 100-year flood profile is required for SFHAs with a Zone A designation. For areas which do not have detailed flooding, a hydraulic model is not required; however BFE's may not be added to the revised FIRM.

☐ Duplicate Effective Model — Natural ☐ Floodway ☐

Copies of the hydraulic analysis used in the effective FIS, referred to as the effective models *(10-, 50-, 100-, and 500-year multi-profile runs and the floodway run)* must be obtained and then reproduced on the requestor's equipment to produce the duplicate effective model. This is required to assure that the effective model input data has been transferred correctly to the requestor's equipment and to assure that the revised data will be integrated into the effective data to provide a continuous *FIS* model upstream and downstream of the revised reach.

☐ Corrected Effective Model — Natural ☐ Floodway ☐

The corrected effective model is the model that corrects any errors that occur in the duplicate effective model, adds any additional cross sections to the duplicate effective model, or incorporates more detailed topographic information than that used in the currently effective model. The corrected effective model must not reflect any man-made physical changes since the date of the effective model. An error could be a technical error in the modeling procedures, or any construction in the floodplain that occurred prior to the date of the effective model but was not incorporated into the effective model.

☐ Existing or Pre-Project Conditions Model — Natural ☐ Floodway ☐

The duplicate effective or corrected model is modified to produce the existing or pre-project conditions model to reflect any modifications that have occurred within the floodplain since the date of the effective model but prior to the construction of the project for which the revision is being requested. If no modification has occurred since the date of the effective model, then this model would be identical to the corrected effective or duplicate effective model.

☐ Revised or Post-Project Conditions Model — Natural ☐ Floodway ☐

The existing or pre-project conditions model *(or duplicate effective or corrected effective model, as appropriate)* is revised to reflect revised or post-project conditions. This model must incorporate any physical changes to the floodplain since the effective model was produced as well as the effects of the project. When the request is for proposed project this model should reflect proposed conditions.

☒ Other: Please attach a sheet describing all other models or calculations submitted. — Natural ☒ Floodway ☐

4. MODEL PARAMETERS (from model used to revise 100-year water surface elevation)

1. Discharges:

	Upstream Limit	Downstream Limit
10-year		
50-year		
100-year	555 cfs	2843 cfs
500-year		

Attach diagram showing changes in 100-year discharge

2. Explain how the starting water surface elevations were determined Due to complex hydraulic conditions, starting WSEL was calculated outside of the HEC-2 model, and a X5 card was used to input the calculated WSEL. Refer to Section 3, Appendix IV

3. Give range of friction loss coefficients *(Manning's "N")* Channel . . . . . 0.025 - 0.03

Overbanks . . . . 0.025 - 0.055

If friction loss coefficients are different anywhere along the revised reach from those used to develop the FIRM, give location, value used in the effective FIS, and revised values and an explanation as to how the revised values were determined.

Location	FIS	Revised
N/A		

Explain:

4. Describe how the cross section geometry data were determined *(e.g., field survey, topographic map, taken from previous study)* and list cross sections that were added.

Most cross-sections were photogrametrically digitized by a mapping company and a few sections were digitized from 2 feet contours. Topography was flown for this project at a scale of 1" = 200', 2' contour interval

4. MODEL PARAMETERS (Cont'd)

5. Explain how reach lengths for channel and overbanks were determined:

All cross sections are situated perpendicular to the flow extending over banks across the entire floodplain. Sections are spaced approximately 600 feet apart. Additional sections were placed where necessary to model the channel.

5. RESULTS (from model used to revise 100-year water surface elevations)

1. Do the results indicate:

a. Water surface elevations higher than end points of cross sections? ☒ Yes ☐ No
Weir flow occurs over the highway. Refer to Section 3, Appendix IV.

b. Supercritical depth? ☐ Yes ☒ No

c. Critical depth? ☒ Yes ☐ No
Areas of street flow in confined areas with low Manning's 'n' value.

d. Other unique situations? ☐ Yes ☒ No

If yes to any of the above, attach an explanation that discusses the situation and how it is presented on the profiles, tables, and maps.

2. What is the maximum change in energy gradient between cross-sections? 6.81 feet

Specify location Between Sections 12.141 and 12.256

3. What is the distance between the cross-sections in 2 above? 610 feet

Specify location N/A

4. What is the maximum distance between cross-sections? 665 feet

Specify location Between Section 11.606 and 11.479

5. Floodway determination

a. What is the maximum surcharge allowed by the community or State? N/A foot

b. What is the maximum surcharge for the revised conditions? N/A foot

Specify location N/A

c. What is the maximum velocity? N/A fps

Specify location N/A

Explain: No floodway is determined

d. Are there any negative surcharge values at any cross-section? ☐ Yes ☒ No

If yes, the floodway may need to widen. If it is not widened, please explain and indicate the maximum negative surcharge.

5. RESULTS (Cont'd)

6. Is the discharge value used to determine the floodway anywhere different from that used to determine the natural 100-year flood elevations? . . . . . ☐ Yes ☒ No

If yes, explain:

_____

_____

_____

7. Do 100-year water surface elevations increase at any location? . . . . . ☐ Yes ☒ No

If yes, please attach a list of the locations where the increases occur, state whether or not the increases are located on the requestor's property, and provide an explanation of the reason for the increases.

_____

_____

_____

Please attach a completed comparison table entitled: Water Surface Elevation Check (See page 6)

6. REVISED FIRM/FBFM AND FLOOD PROFILES

A. The revised water surface elevations tie into those computed by the effective FIS Model *(10-, 50-, 100-, and 500-year)*, downstream of the project at cross-section N/A within N/A feet and upstream of the project at cross section N/A within N/A feet.

B. The revised floodway elevations tie into those computed by the effective FIS model, downstream of the project at cross section N/A within N/A feet and upstream of the project at cross section N/A within N/A feet.

C. *Attach profiles, at the same vertical and horizontal scale as the profiles in the effective FIS report,* showing stream bed and profiles of all floods studied (without encroachment). Also, label all cross sections, road crossings (including low chord and top-of-road data), culverts, tributaries, corporate limits, and study limits. If channel distance has changed, the stationing should be revised for all profile sheets.

D. *Attach a Floodway Data Table showing data for each cross section listed in the published Floodway Data Table in the FIS report.*

Proceed to Riverine/Coastal Mapping Form.

FEDERAL EMERGENCY MANAGEMENT AGENCY

WATER SURFACE ELEVATION CHECK

COMMUNITY NAME	FLOODING SOURCE	PROJECT NAME/IDENTIFIER

	EFFECTIVE			DUPLICATE EFFECTIVE			CORRECTED EFFECTIVE			EXISTING/PRE-PROJECT			REVISED/PROJECT		
SECNO	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]

COMMENTS:

1 - 100-year (natural) Water Surface Elevation 2 - Encroachment (floodway) Water Surface Elevation 3 - Surcharge Value

Include all cross sections in the models between tie-in points. Any interpolated values should be indicated in parentheses.

Sheet ___ of ___

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE HYDRAULIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada

Flooding Source: Rancho Drive
(One form for each flooding source)

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. REACH TO BE REVISED

Downstream limit: Gowan Road

Upstream limit: Ann Road

2. EFFECTIVE FIS

☐ Not studied

☒ Studied by approximate methods

Downstream limit of study Washington Avenue

Upstream limit of study Ann Road

☐ Studied by detailed methods

Downstream limit of study

Upstream limit of study

☐ Floodway delineated

Downstream limit of Floodway

Upstream limit of Floodway

3. HYDRAULIC ANALYSIS

Why is the hydraulic analysis different from that used to develop the FIRM? *(Check all that apply)*

☐ Not studied in FIS

☒ Improved hydrologic data/analysis. Explain: The 100-year discharges within the study limit have been changed as a result of upstream flood control facilities.

☒ Improved hydraulic analysis. Explain: Detailed hydraulic analysis using the HEC-2 computer model was performed.

☒ Flood control structure. Explain: Construction of Angel Park Detention Basin, Buffalo Channel, Gowan South Basin, Gowan North Basin, Gowan Outfall Channel, Kyle Canyon Detention Basin and construction of Highway 95.

☐ Other. Explain:

3. RIVERINE HYDRAULIC ANALYSIS FORM
Models Submitted

Full input and output listings along with files on diskette *(if available)* for each of the models listed below and summary of the source of input parameters used in the models must be provided. The summary must include a complete description of any changes made from model to model *(e.g. duplicate effective model to corrected effective model)*. Only the Duplicate Effective and the Revised or Post-Project Conditions models must be submitted. See instructions for directions on when other models may be required. Only the 100-year flood profile is required for SFHAs with a Zone A designation. For areas which do not have detailed flooding, a hydraulic model is not required; however BFE's may not be added to the revised FIRM.

☐ Duplicate Effective Model — Natural ☐ Floodway ☐

Copies of the hydraulic analysis used in the effective FIS, referred to as the effective models *(10-, 50-, 100-, and 500-year multi-profile runs and the floodway run)* must be obtained and then reproduced on the requestor's equipment to produce the duplicate effective model. This is required to assure that the effective model input data has been transferred correctly to the requestor's equipment and to assure that the revised data will be integrated into the effective data to provide a continuous FIS model upstream and downstream of the revised reach.

☐ Corrected Effective Model — Natural ☐ Floodway ☐

The corrected effective model is the model that corrects any errors that occur in the duplicate effective model, adds any additional cross sections to the duplicate effective model, or incorporates more detailed topographic information than that used in the currently effective model. The corrected effective model must not reflect any man-made physical changes since the date of the effective model. An error could be a technical error in the modeling procedures, or any construction in the floodplain that occurred prior to the date of the effective model but was not incorporated into the effective model.

☐ Existing or Pre-Project Conditions Model — Natural ☐ Floodway ☐

The duplicate effective or corrected model is modified to produce the existing or pre-project conditions model to reflect any modifications that have occurred within the floodplain since the date of the effective model but prior to the construction of the project for which the revision is being requested. If no modification has occurred since the date of the effective model, then this model would be identical to the corrected effective or duplicate effective model.

☐ Revised or Post-Project Conditions Model — Natural ☐ Floodway ☐

The existing or pre-project conditions model *(or duplicate effective or corrected effective model, as appropriate)* is revised to reflect revised or post-project conditions. This model must incorporate any physical changes to the floodplain since the effective model was produced as well as the effects of the project. When the request is for proposed project this model should reflect proposed conditions.

☒ Other: Please attach a sheet describing all other models or calculations submitted. — Natural ☒ Floodway ☐

4. MODEL PARAMETERS (from model used to revise 100-year water surface elevation)

1. Discharges:

	Upstream Limit	Downstream Limit
10-year		
50-year		
100-year	215 cfs	2040 cfs
500-year		

Attach diagram showing changes in 100-year discharge

2. Explain how the starting water surface elevations were determined Slope-Area method and with computed known WSEL.

3. Give range of friction loss coefficients *(Manning's "N")* Channel 0.025-0.03

Overbanks 0.03-0.055

If friction loss coefficients are different anywhere along the revised reach from those used to develop the FIRM, give location, value used in the effective FIS, and revised values and an explanation as to how the revised values were determined.

Location	FIS	Revised
N/A		

Explain:

4. Describe how the cross section geometry data were determined *(e.g., field survey, topographic map, taken from previous study)* and list cross sections that were added.

Most cross-sections were photogrametrically digitized by a mapping company, and a few sections were digitized from 2 feet contours. Topography was flown for this project at a scale of 1" = 200', 2' contour interval.

4. MODEL PARAMETERS (Cont'd)

5. Explain how reach lengths for channel and overbanks were determined:

All cross sections are situated perpendicular to the flow extending over banks across the entire floodplain. Sections are spaced approximately 600 feet apart. Additional sections were placed where necessary to model the channel.

5. RESULTS (from model used to revise 100-year water surface elevations)

1. Do the results indicate:

a. Water surface elevations higher than end points of cross sections? ☒ Yes ☐ No
Weir flow over the road. Refer to Section 3, Appendix IV.

b. Supercritical depth? ☐ Yes ☒ No

c. Critical depth? ☒ Yes ☐ No
Areas of street flow and confined areas with low Manning's 'n' value.

d. Other unique situations? ☐ Yes ☒ No

If yes to any of the above, attach an explanation that discusses the situation and how it is presented on the profiles, tables, and maps.

2. What is the maximum change in energy gradient between cross-sections? 7.27 feet

Specify location Between Sections 11.354 and 11.498

3. What is the distance between the cross-sections in 2 above? 660 feet

Specify location N/A

4. What is the maximum distance between cross-sections? 920 feet

Specify location Between Section 11.875 and 11.701

5. Floodway determination

a. What is the maximum surcharge allowed by the community or State? N/A foot

b. What is the maximum surcharge for the revised conditions? N/A foot

Specify location N/A

c. What is the maximum velocity? N/A fps

Specify location N/A

Explain: Floodway is not determined.

d. Are there any negative surcharge values at any cross-section? ☐ Yes ☒ No

If yes, the floodway may need to widen. If it is not widened, please explain and indicate the maximum negative surcharge.

5. RESULTS (Cont'd)

6. Is the discharge value used to determine the floodway anywhere different from that used to determine the natural 100-year flood elevations? . . . . . ☐ Yes ☒ No

If yes, explain:

_____

_____

_____

7. Do 100-year water surface elevations increase at any location? . . . . . ☐ Yes ☒ No

If yes, please attach a list of the locations where the increases occur, state whether or not the increases are located on the requestor's property, and provide an explanation of the reason for the increases.

_____

_____

_____

Please attach a completed comparison table entitled: Water Surface Elevation Check (See page 6)

6. REVISED FIRM/FBFM AND FLOOD PROFILES

A. The revised water surface elevations tie into those computed by the effective FIS Model *(10-, 50-, 100-, and 500-year)*, downstream of the project at cross-section N/A within N/A feet and upstream of the project at cross section N/A within N/A feet.

B. The revised floodway elevations tie into those computed by the effective FIS model, downstream of the project at cross section N/A within N/A feet and upstream of the project at cross section N/A within N/A feet.

C. Attach profiles, at the same vertical and horizontal scale as the profiles in the effective FIS report, showing stream bed and profiles of all floods studied (without encroachment). Also, label all cross sections, road crossings (including low chord and top-of-road data), culverts, tributaries, corporate limits, and study limits. If channel distance has changed, the stationing should be revised for all profile sheets.

D. Attach a Floodway Data Table showing data for each cross section listed in the published Floodway Data Table in the FIS report.

Proceed to Riverine/Coastal Mapping Form.

FEDERAL EMERGENCY MANAGEMENT AGENCY

WATER SURFACE ELEVATION CHECK

COMMUNITY NAME	FLOODING SOURCE	PROJECT NAME/IDENTIFIER

	EFFECTIVE			DUPLICATE EFFECTIVE			CORRECTED EFFECTIVE			EXISTING/PRE-PROJECT			REVISED/PROJECT		
SECNO	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]

COMMENTS:

1 - 100-year (natural) Water Surface Elevation 2 - Encroachment (floodway) Water Surface Elevation 3 - Surcharge Value

Include all cross sections in the models between tie-in points. Any interpolated values should be indicated in parentheses.

Sheet ___ of ___

Form 5
Riverine/Coastal Mapping

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE/COASTAL MAPPING FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: Clark County, Nevada

Flooding Source: Highway 95

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. MAPPING CHANGES

1. A topographic work map of suitable scale, contour interval, and planimetric definition must be submitted showing *(indicate N/A when not applicable)*:

		Included		
A.	Revised approximate 100-year floodplain boundaries (Zone A)	☐ Yes	☐ No	☒ N/A
B.	Revised detailed 100- and 500-year floodplain boundaries (100-year only)	☒ Yes	☐ No	☐ N/A
C.	Revised 100-year floodway boundaries	☐ Yes	☐ No	☒ N/A
D.	Location and alignment of all cross sections used in the revised hydraulic model with stationing control indicated	☒ Yes	☐ No	☐ N/A
E.	Stream alignments, road and dam alignments	☒ Yes	☐ No	☐ N/A
F.	Current community boundaries	☐ Yes	☒ No	☐ N/A
G.	Effective 100- and 500-year floodplain and 100-year floodway boundaries from the FIRM/FBFM reduced or enlarged to the scale of the topographic work map	☐ Yes	☐ No	☒ N/A
H.	Tie-ins between the effective and revised 100- and 500-year floodplains and 100-year floodway boundaries	☐ Yes	☐ No	☒ N/A
I.	The requestor's property boundaries and community easements	☐ Yes	☐ No	☒ N/A
J.	The signed certification of a registered professional engineer	☒ Yes	☐ No	☐ N/A
K.	Location and description of reference marks	☒ Yes	☐ No	☐ N/A
L.	Vertical datum (example: NGVD, NAVD, etc.)	☒ Yes	☐ No	☐ N/A
M.	Coastal zone designations tie into adjacent areas not being revised	☐ Yes	☐ No	☒ N/A
N.	Location and alignment of all coastal transects used to revise the coastal analyses	☐ Yes	☐ No	☒ N/A

If any of the items above are marked no or N/A, please explain: This reach was not previously studied. No floodways included.

2. What is the source and date of the updated topographic information *(example: orthophoto maps, July 1985; field survey, May 1979, beach profiles, June 1987, etc.)*? Aerial Mapping, 6/2/93

3. What is the scale and contour interval of the following workmaps?
   a. Effective FIS N/A scale _____ Contour interval
   b. Revision Request 1" = 200' scale 2 Contour interval

NOTE: Revised topographic information must be of equal or greater detail.

4. Attach an annotated FIRM and FBFM at the scale of the effective FIRM and FBFM showing the revised 100-year and 500-year floodplains and the 100-year floodway boundaries and how they tie into those shown on the effective FIRM and FBFM downstream and upstream of the revision or adjacent to the area of revision for coastal studies.
   Attach additional pages if needed. Refer to Section 5, Appendix IV

5. Flood Boundaries and 100-year water surface elevations:

Has the 100-year floodplain been shifted or increased or the 100-year water surface elevation increased at any location on property other than the requestor's or community's? ☐ Yes ☐ No N/A

If yes, please give the location of shift or increase and an explanation for the increase.

Area not previously mapped for flood hazard determination.

a. Have the affected property owners been notified of this shift or increase and the effect it will have on their property? . . . . . ☐ Yes ☐ No

If yes, please attach letters from these property owners stating they have no objections to the revised flood boundaries if a LOMR is being requested.

b. What is the number of insurable structures that will be impacted by this shift or increase? _____

6. Have the floodway boundaries shifted or increased at any location compared to those shown on the effective FBFM or FIRM? . . . . . ☐ Yes ☐ No

If yes, explain:

N/A

7. If a V-zone has been designated, has it been delineated to extend landward to the heel of the primary frontal dune? . . . . . ☐ Yes ☐ No

If no, explain:

N/A

8. Manual or digital map submission:

☒ Manual
☐ Digital

Digital map submissions may be used to update digital FIRMs (DFIRMs). For updating DFIRMs, these submissions must be coordinated with FEMA Headquarters as far in advance of submission as possible.

2. EARTH FILL PLACEMENT

1. The fill is: ☐ Existing ☐ Proposed

2. Has fill been/will be placed in the regulatory floodway? . . . . . ☐ Yes ☒ No

   If yes, please attach completed Riverine Hydraulic Analysis Form.

3. Has fill been/will be placed in floodway fringe *(area between the floodway and 100-year floodplain boundaries)*? . . . . . ☐ Yes ☒ No

   If yes, then complete A, B, C, and D below.

   A. Are fill slopes for granular materials steeper than one vertical on one-and-one-half horizontal? . . . . . ☐ Yes ☐ No

      If yes, justify steeper slopes _____

      _____

   B. Is adequate erosion protection provided for fill slopes exposed to moving flood waters? *(Slopes exposed to flows with velocities of up to 5 feet per second (fps) during the 100-year flood must, at a minimum, be protected by a cover of grass, vines, weeds, or similar vegetation; slopes exposed to flows with velocities greater than 5 fps during the 100-year flood must, at a minimum, be protected by stone or rock riprap.)* . . . . . ☐ Yes ☐ No

      If no, describe erosion protection provided _____

      _____

   C. Has all fill placed in revised 100-year floodplain been compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test Method or acceptable equivalent method? . . . . . ☐ Yes ☐ No

   D. Can structures conceivably be constructed on the fill at any time in the future? . . . . . ☐ Yes ☐ No

      If yes, provide certification of fill compaction (item C. above) by the community's NFIP permit official, a registered professional engineer, or an accredited soils engineer.

4. Has fill been/will be placed in a V-zone? . . . . . ☐ Yes ☒ No

   If yes, is the fill protected from erosion by a flood control structure such as a revetment or seawall? . . . . . ☐ Yes ☐ No

   If yes, attach the coastal structures form.

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE/COASTAL MAPPING FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Clark County, Nevada

Flooding Source: Rancho Drive

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. MAPPING CHANGES

1. A topographic work map of suitable scale, contour interval, and planimetric definition must be submitted showing *(indicate N/A when not applicable)*:

		Included		
A.	Revised approximate 100-year floodplain boundaries (Zone A)	☒ Yes	☐ No	☐ N/A
B.	Revised detailed 100- and 500-year floodplain boundaries (100-year only)	☒ Yes	☐ No	☐ N/A
C.	Revised 100-year floodway boundaries	☐ Yes	☐ No	☒ N/A
D.	Location and alignment of all cross sections used in the revised hydraulic model with stationing control indicated	☒ Yes	☐ No	☐ N/A
E.	Stream alignments, road and dam alignments	☒ Yes	☐ No	☐ N/A
F.	Current community boundaries	☐ Yes	☒ No	☐ N/A
G.	Effective 100- and 500-year floodplain and 100-year floodway boundaries from the FIRM/FBFM reduced or enlarged to the scale of the topographic work map	☐ Yes	☒ No	☐ N/A
H.	Tie-ins between the effective and revised 100- and 500-year floodplains and 100-year floodway boundaries	☒ Yes	☐ No	☐ N/A
I.	The requestor's property boundaries and community easements	☐ Yes	☐ No	☒ N/A
J.	The signed certification of a registered professional engineer	☒ Yes	☐ No	☐ N/A
K.	Location and description of reference marks	☒ Yes	☐ No	☐ N/A
L.	Vertical datum (example: NGVD, NAVD, etc.)	☒ Yes	☐ No	☐ N/A
M.	Coastal zone designations tie into adjacent areas not being revised	☐ Yes	☐ No	☒ N/A
N.	Location and alignment of all coastal transects used to revise the coastal analyses	☐ Yes	☐ No	☒ N/A

If any of the items above are marked no or N/A, please explain: Revise existing Zone A to Zone AE.

2. What is the source and date of the updated topographic information *(example: orthophoto maps, July 1985; field survey, May 1979, beach profiles, June 1987, etc.)*? Aerial Mapping 6/2/93

3. What is the scale and contour interval of the following workmaps?

   a. Effective FIS N/A scale _____ Contour interval

   b. Revision Request 1" = 200' scale 2 Contour interval

NOTE: Revised topographic information must be of equal or greater detail.

4. Attach an annotated FIRM and FBFM at the scale of the effective FIRM and FBFM showing the revised 100-year and 500-year floodplains and the 100-year floodway boundaries and how they tie into those shown on the effective FIRM and FBFM downstream and upstream of the revision or adjacent to the area of revision for coastal studies.

Attach additional pages if needed. Refer to Section 5, Appendix IV.

5. Flood Boundaries and 100-year water surface elevations:

Has the 100-year floodplain been shifted or increased or the 100-year water surface elevation increased at any location on property other than the requestor's or community's? ☒ Yes ☐ No

If yes, please give the location of shift or increase and an explanation for the increase.

Refer to Annotated D-FIRM, Section 5, Appendix IV Detailed Study

a. Have the affected property owners been notified of this shift or increase and the effect it will have on their property? . . . . . ☐ Yes ☒ No

If yes, please attach letters from these property owners stating they have no objections to the revised flood boundaries if a LOMR is being requested.

b. What is the number of insurable structures that will be impacted by this shift or increase? Not available

6. Have the floodway boundaries shifted or increased at any location compared to those shown on the effective FBFM or FIRM? . . . . . ☐ Yes ☐ No

If yes, explain:

N/A

7. If a V-zone has been designated, has it been delineated to extend landward to the heel of the primary frontal dune? . . . . . ☐ Yes ☐ No

If no, explain:

N/A

8. Manual or digital map submission:

☒ Manual
☐ Digital

Digital map submissions may be used to update digital FIRMs (DFIRMs). For updating DFIRMs, these submissions must be coordinated with FEMA Headquarters as far in advance of submission as possible.

2. EARTH FILL PLACEMENT

1. The fill is: ☐ Existing ☐ Proposed

2. Has fill been/will be placed in the regulatory floodway? . . . . . ☐ Yes ☒ No

   If yes, please attach completed Riverine Hydraulic Analysis Form.

3. Has fill been/will be placed in floodway fringe *(area between the floodway and 100-year floodplain boundaries)*? . . . . . ☐ Yes ☒ No

   If yes, then complete A, B, C, and D below.

   A. Are fill slopes for granular materials steeper than one vertical on one-and-one-half horizontal? . . . . . ☐ Yes ☐ No

      If yes, justify steeper slopes _____

      _____

   B. Is adequate erosion protection provided for fill slopes exposed to moving flood waters? *(Slopes exposed to flows with velocities of up to 5 feet per second (fps) during the 100-year flood must, at a minimum, be protected by a cover of grass, vines, weeds, or similar vegetation; slopes exposed to flows with velocities greater than 5 fps during the 100-year flood must, at a minimum, be protected by stone or rock riprap.)* . . . . . ☐ Yes ☐ No

      If no, describe erosion protection provided _____

      _____

   C. Has all fill placed in revised 100-year floodplain been compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test Method or acceptable equivalent method? . . . . . ☐ Yes ☐ No

   D. Can structures conceivably be constructed on the fill at any time in the future? . . . . . ☐ Yes ☐ No

      If yes, provide certification of fill compaction (item C. above) by the community's NFIP permit official, a registered professional engineer, or an accredited soils engineer.

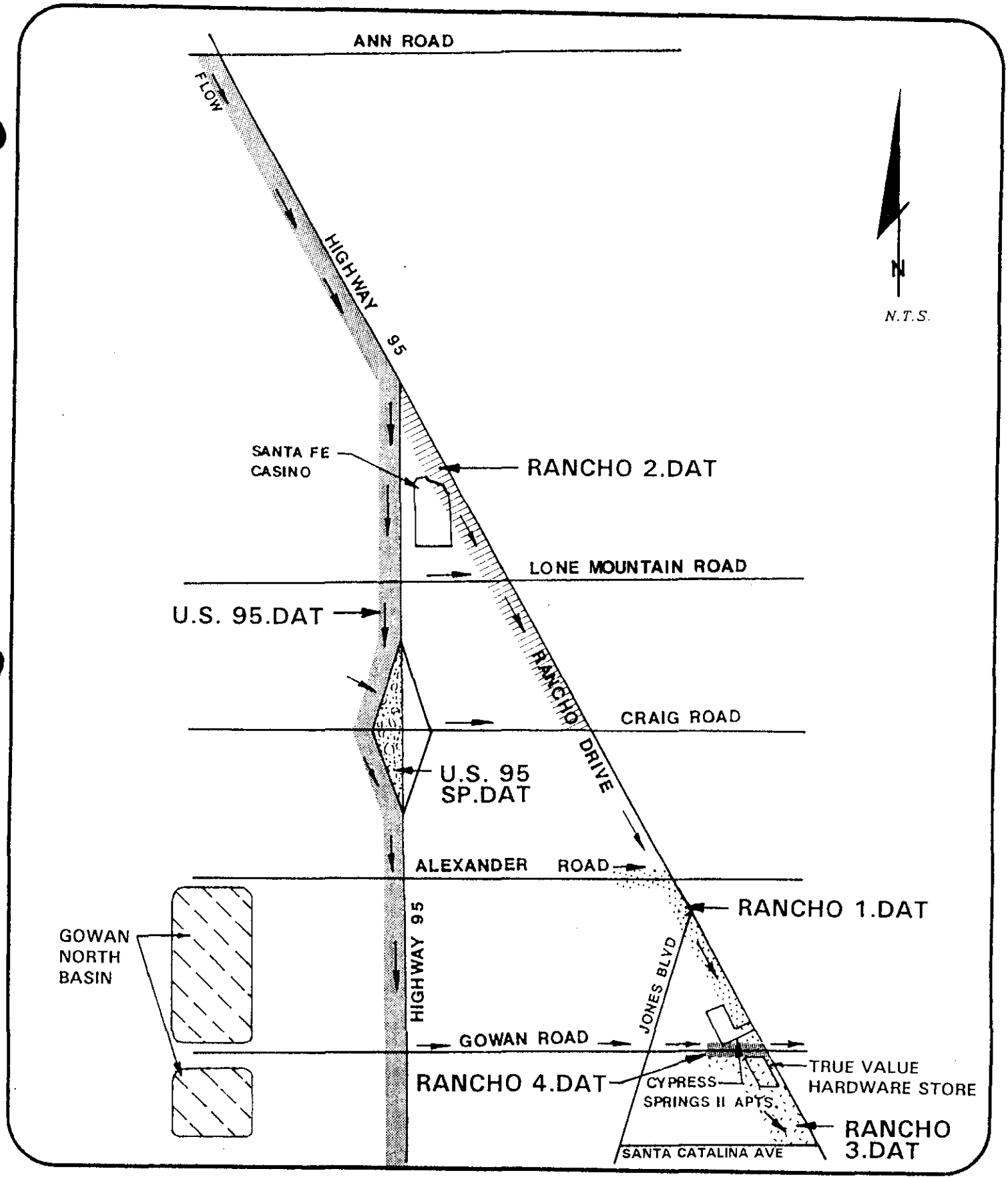
4. Has fill been/will be placed in a V-zone? . . . . . ☐ Yes ☒ No

   If yes, is the fill protected from erosion by a flood control structure such as a revetment or seawall? . . . . . ☐ Yes ☐ No

   If yes, attach the coastal structures form.

Section 2
HEC-2 Models and Cross-Sections

HEC-2 Model	Description
US95.dat	Highway 95 between Ann Road and Gowan Road
US95SP.dat	Split flow at Highway 95 and Craig Road Intersection
Rancho1.dat	Rancho Drive between Gowan Road and Alexander Road
Rancho2.dat	Rancho Drive between Craig Road and Highway 95
Rancho3.dat	Rancho Drive between Michael Way and Gowan Road
Rancho4.dat	Gowan Road between Rancho Drive and Miramar Drive



COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

FIGURE 11
HEC-2 MODEL
INDEX MAP

US95.dat

US95.DAT

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    09JUN94    TIME   12:09:42  *
*******************************************
```


```
*************************************
*  U.S. ARMY CORPS OF ENGINEERS     *
*  HYDROLOGIC ENGINEERING CENTER    *
*  609 SECOND STREET, SUITE D       *
*  DAVIS, CALIFORNIA 95616-4687     *
*          (916) 756-1104           *
*************************************
```


```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                   X
X     X  X        X     X             X
X     X  XXXXXXX   XXXXX              XXXXXXX
```

THIS RUN EXECUTED 09JUN94 12:09:42

```
**************************************
 HEC-2 WATER SURFACE PROFILES

 Version  4.6.2;  May 1991
**************************************


SPLIT FLOW BEING PERFORMED


SF      SPLIT FLOW OVER HIGHWAY 95


JC      NEAR THE INTERSECTION OF HIGHWAY 95 AND ALEXANDER RD.
JP      0       0       0       0       -1

TW      BETWEEN SECTIONS 10.555 AND 10.651
WS      4  10.555  10.651      -1       3
WC      0  2320.4      10    2318     240    2319     490  2319.9
```

```
T1  NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY   CVL JOB # : 930017
T2    BY COE & VAN LOO CONSULTANTS, INC.              FILE NAME: US95.DAT
T3              US 95

   HEC-2 MODEL FOR US 95 BETWEEN ANN RD AND GOWAN RD.



  MANY CULVERTS EXIST UNDER HIGHWAY 95 WITHIN THE STUDY REACH.
  THESE CULVERTS ARE PARALLEL TO CROSS SECTIONS USED IN THIS
  HEC-2 MODEL.
  SINCE IT IS IMPOSSIBLE TO MODEL CULVERTS PARALLEL TO CROSS SECTIONS WITH
  HEC-2, CALCULATIONS WERE DONE OUTSIDE OF THIS MODEL.
  X5 CARDS ARE USED TO INPUT WATER SURFACE ELEVATIONS AT THESE LOCATIONS.
  FOR BACKUP CALCULATIONS, REFER TO TECHNICAL APPENDIX.


  IN SOME AREAS "SSTA" AND ENDST" DO NOT REPRESENT THE ACTUAL FLOODING
  LIMITS. THE DELINEATION WAS BASED ON CONTOURS.

  DUE TO INEFFECTIVE FLOW AREAS OR ISLANDS IN THE FLOODPLAIN,
  IN SOME CASES, "TOPWID" DOES NOT REPRESENT THE FULL WIDTH OF THE FLOODPLAIN.


J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0        2         0         0        -1         0         0         0      2313.8       0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      -1        0        -1


J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     150        38        43         1        13        14        15        26        53        54
       4        25         8

  TRUE Q100 = 2840 CFS
  Q100 ADJUSTED FOR SPLIT FLOW ROUTINE


QT        1      3210
NC    0.025      0.04      0.03      0.1       0.3
ET                7.1                                                  10014.3   10607.2

  BEGIN RIVER MILE 10.00 @ CENTER LINE OF GOWAN RD.
```

```
X1   10.014        74    10106.1    10172.4         0         0         0
  US 95 AND GOWAN RD. INTERSECTION
  STARTING WSEL = 2314.0
  SEE TECHNICAL APPENDIX FOR CALCULATIONS

X5         1    2314.0
GR    2324.7    9935.0    2325.3    9954.8    2325.4    9975.8    2324.9    9994.3    2325.1   10000.0
GR    2325.5   10014.3    2325.2   10032.6    2324.7   10055.8    2323.5   10074.4    2317.5   10092.4
GR    2313.2   10106.0    2309.9   10106.1    2309.2   10115.3    2308.3   10123.1    2306.7   10126.5
GR    2306.1   10137.9    2306.7   10152.2    2307.7   10162.8    2309.9   10172.4    2310.7   10184.4
GR    2310.9   10210.9    2311.4   10234.7    2311.6   10262.8    2312.2   10298.9    2312.5   10323.7
GR    2312.4   10344.5    2312.6   10381.3    2313.1   10397.0    2313.8   10425.1    2313.5   10447.6
GR    2313.6   10476.4    2313.6   10488.7    2313.7   10540.5    2314.2   10581.9    2314.4   10607.2
GR    2314.2   10622.8    2313.5   10631.7    2312.5   10642.0    2311.7   10645.5    2312.6   10658.5
GR    2312.3   10675.4    2312.9   10675.4    2312.9   10680.8    2314.5   10693.0    2315.0   10703.5
GR    2315.2   10717.8    2324.8   10717.8    2324.8   10766.6    2314.8   10766.6    2314.8   10788.0
GR    2316.7   10788.0    2316.7   10803.7    2315.3   10803.7    2315.3   10808.9    2322.3   10808.9
GR    2322.3   10864.5    2314.5   10864.6    2314.5   10891.9    2313.8   10904.4    2313.8   10908.2
GR    2313.2   10908.2    2314.2   10928.0    2313.5   10947.5    2314.2   10947.5    2314.2   10952.9
GR    2315.1   10968.2    2315.8   10980.6    2316.1   10985.9    2316.1   10996.6    2316.1   11024.5
GR    2316.3   11052.7    2316.5   11069.3    2326.7   11069.3    2326.8   11109.0

ET         7.1                                                    10035.4   10501.6
X1   10.120        46    10099.3    10181.3       560       565       560
GR    2319.5    9940.0    2320.1    9961.9    2320.2    9978.4    2317.8    9999.2    2318.4   10000.0
GR    2320.2   10019.4    2320.2   10035.4    2319.1   10056.9    2316.8   10078.6    2311.9   10099.3
GR    2310.8   10109.8    2311.0   10124.5    2311.6   10150.3    2311.8   10181.3    2312.3   10208.8
GR    2312.5   10237.2    2312.3   10269.9    2312.3   10296.1    2313.2   10325.1    2314.6   10357.0
GR    2315.9   10390.1    2317.0   10429.8    2317.5   10462.6    2317.8   10490.7    2319.2   10501.6
GR    2317.7   10526.1    2316.5   10546.6    2316.5   10589.3    2315.7   10615.9    2314.7   10637.8
GR    2314.7   10654.0    2315.9   10662.5    2316.0   10673.8    2315.3   10693.1    2315.2   10699.4
GR    2316.0   10726.4    2316.3   10757.4    2316.5   10786.8    2316.4   10832.8    2317.0   10888.4
GR    2316.3   10894.9    2316.5   10948.6    2317.0   11003.8    2317.2   11057.2    2317.6   11117.9
GR    2317.8   11119.0

ET         7.1                                                    9976.1    10559.4
X1   10.223        57    10076.3    10149.4       545       545       545
GR    2314.7    9933.0    2315.1    9940.3    2315.5    9959.6    2316.0    9976.1    2313.2    9995.8
GR    2313.7   10000.0    2315.6   10016.5    2315.3   10033.1    2314.7   10054.3    2312.0   10076.3
GR    2311.6   10084.2    2312.0   10099.1    2312.3   10149.4    2312.3   10176.6    2313.1   10220.5
GR    2313.6   10271.0    2313.8   10336.6    2314.6   10406.3    2314.8   10451.9    2315.0   10495.1
GR    2314.4   10525.9    2314.6   10544.9    2318.5   10559.4    2318.0   10573.7    2316.1   10581.8
GR    2317.8   10593.3    2316.3   10603.8    2317.2   10612.5    2315.3   10621.3    2316.2   10647.0
GR    2317.7   10662.8    2317.6   10675.2    2317.4   10687.4    2317.2   10695.9    2317.8   10696.2
GR    2317.9   10716.7    2318.1   10762.4    2318.3   10783.8    2318.2   10792.5    2317.6   10792.6
GR    2318.1   10823.1    2318.2   10845.6    2318.7   10845.6    2318.8   10862.6    2319.2   10894.6
GR    2319.3   10920.3    2319.1   10950.7    2319.3   10990.1    2319.4   11023.8    2319.7   11045.8
GR    2319.7   11080.7    2319.8   11113.2    2319.7   11128.0    2319.1   11128.1    2319.5   11157.1
GR    2319.6   11180.8    2319.5   11189.0
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ET		7.1					9984.0	10750		
X1	10.333	62	10083.3	10197.4	585	585	580			
GR	2315.4	9939.0	2315.6	9945.0	2316.2	9966.6	2316.8	9984.0	2314.6	9996.0
GR	2314.2	10000.0	2314.7	10008.9	2316.1	10023.1	2316.3	10039.1	2315.6	10060.9
GR	2312.6	10083.3	2312.3	10092.1	2313.0	10101.8	2312.9	10143.1	2313.4	10197.4
GR	2313.2	10228.5	2313.8	10281.2	2314.3	10338.2	2314.4	10395.9	2315.2	10466.8
GR	2315.9	10539.1	2316.0	10565.5	2315.9	10601.6	2315.8	10615.2	2316.2	10650.4
GR	2316.5	10705.1	2316.8	10751.8	2316.8	10772.4	2315.9	10778.5	2316.5	10796.9
GR	2319.0	10808.4	2319.7	10811.2	2319.9	10825.3	2318.9	10838.3	2319.4	10838.4
GR	2319.4	10845.1	2321.7	10845.1	2321.4	10871.9	2321.1	10915.7	2321.0	10942.3
GR	2320.4	10952.4	2320.0	10952.4	2320.2	10972.4	2320.1	10992.5	2320.6	10992.5
GR	2320.6	11000.0	2321.9	11000.0	2321.9	11000.5	2327.7	11000.5	2327.6	11006.4
GR	2322.0	11006.5	2322.0	11018.6	2331.8	11018.6	2331.7	11071.5	2321.9	11071.5
GR	2321.9	11082.4	2321.9	11096.0	2331.5	11096.1	2331.5	11148.3	2322.0	11148.3
GR	2322.0	11169.3	2333.5	11170.1						

Q ADJUSTED FOR SPLIT FLOW ROUTINE
TOTAL Q100 @ SECTS 10.437 & 10.500 = 2840 CFS
70 CFS FLOWS WITHIN THE MEDIAN AREA TO SOUTH

QT	1	3140								
ET		7.1					10035.8	10900		
X1	10.432	48	10078.6	10157.7	520	520	520			
GR	2316.5	9938.0	2316.5	9942.7	2317.1	9963.4	2317.1	9980.0	2315.7	9992.8
GR	2314.8	9999.5	2314.8	10000.0	2315.8	10012.3	2316.8	10020.2	2317.2	10035.8
GR	2316.6	10050.3	2316.3	10057.9	2313.7	10078.6	2313.0	10088.5	2313.2	10100.7
GR	2313.7	10124.7	2313.8	10157.7	2313.9	10190.2	2314.2	10222.6	2314.4	10259.8
GR	2315.0	10307.8	2315.5	10359.7	2315.5	10399.6	2315.5	10423.1	2315.9	10455.0
GR	2316.2	10497.1	2316.7	10546.4	2316.7	10592.8	2317.0	10624.6	2316.9	10627.7
GR	2317.1	10636.3	2316.9	10645.0	2317.7	10653.8	2317.4	10690.7	2317.7	10737.4
GR	2318.7	10780.2	2318.5	10812.8	2318.6	10847.4	2318.8	10882.7	2319.5	10922.0
GR	2319.3	10964.3	2319.6	11001.9	2319.7	11036.2	2320.3	11082.2	2320.3	11134.6
GR	2320.7	11184.6	2321.3	11225.6	2321.5	11228.3				
ET		7.1					10019.9	10700		
NC				0.3	0.5					
NH	6	0.025	10049.4	0.02	10078.2	0.016	10146.2	0.025	10184.9	0.035
NH	10209	0.1	11162.0							
X1	10.495	54	10078.2	10184.9	335	350	335			
X3	10									
GR	2317.3	9938.0	2317.6	9943.4	2317.8	9963.4	2318.1	9979.2	2317.4	9991.4
GR	2317.0	10000.0	2317.7	10012.6	2318.2	10019.9	2318.0	10035.9	2317.5	10049.4
GR	2317.3	10057.9	2317.4	10069.0	2317.3	10072.9	2314.5	10078.2	2313.9	10090.4
GR	2313.9	10098.1	2313.9	10098.1	2313.8	10146.2	2314.6	10184.9	2315.7	10209
GR	2315.7	10256.8	2315.3	10304.3	2316.2	10350.2	2316.2	10408.3	2316.7	10462.3
GR	2316.9	10502.8	2317.2	10549.4	2317.7	10580.3	2317.5	10614.6	2317.9	10640.9
GR	2318.8	10672.9	2320.4	10682.4	2319.9	10691.3	2320.0	10696.2	2319.4	10704.5
GR	2318.1	10709.8	2318.3	10743.1	2318.3	10771.8	2318.8	10807.8	2318.9	10841.9
GR	2319.3	10875.1	2319.5	10915.7	2319.8	10949.9	2320.1	10980.4	2321.6	10999.5
GR	2320.2	11015.8	2320.7	11051.8	2322.6	11068.2	2321.2	11081.3	2320.9	11096.7
GR	2320.8	11121.7	2320.7	11145.4	2321.9	11153.9	2323.8	11162.0		

ALEXANDER AND US 95 INTERSECTION.

TOTAL Q100 FOR SECT. 10.523 & 10.555 = 3035 CFS
70 CFS FLOWS SOUTH WITHIN THE MEDIAN AREA.

WSEL = 2318.87- CALCULATED BY RATING CURVE METHOD
SEE TECHNICAL APPENDIX FOR CALCULATIONS

QT	1	3330								
NH	5	0.035	10018.3	0.03	10060.3	0.016	10094.5	0.025	10204.9	0.1
NH	11158									
ET		7.1					10057.6	10685.8		
X1	10.523	70	10094.5	10179.7	150	150	150			
X3	10									
X4 CARD USED TO INPUT JERSEY BARRIER										
X4	2	2320.2	10055.6	2320.2	10057.6					
X5	1	2318.87								
GR	2317.2	9937.0	2317.5	9940.4	2318.0	9961.2	2318.1	9977.5	2317.0	9990.1
GR	2316.7	9994.6	2317.4	10000.0	2317.9	10012.9	2318.1	10018.3	2317.9	10034.2
GR	2317.6	10048.5	2317.6	10055.5	2317.5	10060.3	2313.8	10060.4	2313.9	10094.5
GR	2314.0	10132.3	2313.9	10162.5	2314.1	10179.7	2316.2	10187.7	2316.5	10204.9
GR	2316.1	10230.8	2316.0	10275.0	2315.9	10328.6	2315.9	10371.3	2316.2	10414.9
GR	2316.5	10461.7	2317.1	10503.6	2317.2	10537.9	2318.3	10565.2	2318.8	10587.6
GR	2317.2	10606.1	2316.8	10626.0	2318.4	10631.8	2318.1	10656.4	2318.6	10673.8
GR	2319.5	10680.5	2320.0	10685.8	2319.6	10691.6	2319.3	10715.6	2319.2	10730.3
GR	2318.2	10744.3	2319.7	10760.1	2320.9	10773.5	2319.8	10779.3	2320.9	10790.0
GR	2321.1	10793.6	2322.0	10793.8	2321.2	10803.7	2330.6	10803.7	2330.6	10880.8
GR	2321.4	10881.2	2321.3	10888.8	2320.0	10904.1	2320.0	10909.4	2319.5	10909.4
GR	2320.1	10930.5	2319.7	10949.8	2320.3	10949.9	2320.3	10955.6	2321.8	10967.3
GR	2321.9	10975.9	2331.4	10976.0	2331.6	11029.1	2322.2	11029.2	2322.2	11054.0
GR	2320.6	11054.1	2321.3	11077.6	2322.3	11108.4	2322.9	11136.1	2323.1	11158
NC	0.025	0.03	0.03	0.1	0.3					
ET		7.1					10060.9	10628.0		
X1	10.555	84	10073.5	10239.3	165	165	165			
X4 CARD USED TO INPUT JERSEY BARRIER										
X4	2	2320.4	10058.9	2320.4	10060.9					
GR	2317.5	9944.0	2318.0	9966.6	2318.1	9982.4	2317.2	9993.2	2316.9	9997.7
GR	2317.0	10000.0	2317.8	10017.1	2318.3	10022.9	2318.3	10038.9	2317.8	10058.8
GR	2316.2	10073.5	2315.1	10093.2	2314.3	10102.3	2314.8	10112.0	2315.4	10117.6
GR	2314.4	10124.1	2314.6	10150.2	2315.0	10177.4	2314.8	10205.7	2314.7	10221.2
GR	2314.8	10229.4	2316.0	10234.8	2316.5	10239.3	2316.4	10267.0	2316.1	10289.1
GR	2314.8	10302.0	2316.6	10321.7	2317.0	10332.5	2317.0	10341.7	2318.1	10346.4
GR	2316.6	10359.1	2316.8	10390.6	2316.9	10437.8	2317.4	10479.2	2317.8	10502.9
GR	2317.0	10504.4	2317.7	10514.1	2317.5	10521.2	2318.7	10528.3	2318.4	10536.8
GR	2319.5	10549.8	2319.5	10558.8	2319.6	10599.6	2319.8	10628.0	2319.5	10644.1
GR	2318.4	10655.3	2318.5	10677.0	2318.6	10707.9	2318.7	10740.5	2319.1	10763.7
GR	2320.6	10773.9	2320.0	10790.9	2320.3	10798.7	2322.0	10799.2	2321.9	10822.1
GR	2340.0	10822.3	2329.5	10878.9	2321.2	10879.0	2320.8	10889.1	2319.6	10897.8
GR	2319.6	10902.9	2319.3	10903.7	2319.7	10921.8	2319.4	10941.2	2319.7	10942.6
GR	2319.9	10943.7	2320.2	10947.9	2321.4	10957.5	2321.4	10965.7	2330.4	10965.8
GR	2330.3	11030.4	2320.9	11030.5	2321.3	11057.9	2320.7	11058.0	2320.9	11069.0
GR	2321.4	11074.7	2321.9	11086.6	2323.1	11110.8	2323.6	11124.4	2324.1	11160.7
GR	2323.9	11196.1	2323.2	11227.1	2322.7	11256.6	2322.8	11276.4		

QT	1	3330								
ET		7.1					10022.3	10600		
X1	10.651	88	10127.4	10266.0	500	495	505			
GR	2318.5	9935.0	2318.9	9945.6	2320.0	9966.9	2319.3	9982.8	2318.4	9996.6
GR	2317.5	10000.0	2317.7	10006.4	2319.0	10014.8	2319.9	10022.3	2319.2	10040.2
GR	2318.3	10068.4	2316.0	10087.5	2315.3	10095.6	2315.2	10113.3	2315.4	10124.3
GR	2316.2	10127.4	2315.8	10131.7	2314.9	10133.0	2315.1	10149.1	2315.3	10173.6
GR	2315.0	10200.3	2315.6	10224.2	2315.4	10250.1	2315.8	10266.0	2317.2	10269.3
GR	2316.8	10272.9	2316.8	10282.0	2316.8	10300.1	2316.8	10316.1	2316.8	10348.5
GR	2316.9	10384.8	2316.8	10418.3	2316.8	10452.9	2316.6	10467.8	2317.1	10474.8
GR	2316.3	10476.0	2316.4	10483.1	2317.9	10490.6	2317.8	10503.7	2317.9	10515.8
GR	2318.5	10520.8	2319.8	10528.7	2320.9	10536.7	2321.3	10552.5	2330.4	10552.5
GR	2330.4	10616.7	2320.4	10616.7	2320.1	10633.4	2319.7	10638.8	2319.5	10640.1
GR	2319.9	10659.0	2319.5	10677.5	2319.9	10679.0	2320.0	10683.7	2322.2	10694.4
GR	2322.0	10701.3	2332.1	10701.3	2336.4	10762.3	2321.4	10762.3	2321.7	10784.8
GR	2323.1	10785.0	2323.0	10809.6	2323.1	10848.1	2323.1	10874.7	2322.0	10901.1
GR	2322.1	10932.2	2322.5	10956.3	2322.5	10964.0	2331.8	10964.1	2331.6	10986.0
GR	2322.8	10986.3	2322.7	11021.5	2322.6	11050.9	2322.6	11064.3	2324.9	11064.3
GR	2325.1	11092.3	2324.9	11128.1	2324.6	11152.2	2323.5	11163.4	2323.4	11168.5
GR	2323.1	11169.3	2323.4	11187.9	2323.0	11207.3	2323.7	11208.5	2323.6	11214.3
GR	2324.7	11225.2	2324.8	11231.1	2334.9	11231.1				
NC	0.025	0.045	0.03	0.1	0.3					
ET		7.1					10037.3	10600		
X1	10.756	85	10113.9	10265.5	550	550	555			
GR	2318.8	9903.0	2319.1	9906.1	2320.0	9927.7	2319.8	9939.2	2320.2	9943.1
GR	2320.7	9964.2	2320.6	9981.4	2319.5	9993.9	2318.8	10000.0	2319.2	10008.4
GR	2320.6	10020.3	2320.6	10037.3	2320.2	10048.9	2319.7	10062.1	2319.6	10077.8
GR	2319.1	10088.7	2317.2	10113.9	2316.1	10134.6	2316.0	10147.6	2316.0	10152.2
GR	2317.3	10156.0	2317.0	10162.4	2315.9	10162.4	2315.9	10179.3	2316.2	10224.3
GR	2316.5	10265.5	2316.5	10300.9	2318.0	10302.8	2317.5	10336.6	2317.7	10389.5
GR	2318.3	10419.7	2319.6	10429.4	2319.2	10437.0	2318.3	10448.6	2318.6	10465.4
GR	2318.9	10484.6	2318.7	10500.8	2318.6	10510.3	2322.7	10527.2	2324.0	10533.8
GR	2323.9	10554.2	2333.2	10554.2	2333.9	10590.5	2324.3	10590.5	2324.2	10620.9
GR	2322.7	10629.9	2322.5	10632.9	2322.3	10637.9	2321.7	10638.9	2322.9	10666.7
GR	2322.8	10683.8	2322.5	10704.3	2321.6	10716.3	2322.2	10718.0	2322.3	10723.8
GR	2324.5	10732.1	2324.0	10738.7	2335.4	10738.8	2336.0	10790.7	2323.7	10791.3
GR	2325.0	10802.3	2325.7	10808.2	2325.8	10817.8	2344.2	10817.9	2333.8	10874.6
GR	2325.1	10874.6	2323.8	10892.1	2323.5	10895.3	2323.2	10897.0	2323.5	10920.1
GR	2323.8	10938.0	2323.5	10964.8	2323.1	10975.6	2323.7	10977.4	2323.9	10982.3
GR	2324.3	10994.4	2324.9	10998.7	2335.5	10999.0	2335.3	11051.1	2324.7	11051.1
GR	2324.7	11061.7	2326.2	11061.8	2326.6	11074.5	2345.6	11074.5	2345.5	11093.0
ET		7.1					10130	11240		
X1	10.825	17.00	10170	10355	365	420	365			
GR	2319.7	9870	2317	9910	2320	9965	2318.6	10000	2320.4	10035
GR	2316.5	10080	2321.2	10130	2320	10150	2318	10170	2316	10185
GR	2315.5	10200	2316	10210	2317.25	10355	2318	10540	2318.73	10720
GR	2320	10900	2322	11240						

@ CRAIG RD. AND US 95 INTERSECTION FLOW SPLITS INTO TWO DIRECTIONS.

AREAS WEST SIDE OF US 95 SOUTHBOUND RAMPS ARE MODELED IN THIS HEC-2 RUN.
REFER TO CVL HEC-2 MODEL, US95SP.DAT, FOR AREAS BETWEEN US 95 SOUTH AND RAMPS.

1405 CFS OVER TOPS US 95 SOUTH ON-RAMP - SEE US95SP.DAT

QT	1	2670								
ET		7.1					10147.6	11248.3		
X1	10.848	64	10217.6	10260.1	125	125	120			
GR	2319.1	9829.0	2319.5	9843.5	2320.0	9855.6	2318.0	9874.9	2316.3	9898.4
GR	2316.4	9911.3	2318.2	9927.1	2320.4	9946.7	2320.8	9966.4	2321.1	9984.2
GR	2319.9	9994.3	2319.1	10000.0	2318.7	10004.5	2320.7	10018.5	2320.8	10025.1
GR	2320.8	10040.9	2320.4	10062.5	2317.9	10080.0	2317.0	10099.0	2317.3	10106.1
GR	2316.9	10112.5	2319.5	10112.5	2319.5	10117.3	2320.7	10134.0	2321.2	10147.6
GR	2320.8	10159.3	2320.4	10171.9	2319.5	10194.4	2317.8	10217.6	2316.4	10232.2
GR	2316.1	10247.8	2317.5	10256.3	2317.8	10260.1	2317.8	10293.8	2317.9	10338.8
GR	2317.8	10380.8	2317.7	10410.5	2318.2	10470.6	2318.5	10526.9	2318.5	10573.3
GR	2318.0	10617.9	2318.4	10639.2	2318.1	10663.3	2318.6	10689.9	2318.5	10707.1
GR	2318.4	10727.1	2319.1	10744.4	2319.4	10777.4	2319.4	10823.3	2319.6	10858.6
GR	2319.9	10883.1	2320.0	10897.1	2321.3	10904.7	2319.9	10915.8	2321.6	10926.2
GR	2320.2	10938.6	2320.3	10963.8	2320.5	10994.8	2320.4	11021.1	2320.8	11059.4
GR	2321.2	11109.4	2321.8	11164.1	2322.0	11220.1	2322.3	11248.3		

TOTAL FLOW @ THIS LOCATION = 2945 CFS
1680 CFS SPLITS AND FLOWS BETWEEN US 95 SOUTH AND RAMPS
FLOWS COMBINE AGAIN @ SECTION 10.825

NC	0.025	0.055	0.03	0.1	0.3					
QT	1	1265								
ET		7.1					10300.9	11150		
X1	10.938	67	10342.0	10397.3	480	460	480	.		
GR	2321.1	9683.9	2321.5	9689.4	2321.9	9707.4	2322.2	9723.4	2318.7	9748.0
GR	2317.5	9758.0	2316.7	9780.6	2316.9	9815.7	2317.2	9859.5	2317.2	9890.7
GR	2317.3	9906.2	2320.3	9929.6	2321.7	9947.5	2322.3	9966.4	2322.3	9985.6
GR	2320.8	9999.8	2320.5	10000.0	2320.5	10005.4	2321.7	10017.8	2322.4	10025.3
GR	2322.4	10041.3	2321.4	10063.5	2318.5	10094.5	2316.8	10109.7	2316.8	10117.2
GR	2317.8	10127.0	2318.2	10166.4	2318.2	10212.7	2318.6	10249.3	2318.9	10259.2
GR	2320.7	10274.9	2321.1	10285.7	2321.2	10300.9	2320.7	10320.0	2319.0	10342.0
GR	2318.1	10371.4	2317.8	10387.3	2319.4	10397.3	2319.8	10400.1	2319.0	10410.8
GR	2319.3	10466.9	2319.4	10528.2	2319.4	10578.2	2319.8	10640.1	2320.0	10682.2
GR	2320.0	10693.3	2320.5	10701.2	2320.2	10713.9	2320.2	10732.3	2320.2	10745.0
GR	2320.4	10778.0	2320.7	10820.8	2320.9	10836.8	2320.8	10882.0	2321.3	10937.7
GR	2321.6	10962.0	2322.0	10987.5	2321.8	11009.7	2322.4	11030.7	2322.5	11062.7
GR	2322.6	11096.2	2322.6	11142.2	2323.1	11183.1	2323.1	11229.3	2323.4	11259.3
GR	2323.6	11289.7	2323.6	11301.3						
ET		7.1					10352.2	11340.2		
X1	11.015	89	10462.5	10519.9	405	430	405			
GR	2327.7	9604.9	2328.1	9609.9	2328.6	9630.9	2329.6	9644.4	2330.0	9660.7
GR	2328.0	9673.9	2322.3	9694.8	2319.1	9707.9	2318.3	9719.6	2317.7	9756.3
GR	2317.6	9806.5	2317.9	9846.2	2317.8	9855.6	2317.3	9860.9	2318.3	9865.1
GR	2318.6	9888.9	2319.2	9913.4	2320.7	9931.7	2321.7	9941.6	2322.2	9947.9
GR	2322.7	9959.3	2322.8	9970.2	2322.5	9986.8	2321.9	10000.0	2321.3	10007.7
GR	2322.3	10019.1	2322.8	10025.3	2322.9	10042.5	2322.8	10064.7	2322.3	10074.0
GR	2320.3	10081.7	2317.4	10085.9	2317.2	10093.9	2317.3	10137.6	2317.1	10166.5

GR	2316.9	10200.8	2319.6	10205.2	2319.7	10232.6	2320.2	10270.9	2320.4	10298.2
GR	2320.8	10313.7	2323.1	10324.6	2328.4	10340.9	2330.1	10348.4	2330.5	10352.2
GR	2330.1	10370.5	2328.7	10394.1	2328.0	10409.0	2326.8	10422.0	2323.6	10437.9
GR	2321.3	10462.5	2320.1	10486.7	2319.5	10504.2	2321.4	10514.2	2322.3	10519.9
GR	2321.0	10525.1	2320.8	10541.4	2321.3	10572.4	2329.5	10572.4	2329.2	10627.8
GR	2321.0	10627.9	2320.9	10649.3	2320.9	10683.3	2321.0	10697.6	2321.7	10702.4
GR	2321.0	10712.2	2321.4	10724.3	2321.5	10772.2	2321.7	10846.0	2321.7	10918.9
GR	2322.1	10981.8	2322.3	11009.2	2322.5	11018.4	2322.5	11032.8	2322.7	11049.6
GR	2322.6	11087.5	2322.9	11104.7	2322.6	11112.5	2322.8	11123.8	2323.3	11132.9
GR	2323.1	11168.5	2323.9	11220.4	2324.3	11267.5	2324.5	11300.8	2325.5	11312.3
GR	2325.9	11320.5	2324.5	11328.7	2324.3	11332.9	2324.6	11340.2		

CRAIG RD. AND US 95 INTERSECTION

NC	0.025	0.045	0.03	0.1	0.3					
ET		7.1					10353.7	11391.0		
X1	11.080	87	10460.3	10548.5	230	340	340			
GR	2327.6	9602.0	2328.1	9604.4	2328.7	9618.4	2329.7	9634.2	2330.3	9646.1
GR	2330.6	9657.8	2330.3	9662.1	2327.8	9681.3	2322.5	9700.2	2322.2	9702.4
GR	2318.3	9702.6	2318.0	9722.5	2318.2	9762.8	2318.2	9815.8	2318.9	9860.8
GR	2319.9	9887.7	2320.1	9912.7	2320.8	9923.4	2322.4	9936.1	2322.8	9948.4
GR	2323.2	9959.7	2323.2	9971.5	2323.2	9986.9	2322.1	9997.3	2321.8	10000.0
GR	2321.8	10006.4	2322.8	10017.5	2323.4	10027.2	2323.1	10042.3	2322.7	10055.4
GR	2322.5	10066.4	2322.5	10079.3	2322.5	10086.3	2316.3	10086.4	2317.6	10116.8
GR	2317.3	10156.5	2317.8	10192.8	2318.5	10204.4	2320.6	10214.0	2320.0	10240.3
GR	2319.6	10268.6	2319.6	10286.3	2320.2	10298.0	2324.0	10315.7	2327.6	10334.6
GR	2330.1	10349.8	2330.4	10353.7	2330.3	10359.2	2329.6	10372.1	2329.1	10382.9
GR	2328.5	10395.8	2328.0	10404.3	2326.9	10418.3	2324.9	10434.7	2321.9	10460.3
GR	2319.7	10479.0	2319.2	10501.8	2319.3	10519.4	2320.4	10548.5	2320.2	10591.9
GR	2320.8	10628.0	2321.1	10672.8	2321.1	10706.4	2321.1	10732.4	2321.6	10765.0
GR	2321.7	10800.3	2322.0	10838.2	2322.3	10880.4	2322.5	10923.4	2322.9	10969.3
GR	2323.3	11003.1	2322.5	11033.8	2322.7	11061.9	2322.9	11096.4	2322.9	11140.4
GR	2323.4	11188.8	2323.3	11235.1	2324.3	11280.6	2324.3	11314.3	2323.9	11341.6
GR	2324.1	11354.3	2325.5	11359.1	2325.2	11365.4	2324.3	11369.1	2324.5	11383.2
GR	2325.5	11389.9	2327.7	11391.0						

ET		7.1					10349.8	11356.0		
X1	11.123	66	10394.1	10495.8	220	220	230			
GR	2325.2	9634.0	2325.4	9638.4	2325.8	9646.5	2325.8	9660.4	2325.6	9675.6
GR	2324.0	9690.8	2320.6	9717.2	2318.6	9729.6	2318.9	9772.9	2319.2	9831.1
GR	2319.3	9874.0	2319.6	9907.7	2321.9	9929.2	2323.8	9943.3	2324.4	9954.5
GR	2324.4	9966.8	2323.7	9982.9	2322.8	9994.3	2322.5	10000.0	2323.2	10012.8
GR	2324.2	10021.3	2323.9	10038.4	2323.7	10050.0	2323.5	10059.7	2322.2	10071.7
GR	2319.3	10093.9	2319.2	10120.3	2320.0	10162.6	2320.5	10197.9	2320.1	10224.6
GR	2319.1	10246.9	2319.7	10267.7	2320.8	10283.8	2322.9	10304.8	2324.1	10319.8
GR	2324.9	10327.9	2325.0	10331.3	2325.2	10336.6	2325.3	10349.8	2324.9	10361.6
GR	2324.2	10370.1	2321.2	10394.1	2319.8	10411.7	2319.5	10421.4	2320.0	10440.1
GR	2320.2	10448.9	2320.5	10495.8	2320.5	10565.3	2320.6	10624.2	2320.8	10693.6
GR	2321.4	10737.4	2321.0	10752.1	2321.3	10790.3	2321.7	10844.8	2322.1	10901.1
GR	2322.1	10958.4	2322.9	11019.5	2322.6	11079.0	2323.0	11148.3	2323.2	11214.0
GR	2323.8	11281.5	2324.1	11319.7	2323.9	11329.6	2323.8	11344.6	2324.4	11355.1
GR	2325.0	11356.0								

NC	0.025	0.04	0.03	0.1	0.3					
QT	1	2945								
ET		7.1					10158.4	11200		
X1	11.241	48	10184.8	10308.7	620	615	620			
GR	2322.3	9807.0	2322.8	9836.3	2320.8	9856.6	2319.6	9875.3	2319.6	9891.4
GR	2319.7	9907.1	2321.7	9927.8	2322.6	9942.5	2324.1	9965.3	2324.5	9981.7
GR	2322.4	10000.0	2324.3	10021.6	2324.3	10037.5	2323.5	10059.6	2321.8	10076.6
GR	2320.5	10088.9	2320.2	10108.6	2320.1	10131.5	2323.0	10158.4	2322.3	10184.8
GR	2320.4	10200.0	2320.8	10241.8	2321.0	10274.7	2321.5	10308.7	2320.9	10322.7
GR	2321.5	10332.9	2321.3	10379.3	2321.3	10424.5	2321.5	10469.0	2321.7	10522.5
GR	2321.9	10557.6	2322.0	10592.7	2322.2	10642.1	2322.4	10683.4	2322.5	10717.5
GR	2322.7	10757.8	2322.8	10809.0	2323.0	10860.3	2323.2	10900.5	2323.4	10945.0
GR	2323.5	10998.9	2323.7	11040.7	2324.1	11097.8	2324.5	11167.9	2325.0	11251.5
GR	2325.0	11285.2	2325.4	11328.5	2325.2	11337.1				
ET		7.1					10018.6	11100		
X1	11.364	38	10104.1	10347.0	650	650	650			
GR	2324.0	9922.0	2324.5	9950.9	2324.9	9962.7	2324.9	9979.3	2323.0	9998.9
GR	2323.0	10000.0	2325.3	10018.6	2324.7	10046.9	2323.8	10085.4	2322.0	10104.1
GR	2320.9	10116.0	2320.8	10138.2	2321.1	10167.1	2321.4	10235.5	2321.5	10284.5
GR	2321.8	10347.0	2322.2	10428.1	2322.6	10491.5	2322.8	10549.2	2323.1	10614.6
GR	2323.3	10659.7	2323.7	10719.9	2323.7	10781.3	2323.9	10835.3	2324.0	10887.4
GR	2324.2	10941.8	2324.4	10983.0	2324.8	11036.3	2325.0	11075.5	2325.3	11121.2
GR	2325.2	11162.5	2325.3	11196.7	2325.1	11234.3	2327.2	11244.7	2326.1	11249.9
GR	2327.0	11257.2	2326.7	11265.4	2326.0	11273.1				
ET		7.1					10035.7	11100		
X1	11.479	47	10076.8	10409.3	610	600	610			
GR	2324.0	9930.0	2324.6	9935.2	2325.2	9963.2	2325.0	9979.6	2323.2	9994.5
GR	2323.3	10000.0	2325.2	10018.8	2325.2	10035.7	2325.0	10048.0	2324.6	10057.1
GR	2322.1	10076.8	2321.2	10086.7	2320.5	10095.3	2320.8	10117.3	2320.8	10163.3
GR	2320.9	10204.9	2320.9	10236.3	2321.1	10267.6	2321.4	10322.8	2321.6	10365.0
GR	2321.9	10409.3	2322.2	10456.4	2322.5	10513.1	2322.6	10552.8	2322.9	10609.0
GR	2323.1	10653.1	2323.2	10697.8	2323.2	10757.0	2323.6	10811.4	2324.2	10856.6
GR	2324.3	10902.6	2324.4	10948.3	2324.6	10978.3	2324.9	11022.4	2325.1	11068.2
GR	2325.2	11116.4	2325.3	11147.2	2325.5	11163.9	2325.5	11191.1	2326.2	11217.0
GR	2325.8	11235.3	2327.7	11248.7	2326.8	11260.2	2327.6	11271.0	2327.5	11280.0
GR	2326.6	11288.5	2326.3	11293.0						
NC	0.03	0.035	0.03	0.1	0.3					
ET CARD IS USED TO BLOCK OUT INEFFECTIVE FLOW AREA.										
QT	1	225								
ET		7.1					10018.3	10136.8		
X1	11.606	68	10018.3	10136.8	665	920	665			
GR	2325.6	9951.0	2326.2	9974.2	2326.5	9989.8	2324.4	10000.0	2326.7	10018.3
GR	2326.3	10047.6	2325.5	10067.6	2324.3	10083.4	2322.9	10098.0	2321.9	10105.6
GR	2321.8	10110.1	2322.4	10120.6	2322.7	10127.9	2327.3	10136.8	2327.4	10149.6
GR	2330.2	10157.3	2330.6	10163.8	2330.3	10171.1	2329.2	10180.3	2327.2	10195.2
GR	2327.2	10208.4	2322.9	10235.9	2322.9	10312.5	2325.5	10340.9	2326.2	10357.7
GR	2325.7	10367.8	2324.1	10384.3	2324.7	10414.7	2324.8	10438.1	2325.0	10446.3
GR	2325.8	10457.9	2325.1	10470.3	2324.1	10478.3	2323.2	10483.6	2323.0	10601.5
GR	2324.7	10611.8	2325.5	10626.3	2326.4	10637.2	2325.9	10647.3	2325.0	10654.3
GR	2325.1	10660.6	2325.3	10670.7	2324.1	10676.1	2324.7	10689.3	2324.7	10703.4

GR	2324.7	10721.8	2324.4	10731.7	2324.0	10739.4	2324.8	10749.5	2325.2	10770.1
GR	2325.2	10792.2	2325.4	10806.5	2325.9	10822.1	2326.2	10843.0	2326.1	10859.6
GR	2325.2	10875.3	2324.6	10898.5	2324.8	10925.0	2325.2	10955.1	2325.2	11005.9
GR	2325.5	11067.5	2325.6	11126.8	2325.9	11187.2	2326.3	11238.7	2326.5	11267.8
GR	2326.5	11287.8	2326.7	11305.3	2327.6	11307.0				

ET CARD IS USED TO BLOCK OUT INEFFECTIVE FLOW AREA.

ET		7.1					10038.7	10141.3		
X1	11.656	84	10060.1	10133.0	265	265	265			
GR	2325.6	9941.0	2325.6	9941.0	2326.2	9943.5	2326.7	9977.6	2326.5	9982.3
GR	2324.4	9998.9	2324.4	10000.0	2326.4	10021.6	2326.4	10038.7	2325.8	10060.1
GR	2323.3	10082.4	2321.9	10095.9	2321.7	10102.5	2321.9	10109.4	2322.0	10114.4
GR	2322.0	10121.6	2325.1	10133.0	2327.0	10141.3	2329.3	10149.4	2329.1	10154.1
GR	2328.0	10156.8	2328.3	10165.8	2333.2	10178.6	2335.6	10187.9	2335.0	10193.9
GR	2335.0	10200.3	2331.2	10213.8	2327.3	10237.0	2326.5	10262.0	2326.5	10279.4
GR	2324.3	10306.1	2322.6	10314.1	2322.9	10499.3	2323.3	10501.8	2325.0	10508.1
GR	2326.1	10512.9	2326.2	10536.9	2326.6	10575.2	2326.6	10610.9	2326.7	10647.4
GR	2327.1	10671.7	2327.4	10683.1	2325.4	10687.7	2325.2	10694.6	2325.9	10701.8
GR	2327.7	10715.1	2328.3	10726.9	2327.0	10739.9	2326.9	10753.9	2326.3	10771.9
GR	2325.7	10781.4	2325.2	10783.4	2326.2	10809.5	2325.8	10841.3	2326.1	10843.4
GR	2326.2	10857.0	2326.5	10874.8	2326.5	10903.3	2326.8	10941.3	2326.8	10957.4
GR	2328.1	10962.7	2324.9	10971.0	2325.5	10991.7	2326.1	11001.0	2328.0	11019.9
GR	2328.7	11041.6	2328.6	11052.0	2329.3	11058.6	2329.3	11084.1	2329.4	11106.3
GR	2329.2	11113.6	2326.4	11121.6	2326.8	11141.6	2326.7	11155.4	2327.3	11157.9
GR	2327.1	11167.8	2329.3	11176.7	2329.4	11203.4	2329.4	11228.6	2329.1	11243.8
GR	2328.5	11257.5	2326.8	11267.9	2326.5	11268.9	2327.1	11304.0		

ET		7.1					10038.3	10169.7		
X1	11.737	88	10063.6	10149.0	430	430	430			
GR	2326.2	9947.0	2326.5	9968.8	2326.5	9985.4	2324.8	10000.0	2326.5	10022.2
GR	2326.5	10038.3	2325.6	10063.6	2323.6	10085.6	2322.2	10098.1	2321.8	10112.8
GR	2321.5	10121.6	2324.2	10139.6	2325.6	10149.0	2327.7	10159.8	2328.6	10169.7
GR	2327.7	10184.8	2325.7	10204.6	2325.3	10224.6	2325.7	10253.7	2326.1	10281.7
GR	2326.6	10302.5	2327.6	10316.2	2328.7	10328.0	2329.9	10341.5	2330.0	10348.7
GR	2329.7	10357.3	2328.0	10367.5	2327.3	10382.5	2327.7	10390.4	2328.3	10410.8
GR	2328.4	10452.0	2326.6	10469.5	2327.0	10485.0	2326.7	10499.7	2328.0	10507.8
GR	2328.7	10521.0	2328.5	10549.1	2328.5	10566.5	2329.3	10575.6	2330.5	10581.9
GR	2329.7	10599.3	2328.9	10609.2	2326.8	10617.4	2327.6	10638.9	2327.0	10658.4
GR	2328.5	10669.0	2329.1	10681.4	2329.1	10702.2	2329.2	10728.7	2329.2	10746.0
GR	2329.0	10754.7	2328.0	10764.7	2327.9	10776.2	2328.4	10785.8	2331.0	10796.7
GR	2333.1	10806.5	2333.5	10813.4	2332.1	10823.6	2327.7	10845.4	2328.1	10854.7
GR	2327.5	10860.3	2328.1	10882.2	2327.6	10902.8	2328.0	10915.1	2329.4	10927.6
GR	2330.1	10937.2	2330.6	10942.8	2330.6	10962.4	2329.2	10972.6	2329.3	10996.5
GR	2329.4	11024.9	2329.3	11040.6	2328.8	11051.6	2327.5	11063.8	2327.4	11087.7
GR	2327.2	11104.9	2330.0	11115.8	2330.0	11137.0	2329.8	11173.3	2329.9	11193.1
GR	2329.3	11207.1	2328.9	11225.8	2329.9	11228.0	2328.6	11230.7	2329.1	11242.2
GR	2329.5	11254.4	2329.8	11280.7	2329.9	11291.1				

ET		7.1					10014.5	10173.0		
X1	11.828	89	10063.3	10153.8	480	480	480			
GR	2325.8	9945.0	2326.4	9969.2	2326.5	9984.7	2325.0	9995.9	2325.4	10000.0
GR	2326.9	10014.5	2326.8	10031.0	2326.7	10044.8	2326.0	10063.3	2324.3	10076.1
GR	2323.0	10091.6	2322.3	10101.3	2322.4	10116.3	2322.6	10132.6	2324.1	10142.7
GR	2326.9	10153.8	2328.3	10161.9	2328.4	10173.0	2328.3	10186.5	2327.6	10203.3

GR	2326.1	10220.3	2325.8	10237.5	2325.5	10261.8	2325.6	10282.8	2326.1	10301.2
GR	2326.6	10316.0	2328.2	10327.8	2330.0	10335.7	2329.8	10342.3	2328.5	10352.2
GR	2328.8	10361.5	2330.0	10374.7	2331.0	10391.0	2331.7	10400.4	2331.6	10419.7
GR	2331.6	10439.9	2331.1	10452.5	2330.0	10460.4	2329.4	10464.1	2329.9	10482.3
GR	2329.5	10500.2	2329.7	10527.6	2330.0	10575.0	2330.5	10627.1	2330.6	10647.9
GR	2330.6	10687.4	2330.6	10729.1	2330.3	10755.9	2329.8	10777.1	2329.9	10782.8
GR	2329.9	10796.3	2329.7	10811.4	2330.9	10818.1	2331.3	10829.0	2331.6	10845.8
GR	2331.6	10857.3	2331.3	10870.0	2330.9	10876.8	2330.6	10883.8	2330.9	10893.2
GR	2330.2	10897.6	2330.0	10907.2	2327.6	10917.0	2326.4	10927.3	2326.7	10939.2
GR	2327.5	10950.6	2327.9	10964.7	2328.0	10983.6	2328.2	10997.8	2328.3	11010.6
GR	2328.4	11042.0	2328.1	11063.0	2328.2	11074.2	2328.4	11082.4	2328.7	11091.3
GR	2328.5	11096.0	2329.7	11102.4	2331.1	11114.4	2331.1	11128.2	2331.3	11144.1
GR	2331.2	11174.0	2331.1	11203.6	2330.9	11217.3	2330.6	11228.2	2329.1	11241.9
GR	2328.9	11249.6	2329.4	11267.7	2330.6	11290.1	2330.6	11292.1		

213 CFS DIVERTS THROUGH 2 - 6' X 2' RCB UNDER US 95

QT	1	437								
ET		7.1					10015.7	10210.7		
X1	11.915	86	10085.3	10199.1	465	465	460			
X5	1	2327.47								
GR	2328.2	9939.0	2328.5	9942.5	2328.5	9971.0	2328.0	9987.1	2326.1	10000.0
GR	2327.9	10015.7	2327.7	10035.6	2327.0	10065.0	2326.4	10085.3	2322.8	10092.7
GR	2322.8	10115.5	2323.2	10138.3	2323.3	10161.7	2323.6	10180.0	2324.1	10188.4
GR	2326.0	10199.1	2328.1	10210.7	2328.0	10216.9	2326.7	10225.9	2326.5	10238.4
GR	2327.0	10251.3	2327.9	10275.9	2329.9	10290.0	2329.6	10309.4	2328.8	10324.7
GR	2328.2	10328.8	2328.4	10338.5	2329.1	10356.8	2330.2	10370.5	2329.9	10382.0
GR	2329.6	10391.6	2333.4	10401.8	2333.6	10454.5	2333.1	10464.9	2331.7	10477.1
GR	2332.2	10491.2	2331.8	10507.2	2333.1	10521.1	2333.3	10549.3	2333.1	10574.5
GR	2333.3	10605.8	2333.3	10616.5	2333.6	10665.7	2333.1	10677.4	2331.7	10682.7
GR	2332.3	10697.7	2332.1	10712.4	2332.9	10721.6	2334.1	10733.7	2334.6	10742.1
GR	2334.0	10786.5	2333.5	10810.0	2333.5	10832.5	2333.7	10860.5	2334.0	10881.4
GR	2333.5	10887.6	2331.9	10895.7	2332.2	10913.9	2332.2	10926.4	2332.5	10930.1
GR	2334.0	10940.3	2333.8	10961.7	2333.7	10988.4	2333.5	11009.9	2332.8	11020.6
GR	2331.3	11028.9	2331.3	11031.5	2332.2	11037.9	2331.3	11045.6	2331.1	11054.0
GR	2331.5	11066.1	2332.1	11076.0	2333.6	11086.1	2334.2	11095.2	2333.6	11109.7
GR	2333.0	11125.7	2333.2	11149.5	2333.4	11178.3	2334.0	11200.3	2335.0	11217.5
GR	2335.0	11233.7	2335.2	11250.3	2334.4	11263.8	2333.8	11281.2	2332.1	11291.8
GR	2332.4	11297.3								

NC	0.03	0.045	0.03	0.1	0.3					
ET		7.1					10055.8	11160.4		
X1	12.025	66	10096.4	10207.7	580	570	580			
GR	2329.6	9933.7	2329.3	9962.1	2328.5	9984.0	2326.8	10000.0	2326.7	10002.6
GR	2329.0	10026.2	2328.8	10055.8	2328.2	10075.3	2326.0	10096.4	2324.9	10111.2
GR	2325.3	10147.9	2325.2	10184.3	2325.6	10207.7	2325.5	10236.7	2325.7	10260.8
GR	2325.3	10288.5	2325.5	10306.5	2325.0	10319.8	2331.0	10337.7	2334.6	10350.8
GR	2336.4	10359.9	2331.7	10375.0	2332.3	10396.1	2333.2	10402.2	2333.0	10426.8
GR	2333.4	10467.9	2333.0	10481.3	2332.0	10490.1	2329.5	10497.4	2330.3	10508.2
GR	2332.3	10514.3	2332.9	10527.4	2332.4	10539.0	2332.7	10554.0	2333.0	10577.2
GR	2333.5	10602.5	2334.4	10612.1	2335.5	10620.4	2335.8	10642.9	2336.2	10669.8
GR	2336.2	10686.2	2334.7	10698.7	2333.8	10702.8	2334.4	10723.8	2334.3	10737.9
GR	2336.2	10754.1	2336.1	10777.4	2336.2	10810.5	2336.2	10842.8	2336.2	10859.9
GR	2336.2	10954.9	2334.5	10974.3	2334.9	10989.7	2334.5	11006.9	2335.6	11015.0
GR	2336.0	11024.5	2336.1	11044.0	2336.4	11066.8	2336.1	11082.0	2334.4	11096.9

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GR   2334.7   11108.3   2335.2   11117.1   2338.6   11131.8   2340.9   11142.1   2342.2   11154.9
GR   2342.2   11160.4

QT        1       467
  WSEL = 2331.60'
  26 CFS DIVERTS THROUGH  24" RCP UNDER US 95
ET                7.1                                        10026.9     10350
X1   12.141        87   10096.6   10206.7       610       590       610
X5        1   2331.60
GR   2334.3    9935.5   2334.4    9935.5   2333.2    9971.9   2332.5    9976.8   2331.4    9993.0
GR   2331.0   10000.0   2331.9   10012.3   2333.6   10026.9   2333.0   10054.7   2332.6   10077.2
GR   2331.6   10089.9   2331.2   10096.6   2329.1   10104.9   2329.1   10116.8   2328.8   10128.9
GR   2329.1   10143.4   2329.6   10158.6   2330.1   10174.4   2330.4   10190.7   2330.8   10206.7
GR   2330.5   10218.4   2330.6   10222.0   2330.9   10230.1   2330.9   10239.4   2331.1   10252.8
GR   2331.3   10270.4   2331.7   10287.0   2331.4   10301.9   2331.4   10314.8   2331.3   10332.6
GR   2331.8   10353.5   2331.8   10368.2   2331.8   10381.7   2331.3   10395.5   2330.8   10406.4
GR   2330.9   10419.7   2331.2   10433.3   2331.1   10449.3   2331.2   10464.4   2331.2   10474.7
GR   2331.0   10477.5   2331.4   10489.4   2331.8   10496.4   2331.6   10500.2   2331.0   10509.7
GR   2329.9   10516.1   2328.8   10520.5   2328.6   10526.0   2330.7   10537.3   2333.8   10550.2
GR   2335.2   10560.6   2336.0   10568.7   2332.5   10576.5   2332.5   10589.7   2332.6   10602.0
GR   2333.8   10605.5   2335.0   10608.6   2334.4   10619.4   2333.3   10633.4   2334.0   10651.9
GR   2334.6   10672.8   2335.3   10690.9   2336.1   10706.3   2337.2   10715.9   2338.6   10726.2
GR   2339.1   10735.1   2339.2   10745.1   2338.7   10757.1   2337.7   10768.5   2337.8   10773.6
GR   2338.5   10781.3   2338.6   10787.9   2339.2   10863.9   2338.8   10877.0   2338.3   10885.6
GR   2337.3   10901.0   2337.5   10908.5   2337.9   10917.7   2337.7   10929.7   2337.5   10940.4
GR   2337.4   10954.0   2338.0   10965.6   2338.3   10975.7   2338.8   10992.5   2339.9   11037.9
GR   2340.4   11062.4   2340.0   11073.9
  298 CFS THRU 10 X 3.1 RCB UNDER US 95
  WSEL = 2338.2'

QT        1       765
ET                7.1                                        10050     10396.9
X1   12.256        72   10111.6   10139.3       615       595       610
X5        1   2338.2
GR   2339.0    9918.5   2338.6    9950.6   2338.1    9968.4   2337.2    9980.7   2336.2    9992.4
GR   2336.1    9997.9   2336.0   10000.0   2336.4   10006.3   2337.4   10016.5   2339.1   10032.2
GR   2338.7   10058.5   2337.9   10080.6   2337.3   10086.7   2337.2   10089.5   2338.0   10098.8
GR   2333.4   10104.9   2335.3   10111.6   2333.8   10119.2   2335.1   10130.9   2336.0   10139.3
GR   2336.6   10146.1   2337.2   10157.5   2337.8   10179.9   2338.1   10207.5   2338.4   10235.5
GR   2338.5   10260.8   2338.5   10273.1   2337.6   10276.6   2337.8   10281.4   2338.1   10284.3
GR   2338.1   10297.1   2338.1   10305.3   2337.8   10309.4   2337.9   10315.7   2338.4   10321.9
GR   2338.4   10329.1   2336.8   10337.4   2337.6   10350.8   2338.1   10375.4   2338.5   10385.4
GR   2343.0   10396.9   2338.6   10406.0   2338.8   10422.7   2338.8   10440.7   2339.0   10462.9
GR   2338.9   10480.8   2338.5   10495.5   2338.1   10508.2   2337.7   10517.7   2335.6   10526.7
GR   2335.6   10536.2   2337.4   10546.7   2338.9   10556.7   2339.1   10565.0   2339.1   10580.5
GR   2339.7   10598.5   2338.7   10610.4   2338.2   10614.8   2338.4   10624.2   2336.9   10635.6
GR   2339.4   10651.3   2340.7   10658.9   2340.7   10667.5   2342.0   10675.9   2342.3   10704.2
GR   2342.3   10769.1   2342.2   10826.4   2341.8   10934.8   2341.3   10951.5   2341.7   10975.3
GR   2341.8   10982.8   2341.8   10997.7
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ET                7.1                                          10056.9   10325.1
X1    12.375     69.00    10056.9   10125.7       620         620       625
X3        10
GR    2342.0    9923.4    2342.8    9933.3    2343.1      9947.9    2343.2    9963.8    2342.5    9982.9
GR    2342.6   10000.0    2343.0   10023.4    2343.4     10030.0    2344.2   10040.0    2344.3   10056.9
GR    2343.8   10079.1    2342.0   10094.6    2342.3     10099.6    2343.8   10112.3    2343.9   10125.7
GR    2343.9   10132.6    2342.4   10137.4    2343.4     10147.5    2343.6   10158.2    2343.7   10171.2
GR    2343.6   10176.2    2342.7   10180.8    2342.7       10200    2342.7   10267.7    2342.6   10285.4
GR    2342.5   10302.1    2342.4   10310.0    2342.6     10316.2    2345.1   10325.1    2345.1   10350.1
GR    2344.8   10382.4    2344.9   10391.6    2345.1     10398.9    2344.1   10404.8    2344.2   10418.7
GR    2344.0   10422.6    2342.7   10436.0    2344.2     10447.4    2346.5   10464.5    2348.1   10481.5
GR    2350.2   10492.5    2350.4   10502.6    2348.5     10512.2    2347.3   10521.3    2347.2   10528.5
GR    2347.7   10549.9    2347.0   10578.2    2346.4     10609.1    2346.1   10639.6    2345.4   10665.8
GR    2345.1   10691.8    2345.8   10708.5    2345.9     10723.8    2344.3   10737.7    2344.1   10747.9
GR    2342.9   10761.5    2342.5   10780.7    2342.3     10798.6    2343.1   10811.9    2344.9   10827.7
GR    2345.3   10847.4    2345.3   10861.4    2345.7     10896.0    2345.4   10964.9    2345.2   10977.1
GR    2345.8   10998.6    2346.0   11030.7    2346.5     11052.8    2346.6   11061.7

QT          1       527
  ET CARD USED TO BLOCK OUT INEFFECTIVE AREA
ET                7.1                                          10038.7     10300
X1    12.491       76    10038.7   10116.1       620         620       615
GR    2348.0    9917.9    2348.5    9941.1    2348.6      9953.9    2348.2    9961.4    2347.1    9981.9
GR    2345.9   10000.0    2345.9   10009.7    2346.1     10014.2    2347.4   10023.0    2349.6   10033.4
GR    2349.6   10038.7    2348.7   10073.1    2347.8     10085.6    2348.2   10099.1    2348.7   10116.1
GR    2348.0   10131.0    2347.7   10151.2    2347.8     10162.1    2348.3   10169.6    2344.3   10180.2
GR    2344.3     10189    2344.3     10199    2344.3     10215.9    2344.8   10236.1    2344.8   10249.6
GR    2344.7   10271.7    2344.9   10295.2    2345.6     10320.2    2346.4   10341.9    2347.6   10367.7
GR    2348.0   10387.0    2348.2   10417.2    2348.3     10451.4    2348.6   10474.0    2348.3   10488.2
GR    2348.1   10502.6    2347.9   10511.6    2345.8     10526.8    2346.5   10534.3    2346.6   10556.8
GR    2346.5   10577.1    2346.6   10590.0    2345.8     10593.7    2348.1   10612.3    2348.3   10639.4
GR    2348.6   10670.8    2348.0   10692.4    2348.3     10721.8    2348.7   10747.9    2349.1   10779.8
GR    2349.1   10817.5    2348.7   10832.0    2348.6     10844.5    2347.9   10855.4    2347.8   10857.8
GR    2348.0   10888.9    2348.2   10896.4    2348.5     10924.3    2349.2   10955.0    2349.6   10971.3
GR    2349.6   11010.3    2350.3   11024.3    2350.3     11028.6    2350.6   11050.7    2350.8   11089.5
GR    2350.8   11111.6    2350.5   11133.1    2351.3     11158.5    2351.5   11179.2    2351.7   11208.6
GR    2351.6   11232.1    2351.3   11254.8    2351.4     11266.1    2352.1   11279.5    2352.9   11303.9
GR    2353.0   11321.5

ET                7.1                                          10055     10317
X1    12.510     23.00     10080     10120       100         100       100
GR    2348.6     10000      2349     10055      2348       10080    2346.7     10090    2346.7     10110
GR      2348     10120    2348.1     10130      2348       10140    2346.3     10158    2346.3     10189
GR      2348     10211    2348.3     10270      2349       10317      2348     10370      2347     10415
GR      2348     10470    2348.7     10540      2348       10700      2348     10800      2347     10855
GR      2348     10895      2350     11015      2352       11300
  WSEL = 2352.9'
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QT	1	555								
ET		7.1					10047.6	10700		
X1	12.630	96	10085.3	10148.9	635	635	635			
X5	1	2352.9								
GR	2353.1	9922.0	2353.6	9939.6	2353.8	9953.3	2353.0	9958.2	2351.0	9968.4
GR	2350.3	9971.1	2349.9	9971.2	2349.9	9988.2	2350.2	10000.0	2350.4	10014.9
GR	2351.4	10019.7	2352.7	10021.7	2353.7	10027.9	2354.5	10032.4	2354.5	10036.9
GR	2354.5	10047.6	2354.1	10060.7	2353.7	10070.9	2353.0	10079.3	2352.9	10085.3
GR	2349.3	10085.4	2349.5	10106.2	2350.1	10116.5	2351.6	10131.2	2352.7	10148.9
GR	2352.4	10167.2	2352.2	10194.4	2352.7	10223.7	2352.3	10237.0	2352.7	10254.9
GR	2353.4	10269.3	2352.8	10284.1	2354.0	10302.0	2353.7	10318.5	2352.9	10330.6
GR	2352.7	10340.0	2353.2	10363.1	2352.7	10392.9	2352.9	10419.8	2352.8	10444.6
GR	2352.4	10463.3	2352.8	10485.4	2353.6	10507.5	2354.5	10527.8	2355.7	10552.6
GR	2357.3	10579.2	2357.6	10607.5	2357.9	10633.8	2357.3	10661.2	2356.0	10680.3
GR	2355.8	10693.7	2356.2	10712.7	2356.6	10726.3	2356.6	10737.2	2355.6	10756.1
GR	2355.3	10772.4	2355.3	10793.3	2355.7	10811.2	2354.9	10829.4	2354.7	10846.6
GR	2355.2	10869.7	2355.3	10908.7	2355.5	10921.9	2354.9	10941.0	2355.2	10949.3
GR	2356.0	10957.4	2356.2	10963.7	2355.5	10994.5	2355.9	11028.1	2355.6	11051.3
GR	2355.0	11062.2	2353.1	11074.5	2352.4	11080.1	2351.7	11080.1	2352.3	11104.1
GR	2351.9	11124.6	2352.5	11124.6	2352.5	11135.0	2354.2	11144.5	2354.7	11150.9
GR	2354.6	11172.7	2354.8	11197.6	2355.1	11220.1	2354.9	11242.8	2355.1	11269.6
GR	2355.5	11287.1	2356.2	11294.4	2356.5	11297.4	2355.2	11306.2	2354.3	11314.8
GR	2354.1	11322.8	2355.9	11338.6	2356.6	11355.3	2356.8	11378.9	2357.5	11406.1
GR	2358.0	11421.7								
ET		7.1					10031.1	10201.8		
X1	12.707	79	10071.0	10167.2	405	405	405			
GR	2354.9	9914.4	2355.5	9928.3	2355.9	9940.3	2356.3	9973.4	2356.4	10000.0
GR	2356.7	10031.1	2356.4	10048.8	2355.9	10071.0	2354.4	10111.8	2353.9	10127.8
GR	2354.0	10140.8	2352.8	10146.6	2355.2	10154.4	2355.7	10158.4	2355.9	10167.2
GR	2357.4	10180.3	2358.7	10189.2	2358.8	10193.5	2361.1	10201.8	2362.5	10209.7
GR	2360.9	10217.5	2359.2	10226.4	2358.9	10230.5	2359.6	10237.4	2358.8	10245.1
GR	2356.2	10257.8	2354.9	10266.8	2354.3	10271.6	2355.2	10287.4	2355.0	10298.6
GR	2354.5	10317.0	2354.5	10333.3	2354.7	10350.4	2354.9	10372.9	2354.5	10400.2
GR	2353.8	10428.6	2354.4	10456.5	2354.2	10485.1	2354.1	10514.1	2354.1	10544.6
GR	2354.5	10578.3	2354.7	10601.1	2356.0	10624.1	2356.3	10644.4	2356.9	10660.7
GR	2356.3	10674.7	2357.6	10695.8	2357.9	10712.0	2357.6	10729.1	2358.0	10746.6
GR	2357.2	10759.4	2358.0	10771.1	2359.2	10780.1	2360.1	10784.9	2358.6	10793.2
GR	2356.7	10801.4	2356.2	10805.8	2355.8	10906.0	2356.3	10969.3	2356.4	10987.7
GR	2356.3	11000.5	2354.9	11005.3	2354.1	11013.7	2353.9	11013.7	2354.5	11044.0
GR	2354.0	11068.9	2353.6	11082.5	2354.5	11106.4	2354.9	11136.5	2355.3	11166.3
GR	2355.4	11175.7	2356.2	11176.4	2356.3	11197.4	2356.3	11237.8	2356.4	11263.2
GR	2355.9	11264.3	2356.0	11283.1	2356.1	11316.4	2356.1	11331.2		

LIMIT OF DETAILED STUDY @ ANN RD.

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 10.014
WATER EL=X5 CARD= 2314.000

3470 ENCROACHMENT STATIONS= 10014.3 10607.2 TYPE= 1 TARGET= 592.900

10.014	7.90	2314.00	2311.82	2314.00	2314.23	.23	.00	.00	2309.90
2843.0	.9	1927.6	914.4	1.3	421.3	552.6	.0	.0	2309.90
.00	.74	4.58	1.65	.025	.030	.040	.000	2306.10	10103.47
.000736	0.	0.	0.	0	14	0	.00	461.88	10565.34

*SECNO 10.120

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .49

3470 ENCROACHMENT STATIONS= 10035.4 10501.6 TYPE= 1 TARGET= 466.199

10.120	3.83	2314.63	.00	2314.63	2315.03	.40	.74	.05	2311.90
2843.0	62.6	1597.5	1182.9	15.7	266.0	346.1	10.4	4.7	2311.80
.03	3.98	6.00	3.42	.025	.030	.040	.000	2310.80	10087.77
.003063	560.	560.	565.	3	0	0	.00	270.00	10357.77

*SECNO 10.223

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.77

3470 ENCROACHMENT STATIONS= 9976.1 10559.4 TYPE= 1 TARGET= 583.301

10.223	4.20	2315.80	.00	2315.80	2315.93	.12	.87	.03	2312.00
2843.0	337.1	1030.1	1475.7	129.2	274.7	754.3	21.5	10.0	2312.30
.09	2.61	3.75	1.96	.025	.030	.040	.000	2311.60	9977.51
.000981	545.	545.	545.	2	0	0	.00	571.85	10549.36

*SECNO 10.333

3470 ENCROACHMENT STATIONS= 9984.0 10750.0 TYPE= 1 TARGET= 766.000

10.333	4.06	2316.36	.00	2316.36	2316.48	.11	.55	.00	2312.60
2843.0	271.5	1292.2	1279.3	109.4	386.0	712.2	37.4	18.5	2313.40
.15	2.48	3.35	1.80	.025	.030	.040	.000	2312.30	9986.38
.000900	585.	580.	585.	2	0	0	.00	693.93	10680.31

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 10.432

3265 DIVIDED FLOW

3470 ENCROACHMENT STATIONS= 10035.8 10900.0 TYPE= 1 TARGET= 864.200

10.432	3.91	2316.91	.00	2316.91	2317.07	.16	.58	.01	2313.70
2773.0	139.5	1126.2	1507.2	44.0	268.7	678.1	50.5	26.0	2313.80
.20	3.17	4.19	2.22	.025	.030	.040	.000	2313.00	10042.93
.001403	520.	520.	520.	2	0	0	.00	572.26	10645.06

CCHV= .300 CEHV= .500
1490 NH CARD USED
*SECNO 10.495

3301 HV CHANGED MORE THAN HVINS

3470 ENCROACHMENT STATIONS= 10019.9 10700.0 TYPE= 1 TARGET= 680.100

10.495	3.36	2317.16	.00	2317.16	2317.84	.68	.51	.26	2314.50
2773.0	22.6	2389.7	360.7	6.7	335.6	377.9	57.3	30.2	2314.60
.21	3.35	7.12	.95	.020	.018	.076	.000	2313.80	10073.15
.001637	335.	335.	350.	2	0	0	.00	470.98	10544.13

1490 NH CARD USED
*SECNO 10.523
WATER EL=X5 CARD= 2318.870

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.20

3470 ENCROACHMENT STATIONS= 10057.6 10685.8 TYPE= 1 TARGET= 628.200

10.523	5.07	2318.87	.00	2318.87	2319.07	.20	.10	.15	2313.90
2963.0	856.2	1412.1	694.7	172.4	418.3	1057.3	61.3	32.1	2314.10
.23	4.96	3.38	.66	.016	.025	.081	.000	2313.80	10058.93
.000386	150.	150.	150.	0	0	0	.00	616.88	10675.81

CCHV= .100 CEHV= .300
*SECNO 10.555

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IOC	ICONT	CORAR	TOPWID	ENDST

3470 ENCROACHMENT STATIONS= 10060.9 10628.0 TYPE= 1 TARGET= 567.100

10.555	4.76	2319.06	.00	2319.06	2319.14	.08	.07	.01	2316.20
2963.0	18.2	1780.3	1164.5	12.3	687.4	655.7	67.0	34.2	2316.50
.25	1.48	2.59	1.78	.025	.030	.030	.000	2314.30	10064.91
.000412	165.	165.	165.	2	0	0	.00	479.72	10544.63

*SECNO 10.651

3470 ENCROACHMENT STATIONS= 10022.3 10600.0 TYPE= 1 TARGET= 577.700

10.651	4.38	2319.28	.00	2319.28	2319.38	.10	.23	.01	2316.20
3330.0	614.6	1529.9	1185.5	210.6	549.2	597.6	82.6	39.7	2315.80
.30	2.92	2.79	1.98	.025	.030	.030	.000	2314.90	10038.28
.000506	500.	505.	495.	2	0	0	.00	487.23	10525.51

CCHV= .100 CEHV= .300
*SECNO 10.756

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .55

3470 ENCROACHMENT STATIONS= 10037.3 10600.0 TYPE= 1 TARGET= 562.700

10.756	3.74	2319.64	.00	2319.64	2319.88	.24	.46	.04	2317.20
3330.0	122.2	2316.3	891.5	41.1	513.9	419.7	97.4	45.6	2316.50
.34	2.97	4.51	2.12	.025	.030	.045	.000	2315.90	10070.54
.001646	550.	555.	550.	2	0	0	.00	444.07	10514.61

*SECNO 10.825

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.58

3470 ENCROACHMENT STATIONS= 10130.0 11240.0 TYPE= 1 TARGET= 1110.000

10.825	4.68	2320.18	.00	2320.18	2320.28	.10	.38	.01	2318.00
3330.0	39.8	2025.4	1264.8	23.7	672.6	944.7	109.2	51.2	2317.25
.39	1.68	3.01	1.34	.025	.030	.045	.000	2315.50	10147.12
.000662	365.	365.	420.	2	0	0	.00	782.27	10929.38

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 10.848

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .63

3470 ENCROACHMENT STATIONS= 10147.6 11248.3 TYPE= 1 TARGET= 1100.700

10.848	4.20	2320.30	.00	2320.30	2320.38	.08	.10	.00	2317.80
2670.0	111.9	558.3	1999.8	46.3	149.8	1164.8	113.5	53.4	2317.80
.40	2.42	3.73	1.72	.025	.030	.045	.000	2316.10	10174.38
.001063	125.	120.	125.	2	0	0	.00	756.32	10963.91

CCHV= .100 CEHV= .300
*SECNO 10.938

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .35

3470 ENCROACHMENT STATIONS= 10300.9 11150.0 TYPE= 1 TARGET= 849.100

10.938	4.16	2320.86	.00	2320.86	2320.98	.13	.59	.01	2319.00
1265.0	58.5	544.3	662.3	22.6	136.6	472.9	124.1	60.4	2319.40
.45	2.58	3.98	1.40	.025	.030	.055	.000	2316.70	10313.99
.001943	480.	480.	460.	2	0	0	.00	551.61	10888.36

*SECNO 11.015

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .49

3470 ENCROACHMENT STATIONS= 10352.2 11340.2 TYPE= 1 TARGET= 988.000

11.015	5.27	2322.17	2322.11	2322.17	2322.50	.33	1.46	.06	2321.30
1265.0	12.3	603.8	648.9	4.1	96.1	296.9	129.1	65.4	2322.30
.48	3.04	6.28	2.19	.025	.030	.055	.000	2316.90	10453.19
.007978	405.	405.	430.	11	15	0	.00	481.42	10991.44

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .100 CEHV= .300
*SECNO 11.080

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 4.05

3470 ENCROACHMENT STATIONS= 10353.7 11391.0 TYPE= 1 TARGET= 1037.300

11.080	6.60	2322.90	.00	2322.90	2322.95	.05	.42	.03	2321.90
1265.0	3.5	625.1	636.4	4.3	271.2	607.4	134.1	69.8	2320.40
.54	.82	2.31	1.05	.025	.030	.045	.000	2316.30	10451.74
.000485	230.	340.	340.	3	0	0	.00	640.15	11140.68

*SECNO 11.123

3470 ENCROACHMENT STATIONS= 10349.8 11356.0 TYPE= 1 TARGET= 1006.200

11.123	4.41	2323.01	.00	2323.01	2323.04	.02	.08	.00	2321.20
1265.0	12.2	478.4	774.4	13.2	288.6	922.1	139.4	73.4	2320.50
.59	.93	1.66	.84	.025	.030	.045	.000	2318.60	10379.58
.000279	220.	230.	220.	3	0	0	.00	773.53	11153.11

CCHV= .100 CEHV= .300
*SECNO 11.241

3470 ENCROACHMENT STATIONS= 10158.4 11200.0 TYPE= 1 TARGET= 1041.600

11.241	3.85	2323.45	.00	2323.45	2323.58	.13	.51	.03	2322.30
2945.0	44.6	1179.2	1721.1	21.1	309.7	815.5	156.2	84.6	2321.50
.65	2.11	3.81	2.11	.025	.030	.040	.000	2319.60	10158.40
.001743	620.	620.	615.	3	0	0	.00	813.55	10971.95

*SECNO 11.364

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.46

3470 ENCROACHMENT STATIONS= 10018.6 11100.0 TYPE= 1 TARGET= 1081.400

11.364	3.44	2324.24	.00	2324.24	2324.33	.10	.75	.00	2322.00
2945.0	53.0	2021.7	870.2	28.7	703.2	634.3	175.0	97.2	2321.80
.73	1.85	2.88	1.37	.025	.030	.040	.000	2320.80	10067.18
.000817	650.	650.	650.	2	0	0	.00	879.95	10947.13

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 11.479

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.65

3470 ENCROACHMENT STATIONS= 10035.7 11100.0 TYPE= 1 TARGET= 1064.300

11.479	4.07	2324.57	.00	2324.57	2324.62	.05	.28	.00	2322.10
2945.0	28.1	2217.7	699.1	23.9	1137.8	757.9	197.8	109.7	2321.90
.83	1.18	1.95	.92	.025	.030	.040	.000	2320.50	10057.39
.000300	610.	610.	600.	2	0	0	.00	915.39	10972.78

CCHV= .100 CEHV= .300

*SECNO 11.606

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .04

3470 ENCROACHMENT STATIONS= 10018.3 10136.8 TYPE= 1 TARGET= 118.500

11.606	2.97	2324.77	.00	2324.77	2324.85	.08	.22	.01	2326.70
225.0	.0	225.0	.0	.0	98.6	.0	215.4	118.7	100000.00
.91	.00	2.28	.00	.000	.030	.000	.000	2321.80	10077.10
.000988	665.	665.	920.	2	0	0	.00	54.83	10131.92

*SECNO 11.656

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.61

3470 ENCROACHMENT STATIONS= 10038.7 10141.3 TYPE= 1 TARGET= 102.600

11.656	3.27	2324.97	.00	2324.97	2325.01	.04	.15	.00	2325.80
225.0	.0	225.0	.0	.0	140.0	.0	216.1	119.1	2325.10
.96	.00	1.61	.00	.000	.030	.000	.000	2321.70	10067.50
.000383	265.	265.	265.	2	0	0	.00	65.02	10132.52

*SECNO 11.737

3470 ENCROACHMENT STATIONS= 10038.3 10169.7 TYPE= 1 TARGET= 131.400

11.737	3.63	2325.13	.00	2325.13	2325.16	.03	.15	.00	2325.60
225.0	.0	225.0	.0	.0	161.1	.0	217.6	119.8	2325.60
1.04	.00	1.40	.00	.000	.030	.000	.000	2321.50	10068.81
.000300	430.	430.	430.	2	0	0	.00	77.01	10145.82

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 11.828

3470 ENCROACHMENT STATIONS= 10014.5 10173.0 TYPE= 1 TARGET= 158.500

11.828	2.97	2325.27	.00	2325.27	2325.30	.03	.14	.00	2326.00
225.0	.0	225.0	.0	.0	164.8	.0	219.4	120.7	2326.90
1.14	.00	1.37	.00	.000	.030	.000	.000	2322.30	10068.83
.000284	480.	480.	480.	2	0	0	.00	78.50	10147.32

*SECNO 11.915
WATER EL=X5 CARD= 2327.470

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 4.35

3470 ENCROACHMENT STATIONS= 10015.7 10210.7 TYPE= 1 TARGET= 195.000

11.915	4.67	2327.47	.00	2327.47	2327.48	.01	.04	.00	2326.40
437.0	5.6	429.9	1.5	20.3	458.2	6.0	222.9	121.9	2326.00
1.28	.27	.94	.26	.030	.030	.035	.000	2322.80	10045.26
.000057	465.	460.	465.	0	0	0	.00	161.96	10207.22

CCHV= .100 CEHV= .300
*SECNO 12.025

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .59

3470 ENCROACHMENT STATIONS= 10055.8 11160.4 TYPE= 1 TARGET= 1104.601

12.025	2.62	2327.52	.00	2327.52	2327.54	.01	.05	.00	2326.00
437.0	5.8	273.2	158.1	11.0	251.2	236.7	229.4	124.6	2325.60
1.45	.52	1.09	.67	.030	.030	.045	.000	2324.90	10081.86
.000163	580.	580.	570.	2	0	0	.00	245.44	10327.31

*SECNO 12.141
WATER EL=X5 CARD= 2331.600

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .51

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3470 ENCROACHMENT STATIONS= 10026.9 10350.0 TYPE= 1 TARGET= 323.100

12.141	3.00	2331.60	.00	2331.60	2331.66	.06	.18	.01	2331.20
467.0	.6	431.8	34.6	1.3	212.1	55.2	234.7	128.0	2330.80
1.54	.45	2.04	.63	.030	.030	.045	.000	2328.60	10089.90
.000707	610.	610.	590.	0	0	0	.00	246.14	10345.14

*SECNO 12.256
WATER EL=X5 CARD= 2338.200

3265 DIVIDED FLOW

3470 ENCROACHMENT STATIONS= 10050.0 10396.9 TYPE= 1 TARGET= 346.900

12.256	4.80	2338.20	.00	2338.20	2338.47	.27	.74	.06	2335.30
765.0	203.8	449.6	111.7	54.2	93.9	87.7	238.2	131.3	2336.00
1.58	3.76	4.79	1.27	.030	.030	.045	.000	2333.40	10072.31
.001860	615.	610.	595.	0	0	0	.00	237.43	10377.90

*SECNO 12.375
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 10056.9 10325.1 TYPE= 1 TARGET= 268.199

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 2344.30 ELREA= 2343.90

12.375	1.92	2343.92	2343.92	2343.92	2344.08	.16	2.05	.01	2344.30
765.0	.0	125.4	639.6	.0	37.1	202.2	241.6	134.8	2343.90
1.64	.00	3.39	3.16	.000	.030	.045	.000	2342.00	10073.70
.007377	620.	625.	620.	20	20	0	.00	247.20	10320.90

*SECNO 12.491

3470 ENCROACHMENT STATIONS= 10038.7 10300.0 TYPE= 1 TARGET= 261.300

12.491	2.19	2346.49	.00	2346.49	2346.57	.08	2.48	.01	2349.60
527.0	.0	.0	527.0	.0	.0	230.8	244.9	137.4	2348.70
1.71	.00	.00	2.28	.000	.000	.045	.000	2344.30	10174.42
.002095	620.	615.	620.	3	0	0	.00	125.58	10300.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 12.510

3265 DIVIDED FLOW

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 10055.0 10317.0 TYPE= 1 TARGET= 262.000

12.510	1.40	2347.70	2347.70	2347.70	2348.19	.49	.49	.12	2348.00
527.0	.0	172.4	354.6	.0	27.7	66.5	245.3	137.7	2348.00
1.72	.00	6.21	5.33	.000	.030	.045	.000	2346.30	10082.30
.021888	100.	100.	100.	20	14	0	.00	99.38	10207.14

*SECNO 12.630
WATER EL=X5 CARD= 2352.900

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.83

3470 ENCROACHMENT STATIONS= 10047.6 10700.0 TYPE= 1 TARGET= 652.400

12.630	3.60	2352.90	.00	2352.90	2353.07	.17	2.51	.03	2352.90
555.0	.0	506.2	48.8	.0	148.3	68.4	247.6	140.6	2352.70
1.77	.00	3.41	.71	.000	.030	.045	.000	2349.30	10085.30
.001653	635.	635.	635.	0	0	0	.00	303.48	10488.16

*SECNO 12.707
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 10031.1 10201.8 TYPE= 1 TARGET= 170.700

12.707	2.78	2355.58	2355.58	2355.58	2356.19	.61	1.47	.13	2355.90
555.0	.0	555.0	.0	.0	88.6	.0	249.0	142.4	2355.90
1.79	.00	6.27	.00	.000	.030	.000	.000	2352.80	10079.69
.013569	405.	405.	405.	20	15	0	.00	77.75	10157.44

TW BETWEEN SECTIONS 10.555 AND 10.651

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
367.05	367.05	.00	367.05	367.05	.00	5	2319.062	2319.277	10.555	10.651

THIS RUN EXECUTED 09JUN94 12:10:10

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

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SUMMARY PRINTOUT

	SECNO	Q	CWSEL	QLOB	QCH	QROB	VCH	SSTA	ENDST	TOPWID	AREA	DEPTH
*	10.014	2842.95	2314.00	.93	1927.63	914.39	4.58	10103.47	10565.34	461.88	975.14	7.90
*	10.120	2842.95	2314.63	62.60	1597.46	1182.89	6.00	10087.77	10357.77	270.00	627.92	3.83
*	10.223	2842.95	2315.80	337.09	1030.15	1475.72	3.75	9977.51	10549.36	571.85	1158.27	4.20
	10.333	2842.95	2316.36	271.46	1292.17	1279.32	3.35	9986.38	10680.31	693.93	1207.64	4.06
	10.432	2772.95	2316.91	139.51	1126.20	1507.25	4.19	10042.93	10645.06	572.26	990.82	3.91
	10.495	2772.95	2317.16	22.56	2389.72	360.66	7.12	10073.15	10544.13	470.98	720.26	3.36
*	10.523	2962.95	2318.87	856.15	1412.05	694.74	3.38	10058.93	10675.81	616.88	1648.09	5.07
	10.555	2962.95	2319.06	18.18	1780.30	1164.48	2.59	10064.91	10544.63	479.72	1355.40	4.76
	10.651	3330.00	2319.28	614.59	1529.88	1185.53	2.79	10038.28	10525.51	487.23	1357.31	4.38
*	10.756	3330.00	2319.64	122.20	2316.28	891.51	4.51	10070.54	10514.61	444.07	974.70	3.74
*	10.825	3330.00	2320.18	39.83	2025.38	1264.79	3.01	10147.12	10929.38	782.27	1641.03	4.68
*	10.848	2670.00	2320.30	111.91	558.31	1999.78	3.73	10174.38	10963.91	756.32	1360.89	4.20
*	10.938	1265.00	2320.86	58.45	544.28	662.27	3.98	10313.99	10888.36	551.61	632.15	4.16
*	11.015	1265.00	2322.17	12.31	603.80	648.89	6.28	10453.19	10991.44	481.42	397.12	5.27
*	11.080	1265.00	2322.90	3.53	625.09	636.38	2.31	10451.74	11140.68	640.15	882.86	6.60
	11.123	1265.00	2323.01	12.20	478.39	774.41	1.66	10379.58	11153.11	773.53	1223.87	4.41
	11.241	2945.00	2323.45	44.65	1179.24	1721.11	3.81	10158.40	10971.95	813.55	1146.37	3.85

	SECNO	Q	CWSEL	QLOB	QCH	QROB	VCH	SSTA	ENDST	TOPWID	AREA	DEPTH
*	11.364	2945.00	2324.24	53.02	2021.74	870.24	2.88	10067.18	10947.13	879.95	1366.14	3.44
*	11.479	2945.00	2324.57	28.14	2217.75	699.11	1.95	10057.39	10972.78	915.39	1919.61	4.07
*	11.606	225.00	2324.77	.00	225.00	.00	2.28	10077.10	10131.92	54.83	98.56	2.97
*	11.656	225.00	2324.97	.00	225.00	.00	1.61	10067.50	10132.52	65.02	139.96	3.27
	11.737	225.00	2325.13	.00	225.00	.00	1.40	10068.81	10145.82	77.01	161.05	3.63
	11.828	225.00	2325.27	.00	225.00	.00	1.37	10068.83	10147.32	78.50	164.82	2.97
*	11.915	437.00	2327.47	5.55	429.91	1.54	.94	10045.26	10207.22	161.96	484.48	4.67
*	12.025	437.00	2327.52	5.77	273.16	158.07	1.09	10081.86	10327.31	245.44	498.93	2.62
*	12.141	467.00	2331.60	.60	431.79	34.61	2.04	10089.90	10345.14	246.14	268.63	3.00
*	12.256	765.00	2338.20	203.79	449.56	111.65	4.79	10072.31	10377.90	237.43	235.76	4.80
*	12.375	765.00	2343.92	.00	125.42	639.58	3.39	10073.70	10320.90	247.20	239.30	1.92
	12.491	527.00	2346.49	.00	.00	527.00	.00	10174.42	10300.00	125.58	230.79	2.19
*	12.510	527.00	2347.70	.00	172.38	354.62	6.21	10082.30	10207.14	99.38	94.29	1.40
*	12.630	555.00	2352.90	.00	506.24	48.76	3.41	10085.30	10488.16	303.48	216.66	3.60
*	12.707	555.00	2355.58	.00	555.00	.00	6.27	10079.69	10157.44	77.75	88.58	2.78

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SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	10.014	.00	.00	.00	2306.10	2842.95	2314.00	2311.82	2314.23	7.36	4.58	975.14	1048.02
*	10.120	560.00	.00	.00	2310.80	2842.95	2314.63	.00	2315.03	30.63	6.00	627.92	513.72
*	10.223	545.00	.00	.00	2311.60	2842.95	2315.80	.00	2315.93	9.81	3.75	1158.27	907.80
	10.333	580.00	.00	.00	2312.30	2842.95	2316.36	.00	2316.48	9.00	3.35	1207.64	947.83
	10.432	520.00	.00	.00	2313.00	2772.95	2316.91	.00	2317.07	14.03	4.19	990.82	740.18
	10.495	335.00	.00	.00	2313.80	2772.95	2317.16	.00	2317.84	16.37	7.12	720.26	685.28
*	10.523	150.00	.00	.00	2313.80	2962.95	2318.87	.00	2319.07	3.86	3.38	1648.09	1507.38
	10.555	165.00	.00	.00	2314.30	2962.95	2319.06	.00	2319.14	4.12	2.59	1355.40	1460.62
	10.651	505.00	.00	.00	2314.90	3330.00	2319.28	.00	2319.38	5.06	2.79	1357.31	1480.44
*	10.756	555.00	.00	.00	2315.90	3330.00	2319.64	.00	2319.88	16.46	4.51	974.70	820.85
*	10.825	365.00	.00	.00	2315.50	3330.00	2320.18	.00	2320.28	6.62	3.01	1641.03	1294.46
*	10.848	120.00	.00	.00	2316.10	2670.00	2320.30	.00	2320.38	10.63	3.73	1360.89	818.94
*	10.938	480.00	.00	.00	2316.70	1265.00	2320.86	.00	2320.98	19.43	3.98	632.15	286.96
*	11.015	405.00	.00	.00	2316.90	1265.00	2322.17	2322.11	2322.50	79.78	6.28	397.12	141.63
*	11.080	340.00	.00	.00	2316.30	1265.00	2322.90	.00	2322.95	4.85	2.31	882.86	574.12
	11.123	230.00	.00	.00	2318.60	1265.00	2323.01	.00	2323.04	2.79	1.66	1223.87	757.21
	11.241	620.00	.00	.00	2319.60	2945.00	2323.45	.00	2323.58	17.43	3.81	1146.37	705.32
*	11.364	650.00	.00	.00	2320.80	2945.00	2324.24	.00	2324.33	8.17	2.88	1366.14	1030.51
*	11.479	610.00	.00	.00	2320.50	2945.00	2324.57	.00	2324.62	3.00	1.95	1919.61	1699.28
*	11.606	665.00	.00	.00	2321.80	225.00	2324.77	.00	2324.85	9.88	2.28	98.56	71.59
*	11.656	265.00	.00	.00	2321.70	225.00	2324.97	.00	2325.01	3.83	1.61	139.96	114.91
	11.737	430.00	.00	.00	2321.50	225.00	2325.13	.00	2325.16	3.00	1.40	161.05	129.98
	11.828	480.00	.00	.00	2322.30	225.00	2325.27	.00	2325.30	2.84	1.37	164.82	133.41
*	11.915	460.00	.00	.00	2322.80	437.00	2327.47	.00	2327.48	.57	.94	484.48	580.55

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	12.025	580.00	.00	.00	2324.90	437.00	2327.52	.00	2327.54	1.63	1.09	498.93	342.48
*	12.141	610.00	.00	.00	2328.60	467.00	2331.60	.00	2331.66	7.07	2.04	268.63	175.66
*	12.256	610.00	.00	.00	2333.40	765.00	2338.20	.00	2338.47	18.60	4.79	235.76	177.39
*	12.375	625.00	.00	.00	2342.00	765.00	2343.92	2343.92	2344.08	73.77	3.39	239.30	89.07
	12.491	615.00	.00	.00	2344.30	527.00	2346.49	.00	2346.57	20.95	.00	230.79	115.14
*	12.510	100.00	.00	.00	2346.30	527.00	2347.70	2347.70	2348.19	218.88	6.21	94.29	35.62
*	12.630	635.00	.00	.00	2349.30	555.00	2352.90	.00	2353.07	16.53	3.41	216.66	136.49
*	12.707	405.00	.00	.00	2352.80	555.00	2355.58	2355.58	2356.19	135.69	6.27	88.58	47.65

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SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	10.014	2842.95	2314.00	.00	.00	.00	461.88	.00
*	10.120	2842.95	2314.63	.00	.63	.00	270.00	560.00
*	10.223	2842.95	2315.80	.00	1.17	.00	571.85	545.00
	10.333	2842.95	2316.36	.00	.56	.00	693.93	580.00
	10.432	2772.95	2316.91	.00	.54	.00	572.26	520.00
	10.495	2772.95	2317.16	.00	.25	.00	470.98	335.00
*	10.523	2962.95	2318.87	.00	1.71	.00	616.88	150.00
	10.555	2962.95	2319.06	.00	.19	.00	479.72	165.00
	10.651	3330.00	2319.28	.00	.22	.00	487.23	505.00
*	10.756	3330.00	2319.64	.00	.36	.00	444.07	555.00
*	10.825	3330.00	2320.18	.00	.54	.00	782.27	365.00
*	10.848	2670.00	2320.30	.00	.11	.00	756.32	120.00
*	10.938	1265.00	2320.86	.00	.56	.00	551.61	480.00
*	11.015	1265.00	2322.17	.00	1.31	.00	481.42	405.00
*	11.080	1265.00	2322.90	.00	.73	.00	640.15	340.00
	11.123	1265.00	2323.01	.00	.11	.00	773.53	230.00
	11.241	2945.00	2323.45	.00	.44	.00	813.55	620.00
*	11.364	2945.00	2324.24	.00	.79	.00	879.95	650.00
*	11.479	2945.00	2324.57	.00	.34	.00	915.39	610.00
*	11.606	225.00	2324.77	.00	.20	.00	54.83	665.00
*	11.656	225.00	2324.97	.00	.20	.00	65.02	265.00
	11.737	225.00	2325.13	.00	.16	.00	77.01	430.00
	11.828	225.00	2325.27	.00	.14	.00	78.50	480.00
*	11.915	437.00	2327.47	.00	2.20	.00	161.96	460.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	12.025	437.00	2327.52	.00	.05	.00	245.44	580.00
*	12.141	467.00	2331.60	.00	4.08	.00	246.14	610.00
*	12.256	765.00	2338.20	.00	6.60	.00	237.43	610.00
*	12.375	765.00	2343.92	.00	5.72	.00	247.20	625.00
	12.491	527.00	2346.49	.00	2.57	.00	125.58	615.00
*	12.510	527.00	2347.70	.00	1.21	.00	99.38	100.00
*	12.630	555.00	2352.90	.00	5.20	.00	303.48	635.00
*	12.707	555.00	2355.58	.00	2.68	.00	77.75	405.00

SUMMARY OF ERRORS AND SPECIAL NOTES

NOTE SECNO= 10.014 PROFILE= 1 WSEL BASED ON X5 CARD

WARNING SECNO= 10.120 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 10.223 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

NOTE SECNO= 10.523 PROFILE= 1 WSEL BASED ON X5 CARD
WARNING SECNO= 10.523 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 10.756 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 10.825 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 10.848 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 10.938 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 11.015 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 11.080 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 11.364 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 11.479 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 11.606 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 11.656 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

NOTE SECNO= 11.915 PROFILE= 1 WSEL BASED ON X5 CARD
WARNING SECNO= 11.915 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 12.025 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

NOTE SECNO= 12.141 PROFILE= 1 WSEL BASED ON X5 CARD
WARNING SECNO= 12.141 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

NOTE SECNO= 12.256 PROFILE= 1 WSEL BASED ON X5 CARD

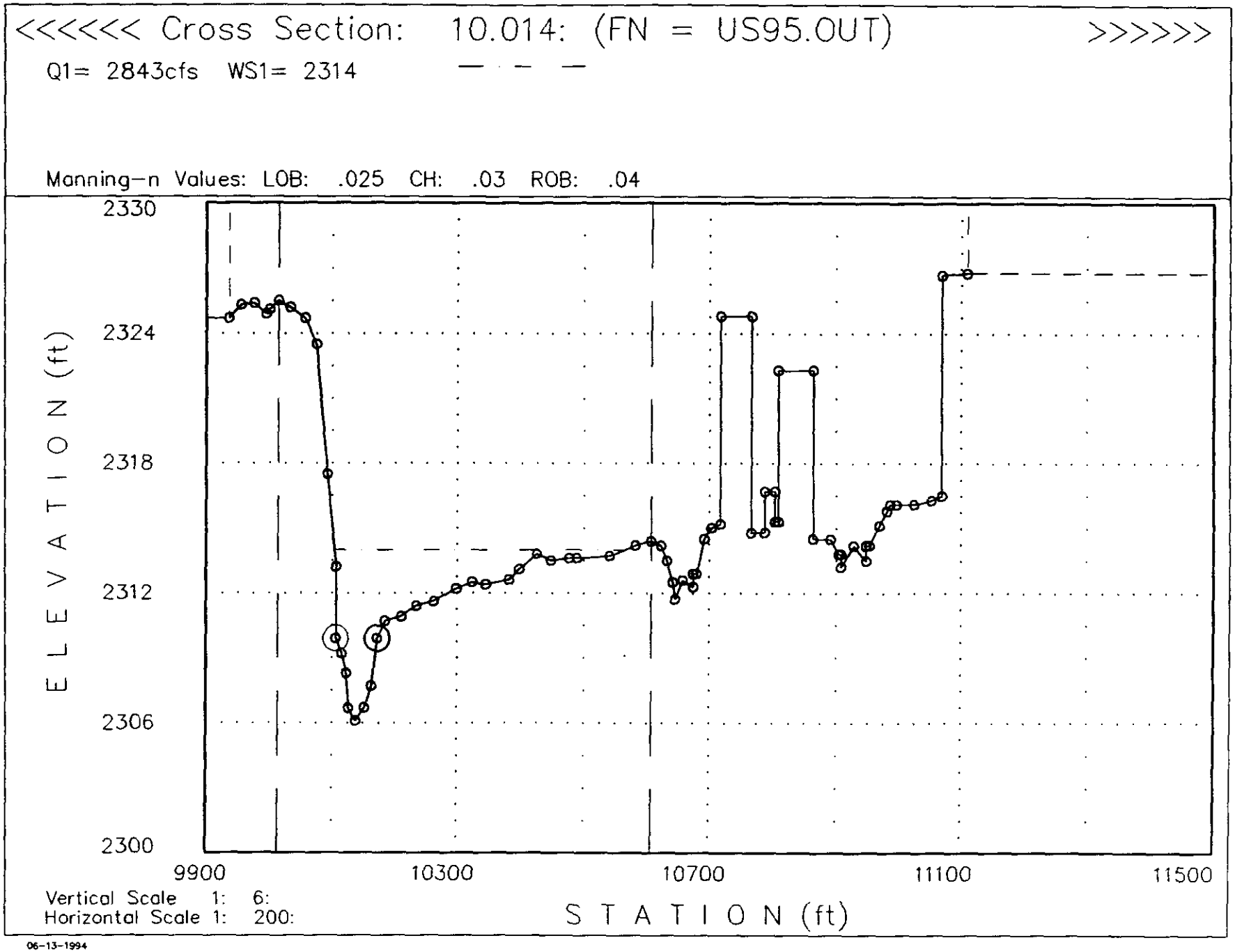
CAUTION SECNO= 12.375 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 12.375 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 12.375 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 12.510 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 12.510 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 12.510 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

NOTE SECNO= 12.630 PROFILE= 1 WSEL BASED ON X5 CARD
WARNING SECNO= 12.630 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 12.707 PROFILE= 1 CRITICAL DEPTH ASSUMED

CAUTION SECNO= 12.707 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 12.707 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL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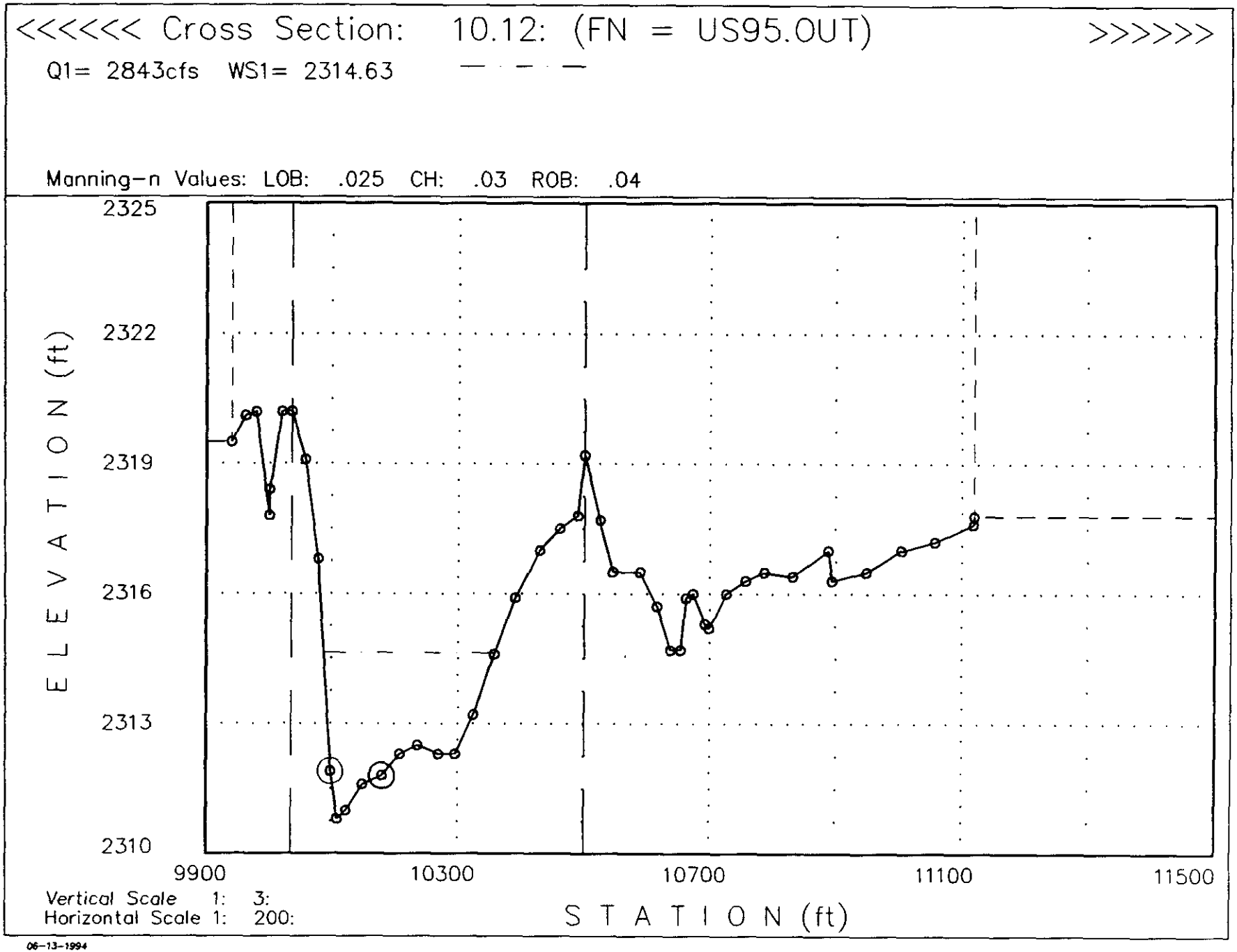
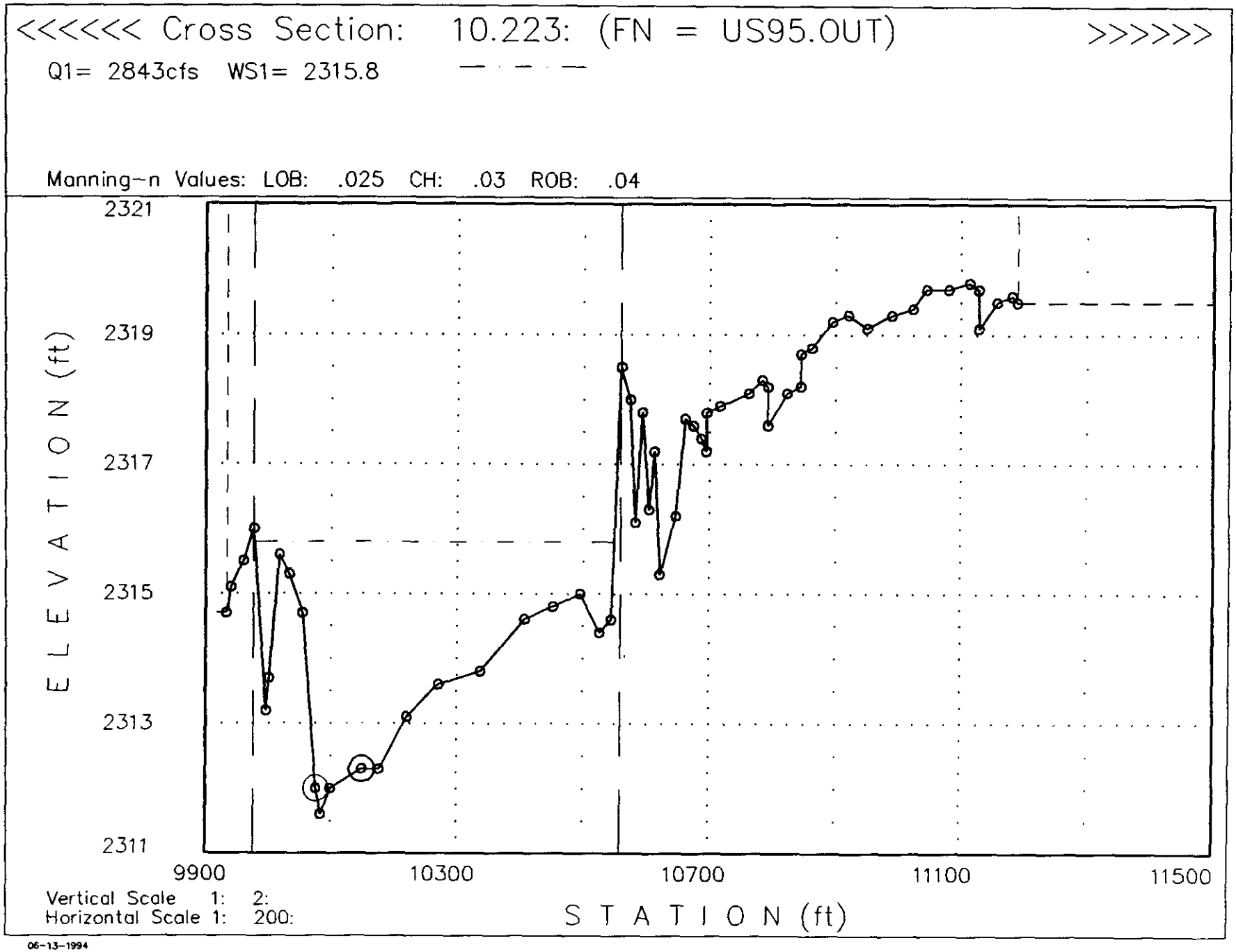
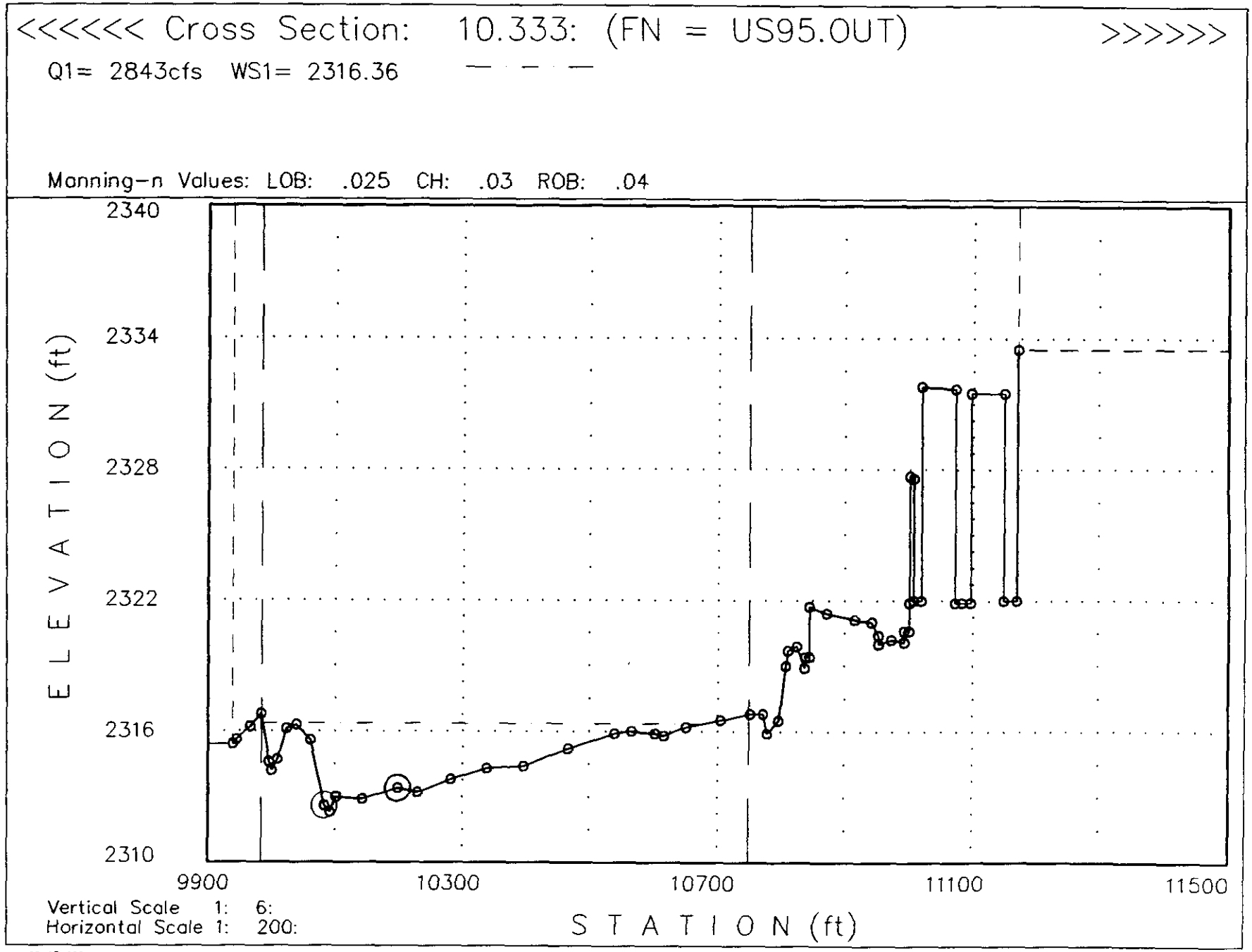
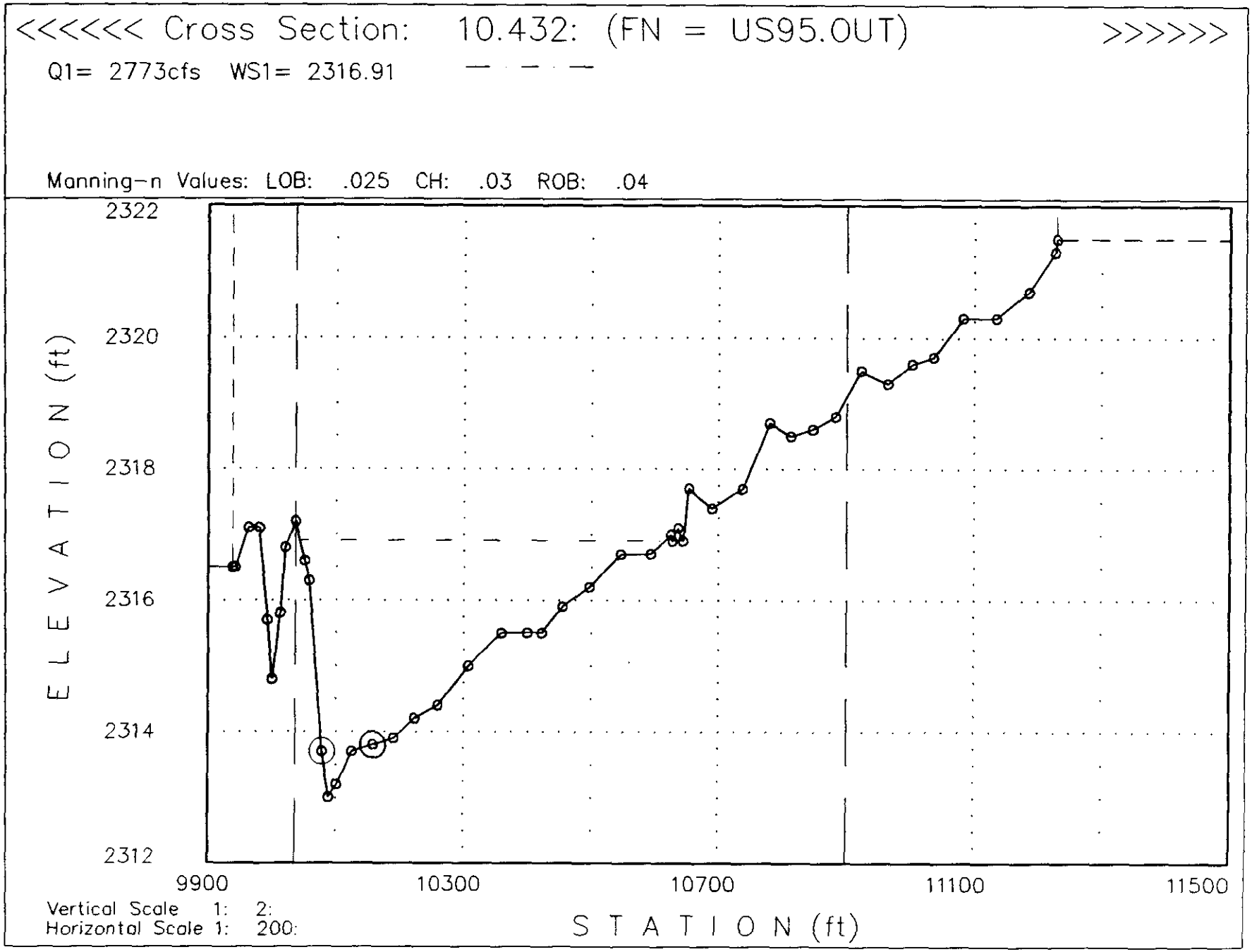
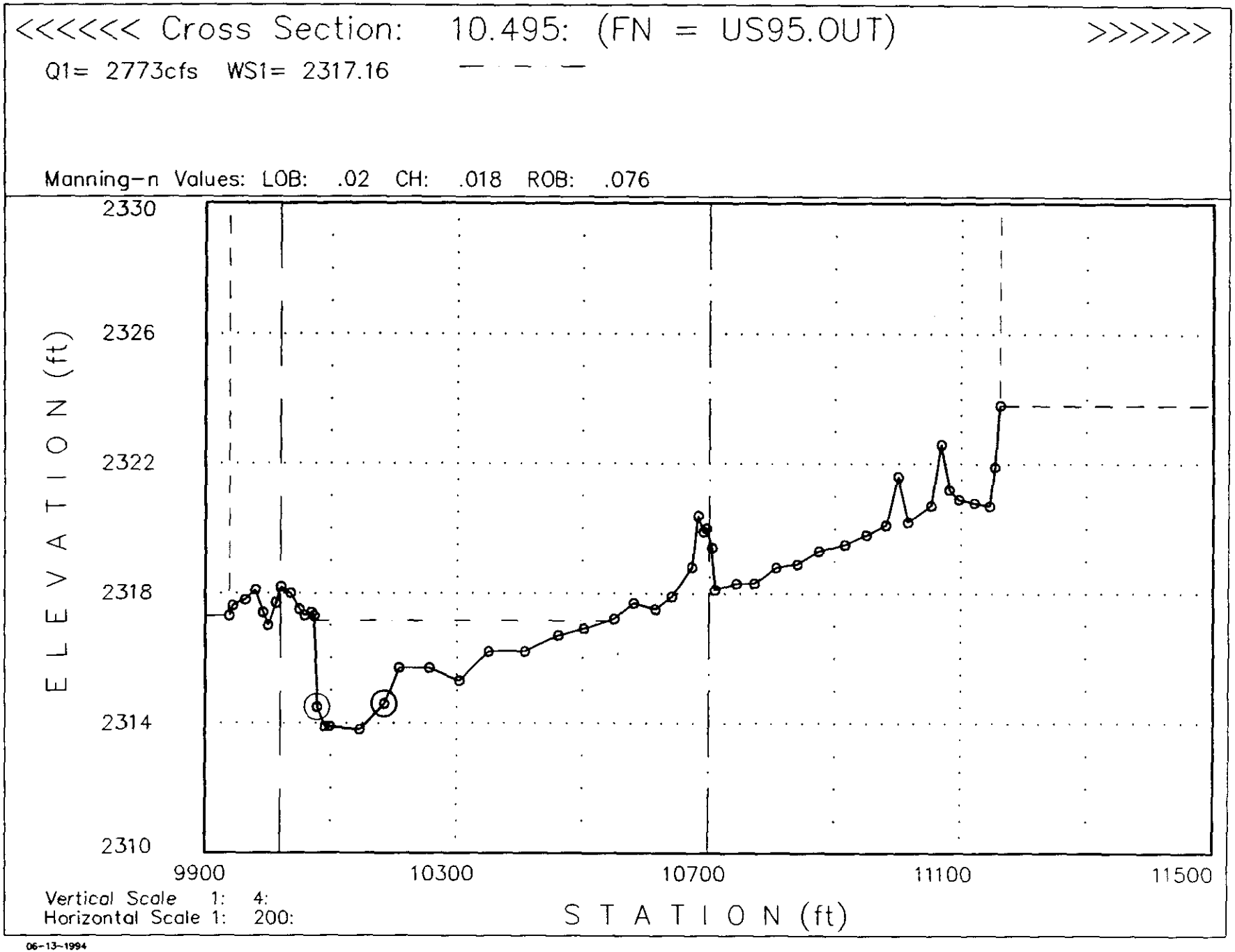
Q1= 2843cfs WS1= 2314
Manning-n Values: LOB: .025 CH: .03 ROB: .04
2330
2324
2318
2312
2306
2300
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994

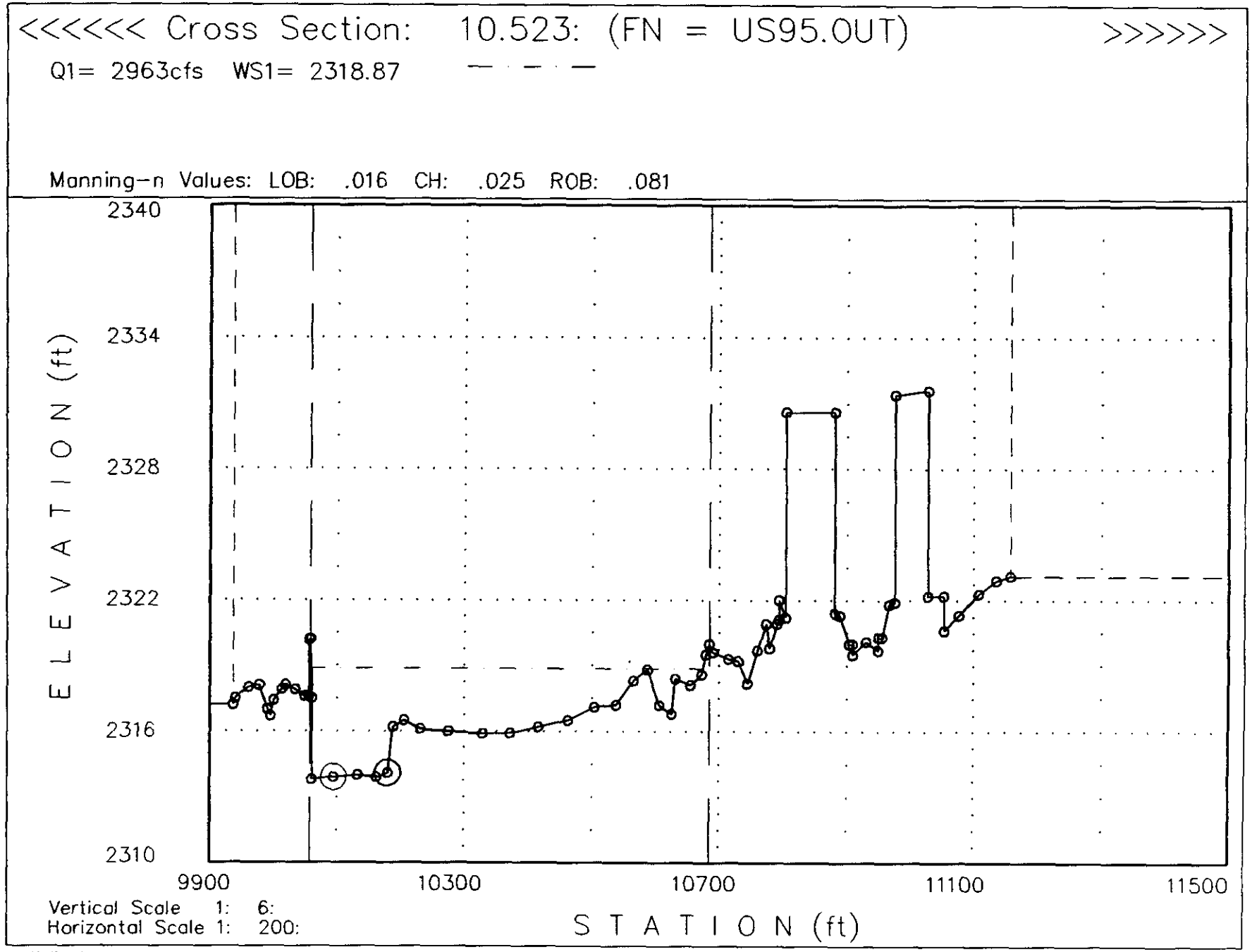

<<<<<< Cross Section: 10.12: (FN = US95.OUT) >>>>>>
Q1= 2843cfs WS1= 2314.63
Manning-n Values: LOB: .025 CH: .03 ROB: .04
2325
2322
2319
2316
2313
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 3:
Horizontal Scale 1: 200:
06-13-1994

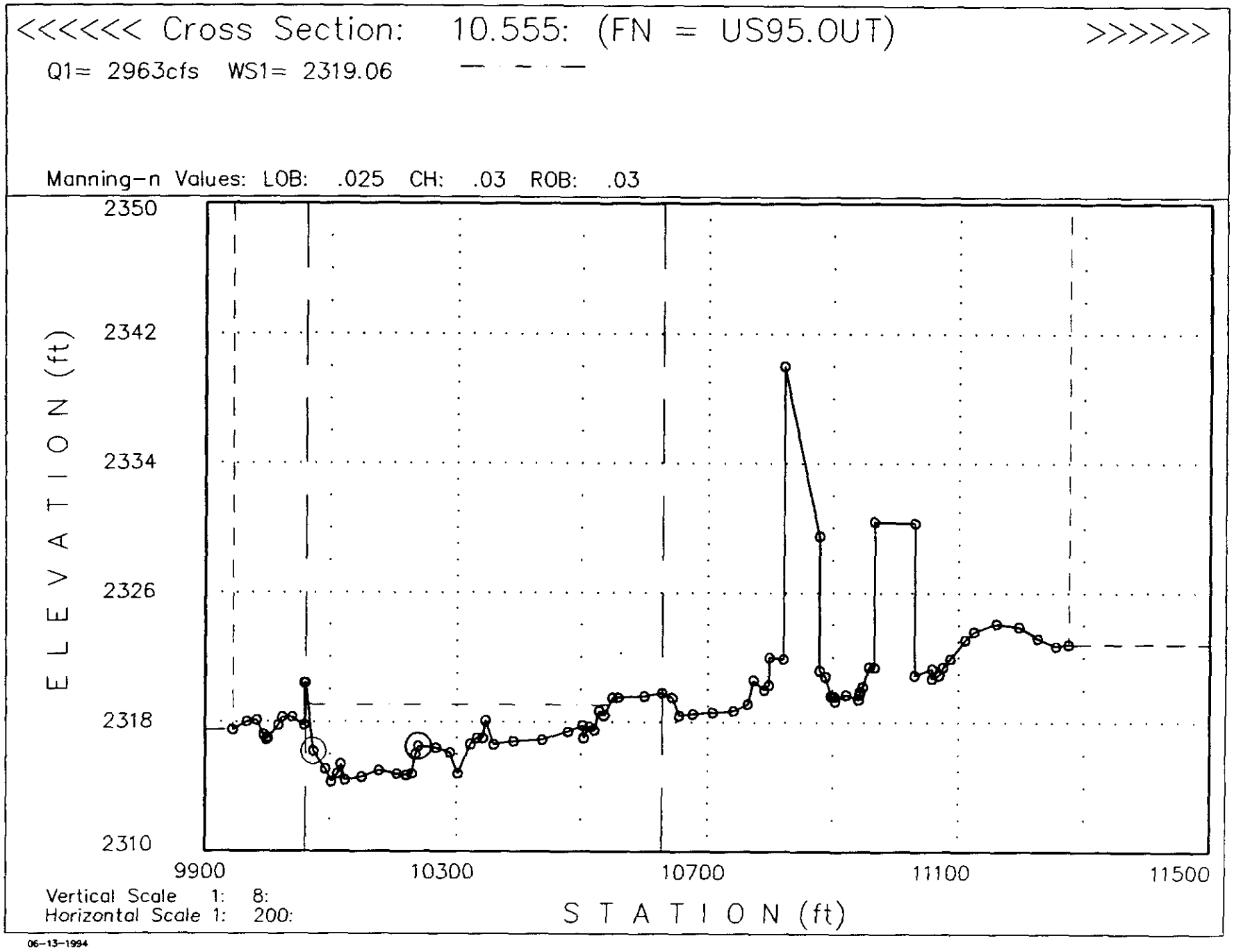

<<<<<< Cross Section: 10.223: (FN = US95.OUT) >>>>>>
Q1= 2843cfs WS1= 2315.8
Manning-n Values: LOB: .025 CH: .03 ROB: .04
2321
2319
2317
2315
2313
2311
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994

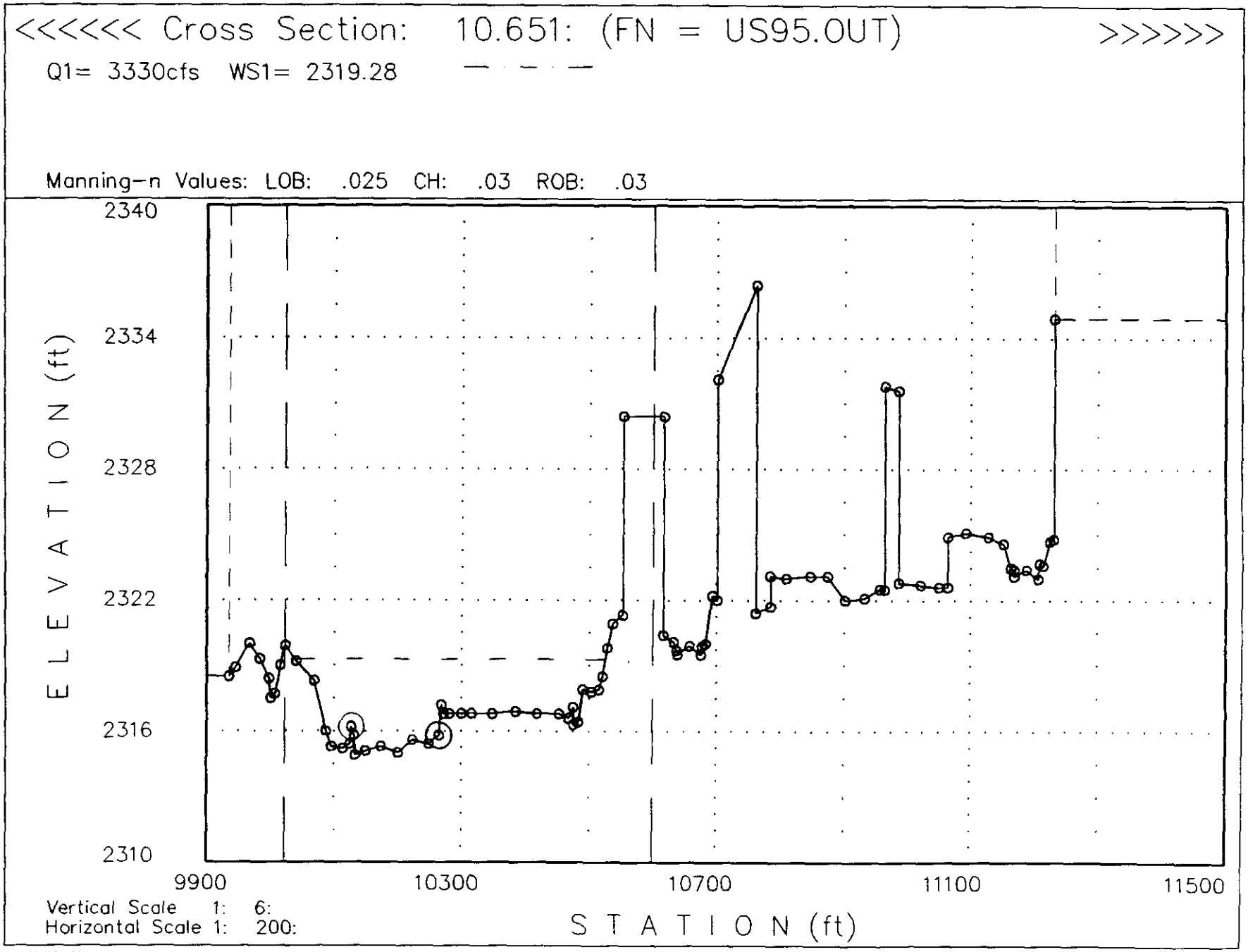

<<<<<< Cross Section: 10.333: (FN = US95.OUT) >>>>>>
Q1= 2843cfs WS1= 2316.36
Manning-n Values: LOB: .025 CH: .03 ROB: .04
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994

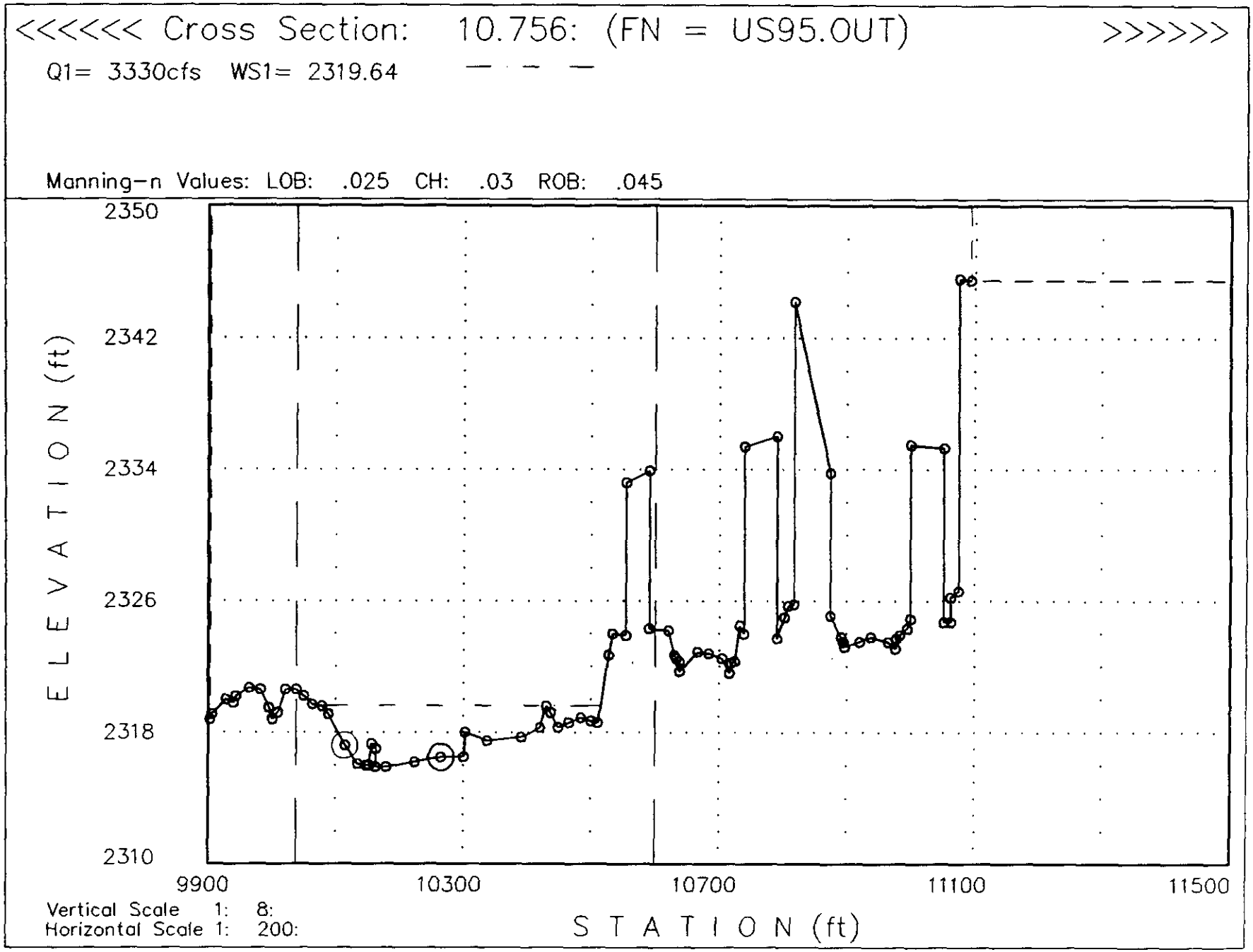

<<<<<< Cross Section: 10.432: (FN = US95.OUT) >>>>>>
Q1= 2773cfs WS1= 2316.91
Manning-n Values: LOB: .025 CH: .03 ROB: .04
2322
2320
2318
2316
2314
2312
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994

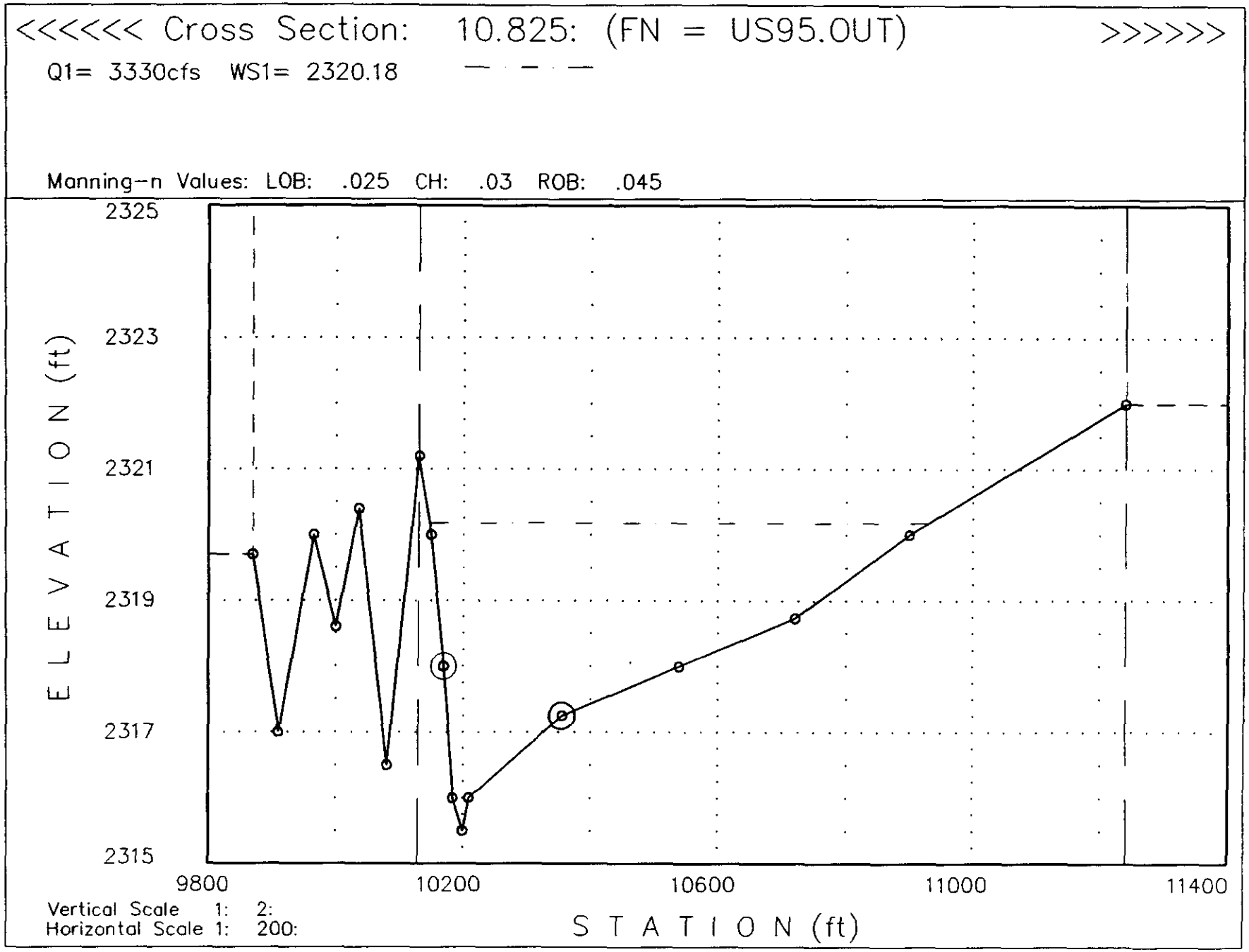

<<<<<< Cross Section: 10.495: (FN = US95.OUT) >>>>>>
Q1= 2773cfs WS1= 2317.16
Manning-n Values: LOB: .02 CH: .018 ROB: .076
2330
2326
2322
2318
2314
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
Vertical Scale 1: 4:
Horizontal Scale 1: 200:
STATION (ft)
06-13-1994

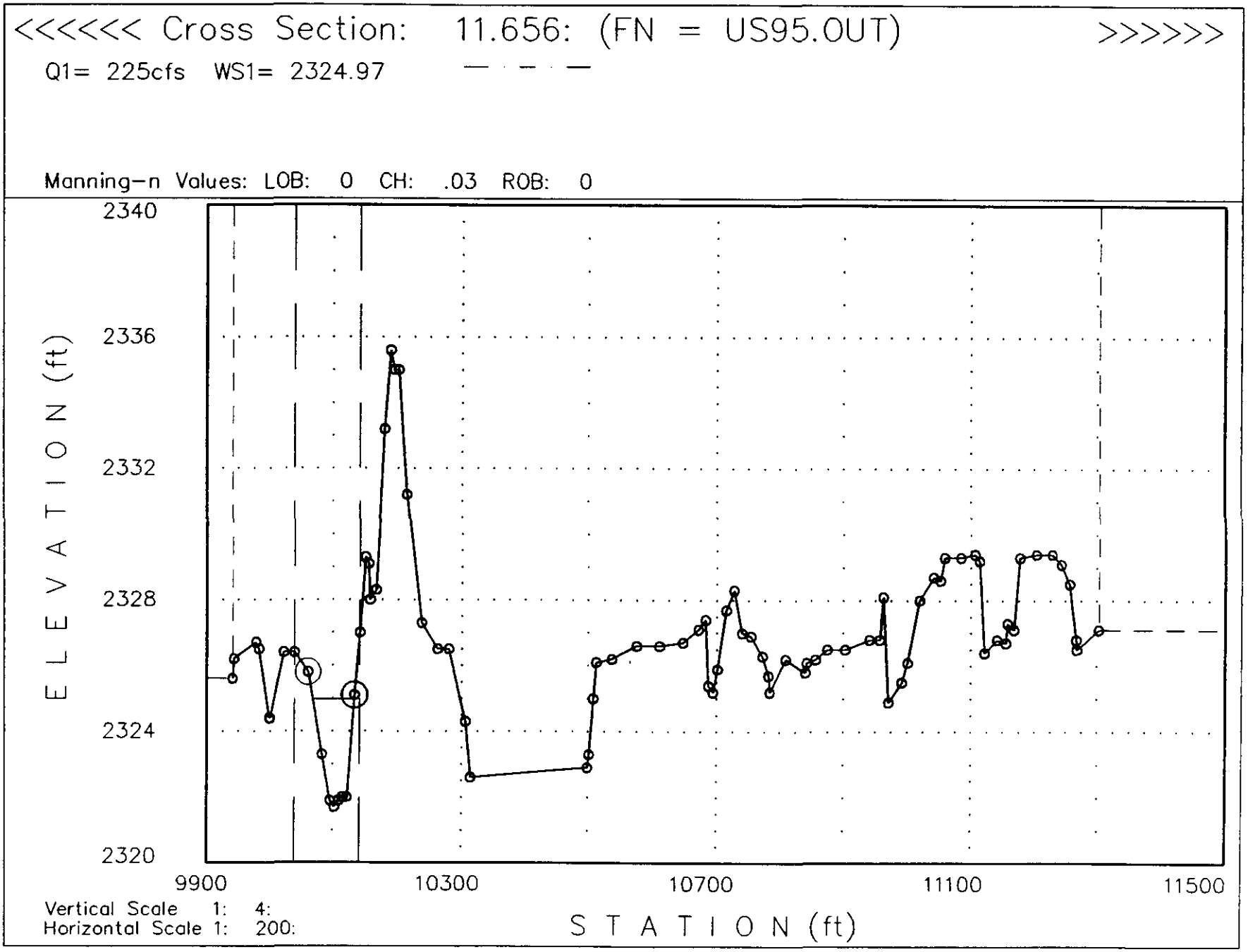

<<<<<< Cross Section: 10.523: (FN = US95.OUT) >>>>>>
Q1= 2963cfs WS1= 2318.87
Manning-n Values: LOB: .016 CH: .025 ROB: .081
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994

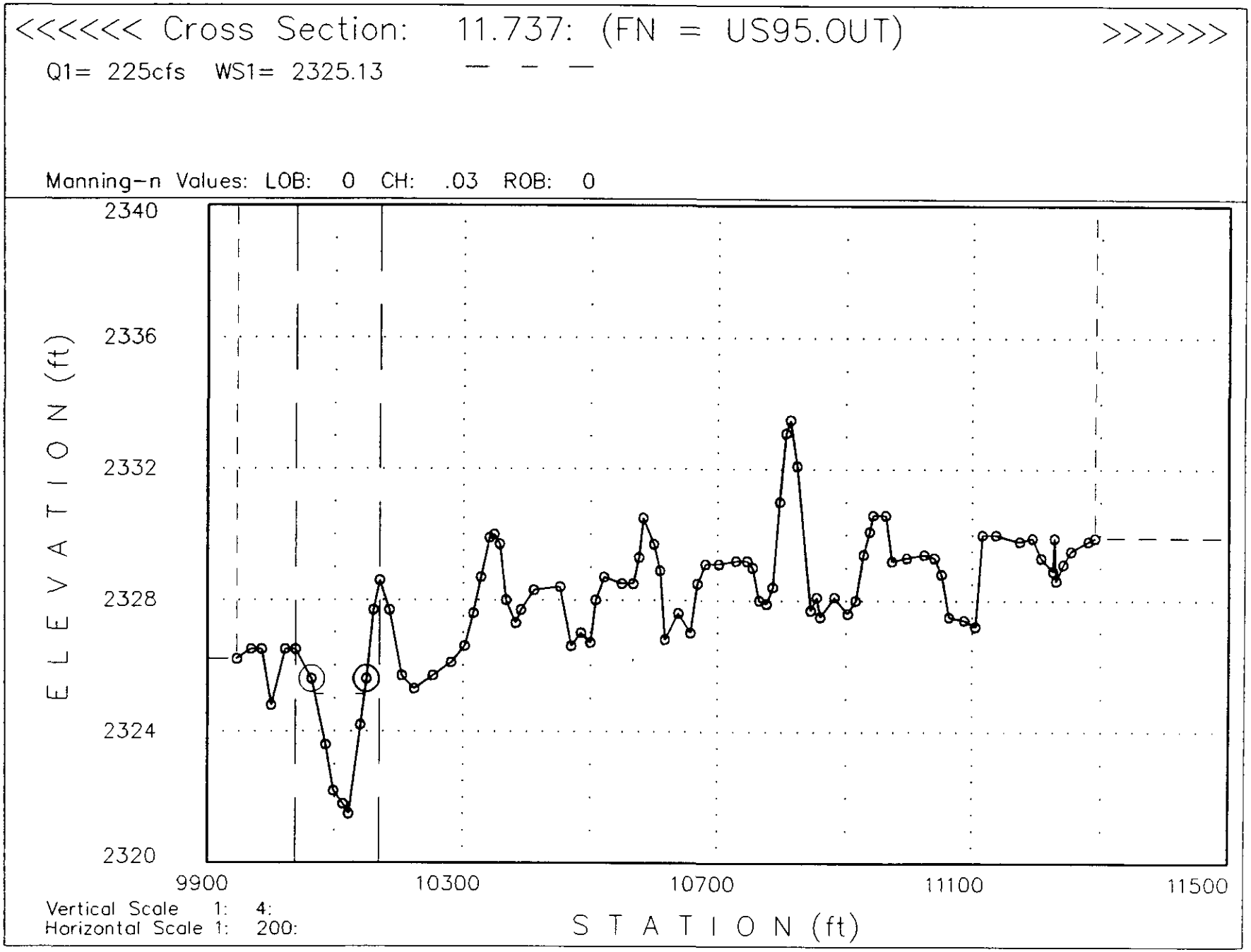

<<<<<< Cross Section: 10.555: (FN = US95.OUT) >>>>>>
Q1= 2963cfs WS1= 2319.06
Manning-n Values: LOB: .025 CH: .03 ROB: .03
2350
2342
2334
2326
2318
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
Vertical Scale 1: 8:
Horizontal Scale 1: 200:
STATION (ft)
06-13-1994

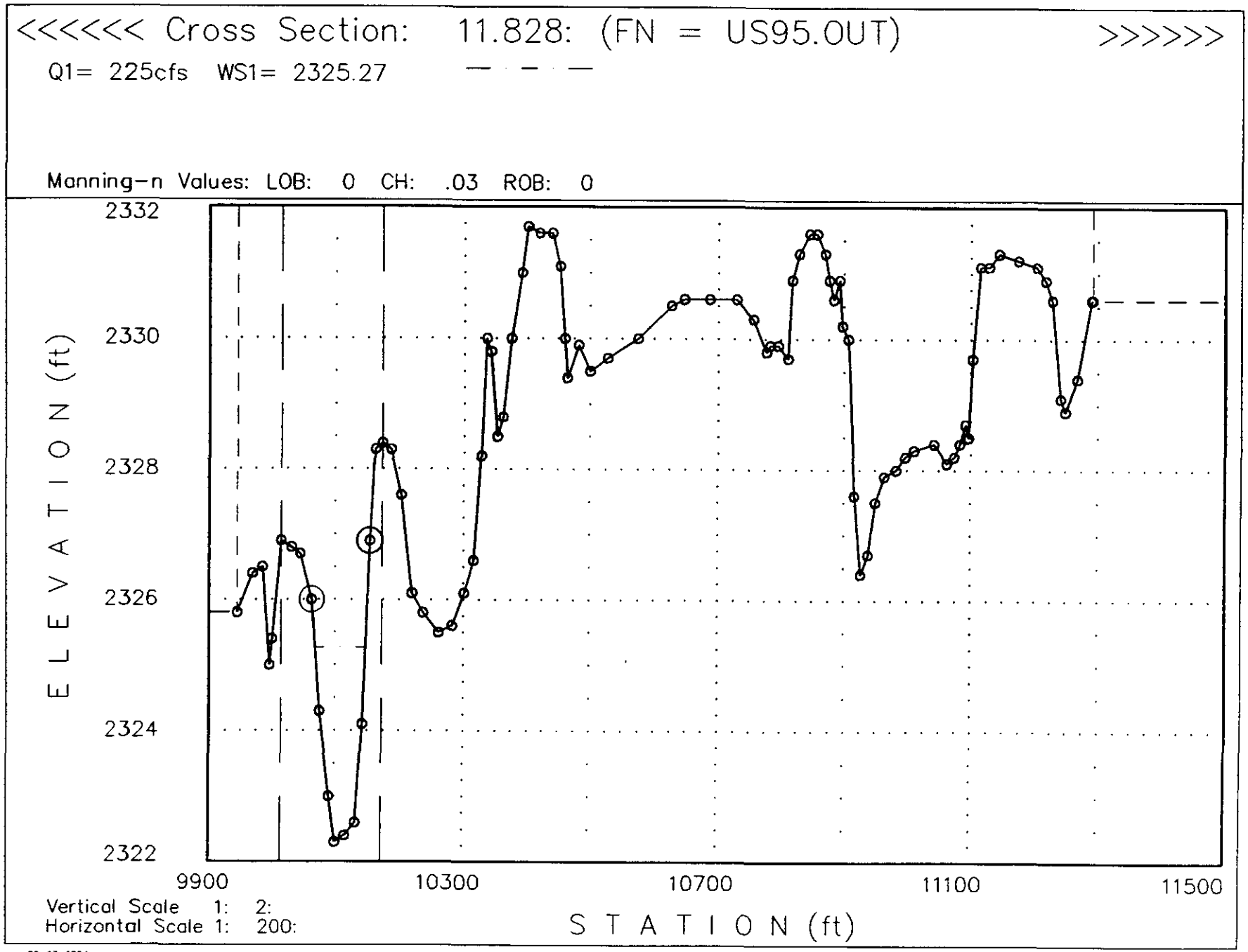

<<<<<< Cross Section: 10.651: (FN = US95.OUT) >>>>>>
Q1= 3330cfs WS1= 2319.28
Manning-n Values: LOB: .025 CH: .03 ROB: .03
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994

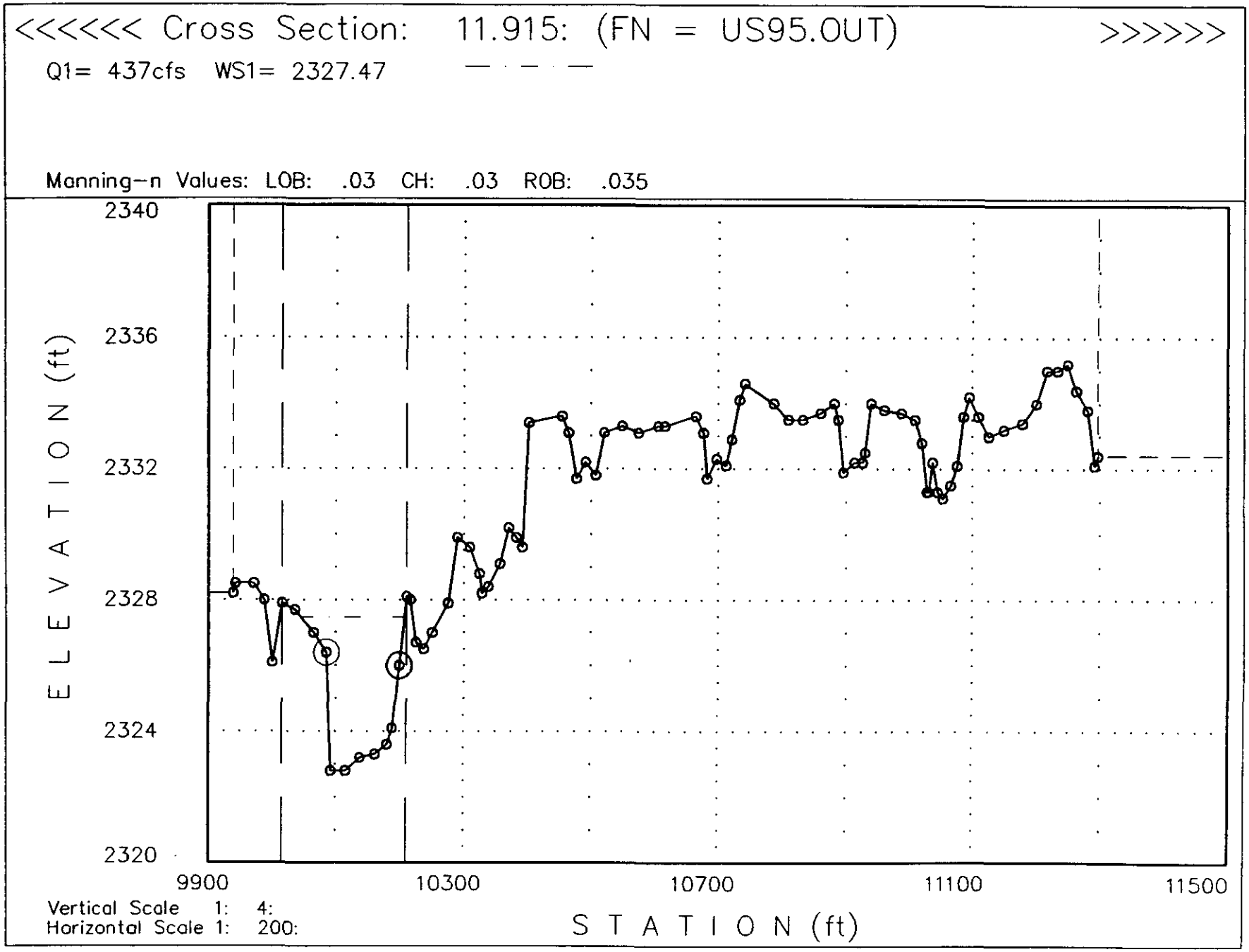

<<<<<< Cross Section: 10.756: (FN = US95.OUT) >>>>>>
Q1= 3330cfs WS1= 2319.64
Manning-n Values: LOB: .025 CH: .03 ROB: .045
2350
2342
2334
2326
2318
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 8:
Horizontal Scale 1: 200:
06-13-1994

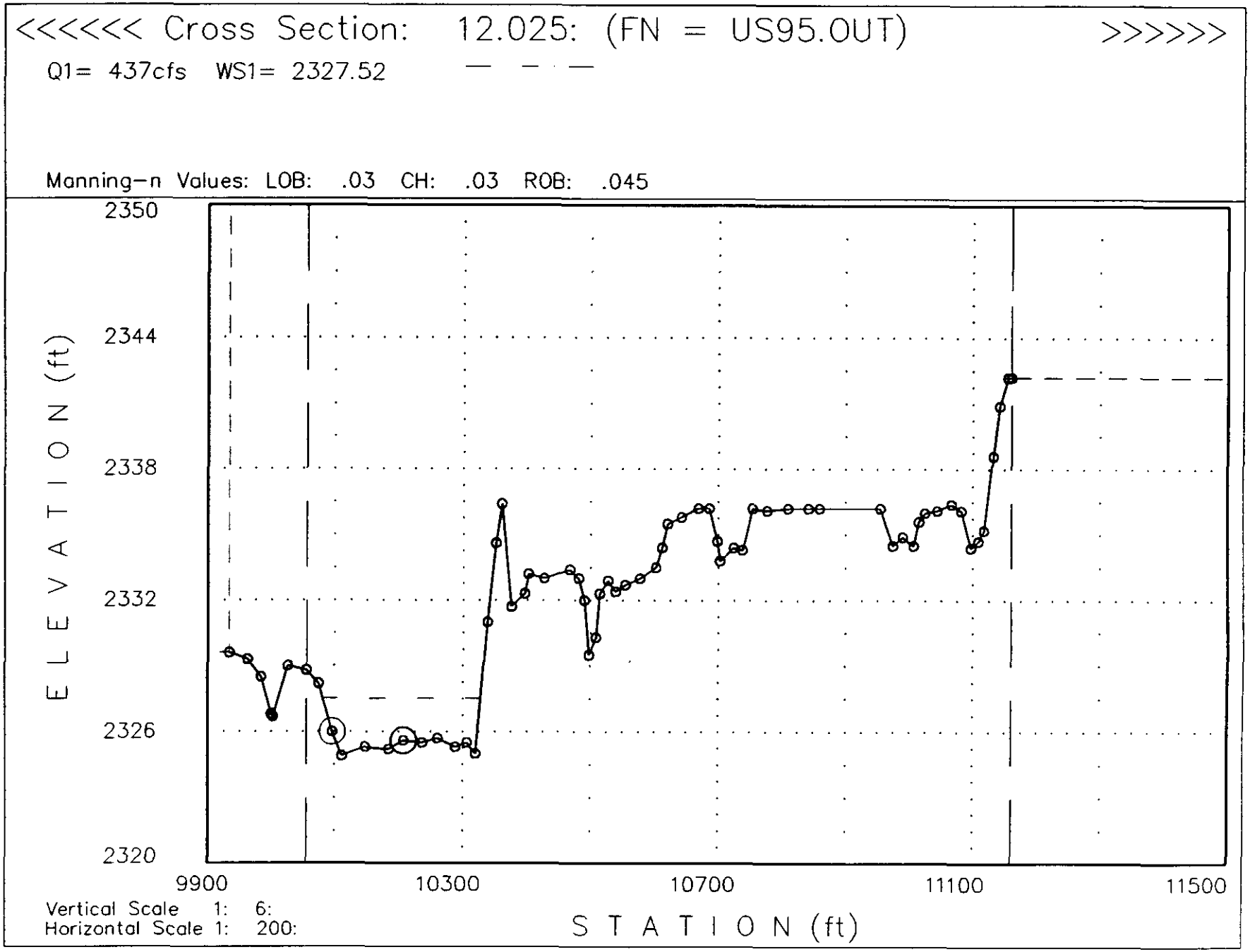

<<<<<< Cross Section: 10.825: (FN = US95.0UT) >>>>>>
Q1= 3330cfs WS1= 2320.18
Manning-n Values: LOB: .025 CH: .03 ROB: .045
2325
2323
2321
2319
2317
2315
ELEVATION (ft)
9800
10200
10600
11000
11400
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994

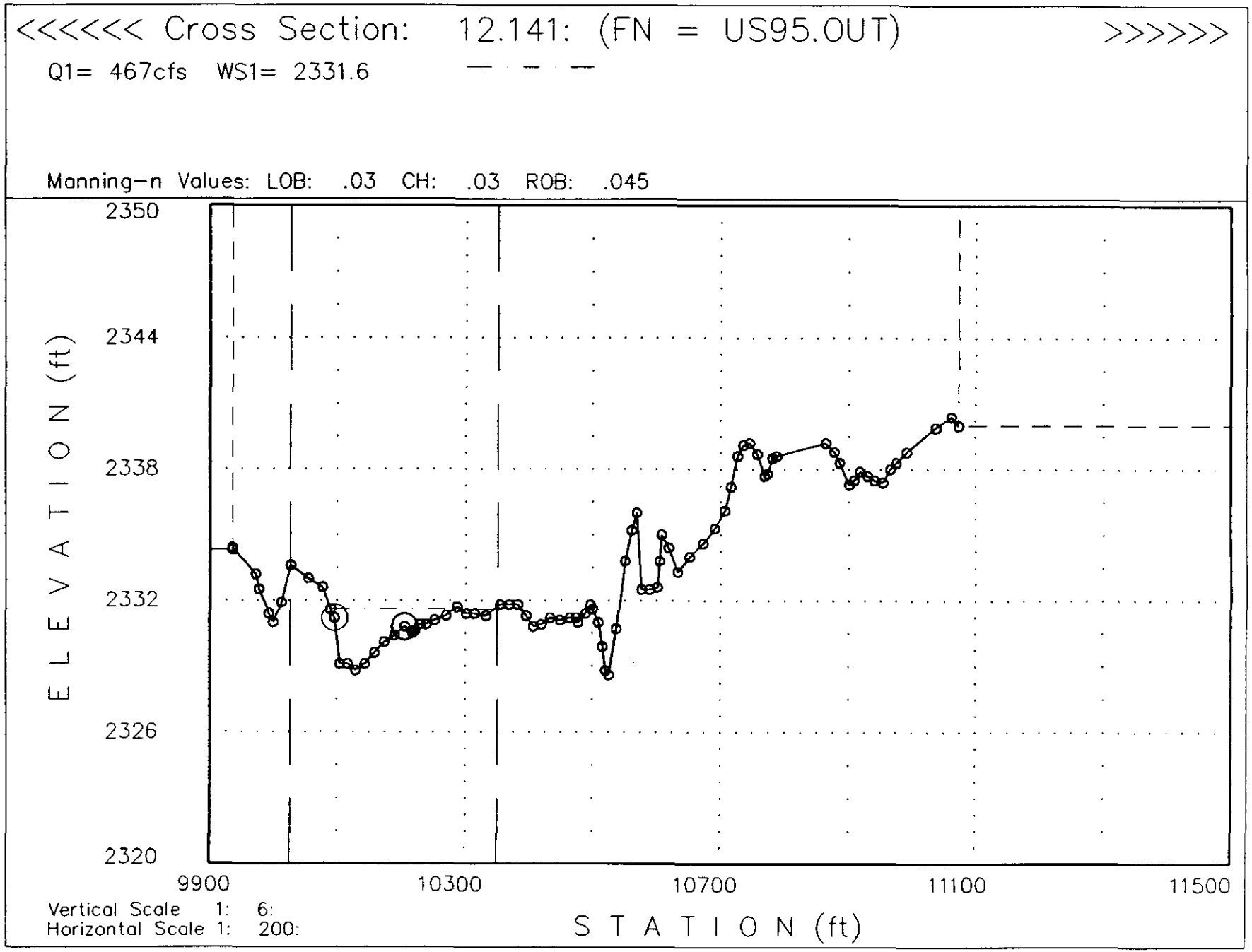

<<<<<< Cross Section: 11.656: (FN = US95.OUT) >>>>>>
Q1= 225cfs WS1= 2324.97
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2340
2336
2332
2328
2324
2320
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 4:
Horizontal Scale 1: 200:
06-13-1994

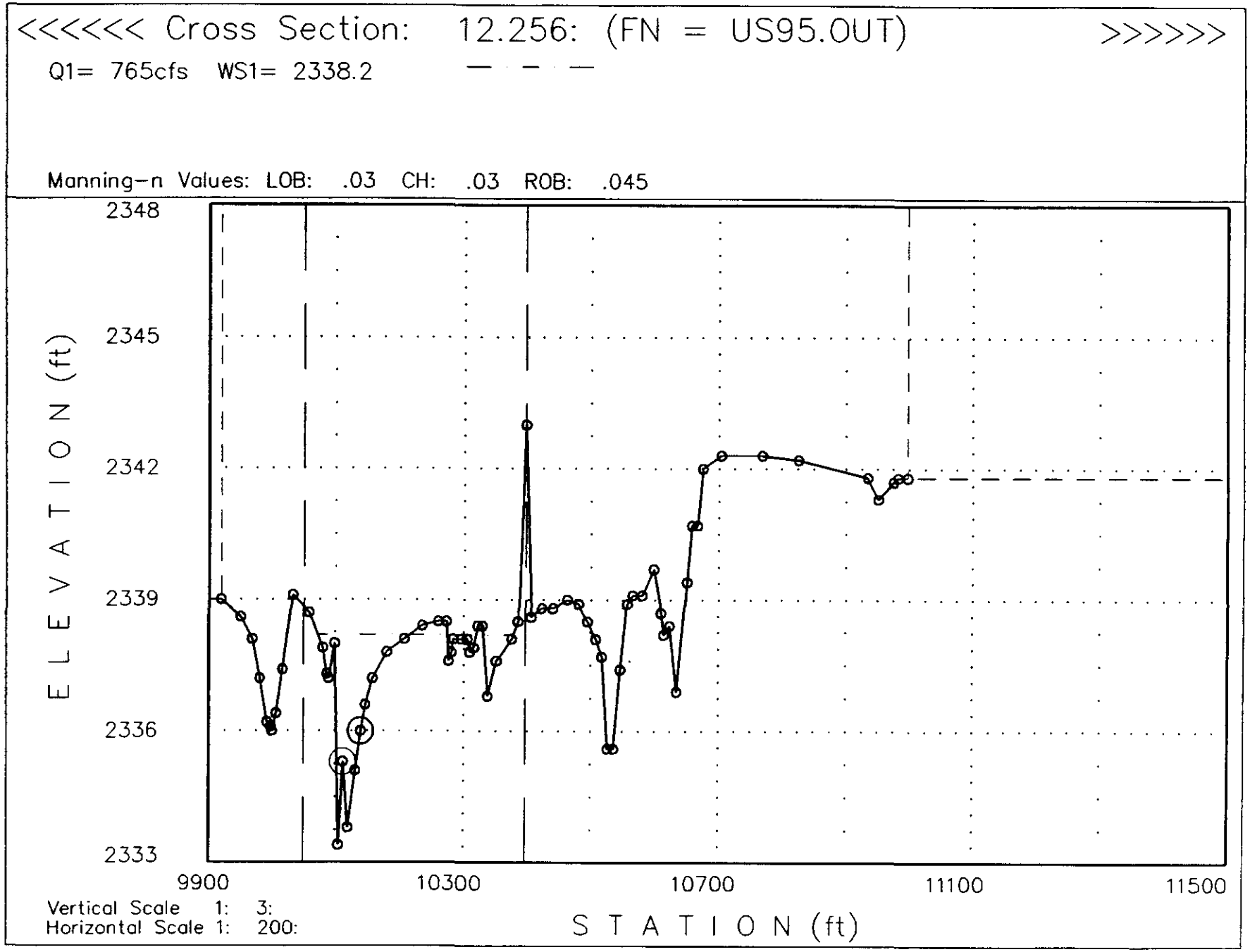

<<<<<< Cross Section: 11.737: (FN = US95.OUT) >>>>>>
Q1= 225cfs WS1= 2325.13
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2340
2336
2332
2328
2324
2320
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 4:
Horizontal Scale 1: 200:
06-09-1994

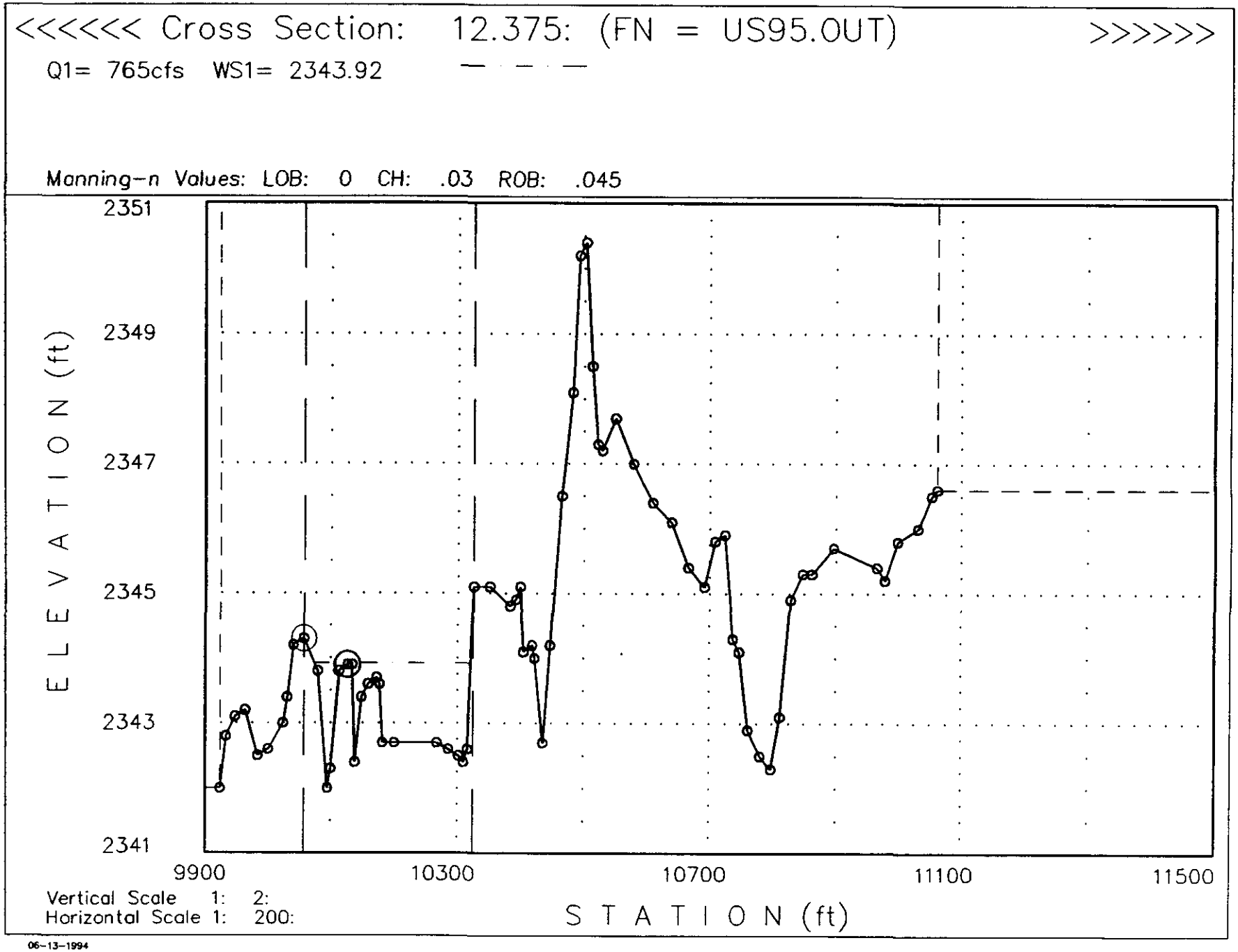

<<<<<< Cross Section: 11.828: (FN = US95.OUT) >>>>>>
Q1= 225cfs WS1= 2325.27
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2332
2330
2328
2326
2324
2322
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994

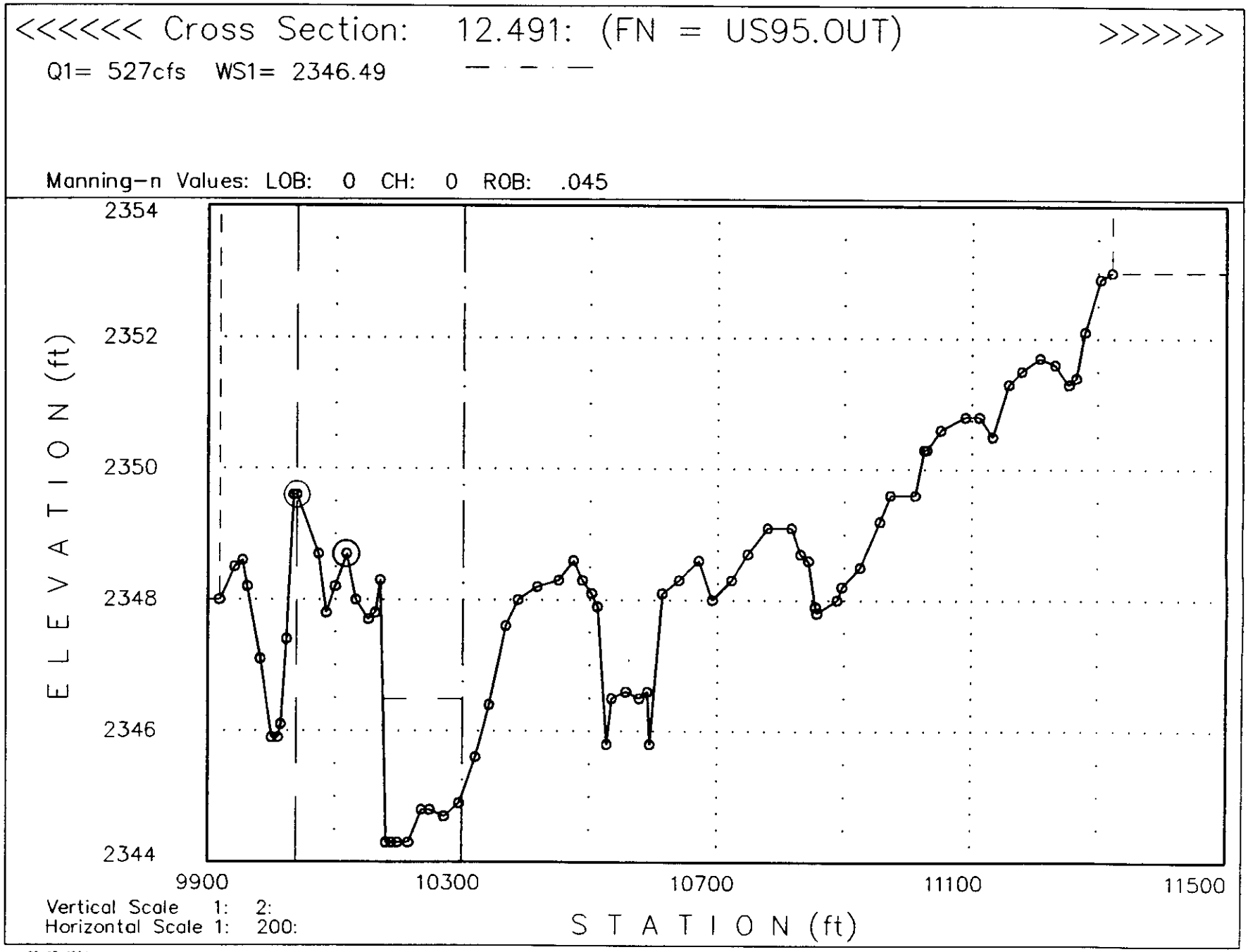

<<<<<< Cross Section: 11.915: (FN = US95.OUT) >>>>>>
Q1= 437cfs WS1= 2327.47
Manning-n Values: LOB: .03 CH: .03 ROB: .035
2340
2336
2332
2328
2324
2320
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 4:
Horizontal Scale 1: 200:
06-13-1994

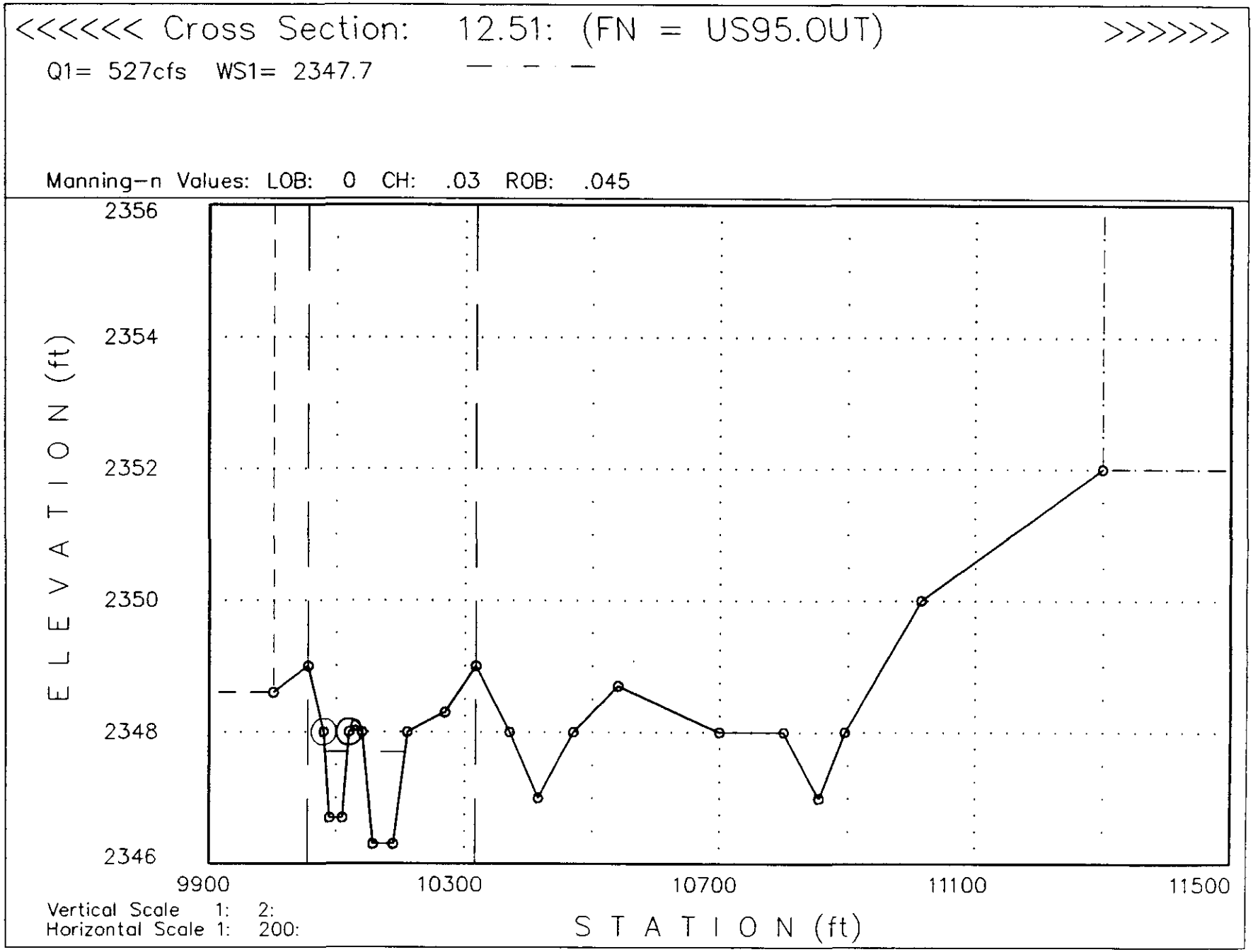

<<<<<< Cross Section: 12.025: (FN = US95.OUT) >>>>>>
Q1= 437cfs WS1= 2327.52
Manning-n Values: LOB: .03 CH: .03 ROB: .045
2350
2344
2338
2332
2326
2320
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994

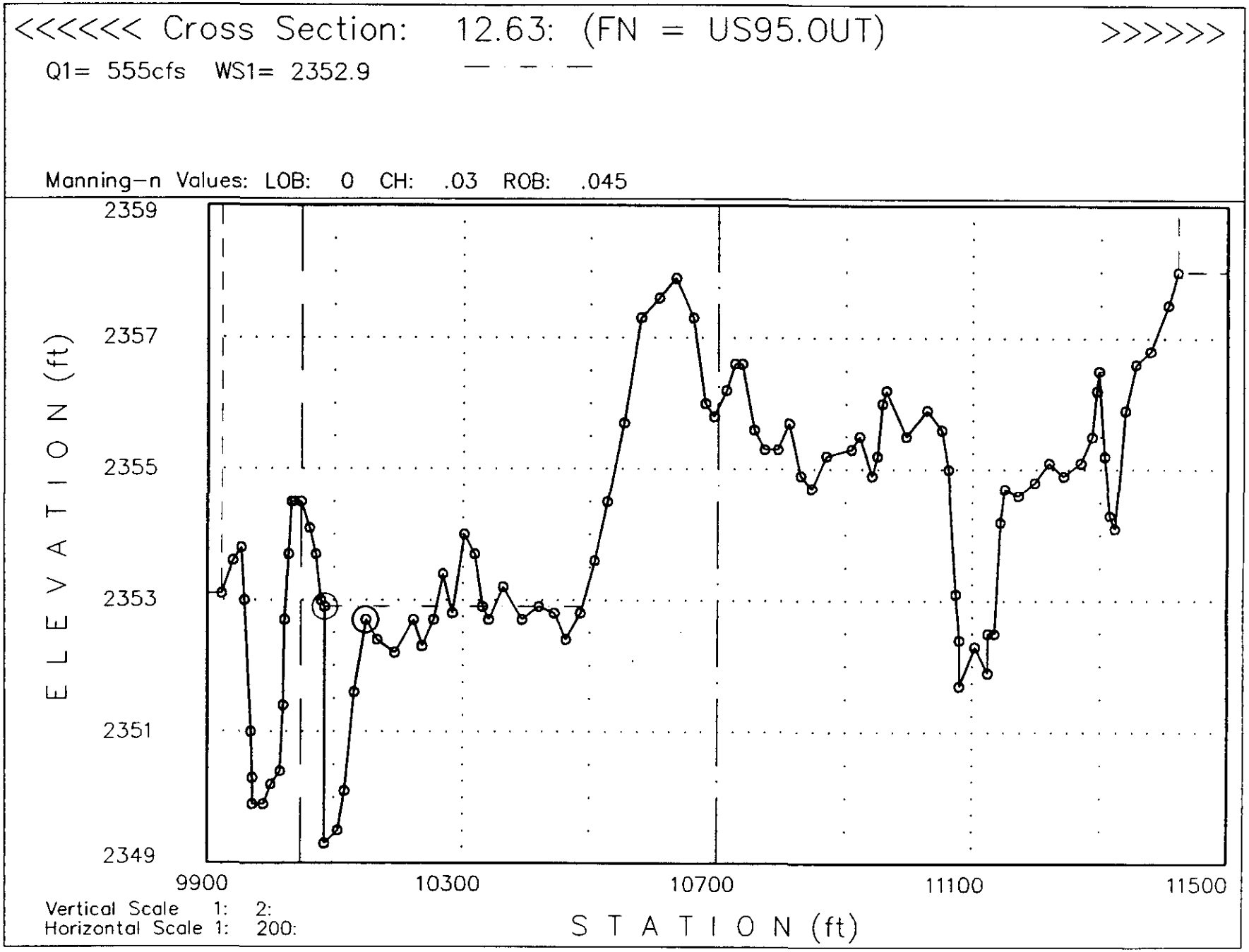

<<<<<< Cross Section: 12.141: (FN = US95.OUT) >>>>>>
Q1= 467cfs WS1= 2331.6
Manning-n Values: LOB: .03 CH: .03 ROB: .045
2350
2344
2338
2332
2326
2320
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994

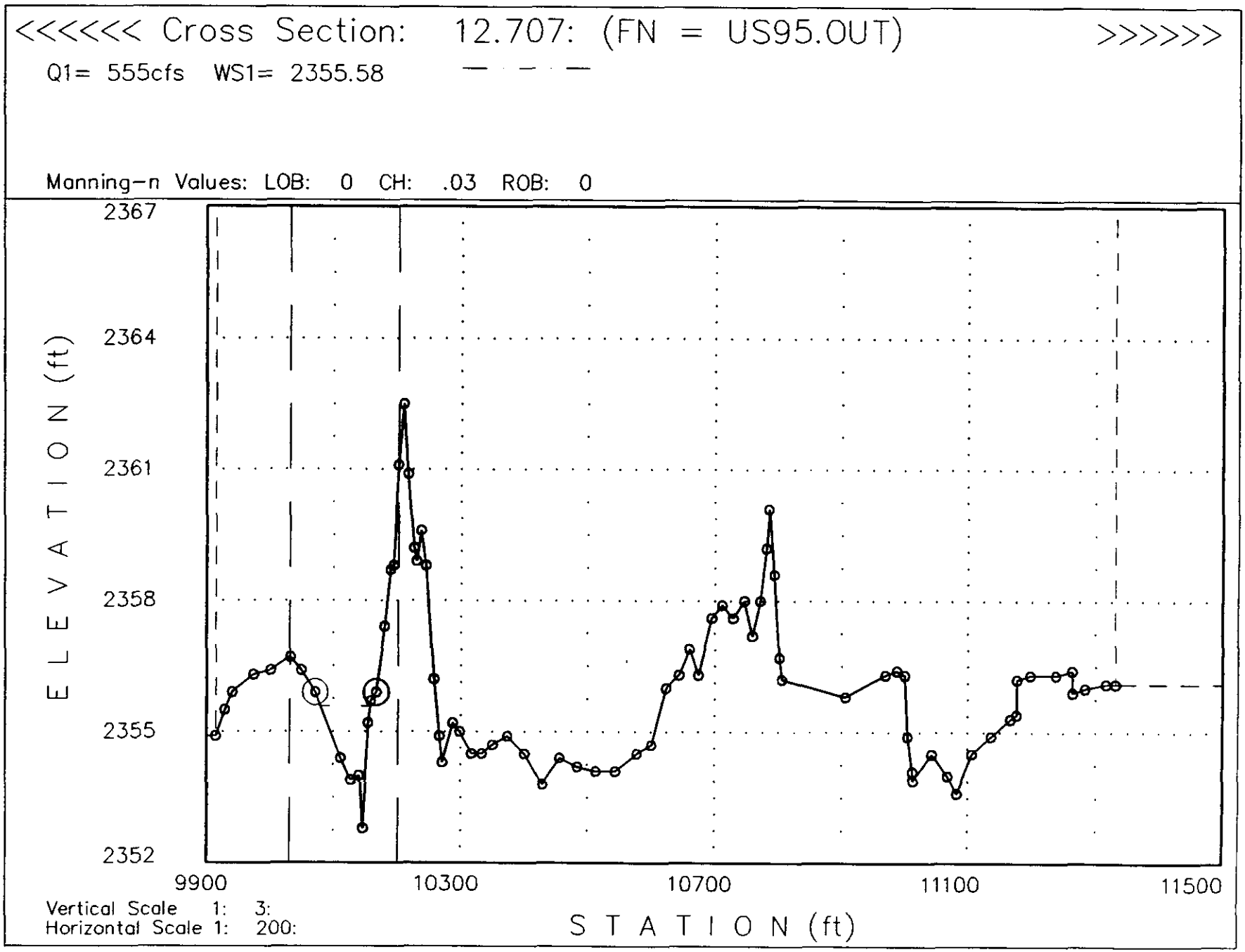

<<<<<< Cross Section: 12.256: (FN = US95.OUT) >>>>>>
Q1= 765cfs WS1= 2338.2
Manning-n Values: LOB: .03 CH: .03 ROB: .045
2348
2345
2342
2339
2336
2333
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 3:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 12.375: (FN = US95.OUT) >>>>>>
Q1= 765cfs WS1= 2343.92
Manning-n Values: LOB: 0 CH: .03 ROB: .045
2351
2349
2347
2345
2343
2341
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 12.491: (FN = US95.OUT) >>>>>>
Q1= 527cfs WS1= 2346.49
Manning-n Values: LOB: 0 CH: 0 ROB: .045
2354
2352
2350
2348
2346
2344
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 12.51: (FN = US95.OUT) >>>>>>
Q1= 527cfs WS1= 2347.7
Manning-n Values: LOB: 0 CH: .03 ROB: .045
2356
2354
2352
2350
2348
2346
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 12.63: (FN = US95.OUT) >>>>>>
Q1= 555cfs WS1= 2352.9
Manning-n Values: LOB: 0 CH: .03 ROB: .045
2359
2357
2355
2353
2351
2349
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 12.707: (FN = US95.OUT) >>>>>>
Q1= 555cfs WS1= 2355.58
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2367
2364
2361
2358
2355
2352
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 3:
Horizontal Scale 1: 200:
06-13-1994

US95SP.dat

US95SP.DAT

```
*********************************************
*  HEC-2 WATER SURFACE PROFILES             *
*                                           *
*  Version   4.6.2;  May 1991               *
*                                           *
*  RUN DATE    09JUN94     TIME    13:00:38 *
*********************************************
```

```
*****************************************
*  U.S. ARMY CORPS OF ENGINEERS         *
*  HYDROLOGIC ENGINEERING CENTER        *
*  609 SECOND STREET, SUITE D           *
*  DAVIS, CALIFORNIA 95616-4687         *
*          (916) 756-1104               *
*****************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

THIS RUN EXECUTED 09JUN94 13:00:38

```
**************************************
 HEC-2 WATER SURFACE PROFILES

 Version  4.6.2;  May 1991
**************************************



SPLIT FLOW BEING PERFORMED


SF      SPLIT FLOWS NEAR CRAIG RD. & US 95 INTERSECTION.


JC       ON-RAMP
JP     0        0       0      -1       0

TW      BETWEEN SECTIONS 10.848 AND 10.938
WS     5  10.848  10.938      -1       3
WC     0  2321.2     130    2320     300  2318.7     420    2320     475  2321.2

TW      BETWEEN SECTIONS 10.938 AND 11.015
WS     5  10.938  11.015      -1       3
WC     0  2321.2      80    2322     180    2324     230    2326     390  2330.5
```

THE 100-YEAR PEAK FLOW SPLITS INTO TWO DIRECTIONS @ US 95 AND CRAIG RD.
INTERSECTION AND COMBINES AGAIN APPROX. 1300 FEET DOWNSTREAM.
THIS HEC-2 IS TO MODEL AREAS BETWEEN U.S. 95 SOUTHBOUND AND RAMPS.
REFER TO US95.DAT BY CVL CONSULTANTS, INC.

```
T1      NORTHWEST LAS VEGAS FIS RESTUDY                FILE NAME : US95SP.DAT
T2      BY COE & VAN LOO CONSULTANTS, INC.             CVL JOB # : 930017
T3         US 95 SPLIT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

        0         2         0         0        -1         0         0         0    2318.5         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

       -1         0        -1

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

      150        38        43         1        13        14        15        26        53        54
        4        25

QT        1      1680
NC     0.03      0.03     0.025       0.1       0.3
ET                 7.1                                            10040.9   10147.6
  STARTING WSEL =2320.48
  SEE TECHNICAL APPENDIX FOR CALCULATIONS
X1   10.848        64  10062.5  10112.5         0         0         0
X5        1   2320.48
GR   2319.1    9829.0   2319.5   9843.5    2320.0    9855.6    2318.0    9874.9    2316.3    9898.4
GR   2316.4    9911.3   2318.2   9927.1    2320.4    9946.7    2320.8    9966.4    2321.1    9984.2
GR   2319.9    9994.3   2319.1  10000.0    2318.7   10004.5    2320.7   10018.5    2320.8   10025.1
GR   2320.8   10040.9   2320.4  10062.5    2317.9   10080.0    2317.0   10099.0    2317.3   10106.1
GR   2316.9   10112.5   2319.5  10112.5    2319.5   10117.3    2320.7   10134.0    2321.2   10147.6
GR   2320.8   10159.3   2320.4  10171.9    2319.5   10194.4    2317.8   10217.6    2316.4   10232.2
GR   2316.1   10247.8   2317.5  10256.3    2317.8   10260.1    2317.8   10293.8    2317.9   10338.8
GR   2317.8   10380.8   2317.7  10410.5    2318.2   10470.6    2318.5   10526.9    2318.5   10573.3
GR   2318.0   10617.9   2318.4  10639.2    2318.1   10663.3    2318.6   10689.9    2318.5   10707.1
GR   2318.4   10727.1   2319.1  10744.4    2319.4   10777.4    2319.4   10823.3    2319.6   10858.6
GR   2319.9   10883.1   2320.0  10897.1    2321.3   10904.7    2319.9   10915.8    2321.6   10926.2
GR   2320.2   10938.6   2320.3  10963.8    2320.5   10994.8    2320.4   11021.1    2320.8   11059.4
GR   2321.2   11109.4   2321.8  11164.1    2322.0   11220.1    2322.3   11248.3

ET                 7.1                                            10041.3   10300.9
X1   10.938        67  10094.5  10166.4       455       455       455
GR   2321.1    9683.9   2321.5   9689.4    2321.9    9707.4    2322.2    9723.4    2318.7    9748.0
GR   2317.5    9758.0   2316.7   9780.6    2316.9    9815.7    2317.2    9859.5    2317.2    9890.7
GR   2317.3    9906.2   2320.3   9929.6    2321.7    9947.5    2322.3    9966.4    2322.3    9985.6
GR   2320.8    9999.8   2320.5  10000.0    2320.5   10005.4    2321.7   10017.8    2322.4   10025.3
```

```
GR  2322.4   10041.3   2321.4   10063.5   2318.5   10094.5   2316.8   10109.7   2316.8   10117.2
GR  2317.8   10127.0   2318.2   10166.4   2318.2   10212.7   2318.6   10249.3   2318.9   10259.2
GR  2320.7   10274.9   2321.1   10285.7   2321.2   10300.9   2320.7   10320.0   2319.0   10342.0
GR  2318.1   10371.4   2317.8   10387.3   2319.4   10397.3   2319.8   10400.1   2319.0   10410.8
GR  2319.3   10466.9   2319.4   10528.2   2319.4   10578.2   2319.8   10640.1   2320.0   10682.2
GR  2320.0   10693.3   2320.5   10701.2   2320.2   10713.9   2320.2   10732.3   2320.2   10745.0
GR  2320.4   10778.0   2320.7   10820.8   2320.9   10836.8   2320.8   10882.0   2321.3   10937.7
GR  2321.6   10962.0   2322.0   10987.5   2321.8   11009.7   2322.4   11030.7   2322.5   11062.7
GR  2322.6   11096.2   2322.6   11142.2   2323.1   11183.1   2323.1   11229.3   2323.4   11259.3
GR  2323.6   11289.7   2323.6   11301.3

ET          7.1                                              10042.5  10352.2
NH      5   0.035     10042.5      0.03  10081.7     0.016   10137.6      0.02  10200.8      0.08
NH  11340.  2
X1  11.015      89     10081.7  10205.2       385       385       385
GR  2327.7   9604.9   2328.1   9609.9   2328.6   9630.9   2329.6   9644.4   2330.0   9660.7
GR  2328.0   9673.9   2322.3   9694.8   2319.1   9707.9   2318.3   9719.6   2317.7   9756.3
GR  2317.6   9806.5   2317.9   9846.2   2317.8   9855.6   2317.3   9860.9   2318.3   9865.1
GR  2318.6   9888.9   2319.2   9913.4   2320.7   9931.7   2321.7   9941.6   2322.2   9947.9
GR  2322.7   9959.3   2322.8   9970.2   2322.5   9986.8   2321.9   10000.0  2321.3   10007.7
GR  2322.3   10019.1  2322.8   10025.3  2322.9   10042.5  2322.8   10064.7  2322.3   10074.0
GR  2320.3   10081.7  2317.4   10085.9  2317.2   10093.9  2317.3   10137.6  2317.1   10166.5
GR  2316.9   10200.8  2319.6   10205.2  2319.7   10232.6  2320.2   10270.9  2320.4   10298.2
GR  2320.8   10313.7  2323.1   10324.6  2328.4   10340.9  2330.1   10348.4  2330.5   10352.2
GR  2330.1   10370.5  2328.7   10394.1  2328.0   10409.0  2326.8   10422.0  2323.6   10437.9
GR  2321.3   10462.5  2320.1   10486.7  2319.5   10504.2  2321.4   10514.2  2322.3   10519.9
GR  2321.0   10525.1  2320.8   10541.4  2321.3   10572.4  2329.5   10572.4  2329.2   10627.8
GR  2321.0   10627.9  2320.9   10649.3  2320.9   10683.3  2321.0   10697.6  2321.7   10702.4
GR  2321.0   10712.2  2321.4   10724.3  2321.5   10772.2  2321.7   10846.0  2321.7   10918.9
GR  2322.1   10981.8  2322.3   11009.2  2322.5   11018.4  2322.5   11032.8  2322.7   11049.6
GR  2322.6   11087.5  2322.9   11104.7  2322.6   11112.5  2322.8   11123.8  2323.3   11132.9
GR  2323.1   11168.5  2323.9   11220.4  2324.3   11267.5  2324.5   11300.8  2325.5   11312.3
GR  2325.9   11320.5  2324.5   11328.7  2324.3   11332.9  2324.6   11340.2
```

CRAIG RD. AND US 95 INTERSECTION
SPECIAL CULVERT ROUTINE IS NOT USED FOR THIS AREA SINCE CULVERT FLOWS
AND CHANNEL FLOWS OCCUR AT THE SAME ELEVATION.
RATING CURVE METHOD WAS USED TO DETERMINE WSEL FOR THIS CROSS SECTION.

WSEL = 2321.33
SEE TECHNICAL APPENDIX __ FOR CALCULATIONS.

```
ET          7.1                                              10027.2  10353.7
X1  11.080      87     10086.3  10214.0       240       240       240
X5      1   2321.33
GR  2327.6   9602.0   2328.1   9604.4   2328.7   9618.4   2329.7   9634.2   2330.3   9646.1
GR  2330.6   9657.8   2330.3   9662.1   2327.8   9681.3   2322.5   9700.2   2322.2   9702.4
GR  2318.3   9702.6   2318.0   9722.5   2318.2   9762.8   2318.2   9815.8   2318.9   9860.8
GR  2319.9   9887.7   2320.1   9912.7   2320.8   9923.4   2322.4   9936.1   2322.8   9948.4
GR  2323.2   9959.7   2323.2   9971.5   2323.2   9986.9   2322.1   9997.3   2321.8   10000.0
GR  2321.8   10006.4  2322.8   10017.5  2323.4   10027.2  2323.1   10042.3  2322.7   10055.4
GR  2322.5   10066.4  2322.5   10079.3  2322.5   10086.3  2316.3   10086.4  2317.6   10116.8
GR  2317.3   10156.5  2317.8   10192.8  2318.5   10204.4  2320.6   10214.0  2320.0   10240.3
```

GR	2319.6	10268.6	2319.6	10286.3	2320.2	10298.0	2324.0	10315.7	2327.6	10334.6
GR	2330.1	10349.8	2330.4	10353.7	2330.3	10359.2	2329.6	10372.1	2329.1	10382.9
GR	2328.5	10395.8	2328.0	10404.3	2326.9	10418.3	2324.9	10434.7	2321.9	10460.3
GR	2319.7	10479.0	2319.2	10501.8	2319.3	10519.4	2320.4	10548.5	2320.2	10591.9
GR	2320.8	10628.0	2321.1	10672.8	2321.1	10706.4	2321.1	10732.4	2321.6	10765.0
GR	2321.7	10800.3	2322.0	10838.2	2322.3	10880.4	2322.5	10923.4	2322.9	10969.3
GR	2323.3	11003.1	2322.5	11033.8	2322.7	11061.9	2322.9	11096.4	2322.9	11140.4
GR	2323.4	11188.8	2323.3	11235.1	2324.3	11280.6	2324.3	11314.3	2323.9	11341.6
GR	2324.1	11354.3	2325.5	11359.1	2325.2	11365.4	2324.3	11369.1	2324.5	11383.2
GR	2325.5	11389.9	2327.7	11391.0						
ET		7.1					10021.3	10349.8		
X1	11.123	66	10071.7	10197.9	210	210	210			
GR	2325.2	9634.0	2325.4	9638.4	2325.8	9646.5	2325.8	9660.4	2325.6	9675.6
GR	2324.0	9690.8	2320.6	9717.2	2318.6	9729.6	2318.9	9772.9	2319.2	9831.1
GR	2319.3	9874.0	2319.6	9907.7	2321.9	9929.2	2323.8	9943.3	2324.4	9954.5
GR	2324.4	9966.8	2323.7	9982.9	2322.8	9994.3	2322.5	10000.0	2323.2	10012.8
GR	2324.2	10021.3	2323.9	10038.4	2323.7	10050.0	2323.5	10059.7	2322.2	10071.7
GR	2319.3	10093.9	2319.2	10120.3	2320.0	10162.6	2320.5	10197.9	2320.1	10224.6
GR	2319.1	10246.9	2319.7	10267.7	2320.8	10283.8	2322.9	10304.8	2324.1	10319.8
GR	2324.9	10327.9	2325.0	10331.3	2325.2	10336.6	2325.3	10349.8	2324.9	10361.6
GR	2324.2	10370.1	2321.2	10394.1	2319.8	10411.7	2319.5	10421.4	2320.0	10440.1
GR	2320.2	10448.9	2320.5	10495.8	2320.5	10565.3	2320.6	10624.2	2320.8	10693.6
GR	2321.4	10737.4	2321.0	10752.1	2321.3	10790.3	2321.7	10844.8	2322.1	10901.1
GR	2322.1	10958.4	2322.9	11019.5	2322.6	11079.0	2323.0	11148.3	2323.2	11214.0
GR	2323.8	11281.5	2324.1	11319.7	2323.9	11329.6	2323.8	11344.6	2324.4	11355.1
GR	2325.0	11356.0								

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 10.848
WATER EL=X5 CARD= 2320.480

3470 ENCROACHMENT STATIONS= 10040.9 10147.6 TYPE= 1 TARGET= 106.699

10.848	4.38	2320.48	2318.61	2320.48	2320.55	.07	.00	.00	2320.40
275.3	.0	266.6	8.7	.2	126.1	11.4	.0	.0	2319.50
.00	.12	2.11	.76	.030	.025	.030	.000	2316.10	10058.18
.000396	0.	0.	0.	0	13	0	.00	72.76	10130.94

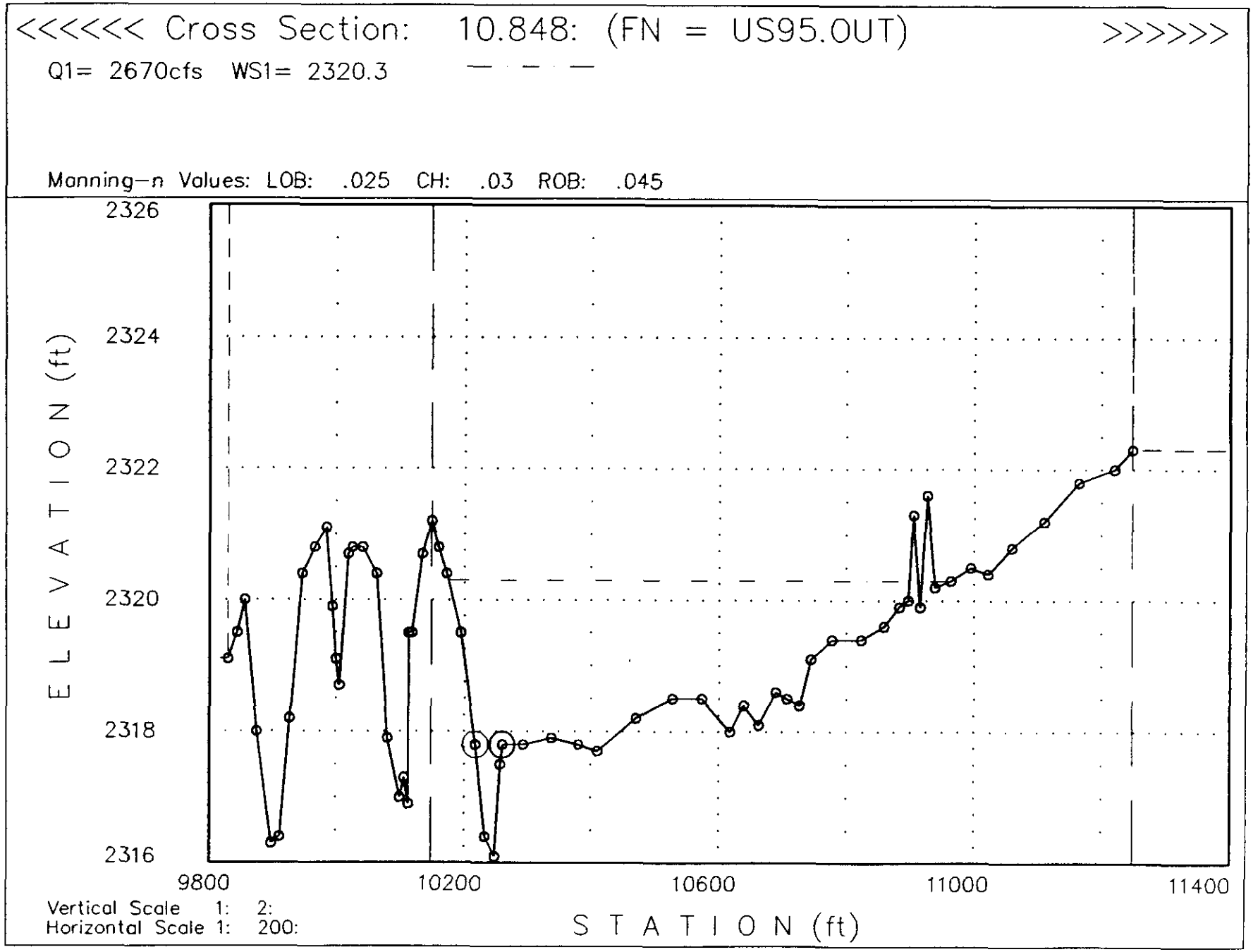
*SECNO 10.938

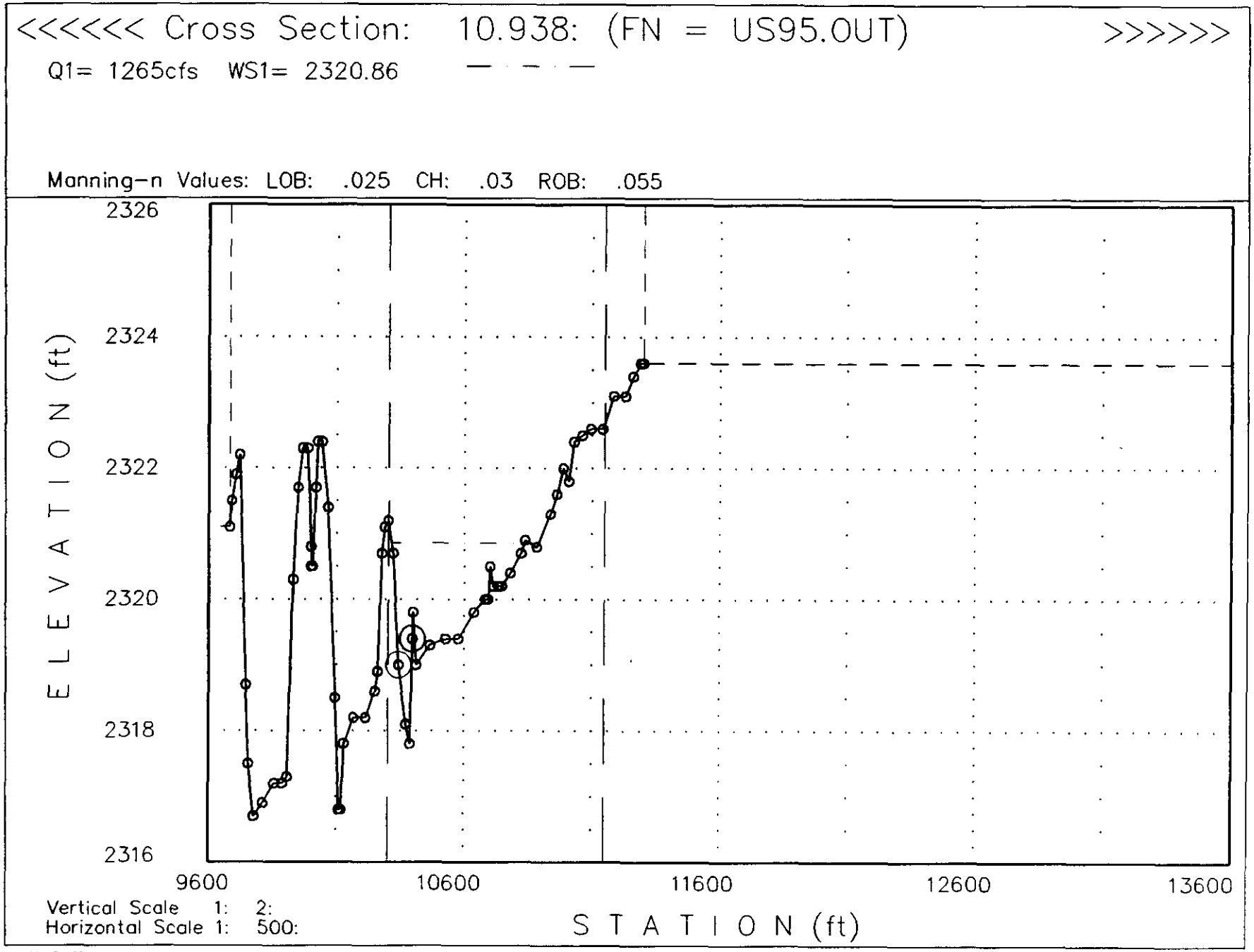
3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.68

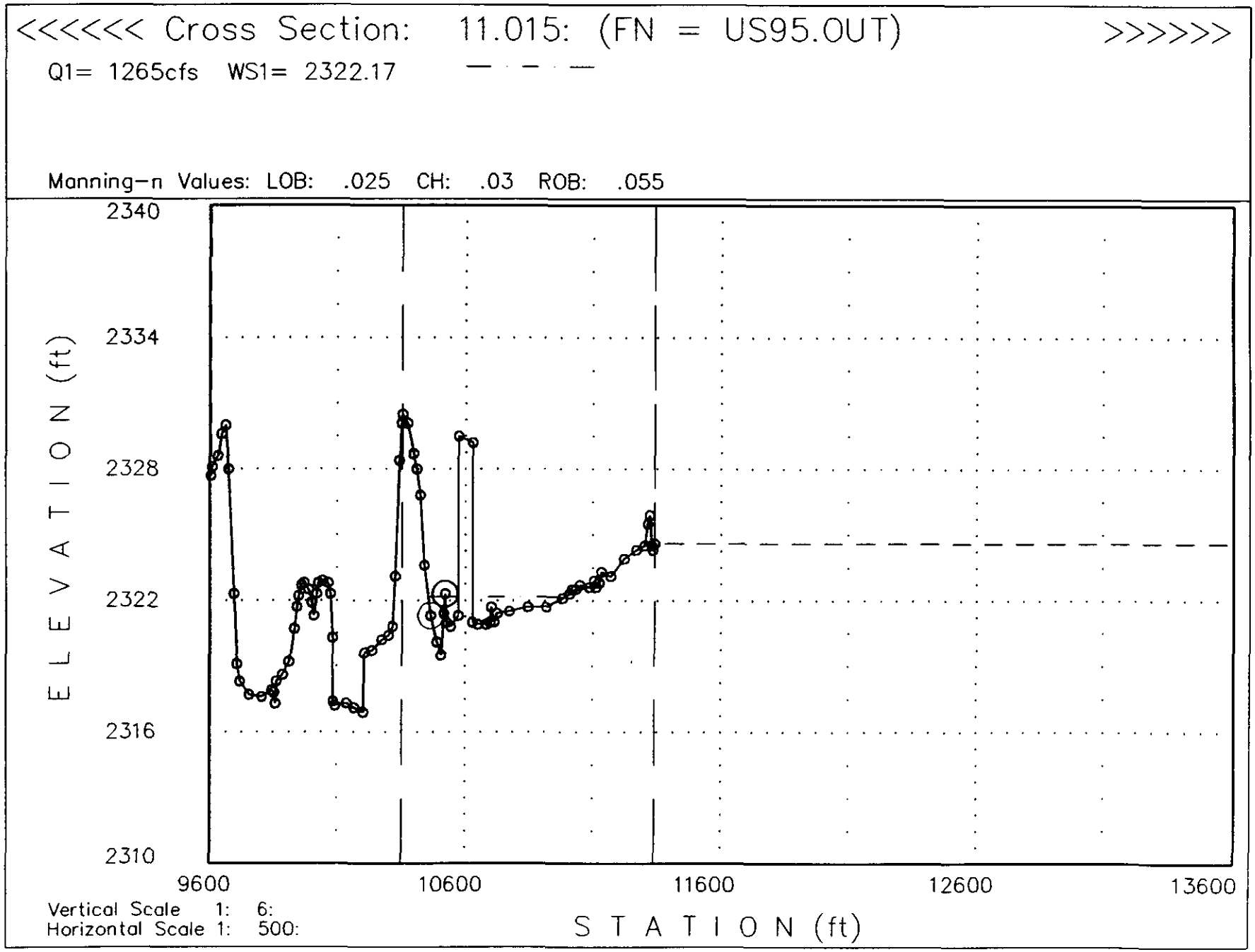
3470 ENCROACHMENT STATIONS= 10041.3 10300.9 TYPE= 1 TARGET= 259.601

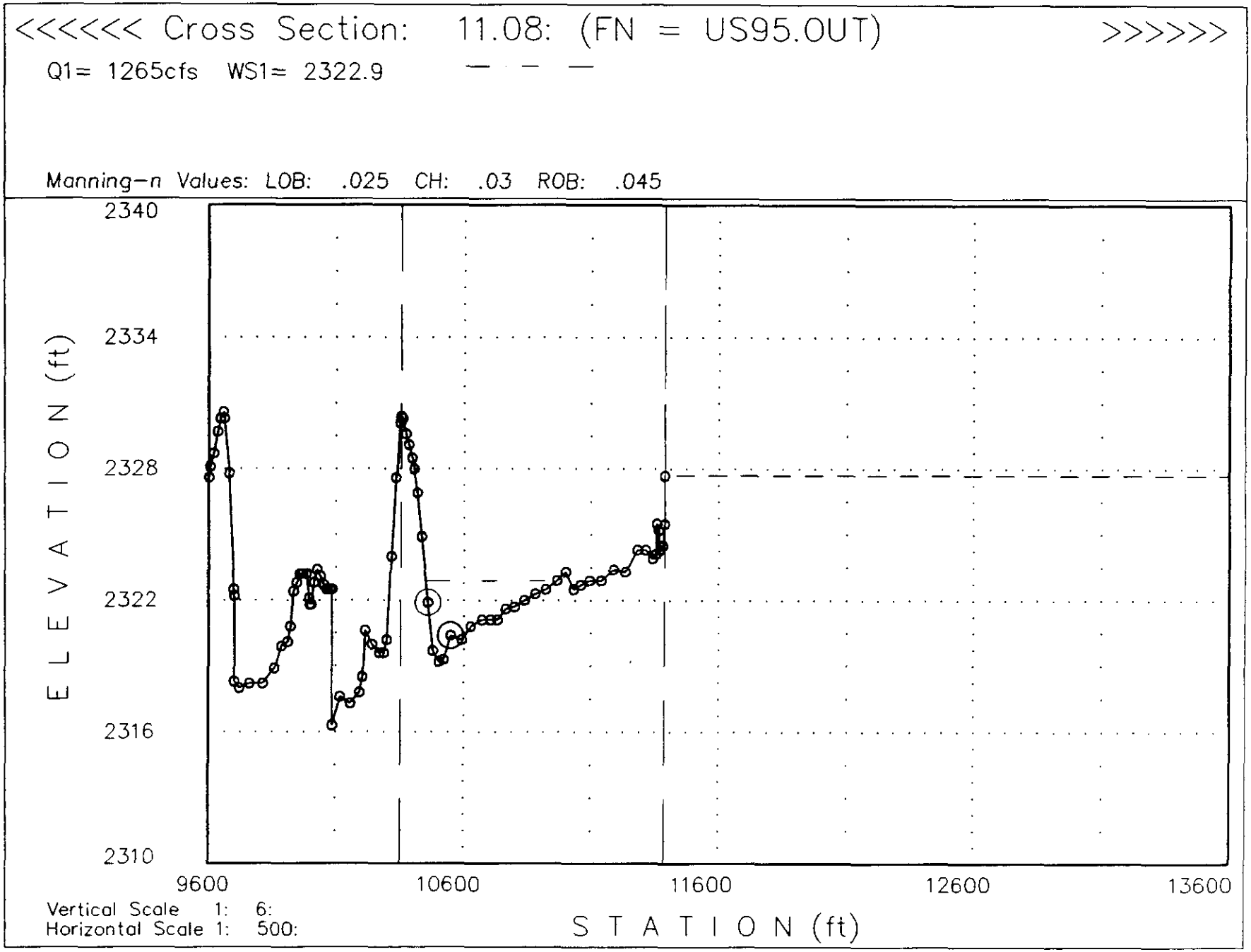
10.938	4.10	2320.80	.00	2320.79	2321.00	.20	.42	.04	2318.50
1680.0	50.3	923.4	706.3	28.2	222.1	243.8	3.3	1.5	2318.20
.04	1.79	4.16	2.90	.030	.025	.030	.000	2316.70	10069.97
.001090	455.	455.	455.	2	0	0	.00	207.50	10277.46

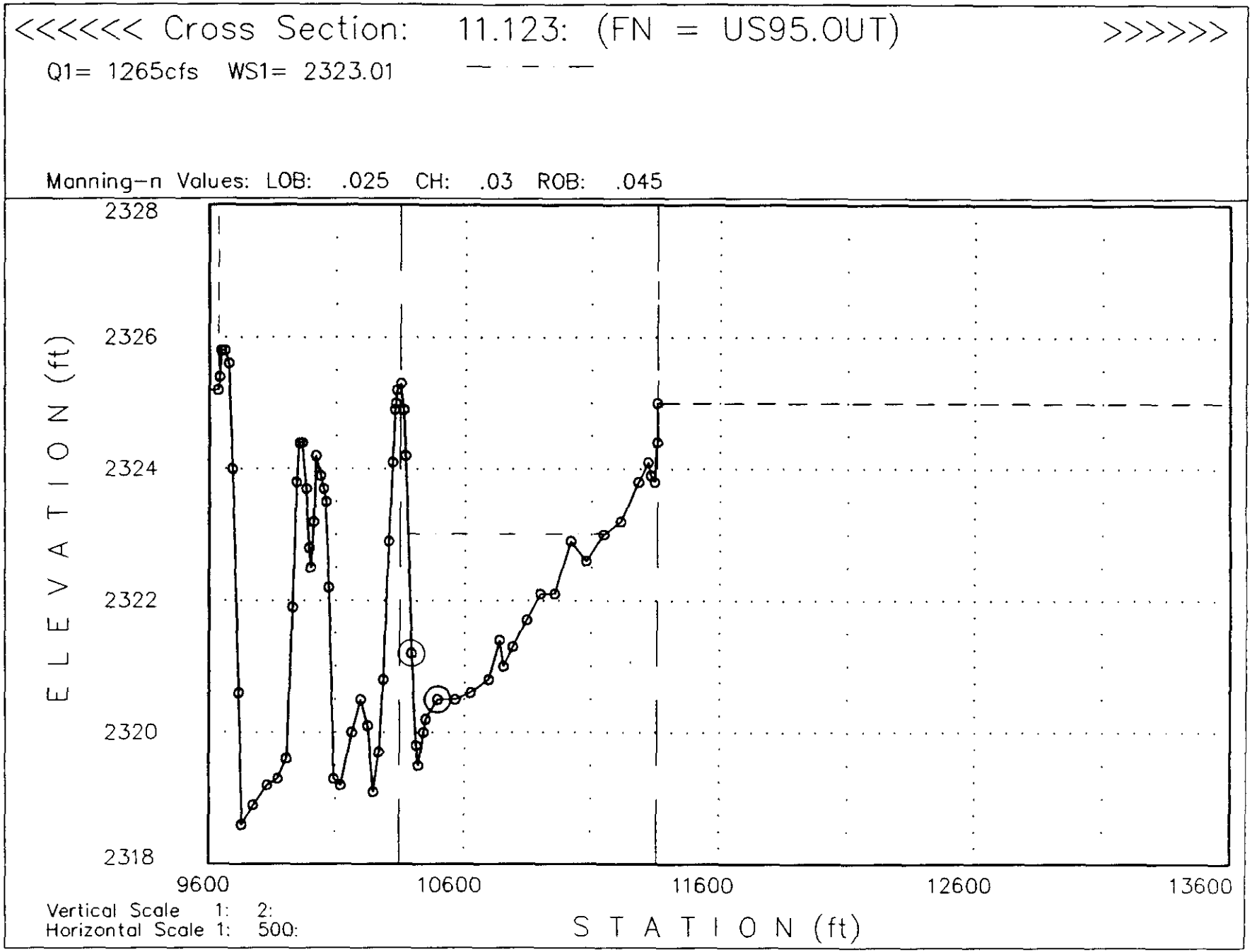
1490 NH CARD USED
*SECNO 11.015
1530 MANNINGS N VALUES FOR CHANNEL COMPOSITED

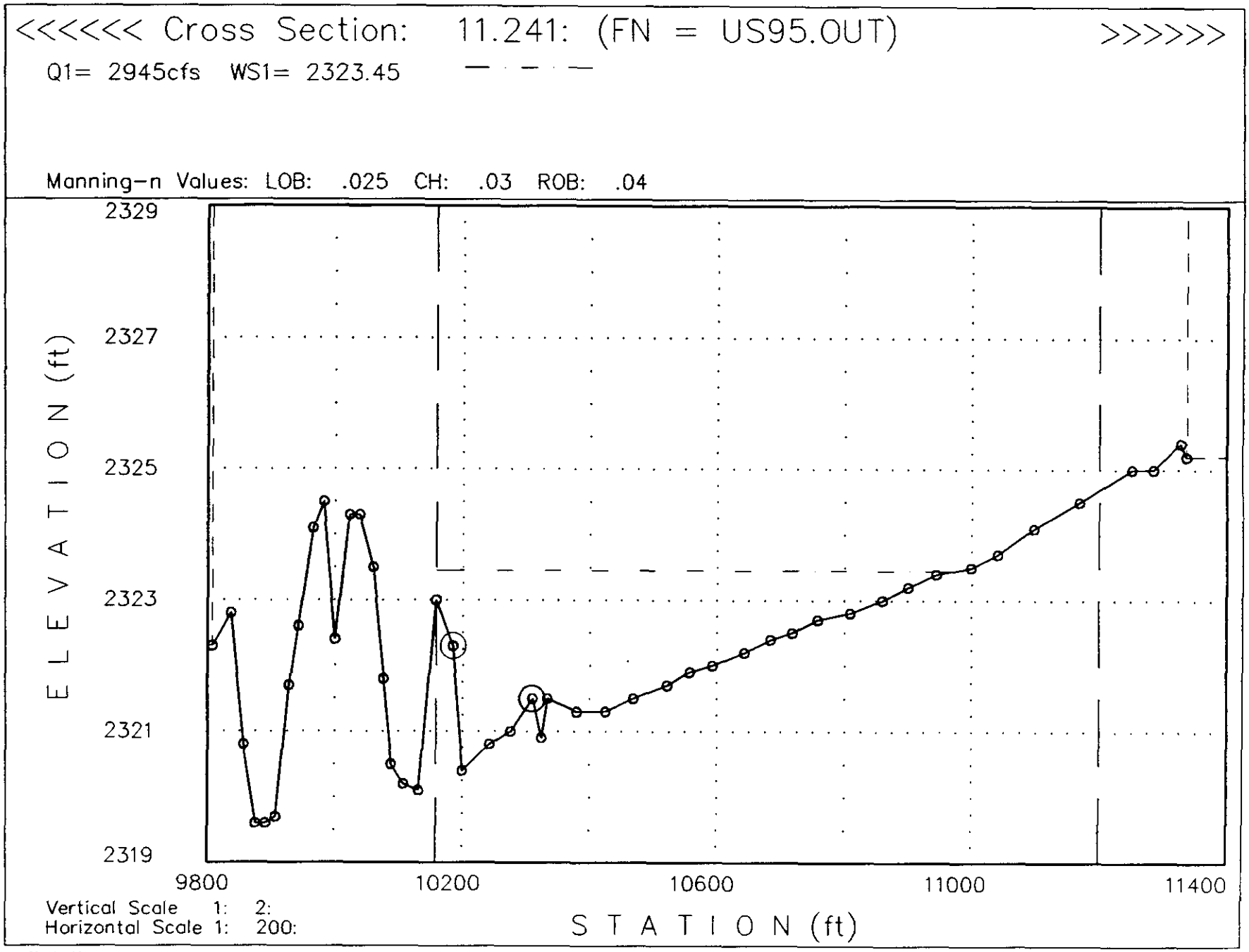

<<<<<< Cross Section: 10.848: (FN = US95.OUT) >>>>>>
Q1= 2670cfs WS1= 2320.3
Manning-n Values: LOB: .025 CH: .03 ROB: .045
2326
2324
2322
2320
2318
2316
ELEVATION (ft)
9800
10200
10600
11000
11400
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994

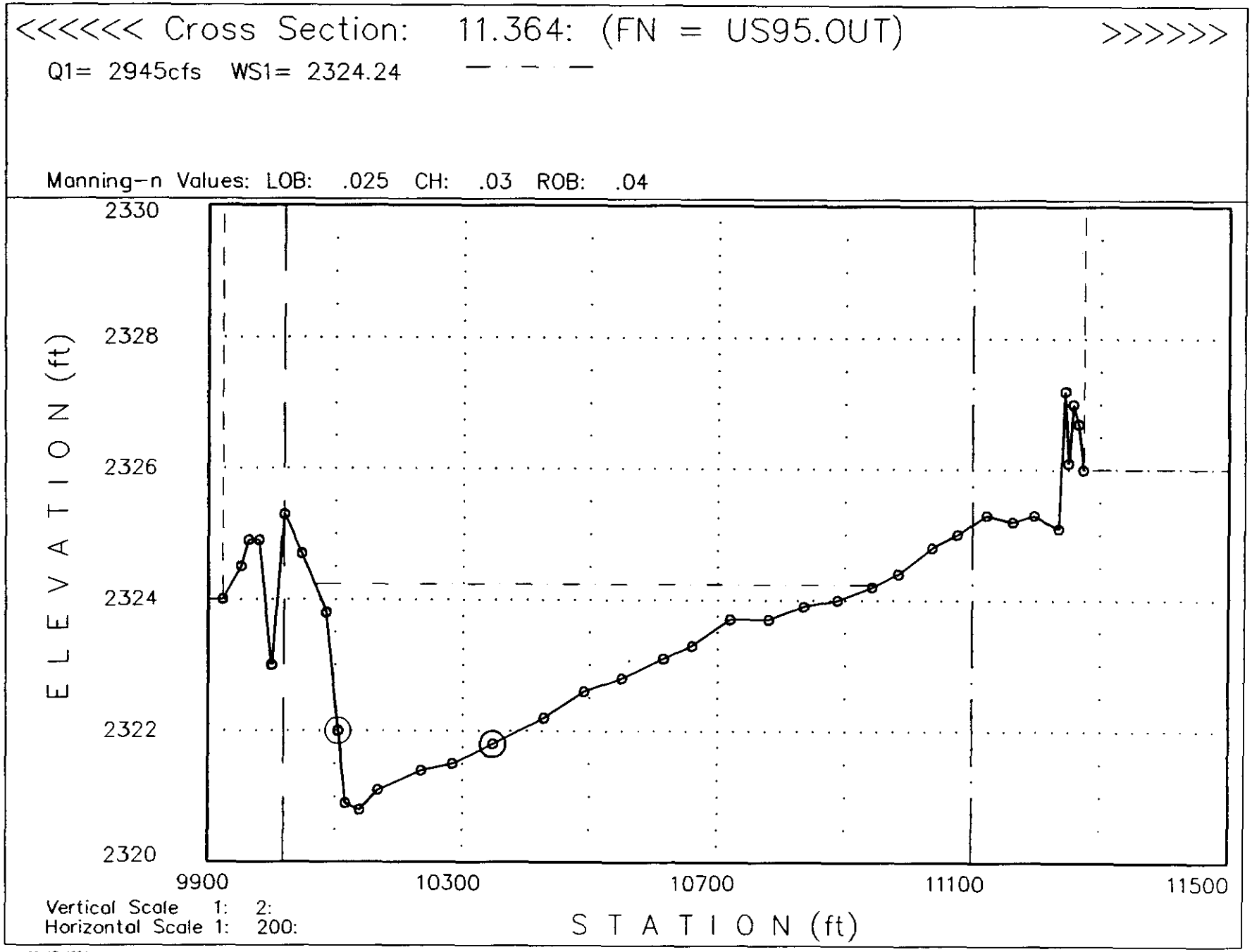

<<<<<< Cross Section: 10.938: (FN = US95.OUT) >>>>>>
Q1= 1265cfs WS1= 2320.86
Manning-n Values: LOB: .025 CH: .03 ROB: .055
2326
2324
2322
2320
2318
2316
ELEVATION (ft)
9600
10600
11600
12600
13600
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 500:
06-13-1994

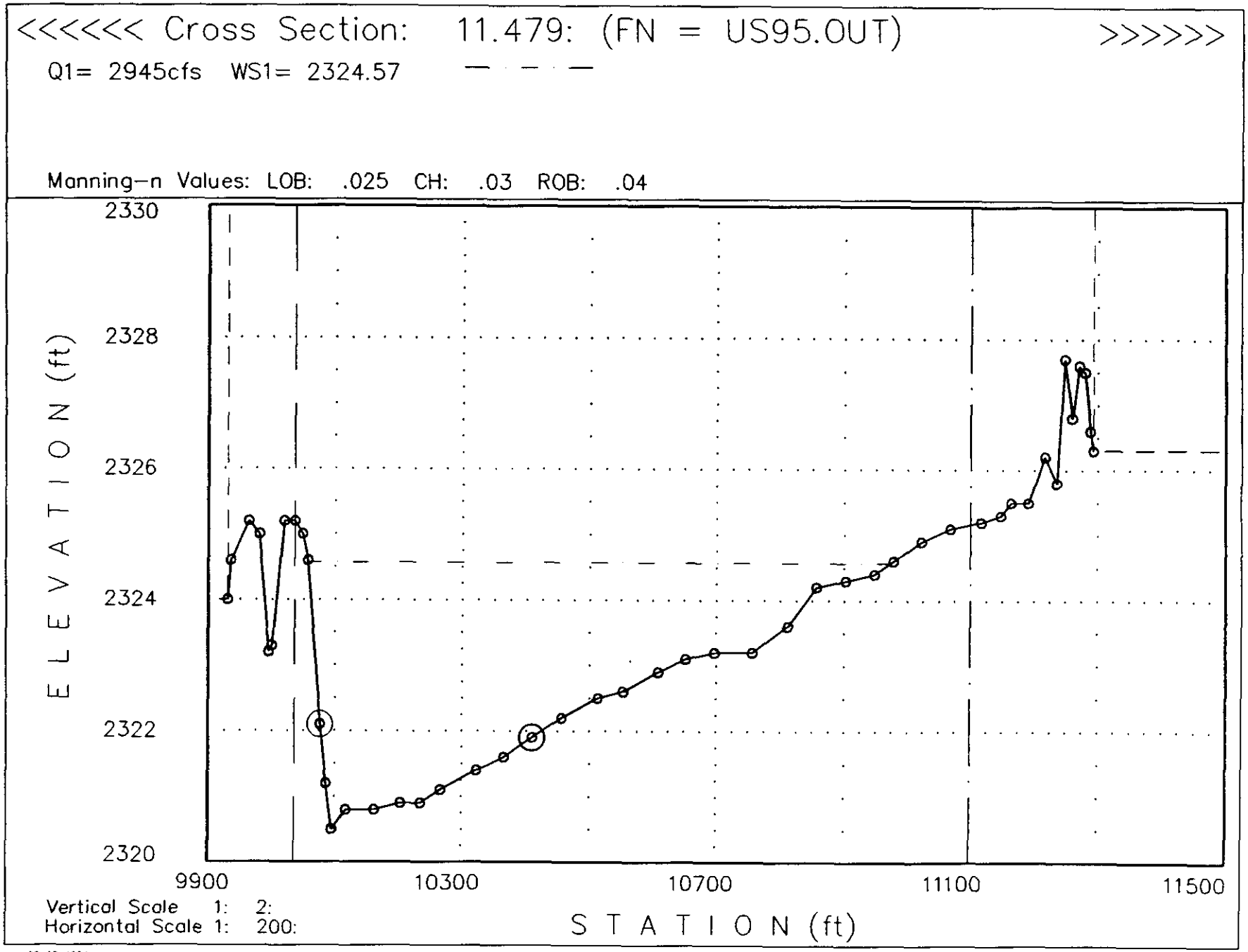

<<<<<< Cross Section: 11.015: (FN = US95.OUT) >>>>>>
Q1= 1265cfs WS1= 2322.17
Manning-n Values: LOB: .025 CH: .03 ROB: .055
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9600
10600
11600
12600
13600
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 500:
06-13-1994

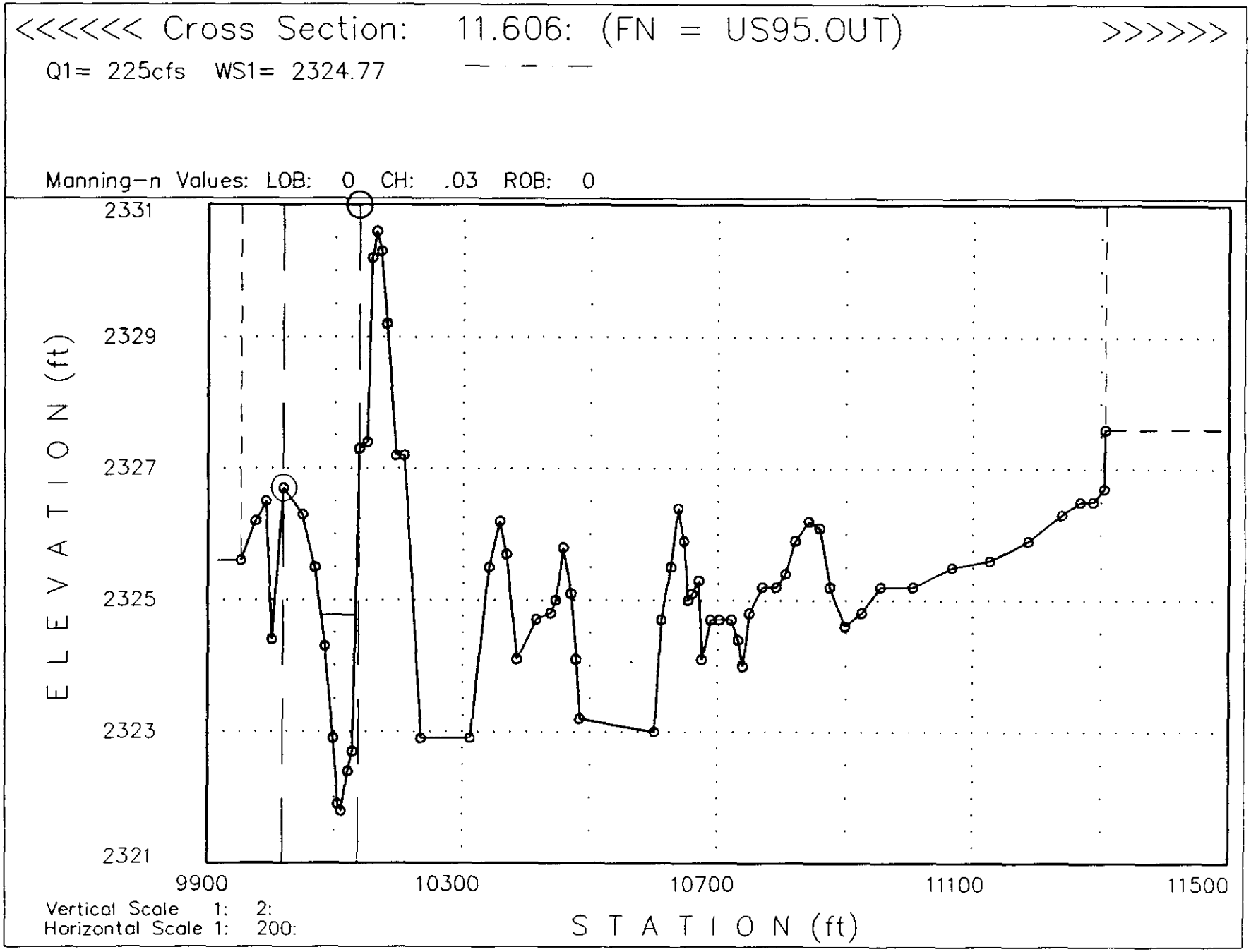

<<<<<< Cross Section: 11.08: (FN = US95.OUT) >>>>>>
Q1= 1265cfs WS1= 2322.9
Manning-n Values: LOB: .025 CH: .03 ROB: .045
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9600
10600
11600
12600
13600
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 500:
06-13-1994


<<<<<< Cross Section: 11.123: (FN = US95.OUT) >>>>>>
Q1= 1265cfs WS1= 2323.01
Manning-n Values: LOB: .025 CH: .03 ROB: .045
2328
2326
2324
2322
2320
2318
ELEVATION (ft)
9600
10600
11600
12600
13600
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 500:
06-13-1994


<<<<<< Cross Section: 11.241: (FN = US95.OUT) >>>>>>
Q1= 2945cfs WS1= 2323.45
Manning-n Values: LOB: .025 CH: .03 ROB: .04
2329
2327
2325
2323
2321
2319
ELEVATION (ft)
9800
10200
10600
11000
11400
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 11.364: (FN = US95.OUT) >>>>>>
Q1= 2945cfs WS1= 2324.24
Manning-n Values: LOB: .025 CH: .03 ROB: .04
2330
2328
2326
2324
2322
2320
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 11.479: (FN = US95.OUT) >>>>>>
Q1= 2945cfs WS1= 2324.57
Manning-n Values: LOB: .025 CH: .03 ROB: .04
2330
2328
2326
2324
2322
2320
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 11.606: (FN = US95.OUT) >>>>>>
Q1= 225cfs WS1= 2324.77
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2331
2329
2327
2325
2323
2321
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.56

3470 ENCROACHMENT STATIONS= 10042.5 10352.2 TYPE= 1 TARGET= 309.700

11.015	4.18	2321.08	.00	2321.07	2321.26	.18	.26	.00	2320.30
1680.0	.6	1632.2	47.2	1.2	471.7	111.6	8.1	3.4	2319.60
.07	.55	3.46	.42	.030	.022	.080	.000	2316.90	10078.69
.000450	385.	385.	385.	2	0	0	.00	236.34	10315.04

*SECNO 11.080
WATER EL=X5 CARD= 2321.330

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3470 ENCROACHMENT STATIONS= 10027.2 10353.7 TYPE= 1 TARGET= 326.500

11.080	5.03	2321.33	.00	2321.33	2321.50	.17	.10	.00	2322.50
1680.0	.0	1625.7	54.3	.0	478.6	120.7	11.3	4.7	2320.60
.09	.00	3.40	.45	.000	.020	.080	.000	2316.30	10086.32
.000367	240.	240.	240.	0	0	0	.00	216.95	10303.26

*SECNO 11.123
1530 MANNINGS N VALUES FOR CHANNEL COMPOSITED

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 10021.3 10349.8 TYPE= 1 TARGET= 328.500

11.123	2.80	2321.40	2321.40	2321.40	2322.18	.78	.19	.18	2322.20
1680.0	.0	1448.2	231.8	.0	190.1	131.2	13.5	5.7	2320.50
.10	.00	7.62	1.77	.000	.019	.080	.000	2318.60	10077.84
.004952	210.	210.	210.	20	11	0	.00	211.93	10289.78

TW BETWEEN SECTIONS 10.848 AND 10.938

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
1404.68	1414.14	.67	1404.68	1414.14	.67	7	2320.480	2320.800	10.848	10.938

TW BETWEEN SECTIONS 10.938 AND 11.015

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
.00	.00	.00	1404.68	1414.14	.67	7	2320.800	2321.082	10.938	11.015

THIS RUN EXECUTED 09JUN94 13:00:46

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

US 95 SPLIT

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	QLOB	QCH	QROB	VCH	SSTA	ENDST	TOPWID	AREA
*	10.848	275.32	2320.48	.02	266.63	8.67	2.11	10058.18	10130.94	72.76	137.68
*	10.938	1680.00	2320.80	50.31	923.41	706.28	4.16	10069.97	10277.46	207.50	494.07
*	11.015	1680.00	2321.08	.65	1632.18	47.18	3.46	10078.69	10315.04	236.34	584.48
*	11.080	1680.00	2321.33	.00	1625.71	54.29	3.40	10086.32	10303.26	216.95	599.30
*	11.123	1680.00	2321.40	.00	1448.22	231.78	7.62	10077.84	10289.78	211.93	321.31

US 95 SPLIT

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	10.848	.00	.00	.00	2316.10	275.32	2320.48	2318.61	2320.55	3.96	2.11	137.68	138.30
*	10.938	455.00	.00	.00	2316.70	1680.00	2320.80	.00	2321.00	10.90	4.16	494.07	508.89
*	11.015	385.00	.00	.00	2316.90	1680.00	2321.08	.00	2321.26	4.50	3.46	584.48	791.57
*	11.080	240.00	.00	.00	2316.30	1680.00	2321.33	.00	2321.50	3.67	3.40	599.30	876.36
*	11.123	210.00	.00	.00	2318.60	1680.00	2321.40	2321.40	2322.18	49.52	7.62	321.31	238.74

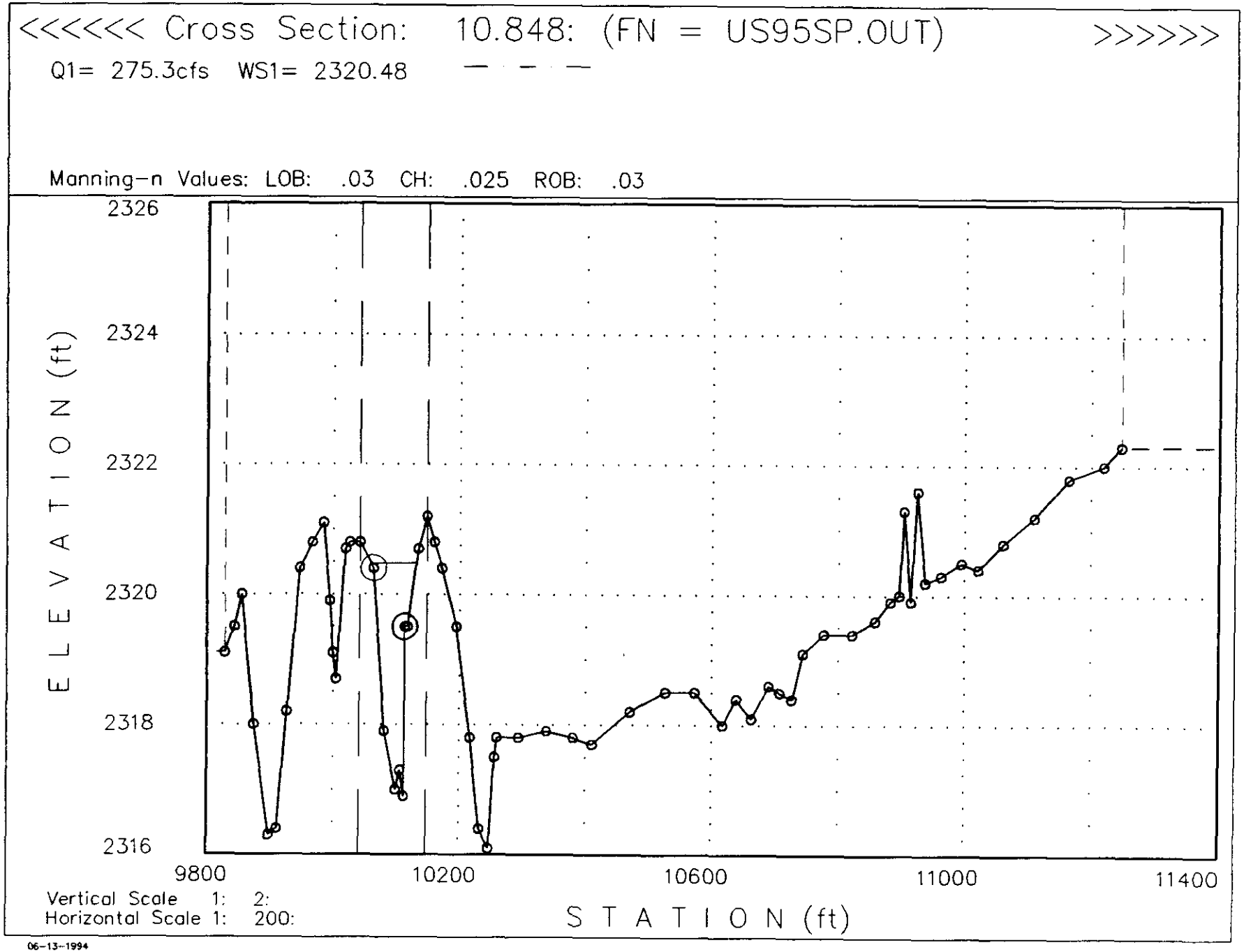
US 95 SPLIT

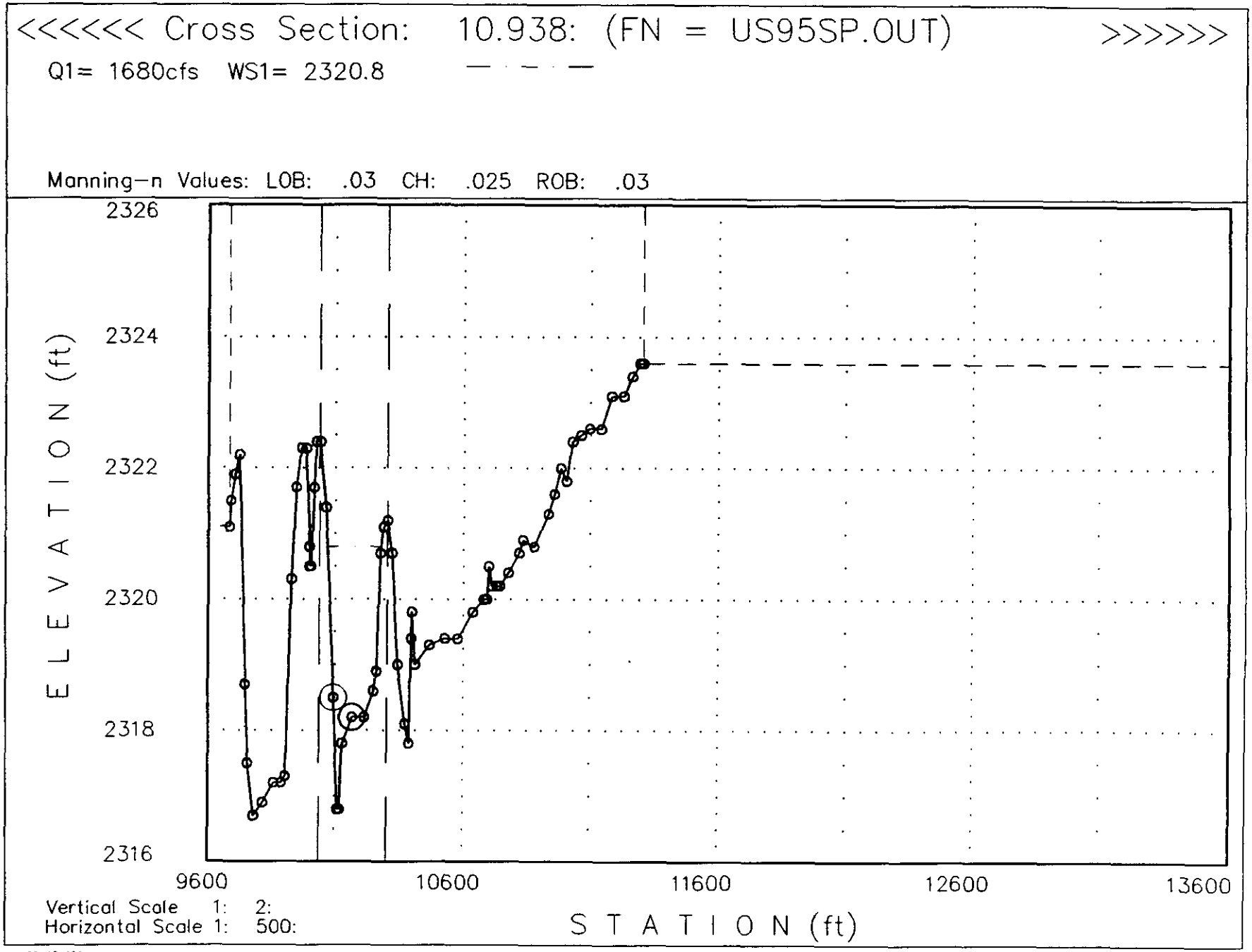
SUMMARY PRINTOUT TABLE 150

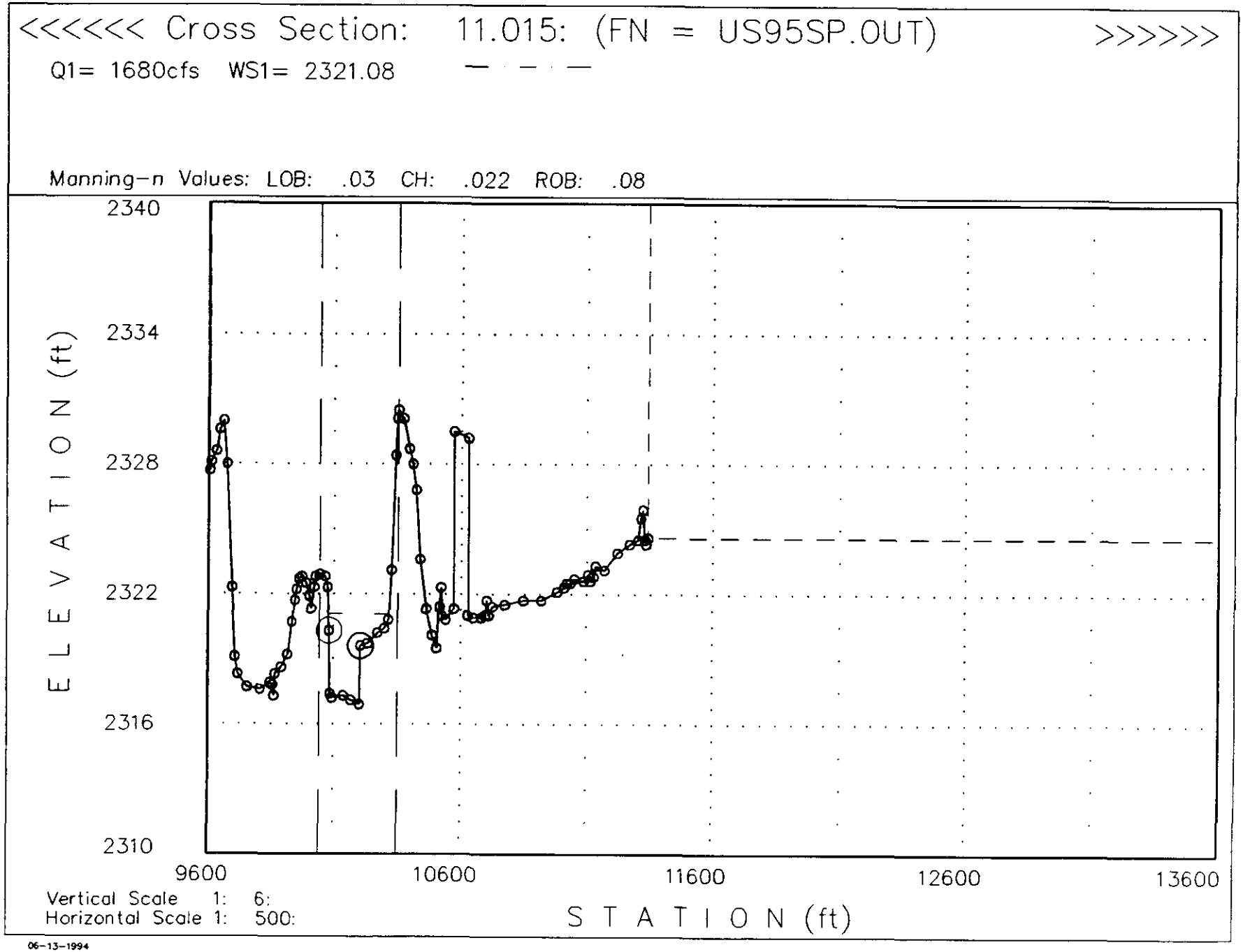
	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	10.848	275.32	2320.48	.00	.00	.00	72.76	.00
•	10.938	1680.00	2320.80	.00	.32	.00	207.50	455.00
•	11.015	1680.00	2321.08	.00	.28	.01	236.34	385.00
*	11.080	1680.00	2321.33	.00	.25	.00	216.95	240.00
*	11.123	1680.00	2321.40	.00	.07	.00	211.93	210.00

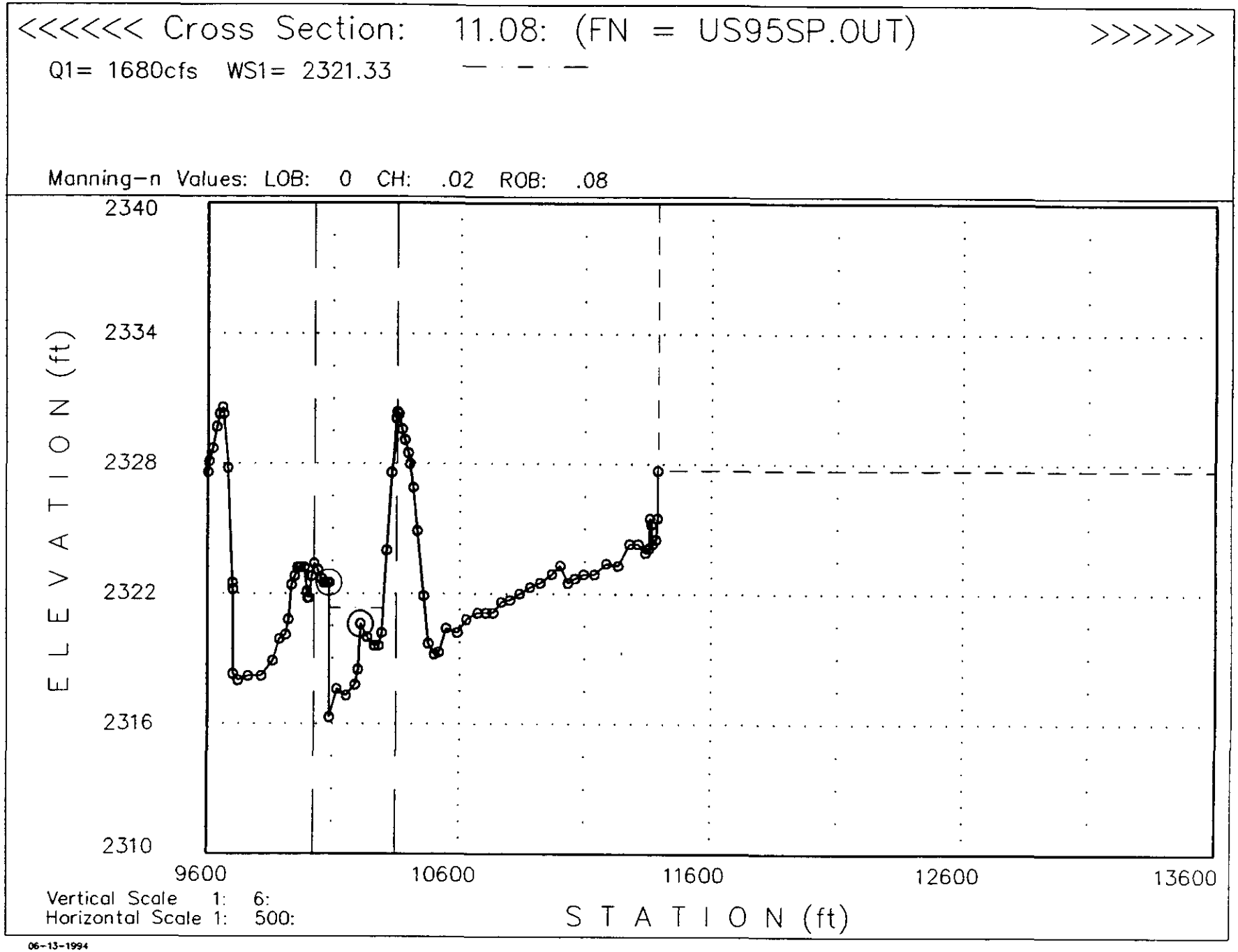
SUMMARY OF ERRORS AND SPECIAL NOTES

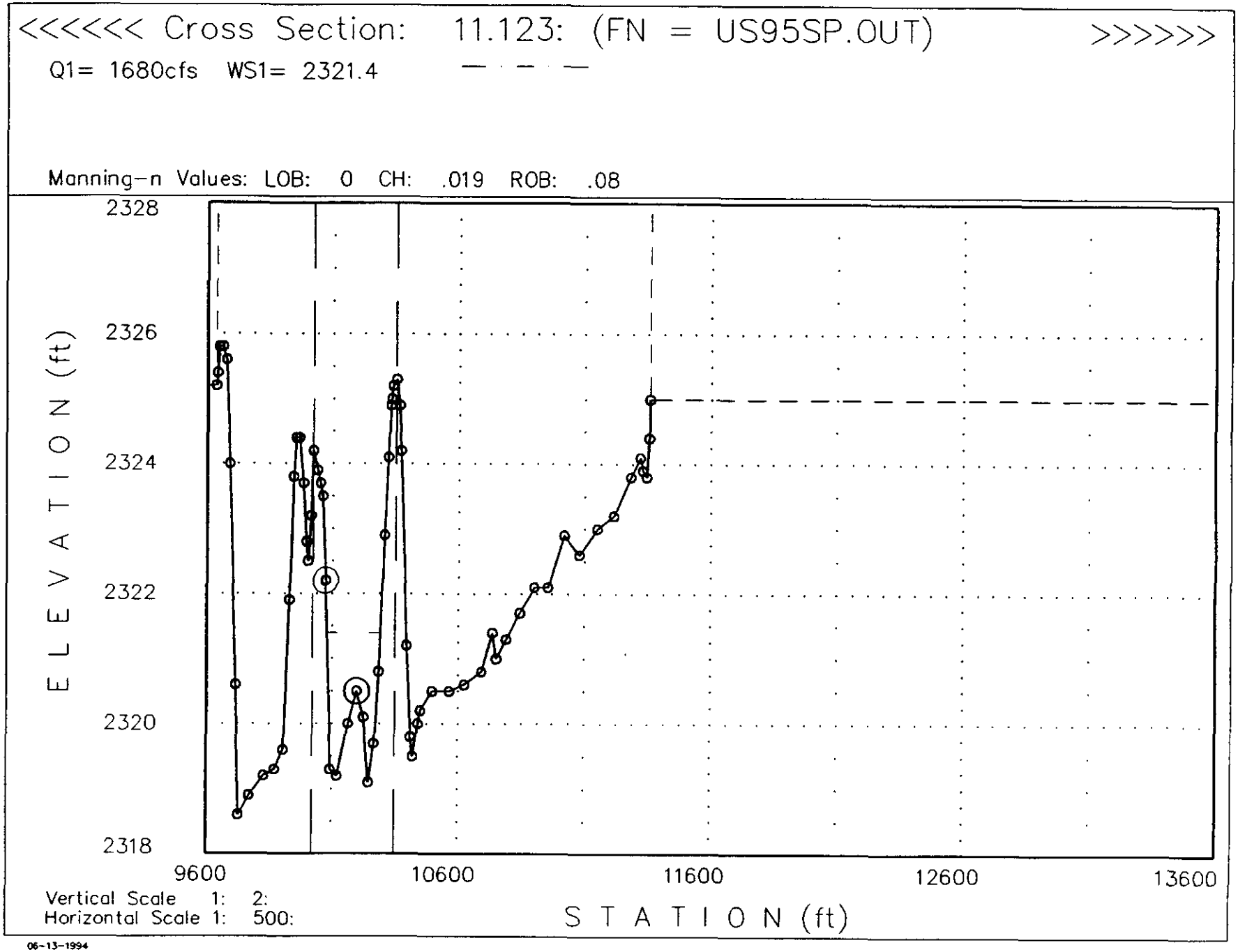
NOTE	SECNO=	10.848	PROFILE=	1	WSEL BASED ON X5 CARD
WARNING	SECNO=	10.938	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING	SECNO=	11.015	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
NOTE	SECNO=	11.080	PROFILE=	1	WSEL BASED ON X5 CARD
CAUTION	SECNO=	11.123	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION	SECNO=	11.123	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION	SECNO=	11.123	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL


<<<<<< Cross Section: 10.848: (FN = US95SP.OUT) >>>>>>
Q1= 275.3cfs WS1= 2320.48
Manning-n Values: LOB: .03 CH: .025 ROB: .03
2326
2324
2322
2320
2318
2316
ELEVATION (ft)
9800
10200
10600
11000
11400
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 10.938: (FN = US95SP.OUT) >>>>>>
Q1= 1680cfs WS1= 2320.8
Manning-n Values: LOB: .03 CH: .025 ROB: .03
2326
2324
2322
2320
2318
2316
ELEVATION (ft)
9600
10600
11600
12600
13600
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 500:
06-13-1994


<<<<<< Cross Section: 11.015: (FN = US95SP.OUT) >>>>>>
Q1= 1680cfs WS1= 2321.08
Manning-n Values: LOB: .03 CH: .022 ROB: .08
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9600
10600
11600
12600
13600
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 500:
06-13-1994


<<<<<< Cross Section: 11.08: (FN = US95SP.OUT) >>>>>>
Q1= 1680cfs WS1= 2321.33
Manning-n Values: LOB: 0 CH: .02 ROB: .08
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9600
10600
11600
12600
13600
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 500:
06-13-1994


<<<<<< Cross Section: 11.123: (FN = US95SP.OUT) >>>>>>
Q1= 1680cfs WS1= 2321.4
Manning-n Values: LOB: 0 CH: .019 ROB: .08
2328
2326
2324
2322
2320
2318
ELEVATION (ft)
9600
10600
11600
12600
13600
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 500:
06-13-1994

Rancho1.dat

RANCHO1.DAT

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    09JUN94    TIME   13:07:17  *
*******************************************
```


```
*****************************************
*  U.S. ARMY CORPS OF ENGINEERS         *
*  HYDROLOGIC ENGINEERING CENTER        *
*  609 SECOND STREET, SUITE D           *
*  DAVIS, CALIFORNIA 95616-4687         *
*          (916) 756-1104               *
*****************************************
```


```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                   X
X     X  X        X     X             X
X     X  XXXXXXX   XXXXX              XXXXXXX
```

THIS RUN EXECUTED 09JUN94 13:07:17

```
**************************************
 HEC-2 WATER SURFACE PROFILES

 Version  4.6.2;  May 1991
**************************************



SPLIT FLOW BEING PERFORMED


SF      WEIR OVER RANCHO NEAR CRYSTAL PALACE


JC      BETWEEN SECTIONS 10.270 AND 10.333
JP     0       0       0      -1       0

TW      10.270 & 10.333
WS     2  10.270  10.333      -1       3
WC     0 2256.56     330  2258.0

TW      10.333 & 10.392
WS     2  10.333  10.392      -1       3
WC     0  2258.0     315  2260.0
```

```
T1  NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY        CVL JOB # 930017
T2  BY COE & VAN LOO CONSULANTS, INC.                FILE NAME: rancho1.dat
T3      RANCHO DRIVE

        HEC-2 MODEL FOR RANCHO DR. BETWEEN GOWAN RD. AND ALEX. RD
        100-YEAR, 6-HOUR EVENT, EXISTING CONDITIONS
        REFER TO RANCHO2.DAT FOR RANCHO DR. BETWEEN CRAIG RD. & U.S. 95


  COMPLEX HYDRAULIC CONDITIONS EXIST ALONG RANCHO DRIVE WHICH CANNOT BE
  ACCURATELY MODELED WITHIN THE HEC-2.
  CALCULATIONS OUTSIDE OF THE HEC-2 MODEL WERE ESSENTIAL TO COMPUTE WSEL
  AT SEVERAL LOCATIONS. CALCULATIONS ARE PROVIDED IN TECHNICAL APPENDIX
  X5 CARDS ARE USED TO INPUT THE WSEL.


  IN SOME AREAS "SSTA" AND "ENDST" DO NOT REPRESENT THE ACTUAL FLOODING
  LIMITS. THE DELINEATION WAS BASED ON CONTOURS AND SPOT ELEVATIONS.

  DUE TO INEFFECTIVE FLOW AREAS OR ISLANDS IN THE FLOODPLAIN,
  IN SOME CASES, "TOPWID" DOES NOT REPRESENT THE FULL WIDTH OF THE FLOODPLAIN.


J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0        2         0         0        -1         0         0         0      2250         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      -1         0        -1                                                                  15


J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     150        38        43         1        13        14        15        26        53        54
       4        25         8
  LIMIT OF DETAILED STUDY
  GOWAN RD. AND RANCHO DR. INTERSECTION
  STARTING WSEL = 2253.2'
  REFER TO TECHNICAL APPENDIX FOR CALCULATIONS


QT        1       1060
  ACTUAL Q = 915
  REVISED FOR SPLIT FLOW ROUTINE  - SEE OUTPUT
NC      0.03      0.03      0.03       0.1       0.3
ET                 7.1                                                10012.6   11162.9
X1    10.000        30   10037.3   10224.3         0         0         0
X5         1    2253.2
GR    2249.6    9947.6    2249.4    9947.6    2252.2    9966.6    2252.5    9984.7    2252.4   10000.0
GR    2252.6   10012.6    2252.5   10037.3    2251.9   10055.6    2251.9   10102.1    2252.0   10174.3
GR    2251.9   10179.6    2252.1   10224.3    2252.4   10292.4    2252.9   10350.8    2252.9   10422.4
```

```
GR   2253.4    10479.2    2253.6    10530.4    2254.0    10588.0    2254.2    10638.0    2255.0    10693.6
GR   2255.4    10753.0    2255.8    10802.7    2256.5    10849.8    2256.5    10889.2    2256.7    10930.5
GR   2257.0    10970.4    2257.6    11028.1    2257.9    11083.1    2258.8    11145.3    2258.7    11162.9

QT        1         464
  ACTUAL Q = 319 CFS
  REVISED FOR SPLIT FLOW ROUTINE - SEE OUTPUT
NC    0.016     0.016     0.016       0.3       0.5
  CONCRETE CHANNEL
X1   10.053       5.0     10070     10115       300       250       280
GR   2253.2     10070    2246.4     10082    2246.4     10096    2253.2     10115    2255.4     10117


  2 - 48" CMP PROJECTING
  REFER TO THE GRADING PLAN FOR CYPRESS  SPRINGS II APTS


NC    0.03      0.03      0.025       0.3       0.5
SC   2.024       0.8        2.9         0         4         0       402       2.3    2248.41    2246.40
X1   10.129      10.0      10062     10117       402       402       402
X2                             2    2252.41      2253
X3       10
X4        1   2253.62      10000
BT       -6     10000    2253.62                10065   2253.06                10082   2253.85
BT              10117    2253.85                10172      2253                10178    2256.7
GR   2253.6     10000    2253.6      10062      2252     10077   2248.41     10087   2248.41     10097
GR     2251     10107      2252      10111    2252.9     10117    2253.0     10172    2256.7     10178

NC    0.03      0.03      0.025       0.1       0.3
X1   10.145      11.0      10068     10117        85        85        85
GR   2254.5     10000      2254      10068      2252     10077      2251     10080      2250     10083
GR   2249.1     10090      2250      10102      2251     10107      2252     10112      2253     10117
GR   2257.5     10145


QT        1         488
  ACTUAL Q = 343 CFS
  REVISED FOR SPLIT FLOW ROUTINE - SEE OUTPUT
X1   10.207      10.0      10067     10114       325       325       325
X4        1    2255.5      10000
GR   2255.5     10000      2255      10067      2254     10073      2253     10077      2252     10082
GR   2251.5     10092      2252      10106      2253     10110      2254     10114    2254.7     10157

NC    0.03     0.045      0.03       0.1       0.3
  ACTUAL Q =285 CFS
  40 CFS IN SNORKEL CIRCLE
  REVISED FOR SPLIT FLOW ROUTINE  - SEE OUTPUT
QT        1         390
ET                  7.1                                            10034.5    10118.4
```

```
X1   10.270      51   10034.5   10110.0      335      335      335
GR   2255.8  9951.5    2255.0    9959.1   2255.4   9972.4   2255.6  9986.3   2255.7  10000.0
GR   2256.2 10007.4    2255.9   10013.3  2256.56  10034.5   2255.2 10057.5   2256.0  10060.3
GR   2255.9 10073.2    2255.3   10105.2   2257.7  10110.0   2259.5 10118.4   2259.4  10121.6
GR   2258.8 10122.6    2258.7   10184.9   2256.1  10215.5   2255.1 10222.8   2255.8  10239.7
GR   2254.9 10262.0    2256.3   10282.5   2257.6  10302.3   2259.0 10328.7   2258.7  10365.6
GR   2255.7 10379.2    2256.2   10403.5   2257.9  10421.8   2258.8 10483.0   2258.3  10504.2
GR   2258.0 10521.3    2258.4   10539.5   2258.1  10558.7   2259.5 10577.0   2260.8  10601.3
GR   2261.0 10632.9    2260.6   10669.0   2260.1  10683.0   2260.5 10694.2   2260.2  10720.5
GR   2260.9 10736.9    2261.4   10760.9   2261.7  10781.1   2261.4 10809.5   2261.5  10833.5
GR   2262.5 10852.2    2262.3   10876.4   2263.1  10892.6   2263.6 10914.2   2263.7  10934.6
GR   2263.8 10947.0

QT         1      430
NH       7.0    0.025     10055     0.03    10110      5.0    10195     0.04    10275      5.0
NH     10370    0.025     10382     0.05    10585
X1    10.333    15.00     10055    10110      330      330      330
GR      2258    10000    2257.3    10042   2257.9    10055   2256.8    10080   2256.7    10090
GR      2258    10110      2258    10195     2258    10260     2258    10275     2260    10290
GR      2260    10355    2258.3    10370   2258.3    10382     2260    10450     2262    10585

NC      0.03    0.045      0.03      0.1      0.3
ET               7.1                                        10014.6  10928.8
X1    10.392      43   10058.7   10250.5      315      315      315
GR   2255.3  9940.2    2258.6    9957.2   2259.7   9979.5   2259.8  9991.8   2259.9  10000.0
GR   2260.1 10014.6    2259.9   10032.7   2259.2  10051.1   2259.8 10058.7   2259.0  10077.3
GR   2258.3 10092.3    2258.0   10112.4   2258.6  10154.1   2259.2 10194.3   2259.3  10229.9
GR   2259.6 10250.5    2274.4   10252.8   2274.3  10352.7   2259.9 10359.2   2259.5  10385.7
GR   2260.9 10395.9    2260.8   10417.6   2261.3  10455.7   2262.0 10491.1   2263.5  10529.3
GR   2264.1 10563.4    2272.9   10564.4   2273.0  10592.4   2264.0 10597.0   2263.7  10633.7
GR   2264.2 10665.9    2264.9   10689.5   2265.1  10700.9   2264.3 10718.6   2265.0  10730.1
GR   2265.7 10753.6    2265.9   10777.8   2275.7  10778.3   2274.3 10839.2   2266.4  10844.7
GR   2266.5 10876.5    2266.8   10906.2   2266.9  10928.8

QT         1      580
ET               7.1                                        10000  11291.3
X1    10.563       24   10030.4   10086.4      900      820      900

  WEIR FLOW OVER JONES BLVD.
  REFER TO TECHNICAL APPENDIX FOR CALCS.

X5         1   2265.4
GR    2263.8  9944.8    2264.8    9954.2   2265.6  10000.0   2265.5 10030.4   2264.8  10052.8
GR    2265.5 10086.4    2265.6   10132.3   2265.9  10152.0   2266.2 10219.7   2265.5  10289.2
GR    2265.5 10304.3    2265.3   10386.3   2264.9  10418.9   2264.4 10488.4   2264.4  10559.5
GR    2264.7 10641.4    2265.0   10708.1   2265.6  10790.0   2265.9 10890.0   2266.0  10990.5
GR    2266.5 11087.4    2267.1   11169.9   2267.2  11246.4   2267.6 11291.3

ET               7.1                                        10014.4  10196.5
X1    10.643       32   10054.1   10173.8      425      500      425
GR    2266.3  9947.0    2266.8    9959.4   2267.4   9981.3   2267.9 10000.0   2268.1  10014.4
GR    2267.3 10032.0    2266.1   10054.1   2264.9  10068.3   2264.9 10082.7   2265.4  10111.7
GR    2265.5 10147.9    2266.0   10173.8   2269.9  10196.5   2269.1 10221.0   2267.5  10229.6
GR    2266.8 10240.0    2270.6   10255.5   2266.7  10265.5   2267.1 10286.6   2270.8  10301.7
```

GR	2270.2	10305.6	2267.5	10313.5	2270.6	10330.2	2267.2	10340.4	2267.5	10375.4
GR	2267.8	10446.2	2268.4	10522.5	2268.9	10603.1	2269.3	10688.2	2270.3	10776.5
GR	2270.8	10860.2	2271.0	10900.6						
NC	0.03	0.03	0.025	.1	.3					
QT	1	580								
X1	10.723	5	10055	10197	430	400	425			
GR	2268.8	10000	2268	10055	2266.19	10135	2268	10197	2270	10280
X1	10.793	7	10022	10118	415	325	370			
GR	2270	10000	2268	10022	2267.1	10038	2267.9	10075	2267.1	10104
GR	2268	10118	2270	10132						
X1	10.868	9	10232	10332	380	410	390			
GR	2273.2	10000	2272	10220	2270	10232	2268.7	10252	2269.8	10270
GR	2268.9	10312	2270	10332	2272	10363	2274	10392		

REFER TO RANCHO2.DAT BY CVL CONSULTANTS, INC FOR AREAS BETWEEN
CRAIG RD. AND U.S. 95

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 10.000
WATER EL=X5 CARD= 2253.200

3470 ENCROACHMENT STATIONS= 10012.6 11162.9 TYPE= 1 TARGET= 1150.301

10.000	3.80	2253.20	2252.81	2253.20	2253.30	.10	.00	.00	2252.50
915.0	29.3	650.1	235.5	16.1	229.3	123.4	.0	.0	2252.10
.00	1.83	2.84	1.91	.030	.030	.030	.000	2249.40	10012.60
.002498	0.	0.	0.	0	13	0	.00	443.89	10456.49

FLOW DISTRIBUTION FOR SECNO= 10.00 CWSEL= 2253.20

STA=	10013.	10037.	10224.	10292.	10351.	10422.	10456.
PER Q=	3.2	71.1	16.9	5.8	2.6	.4	
AREA=	16.1	229.3	64.7	32.1	21.5	5.1	
VEL=	1.8	2.8	2.4	1.7	1.1	.7	
DEPTH=	.6	1.2	.9	.6	.3	.2	

CCHV= .300 CEHV= .500
*SECNO 10.053
3280 CROSS SECTION 10.05 EXTENDED .18 FEET

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.81

10.053	6.98	2253.38	.00	2253.38	2253.41	.04	.09	.02	2253.20
319.0	.0	319.0	.0	.0	208.5	.0	1.8	1.5	2253.20
.05	.00	1.53	.01	.000	.016	.000	.000	2246.40	10070.00
.000038	300.	280.	250.	3	0	0	.00	45.16	10115.16

FLOW DISTRIBUTION FOR SECNO= 10.05 CWSEL= 2253.38

STA=	10070.	10115.
PER Q=	100.0	
AREA=	208.5	
VEL=	1.5	
DEPTH=	4.6	

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .300 CEHV= .500

SPECIAL CULVERT

SC	CUNO	CUNV	ENTLC	COFQ	RDLEN	RISE	SPAN	CULVLN	CHRT	SCL	ELCHU	ELCHD
	2	.024	.80	2.90	.00	4.00	.00	402.00	2	3	2248.41	2246.40

CHART 2 - CORRUGATED METAL PIPE CULVERT
SCALE 3 - PIPE PROJECTING FROM FILL

5135, EGOC= 2274.77 ..MAY BE TOO LARGE IF OUTLET CONTROLS.
*SECNO 10.129

SPECIAL CULVERT OUTLET CONTROL + WEIR FLOW EG = 2254.11
3280 CROSS SECTION 10.13 EXTENDED .48 FEET

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .53

SPECIAL CULVERT

EGIC	EGOC	H4	QWEIR	QCULV	VCH	ACULV	ELTRD	WEIRLN
2259.47	2274.77	.70	260.	59.	1.508	25.1	2253.00	174.

10.129	5.67	2254.08	.00	2254.08	2254.11	.03	.70	.00	2253.60
319.0	10.2	269.2	39.6	29.1	178.5	63.1	4.0	2.5	2252.90
.13	.35	1.51	.63	.030	.025	.030	.000	2248.41	10000.00
.000138	402.	402.	402.	2	0	0	.00	173.75	10173.75

FLOW DISTRIBUTION FOR SECNO= 10.13 CWSEL= 2254.08

STA=	10000.	10062.	10117.	10172.	10174.
PER Q=	3.2	84.4	12.3	.1	
AREA=	29.1	178.5	62.2	.9	
VEL=	.4	1.5	.6	.3	
DEPTH=	.5	3.2	1.1	.5	

CCHV= .100 CEHV= .300
*SECNO 10.145

10.145	4.97	2254.07	.00	2254.07	2254.14	.07	.02	.01	2254.00
319.0	.0	317.1	1.9	.4	152.6	3.6	4.4	2.7	2253.00
.14	.09	2.08	.54	.030	.025	.030	.000	2249.10	10058.24
.000276	85.	85.	85.	2	0	0	.00	65.43	10123.67

FLOW DISTRIBUTION FOR SECNO= 10.15 CWSEL= 2254.07

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

STA= 10058. 10068. 10117. 10124.
PER Q= .0 99.4 .6
AREA= .4 152.6 3.6
VEL= .1 2.1 .5
DEPTH= .0 3.1 .5

*SECNO 10.207

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .35

10.207	2.61	2254.11	.00	2254.11	2254.42	.31	.21	.07	2255.00
343.0	.0	342.8	.2	.0	76.3	.4	5.3	3.2	2254.00
.16	.00	4.49	.38	.000	.025	.030	.000	2251.50	10072.30
.002594	325.	325.	325.	3	0	0	.00	48.84	10121.14

FLOW DISTRIBUTION FOR SECNO= 10.21 CWSEL= 2254.11

STA= 10072. 10114. 10121.
PER Q= 100.0 .0
AREA= 76.3 .4
VEL= 4.5 .4
DEPTH= 1.8 .1

CCHV= .100 CEHV= .300
*SECNO 10.270
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 10034.5 10118.4 TYPE= 1 TARGET= 83.900

10.270	1.54	2256.44	2256.44	2256.44	2256.81	.37	1.53	.02	2256.56
245.0	.0	245.0	.0	.0	50.1	.0	5.8	3.6	2257.70
.18	.00	4.89	.00	.000	.030	.000	.000	2254.90	10036.46
.015600	335.	335.	335.	20	14	0	.00	71.03	10107.49

FLOW DISTRIBUTION FOR SECNO= 10.27 CWSEL= 2256.44

STA= 10036. 10110.
PER Q= 100.0
AREA= 50.1
VEL= 4.9
DEPTH= .7

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

1490 NH CARD USED
*SECNO 10.333

3265 DIVIDED FLOW

3280 CROSS SECTION 10.33 EXTENDED .43 FEET

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.37

10.333	1.73	2258.43	.00	2258.43	2258.56	.13	1.72	.02	2257.90
373.1	124.7	205.4	43.0	43.6	65.4	73.7	6.7	5.0	2258.00
.22	2.86	3.14	.58	.025	.030	.080	.000	2256.70	10000.00
.003193	330.	330.	330.	6	0	0	.00	296.59	10387.21

FLOW DISTRIBUTION FOR SECNO= 10.33 CWSEL= 2258.43

STA=	10000.	10042.	10055.	10110.	10195.	10260.	10275.	10382.	10387.
PER Q=	24.8	8.6	55.1	.1	9.0	2.1	.4	.0	
AREA=	32.8	10.8	65.4	36.6	28.0	6.5	2.3	.3	
VEL=	2.8	3.0	3.1	.0	1.2	1.2	.6	.3	
DEPTH=	.8	.8	1.2	.4	.4	.4	.0	.1	

CCHV= .100 CEHV= .300
*SECNO 10.392

3265 DIVIDED FLOW

3470 ENCROACHMENT STATIONS= 10014.6 10928.8 TYPE= 1 TARGET= 914.200

10.392	4.32	2259.62	.00	2259.62	2259.75	.12	1.19	.00	2259.80
430.0	4.1	425.7	.2	3.5	150.1	.6	7.9	6.9	2259.60
.25	1.17	2.84	.31	.030	.030	.045	.000	2255.30	10039.94
.004422	315.	315.	315.	6	0	0	.00	213.42	10386.61

FLOW DISTRIBUTION FOR SECNO= 10.39 CWSEL= 2259.62

STA=	10040.	10051.	10056.	10251.	10386.	10387.
PER Q=	.6	.3	99.0	.0	.0	
AREA=	2.4	1.1	150.1	.5	.1	
VEL=	1.2	1.2	2.8	.3	.0	
DEPTH=	.2	.2	.8	.0	.1	

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 10.563
WATER EL=X5 CARD= 2265.400

3265 DIVIDED FLOW

3470 ENCROACHMENT STATIONS= 10000.0 11291.3 TYPE= 1 TARGET= 1291.300

10.563	1.60	2265.40	.00	2265.40	2265.47	.07	4.68	.01	2265.50
580.0	.0	25.6	554.4	.0	14.4	252.3	12.0	13.5	2265.50
.36	.00	1.78	2.20	.000	.030	.045	.000	2263.80	10033.60
.006416	900.	900.	820.	0	0	0	.00	465.32	10762.68

FLOW DISTRIBUTION FOR SECNO= 10.56 CWSEL= 2265.40

STA=	10034.	10086.	10386.	10419.	10488.	10560.	10641.	10708.	10763.
PER Q=	4.4	.1	2.0	19.6	32.4	28.5	11.2	1.7	
AREA=	14.4	2.0	9.8	52.1	71.1	69.6	36.7	10.9	
VEL=	1.8	.4	1.2	2.2	2.6	2.4	1.8	.9	
DEPTH=	.3	.0	.3	.8	1.0	.8	.5	.2	

*SECNO 10.643

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.74

3470 ENCROACHMENT STATIONS= 10014.4 10196.5 TYPE= 1 TARGET= 182.100

10.643	2.03	2266.93	.00	2266.93	2267.08	.14	1.58	.02	2266.10
580.0	8.2	569.5	2.3	6.4	185.8	2.5	14.5	16.8	2266.00
.40	1.28	3.06	.91	.030	.030	.045	.000	2264.90	10038.73
.002130	425.	425.	500.	4	0	0	.00	140.51	10179.24

FLOW DISTRIBUTION FOR SECNO= 10.64 CWSEL= 2266.93

STA=	10039.	10054.	10174.	10179.
PER Q=	1.4	98.2	.4	
AREA=	6.4	185.8	2.5	
VEL=	1.3	3.1	.9	
DEPTH=	.4	1.6	.5	

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .100 CEHV= .300
*SECNO 10.723

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .70

10.723	1.93	2268.12	.00	2268.12	2268.36	.25	1.26	.03	2268.00
580.0	.2	579.6	.1	.5	145.2	.3	16.1	18.2	2268.00
.43	.50	3.99	.50	.030	.025	.030	.000	2266.19	10046.91
.004378	430.	425.	400.	2	0	0	.00	154.97	10201.88

FLOW DISTRIBUTION FOR SECNO= 10.72 CWSEL= 2268.12

STA=	10047.	10055.	10197.	10202.
PER Q=	.0	99.9	.0	
AREA=	.5	145.2	.3	
VEL=	.5	4.0	.5	
DEPTH=	.1	1.0	.1	

*SECNO 10.793

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.56

10.793	2.07	2269.17	.00	2269.17	2269.36	.19	.99	.01	2268.00
580.0	11.1	561.9	7.0	7.6	159.0	4.8	17.5	19.4	2268.00
.46	1.47	3.53	1.46	.030	.025	.030	.000	2267.10	10009.11
.001805	415.	370.	325.	2	0	0	.00	117.10	10126.21

FLOW DISTRIBUTION FOR SECNO= 10.79 CWSEL= 2269.17

STA=	10009.	10022.	10118.	10126.
PER Q=	1.9	96.9	1.2	
AREA=	7.6	159.0	4.8	
VEL=	1.5	3.5	1.5	
DEPTH=	.6	1.7	.6	

*SECNO 10.868
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10.868	1.66	2270.36	2270.36	2270.36	2270.87	.51	1.35	.09	2270.00
580.0	.6	577.9	1.5	.4	101.1	1.0	18.7	20.4	2270.00
.48	1.50	5.72	1.51	.030	.025	.030	.000	2268.70	10229.82
.009125	380.	390.	410.	2	15	0	.00	107.80	10337.63

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 10.87 CWSEL= 2270.36

STA=	10230.	10232.	10332.	10338.
PER Q=	.1	99.6	.3	
AREA=	.4	101.1	1.0	
VEL=	1.5	5.7	1.5	
DEPTH=	.2	1.0	.2	

TW 10.270 & 10.333

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
88.09	88.09	.00	88.09	88.09	.00	8	2256.444	2258.430	10.270	10.333

TW 10.333 & 10.392

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
56.90	56.94	.07	144.99	145.03	.02	8	2258.430	2259.624	10.333	10.392

THIS RUN EXECUTED 09JUN94 13:07:28

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

RANCHO DRIVE

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	QLOB	QCH	QROB	VCH	SSTA	ENDST	TOPWID	AREA	DEPTH
*	10.000	915.01	2253.20	29.34	650.11	235.55	2.84	10012.60	10456.49	443.89	368.73	3.80
*	10.053	319.01	2253.38	.00	319.01	.00	1.53	10070.00	10115.16	45.16	208.51	6.98
*	10.129	319.01	2254.08	10.25	269.20	39.56	1.51	10000.00	10173.75	173.75	270.75	5.67
	10.145	319.01	2254.07	.03	317.05	1.92	2.08	10058.24	10123.67	65.43	156.49	4.97
*	10.207	343.01	2254.11	.00	342.85	.16	4.49	10072.30	10121.14	48.84	76.72	2.61
*	10.270	245.01	2256.44	.00	245.00	.00	4.89	10036.46	10107.49	71.03	50.15	1.54
*	10.333	373.10	2258.43	124.68	205.41	43.00	3.14	10000.00	10387.21	296.59	182.69	1.73
	10.392	430.00	2259.62	4.11	425.71	.18	2.84	10039.94	10386.61	213.42	154.15	4.32
*	10.563	580.00	2265.40	.00	25.58	554.42	1.78	10033.60	10762.68	465.32	266.65	1.60
*	10.643	580.00	2266.93	8.18	569.51	2.31	3.06	10038.73	10179.24	140.51	194.80	2.03
*	10.723	580.00	2268.12	.24	579.62	.14	3.99	10046.91	10201.88	154.97	145.99	1.93
*	10.793	580.00	2269.17	11.10	561.86	7.04	3.53	10009.11	10126.21	117.10	171.39	2.07
*	10.868	580.00	2270.36	.59	577.86	1.55	5.72	10229.82	10337.63	107.80	102.52	1.66

RANCHO DRIVE

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	10.000	.00	.00	.00	2249.40	915.01	2253.20	2252.81	2253.30	24.98	2.84	368.73	183.08
*	10.053	280.00	.00	.00	2246.40	319.01	2253.38	.00	2253.41	.38	1.53	208.51	514.49
*	10.129	402.00	2253.00	2252.41	2248.41	319.01	2254.08	.00	2254.11	1.38	1.51	270.75	271.60
	10.145	85.00	.00	.00	2249.10	319.01	2254.07	.00	2254.14	2.76	2.08	156.49	192.13
*	10.207	325.00	.00	.00	2251.50	343.01	2254.11	.00	2254.42	25.94	4.49	76.72	67.35
*	10.270	335.00	.00	.00	2254.90	245.01	2256.44	2256.44	2256.81	156.00	4.89	50.15	19.62
*	10.333	330.00	.00	.00	2256.70	373.10	2258.43	.00	2258.56	31.93	3.14	182.69	66.03
	10.392	315.00	.00	.00	2255.30	430.00	2259.62	.00	2259.75	44.22	2.84	154.15	64.66
*	10.563	900.00	.00	.00	2263.80	580.00	2265.40	.00	2265.47	64.16	1.78	266.65	72.41
*	10.643	425.00	.00	.00	2264.90	580.00	2266.93	.00	2267.08	21.30	3.06	194.80	125.67
*	10.723	425.00	.00	.00	2266.19	580.00	2268.12	.00	2268.36	43.78	3.99	145.99	87.66
*	10.793	370.00	.00	.00	2267.10	580.00	2269.17	.00	2269.36	18.05	3.53	171.39	136.54
*	10.868	390.00	.00	.00	2268.70	580.00	2270.36	2270.36	2270.87	91.25	5.72	102.52	60.72

RANCHO DRIVE

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	10.000	915.01	2253.20	.00	.00	.00	443.89	.00
*	10.053	319.01	2253.38	.00	.18	.00	45.16	280.00
*	10.129	319.01	2254.08	.00	.70	.00	173.75	402.00
	10.145	319.01	2254.07	.00	-.01	.00	65.43	85.00
*	10.207	343.01	2254.11	.00	.04	.00	48.84	325.00
*	10.270	245.01	2256.44	.00	2.33	.00	71.03	335.00
*	10.333	373.10	2258.43	.00	1.99	.00	296.59	330.00
	10.392	430.00	2259.62	.00	1.19	.00	213.42	315.00
*	10.563	580.00	2265.40	.00	5.78	.00	465.32	900.00
*	10.643	580.00	2266.93	.00	1.53	.00	140.51	425.00
*	10.723	580.00	2268.12	.00	1.18	.00	154.97	425.00
*	10.793	580.00	2269.17	.00	1.06	.00	117.10	370.00
*	10.868	580.00	2270.36	.00	1.19	.00	107.80	390.00

SUMMARY OF ERRORS AND SPECIAL NOTES

NOTE SECNO= 10.000 PROFILE= 1 WSEL BASED ON X5 CARD

WARNING SECNO= 10.053 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 10.129 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 10.207 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 10.270 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 10.270 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 10.270 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO= 10.333 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

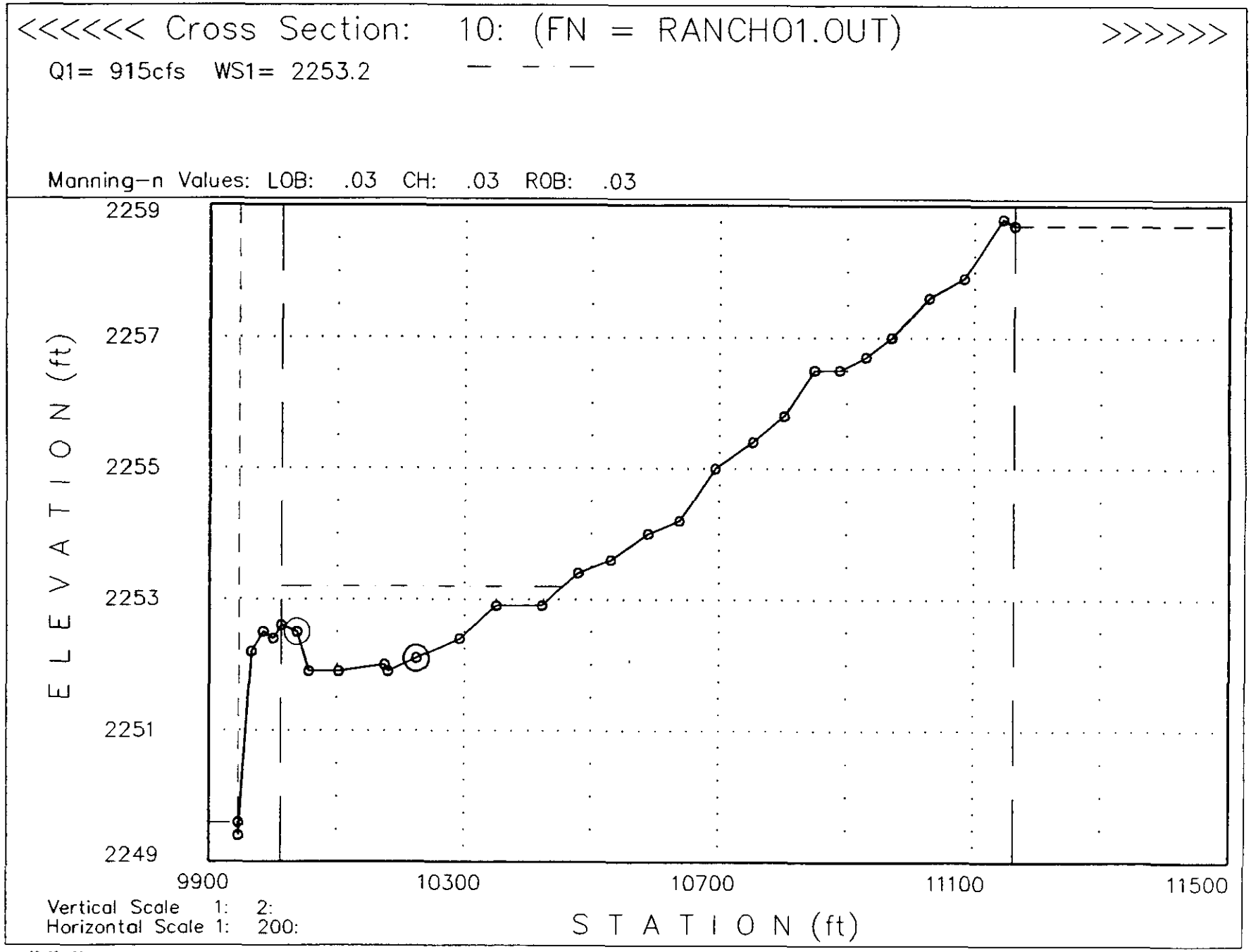
NOTE SECNO= 10.563 PROFILE= 1 WSEL BASED ON X5 CARD

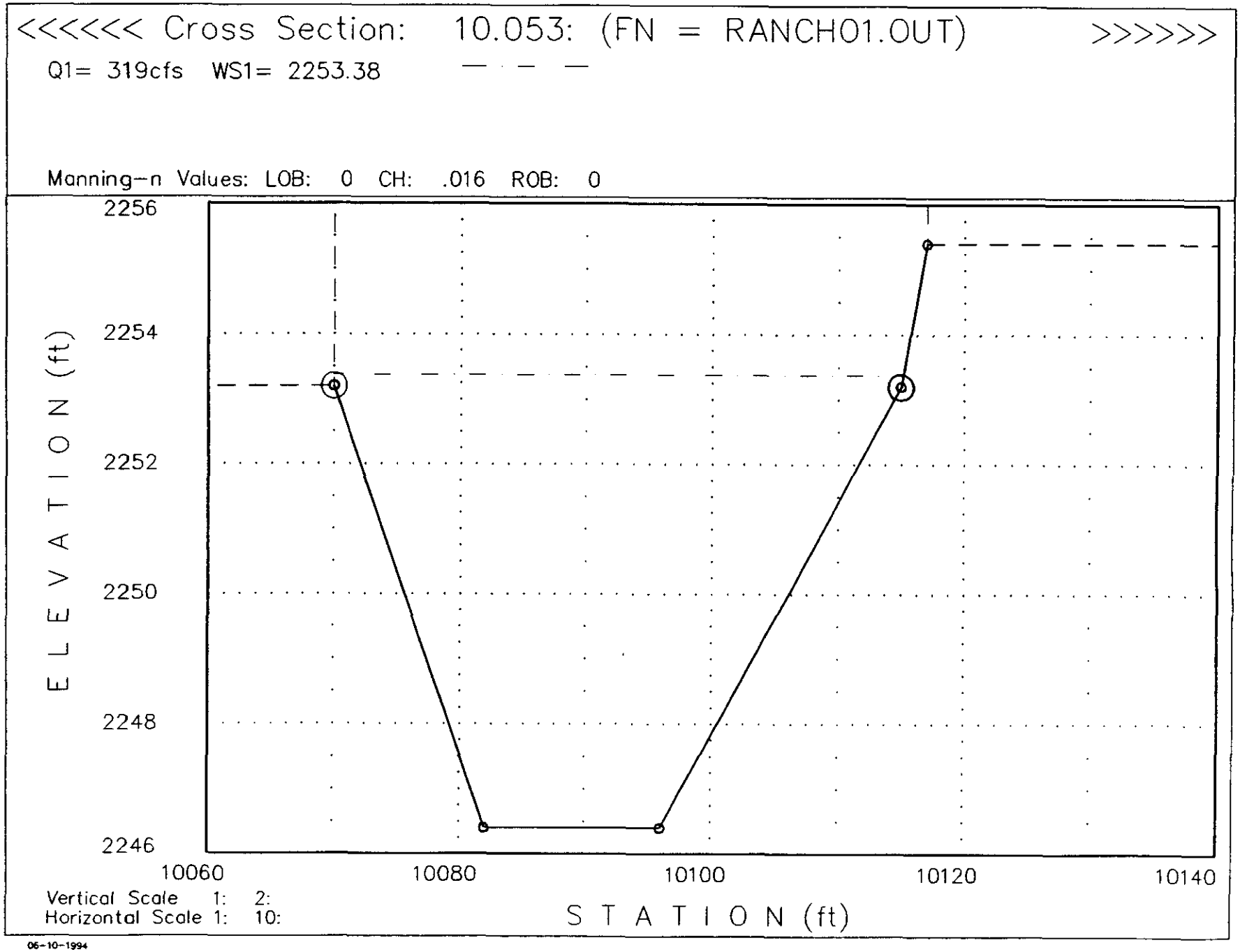
WARNING SECNO= 10.643 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

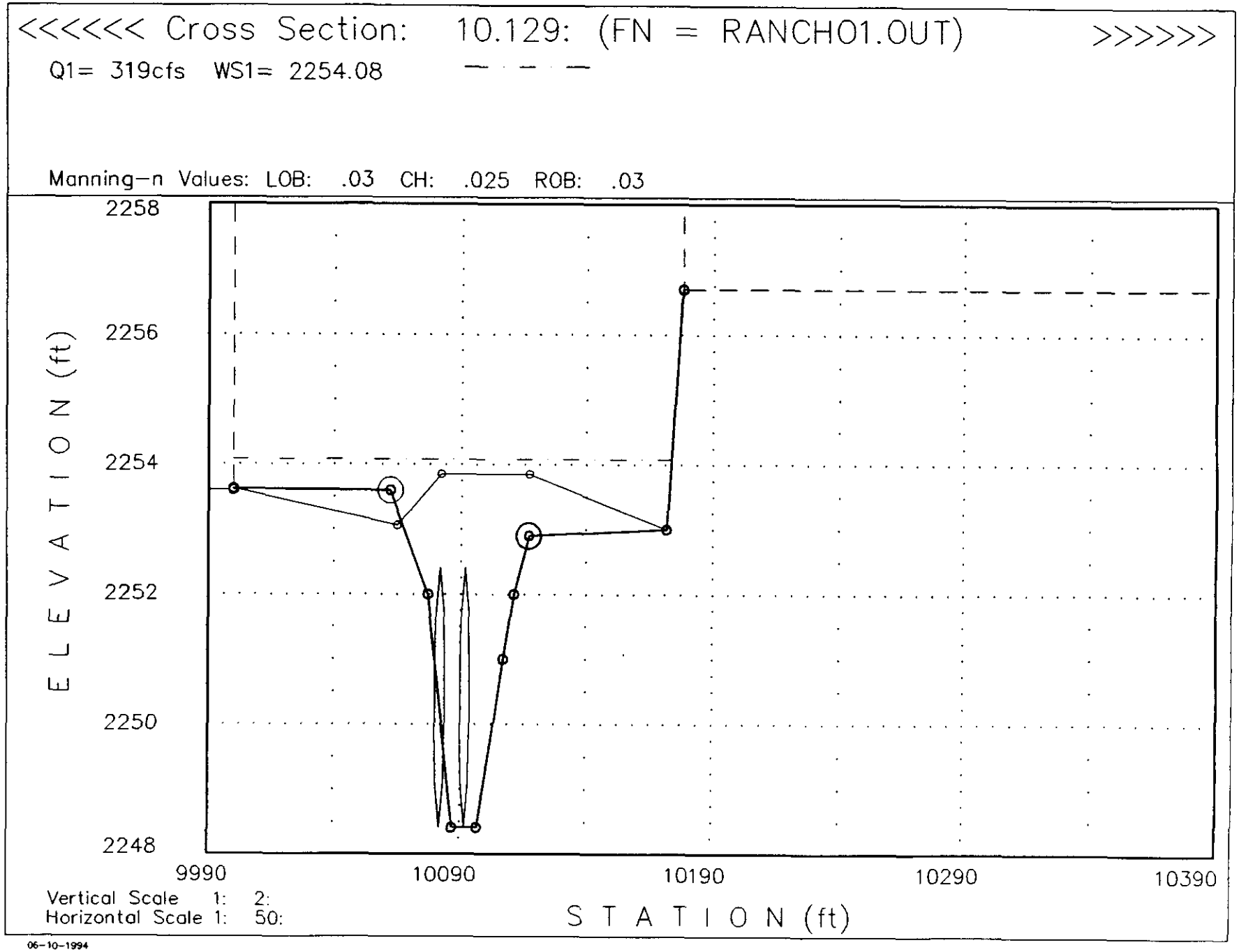
WARNING SECNO= 10.723 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

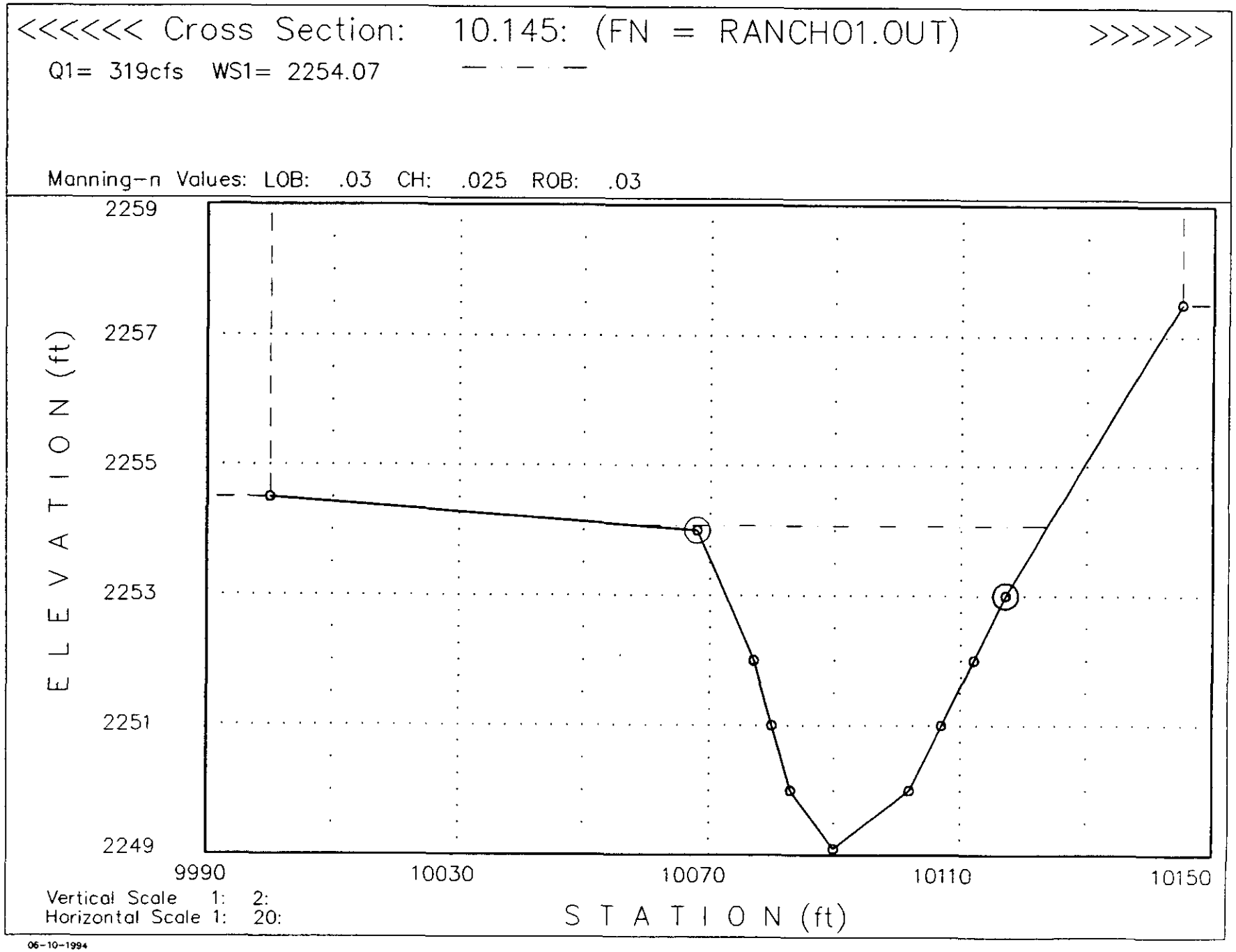
WARNING SECNO= 10.793 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

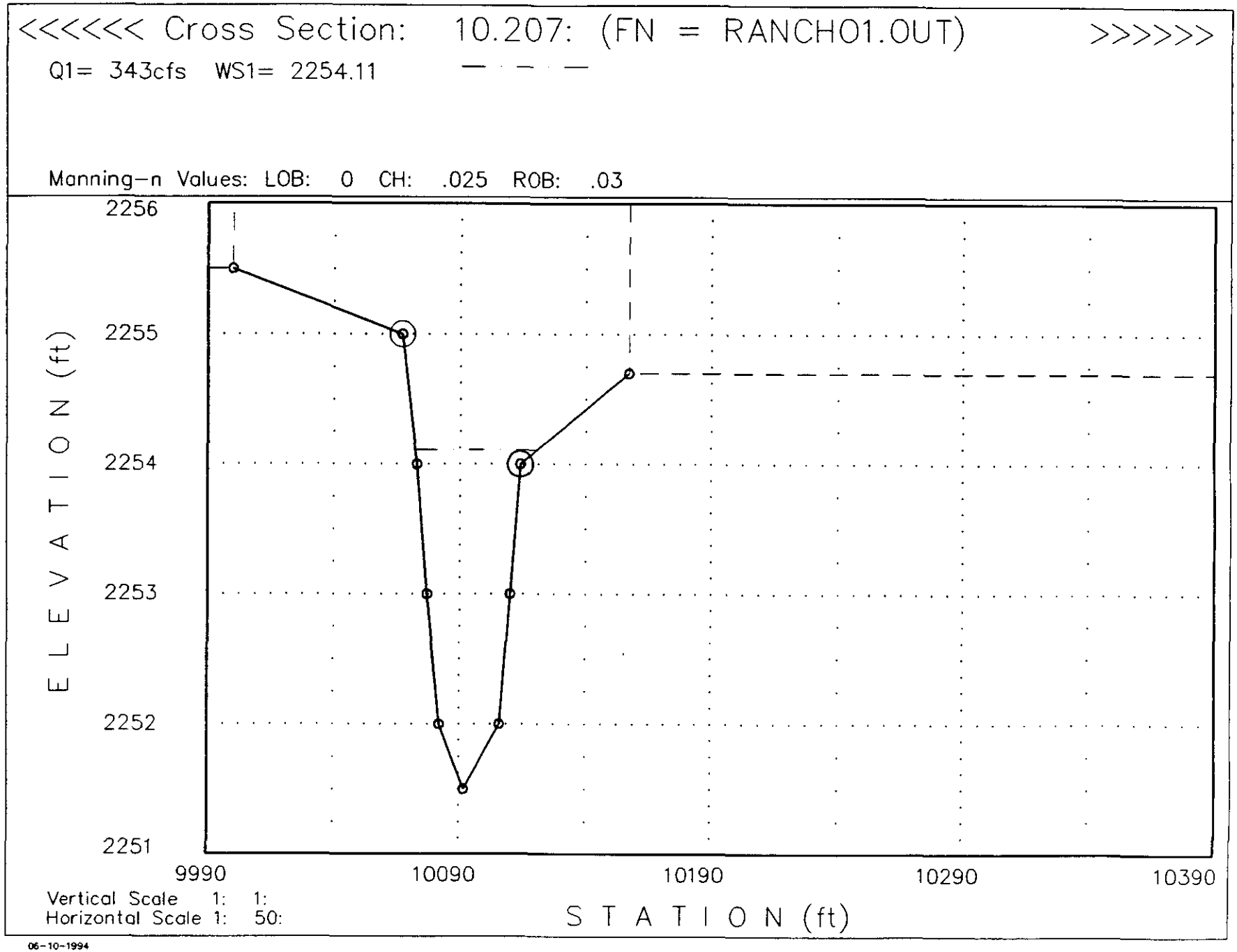
CAUTION SECNO= 10.868 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 10.868 PROFILE= 1 MINIMUM SPECIFIC ENERGY

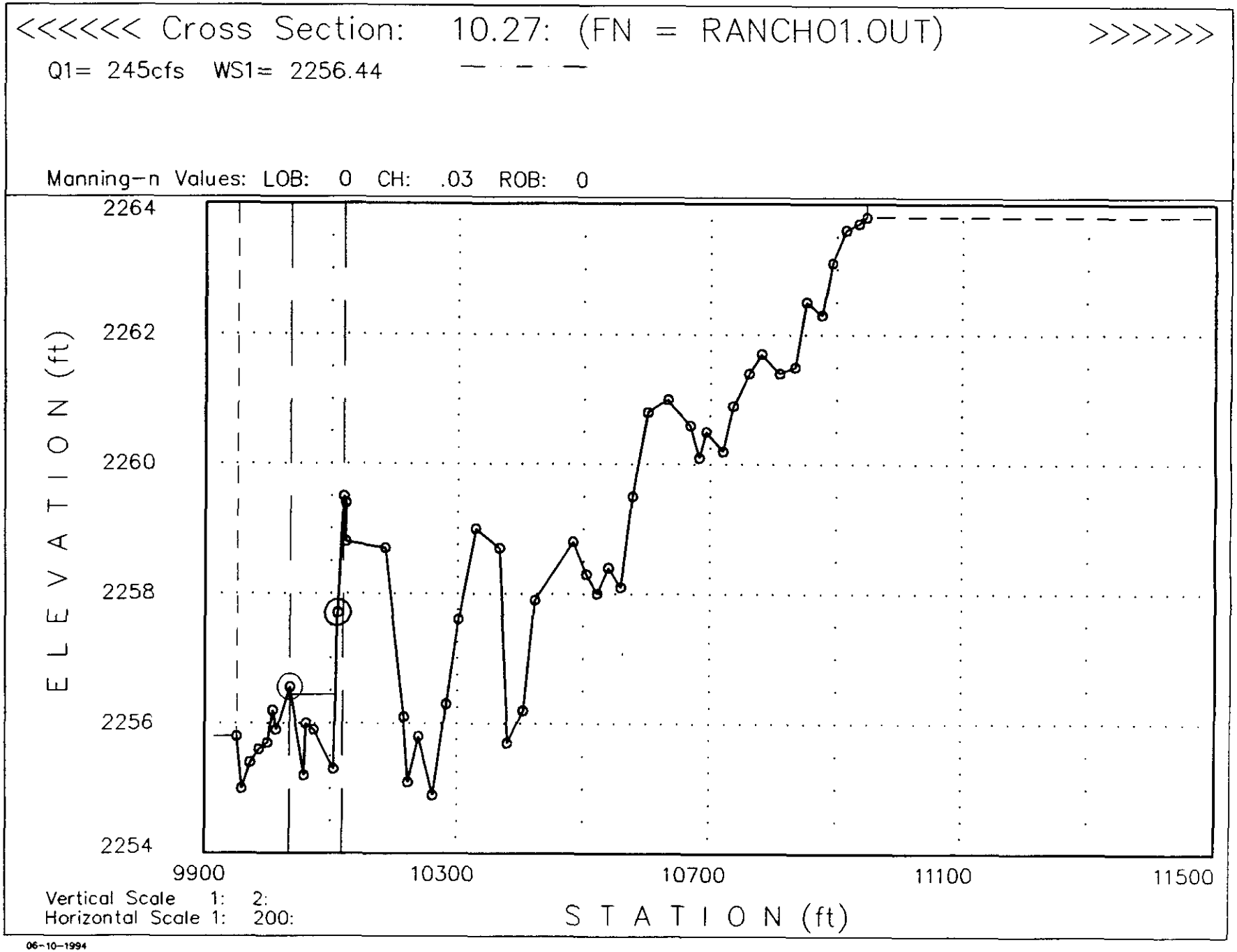

<<<<<< Cross Section: 10: (FN = RANCH01.OUT) >>>>>>
Q1= 915cfs WS1= 2253.2
Manning-n Values: LOB: .03 CH: .03 ROB: .03
2259
2257
2255
2253
2251
2249
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-10-1994

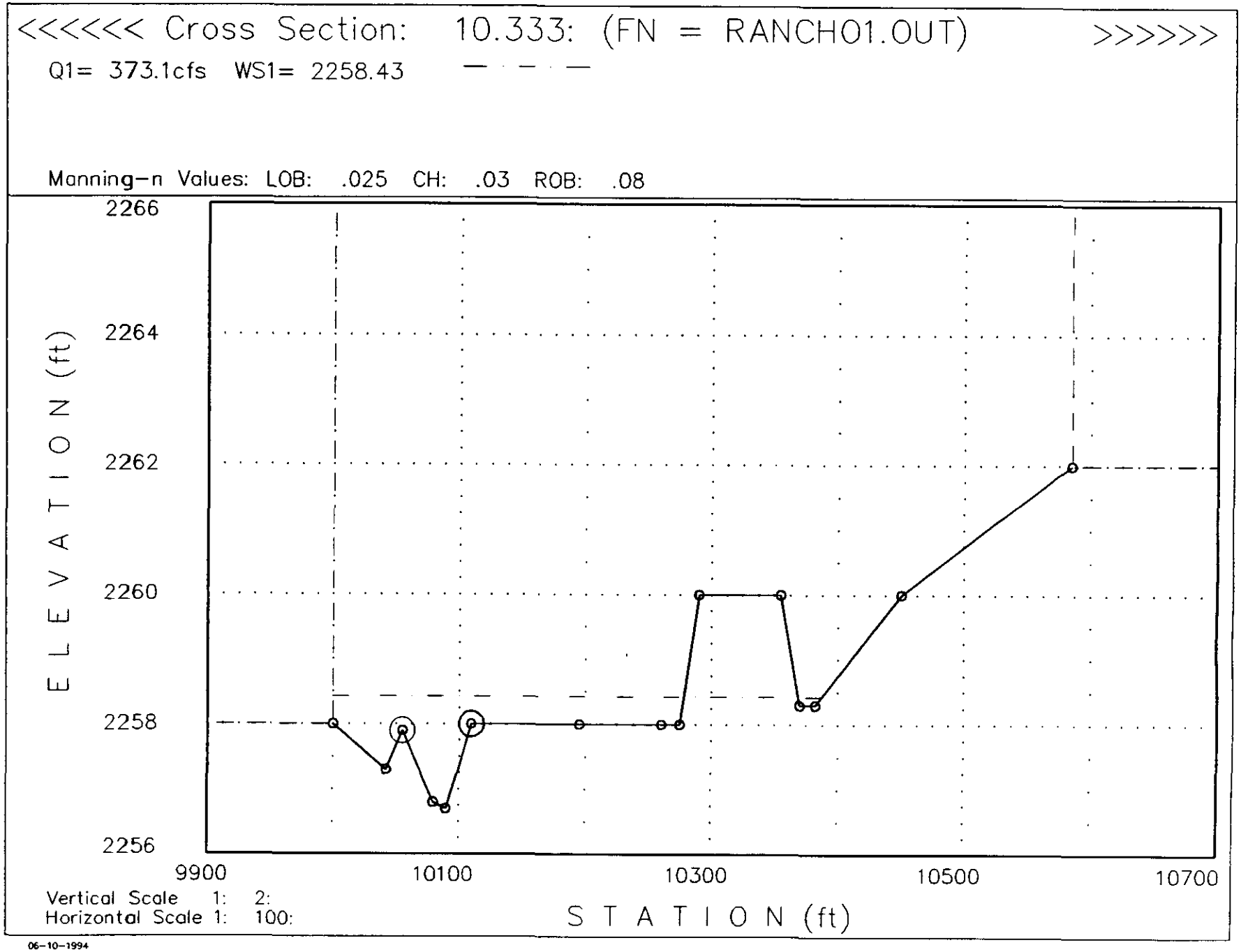

<<<<<< Cross Section: 10.053: (FN = RANCH01.OUT) >>>>>>
Q1= 319cfs WS1= 2253.38
Manning-n Values: LOB: 0 CH: .016 ROB: 0
2256
2254
2252
2250
2248
2246
ELEVATION (ft)
10060
10080
10100
10120
10140
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 10:
06-10-1994

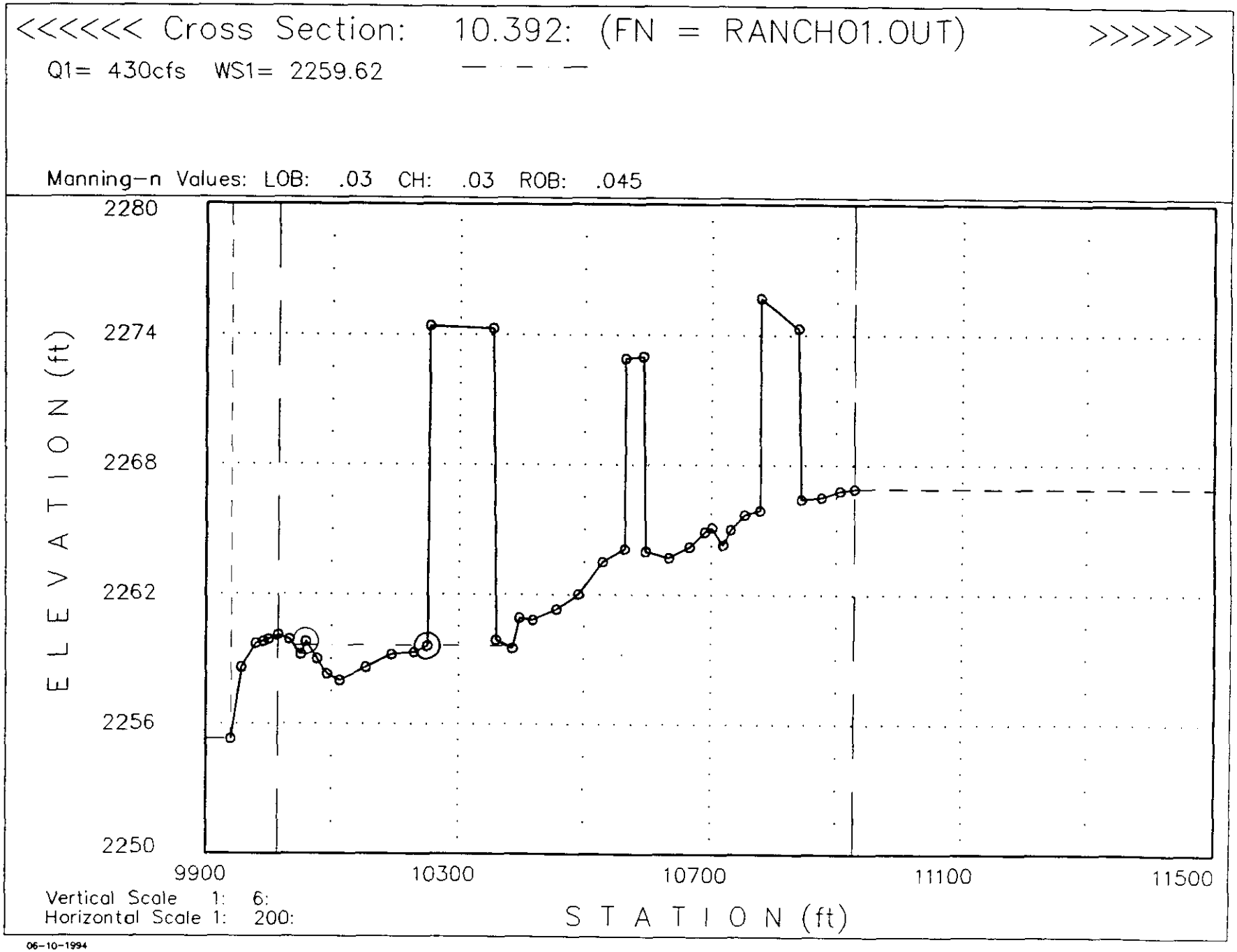

<<<<<< Cross Section: 10.129: (FN = RANCH01.OUT) >>>>>>
Q1= 319cfs WS1= 2254.08
Manning-n Values: LOB: .03 CH: .025 ROB: .03
2258
2256
2254
2252
2250
2248
ELEVATION (ft)
9990
10090
10190
10290
10390
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 50:
06-10-1994

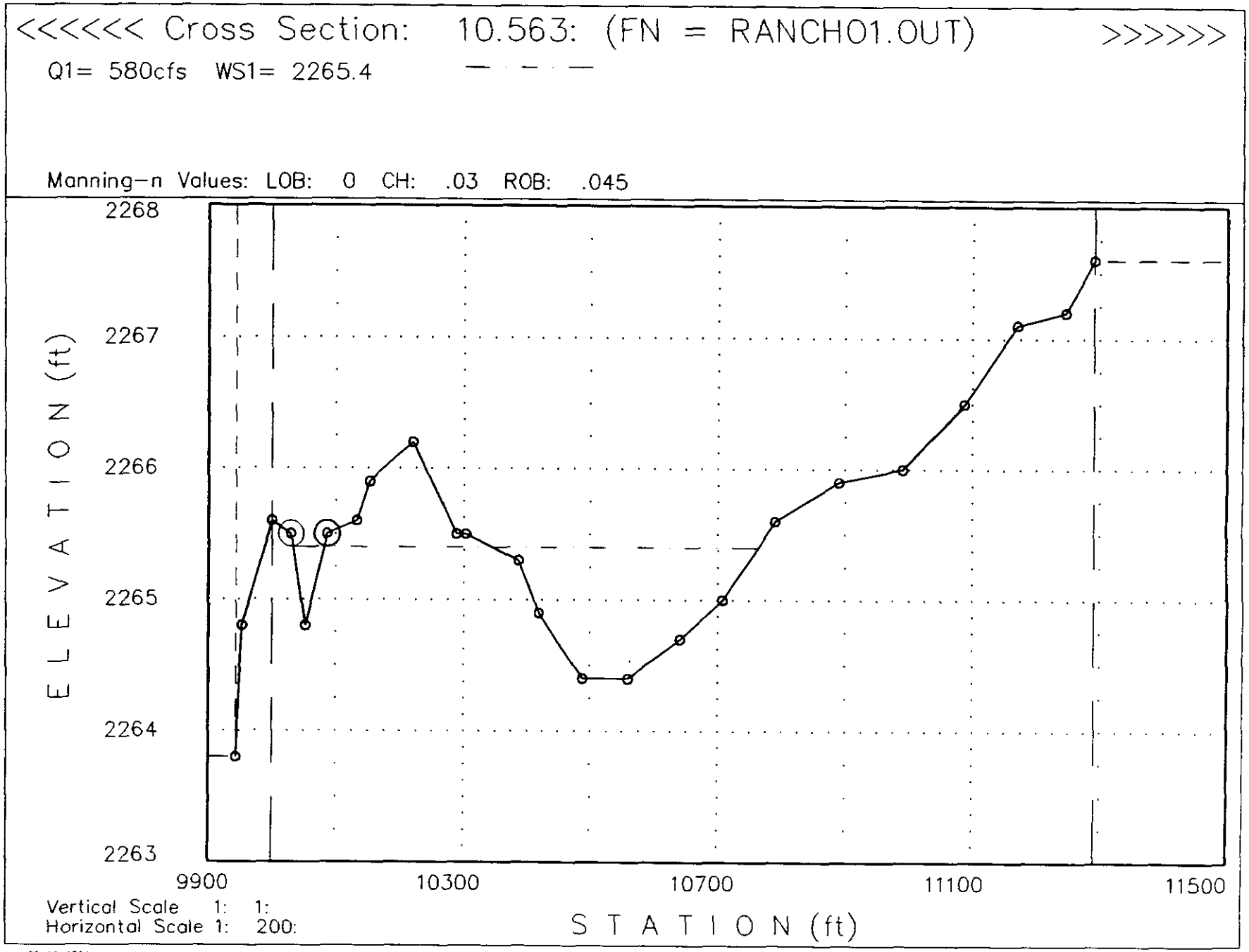

<<<<<< Cross Section: 10.145: (FN = RANCHO1.OUT) >>>>>>
Q1= 319cfs WS1= 2254.07
Manning-n Values: LOB: .03 CH: .025 ROB: .03
2259
2257
2255
2253
2251
2249
ELEVATION (ft)
9990
10030
10070
10110
10150
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 20:
06-10-1994

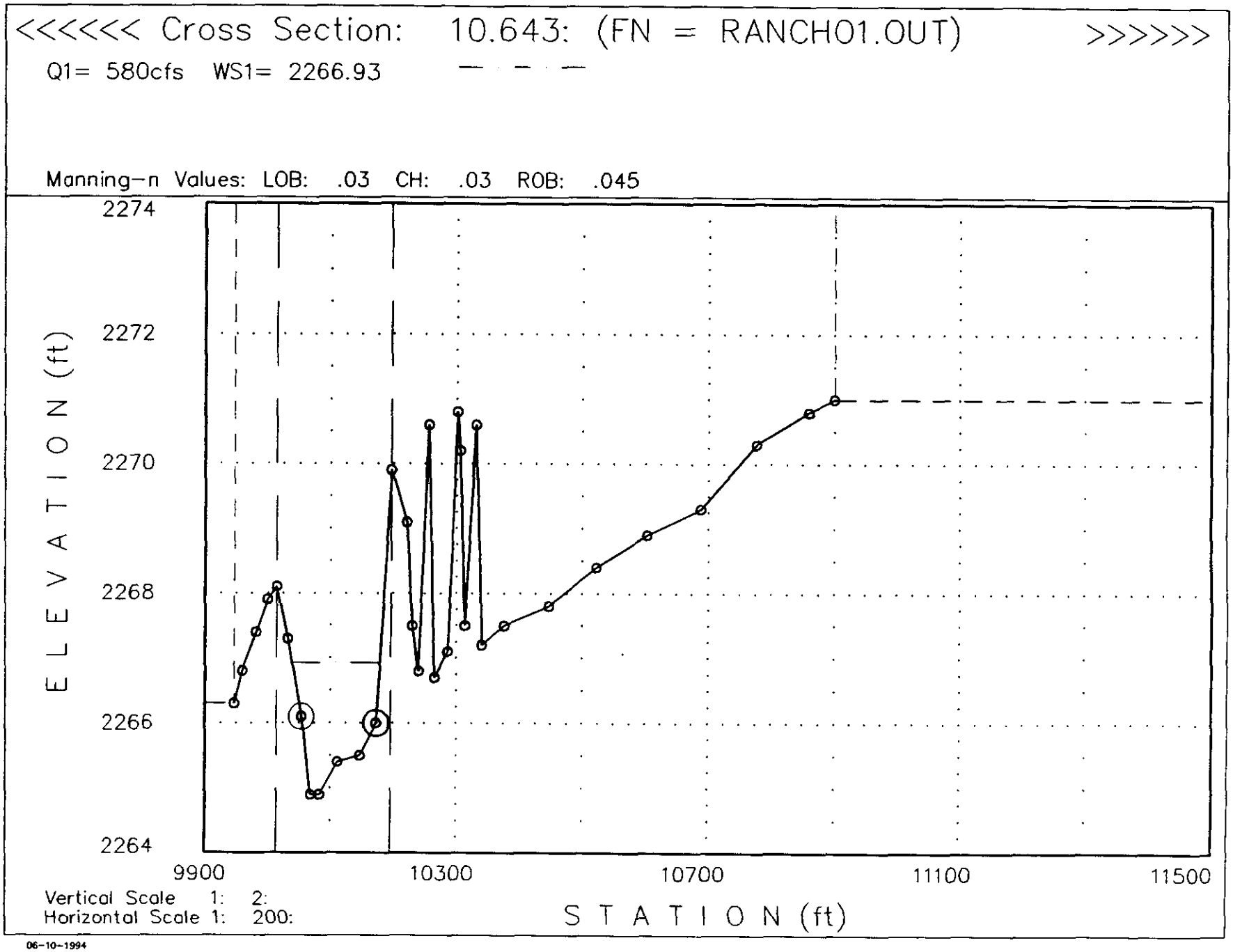

<<<<<< Cross Section: 10.207: (FN = RANCH01.OUT) >>>>>>
Q1= 343cfs WS1= 2254.11
Manning-n Values: LOB: 0 CH: .025 ROB: .03
2256
2255
2254
2253
2252
2251
ELEVATION (ft)
9990
10090
10190
10290
10390
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 50:
06-10-1994


<<<<<< Cross Section: 10.27: (FN = RANCH01.OUT) >>>>>>
Q1= 245cfs WS1= 2256.44
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2264
2262
2260
2258
2256
2254
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-10-1994

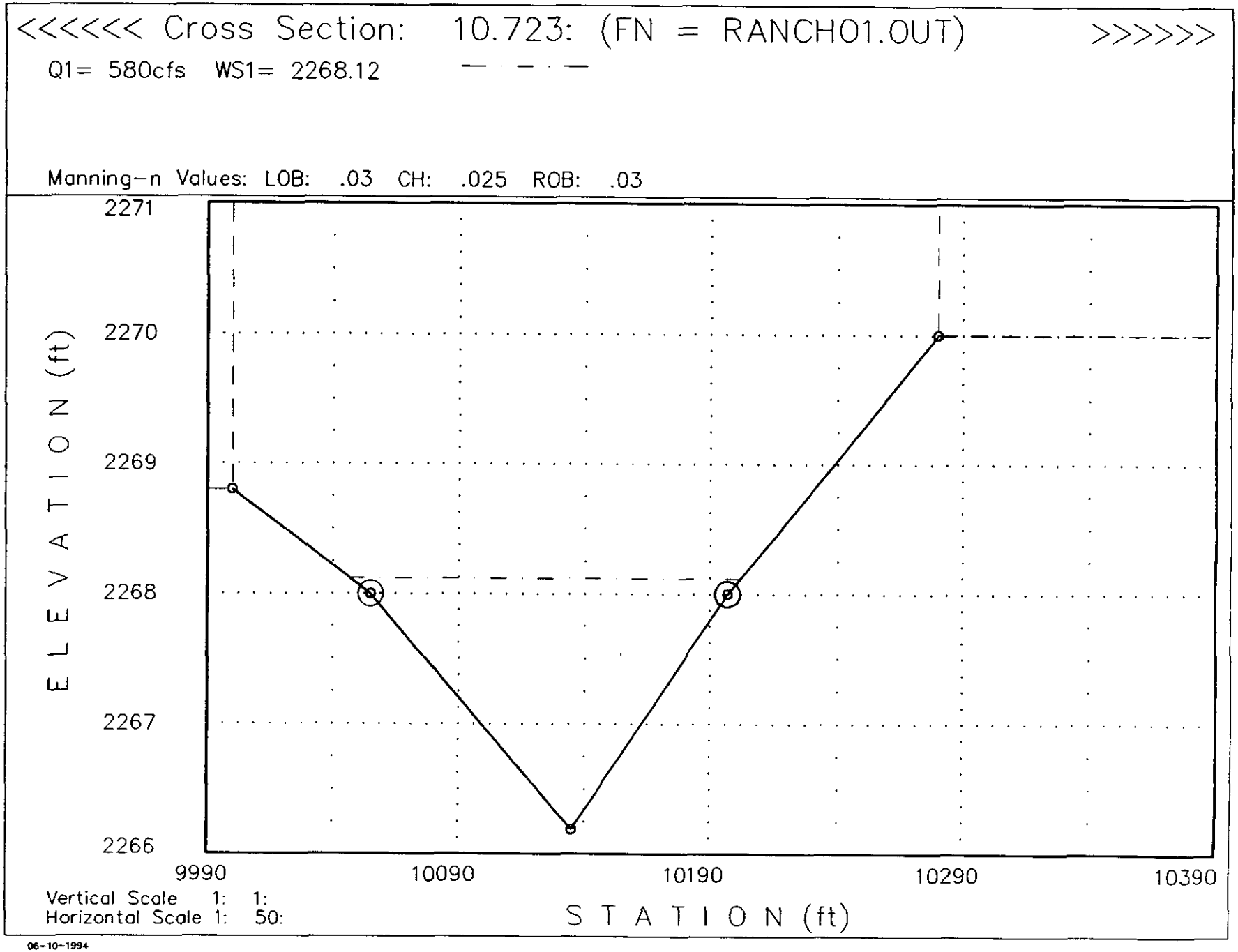

<<<<<< Cross Section: 10.333: (FN = RANCH01.OUT) >>>>>>
Q1= 373.1cfs WS1= 2258.43
Manning-n Values: LOB: .025 CH: .03 ROB: .08
2266
2264
2262
2260
2258
2256
ELEVATION (ft)
9900
10100
10300
10500
10700
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 100:
06-10-1994

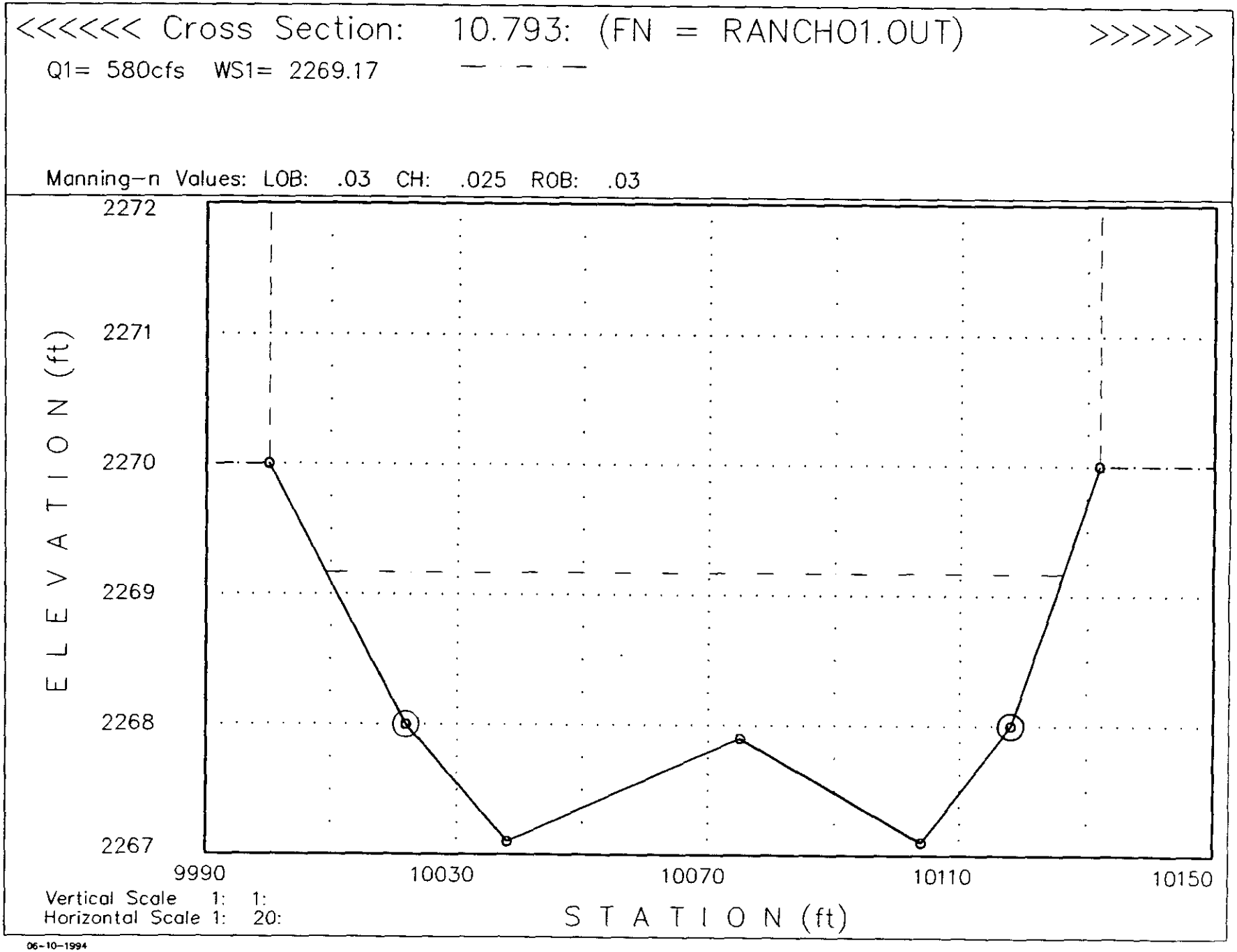

<<<<<< Cross Section: 10.392: (FN = RANCHO1.OUT) >>>>>>
Q1= 430cfs WS1= 2259.62
Manning-n Values: LOB: .03 CH: .03 ROB: .045
2280
2274
2268
2262
2256
2250
ELEVATION (ft)
9900
10300
10700
11100
11500
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
STATION (ft)
06-10-1994

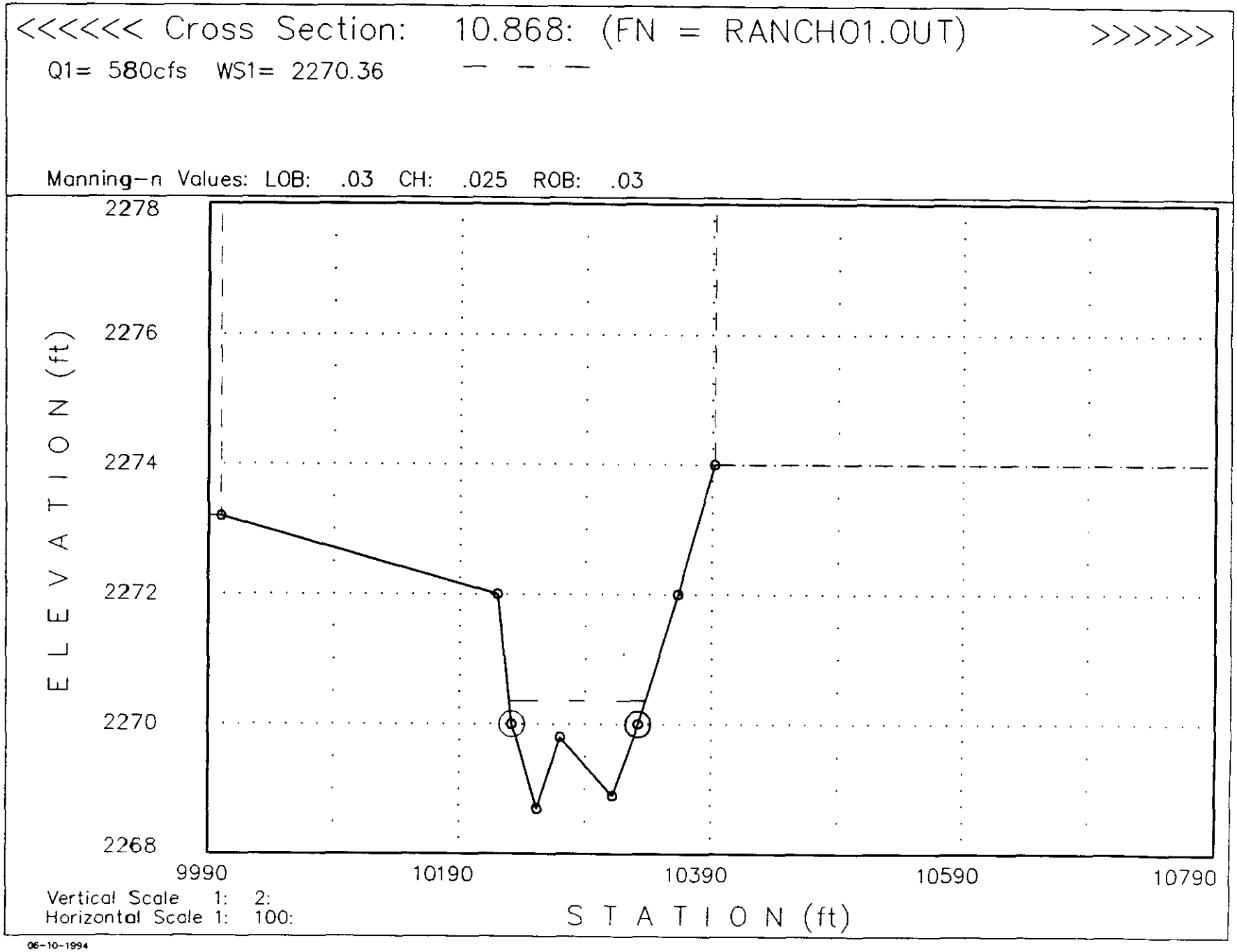

<<<<<< Cross Section: 10.563: (FN = RANCHO1.OUT) >>>>>>
Q1= 580cfs WS1= 2265.4
Manning-n Values: LOB: 0 CH: .03 ROB: .045
2268
2267
2266
2265
2264
2263
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 200:
06-10-1994


<<<<<< Cross Section: 10.643: (FN = RANCH01.OUT) >>>>>>
Q1= 580cfs WS1= 2266.93
Manning-n Values: LOB: .03 CH: .03 ROB: .045
2274
2272
2270
2268
2266
2264
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:

06-10-1994


<<<<<< Cross Section: 10.723: (FN = RANCH01.OUT) >>>>>>
Q1= 580cfs WS1= 2268.12
Manning-n Values: LOB: .03 CH: .025 ROB: .03
2271
2270
2269
2268
2267
2266
ELEVATION (ft)
9990
10090
10190
10290
10390
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 50:
06-10-1994


<<<<<< Cross Section: 10.793: (FN = RANCHO1.OUT) >>>>>>
Q1= 580cfs WS1= 2269.17
Manning-n Values: LOB: .03 CH: .025 ROB: .03
2272
2271
2270
2269
2268
2267
ELEVATION (ft)
9990
10030
10070
10110
10150
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 20:
06-10-1994


<<<<<< Cross Section: 10.868: (FN = RANCH01.OUT) >>>>>>
Q1= 580cfs WS1= 2270.36
Manning-n Values: LOB: .03 CH: .025 ROB: .03
2278
2276
2274
2272
2270
2268
ELEVATION (ft)
9990
10190
10390
10590
10790
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 100:
06-10-1994

Rancho2.dat

RANCHO2.DAT

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    09JUN94    TIME   13:14:44  *
*******************************************
```


```
*****************************************
*  U.S. ARMY CORPS OF ENGINEERS         *
*  HYDROLOGIC ENGINEERING CENTER        *
*  609 SECOND STREET, SUITE D           *
*  DAVIS, CALIFORNIA 95616-4687         *
*          (916) 756-1104               *
*****************************************
```


```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                   X
X     X  X        X     X             X
X     X  XXXXXXX  XXXXX               XXXXXXX
```

THIS RUN EXECUTED 09JUN94 13:14:44

```
**************************************
 HEC-2 WATER SURFACE PROFILES

 Version  4.6.2;  May 1991
**************************************



SPLIT FLOW BEING PERFORMED


SF       SPLIT FLOW


JC       BETWEEN SECTS. 12.543 & 12.557
JP     0        0        0       -1        0

TW       SPLIT ON LEFT SIDE
WS     2  12.543  12.557  12.472    2.85
WC     0  2322.0       75  2322.2

TW       SPLIT ON RIGHT SIDE
WS     2  12.543  12.557  12.472    2.85
WC     0  2322.2       75  2322.6
```

```
T1  NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY        CVL JOB # 930017
T2  BY COE & VAN LOO CONSULANTS, INC.                FILE NAME: RANCHO2.DAT
T3      RANCHO DRIVE

        HEC-2 MODEL FOR RANCHO DR. BETWEEN CRAIG RD AND  U.S. 95
        100-YEAR, 6-HOUR EVENT, EXISTING CONDITIONS


  COMPLEX HYDRAULIC CONDITIONS EXIST ALONG RANCHO DRIVE WHICH CANNOT BE
  ACCURATELY MODELED WITHIN THE HEC-2.
  CALCULATIONS OUTSIDE OF THE HEC-2 MODEL WERE ESSENTIAL TO COMPUTE WSEL
  AT SEVERAL LOCATIONS. CALCULATIONS ARE PROVIDED IN TECHNICAL APPENDIX __.
  X5 CARDS ARE USED TO INPUT THE WSEL.


  IN SOME AREAS "SSTA" AND "ENDST" DO NOT REPRESENT THE ACTUAL FLOODING
  LIMITS. THE DELINEATION WAS BASED ON CONTOURS AND SPOT ELEVATIONS.


  DUE TO INEFFECTIVE FLOW AREAS OR ISLANDS IN THE FLOODPLAIN,
  IN SOME CASES, "TOPWID" DOES NOT REPRESENT THE FULL WIDTH OF THE FLOODPLAIN.


J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0        2         0         0         0         0         0         0    2292.1         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      -1        0        -1

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     150        38        43         1        13        14        15        26        53        54
       4        25         8

  BEGIN RIVER MILE 10.00 @ CENTER LINE OF GOWAN RD.

  TOTAL Q100 = 180 CFS @ CRAIG RD & RANCHO DR. INTERSECTION.
  TOTAL Q100 GETS INTERCEPTED BY CRAIG RD. STORM DRAIN SYSTEM.
  ONLY LOCAL FLOW IMPACTS AREAS ALONG RANCHO DR. BETWEEN
  CRAIG RD. AND ALEXANDER RD.

  STARTING WSEL = 2292.1'
```

```
QT         1        180
NC      0.03       0.03      0.02       0.1       0.3
ET                  7.1                                    10016.9    11102.8
X1    11.354          8     10310     10325         0          0          0
GR    2293.4      10000    2296.8     10308    2291.83     10310    2291.83     10319    2286.08     10320
GR    2286.1      10324    2291.83    10325    2294.08     10365

QT         1        220
NC      0.025      0.045     0.03       0.1       0.3
ET                  7.1                                    10008.3    11012.6
X1    11.498         58    10032.6    10179.3       680        650        660
GR    2300.2      9962.8    2299.9     9970.3    2300.5     9990.0    2300.6     10000.0    2301.5     10008.3
GR    2300.5     10012.8    2300.4    10032.6    2299.9    10061.6    2300.1     10071.1    2299.3     10088.1
GR    2298.1     10111.5    2298.6    10131.0    2300.1    10149.7    2300.7     10179.3    2301.1     10229.0
GR    2301.4     10264.3    2302.5    10277.6    2303.5    10291.0    2302.9     10310.9    2311.3     10312.6
GR    2311.2     10360.0    2303.1    10361.3    2300.5    10386.1    2301.4     10409.3    2300.7     10428.3
GR    2301.3     10450.1    2302.8    10480.9    2302.5    10486.5    2310.7     10489.1    2310.8     10523.1
GR    2302.5     10527.3    2303.0    10563.5    2303.4    10576.0    2301.5     10583.4    2301.3     10595.8
GR    2301.9     10615.6    2302.4    10630.9    2301.5    10663.0    2302.6     10677.3    2303.3     10696.4
GR    2315.1     10699.4    2312.3    10721.8    2304.1    10726.9    2304.0     10737.7    2321.8     10739.0
GR    2319.1     10777.5    2304.9    10784.6    2304.4    10802.3    2303.7     10828.0    2303.0     10839.6
GR    2304.1     10871.0    2305.4    10897.8    2306.6    10929.0    2305.9     10953.8    2309.2     10963.7
GR    2305.2     10973.5    2305.1    11000.7    2305.3    11012.6

ET                  7.1                                    10015.5    10400
X1    11.630         45    10015.5    10154.0       700        700        700
GR    2306.6      9956.4    2307.6     9982.3    2307.8     10000.0    2307.8     10015.5    2307.4     10035.7
GR    2306.9     10056.1    2305.9    10074.9    2306.0    10084.7    2306.6     10114.6    2307.4     10154.0
GR    2307.5     10235.8    2307.8    10298.0    2308.3    10362.6    2309.0     10401.5    2309.4     10418.3
GR    2310.1     10429.4    2308.8    10444.2    2308.8    10472.9    2308.8     10487.0    2321.2     10487.1
GR    2322.0     10542.1    2308.8    10548.1    2308.3    10582.7    2307.3     10598.1    2306.7     10607.7
GR    2307.3     10639.5    2306.9    10665.2    2307.8    10678.2    2309.2     10703.0    2309.8     10727.7
GR    2318.1     10731.7    2323.7    10763.4    2309.8    10766.8    2309.9     10794.2    2310.7     10826.0
GR    2312.1     10852.0    2312.1    10859.1    2321.5    10860.8    2320.8     10933.6    2312.6     10937.8
GR    2311.8     10953.8    2310.9    10970.2    2310.1    10978.4    2310.9     11010.9    2310.8     11021.2

ET                  7.1                                    10013.2    11154.5
QT         1        210
  WEIR FLOW OVER PAINTED DESERT DRIVE.
  WSEL = 2309.88
  REFER TO TECHNICAL APPENDIX FOR CALCS.
X1    11.701         74    10028.0    10407.9       360        490        375
X5         1    2309.88
GR    2309.0      9948.9    2309.0     9948.9    2309.6     9953.8    2310.0     9963.2     2310.4     9976.5
GR    2310.4      9987.9    2310.4     9990.6    2310.8     9991.0    2310.1     9992.5     2310.4     10000.0
GR    2310.2     10012.6    2310.7    10013.2    2310.2    10014.1    2310.3     10016.4    2310.3     10028.0
GR    2309.6     10041.8    2309.6    10054.1    2309.5    10069.2    2309.4     10092.8    2309.3     10115.1
GR    2309.4     10142.3    2309.5    10175.8    2309.4    10208.8    2309.4     10239.5    2309.6     10274.3
GR    2309.7     10308.9    2310.0    10343.6    2310.1    10380.6    2310.3     10407.9    2310.7     10432.5
GR    2310.9     10453.2    2311.0    10481.8    2311.6    10506.1    2311.4     10509.4    2311.4     10515.3
GR    2311.3     10524.6    2312.1    10540.7    2311.8    10563.2    2311.4     10572.5    2312.9     10583.1
GR    2313.9     10588.3    2312.7    10596.2    2312.0    10607.3    2311.8     10618.4    2312.4     10636.5
GR    2312.5     10656.3    2312.6    10679.7    2312.9    10707.3    2313.2     10733.0    2313.2     10756.3
```

GR	2314.0	10767.5	2314.8	10774.2	2314.6	10801.4	2318	10801.4	2318	10846.1
GR	2314.4	10846.1	2314.3	10865.8	2313.7	10893.4	2313.8	10906.0	2313.9	10933.2
GR	2314.5	10958.1	2318	10958.1	2318	11017.9	2315.1	11018.6	2314.2	11039.8
GR	2313.1	11055.8	2313.1	11064.5	2312.7	11064.5	2313.5	11077.5	2313.6	11097.5
GR	2314.1	11111.7	2314.1	11135.6	2314.0	11151.4	2314.2	11154.5		
QT	1	250								
NC	0.025	0.055	0.03	0.1	0.3					
ET		7.1					10012.3	11043.8		
X1	11.875	79	10071.1	10208.0	930	840	920			
GR	2313.2	9948.1	2314.4	9952.6	2314.8	9962.9	2315.3	9975.3	2315.4	9987.3
GR	2315.4	9990.3	2315.6	9990.8	2315.3	9992.6	2315.2	10000.0	2315.3	10011.6
GR	2315.6	10012.3	2315.3	10012.9	2315.3	10015.1	2315.1	10026.8	2314.9	10040.4
GR	2314.3	10049.7	2312.8	10057.4	2312.8	10066.7	2313.1	10071.1	2312.9	10081.5
GR	2312.7	10094.3	2312.7	10104.8	2312.3	10113.8	2311.8	10123.5	2312.2	10138.6
GR	2312.3	10155.9	2312.3	10174.1	2312.7	10186.4	2312.8	10191.9	2312.2	10196.9
GR	2312.2	10204.2	2313.4	10208.0	2312.9	10229.6	2312.8	10256.9	2312.8	10280.2
GR	2313.0	10302.3	2312.5	10307.3	2312.7	10313.1	2313.1	10317.6	2313.2	10334.1
GR	2313.1	10347.4	2313.0	10357.4	2313.0	10370.0	2313.0	10380.1	2312.9	10394.6
GR	2313.2	10412.2	2313.5	10431.5	2313.8	10451.8	2314.2	10469.7	2313.9	10494.0
GR	2313.9	10520.9	2313.9	10540.7	2314.0	10561.6	2314.2	10584.5	2314.3	10607.0
GR	2315.7	10622.1	2316.1	10636.6	2318.0	10653.8	2317.0	10674.3	2317.5	10689.3
GR	2317.0	10706.3	2317.1	10722.6	2316.9	10731.7	2316.9	10746.5	2315.1	10754.2
GR	2315.0	10781.0	2315.1	10808.3	2315.2	10838.0	2315.3	10864.4	2315.4	10898.6
GR	2315.4	10917.5	2316.2	10928.5	2315.7	10938.1	2316.1	10948.5	2315.7	10967.8
GR	2315.8	10986.5	2315.8	11007.2	2316.0	11035.1	2316.1	11043.8		
QT	1	250								
ET		7.1					10008.8	11069.2		
X1	11.991	78	10180.9	10211.4	610	630	610			
GR	2316.2	9951.7	2316.5	9959.5	2316.7	9972.4	2316.8	9985.0	2316.8	9994.8
GR	2317.3	9995.4	2316.8	9996.8	2316.8	10000.0	2316.7	10008.1	2317.2	10008.8
GR	2316.8	10009.7	2316.8	10011.1	2316.7	10022.9	2316.4	10036.5	2316.1	10046.1
GR	2315.5	10051.4	2314.7	10056.1	2314.7	10071.0	2315.3	10087.7	2315.9	10104.3
GR	2318.1	10111.3	2318.2	10115.4	2317.4	10119.4	2318.8	10126.4	2317.1	10132.9
GR	2318.9	10139.4	2317.9	10144.6	2319.7	10151.8	2319.5	10157.5	2317.9	10160.9
GR	2319.7	10166.8	2318.8	10171.8	2314.9	10180.9	2313.7	10188.5	2313.6	10196.3
GR	2314.3	10206.3	2315.6	10211.4	2315.1	10229.5	2315.4	10254.1	2315.4	10276.4
GR	2316.0	10298.9	2316.1	10321.2	2316.6	10341.9	2316.6	10363.5	2315.9	10385.1
GR	2314.7	10392.7	2314.6	10406.8	2314.8	10427.2	2314.6	10453.0	2314.9	10477.4
GR	2314.9	10504.5	2315.3	10525.6	2315.2	10540.1	2315.7	10547.7	2314.9	10553.4
GR	2314.3	10557.0	2314.6	10564.4	2315.8	10570.3	2315.2	10599.3	2315.2	10634.6
GR	2315.2	10666.8	2315.6	10708.2	2315.6	10749.6	2315.5	10784.6	2315.6	10816.0
GR	2315.7	10849.8	2316.0	10878.9	2316.0	10912.5	2315.9	10934.1	2315.8	10947.4
GR	2316.4	10958.8	2316.7	10973.5	2316.3	10986.4	2316.0	11005.2	2316.3	11020.9
GR	2316.3	11041.2	2316.2	11051.2	2316.4	11069.2				
QT	1	150								
ET		7.1					10069.8	10519.9		

WEIR FLOW OVER LONE MOUNTAIN RD.
REFER TO TECHNICAL APPENDIX FOR CALCS.

X1	12.058	23	10145.5	10374.3	305	450	355			
X5	1	2315.97								
GR	2314.2	10000.0	2316.4	10018.4	2317.1	10028.4	2317.2	10041.4	2317.4	10060.7
GR	2317.6	10069.8	2317.2	10092.4	2316.8	10106.2	2316.6	10116.2	2316.7	10116.4
GR	2315.9	10145.5	2315.7	10180.0	2315.3	10216.0	2315.6	10256.6	2315.6	10288.6
GR	2315.6	10327.8	2315.8	10374.3	2315.9	10427.2	2316.2	10479.5	2316.4	10519.9
GR	2317.4	10690	2318	10955	2318.3	11280				
QT	1	150								
ET		7.1					9989.2	10145.9		
X1	12.142	68	10048.6	10145.9	485	380	445			
GR	2318.3	9955.2	2318.3	9961.5	2318.5	9974.4	2318.7	9988.7	2319.0	9989.2
GR	2318.8	9990.8	2318.8	10000.0	2318.6	10009.9	2318.9	10010.7	2318.6	10011.5
GR	2318.6	10013.9	2318.6	10025.4	2318.3	10039.1	2318.2	10048.6	2315.3	10060.6
GR	2314.5	10068.8	2314.4	10077.7	2315.1	10085.2	2315.3	10094.7	2315.7	10117.5
GR	2315.9	10141.2	2317.5	10145.9	2315.6	10154.5	2315.8	10185.4	2316.1	10223.5
GR	2316.1	10257.1	2316.1	10274.8	2316.9	10290.1	2316.4	10304.8	2316.5	10319.8
GR	2316.0	10336.7	2316.2	10359.2	2316.5	10383.5	2316.9	10410.0	2317.2	10420.2
GR	2318.3	10423.6	2318.3	10430.6	2318.6	10441.8	2332.9	10441.9	2330.8	10533.4
GR	2318.4	10533.5	2318.4	10563.5	2318.2	10572.8	2317.8	10594.6	2318.0	10606.7
GR	2317.5	10606.9	2318.1	10632.9	2318.8	10658.0	2318.9	10676.0	2319.1	10694.2
GR	2318.3	10718.0	2318.7	10751.0	2319.0	10769.3	2319.0	10785.9	2319.4	10804.3
GR	2318.8	10815.1	2319.0	10828.9	2318.9	10851.3	2319.1	10883.2	2318.2	10912.5
GR	2318.6	10929.7	2318.7	10952.9	2318.2	10968.4	2318.2	10986.8	2318.5	10992.7
GR	2318.3	11009.9	2318.5	11035.4	2318.4	11055.4				
QT	1	180								
NC	0.025	0.035	0.03	0.3	0.5					
ET		7.1					10015.7	11039.8		
X1	12.221	51	10080.4	10101.5	413	413	413			
X3	10									
GR	2319.1	9950.8	2319.5	9952.8	2319.6	9961.9	2319.8	9975.4	2319.9	9989.2
GR	2320.3	9989.2	2320.0	9991.2	2319.9	10000.0	2320.0	10014.8	2320.4	10015.7
GR	2319.7	10016.6	2319.7	10018.9	2319.7	10029.9	2319.6	10043.9	2319.0	10059.1
GR	2319.8	10059.1	2320.1	10068.9	2320.2	10080.4	2316.1	10080.5	2315.0	10087.5
GR	2315.7	10092.1	2319.5	10092.2	2319.7	10101.5	2319.6	10121.3	2319.0	10122.1
GR	2319.1	10133.5	2319.3	10178.9	2319.4	10222.2	2319.8	10264.0	2320.2	10318.9
GR	2320.9	10366.4	2321.3	10417.9	2321.6	10464.2	2321.8	10501.8	2321.2	10551.8
GR	2321.2	10589.3	2321.5	10634.0	2321.9	10672.2	2322.1	10707.8	2322.8	10708.1
GR	2323.0	10723.6	2323.3	10744.0	2323.2	10763.8	2323.0	10782.9	2322.0	10782.9
GR	2322.1	10810.7	2322.0	10857.2	2321.8	10904.3	2321.1	10957.6	2320.6	11005.2
GR	2320.4	11039.8								

2 - 6' X 3' RCB UNDER ENTRANCE ROAD TO SANTA FE CASINO

SC	2.013	0.2	2.9	0	3	6	65	9.1	2315.2	2315.0
ET		7.1					10010.1	10693.6		
X1	12.236	58	10056.6	10096.5	80	80	80			
X2			2	2318.2	2319.8					
X3	10									
BT	-9	9947.8	2319.1		10010.1	2320.4		10056.6	2319.8	
BT		10096.5	2319.8		10291.4	2320.2		10693.5	2323.1	
BT		10693.6	2330		10774.0	2330		11045.2	2321.0	

GR	2319.1	9947.8	2319.3	9956.1	2319.5	9969.5	2319.6	9982.6	2319.9	9993.0
GR	2320.3	9994.4	2319.8	9996.2	2319.9	10000.0	2320.0	10009.5	2320.4	10010.1
GR	2319.9	10011.4	2319.7	10014.8	2319.6	10024.9	2319.1	10035.5	2319.0	10049.5
GR	2319.8	10049.6	2319.6	10056.6	2317.8	10067.7	2316.1	10074.1	2315.3	10079.6
GR	2315.2	10083.0	2316.4	10090.6	2316.6	10096.5	2318.9	10096.5	2318.9	10109.9
GR	2319.1	10118.0	2318.4	10118.0	2319.4	10134.2	2319.5	10163.5	2319.6	10204.2
GR	2319.9	10250.3	2320.2	10291.4	2320.5	10349.0	2320.9	10395.7	2321.3	10447.3
GR	2321.9	10494.4	2321.4	10540.9	2321.6	10584.6	2322.0	10622.6	2322.0	10647.5
GR	2322.5	10647.5	2322.8	10662.7	2322.8	10677.2	2322.8	10681.3	2323.1	10693.5
GR	2330	10693.6	2330	10774.0	2322.5	10774.0	2322.8	10815.1	2323.1	10854.5
GR	2323.1	10871.8	2323.2	10877.4	2322.2	10877.5	2321.9	10911.3	2321.5	10951.9
GR	2321.3	10983.8	2320.9	11017.6	2321.0	11045.2				
ET		7.1					10008.8	10300		
X1	12.261	68	10055.0	10114.9	135	135	135			
X3	10									
GR	2318.8	9936.9	2319.7	9943.4	2320.0	9952.0	2320.3	9965.4	2320.5	9977.7
GR	2320.0	9989.5	2320.7	9990.9	2320.2	9991.9	2320.2	10000.0	2320.2	10008.3
GR	2320.7	10008.8	2320.1	10009.9	2320.2	10013.2	2320.3	10023.7	2320.0	10035.1
GR	2319.5	10047.7	2320.0	10047.8	2320.0	10055.0	2317.1	10071.4	2316.3	10078.7
GR	2316.2	10084.5	2316.3	10090.6	2317.6	10100.7	2318.5	10109.9	2318.8	10114.9
GR	2318.6	10118.9	2317.9	10119.1	2318.4	10131.7	2319.3	10161.8	2319.6	10204.0
GR	2320.3	10243.4	2320.8	10280.5	2321.8	10325.0	2322.1	10361.9	2322.1	10379.2
GR	2322.9	10379.3	2323.3	10396.2	2323.6	10405.8	2325.5	10420.0	2326.1	10426.1
GR	2325.3	10435.2	2323.5	10444.0	2323.3	10460.5	2323.5	10477.1	2323.4	10506.3
GR	2323.4	10532.8	2323.7	10544.1	2323.1	10552.5	2323.2	10571.5	2322.9	10588.8
GR	2350	10588.8	2350	10666.8	2338.8	10667.0	2339.6	10770.1	2322.2	10770.1
GR	2322.4	10795.6	2318.8	10795.6	2318.6	10819.9	2320.1	10848.4	2322.6	10848.6
GR	2324.0	10883.1	2323.8	10897.7	2346.6	10897.7	2346.3	10939.7	2322.3	10939.7
GR	2321.8	10989.4	2322.0	11010.0	2321.9	11035.6				
ET		7.1					10008.2	11026.5		
X1	12.291	44	10065.3	10099.6	155	155	155			
X3	10									
GR	2320.0	9946.4	2320.2	9954.9	2320.6	9968.5	2320.8	9981.7	2320.8	9992.7
GR	2321.1	9993.6	2320.8	9995.6	2320.9	10000.0	2321.0	10007.6	2321.4	10008.2
GR	2320.8	10008.5	2320.9	10019.2	2320.6	10029.8	2320.0	10046.0	2319.9	10057.1
GR	2320.9	10057.2	2320.6	10065.3	2319.1	10073.3	2319.0	10075.0	2317.6	10075.2
GR	2316.2	10081.6	2315.9	10087.3	2316.7	10096.3	2317.7	10099.0	2319.6	10099.6
GR	2319.5	10104.0	2320.2	10121.0	2320.3	10155.9	2320.4	10197.7	2320.9	10226.3
GR	2320.8	10253.7	2320.4	10253.9	2320.7	10278.9	2322.1	10325.7	2322.2	10337.6
GR	2322.6	10374.0	2322.7	10389.1	2323.5	10389.2	2323.5	10410.2	2322.9	10410.3
GR	2323.1	10430.4	2323.1	10445.7	2341.5	10445.7	2343.8	11026.5		

2 - 6' X 3' RCB UNDER ENTRANCE ROAD TO SANTA FE CASINO

SC	2.013	0.2	2.9	0	3	6	150	9.1	2316.9	2315.9
ET		7.1					10008.4	10514.6		
X1	12.323	46	10071.2	10136.3	170	170	170			
X2			2	2319.9	2321.50					
X3	10									
BT	-9	9941.5	2319.1		10008.4	2322.0		10071.2	2321.5	
BT		10136.3	2321.5		10439.5	2322		10514.6	2323.3	

		10514.7	2330		10998.3	2330		11018.2	2323.3	
GR	2319.1	9941.5	2320.5	9950.9	2320.5	9959.2	2321.0	9972.4	2321.1	9990.6
GR	2321.9	9991.6	2321.5	9993.6	2321.4	9997.2	2321.5	10000.0	2322.0	10008.4
GR	2321.6	10008.4	2321.7	10017.3	2321.4	10034.9	2320.4	10047.4	2320.3	10063.6
GR	2321.1	10063.7	2321.1	10071.2	2318.9	10078.9	2317.2	10084.4	2316.9	10093.3
GR	2316.9	10103.5	2317.6	10108.2	2319.0	10113.1	2319.9	10136.3	2319.5	10165.5
GR	2319.8	10206.7	2319.2	10224.7	2320.0	10280.9	2319.9	10300.5	2320.6	10300.5
GR	2320.9	10323.5	2321.0	10338.6	2320.3	10338.6	2320.9	10372.7	2321.0	10396.7
GR	2321.2	10439.2	2322.0	10439.5	2321.9	10448.1	2322.3	10479.5	2322.4	10499.9
GR	2323.0	10509.7	2323.3	10514.6	2330	10514.6	2330	10998.3	2323.3	10998.5
GR	2323.3	11018.2								

ET CARD IS USED TO BLOCK OUT AN INEFFECTIVE FLOW AREA, BUT THIS AREA WILL BE INCLUDED IN THE FLOODPLAIN.

NC	0.025	0.035	0.03	0.1	0.3					
ET		7.1					10060.9	10296.2		
X1	12.372	46	10060.9	10108.6	260	280	260			
GR	2319.9	9932.3	2321.0	9938.5	2321.2	9947.8	2321.5	9961.1	2321.6	9973.1
GR	2321.7	9975.8	2322.2	9976.3	2321.4	9978.1	2320.9	9990.0	2320.8	9995.9
GR	2321.1	10000.0	2321.8	10014.6	2322.0	10015.2	2321.6	10015.9	2321.7	10020.6
GR	2321.7	10032.3	2321.4	10045.1	2321.1	10053.2	2321.9	10053.4	2322.0	10060.9
GR	2319.8	10071.4	2317.6	10082.8	2317.6	10096.6	2318.9	10099.9	2320.1	10108.6
GR	2319.1	10118.3	2318.6	10118.5	2319.4	10146.8	2319.6	10190.2	2319.8	10232.9
GR	2319.9	10296.2	2319.5	10354.2	2320.0	10415.7	2320.4	10473.4	2319.9	10545.9
GR	2320.4	10598.4	2321.2	10663.1	2321.7	10712.6	2321.5	10762.8	2321.9	10815.6
GR	2321.6	10850.4	2322.3	10850.4	2322.3	10859.8	2321.7	10859.8	2322.2	10901.2
GR	2322.3	10910.6								

ET		7.1					10030.8	10691.4		
X1	12.472	47	10073.1	10129.4	530	550	530			
GR	2322.0	9933.3	2322.7	9940.8	2323.0	9949.3	2323.2	9963.1	2323.4	9974.5
GR	2323.4	9976.4	2323.8	9977.8	2323.1	9980.5	2322.9	9995.6	2322.8	10000.0
GR	2323.3	10019.7	2323.6	10025.7	2323.6	10030.8	2323.4	10042.2	2323.0	10056.2
GR	2323.0	10065.2	2321.5	10073.1	2319.8	10084.5	2319.6	10092.9	2319.3	10100.3
GR	2319.4	10113.9	2320.1	10119.9	2320.9	10125.9	2321.3	10129.4	2321.0	10138.4
GR	2320.8	10138.4	2321.1	10154.9	2321.1	10185.1	2321.1	10224.5	2321.4	10267.4
GR	2321.6	10310.0	2321.9	10346.4	2322.1	10389.2	2322.8	10433.8	2322.6	10475.7
GR	2322.7	10508.4	2323.2	10508.4	2323.9	10524.4	2323.7	10543.1	2322.2	10568.1
GR	2321.6	10572.4	2321.5	10592.5	2321.5	10625.1	2321.9	10641.3	2324.4	10666.9
GR	2326.1	10687.6	2326.1	10691.4						

ET CARD IS USED TO BLOCK OUT AN INEFFECTIVE FLOW AREA, BUT THIS AREA WILL BE INCLUDED IN THE FLOODPLAIN.

QT	1	215								
NC	0.05	0.035	0.03	.1	.3					
ET		7.1					10505	10612		
X1	12.543	13.00	10520	10612	400	365	370			
GR	2326	10000	2324	10115	2322	10138	2322	10242	2321.5	10380
GR	2322	10505	2322	10520	2322	10532	2320.9	10540	2320.8	10550
GR	2320.9	10560	2322	10573	2322.2	10612				

ET		7.1					9968.0	10040.3		
X1	12.557	23.00	9980.7	10026.0	75	75	75			
GR	2322.9	9632.0	2322.4	9651.1	2322.3	9673.2	2322.2	9696.1	2322.1	9716.1
GR	2321.5	9732.8	2321.4	9744.2	2322.0	9758.9	2322.0	9780.9	2322.0	9806.5
GR	2322.0	9832.9	2322.0	9860.3	2322.1	9884.0	2322.0	9913.3	2321.8	9942.2
GR	2321.9	9960.2	2322.2	9968.0	2322.2	9980.7	2322.2	9993.6	2321.6	10000.0
GR	2321.8	10015.9	2322.6	10026.0	2322.6	10040.3				

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 11.354

3470 ENCROACHMENT STATIONS= 10016.9 11102.8 TYPE= 1 TARGET= 1085.899

11.354	6.02	2292.10	.00	2292.10	2292.57	.47	.00	.00	2291.83
180.0	.0	179.5	.5	.0	32.8	.6	.0	.0	2291.83
.00	.03	5.48	.79	.030	.020	.030	.000	2286.08	10309.89
.003725	0.	0.	0.	0	0	0	.00	19.91	10329.80

CCHV= .100 CEHV= .300
*SECNO 11.498
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 10008.3 11012.6 TYPE= 1 TARGET= 1004.300

11.498	1.35	2299.45	2299.45	2299.45	2299.84	.39	4.63	.01	2300.40
220.0	.0	220.0	.0	.0	43.8	.0	.6	.6	2300.70
.04	.00	5.02	.00	.000	.030	.000	.000	2298.10	10084.89
.014535	680.	660.	650.	7	17	0	.00	56.72	10141.61

*SECNO 11.630

3470 ENCROACHMENT STATIONS= 10015.5 10400.0 TYPE= 1 TARGET= 384.500

11.630	1.30	2307.20	.00	2307.20	2307.38	.18	7.52	.02	2307.80
220.0	.0	220.0	.0	.0	65.3	.0	1.5	1.8	2307.40
.09	.00	3.37	.00	.000	.030	.000	.000	2305.90	10043.71
.008253	700.	700.	700.	4	0	0	.00	100.62	10144.33

*SECNO 11.701
WATER EL=X5 CARD= 2309.880

3470 ENCROACHMENT STATIONS= 10013.2 11154.5 TYPE= 1 TARGET= 1141.300

11.701	.88	2309.88	.00	2309.88	2309.93	.05	2.43	.01	2310.30
210.0	.0	210.0	.0	.0	111.9	.0	2.2	3.5	2310.30
.15	.00	1.88	.00	.000	.030	.000	.000	2309.00	10036.28
.005185	360.	375.	490.	0	0	0	.00	293.42	10329.71

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .100 CEHV= .300
*SECNO 11.875

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.63

3470 ENCROACHMENT STATIONS= 10012.3 11043.8 TYPE= 1 TARGET= 1031.500

11.875	1.38	2313.18	.00	2313.18	2313.24	.06	3.30	.00	2313.10
250.0	7.2	215.4	27.4	4.8	100.9	43.6	4.9	10.0	2313.40
.28	1.49	2.14	.63	.025	.030	.055	.000	2311.80	10055.48
.002777	930.	920.	840.	4	0	0	.00	337.41	10410.74

*SECNO 11.991

3265 DIVIDED FLOW

3470 ENCROACHMENT STATIONS= 10008.8 11069.2 TYPE= 1 TARGET= 1060.400

11.991	1.67	2315.27	.00	2315.27	2315.40	.13	2.14	.02	2314.90
250.0	32.6	130.3	87.1	14.1	35.0	79.2	6.9	14.8	2315.60
.35	2.32	3.72	1.10	.025	.030	.055	.000	2313.60	10052.76
.004484	610.	610.	630.	4	0	0	.00	324.43	10673.85

*SECNO 12.058
WATER EL=X5 CARD= 2315.970

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .57

3470 ENCROACHMENT STATIONS= 10069.8 10519.9 TYPE= 1 TARGET= 450.101

12.058	1.77	2315.97	.00	2315.97	2316.02	.05	1.72	.01	2315.90
150.0	.0	147.0	3.0	.1	82.8	6.8	7.9	17.6	2315.80
.40	.04	1.78	.45	.025	.030	.055	.000	2314.20	10142.95
.004984	305.	355.	450.	0	0	0	.00	296.46	10439.41

*SECNO 12.142

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.85

3470 ENCROACHMENT STATIONS= 9989.2 10145.9 TYPE= 1 TARGET= 156.700

12.142	2.19	2316.59	.00	2316.59	2316.62	.03	.60	.00	2318.20
150.0	.0	150.0	.0	.0	107.4	.0	8.9	19.5	100000.00
.49	.00	1.40	.00	.000	.030	.000	.000	2314.40	10055.27
.000613	485.	445.	380.	4	0	0	.00	87.95	10143.22

CCHV= .300 CEHV= .500
*SECNO 12.221

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 10015.7 11039.8 TYPE= 1 TARGET= 1024.100

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 2320.20 ELREA= 2319.70

12.221	2.42	2317.42	2317.42	2317.42	2318.40	.98	.79	.47	2320.20
180.0	.0	180.0	.0	.0	22.7	.0	9.5	20.0	2319.70
.51	.00	7.94	.00	.000	.030	.000	.000	2315.00	10080.47
.014506	413.	413.	413.	20	8	0	.00	11.68	10092.15

SPECIAL CULVERT

SC	CUNO	CUNV	ENTLC	COFQ	RDLEN	RISE	SPAN	CULVLN	CHRT	SCL	ELCHU	ELCHD
	2	.013	.20	2.90	.00	3.00	6.00	65.00	9	1	2315.20	2315.00

CHART 9 - BOX CULVERT WITH FLARED WINGWALL AND INLET TOP EDGE BEVEL
SCALE 1 - WINGWALL FLARED 45 DEGREES; INLET TOP EDGE = 0.043D

*SECNO 12.236

SPECIAL CULVERT INLET CONTROL
EGIC = 2318.303 EGOC = 2318.290 PCWSE= 2317.421 ELTRD= 2319.800

5150, EG OF 2318.30 LESS THAN XEG OF 2318.40

3301 HV CHANGED MORE THAN HVINS

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.15

SPECIAL CULVERT

EGIC	EGOC	H4	QWEIR	QCULV	VCH	ACULV	ELTRD	WEIRLN
2318.30	2318.29	.00	0.	180.	2.867	36.0	2319.80	0.

3470 ENCROACHMENT STATIONS= 10010.1 10693.6 TYPE= 1 TARGET= 683.500

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 2319.60 ELREA= 2318.90

12.236	3.07	2318.27	.00	2318.27	2318.40	.13	.00	.00	2319.60
180.0	.0	180.0	.0	.0	62.8	.0	9.6	20.1	2318.90
.51	.00	2.87	.00	.000	.030	.000	.000	2315.20	10064.79
.001467	80.	80.	80.	3	0	0	.00	31.71	10096.50

*SECNO 12.261

3470 ENCROACHMENT STATIONS= 10008.8 10300.0 TYPE= 1 TARGET= 291.200

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 2320.00 ELREA= 2318.80

12.261	2.31	2318.51	.00	2318.51	2318.63	.12	.23	.00	2320.00
180.0	.0	180.0	.0	.0	65.9	.0	9.8	20.2	2318.80
.53	.00	2.73	.00	.000	.030	.000	.000	2316.20	10063.41
.001941	135.	135.	135.	3	0	0	.00	46.72	10110.12

*SECNO 12.291

3470 ENCROACHMENT STATIONS= 10008.2 11026.5 TYPE= 1 TARGET= 1018.300

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 2320.60 ELREA= 2319.60

12.291	2.87	2318.77	.00	2318.77	2318.94	.17	.28	.03	2320.60
180.0	.0	180.0	.0	.0	54.1	.0	10.0	20.3	2319.60
.54	.00	3.32	.00	.000	.030	.000	.000	2315.90	10075.03
.001735	155.	155.	155.	2	0	0	.00	24.30	10099.34

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

SPECIAL CULVERT

SC	CUNO	CUNV	ENTLC	COFQ	RDLEN	RISE	SPAN	CULVLN	CHRT	SCL	ELCHU	ELCHD
	2	.013	.20	2.90	.00	3.00	6.00	150.00	9	1	2316.90	2315.90

CHART 9 - BOX CULVERT WITH FLARED WINGWALL AND INLET TOP EDGE BEVEL
SCALE 1 - WINGWALL FLARED 45 DEGREES; INLET TOP EDGE = 0.043D

*SECNO 12.323

SPECIAL CULVERT OUTLET CONTROL
EGIC = 2320.003 EGOC = 2320.024 PCWSE= 2318.769 ELTRD= 2321.500

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.97

SPECIAL CULVERT

EGIC	EGOC	H4	QWEIR	QCULV	VCH	ACULV	ELTRD	WEIRLN
2320.00	2320.02	1.08	0.	180.	1.480	36.0	2321.50	0.

3470 ENCROACHMENT STATIONS= 10008.4 10514.6 TYPE= 1 TARGET= 506.199

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 2321.10 ELREA= 2319.90

12.323	3.09	2319.99	.00	2319.99	2320.02	.03	1.08	.00	2321.10
180.0	.0	154.5	25.5	.0	104.4	54.7	10.4	20.8	2319.90
.58	.00	1.48	.47	.000	.030	.035	.000	2316.90	10075.07
.000445	170.	170.	170.	2	0	0	.00	223.94	10300.50

CCHV= .100 CEHV= .300
*SECNO 12.372

3470 ENCROACHMENT STATIONS= 10060.9 10296.2 TYPE= 1 TARGET= 235.300

12.372	2.53	2320.13	.00	2320.13	2320.16	.03	.13	.00	2322.00
180.0	.0	103.0	77.0	.0	62.9	99.7	11.4	22.2	2320.10
.63	.00	1.64	.77	.000	.030	.035	.000	2317.60	10069.85
.000583	260.	260.	280.	2	0	0	.00	226.35	10296.20

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 12.472

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .31

3470 ENCROACHMENT STATIONS= 10030.8 10691.4 TYPE= 1 TARGET= 660.601

12.472	1.41	2320.71	.00	2320.71	2320.95	.23	.73	.06	2321.50
180.0	.0	180.0	.0	.0	46.5	.0	12.7	23.9	2321.30
.67	.00	3.87	.00	.000	.030	.000	.000	2319.30	10078.36
.006074	530.	530.	550.	3	0	0	.00	46.16	10124.52

CCHV= .100 CEHV= .300
*SECNO 12.543
3280 CROSS SECTION 12.54 EXTENDED .16 FEET

3470 ENCROACHMENT STATIONS= 10505.0 10612.0 TYPE= 1 TARGET= 107.000

12.543	1.56	2322.36	.00	2322.36	2322.41	.05	1.45	.02	2322.00
123.8	3.9	119.9	.0	5.4	63.8	.0	13.2	24.6	100000.00
.73	.72	1.88	.00	.050	.030	.000	.000	2320.80	10505.00
.002354	400.	370.	365.	4	0	0	.00	107.00	10612.00

*SECNO 12.557
3280 CROSS SECTION 12.56 EXTENDED .22 FEET

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 9968.0 10040.3 TYPE= 1 TARGET= 72.300

12.557	1.42	2322.82	2322.82	2322.82	2323.18	.36	.44	.09	2322.20
215.0	18.8	190.6	5.5	7.9	38.0	3.2	13.3	24.7	2322.60
.73	2.39	5.02	1.75	.050	.030	.035	.000	2321.40	9968.00
.013000	75.	75.	75.	20	15	0	.00	72.30	10040.30

TW SPLIT ON LEFT SIDE

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
73.63	73.81	.25	73.63	73.81	.25	10	2322.358	2322.821	12.543	12.557

TW SPLIT ON RIGHT SIDE

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
17.60	17.65	.32	91.22	91.47	.27	10	2322.358	2322.821	12.543	12.557

THIS RUN EXECUTED 09JUN94 13:15:06

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

RANCHO DRIVE

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	QLOB	QCH	QROB	VCH	SSTA	ENDST	TOPWID	AREA	DEPTH
	11.354	180.00	2292.10	.00	179.48	.52	5.48	10309.89	10329.80	19.91	33.41	6.02
*	11.498	220.00	2299.45	.00	220.00	.00	5.02	10084.89	10141.61	56.72	43.80	1.35
	11.630	220.00	2307.20	.00	220.00	.00	3.37	10043.71	10144.33	100.62	65.27	1.30
*	11.701	210.00	2309.88	.00	210.00	.00	1.88	10036.28	10329.71	293.42	111.94	.88
*	11.875	250.00	2313.18	7.19	215.44	27.36	2.14	10055.48	10410.74	337.41	149.32	1.38
	11.991	250.00	2315.27	32.64	130.26	87.10	3.72	10052.76	10673.85	324.43	128.26	1.67
*	12.058	150.00	2315.97	.00	146.96	3.03	1.78	10142.95	10439.41	296.46	89.64	1.77
*	12.142	150.00	2316.59	.00	150.00	.00	1.40	10055.27	10143.22	87.95	107.38	2.19
*	12.221	180.00	2317.42	.00	180.00	.00	7.94	10080.47	10092.15	11.68	22.68	2.42
*	12.236	180.00	2318.27	.00	180.00	.00	2.87	10064.79	10096.50	31.71	62.79	3.07
	12.261	180.00	2318.51	.00	180.00	.00	2.73	10063.41	10110.12	46.72	65.87	2.31
	12.291	180.00	2318.77	.00	180.00	.00	3.32	10075.03	10099.34	24.30	54.14	2.87
*	12.323	180.00	2319.99	.00	154.54	25.46	1.48	10075.07	10300.50	223.94	159.12	3.09
	12.372	180.00	2320.13	.00	102.97	77.03	1.64	10069.85	10296.20	226.35	162.66	2.53
*	12.472	180.00	2320.71	.00	180.00	.00	3.87	10078.36	10124.52	46.16	46.50	1.41
	12.543	123.78	2322.36	3.88	119.89	.00	1.88	10505.00	10612.00	107.00	69.21	1.56
*	12.557	215.00	2322.82	18.84	190.64	5.52	5.02	9968.00	10040.30	72.30	49.03	1.42

RANCHO DRIVE

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	11.354	.00	.00	.00	2286.08	180.00	2292.10	.00	2292.57	37.25	5.48	33.41	29.49
*	11.498	660.00	.00	.00	2298.10	220.00	2299.45	2299.45	2299.84	145.35	5.02	43.80	18.25
	11.630	700.00	.00	.00	2305.90	220.00	2307.20	.00	2307.38	82.53	3.37	65.27	24.22
*	11.701	375.00	.00	.00	2309.00	210.00	2309.88	.00	2309.93	51.85	1.88	111.94	29.16
*	11.875	920.00	.00	.00	2311.80	250.00	2313.18	.00	2313.24	27.77	2.14	149.32	47.44
	11.991	610.00	.00	.00	2313.60	250.00	2315.27	.00	2315.40	44.84	3.72	128.26	37.33
*	12.058	355.00	.00	.00	2314.20	150.00	2315.97	.00	2316.02	49.84	1.78	89.64	21.25
*	12.142	445.00	.00	.00	2314.40	150.00	2316.59	.00	2316.62	6.13	1.40	107.38	60.60
*	12.221	413.00	.00	.00	2315.00	180.00	2317.42	2317.42	2318.40	145.06	7.94	22.68	14.94
*	12.236	80.00	2319.80	2318.20	2315.20	180.00	2318.27	.00	2318.40	14.67	2.87	62.79	47.00
	12.261	135.00	.00	.00	2316.20	180.00	2318.51	.00	2318.63	19.41	2.73	65.87	40.86
	12.291	155.00	.00	.00	2315.90	180.00	2318.77	.00	2318.94	17.35	3.32	54.14	43.22
*	12.323	170.00	2321.50	2319.90	2316.90	180.00	2319.99	.00	2320.02	4.45	1.48	159.12	85.32
	12.372	260.00	.00	.00	2317.60	180.00	2320.13	.00	2320.16	5.83	1.64	162.66	74.57
*	12.472	530.00	.00	.00	2319.30	180.00	2320.71	.00	2320.95	60.74	3.87	46.50	23.10
	12.543	370.00	.00	.00	2320.80	123.78	2322.36	.00	2322.41	23.54	1.88	69.21	25.51
*	12.557	75.00	.00	.00	2321.40	215.00	2322.82	2322.82	2323.18	130.00	5.02	49.03	18.86

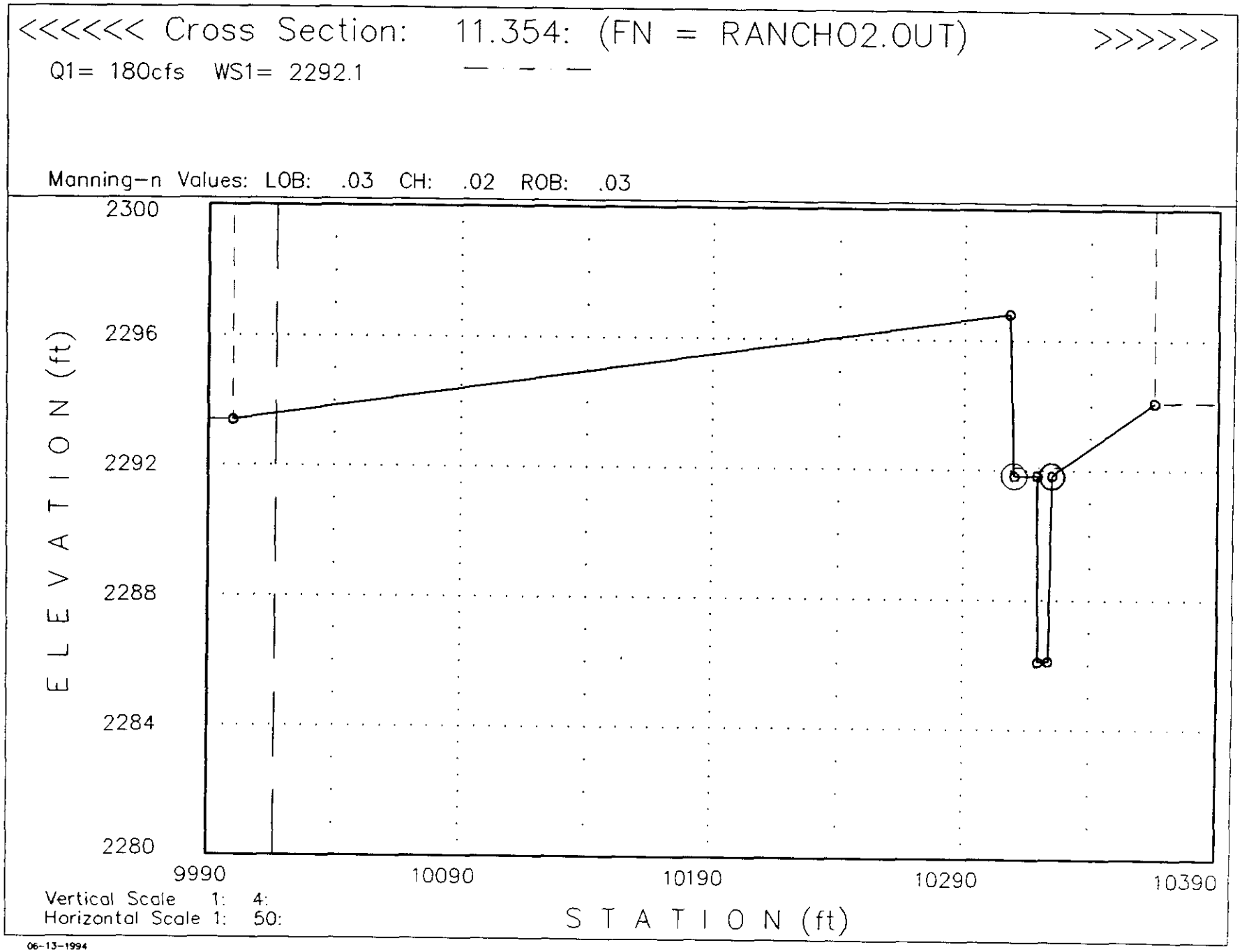
RANCHO DRIVE

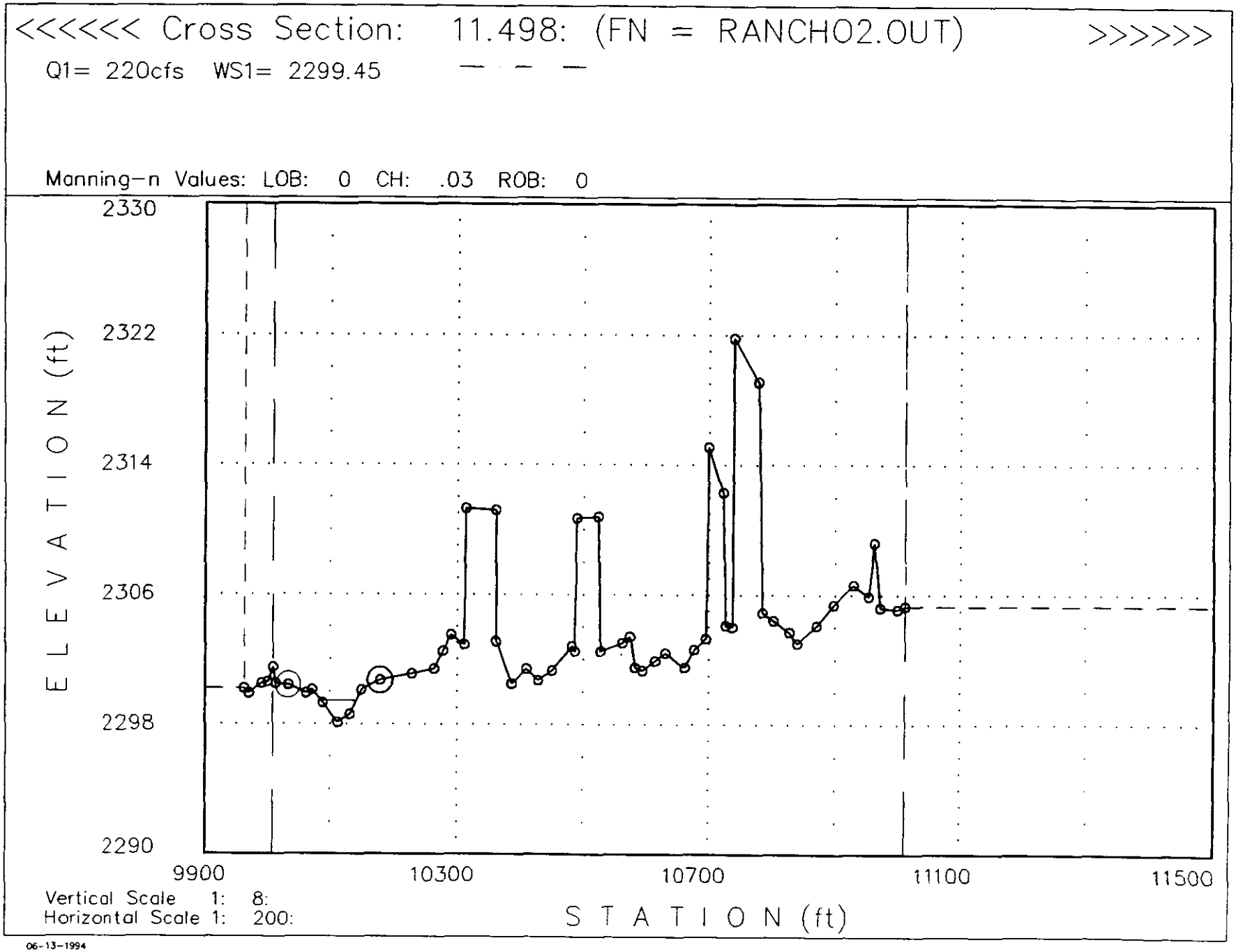
SUMMARY PRINTOUT TABLE 150

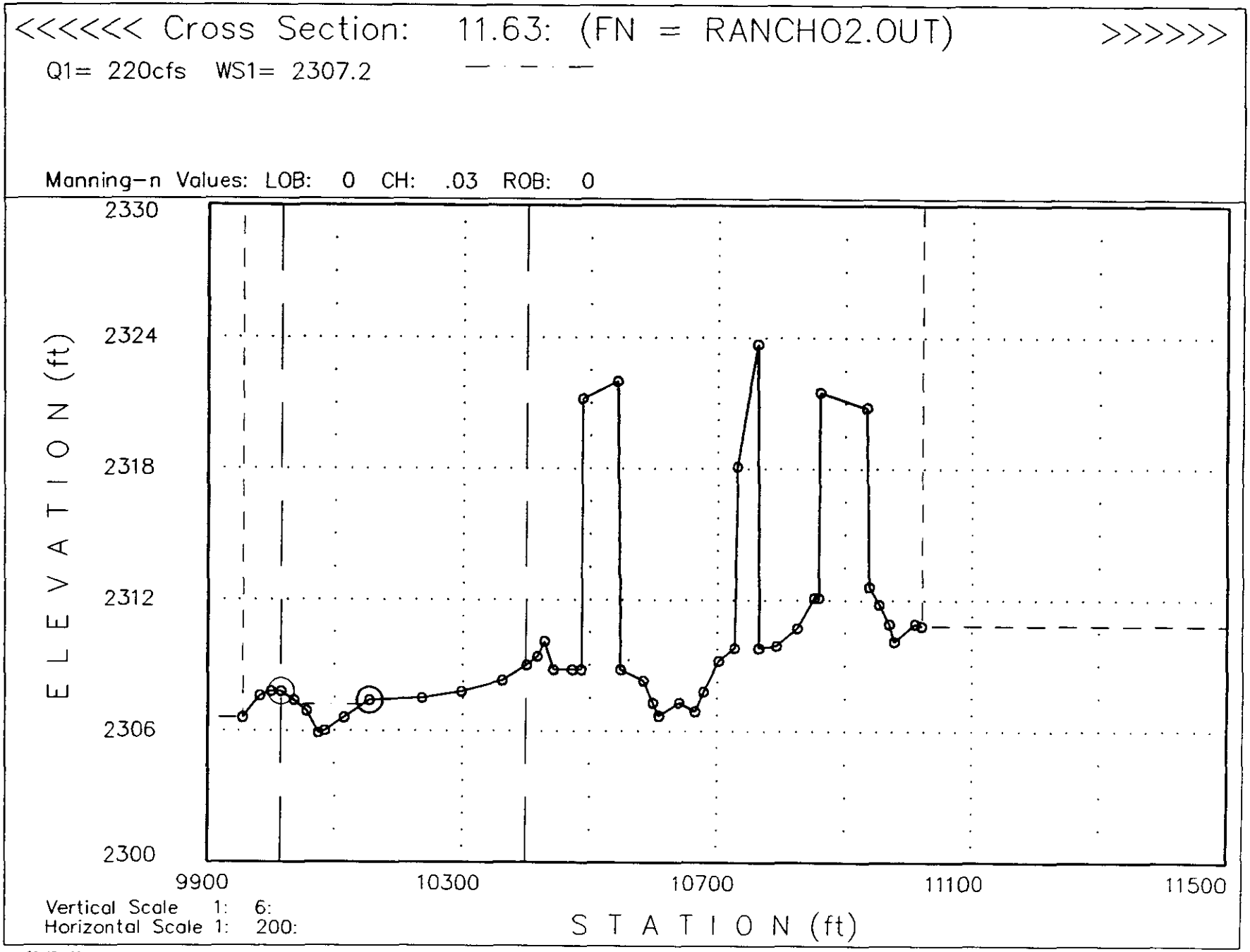
	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	11.354	180.00	2292.10	.00	.00	.00	19.91	.00
*	11.498	220.00	2299.45	.00	7.35	.00	56.72	660.00
	11.630	220.00	2307.20	.00	7.75	.00	100.62	700.00
*	11.701	210.00	2309.88	.00	2.68	.00	293.42	375.00
*	11.875	250.00	2313.18	.00	3.30	.00	337.41	920.00
	11.991	250.00	2315.27	.00	2.09	.00	324.43	610.00
*	12.058	150.00	2315.97	.00	.70	.00	296.46	355.00
*	12.142	150.00	2316.59	.00	.62	.00	87.95	445.00
*	12.221	180.00	2317.42	.00	.83	.00	11.68	413.00
*	12.236	180.00	2318.27	.00	.85	.00	31.71	80.00
	12.261	180.00	2318.51	.00	.24	.00	46.72	135.00
	12.291	180.00	2318.77	.00	.26	.00	24.30	155.00
*	12.323	180.00	2319.99	.00	1.23	.00	223.94	170.00
	12.372	180.00	2320.13	.00	.14	.00	226.35	260.00
*	12.472	180.00	2320.71	.00	.58	.00	46.16	530.00
	12.543	123.78	2322.36	.00	1.64	.00	107.00	370.00
*	12.557	215.00	2322.82	.00	.46	.00	72.30	75.00

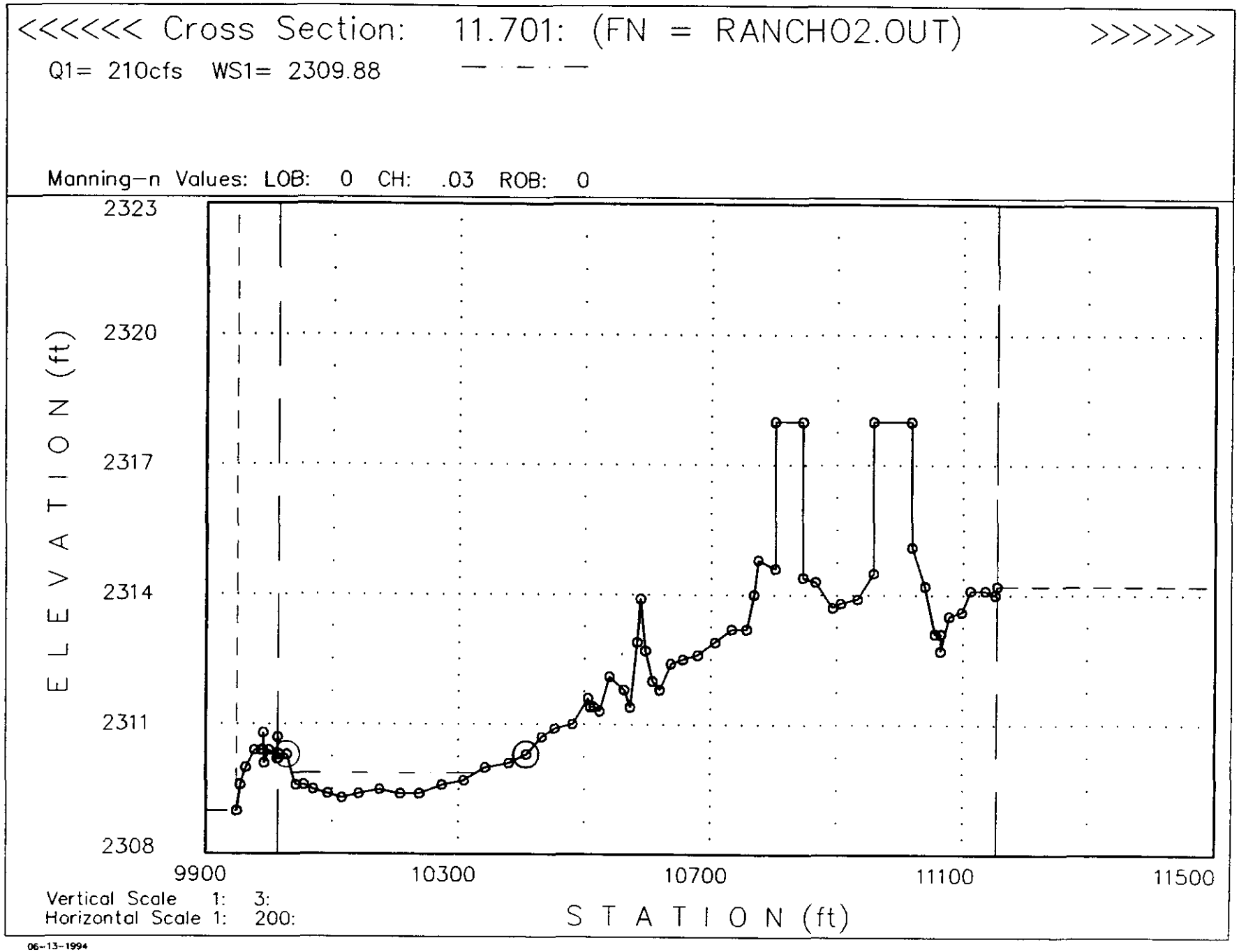
SUMMARY OF ERRORS AND SPECIAL NOTES

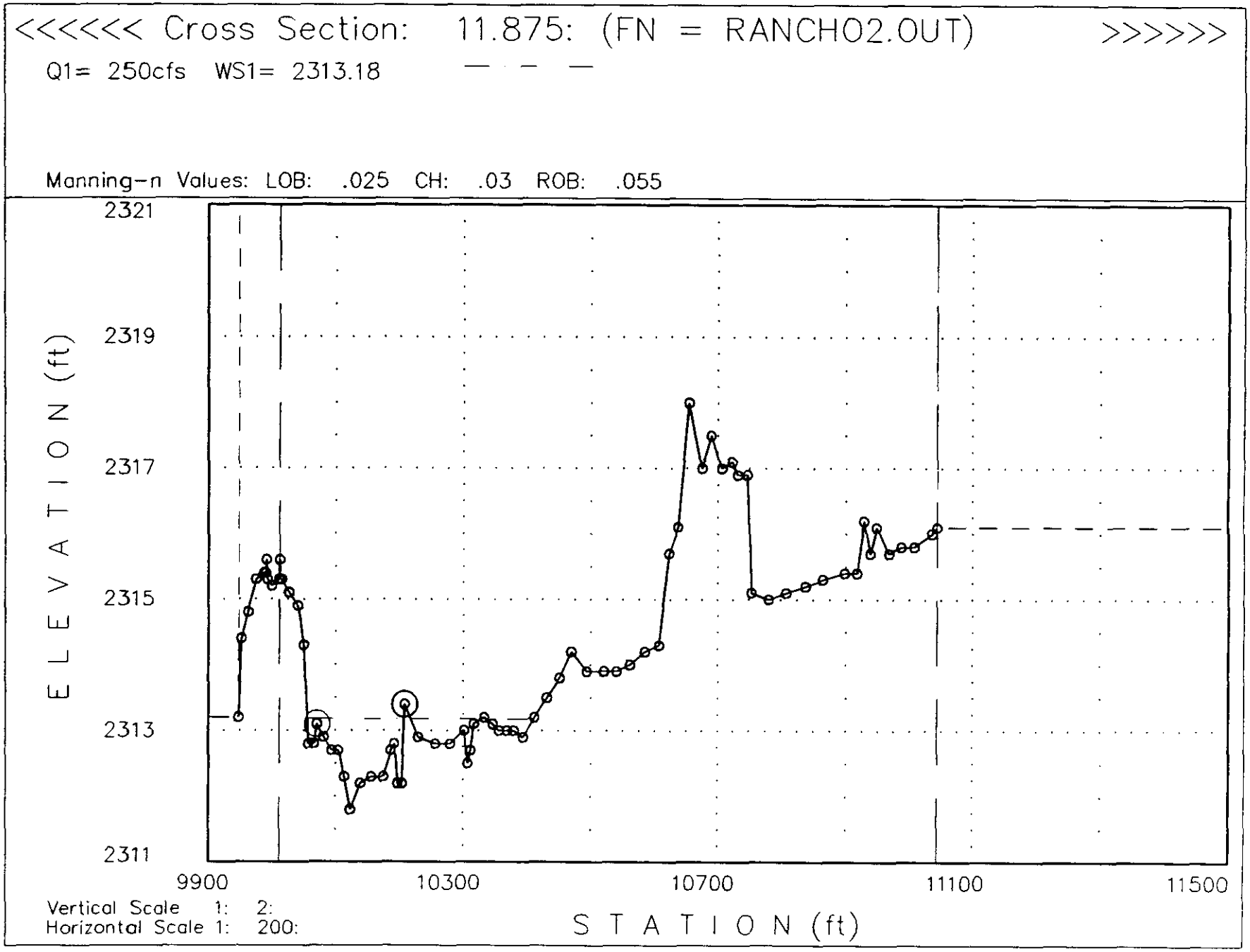
```
CAUTION SECNO=     11.498  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     11.498  PROFILE=  1  MINIMUM SPECIFIC ENERGY

NOTE    SECNO=     11.701  PROFILE=  1  WSEL BASED ON X5 CARD

WARNING SECNO=     11.875  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

NOTE    SECNO=     12.058  PROFILE=  1  WSEL BASED ON X5 CARD
WARNING SECNO=     12.058  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     12.142  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     12.221  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     12.221  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     12.221  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=     12.236  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     12.323  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     12.472  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     12.557  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     12.557  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     12.557  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
```

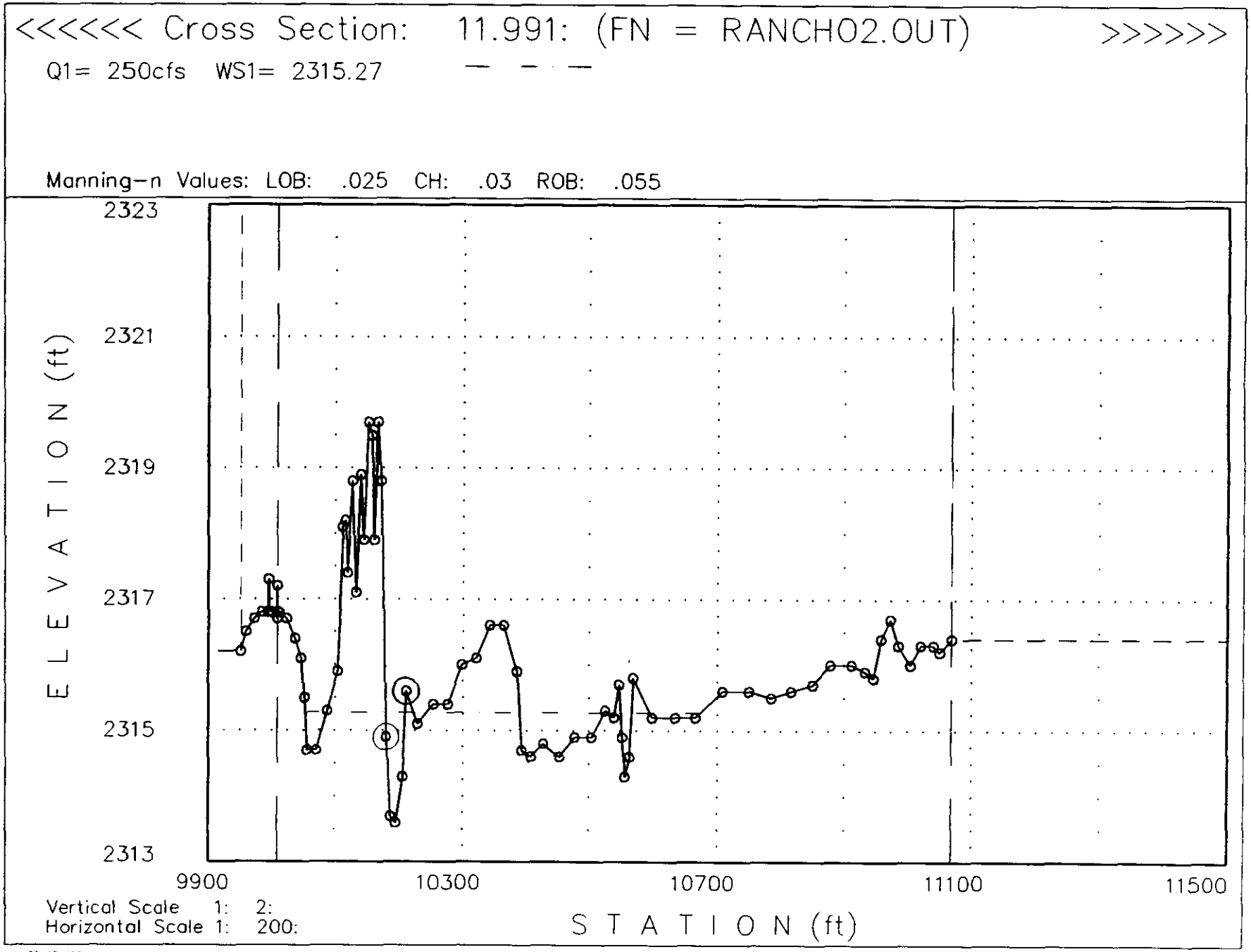

<<<<<< Cross Section: 11.354: (FN = RANCH02.OUT) >>>>>>
Q1= 180cfs WS1= 2292.1
Manning-n Values: LOB: .03 CH: .02 ROB: .03
2300
2296
2292
2288
2284
2280
ELEVATION (ft)
9990
10090
10190
10290
10390
STATION (ft)
Vertical Scale 1: 4:
Horizontal Scale 1: 50:
06-13-1994

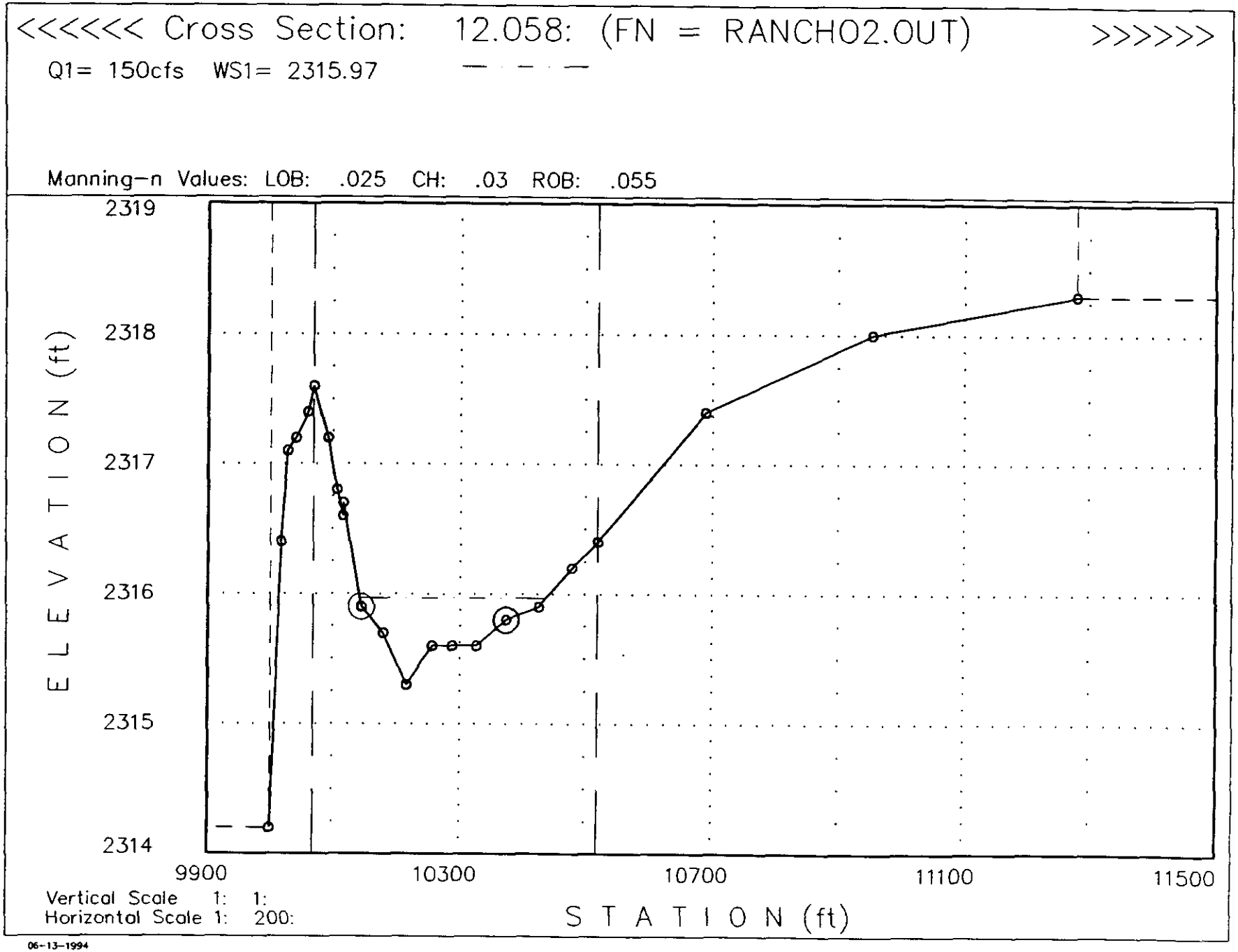

<<<<<< Cross Section: 11.498: (FN = RANCHO2.OUT) >>>>>>
Q1= 220cfs WS1= 2299.45
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2330
2322
2314
2306
2298
2290
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 8:
Horizontal Scale 1: 200:
06-13-1994

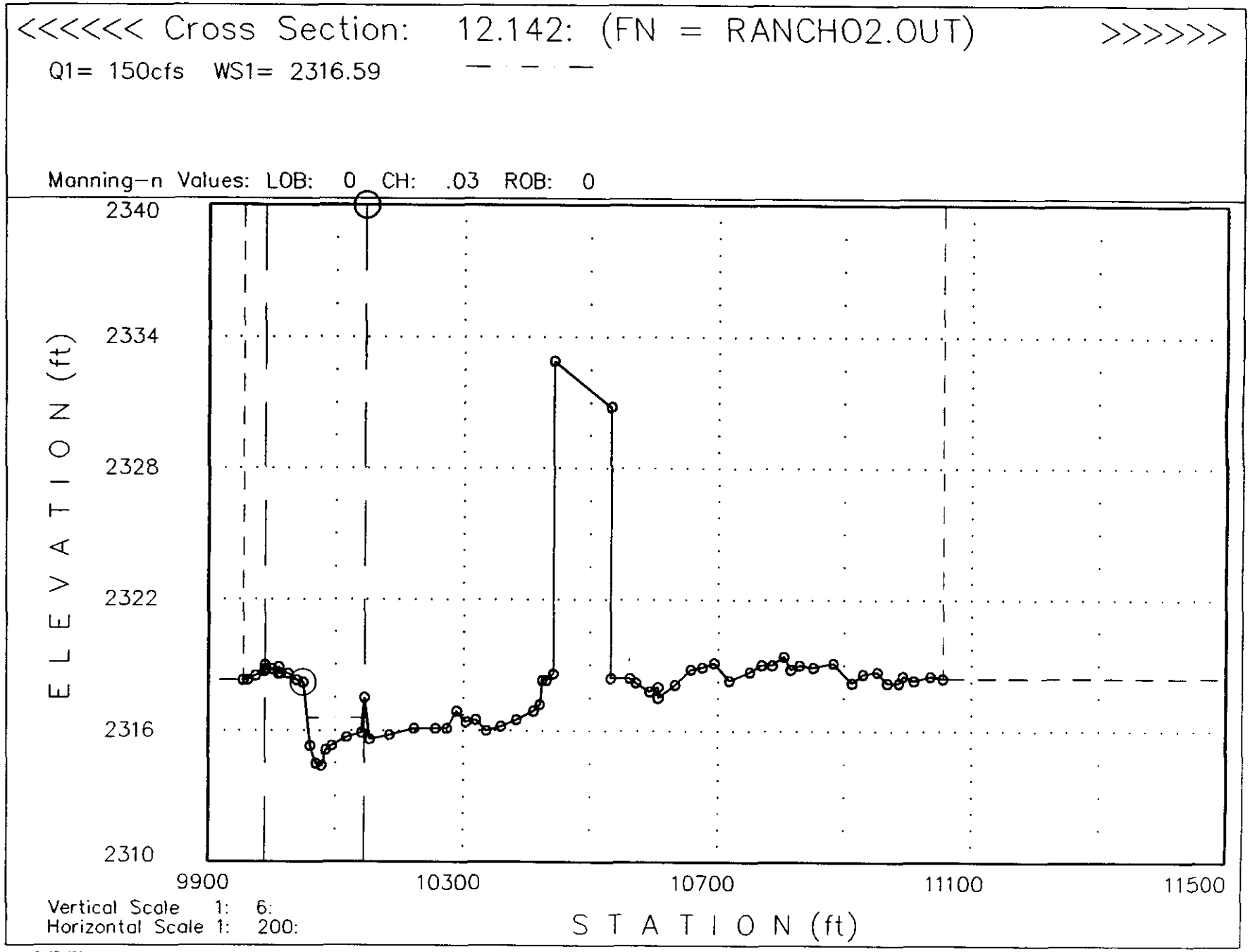

<<<<<< Cross Section: 11.63: (FN = RANCHO2.OUT) >>>>>>
Q1= 220cfs WS1= 2307.2
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2330
2324
2318
2312
2306
2300
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994

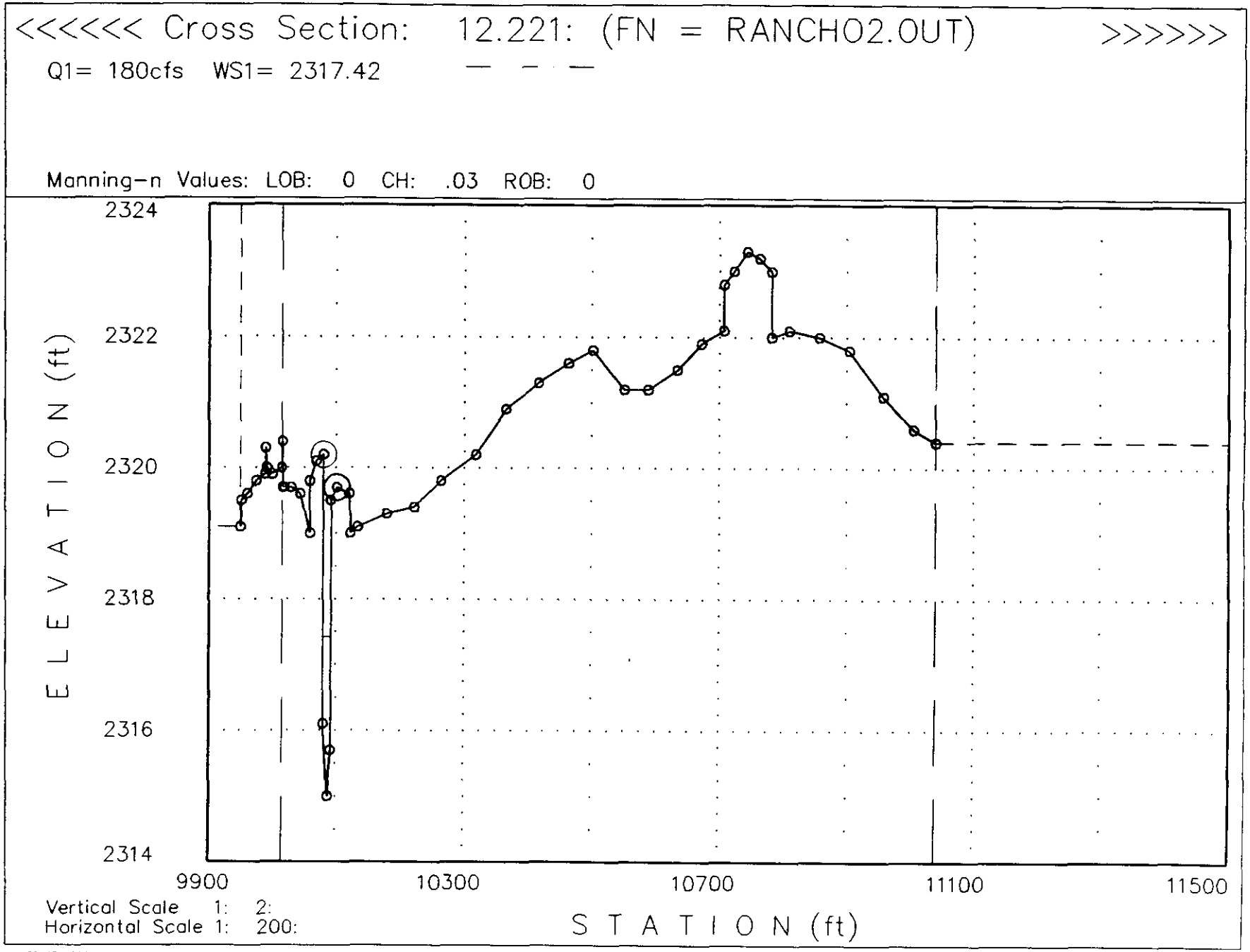

<<<<<< Cross Section: 11.701: (FN = RANCH02.OUT) >>>>>>
Q1= 210cfs WS1= 2309.88
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2323
2320
2317
2314
2311
2308
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 3:
Horizontal Scale 1: 200:
06-13-1994

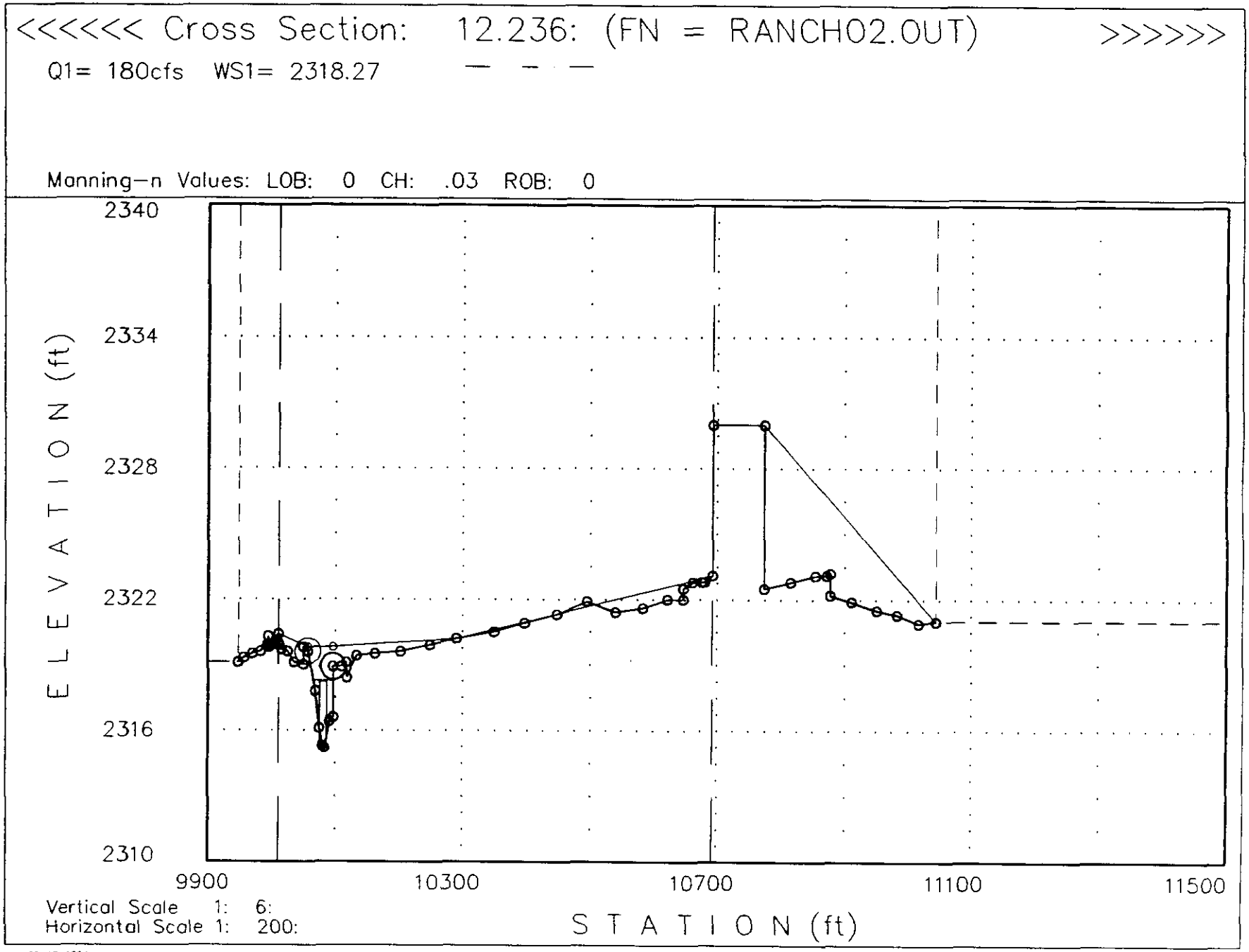

<<<<<< Cross Section: 11.875: (FN = RANCHO2.OUT) >>>>>>
Q1= 250cfs WS1= 2313.18
Manning-n Values: LOB: .025 CH: .03 ROB: .055
2321
2319
2317
2315
2313
2311
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994

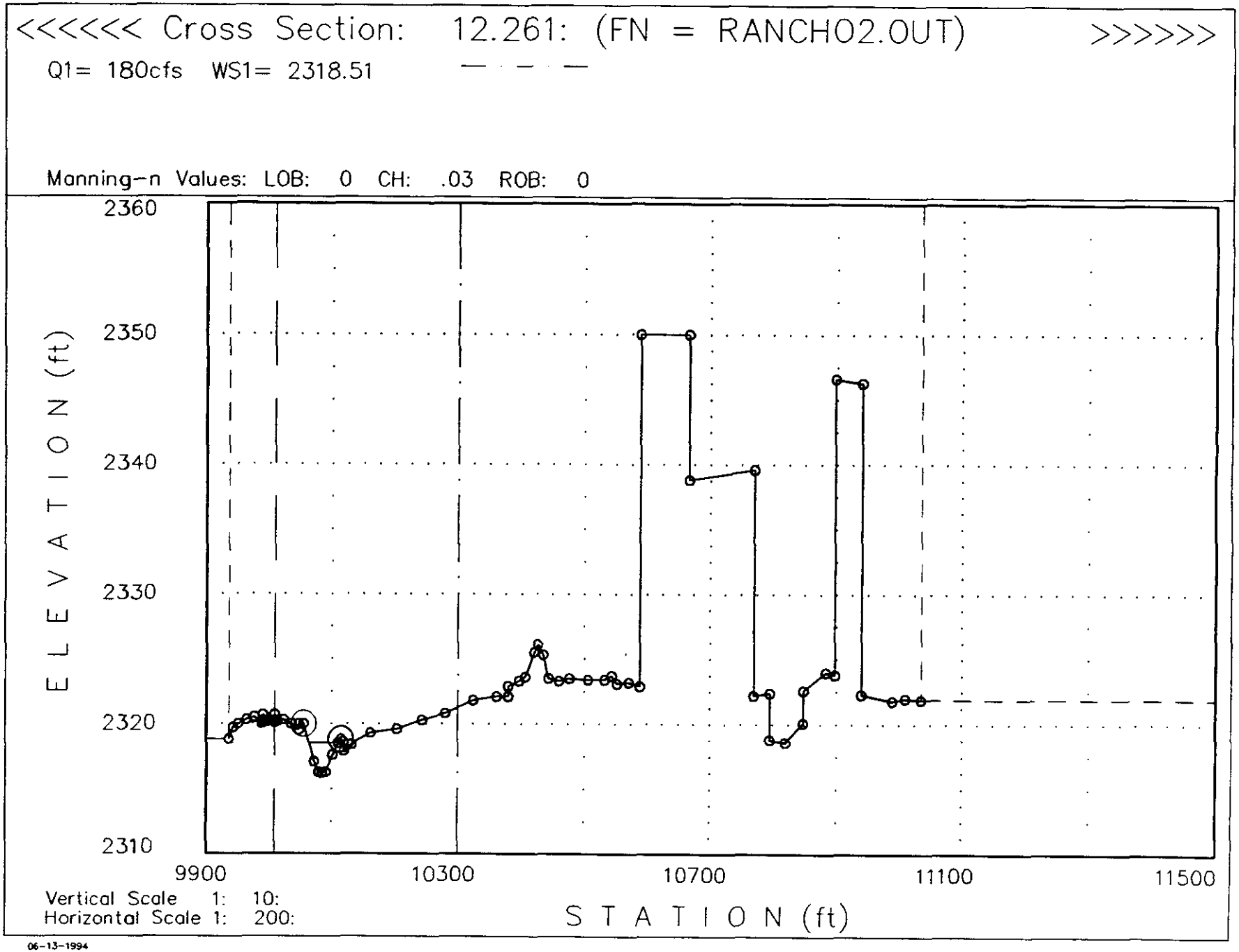

<<<<<< Cross Section: 11.991: (FN = RANCHO2.OUT) >>>>>>
Q1= 250cfs WS1= 2315.27
Manning-n Values: LOB: .025 CH: .03 ROB: .055
2323
2321
2319
2317
2315
2313
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994

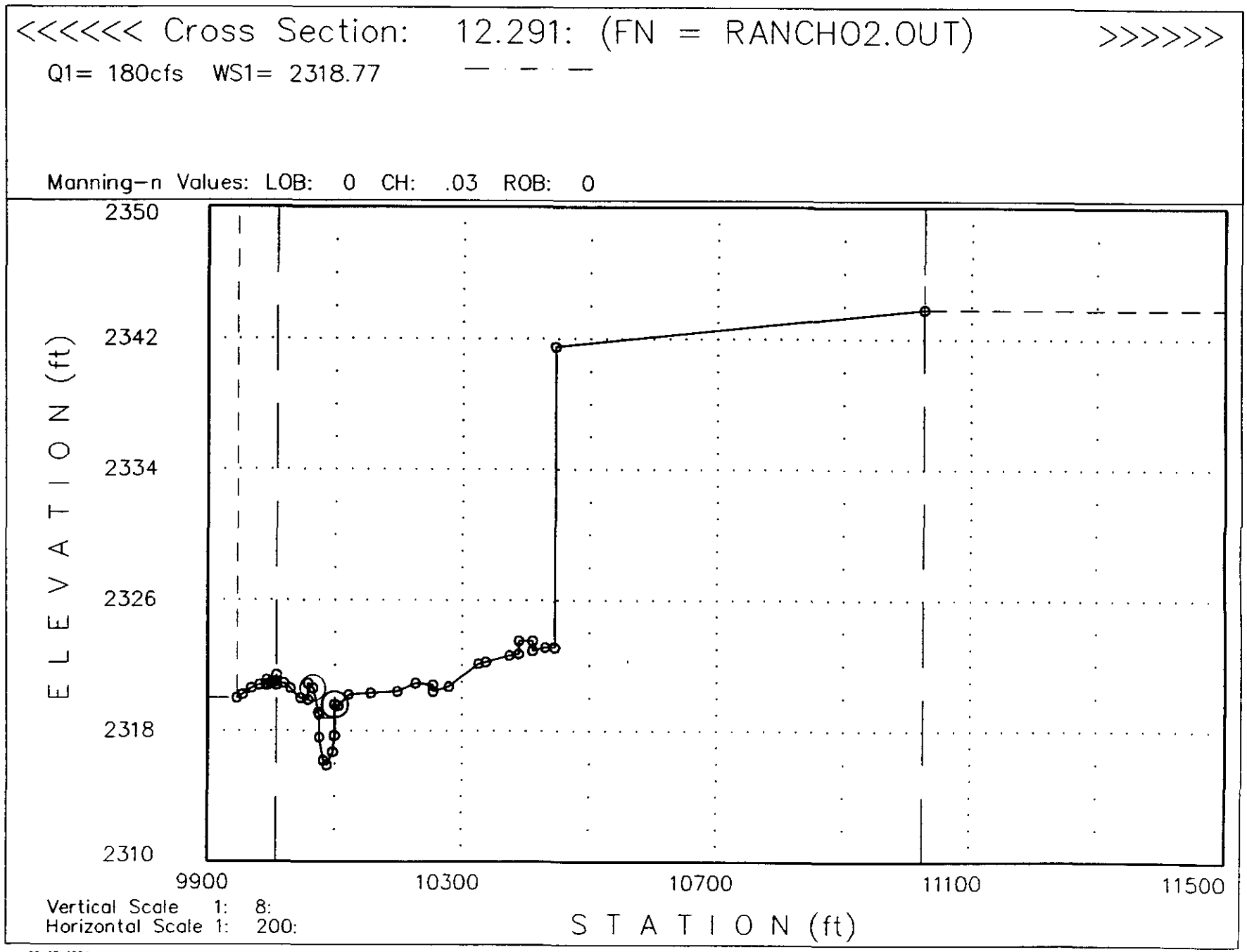

<<<<<< Cross Section: 12.058: (FN = RANCHO2.OUT) >>>>>>
Q1= 150cfs WS1= 2315.97
Manning-n Values: LOB: .025 CH: .03 ROB: .055
2319
2318
2317
2316
2315
2314
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 200:
06-13-1994

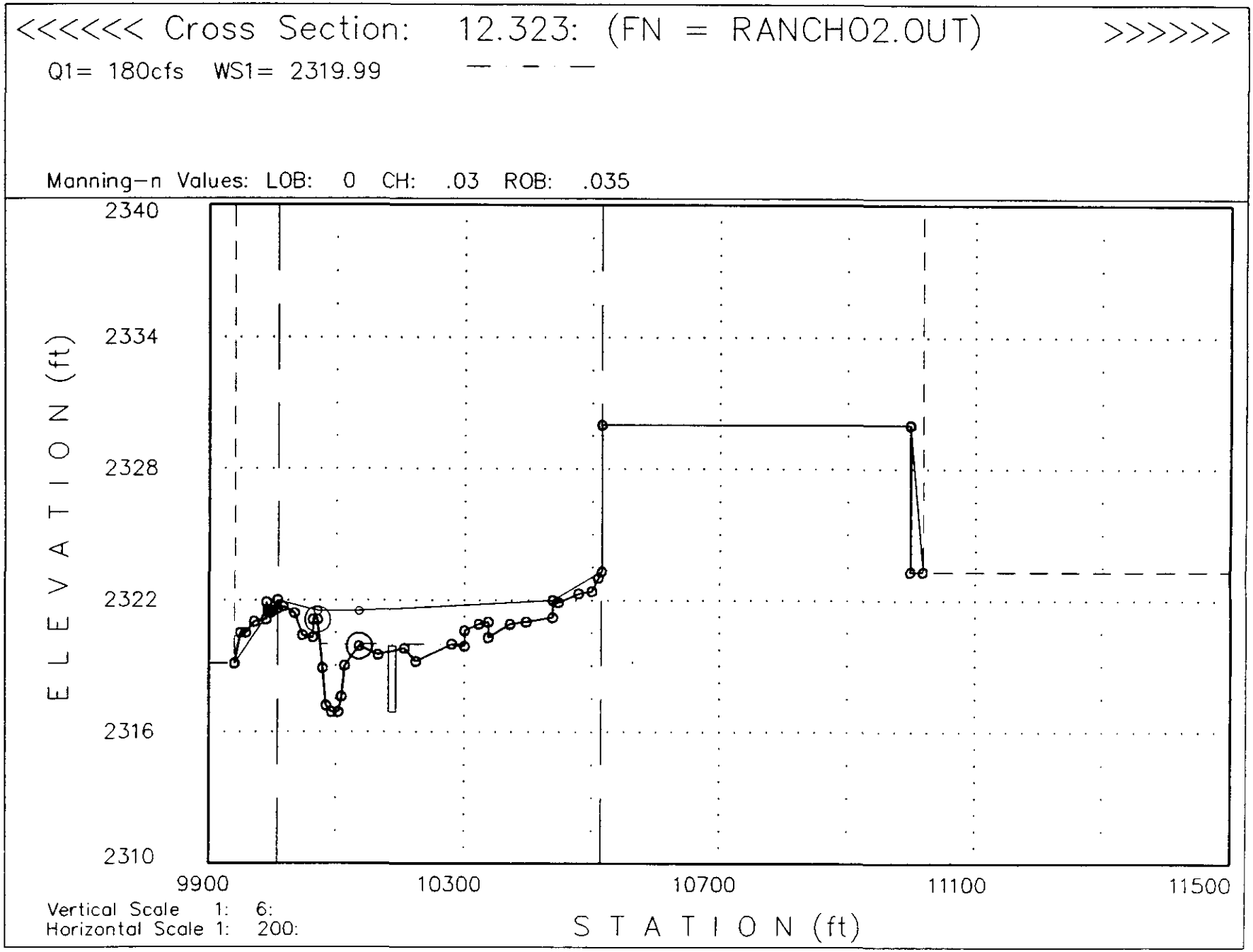

<<<<<< Cross Section: 12.142: (FN = RANCHO2.OUT) >>>>>>
Q1= 150cfs WS1= 2316.59
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994

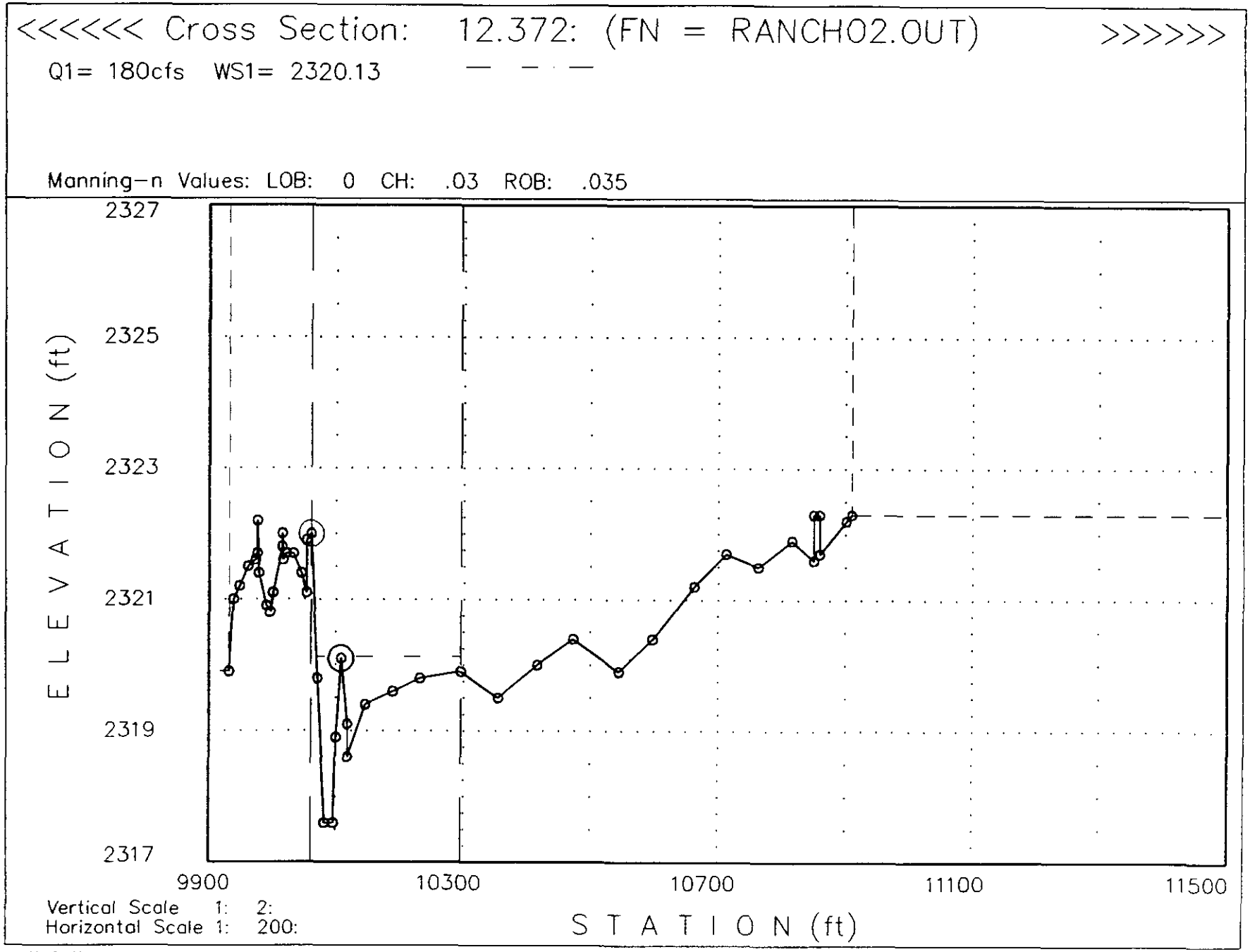

<<<<<< Cross Section: 12.221: (FN = RANCHO2.OUT) >>>>>>
Q1= 180cfs WS1= 2317.42
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2324
2322
2320
2318
2316
2314
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994

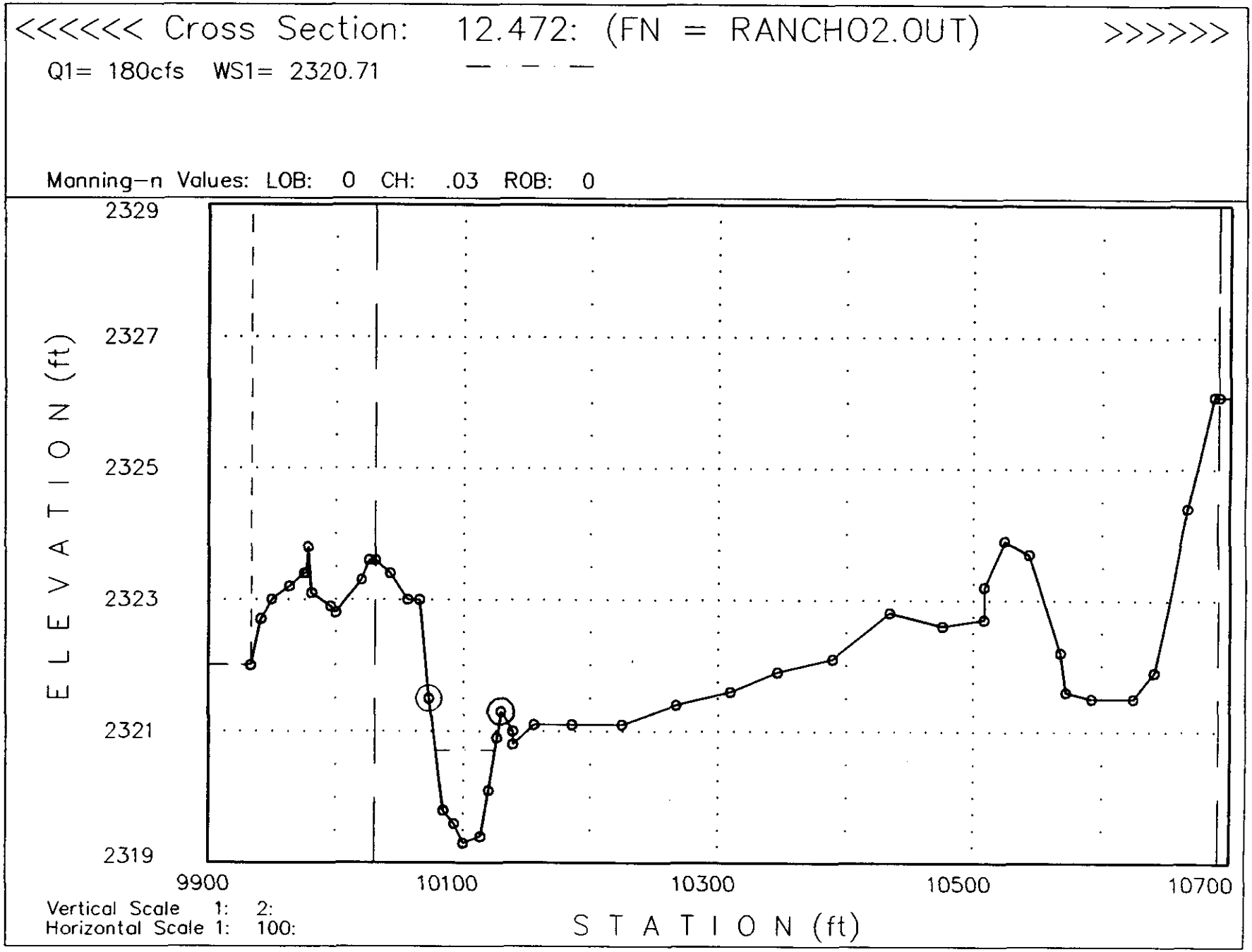

<<<<<< Cross Section: 12.236: (FN = RANCH02.OUT) >>>>>>
Q1= 180cfs WS1= 2318.27
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994

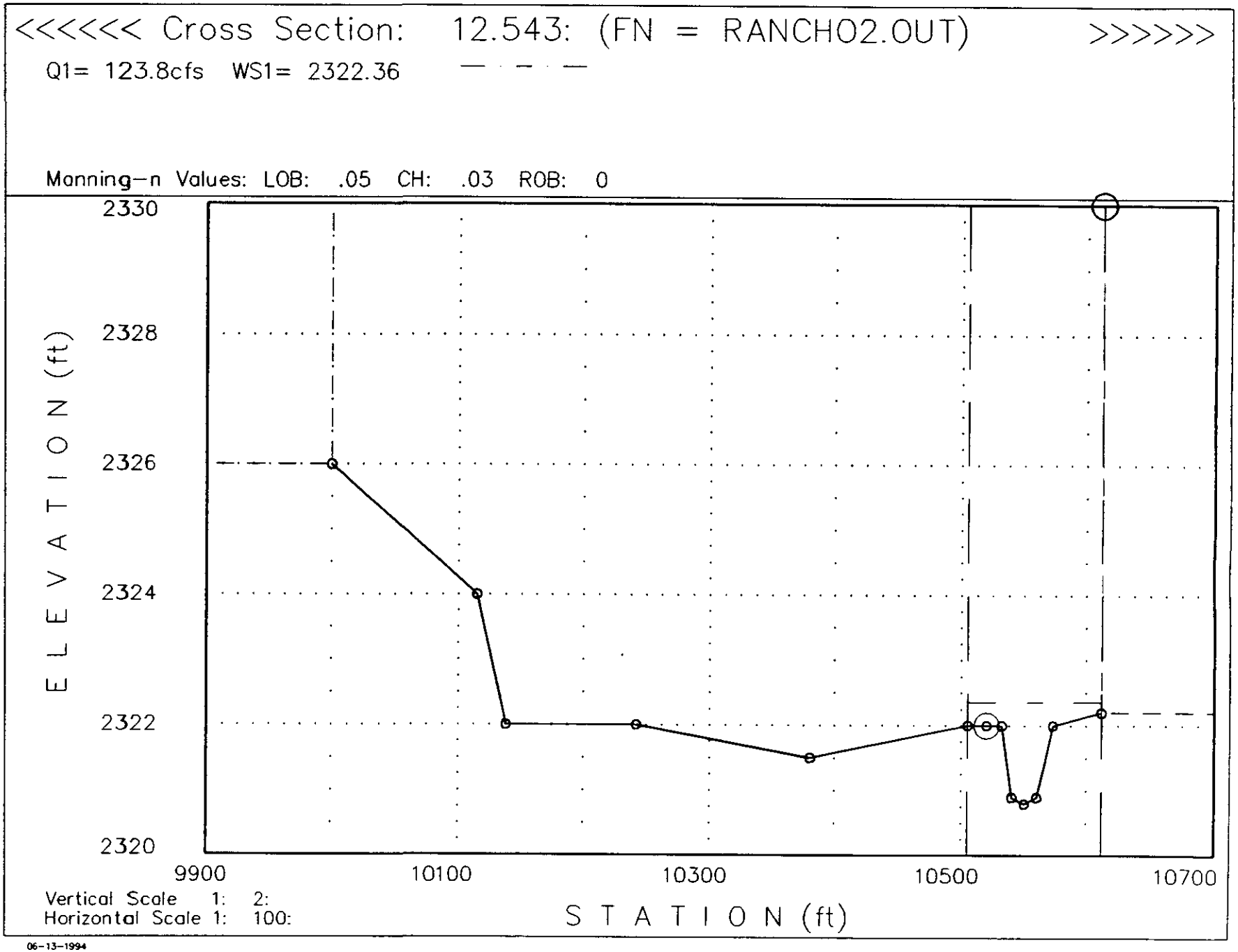

<<<<<< Cross Section: 12.261: (FN = RANCHO2.OUT) >>>>>>
Q1= 180cfs WS1= 2318.51
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2360
2350
2340
2330
2320
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 10:
Horizontal Scale 1: 200:
06-13-1994

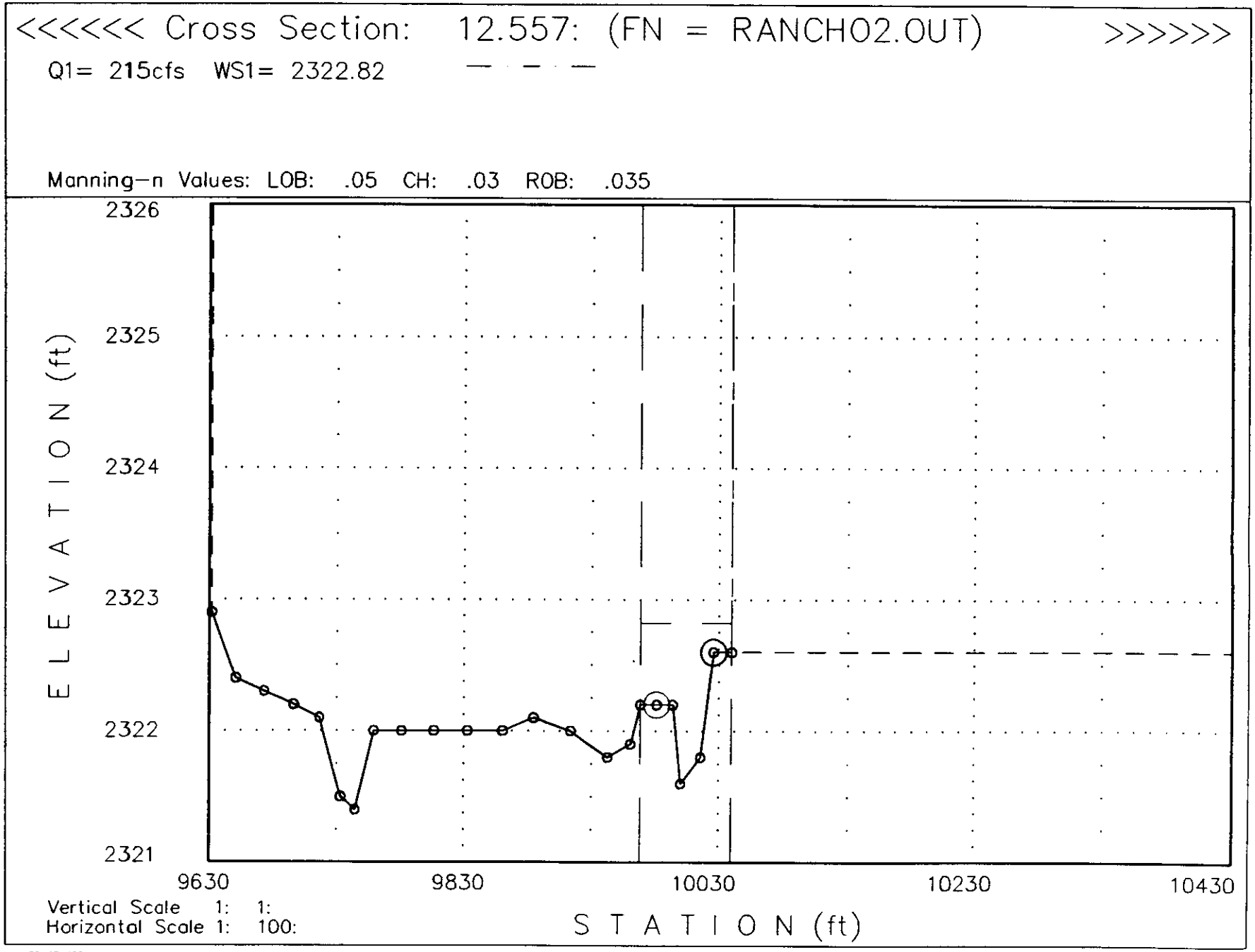

<<<<<< Cross Section: 12.291: (FN = RANCHO2.OUT) >>>>>>
Q1= 180cfs WS1= 2318.77
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2350
2342
2334
2326
2318
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 8:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 12.323: (FN = RANCH02.OUT) >>>>>>
Q1= 180cfs WS1= 2319.99
Manning-n Values: LOB: 0 CH: .03 ROB: .035
2340
2334
2328
2322
2316
2310
ELEVATION (ft)
9900
10300
10700
11100
11500
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
STATION (ft)
06-13-1994


<<<<<< Cross Section: 12.372: (FN = RANCH02.OUT) >>>>>>
Q1= 180cfs WS1= 2320.13
Manning-n Values: LOB: 0 CH: .03 ROB: .035
2327
2325
2323
2321
2319
2317
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 12.472: (FN = RANCHO2.OUT) >>>>>>
Q1= 180cfs WS1= 2320.71
Manning-n Values: LOB: 0 CH: .03 ROB: 0
2329
2327
2325
2323
2321
2319
ELEVATION (ft)
9900
10100
10300
10500
10700
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 100:
06-13-1994


<<<<<< Cross Section: 12.543: (FN = RANCH02.OUT) >>>>>>
Q1= 123.8cfs WS1= 2322.36
Manning-n Values: LOB: .05 CH: .03 ROB: 0
2330
2328
2326
2324
2322
2320
ELEVATION (ft)
9900
10100
10300
10500
10700
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 100:
06-13-1994


<<<<<< Cross Section: 12.557: (FN = RANCHO2.OUT) >>>>>>
Q1= 215cfs WS1= 2322.82
Manning-n Values: LOB: .05 CH: .03 ROB: .035
2326
2325
2324
2323
2322
2321
ELEVATION (ft)
9630
9830
10030
10230
10430
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 100:
06-13-1994

Rancho3.dat

RANCHO3.DAT

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    09JUN94    TIME   13:20:55  *
*******************************************
```


```
*****************************************
*  U.S. ARMY CORPS OF ENGINEERS         *
*  HYDROLOGIC ENGINEERING CENTER        *
*  609 SECOND STREET, SUITE D           *
*  DAVIS, CALIFORNIA 95616-4687         *
*          (916) 756-1104               *
*****************************************
```


```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                   X
X     X  X        X     X             X
X     X  XXXXXXX  XXXXX               XXXXXXX
```

THIS RUN EXECUTED 09JUN94 13:20:55

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**************************************
 HEC-2 WATER SURFACE PROFILES

 Version  4.6.2;  May 1991
**************************************


T1  NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY        CVL JOB # 930017
T2  BY COE & VAN LOO CONSULANTS, INC.                FILE NAME: rancho3.dat
T3      RANCHO DRIVE


J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0        2         0         0    0.0018         0         0         0      2252         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      -1         0        -1


J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     150        38        43         1         3        13        14        15        26        53
      54         4        25
  MICHAEL  WAY
  831 CFS FROM SANTA CATALINA AVE.

QT        1      2040
NC    0.035     0.045     0.035       0.1       0.3
ET                7.1                                           10026.0     10360
X1    9.764      44.0   10226.2   10341.1         0         0         0
GR   2250.5    9947.6    2251.4    9966.3    2251.8    9985.2    2251.8     10000    2251.8   10014.1
GR   2252.2   10026.0    2251.7   10037.7    2251.2     10060    2250.9     10066    2250.4   10113.6
GR   2250.4   10136.7    2249.9   10187.4    2249.5   10226.2    2249.5   10255.9    2249.4   10302.2
GR   2249.2   10314.5    2249.6   10341.1      2249   10374.0    2248.9   10386.5    2249.6   10402.9
GR   2250.6   10430.9    2250.7   10444.5    2259.3   10445.4    2259.6   10516.7    2250.6   10518.2
GR   2250.6   10525.1    2259.4   10526.4    2259.4   10587.9    2259.8   10598.3    2251.0  10600.70
GR   2250.8   10638.5    2250.2   10685.5    2250.4   10685.6    2250.5   10723.6    2250.3   10787.5
GR   2250.2   10803.1    2250.5   10844.6    2250.5   10887.2    2251.3   10927.5    2251.6   10977.0
GR   2251.9   11028.8    2252.1   11097.3    2252.5   11158.2    2252.8   11181.2

QT        1      1208
ET                7.1                                          10000.00    10963.0
X1    9.897        52   10060.8   10207.8       600       785       700
GR   2249.6    9948.6    2250.1    9951.8    2251.8    9964.7    2252.4    9985.5    2252.7    9998.2
GR   2253.0   10000.0    2252.4   10012.6    2252.4   10025.7    2252.2   10037.9    2251.8   10051.0
GR   2251.4   10060.8    2249.2   10075.0    2249.7   10098.2    2249.2   10130.2    2250.0   10150.9
GR   2250.5   10170.8    2250.8   10207.8    2250.8   10259.1    2250.8   10296.9    2250.8   10343.9
GR   2251.5   10382.3    2251.8   10419.2    2252.1   10454.8    2252.6   10475.3    2251.7   10494.6
GR   2252.0   10515.2    2253.0   10528.8    2253.6   10542.2    2252.7   10552.6    2252.9   10590.3
GR   2253.1   10627.3    2253.7   10649.1    2254.2   10663.0    2255.6   10674.9    2255.5   10701.4
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GR   2263.5    10702.2    2263.3    10755.6    2255.1    10758.6    2254.4    10781.6    2254.6    10798.6
GR   2254.4    10819.6    2255.1    10836.6    2265.2    10836.7    2264.7    10861.4    2256.2    10866.1
GR   2256.4    10896.9    2256.6    10920.7    2264.8    10920.9    2264.7    10945.8    2257.2    10955.4
GR   2257.2    10962.4    2265.2    10963.0

QT         1        1040
X1     9.957           5       1002       1065        315        315        315
GR      2260        1000     2252.1       1002     2252.6       1065       2254       1230       2256       1270

X1     9.992           5       1002       1060        182        182        182
GR      2260        1000     2252.5       1002       2253       1060       2254       1232       2256       1270
  FLOWS IN GOWAN RD SPLIT INTO TWO DIRECTIONS NEAR TRUE VALUE HARDWARE STORE.
  SPLIT FLOW WAS ESTIMATED BY BALANCING EG @ SECT # 10.062 & 10.117.
  REFER TO RANCHO4.DAT

ET                    7.1                                              1186       1460
X1    10.062          11       1230       1332        210        180        190
GR      2256        1000       2254       1100       2253       1122     2253.4       1143     2253.4       1170
GR    2253.6        1185       2254       1186       2254       1230     2253.2       1265       2254       1332
GR      2256        1460

NC      0.03        0.03      0.025         .1         .3
QT         1        1840
ET                    7.1                                              1040       1330
X1    10.093          15       1119       1170        160        140        160
GR      2258        1000       2256       1028       2254       1050     2253.9       1065       2254       1080
GR    2254.3        1100     2254.3       1115     2254.6       1119       2254       1120     2253.7       1145
GR      2254        1170       2256       1185       2256       1280       2258       1290       2258       1330

ET                    7.1                                              1072       1155
X1    10.117           7       1072       1155        135        130        135
GR    2256.4        1000       2256       1072     2255.3       1092     2255.4       1110     2255.5       1140
GR      2256        1155       2258       1245
```

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 9.764

3470 ENCROACHMENT STATIONS= 10026.0 10360.0 TYPE= 1 TARGET= 334.000

9.764	3.19	2252.09	.00	.00	2252.23	.15	.00	.00	2249.50
2040.0	862.5	1054.1	123.5	320.0	304.5	50.2	.0	.0	2249.60
.00	2.69	3.46	2.46	.035	.035	.045	.000	2248.90	10028.69
.001813	0.	0.	0.	0	0	4	.00	331.31	10360.00

*SECNO 9.897

3265 DIVIDED FLOW

3470 ENCROACHMENT STATIONS= 10000.0 10963.0 TYPE= 1 TARGET= 963.000

9.897	3.65	2252.85	.00	.00	2252.88	.03	.63	.01	2251.40
1208.0	28.1	737.4	442.5	37.9	423.9	471.0	13.0	7.2	2250.80
.14	.74	1.74	.94	.035	.035	.045	.000	2249.20	10003.21
.000410	600.	700.	785.	3	0	0	.00	552.91	10580.31

*SECNO 9.957
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9.957	1.95	2254.05	2254.05	.00	2254.51	.46	.33	.13	2252.10
1040.0	.8	684.5	354.7	.5	106.8	123.1	17.2	10.0	2252.60
.15	1.73	6.41	2.88	.035	.035	.045	.000	2252.10	1001.51
.011261	315.	315.	315.	20	11	0	.00	229.41	1230.92

*SECNO 9.992

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.43

9.992	2.63	2255.13	.00	.00	2255.24	.11	.70	.04	2252.50
1040.0	.8	460.1	579.1	.9	138.7	294.7	18.6	11.0	2253.00
.17	.90	3.32	1.96	.035	.035	.045	.000	2252.50	1001.30
.001908	182.	182.	182.	3	0	0	.00	252.39	1253.69

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 10.062

3470 ENCROACHMENT STATIONS= 1186.0 1460.0 TYPE= 1 TARGET= 274.000

10.062	2.54	2255.54	.00	.00	2255.71	.17	.45	.02	2254.00
1040.0	206.0	718.6	115.4	67.6	197.5	75.5	20.3	12.1	2254.00
.19	3.05	3.64	1.53	.035	.035	.045	.000	2253.00	1186.00
.003044	210.	190.	180.	3	0	0	.00	244.31	1430.31

CCHV= .100 CEHV= .300
*SECNO 10.093

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 1040.0 1330.0 TYPE= 1 TARGET= 290.000

10.093	2.21	2255.91	2255.91	.00	2256.78	.87	.84	.21	2254.60
1840.0	889.4	892.4	58.2	138.4	104.5	13.7	21.3	12.8	2254.00
.19	6.43	8.54	4.26	.030	.025	.030	.000	2253.70	1040.00
.007958	160.	160.	140.	1	9	0	.00	144.31	1184.31

*SECNO 10.117
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 1072.0 1155.0 TYPE= 1 TARGET= 83.000

10.117	2.70	2258.00	2258.00	.00	2259.25	1.25	1.03	.12	2256.00
1840.0	.0	1840.0	.0	.0	204.8	.0	22.1	13.1	100000.00
.20	.00	8.98	.00	.000	.025	.000	.000	2255.30	1072.00
.007294	135.	135.	130.	20	11	0	.00	83.00	1155.00

THIS RUN EXECUTED 09JUN94 13:20:57

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

RANCHO DRIVE

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	EG	QLOB	QCH	QROB	VCH	SSTA	ENDST	TOPWID	AREA
	9.764	2040.00	2252.09	2252.23	862.45	1054.10	123.45	3.46	10028.69	10360.00	331.31	674.73
	9.897	1208.00	2252.85	2252.88	28.14	737.40	442.47	1.74	10003.21	10580.31	552.91	932.84
*	9.957	1040.00	2254.05	2254.51	.83	684.50	354.67	6.41	1001.51	1230.92	229.41	230.40
*	9.992	1040.00	2255.13	2255.24	.84	460.09	579.07	3.32	1001.30	1253.69	252.39	434.38
	10.062	1040.00	2255.54	2255.71	206.03	718.60	115.37	3.64	1186.00	1430.31	244.31	340.59
*	10.093	1840.00	2255.91	2256.78	889.42	892.42	58.15	8.54	1040.00	1184.31	144.31	256.61
*	10.117	1840.00	2258.00	2259.25	.00	1840.00	.00	8.98	1072.00	1155.00	83.00	204.83

RANCHO DRIVE

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	9.764	.00	.00	.00	2248.90	2040.00	2252.09	.00	2252.23	18.13	3.46	674.73	479.09
	9.897	700.00	.00	.00	2249.20	1208.00	2252.85	.00	2252.88	4.10	1.74	932.84	596.70
*	9.957	315.00	.00	.00	2252.10	1040.00	2254.05	2254.05	2254.51	112.61	6.41	230.40	98.00
*	9.992	182.00	.00	.00	2252.50	1040.00	2255.13	.00	2255.24	19.08	3.32	434.38	238.08
	10.062	190.00	.00	.00	2253.00	1040.00	2255.54	.00	2255.71	30.44	3.64	340.59	188.50
*	10.093	160.00	.00	.00	2253.70	1840.00	2255.91	2255.91	2256.78	79.58	8.54	256.61	206.26
*	10.117	135.00	.00	.00	2255.30	1840.00	2258.00	2258.00	2259.25	72.94	8.98	204.83	215.44

RANCHO DRIVE

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	9.764	2040.00	2252.09	.00	.00	.00	331.31	.00
	9.897	1208.00	2252.85	.00	.76	.00	552.91	700.00
*	9.957	1040.00	2254.05	.00	1.20	.00	229.41	315.00
*	9.992	1040.00	2255.13	.00	1.09	.00	252.39	182.00
	10.062	1040.00	2255.54	.00	.40	.00	244.31	190.00
*	10.093	1840.00	2255.91	.00	.37	.00	144.31	160.00
*	10.117	1840.00	2258.00	.00	2.09	.00	83.00	135.00

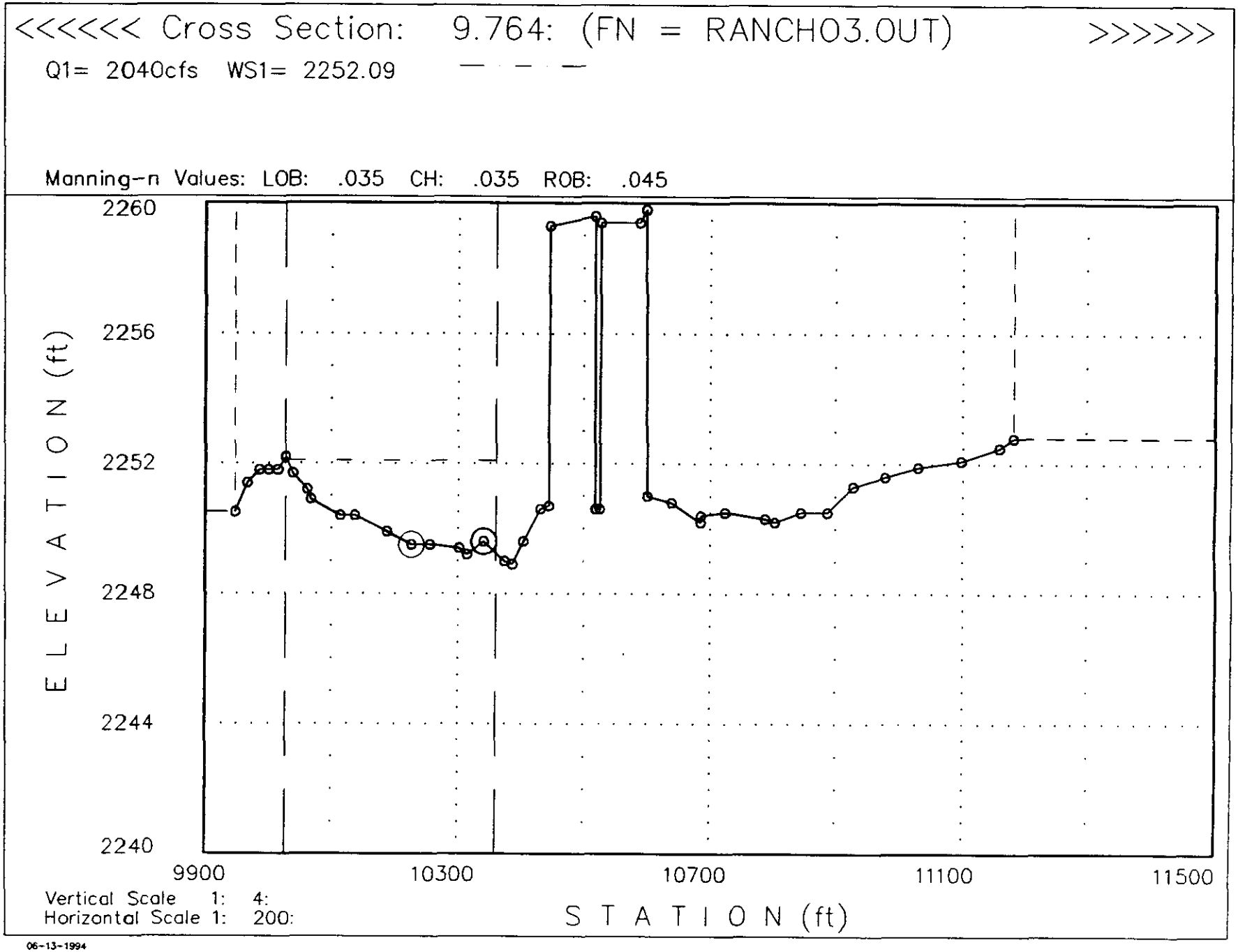
SUMMARY OF ERRORS AND SPECIAL NOTES

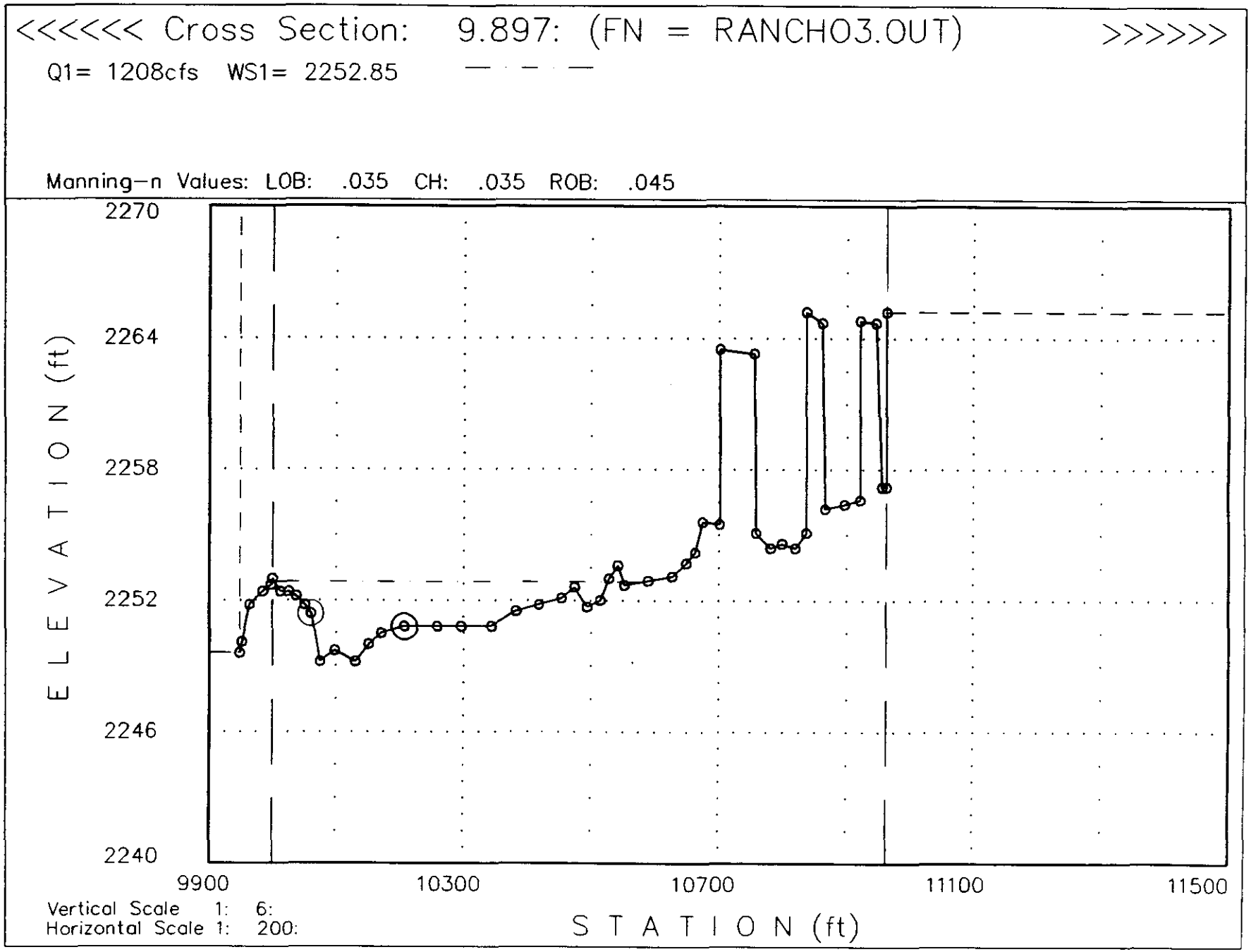
```
CAUTION SECNO=     9.957  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     9.957  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     9.957  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

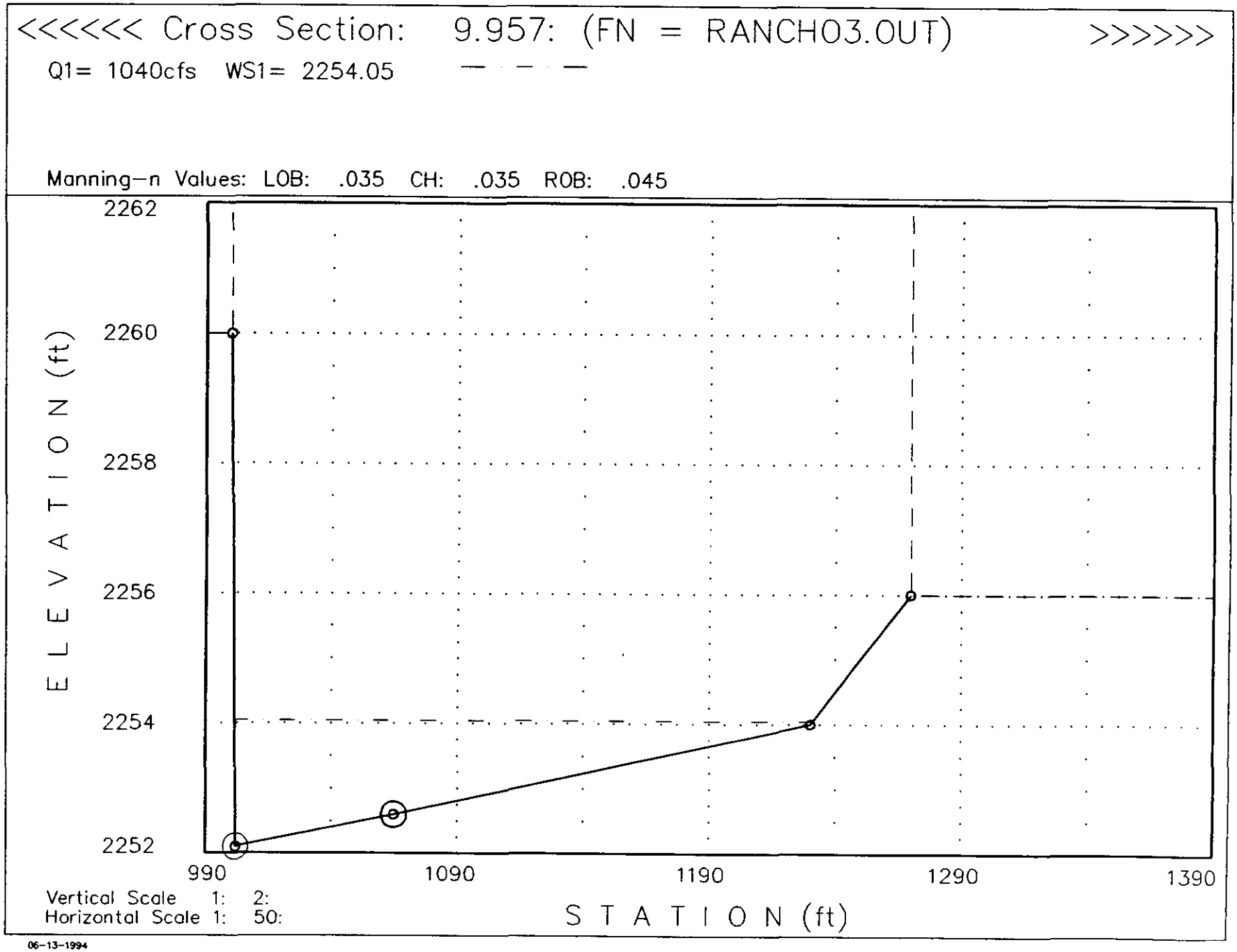
WARNING SECNO=     9.992  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

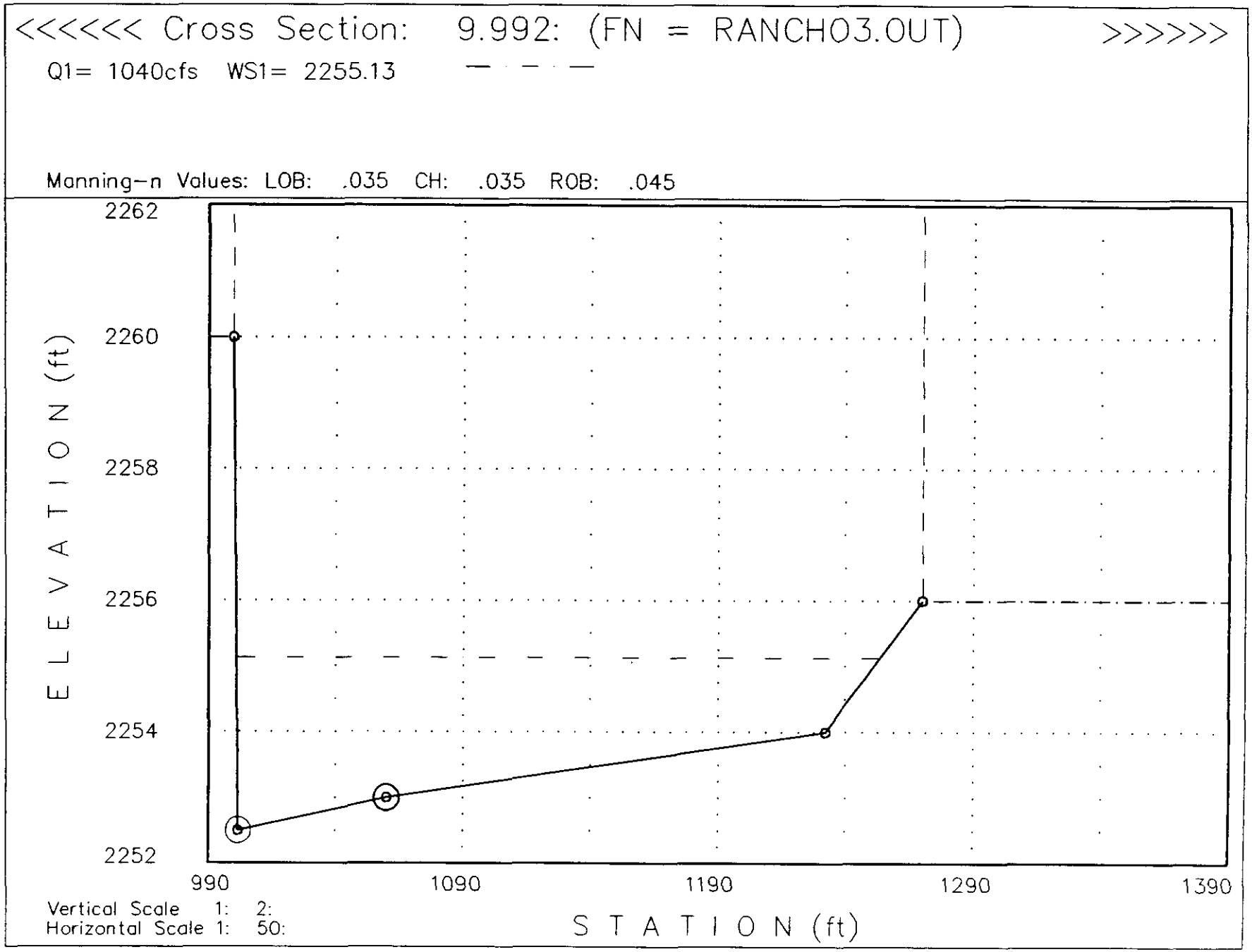
CAUTION SECNO=    10.093  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    10.093  PROFILE=  1  MINIMUM SPECIFIC ENERGY

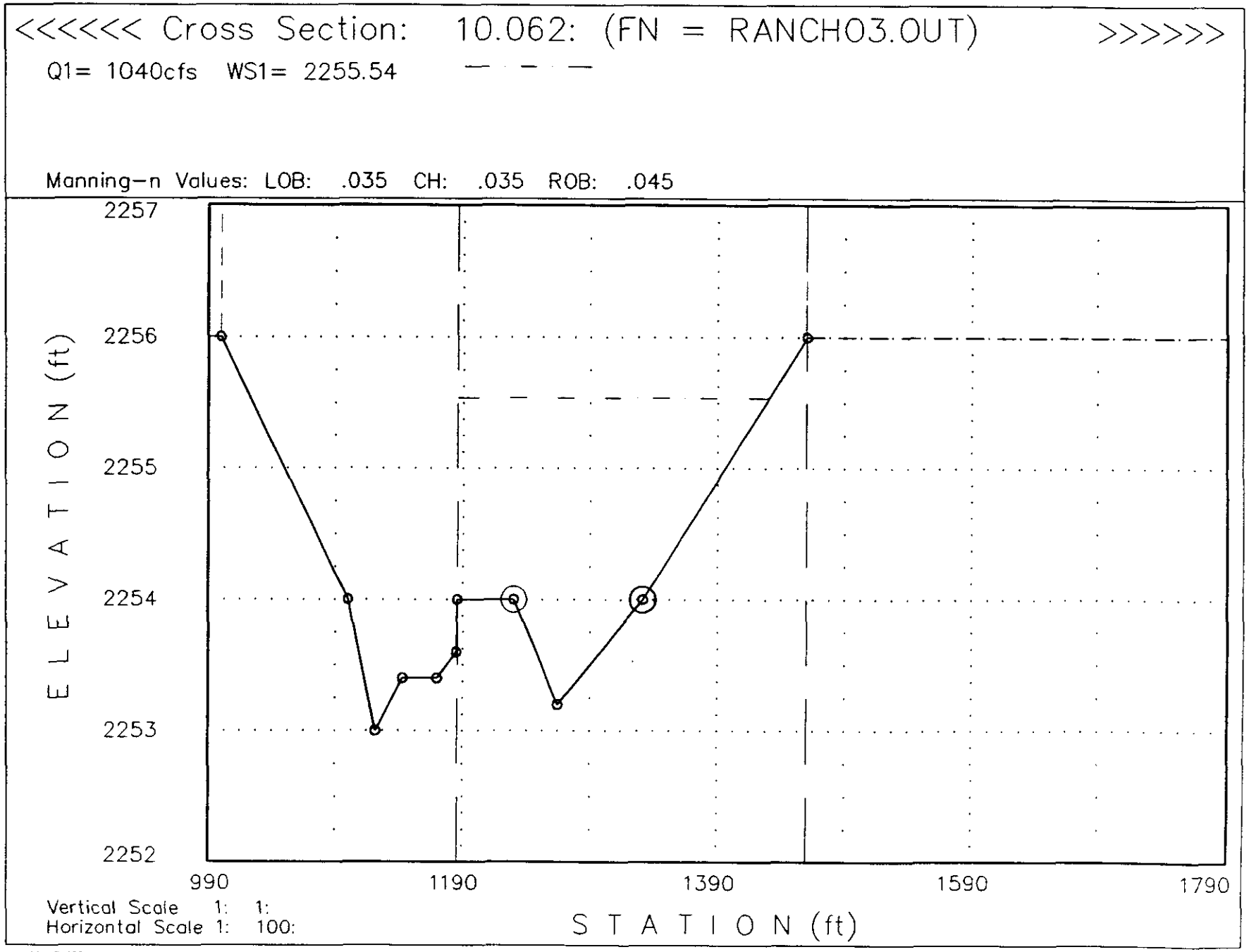
CAUTION SECNO=    10.117  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    10.117  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=    10.117  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
```

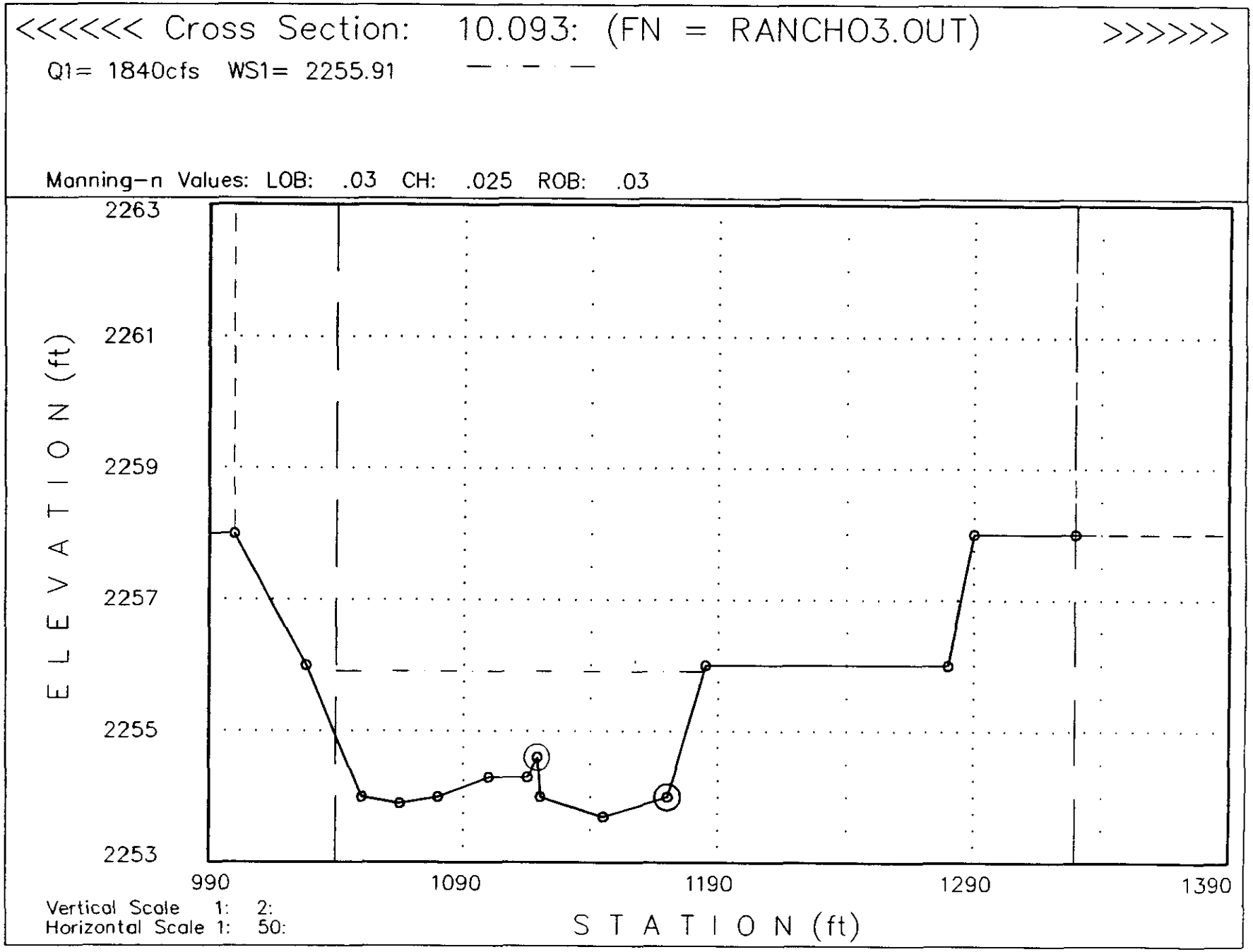

<<<<<< Cross Section: 9.764: (FN = RANCH03.OUT) >>>>>>
Q1= 2040cfs WS1= 2252.09
Manning-n Values: LOB: .035 CH: .035 ROB: .045
2260
2256
2252
2248
2244
2240
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 4:
Horizontal Scale 1: 200:
06-13-1994

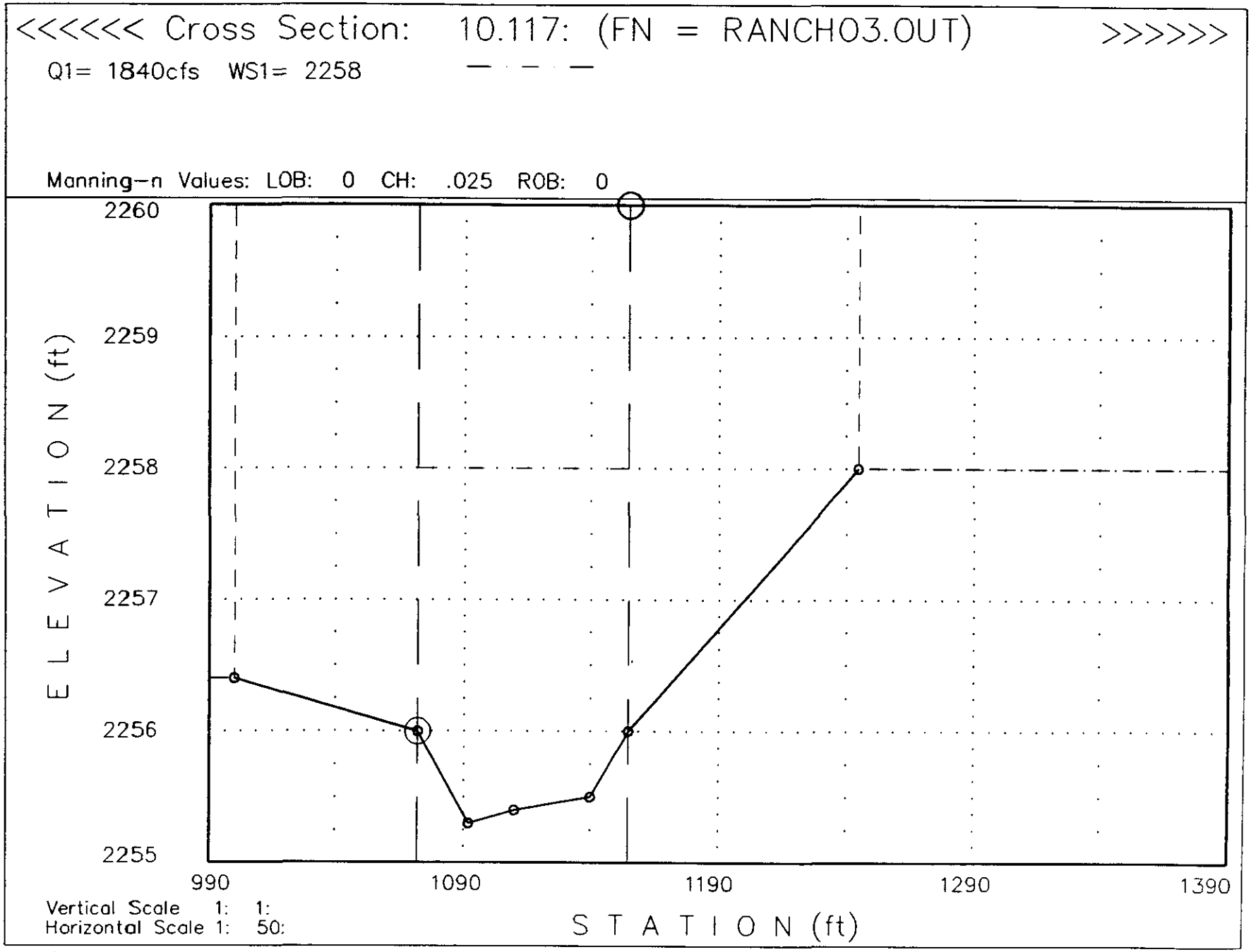

<<<<<< Cross Section: 9.897: (FN = RANCHO3.OUT) >>>>>>
Q1= 1208cfs WS1= 2252.85
Manning-n Values: LOB: .035 CH: .035 ROB: .045
2270
2264
2258
2252
2246
2240
ELEVATION (ft)
9900
10300
10700
11100
11500
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 200:
06-13-1994


<<<<<< Cross Section: 9.957: (FN = RANCH03.OUT) >>>>>>
Q1= 1040cfs WS1= 2254.05
Manning-n Values: LOB: .035 CH: .035 ROB: .045
2262
2260
2258
2256
2254
2252
ELEVATION (ft)
990
1090
1190
1290
1390
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 50:
06-13-1994


<<<<<< Cross Section: 9.992: (FN = RANCH03.OUT) >>>>>>
Q1= 1040cfs WS1= 2255.13
Manning-n Values: LOB: .035 CH: .035 ROB: .045
2262
2260
2258
2256
2254
2252
ELEVATION (ft)
990
1090
1190
1290
1390
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 50:
06-13-1994


<<<<<< Cross Section: 10.062: (FN = RANCH03.OUT) >>>>>>
Q1= 1040cfs WS1= 2255.54
Manning-n Values: LOB: .035 CH: .035 ROB: .045
2257
2256
2255
2254
2253
2252
ELEVATION (ft)
990
1190
1390
1590
1790
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 100:
06-13-1994


<<<<<< Cross Section: 10.093: (FN = RANCHO3.OUT) >>>>>>
Q1= 1840cfs WS1= 2255.91
Manning-n Values: LOB: .03 CH: .025 ROB: .03
2263
2261
2259
2257
2255
2253
ELEVATION (ft)
990
1090
1190
1290
1390
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 50:
06-13-1994


<<<<<< Cross Section: 10.117: (FN = RANCH03.OUT) >>>>>>
Q1= 1840cfs WS1= 2258
Manning-n Values: LOB: 0 CH: .025 ROB: 0
2260
2259
2258
2257
2256
2255
ELEVATION (ft)
990
1090
1190
1290
1390
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 50:
06-13-1994

Rancho4.dat

RANCHO4.DAT

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    09JUN94     TIME   13:24:07 *
*******************************************
```


```
****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*           (916) 756-1104             *
****************************************
```


```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                   X
X     X  X        X     X             X
X     X  XXXXXXX   XXXXX              XXXXXXX
```

THIS RUN EXECUTED 09JUN94 13:24:07

```
**************************************
 HEC-2 WATER SURFACE PROFILES

 Version  4.6.2;  May 1991
**************************************


T1  NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY        CVL JOB # 930017
T2  BY COE & VAN LOO CONSULANTS, INC.                  FILE NAME: RANCHO4.DAT
T3      GOWAN SPLIT


J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0        2         0         0     0.006         0         0         0      2260         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      -1         0        -1


J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     150        38        43         1         3        13        14        15        26        53
      54         4        25

  ET CARDS ARE USED TO BLOCK OUT INEFFECTIVE FLOW AREA
  FLOODPLAIN BOUNDARY WILL BE DELINEATED BASED ON "WSEL"


QT        1       800
NC     0.03      0.03     0.025       0.1       0.3
ET                7.1                                          1000      1085
X1   10.034      7.00      1018      1085         0         0         0
GR   2254.2      1000      2254      1018   2252.25      1030   2252.25      1040   2252.67      1052
GR   2252.7      1070   2252.85      1085
  FLOWS IN GOWAN RD. SPLIT INTO TWO DIRECTIONS NEAR TRUE VALUE HARDWARE STORE.
  SPLIT FLOW WAS ESTIMATED BY BALANCING EG @ SECT # 10.062 & 10.117
  REFER TO RANCHO3.DAT

ET                7.1                                          1100      1186
X1   10.062        11      1100      1185       150       150       150
GR     2256      1000      2254      1100      2253      1122    2253.4      1143    2253.4      1170
GR   2253.6      1185      2254      1186      2254      1230    2253.2      1265      2254      1332
GR     2256      1460
```

QT	1	1840								
ET		7.1					1040	1330		
X1	10.093	15.0	1050	1119	160	160	160			
GR	2258	1000	2256	1028	2254	1050	2253.9	1065	2254	1080
GR	2254.3	1100	2254.3	1115	2254.6	1119	2254	1120	2253.7	1145
GR	2254	1170	2256	1185	2256	1280	2258	1290	2258	1330
QT	1	1840								
ET		7.1					1072	1155		
X1	10.117	7.0	1072	1155	135	125	135			
GR	2256.4	1000	2256	1072	2255.3	1092	2255.4	1110	2255.5	1140
GR	2256	1155	2258	1245						

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 10.034
3280 CROSS SECTION 10.03 EXTENDED 1.61 FEET

3470 ENCROACHMENT STATIONS= 1000.0 1085.0 TYPE= 1 TARGET= 85.000

10.034	2.21	2254.46	.00	.00	2255.13	.67	.00	.00	2254.00
800.0	12.2	787.8	.0	6.4	119.1	.0	.0	.0	100000.00
.00	1.90	6.61	.00	.030	.025	.000	.000	2252.25	1000.00
.005951	0.	0.	0.	0	0	6	.00	85.00	1085.00

*SECNO 10.062

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.51

3470 ENCROACHMENT STATIONS= 1100.0 1186.0 TYPE= 1 TARGET= 86.000

10.062	2.38	2255.38	.00	.00	2255.72	.35	.56	.03	2254.00
800.0	.0	797.0	3.0	.0	168.6	1.6	.5	.3	2253.60
.01	.00	4.73	1.88	.000	.025	.030	.000	2253.00	1100.00
.002594	150.	150.	150.	2	0	0	.00	86.00	1186.00

*SECNO 10.093
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 1040.0 1330.0 TYPE= 1 TARGET= 290.000

10.093	2.36	2256.06	2256.06	.00	2256.73	.67	.72	.10	2254.00
1840.0	78.5	965.7	795.8	16.1	134.3	133.8	1.3	.9	2254.60
.02	4.89	7.19	5.95	.030	.025	.030	.000	2253.70	1040.00
.006020	160.	160.	160.	3	5	0	.00	240.30	1280.30

*SECNO 10.117
3280 CROSS SECTION 10.12 EXTENDED .01 FEET

3301 HV CHANGED MORE THAN HVINS

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 1072.0 1155.0 TYPE= 1 TARGET= 83.000

10.117	2.71	2258.01	2258.01	.00	2259.25	1.24	.87	.17	2256.00
1840.0	.0	1840.0	.0	.0	205.6	.0	2.1	1.4	100000.00
.02	.00	8.95	.00	.000	.025	.000	.000	2255.30	1072.00
.007201	135.	135.	125.	20	8	0	.00	83.00	1155.00

THIS RUN EXECUTED 09JUN94 13:24:08

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

GOWAN SPLIT

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	EG	QLOB	QCH	QROB	VCH	SSTA	ENDST	TOPWID	AREA
	10.034	800.00	2254.46	2255.13	12.20	787.80	.00	6.61	1000.00	1085.00	85.00	125.51
*	10.062	800.00	2255.38	2255.72	.00	797.04	2.96	4.73	1100.00	1186.00	86.00	170.18
•	10.093	1840.00	2256.06	2256.73	78.46	965.74	795.79	7.19	1040.00	1280.30	240.30	284.22
*	10.117	1840.00	2258.01	2259.25	.00	1840.00	.00	8.95	1072.00	1155.00	83.00	205.64

GOWAN SPLIT

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	10.034	.00	.00	.00	2252.25	800.00	2254.46	.00	2255.13	59.51	6.61	125.51	103.70
*	10.062	150.00	.00	.00	2253.00	800.00	2255.38	.00	2255.72	25.94	4.73	170.18	157.08
*	10.093	160.00	.00	.00	2253.70	1840.00	2256.06	2256.06	2256.73	60.20	7.19	284.22	237.15
*	10.117	135.00	.00	.00	2255.30	1840.00	2258.01	2258.01	2259.25	72.01	8.95	205.64	216.84

GOWAN SPLIT

SUMMARY PRINTOUT TABLE 150

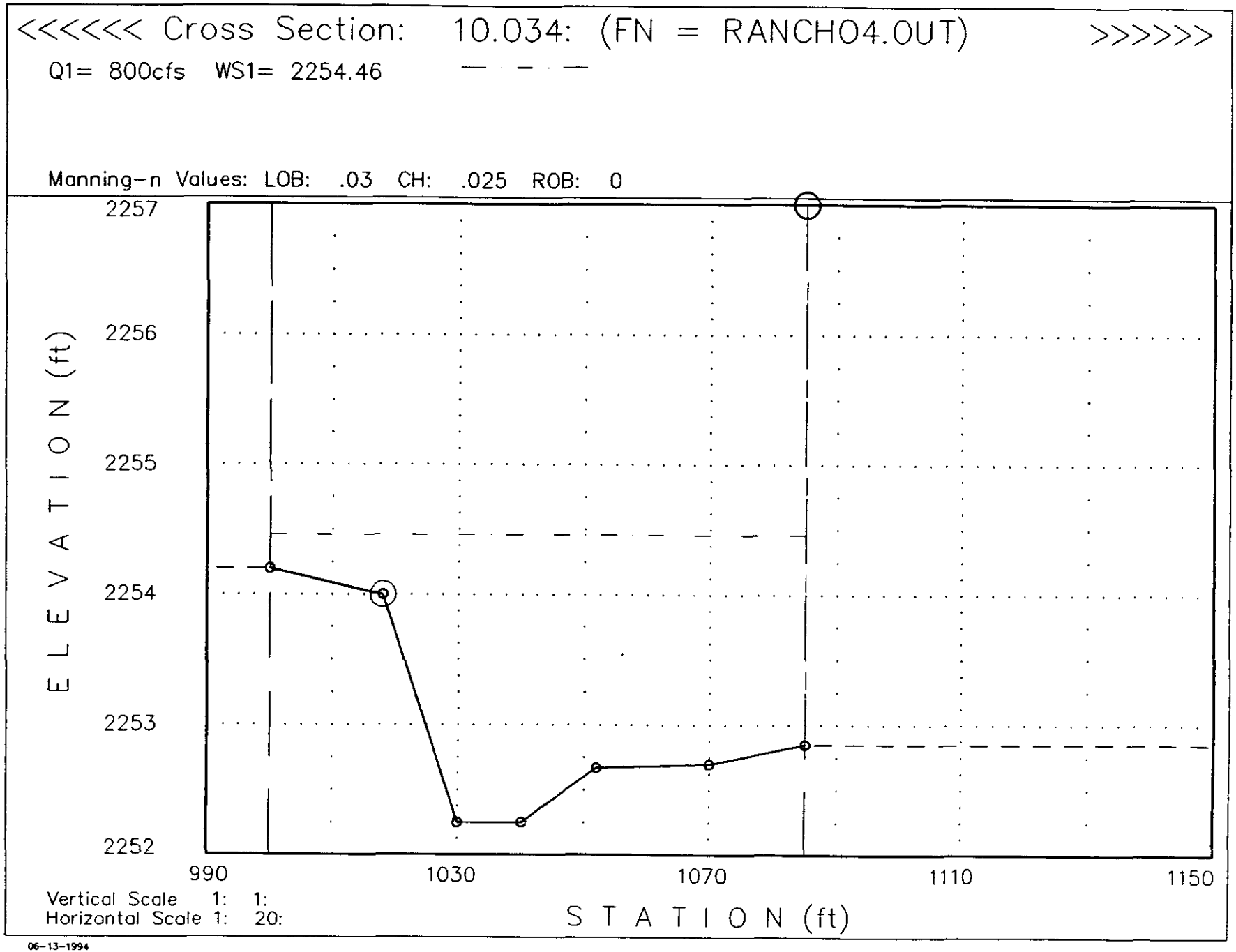
	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	10.034	800.00	2254.46	.00	.00	.00	85.00	.00
*	10.062	800.00	2255.38	.00	.92	.00	86.00	150.00
*	10.093	1840.00	2256.06	.00	.68	.00	240.30	160.00
*	10.117	1840.00	2258.01	.00	1.95	.00	83.00	135.00

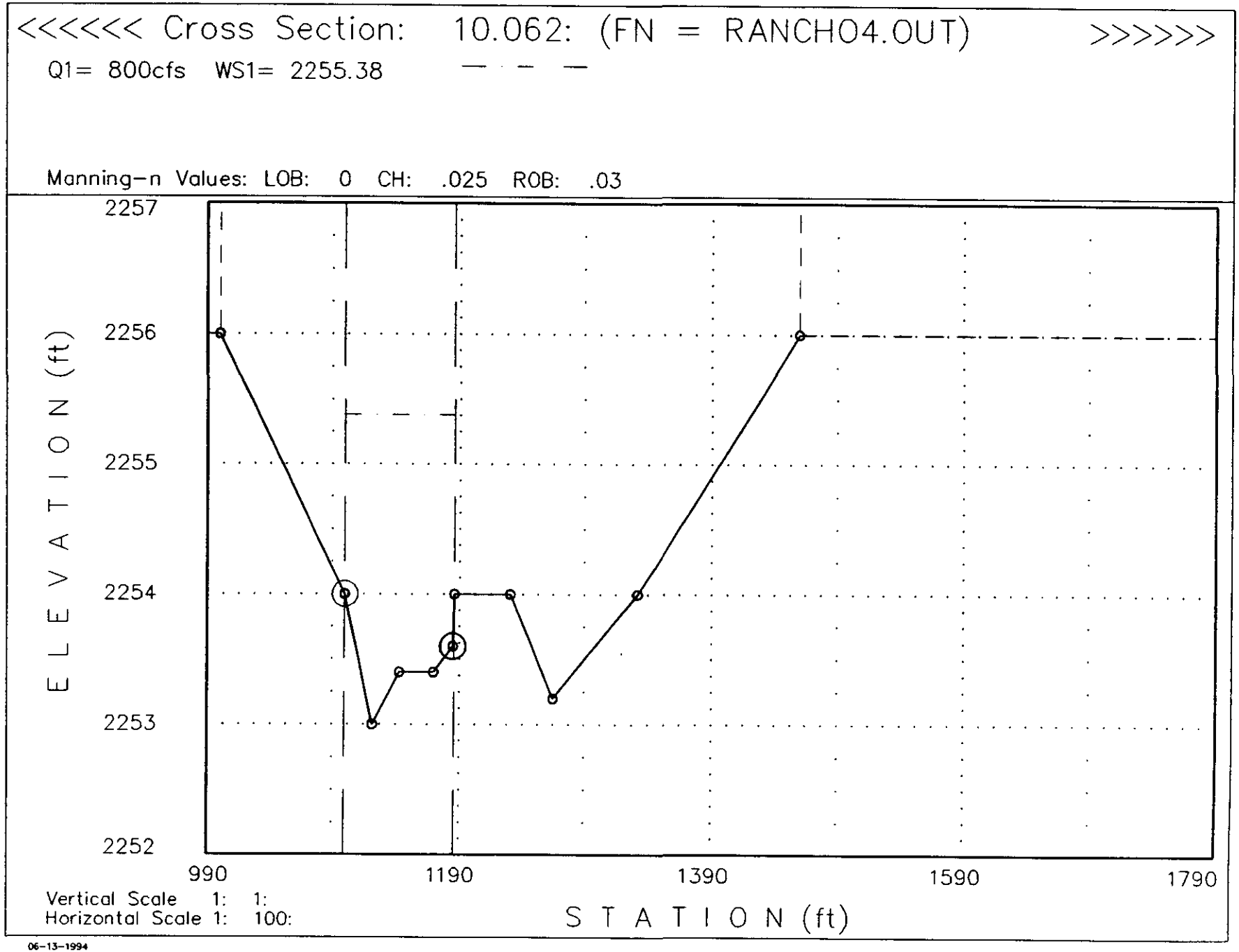
SUMMARY OF ERRORS AND SPECIAL NOTES

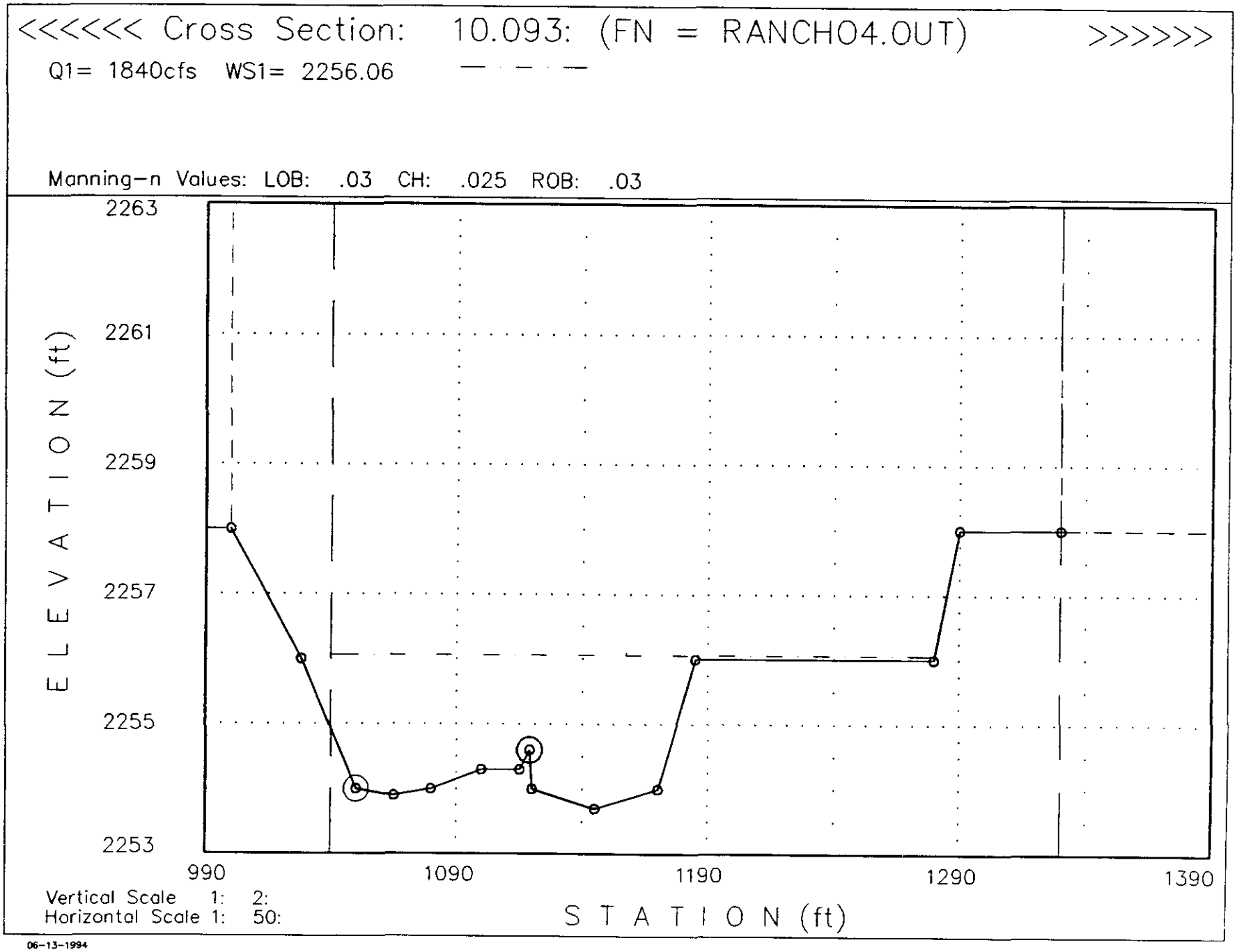
WARNING SECNO= 10.062 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

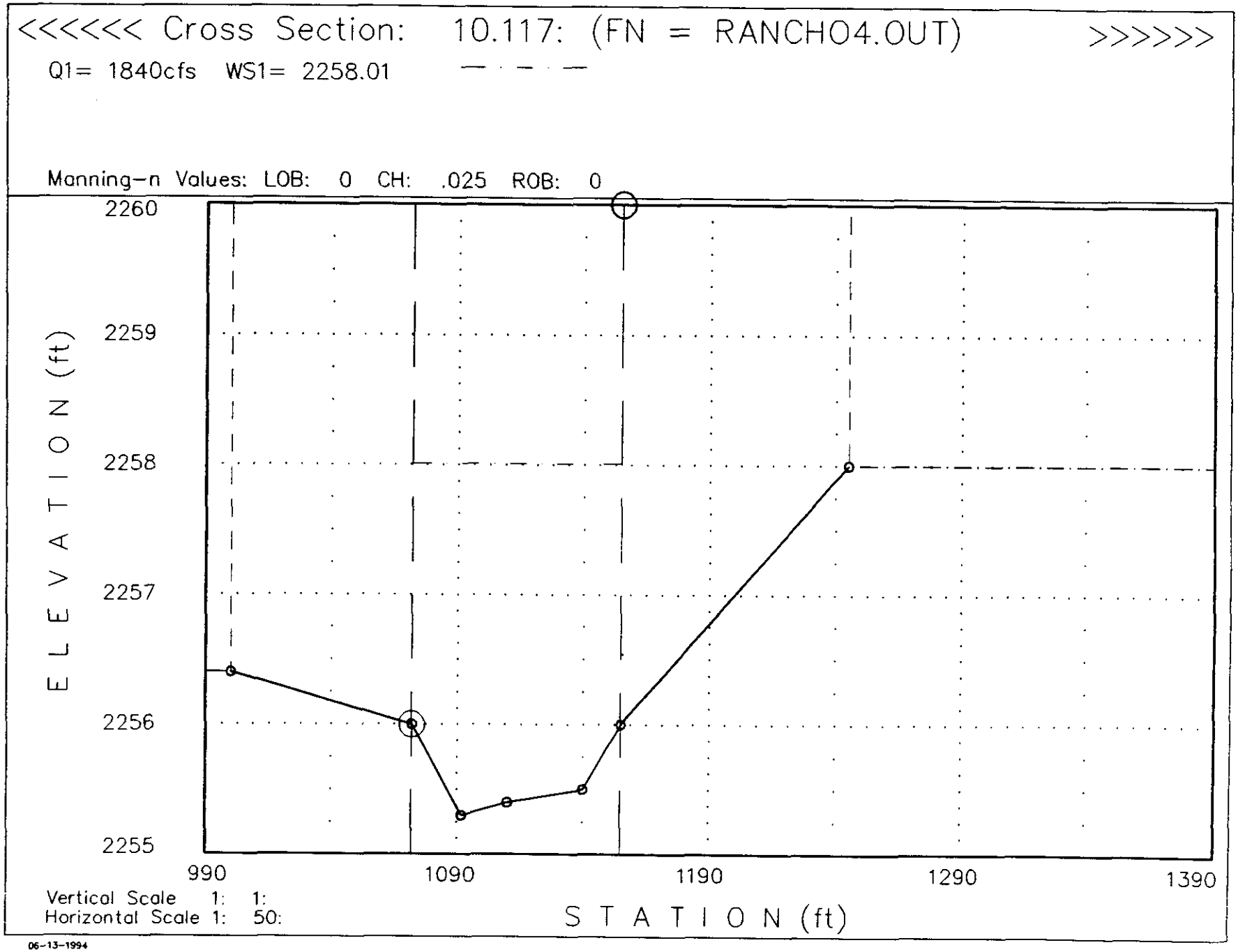
CAUTION SECNO= 10.093 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 10.093 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 10.117 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 10.117 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 10.117 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL


<<<<<< Cross Section: 10.034: (FN = RANCH04.OUT) >>>>>>
Q1= 800cfs WS1= 2254.46
Manning-n Values: LOB: .03 CH: .025 ROB: 0
2257
2256
2255
2254
2253
2252
ELEVATION (ft)
990
1030
1070
1110
1150
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 20:
06-13-1994


<<<<<< Cross Section: 10.062: (FN = RANCH04.OUT) >>>>>>
Q1= 800cfs WS1= 2255.38
Manning-n Values: LOB: 0 CH: .025 ROB: .03
2257
2256
2255
2254
2253
2252
ELEVATION (ft)
990
1190
1390
1590
1790
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 100:
06-13-1994


<<<<<< Cross Section: 10.093: (FN = RANCHO4.OUT) >>>>>>
Q1= 1840cfs WS1= 2256.06
Manning-n Values: LOB: .03 CH: .025 ROB: .03
2263
2261
2259
2257
2255
2253
ELEVATION (ft)
990
1090
1190
1290
1390
Vertical Scale 1: 2:
Horizontal Scale 1: 50:
STATION (ft)
06-13-1994


<<<<<< Cross Section: 10.117: (FN = RANCHO4.OUT) >>>>>>
Q1= 1840cfs WS1= 2258.01
Manning-n Values: LOB: 0 CH: .025 ROB: 0
2260
2259
2258
2257
2256
2255
ELEVATION (ft)
990
1090
1190
1290
1390
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 50:
06-13-1994

Section 3
Hand Calculations

COE & VAN LOO
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project: NWLVFL
Project No. 930017
Sheet No. _____ of _____
Calculated by YS Date _____
Checked by _____ Date _____

Gowan Road & US 95 Intersection

WSEL	Qculv1	Qweir	Qculv2	Qtotal
2314.0	439	2205	126	2770
2314.4	456	3241	131	3828

Q_{100} = 2843 cfs

Starting WSEL = 2314.0

COE & VAN LOO
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project _____

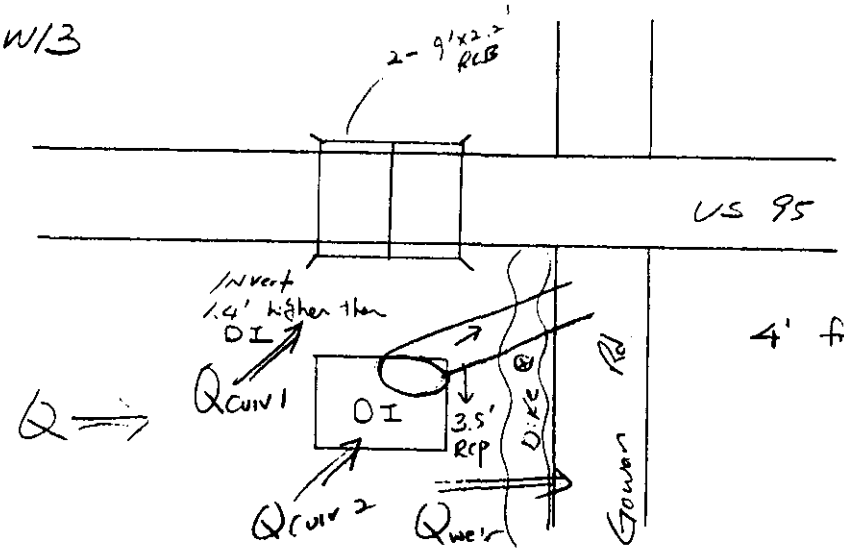
Project No. 92017

Sheet No. _____ of _____

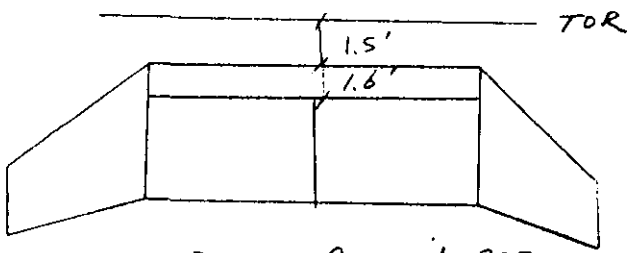
Calculated by YS Date 9/24/92

Checked by _____ Date _____

HW13



4' from D.I.



2 — 9x 2.2' RCB

l = 230'

COE & VAN LOO
PLANNING ENGINEERING
LANDSCAPE ARCHITECTURE

Project NWLVFIS
Project No. 80017
Sheet No. _____ of _____
Calculated by MS Date 12/22/10
Checked by _____ Date _____

Weir Section

20/1000, 13/1020, 10.5/1075, 13/1110, 14/1510, 14/1540, 12.2/1580, 14/1630, 16/1970.

C = 2.8

WSEL	TW	A	d	$Q = CLH^{3/2}$
14.4	677	865.4	1.43	3,241
14.0	571.5	708.5	1.23	2,205
13.6	476.0	499.8	1.05	1,434
13.2	374.5	327.7	0.88	866
12.80	273.0	198.2	0.73	477
12.40	171.5	109.3	0.64	246

4550 NORTH 12TH STREET • PHOENIX, ARIZONA 85014 • PHONE (602) 264-6831

Project 8007
Project No.
Sheet No. of
Calculated by Date

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Gowan & US95

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	9	Bed Slope:	0.00500	Max Elev:	20.0
Bank Stations.....Left:	1000.0	Right....:	1970.0	Min Elev:	10.5
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	20.0	1000.0	2)	12.0	1030.0	3)	10.5	1075.0	4)	12.0	1110.0
5)	14.0	1510.0	6)	14.0	1540.0	7)	12.2	1580.0	8)	14.0	1630.0
9)	16.0	1970.0									

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
14.40	4282.0	4.4	0.655	0.030	1.4	677.0	965.4	677.5
14.00	2842.6	4.0	0.638	0.030	1.2	577.5	708.5	577.9
13.60	1795.6	3.6	0.622	0.030	1.0	476.0	497.8	476.3
13.20	1049.6	3.2	0.603	0.030	0.9	374.5	327.7	374.8
12.80	560.5	2.8	0.585	0.030	0.7	273.0	198.2	273.2
12.40	283.4	2.6	0.572	0.030	0.6	171.5	109.3	171.6

NOTES:

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 24, 1993
2 - 9' X 2.2' RCB UNDER US 95 NEAR GOWANS & US95 INTER.

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	9.00
Culvert Rise (Height of Opening) (feet)	2.20
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	230.0
Culvert Slope (feet per foot)	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
40.0	2.00	1.35	-0.14	0.60	0.85	0.60	7.46
60.0	2.00	1.79	0.06	0.77	1.11	0.77	8.65
80.0	2.00	2.18	0.34	0.93	1.35	0.93	9.59
100.0	2.00	2.54	0.70	1.07	1.57	1.07	10.38
120.0	2.00	3.20	1.14	1.21	1.77	1.21	11.05
140.0	2.00	3.71	1.74	1.34	1.96	1.34	11.65
160.0	2.00	4.30	2.43	1.46	2.14	1.46	12.19
180.0	2.00	4.96	3.15	1.58	2.20	1.58	12.68
200.0	2.00	5.71	3.91	1.69	2.20	1.69	13.12
220.0	2.00	6.53	4.75	1.81	2.20	1.81	13.53
240.0	2.00	7.44	5.67	1.92	2.20	1.92	13.91
260.0	2.00	8.42	6.67	2.02	2.20	2.02	14.28

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PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 27, 1993
3.5' RCP NEAR GOWAN RD & US 95 INTER.
INTO GOWAN OUTFALL PIPE
ASSUMED INLET CONTROL

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	3.50
FHWA Chart Number (1,2 or 3)	1
Scale Number on Chart (Type of Culvert Entrance)	3
Manning's Roughness Coefficient (n-value)	0.0150
Entrance Loss Coefficient of Culvert Opening	0.50
Culvert Length (feet)	100.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
60.0	2.00	3.70	-0.66	1.33	2.43	1.33	17.89
80.0	3.00	4.60	0.59	1.56	2.79	1.56	19.29
100.0	3.00	5.84	2.11	1.76	3.07	1.76	20.58
120.0	3.00	7.34	3.88	1.98	3.25	1.98	21.32
140.0	3.00	9.12	5.92	2.20	3.35	2.20	22.01
160.0	3.00	11.18	8.25	2.42	3.41	2.42	22.58
180.0	3.00	13.51	10.86	2.67	3.44	2.67	22.89
200.0	3.00	16.11	13.78	2.96	3.46	2.96	23.07

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LANDSCAPE ARCHITECTURE

Project NWLVFLS

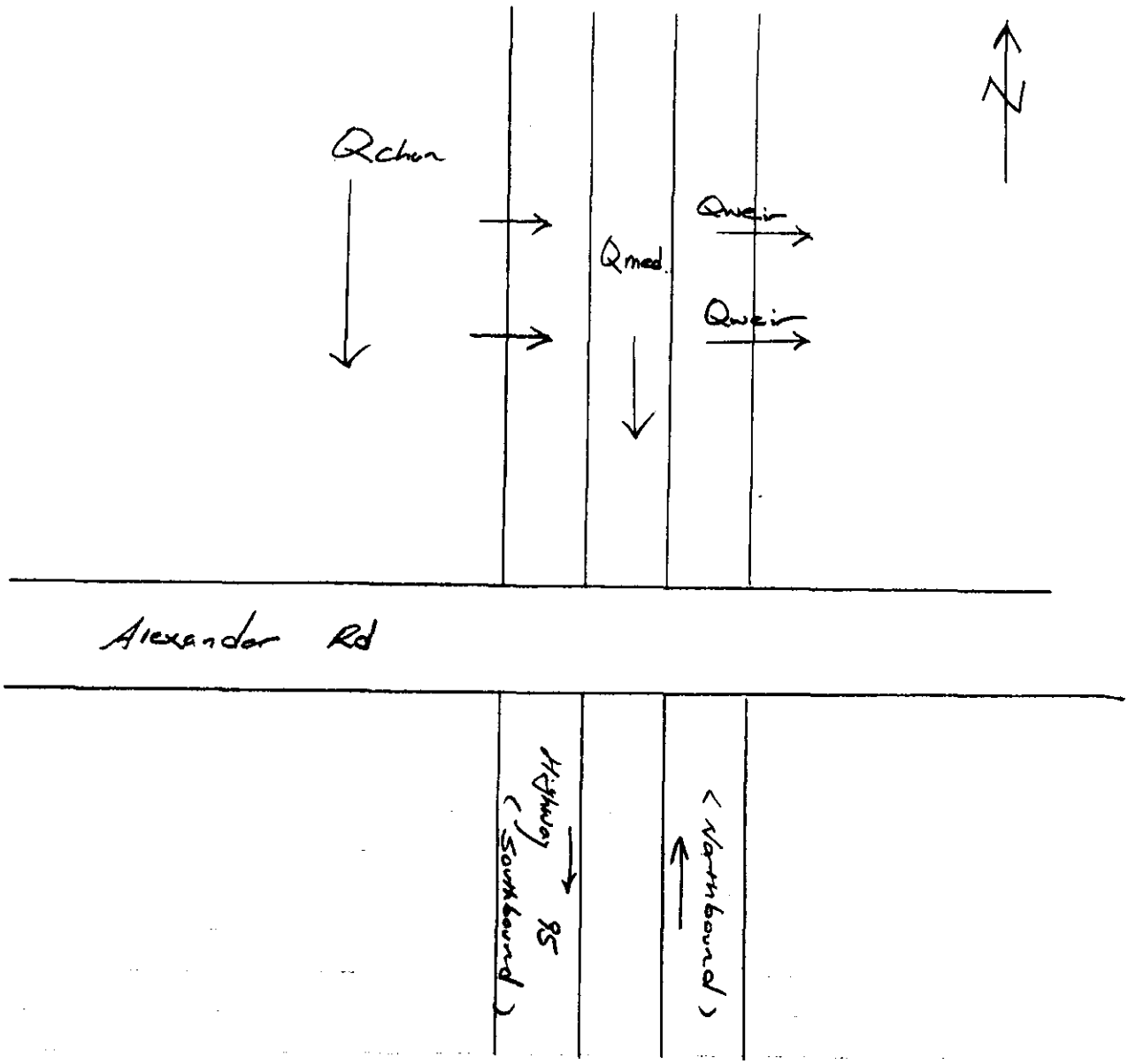
Project No. 83007

Sheet No. _____ of _____

Calculated by JS Date 3/28/84

Checked by _____ Date _____

At Alexander Rd and Highway 95 Intersection



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DSCAPE ARCHITECTURE

Project NWLVFLC

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Q = CLH^1.5, L = 655, C = 3

Elev.	Qmed	Qweir	Qtotal
18.1	42	0	42
18.2	51	62	113
18.4	77	323	400
18.6	107	695	802
18.8	141	1150	1291

366

Project NWLVFIS
Project No.
Sheet No. of
Calculated by Date

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Highway 85 Median area near Alexander Rd

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	6	Bed Slope:	0.00122	Max Elev:	2318.1
Bank Stations.....Left:	9990.1	Right....:	10000.0	Min Elev:	2316.7
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.025	CHANNEL..:	0.020	ROB.....:	0.025

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2318.1	9977.5	2)	2317.0	9990.1	3)	2316.7	9994.6	4)	2317.4	10000.0
5)	2317.9	10012.9	6)	2318.1	10018.3						

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
2317.80	20.1	1.4	0.365	0.022	0.5	29.4	14.1	29.5
2318.00	32.2	1.6	0.367	0.023	0.6	37.0	20.7	37.1
2318.20	51.2	1.8	0.375	0.023	0.7	40.8	28.6	40.9
2318.40	77.0	2.1	0.388	0.023	0.9	40.8	36.8	40.9
2318.60	106.9	2.4	0.399	0.023	1.1	40.8	45.0	40.9
2318.80	140.6	2.6	0.409	0.023	1.3	40.8	53.1	40.9

NOTES:

COE & VAN LOO

Project _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

@ Alexander Rd & Vs 95 Intersection.

Q_{100} : 2963 cfs plus 70 cfs in median area

WSEL	(4-10x4) $Q_{CULV\,1}$	(2-7x2) (DQ) $Q_{CULV\,2}$	Q_{chan}	Alexander Q_{weir}	Q_{total}
18.22	892	201	1200	–	2393
18.67	1200	216	1400	–	2816
19.10	1234	231	1600	57	3127
18.87	1218	223	1495	27	2963

Calculated WSEL = 2318.87'

COE & VAN LOO
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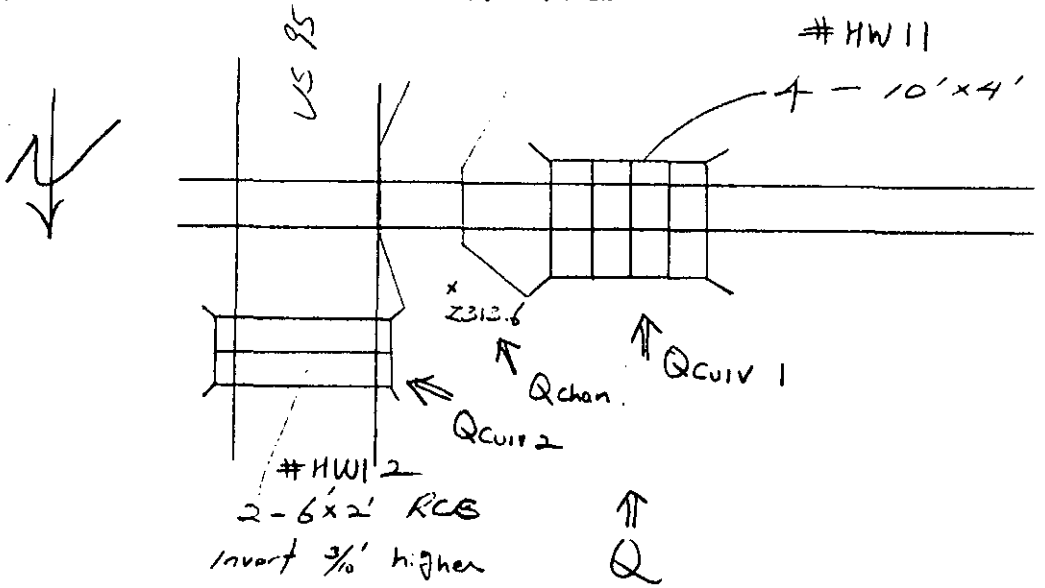
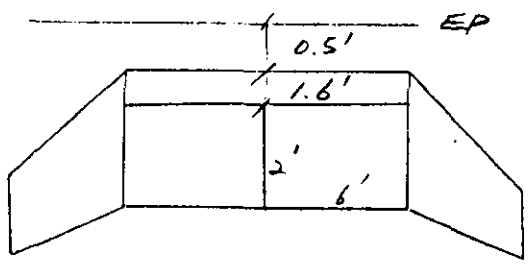
[illegible] ARCHITECTURE

Project NWLVFLS
Project No. Sec. 17
Sheet No. _____ of _____
Calculated by JS Date 9/24/92
Checked by _____ Date _____

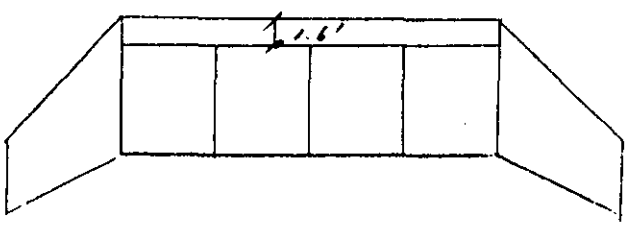
HW11
HW12



Channel, W = 29'
H = 3.8'
n = 0.018



2 - 6'x2' RCB
INVERT = 2313.9
Wingwall - 45°
Headwall - Beveled Top edge
l = 160'



4 - 10'x4' RCB

Wingwall - 45°
Headwall - Beveled Top edge
l = 125'

BOX CULVERT ANALYSIS

[illegible] OF CULVERT PERFORMANCE CURVE

January 6, 1994

4 - 10' X 4' RCB UNDER ALEXANDER

TW = 3.8'

INV = 13.6'

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	10.00
Culvert Rise (Height of Opening) (feet).....	4.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0130
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	127.0
Culvert Slope (feet per foot).....	0.0010

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
40.0	3.80	1.24	3.70	1.15	0.79	3.80	1.05
60.0	3.80	1.63	3.73	1.51	1.04	3.80	1.58
80.0	3.80	1.99	3.77	1.82	1.26	3.80	2.11
100.0	3.80	2.32	3.83	2.12	1.46	3.80	2.63
120.0	3.80	2.63	3.89	2.40	1.65	3.80	3.16
140.0	3.80	2.92	3.97	2.68	1.83	3.80	3.68
160.0	3.80	3.20	4.07	2.94	2.00	3.80	4.21
180.0	3.80	3.47	4.17	3.19	2.16	3.80	4.74
200.0	3.80	3.73	4.29	3.44	2.32	3.80	5.26
220.0	3.80	3.99	4.42	3.69	2.47	3.80	5.79
240.0	3.80	4.23	4.56	3.93	2.62	3.80	6.32
260.0	3.80	4.48	4.71	4.00	2.76	3.80	6.84
240.0	3.80	4.23	4.56	3.93	2.62	3.80	6.32
260.0	3.80	4.48	4.71	4.00	2.76	3.80	6.84
280.0	3.80	4.71	4.88	4.00	2.90	3.80	7.37
300.0	3.80	5.31	5.06	4.00	3.03	4.00	7.50
320.0	3.80	5.70	5.25	4.00	3.17	4.00	8.00
340.0	3.80	6.02	5.45	4.00	3.30	4.00	8.50
360.0	3.80	6.36	5.67	4.00	3.43	4.00	9.00
380.0	3.80	6.71	5.90	4.00	3.55	4.00	9.50
400.0	3.80	7.09	6.18	4.00	3.68	4.00	10.00

==========

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BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 24, 1993
2 - 6' X 2' RCB UNDER US 95 NEAR ALEXANDER & US 95 INTERSECTION

INV = 2013.9'

PROGRAM INPUT DATA:

DESCRIPTION	VALU
Culvert Span (Width of Opening) (feet).....	6.00
Culvert Rise (Height of Opening) (feet).....	2.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.013
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	160.0
Culvert Slope (feet per foot).....	0.010

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outle Velocit (fps
20.0	1.00	1.11	-0.15	0.51	0.70	0.51	6.5
40.0	2.00	1.79	0.81	0.79	1.11	0.79	8.3
60.0	2.00	2.40	1.31	1.04	1.46	1.04	9.6
80.0	2.00	3.33	2.02	1.26	1.77	1.26	10.5
100.0	2.00	4.29	2.93	1.47	2.00	1.47	11.3
120.0	2.00	5.47	4.05	1.67	2.00	1.67	11.9
140.0	2.00	6.86	5.37	1.86	2.00	1.86	12.5
160.0	2.00	8.46	6.89	2.00	2.00	2.00	13.3

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Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Weir Section
@ Alexander Rd

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	3	Bed Slope:	0.00500	Max Elev:	20.0
Bank Stations.....Left:	1000.0	Right....:	1410.0	Min Elev:	18.6
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	20.0	1000.0	2)	18.6	1130.0	3)	20.0	1410.0			

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
18.80	4.4	0.8	0.421	0.030	0.1	58.6	5.9	58.6
19.00	28.1	1.2	0.472	0.030	0.2	117.1	23.4	117.1
19.20	82.7	1.6	0.505	0.030	0.3	175.7	52.7	175.7
19.40	178.2	1.9	0.530	0.030	0.4	234.3	93.7	234.3
19.60	323.1	2.2	0.550	0.030	0.5	292.9	146.4	292.9
19.80	525.4	2.5	0.567	0.030	0.6	351.4	210.9	351.4

NOTES:

$C = 2.9$

hyd depth

$Q = CLy^{3/2}$

hyd depth	Q
0.2	30
0.3	84
0.4	172
0.5	300
0.6	473

TRAPEZOIDAL CHANNEL ANALYSIS
STANDARD STEP WATER SURFACE PROFILE

January 6, 1994
CONCRETE CHANNEL

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)	1200.0
Channel Bottom Slope (feet per foot)	0.0010
Manning's Roughness Coefficient (n-value)	0.0160
Channel Side Slope - Left Side (horizontal/vertical)	0.00
Channel Side Slope - Right Side (horizontal/vertical)	0.00
Channel Bottom Width (feet)	29.0
Channel Flow-Line Elevation at Starting Station (feet)	13.45
Water Surface Elevation at Starting Station (feet)	17.17
Starting Channel Station (feet)	1000.00

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)	5.57
Critical Depth (feet)	3.76

Station (ft)	Flowline (ft)	WS Elev. (ft)	Depth (ft)	Flow Area (sq ft)	Vel (fps)	Velocity Head(ft)	EGL Slope (ft/ft)
1000.0	13.45	17.21	3.76	109.05	11.00	1.880	0.003265
1150.0	13.60	18.22	4.62	134.02	8.95	1.245	0.001746

==========

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
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TRAPEZOIDAL CHANNEL ANALYSIS
STANDARD STEP WATER SURFACE PROFILE

January 6, 1994
CONCRETE CHANNEL

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	1400.0
Channel Bottom Slope (feet per foot).....	0.0010
Manning's Roughness Coefficient (n-value).....	0.0160
Channel Side Slope - Left Side (horizontal/vertical)....	0.00
Channel Side Slope - Right Side (horizontal/vertical)...	0.00
Channel Bottom Width (feet).....	29.0
Channel Flow-Line Elevation at Starting Station (feet)..	13.45
Water Surface Elevation at Starting Station (feet).....	17.17
Starting Channel Station (feet).....	1000.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	6.18
Critical Depth (feet).....	4.17

Station (ft)	Flowline (ft)	WS Elev. (ft)	Depth (ft)	Flow Area (sq ft)	Vel (fps)	Velocity Head(ft)	EGL Slope (ft/ft)
1000.0	13.45	17.62	4.17	120.86	11.58	2.084	0.003249
1150.0	13.60	18.67	5.07	147.13	9.52	1.406	0.001796

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TRAPEZOIDAL CHANNEL ANALYSIS
STANDARD STEP WATER SURFACE PROFILE

January 6, 1994
CONCRETE CHANNEL

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	1600.0
Channel Bottom Slope (feet per foot).....	0.0010
Manning's Roughness Coefficient (n-value).....	0.0160
Channel Side Slope - Left Side (horizontal/vertical)....	0.00
Channel Side Slope - Right Side (horizontal/vertical)...	0.00
Channel Bottom Width (feet).....	29.0
Channel Flow-Line Elevation at Starting Station (feet)..	13.45
Water Surface Elevation at Starting Station (feet).....	17.17
Starting Channel Station (feet).....	1000.00

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	6.78
Critical Depth (feet).....	4.56

Station (ft)	Flowline (ft)	WS Elev. (ft)	Depth (ft)	Flow Area (sq ft)	Vel (fps)	Velocity Head(ft)	EGL Slope (ft/ft)
1000.0	13.45	18.01	4.56	132.11	12.11	2.278	0.003242
1150.0	13.60	19.10	5.50	159.61	10.02	1.560	0.001841

==========

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Project NWLVFLS
Project No. 20017
Sheet No. ____ of ____
Calculated by JS Date 1/6/12
Checked by ____ Date ____

On-ramp near US 95 & Craig Rd intersection

6-8'x3' RCB — outlet control

INV = 2315.2'
TW = 5.3'

Q_{100}	WSEL
581	20.8
476	
258	20.46
275	20.48 — OK

Q_{100} = 275 cfs — starting WSEL = 2320.48'

BOX CULVERT ANALYSIS

[illegible] N OF CULVERT PERFORMANCE CURVE

January 6, 1994

6 - 8' X 3' RCB UNDER ON-RAMP NEAR CRAIG RD & US 95 INTER.

INV. = 2315.2'

TAIL WATER = 5.3'

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	8.00
Culvert Rise (Height of Opening) (feet)	3.00
FHWA Chart Number (8,9,10,11,12 or 13)	9
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	124.0
Culvert Slope (feet per foot)	0.0010

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	5.30	0.94	5.19	0.87	0.58	3.00	0.83
40.0	5.30	1.49	5.25	1.37	0.92	3.00	1.67
60.0	5.30	1.95	5.34	1.80	1.20	3.00	2.50
80.0	5.30	2.37	5.48	2.19	1.46	3.00	3.33
100.0	5.30	2.75	5.65	2.57	1.69	3.00	4.17
120.0	5.30	3.10	5.85	2.93	1.91	3.00	5.00
140.0	5.30	3.44	6.10	3.00	2.12	3.00	5.83
160.0	5.30	3.78	6.38	3.00	2.32	3.00	6.67
180.0	5.30	4.14	6.70	3.00	2.51	3.00	7.50
200.0	5.30	4.55	7.05	3.00	2.69	3.00	8.33
220.0	5.30	5.00	7.45	3.00	2.86	3.00	9.17
240.0	5.30	5.49	7.88	3.00	3.00	3.00	10.00
260.0	5.30	6.03	8.35	3.00	3.00	3.00	10.83
280.0	5.30	6.61	8.86	3.00	3.00	3.00	11.67
300.0	5.30	7.23	9.40	3.00	3.00	3.00	12.50

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Project _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

@ Coig Rd + U.S. 95 Intersection

WSEL	(4-10x4) Qcuiv1	(2-6x2) Qcuiv2	Qchan	Q-total
21.29	460	128	1000	1588
21.45	589	135	1200	1924

Total Q
$Q_{100} = 1680$.

Computed WSEL.
WSEL = 21.33

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

January 7, 1994
4 - 10' x 4' rcb under craig underpass
inv = 2316.9'
tw = 4.6'

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	10.00
Culvert Rise (Height of Opening) (feet).....	4.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0130
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	226.0
Culvert Slope (feet per foot).....	0.0020

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
100.0	4.60	2.32	4.33	1.68	1.46	4.00	2.50
120.0	4.60	2.63	4.41	1.90	1.65	4.00	3.00
140.0	4.60	2.92	4.51	2.11	1.83	4.00	3.50
160.0	4.60	3.20	4.62	2.31	2.00	4.00	4.00
180.0	4.60	3.47	4.74	2.50	2.16	4.00	4.50
200.0	4.60	3.73	4.88	2.69	2.32	4.00	5.00
220.0	4.60	3.99	5.04	2.88	2.47	4.00	5.50
240.0	4.60	4.23	5.20	3.06	2.62	4.00	6.00
260.0	4.60	4.48	5.39	3.24	2.76	4.00	6.50
280.0	4.60	4.71	5.58	3.42	2.90	4.00	7.00
300.0	4.60	5.31	5.80	3.59	3.03	4.00	7.50

320.0	4.60	5.70	6.02	3.76	3.17	4.00	8.00
340.0	4.60	6.02	6.27	3.93	3.30	4.00	8.50
360.0	4.60	6.36	6.52	4.00	3.43	4.00	9.00
380.0	4.60	6.71	6.79	4.00	3.55	4.00	9.50
400.0	4.60	7.09	7.08	4.00	3.68	4.00	10.00
420.0	4.60	7.48	7.38	4.00	3.80	4.00	10.50
440.0	4.60	7.90	7.70	4.00	3.92	4.00	11.00
460.0	4.60	8.33	8.03	4.00	4.00	4.00	11.50
480.0	4.60	8.78	8.37	4.00	4.00	4.00	12.00
500.0	4.60	9.26	8.73	4.00	4.00	4.00	12.50

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TRAPEZOIDAL CHANNEL ANALYSIS
STANDARD STEP WATER SURFACE PROFILE

January 7, 1994
craig rd - concrete channel

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)	1000.0
Channel Bottom Slope (feet per foot)	0.0020
Manning's Roughness Coefficient (n-value)	0.0160
Channel Side Slope - Left Side (horizontal/vertical)	0.00
Channel Side Slope - Right Side (horizontal/vertical)	0.00
Channel Bottom Width (feet)	29.0
Channel flow-Line Elevation at Starting Station (feet)	16.45
Water Surface Elevation at Starting Station (feet)	21.08
Starting Channel Station (feet)	1000.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)	3.92
Critical Depth (feet)	3.33

Station (ft)	Flowline (ft)	WS Elev. (ft)	Depth (ft)	Flow Area (sq ft)	Vel (fps)	Velocity Head(ft)	EGL Slope (ft/ft)
1000.0	16.45	21.08	4.63	134.27	7.45	0.861	0.001206
1240.0	16.93	21.29	4.36	126.36	7.91	0.972	0.001448

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
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TRAPEZOIDAL CHANNEL ANALYSIS
STANDARD STEP WATER SURFACE PROFILE

January 7, 1994
craig rd - concrete channel

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	1200.0
Channel Bottom Slope (feet per foot).....	0.0020
Manning's Roughness Coefficient (n-value).....	0.0160
Channel Side Slope - Left Side (horizontal/vertical)....	0.00
Channel Side Slope - Right Side (horizontal/vertical)...	0.00
Channel Bottom Width (feet).....	29.0
Channel Flow-Line Elevation at Starting Station (feet)..	16.45
Water Surface Elevation at Starting Station (feet).....	21.08
Starting Channel Station (feet).....	1000.00

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	4.42
Critical Depth (feet).....	3.76

Station (ft)	Flowline (ft)	WS Elev. (ft)	Depth (ft)	Flow Area (sq ft)	Vel (fps)	Velocity Head(ft)	EGL Slope (ft/ft)
1000.0	16.45	21.08	4.63	134.27	8.94	1.240	0.001736
1240.0	16.93	21.45	4.52	131.15	9.15	1.300	0.001864

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Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

SANTA CATALINA Ave

Sect# S1

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	7	Bed Slope:	0.00600	Max Elev:	2252.0
Bank Stations.....Left:	1000.0	Right....:	1060.0	Min Elev:	2251.9
Encroachment Stations..Left:	1006.0	Right....:	1060.0		
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.020	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2254.0	1000.0	2)	2252.0	1006.0	3)	2251.9	1018.0	4)	2252.0	1035.0
5)	2251.9	1055.0	6)	2252.0	1060.0	7)	2254.0	1120.0			

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
2252.00	2.1	0.8	0.616	0.020	0.1	54.0	2.7	54.0
2252.50	114.8	3.9	0.918	0.020	0.6	54.0	29.7	54.0
2253.00	337.1	5.9	1.022	0.020	1.1	54.0	56.7	54.0
2253.50	645.2	7.7	1.091	0.020	1.6	54.0	83.7	54.0
2254.00	1028.1	9.3	1.143	0.020	2.1	54.0	110.7	54.0

NOTES:

Q_{100} = 831 cfs

WSEL = 2253.74'

ZONE A
EXISTING)

9.8

FP=2252.88

9.7

FP=2252.09

JAY AVE

2250

2250

ERM10

LIMIT OF DETAILED STUDY

MICHAEL WAY

ZONE
(EXIST

ZONE AE

2253

2254

VENICE

BAY CIR

CABRILLO CIR

LIMITS OF DETAILED STUDY

MIRAMAR

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ANNING • ENGINEERING
DSCAPE ARCHITECTURE

Project NWVL

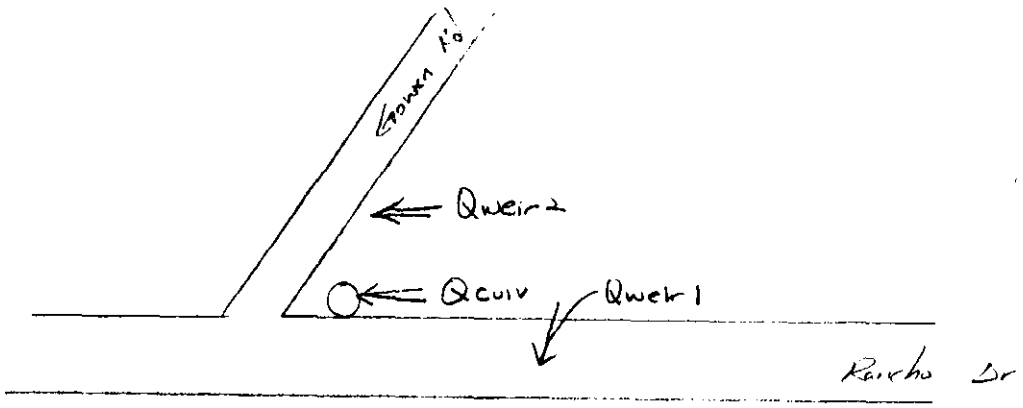
Project No. 8017

Sheet No. _____ of _____

Calculated by YL Date 10/27/83

Checked by _____ Date _____

Ratings @ Gowan & Rancho Intersection



* Refer to hydrology notebook

Elev.	Qculv	Qweir 1	Qweir 2	Qtotal
44.4 (INV)	0	0	0	0
52	170	0	0	170
52.5	181	—	—	—
53.0	189	393	117	699
53.4	195	1037	221	1453
53.8	202	1982	344	2528

↳ assumed inlet Control

COE & VAN LOO
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project _____

Project No. _____

Sheet No. _____ of _____

Calculated by _____ Date _____

Checked by _____ Date _____

Diversion through 4'x4' RCB to Gowan Storm Drain

DI	0	170	699	1453	2528
DQ	0	170	189	185	202

Weir flow over Gowan (to South)

DI	0	510	1258	2326
DQ	0	117	221	344
EL		53.0	53.4	53.8

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 6, 1993
4'x 4' RCB @ RANCHO & GOWAN
INLET CONTROL ASSUMED

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	4.00
Culvert Rise (Height of Opening) (feet).....	4.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	100.0
Culvert Slope (feet per foot).....	0.0100

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
100.0	4.00	4.36	4.16	2.01	2.69	2.01	12.41
120.0	4.00	5.31	4.67	2.31	3.03	2.31	12.97
140.0	4.00	6.19	5.28	2.60	3.36	2.60	13.44
160.0	4.00	7.09	5.98	2.89	3.68	2.89	13.84
180.0	4.00	8.11	6.77	3.17	4.00	3.17	14.19
200.0	4.00	9.26	7.65	3.45	4.00	3.45	14.49
220.0	4.00	10.52	8.63	3.73	4.00	3.73	14.76

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Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Weir over Rancho to east

Weir # 1

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	9	Bed Slope:	0.00500	Max Elev:	54.5
Bank Stations.....Left:	970.0	Right....:	1960.0	Min Elev:	52.2
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.020	CHANNEL..:	0.020	ROB.....:	0.020

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	52.5	970.0	2)	52.2	975.0	3)	52.2	1000.0	4)	52.2	1060.0
5)	52.5	1065.0	6)	52.7	1350.0	7)	53.5	1620.0	8)	54.0	1805.0
9)	54.5	1960.0									

C = 3.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	Avg d (ft)	$Q = C L y^{3/2}$
52.80	243.6	2.2	0.744	0.020	0.3	413.7	111.3	413.8	0.27	174
53.00	589.0	2.9	0.800	0.020	0.4	481.2	200.8	481.3	0.42	393
53.20	1076.0	3.5	0.839	0.020	0.6	548.8	303.8	548.8	0.55	672
53.40	1710.8	4.1	0.869	0.020	0.7	616.3	420.3	616.3	0.68	1,037
53.60	2494.7	4.5	0.892	0.020	0.8	687.0	550.4	687.0	0.80	1,474
53.80	3439.1	4.9	0.912	0.020	0.9	761.0	695.2	761.0	0.91	1,982

NOTES:

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Weir over Gorian to South

Weir #2

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	3	Bed Slope:	0.00500	Max Elev:	52.5
Bank Stations.....Left:	1000.0	Right....:	1060.0	Min Elev:	52.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.020	CHANNEL..:	0.020	ROB.....:	0.020

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	52.5	1000.0	2)	52.0	1057.0	3)	52.0	1060.0			

COMPUTED PARAMETERS:

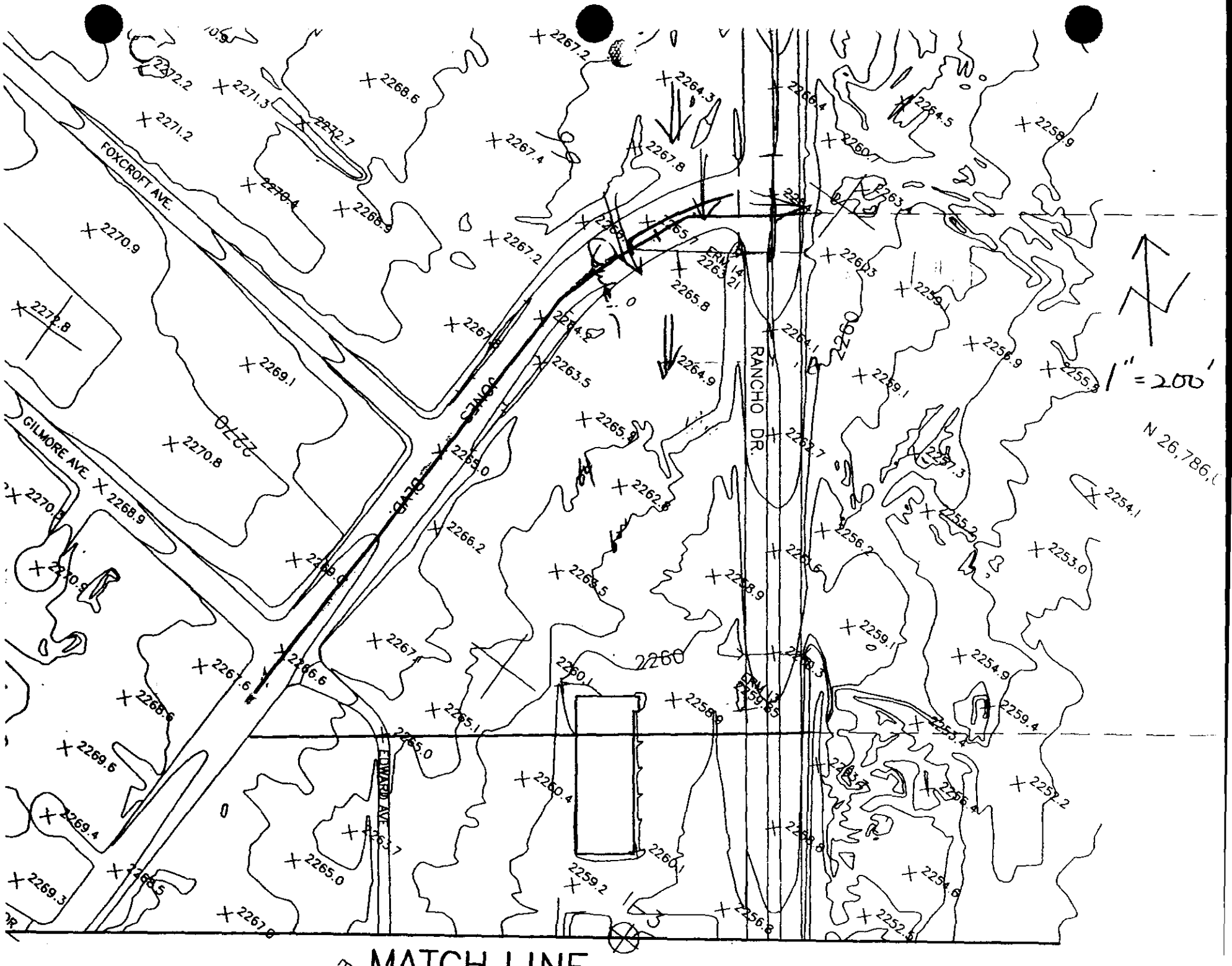
WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
52.80	120.8	3.6	0.841	0.020	0.6	60.0	33.7	60.0
53.00	200.6	4.4	0.885	0.020	0.8	60.0	45.8	60.0
53.20	295.8	5.1	0.920	0.020	1.0	60.0	57.8	60.0
53.40	405.1	5.8	0.949	0.020	1.2	60.0	69.8	60.0
53.60	527.8	6.5	0.975	0.020	1.4	60.0	81.7	60.0
53.80	663.2	7.1	0.997	0.020	1.6	60.0	93.7	60.0

NOTES:

Weir flow

$C = 2.95$

Avg d (ft)	$Q = CLH^{3/2}$
0.56	74
0.76	117
0.96	166
1.16	221
1.36	281
1.56	344


FOXCROFT AVE.
GILMORE AVE.
EDWARD AVE.
RANCHO DR.
2260
1" = 200'
MATCH LINE

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

COMPUTATIONS

LOCATION/DESCRIPTION:

Jones and Rancho Dr Intersection

Weir flow over Jones

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points: 18 Bed Slope:0.00500 Max Elev: 2266.2
Bank Stations.....Left: 10000.0 Right....:10990.5 Min Elev: 2264.4
Encroachment Stations..Left: Right....:
Manning-n Values.....LOB: 0.030 CHANNEL..: 0.030 ROB.....: 0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2265.6	10000.0	2)	2265.5	10030.4	3)	2264.8	10052.8	4)	2265.5	10086.4
5)	2265.6	10132.3	6)	2265.9	10152.0	7)	2266.2	10219.7	8)	2265.5	10289.2
9)	2265.5	10304.3	10)	2265.3	10386.3	11)	2264.9	10418.9	12)	2264.4	10488.4
13)	2264.4	10559.5	14)	2264.7	10641.4	15)	2265.0	10708.1	16)	2265.6	10790.0
17)	2265.9	10890.0	18)	2266.0	10990.5						

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	Avg d (ft)	$Q = Cy^{3/2}$, C = 2.9
2264.60	21.9	1.0	0.448	0.030	0.1	153.6	22.5	153.6	0.146	25
2264.80	88.4	1.4	0.495	0.030	0.3	230.9	61.2	230.9	0.265	91
2265.00	209.1	1.8	0.523	0.030	0.4	313.4	115.9	313.4	0.370	204
2265.20	404.2	2.2	0.549	0.030	0.5	372.9	184.5	372.9	0.495	377
2265.40	644.3	2.4	0.563	0.030	0.6	465.3	266.6	465.3	0.573	585
2265.60	919.8	2.4	0.564	0.030	0.6	643.0	375.7	643.1	0.584	832

NOTES:

300 cfs — EGL 2265.11

516 — EGL 2265.4

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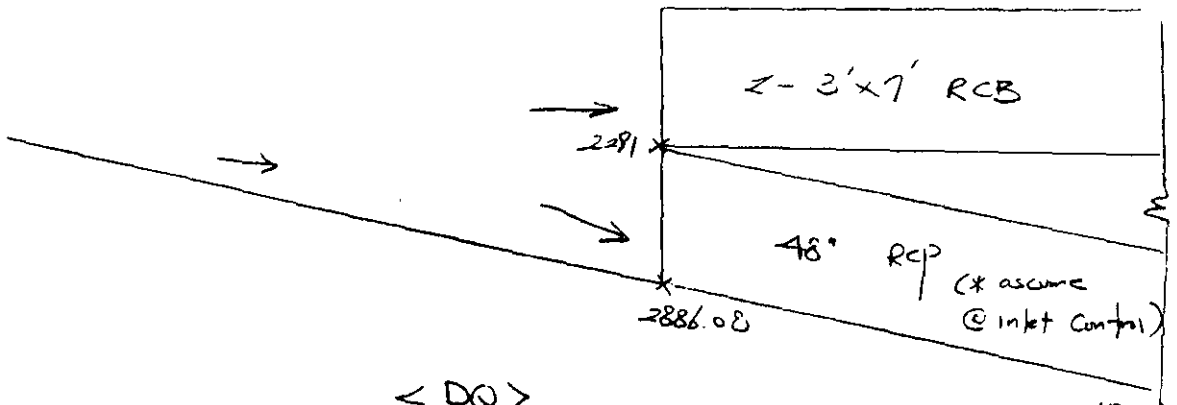
Project NAVAJO'S
Project No 82017
Sheet No _____ of _____
Calculated by JS Date 3/15/84
Checked by _____ Date _____

Near Craig Rd and Rancho Dr. Intersection.



	<DQ>		<DI>
ELEV	Q 48" rcp	Q 2-3'x7' RCB	Qtotal
2886.08	0	0	0
2889.17	50	0	50
2891.0	103	0	103
2892.0	126	40	166
2893.5	155	154	310
2895.0	180	275	454

Q100	WSEL
180	2892.1

PIPE CULVERT ANALYSIS

CULVERT PERFORMANCE CURVE

March 28, 1994

48" RCP STORM DRAIN PIPE UNDER CRAIG RD

INV = 2286.08

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)	4.00
FHWA Chart Number (1,2 or 3)	1
Scale Number on Chart (Type of Culvert Entrance)	2
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	200.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	2.00	1.25	-7.52	0.48	0.92	0.48	11.56
20.0	2.00	1.81	-7.26	0.68	1.32	0.68	14.23
30.0	2.00	2.27	-6.99	0.83	1.62	0.83	16.04
40.0	2.00	2.69	-6.71	0.96	1.89	0.96	17.22
50.0	2.00	3.09	-6.40	1.07	2.12	1.07	18.54
60.0	2.00	3.47	-6.06	1.17	2.33	1.17	19.57
70.0	2.00	3.85	-5.69	1.27	2.53	1.27	20.45
80.0	2.00	4.23	-5.27	1.36	2.71	1.36	21.22
90.0	2.00	4.63	-4.83	1.45	2.88	1.45	21.94
100.0	2.00	4.83	-4.34	1.53	3.03	1.53	22.58
110.0	2.00	5.19	-3.82	1.61	3.17	1.61	23.17
120.0	2.00	5.62	-3.26	1.69	3.30	1.69	23.69
130.0	2.00	6.08	-2.67	1.77	3.41	1.77	24.22
140.0	2.00	6.58	-2.04	1.85	3.51	1.85	24.71
150.0	2.00	7.12	-1.38	1.91	3.60	1.91	25.25
160.0	2.00	7.69	-0.68	1.99	3.67	1.99	25.56
170.0	2.00	8.30	0.06	2.07	3.73	2.07	25.91
180.0	2.00	8.95	0.83	2.15	3.77	2.15	26.18
190.0	2.00	9.63	1.65	2.21	3.81	2.21	26.64
200.0	2.00	10.35	2.50	2.29	3.85	2.29	26.93

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BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 28, 1994
2 - 7' X 3' RCB UNDER CRAIG RD
INV = 1291

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	7.00
Culvert Rise (Height of Opening) (feet)	3.00
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0130
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	200.0
Culvert Slope (feet per foot)	0.0500

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	2.00	0.99	-7.97	0.28	0.63	0.28	10.34
40.0	2.00	1.59	-7.88	0.43	1.00	0.43	13.43
60.0	2.00	2.10	-7.57	0.55	1.32	0.55	15.58
10.0	2.00	0.62	-7.99	0.18	0.40	0.18	7.92
20.0	2.00	0.99	-7.97	0.28	0.63	0.28	10.34
30.0	2.00	1.30	-7.93	0.36	0.83	0.36	12.06
40.0	2.00	1.59	-7.88	0.43	1.00	0.43	13.43
50.0	2.00	1.85	-7.73	0.49	1.17	0.49	14.59
60.0	2.00	2.10	-7.57	0.55	1.32	0.55	15.58
70.0	2.00	2.33	-7.41	0.61	1.46	0.61	16.48
80.0	2.00	2.56	-7.23	0.66	1.59	0.66	17.29
90.0	2.00	2.78	-7.03	0.71	1.73	0.71	18.03
100.0	2.00	2.99	-6.83	0.76	1.85	0.76	18.72
110.0	2.00	3.19	-6.61	0.81	1.97	0.81	19.36
120.0	2.00	3.39	-6.38	0.86	2.09	0.86	19.96
130.0	2.00	3.68	-6.14	0.90	2.20	0.90	20.52
140.0	2.00	4.11	-5.88	0.95	2.32	0.95	21.05
150.0	2.00	4.39	-5.61	0.99	2.42	0.99	21.56

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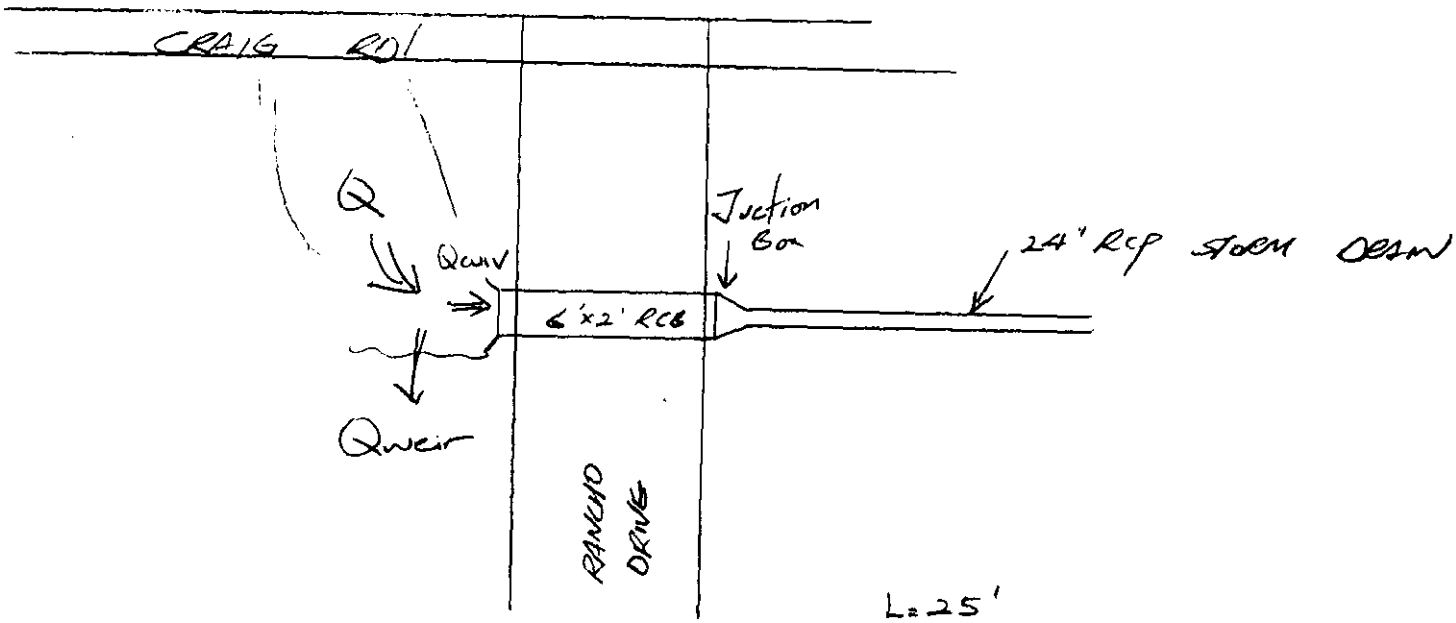
Project VALLEY VIEW
Project No. 83017
Sheet No. _____ of _____
Calculated by JS Date 3/28/84
Checked by _____ Date _____



L=25'
C=2.7

Elev	Qcurv	Qweir	Qtotal
87.40	0	0	0
89.40	47	0	47
89.80	60	17	88

Assume 24" RCP can carry up to 60 cfs

DI	0	47	88	150	500
DQ	0	47	60	60	60

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 28, 1994
6' X 2' RCB UNDER RANCHO DR. NEAR CRAIG RD

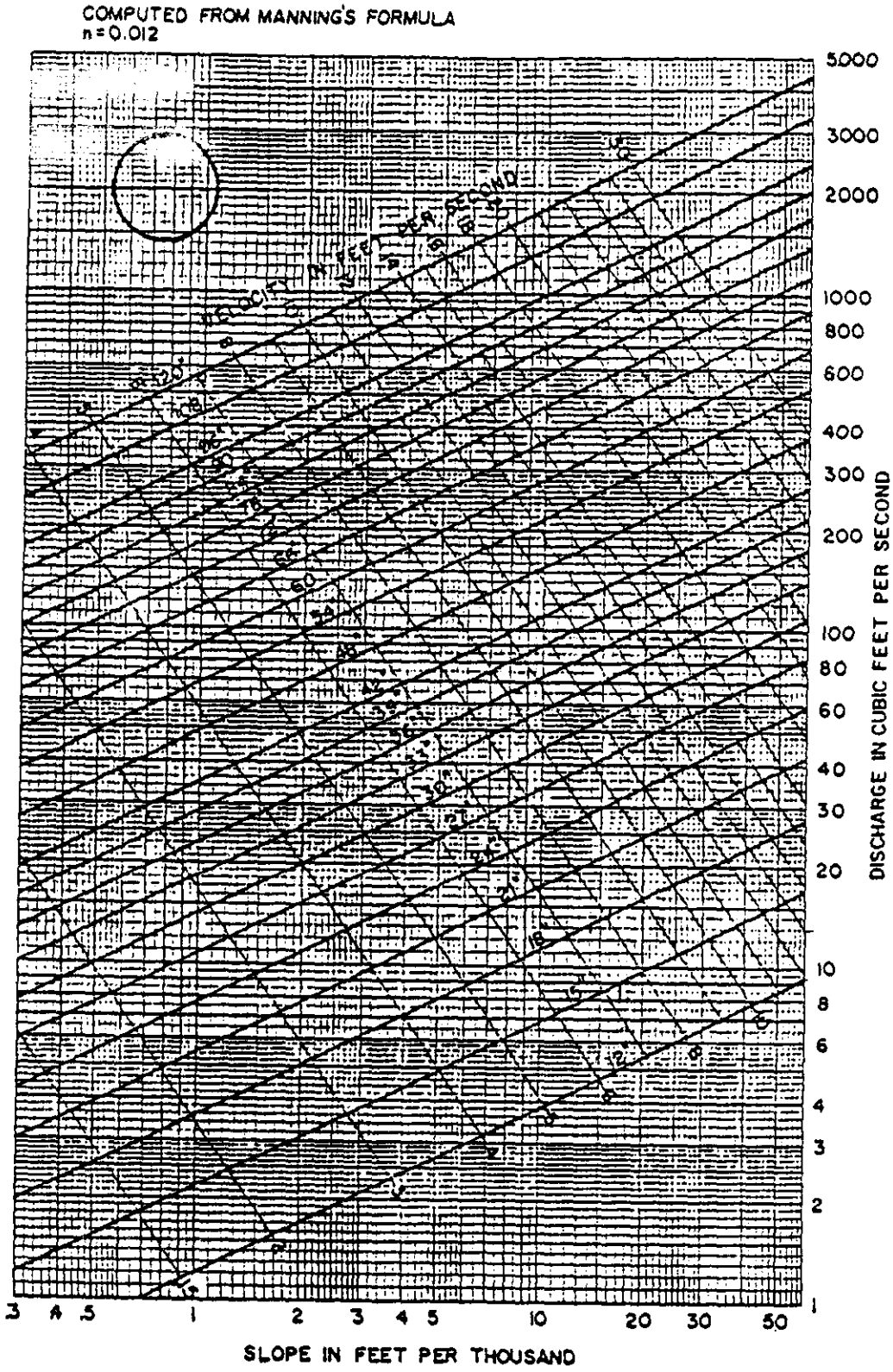
PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet)	6.00
Culvert Rise (Height of Opening) (feet)	2.00
FHWA Chart Number (8,9,10,11,12 or 13)	8
Scale Number on Chart (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.0120
Entrance Loss Coefficient of Culvert Opening	0.20
Culvert Length (feet)	110.0
Culvert Slope (feet per foot)	0.0100

PROGRAM RESULTS:

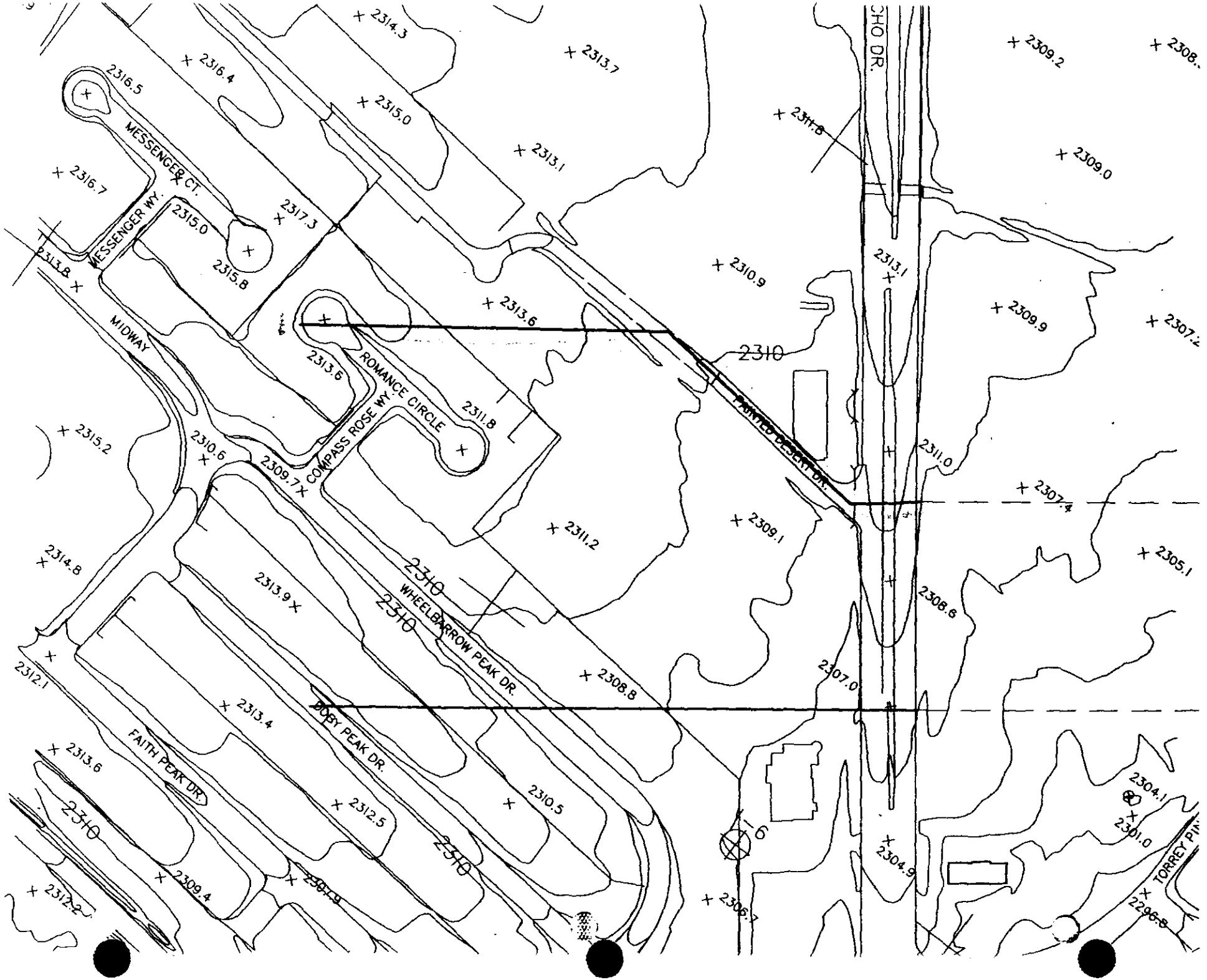
Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	2.00	0.69	0.92	0.31	0.44	2.00	0.83
20.0	2.00	1.11	0.98	0.48	0.70	0.48	6.91
30.0	2.00	1.47	1.08	0.63	0.92	0.63	7.99
40.0	2.00	1.79	1.22	0.75	1.11	0.75	8.84
50.0	2.00	2.09	1.41	0.87	1.29	0.87	9.54
60.0	2.00	2.40	1.63	0.99	1.46	0.99	10.15
70.0	2.00	2.93	1.89	1.09	1.62	1.09	10.68
80.0	2.00	3.33	2.19	1.20	1.77	1.20	11.15
90.0	2.00	3.79	2.54	1.30	1.91	1.30	11.58
100.0	2.00	4.29	2.92	1.39	2.00	1.39	11.97
110.0	2.00	4.85	3.35	1.49	2.00	1.49	12.33
120.0	2.00	5.47	3.81	1.58	2.00	1.58	12.66
130.0	2.00	6.14	4.32	1.67	2.00	1.67	12.97
140.0	2.00	6.86	4.86	1.76	2.00	1.76	13.26
150.0	2.00	7.64	5.45	1.85	2.00	1.85	13.54

BOX CULVERT ANALYSIS COMPUTER PROGRAM Version 1.6 Copyright (c) 1986 Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092 (713) 895-8322. All Rights Reserved.



DISCHARGE CAPACITY OF CONCRETE PIPE FLOWING FULL

FIGURE 3-51


MESSENGER CT.
MESSENGER WY.
MIDWAY
ROMANCE CIRCLE
COMPASS ROSE WY.
PAINTED DESERT DR.
WHEELBARROW PEAK DR.
DOBSY PEAK DR.
FAITH PEAK DR.
TORREY PI
2316.5
2316.4
2314.3
2313.7
2315.0
2311.8
2313.1
2316.7
2315.0
2317.3
2315.8
2313.8
2310.9
2313.6
2313.6
2311.8
2315.2
2310.6
2309.7
2311.2
2309.1
2314.8
2313.9
2310
2310
2308.8
2307.0
2312.1
2313.4
2313.6
2312.5
2310.5
2310
2309.4
2307.9
2312.2
2309.2
2308.
2309.0
2309.9
2307.2
2310
2311.0
2307.4
2305.1
2308.6
2304.1
2301.0
2304.9
2306.2
2296.8

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Painted Desert Drive Weir Section

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points: 18 Bed Slope:0.00500 Max Elev: 2310.7
Bank Stations.....Left: 10013.2 Right....:10407.9 Min Elev: 2309.3
Encroachment Stations..Left: Right....:
Manning-n Values.....LOB: 0.030 CHANNEL..: 0.030 ROB.....: 0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2310.7	10013.2	2)	2310.2	10014.1	3)	2310.3	10016.4	4)	2310.3	10028.0
5)	2309.6	10041.8	6)	2309.6	10054.1	7)	2309.5	10069.2	8)	2309.4	10092.8
9)	2309.3	10115.1	10)	2309.4	10142.3	11)	2309.5	10175.8	12)	2309.4	10208.8
13)	2309.4	10239.5	14)	2309.6	10274.3	15)	2309.7	10308.9	16)	2310.0	10343.6
17)	2310.1	10380.6	18)	2310.3	10407.9						

C = 2.9

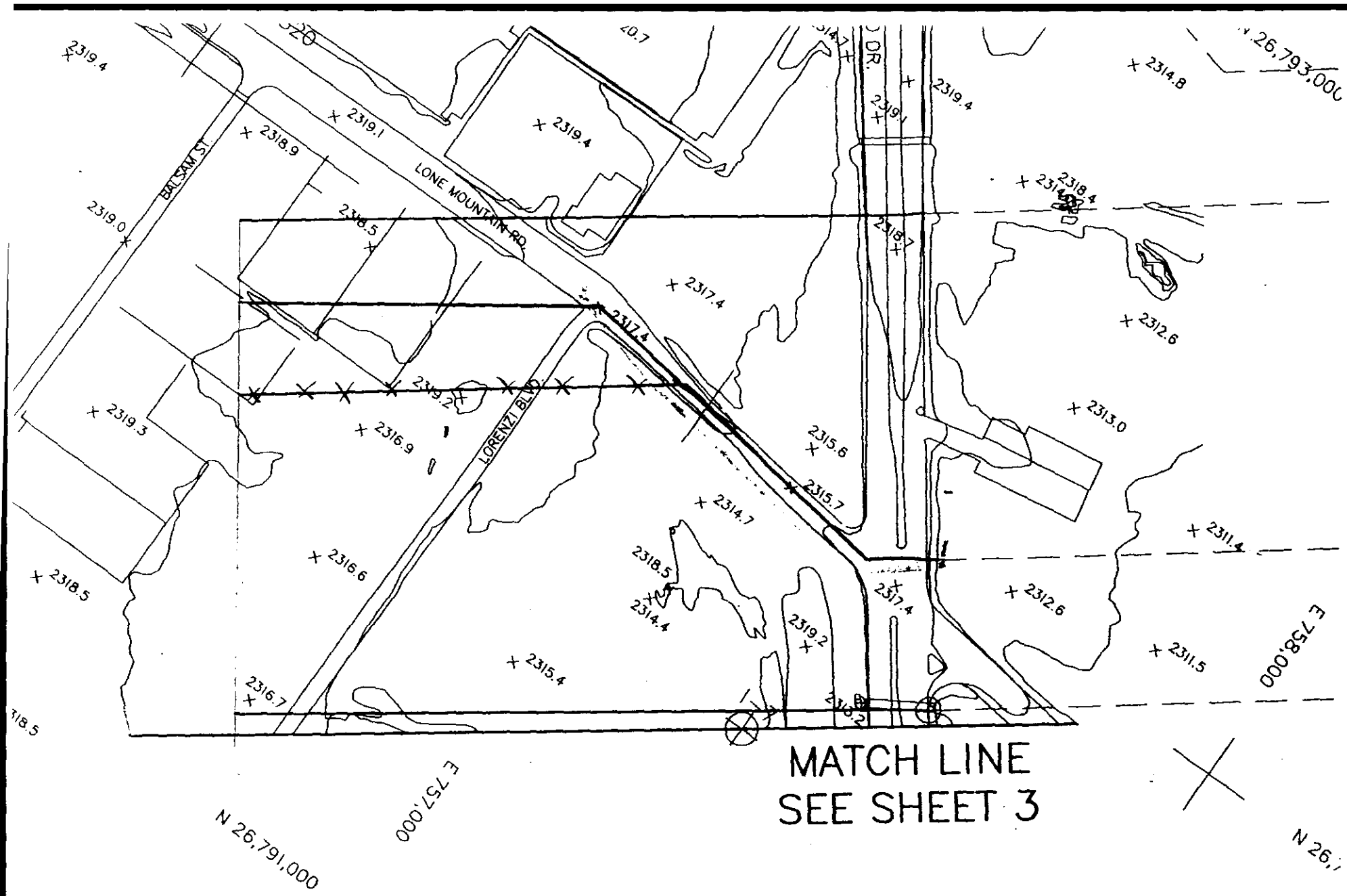
COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	Avg Depth (ft)	$Q = CLH^{3/2}$
2310.60	1254.7	3.4	0.611	0.030	0.9	394.5	372.4	394.6	0.94	1043
2310.40	844.1	2.9	0.588	0.030	0.7	394.2	293.4	394.2	0.74	728
2310.20	536.9	2.5	0.566	0.030	0.6	364.3	216.7	364.3	0.59	479
2310.00	317.4	2.1	0.546	0.030	0.5	309.7	148.2	309.7	0.48	299
2309.80	144.1	1.6	0.509	0.030	0.3	282.6	88.9	282.6	0.31	141
2309.60	38.2	1.1	0.457	0.030	0.2	220.2	36.3	220.2	0.16	41

NOTES:

Q_{100} = 160 wsel = 2309.78

TW = 2309.53


BALSAM ST.
LONE MOUNTAIN RD.
LORENZI BLVD.
2319.4
2319.1
2318.9
2319.0
2318.5
2319.3
2316.5
2316.9
2316.6
2316.7
2317.4
2317.4
2319.2
2315.6
2315.7
2314.7
2318.5
2314.4
2315.4
2319.2
2316.2
2317.4
2319.4
2319.1
2314.8
2318.4
2318.7
2317.4
2312.6
2313.0
2311.4
2312.6
2311.5
N 26,793,000
E 758,000
E 757,000
N 26,791,000
MATCH LINE
SEE SHEET 3

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Lone Mountain Rd 4 Weir Sect.

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	18	Bed Slope:	0.00500	Max Elev:	2318.3
Bank Stations.....Left:	1280.0	Right....:	10955.0	Min Elev:	2315.3
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.030	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2318.3	1280.0	2)	2317.6	10069.8	3)	2317.2	10092.4	4)	2316.8	10106.2
5)	2316.6	10116.2	6)	2316.7	10116.4	7)	2315.9	10145.5	8)	2315.7	10180.0
9)	2315.3	10216.0	10)	2315.6	10256.6	11)	2315.6	10288.6	12)	2315.6	10327.8
13)	2315.8	10374.3	14)	2315.9	10427.2	15)	2316.2	10479.5	16)	2316.4	10519.9
17)	2317.4	10690.0	18)	2318.0	10955.0						

$C = 2.9$

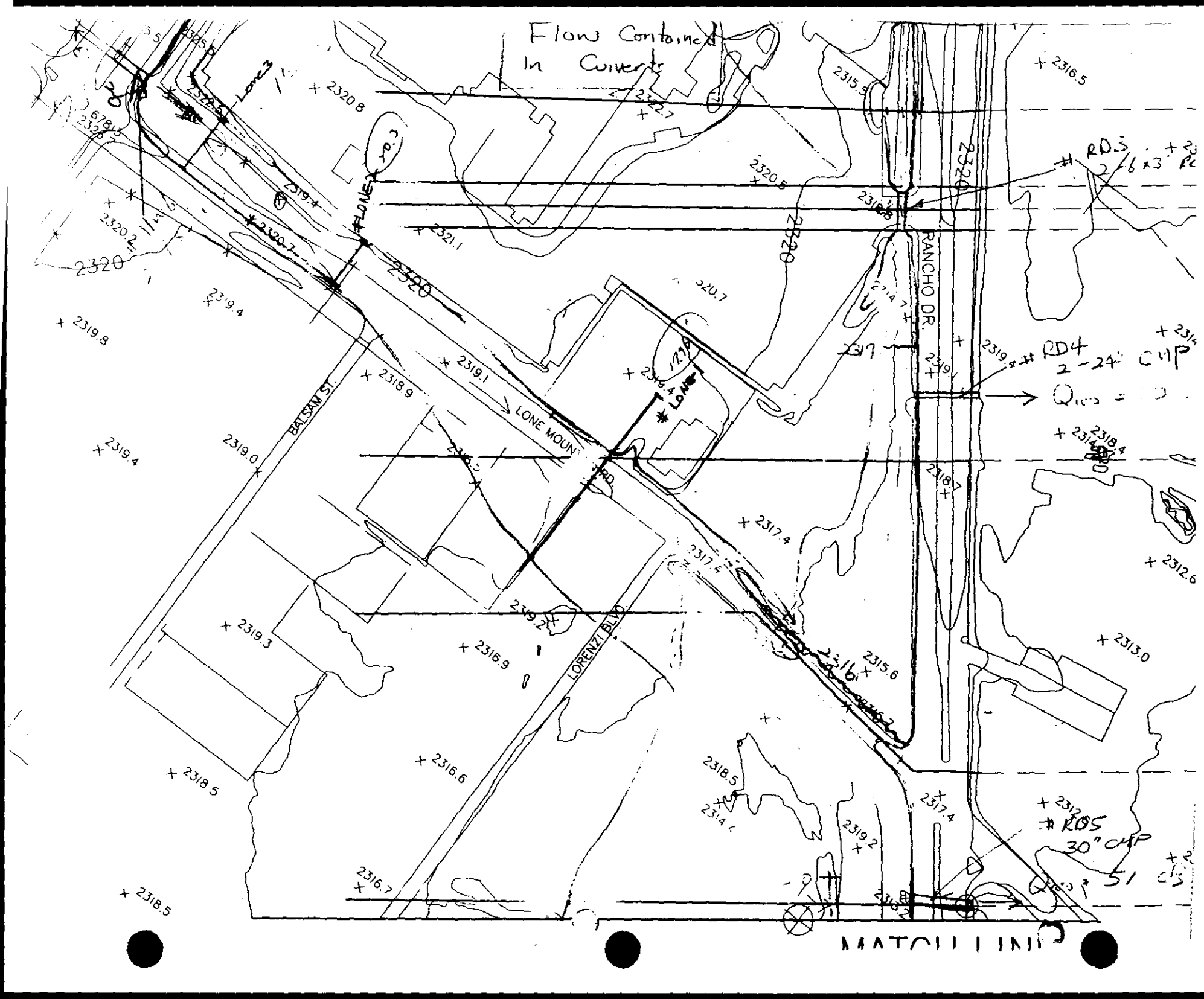
COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	Adj depth	$Q = CLy^{3/2}$
2316.80	1297.9	3.2	0.601	0.030	0.9	481.8	411.6	481.8	0.85	1095
2316.60	914.2	2.9	0.587	0.030	0.7	433.9	319.9	433.9	0.74	801
2316.40	593.5	2.5	0.567	0.030	0.6	392.6	237.1	392.6	0.62	529
2316.20	347.8	2.1	0.545	0.030	0.5	344.9	163.4	344.9	0.47	322 <
2316.00	163.6	1.7	0.512	0.030	0.3	302.8	98.6	302.8	0.33	166
2315.80	55.7	1.2	0.476	0.030	0.2	211.6	44.8	211.6	0.21	60

NOTES:

$Q_{100} = 350$, WSEL = 2316.17'

$Q_{100} = 150$, WSEL = 2315.97'


Flow Contained In Culverts
RANCHO DR.
BALSAM ST.
LONE MOUNTAIN RD.
LORENZI BLVD.
RD4
2-24" CMP
RD5
30" CMP
MATCH LINE

Project KINGVFIS
Project No. 30017
Sheet No. _____ of _____
Calculated by _____ Date _____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Long Mountain RD #Lane 1
between BALSAM ST & LORENZI BLVD

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	8	Bed Slope:	0.00650	Max Elev:	19.0
Bank Stations.....Left:	1125.0	Right....:	1380.0	Min Elev:	17.2
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.035	CHANNEL..:	0.025	ROB.....:	0.035

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	19.0	1000.0	2)	18.0	1125.0	3)	17.4	1142.0	4)	18.0	1170.0
5)	18.2	1185.0	6)	18.0	1205.0	7)	17.2	1233.0	8)	18.0	1380.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
18.00	209.7	2.5	0.719	0.025	0.4	220.0	83.5	220.0
17.90	144.2	2.3	0.702	0.025	0.3	190.6	63.0	190.7
17.80	93.4	2.1	0.684	0.025	0.3	161.2	45.4	161.3
17.70	55.7	1.8	0.662	0.025	0.2	131.9	30.7	131.9
17.60	29.6	1.6	0.638	0.025	0.2	102.5	19.0	102.5
17.50	13.2	1.3	0.608	0.025	0.1	73.1	10.2	73.1

NOTES:

$Q_{100} = 170$, WSEL = 17.96

Avg d = 0.36'

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Lone Mountain Rd #LONE2

111' North of Balsam st

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	4	Bed Slope:	0.00200	Max Elev:	2320.0
Bank Stations.....Left:	1000.0	Right....:	1090.0	Min Elev:	2319.0
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.030	CHANNEL..:	0.025	ROB.....:	0.030

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2320.0	1000.0	2)	2319.0	1035.0	3)	2319.0	1045.0	4)	2320.0	1090.0

COMPUTED PARAMETERS:

WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
2320.00	89.8	1.8	0.425	0.025	0.6	90.0	50.0	90.0
2320.20	149.9	2.2	0.447	0.025	0.8	90.0	68.0	90.0
2320.40	221.7	2.6	0.465	0.025	1.0	90.0	86.0	90.0
2320.60	304.4	2.9	0.480	0.025	1.2	90.0	104.0	90.0

NOTES:

Q_{100} = 170 cfs

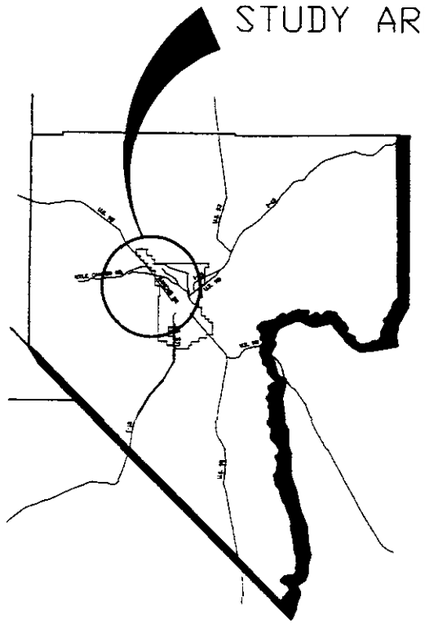
Avg d. 0.85'

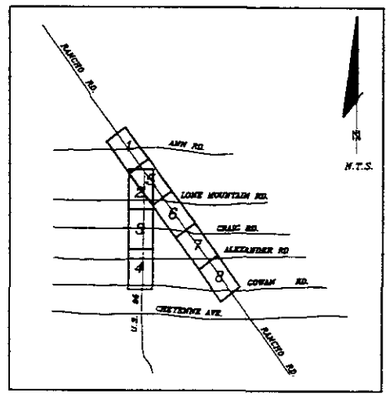
Section 4
Floodplain Delineation Maps

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
FLOODPLAIN DELINEATION MAPS

FOR

NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY
HIGHWAY 95 AND RANCHO DRIVE





INDEX MAP

NOTE:

THE STUDY AREA INCLUDES LAND WITHIN THE JURISDICTION OF THE CITY OF LAS VEGAS, THE CITY OF NORTH LAS VEGAS, AND CLARK COUNTY. ALL ANALYSES AND FLOODPLAIN DELINEATIONS WERE REVIEWED AND APPROVED BY A COMMITTEE COMPRISED OF REPRESENTATIVES OF THE CCRFCD AND THE AFOREMENTIONED JURISDICTIONS.

REGISTERED PROFESSIONAL ENGINEER · STATE OF NEVADA
PAUL W.R. HOSKIN
CIVIL
No. 9845

8/24/xx

COE & VAN LOO

. PLANNING . ENGINEERING
. LANDSCAPE . ARCHITECTURE

4550 N 12TH ST. PHOENIX, AZ 85014 (602) 264-6831
500 E TROPICANA AVE, SUITE 110, A-19 LAS VEGAS, NV 89119 (702) 798-8240

SHEET 1A

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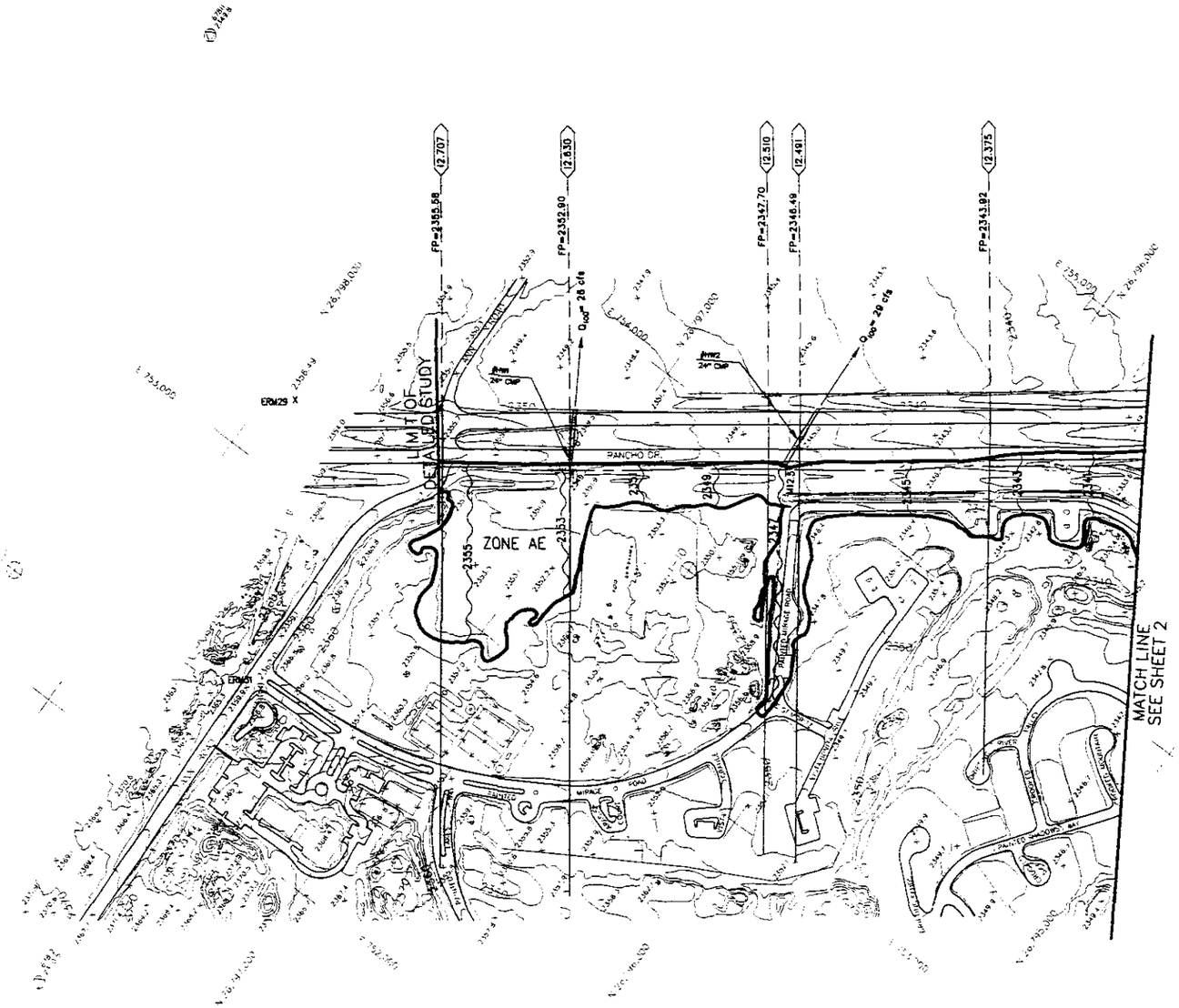


CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

FLOODPLAIN DELINEATION FOR

RANCHO DRIVE

LEGEND

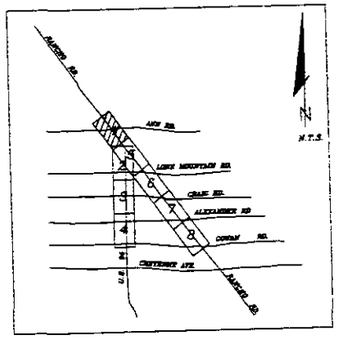
100-YR FLOODPLAIN BOUNDARY	
HYDRAULIC BASE LINE WITH RIVER MILE	M12.0 — M13.0
CROSS SECTION	FP=100 Yr WSE
ELEVATION REFERENCE MARK	ERM3 X
BASE FLOOD ELEVATIONS	2211
ZONE DESIGNATIONS	ZONE AE
ZONE LIMIT	XXXXXXXXXX
STRUCTURE CROSS-REFERENCE NO.	

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL VERTICAL DATUM OF 1988

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
ERM29	2356.49	BRASS CAP USC & GS 3M & 5199 (RESET 1983), 400' NORTHWEST OF ANN ROAD, 700' EAST OF U.S. 95. FLV90-275SN6
ERM31	2360.01	RIVET & PLATE IN T/C SOUTHWEST CORNER PAINTED MIRAGE ROAD & ANN ROAD. FLV90-348SN6

NOTES



200 0' 200 400
SCALE: 1"= 200'
CONTOUR INTERVAL = 2' FEET

RANCHO DRIVE 100-YEAR PEAK FLOW	
CROSS SECTION	FLOW (cfs)
12.375	765
12.491	527
12.510	527
12.630	555
12.707	555

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

SUBMITTED BY: PAUL W. R. HOSKIN, P.E.	DESIGN	BY Y.K.S.
	DESIGN CHK.	P.W.R.H./J.M.
	PLANS	M.G.P.
	PLANS CHK.	Y.K.S./P.W.R.H.
	SHEET	1 OF 8

COE & VAN LOO CONSULTANTS, INC.

CVL # 93001701 DWG. NAME: LVF1SS

AERIAL MAPPING COMPANY, INC.
PHOENIX, ARIZONA
FLIGHT DATE: 6-02-1993

THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1"= 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS AND IS BASED ON GROUND CONTROL SURVEY DATA PROVIDED BY PENTACORE SURVEYING, INC., LAS VEGAS, NEVADA.

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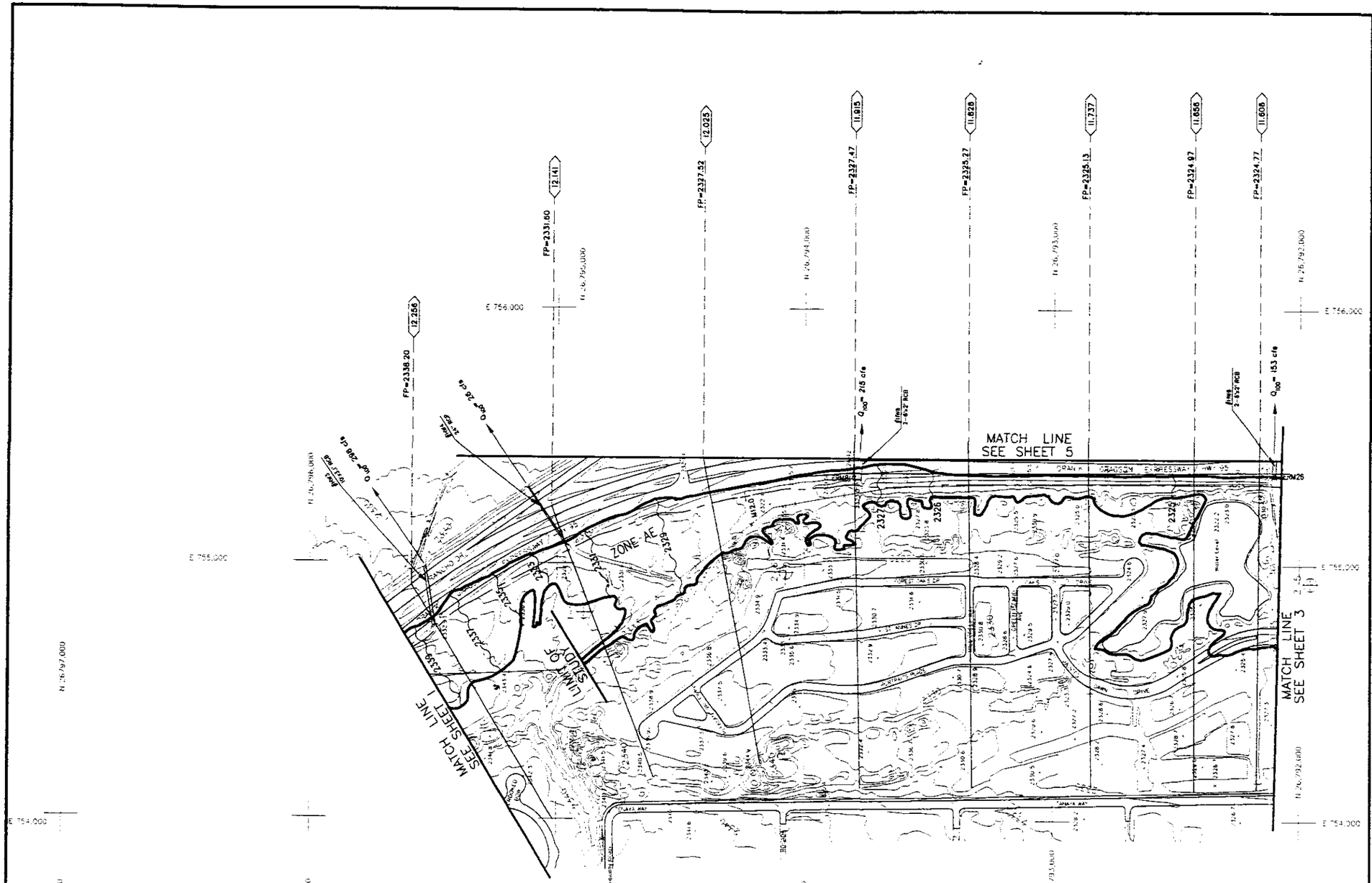


CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

FLOODPLAIN DELINEATION FOR

HIGHWAY 95

LEGEND

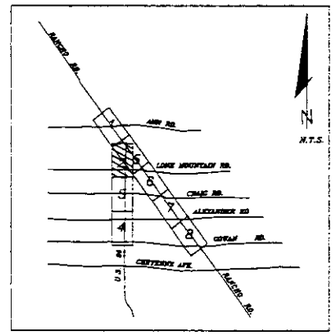
100-YR FLOODPLAIN BOUNDARY	
HYDRAULIC BASE LINE WITH RIVER MILE	M12.0 — M13.0
CROSS SECTION	10.0 — FP=100 Yr WSE — 10.0
ELEVATION REFERENCE MARK	ERM3 X
BASE FLOOD ELEVATIONS	2211
ZONE DESIGNATIONS	ZONE AE
ZONE LIMIT	XXXXXXXXX
STRUCTURE CROSS-REFERENCE NO.	p-m6

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL VERTICAL DATUM OF 1988

E.R. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
ERM8	2325.42	TOP OF SOUTHERLY END OF HEADWALL WEST SIDE OF U.S. 95 ON LINE WITH NORTH FENCE LINE OF SANTA FE PARKING LOT.
ERM26	2325.06	BROKEN RIVET IN TOP OF SOUTH END OF HEADWALL NORTHWEST CORNER OF LONE MOUNTAIN ROAD AND U.S. 95.

NOTES



200 0' 200 400

SCALE: 1" = 200'

CONTOUR INTERVAL = 2' FEET

HIGHWAY 95
100-YEAR PEAK FLOW

CROSS SECTION	FLOW (cfs)
11.606	225
11.656	225
11.737	225
11.828	225
11.915	437
12.025	437
12.141	467
12.256	765

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

SUBMITTED BY: PAUL W. R. HOSKIN, P.E.	DESIGN	BY Y.K.S.
	DESIGN CHK.	P.W.R.H./J.M.
	PLANS	M.G.P.
	PLANS CHK.	Y.K.S./P.W.R.H.
	SHEET	2 OF 8

COE & VAN LOO CONSULTANTS, INC.

CVL # 93001701 DWG. NAME: LVF2S3

AERIAL MAPPING COMPANY, INC.
PHOENIX, ARIZONA
FLIGHT DATE: 6-02-1993

THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1"= 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS AND IS BASED ON GROUND CONTROL SURVEY DATA PROVIDED BY PENTACORE SURVEYING, INC., LAS VEGAS, NEVADA.

REDUCED COPY
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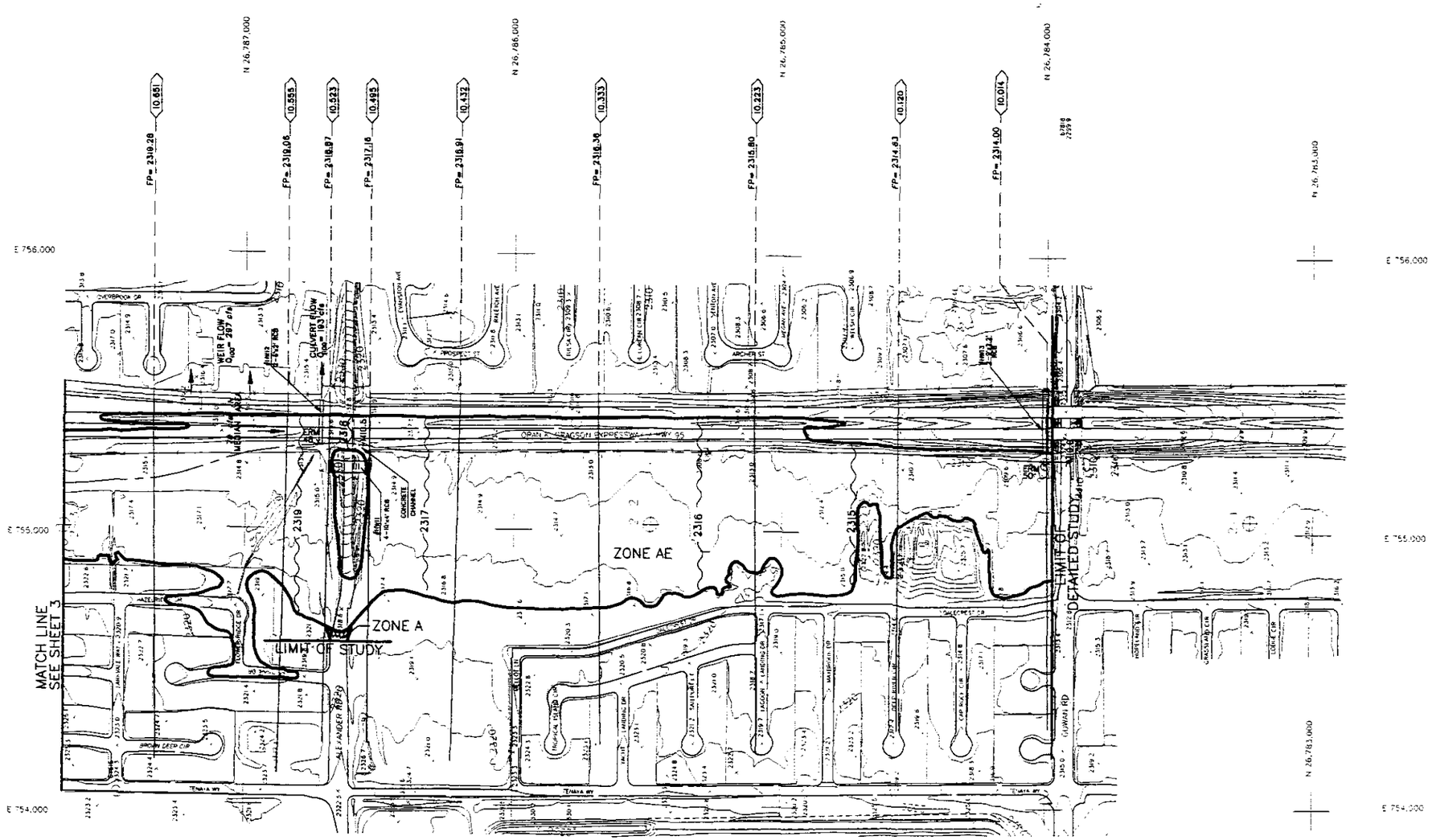
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

FLOODPLAIN DELINEATION FOR

HIGHWAY 95



LEGEND

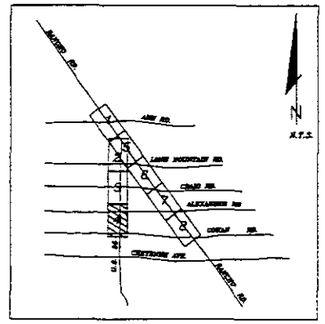
100-YR FLOODPLAIN BOUNDARY	
HYDRAULIC BASE LINE WITH RIVER MILE	M12.0 — M13.0
CROSS SECTION	10.0 — FP=100 Yr WSE — 10.0
ELEVATION REFERENCE MARK	ERM3 X
BASE FLOOD ELEVATIONS	~ 2211 ~
ZONE DESIGNATIONS	ZONE AE
ZONE LIMIT	XXXXXXXXX
STRUCTURE CROSS-REFERENCE NO.	

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL VERTICAL DATUM OF 1988

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
ERM48	2317.87	FOUND RIVET AND WASHER IN TOP OF WEST HEADWALL AT NORTHWEST SIDE OF ALEXANDER AND U.S. 95.
ERM50	2307.81	MIDDLE OF NORTH EDGE OF 7'x7' CONCRETE DRAIN INLET STRUCTURE 100' +/- WEST OF U.S. 95 AND 75' +/- NORTH OF GOWAN ROAD.

NOTES



200 0' 200 400
SCALE: 1"= 200'
CONTOUR INTERVAL = 2' FEET

HIGHWAY 95
100-YEAR PEAK FLOW

CROSS SECTION	FLOW (cfs)
10.014	2843
10.120	2843
10.223	2843
10.333	2843
10.432	2843
10.495	2843
10.523	3033
10.555	3033
10.651	3330

AERIAL MAPPING COMPANY, INC.
PHOENIX, ARIZONA
FLIGHT DATE: 6-02-1983

THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1"= 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS AND IS BASED ON GROUND CONTROL SURVEY DATA PROVIDED BY PENTACORE SURVEYING, INC., LAS VEGAS, NEVADA.

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

SUBMITTED BY: PAUL W. R. HOSKIN, P.E.	
DESIGN	BY Y.K.S.
DESIGN CHK.	P.W.R.H./J.M.
PLANS	M.G.P.
PLANS CHK.	Y.K.S./P.W.R.H.
SHEET	4 of 8

COE & VAN LOO CONSULTANTS, INC.

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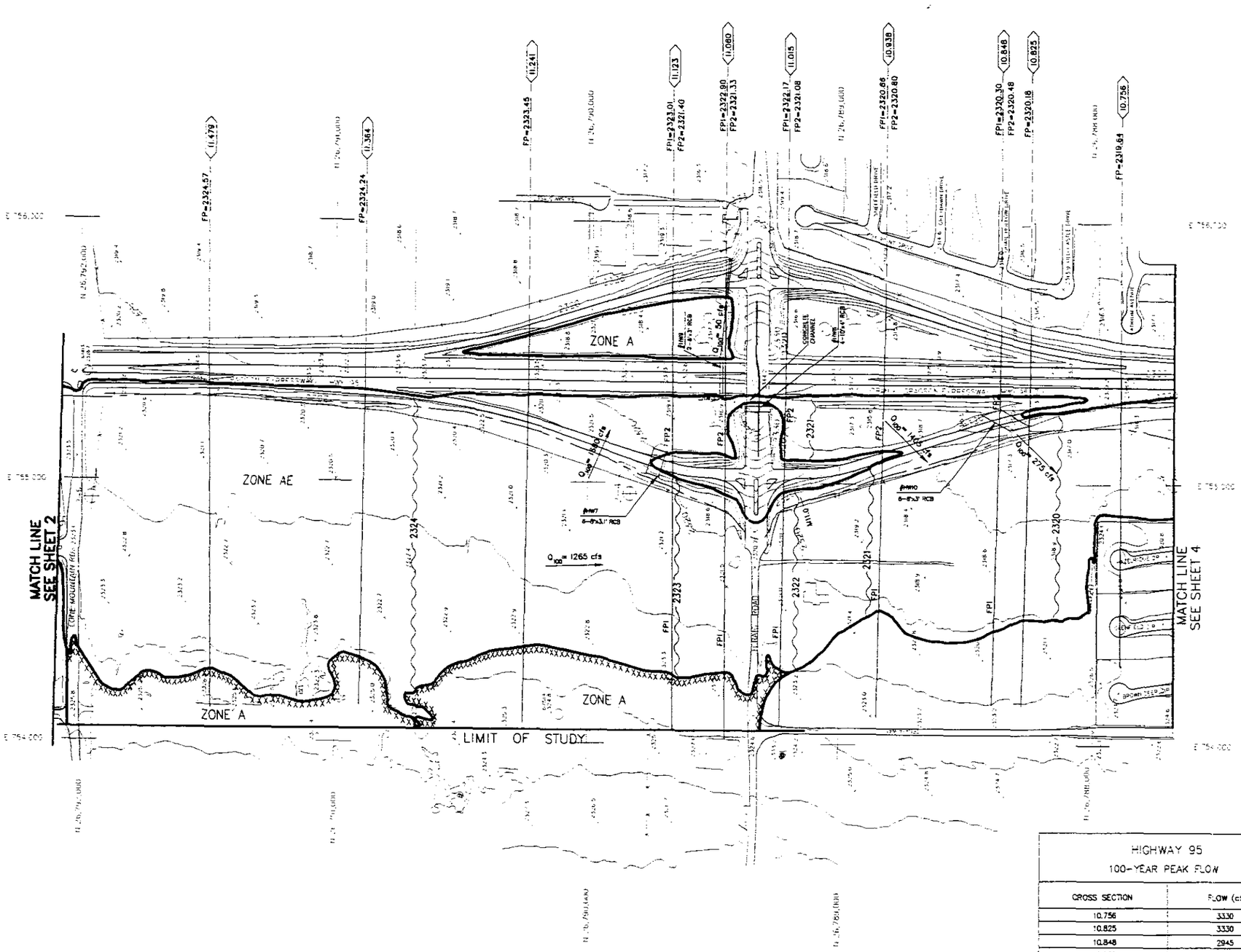
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

FLOODPLAIN DELINEATION FOR

HIGHWAY 95



LEGEND

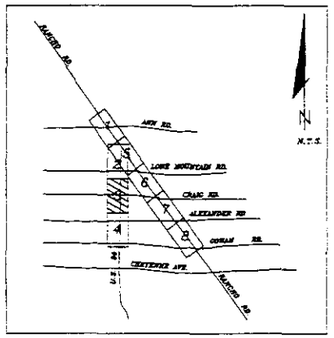
100-YR FLOODPLAIN BOUNDARY	
HYDRAULIC BASE LINE WITH RIVER MILE	M12.0 — M13.0
CROSS SECTION	10.0 — FP=100 YR WSE — 10.0
ELEVATION REFERENCE MARK	ERM3 X
BASE FLOOD ELEVATIONS	2211
ZONE DESIGNATIONS	ZONE AE
ZONE LIMIT	XXXXXXXXX
STRUCTURE CROSS-REFERENCE NO.	RHW8

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL VERTICAL DATUM OF 1988

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
ERM53	2322.85	SOUTH END OF HEADWALL 25' WEST OF EDGE OF PAVEMENT U.S. 95 SOUTHBOUND, 100' +/- NORTH OF CRAIG ROAD.

NOTES



200 0' 200 400

SCALE: 1" = 200'
CONTOUR INTERVAL = 2' FEET

HIGHWAY 95
100-YEAR PEAK FLOW

CROSS SECTION	FLOW (cfs)
10.756	3330
10.825	3330
10.848	2945
10.938	2945
11.015	2945
11.080	2945
11.123	2945
11.241	2945
11.364	2945
11.479	2945

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

SUBMITTED BY: PAUL W. R. HOSKIN, P.E.	
DESIGN	BY Y.K.S.
DESIGN CHK.	P.W.R.H./J.M.
PLANS	M.G.P.
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SHEET	3 OF 8

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PLANNING ENGINEERING LANDSCAPE ARCHITECTURE

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PHOENIX, ARIZONA
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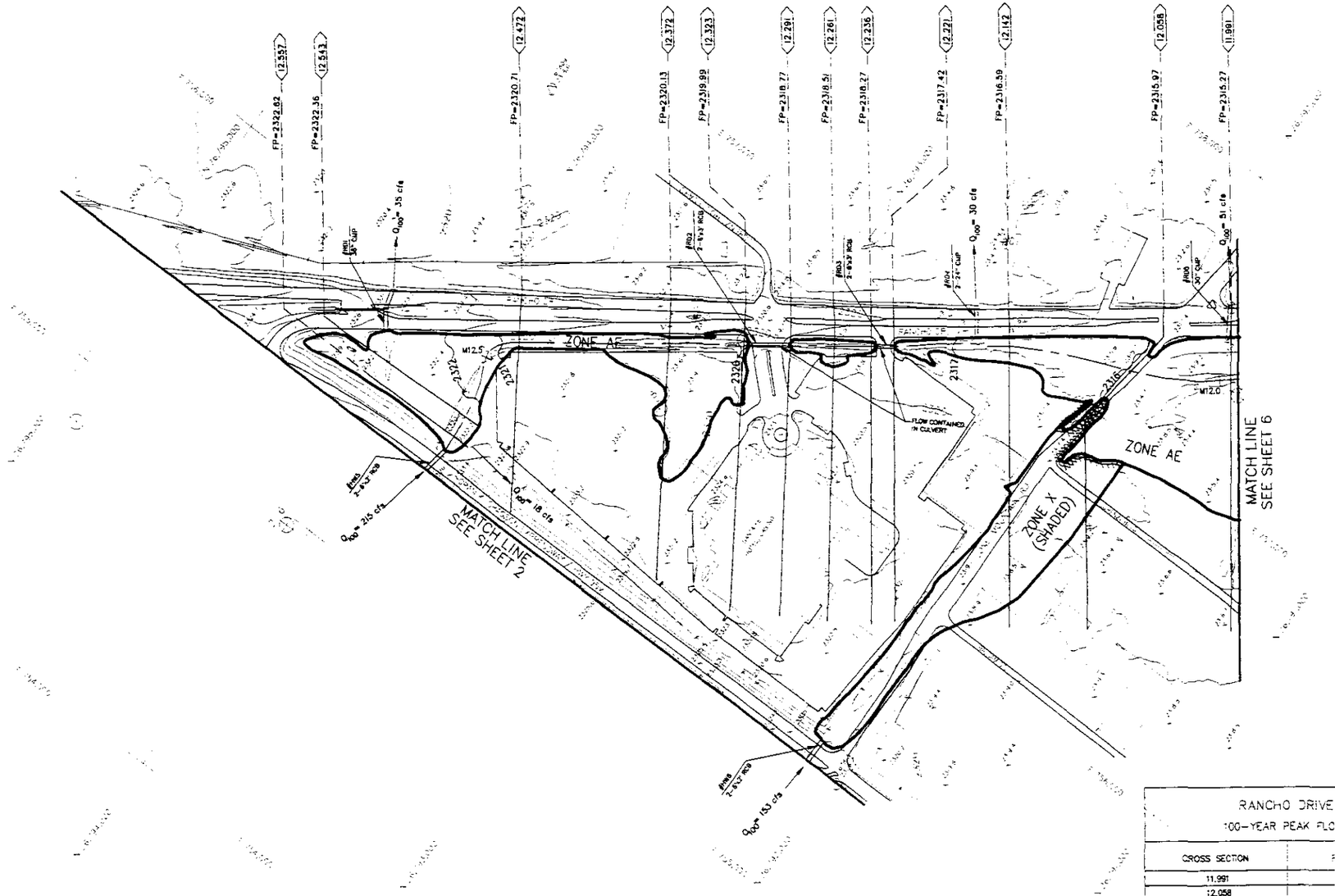


CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

FLOODPLAIN DELINEATION FOR

RANCHO DRIVE

LEGEND

- 100-YR FLOODPLAIN BOUNDARY
- HYDRAULIC BASE LINE WITH RIVER MILE — M12.0 — M13.0
- CROSS SECTION — 10.0 — FP=100 Yr WSE — 10.0
- ELEVATION REFERENCE MARK — ERM3 X
- BASE FLOOD ELEVATIONS — 2211
- ZONE DESIGNATIONS — ZONE AE
- ZONE LIMIT — XXXXXXXXXX
- STRUCTURE CROSS-SECTION NO. — #R02

ELEVATION REFERENCE MARKS

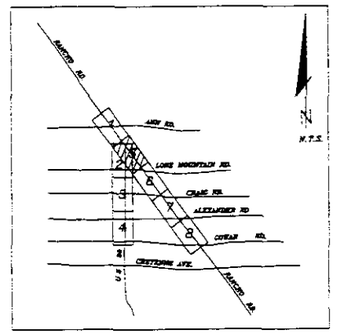
NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL VERTICAL DATUM OF 1988

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION

NOTES

RANCHO DRIVE
100-YEAR PEAK FLOW

CROSS SECTION	FLOW (cfs)
11.991	250
12.058	150
12.142	150
12.221	180
12.236	180
12.261	180
12.291	180
12.323	180
12.372	180
12.472	180
12.543	215
12.557	215



200 0' 200 400
SCALE: 1"= 200'
CONTOUR INTERVAL = 2' FEET

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

SUBMITTED BY: PAUL W. R. HOSKIN, P.E.	DESIGN	BY Y.K.S.
	DESIGN CHK.	P.W.R.H./J.M.
	PLANS	M.G.P.
	PLANS CHK.	Y.K.S./P.W.R.H.
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PHOENIX, ARIZONA
FLIGHT DATE: 8-02-1993

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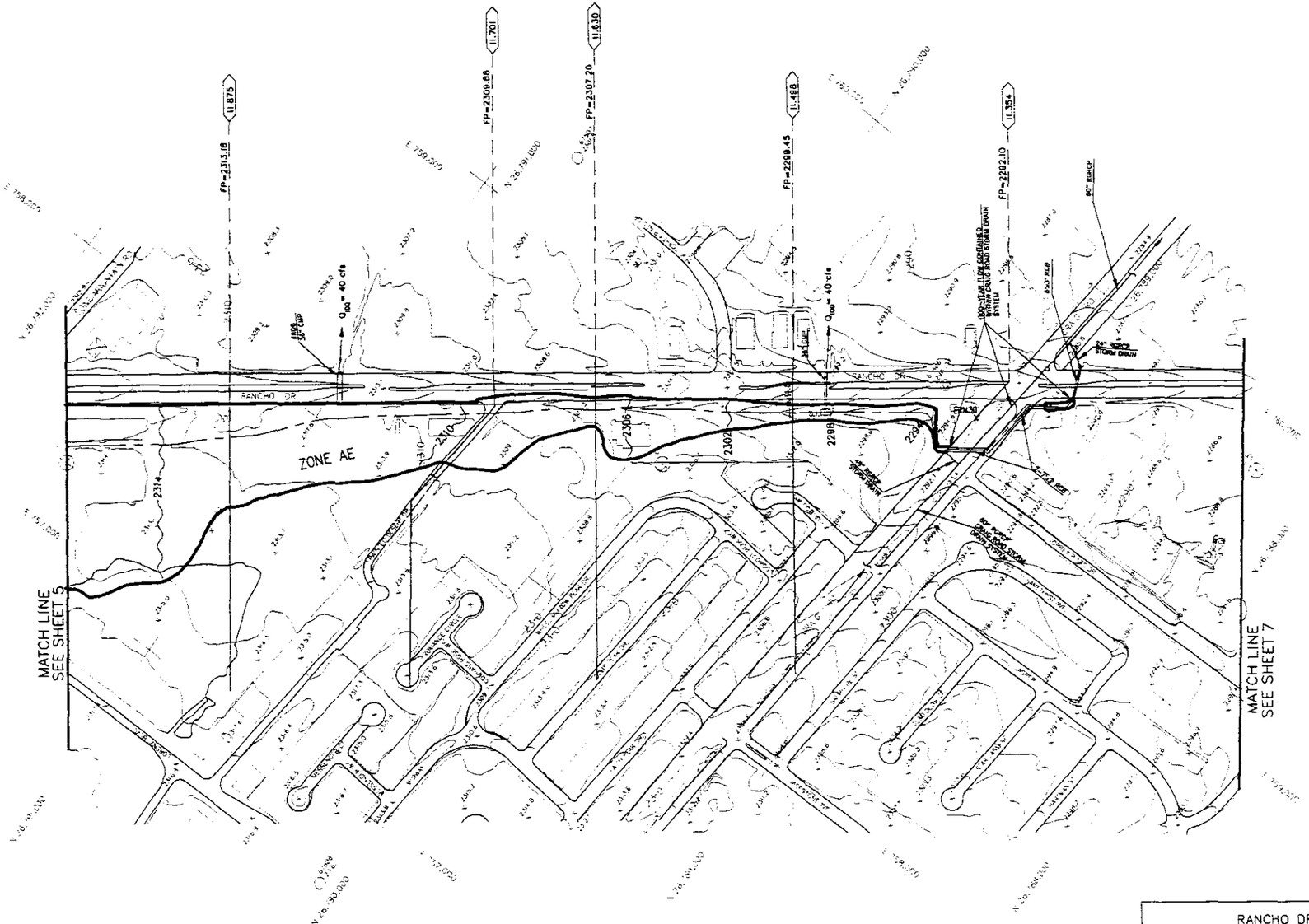


CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

FLOODPLAIN DELINEATION FOR

RANCHO DRIVE

LEGEND

100-YR FLOODPLAIN BOUNDARY	
HYDRAULIC BASE LINE WITH RIVER MILE	M12.0 — M13.0
CROSS SECTION	10.0 FP=100 YR WSE 10.0
ELEVATION REFERENCE MARK	ERM3 x
BASE FLOOD ELEVATIONS	2211
ZONE DESIGNATIONS	ZONE AE
ZONE LIMIT	XXXXXXXXXX
STRUCTURE CROSS-REFERENCE NO.	#R02

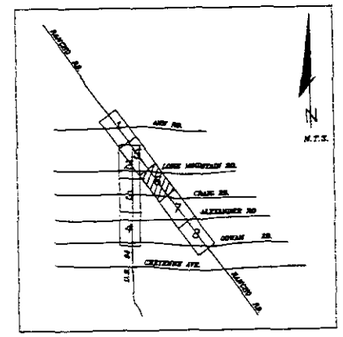
ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL VERTICAL DATUM OF 1988

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
ERM30	2294.29	RIVET AND PLATE NORTHWEST CORNER RANCHO AND CRAIG ON CRAIG ROAD

NOTES

SINCE COMPLETION OF AERIAL FLIGHT AND MAPPING, CRAIG ROAD HAS BEEN REGRADED, WIDENED, AND A STORM DRAINAGE SYSTEM HAS BEEN INSTALLED. REFER TO CRAIG ROAD UTILITY PLAN AND PROFILE BY HEFNER ENGINEERING.



200 0' 200 400

SCALE: 1" = 200'

CONTOUR INTERVAL = 2' FEET

RANCHO DRIVE 100-YEAR PEAK FLOW	
CROSS SECTION	FLOW (cfs)
11.354	180
11.498	220
11.630	220
11.701	210
11.875	150

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

SUBMITTED BY: PAUL W. R. HOSKIN, P.E.

	BY
DESIGN	Y.K.S.
DESIGN CHK.	P.W.R.H./J.M.
PLANS	M.G.P.
PLANS CHK.	Y.K.S./P.W.R.H.
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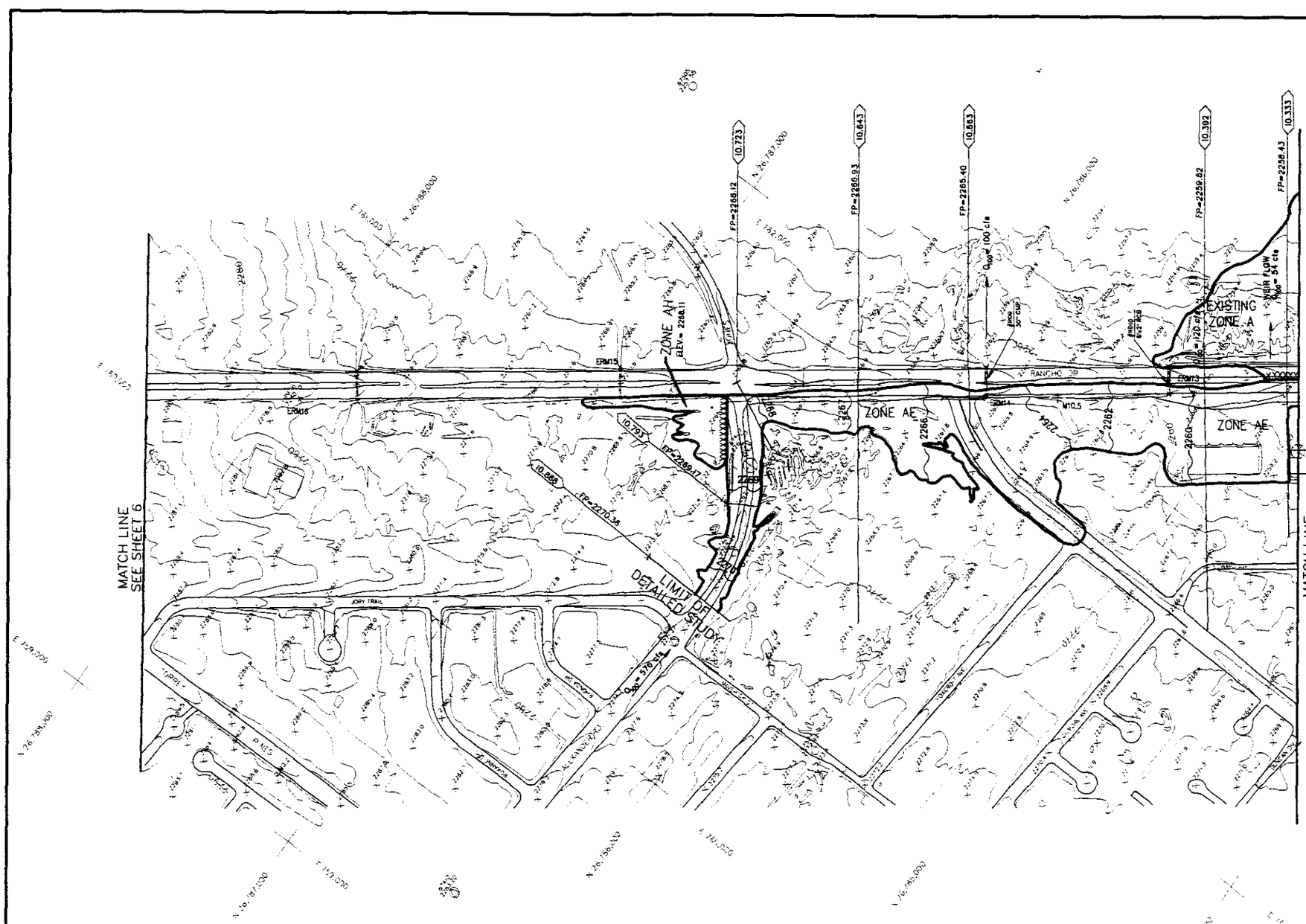


CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

FLOODPLAIN DELINEATION FOR

RANCHO DRIVE

LEGEND

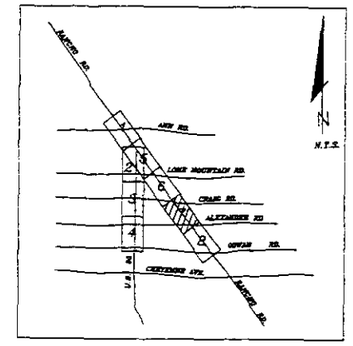
100-YR FLOODPLAIN BOUNDARY	
HYDRAULIC BASE LINE WITH RIVER MILE	M12.0 — M13.0
CROSS SECTION	10.0 — FD=100 Yr WSE — 10.0
ELEVATION REFERENCE MARK	ERM3 X
BASE FLOOD ELEVATIONS	2211
ZONE DESIGNATIONS	ZONE AE
ZONE LIMIT	XXXXXXXXXX
STRUCTURE CROSS-REFERENCE	@832

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL VERTICAL DATUM OF 1988

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
ERM13	2259.94	RIVET AND PLATE WEST SIDE OF RANCHO SOUTH OF NORTH D/W TO CRYSTAL PALACE, RINK 1200' +/- NORTH OF DURICAN DRIVE. 7C00 - 12NW8
ERM14	2263.21	RIVET AND PLATE IN SOUTH END OF HEADWALL 7' +/- EAST OF E/P, 450' +/- SOUTH OF JONES. 7C00 - 12NE5
ERM15	2269.87	RIVET AND PLATE IN SOUTH END OF HEADWALL 4.5'+/- EAST OF E/P ON RANCHO, 450' +/- NORTH OF JONES. 7C00 - 12NE
ERM16	2280.55	RIVET AND PLATE T/C WEST SIDE OF RANCHO JUST SOUTH OF NORTH D/W TO HORIZON RECOVERY CENTER. 7C00 - 25E5

NOTES



200 0' 200 400
SCALE: 1"= 200'
CONTOUR INTERVAL = 2' FEET

RANCHO DRIVE 100-YEAR PEAK FLOW	
CROSS SECTION	FLOW (cfs)
10.333	373
10.392	430
10.563	580
10.643	580
10.723	580
10.773	580
10.868	580

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

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PHOENIX, ARIZONA
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CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

FLOODPLAIN DELINEATION FOR

RANCHO DRIVE

LEGEND

100-YR FLOODPLAIN BOUNDARY	
HYDRAULIC BASE LINE WITH RIVER MILE	M12.0 — M13.0
CROSS SECTION	FP=100 Yr WSE
ELEVATION REFERENCE MARK	ERM3 X
BASE FLOOD ELEVATIONS	2211
ZONE DESIGNATIONS	ZONE AE
ZONE LIMIT	XXXXXXXXXX
STRUCTURE CROSS-REFERENCE NO.	#802

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL VERTICAL DATUM OF 1988

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
ERM10	2251.095	RIVET AND PLATE SOUTHWEST CORNER OF RANCHO AND MICHAEL WAY T/C SCR ON RANCHO DRIVE. 7000 - 1258
ERM11	2251.83	RIVET AND PLATE SOUTHWEST CORNER RANCHO AND GOWAN T/C SCR ON GOWAN ROAD. 7000 - 1264
ERM12	2254.24	USC AND GS BRASS CAP T-398 IN CENTERLINE MEDIAN OF RANCHO 250' +/- SOUTH OF DUNCAN DRIVE

NOTES

RANCHO DRIVE
100-YEAR PEAK FLOW (RANCHO 1.DAT)

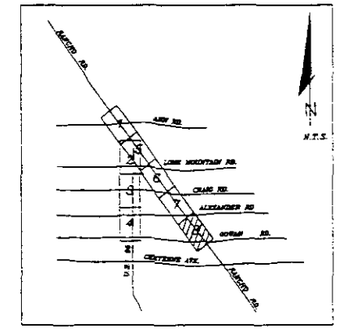
CROSS SECTION	FLOW (cfs)
10.000	915
10.053	319
10.129	319
10.145	319
10.207	343
10.270	285

RANCHO DRIVE
100-YEAR PEAK FLOW (RANCHO 3.DAT)

CROSS SECTION	FLOW (cfs)
9.764	2040
9.897	1238
9.957	1040
9.992	1040
10.062	1040

RANCHO DRIVE
100-YEAR PEAK FLOW (RANCHO 4.DAT)

CROSS SECTION	FLOW (cfs)
10.034	800
10.082	800
10.093	1840
10.117	1840



200 0' 200 400
SCALE: 1" = 200'
CONTOUR INTERVAL = 2' FEET

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

SUBMITTED BY: PAUL W. R. HOSKIN, P.E.	DESIGN	BY Y.K.S.
	DESIGN CHK.	P.W.R.H./J.M.
	PLANS	M.G.P.
	PLANS CHK.	Y.K.S./P.W.R.H.
	SHEET	8 of 8

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AERIAL MAPPING COMPANY, INC.
PHOENIX, ARIZONA
FLIGHT DATE: 6-02-1983

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Section 5
Annotated D-FIRM

NORTHWEST FLOOD STUDY_d

NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY

Clark County, Nevada

Technical Data Notebook Appendix V
Supporting Technical Data for Approximate Study Area

Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

CVL CONSULTANTS, INC., 6655 W. SAHARA, SUITE A-200, LAS VEGAS, NV 89103 (702) 368-3008
PENTACORE ENGINEERING, INC., 6763 W. CHARLESTON BLVD., LAS VEGAS, NV 89102 (702) 258-0115

Northwest Las Vegas Flood Insurance Study Restudy
Clark County, Nevada

Technical Data Notebook
Appendix V - Supporting Technical Data for Approximate Study Area

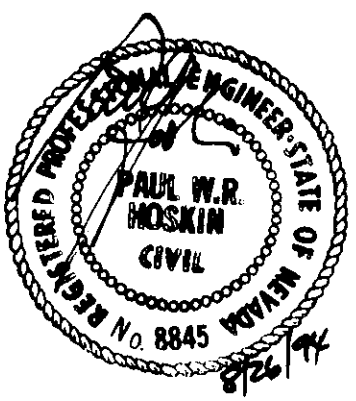
Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

C L A R K C O U N T Y
REGIONAL FLOOD CONTROL DISTRICT

301 East Clark Avenue, Suite 300
Las Vegas, Nevada 89101

August 26, 1994



CVL CONSULTANTS, INC., 6655 W. SAHARA, SUITE A-200, LAS VEGAS, NV 89103 (702) 368-3008
PENTACORE ENGINEERING, INC., 6763 W. CHARLESTON BLVD., LAS VEGAS NV 89102 (702) 258-0115

Flood Insurance Study Restudy
for
Northwest Las Vegas

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Flood Insurance Study Restudy
for
Northwest Las Vegas

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Flood Insurance Study Restudy
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Flood Insurance Study Restudy
for
Northwest Las Vegas

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Flood Insurance Study Restudy
for
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Section 1
Carey/Lake Mead Area

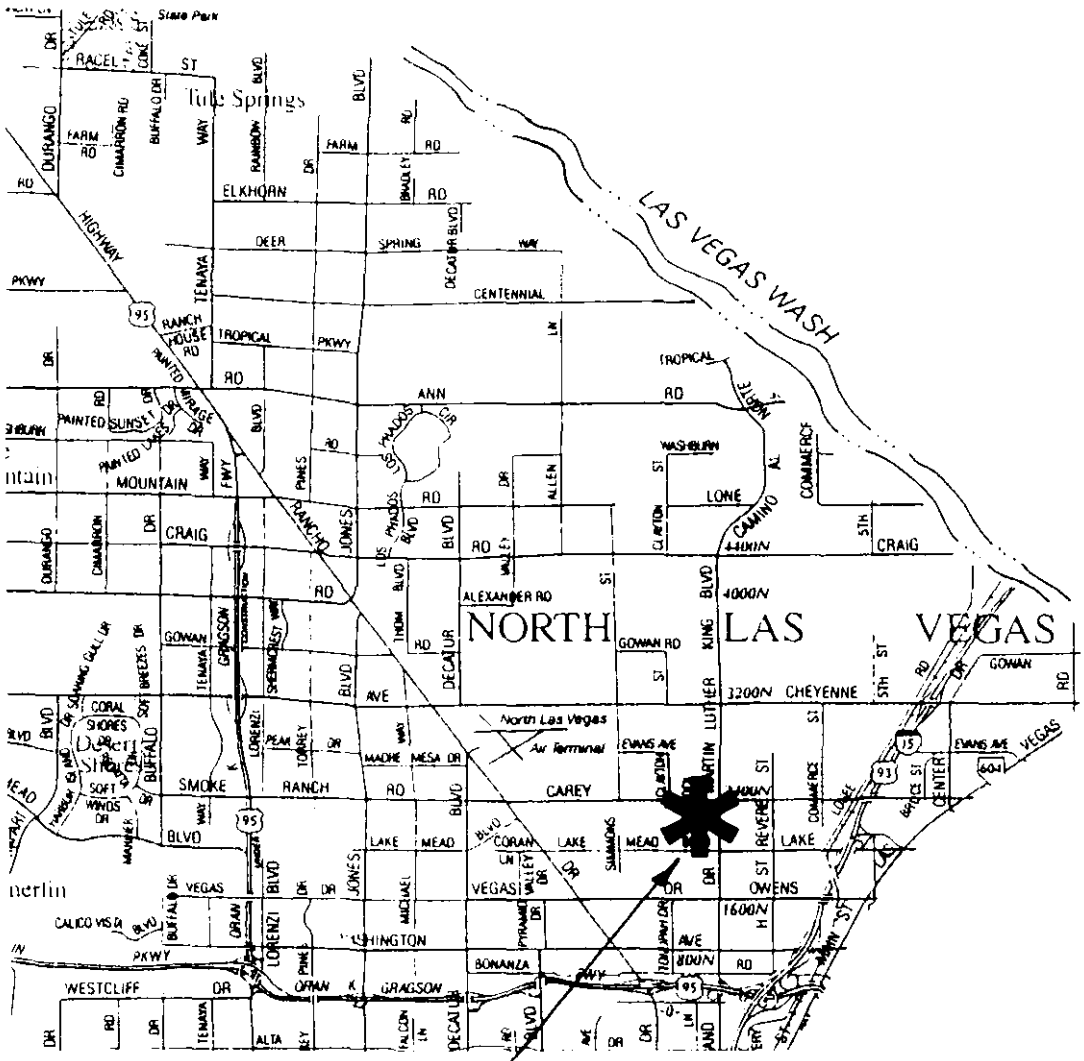
REQUEST FOR LOMR
Carey/Lake Mead Area

The Carey/Lake Mead Detention Basin is located along the alignment of Simmons Street between Carey Avenue and Lake Mead Boulevard, Section 20, Township 20S, Range 61E, M.D.M. The purpose of this study is to revise the existing flood zone to indicate Zone "A" within the limits of the basin.

The Carey/Lake Mead Detention Basin was designed by VTN, Nevada. Abstracts taken from the design and construction documents are included in Appendix II - Section 3. This project was funded by the Clark County Regional Flood Control District, with a final walk through inspection on September 6, 1992. This study concludes that the limits of the detention basin should be designated as Zone "A".

The preliminary DFIRM indicates that an area downstream of the Carey/Lake Mead Detention Basin is located within Flood Zone "AO". The area extends along the alignment of Balzar Street, "H" Street, and Lake Mead Boulevard in the City of Las Vegas, Sections 20, 21, and 22, Township 20S, Range 61E, M.D.M. Construction of the upstream detention basin has removed much of the source that contributed to flooding in this area as demonstrated by the hydrology model for the area (WASH.DAT, see Appendix III - Section 2).

The purpose of this study is to revise the existing Flood Zone "AO" as shown on the attached annotated D-FIRM. Using 1" = 200' topographic mapping produced by Cooper Aerial of Nevada in 1984, street cross sections were developed for Balzar Street, "H" Street, and Lake Mead Boulevard. Street sections indicate that flows are taken on Balzar Street, "H" Street, and Lake Mead Boulevard, therefore reducing the existing Zone "AO". Flow arrows on the attached exhibits indicate direction of street flow. On "H" Street near Lawry Street, approximately 220 cfs leaves the study area. Rating curves were developed for street flow and weir flow in order to determine the magnitude of the flow split.



N.T.S.

COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE · ARCHITECTURE

LOCATION MAP

JOB # 930017 6/94

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for ving instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ☐ Physical change
     - ■ Existing
     - ☐ Proposed
   - ☐ Improved methodology
   - ☐ Improved data
   - ☐ Floodway revision
   - ☐ Other _____
     Explain _____
2. Flooding Source: Zone "AO" local flooding, between Carey Avenue and Lake Mead Blvd.
3. Project Name/Identifier: NW Las Vegas FIS Restudy
4. FEMA zone designations affected: Zone "AO"
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	[illegible]20007	City of North Las Vegas	Clark County	NV	32003C & 2160D	2160D	7/29/93

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding	Structures	Disciplines*
☐ Riverine	☐ Channelization	■ Water Resources
☐ Coastal	☐ Levee/Floodwall	■ Hydrology
☐ Alluvial Fan	☐ Bridge/Culvert	■ Hydraulics
■ Shallow Flooding *(e.g. Zones AO and AH)*	☐ Dam	☐ Sediment Transport
☐ Lakes	☐ Coastal	☐ Interior Drainage
Affected by wind/wave action	☐ Fill	☐ Structural
☐ Yes	☐ Pump Station	☐ Geotechnical
■ No	■ None	☐ Land Surveying
	☐ Channel Relocation	☐ Other *(describe)*
	☐ Excavation	
	☐ Other *(describe)*	
☐ Other *(describe)* _____	_____	_____

* Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ☐ Yes ■ No
8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? ☐ Yes ■ No
   If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

□ Yes ■ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the val of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? □ Yes □ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? □ Yes □ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? □ Yes ■ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? □ Yes ■ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ■ is □ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ■ Yes □ No

14. Does this revision request have the endorsement of the community? ■ Yes □ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? □ Yes ■ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by N/A (entity)

N/A with a maximum interval of N/A months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by N/A (entity)

to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, □ has □ has not been prepared for the flood control structure.

D. The community is willing to assume ☐ responsibility for ☐ performing ☐ overseeing compliance with the maintenance and operation plans of the No flood control structure involved.
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

X b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

1. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	■ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	■ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☐ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☐ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☐ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☐ Yes ☐ No

Initial fee amount: $ _____

METHOD OF PAYMENT (Check one box)

PAYMENT ENCLOSED ☐ VISA ☐ MASTERCARD CARD NUMBER

Check or money order only.

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

_____
Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☐ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Douglas B. Blatchford
Signature of Revision Requestor

Douglas B. Blatchford, Senior Engineer
Printed Name and Title of Revision Requestor

Pentacore Engineering, Inc.
Company Name

September 20, 1994
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

_____
Signature of Community Official

_____
Printed Name and Title of Community Official

_____
Community Name

_____
Date

Does this request impact any other communities? ☐ Yes ■ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148 Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

ic reporting burden for this form is estimated to average .23 hour per response. The burden estimate includes the ... for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in Water Resources (hydrology and hydraulics)
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 8 years experience in the expertise listed above.
4. I have ☐ prepared ■ reviewed the attached supporting data and analyses related to my expertise.
5. I ■ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Revision of Zone "AO" local flooding between Carey Avenue and Lake Mead Boulevard
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☐ Examined plans and specifications and compared with completed projects.
   d. ■ Other Floodplain not modified by construction

8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Douglas B. Blatchford
(please print or type)

Title: Senior Engineer
(please print or type)

Registration No. 10783 Expiration Date: 12/31/94

State Nevada

Type of License Civil Engineer

Signature

Date

*Specify Subdiscipline

Seal
(Optional)

...te: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY **HYDROLOGIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.67 hours per response. The burden estimate includes the time for wing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the ... Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: City of North Las Vegas

Flooding Source: Zone "AO" local flooding, between Carey Avenue and Lake Mead Blvd.
(One form for each flooding source)

Project Name/Identifier: NW Las Vegas FIS Restudy

1. HYDROLOGIC ANALYSIS IN FIS

- ☐ Approximate study stream (Zone A)
- ■ Detailed study stream (briefly explain methodology) _____

2. REASON FOR NEW HYDROLOGIC ANALYSIS

- ☐ No existing analysis
- ■ Improved data *(see data revision on page 3)*
- ☐ Changed physical conditions of watershed *(explain)* _____
- ☐ Alternative methodology *(justify why the revised model is better than model used in the effective FIS)*
- ☐ Evaluation of proposed conditions (CLOMRs only) (explain) _____
- ☐ Other _____

If a computer program/model was used in revising the hydrologic analysis, please provide a diskette with the input files for the 10-, 50-, 100- and 500-year recurrence intervals.

Only the 100-year recurrence interval need be included for SFHAs designated as Zone A.

3. APPROVAL OF ANALYSIS

- ■ Approval of the hydrologic analysis, including the resulting peak discharge value(s) has been provided by the appropriate local, state, or Federal Agency. (i.e., Clark County Regional Flood Control District)

  Attach evidence of approval.
- ☐ Approval of the hydrologic analysis is not required by any local, State or Federal Agency.

4. REVIEW OF RESULTS

Stream: N/A

Comparison of 100-year Discharges

Location:	Drainage area (Sq. mi.)	FIS (cfs):	Revised (cfs):

Note: When revised discharges are not significantly different than FIS discharges, FEMA may require a confidence limits analysis on attachment D at a later date to complete the review.

As is often the case with revision requests, only a portion of a stream may actually be revised or be affected by a revision. Therefore, transition to the unrevised portion is important to maintain the continuity of the study. NFIP regulations stipulate that such a transition must be assured. What is the transition from the proposed discharges to the effective discharges? Please explain how the transition was made *(attach separate sheet if necessary)*.

ATTACH A COMPLETED REVIEW OF RESULTS PAGE FOR EACH FLOODING SOURCE.

Is the new hydrologic **analysis** being developed solely to revise the flow values presented in the FIS *(i.e. no changed hydraulic conditions)?* ☐ Yes ■ No

If yes, does the 100-year water surface elevation change by 1.0 foot or more? ■ Yes ☐ No

FEMA does not normally revise NFIP maps solely due to insignificant flow changes where changes in 100-year water surface elevation are less than 1.0 foot.

5. HISTORICAL FLOODING INFORMATION N/A

Is historical data available for the flooding source? ☐ Yes ■ No

If yes, provide the following:

Location along flooding source: _____

Maximum peak discharge: _____ cfs

Second highest peak discharge: _____ cfs

Source of information: _____

6. GAGE RECORD INFORMATION N/A

Location of nearest gage to project site *(along flooding source or similar watershed; specify)*

_____

Gaging Station: _____

Drainage area at gage: _____ mi^2

Number of years of data: _____

7. DATA REVISION

Please use the following table to list all the data and/or parameters affected by this request and identify them as new data *(New)* or as revising existing data *(Revised)*. *(If necessary, attach a separate sheet.)*

Data Parameter	New	Revised	Data Source
ing contours and ground elevations		■	topographic maps with contours @ 2' intervals (see attached exhibit)

- Data source can be from a Federal, State, or local government agency, or from a private source. Some State and local governments may have less strict data requirements than Federal agencies, in which case the hydrologic data may not be accepted by FEMA unless it is demonstrated that the data give a better estimate of the flood discharge.
- Attach documentation corroborating each data source *(i.e., certified statement, report, bibliographical reference to a published document)*. In the case of a published document or a government report, providing copies of the cover and pertinent pages may be helpful.

8. METHODOLOGY FOR NEW ANALYSIS

Statistical Analysis of Gage Records *(use Attachment A)*

Regional Regression Equations *(use Attachment B)*

Precipitation/Runoff Model *(use Attachment C)*

Other *(specify; attach backup computations and supporting data)* _____

_____

ATTACHMENT A: STATISTICAL ANALYSIS OF GAGE RECORDS

Gaging Station: _____

Gage Location (latitude and longitude): _____

		FIS:		Revised:	
1.	Number of years of data				
	Systematic				
	Historical				
2.	Homogeneous data	Yes	No	Yes	No
3.	Data adjustments	Yes	No	Yes	No
4.	Number of high outliers				
	Low outliers				
	Zero events				
5.	Generalized skew				
6.	Station skew				
7.	Adopted skew				
8.	Probability distribution used (justify if log-Pearson III was not used)				
9.	Transfer equations to ungaged sites.			Yes	No
	If yes, specify method				
10.	Expected probability*			Yes	No
11.	Comparison of results with other analyses.			Yes	No
	If yes, describe comparison				

* FEMA does not accept expected probability analyses for the purpose of reflecting flood hazard information in a FIS.

If any data is not available, indicate by N/A.

Attach analysis including plot of flood frequency curve.

1. Bibliographical Reference:

_____

_____

_____

(Attach a copy of title page, table of contents, and pertinent pages including equations.)

2. Gaged or ungaged stream: _____

3. Hydrologic region(s): _____
Attach backup map.

4. Provide parameters, values, and source of data used to define parameters.

_____

_____

_____

		FIS:		Revised:	
5.	Urbanized conditions calculations	Yes	No	Yes	No
6.	Percent of watershed urbanization	_____		_____	
7.	Is the watershed controlled?	Yes	No	Yes	No
8.	Comparison with other analyses	Yes	No	Yes	No

If the answer to 5, 7, or 8 is yes, explain methodology in Comments.

If data is not available, indicate by N/A.

Comments

_____

_____

_____

_____

Attach computation and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT C: PRECIPITATION/RUNOFF MODEL

		FIS:	Revised:
1.	Method or model used:	(No FIS Model)	HEC-1
	Version:		IBMXT 512X
	Date:		2/1/85
2.	Source of rainfall depth:		NOAA (73) Adjusted by USACE - LA
3.	Source of rainfall distribution:		Hydro 80
4.	Rainfall duration:		6 hour
5.	Areal adjustment to precipitation (%):		USACE, 1988, 77%
6.	Hydrograph development method:		SCS Unit Hydrograph
7.	Loss rate method:		SCS - 1982
	Source of soils information:		
	Source of land use information:		
8.	Channel routing method:		Kinnematic Wave
9.	Reservoir routing:	Yes No	Yes ■ No
10.	Baseflow considerations:	Yes No	Yes ■ No
	If yes, explain how baseflow was determined:		
11.	Snowmelt considerations:	Yes No	Yes ■ No
12.	Model calibration:	Yes No	Yes No
	If yes, explain how calibration was performed		
13.	Future land use condition:		Yes No
	If yes, explain why:		

Note: FEMA policy is to base flooding on existing conditions.

If data is not available, indicate by N/A.

Attach precipitation/runoff model, hydrologic model schematic, curve number calculations, time of concentration calculations, and supporting maps, delineating the watershed boundary and drainage area divides.

Stream: _____

Select one location for Confidence Limits Evaluation *(describe location)*: _____

_____

Discharges for selected location:

Exceedance Probability		FIS		Revised	
10%	(10-year)	_____	cfs	_____	cfs
2%	(50-year)	_____	cfs	_____	cfs
1%	(100-year)	_____	cfs	_____	cfs
0.2%	(500-year)	_____	cfs	_____	cfs

1% (100-year) Flood Confidence Intervals

90% Confidence Interval: 5% limit _____ cfs
95% limit _____ cfs

50% Confidence Interval: 25% limit _____ cfs
75% limit _____ cfs

If the value of the 100-year frequency flood in the FIS is beyond the 50% confidence interval but within the 90% confidence interval, does the 100-year water surface elevation change by 1.0 foot or more? Yes No

An example of confidence limits analysis can be found in Appendix 9 of Bulletin 17B.

Attach Confidence Limits Analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE HYDRAULIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: North Las Vegas

Flooding Source: Zone "AO" local flooding, between Carey Avenue and Lake Mead Blvd.
(One form for each flooding source)

Project Name/Identifier: NW Las Vegas FIS Restudy

1. REACH TO BE REVISED

Downstream limit: Cadillac Lane, as shown on attached exhibit

Upstream limit: "W" Street as shown on attached exhibit - downstream limits of study.

2. EFFECTIVE FIS

- ☐ Not studied
- ☐ Studied by approximate methods
  - Downstream limit of study _____
  - Upstream limit of study _____
- ■ Studied by detailed methods
  - Downstream limit of study Cadillac Lane, as shown on attached exhibit
  - Upstream limit of study "W" Street, as shown on attached exhibit
- ☐ Floodway delineated
  - Downstream limit of Floodway _____
  - Upstream limit of Floodway _____

3. HYDRAULIC ANALYSIS

Why is the hydraulic analysis different from that used to develop the FIRM? *(Check all that apply)*

- ☐ Not studied in FIS
- ■ Improved hydrologic data/analysis. Explain: Contours at 2' intervals at 200 scale
- ☐ Improved hydraulic analysis. Explain: _____
- ☐ Flood control structure. Explain: _____
- ☐ Other. Explain: _____

3. RIVERINE HYDRAULIC ANALYSIS FORM
Models Submitted

Full input and output listings along with files on diskette *(if available)* for each of the models listed below and summary of the source put parameters used in the models must be provided. The summary must include a complete description of any changes made . model to model *(e.g. duplicate effective model to corrected effective model)*. Only the Duplicate Effective and the Revised or Post-Project Conditions models must be submitted. See instructions for directions on when other models may be required. Only the 100-year flood profile is required for SFHAs with a Zone A designation. For areas which do not have detailed flooding, a hydraulic model is not required; however BFE's may not be added to the revised FIRM.

		Natural	Floodway
☐	Duplicate Effective Model	☐	☐

Copies of the hydraulic analysis used in the effective FIS, referred to as the effective models *(10-, 50-, 100-, and 500-year multi-profile runs and the floodway run)* must be obtained and then reproduced on the requestor's equipment to produce the duplicate effective model. This is required to assure that the effective model input data has been transferred correctly to the requestor's equipment and to assure that the revised data will be integrated into the effective data to provide a continuous FIS model upstream and downstream of the revised reach.

		Natural	Floodway
☐	Corrected Effective Model	☐	☐

The corrected effective model is the model that corrects any errors that occur in the duplicate effective model, adds any additional cross sections to the duplicate effective model, or incorporates more detailed topographic information than that used in the currently effective model. The corrected effective model must not reflect any man-made physical changes since the date of the effective model. An error could be a technical error in the modeling procedures, or any construction in the floodplain that occurred prior to the date of the effective model but was not incorporated into the effective model.

		Natural	Floodway
☐	Existing or Pre-Project Conditions Model	☐	☐

The duplicate effective or corrected model is modified to produce the existing or pre-project conditions model to reflect any modifications that have occurred within the floodplain since the date of the effective model but prior to the construction of the project for which the revision is being requested. If no modification has occurred since the date of the effective model, then this model would be identical to the corrected effective or duplicate effective model.

		Natural	Floodway
■	Revised or Post-Project Conditions Model	■	☐

The existing or pre-project conditions model *(or duplicate effective or corrected effective model, as appropriate)* is revised to reflect revised or post-project conditions. This model must incorporate any physical changes to the floodplain since the effective model was produced as well as the effects of the project. When the request is for proposed project this model should reflect proposed conditions.

		Natural	Floodway
☐	Other: Please attach a sheet describing all other models or calculations submitted.	☐	☐

4. MODEL PARAMETERS (from model used to revise 100-year water surface elevation)

1. Discharges:

	Upstream Limit	Downstream Limit
10-year		
50-year		
100-year	598 cfs	520 cfs
500-year		

Attach diagram showing changes in 100-year discharge - Please see attached diagrams.

2. Explain how the starting water surface elevations were determined Starting water surface elevations were determined by street cross sectional data.

3. Give range of friction loss coefficients *(Manning's "N")* Channel 016

Overbanks 040

If friction loss coefficients are different anywhere along the revised reach from those used to develop the FIRM, give location, value used in the effective FIS, and revised values and an explanation as to how the revised values were determined. - Friction loss coefficients are not different along the reach.

Location	FIS	Revised

Explain:

4. Describe how the cross section geometry data were determined *(e.g., field survey, topographic map, taken from previous study)* and list cross sections that were added.

Street cross sectional geometry was determined by topographic maps. (2 foot contour interval) and standard street cross sections.

5. *Explain how reach lengths for channel and overbanks were determined:*

Because this area is urban (streets are assumed channels) the cross sections for each street was taken and depth of flow calculated accordingly (see attached street cross sections).

5. RESULTS (from model used to revise 100-year water surface elevations)

1. Do the results indicate:

a. Water surface elevations higher than end points of cross sections? . . . . . ☐ Yes ■ No

b. Supercritical depth? . . . . . ☐ Yes ■ No

c. Critical depth? . . . . . ☐ Yes ■ No

d. Other unique situations? . . . . . ☐ Yes ■ No

If yes to any of the above, attach an explanation that discusses the situation and how it is presented on the profiles, tables, and maps.

2. What is the maximum change in energy gradient between cross-sections? . . . . . N/A

Specify location . . . . . _____

3. What is the distance between the cross-sections in 2 above? . . . . . N/A

Specify location . . . . . _____

4. What is the maximum distance between cross-sections? . . . . . N/A

Specify location . . . . . _____

5. Floodway determination N/A

a. What is the maximum surcharge allowed by the community or State? . . . . . _____ foot

b. What is the maximum surcharge for the revised conditions? . . . . . _____ foot

Specify location . . . . . _____

c. What is the maximum velocity? . . . . . _____ fps

Specify location . . . . . _____

Explain: _____

d. Are there any negative surcharge values at any cross-section? ☐ Yes ■ No

If yes, the floodway may need to widen. If it is not widened, please explain and indicate the maximum negative surcharge.

Is the discharge value used to determine the floodway anywhere different from that used to determine the natural 100-year flood elevations? . . . . . ☐ Yes ■ No

If yes, explain:

_____

_____

_____

7. Do 100-year water surface elevations increase at any location? . . . . . ☐ Yes ■ No

If yes, please attach a list of the locations where the increases occur, state whether or not the increases are located on the requestor's property, and provide an explanation of the reason for the increases.

_____

_____

_____

Please attach a completed comparison table entitled: Water Surface Elevation Check (See page 6)

6. REVISED FIRM/FBFM AND FLOOD PROFILES

A. The revised water surface elevations tie into those computed by the effective FIS Model *(10-, 50-, 100-, and 500-year)*, downstream of the project at cross-section _____ within _____ feet and upstream of the project at cross section _____ within _____ feet. (See note)

The revised water surface elevations begin and end at the existing limits of the detailed study, and therefore do not tie into an existing FIS Model (see attached D-FIRM).

B. The revised floodway elevations tie into those computed by the effective FIS model, downstream of the project at cross section _____ within _____ feet and upstream of the project at cross section _____ within _____ feet.

C. Attach profiles, at the same vertical and horizontal scale as the profiles in the effective FIS report, showing stream bed and profiles of all floods studied (without encroachment). Also, label all cross sections, road crossings (including low chord and top-of-road data), culverts, tributaries, corporate limits, and study limits. If channel distance has changed, the stationing should be revised for all profile sheets. N/A

D. Attach a Floodway Data Table showing data for each cross section listed in the published Floodway Data Table in the FIS report. N/A

Proceed to Riverine/Coastal Mapping Form.

FEDERAL EMERGENCY 'AGEMENT AGENCY

WATER SURFACE VATION CHECK

COMMUNITY NAME	FLOODING SOURCE	PROJECT NAME/IDENTIFIER

	EFFECTIVE			DUPLICATE EFFECTIVE			CORRECTED EFFECTIVE			EXISTING/PRE-PROJECT			REVISED/PROJECT		
SECNO	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]

COMMENTS: Please see attached exhibits and street x-sections that provide depth of flows in Belzer, Lake Mead, and "H" Street for the 100-year discharge.

1 - 100-year (natural) Water Surface Elevation 2 - Encroachment (floodway) Water Surface Elevation 3 - Surcharge Value

Include all cross sections in the models between tie-in points. Any interpolated values should be indicated in parentheses.

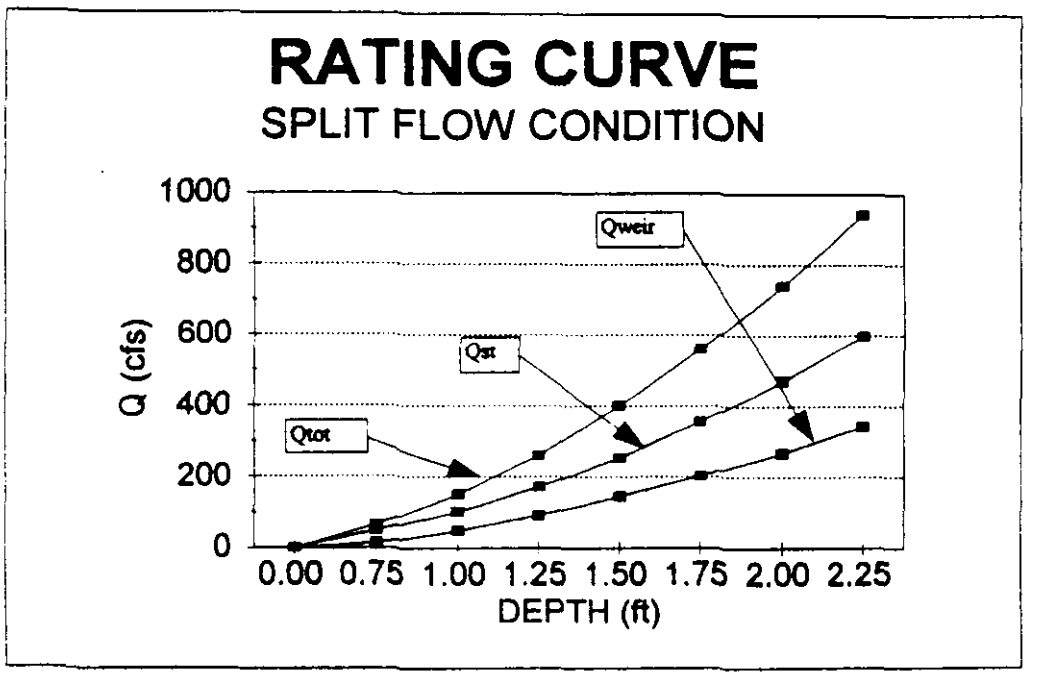
Sheet ___ of ___

RATING CURVE FOR SPLIT FLOW CONDITION

ZONE AO

DEPTH (ft)	Qweir (cfs)	Qst (cfs)	Qtot (cfs)
0.00	0	0	0
0.75	15	49	64
1.00	48	102	150
1.25	92	171	263
1.50	144	256	400
1.75	204	356	560
2.00	270	470	740
2.25	342	598	940

TABLE BASED ON:
WEIR FLOW AT CROWN
WHERE:
Q=C*L*(D-.54)^1.5
C=3
L=51

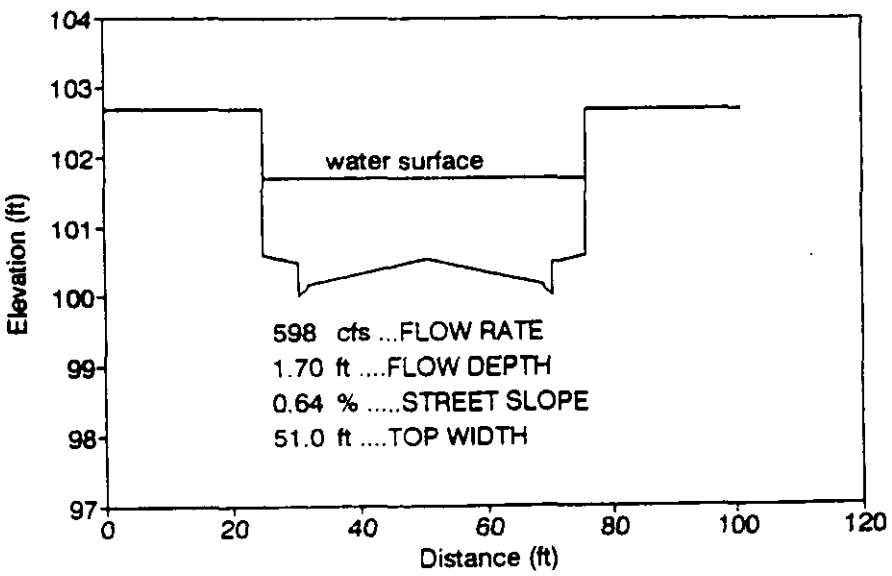


STREET FLOWS

BALZAR AVENUE-100 YEAR FLOW

Input variables:			**Output variables:**		
Flow depth, d	1.70	ft	Capacity at d	598.0	cfs
Road width	41.0	ft	Velocity	8.8	fps
Crown height	0.54	ft	Top width	51.0	ft
Street slope	0.64	%			
Sidewalk width	5.0	ft	SECTION:		
Curb height	6	in	Cross Slope	2.0	%
Median width	0.0	ft	Gutter Depression	2.0	in
Rt back of walk	100.0	%	Depth - Velocity Product	15.06	
Lt back of walk	100.0	%	Manning's n	0.016	

BALZAR AVENUE-100 YEAR FLOW

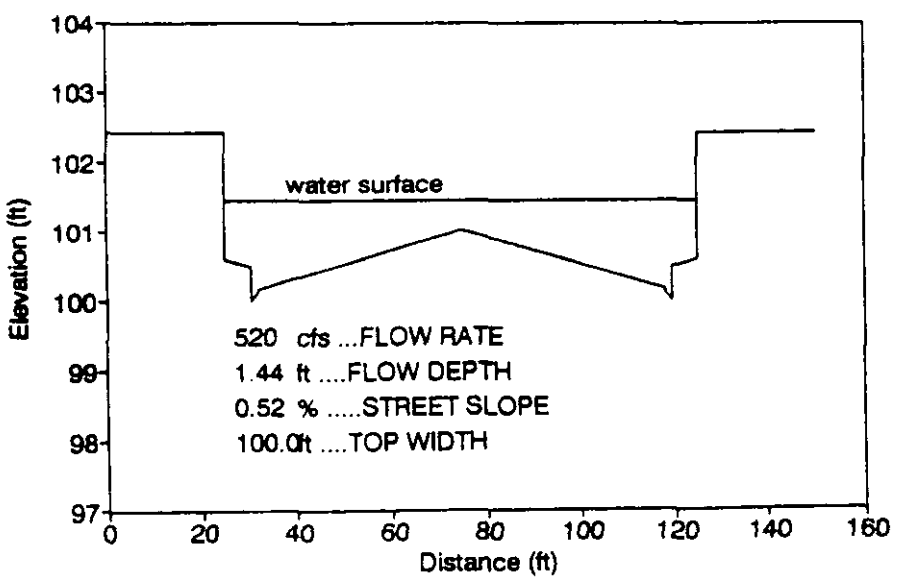


STREET FLOWS

LAKE MEAD BOULEVARD-100 YEAR FLOW

Input variables:			**Output variables:**		
Flow depth, d	1.44	ft	Capacity at d	520.0	cfs
Road width	90.0	ft	Velocity	6.0	fps
Crown height	1.03	ft	Top width	100.0	ft
Street slope	0.52	%			
Sidewalk width	5.0	ft	SECTION:		
Curb height	6	in	Cross Slope	2.0	%
Median width	0.0	ft	Gutter Depression	2.0	in
Rt back of walk	100.0	%	Depth - Velocity Product	8.67	
Lt back of walk	100.0	%	Manning's n	0.016	

LAKE MEAD BOULEVARD-100 YEAR FLOW

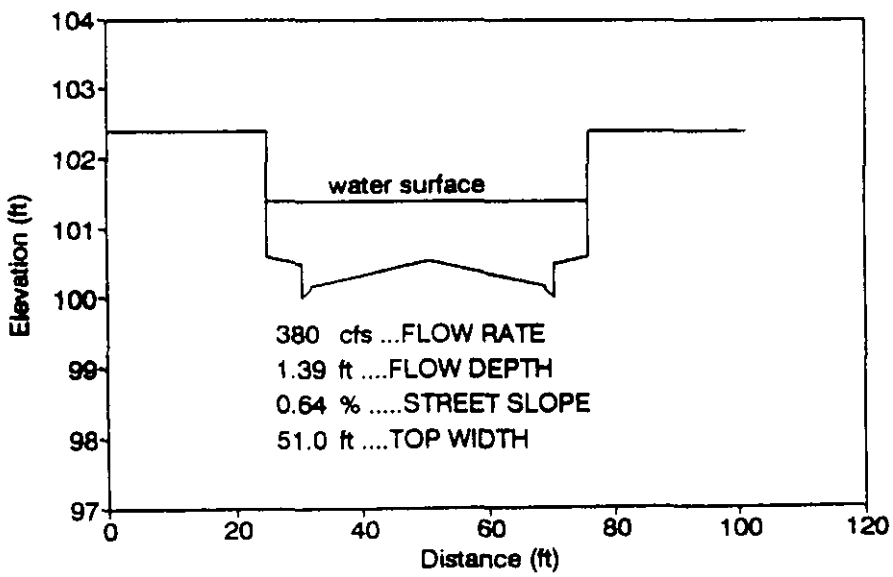


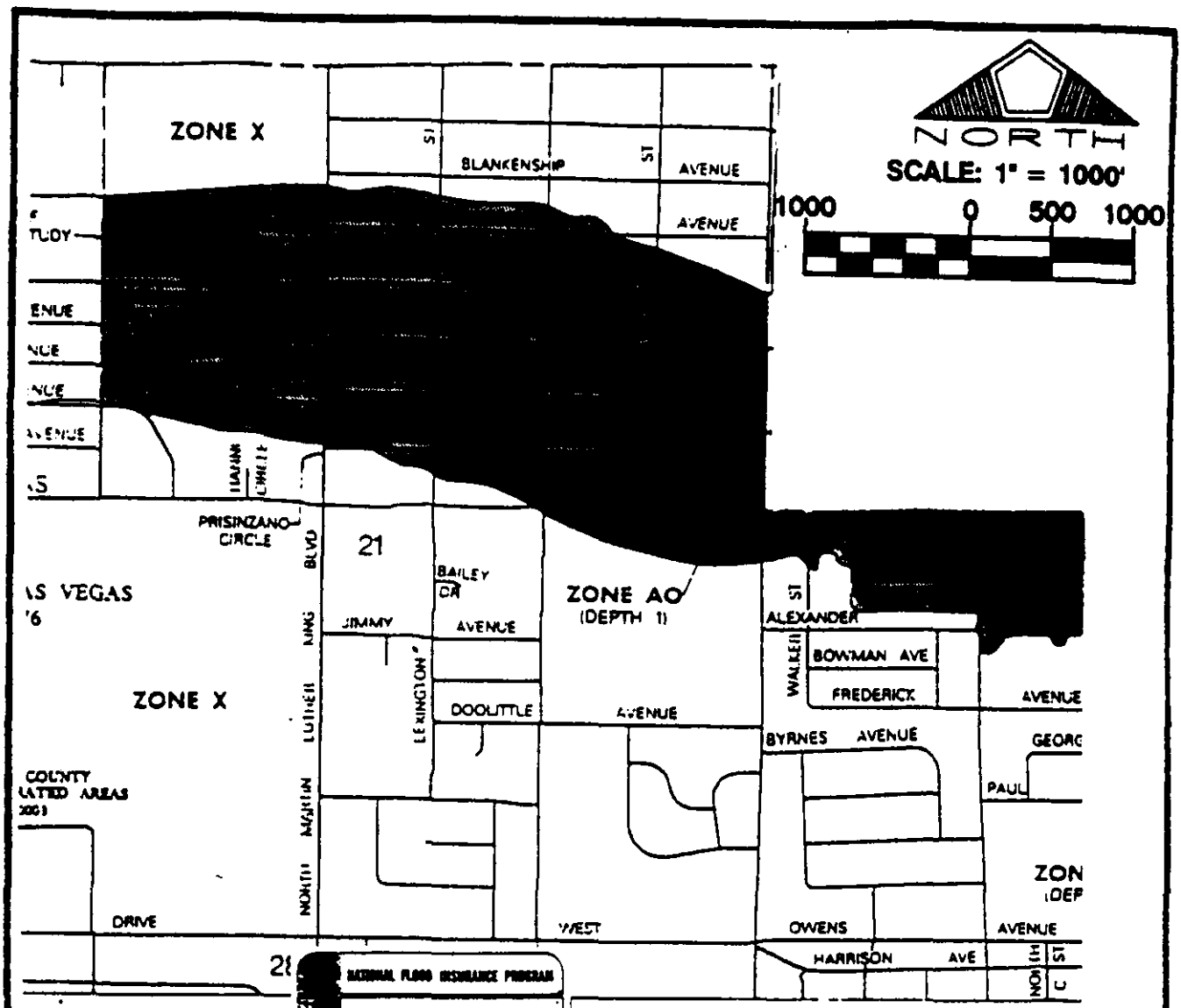
STREET FLOWS

"H" ST - 100 YEAR FLOW

Input variables:			**Output variables:**		
Flow depth, d	1.39	ft	Capacity at d	380.0	cfs
Road width	41.0	ft	Velocity	7.4	fps
Crown height	0.54	ft	Top width	51.0	ft
Street slope	0.64	%			
Sidewalk width	5.0	ft	SECTION:		
Curb height	6	in	Cross Slope	2.0	%
Median width	0.0	ft	Gutter Depression	2.0	in
Rt back of walk	100.0	%	Depth - Velocity Product	10.24	
Lt back of walk	100.0	%	Manning's n	0.016	

"H" ST - 100 YEAR FLOW





NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2160 OF 4000

MAP NUMBER 32003C2160 B

EFFECTIVE DATE: PRELIMINARY

MICHAEL BAKER, JR., INC.

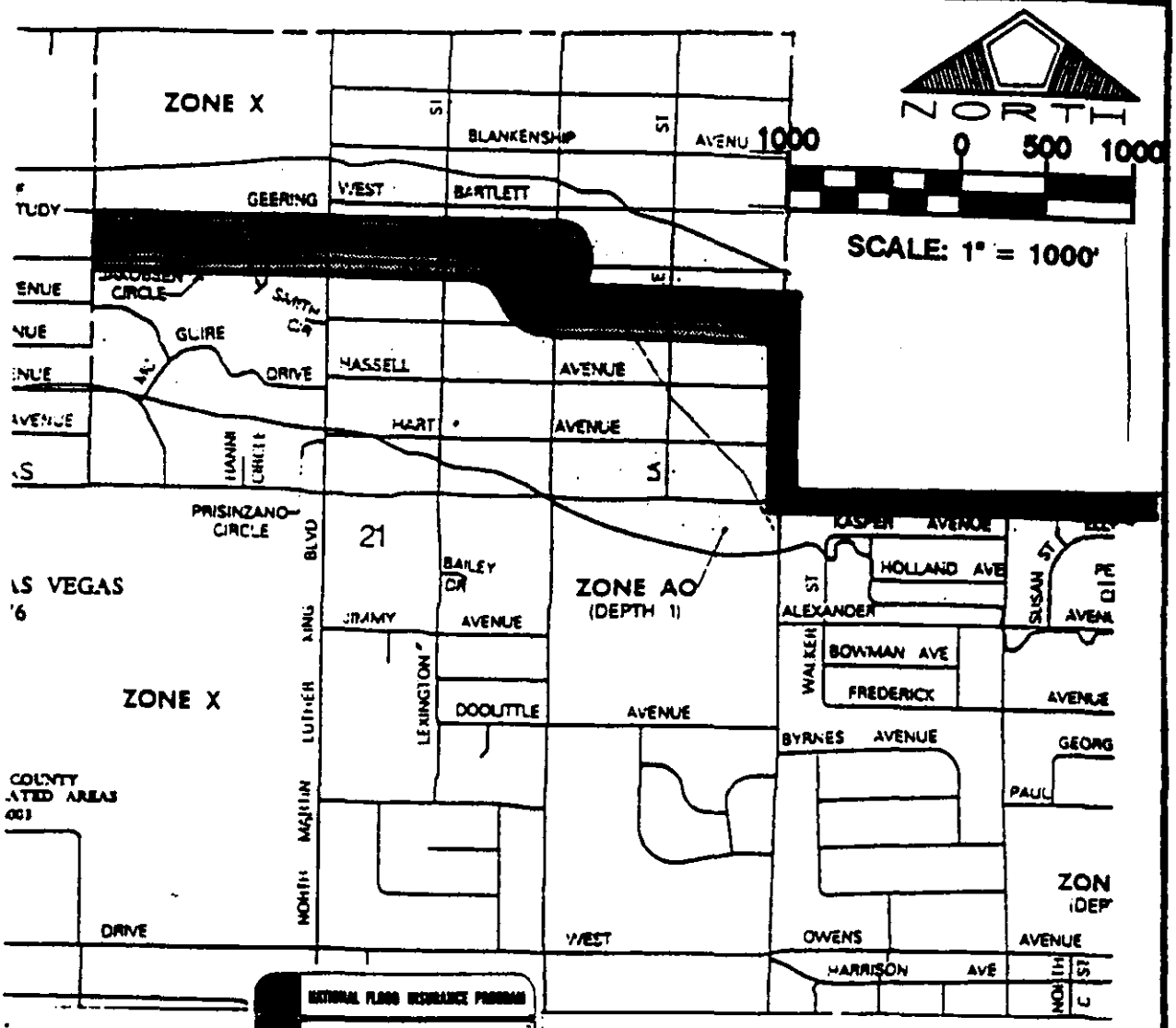
JUL 29 1983

Federal Emergency Management Agency

NORTHWEST LAS VEGAS FIS STUDY

D - FIRM

PENTACORE
Engineering, Inc.
5763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 256-[illegible]



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2100 OF 4000

MAP NUMBER
320003C2100 B

EFFECTIVE DATE:
PRELIMINARY

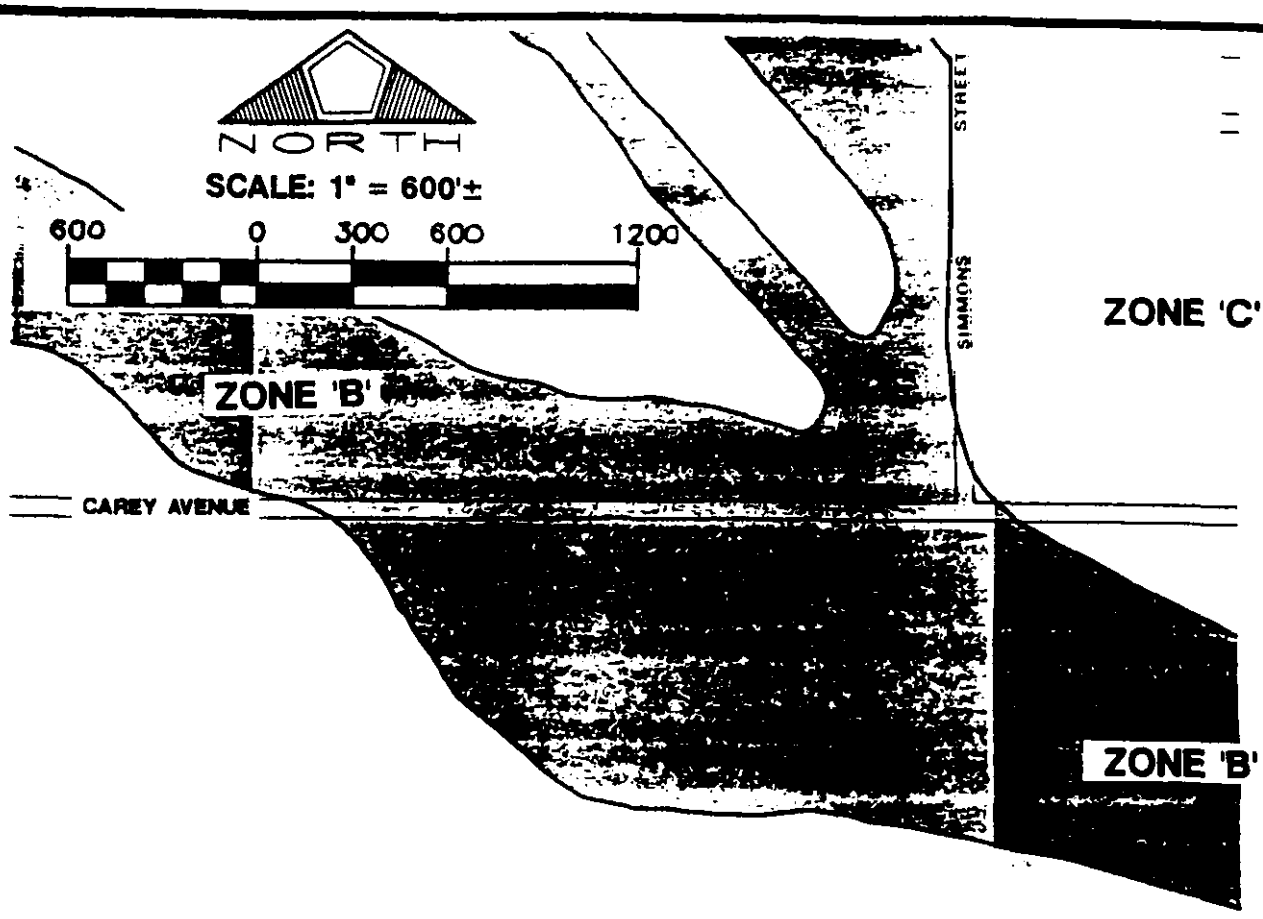
JUL 29 1983

Federal Emergency Management Agency

NORTHWEST LAS VEGAS FIS STUDY

ANNOTATED D-FIRM

PENTACORE
Engineering, Inc.
5763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 256-[illegible]



FIRM
FLOOD INSURANCE RATE MAP

CITY OF
NORTH LAS VEGAS
NEVADA
CLARK COUNTY

PANEL 3 OF 6

COMMUNITY-PANEL NUMBER
320007 0003 C

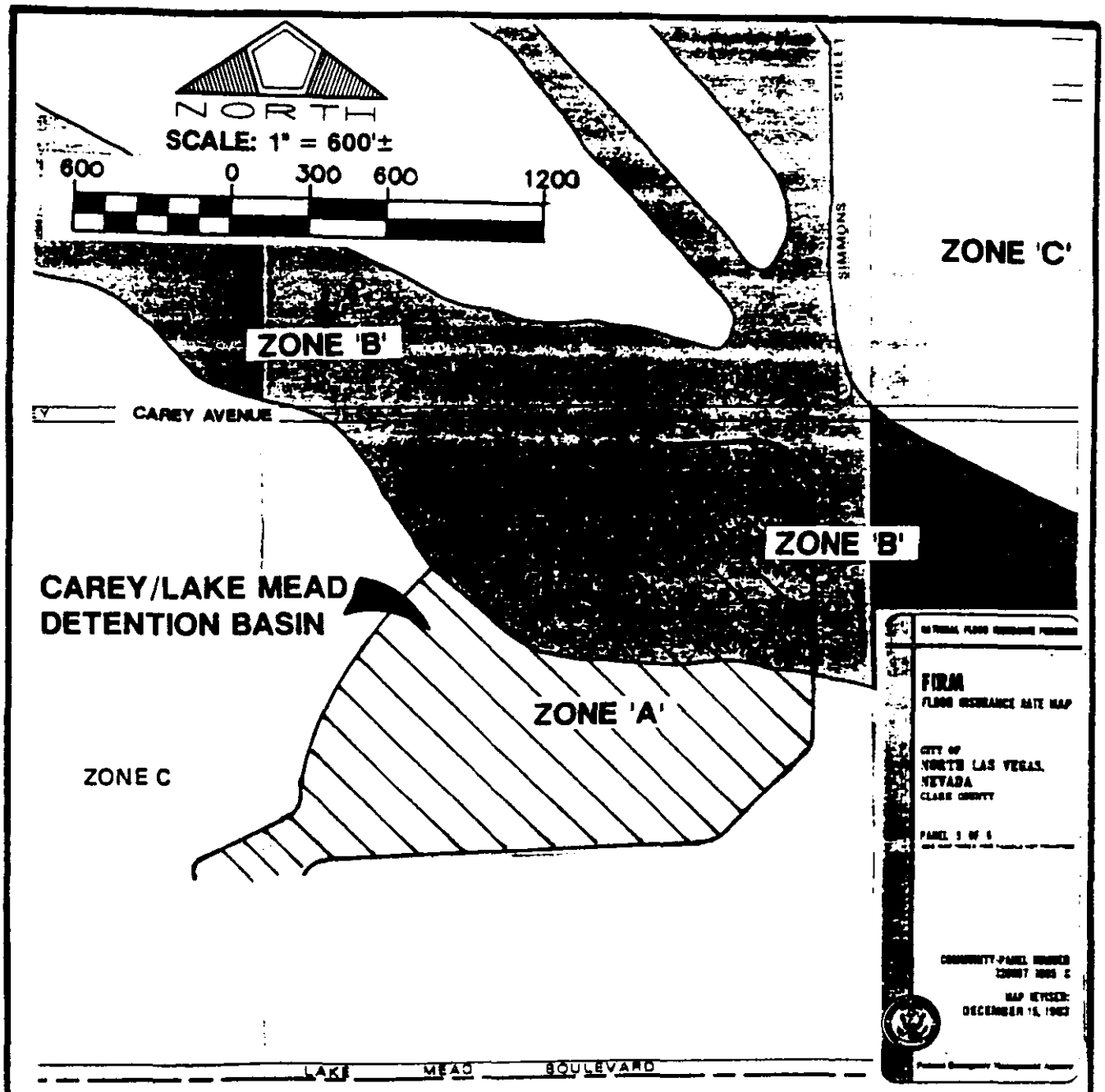
MAP REVISED:
DECEMBER 15, 1983

LAKE MEAD BOULEVARD

NORTHWEST LAS VEGAS FIS STUDY

FIRM MAP

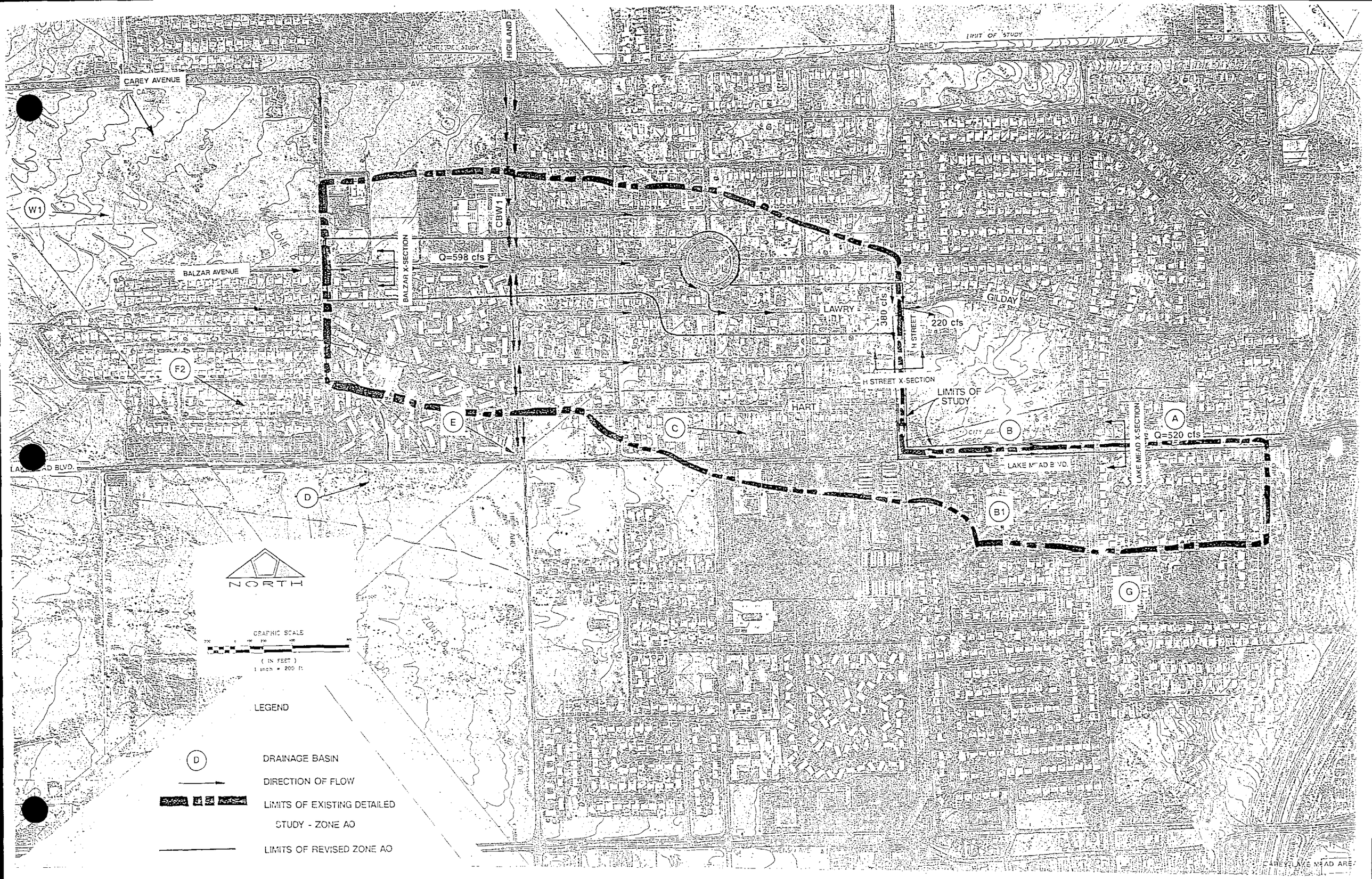
PENTACORE
Engineering, Inc.
6763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 256-[illegible]



NORTHWEST LAS VEGAS FIS STUDY

ANNOTATED FIRM

PENTACORE
Engineering, Inc.
6763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 258-3115


CAREY AVENUE
BALZAR AVENUE
HIGHLAND
CBW1
BALZAR X-SECTION
Q=598 cfs
LAWRY
380 cfs
H STREET
220 cfs
H STREET X-SECTION
GILDAY
HART
LIMITS OF STUDY
LIMIT OF STUDY
LAKE MEAD BLVD.
LAKE MEAD X-SECTION
Q=520 cfs
W1
F2
E
C
D
B
B1
A
G
NORTH
GRAPHIC SCALE
(IN FEET)
1 inch = 200 ft.
LEGEND
DRAINAGE BASIN
DIRECTION OF FLOW
LIMITS OF EXISTING DETAILED STUDY - ZONE AO
LIMITS OF REVISED ZONE AO
CAREY/LAKE MEAD ARE

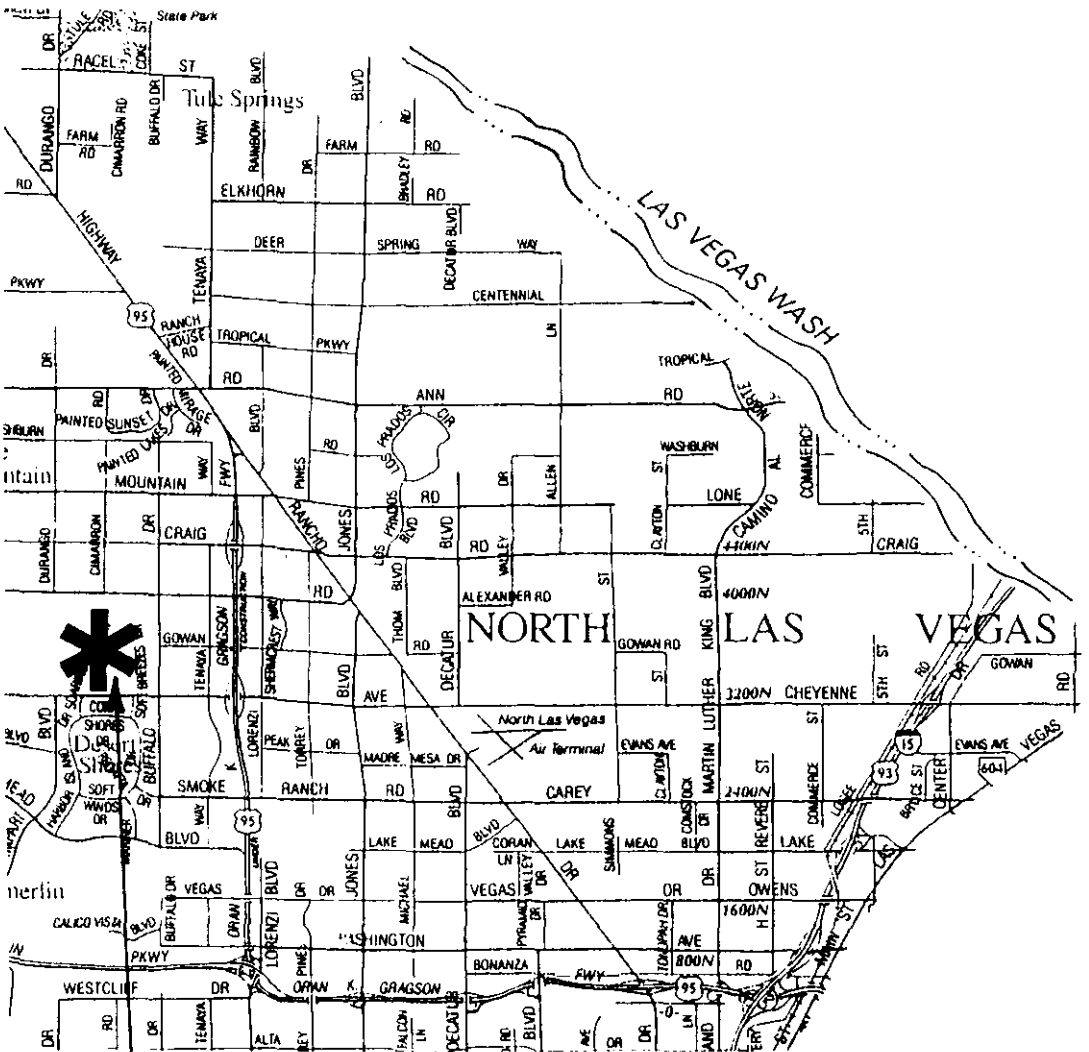
Section 2

Section 2
West Cheyenne and North Buffalo

REQUEST FOR LOMR
West Cheyenne and North Buffalo

This flood Zone "A" is located in the Southeast Quarter of the Southwest Quarter of Section 9, Township 20S, Range 60E, M.D.M., adjacent to West Cheyenne Avenue and North Buffalo Drive, Las Vegas, Nevada (FIRM Map No. 32003C, Panel 2135D). The zone was mapped as a local, depressed area designated by FEMA as Zone "A". The enclosed topographic map indicates that this local depression which exists on the western edge of the flood zone has subsequently been removed.

The mapping, which is available at a scale of 1" = 200' with 2' contour interval, illustrates that the area which is currently designated as Zone "A" has very little contributing drainage areas and can freely drain. Construction of the Cheyenne Channel, immediately to the south, also eliminates any drainage that may have reached this area in the past.



W. CHEYENNE &
N. BUFFALO

N.T.S.

COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

LOCATION MAP

JOB # 930017 6/94

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*

- ■ Physical change
  - ■ Existing
  - □ Proposed
- □ Improved methodology
- ■ Improved data
- ■ Floodway revision
- □ Other _____
  Explain _____

2. Flooding Source: Local Flooding tributary to the Gowen Detention Basin
3. Project Name/Identifier: NW Flood Insurance Study Restudy
4. FEMA zone designations affected: A
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	320003	Clark County,	Clark County	NV	320003	1000B	09/29/89

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding	Structures	Disciplines*
■ Riverine	□ Channelization	■ Water Resources
□ Coastal	□ Levee/Floodwall	■ Hydrology
□ Alluvial Fan	□ Bridge/Culvert	■ Hydraulics
□ Shallow Flooding *(e.g. Zones AO and AH)*	□ Dam	□ Sediment Transport
□ Lakes	□ Coastal	□ Interior Drainage
	□ Fill	□ Structural
Affected by wind/wave action	□ Pump Station	□ Geotechnical
□ Yes	■ None	□ Land Surveying
■ No	□ Channel Relocation	□ Other *(describe)*
	□ Excavation	
	□ Other *(describe)*	
□ Other *(describe)* _____	_____	_____

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? □ Yes ■ No
   Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? □ Yes ■ No
   If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

□ Yes ■ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? □ Yes ■ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? □ Yes ■ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? □ Yes ■ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? □ Yes ■ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ■ is □ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ■ Yes □ No

14. Does this revision request have the endorsement of the community? ■ Yes □ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? □ Yes ■ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by _____ (entity) _____ with a maximum interval of _____ months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by _____ (entity) to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, □ has ■ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☒ performing ☐ overseeing compliance with the maintenance and operation plans of the N/A
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

__X__b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

17. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• *Hydrologic analysis for flooding source differs from that used to develop FIRM*	☐ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☐ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☒ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☐ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☒ Dam Form (Form 11)
The request involves structures credited as providing protection from the 100-year flood on *an alluvial fan*	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☒ Yes ☐ No

Initial fee amount: $ _____

METHOD OF PAYMENT (Check one box)

☐ PAYMENT ENCLOSED ☐ VISA ☐ MASTERCARD CARD NUMBER

Check or money order only.

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

_____
Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Douglas B. Blatchford
Signature of Revision Requestor

Douglas B. Blatchford, Senior Engineer
Printed Name and Title of Revision Requestor

Pentacore Engineering, Inc.
Company Name

August 26, 1994
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

_____
Signature of Community Official

_____
Printed Name and Title of Community Official

_____
Community Name

_____
Date

Does this request impact any other communities? ☐ Yes ☒ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY
CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. *This certification is in accordance with 44 CFR Ch. I, Section 65.2.*
2. I am licensed with an expertise in hydrology, hydraulics
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. *I have* 8 *years experience in the expertise listed above.*
4. I have ☐ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Removal of FEMA Zone A, West Cheyenne and Buffalo Drive
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☐ Examined plans and specifications and compared with completed projects.
   d. ☒ *Other* Field investigation verifies topographic survey
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Douglas B. Blatchford
(please print or type)

Title: Senior Engineer
(please print or type)

Registration No. 10783 Expiration Date: 12/31/94

State Nevada

Type of License Civil

Douglas B. Blatchford
Signature

August 26, 1994
Date

Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE/COASTAL MAPPING FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County

Flooding Source: Local Flooding - tributary to the Gowan Detention Basin

Project Name/Identifier: NW Flood Insurance Study Restudy

1. MAPPING CHANGES

1. A topographic work map of suitable scale, contour interval, and planimetric definition must be submitted showing *(indicate N/A when not applicable)*:

		Included		
A.	Revised approximate 100-year floodplain boundaries (Zone A)	☒ Yes	☐ No	☐ N/A
B.	Revised detailed 100- and 500-year floodplain boundaries	☒ Yes	☐ No	☐ N/A
C.	Revised 100-year floodway boundaries	☐ Yes	☐ No	☒ N/A
D.	Location and alignment of all cross sections used in the revised hydraulic model with stationing control indicated	☐ Yes	☐ No	☒ N/A
E.	Stream alignments, road and dam alignments	☐ Yes	☐ No	☒ N/A
F.	Current community boundaries	☐ Yes	☐ No	☒ N/A
G.	Effective 100- and 500-year floodplain and 100-year floodway boundaries from the FIRM/FBFM reduced or enlarged to the scale of the topographic work map	☒ Yes	☐ No	☐ N/A
H.	Tie-ins between the effective and revised 100- and 500-year floodplains and 100-year floodway boundaries	☐ Yes	☐ No	☒ N/A
I.	The requestor's property boundaries and community easements	☐ Yes	☐ No	☒ N/A
J.	The signed certification of a registered professional engineer	☒ Yes	☐ No	☐ N/A
K.	Location and description of reference marks	☒ Yes	☐ No	☐ N/A
L.	Vertical datum (example: NGVD, NAVD, etc.)	☒ Yes	☐ No	☐ N/A
M.	Coastal zone designations tie into adjacent areas not being revised	☐ Yes	☐ No	☒ N/A
N.	Location and alignment of all coastal transects used to revise the coastal analyses	☐ Yes	☐ No	☒ N/A

If any of the items above are marked no or N/A, please explain: C) No floodway boundary applies; D) No hydraulic model used; E) No streams, road, and dam alignments; F) No boundaries on map; H) No tie-ins; I) No property boundaries or easements; M) Not at coast; N) Not at coast.

2. What is the source and date of the updated topographic information *(example: orthophoto maps, July 1985; field survey, May 1979, beach profiles, June 1987, etc.)*? USGS Topo

3. What is the scale and contour interval of the following workmaps?
   a. Effective FIS _____ scale _____ Contour interval
   b. Revision Request 1" = 400' scale 2' Contour interval

NOTE: Revised topographic information must be of equal or greater detail.

4. Attach an annotated FIRM and FBFM at the scale of the effective FIRM and FBFM showing the revised 100-year and 500-year floodplains and the 100-year floodway boundaries and how they tie into those shown on the effective FIRM and FBFM downstream and upstream of the revision or adjacent to the area of revision for coastal studies.

Attach additional pages if needed.

5. Flood Boundaries and 100-year water surface elevations:

Has the 100-year floodplain been shifted or increased or the 100-year water surface elevation increased at any location on property other than the requestor's or community's? ☐ Yes ☒ No

If yes, please give the location of shift or increase and an explanation for the increase.

a. Have the affected property owners been notified of this shift or increase and the effect it will have on their property? . . . . . ☐ Yes ☒ No

If yes, please attach letters from these property owners stating they have no objections to the revised flood boundaries if a LOMR is being requested.

b. What is the number of insurable structures that will be impacted by this shift or increase? None

6. Have the floodway boundaries shifted or increased at any location compared to those shown on the effective FBFM or FIRM? . . . . . ☐ Yes ☒ No

If yes, explain:

7. If a V-zone has been designated, has it been delineated to extend landward to the heel of the primary frontal dune? . . . . . ☐ Yes ☒ No

If no, explain:

8. Manual or digital map submission:

☒ Manual
☐ Digital

Digital map submissions may be used to update digital FIRMs (DFIRMs). For updating DFIRMs, these submissions must be coordinated with FEMA Headquarters as far in advance of submission as possible.

1. The fill is: ■ Existing □ Proposed

2. Has fill been/will be placed in the regulatory floodway? . . . . . □ Yes ■ No

If yes, please attach completed Riverine Hydraulic Analysis Form.

3. Has fill been/will be placed in floodway fringe *(area between the floodway and 100-year floodplain boundaries)*? . . . . . □ Yes ■ No

If yes, then complete A, B, C, and D below.

A. Are fill slopes for granular materials steeper than one vertical on one-and-one-half horizontal? . . . . . □ Yes □ No

If yes, justify steeper slopes _____

_____

B. Is adequate erosion protection provided for fill slopes exposed to moving flood waters? *(Slopes exposed to flows with velocities of up to 5 feet per second (fps) during the 100-year flood must, at a minimum, be protected by a cover of grass, vines, weeds, or similar vegetation; slopes exposed to flows with velocities greater than 5 fps during the 100-year flood must, at a minimum, be protected by stone or rock riprap.)* . . . . . □ Yes □ No

If no, describe erosion protection provided _____

_____

C. Has all fill placed in revised 100-year floodplain been compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test Method or acceptable equivalent method? . . . . . □ Yes □ No

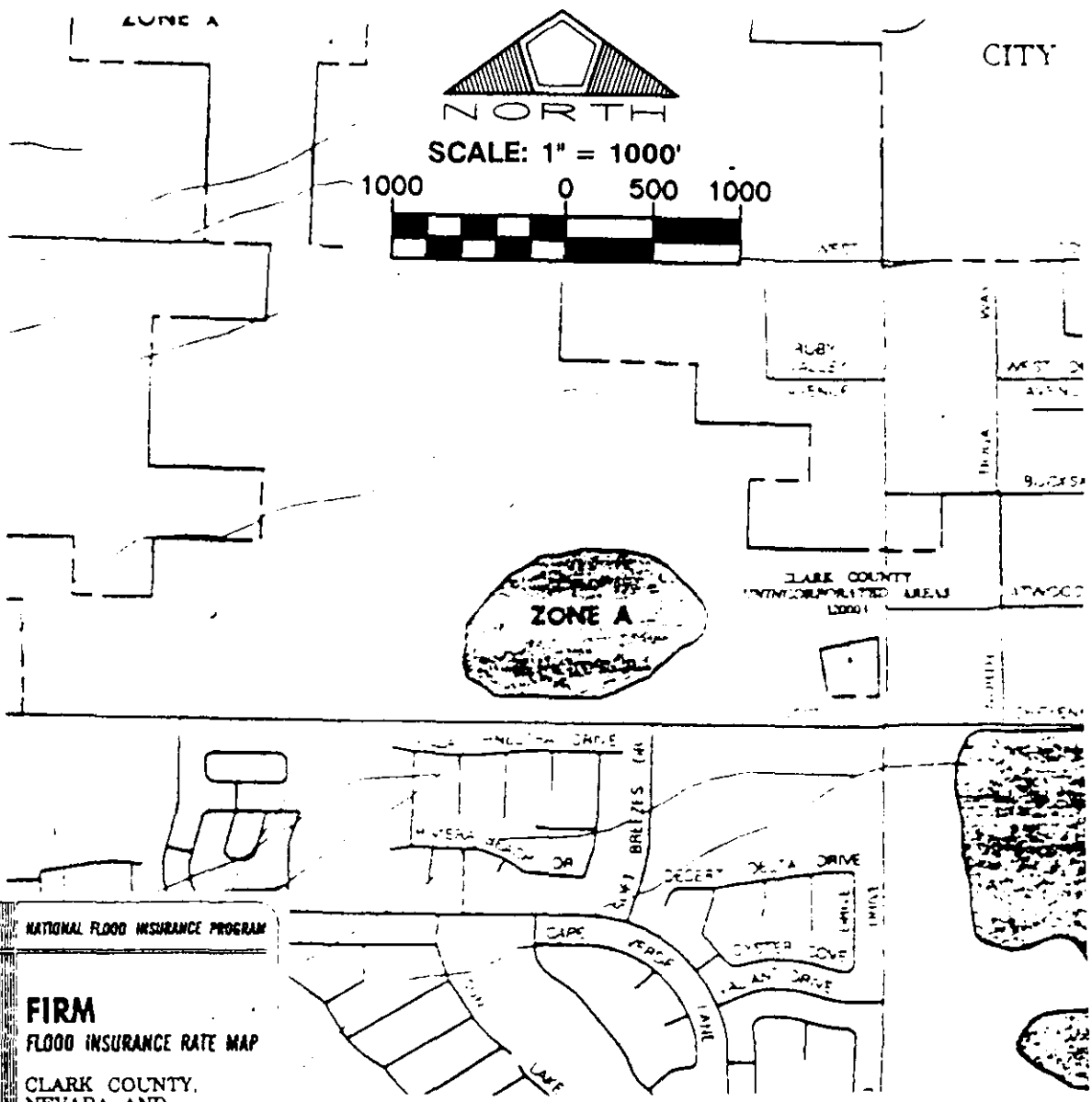
D. Can structures conceivably be constructed on the fill at any time in the future? . . . . . □ Yes □ No

If yes, provide certification of fill compaction (item C. above) by the community's NFIP permit official, a registered professional engineer, or an accredited soils engineer.

4. Has fill been/will be placed in a V-zone? . . . . . □ Yes ■ No

If yes, is the fill protected from erosion by a flood control structure such as a revetment or seawall? . . . . . □ Yes □ No

If yes, attach the coastal structures form.



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2135 OF 4090

(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY NUMBER PANEL SUFFIX

MAP NUMBER
32003C2135 D

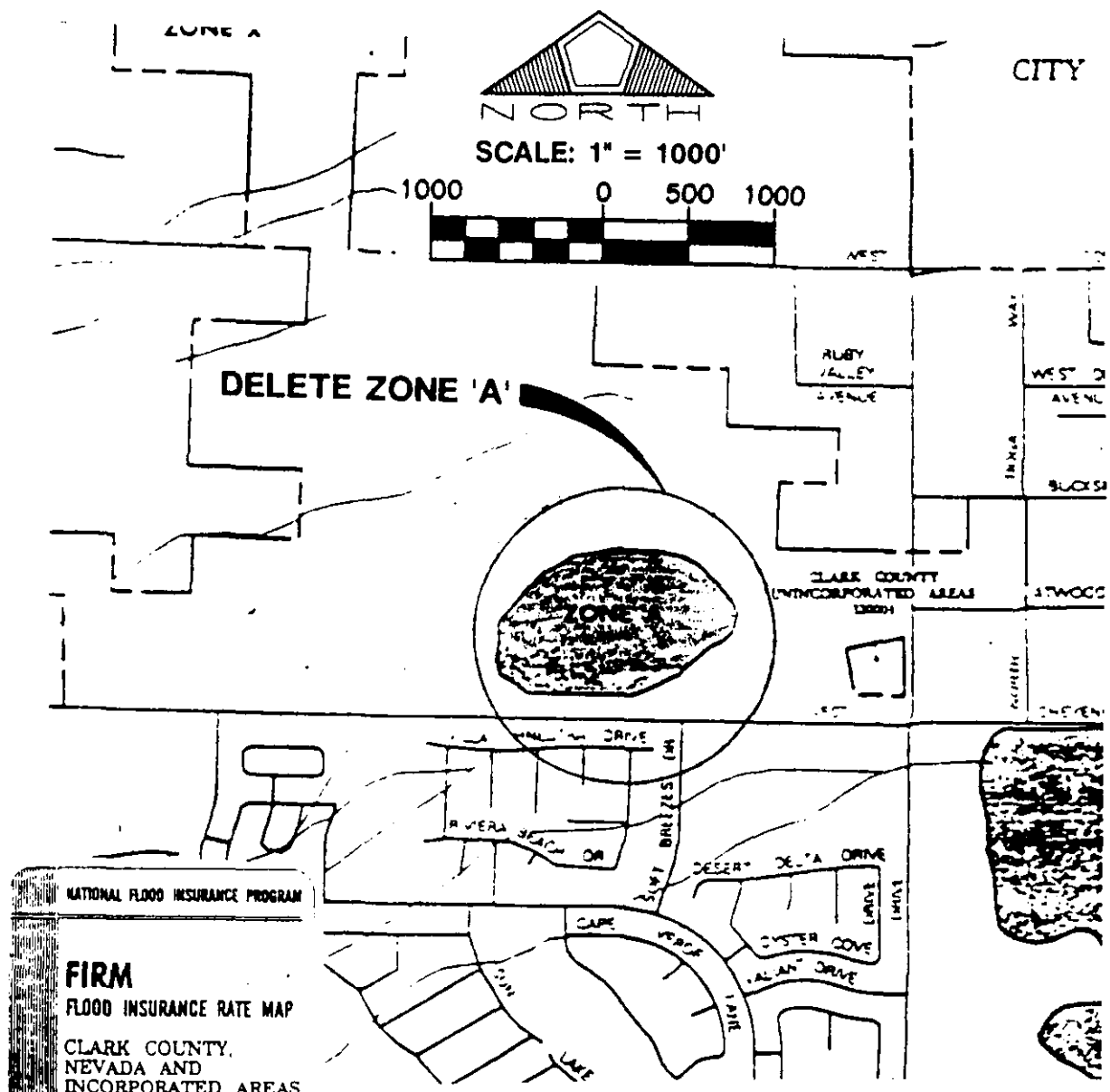
EFFECTIVE DATE:
PRELIMINARY
MICHAEL BAKER, JR. INC.

JUN 2 9 2001

NORTHWEST LAS VEGAS FIS STUDY

D-FIRM

PENTACORE
Engineering, Inc.
8763 West Charleston Boulevard
Las Vegas, Nevada 89132
(702) 256-3115



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2135 OF 4000

MAP NUMBER
32003C2135 D

EFFECTIVE DATE:
PRELIMINARY
MICHAEL BAKER JR

JUL 2 9 [illegible]

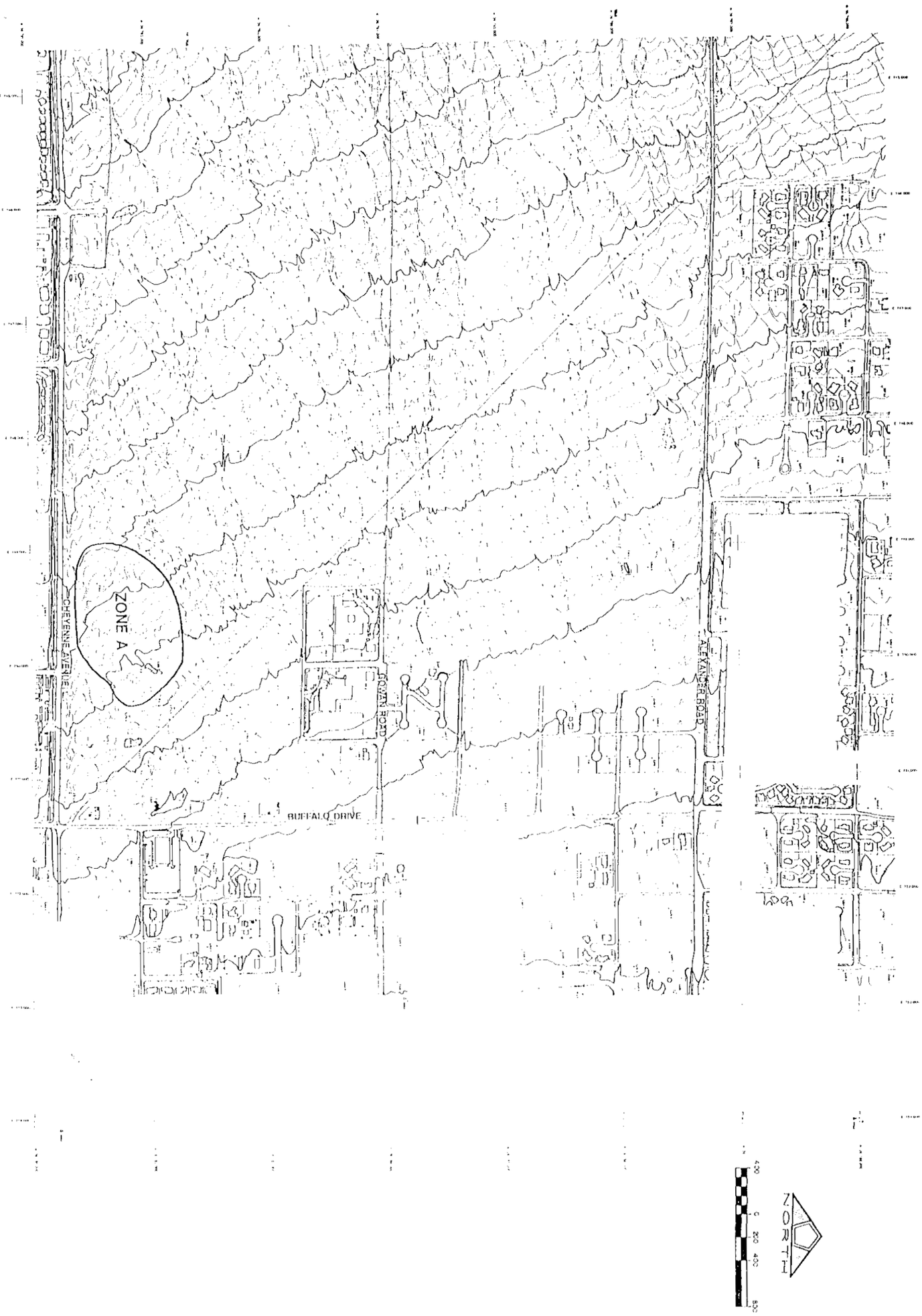
NORTHWEST LAS VEGAS FIS STUDY

ANNOTATED D-FIRM

PENTACORE
Engineering, Inc.

6763 West Charleston Boulevard
Las Vegas, Nevada 89102

(702) 256-[illegible]



CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

NORTHWEST LAS VEGAS FIS RESTUDY

ZONE A ADJACENT WEST OF CHEYENNE AVE. & BUFFALO DR.

PENTACORE Engineering, Inc.

6763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 258-0151

DATE:
DRAWN BY:
DESIGNED BY:
CHECKED BY:
JOB NO.:
SCALE:

RECOMMENDED:

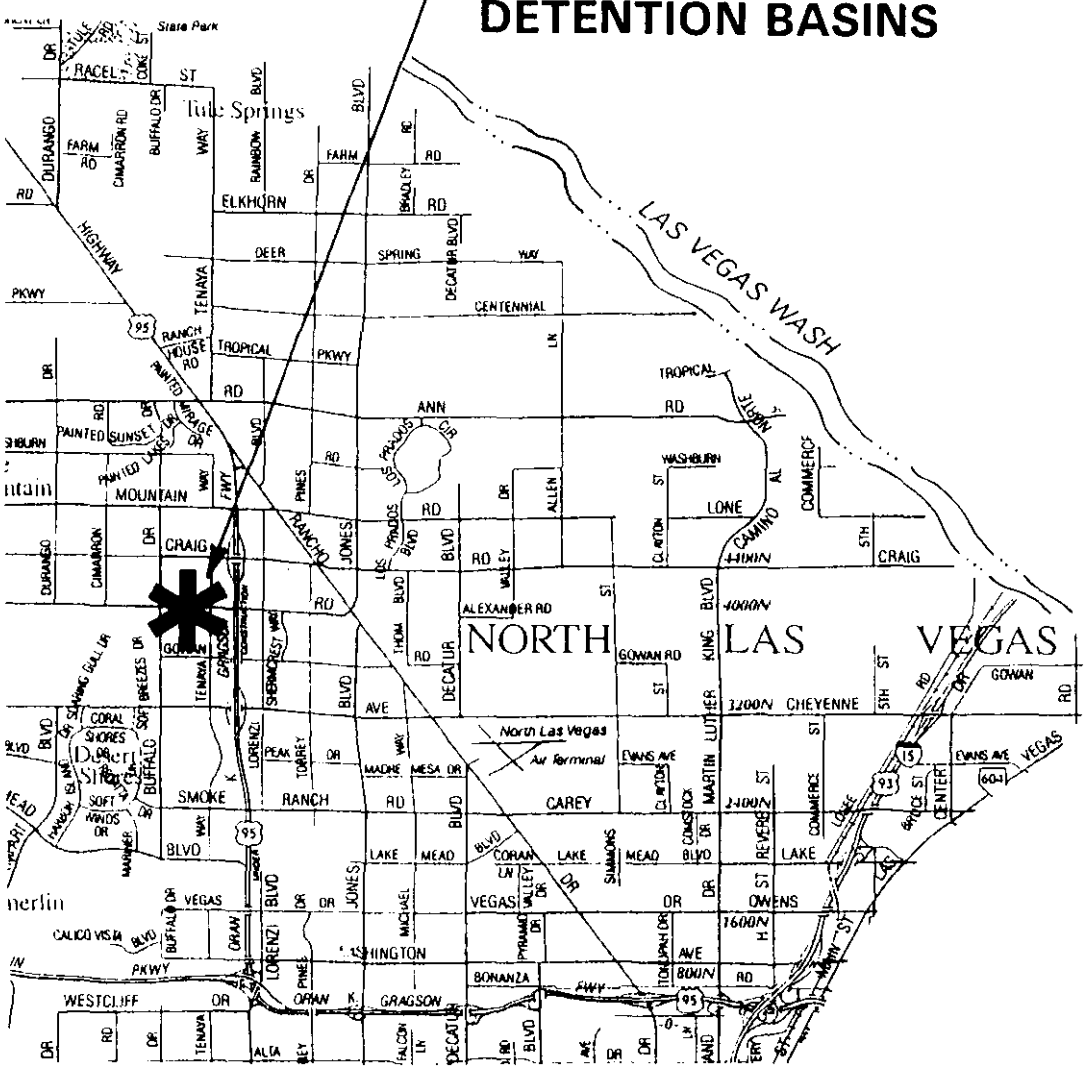
CHIEF, M. & R. DIVISION DATE

NO. DESCRIPTION DATE APPD.

Section 3

Section 3
Gowan Detention Basins

GOWAN DETENTION BASINS



N.T.S.

COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

LOCATION MAP

JOB # 930017 6/94

REQUEST FOR LOMR
Gowan North Detention Basin

The Gowan Detention Basins, Lower and Upper North are located adjacent to Gowan Road between Buffalo Drive and Highway 95, in Section 10, Township 20S, Range 60E, M.D.M. The purpose of this study is to revise the Flood Insurance Rate Map to add Flood Zone "A" at the location of each basin. The existing Flood Insurance Rate Map shows no Flood Zone "A" at the Gowan Basins.

The Gowan Detention Basins were designed by the Poggemeyer Design Group. The project was coordinated and funded by the Clark County Regional Flood Control District. The purpose of the Gowan Detention Basins, Lower and Upper North is to reduce downstream flooding.

The new flood zone is justified by the enclosed grading plans which were taken from construction plans prepared by the Poggemeyer Design Group. Construction of the Gowan Basins has been completed per these plans.

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

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1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ■ Physical change
     - ■ Existing
     - □ Proposed
   - □ Improved methodology
   - □ Improved data
   - □ Floodway revision
   - □ Other _____

   Explain The Gowan Detention Basins have been constructed.
2. Flooding Source: Zone "A" caused by construction of Gowan Detension Basin Upper North
3. Project Name/Identifier: Northwest Las Vegas Flood Insurance Study, Restudy
4. FEMA zone designations affected: Zone A

   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	32003	Clark County	Clark	NV	32003C	2135	
	32003	Clark County	Clark	NV	32003C	2155	

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding	Structures	Disciplines*
□ Riverine	□ Channelization	■ Water Resources
□ Coastal	□ Levee/Floodwall	■ Hydrology
■ Alluvial Fan	□ Bridge/Culvert	□ Hydraulics
□ Shallow Flooding *(e.g. Zones AO and AH)*	□ Dam	□ Sediment Transport
□ Lakes	□ Coastal	□ *Interior Drainage*
	□ Fill	□ Structural
Affected by wind/wave action	□ Pump Station	□ Geotechnical
□ Yes	□ None	□ Land Surveying
■ No	□ Channel Relocation	□ Other *(describe)*
	□ Excavation	
	■ Other *(describe)*	
□ Other *(describe)* _____	Detention Basin _____	_____

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

Does the affected flooding source have a floodway designated on the effective FIRM or FBFM?	□ Yes	■ No
Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM?	□ Yes	■ No

If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

☐ Yes ☒ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways: (No flooding)

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☐ Yes ☒ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☒ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☒ Yes ☐ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? ☒ Yes ☐ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted. Detention Basin constructed for Public Benefit.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? ☒ Yes ☐ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by City of Las Vegas (entity) _____ with a maximum interval of 6 months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by City of Las Vegas (entity) to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☒ has ☐ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ■ performing □ overseeing compliance with the maintenance and operation plans of the Gowan Detention Basins
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

__X__b.LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

7. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	■ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	□ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	□ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	□ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	□ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	□ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	□ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	□ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	■ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	□ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☒ Yes ☐ No

Initial fee amount: $ _____

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ VISA ☐ MASTERCARD **CARD NUMBER**

Check or money order only.

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

_____
Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: *I understand that my signature* indicates that all information submitted in support of this request is correct.

Douglas B. Blatchford
Signature of Revision Requestor

Douglas B. Blatchford, Senior Engineer
Printed Name and Title of Revision Requestor

Pentacore Engineering, Inc.
Company Name

August 26, 1994
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

Signature of Community Official

Printed Name and Title of Community Official

Community Name

Date

Does this request impact any other communities? ☐ Yes ☒ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in Water resources (hydrology and hydraulics)
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 8 years experience in the expertise listed above.
4. I have ☐ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Gowan Detention Basin (upper north) FIRM revision
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☒ Examined plans and specifications and compared with completed projects.
   d. ☐ Other _____
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Douglas B. Blatchford
(please print or type)

Title: Senior Engineer
(please print or type)

Registration No. 10783 Expiration Date: 12/31/94

State Nevada

Type of License Civil Engineer

Douglas B. Blatchford
Signature

August 26, 1994
Date

*Specify Subdiscipline

Seal
(Optional)

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY **DAM FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 0.5 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada

Flooding Source: Gowan Detention Basin

Project Name/Identifier: Northwest Las Vegas Flood Insurance Study Restudy

IDENTIFIER

Name of Dam: Upper North Gowan Detention Basin

Location of dam along flood source (in terms of stream distance or cross section identifier):

Check one of the following:

- ☐ Existing dam
- ■ New dam
- ☐ Modifications of existing dam (describe modifications) _____

Was the dam designed by _____ Federal agency _____ State agency

__X__ Local government agency _____ Private organization?

BACKGROUND

Does the dam have dedicated flood control storage? ■ Yes ☐ No

Does the project involve revised hydrology? ■ Yes ☐ No

If yes, complete Hydrologic Analysis Form and include calculations of the 100-year inflow flood hydrograph routed through the dam with the beginning pool at the normal pool elevation (spillway crest elevation for ungated spillway). Include any inflow hydrograph bulking by watershed sediment yield and provide necessary debris and sediment yield analysis.

Does the revised hydrology affect the 100-year water-surface elevation behind the dam or downstream of the dam?

■ Yes ☐ No

If yes, complete the Riverine Hydraulic Analysis Form and complete the table shown on the following page.

RESULTS

	Stillwater Elevation Behind the Dam	
	FIS	Revised
10-year	N/A	N/A
50-year	N/A	N/A
100-year	N/A	2326
500-year	N/A	2329
Normal Pool Elevation	N/A	*see note

Was long term sediment accumulation taken into consideration in determining the normal pool elevation?
*Standing water does not affect the detention basin because of the arid conditions in the Las Vegas Valley

■ Yes □ No

Was the dam designed to withstand the hydrostatic and hydrodynamic forces associated with floods greater than the 100-year flood?

■ Yes □ No

If no, and the dam has a reasonable probability of failure during the 100-year flood, please attach dam break analysis.

Provide the following data on the dam:

Height: 22 feet

Crest Elevation: 2330.10

100-year flood storage capacity: 700 ac.- ft.

Freeboard (measured from 100-year water surface elevation): 4 feet

Spillway(s):

Type: □ gated ■ ungated

Width: 1770 feet

Height: 18 feet

Crest Elevation: 2326

Outlet(s):

Type: □ gated ■ ungated

Width: 96"

Height: 96"

Diameter:

Invert Elevation: 2307.0

Explain flow regulation plan: The North Gowan Detention Basins were designed to reduce the peak flow of a 100 year storm from 2350 cfs to 550 cfs.

Are the project features, including the emergency spillway, designed to accommodate the 100-year flood discharge without *overtopping the dam?*

■ Yes □ No

Was the dam designed in accordance with all currently applicable local, State, and Federal regulations?

■ Yes □ No

If no, please provide explanation.

FEMA may request a list of regulations that have been complied with and supporting documentation demonstrating compliance with these regulations.

Attach copy of formal operation and maintenance plan

Answer N/A to any questions which are not applicable

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

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1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*

- ☒ *Physical change*
  - ☒ Existing
  - ☐ Proposed
- ☐ Improved methodology
- ☐ Improved data
- ☐ *Floodway revision*
- ☐ Other _____

Explain The Gowan Detention Basins have been constructed.

2. Flooding Source: Zone "A" caused by construction of Gowan Detention Basin, Lower North.
3. Project Name/Identifier: Northwest Las Vegas Flood Insurance Study, Restudy
4. FEMA zone designations affected: Zone A

(example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)

5. The NFIP *map panel(s) affected for all impacted communities is (are):*

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	32003	Clark County	Clark	NV	32003C	2135	
	32003	Clark County	Clark	NV	32003C	2155	

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding	Structures	Disciplines*
☐ Riverine	☐ Channelization	☒ Water Resources
☐ Coastal	☐ Levee/Floodwall	☒ Hydrology
☒ Alluvial Fan	☐ Bridge/Culvert	☐ Hydraulics
☐ Shallow Flooding *(e.g. Zones AO and AH)*	☐ Dam	☐ Sediment Transport
☐ Lakes	☐ Coastal	☐ Interior Drainage
	☐ Fill	☐ Structural
Affected by wind/wave action	☐ Pump Station	☐ Geotechnical
☐ Yes	☐ None	☐ Land Surveying
☒ No	☐ Channel Relocation	☐ *Other (describe)*
	☐ Excavation	
☐ Other *(describe)* _____	☒ Other *(describe)* Detention Basin	

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

Does the affected flooding source have a floodway designated on the effective FIRM or FBFM?	☐ Yes	☒ No
Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM?	☐ Yes	☒ No

If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

☐ Yes ☒ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways: (No flooding)

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☐ Yes ☒ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☒ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☒ Yes ☐ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? ☒ Yes ☐ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted. Detention Basin constructed for Public Benefit.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? ☒ Yes ☐ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by City of Las Vegas (entity) _____ with a maximum interval of 6 months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by City of Las Vegas (entity) to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☒ has ☐ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☒ performing ☐ overseeing compliance with the maintenance and operation plans of the Gowan Detention Basin, Lower North
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

__X__b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. *Other:* Describe _____

8. FORMS INCLUDED

17. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	☒ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☐ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☐ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☐ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☒ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☒ Yes ☐ No

Initial fee amount: $ _____

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ *VISA* ☐ *MASTERCARD* *CARD NUMBER*

Check or money order only.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

_____
Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Douglas B. Blatchford
Signature of Revision Requestor

Douglas B. Blatchford, Senior Engineer
Printed Name and Title of Revision Requestor

Pentacore Engineering, Inc.
Company Name

August 26, 1994
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

_____
Signature of Community Official

_____
Printed Name and Title of Community Official

_____
Community Name

_____
Date

Does this request impact any other communities? ☐ Yes ☒ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY **CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. *This certification is in accordance with 44 CFR Ch. I, Section 65.2.*
2. I am licensed with an expertise in Water resources (hydrology and hydraulics)
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 8 years experience in the expertise listed above.
4. I have ☐ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Gowan North (Lower) FIRM revision.
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☒ Examined plans and specifications and compared with completed projects.
   d. ☐ Other _____
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Douglas B. Blatchford
(please print or type)

Title: Senior Engineer
(please print or type)

Registration No. 10783 Expiration Date: 12/31/94

State Nevada

Type of License Civil Engineer

Douglas B. Blatchford
Signature

August 26, 1994
Date

*Specify Subdiscipline

Seal
(Optional)

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY DAM FORM	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 0.5 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada

Flooding Source: Gowan Detention Basin, Lower North

Project Name/Identifier: Northwest Las Vegas Flood Insurance Study Restudy

IDENTIFIER

Name of Dam: Lower North Gowan Detention Basin

Location of dam along flood source (in terms of stream distance or cross section identifier):

Check one of the following:

- ☐ Existing dam
- ● New dam
- ☐ Modifications of existing dam (describe modifications) _____

Was the dam designed by _____ Federal agency _____ State agency

__X__ Local government agency _____ Private organization?

BACKGROUND

Does the dam have dedicated flood control storage? ■ Yes ☐ No

Does the project involve revised hydrology? ■ Yes ☐ No

If yes, complete Hydrologic Analysis Form and include calculations of the 100-year inflow flood hydrograph routed through the dam with the beginning pool at the normal pool elevation (spillway crest elevation for ungated spillway). Include any inflow hydrograph bulking by watershed sediment yield and provide necessary debris and sediment yield analysis.

Does the revised hydrology affect the 100-year water-surface elevation behind the dam or downstream of the dam?

■ Yes ☐ No

If yes, complete the Riverine Hydraulic Analysis Form and complete the table shown on the following page.

RESULTS

	Stillwater Elevation Behind the Dam	
	FIS	Revised
10-year	N/A	N/A
50-year	N/A	N/A
100-year	N/A	2326
500-year	N/A	2329
Normal Pool Elevation	N/A	*see note

Was long term sediment accumulation taken into consideration in determining the normal pool elevation?
*Standing water does not affect the detention basin because of the arid conditions in the Las Vegas Valley

■ Yes □ No

Was the dam designed to withstand the hydrostatic and hydrodynamic forces associated with floods greater than the 100-year flood?

■ Yes □ No

If no, and the dam has a reasonable probability of failure during the 100-year flood, please attach dam break analysis.

Provide the following data on the dam:

Height: 24.10

Crest Elevation: 2330

100-year flood storage capacity: 260 ac.- ft.

Freeboard (measured from 100-year water surface elevation): 4 feet

Spillway(s):

Type: □ gated ■ ungated

Width: 90 feet

Height: 20 feet

Crest Elevation: 2326

Outlet(s):

Type: □ gated ■ ungated

Width: 96"

Height: 96"

Diameter: _____

Invert Elevation: 2305.43

Explain flow regulation plan: The North Gowan Detention Basins were designed to reduce the peak flow of a 100 year storm from 2350 cfs to 550 cfs.

Are the project features, including the emergency spillway, designed to accommodate the 100-year flood discharge without overtopping the dam?

■ Yes □ No

Was the dam designed in accordance with all currently applicable local, State, and Federal regulations?

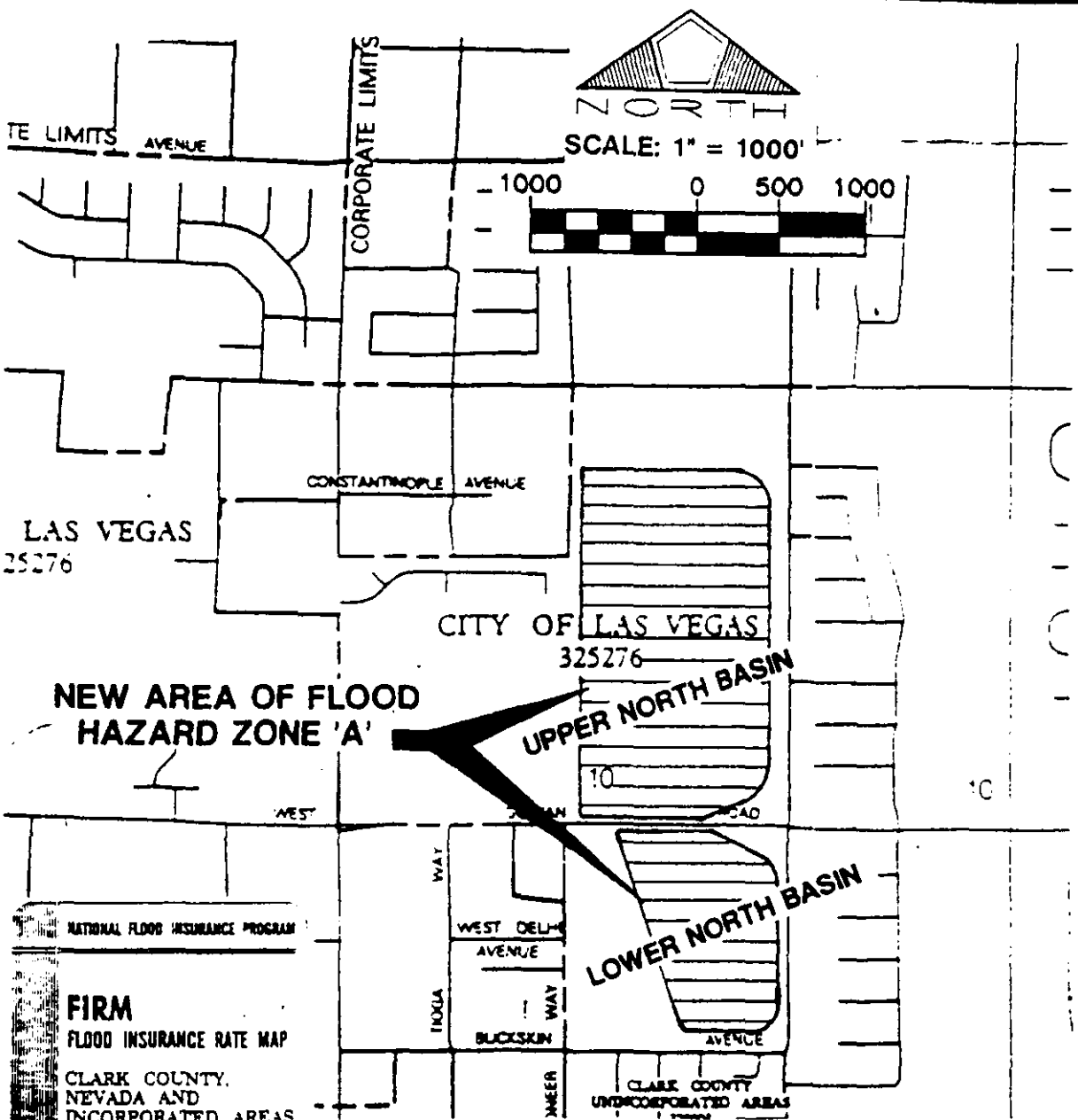
■ Yes □ No

If no, please provide explanation. _____

FEMA may request a list of regulations that have been *complied with and supporting* documentation demonstrating compliance with these regulations.

Attach copy of formal operation and maintenance plan

Answer N/A to any questions which are not applicable



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2135 OF 4000

MAP NUMBER
32003C2135 D

EFFECTIVE DATE:
PRELIMINARY
MICHAEL BAKER JR

NORTHWEST LAS VEGAS FIS STUDY

ANNOTATED D-FIRM

PENTACORE
Engineering, Inc.

NO.	DESCRIPTION	DATE	APP'D

RECOMMENDED:

JEFFREY M. RASMUSSON
N.C.E. # 7815

DATE

DATE : 2/26/04
DRAWN BY : AJ
DESIGNED BY :
CHECKED BY :
JOB NO. : 3142.0001
SCALE : AS SHOWN

CORE Engineering, Inc.
(702) 258-0115

PENTACORE
6763 West Charleston Boulevard
Las Vegas, Nevada 89102

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
NORTHWEST LAS VEGAS FIS RESTUDY
GOWAN DETENTION BASINS--UPPER & LOWER NORTH

SHEET 1 OF 1

REQUEST FOR LOMR
Gowan South Detention Basin

The Gowan South Detention Basin is located southeast of the intersection of Cheyenne Avenue and North Buffalo Drive, Section 15, Township 20S, Range 60E, M.D.M. The purpose of this analysis is to revise the existing limits of the Zone "A" at the Gowan South Detention Basin. The proposed revision would reduce the existing Flood Zone "A" to the limits of the basin itself.

The Gowan South detention basin was designed by the Poggemeyer Design Group. This project was coordinated and funded by the Clark County Regional Flood Control District. The purpose of the Gowan South Detention Basin is to reduce the peak discharge from the upstream hydrograph by flow detention and discharge of the attenuated flow into the Gowan outfall.

The revised flood zone is justified by the enclosed grading plans which were taken from construction plans prepared by the Poggemeyer Design Group. Construction of the Gowan Basins has been completed per these plans.

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ■ Physical change
     - ● Existing
     - ☒ Proposed
   - □ Improved methodology
   - □ Improved data
   - □ Floodway revision
   - □ Other _____
     Explain The Gowan Detention Basins have been constructed.
2. Flooding Source: Gowan Drainage Basin - South
3. Project Name/Identifier: Northwest Las Vegas Flood Insurance Study Restudy
4. FEMA zone designations affected: Zone "A"
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	32003	Clark County	Clark	NV	32003C	2135	
	32003	Clark County	Clark	NV	32003C	2155	

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding	Structures	Disciplines*
■ Riverine	□ Channelization	■ Water Resources
□ Coastal	□ Levee/Floodwall	● Hydrology
■ Alluvial Fan	□ Bridge/Culvert	□ Hydraulics
□ Shallow Flooding *(e.g. Zones AO and AH)*	□ Dam	□ Sediment Transport
□ Lakes	□ Coastal	□ Interior Drainage
	□ Fill	□ Structural
Affected by wind/wave action	□ Pump Station	□ Geotechnical
□ Yes	□ None	□ Land Surveying
■ No	□ Channel Relocation	☒ Other *(describe)*
	□ Excavation	
	■ Other *(describe)* Detention Basin	
□ Other *(describe)* _____		

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

a. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? □ Yes ■ No
b. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? □ Yes ■ No
If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

□ Yes ■ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. *With floodways: (No flooding)*

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? □ Yes ■ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? □ Yes ■ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ■ Yes □ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? ■ Yes □ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted. Detention Basin constructed for Public Benefit.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ■ is □ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ■ Yes □ No

14. Does this revision request have the endorsement of the community? ■ Yes □ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? ■ Yes □ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by City of Las Vegas (entity)

_____ with a maximum interval of 6 months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by City of Las Vegas (entity)

to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ■ has □ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ■ performing ☐ overseeing compliance with the maintenance and operation plans of the Gowan Detention Basins
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

__X__b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

7. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	■ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☐ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☐ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
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• The request involves an existing, proposed, or modified dam	■ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☒ Yes ☐ No

Initial fee amount: $ _____

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ VISA ☐ MASTERCARD **CARD NUMBER**

Check or money order only.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

_____
Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☐ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: *I understand that my signature indicates that* all information submitted in support of this request is correct.

Douglas B. Blatchford
Signature of Revision Requestor

Douglas B. Blatchford, Senior Engineer
Printed Name and Title of Revision Requestor

Pentacore Engineering, Inc.
Company Name

August 26, 1999
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

Signature of Community Official

Printed Name and Title of *Community Official*

Community Name

Date

Does this request impact any other communities? ☐ Yes ☒ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148 Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

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1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in Water resources (hydrology and hydraulics)
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 8 years experience in the expertise listed above.
4. I have ☐ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:

   _____
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.

   b. ☐ Compared plans and specifications with as-built survey information.

   c. ☒ Examined plans and specifications and compared with completed projects.

   d. ☐ Other _____
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Douglas B. Blatchford
(please print or type)

Title: Senior Engineer
(please print or type)

Registration No. 10783 Expiration Date: 12/31/94

State Nevada

Type of License Civil Engineering

Douglas B. Blatchford
Signature

August 26, 1994
Date

*Specify Subdiscipline

Seal
(Optional)

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY RIVERINE/COASTAL MAPPING FORM	O.M.B. Burden No. 3067-0148 Expires July 31, 1994	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Las Vegas

Flooding Source: Runoff from the Gowan South Drainage Basin causing Zone "A" flooding

Project Name/Identifier: Northwest Las Vegas Flood Insurance Study Restudy

1. MAPPING CHANGES

1. A topographic work map of suitable scale, contour interval, and planimetric definition must be submitted showing *(indicate N/A when not applicable)*:

		Included		
A.	Revised approximate 100-year floodplain boundaries (Zone A)	■ Yes	□ No	□ N/A
B.	Revised detailed 100- and 500-year floodplain boundaries	■ Yes	□ No	□ N/A
C.	Revised 100-year floodway boundaries	□ Yes	□ No	■ N/A
D.	Location and alignment of all cross sections used in the revised hydraulic model with stationing control indicated	□ Yes	□ No	■ N/A
E.	Stream alignments, road and dam alignments	■ Yes	□ No	□ N/A
F.	Current community boundaries	■ Yes	□ No	□ N/A
G.	Effective 100- and 500-year floodplain and 100-year floodway boundaries from the FIRM/FBFM reduced or enlarged to the scale of the topographic work map	■ Yes	□ No	□ N/A
H.	Tie-ins between the effective and revised 100- and 500-year floodplains and 100-year floodway boundaries	□ Yes	□ No	■ N/A
I.	The requestor's property boundaries and community easements	□ Yes	□ No	■ N/A
J.	The signed certification of a registered professional engineer	■ Yes	□ No	□ N/A
K.	Location and description of reference marks	■ Yes	□ No	□ N/A
L.	Vertical datum (example: NGVD, NAVD, etc.)	■ Yes	□ No	□ N/A
M.	Coastal zone designations tie into adjacent areas not being revised	□ Yes	□ No	■ N/A
N.	Location and alignment of all coastal transects used to revise the coastal analyses	□ Yes	□ No	■ N/A

If any of the items above are marked no or N/A, please explain: C) Not in floodway; D) No hydraulic model used; H) No tie-ins required; I) No easments or property lines crossing property; M) Not at coast; N) Not at coast.

2. What is the source and date of the updated topographic information *(example: orthophoto maps, July 1985; field survey, May 1979, beach profiles, June 1987, etc.)*? Topographic, 1/17/92

3. What is the scale and contour interval of the following workmaps?
   a. Effective FIS 1" = 2000 scale _____ Contour interval
   b. Revision Request _____ scale _____ Contour interval

NOTE: Revised topographic information must be of equal or greater detail.

4. Attach an annotated FIRM and FBFM at the scale of the effective FIRM and FBFM showing the revised 100-year and 500-year floodplains and the 100-year floodway boundaries and how they tie into those shown on the effective FIRM and FBFM downstream and upstream of the revision or adjacent to the area of revision for coastal studies.
Attach additional pages if needed.

5. Flood Boundaries and 100-year water surface elevations:

Has the 100-year floodplain been shifted or increased or the 100-year water surface elevation increased at any location on property other than the requestor's or community's? ☐ Yes ■ No

If yes, please give the location of shift or increase and an explanation for the increase.

_____

_____

_____

a. Have the affected property owners been notified of this shift or increase and the effect it will have on their property? . . . . . ☐ Yes ■ No

If yes, please attach letters from these property owners stating they have no objections to the revised flood boundaries if a LOMR is being requested.

b. What is the number of insurable structures that will be impacted by this shift or increase? _____

6. Have the floodway boundaries shifted or increased at any location compared to those shown on the effective FBFM or FIRM? . . . . . ☐ Yes ■ No

If yes, explain:

_____

_____

_____

7. If a V-zone has been designated, has it been delineated to extend landward to the heel of the primary frontal dune? . . . . . ☐ Yes ■ No

If no, explain:

_____

_____

_____

8. Manual or digital map submission:

■ Manual
☐ Digital

Digital map submissions may be used to update digital FIRMs (DFIRMs). For updating DFIRMs, these submissions must be coordinated with FEMA Headquarters as far in advance of submission as possible.

2. EARTH FILL PLACEMENT

1. The fill is: ■ Existing □ Proposed

2. Has fill been/will be placed in the regulatory floodway? . . . . . □ Yes ■ No

   If yes, please attach completed Riverine Hydraulic Analysis Form.

3. Has fill been/will be placed in floodway fringe *(area between the floodway and 100-year floodplain boundaries)*? . . . . . □ Yes ■ No

   If yes, then complete A, B, C, and D below.

   A. Are fill slopes for granular materials steeper than one vertical on one-and-one-half horizontal? . . . . . □ Yes □ No

      If yes, justify steeper slopes _____

      _____

   B. Is adequate erosion protection provided for fill slopes exposed to moving flood waters? *(Slopes exposed to flows with velocities of up to 5 feet per second (fps) during the 100-year flood must, at a minimum, be protected by a cover of grass, vines, weeds, or similar vegetation; slopes exposed to flows with velocities greater than 5 fps during the 100-year flood must, at a minimum, be protected by stone or rock riprap.)* . . . . . □ Yes □ No

      If no, describe erosion protection provided _____

      _____

   C. Has all fill placed in revised 100-year floodplain been compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test Method or acceptable equivalent method? . . . . . □ Yes □ No

   D. Can structures conceivably be constructed on the fill at any time in the future? . . . . . □ Yes □ No

      If yes, provide certification of fill compaction (item C. above) by the community's NFIP permit official, a registered professional engineer, or an accredited soils engineer.

4. Has fill been/will be placed in a V-zone? . . . . . □ Yes ■ No

   If yes, is the fill protected from erosion by a flood control structure such as a revetment or seawall? . . . . . □ Yes □ No

   If yes, attach the coastal structures form.

FEDERAL EMERGENCY MANAGEMENT AGENCY **DAM FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: Clark County, Nevada

Flooding Source: Gowan Detention Basin

Project Name/Identifier: Northwest Las Vegas Flood Insurance Study

IDENTIFIER

Name of Dam: Gowan South Detention Basin

Location of dam along flood source (in terms of stream distance or cross section identifier):

Check one of the following:

- ☐ Existing dam
- ■ New dam
- ☐ Modifications of existing dam (describe modifications) _____

Was the dam designed by _____ Federal agency _____ State agency

__X__ Local government agency _____ Private organization?

BACKGROUND

Does the dam have dedicated flood control storage? ■ Yes ☐ No

Does the project involve revised hydrology? ■ Yes ☐ No

If yes, complete Hydrologic Analysis Form and include calculations of the 100-year inflow flood hydrograph routed through the dam with the beginning pool at the normal pool elevation (spillway crest elevation for ungated spillway). Include any inflow hydrograph bulking by watershed sediment yield and provide necessary debris and sediment yield analysis.

Does the revised hydrology affect the 100-year water-surface elevation behind the dam or downstream of the dam?

■ Yes ☐ No

If yes, complete the Riverine Hydraulic Analysis Form and complete the table shown on the following page.

RESULTS

	Stillwater Elevation Behind the Dam	
	FIS	Revised
10-year	N/A	N/A
50-year	N/A	N/A
100-year	N/A	2349.6
500-year	N/A	N/A
Normal Pool Elevation	N/A	*see note

Was long term sediment accumulation taken into consideration in determining the normal pool elevation?
*Standing water does not affect the detention basin because of the arid conditions in the Las Vegas Valley

■ Yes □ No

Was the dam designed to withstand the hydrostatic and hydrodynamic forces associated with floods greater than the 100-year flood?

■ Yes □ No

If no, and the dam has a reasonable probability of failure during the 100-year flood, please attach dam break analysis.

Provide the following data on the dam:

Height: 19.8

Crest Elevation: 2355.2

100-year flood storage capacity: 455 ac.- ft. w\o tailwater; 375 ac-ft w\ tailwater

Freeboard (measured from 100-year water surface elevation): 5.6 feet

Spillway(s):

Type: □ gated ■ ungated

Width: 315 feet at 2355.2 with a lower notch, 200 feet at 2349.6

Height: 20 feet

Crest Elevation: 2355.2

Outlet(s):

Type: □ gated ■ ungated

Width: _____

Height: _____

Diameter: 72"

Invert Elevation: 2325.33

Explain flow regulation plan: The North Gowan Detention Basins were designed to reduce the peak flow of a 100 year storm from 2125 cfs to 455 cfs.

Are the project features, including the emergency spillway, designed to accommodate the 100-year flood discharge without overtopping the dam?

■ Yes □ No

Was the dam designed in accordance with all currently applicable local, State, and Federal regulations?

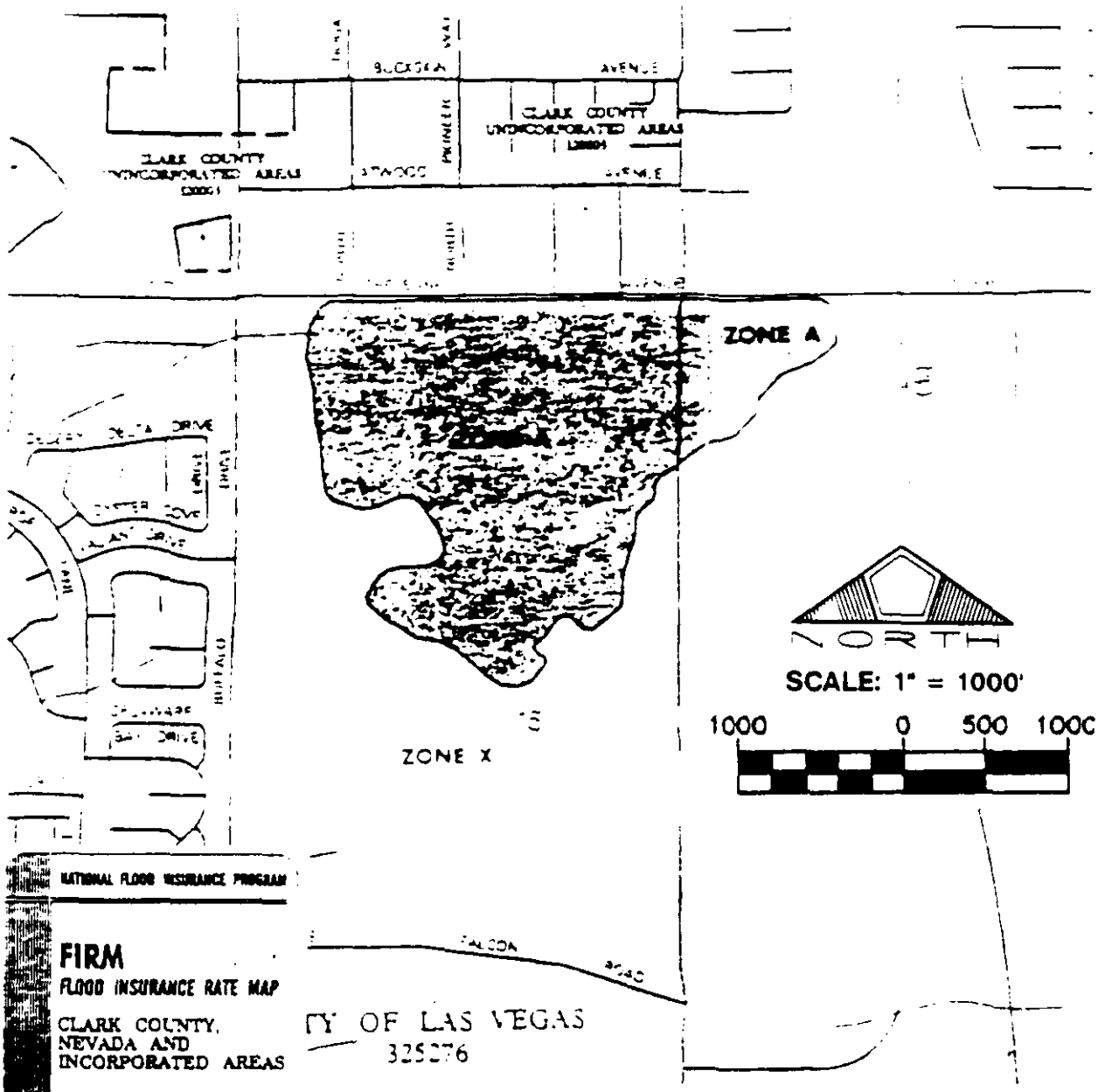
■ Yes □ No

If no, please provide explanation. _____

FEMA may request a list of regulations that have been complied with and supporting documentation demonstrating compliance with these regulations.

Attach copy of formal operation and maintenance plan

Answer N/A to any questions which are not applicable

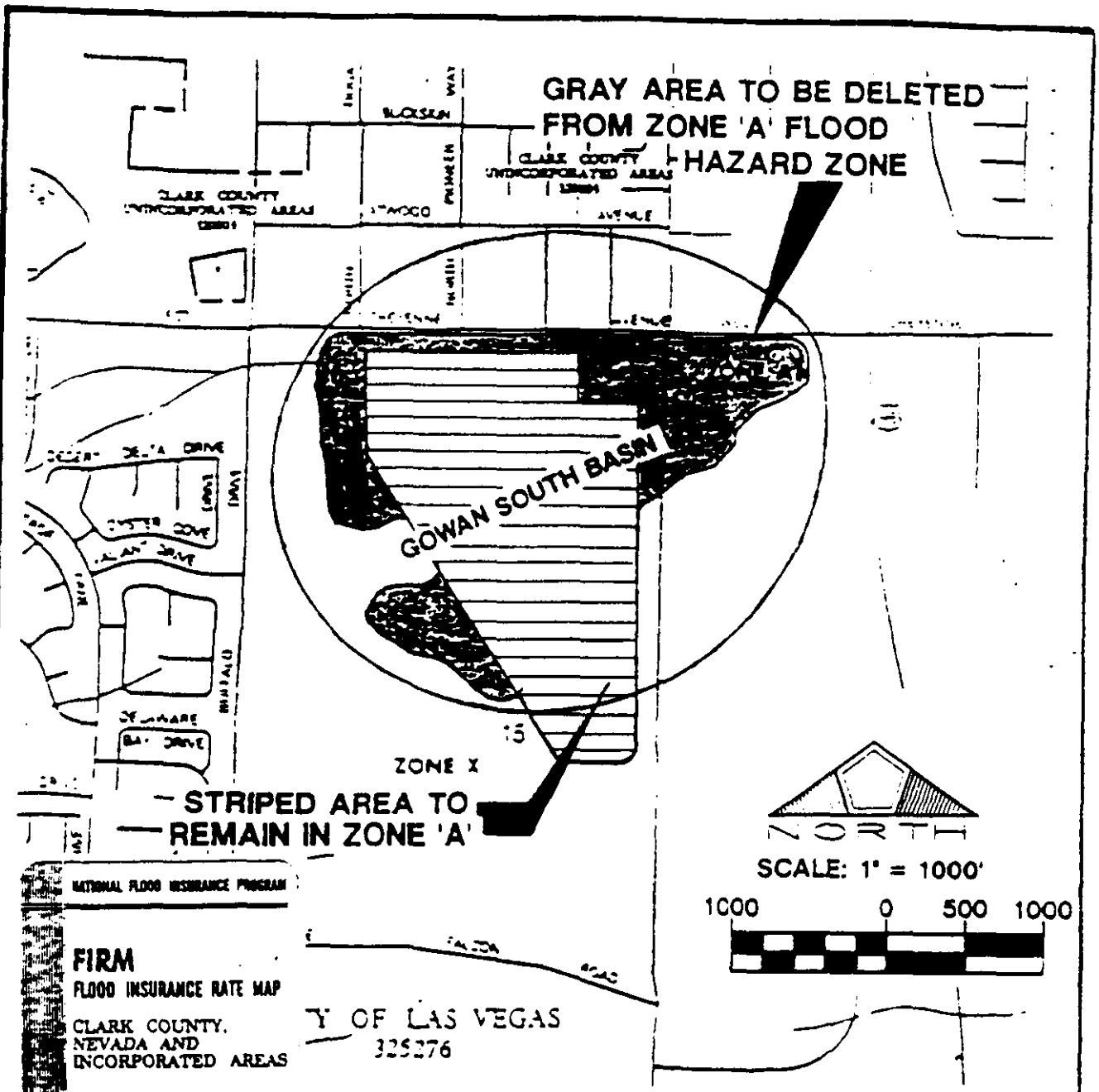


NORTHWEST LAS VEGAS FIS STUDY

D-FIRM

PENTACORE

Engineering



NORTHWEST LAS VEGAS FIS STUDY

ANNOTATED D-FIRM

PENTACORE

Engineering

NO.	DESCRIPTION	DATE	APP'D

RECOMMENDED

DEAN M. RASMUSSON
R.E. # 9193

DATE

DATE: 5/26/94
DRAWN BY: ALF
DESIGNED BY:
CHECKED BY:
JOB NO.: 94-0001
SCALE: AS SHOWN

PENTACORE
Engineering, Inc.
6763 West Charleston Boulevard
Las Vegas, Nevada 89107
(702) 258-0115

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
NORTHWEST LAS VEGAS FIS RESTUDY
GOWAN DETENTION BASIN - SOUTH

SHEET
1
OF

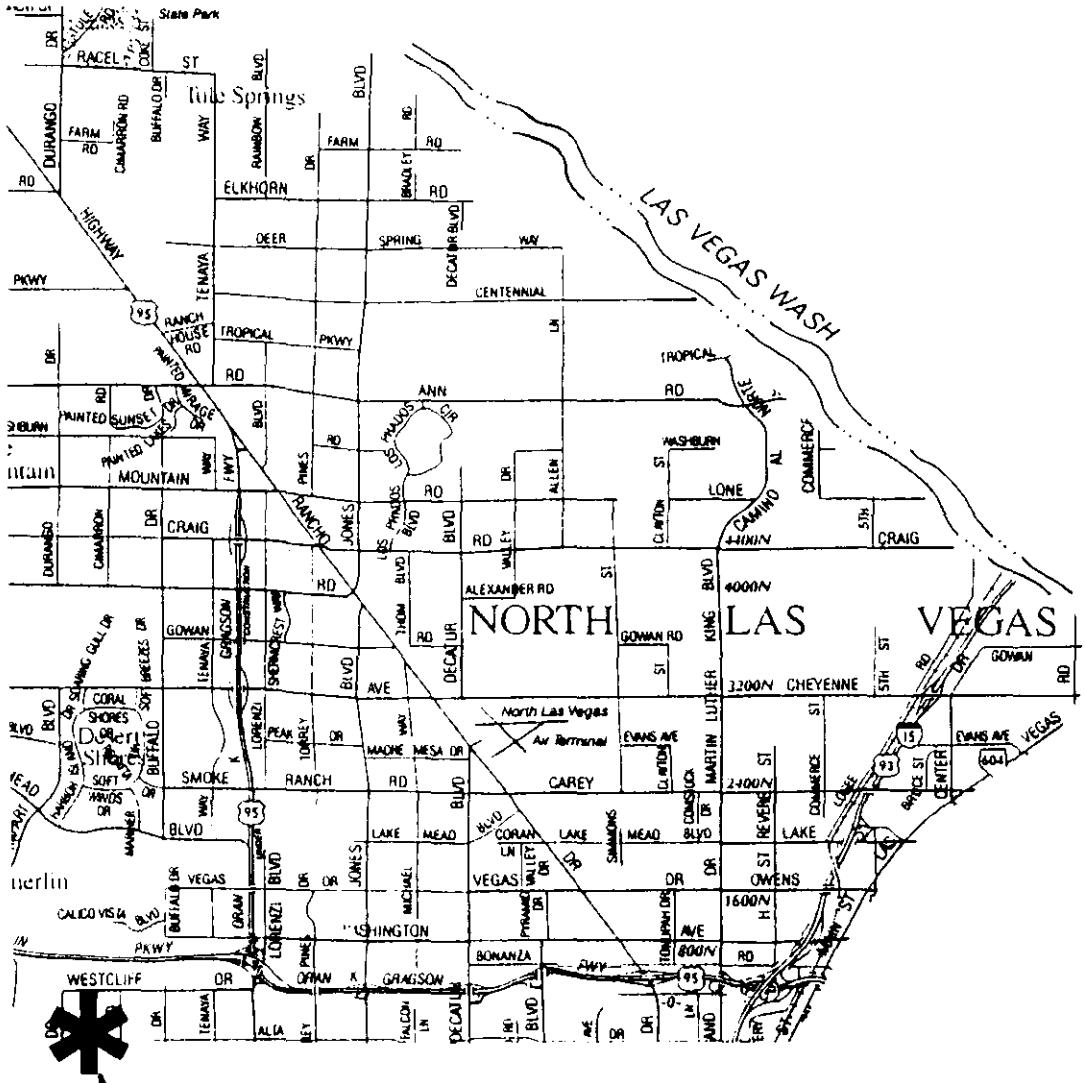
Section 4
Durango Drive

REQUEST FOR LOMR
Durango Drive

This study area is located northeast of the Durango Drive and Charleston Boulevard intersection, in the City of Las Vegas, Nevada, within the southwest corner of Section 33, Township 20S, Range 60E, M.D.M. The purpose of this request for a LOMR is to eliminate the existing Zone "A" due to changed conditions which have resulted from the construction of Durango Drive.

Durango Drive was designed by Engineers and Surveyors, Inc. (ESI). Funding for Durango Drive was shared by the Clark County Regional Transportation Commission (CCRTC) and the Clark County Regional Flood Control District (CCRFCD). Portions of the CCRFCD funding provided for the installation of a 84-inch storm drain in Durango Drive. This storm drain, along with street flows in Durango Drive, direct storm runoff north, thereby removing the source of flooding for the existing Zone "A". The results of this study conclude that the existing Zone "A" is no longer necessary because Durango Drive would act as a barrier to upstream flows from the west and would divert these flows to the north.

Copies of "As-Built" plans for the Durango Drive and storm drain plans are attached. A hydrologic analysis for a single watershed was prepared using the HEC-2 model. The drainage area that is tributary to the flood zone downstream of Durango Drive was delineated based upon field reconnaissance and aerial photographs and is illustrated on the attached exhibit. Results from the HEC-2 analysis indicate a 100-year peak discharge of 195 cfs at the point of interest. A hydraulic analysis of the 84-inch storm drain indicates that it has a capacity of 534 cfs. Durango Drive has an additional 397 cfs of capacity at a depth of 1.12 feet. It is concluded that urban development of the area, in conjunction with the storm drain improvements, warrant the removal of this Zone "A".



N.T.S.

COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

LOCATION MAP

JOB # 930017 6/94

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ■ Physical change
     - ■ Existing
     - □ Proposed
   - □ Improved methodology
   - □ Improved data
   - □ Floodway revision
   - □ Other _____
     Explain _____
2. Flooding Source: Zone A downstream of Durango Drive
3. Project Name/Identifier: NW Las Vegas Flood Insurance Study Restudy
4. FEMA zone designations affected: Zone A
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	320003	Las Vegas, City	Clark County	NV	32003C	2145D	6/29/93

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding	Structures	Disciplines*
□ Riverine	□ Channelization	■ Water Resources
□ Coastal	□ Levee/Floodwall	□ Hydrology
□ Alluvial Fan	□ Bridge/Culvert	□ Hydraulics
□ Shallow Flooding *(e.g. Zones AO and AH)*	□ Dam	□ Sediment Transport
□ Lakes	□ Coastal	□ Interior Drainage
	□ Fill	□ Structural
Affected by wind/wave action	□ Pump Station	□ Geotechnical
□ Yes	■ None	□ Land Surveying
■ No	□ Channel Relocation	□ Other *(describe)*
	□ Excavation	
	□ *Other (describe)*	

■ Other *(describe)* See attached letter

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

a. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ■ Yes □ No
b. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? ■ Yes □ No
If yes, give reason: Zone A truncated by construction of Durango Drive

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

□ Yes ■ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? □ Yes ■ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? □ Yes ■ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? □ Yes ■ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? □ Yes ■ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ■ is □ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ■ Yes □ No

14. Does this revision request have the endorsement of the community? ■ Yes □ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? □ Yes ■ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by _____ (entity)

_____ with a maximum interval of _____ months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by _____ (entity)

to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by *individual name or title*, and provisions for testing the plan at intervals not less than one year, □ has ■ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ■ performing □ overseeing compliance with the maintenance and operation plans of the Durango Drive Storm Drain/Durango Drive
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

X__b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. I, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. I, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

17. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	■ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	□ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	□ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	□ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	□ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	□ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	□ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	□ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	□ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	□ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ■ Yes ☐ No

Initial fee amount: $ _____

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ VISA ☐ MASTERCARD CARD NUMBER

Check or money order only.

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

_____
Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☐ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Douglas B. Blatchford
Signature of Revision Requestor

Douglas B. Blatchford, Senior Engineer
Printed Name and Title of Revision Requestor

Pentacore Engineering, Inc.
Company Name

August 26, 1999
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

_____
Signature of Community Official

_____
Printed Name and Title of Community Official

_____
Community Name

_____
Date

Does this request impact any other communities? ☐ Yes ■ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148 Expires July 31, 1994

FEMA USE ONLY

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1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I *am licensed with an expertise in* Water resources (hydrology and hydraulics)
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 8 years experience in the expertise listed above.
4. I have ☐ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Deletion of FEMA Zone A adjacent Durango Drive and Charleston, as shown on the enlosed areal photo
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☒ Examined plans and specifications and compared with completed projects.
   d. ☐ Other _____
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Douglas B. Blatchford
(please print or type)

Title: Senior Engineer
(please print or type)

Registration No. 10783

Expiration Date: 12/31/94

State Nevada

Type of License Civil Engineering

Douglas B. Blatchford
Signature

August 26 1994
Date

*Specify Subdiscipline

Seal
(Optional)

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE/COASTAL MAPPING FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

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Community Name: City of Las Vegas

Flooding Source: Zone "A" downstream of Durango Drive

Project Name/Identifier: NW Las Vegas Flood Insurance Study

1. MAPPING CHANGES

1. A topographic work map of suitable scale, contour interval, and planimetric definition must be submitted showing *(indicate N/A when not applicable)*:

		Included		
A.	Revised approximate 100-year floodplain boundaries (Zone A)	■ Yes	□ No	□ N/A
B.	Revised detailed 100- and 500-year floodplain boundaries	■ Yes	□ No	□ N/A
C.	Revised 100-year floodway boundaries	□ Yes	□ No	■ N/A
D.	Location and alignment of all cross sections used in the revised hydraulic model with stationing control indicated	□ Yes	□ No	■ N/A
E.	Stream alignments, road and dam alignments	■ Yes	□ No	□ N/A
F.	Current community boundaries	■ Yes	□ No	□ N/A
G.	Effective 100- and 500-year floodplain and 100-year floodway boundaries from the FIRM/FBFM reduced or enlarged to the scale of the topographic work map	■ Yes	□ No	□ N/A
H.	Tie-ins between the effective and revised 100- and 500-year floodplains and 100-year floodway boundaries	□ Yes	□ No	■ N/A
I.	The requestor's property boundaries and community easements	□ Yes	□ No	■ N/A
J.	The signed certification of a registered professional engineer	■ Yes	□ No	□ N/A
K.	Location and description of reference marks	■ Yes	□ No	□ N/A
L.	Vertical datum (example: NGVD, NAVD, etc.)	■ Yes	□ No	□ N/A
M.	Coastal zone designations tie into adjacent areas not being revised	□ Yes	□ No	■ N/A
N.	Location and alignment of all coastal transects used to revise the coastal analyses	□ Yes	□ No	■ N/A

If any of the items above are marked no or N/A, please explain: C) Not in floodway; D) No hydraulic model required; H) No tie-ins required; I) No property boundaries or easements involved; M) Not at coast; N) Not at coast

2. What is the source and date of the updated topographic information *(example: orthophoto maps, July 1985; field survey, May 1979, beach profiles, June 1987, etc.)*? _____

3. What is the scale and contour interval of the following workmaps?
   a. Effective FIS _____ scale _____ Contour interval
   b. Revision Request _____ scale _____ Contour interval

NOTE: Revised topographic information must be of equal or greater detail.

4. Attach an annotated FIRM and FBFM at the scale of the effective FIRM and FBFM showing the revised 100-year and 500-year floodplains and the 100-year floodway boundaries and how they tie into those shown on the effective FIRM and FBFM downstream and upstream of the revision or adjacent to the area of revision for coastal studies.
Attach additional pages if needed.

5. Flood Boundaries and 100-year water surface elevations:

Has the 100-year floodplain been shifted or increased or the 100-year water surface elevation increased at any location on property other than the requestor's or community's? ☐ Yes ■ No

If yes, please give the location of shift or increase and an explanation for the increase.

_____

_____

_____

a. Have the affected property owners been notified of this shift or increase and the effect it will have on their property? . . . . . ☐ Yes ■ No

If yes, please attach letters from these property owners stating they have no objections to the revised flood boundaries if a LOMR is being requested.

b. What is the number of insurable structures that will be impacted by this shift or increase? _____

6. Have the floodway boundaries shifted or increased at any location compared to those shown on the effective FBFM or FIRM? . . . . . ☐ Yes ■ No

If yes, explain:

_____

_____

_____

7. If a V-zone has been designated, has it been delineated to extend landward to the heel of the primary frontal dune? . . . . . ☐ Yes ■ No

If no, explain:

_____

_____

_____

8. Manual or digital map submission:

■ Manual
☐ Digital

Digital map submissions may be used to update digital FIRMs (DFIRMs). For updating DFIRMs, these submissions must be coordinated with FEMA Headquarters as far in advance of submission as possible.

2. EARTH FILL PLACEMENT

1. The fill is: ■ Existing □ Proposed

2. Has fill been/will be placed in the regulatory floodway? . . . . . □ Yes ■ No

   If yes, please attach completed Riverine Hydraulic Analysis Form.

3. Has fill been/will be placed in floodway fringe *(area between the floodway and 100-year floodplain boundaries)*? . . . . . □ Yes ■ No

   If yes, then complete A, B, C, and D below.

   A. Are fill slopes for granular materials steeper than one vertical on one-and-one-half horizontal? . . . . . □ Yes □ No

      If yes, justify steeper slopes _____

      _____

   B. Is adequate erosion protection provided for fill slopes exposed to moving flood waters? *(Slopes exposed to flows with velocities of up to 5 feet per second (fps) during the 100-year flood must, at a minimum, be protected by a cover of grass, vines, weeds, or similar vegetation; slopes exposed to flows with velocities greater than 5 fps during the 100-year flood must, at a minimum, be protected by stone or rock riprap.)* . . . . . □ Yes □ No

      If no, describe erosion protection provided _____

      _____

   C. Has all fill placed in revised 100-year floodplain been compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test Method or acceptable equivalent method? . . . . . □ Yes □ No

   D. Can structures conceivably be constructed on the fill at any time in the future? . . . . . □ Yes □ No

      If yes, provide certification of fill compaction (item C. above) by the community's NFIP permit official, a registered professional engineer, or an accredited soils engineer.

4. Has fill been/will be placed in a V-zone? . . . . . □ Yes ■ No

   If yes, is the fill protected from erosion by a flood control structure such as a revetment or seawall? . . . . . □ Yes □ No

   If yes, attach the coastal structures form.

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
          *DIAGRAM
    1     ID    MW LV FIS RESTUDY
    2     ID    DURANGO DRIVE DRAINAGE BASIN
    3     ID    SEPTEMBER 29, 1994
    4     IT      3       0       0     300
    5     IO      5       0
    6     IN      5       0       0
    7     JR    PREC     .57    1.00

    8     KK      1   EXISTING BASIN UPSTREAM OF DURANGO DRIVE
    9     BA   .183
   10     PC   .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
   11     PC   .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
   12     PC   .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
   13     PC   .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
   14     PC   .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
   15     PC   .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
   16     PC   .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
   17     PC   .998    .999   1.00
   18     PB  3.04
   19     LS     0      92
   20     UD   .49
   21     ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT
LINE

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW

8 1

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

NW LV FIS RESTUDY
DURANGO DRIVE DRAINAGE BASIN
SEPTEMBER 29, 1994

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	3	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1457	ENDING TIME

COMPUTATION INTERVAL .05 HOURS
TOTAL TIME BASE 14.95 HOURS

ENGLISH UNITS

JP MULTI-PLAN OPTION

NPLAN	1	NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.57 1.00

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION	
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2
					.57	1.00
HYDROGRAPH AT	1	.18	1	FLOW	92.	195.
				TIME	3.95	3.90

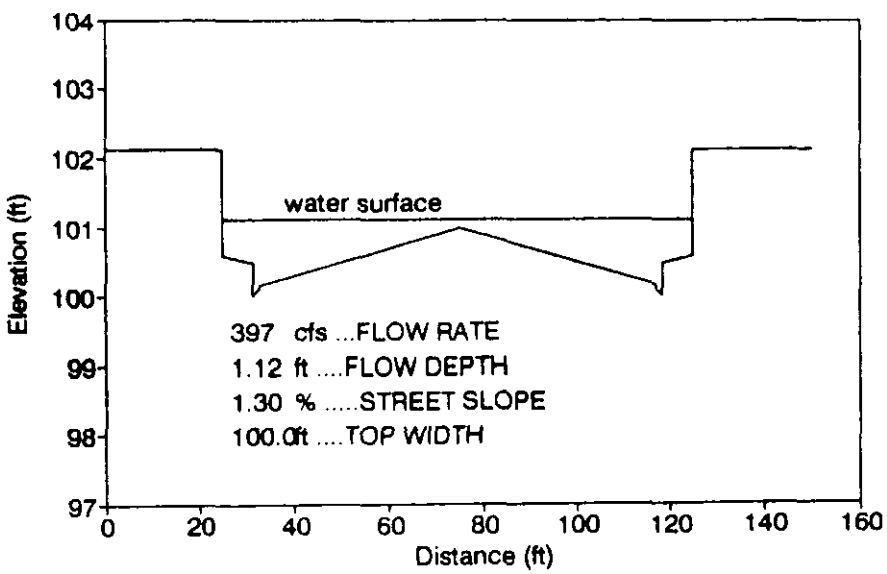
*** NORMAL END OF HEC-1 ***

STREET FLOWS

DURANGO DRIVE-100 YR CAPACITY

Input variables:			**Output variables:**		
Flow depth, d	1.12	ft	Capacity at d	397.3	cfs
Road width	88.0	ft	Velocity	7.1	fps
Crown height	1.01	ft	Top width	100.0	ft
Street slope	1.30	%			
Sidewalk width	6.0	ft	SECTION:		
Curb height	6	in	Cross Slope	2.0	%
Median width	0.0	ft	Gutter Depression	2.0	in
Rt back of walk	100.0	%	Depth - Velocity Product	8.00	
Lt back of walk	100.0	%	Manning's n	0.016	

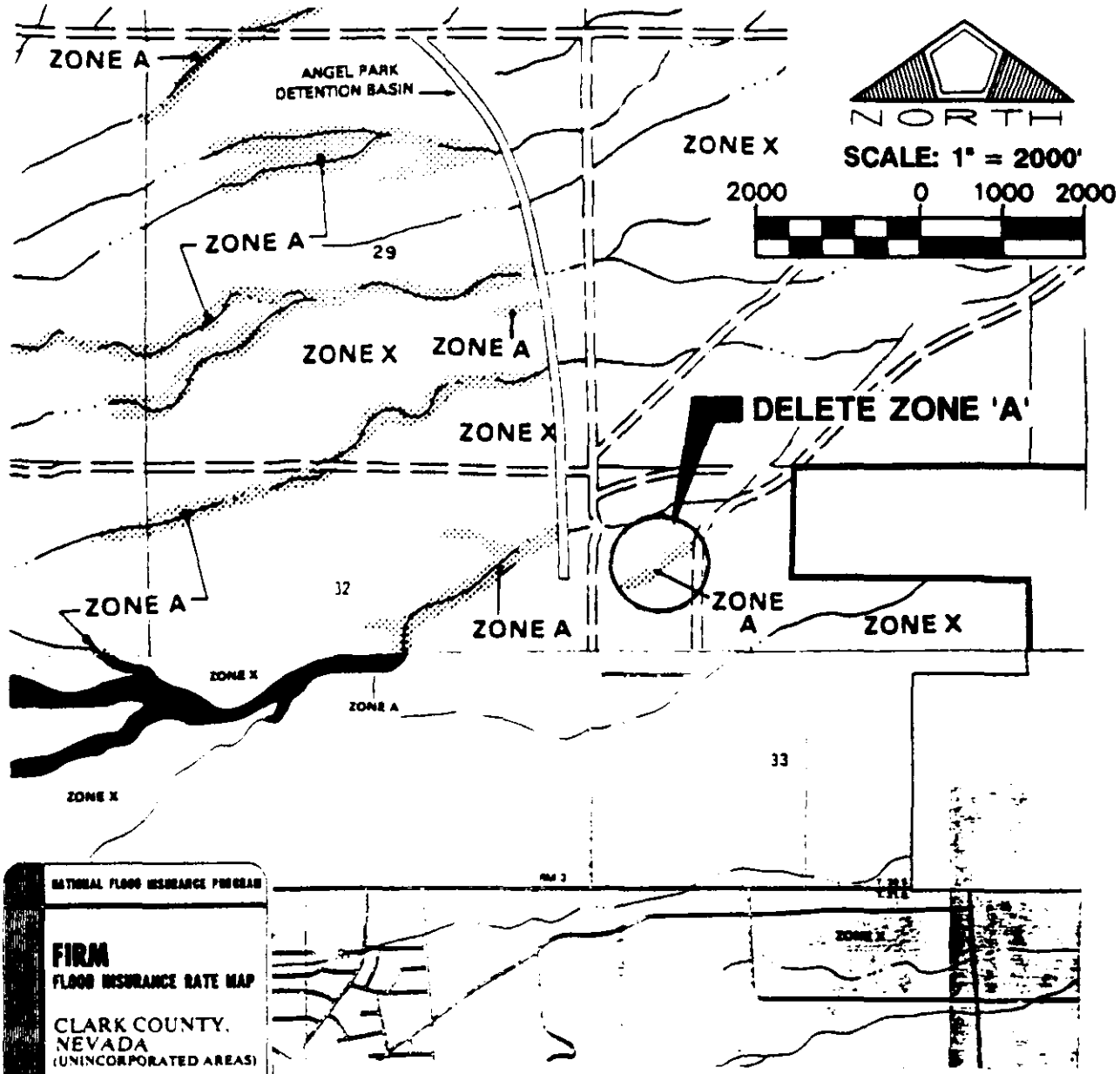
DURANGO DRIVE-100 YR CAPACITY



PARTIALY FULL CIRCULAR CONDUIT

84" RCP IN DURANGO DRIVE

Input variables:			**Output variables:**		
Discharge, Q	534.49	cfs	Depth	7.00	ft
Pipe size	7.00	ft	Velocity	13.89	fps
Manning's n	0.013				
Pipe slope	0.0070	ft/ft			



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA
(UNINCORPORATED AREAS)

PANEL 1000 OF 2625

PANEL LOCATION

COMMUNITY-PANEL NUMBER
320003 1000 B

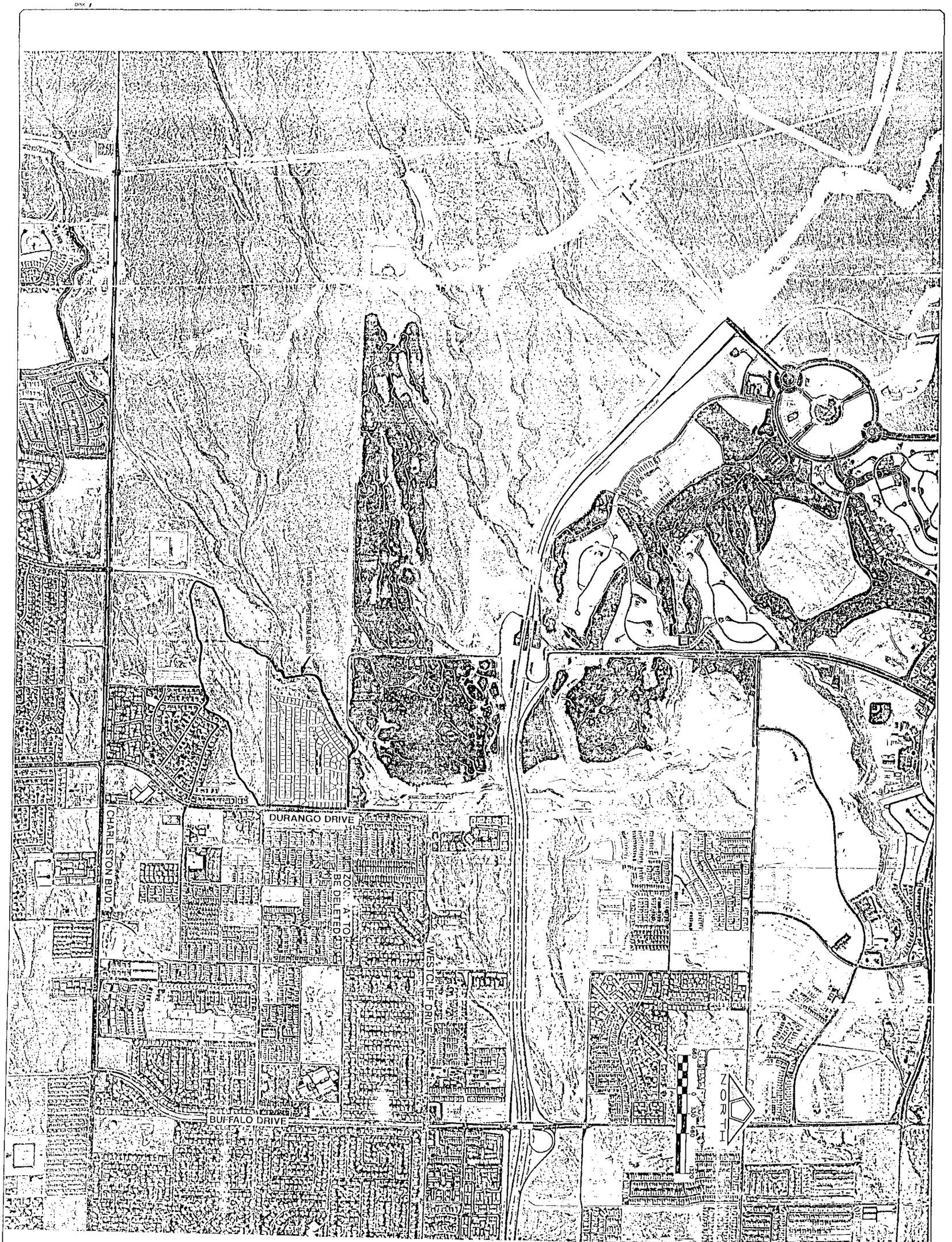
EFFECTIVE DATE:
SEPTEMBER 29, 1989

Federal Emergency Management Agency

NORTHWEST LAS VEGAS FIS STUDY

ANNOTATED D-FIRM

PENTACORE
Engineering, inc.
8763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 256-0115



CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

NORTHWEST LAS VEGAS FIS RESTUDY

ZONE A DOWNSTREAM OF DURANGO DRIVE

PENTACORE
Engineering, Inc.
6763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 258-0115

DATE:
DRAWN BY:
DESIGNED BY:
CHECKED BY:
JOB NO.:
SCALE:

RECOMMENDED

DATE

NO. DESCRIPTION DATE APP'D

350.00' - 84" RCP (D.o.i. =1000)

150.00' - 84" RCP W/ RUBBER GASKETS (D.o.i. = 1000)

NOTE: STATIONING IS ALONG ℄ OF STREET

EXISTING GROUND Ⓔ ℄

FINISH GRADE Ⓐ ℄

0.5%

1.0%

36" WATER LINE 15' LT.

2635

2630

2625

91+00 | 91+50 | 92+00 | 92+50 | 93+00 | 93+50 | 94+00 | 94+50 | 95+00 | 95+50 | 96+00

BENCHMARK

POINT NAIL IN NATURE OF BUTLURE PANEL AT THE INTERSECTION OF CHARLESTON BLVD. AND DURANGO DR. I.E. = 2654.41 (USC & GS DATUM)

QUANTITY ESTIMATE

84" STORM DRAIN	CLASS II	350 L.F.
48" STORM DRAIN MANHOLE	(T TYPE)	2 EA.
24" TYPE "A" DROP INLET		1 EA.
24" STORM DRAIN	CLASS III	12 L.F.
84" STORM DRAIN	CLASS II	150 L.F.
84" STORM DRAIN	CLASS III	75 L.F.
24" TYPE "A" DROP INLET		1 EA.

NOTE: ALL STORM DRAIN PIPE JOINTS FROM STA 94+50 NORTH TO THE PROJECT END SHALL HAVE RUBBER GASKETS FOR PRESSURE FLOW.

MATCH LINE – SEE SHEET 18 STA. 91+00

MATCH LINE – SEE SHEET 20 STA. 96+00

84" SD

DURANGO DRIVE

CITY OF LAS VEGAS NEVADA

STORM DRAIN PLAN & PROFILE
(DURANGO DRIVE - STA. 91+00 TO 96+00)

DURANGO DRIVE

W.O. NO.

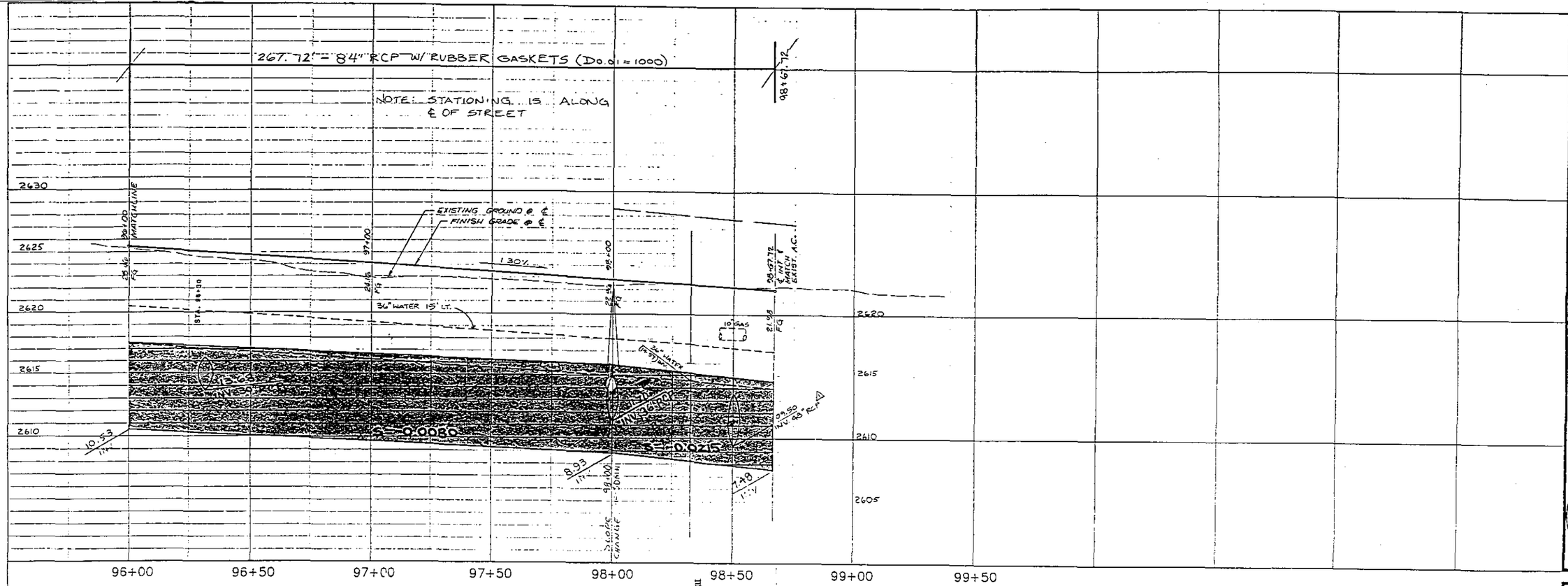
BY

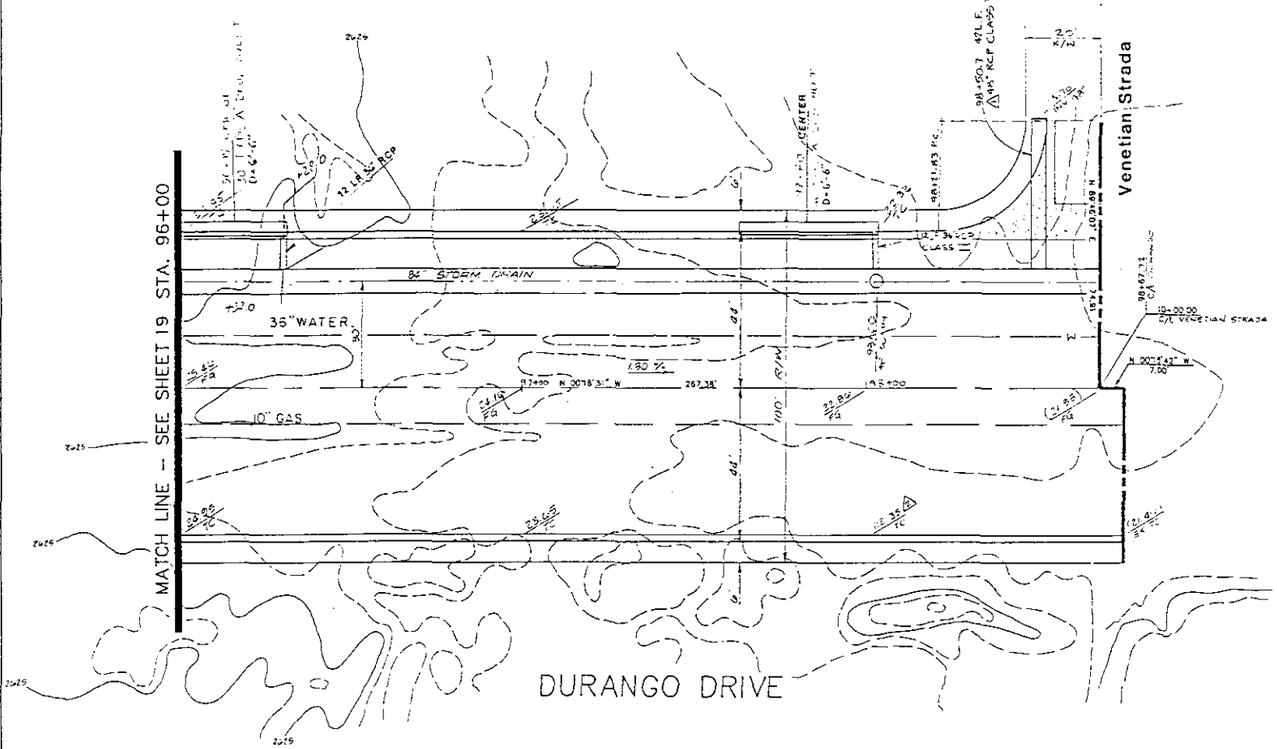
DATE

SCALE HORIZ. 1"=50' VERT. 1"=5'

SHEET 19 OF 30 SHEETS

107-01648





N

CURVE DATA TABLE

CURVE	RADIUS	LENGTH	TANGENT	DELTA
C1	25.00	39.23'	24.96'	89°53'11"
C2	31.00	48.63'	30.96'	89°53'11"

BENCHMARK

CONC. NAIL IN MIDDLE OF PICTURE PANEL AT THE INTERSECTION OF CHARLESTON BLVD. AND DURANGO DRIVE.
ELEV. = 2564.41 (U.S.C. & G.S. DATUM)

QUANTITY ESTIMATE

84" STORM DRAIN, CLASS II	268 L.F.
48" STORM DRAIN MANHOLE (T TYPE)	1 EA.
30" TYPE "A" DROP INLET	1 EA.
36" STORM DRAIN, CLASS III	24 L.F.
40" TYPE "A" DROP INLET	1EA
MANHOLE FABRICATION	1EA
48" STORM DRAIN, CLASS III	40 L.F.

AS BUILT

REV	DATE	BY
1	4-6-89	J.S.
2	12-14-89	WMM

REVISION: 1) ALT 48" RCP AT 1.5%FALL 2) CHANGE 48" FES TO MATCH DIPPER PLANS

CITY OF LAS VEGAS NEVADA

TITLE: STORM DRAIN PLAN AND PROFILE (DURANGO DRIVE – STA. 96+00 TO 98+67.38)

PROJECT: DURANGO DRIVE

BY
DATE
SCALE HORIZ. 1" = 20' VERT. 1" = 4'

SHEET 20 OF 30 SHEETS

107-V1649

Section 5
Buffalo Channel and Tributary

REQUEST FOR LOMR
Buffalo Channel and Tributary

This study area is located north of Lake Mead Drive, and west of Highway 95 in the City of Las Vegas, Nevada, within Sections 22 and 23, Township 20S, Range 60E, M.D.M. The purpose of this LOMR is to reduce the existing Zone "A" designation west of the Buffalo Channel based upon revised 100-year water surface elevation computations and to remove the existing Zone "A" designation east and downstream of the Buffalo Channel.

The natural drainage channel to the west outlets into the existing Buffalo Channel, a construction project funded by the Clark County Regional Flood Control District (CCRFCD), the City of Las Vegas, and Clark County. Design plans for Buffalo Channel from Vegas Drive to 500 feet north of Peak Drive were prepared by G.C. Wallace, Inc. Design plans for Buffalo Channel from Summerlin Parkway to Vegas Drive were prepared by VTN Nevada.

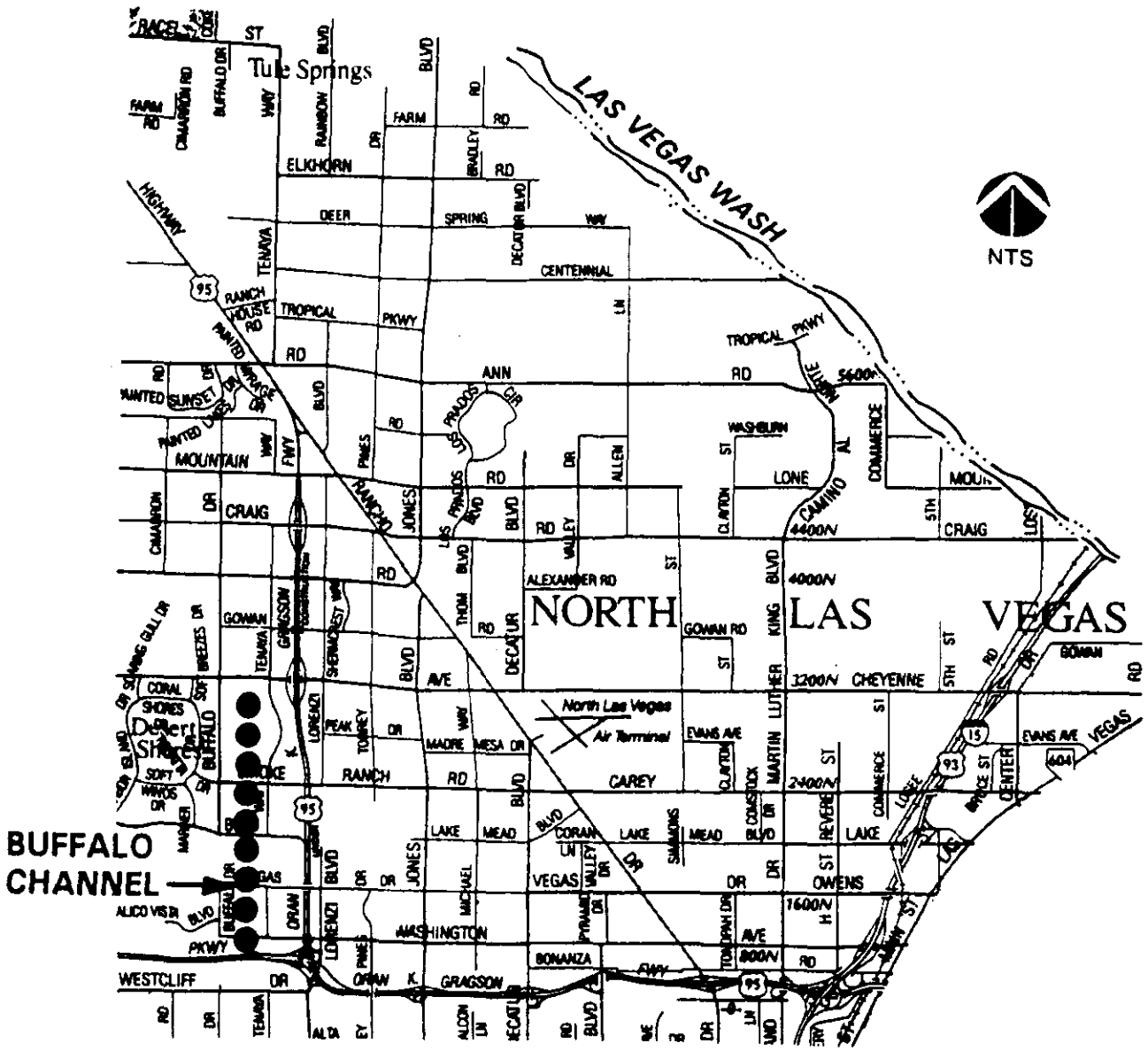
This request for LOMR is divided into two parts as follows:

East Buffalo Channel

The Zone "A" floodplain located east of the Buffalo Channel is now flood protected by the Buffalo Channel. The channel, which was constructed as a part of Gowan Basin system, provides an outfall for the Angel Park detention basin and flood protection to areas to the east. Using discharges developed as a part of this study's new hydrologic model, a backwater surface profiled analysis was performed using the program *Water Surface Pressure Gradient (WSPG)*. As-built design plans prepared by G.C. Wallace and VTN Nevada were used to determine the channel cross-section and profile grades. Results from the analysis are enclosed and have been illustrated on copies of the design plans. Results indicate that the flow can be safely conveyed within the channel with freeboard. The Zone "A" located downstream (east of the Buffalo Channel) should be removed and shown as "contained within the Buffalo Channel."

West of Buffalo Channel

Currently, an area west of the Buffalo Channel, east of Buffalo Drive, and north of Lake Mead Drive is shown to lie within a Zone "A". Recent detailed topography of the area, at a scale of 1" = 50' and 1' contour interval, was used to develop a HEC-2 analysis for this reach. Results from this analysis are delineated on the attached exhibit and demonstrate that the floodplain width has been substantially reduced from that shown on the current FIRM or preliminary D-FIRM. This study concludes that the Zone "A" delineation should be reduced to the 100-year water surface elevation, as plotted on the enclosed exhibit.



CVL
COE & VAN LOO CONSULTANTS
PENTACORE

FIGURE 1
LOCATION MAP

FEDERAL EMERGENCY MANAGEMENT AGENCY REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM	O M B Burden No 3067-0148 Expires July 31, 1994	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ☒ Physical change
     - ☒ Existing
     - ☐ Proposed
   - ☒ Improved methodology
   - ☐ Improved data
   - ☐ Floodway revision
   - ☐ Other _____

   Explain _____
2. Flooding Source: Zone A local flooding
3. Project Name/Identifier: Buffalo Channel
4. FEMA zone designations affected: Zone A
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	County	State	Map No	Panel No.	Effective Date
EX: 480301	Katy,City	Harris, Fort Bend	TX	480301	0005D	02/08/83
480287	Harris County	Harris	TX	48201C	0220G	09/28/90
320003	Clark County	Clark	NV	320003	1000B	09/29/89
* 32003	Clark County	Clark	NV	32003C	2135D	—
* 32003	Clark County	Clark	NV	32003C	2155D	—

* D-firms not yet effective.

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding
- ☒ Riverine
- ☐ Coastal
- ☐ Alluvial Fan
- ☐ Shallow Flooding *(e.g. Zones AO and AH)*
- ☐ Lakes

Affected by wind/wave action
- ☐ Yes
- ☐ No

Structures
- ☒ Channelization
- ☐ Levee/Floodwall
- ☐ Bridge/Culvert
- ☐ Dam
- ☐ Coastal Fill
- ☐ Pump Station
- ☐ None
- ☐ Channel Relocation
- ☐ Excavation
- ☐ Other *(describe)*

Disciplines*
- ☒ Water Resources
  - ☒ Hydrology
  - ☒ Hydraulics
  - ☐ Sediment Transport
  - ☐ Interior Drainage
- ☐ Structural
- ☐ Geotechnical
- ☐ Land Surveying
- ☐ Other *(describe)*

☐ Other(describe) _____ _____ _____

* Attach completed "Certification by Registered Professional Engineer and or Land Surveyor" Form for each discipline checked. (Form 2)

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ☐ Yes ☒ No
8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM ☐ Yes ☒ No

   If yes, give reason _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9 Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?
☒ Yes ☐ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☐ Yes ☒ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☐ No N/A

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☒ Yes ☐ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot (*or other surcharge limit if community or state has adopted more stringent criteria*)? ☐ Yes ☒ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted

4. REVISION REQUESTOR ACKNOWLEDGMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGMENT

13 Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgment and /or notification is required for all requests as outlined in Section 65.4 (b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g., levees, floodwalls, channelization, basins, dams)?
☒ Yes ☐ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by City of Las Vegas (entity)

_____ with a maximum interval of 12 months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by City of Las Vegas (entity)

to ensure the integrity and degree of flood protection of the structure

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☒ has ☐ has not been prepared for the flood control structure

15. The community is willing to assume responsibility for [X] performing [ ] overseeing compliance with the maintenance and operation plans of the Buffalo Channel (Name) flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A guide for Community Officials," dated January 1990, this request is for a:

____	a.	CLOMR	A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.
X	b.	LOMR	A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. I Parts 60 and 65.)*
____	c.	PMR	A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. I, Parts 60 and 65.)*
____	d.	Other:	Describe ____

8. FORMS INCLUDED

17. Form 2 entitled, "Certification By Registered Professional Engineer and/or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	[X] Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	[ ] Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway *delineation is requested*	[ ] Riverine /Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	[X] Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	[ ] Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	[ ] Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	[ ] Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	[ ] Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	[ ] Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	[ ] Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18 The *minimum initial review fee for the appropriate request category* has been included ☒ Yes ☐ No

Initial fee amount: $ -0-

METHOD OF PAYMENT (Check one box)

☐ PAYMENT ENCLOSED ☐ VISA ☐ MASTERCARD

Check or money order only.
Make payable to
National Flood Insurance Program

CARD NUMBER

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

EXP. Date ☐☐☐☐

Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Dean W Rasmuson

Signature of Revision Requester

Dean W. Rasmuson, Senior Engineer

Printed Name and Title of Revision Requester

Pentacore Engineering, Inc.

Company Name

1/18/94

Date

Note: Signature indicates that the community understands, from the revision requester, the impacts of the revision on flooding conditions in the community

Signature of Community Official

Printed Name and Title of Community Official

Community Name

Date

Does this request impact any other communities? ☐ Yes ☒ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review

FEDERAL EMERGENCY MANAGEMENT AGENCY

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O M B Burden No 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average . 23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067- 0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2

2. I am licensed with an expertise in hydrology and hydraulics
(example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)** structural, geotechnical, land surveying.)

3. I have 9 years experience in the expertise listed above.

4. I have ☐ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.

5. I ☒ have ☐ have not visited and physically viewed the project.

6. In my opinion, the following analyses and /or designs, is/are being *certified:*

hydrologic analysis, hydraulics and channel construction

7. Base upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

Basis for above statement: (check all that apply)

a. ☐ Viewed all phases of actual construction.

b. ☐ Compared plans and specifications with as-built survey information.

c. ☒ *Examined plans and specifications and compared with completed projects.*

d. ☐ Other _____

8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001

Name: Dean W. Rasmuson
(please print or type)

Title: Senior Engineer
(please print or type)

Registration No. 9193 Expiration Date: 12/31/95

State Nevada

Type of License Civil

Dean W. Rasmuson
Signature

1/18/94
Date

Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply

FEDERAL EMERGENCY MANAGEMENT AGENCY **HYDROLOGIC ANALYSIS FORM**	O.M.B. Burden No. 3067-0148 Expires July 31, 1994	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.67 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada

Flooding Source: Zone A local flooding to Buffalo Channel
(One form for each flooding source)

Project Name/Identifier: Buffalo Channel

1. HYDROLOGIC ANALYSIS IN FIS

☒ Approximate study stream (Zone A)
☐ Detailed study stream (briefly explain methodology) _____

2. REASON FOR NEW HYDROLOGIC ANALYSIS

☐ No existing analysis
☐ Improved data *(see data revision on page 3)*
☒ Changed physical conditions of watershed *(explain)* Construction of Buffalo Channel has contained the storm flows.
☐ Alternative methodology *(justify why the revised model is better than model used in the effective FIS)*
☐ Evaluation of proposed conditions (CLOMRs only) (explain) _____
☐ Other _____

If a computer program/model was used in revising the hydrologic analysis, please provide a diskette with the input files for the 10-, 50-, 100 - and 500-year recurrence intervals. Computer diskettes are not available.

Only the 100-year recurrence interval need be included for SFHAs designated as Zone A.

3. APPROVAL OF ANALYSIS

☒ Approval of hydrologic analysis, including the resulting peak discharge value (s) has been provided by the appropriate local, state, or Federal Agency. (i.e., City of Las Vegas and Clark County Regional Flood Control District)
Attach evidence of approval.
☐ Approval of the hydrologic analysis is not required by any local, State, or Federal Agency

Stream: Buffalo Channel

Comparison of 100-year Discharges

Location:	Drainage area (Sq mi.)	FIS (cfs):	Revised (cfs):
sta 0+00 to 118+58	4	N/A	1360

Note: When revised discharges are not significantly different than FIS discharges, FEMA may require a confidence limits analysis on attachment D at a later date to complete the review.

As is often the case with revision requests, only a portion of a stream may actually be revised or be affected by a revision. Therefore, transition to the unrevised portion is important to maintain the continuity of the study. NFIP regulations stipulate that such a transition must be assured. What is the transition from the proposed discharges to the effective discharges? Please explain how the transition was made *(attach separate sheet if necessary)*

ATTACH A COMPLETED REVIEW OF RESULTS PAGE FOR EACH FLOODING SOURCE.

Is the new hydrologic analysis being developed solely to revise the flow values presented in the FIS *(i.e. no changed hydraulic conditions)*? ☐ Yes ☒ No

If yes, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No N/A

FEMA does not normally revise NFIP maps solely due to insignificant flow changes where changes in 100-year water surface elevation are less than 1.0 foot.

5. HISTORICAL FLOODING INFORMATION

Is historical data available for the flooding source? ☐ Yes ☒ No

If yes, provide the following:

Location along flooding source: N/A

Maximum peak discharge: N/A cfs

Second highest peak discharge: N/A cfs

Source of information: N/A

6. GAGE RECORD INFORMATION

Location of nearest gage to project site *(along flooding source or similar watershed; specify)*

N/A

Gaging Station: _____

Drainage area at gage: _____ mi^2

Number of years of data: _____

7. DATA REVISION

Please use the following table to list all the data and/or parameters affected by this request and identify them as new data *(New)* or as revising existing data *(Revised)*. *(If necessary, attach a separate sheet.)*

Data Parameter	New	Revised	Data Source
rainfall depth	☒	☐	NOAA adjusted by corps
depth area reduction factor	☒	☐	corps
	☐	☐	
	☐	☐	
	☐	☐	

- Data source can be from a Federal, State, or local government agency, or from a private source. Some State and local governments may have less strict data requirements than Federal agencies, in which case the hydrologic data may not be accepted by FEMA unless it is demonstrated that the data give a better estimate of the flood discharge.
- Attach documentation corroborating each data source *(i.e., certified statement, report, bibliographical reference to a published document)*. In the case of a published document or a government report, providing copies of the cover and pertinent pages may be helpful.

8. METHODOLOGY FOR NEW ANALYSIS

☐ Statistical Analysis of Gage Records *(use Attachment A)*

☐ Regional Regression Equations *(use Attachment B)*

☒ Precipitation/Runoff Model *(use Attachment C)*

☐ Other *(specify; attach backup computations and supporting data)* _____

		FIS	Revised
1.	Method or model used:	N/A	HEC-1
	Version:		IBM XT 512K
	Date:		FEB. 1 1985
2.	Source of rainfall depth:		NOAA
3.	Source of rainfall distribution:		ARMY CORPS
4.	Rainfall duration:		6 HOUR
5.	Areal adjustment to precipitation (%):		93%
6.	Hydrograph development method:		SCS UNIT
7.	Loss rate method:		CN
	Source of soils information:		SCS
	Source of land use information		AERIAL PHOTOS
8.	Channel routing method:		KINEMATIC
9.	Reservoir routing:	☐ Yes ☐ No	☐ Yes ☒ No
10.	Baseflow considerations:	☐ Yes ☐ No	☐ Yes ☒ No

If yes, explain how baseflow was determined:

11.	Snowmelt considerations:	☐ Yes ☐ No	☐ Yes ☒ No
12.	Model calibration:	☐ Yes ☐ No	☐ Yes ☒ No

If yes, explain how calibration was performed

13.	Future land use condition:	☐ Yes ☒ No

If yes, explain why

NOTE: FEMA policy is to base flooding on existing conditions.
If data is not available, indicate by N/A.

Attach precipitation/runoff model, hydrologic model schematic, curve number calculations, time of concentration calculations, and supporting maps, delineating the watershed boundary and drainage area divides.

FEDERAL EMERGENCY MANAGEMENT AGENCY **CHANNELIZATION FORM**	O M B Burden No. 3067-0148 Expires July 31 1994	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1.75 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: CLARK COUNTY NEVADA

Flooding Source: ZONE A LOCAL FLOODING

Project Name/Identifier: BUFFALO CHANNEL

1. EXTENT OF CHANNELIZATION

Downstream limit: 0 + 00 GOWAN DETENTION BASIN

Upstream limit: 118 + 58 SUMMERLIN PARKWAY

2. CHANNEL DESCRIPTION

1. Describe the inlet to the channel: Connection to existing box culverts which extend under Summerlin Parkway

2. Briefly describe the shape of the channel *(both cross sectional and planimetric configuration)* and its lining *(channel bottom and sides)*: Channel varies Trapezoidal to rectangular with several box culverts

3. Describe the outlet from the channel: Outlet is into the existing Gowan South Detention Basin

4. The channelization includes:

- ☐ Levees *(Attach Levee Form)*
- ☐ Drop structures
- ☐ Superelevated sections
- ☒ Transitions in cross sectional geometry
- ☐ Debris basin/detention basin
- ☐ Energy dissipater
- ☐ Other

5. Attach the following:

a. Certified engineering drawings showing channel alignment and locations of inlet, outlet, and items checkec in item 4

b. Typical cross sections and profiles of channel banks and invert

3. HYDRAULIC CONSIDERATIONS

1. What is the 100-year discharge? ..... 1360 cfs
2. Do the cross sections in the hydraulic model match the typical cross sections in the plans? ☒ Yes ☐ No
3. Are the channel banks higher than the 100- year flood elevations everywhere? ..... ☒ Yes ☐ No
4. Are the channel banks higher than the 100-year flood energy grade lines everywhere? .. ☐ Yes ☒ No
5. Is the land on both sides of the channel above the adjacent 100-year flood elevation at all points along the channel? ..... ☒ Yes ☐ No
6. What is the range of freeboard? ..... 1 – 3 feet
7. What is the range of the 100-year flood velocities? ..... 15 – 28 ft/sec
8. What is the lining type? (both bottom and sides) Concrete

   Explain how the channel lining prevents erosion and maintains channel stability *(attach documentation)*

   N/A

9. What is the design elevation in the channel based on?

   ☐ Subcritical flow
   ☐ Critical flow
   ☒ Supercritical flow
   ☐ Energy grade line

   Is 100-year flood profile based on the above type of flow? ..... ☒ Yes ☐ No

   If no, explain: _____

10. Is there the potential for a hydraulic jump at the following locations?

    Inlet to channel ..... ☐ Yes ☒ No
    Outlet of channel ..... ☒ Yes ☐ No
    At Drop Structures ..... ☐ Yes ☒ No
    At Transitions ..... ☐ Yes ☒ No
    Other locations. Explain: _____

    If the answer to any of the above is yes, please explain how the hydraulic jump is controlled and the effects of the hydraulic jump on the stability of the channel.

    Explain: The hydraulic jump is controlled by a concrete energy dissipating structure at the outlet.

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year water surface elevations and/or the capacity of the channel? ..... ☐ Yes ☒ No

   B. Based on the conditions of the watershed and stream bed, is there a potential for sediment transport (including scour and deposition) to affect the 100-year water surface elevations and /or the capacity of the channel? ..... ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment (bed) load?
   _____cfs (attach gradation curve)

   Explain method used to estimate load N/A

   _____

   _____

   _____

   _____

   B. Is the *100-year flood velocity anywhere within the channel* less than the 100-year flood velocity of the inlet? ☐ Yes ☐ No

   C. Will sediment accumulate anywhere within the channel? ☐ Yes ☐ No

   D. Will deposition or scour occur at or near the inlet? ☐ Yes ☐ No

   E. Will deposition or scour occur at or near the outlet? ☐ Yes ☐ No

Attach documentation showing affects on the Hydrologic and Hydraulic analyses

BUFFALO CHANNEL HYDRAULIC ANALYSIS

CVL CONSULTANTS, INC.
Land Planning
Land Surveying
Civil Engineering
Water Resources Engineering

July 14, 1994

Clark County Regional Flood Control District
301 E. Clark Avenue, Suite 301
Las Vegas, NV 89101

Attn: Mr. Kevin Eubanks, P.E.

Re: *Northwest Las Vegas FIS Restudy*
Angel Park Detention Basin
Buffalo Channel

Dear Kevin:

As you requested, listed below are the 100-year inflows and outflows at Angel Park Detention Basin, and the 100-year peak discharge in the Buffalo Channel near Lake Mead Boulevard.

The Angel Park Detention Basin consists of two basins which are hydraulically interconnected. Both north and south basins have spillways and outflow pipes. The basin routing card provided in the HEC-1 by J.M. Montgomery in the FIS Hydrology Report, in conjunction with modifications to the precipitation and depth-area reduction factors by CVL, was used to determine the design condition inflows and outflows. Construction of the Angel Park Detention Basin has not yet been completed and therefore CVL made modifications to the basin storage volume curves to reflect the "As-Built" condition. Both design and "As-Built" inflow and outflow conditions are listed below.

Angel Park Detention Basin

Location	Q_{100} (cfs)	
	Design	As-Built
Angel Park Detention Basin Total Inflow	6,494	6,494
Total Outflow from Angel Park Detention Basin	559	3,225
Outflow from Angel Park North Detention Basin		
54" RCP	374	387
Spillways	67	1,227
Outflow from Angel Park South Detention Basin		
24" RCP	33	33
Spillway	85	1,578

Total Contributing Area = 24.13 mi^2
DARF = 0.77

North & South Spillway Elev.	100-Year WSEL	
	Design	As-Built
2618.40	2618.55	2619.26

Outflow from the south basin enters Westcliff Drive and leaves the study area. Outflow from the north basin is routed into the Buffalo Channel.

Using the above information, we have conducted a further evaluation of the downstream effects of discharges on the Buffalo Channel. Two different storm centerings were modeled for the Buffalo Channel near Lake Mead Boulevard. For the first case, it was assumed that the entire watershed upstream and downstream of the Angel Park detention basin would contribute to runoff in the Buffalo Channel, while the second case assumed a zero outflow from the basin, and modeled a storm over the watersheds below the basin.

Buffalo Channel

Location	Q_{100} (cfs)		
	w/Angel Park Basin Outflow		w/o Angel Park Basin Outflow
	Design	As-Built	
Buffalo Channel Near Lake Mead Boulevard	1,486	1,576	1,542

	DARF	Contributing Area (Mi^2)	Storm Distribution
With Angel Park Basin Outflow	0.75	28.7	SDN5
Without Angel Park Basin Outflow	0.91	4.6	SDN3

For the purposes of this study, the worst case scenario is recommended. With this information we will proceed with inclusion of the Buffalo Channel in the LOMR submittal package. If you have any further questions, please feel free to contact me.

Sincerely,

COE & VAN LOO
Consultants, Inc.

Paul W. R. Hoskin, P.E.
Vice President

PWRH:rbb

cc: Mark Sorensen, CLV
Randy Tarr, NLV
Bill Brandt, CCPWD
Phu Simpson, CCPWD
Dean Rasmuson, PEI
Mike Koizumi, CVL
Jack Moody, CVL

CVL

F0515P

WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING

CARD CODE	SECT NO	CHN TYPE	NO OF PIERS	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	1	0	0.00	7.00	15.00	2.00	2.00	0.00										
CD	2	3	0	0.00	7.00	22.00	0.00	0.00	0.00										
CD	3	1	0	0.00	7.00	12.00	2.00	2.00	0.00										
CD	4	1	0	0.00	3.00	12.00	2.00	2.00	0.00										
CD	5	2	0	0.00	10.00	22.00			0.00										
CD	6	3	1	2.00	7.00	22.00	0.00	0.00	0.00										
CD	7	2	0	0.00	7.00	22.00			0.00										
CD	8	1	0	0.00	7.00	12.00	2.00	2.00	0.00										
CD	9	1	0	0.00	6.00	10.00	2.00	2.00	0.00										
CD	10	3	1	1.00	7.00	22.00	0.00	0.00	0.00										
CD	11	2	0	0.00	7.00	16.00			0.00										
CD	13	2	0	0.00	9.50	16.00			0.00										
CD	14	3	0	0.00	4.00	50.00	0.00	0.00	0.00										
CD	16	3	0	0.00	8.00	12.00	0.00	0.00	0.00										

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET * * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	0.00	2350.72	1	2355.80

ELEMENT NO 2 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	204.36	2351.46	1	0.013	325.00	0.00	0.00	0

ELEMENT NO 3 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	390.42	2352.13	1	0.013	0.00	0.00	0.00	0

ELEMENT NO 4 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	447.14	2352.42	5	0.013

ELEMENT NO 5 IS A BRIDGE EXIT *

U/S DATA	STATION	INVERT	SECT
	447.14	2352.42	6

ELEMENT NO 6 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	527.90	2352.82	6	0.013	0.00	0.00	0.00	0

ELEMENT NO 7 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	557.52	2352.97	6	0.013	0.00	0.00	0.00	0

ELEMENT NO 8 IS A BRIDGE ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	557.52	2352.97	6	0.670

ELEMENT NO 9 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	701.42	2355.10	3	0.013

ELEMENT NO 10 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1171.30	2362.05	3	0.013	0.00	0.00	0.00	0

ELEMENT NO 11 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2071.30	2367.09	3	0.013	0.00	0.00	0.00	0

ELEMENT NO 12 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2371.30	2370.00	3	0.013	0.00	0.00	0.00	0

ELEMENT NO 13 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2446.30	2370.71	3	0.013	0.00	0.00	0.00	0

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 14 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MIN H
	2484.10	2371.07	3	0.013	0.00	0.00	0.00	0

ELEMENT NO 15 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	2676.30	2372.89	5	0.013

ELEMENT NO 16 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MIN H
	2700.61	2373.13	5	0.013	0.00	0.00	0.00	0

ELEMENT NO 17 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MIN H
	2785.82	2373.93	5	0.013	500.00	0.00	0.00	0

ELEMENT NO 18 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	2849.02	2374.55	5	0.013

ELEMENT NO 19 IS A BRIDGE EXIT *

U/S DATA	STATION	INVERT	SECT
	2849.02	2374.55	6

ELEMENT NO 20 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MIN H
	2981.29	2377.90	6	0.013	0.00	0.00	0.00	0

ELEMENT NO 21 IS A BRIDGE ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	2981.29	2377.90	6	0.670

ELEMENT NO 22 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	2981.29	2377.91	5	0.013

ELEMENT NO 23 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	3031.30	2378.21	8	0.013

ELEMENT NO 24 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MIN H
	5038.30	2390.67	8	0.013	0.00	0.00	0.00	0

ELEMENT NO 25 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MIN H
	5118.30	2391.19	8	0.013	0.00	0.00	0.00	0

ELEMENT NO 26 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MIN H
	5342.30	2392.58	8	0.013	0.00	0.00	0.00	0

ELEMENT NO 27 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	5392.30	2392.89	7	0.013

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 28 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5414.84	2393.03	7	0.013	0.00	0.00	0.00	0

ELEMENT NO 29 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5471.30	2393.35	7	0.013	500.00	0.00	0.00	0

ELEMENT NO 30 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5525.01	2393.89	7	0.013	500.00	0.00	0.00	0

ELEMENT NO 31 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	5533.59	2393.98	10	0.013

ELEMENT NO 32 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5635.34	2394.98	10	0.013	0.00	0.00	0.00	0

ELEMENT NO 33 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	5635.34	2395.06	7	0.013

ELEMENT NO 34 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5753.08	2396.15	7	0.013	500.00	0.00	0.00	0

ELEMENT NO 35 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5777.28	2396.39	7	0.013	0.00	0.00	0.00	0

ELEMENT NO 36 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	5827.29	2396.89	8	0.013

ELEMENT NO 37 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5870.28	2397.35	8	0.013	0.00	0.00	0.00	0

ELEMENT NO 38 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	6070.28	2407.47	8	0.013	0.00	0.00	0.00	0

ELEMENT NO 39 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	8080.29	2419.12	8	0.013	0.00	0.00	0.00	0

ELEMENT NO 40 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	8130.29	2419.41	7	0.013

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 41 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	8143.59	2419.49	7	0.013	0.00	0.00	0.00	0

ELEMENT NO 42 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	8177.29	2419.69	7	0.013	500.00	0.00	0.00	0

ELEMENT NO 43 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	8197.67	2419.81	7	0.013	0.00	0.00	0.00	0

ELEMENT NO 44 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	8220.36	2419.89	7	0.013

ELEMENT NO 45 IS A BRIDGE EXIT *

U/S DATA	STATION	INVERT	SECT
	8220.36	2419.89	10

ELEMENT NO 46 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	8300.80	2420.84	10	0.013	0.00	0.00	0.00	0

ELEMENT NO 47 IS A BRIDGE ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	8300.80	2420.84	10	0.670

ELEMENT NO 48 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	8316.15	2420.85	11	0.013

ELEMENT NO 49 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	8470.06	2421.53	11	0.013	0.00	0.00	0.00	0

ELEMENT NO 50 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	8904.52	2423.48	11	0.013	0.00	0.00	0.00	0

ELEMENT NO 51 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	8923.55	2423.57	11	0.013	100.00	0.00	0.00	0

ELEMENT NO 52 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	9248.06	2425.03	11	0.013	0.00	0.00	0.00	0

ELEMENT NO 53 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	9267.09	2425.11	11	0.013

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 54 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	9270.06	2425.12	11	0.013	0.00	0.00	0.00	0

ELEMENT NO 55 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	10300.06	2434.14	11	0.013	0.00	0.00	0.00	0

ELEMENT NO 56 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	10301.06	2434.59	13	0.013

ELEMENT NO 57 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	10620.06	2435.24	13	0.013	0.00	0.00	0.00	0

ELEMENT NO 58 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	10920.06	2436.28	16	0.013

ELEMENT NO 59 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	11010.06	2436.59	16	0.013	0.00	0.00	0.00	0

ELEMENT NO 60 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	11010.06	2436.60	1	0.013

ELEMENT NO 61 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	11724.66	2439.05	1	0.013	0.00	0.00	0.00	0

ELEMENT NO 62 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	11724.66	2439.06	16	0.013

ELEMENT NO 63 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N
	11955.88	2439.86	16	0.013

ELEMENT NO 64 IS A SYSTEM HEADWORKS * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	11955.88	2439.86	16	2445.50

NO EDIT ERRORS ENCOUNTERED-COMPUTATION IS NOW BEGINNING

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
0.00	2350.72	4.032	2354.752	1576.0	16.95	4.460	2359.212	1.11	5.465		7.00	15.00	2.00	0	0.00
85.12	0.00362					.005767	0.49			4.508			2.00		
85.12	2351.03	3.945	2354.973	1576.0	17.45	4.731	2359.704	1.16	5.465		7.00	15.00	2.00	0	0.00
119.24	0.00362					.006433	0.77			4.508			2.00		
204.36	2351.46	3.807	2355.267	1576.0	18.31	5.204	2360.471	0.00	5.465		7.00	15.00	2.00	0	0.00
93.01	0.00360					.007302	0.68			4.514			2.00		
297.37	2351.80	3.686	2355.481	1576.0	19.11	5.671	2361.152	0.00	5.465		7.00	15.00	2.00	0	0.00
93.05	0.00360					.008297	0.77			4.514			2.00		
390.42	2352.13	3.556	2355.686	1576.0	20.04	6.238	2361.924	0.00	5.465		7.00	15.00	2.00	0	0.00
[illegible]NS STR	0.00511					.008901	0.50						2.00		
447.14	2352.42	3.470	2355.890	1576.0	20.64	6.618	2362.508	0.00	5.423		10.00	22.00	0.00	0	0.00
BRIDGE EXIT													0.00		
447.14	2352.42	3.959	2356.379	1576.0	19.91	6.153	2362.532	0.00	5.779		7.00	22.00	0.00	1	2.00
13.60	0.00495					.010674	0.15			5.237			0.00		
460.74	2352.49	3.922	2356.409	1576.0	20.09	6.268	2362.677	0.00	5.779		7.00	22.00	0.00	1	2.00
67.16	0.00495					.011567	0.78			5.237			0.00		
527.90	2352.82	3.740	2356.560	1576.0	21.07	6.894	2363.454	0.00	5.779		7.00	22.00	0.00	1	2.00
29.62	0.00506					.012710	0.38			5.193			0.00		
557.52	2352.97	3.659	2356.629	1576.0	21.54	7.202	2363.831	0.00	5.779		7.00	22.00	0.00	1	2.00
BRIDGE ENTRANCE													0.00		
557.52	2352.97	2.999	2355.969	1576.0	23.89	8.859	2364.828	0.00	5.423		7.00	22.00	0.00	0	0.00
[illegible]NS STR	0.01480					.012958	1.86						0.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	ANGBPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
701.42	2355.10	3.599	2358.699	1576.0	22.81	8.078	2366.777	0.00	5.889		7.00	12.00	2.00	0	0.00
54.37	0.01479					.011794	0.64			3.406			2.00		
755.79	2355.90	3.631	2359.535	1576.0	22.53	7.884	2367.419	0.00	5.889		7.00	12.00	2.00	0	0.00
150.56	0.01479					.010877	1.64			3.406			2.00		
906.35	2358.13	3.759	2361.890	1576.0	21.48	7.167	2369.057	0.00	5.889		7.00	12.00	2.00	0	0.00
98.94	0.01479					.009531	0.94			3.406			2.00		
1005.29	2359.59	3.890	2363.485	1576.0	20.48	6.516	2370.001	0.00	5.889		7.00	12.00	2.00	0	0.00
71.05	0.01479					.008353	0.59			3.406			2.00		
1076.34	2360.65	4.025	2364.671	1576.0	19.53	5.923	2370.594	0.00	5.889		7.00	12.00	2.00	0	0.00
53.53	0.01479					.007323	0.39			3.406			2.00		
1129.87	2361.44	4.163	2365.600	1576.0	18.62	5.385	2370.985	0.00	5.889		7.00	12.00	2.00	0	0.00
41.43	0.01479					.006421	0.27			3.406			2.00		
1171.30	2362.05	4.306	2366.356	1576.0	17.76	4.895	2371.251	0.00	5.889		7.00	12.00	2.00	0	0.00
236.08	0.00560					.006162	1.45			4.383			2.00		
1407.38	2363.37	4.249	2367.621	1576.0	18.10	5.086	2372.707	0.00	5.889		7.00	12.00	2.00	0	0.00
314.47	0.00560					.006769	2.13			4.383			2.00		
1721.85	2365.13	4.107	2369.240	1576.0	18.98	5.595	2374.835	0.00	5.889		7.00	12.00	2.00	0	0.00
199.16	0.00560					.007720	1.54			4.383			2.00		
1921.01	2366.25	3.970	2370.218	1576.0	19.91	6.154	2376.372	0.00	5.889		7.00	12.00	2.00	0	0.00
150.29	0.00560					.008807	1.32			4.383			2.00		
2071.30	2367.09	3.837	2370.927	1576.0	20.88	6.769	2377.696	0.00	5.889		7.00	12.00	2.00	0	0.00
300.00	0.00970					.009210	2.76			3.804			2.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	ANGBPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
2371.30	2370.00	3.875	2373.875	1576.0	20.59	6.584	2380.459	0.00	5.889		7.00	12.00	2.00	0	0.00
75.00	0.00947					.008993	0.67			3.828			2.00		
2446.30	2370.71	3.884	2374.594	1576.0	20.53	6.542	2381.136	0.00	5.889		7.00	12.00	2.00	0	0.00
37.80	0.00952					.008926	0.34			3.822			2.00		
2484.10	2371.07	3.890	2374.960	1576.0	20.48	6.513	2381.473	0.00	5.889		7.00	12.00	2.00	0	0.00
TRANS STR	0.00947					.009614	1.85						2.00		
2676.30	2372.89	3.309	2376.199	1576.0	21.65	7.277	2383.476	0.00	5.423		10.00	22.00	0.00	0	0.00
24.31	0.00987					.010346	0.25			3.359			0.00		
2700.61	2373.13	3.305	2376.435	1576.0	21.67	7.293	2383.728	0.64	5.423		10.00	22.00	0.00	0	0.00
85.21	0.00939					.010495	0.89			3.415			0.00		
2785.82	2373.93	3.278	2377.208	1576.0	21.85	7.415	2384.623	0.00	5.423		10.00	22.00	0.00	0	0.00
TRANS STR	0.00981					.010742	0.68						0.00		
2849.02	2374.55	3.255	2377.805	1576.0	22.01	7.521	2385.326	0.00	5.423		10.00	22.00	0.00	0	0.00
BRIDGE EXIT													0.00		
2849.02	2374.55	3.681	2378.231	1576.0	21.40	7.114	2385.345	0.00	5.779		7.00	22.00	0.00	1	2.00
11.83	0.02533					.012618	0.15			2.893			0.00		
2860.85	2374.85	3.735	2378.585	1576.0	21.10	6.910	2385.495	0.00	5.779		7.00	22.00	0.00	1	2.00
32.50	0.02533					.011604	0.38			2.893			0.00		
2893.35	2375.67	3.918	2379.591	1576.0	20.11	6.282	2385.873	0.00	5.779		7.00	22.00	0.00	1	2.00
25.08	0.02533					.010180	0.26			2.893			0.00		
2918.43	2376.31	4.109	2380.417	1576.0	19.18	5.711	2386.128	0.00	5.779		7.00	22.00	0.00	1	2.00
19.44	0.02533					.008937	0.17			2.893			0.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	WPRO
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
2937.87	2376.80	4.309	2381.109	1576.0	18.29	5.192	2386.301	0.00	5.779		7.00	22.00	0.00	1	2.00
14.97	0.02533					.007852	0.12			2.893			0.00		
2952.84	2377.18	4.520	2381.699	1576.0	17.43	4.720	2386.419	0.00	5.779		7.00	22.00	0.00	1	2.00
11.31	0.02533					.006903	0.08			2.893			0.00		
2964.15	2377.47	4.740	2382.206	1576.0	16.62	4.291	2386.497	0.00	5.779		7.00	22.00	0.00	1	2.00
8.25	0.02533					.006075	0.05			2.893			0.00		
2972.40	2377.68	4.972	2382.647	1576.0	15.85	3.901	2386.548	0.00	5.779		7.00	22.00	0.00	1	2.00
5.60	0.02533					.005349	0.03			2.893			0.00		
2978.00	2377.82	5.214	2383.031	1576.0	15.11	3.546	2386.577	0.00	5.779		7.00	22.00	0.00	1	2.00
3.29	0.02533					.004713	0.02			2.893			0.00		
2981.29	2377.90	5.469	2383.369	1576.0	14.41	3.224	2386.593	0.00	5.779		7.00	22.00	0.00	1	2.00
BRIDGE ENTRANCE													0.00		
2981.29	2377.90	3.844	2381.744	1576.0	18.64	5.392	2387.136	0.00	5.423		7.00	22.00	0.00	0	0.00
TRANS STR	0.00000					.006571	0.00						0.00		
2981.29	2377.91	3.848	2381.758	1576.0	18.62	5.381	2387.139	0.00	5.423		10.00	22.00	0.00	0	0.00
TRANS STR	0.00600					.006384	0.32						0.00		
3031.30	2378.21	4.269	2382.480	1576.0	17.98	5.017	2387.497	0.00	5.889		7.00	12.00	2.00	0	0.00
40.82	0.00621					.006207	0.25			4.269			2.00		
3072.12	2378.46	4.269	2382.733	1576.0	17.98	5.017	2387.750	0.00	5.889		7.00	12.00	2.00	0	0.00
892.71	0.00621					.006221	5.55			4.269			2.00		
3964.83	2384.01	4.264	2388.270	1576.0	18.01	5.034	2393.304	0.00	5.889		7.00	12.00	2.00	0	0.00
777.03	0.00621					.006674	5.19			4.269			2.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
4741.86	2388.83	4.122	2392.952	1576.0	18.88	5.538	2398.490	0.00	5.889		7.00	12.00	2.00	0	0.00
296.44	0.00621					.007612	2.26			4.269			2.00		
5038.30	2390.67	3.985	2394.655	1576.0	19.81	6.091	2400.746	0.00	5.889		7.00	12.00	2.00	0	0.00
80.00	0.00650					.008284	0.66			4.219			2.00		
5118.30	2391.19	3.942	2395.132	1576.0	20.11	6.277	2401.409	0.00	5.889		7.00	12.00	2.00	0	0.00
65.50	0.00620					.008650	0.57			4.269			2.00		
5183.80	2391.60	3.897	2395.493	1576.0	20.43	6.484	2401.977	0.00	5.889		7.00	12.00	2.00	0	0.00
158.50	0.00620					.009467	1.50			4.269			2.00		
5342.30	2392.58	3.765	2396.345	1576.0	21.43	7.132	2403.477	0.00	5.889		7.00	12.00	2.00	0	0.00
TRANS STR	0.00620					.011334	0.57						2.00		
5392.30	2392.89	3.101	2395.991	1576.0	23.10	8.286	2404.277	0.00	5.423		7.00	22.00	0.00	0	0.00
22.54	0.00621					.012792	0.29			3.919			0.00		
5414.84	2393.03	3.067	2396.097	1576.0	23.36	8.472	2404.569	0.75	5.423		7.00	22.00	0.00	0	0.00
56.46	0.00567					.013655	0.77			4.042			0.00		
5471.30	2393.35	2.973	2396.323	1576.0	24.10	9.017	2405.340	0.79	5.423		7.00	22.00	0.00	0	0.00
53.71	0.01005					.014664	0.79			3.339			0.00		
5525.01	2393.89	2.925	2396.815	1576.0	24.49	9.313	2406.128	0.00	5.423		7.00	22.00	0.00	0	0.00
TRANS STR	0.01049					.016907	0.15						0.00		
5533.59	2393.98	3.079	2397.059	1576.0	24.38	9.228	2406.287	0.00	5.594		7.00	22.00	0.00	1	1.00
30.16	0.00983					.019289	0.58			3.879			0.00		
5563.75	2394.28	3.023	2397.299	1576.0	24.83	9.571	2406.870	0.00	5.594		7.00	22.00	0.00	1	1.00
71.59	0.00983					.021230	1.52			3.879			0.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	LW/BPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
5635.34	2394.98	2.882	2397.862	1576.0	26.04	10.528	2408.390	0.00	5.594		7.00	22.00	0.00	1	1.00
TRANS STR	0.00000					.020506	0.00						0.00		
5635.34	2395.06	2.741	2397.801	1576.0	26.14	10.608	2408.409	0.93	5.423		7.00	22.00	0.00	0	0.00
33.95	0.00926					.018841	0.64			3.431			0.00		
5669.29	2395.37	2.694	2398.068	1576.0	26.60	10.983	2409.051	0.97	5.423		7.00	22.00	0.00	0	0.00
83.79	0.00926					.020870	1.75			3.431			0.00		
5753.08	2396.15	2.568	2398.718	1576.0	27.89	12.081	2410.799	0.00	5.423		7.00	22.00	0.00	0	0.00
24.20	0.00992					.022909	0.55			3.354			0.00		
5777.28	2396.39	2.531	2398.921	1576.0	28.30	12.438	2411.359	0.00	5.423		7.00	22.00	0.00	0	0.00
TRANS STR	0.01000					.022847	1.14						0.00		
5827.29	2396.89	3.056	2399.946	1576.0	28.47	12.590	2412.536	0.00	5.889		7.00	12.00	2.00	0	0.00
42.99	0.01070					.023003	0.99			3.708			2.00		
5870.28	2397.35	3.005	2400.355	1576.0	29.13	13.173	2413.528	0.00	5.889		7.00	12.00	2.00	0	0.00
26.07	0.05060					.022741	0.59			2.449			2.00		
5896.35	2398.67	3.075	2401.744	1576.0	28.23	12.378	2414.122	0.00	5.889		7.00	12.00	2.00	0	0.00
33.57	0.05060					.020392	0.68			2.449			2.00		
5929.92	2400.37	3.186	2403.554	1576.0	26.92	11.253	2414.807	0.00	5.889		7.00	12.00	2.00	0	0.00
27.74	0.05060					.017848	0.50			2.449			2.00		
5957.66	2401.77	3.301	2405.073	1576.0	25.67	10.230	2415.303	0.00	5.889		7.00	12.00	2.00	0	0.00
23.23	0.05060					.015626	0.36			2.449			2.00		
5980.89	2402.95	3.419	2406.366	1576.0	24.47	9.300	2415.666	0.00	5.889		7.00	12.00	2.00	0	0.00
19.61	0.05060					.013683	0.27			2.449			2.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
6000.50	2403.94	3.540	2407.479	1576.0	23.33	8.454	2415.933	0.00	5.889		7.00	12.00	2.00	0	0.00
16.67	0.05060					.011985	0.20			2.449			2.00		
6017.17	2404.78	3.665	2408.448	1576.0	22.25	7.686	2416.134	0.00	5.889		7.00	12.00	2.00	0	0.00
14.22	0.05060					.010500	0.15			2.449			2.00		
6031.39	2405.50	3.793	2409.295	1576.0	21.21	6.987	2416.282	0.00	5.889		7.00	12.00	2.00	0	0.00
12.15	0.05060					.009201	0.11			2.449			2.00		
6043.54	2406.12	3.925	2410.042	1576.0	20.23	6.352	2416.394	0.00	5.889		7.00	12.00	2.00	0	0.00
10.38	0.05060					.008065	0.08			2.449			2.00		
6053.92	2406.64	4.061	2410.703	1576.0	19.28	5.775	2416.478	0.00	5.889		7.00	12.00	2.00	0	0.00
8.85	0.05060					.007071	0.06			2.449			2.00		
6062.77	2407.09	4.201	2411.291	1576.0	18.39	5.250	2416.541	0.00	5.889		7.00	12.00	2.00	0	0.00
7.51	0.05060					.006200	0.05			2.449			2.00		
6070.28	2407.47	4.345	2411.815	1576.0	17.53	4.772	2416.587	0.00	5.889		7.00	12.00	2.00	0	0.00
1184.40	0.00580					.005794	6.86			4.345			2.00		
7254.68	2414.34	4.345	2418.680	1576.0	17.53	4.772	2423.452	0.00	5.889		7.00	12.00	2.00	0	0.00
825.61	0.00580					.006084	5.02			4.345			2.00		
8080.29	2419.12	4.240	2423.360	1576.0	18.15	5.114	2428.474	0.00	5.889		7.00	12.00	2.00	0	0.00
TRANS STR	0.00580					.006941	0.35						2.00		
8130.29	2419.41	3.679	2423.089	1576.0	19.47	5.888	2428.977	0.00	5.423		7.00	22.00	0.00	0	0.00
13.30	0.00602					.007536	0.10			3.962			0.00		
8143.59	2419.49	3.669	2423.159	1576.0	19.52	5.918	2429.077	0.52	5.423		7.00	22.00	0.00	0	0.00
33.70	0.00594					.007645	0.26			3.980			0.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
8177.29	2419.69	3.644	2423.334	1576.0	19.66	6.001	2429.335	0.00	5.423		7.00	22.00	0.00	0	0.00
20.38	0.00589					.007779	0.16			3.990			0.00		
8197.67	2419.81	3.627	2423.437	1576.0	19.75	6.057	2429.494	0.00	5.423		7.00	22.00	0.00	0	0.00
TRANS STR	0.00353					.008032	0.18						0.00		
8220.36	2419.89	3.568	2423.458	1576.0	20.08	6.259	2429.717	0.00	5.423		7.00	22.00	0.00	0	0.00
BRIDGE EXIT													0.00		
8220.36	2419.89	3.810	2423.700	1576.0	19.70	6.024	2429.724	0.00	5.594		7.00	22.00	0.00	1	1.00
80.44	0.01181					.010084	0.81			3.631			0.00		
8300.80	2420.84	3.877	2424.717	1576.0	19.36	5.818	2430.535	0.00	5.594		7.00	22.00	0.00	1	1.00
DGE ENTRANCE													0.00		
8300.80	2420.84	3.474	2424.314	1576.0	20.62	6.602	2430.916	0.00	5.423		7.00	22.00	0.00	0	0.00
TRANS STR	0.00065					.006802	0.10						0.00		
8316.15	2420.85	5.662	2426.512	1576.0	17.40	4.700	2431.212	0.00	6.706		7.00	16.00	0.00	0	0.00
153.91	0.00442					.004781	0.74			5.783			0.00		
8470.06	2421.53	5.581	2427.111	1576.0	17.65	4.836	2431.947	0.00	6.706		7.00	16.00	0.00	0	0.00
211.16	0.00449					.005073	1.07			5.750			0.00		
8681.22	2422.48	5.428	2427.906	1576.0	18.15	5.113	2433.019	0.00	6.706		7.00	16.00	0.00	0	0.00
223.30	0.00449					.005647	1.26			5.750			0.00		
8904.52	2423.48	5.175	2428.655	1576.0	19.03	5.625	2434.280	1.80	6.706		7.00	16.00	0.00	0	0.00
19.03	0.00473					.006058	0.12			5.643			0.00		
8923.55	2423.57	5.154	2428.724	1576.0	19.11	5.672	2434.396	0.00	6.706		7.00	16.00	0.00	0	0.00
44.39	0.00450					.006198	0.28			5.745			0.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	WPRF
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
8967.94	2423.77	5.092	2428.862	1576.0	19.34	5.809	2434.671	0.00	6.706		7.00	16.00	0.00	0	0.00
152.36	0.00450					.006757	1.03			5.745			0.00		
9120.30	2424.45	4.855	2429.310	1576.0	20.29	6.390	2435.700	0.00	6.706		7.00	16.00	0.00	0	0.00
127.76	0.00450					.007732	0.99			5.745			0.00		
9248.06	2425.03	4.630	2429.660	1576.0	21.28	7.029	2436.689	0.00	6.706		7.00	16.00	0.00	0	0.00
TRANS STR	0.00420					.008396	0.16						0.00		
9267.09	2425.11	4.575	2429.685	1576.0	21.53	7.198	2436.883	0.00	6.706		7.00	16.00	0.00	0	0.00
2.97	0.00337					.008556	0.03			6.382			0.00		
9270.06	2425.12	4.568	2429.688	1576.0	21.56	7.221	2436.909	0.00	6.706		7.00	16.00	0.00	0	0.00
538.21	0.00876					.008209	4.42			4.534			0.00		
9808.27	2429.83	4.714	2434.547	1576.0	20.90	6.780	2441.327	0.00	6.706		7.00	16.00	0.00	0	0.00
273.67	0.00876					.007346	2.01			4.534			0.00		
10081.94	2432.23	4.944	2437.174	1576.0	19.92	6.163	2443.337	0.00	6.706		7.00	16.00	0.00	0	0.00
136.53	0.00876					.006420	0.88			4.534			0.00		
10218.47	2433.43	5.185	2438.611	1576.0	19.00	5.603	2444.214	0.00	6.706		7.00	16.00	0.00	0	0.00
81.59	0.00876					.005616	0.46			4.534			0.00		
10300.06	2434.14	5.439	2439.579	1576.0	18.11	5.094	2444.673	0.00	6.706		7.00	16.00	0.00	0	0.00
TRANS STR	0.45000					.004605	0.00						0.00		
10301.06	2434.59	6.012	2440.602	1576.0	16.38	4.168	2444.770	0.00	6.706		9.50	16.00	0.00	0	0.00
37.00	0.00204					.004135	0.15			7.680			0.00		
10338.06	2434.66	5.839	2440.504	1576.0	16.87	4.419	2444.923	0.00	6.706		9.50	16.00	0.00	0	0.00
66.26	0.00204					.004606	0.31			7.680			0.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
10404.32	2434.80	5.567	2440.367	1576.0	17.69	4.861	2445.228	0.00	6.706		9.50	16.00	0.00	0	0.00
70.45	0.00204					.005260	0.37			7.680			0.00		
10474.77	2434.94	5.308	2440.252	1576.0	18.56	5.347	2445.599	0.00	6.706		9.50	16.00	0.00	0	0.00
72.39	0.00204					.006012	0.44			7.680			0.00		
10547.16	2435.09	5.061	2440.152	1576.0	19.46	5.882	2446.034	0.00	6.706		9.50	16.00	0.00	0	0.00
72.90	0.00204					.006876	0.50			7.680			0.00		
10620.06	2435.24	4.826	2440.066	1576.0	20.41	6.470	2446.536	0.00	6.706		9.50	16.00	0.00	0	0.00
TRANS STR	0.00347					.005664	1.70						0.00		
10920.06	2436.28	8.000	2444.280	1576.0	16.46	4.207	2448.487	0.00	8.000		8.00	12.00	0.00	0	0.00
90.00	0.00344					.006475	0.58			8.000			0.00		
11010.06	2436.59	8.273	2444.863	1576.0	16.46	4.207	2449.070	0.00	8.000		8.00	12.00	0.00	0	0.00
TRANS STR	0.00000					.003263	0.00						0.00		
11010.06	2436.60	12.731	2449.331	1576.0	3.06	0.145	2449.476	0.00	5.465		7.00	15.00	2.00	0	0.00
104.73	0.00343					.000055	0.01			4.573			2.00		
11114.79	2436.96	12.363	2449.322	1576.0	3.21	0.160	2449.482	0.00	5.465		7.00	15.00	2.00	0	0.00
101.82	0.00343					.000063	0.01			4.573			2.00		
11216.61	2437.31	12.005	2449.313	1576.0	3.37	0.176	2449.489	0.00	5.465		7.00	15.00	2.00	0	0.00
98.95	0.00343					.000072	0.01			4.573			2.00		
11315.56	2437.65	11.655	2449.302	1576.0	3.53	0.193	2449.495	0.00	5.465		7.00	15.00	2.00	0	0.00
96.11	0.00343					.000082	0.01			4.573			2.00		
11411.67	2437.98	11.314	2449.291	1576.0	3.70	0.213	2449.504	0.00	5.465		7.00	15.00	2.00	0	0.00
93.30	0.00343					.000093	0.01			4.573			2.00		

WATER SURFACE PROFILE LISTING

BUFFALO CHANNEL WATER SURFACE PROFILE
100-YEAR DESIGN FLOW
FEBRUARY 1994 FILE BUFFALO

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF			NORM DEPTH			ZR		
11504.97	2438.30	10.981	2449.278	1576.0	3.88	0.234	2449.512	0.00	5.465		7.00	15.00	2.00	0	0.00
90.51	0.00343					.000105	0.01			4.573			2.00		
11595.48	2438.61	10.657	2449.264	1576.0	4.07	0.257	2449.521	0.00	5.465		7.00	15.00	2.00	0	0.00
87.73	0.00343					.000120	0.01			4.573			2.00		
11683.21	2438.91	10.341	2449.249	1576.0	4.27	0.283	2449.532	0.00	5.465		7.00	15.00	2.00	0	0.00
41.45	0.00343					.000131	0.01			4.573			2.00		
11724.66	2439.05	10.192	2449.242	1576.0	4.37	0.297	2449.539	0.00	5.465		7.00	15.00	2.00	0	0.00
TRANS STR	0.00000												2.00		
11724.66	2439.06	7.012	2446.072	1576.0	18.73	5.448	2451.520	0.00	8.000		8.00	12.00	0.00	0	0.00
TRANS STR	0.00346					.007809	1.81						0.00		
11955.88	2439.86	5.640	2445.500	1576.0	23.29	8.420	2453.920	0.00	8.000		8.00	12.00	0.00	0	0.00

DEPARTMENT OF PUBLIC WORKS

Mayor:
RON LURIE

Councilmen:
BOB NOLEN
STEVE MILLER
ARNIE ADAMSEN
SCOTT HIGGINSON

City Manager:
ASHLEY HALL

Director of Public Works:
RICHARD D. GOECKE

City Engineer:
GARY A. PRESSWOOD,P.E.

ANGEL PARK
OUTLET & CHANNEL

FUNDED BY: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
CITY OF LAS VEGAS
CLARK COUNTY

APPROVALS

City Engineer — DATE

Clark County Regional Flood Control District — DATE

(FOR DAM ONLY)
Nevada State Dam Safety Engineer — DATE

Southwest Gas Company — 9-11-89 DATE

Nevada Power Company — DATE

Community Cable T.V., Inc. — 9-11-89 DATE

Las Vegas Valley Water District — DATE

Central Telephone Company — 9/21/89 DATE

Clark County Department of Public Works — 9-2-89 Date

ENGINEERING PLANNING DIVISION
BID NO: 91.1730.01

AUGUST 1989

731-49

66" R.C.P. STORM DRAIN

C L CHANNEL CURVE DATA

	Δ	R	L	T
(1)	3° 51' 43"	500.00	33.70'	16.86'
(2)	4° 44' 15"	500.00	41.34'	20.68'

PROPOSED L OF FUTURE CHANNEL (BY OTHERS)

6' CHAIN LINK FENCE PER N.D.O.T STD. DWG. NO. R-6.3.1

APPPOXIMATE LIMITS OF FILL - GRADE TO DRAIN

COMPACTION AREA

GRAVEL ROAD

DELETED

DELETED

FENCE DELETED

TEMPORARY TOE TO BE FENCED

PIONEER WAY

BRIDGE

TRANSITION

EXISTING DESERT PALMS

EXISTING MASONRY BLOCK WALL

EXISTING MASONRY BLOCK WALL

EXISTING MASONRY BLOCK WALL PER GENERAL NOTE NO. 4 SHT NO. 2

PROPOSED TENAYA WEST

VEGAS DRIVE

BUFFALO CHANNEL (NORTH)

NORTH

211+60 MATCH LINE SEE SHEET 14

72+21.29

NOTE: ALL F.A. ALONG E OF CHANNEL

① FUTURE TYPE B CONCRETE BARRIER RAIL PER N.D.O.T. STD. DWG. NO. R-8.3.1

PLAN
SCALE: 1"=40'

PROFILE
SCALE: HORIZ. 1"=40'
VERT. 1"=10'

CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
PLAN AND PROFILE
STATION 200+54.60 TO 211+60

SHEET 13

JOB NO. 412.330

G.C. WALLACE, INC.
Engineering/Architecture

DESCRIPTION: MISCELLANEOUS

DESIGNED: M. Rahimi
DRAWN: M. Rahimi
CHECKED: M. Rahimi

72+21.29
211+50 MATCH LINE - SEE SHT. 13

214+69.00 ℄ INLET #3

218+65.00 ℄ INLET #4

MATCH EXIST.

MATCH EXIST.

6' CHAINLINK FENCE PER N.D.O.T. STD. DWG. R-6.3.1

TEMPORARY FENCE SEE R-K2

RUBBERY STONE FENCE

EXISTING 18" TORTOISE FENCE SEE GENERAL NOTES NO.14 SHT. NO. 2

222+50 MATCH LINE - SEE SHT. 15
61+21.79

N01°41'09"E

215+00

220+00

N01°41'09"E

214+41.71

SH W-22

A 22

1 21

1 21

1 21

1 21

BUFFALO CHANNEL (NORTH)

NORTH

PLAN
SCALE: 1" = 40'

EXIST. GRADE @ TOP OF LINING (WEST)

FINISH GRADE @ TOP OF LINING (WEST)

S=.0058

SECTION (8)

EXIST. GRADE @ ℄ OF CHANNEL

FINISH GRADE @ ℄ OF CHANNEL

S=.0058

FINISH GRADE @ TOP OF LINING (EAST)

S=.0058

EXIST. GRADE @ TOP OF LINING (EAST)

72+21.29

61+21.79

2420
2410

212 213 214 215+00 216 217 218 219 220+00 221 222

PROFILE
SCALE: HORIZ. 1" = 40'
VERT. 1" = 10'

JOB NO. 412.330

REV	DATE	DESCRIPTION
1	05-1-92	MISCELLANEOUS

RECORD DRAWING 13 MAY 92

G.C. WALLACE, INC.
Engineering/Architecture

CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
PLAN AND PROFILE
STATION 211+50 TO 222+50

SHEET 14

CURVE DATA				
NO.	Δ	R	L	T
1	12°57'28"	500'	105.44'	54.24
2	12°57'36"	500'	116.17'	58.31

61+21.79
222+50 MATCH LINE - SEE SHT. 14

233+50 MATCH LINE - SEE SHT. 16
50+21.29

SECTION (8) | SECTION (7) | SECTION (10) | BRIDGE | SECTION (7) | TRANS. | SECTION (8)

BUFFALO CHANNEL (NORTH)

PLAN
SCALE: 1" = 40'

① FUTURE TYPE B CONCRETE BARRIER RAIL PER N.D.O.T. STD. DWG. NO R-8.3.1.

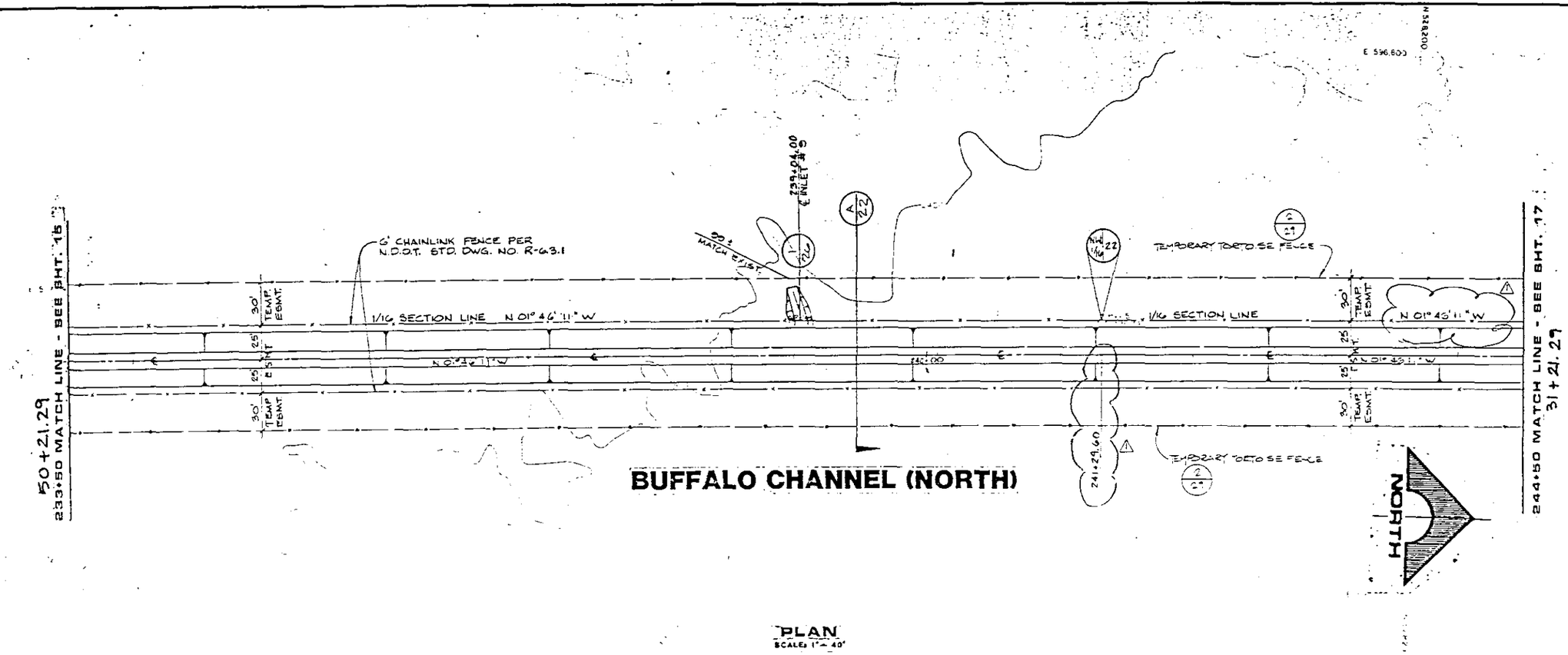
PROFILE
SCALES: HORIZ. 1" = 40'
VERT. 1" = 10'

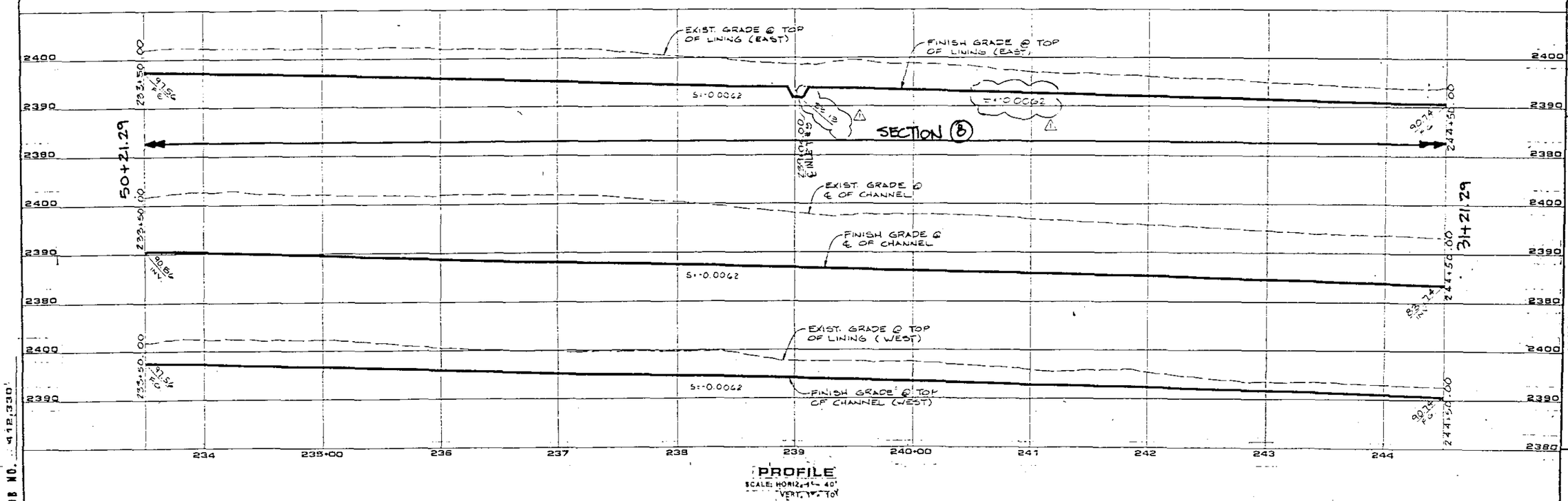
CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
PLAN AND PROFILE
STATION 222+50 TO 233+50

G.C. WALLACE, INC.
Engineering/Architecture

SHEET 15 OF 31 SHEETS

JOB NO. 412,330





REV	DATE	DESCRIPTION
1	10/31/88	MISCELL. CHECKS

RECOMMENDED [illegible] 12/1/88

DATE

G.C. WALLACE, INC. (RECORD DRAWING 13 MAY 92)
Engineering/Architecture
1111 SOUTH RAINBOW BLVD (LAS VEGAS, NEVADA 89102)

CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
PLAN AND PROFILE
STATION 233+50 TO 244+50

SHEET 16 OF 31 SHEETS

JOB NO. 412,330

BUFFALO CHANNEL (NORTH)

PLAN
SCALE: 1" = 40'

PROFILE
SCALES: HORIZ. 1" = 40'
VERT. 1" = 10'

NORTH

39+21.29
244+50 MATCH LINE - SEE SHT. 16

255+40 MATCH LINE - SEE SHT. 18
28+31.29

APPROX. LIMITS OF GRADING

MATCH EXIST.

246+03.00 ℄ INLET # 10

246+71.00 ℄ INLET # 11

247+10

245+55

TEMPORARY TORTOISE FENCE

6' CHAINLINK FENCE PER N.D.O.T. STD. DWG. NO. R-6.3.1

N 01°46'11" W

30' TEMP. ESMT.

25' ESMT.

15' TEMP. ESMT.

DELETE RAMP

251+85.00 BEGIN RAMP #4

253+27.20 END RAMP #4

245

12' DOUBLE SWING GATE PER N.D.O.T. STD. DWG. No. R-6.3.3

EXIST. VALVES

FUTURE 8" ϕ S.S. (BYPASS)

EDGE OF ASPHALT

GRAVEL ROAD

4" TELE. DUCT

COMPACTION AREA

SMOKE RANCH ROAD

SECTION LINE

254+72.28

265+22.28

BEGIN RECT CONC. CHANNEL

254+40.00

29+81.29

29+49.02

30+31.29

BEGIN TRANS

SECTION (5)

SECTION (6)

TRANS

SEC (3)

SEC (4)

SEC (5)

① FUTURE TYPE D CONCRETE BARRIER RAIL PER N.D.O.T. STD. DWG. NO. R-8.3.1.

② CONSTRUCT 50-FOOT CONCRETE ENCASEMENT PER DETAIL

EXIST. GRADE & TOP OF LINING (WEST)
F.G. & TOP OF LINING (WEST)
EXIST. GRADE & ℄ OF CHANNEL
F.G. & ℄ OF CHANNEL
EXIST. GRADE & TOP OF LINING (EAST)
F.G. & TOP OF LINING (EAST)

S=-0.0062
S=-0.0095
S=-0.0174

BRIDGE

STA. 30+31.29 BEGIN TRANS.
TRANSITION
29+81.29 END TRANSITION

2390
2380
2370

245+00 246 247 248 249 250+00 251 252 253 254 255+00

NO.	DATE	DESCRIPTION
1	10/1/91	MISCELLANEOUS
2	11/1/91	AS-BUILT

RECOMMENDED FOR APPROVAL
Mohammed S. Rahim
CITY ENGINEER
12/1/91

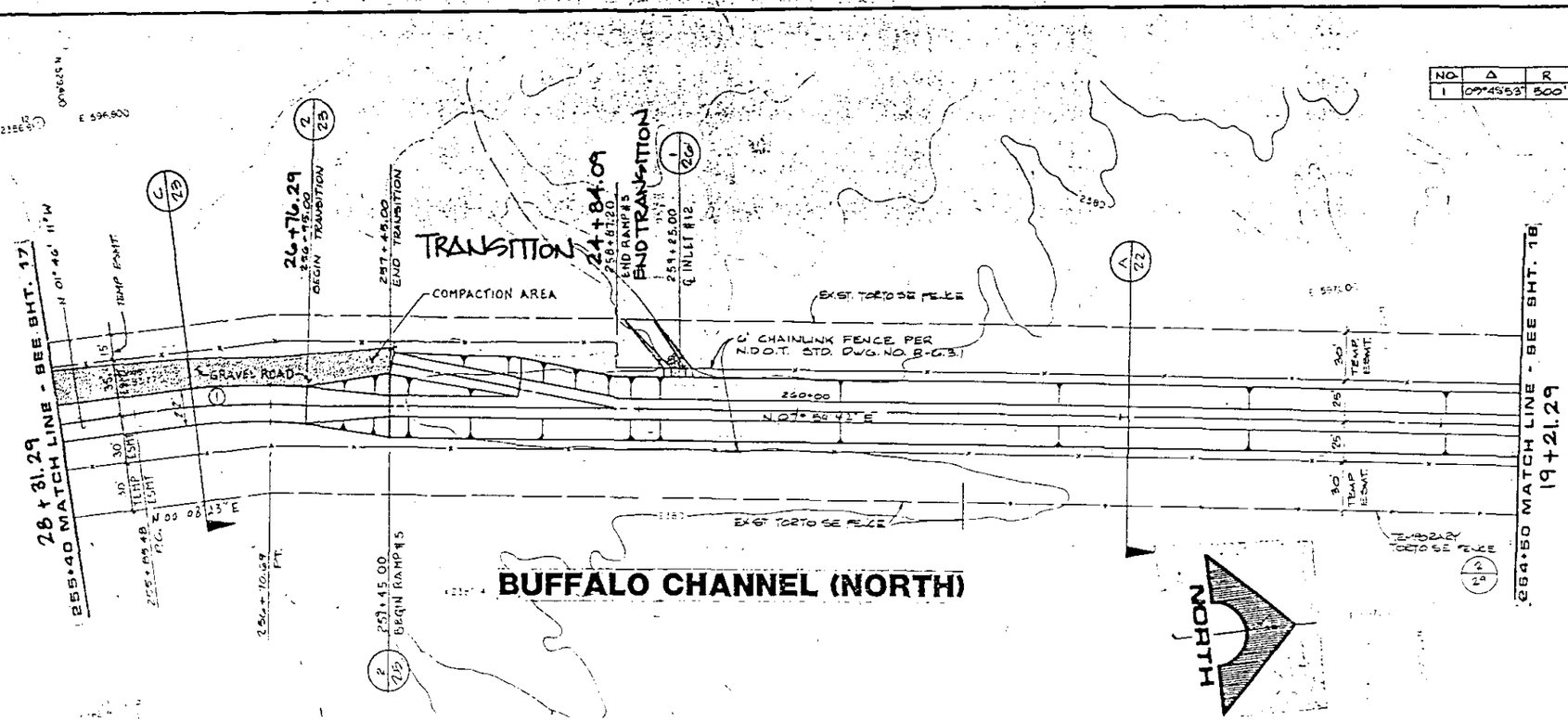
G.C. WALLACE, INC.
Engineering/Architecture

CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
PLAN AND PROFILE
STATION 244+50 TO 255+40

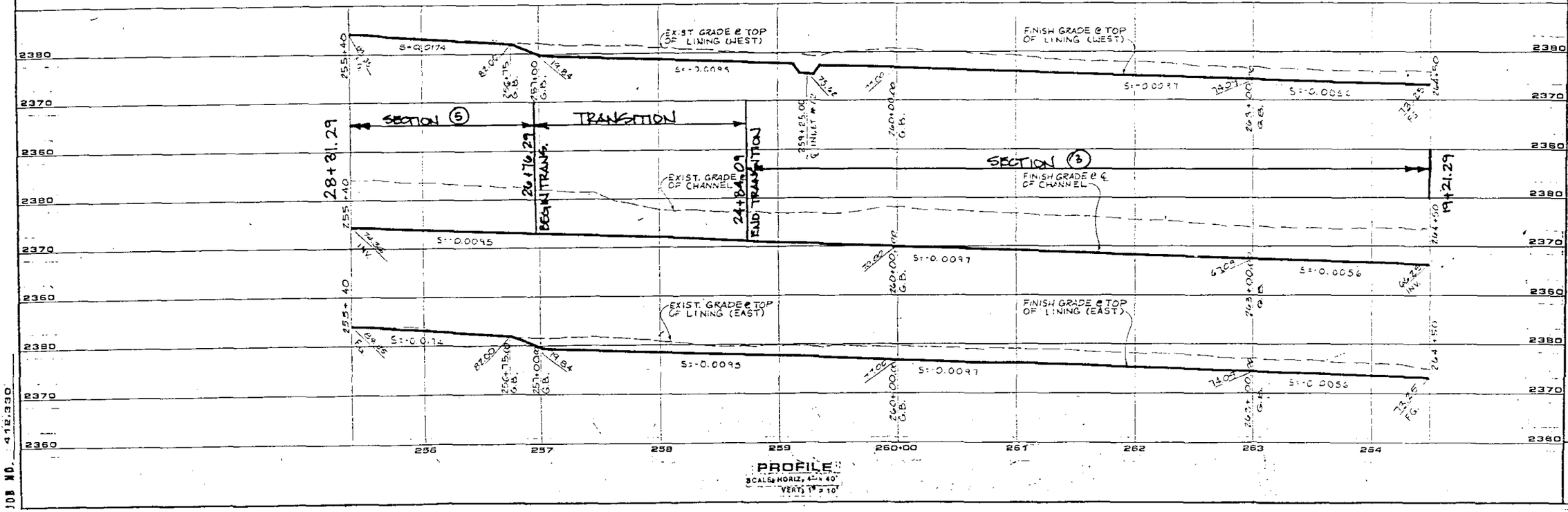
SHEET 17 OF 31 SHEETS

JOB NO. 412.330

NO.	Δ	R	L	T
1	09°45'53"	500'	89.21'	42.11'



PLAN
SCALE 1" = 40'



PROFILE
SCALE: HORIZ. 1" = 40'
VERT. 1" = 10'

JOB NO. 412.330

NO	DESCRIPTION	BY	DATE

RECOMMENDED [illegible] 12/1/09

G.C. WALLACE, INC.
Engineering/Architecture
RECORD DRAWINGS 13 MAY 92
1555 SOUTH RAINBOW BOULEVARD LAS VEGAS NEVADA 89102

CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
PLAN AND PROFILE
STATION 264+00 TO 264+50

SHEET 18 OF 31 SHEETS

19+21.29
264+50 MATCH LINE - SEE SHT. 18

265+00

265+80 ℄ INLET #13

30' TEMP ESMT

25' ESMT

200 LF 8'ϕ SS @ 5.04%

A/22

EXIST. TORROSE FENCE

270+00

N.01°59'42"E

271+65

1/26

272+00

272+50.00 ℄ INLET #14

60' TEMP ESMT

APPROX. LIMITS OF FILL GRADE TO DRAIN

6' CHAINLINK FENCE PER N.D.O.T. STD. DWG. NO. R-6.3.1

274+30

30' TEMP ESMT

25' ESMT

275+00

275+05.00 ℄ INLET #15

272+15

1/26

275+60 MATCH LINE - SEE SHT. 20
8+21.29

TEMPORARY TORROSE FENCE

2/29

6' CHAINLINK FENCE PER N.D.O.T. STD. DWG. NO. R-6.3.1

INSTALL 8" SS PIPE (PVC)

267+34 ℄ SS

BUFFALO CHANNEL (NORTH)

NORTH

PLAN
SCALE: 1" = 40'

EXIST. GRADE & TOP OF LINING (WEST)
FINISH GRADE & TOP OF LINING (WEST)
EXIST. GRADE & ℄ OF CHANNEL
FINISH GRADE & ℄ OF CHANNEL
EXIST. GRADE & TOP OF LINING (EAST)
FINISH GRADE & TOP OF LINING (EAST)

2380
2370
2360

S=-0.0056
S=-0.0148

19+21.29
264+50 13.25 F.G.
265+80 ℄ INLET #13
SECTION (3)
272+00.00 G.B.
272+50.00 ℄ INLET #14
275+05.00 ℄ INLET #15
275+60
8+21.29

264+50 8'ϕ SS INV. 8.76
586 8'ϕ SS INV.
272+00.00 G.B. 62.05
275+60 INV.

264+50 13.25 F.G.
272+00.00 G.B. 69.05
275+60 G.B. F.G.

265+00 266 267 268 269 270+00 271 272 273 274 275+00

PROFILE
SCALE: HORIZ. 1" = 40'
VERT. 1" = 10'

08 NO. 412.330

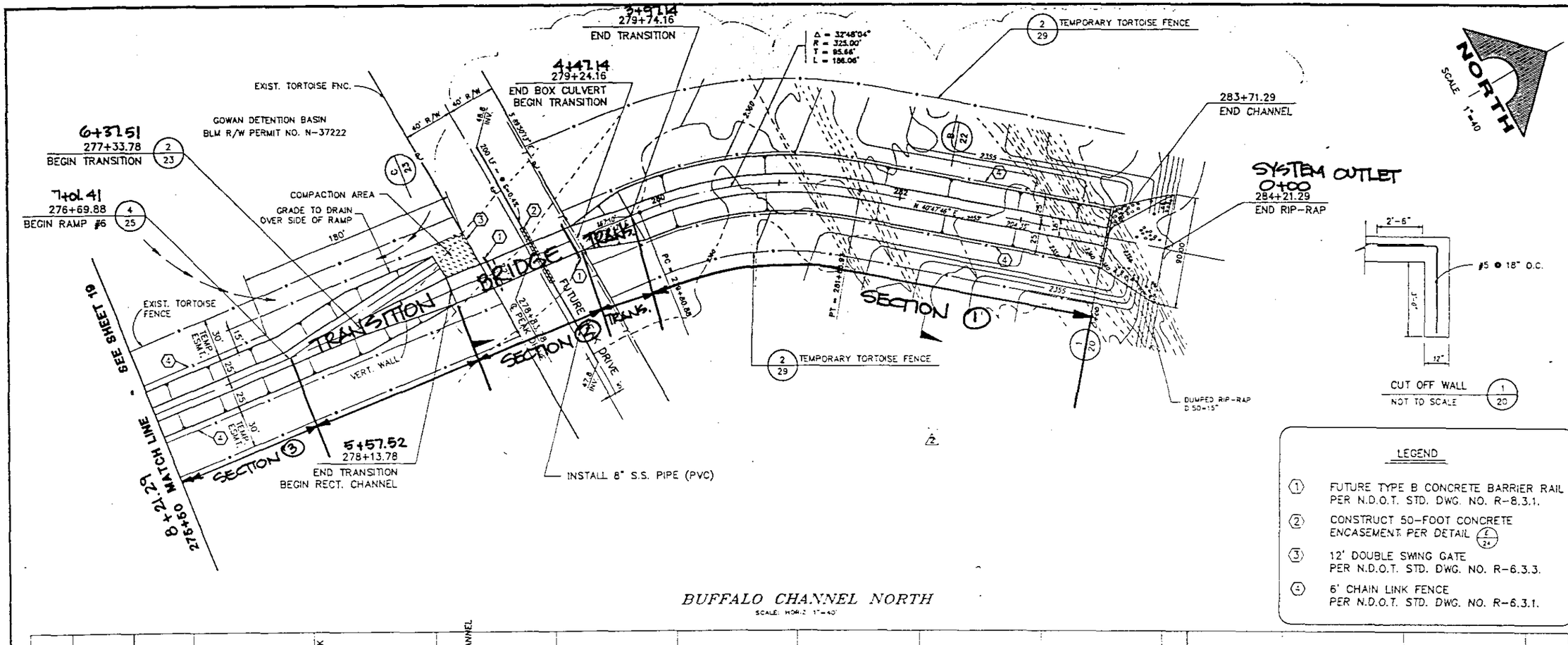
G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD. LAS VEGAS, NEVADA 89102

NO.	DATE	DESCRIPTION
1	8/10/89	MISCELLANEOUS
2	8/30/89	AS-BUILT

ALLEN C. HALL No. 7238 REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
12/1/89

CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
PLAN AND PROFILE
STATION 234+50 TO 275+50

SHEET 19 OF 31 SHEETS

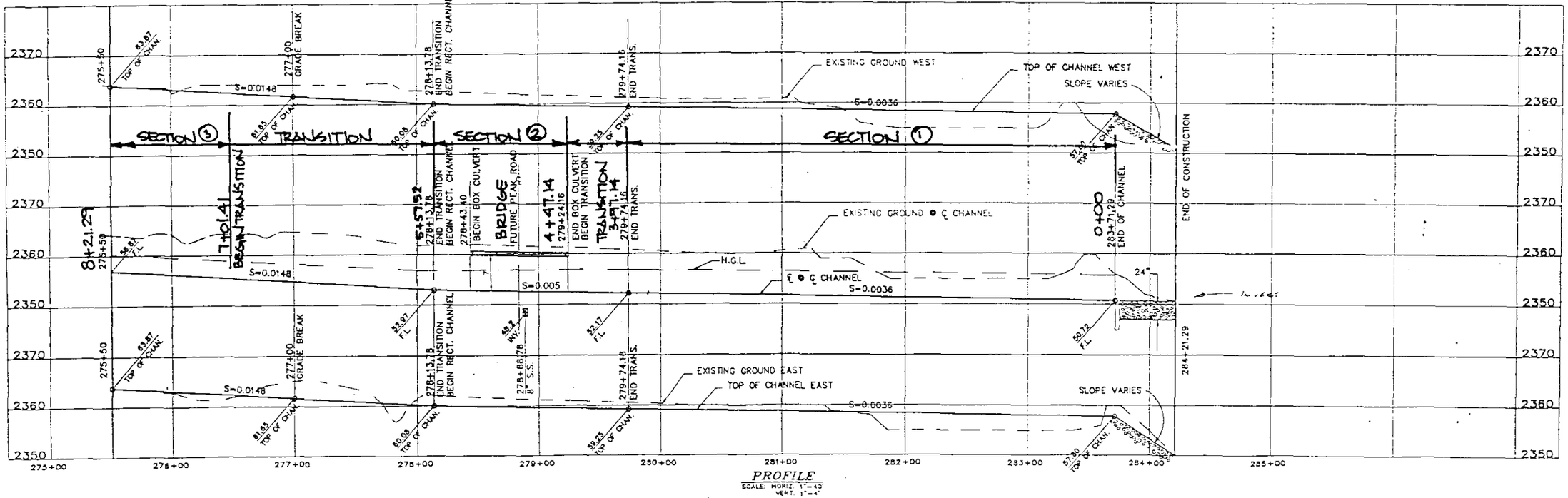


BUFFALO CHANNEL NORTH

SCALE: HORIZ. 1"=40'

LEGEND

1. FUTURE TYPE B CONCRETE BARRIER RAIL PER N.D.O.T. STD. DWG. NO. R-8.3.1.
2. CONSTRUCT 50-FOOT CONCRETE ENCASEMENT PER DETAIL (4/24)
3. 12' DOUBLE SWING GATE PER N.D.O.T. STD. DWG. NO. R-6.3.3.
4. 6' CHAIN LINK FENCE PER N.D.O.T. STD. DWG. NO. R-6.3.1.



PROFILE

SCALE: HORIZ. 1"=40' VERT. 1"=4'

RECOMMENDED — MOHAMMAD S. RAHIM — 7188 — R.E. NO. — DATE — Mohammad S. Rahim — 10/15/97

NO.	DESCRIPTION	DATE
1	ALIGNMENT CHANGE	4-14-97

G.C. WALLACE, INC. — Engineering/Architecture — 1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

CITY OF LAS VEGAS

ANGEL PARK OUTLET AND OUTFALL

PLAN AND PROFILE

STA. 278+13.78 TO STA. 283+71.11

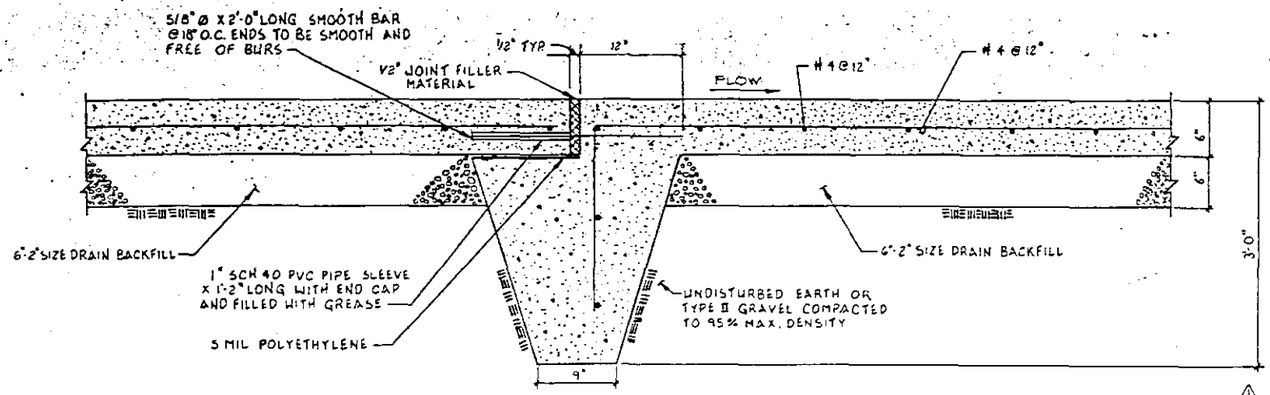
SHEET 20

SHT 1 OF 1

ON DISK 1

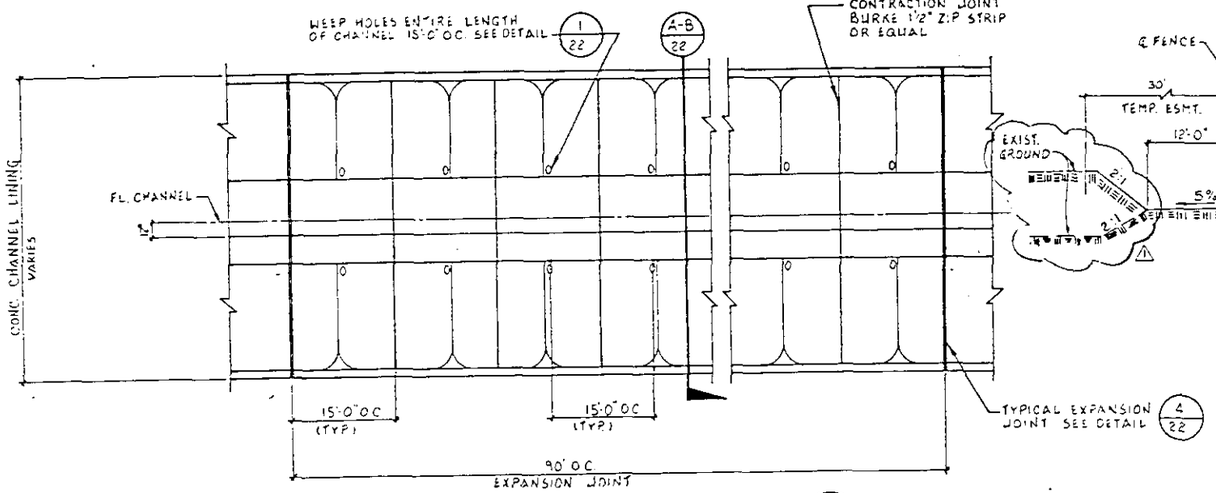
A_P1.DWG

731-20

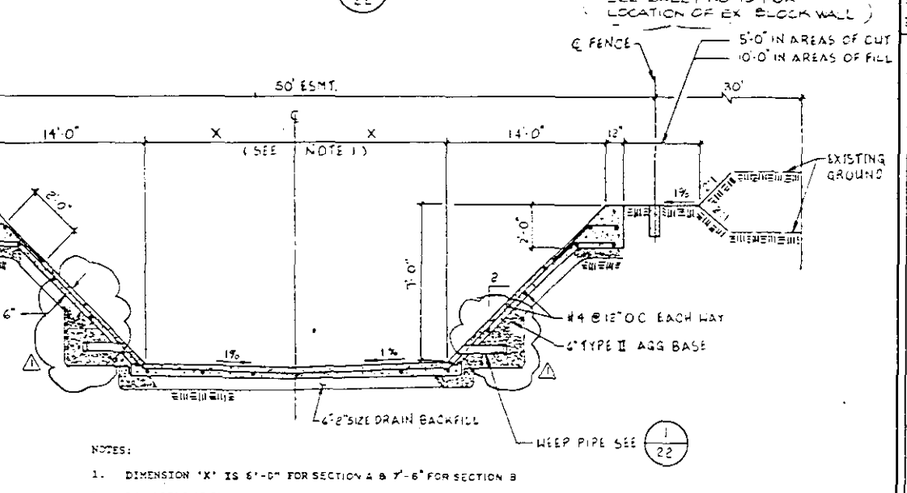


TYPICAL EXPANSION JIONT DETAIL — NOT TO SCALE — 4/22

NOTE: SEE SHEET NO 18 FOR LOCATION OF EX BLOCK WALL



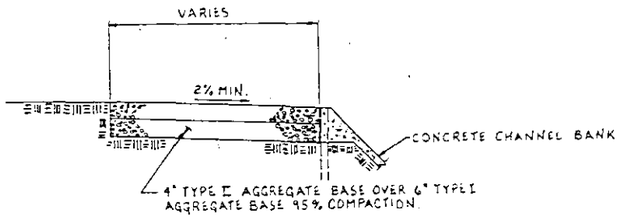
TYPICAL CHANNEL PLAN (TRAP SECTION) — NOT TO SCALE — 5/22



NOTES:

1. DIMENSION 'X' IS 6'-0" FOR SECTION A & 7'-6" FOR SECTION B
2. IN AREAS WHERE THERE IS NO EASEMENT SHOWN ON THE PLANS, INSTALL FENCE ON EACH SIDE OF CHANNEL, 25' FROM THE CENTERLINE, AS SHOWN HERE AND ON THE PLANS.

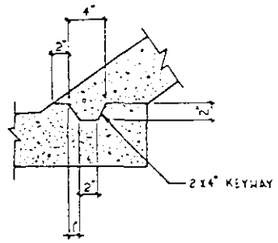
CONC. CHANNEL SECTION — NOT TO SCALE — A 22 / B 22



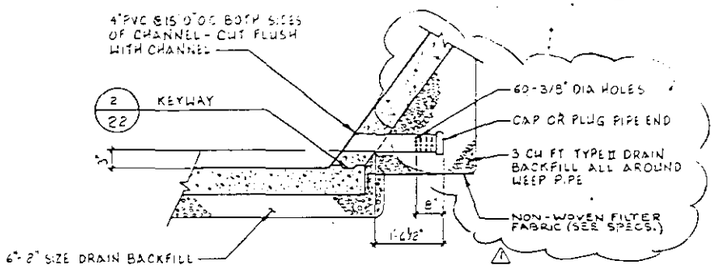
TYPICAL GRAVEL ACCESS ROAD — NOT TO SCALE — D/22

NOTES:

1. NATIVE MATERIAL MAY BE USED IN LIEU OF TYPE I AGGREGATE BASE IF APPROVED BY THE CITY ENGINEER
2. COMPACTION OF AGGREGATE BASE AND SUBGRADE PREPARATION SHALL BE IN ACCORDANCE WITH THE "STANDARD SPECIFICATION."



KEYWAY DETAIL — NOT TO SCALE — 2/22



WEEP PIPE DETAIL — NOT TO SCALE — 1/22

JOB NO. 412.330

REV	DATE	DESCRIPTION
1	8/17/90	MISCELLANEOUS

RECOMMENDED: [signature] 8/16/90

G.C. WALLACE, INC. Engineering/Architecture

CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
CHANNEL DETAILS

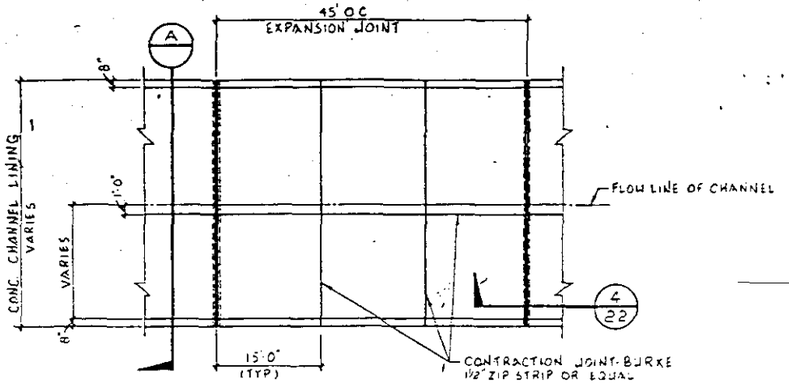
SHEET 22 OF 31 SHEETS

STRUCTURAL NOTES

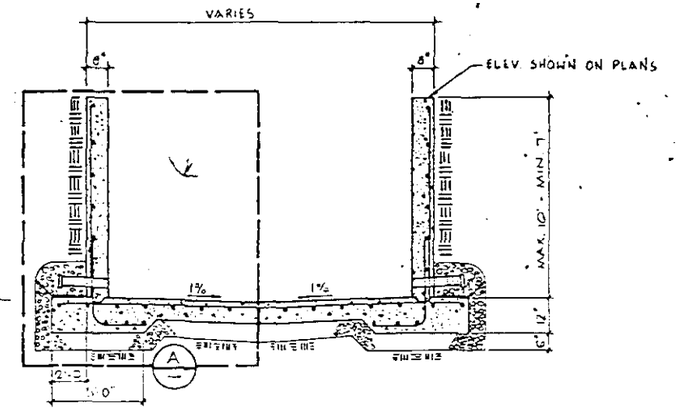
1. DESIGN SPECIFICATIONS: AASHTO "STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, THIRTEENTH EDITION, 1983" AND INTERIM SPECIFICATIONS THROUGH 1986.
2. CONCRETE SHALL MEET THE REQUIREMENTS OF CLARK COUNTY STANDARDS, EXCEPT AS MODIFIED BY THE PROJECT SPECIFICATIONS. ALL STRUCTURAL CONCRETE SHALL DEVELOP A COMPRESSIVE STRENGTH OF 3000 PSI MINIMUM IN 28 DAYS (6 SACK MINIMUM).
3. ALL REINFORCING STEEL SHALL MEET THE REQUIREMENTS OF ASTM A-615, GRADE 60. STAGGER SPLICES NOT SHOWN. HOOKS MAY BE ROTATED OR TILTED, AS NECESSARY FOR CLEARANCE. REINFORCEMENT SHALL HAVE A 3-INCH CLEARANCE IF CONCRETE IS CAST AGAINST SOIL AND 2-INCH IF FORMED, UNLESS OTHERWISE NOTED ON THE PLANS.
4. THE CONTRACTOR SHALL ALLOW SUFFICIENT TIME FOR INSPECTION OF THE SUBGRADE PRIOR TO PLACING BASE FOR FLOOR OF STRUCTURE AND FOOTINGS.
5. TYPE V CEMENT ONLY.

EXPANSION JOINT FILLER MATERIAL

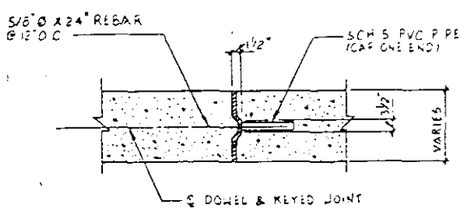
WHERE EXPANSION JOINT FILLER IS INDICATED THE MATERIALS SHALL BE OF THE PREFORMED NON-EXTRUDING TYPE JOINT FILLER WHICH MAY BE CONSTRUCTED OF OPEN CELLULAR SPONGE RUBBER, OR CLOSED CELLULAR SPONGE RUBBER OF FIRM TEXTURE. BITUMINOUS FIBER TYPE WILL NOT BE PERMITTED. ALL NON-EXTRUDING AND RESILIENT-TYPE PREFORMED EXPANSION JOINT FILLERS SHALL CONFORM TO THE REQUIREMENTS AND TESTS SET FORTH IN "SPECIFICATIONS FOR PREFORMED SPONGE RUBBER AND CORK EXPANSION JOINT FILLERS FOR CONCRETE PAVING AND STRUCTURAL CONSTRUCTION:, TYPE 1 (ASTM D1752), EXCEPT AS OTHERWISE PROVIDED HEREIN. PREFORMED BITUMINOUS FIBER TYPE JOINT FILLER SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M153, TYPE III, AND SHALL BE PUNCHED TO ADMIT DOWELS WHERE CALLED FOR. THE FILLER FOR EACH JOINT SHALL BE FURNISHED IN A SINGLE PIECE FOR THE FULL DEPTH AND WIDTH REQUIRED FOR THE JOINT UNLESS OTHERWISE AUTHORIZED BY THE ENGINEER. WHEN THE USE OF MORE THAN ONE PIECE IS AUTHORIZED FOR A JOINT, THE ABUTTING ENDS SHALL BE FASTENED SECURELY AND HELD ACCURATELY IN PLACE, BY STAPLING OR OTHER POSITIVE FASTENING SATISFACTORY TO THE ENGINEER.



TYPICAL CHANNEL DETAIL (RECTANGULAR) — 1/23
NOT TO SCALE

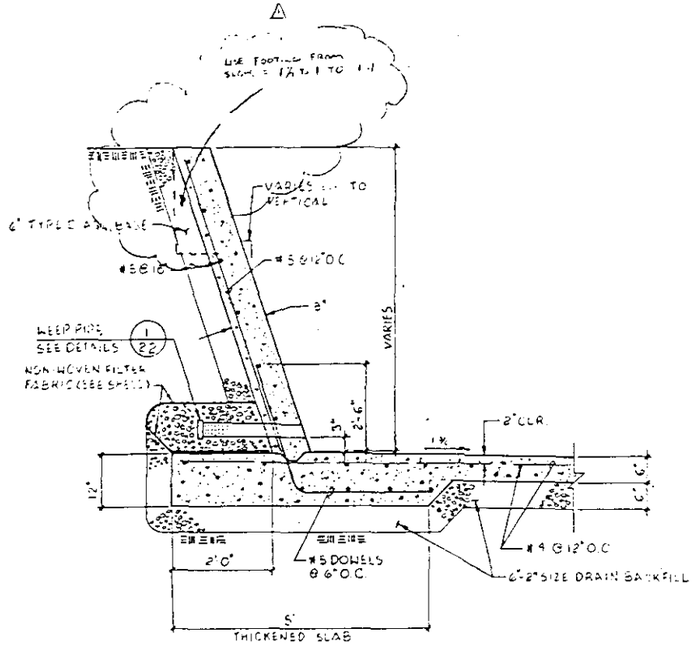


CONC. CHANNEL SECTION — C/23
NOT TO SCALE

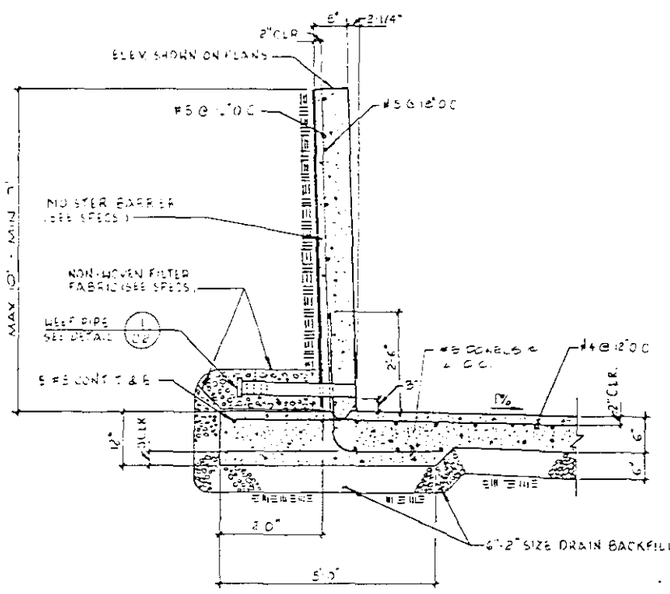


NOTE:
OMIT DOWEL AT TOP OF WALL TO ALLOW INSTALLATION OF FENCE POST PIPE SLEEVE AS REQUIRED

WALL EXPANSION SECTION — TYP/—
NOT TO SCALE



TRANSITION WALL DETAIL — 2/23



CHANNEL SECTION DETAIL — A/—
NOT TO SCALE

REV	DATE	DESCRIPTION
Δ	2-93	AS-BUILT

RECOMMENDED G.C. Wallace Jr. 3/15/93 DATE

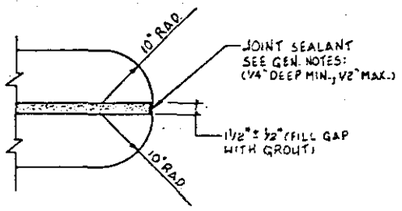
APPROVED DATE

G.C. WALLACE, INC.
Engineering/Architecture
DRAWING 13 MAY 92
1555 SOUTH RAINBOW BLVD. LAS VEGAS, NEVADA 89102

CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
CHANNEL DETAILS

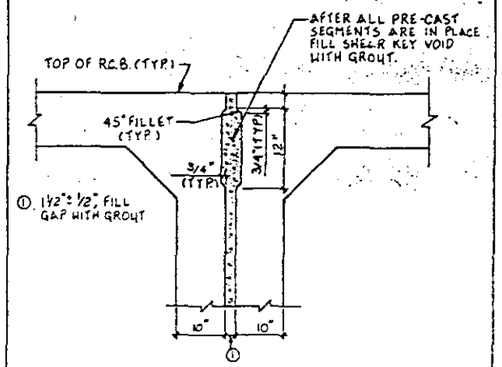
SHEET 23 OF 31 SHEETS

JOB NO. 412.330

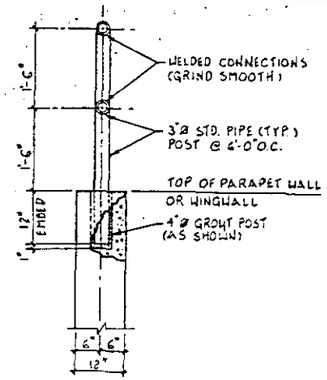


NOTE:
RADIUS SIDE WALL OF UPSTREAM END ONLY.

TYP. RCB SIDE WALL AT UPSTREAM END SCALE: 3/4"=1'-0" (B/—)

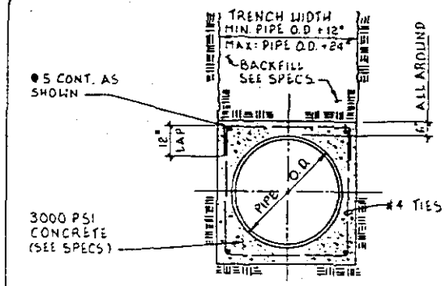


TYP. RCB SEPERATION DETAIL
SCALE: 3/4"=1'-0"

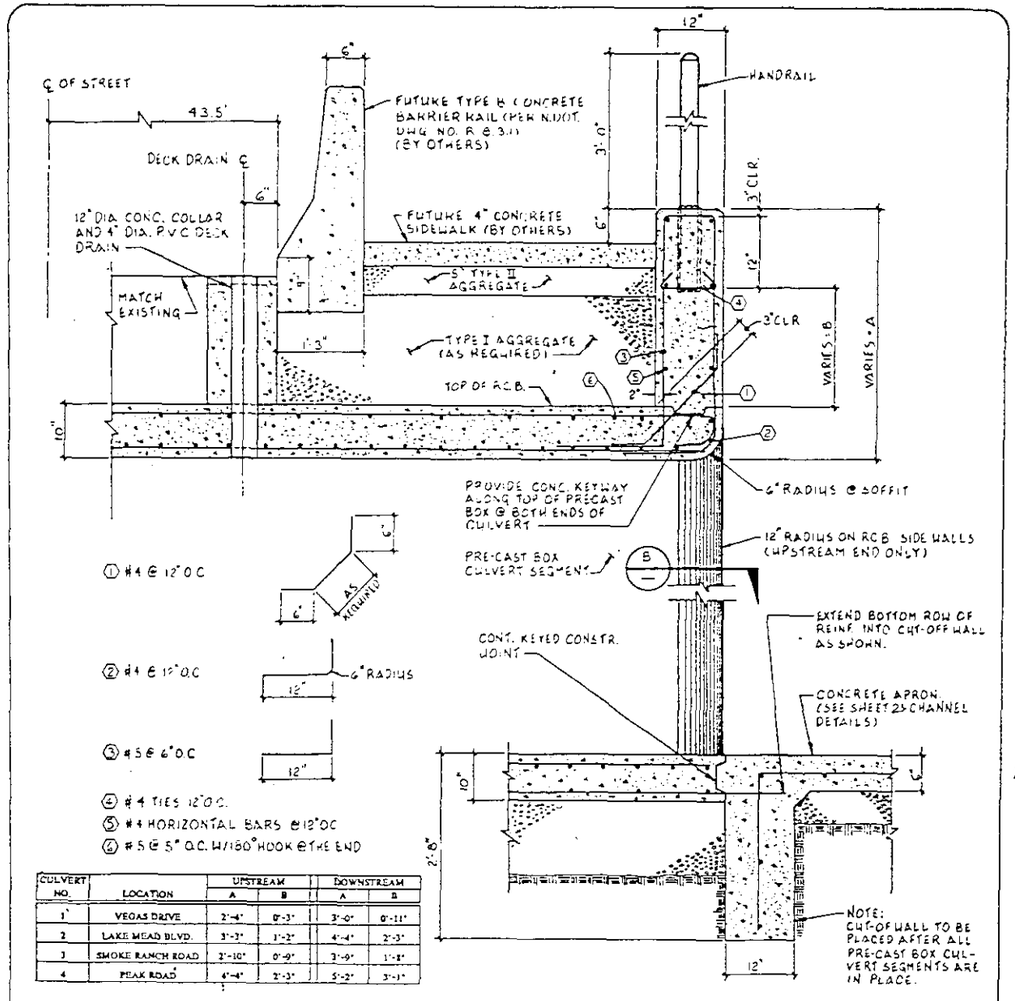


HANDRAIL DETAIL (D/—)
SCALE: 3/4"=1'-0"

① PRECAST CONCRETE BOX CULVERT PER NDOT. STD. DWG. NO. B-20.1.8-(502)
② TYPE B CONCRETE BARRIER RAIL PER NDOT STD. DWG. NO. R-8.3.1

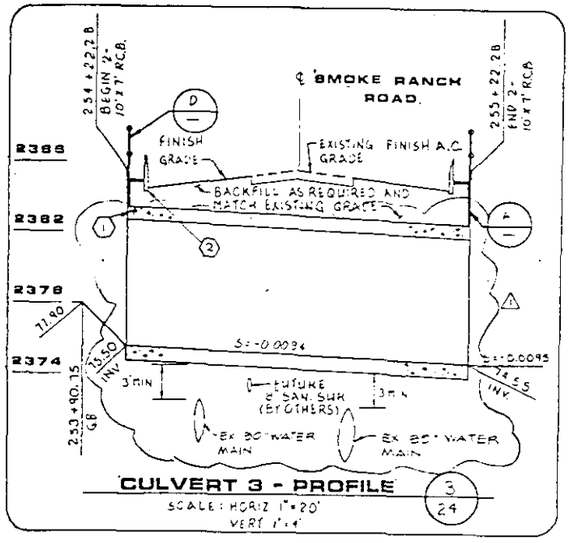


CONCRETE ENCASEMENT DETAIL (E/24)
NO TO SCALE

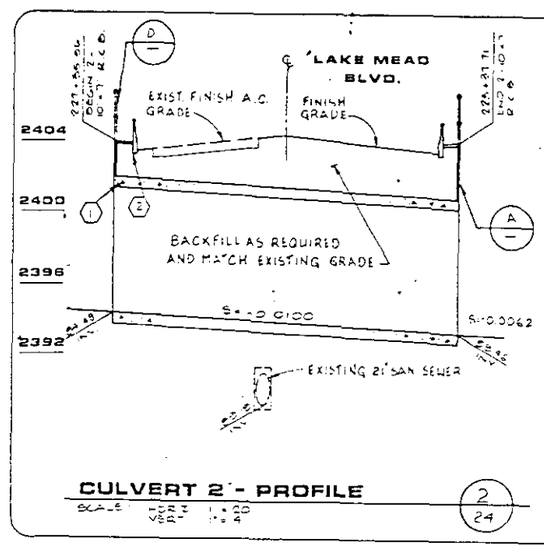


CULVERT NO.	LOCATION	UPSTREAM A	UPSTREAM B	DOWNSTREAM A	DOWNSTREAM B
1	VEGAS DRIVE	2'-4"	0'-3"	3'-0"	0'-11"
2	LAKE MEAD BLVD.	3'-3"	1'-2"	4'-4"	2'-3"
3	SMOKE RANCH ROAD	2'-10"	0'-9"	3'-9"	1'-8"
4	PEAK ROAD	4'-4"	2'-3"	5'-2"	3'-1"

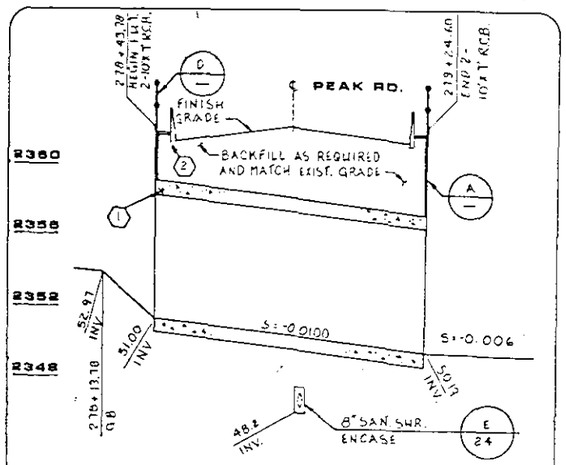
TYP. PRE-CAST BOX CULVERT (END SECTION) SCALE: 1"=1'-0" (A/—)



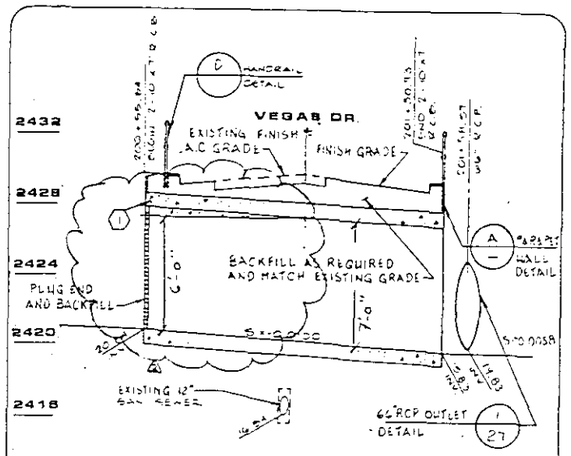
CULVERT 3 - PROFILE
SCALE: HORIZ 1"=20' VERT 1"=4' (3/24)



CULVERT 2 - PROFILE
SCALE: HORIZ 1"=20' VERT 1"=4' (2/24)



CULVERT 4 - PROFILE
SCALE: HORIZ 1"=20' VERT 1"=4' (4/24)



CULVERT 1 - PROFILE
SCALE: HORIZ 1"=20' VERT 1"=4' (1/24)

RECOMMENDED — DATE 12/1/92

REV	DATE	DESCRIPTION
1	10/8/92	MISCELLANEOUS
2	11/4/92	AS-BUILT

G.C. WALLACE, INC. Engineering/Architecture

CITY OF LAS VEGAS
ANGEL PARK OUTLET AND OUTFALL
MISC. CULVERT DETAILS

SHEET 24 OF 33 SHEETS

108 NO. 412.330

DEPARTMENT OF PUBLIC WORKS

Mayor:
JAN LAVERTY JONES

Councilmen:
BOB NOLEN
ARNIE ADAMSEN
SCOTT HIGGINSON
FRANK HAWKINS, JR.

City Manager:
WILLIAM J. NOONAN

Director of Public Works:
RICHARD D. GOECKE

City Engineer:
DENNIS ANDERSON, P.E.

BUFFALO CHANNEL

SUMMERLIN PARKWAY TO VEGA'S DRIVE

FUNDED BY:
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

PREPARED BY:
VTN NEVADA

APPROVALS

City Engineer	11-23-92 Date
Chief of Engineering Design	11/3/92 Date
Chief of Construction Services	Date
CCRFCD	Date
Central Telephone Company	7/29/92 Date
Las Vegas Valley Water District	7/29/92 Date
Nevada Power Company	8/24/92 Date
Southwest Gas Company	08/07/92 Date
Community Cable T.V. Inc	11/9/92 Date
ADA Coordinator	11/92 Date

PRINTED JUN 10 1993 VTN NEVADA

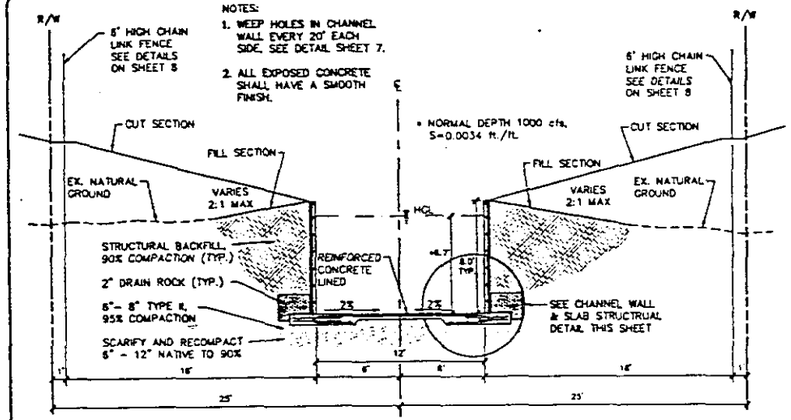
VTN nevada
CONSULTING ENGINEERS • PLANNERS • LAND SURVEYORS
2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89102-5148 PHONE (702) 873-7500 FAX (702) 362-2387

REVISIONS | DATE

DEPARTMENT OF PUBLIC WORKS
PROJECT BUFFALO CHANNEL
SHEET COVER SHEET
BID NO. 93.1730.03

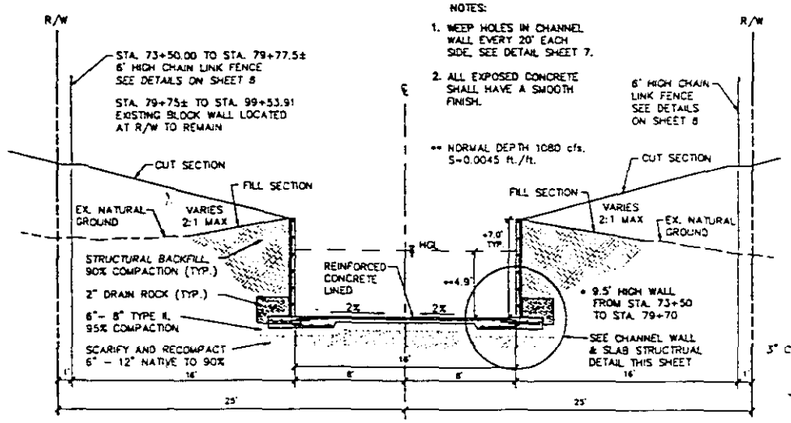
CITY OF LAS VEGAS NEVADA

DRAWING NO. 731-56 | 1/14



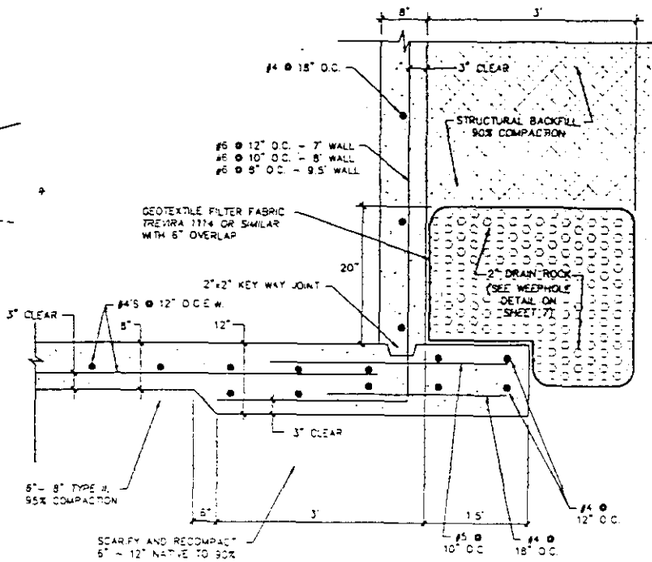
SECTION A-A
TYPICAL 12' WIDE CHANNEL CROSS-SECTION
STA. 65+45.40 TO STA. 72+60.00

SCALE: 1"=5'



SECTION B-B
TYPICAL 16' WIDE CHANNEL CROSS-SECTION
STA. 73+50.00 TO STA. 99+53.91

SCALE: 1"=5'



CHANNEL WALL AND SLAB STRUCTURAL DETAIL

NO SCALE

SECTION C-C
STA. 67+00.00 TO STA. 70+00.00

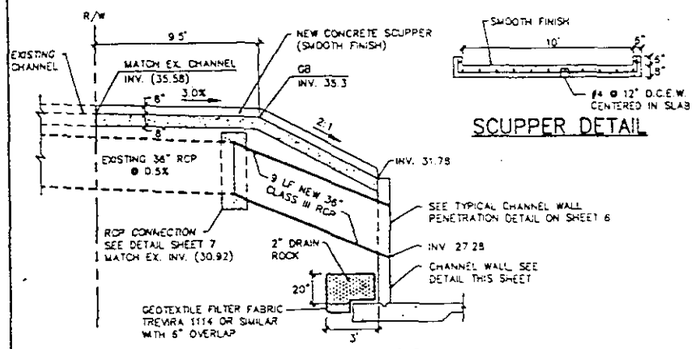
SCALE: 1"=4'

SECTION D-D
STA. 74+50.00± TO STA. 75+90.00

SCALE: 1"=4'

SECTION E-E
STA. 75+90.00 TO STA. 79+75.00

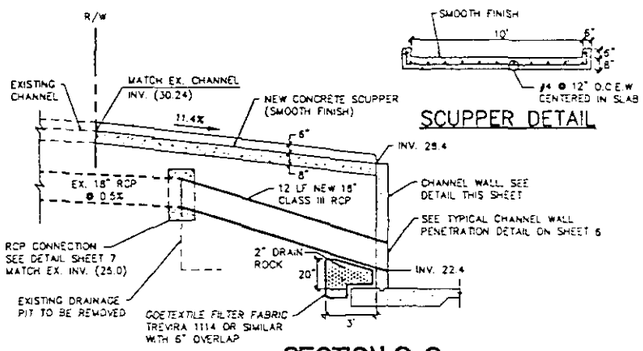
SCALE: 1"=4'



SCUPPER DETAIL

SECTION F-F
STA. 90+37.35 LT.

SCALE: 1"=4'



SCUPPER DETAIL

SECTION G-G
STA. 97+96.11 LT.

SCALE: 1"=4'

PRINTED JUN 10 1993

DEPARTMENT OF PUBLIC WORKS
CITY OF LAS VEGAS, NEVADA

CONSULTING ENGINEERS • PLANNERS • LAND SURVEYORS
2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89102-5148 PHONE (702) 873-7550 FAX (702) 362-2597

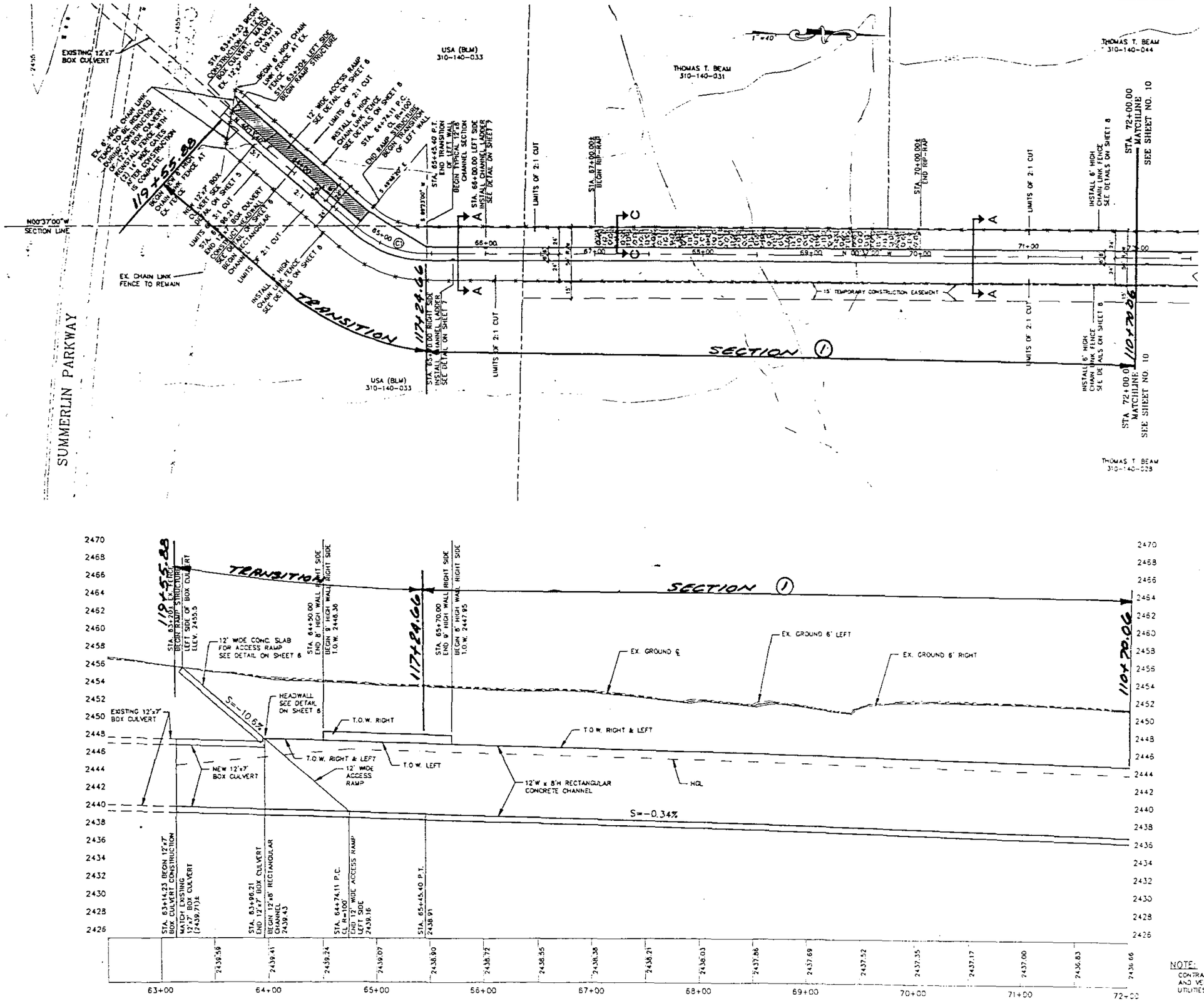
REV | DATE | BY

TITLE: TYPICAL CROSS-SECTIONS

PROJECT: BUFFALO CHANNEL
SUMMERLIN PARKWAY TO VEGAS DRIVE

SEAL: REGISTERED PROFESSIONAL ENGINEER, STATE OF NEVADA, ROGER F. SORENSON, CIVIL, No. 9686
10-13-92

WO NO	4270 BID 93.1730.03
BY	RFS/TMM
DATE	OCT. 1992
SCALE	HORIZ AS NOTED VERT AS NOTED
SHEET	4 OF 14 SHEETS
DWG.	731-56



CENTERLINE CURVE DATA

CURVE	RADIUS	LENGTH	DELTA
C1	100.00'	71.29'	40°50'40"

LEGEND

- NEW BOX CULVERT
- NEW 12' CONCRETE ACCESS RAMP
- 18" GROUTED CLASS 1 RIP-RAP
- CUT / FILL LIMITS

NOTES:

1. SEE SHEET NO. 4 FOR SECTIONS A-A & C-C.
2. SEE SHEET NO.'S 5 & 6 FOR BOX CULVERT, HEADWALL, ACCESS RAMP AND RETAINING WALL DETAIL.

NOTE:
CONTRACTOR MUST VERIFY HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES BEFORE BEGINNING CONSTRUCTION.

DEPARTMENT OF PUBLIC WORKS
CITY OF LAS VEGAS, NEVADA

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2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89102-5148 PHONE (702) 873-7550 FAX (702) 362-2597

REV | DATE | BY | REVISION

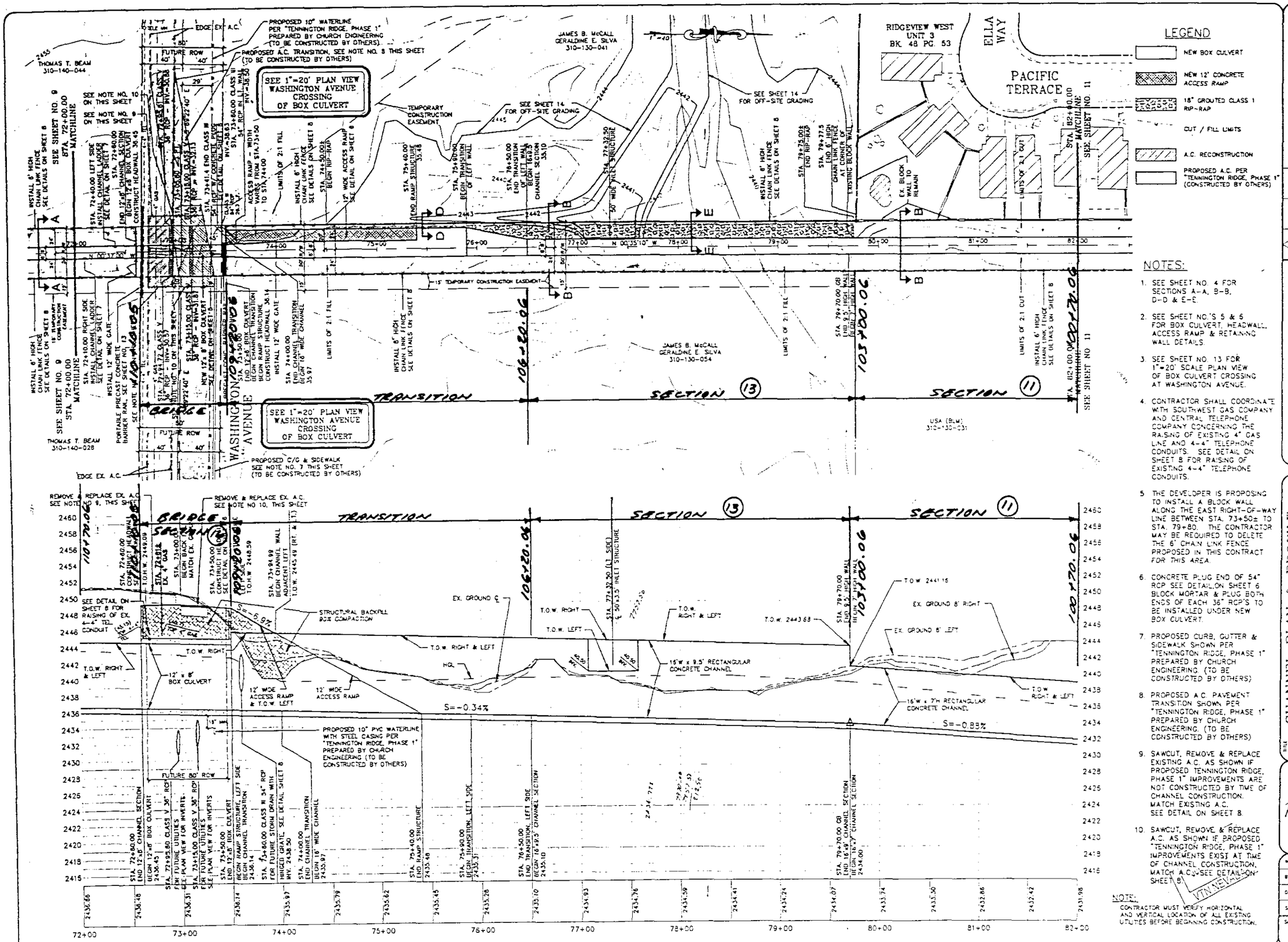
TITLE: CHANNEL PLAN & PROFILE STA. 63+14.23 TO STA. 72+00.00 \ BUFFALO CHANNEL

PROJECT: BUFFALO CHANNEL
SUMMERLIN PARKWAY TO VEGAS DRIVE

ROGER F. SORENSON No. 9696 REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA CIVIL
10-19-92

EXPIRES JUNE 30, 1993

WO NO	4270 BID# 93-1730.03
BY	RFS/TMM
DATE	OCT. 1992
SCALE	HORIZ 1"=40' VERT 1"=5'
SHEET	9 OF 14 SHEETS
DWG.	731-56



DEPARTMENT OF PUBLIC WORKS
CITY OF LAS VEGAS, NEVADA

CONSULTING ENGINEERS • PLANNERS • LAND SURVEYORS
2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89102-5148 PHONE (702) 873-7550 FAX (702) 362-2597

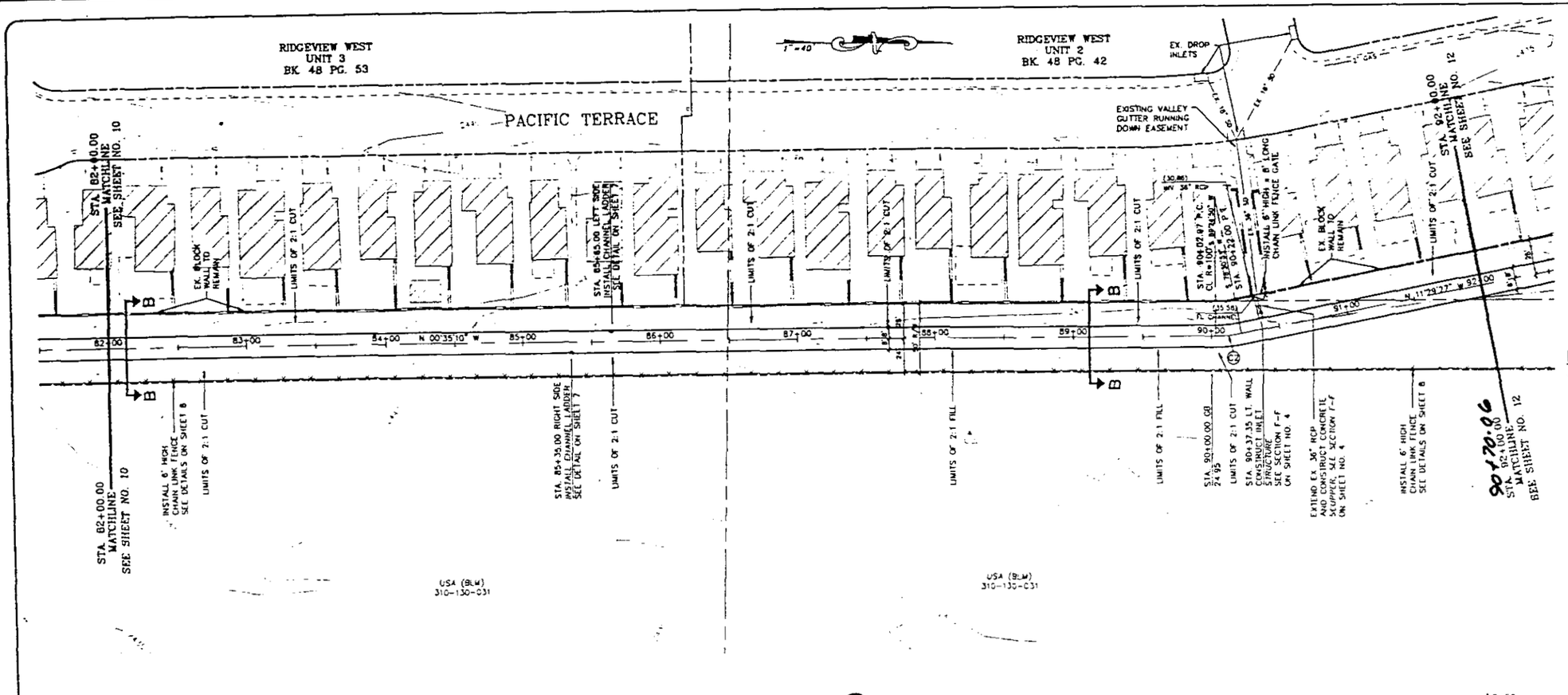
REV	DATE	BY	REVISION

TITLE: CHANNEL PLAN & PROFILE STA. 72+00.00 TO STA. 82+00.00 BUFFALO CHANNEL

PROJECT: BUFFALO CHANNEL SUMMERLIN PARKWAY TO VEGAS DRIVE

SEAL

JOB NO.	4270 BID 93 1730.03
BY	RFS/TMM
DATE	JAN. 1993
SCALE	HORIZ. 1"=40' VERT. 1"=5
SHEET	10R OF 14 SHEETS
DWG.	731-56



CENTERLINE CURVE DATA

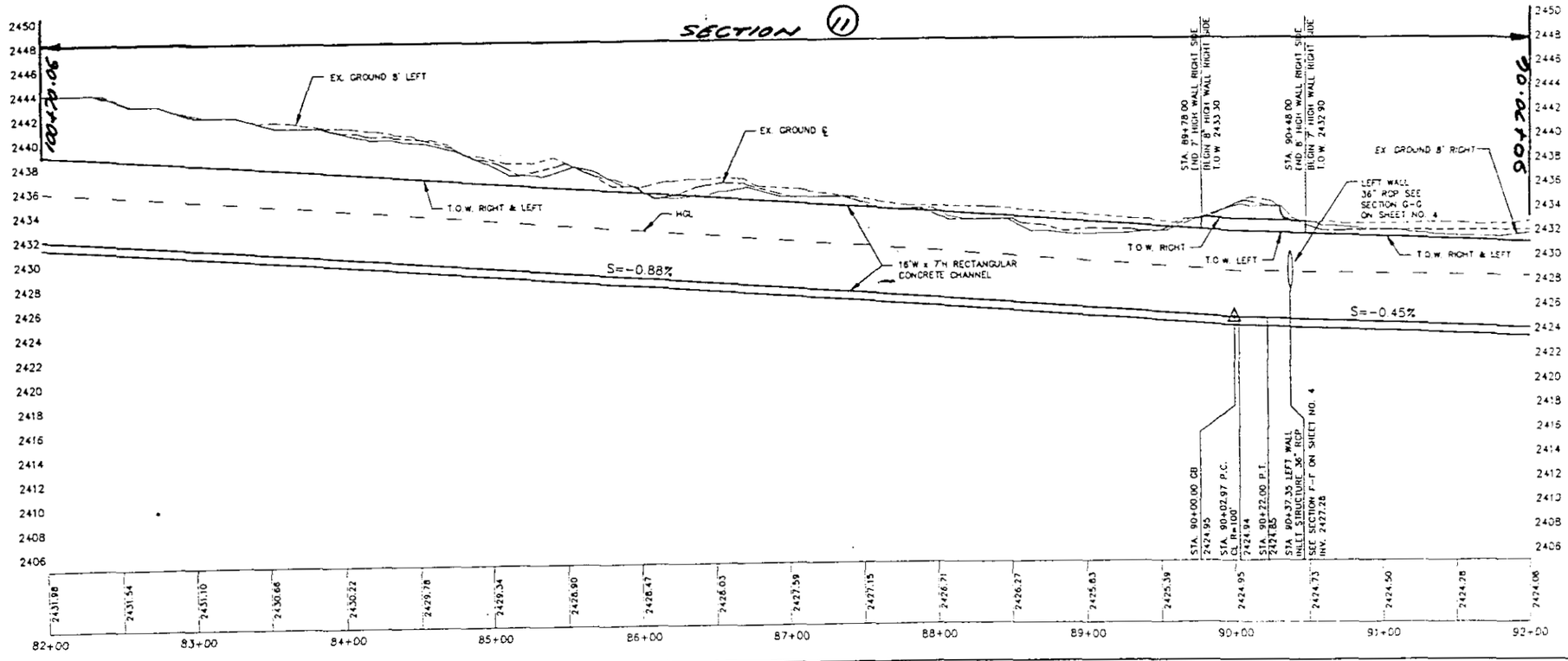
CURVE	RADIUS	LENGTH	DELTA
C2	100.00'	19.03'	10°54'17"

LEGEND

CUT / FILL LIMITS

NOTE:

1. SEE SHEET NO. 4 FOR SECTIONS B-B & F-F.



NOTE:
CONTRACTOR MUST VERIFY HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES BEFORE BEGINNING CONSTRUCTION.

PLOTTED JUN 10 1992 NEVADA

DEPARTMENT OF PUBLIC WORKS
CITY OF LAS VEGAS, NEVADA

CONSULTING ENGINEERS • PLANNERS • LAND SURVEYORS
2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA 89102-5148 PHONE (702) 873-7500 FAX (702) 362-2597

vtn nevada

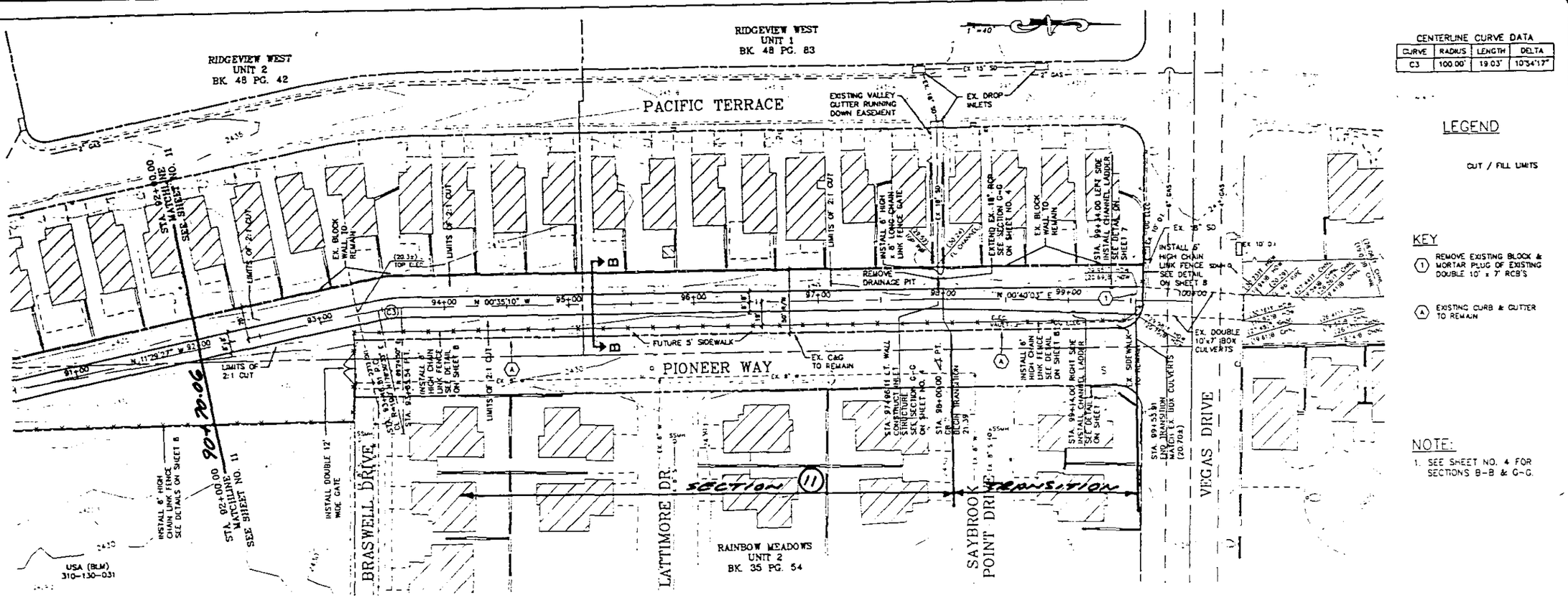
REVISION | BY | DATE | APP'D

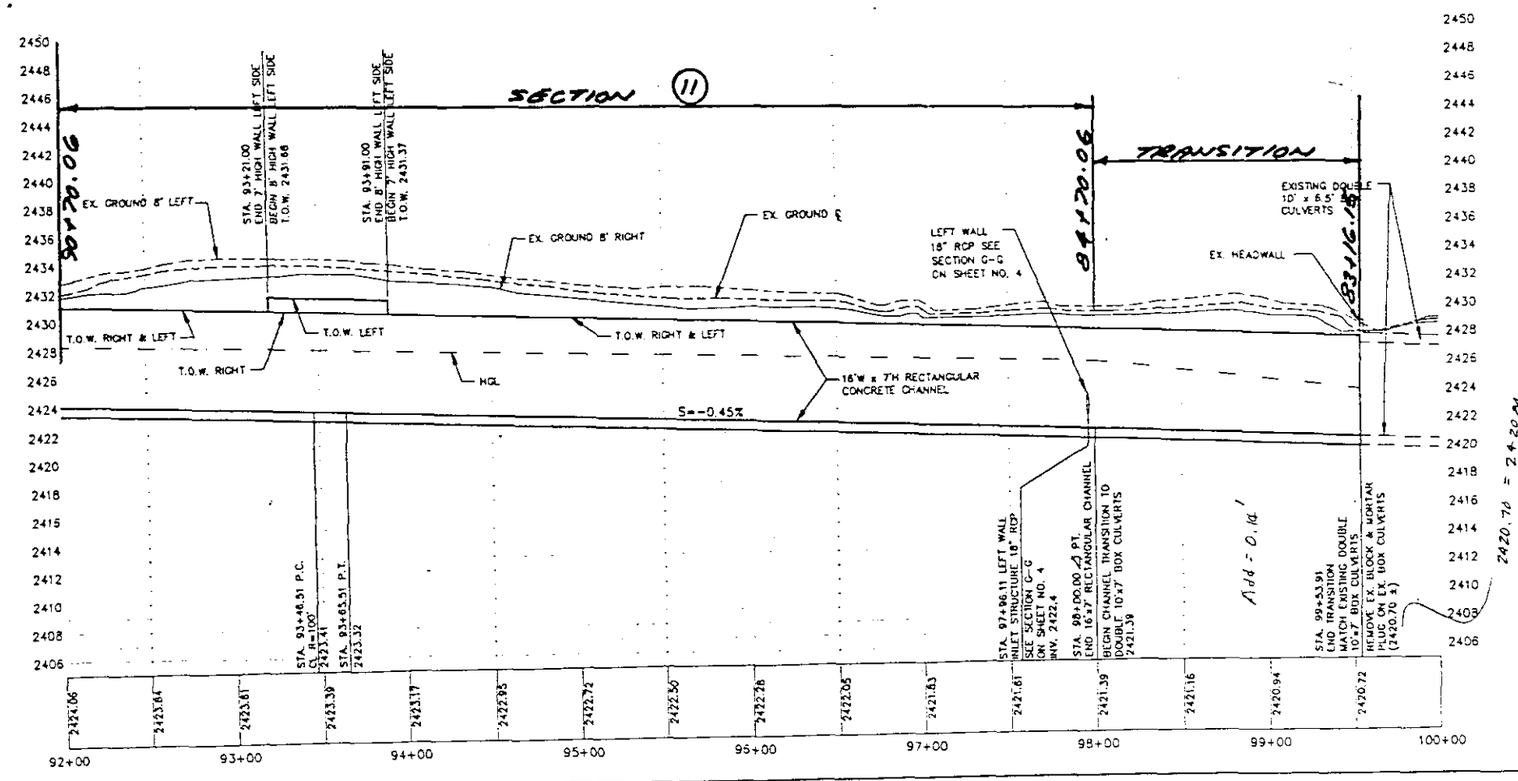
TITLE: CHANNEL PLAN & PROFILE STA. 82+00.00 TO STA. 92+00.00 BUFFALO CHANNEL

PROJECT: BUFFALO CHANNEL SUMMERLIN PARKWAY TO VEGAS DRIVE

SEAL: REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA ROGER F. SORENSON No. 9648 CIVIL
6-19-92

JOB NO. 4270 BID# 93 1730.03
BY RFS/TWM
DATE OCT. 1992
SCALE HORIZ 1"=40' VERT 1"=5'
SHEET 11 OF 14 SHEETS
DWG. 731-56





NOTE:
CONTRACTOR MUST VERIFY HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES BEFORE BEGINNING CONSTRUCTION.

PRINTED JUN 10 1993 VTN NEVADA

DEPARTMENT OF PUBLIC WORKS
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LAS VEGAS, NEVADA 89102-5148 PHONE (702) 873-7550 FAX (702) 362-2597

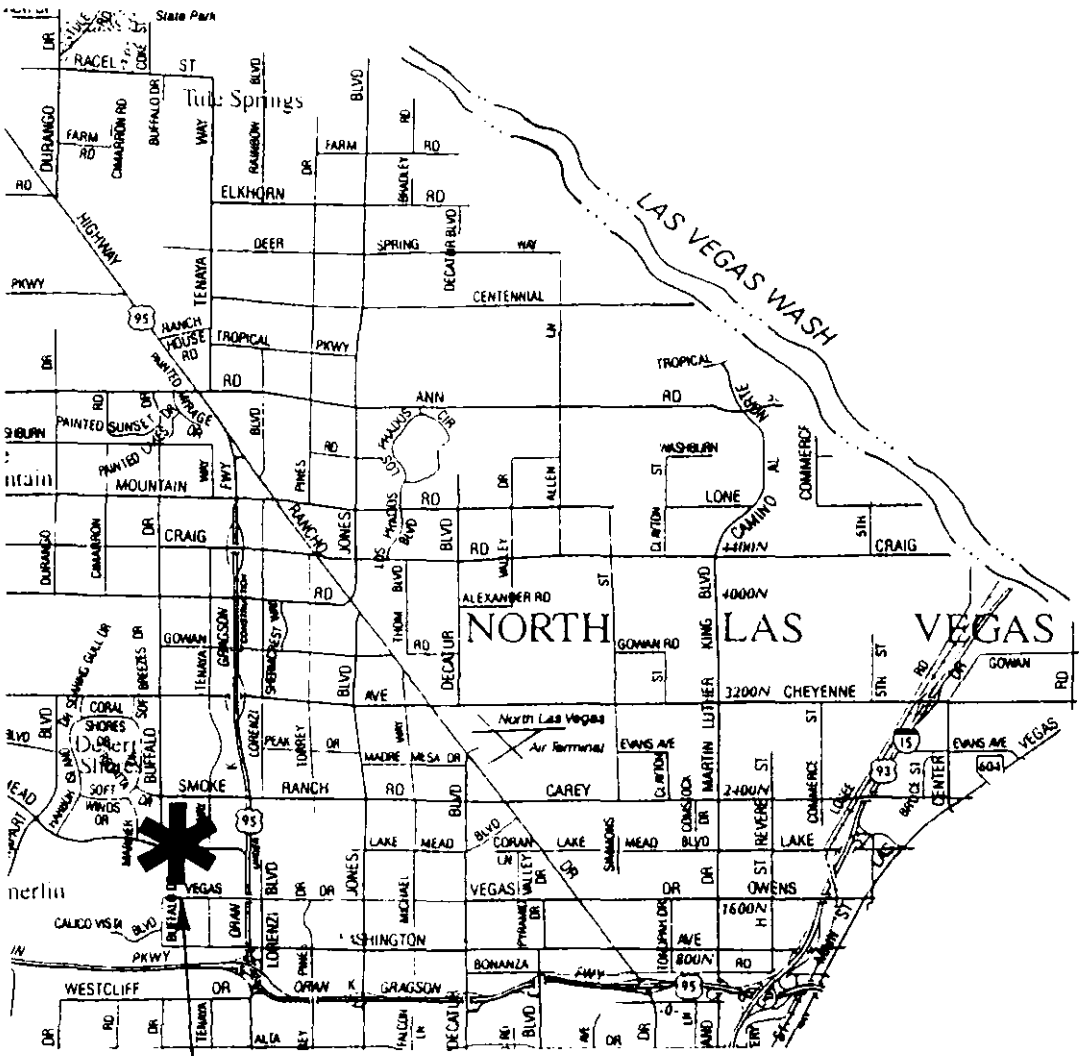
REV | DATE | BY | REVISION

TITLE: CHANNEL PLAN & PROFILE STA. 92+00.00 TO STA. 99+53.91 BUFFALO CHANNEL

PROJECT: BUFFALO CHANNEL
SUMMERLIN PARKWAY TO VEGAS DRIVE

SEAL: REGISTERED PROFESSIONAL ENGINEER ROGER F. SORENSON CIVIL 9550 STATE OF NEVADA
10-19-92

WO NO 4270 BID# 93.1730.33
BY RFS/TMM
DATE OCT. 1992
SCALE HORIZ 1"=40' VERT 1"=4'
SHEET 12 OF 14 SHEETS
DWG. 731-56



COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

LOCATION MAP

JOB # 930017 6/94

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. *Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to:* Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ■ Physical change
     - ■ Existing
     - □ *Proposed*
   - □ Improved methodology
   - □ Improved data
   - □ Floodway revision
   - □ Other _____
     Explain _____
2. Flooding Source: Natural channel upstream of North Buffalo Drive
3. Project Name/Identifier: Northwest Las Vegas Flood Insurance Study Restudy
4. FEMA zone designations affected: Zone A
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	325276	Las Vegas	Clark County	NV	32003C	2135D	9/28/89

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding	Structures	Disciplines*
■ Riverine	□ Channelization	■ Water Resources
□ Coastal	□ Levee/Floodwall	■ Hydrology
□ Alluvial Fan	□ Bridge/Culvert	■ Hydraulics
□ Shallow Flooding *(e.g. Zones AO and AH)*	□ Dam	□ Sediment Transport
□ Lakes	□ *Coastal*	□ Interior Drainage
	□ Fill	□ Structural
Affected by wind/wave action	□ Pump Station	□ Geotechnical
□ Yes	■ None	□ Land Surveying
■ No	□ Channel Relocation	□ Other *(describe)*
	□ Excavation	
□ Other *(describe)* _____	□ Other *(describe)* _____	_____

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

a. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ■ Yes □ No
b. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? ■ Yes □ No
   If yes, give reason: Elevation of existing ground above the flood plain.

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

□ Yes ■ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? □ Yes □ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? □ Yes □ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ■ Yes □ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? □ Yes ■ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read *NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72*, I believe that the proposed revision ■ is □ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ■ Yes □ No

14. Does this revision request have the endorsement of the community? ■ Yes □ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? □ Yes ■ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by _____ (entity)

_____ with a maximum interval of _____ months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by _____ (entity)

to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, □ has ■ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☐ performing ■ overseeing compliance with the maintenance and operation plans of the Northwest LV FIS Study
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

X b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

_____

_____

8. FORMS INCLUDED

17. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	■ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	■ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☐ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☐ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☐ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

9. INITIAL REVIEW FEE

18. The *minimum initial review fee for the appropriate request category* has been included. ☒ Yes ☐ No

Initial fee amount: $ _____

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ VISA ☐ MASTERCARD CARD NUMBER

Check or money order only.

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

_____
Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☐ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Douglas B. Blatchford
Signature of Revision Requestor

Douglas B. Blatchford, Senior Engineer
Printed Name and Title of Revision Requestor

Pentacore Engineering, Inc.
Company Name

August 26, 1994
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

_____
Signature of Community Official

_____
Printed Name and Title of Community Official

_____
Community Name

_____
Date

Does this request impact any other communities? ☐ Yes ☒ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in Hydrology and Hydraulics
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 8 years experience in the expertise listed above.
4. I have ■ prepared □ reviewed the attached supporting data and analyses related to my expertise.
5. I ■ have □ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   HEC-1 Hydrologic Analysis and HEC-2 Hydraulic Analysis for subject area.
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. □ Viewed all phases of actual construction.
   b. ■ Compared plans and specifications with as-built survey information.
   c. □ Examined plans and specifications and compared with completed projects.
   d. □ Other _____
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Douglas B. Blatchford
(please print or type)

Title: Senior Engineer, Pentacore Engineering, Inc.
(please print or type)

Registration No. 10783 Expiration Date: 12/31/94

State Nevada

Type of License Civil

Douglas B. Blatchford
Signature

August 26, 1994
Date

*Specify Subdiscipline

Seal
(Optional)

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE HYDRAULIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Las Vegas, Nevada

Flooding Source: Zone A, Upstream of Buffalo Channel
(One form for each flooding source)

Project Name/Identifier: NW LV FIS Restudy

1. REACH TO BE REVISED

Downstream limit: Existing Buffalo Channel

Upstream limit: North Buffalo Drive

2. EFFECTIVE FIS

- ☐ Not studied
- ☐ Studied by approximate methods
  - Downstream limit of study _____
  - Upstream limit of study _____
- ■ Studied by detailed methods
  - Downstream limit of study Existing Buffalo Channel
  - Upstream limit of study North Buffalo Drive
- ☐ Floodway delineated
  - Downstream limit of Floodway _____
  - Upstream limit of Floodway _____

3. HYDRAULIC ANALYSIS

Why is the hydraulic analysis different from that used to develop the FIRM? *(Check all that apply)*

- ☐ Not studied in FIS
- ☐ Improved hydrologic data/analysis. Explain: _____
- ■ Improved hydraulic analysis. Explain: HEC-2 cross sections were taken from 50 scale topographic with 1' contours
- ☐ Flood control structure. Explain: _____
- ☐ Other. Explain: _____

3. RIVERINE HYDRAULIC ANALYSIS FORM
Models Submitted

Full input and output listings along with files on diskette *(if available)* for each of the models listed below and summary of the source f input parameters used in the models must be provided. The summary must include a complete description of any changes made from model to model *(e.g. duplicate effective model to corrected effective model)*. Only the Duplicate Effective and the Revised or Post-Project Conditions models must be submitted. See instructions for directions on when other models may be required. Only the 100-year flood profile is required for SFHAs with a Zone A designation. For areas which do not have detailed flooding, a hydraulic model is not required; however BFE's may not be added to the revised FIRM.

☐ Duplicate Effective Model — Natural ☐ Floodway ☐

Copies of the hydraulic analysis used in the effective FIS, referred to as the effective models *(10-, 50-, 100-, and 500-year multi-profile runs and the floodway run)* must be obtained and then reproduced on the requestor's equipment to produce the duplicate effective model. This is required to assure that the effective model input data has been transferred correctly to the requestor's equipment and to assure that the revised data will be integrated into the effective data to provide a continuous FIS model upstream and downstream of the revised reach.

☐ Corrected Effective Model — Natural ☐ Floodway ☐

The corrected effective model is the model that corrects any errors that occur in the duplicate effective model, adds any additional cross sections to the duplicate effective model, or incorporates more detailed topographic information than that used in the currently effective model. The corrected effective model must not reflect any man-made physical changes since the date of the effective model. An error could be a technical error in the modeling procedures, or any construction in the floodplain that occurred prior to the date of the effective model but was not incorporated into the effective model.

☐ *Existing* or Pre-Project *Conditions* Model — Natural ☐ Floodway ☐

The duplicate effective or corrected model is modified to produce the existing or pre-project conditions model to reflect any modifications that have occurred within the floodplain since the date of the effective model but prior to the construction of the project for which the revision is being requested. If no modification has occurred since the date of the effective model, then this model would be identical to the corrected effective or duplicate effective model.

■ Revised or Post-Project Conditions Model — Natural ☐ Floodway ■

The existing or pre-project conditions model *(or duplicate effective or corrected effective model, as appropriate)* is revised to reflect revised or post-project conditions. This model must incorporate any physical changes to the floodplain since the effective model was produced as well as the effects of the project. When the request is for proposed project this model should reflect proposed conditions.

☐ Other: Please attach a sheet describing all other models or calculations submitted. — Natural ☐ Floodway ☐

4. MODEL PARAMETERS (from model used to revise 100-year water surface elevation)

1. Discharges:

	Upstream Limit	Downstream Limit
10-year		
50-year		
100-year	664 cfs	664 cfs
500-year		

Attach diagram showing changes in 100-year discharge

2. Explain how the starting water surface elevations were determined _____

3. Give range of friction loss coefficients *(Manning's "N")* Channel 0.028

Overbanks 0.033

If friction loss coefficients are different anywhere along the revised reach from those used to develop the FIRM, give location, value used in the effective FIS, and revised values and an explanation as to how the revised values were determined.

Location	FIS	Revised

Explain: _____

4. Describe how the cross section geometry data were determined *(e.g., field survey, topographic map, taken from previous study)* and list cross sections that were added.

Cross section data were determined by topographic maps.

5. Explain how reach lengths for channel and overbanks were determined:

Reach lengths were determined where changes in channel cross sections occurred. This was done to model uniform cross sections for the entire reach.

5. RESULTS (from model used to revise 100-year water surface elevations)

1. Do the results indicate:

a. Water surface elevations higher than end points of cross sections? . . . . . ☐ Yes ■ No

b. Supercritical depth? . . . . . ■ Yes ☐ No

c. Critical depth? . . . . . ■ Yes ☐ No

d. Other unique situations? . . . . . ☐ Yes ■ No

If yes to any of the above, attach an explanation that discusses the situation and how it is presented on the profiles, tables, and maps. See attached explanation.

2. What is the maximum change in energy gradient between cross-sections? . . . . . 2.76 Ft.

Specify location . . . . . Sta. 14+02 Sta. 10+52

3. What is the distance between the cross-sections in 2 above? . . . . . 350 ft.

Specify location . . . . . Sta. 14+02 Sta. 10+52

4. What is the maximum distance between cross-sections? . . . . . 462'

Specify location . . . . . Sta. 7+12 Sta. 2+50

5. Floodway determination This analysis does not apply to floodway determination

a. What is the maximum surcharge allowed by the community or State? . . . . . _____ foot

b. What is the maximum surcharge for the revised conditions? . . . . . _____ foot

Specify location . . . . . _____

c. What is the maximum velocity? . . . . . _____ fps

Specify location . . . . . _____

Explain: _____

d. Are there any negative surcharge values at any cross-section? ☐ Yes ☐ No

If yes, the floodway may need to widen. If it is not widened, please explain and indicate the maximum negative surcharge.

6. Is the discharge value used to determine the floodway anywhere different from that used to determine the natural 100-year flood elevations? . . . . . ☐ Yes ■ No

If yes, explain:

_____

_____

_____

7. Do 100-year water surface elevations increase at any location? . . . . . ☐ Yes ■ No

If yes, please attach a list of the locations where the increases occur, state whether or not the increases are located on the requestor's property, and provide an explanation of the reason for the increases.

_____

_____

_____

Please attach a completed comparison table entitled: Water Surface Elevation Check (See page 6)

6. REVISED FIRM/FBFM AND FLOOD PROFILES

Revisions are being made on Zone "A". Floodway elevations and water surface elevations do not apply.

A. The revised water surface elevations tie into those computed by the effective FIS Model *(10-, 50-, 100-, and 500-year)*, downstream of the project at cross-section 0+00 within 100 feet and upstream of the project at cross section 14+02 within 100 feet.

B. The revised floodway elevations tie into those computed by the effective FIS model, downstream of the project at cross section 0+00 within 100 feet and upstream of the project at cross section 14+02 within 100 feet.

C. Attach profiles, at the same vertical and horizontal scale as the profiles in the effective FIS report, showing stream bed and profiles of all floods studied (without encroachment). Also, label all cross sections, road crossings (including low chord and top-of-road data), culverts, tributaries, corporate limits, and study limits. If channel distance has changed, the stationing should be revised for all profile sheets. (See attached HEC-2 analysis and plotted WSE's)

D. Attach a Floodway Data Table showing data for each cross section listed in the published Floodway Data Table in the FIS report. (See attached HEC-2 analysis and plotted WSE's)

Proceed to Riverine/Coastal Mapping Form.

FEDERAL EMERGENCY MANAGEMENT AGENCY

WATER SURFACE ELEVATION CHECK

COMMUNITY NAME	FLOODING SOURCE	PROJECT NAME/IDENTIFIER

	EFFECTIVE			DUPLICATE EFFECTIVE			CORRECTED EFFECTIVE			EXISTING/PRE-PROJECT			REVISED/PROJECT		
SECNO	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]

COMMENTS: See attached HEC-2 analysis for the revised Zone "A" determination.

1 - 100-year (natural) Water Surface Elevation 2 - Encroachment (floodway) Water Surface Elevation 3 - Surcharge Value

Include all cross sections in the models between tie-in points. Any interpolated values should be indicated in parentheses.

Sheet ___ of ___

The US Army Corp of Engineer's HEC-2 Water Surface Profile program was used to calculate the 100-year discharge. Cross sections are plotted on a topographic map at 50 scale with 1' contours. The station and water surface elevation for the 100-year discharge is plotted delineating the extent of the floodplain. Critical depth is calculated at Sta. 1+25 and 10+52. Supercritical flows occur at Sta. 2+50, Sta. 7+12, and Sta. 14+02 as indicated on the attached HEC-2 model.

THIS RUN EXECUTED 06/01/94 08:13:57

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  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01.02.03.04.05.06
  MODIFICATION -  50.51.52.53.54.55.56
  IBM-PC-XT VERSION APRIL 1985
**************************************************

T1      FIS-5
T2      MARCH 1994      SUPERCRITICAL RUN
T3      100 YEAR FLOW BETWEEN BUFFALO DRIVE AND PIONEER CHANNEL   FIS.H2

J1  ICHECK    INO       NINV      IDIR      STRT      METRIC    NVINS     O         WSEL      FO

       0.        2.        0.        1.   .064000       .00        .0        0.      .000      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

     -1.000      .000    -1.000      .000      .000      .000      .000      .000      .000      .000

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     38.000    43.000     8.000    42.000     1.000    53.000    54.000    26.000    55.000    56.000


OT      1.000   664.000      .000      .000      .000      .000      .000      .000      .000      .000
NC       .033      .033      .028      .100      .300      .000      .000      .000      .000      .000
X1   1402.000    30.000   660.000   830.000   350.000   350.000   350.000      .000      .000      .000
GR   2425.000   602.000  2424.000   614.000  2423.000   633.000  2422.000   644.000  2421.000   652.000
GR   2420.000   657.000  2419.000   660.000  2418.000   663.000  2417.000   664.000  2416.000   665.000
GR   2415.000   671.000  2415.000   700.000  2416.000   706.000  2416.000   711.000  2416.000   722.000
GR   2416.000   727.000  2417.000   789.000  2418.000   819.000  2419.000   821.000  2420.000   823.000
GR   2421.000   826.000  2421.000   828.000  2421.000   830.000  2420.000   835.000  2419.000   852.000
GR   2419.000   874.000  2420.000   882.000  2421.000   886.000  2422.000   890.000  2423.000   922.000

X1   1052.000    33.000   658.000   767.000   320.000   350.000   355.000      .000      .000      .000
GR   2420.000   500.000  2420.000   510.000  2419.000   512.000  2418.000   520.000  2417.000   530.000
GR   2416.000   600.000  2415.000   620.000  2414.000   635.000  2413.000   647.000  2412.000   652.000
GR   2411.000   655.000  2410.000   658.000  2409.000   682.000  2408.000   690.000  2407.000   700.000
GR   2408.000   710.000  2409.000   720.000  2409.000   725.000  2409.000   750.000  2410.000   765.000
GR   2411.000   767.000  2412.000   779.000  2413.000   782.000  2414.000   785.000  2415.000   789.000
GR   2416.000   790.000  2417.000   792.000  2418.000   794.000  2419.000   796.000  2420.000   799.000
GR   2421.000   819.000  2422.000   890.000  2423.000   900.000      .000      .000      .000      .000

X1    712.000    19.000   670.000   730.000   375.000   325.000   350.000      .000      .000      .000
GR   2416.000   500.000  2416.000   508.000  2415.000   510.000  2410.000   568.000  2409.000   580.000
GR   2408.000   597.000  2407.000   618.000  2406.000   650.000  2405.000   670.000  2404.000   692.000
     2403.000   706.000  2402.000   720.000  2402.000   725.000  2405.000   730.000  2410.000   740.000
GR   2411.000   758.000  2412.000   889.000  2413.000   890.000  2413.000   900.000      .000      .000
```

XI	250.000	18.000	683.000	725.000	225.000	250.000	237.000	.000	.000	.000
GR	2405.000	673.000	2404.000	679.000	2403.000	683.000	2402.000	687.000	2401.000	691.000
GR	2400.000	692.000	2399.000	693.000	2398.000	694.000	2397.500	700.000	2398.000	705.000
GR	2399.000	710.000	2400.000	725.000	2402.000	770.000	2402.000	795.000	2403.000	845.000
GR	2404.000	850.000	2405.000	855.000	2406.000	865.000	.000	.000	.000	.000
XI	125.000	12.000	680.000	712.000	.000	.000	.000	.000	.000	.000
GR	2402.000	580.000	2401.000	675.000	2400.000	680.000	2399.000	682.000	2398.000	685.000
GR	2397.000	690.000	2396.500	700.000	2397.000	708.000	2398.000	710.000	2399.000	712.000
GR	2400.000	715.000	2400.000	730.000	.000	.000	.000	.000	.000	.000
EJ	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

SECNO	DEPTH	CWSEL	CRIWS	WSELR	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 1402.000
2096 WSEL NOT GIVEN,AVG OF MAX,MIN USED

1402.00	1.36	2416.36	2416.91	.00	2418.17	1.81	.00	.00	2419.00
664.	0.	664.	0.	0.	62.	0.	0.	0.	2421.00
.00	.00	10.79	.00	.033	.028	.033	.000	2415.00	664.64
.063692	0.	0.	0.	0	17	6	.00	84.78	749.42

*SECNO 1052.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

1052.00	2.84	2409.84	2409.84	.00	2410.41	.57	7.98	8.72	2410.00
664.	0.	664.	0.	0.	110.	0.	1.	1.	2411.00
.02	.00	6.05	.00	.033	.028	.033	.000	2407.00	661.86
.011609	350.	350.	350.	20	20	0	.00	100.73	762.59

*SECNO 712.000

712.00	2.90	2404.90	2405.05	.00	2405.88	.97	4.49	.04	2405.00
664.	0.	664.	0.	0.	84.	0.	1.	1.	2405.00
.03	.00	7.92	.00	.033	.028	.033	.000	2402.00	672.13
.013832	320.	355.	350.	3	8	0	.00	57.71	729.84

*SECNO 250.000

250.00	3.53	2401.03	2401.15	.00	2402.05	1.02	3.82	.00	2403.00
664.	0.	632.	32.	0.	76.	12.	2.	2.	2400.00
.04	.00	8.30	2.71	.033	.028	.033	.000	2397.50	690.90
.008859	375.	350.	325.	3	11	0	.00	57.17	748.07

*SECNO 125.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

125.00	3.20	2399.70	2399.70	.00	2400.91	1.20	2.12	1.23	2400.00
664.	0.	662.	2.	0.	75.	1.	3.	2.	2399.00
.05	.00	8.82	2.05	.033	.028	.033	.000	2396.50	680.59
.008972	225.	237.	250.	20	11	0	.00	33.52	714.11

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  ERROR CODE -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION APRIL 1985
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

100 YEAR FLOW BETWEEN BO

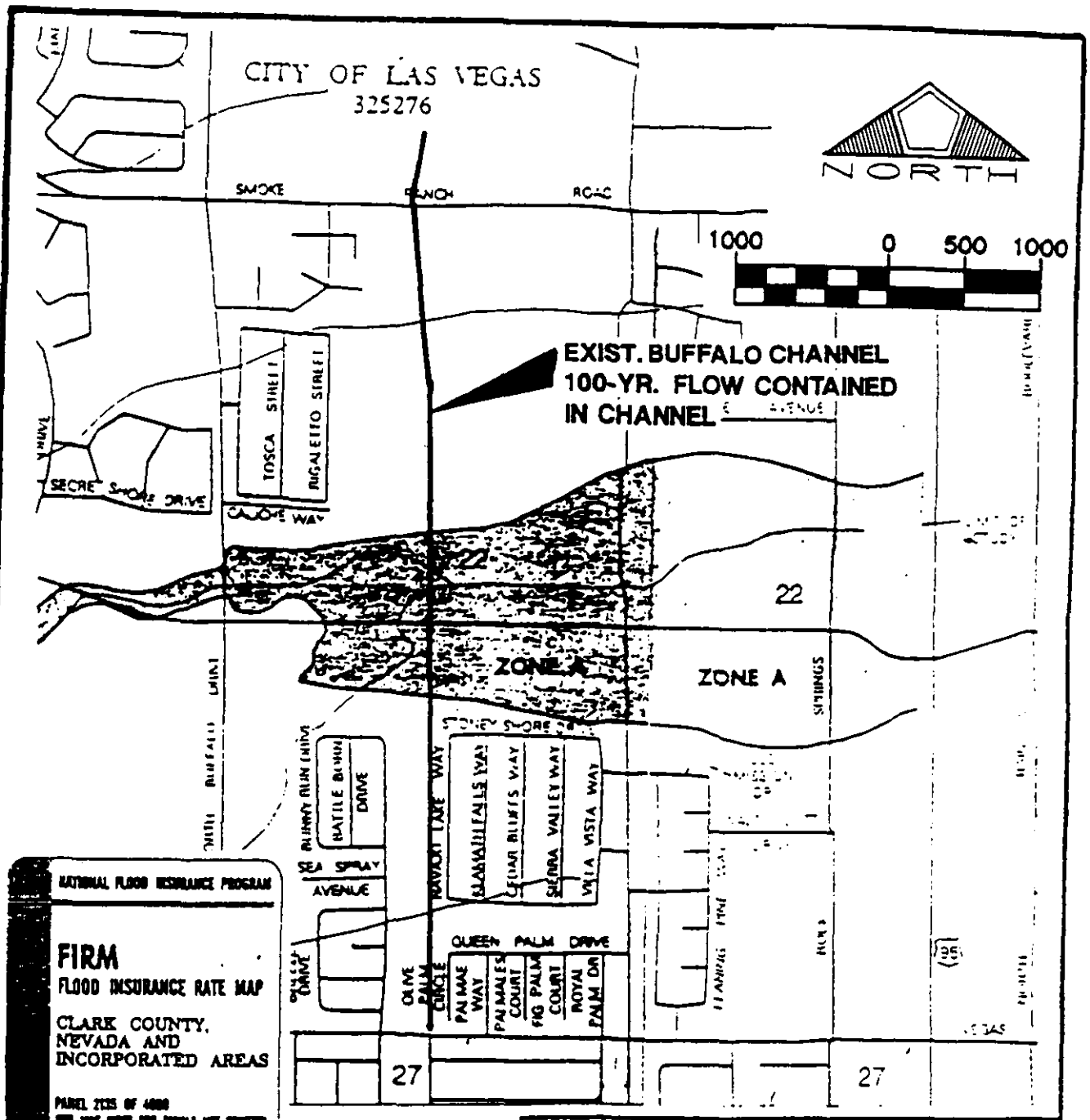
SUMMARY PRINTOUT

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VCH	VLOB	VROB
	1402.000	664.00	1.36	2415.00	2416.36	664.64	749.42	10.79	.00	.00
*	1052.000	664.00	2.84	2407.00	2409.84	661.86	762.59	6.05	.00	.00
	712.000	664.00	2.90	2402.00	2404.90	672.13	729.84	7.92	.00	.00
	250.000	664.00	3.53	2397.50	2401.03	690.90	748.07	8.30	.00	2.71
*	125.000	664.00	3.20	2396.50	2399.70	680.59	714.11	8.82	.00	2.05

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 1052.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1052.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 1052.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

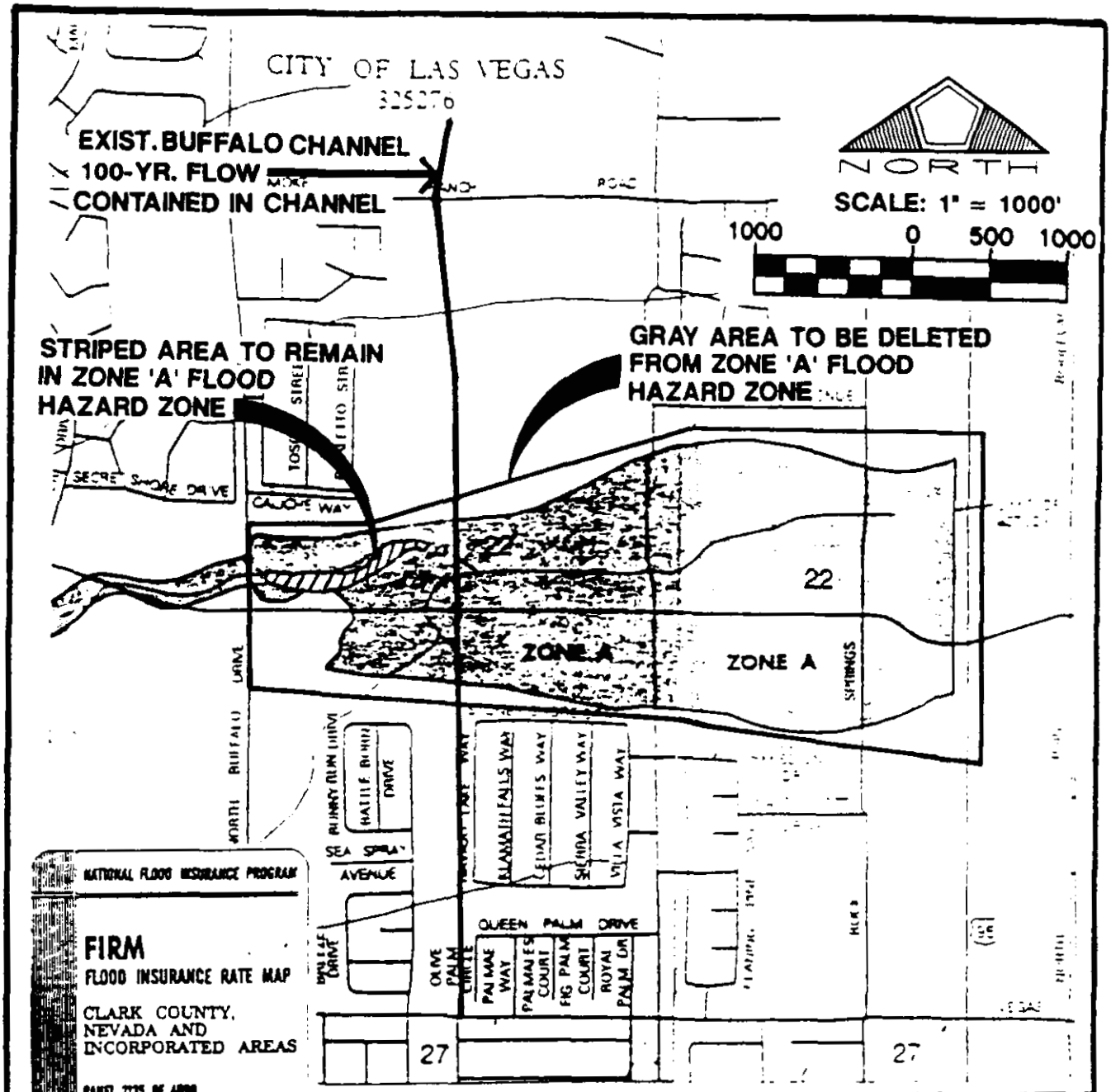
CAUTION SECNO= 125.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 125.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 125.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL



NORTHWEST LAS VEGAS FIS STUDY

D-FIRM

PENTACORE
Engineering, Inc.
6763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 256-7113



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2135 OF 4000

MAP NUMBER
32003C2135 B

EFFECTIVE DATE:
PRELIMINARY
MICHAEL BAKER, JR.

JUN 2 9 2001

NORTHWEST LAS VEGAS FIS STUDY

ANNOTATED D-FIRM

PENTACORE
Engineering, Inc.

6781 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 256-

LEGEND

WSE — WATER SURFACE ELEVATION

125 — STATION OF CROSS SECTION

LIMITS OF 100-YEAR DISCHARGE

NORTH

SCALE: 1" = 50'

50 0 25 50 100

EX. PACIFIC HARBORS

N89°30'31"W 1335.49'

BUFFALO DRIVE

671.91'

N02°00'58"W

WSE 2416.36

WSE 2409.84

WSE 2404.90

WSE 2401.03

WSE 2416.36

Q = 664 cfs

FUTURE R/W LINE

EX. SEWER STUB

EX. WATER STUB

10" SEWER

21" SEWER

12" WATER

N89°34'43"W 1329.97'

N89°34'43"W 10.00'

N01°33'02"W 333.27'

N01°33'02"W 124.11'

N28°42'56"E 88.72'

N61°17'04"W 57.76'

N07°57'35"E 66.49'

N01°33'02"W 50.03'

BUFFALO CHANNEL

LAKE MEAD BLVD.

1402 1403 1404 1405 1406 1407 1408 1409 1410 1411 1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423 1424 1425 1426 1427 1428 1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441

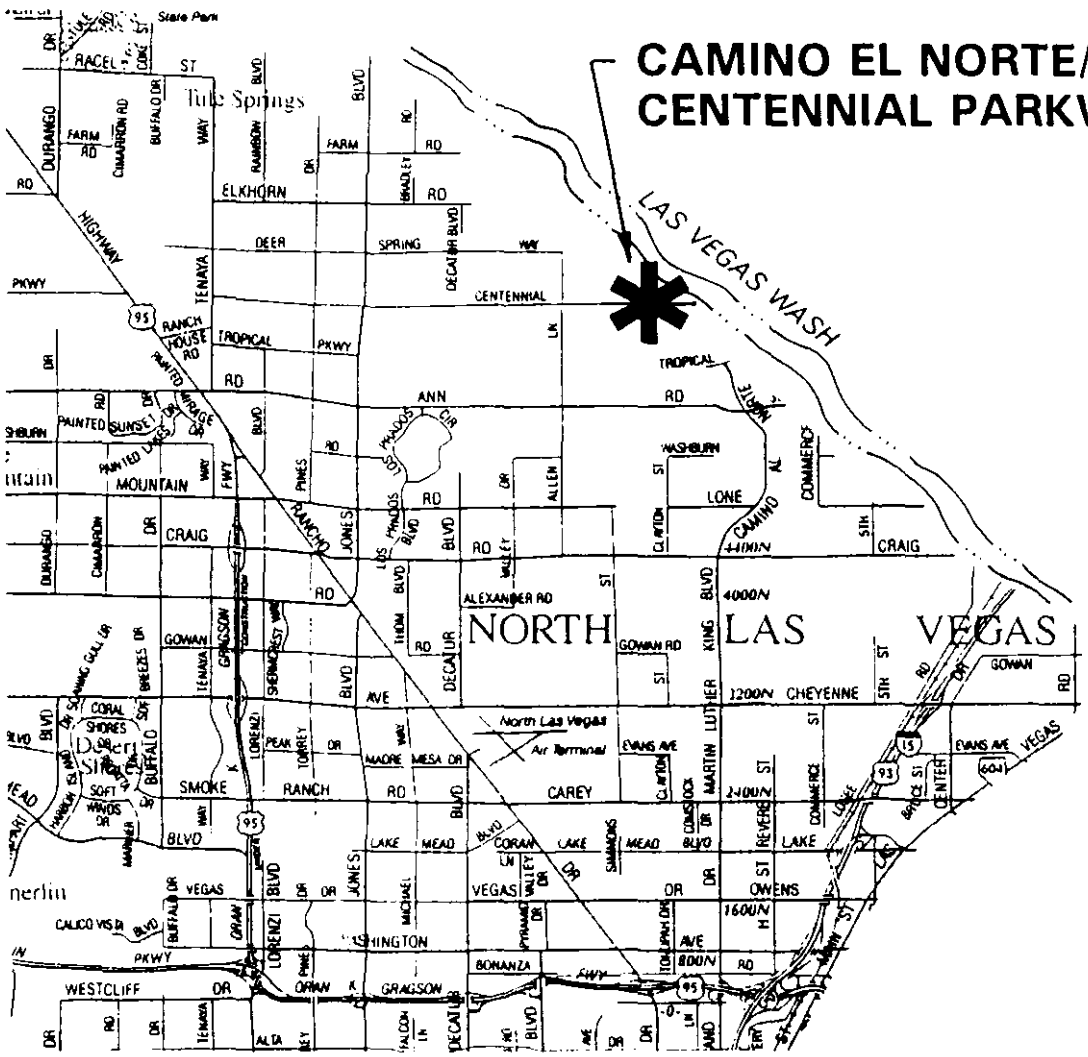
Section 6
Camino El Norte/Centennial Parkway

REQUEST FOR LOMR
Camino El Norte/Centennial Parkway

The effective FIRM and preliminary D-FIRM both show a large approximate Zone "A" located north of Centennial Parkway near Clayton Road. This flood zone lies within the City of North Las Vegas, in portions of Section 21, 28, and 33, Township 19S, Range 61E, M.D.M., Clark County, Nevada. This area is located downstream of the Upper Las Vegas Wash Detention Basin and Diversion Dike. The diversion structures were designed by Black and Veatch, and funded by the Clark County Regional Flood Control District. The City Council of North Las Vegas accepted the Notice of Completion on January 19, 1994.

The purpose of the Diversion Dike is to route flows from the Upper Las Vegas Wash to the Upper Las Vegas Wash Detention Basin. As a result, the contributing drainage area to the currently designated Zone "A" has been reduced. This restudy reviews the hydrology and hydraulics of the upstream drainage with the diversion dike in place. It concludes that much of the Zone "A" delineated on the preliminary D-FIRM can be reduced as a result of the new upstream Diversion Dike and Upper Las Vegas Wash Detention Basin.

A HEC-1 hydrologic model was prepared by G.C. Wallace for a land development referred to as the Eldorado site. Two drainage areas, denoted as ENI and EWI, were evaluated and are illustrated on the attached drainage area exhibit. Recent aerial topography was used to develop cross-sections A1 through A5, B1 through B3 and C1 through C3 as shown on the attached exhibit. A hydraulic analysis was then performed, assuming uniform depth, using the peak discharges from the HEC-1 model. Revised floodplain limited were then delineated. The revised floodplain has been delineated on an Annotated D-FIRM. A request is therefore made to reduce the Zone "A" flood limits to those shown on the Annotated D-FIRM on the basis of improved hydrology and topographic mapping.



COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

LOCATION MAP

JOB # 930017 6/94

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ■ Physical change
     - ■ Existing
     - □ Proposed
   - □ Improved methodology
   - □ Improved data
   - □ Floodway revision
   - □ Other _____
     Explain _____
2. Flooding Source: Zone A at Eldorado Project Site
3. Project Name/Identifier: NW LV FIS Restudy
4. FEMA zone designations affected: Zone A, Sec. 20 & 21, T19S, R61E MDM
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	320007	North Las Vegas	Clark County	NV		0003C	12/15/83

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding	Structures	Disciplines*
■ Riverine	□ Channelization	● Water Resources
□ Coastal	□ Levee/Floodwall	■ Hydrology
■ Alluvial Fan	□ Bridge/Culvert	□ Hydraulics
□ Shallow Flooding *(e.g. Zones AO and AH)*	□ Dam	□ Sediment Transport
□ Lakes	□ Coastal	□ Interior Drainage
	□ Fill	□ Structural
Affected by wind/wave action	□ Pump Station	□ Geotechnical
□ Yes	□ None	□ Land Surveying
□ No	□ Channel Relocation	□ Other *(describe)*
	□ Excavation	
	■ Other *(describe)*	
□ Other *(describe)* _____	Upstream Berm	_____

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

a. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ■ Yes □ No
b. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? ■ Yes □ No
If yes, give reason: Construction of upstream berm has reduced flood hazard significantly.

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

□ Yes ■ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? □ Yes ■ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? □ Yes ■ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? □ Yes ■ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? □ Yes ■ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ■ is □ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ■ Yes □ No

14. Does this revision request have the endorsement of the community? ■ Yes □ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? ■ Yes □ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by Clark County Regional Flood Control District (entity) _____ with a maximum interval of 6 months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by Clark County Regional Flood Control District (entity) to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ■ has □ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ■ performing □ overseeing compliance with the maintenance and operation plans of the upstream berm
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

X b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

7. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	■ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	□ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	□ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	□ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	□ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	□ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	□ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	□ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	□ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	□ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☒ Yes ☐ No

Initial fee amount: $ _____

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ *VISA* ☐ *MASTERCARD* *CARD NUMBER*

Check or money order only.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

_____
Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☐ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Douglas B. Blatchford
Signature of Revision Requestor

Douglas B. Blatchford, Senior Engineer
Printed Name and Title of Revision Requestor

Pentacore Engineering, Inc.
Company Name

August 26, 1994
Date

Note: Signature indicates that the community understands, *from the revision requestor*, the impacts of the revision on flooding conditions in the community.

_____
Signature of Community Official

_____
Printed Name and Title of Community Official

_____
Community Name

_____
Date

Does this request impact any other communities? ☐ Yes ☒ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY
CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148 Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in Water Resources (hydrology and hydraulics)
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 8 years experience in the expertise listed above.
4. I have ☐ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Revision of Zone A based on construction of upstream berm
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☒ Examined plans and specifications and compared with completed projects.
   d. ☐ Other _____
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Douglas B. Blatchford
(please print or type)

Title: Senior Engineer
(please print or type)

Registration No. 10783 Expiration Date: 12/31/94

State Nevada

Type of License Civil Engineer

Douglas B. Blatchford
Signature

August 26, 1994
Date

Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY RIVERINE/COASTAL MAPPING FORM	O.M.B. Burden No. 3067-0148 Expires July 31, 1994	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: North Las Vegas, Nevada

Flooding Source: Zone "A" at Eldorado Project Site

Project Name/Identifier: Northwest Las Vegas FIS Restudy

1. MAPPING CHANGES

1. A topographic work map of suitable scale, contour interval, and planimetric definition must be submitted showing *(indicate N/A when not applicable)*:

		Included
A.	Revised *approximate 100-year floodplain* boundaries (Zone A)	■ Yes □ No □ N/A
B.	Revised detailed 100- and 500-year floodplain boundaries	■ Yes □ No □ N/A
C.	Revised 100-year floodway boundaries	□ Yes □ No ■ N/A
D.	Location and alignment of all cross sections used in the revised *hydraulic model with stationing* control indicated	■ Yes □ No □ N/A
E.	Stream alignments, road and dam alignments	■ Yes □ No □ N/A
F.	Current community boundaries	■ Yes □ No □ N/A
G.	Effective 100- and 500-year floodplain and 100-year floodway boundaries from the FIRM/FBFM reduced or enlarged to the scale of the topographic work map	■ Yes □ No □ N/A
H.	Tie-ins between the effective and revised 100- and 500-year floodplains and 100-year floodway boundaries	■ Yes □ No □ N/A
I.	The requestor's property boundaries and community easements	■ Yes □ No □ N/A
J.	The signed certification of a registered professional engineer	■ Yes □ No □ N/A
K.	Location and description of reference marks	■ Yes □ No □ N/A
L.	Vertical datum (example: NGVD, NAVD, etc.)	■ Yes □ No □ N/A
M.	Coastal zone designations tie into adjacent areas not being revised	□ Yes □ No ■ N/A
N.	Location and alignment of all coastal transects used to revise the coastal analyses	□ Yes □ No ■ N/A

If any of the items above are marked no or N/A, please explain: Items M & N - not located at the coast

2. What is the source and date of the updated topographic information *(example: orthophoto maps, July 1985; field survey, May 1979, beach profiles, June 1987, etc.)*? Aero - Graphics, Inc. Salt Lake City

3. What is the scale and contour interval of the following workmaps?

a. Effective FIS 1" = 2000' scale _____ Contour interval

b. Revision Request 1" = 600' scale 4' Contour interval

NOTE: Revised topographic information must be of equal or greater detail.

4. Attach an annotated FIRM and FBFM at the scale of the effective FIRM and FBFM showing the revised 100-year and 500-year floodplains and the 100-year floodway boundaries and how they tie into those shown on the effective FIRM and FBFM downstream and upstream of the revision or adjacent to the area of revision for coastal studies.

Attach additional pages if needed.

IRREGULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

ELDORADO PROJECT SITE
SECTION B-B

PROGRAM DATA:

FLOW RATE (cfs)	371.0
CHANNEL BOTTOM SLOPE (ft/ft)	0.0200
MANNINGS ROUGHNESS COEFFICIENT (n-value)	0.0323
NORMAL DEPTH (ft)	2.91
FLOW VELOCITY (fps)	7.12
VELOCITY HEAD (ft)	0.79
ENERGY HEAD (ft)	3.70
AREA OF FLOW (sq ft)	52.12
WETTED PERIMETER (ft)	45.54
CRITICAL DEPTH (ft)	1.75
FROUDE NUMBER	0.94

IRREGULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

ELDORADO PROJECT SITE
SECTION A-A

PROGRAM DATA:

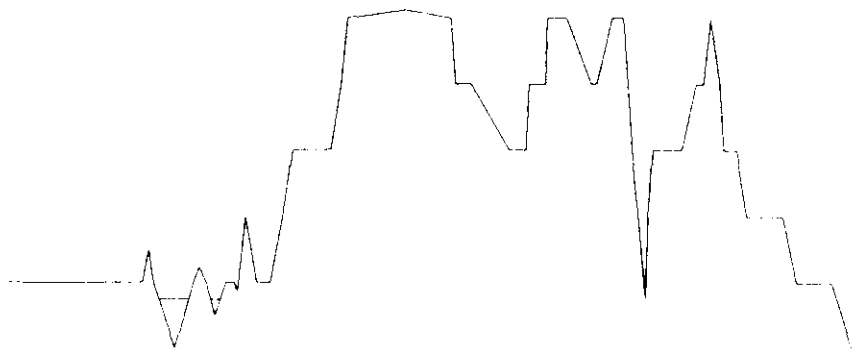
FLOW RATE (cfs)	671.0
CHANNEL BOTTOM SLOPE (ft/ft)	0.0200
MANNINGS ROUGHNESS COEFFICIENT (n-value)	0.0280
NORMAL DEPTH (ft)	4.48
FLOW VELOCITY (fps)	10.74
VELOCITY HEAD (ft)	1.79
ENERGY HEAD (ft)	6.27
AREA OF FLOW (sq ft)	62.84
WETTED PERIMETER (ft)	36.69
CRITICAL DEPTH (ft)	2.18
FROUDE NUMBER	1.37

IRREGULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

ELDORADO PROJECT SITE
SECTION B-B

PROGRAM DATA

FLOW RATE (cfs)	371.0
CHANNEL BOTTOM SLOPE (ft/ft)	0.0200
MANNINGS ROUGHNESS (n- value)	0.0350
NORMAL DEPTH (ft)	2.96
FLOW VELOCITY (fps)	7.42
VELOCITY HEAD (ft)	0.85
ENERGY HEAD (ft)	3.81
AREA OF FLOW (ft)	50.32
WETTED PERIMETER (ft)	40.03
CRITICAL DEPTH (ft)	1.82
FROUDE NUMBER	0.97

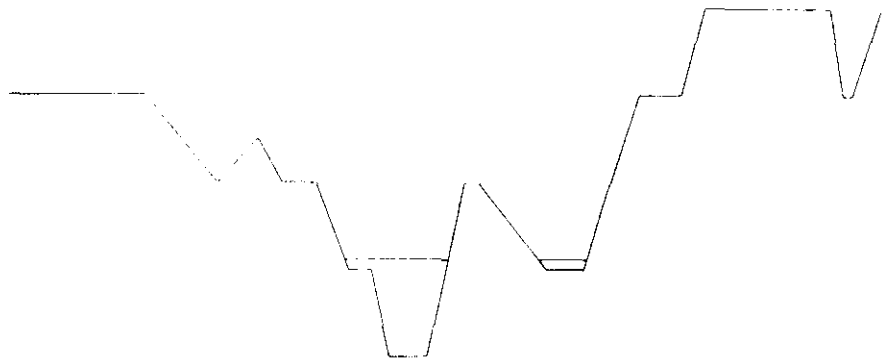


IRREGULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

ELDORADO PROJECT SITE
SECTION A-A

PROGRAM DATA

FLOW RATE (cfs)	671.0
CHANNEL BOTTOM SLOPE (ft/ft)	0.0200
MANNINGS ROUGHNESS (n value)	0.0280
NORMAL DEPTH (ft)	4.48
FLOW VELOCITY (fps)	10.74
VELOCITY HEAD (ft)	1.79
ENERGY HEAD (ft)	6.27
AREA OF FLOW (ft)	62.84
WETTED PERIMETER (ft)	36.69
CRITICAL DEPTH (ft)	2.18
FROUDE NUMBER	1.37



HYDROLOGIC ANALYSIS

HEC-1 MODEL

FLOOD HYDROGRAPH PACKAGE (HEC-1)
SEPTEMBER 1998
VERSION 4.0

RUN DATE 06/21/1993 TIME 14:16:00

U.S. ARMY CORPS OF ENGINEERS
HYDROLOGIC ENGINEERING CENTER
609 SECOND STREET
DAVIS, CALIFORNIA 95616
(916) 756-1104

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

Full Microcomputer Implementation
by
Haestad Methods, Inc.

37 Brookside Road • Waterbury, Connecticut 06708 • (203) 755-1666

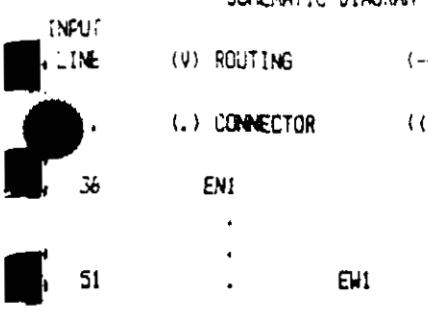
THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          *DIAGRAM
    1     ID   ************************************************************
    2     ID   * ..................................................... *
    3     ID   * :            PARDEE DEVELOPMENT CORPORATION          : *
    4     ID   * :                  E L D O R A D O                   : *
    5     ID   * :                   EXISTING  CONDITIONS- FEMA SUBMITTAL: *
    6     ID   * :.....................................................: *
    7     ID   * :            RETURN PERIOD_ _ _10 & 100-YEAR         : *
    8     ID   * :            DISTRIBUTUION_ _ _ _6-HOUR SDN3         : *
    9     ID   * :            PROJECT NO_ _ _ _ _5523.0093            : *
   10     ID   * :            FILENAME_ _ _ _ _ _FEMA.ELD             : *
   11     ID   * :            DATE_ _ _ _ _ _ _ 06/18/93              : *
   12     ID   * :            MODELED BY_ _ _ _ ROY DAVIS             : *
   13     ID   * :.....................................................: *
   14     ID   ************************************************************
   15     ID   *  1.  THE POINT PRECIPITATION VALUES WERE TAKEN FROM THE    *
   16     ID   *      MCCARRAN AIRPORT GAGE DATES.  THE 100-YEAR, 6-HOUR    *
   17     ID   *      POINT PRECIPITATION VALUE USED IS 2.77 INCHES.        *
   18     ID   *      THE TEN YEAR RAINFALL IS 1.58 INCHES OR .57 OF THE    *
   19     ID   *      100-YEAR RAINFALL.                                    *
   20     ID   ************************************************************
   21     ID   *  2. THIS MODEL SIMULATES THE OFF-SITE EXISTING RUNOFF      *
   22     ID   *    CONDITIONS FOR THE PORTION OF ELDORADO NORTH OF         *
   23     ID   *    CENTENNIAL PARKWAY, THE DESIGNATED FEMA FLOOD ZONE.     *
   24     ID   ************************************************************
   25     ID   *  3.  CURVE  UMBER (CN) AND LAND USE INFORMATION           *
   26     ID   *      (DESERT BRUSH).....NORTH... CN = 92                   *
   27     ID   *      (DESERT BRUSH).....WEST....CN=81                      *
   28     ID   *      THE CURVE NUMBERS USED ARE COMPOSITE                  *
   29     ID   *    CURVE NUMBERS BASED ON THE VARIOUS SOIL                 *
   30     ID   *    TYPES FOUND IN THE WATERSHEDS.                          *
   31     ID   ************************************************************
   32     IT       5       0       0     300
   33     IO       5       0
   34     IN       5       0       0
   35     JR    PREC     .57       1

   36     KK     EN1
   37     KM  EXISTING CONDITION DRAINAGE BASIN EN1 IMPACTING
   38     KM   THE AREA NORTH OF CENTENNIAL PARKWAY ON THE ELDORADO SITE
   39     BA   2.483
   40     PB    2.56
   41     PC  0.000   .0200   .0570   .0700   .0870   .1080   .1240   .1300   .1300   .1300
   42     PC  .1300   .1300   .1300   .1330   .1400   .1420   .1480   .1580   .1720   .1810
   43     PC  .1900   .1970   .1990   .2000   .2010   .2040   .2140   .2290   .2410   .2490
   44     PC  .2510   .2560   .2700   .2780   .2810   .2830   .2950   .3220   .3520   .4090
   45     PC  .4990   .5900   .7100   .7440   .7810   .8120   .8190   .8350   .8510   .8560
   46     PC  .8600   .8680   .8760   .8380   .9100   .9260   .9370   .9500   .9700   .9760
   47     PC  .9820   .9850   .9870   .9890   .9900   .9930   .9930   .9940   .9950   .9980
   48     PC  .9980   .9990  1.000
   49     LS     0     82
   50     UD   1.33
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  51      KK    EW1
  52      KM  EXISTING CONDITION DRAINAGE BASIN IMPACTING
  53      KM  THE WESTERN BOUNDARY OF THE ELDORADO SITE
  54      BA   1.337
  55      PB   2.65
  56      LS      0      81
  57      UD   1.29
  58      ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*        SEPTEMBER 1990                 *
*         VERSION 4.0                   *
*                                       *
*  RUN DATE  06/21/1993  TIME  14:16:00 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*         (916) 756-1104                *
*                                       *
*****************************************
```


```
*****************************************************************
* ............................................................. *
* :            PARDEE DEVELOPMENT CORPORATION               : *
* :                  E L D O R A D O                        : *
* :                   EXISTING  CONDITIONS- FEMA SUBMITTAL: * *
* :.........................................................: *
* :            RETURN PERIOD_ _ _10 & 100-YEAR              : *
* :            DISTRIBUTUION_ _ _ _6-HOUR SDN3              : *
* :            PROJECT NO_ _ _ _ _5523.0093                 : *
* :            FILENAME_ _ _ _ _ _FEMA.ELD                  : *
* :            DATE_ _ _ _ _ _ _ _06/18/93                  : *
* :            MODELED BY_ _ _ _ _ROY DAVIS                 : *
* :.........................................................: *
*****************************************************************
* 1.  THE POINT PRECIPITATION VALUES WERE TAKEN FROM THE        *
*     MCCARRAN AIRPORT GAGE DATES.  THE 100-YEAR, 6-HOUR        *
*     POINT PRECIPITATION VALUE USED IS 2.77 INCHES.            *
*     THE TEN YEAR RAINFALL IS 1.58 INCHES OR .57 OF THE        *
*     100-YEAR RAINFALL.                                        *
*****************************************************************
* 2. THIS MODEL SIMULATES THE OFF-SITE EXISTING RUNOFF          *
*   CONDITIONS FOR THE PORTION OF ELDORADO NORTH OF             *
*   CENTENNIAL PARKWAY, THE DESIGNATED FEMA FLOOD ZONE.         *
*****************************************************************
* 3.  CURVE  UMBER (CN) AND LAND USE INFORMATION                *
*     (DESERT BRUSH).....NORTH... CN = 82                       *
*     (DESERT BRUSH).....WEST....CN=81                          *
*     THE CURVE NUMBERS USED ARE COMPOSITE                      *
*   CURVE NUMBERS BASED ON THE VARIOUS SOIL                     *
*   TYPES FOUND IN THE WATERSHEDS.                              *
*****************************************************************
```

```
33 IO        OUTPUT CONTROL VARIABLES
                 IPRNT         5  PRINT CONTROL
                 IPLOT         0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT         HYDROGRAPH TIME DATA
                 NMIN          5  MINUTES IN COMPUTATION INTERVAL
                 IDATE     1   0  STARTING DATE
                 ITIME       0000  STARTING TIME
                   NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                NDDATE     2   0  ENDING DATE
```

```
              NDTIME        0855  ENDING TIME
              ICENT           19  CENTURY MARK

          COMPUTATION INTERVAL      .08 HOURS
              TOTAL TIME BASE   24.92 HOURS

ENGLISH UNITS
     DRAINAGE AREA          SQUARE MILES
     PRECIPITATION DEPTH    INCHES
     LENGTH, ELEVATION      FEET
     FLOW                   CUBIC FEET PER SECOND
     STORAGE VOLUME         ACRE-FEET
     SURFACE AREA           ACRES
     TEMPERATURE            DEGREES FAHRENHEIT

JP       MULTI-PLAN OPTION
              NPLAN           1  NUMBER OF PLANS

JR       MULTI-RATIO OPTION
         RATIOS OF PRECIPITATION
         .57      1.00
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION	
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2
					.57	1.00
HYDROGRAPH AT	EN1	2.48	1	FLOW	205.	671.
				TIME	5.17	4.92
HYDROGRAPH AT	EW1	1.34	1	FLOW	111.	371.
				TIME	5.17	4.92

*** NORMAL END OF HEC-1 ***
NORMAL END OF HEC-1

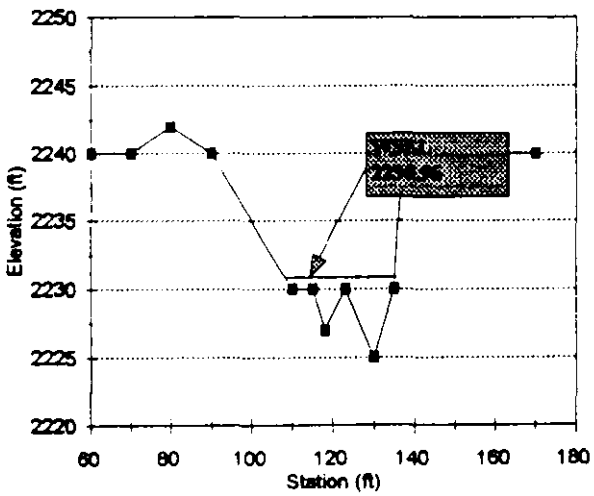
Elevation	Station
2240	170
2240	160
2240	150
2240	145
2240	137
2230	135
2225	130
2230	123
2227	118
2230	115
2230	110
2240	90
2242	80
2240	70
2240	60

Cross section data

SECTION A-A

FLOW RATE (cfs)	671
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	5.96
FLOW VELOCITY (fps)	10.04
VELOCITY HEAD (ft)	1.56
ENERGY HEAD (ft)	7.52
AREA OF FLOW (sq ft)	67.01
WETTED PERIMETER (ft)	33.870
CRITICAL DEPTH (ft)	2.64
FROUDE NUMBER	1.12

CROSS SECTION

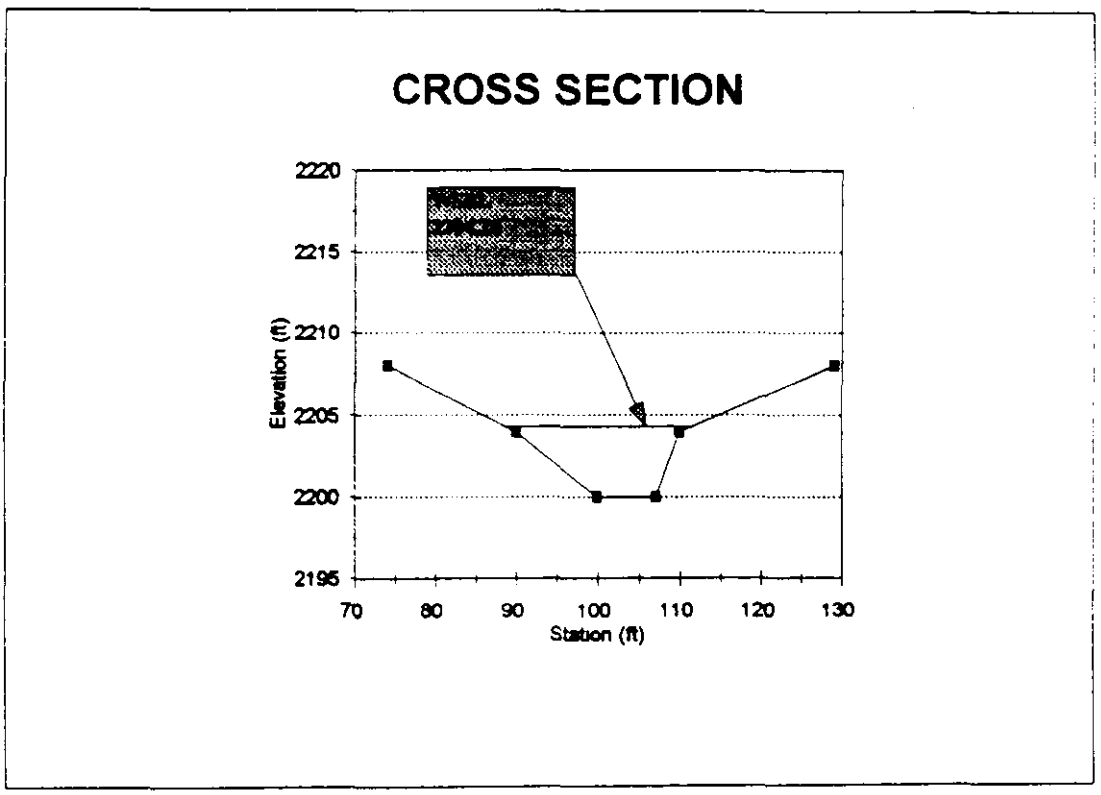


Elevation	Station
2208	129
2204	110
2200	107
2200	100
2204	90
2208	74

Cross section data

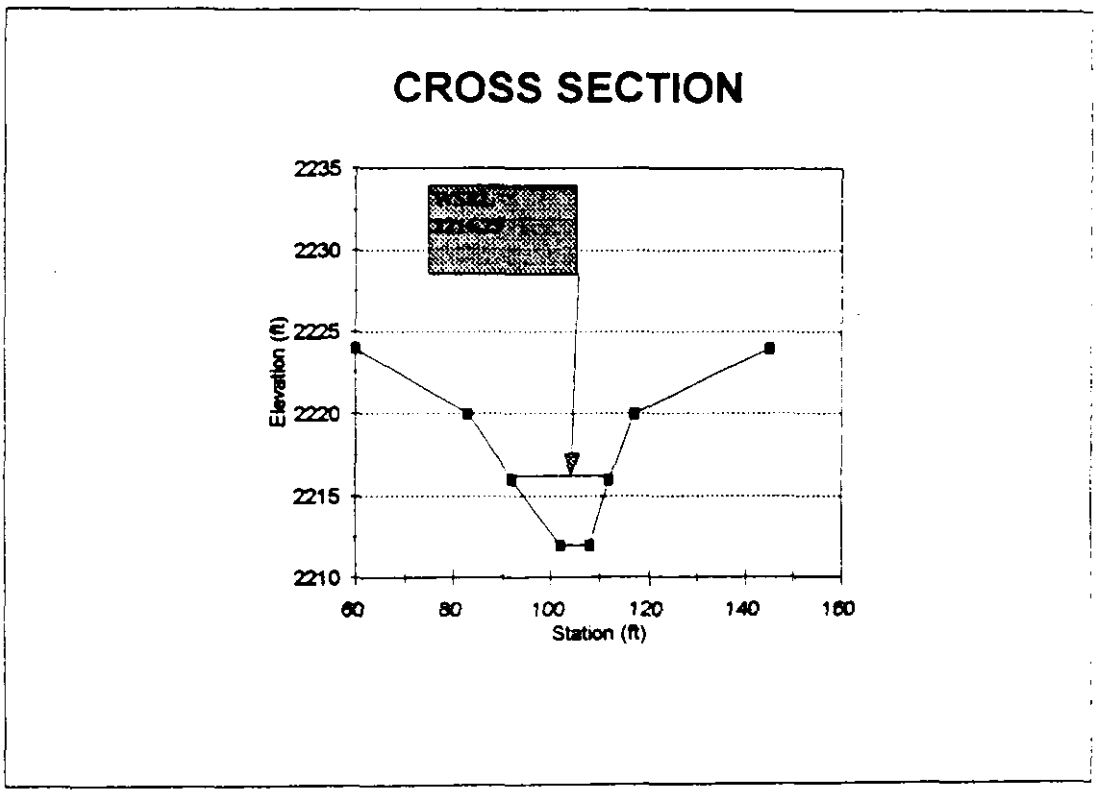
SECTION A1-A1

FLOW RATE (cfs)	671
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	4.26
FLOW VELOCITY (fps)	11.32
VELOCITY HEAD (ft)	1.99
ENERGY HEAD (ft)	6.25
AREA OF FLOW (sq ft)	59.48
WETTED PERIMETER (ft)	25.100
CRITICAL DEPTH (ft)	2.69
FROUDE NUMBER	1.22



Elevation	Station
2224	145
2220	117
2216	112
2212	108
2212	102
2216	92
2220	83
2224	60

Cross section data	SECTION A2-A2
FLOW RATE (cfs)	671
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	4.29
FLOW VELOCITY (fps)	11.59
VELOCITY HEAD (ft)	2.08
ENERGY HEAD (ft)	6.37
AREA OF FLOW (sq ft)	57.93
WETTED PERIMETER (ft)	23.600
CRITICAL DEPTH (ft)	3.01
FROUDE NUMBER	1.23



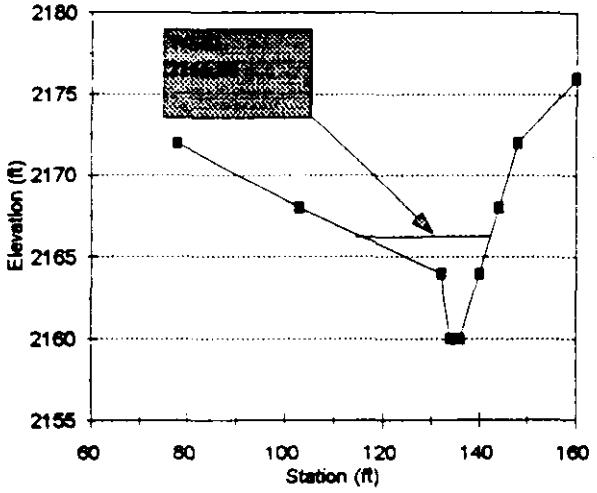
Elevation	Station
2176	160
2172	148
2168	144
2164	140
2160	136
2160	134
2164	132
2168	103
2172	78

Cross section data

SECTION A3-A3

FLOW RATE (cfs)	671
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	6.56
FLOW VELOCITY (fps)	9.97
VELOCITY HEAD (ft)	1.54
ENERGY HEAD (ft)	8.1
AREA OF FLOW (sq ft)	67.5
WETTED PERIMETER (ft)	34.480
CRITICAL DEPTH (ft)	2.42
FROUDE NUMBER	1.15

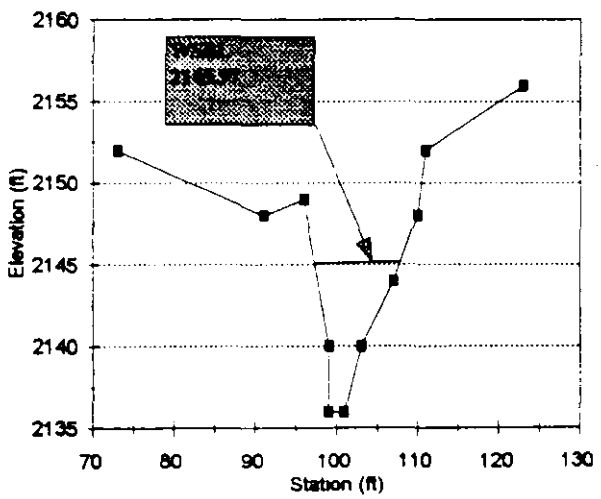
CROSS SECTION



Elevation	Station
2152	73
2148	91
2149	96
2140	99
2136	99
2136	101
2140	103
2144	107
2148	110
2152	111
2156	123

Cross section data	SECTION A4-A4
FLOW RATE (cfs)	671
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	9.97
FLOW VELOCITY (fps)	11.34
VELOCITY HEAD (ft)	2.00
ENERGY HEAD (ft)	11.97
AREA OF FLOW (sq ft)	59.16
WETTED PERIMETER (ft)	24.880
CRITICAL DEPTH (ft)	4.9
FROUDE NUMBER	0.88

CROSS SECTION



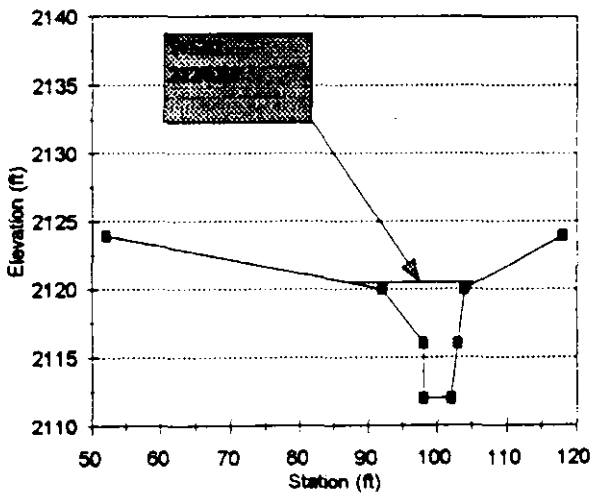
Elevation	Station
2124	52
2120	92
2116	98
2112	98
2112	102
2116	103
2120	104
2124	118

Cross section data

SECTION A5-A5

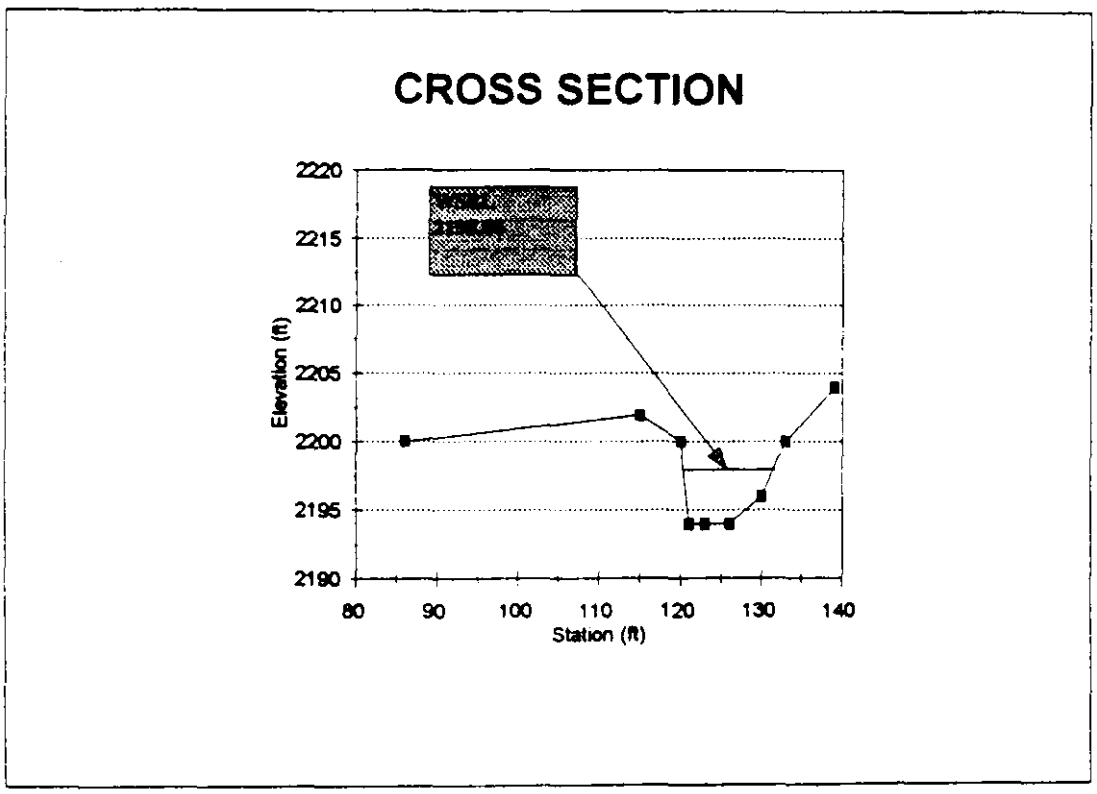
FLOW RATE (cfs)	671
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	8.81
FLOW VELOCITY (fps)	10.00
VELOCITY HEAD (ft)	1.55
ENERGY HEAD (ft)	10.36
AREA OF FLOW (sq ft)	67.14
WETTED PERIMETER (ft)	34.13
CRITICAL DEPTH (ft)	2.85
FROUDE NUMBER	1.03

CROSS SECTION



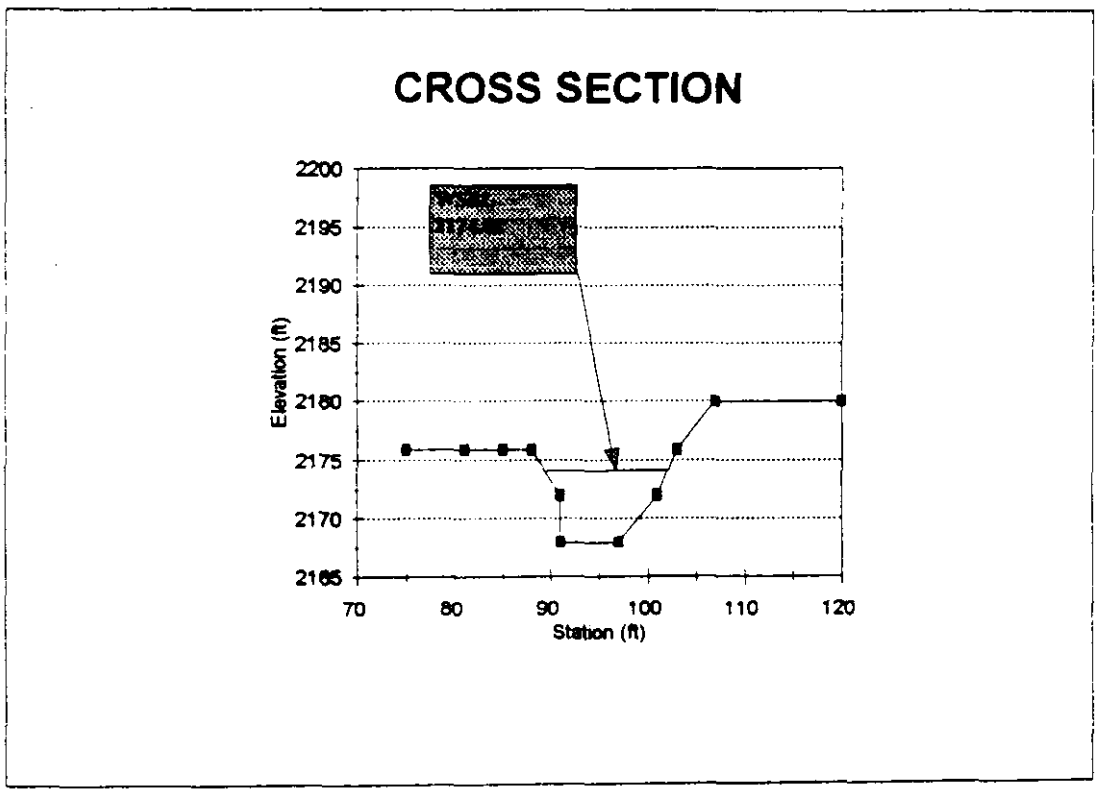
Elevation	Station
2204	139
2200	133
2196	130
2194	126
2194	123
2194	121
2200	120
2202	115
2200	86

Cross section data	SECTION B1-B1
FLOW RATE (cfs)	371
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	4.00
FLOW VELOCITY (fps)	10.69
VELOCITY HEAD (ft)	1.77
ENERGY HEAD (ft)	5.77
AREA OF FLOW (sq ft)	34.83
WETTED PERIMETER (ft)	16.030
CRITICAL DEPTH (ft)	3.23
FROUDE NUMBER	1.07



Elevation	Station
2180	120
2180	107
2176	103
2172	101
2168	97
2168	91
2172	91
2176	88
2176	85
2176	81
2176	75

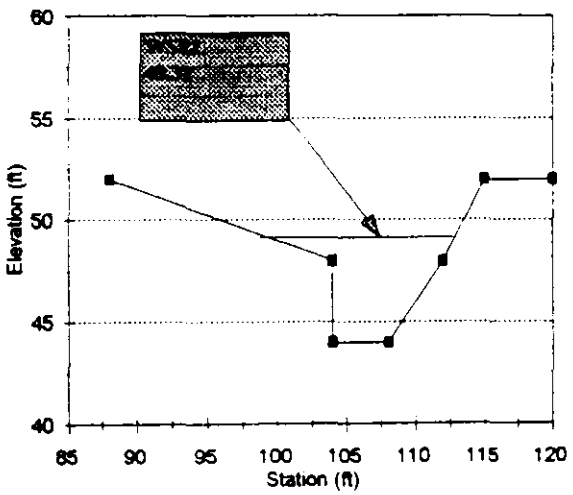
Cross section data	SECTION B2-B2
FLOW RATE (cfs)	671
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	6.02
FLOW VELOCITY (fps)	12.28
VELOCITY HEAD (ft)	2.34
ENERGY HEAD (ft)	8.36
AREA OF FLOW (sq ft)	54.74
WETTED PERIMETER (ft)	20.440
CRITICAL DEPTH (ft)	4.44
FROUDE NUMBER	1.04



Elevation	Station
52	120
52	115
48	112
44	108
44	104
48	104
52	88

Cross section data	SECTION B3-B3
FLOW RATE (cfs)	371
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	5.31
FLOW VELOCITY (fps)	9.64
VELOCITY HEAD (ft)	1.44
ENERGY HEAD (ft)	6.75
AREA OF FLOW (sq ft)	38.56
WETTED PERIMETER (ft)	20.700
CRITICAL DEPTH (ft)	2.72
FROUDE NUMBER	1.03

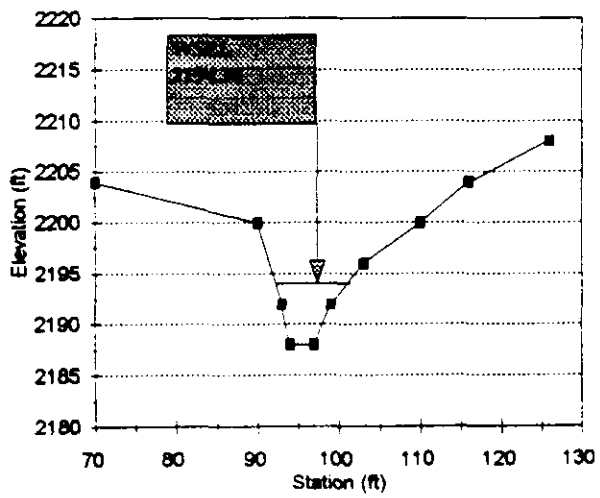
CROSS SECTION



Elevation	Station
2208	126
2204	116
2200	110
2196	103
2192	99
2188	97
2188	94
2192	93
2200	90
2204	70

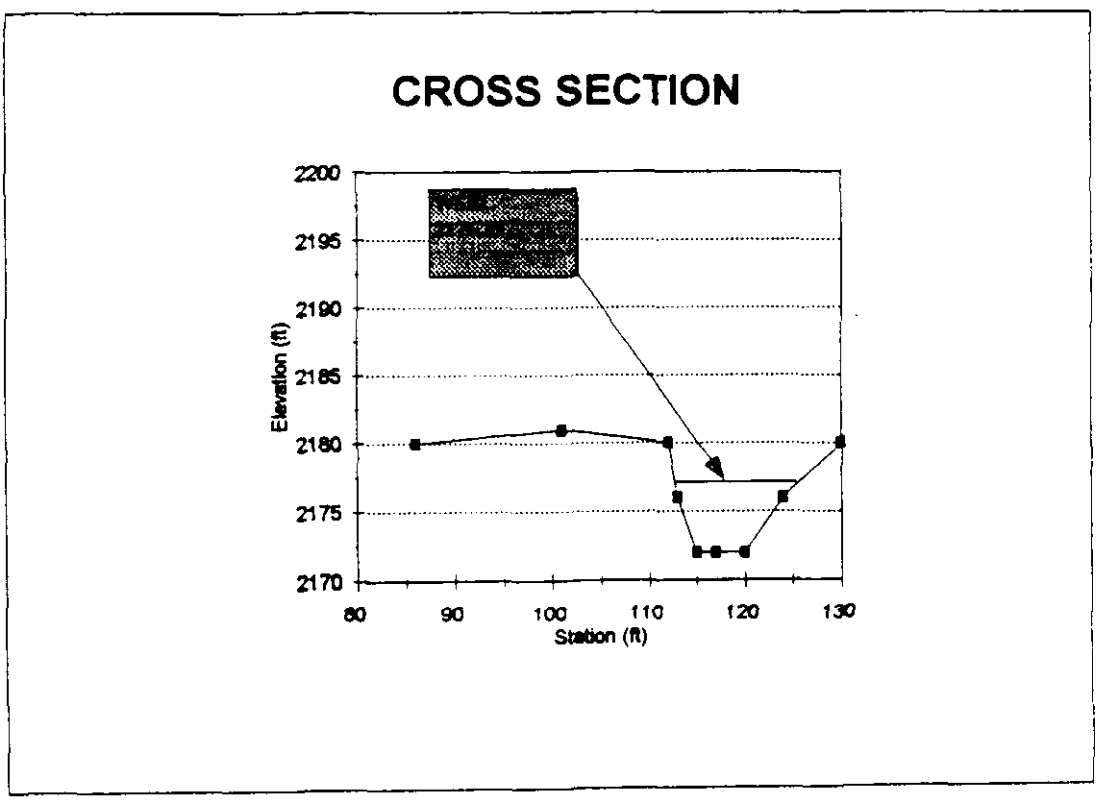
Cross section data	SECTION C1-C1
FLOW RATE (cfs)	371
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	6.36
FLOW VELOCITY (fps)	10.32
VELOCITY HEAD (ft)	1.65
ENERGY HEAD (ft)	8.01
AREA OF FLOW (sq ft)	35.98
WETTED PERIMETER (ft)	17.450
CRITICAL DEPTH (ft)	3.79
FROUDE NUMBER	0.92

CROSS SECTION



Elevation	Station
2180	130
2176	124
2172	120
2172	117
2172	115
2176	113
2180	112
2181	101
2180	86

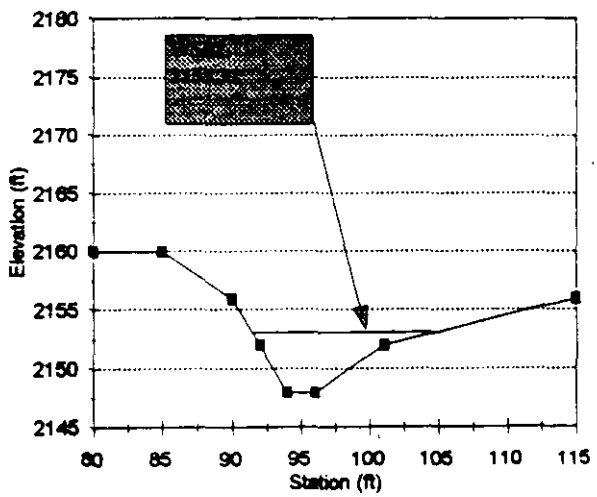
Cross section data	SECTION C2-C2
FLOW RATE (cfs)	371
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	4.23
FLOW VELOCITY (fps)	10.74
VELOCITY HEAD (ft)	1.79
ENERGY HEAD (ft)	6.02
AREA OF FLOW (sq ft)	34.57
WETTED PERIMETER (ft)	15.78
CRITICAL DEPTH (ft)	3.14
FROUDE NUMBER	1.09



Elevation	Station
2156	115
2152	101
2148	96
2148	94
2152	92
2156	90
2160	85
2160	80

Cross section data	SECTION C3-C3
FLOW RATE (cfs)	371
CHANNEL BOTTOM SLOPE (ft/ft)	0.020
MANNINGS (n-VALUE)	0.033
NORMAL DEPTH (ft)	5.32
FLOW VELOCITY (fps)	9.94
VELOCITY HEAD (ft)	1.53
ENERGY HEAD (ft)	6.85
AREA OF FLOW (sq ft)	37.36
WETTED PERIMETER (ft)	19.150
CRITICAL DEPTH (ft)	2.67
FROUDE NUMBER	1.08

CROSS SECTION



CITY OF NORTH LAS VEGAS
320007

17

16

ZONE X

ZONE A

20

21

ZONE X

CENTENNIAL

PKWY.

LIMIT OF STUDY

CORPORATE LIMITS

29

28

TROPICAL

3E RD

LIMIT OF STUDY

PARKWAY

WHITEHOLLOW AVE

1000 0 500 1000

NORTH

SCALE: 1" = 1000'

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA AND INCORPORATED AREAS
PANEL 1770 OF 4000
MAP NUMBER 320007 0770 B
EFFECTIVE DATE:
PRELIMINARY
MICHAEL BAKER, JR., INC.
JUL 29 1998
NATIONAL FLOOD INSURANCE PROGRAM
Federal Emergency Management Agency

D-FIRM

NORTHWEST LAS VEGAS FIS STUDY

PENTACORE
Engineering, Inc.
8763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 256-0115

CITY OF NORTH LAS VEGAS
320007

17

16

ZONE X

AREA TO BE REMOVED FROM FLOOD PLAIN

ZONE A

BOUNDARY OF REVISED FLOOD ZONE 'A'

20

ZONE X

CENTENNIAL PKWY.

CORPORATE LIMITS

29

28

TROPICAL

LIMIT OF STUDY

PARKWAY

WHITEHOLLOW AVE

RD

1000 0 500 1000

NORTH

SCALE: 1" = 1000'

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA AND INCORPORATED AREAS
PRELIMINARY
MICHAEL BADEN, JR., INC.
JUL 29 1988

ANNOTATED D-FIRM

NORTHWEST LAS VEGAS FIS STUDY

PENTACORE
Engineering, Inc
6701 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 256-0115

D E S E R T N A T I O N A L W I L D L I F E R E F U G E

EXISTING DIVERSION BERM

EXISTING UPPER LAS VEGAS WASH DETENTION BASIN

EXISTING NATURAL WASH

BASIN ENI

BASIN EWI

DESIGNATED FEMA ZONE "A"

EXISTING NORTH LAS VEGAS DETENTION BASIN

NOTE: SEE 600 SCALE EXHIBIT FOR X-SECTION LOCATIONS

CENTENNIAL PARKWAY

LIMITS OF APPROXIMATE STUDY

CLAYTON ROAD

REVERE STREET

ANN ROAD

LAS VEGAS

NORTH

2000 0 1000 2000

SCALE: 1" = 2000'

REF: WALLACE G.C. "FEMA FLOOD HAZARD DESIGNNATION INFORMATION", JUNE 1993

NO.	DESCRIPTION	DATE	APP'D

RECOMMENDED: DATE

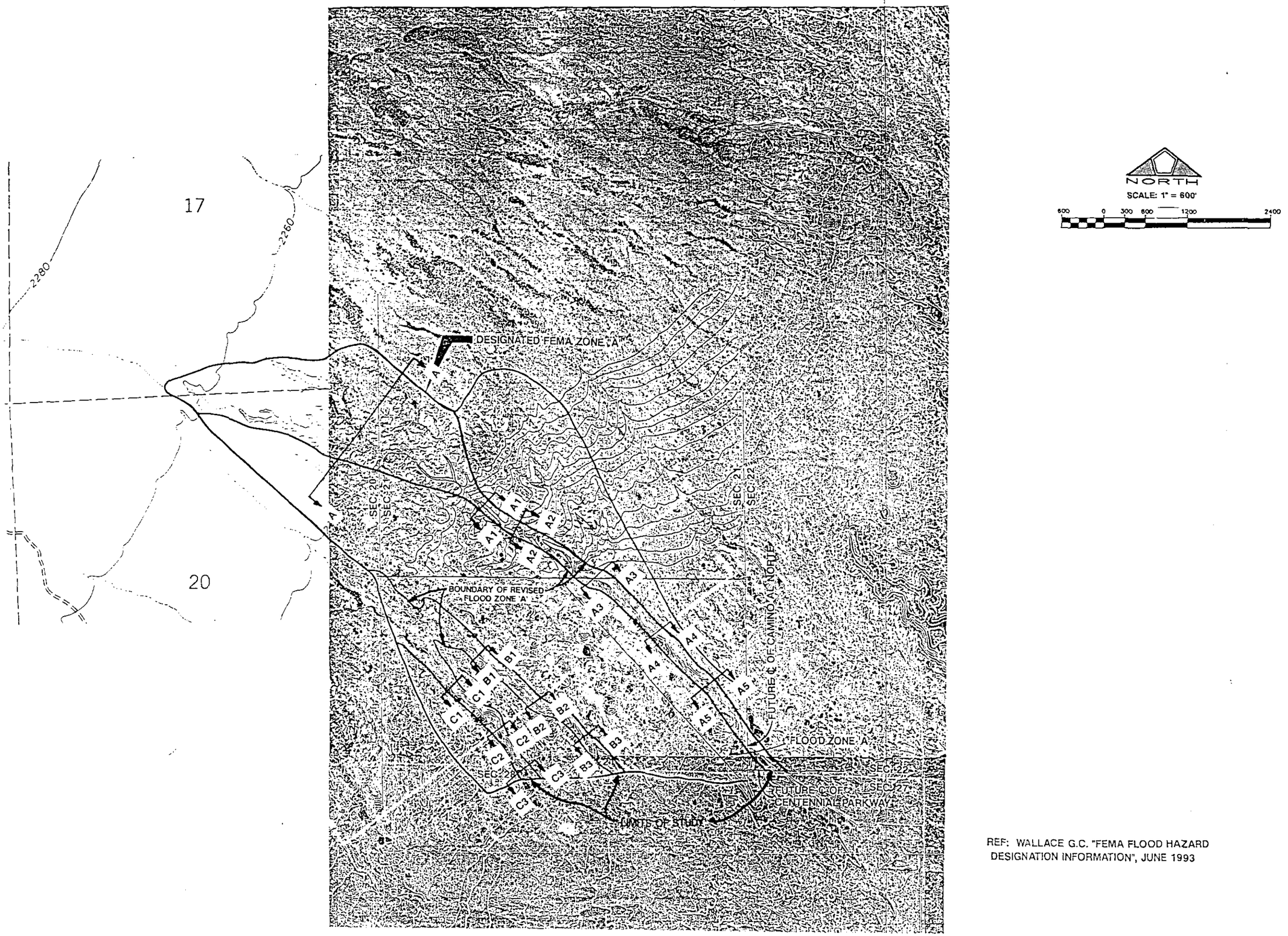
DRAWN BY: K. KAMPSON
N. I. # 993

DATE: 7/26/94
DRAWN BY: AIF
DESIGNED BY:
CHECKED BY:
JOB NO.: 0942.2000
SCALE: AS SHOWN

PENTACORE
Engineering, Inc.
6763 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 258-0115

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
NORTHWEST LAS VEGAS FIS RESTUDY

1



NORTH

SCALE: 1" = 600'

600 0 300 600 1200 2400

REF: WALLACE G.C. "FEMA FLOOD HAZARD DESIGNATION INFORMATION", JUNE 1993

NO.	DESCRIPTION	DATE	APP'D

RECOMMENDED: DATE

BRIAN W. DAVIDSON
N. E. # 8193

DATE : 5/16/94
DRAWN BY : AJF
DESIGNED BY :
CHECKED BY :
JOB NO. : 0142.0001
SCALE : AS SHOWN

PENTACORE
Engineering, Inc.
9783 West Charleston Boulevard
Las Vegas, Nevada 89102
(702) 258-0115

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

NORTHWEST LAS VEGAS FIS RESTUDY

SHEET 1 OF 1

Section 7

Section 7
Las Vegas Wash Diversion Dike

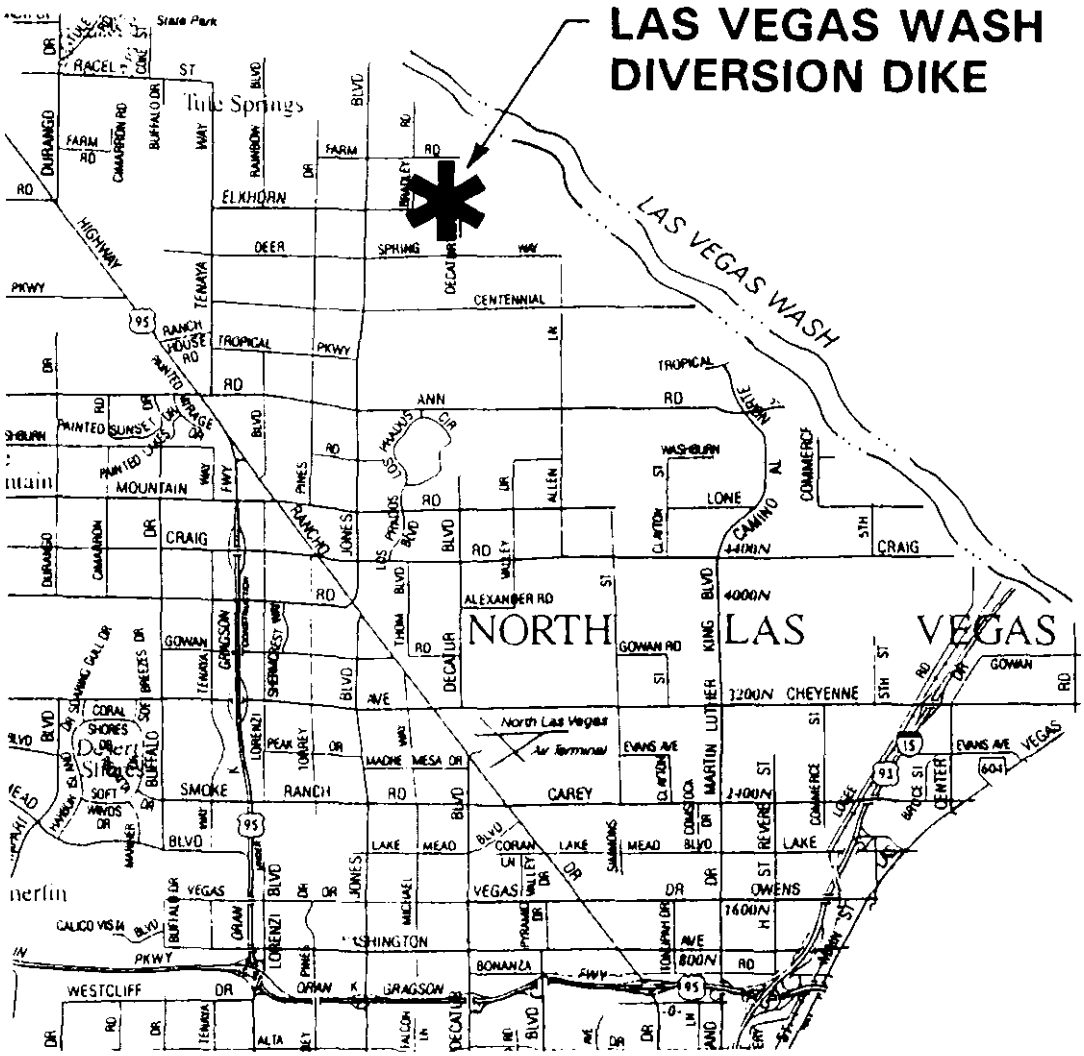
REQUEST FOR LOMR
Las Vegas Wash Diversion Dike

The purpose of this revision is to change an existing Zone "A" to Zone "X". The Zone "A" is located in portions of Sections 2, 3, 11, 12, 13, and 14, Township 19 South, Range 60 East, FIRM No. 320003-0775B and 325276-0010B.

The Upper Las Vegas Wash Diversion Dike and Detention Basin were constructed as a part of the CCRFCD *Flood Control Master Plan*. The dike's purpose is to contain runoff within the Las Vegas Wash, and to discharge flow into the Upper Las Vegas Wash Detention Basin. The construction plans were prepared by Black & Veatch for the City of North Las Vegas in 1991, and the construction was completed in January 1994. This project was funded by the Clark County Regional Flood Control District.

As a result of construction of the Upper Las Vegas Wash Diversion Dike, the flow which used to inundate the subject area is now diverted east to the Upper Las Vegas Wash Detention Basin. Only local runoff with a drainage area of less than one square mile now contributes to the currently designated flood zone.

USGS topographic maps at a scale of 1" = 2000', with a contour interval of 20 feet, were used to delineate the contributing watershed. At Decatur Boulevard, the City of Las Vegas corporate boundary and the downstream limits of study, the watershed area was determined to be approximately 0.95 square miles. Since the drainage area is now less than one square mile it is requested that the Zone "A" designation be removed and replaced with Zone "X".



N.T.S.

COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

LOCATION MAP

JOB # 930017 6/94

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*

- [X] Physical change
  - [X] Existing
  - [ ] Proposed
- [ ] *Improved methodology*
- [ ] Improved data
- [ ] Floodway revision
- [X] Other _____

Explain Upper Las Vegas Diversion Dike has been constructed

2. Flooding Source: Las Vegas Wash
3. Project Name/Identifier: Northwest Las Vegas FIS Restudy
4. FEMA zone designations affected: Zone "A"

(example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)

5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	320003	Clark County	Clark	NV	320003	0775B	9/29/89
	325276	City of Las Vegas	Clark	NV	325276	0010B	9/30/80

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding
- [ ] Riverine
- [ ] Coastal
- [ ] Alluvial Fan
- [X] Shallow Flooding *(e.g. Zones AO and*
- [ ] Lakes

Affected by wind/wave action
- [ ] Yes
- [X] No

- [ ] Other *(describe)* _____

Structures
- [ ] Channelization
- [ ] Levee/Floodwall
- [ ] Bridge/Culvert
- [ ] Dam
- [ ] Coastal
- [ ] Fill
- [ ] Pump Station
- [ ] None
- [ ] Channel Relocation
- [ ] Excavation
- [X] Other *(describe)*

Dike

Disciplines*
- [X] Water Resources
  - [X] Hydrology
  - [X] Hydraulics
  - [ ] Sediment Transport
  - [ ] Interior Drainage
- [ ] Structural
- [ ] Geotechnical
- [ ] Land Surveying
- [ ] Other *(describe)*

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? [ ] Yes [X] No
8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? [ ] Yes [X] No

If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

☐ Yes ☒ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☐ Yes ☒ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☐ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☒ Yes ☐ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? ☐ Yes ☒ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)?

☒ Yes ☐ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by City of Las Vegas (entity) _____ with a maximum interval of 6 months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by City of Las Vegas (entity) to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☐ has ☒ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for [X] performing [ ] overseeing compliance with the maintenance and operation plans of the Upper Las Vegas Diversion Dike
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

__X__b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

17. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	[X] Hydrologic Analysis Form (Form 3) - Refer to Appendix III
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	[ ] Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	[ ] Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	[ ] Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	[ ] Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	[ ] Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	[ ] Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	[ ] Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	[X] Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	[ ] Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☐ Yes ☒ No

Initial fee amount: $ EXEMPT

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ VISA ☐ MASTERCARD **CARD NUMBER**

Check or money order only.

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: *I understand that my signature indicates that all* information submitted in support of this request is correct.

Signature of Revision Requestor

Paul W.R. Hoskin, P.E., Vice President
Printed Name and Title of Revision Requestor

Coe & Van Loo Consultants, Inc.
Company Name

8/26/96
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

Signature of Community Official

Kevin Eubanks, P.E., Assistant General Manager
Printed Name and Title of Community Official

Clark County Regional Flood Control District
Community Name

Date

Does this request impact any other communities? ☒ Yes ☐ No

Impacts City of Las Vegas and unincorporated Clark County. Refer to Community Concurrence Letter.

yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in hydrology and hydraulics
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 14 years experience in the expertise listed above.
4. I have ☒ prepared ☐ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Hydrologic, hydraulic & floodplain analyses
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☐ Examined plans and specifications and compared with completed projects.
   d. ☒ Other Compiled and reviewed plans and design reports
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Paul W.R. Hoskin, P.E.
(please print or type)

Title: Vice President
(please print or type)

Registration No. 8845

Expiration Date:

State Nevada

Type of License Civil

Signature

8/26/94
Date

REGISTERED PROFESSIONAL ENGINEER · STATE OF NEVADA
PAUL W.R. HOSKIN
CIVIL
No. 8845

Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY **DAM FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 0.5 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada

Flooding Source: Upper Las Vegas Wash Diversion Dike

Project Name/Identifier: Northwest Las Vegas Flood Insurance Study Restudy

IDENTIFIER

Name of Dam: Upper Las Vegas Wash Diversion Dike

Location of dam along flood source (in terms of stream distance or cross section identifier):

N/A

Check one of the following:

☐ Existing dam

☒ New dam

☐ Modifications of existing dam (describe modifications) _____

Was the dam designed by _____ Federal agency _____ State agency

__X__ Local government agency _____ Private organization?

BACKGROUND

Does the dam have dedicated flood control storage? ☒ Yes ☐ No

Does the project involve revised hydrology? ☐ Yes ☒ No

If yes, complete Hydrologic Analysis Form and include calculations of the 100-year inflow flood hydrograph routed through the dam with the beginning pool at the normal pool elevation (spillway crest elevation for ungated spillway). Include any inflow hydrograph bulking by watershed sediment yield and provide necessary debris and sediment yield analysis.

Does the revised hydrology affect the 100-year water-surface elevation behind the dam or downstream of the dam?

☒ Yes ☐ No

If yes, complete the Riverine Hydraulic Analysis Form and complete the table shown on the following page.

	Stillwater Elevation Behind the Dam	
	FIS	Revised
10-year	N/A	N/A
50-year	N/A	N/A
100-year	N/A	N/A
500-year	N/A	N/A
Normal Pool Elevation	N/A	N/A

Was *long term* sediment accumulation taken into consideration in determining the normal pool elevation?

☒ Yes ☐ No

Was the dam designed to withstand the hydrostatic and hydrodynamic forces associated with floods greater than the 100-year flood?

☒ Yes ☐ No

If no, and the dam has a reasonable probability of failure during the 100-year flood, please attach dam break analysis.

Provide the following data on the dam:

Height: 8 feet

Crest Elevation: varies

100-year flood storage capacity: N/A

Freeboard (measured from 100-year water surface elevation): 3.75 feet

Spillway(s):

Type: ☐ gated ☒ ungated

Width: N/A

Height: N/A

Crest Elevation: N/A

Outlet(s):

Type: ☐ gated ☒ ungated

Width: N/A

Height: N/A

Diameter: N/A

Invert Elevation: N/A

Explain flow regulation plan: _____

Are the project features, including the emergency spillway, designed to accommodate the 100-year flood discharge without overtopping the dam?

☒ Yes ☐ No

Was the dam designed in accordance with all currently applicable local, State, and Federal regulations?

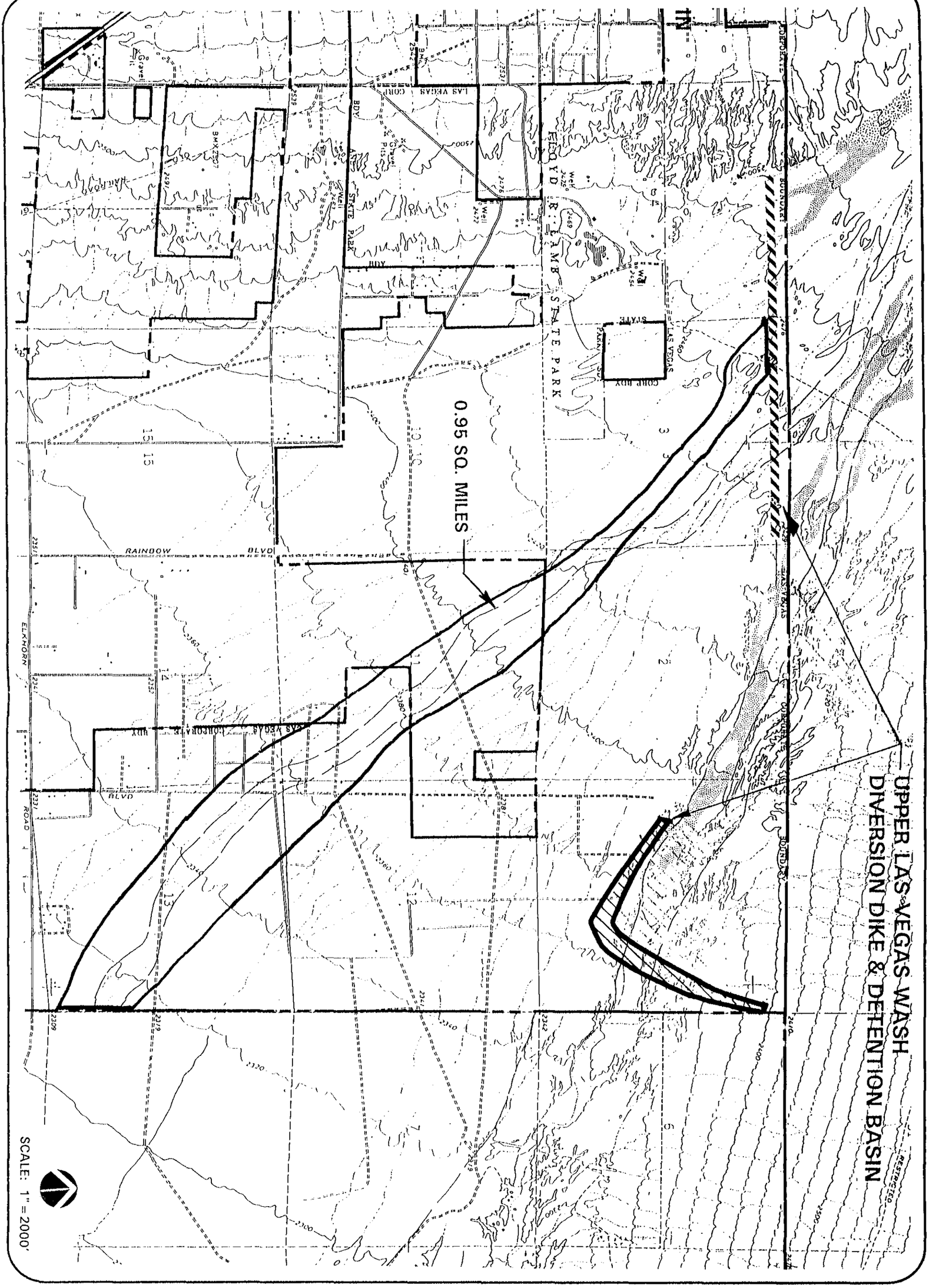
☒ Yes ☐ No

If no, please provide explanation. _____

FEMA may request a list of regulations that have been complied with and *supporting documentation* demonstrating compliance with these regulations.

Attach copy of formal operation and maintenance plan

Answer N/A to any questions which are not applicable



COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

NORTHWEST LAS VEGAS
F.I.S. RESTUDY
WATERSHED MAP

NORTHWEST LAS VEGAS
F.I.S. RESTUDY
ANNOTATED D - FIRM

CHANGE ZONE "A" TO ZONE "X"

ZONE A CONTAINED WITHIN THE RIGHT-OF-WAY AND THE SOUTHERN EMBANKMENT OF LONE MOUNTAIN ROAD FROM JONES BOULEVARD TO DECATUR BOULEVARD.

ZONE A

ZONE X

CLARK COUNTY
UNINCORPORATED AREAS
320003

CITY OF LAS VEGAS
320005

CLARK COUNTY

CITY OF LAS VEGAS

WEST ROSADA WAY

WEST LA MADRE WAY

NORTH TORREY PINES DRIVE

NORTH JONES BOULEVARD

NORTH DECATUR BOULEVARD

WEST LONE MOUNTAIN ROAD

ECHO CANYON CIR

KEY VISTA CIR

CEDAR GROVE CIR

MUSTANG ST

MINERVA DRIVE

DORCHESTER CIR

KRAFT AVE

SADLER

BLUSH AVENUE

BRIAR ROSE LN

CRIMSON RIDGE

RED SATURN DR

WADSWORTH CT

VERDE WAY

LEON AVENUE

LINDSIDE DR

COST TREE CIR

TAMANAR DRIVE

MARYVALE

NORWAY

PINON DRIVE

YELLOW PINE LN

AUSTRIAN DR

LAKES STREET

FIESTA

NEW DAWN COURT

ROYAL SUNSET CT

SUN GLORY CT

WHITE DAWN COURT

ENGLISH COMPASS BOW LN

BOSTON NY CT

DEL ORO DRIVE

GONZALES

VINCENTE

LA REINA CIR

CAMINO

CHARNETA COURT

SANDHORSE COURT LN

SOLIMAR

CRIMSON LEAF DR

INEZ DR

CAMPO CIR

LA LIMA CT

LINDA CT

CRAIG RD

ROMANCE CIRCLE

WHEELBARROW PEAK DR

DOBY PEAK DRIVE

FAITH PEAK DRIVE

SAPPHIRE STREET

GLADIOLUS CT

STAR JASMINE CT

AMETHYST AVENUE

HARTMAN

JADESTONE AVE

BAMBOO COURT

DELPHINIUM AVE

ROY ROGERS DRIVE

OUIDA WAY

M RAGRANDE DR

JENNIFER COURT

DRIVE

ROXANNE

RHONDA DR

IRL

PHILS

PATRICIA AVE

DOC HOLIDAY AVE

IRA ST

KISHA CT

IVORY CIR

BAT MASTERSON CIRCLE

LINDSEY CIR

LAKE TAHOE ST

YUKON

THERESA

TUFFER

GEORGENA DR

HICKAM AVENUE

BLACKMON CIRCLE

DIMICK AVENUE

DALE SCOTT

TYLER WILLIAM LN

NANCY

MARGARITE LN

THOM

LIMIT OF STUDY

SANTA MONICA AVENUE

SAN MIGUEL

CINDERWOOD CT

SAN JUAN AVENUE

SAN DIEGO STREET

HATCH

ALEXANDER ROAD

MONICA JOY LN

MISSY MARIE LN

JUDY CT

LEO DR

HOLSTER AVE

GILMORE AVENUE

MARTINELLI

SHORT DRIVE

CATTLEMAN AVENUE

DUSTY TRL

SAN MATEO ST

SAN DIEGO ST

SAN MATEO STREET

EXPRESS STREET

VALLEY

31

36

1

2

FIRM
FLOOD INSURANCE RATE MA
CLARK COUNTY, NEVADA AND INCORPORATED ARE.
PANEL 2155 OF 4090

PRELIMIN
MICHAEL BAKER, JR., INC.
EFFECTIVE DA

NATIONAL FLOOD INSURANCE PROGR

COE & VAN LOO
ENGINEERING
LANDSCAPE ARCHITECTURE

Section 8
Lone Mountain Road/Rancho Drive

REQUEST FOR LOMR
Lone Mountain Road/Rancho Drive

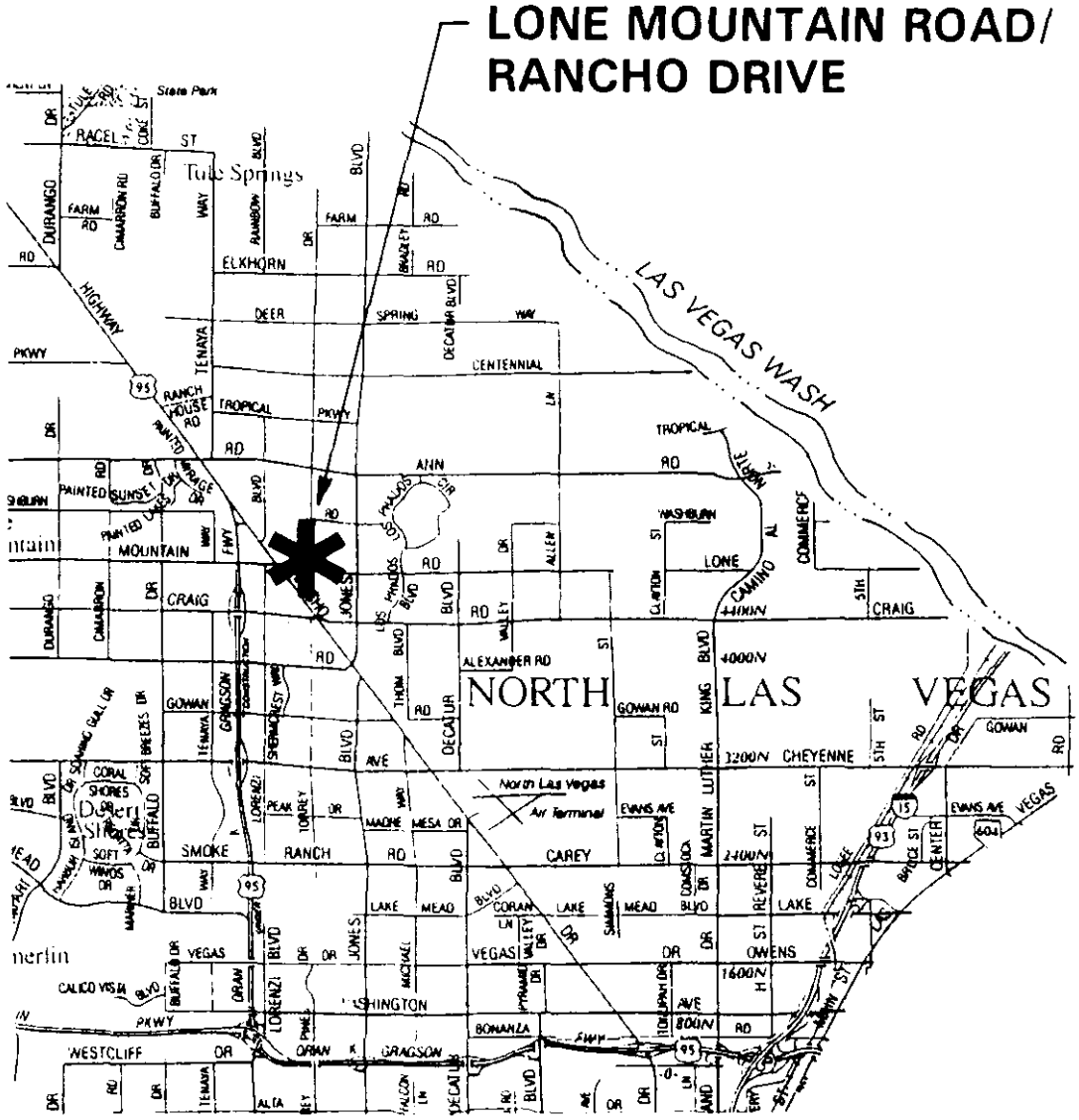
The purpose of this revision is to change an existing Zone "A" to Zone "X". The Zone "A" is located in Section 35, Township 19 South, Range 60 East and Section 2, Township 20 South, Range 60 East, FIRM No. 325276-0015C.

The construction of Highway 95 between Gowan Road and Rancho Drive was completed in 1979. This project was federally funded and was designed by the Nevada Department of Transportation (NDOT). The Highway 95 is elevated above adjacent ground and forms a barrier to drainage flows along its length.

Highway 95 would divert a majority of the 100-year discharge south along its east side toward Gowan Road. As a result, the flows reaching Rancho Drive have been much reduced and only minor diverted flows and local runoffs impact areas along Rancho Drive.

At the intersection of Rancho Drive and Lone Mountain Road, approximately 120 cfs diverts west through culverts under Rancho Drive and inundate the subjected area, designated as Zone "A". A hydraulic analysis was performed to evaluate the flow depth. The average flow depth was found to vary from 0.2 feet to 0.5 feet. Hydraulic calculations and cross section locations are included in this section.

The 120 cfs is the result of combined discharges from three existing culverts across Rancho Drive. These discharges, which are shown on the attached exhibit, were determined during the course of the hydrologic and hydraulic analyses which are documented in Appendices III and IV. The detailed study shows that no flow will overtop Rancho Drive. Hydraulic analysis of each cross-section indicates that the flow depth at each location is less than one foot. A change in flood zone from Zone "A" to Zone "X" is therefore requested. Downstream of Jones Boulevard, the Zone "A" is currently shown to be contained within the Lone Mountain Road right-of-way. It is also requested that this Zone "A" designation be removed since the average flow depth in the street is less than one foot.



N.T.S.

COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

LOCATION MAP

JOB # 930017 6/94

FEDERAL EMERGENCY MANAGEMENT AGENCY
REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*

- [X] Physical change
  - [X] Existing
  - [ ] Proposed
- [ ] Improved methodology
- [ ] Improved data
- [ ] Floodway revision
- [X] Other Highway 95 has been constructed.
  Explain _____

2. Flooding Source: Rancho Drive
3. Project Name/Identifier: Northwest Las Vegas FIS Restudy
4. FEMA zone designations affected: A
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	325276	City of Las Vegas	Clark	NV	325276	0015C	10/18/83

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding
- [ ] Riverine
- [ ] Coastal
- [ ] Alluvial Fan
- [X] Shallow Flooding *(e.g. Zones AO and*
- [ ] Lakes

Affected by wind/wave action
- [ ] Yes
- [X] No

- [ ] Other *(describe)* _____

Structures
- [ ] Channelization
- [ ] Levee/Floodwall
- [X] Bridge/Culvert
- [ ] Dam
- [ ] Coastal
- [ ] Fill
- [ ] Pump Station
- [ ] None
- [ ] Channel Relocation
- [ ] Excavation
- [ ] Other *(describe)*

Disciplines*
- [X] Water Resources
  - [X] Hydrology
  - [X] Hydraulics
  - [ ] Sediment Transport
  - [ ] Interior Drainage
- [ ] Structural
- [ ] Geotechnical
- [ ] Land Surveying
- [ ] Other *(describe)*

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? [ ] Yes [X] No
8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? [ ] Yes [X] No
   If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

☐ Yes ☒ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways: N/A

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☐ Yes ☒ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☐ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☐ Yes ☒ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? ☐ Yes ☒ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

3. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)?

☐ Yes ☒ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by _____ (entity)

_____ with a maximum interval of _____ months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by _____ (entity)

to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☐ has ☐ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☐ performing ☐ overseeing compliance with the maintenance and operation plans of the _____
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. 1, Parts 60, 65, and 72)*.

_X_b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

_____

_____

8. FORMS INCLUDED

17. *Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.*

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	☒ Hydrologic Analysis Form (Form 3) - Refer to Technical Data Notebook - Appendix III
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☐ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☐ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☐ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☐ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☐ Yes ☒ No

Initial fee amount: $ EXEMPT

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ VISA ☐ MASTERCARD **CARD NUMBER**

Check or money order only.

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Signature of Revision Requestor

Paul W.R. Hoskin, Vice President
Printed Name and Title of Revision Requestor

Coe & Van Loo Consultants, Inc.
Company Name

8/26/94
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

Signature of Community Official

Printed Name and Title of Community Official

Community Name

Date

Does this request impact any other communities? ☒ Yes ☐ No
City of Las Vegas. Refer to Community Concurrence Letter

yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148 Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

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1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in hydrology and hydraulics
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 14 years experience in the expertise listed above.
4. I have ☒ prepared ☐ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Hydrologic, hydraulic & floodplain analyses
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☐ Examined plans and specifications and compared with completed projects.
   d. ☒ Other Compiled and reviewed plans and design reports
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Paul W.R. Hoskin, P.E.
(please print or type)

Title: Vice President
(please print or type)

Registration No. 8845

Expiration Date: _____

State Nevada

Type of License Civil

Signature

8/26/94
Date

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
PAUL W.R. HOSKIN
CIVIL

Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

Project NWLVFIS
Project No.
Sheet No. of
Calculated by Date

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

[illegible] / Rancho

CROSS SECTION PARAMETERS: FILENAME: LMA1.SEC

No. of Cross Section Points:	5	Bed Slope:	0.00500	Max Elev:	2311.0
Bank Stations.....Left:	1000.0	Right....:	1075.0	Min Elev:	2309.2
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.045	CHANNEL..:	0.035	ROB.....:	0.045

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2311.0	1000.0	2)	2310.0	1026.0	3)	2309.2	1042.0	4)	2310.0	1058.0
5)	2310.8	1075.0									

COMPUTED PARAMETERS:

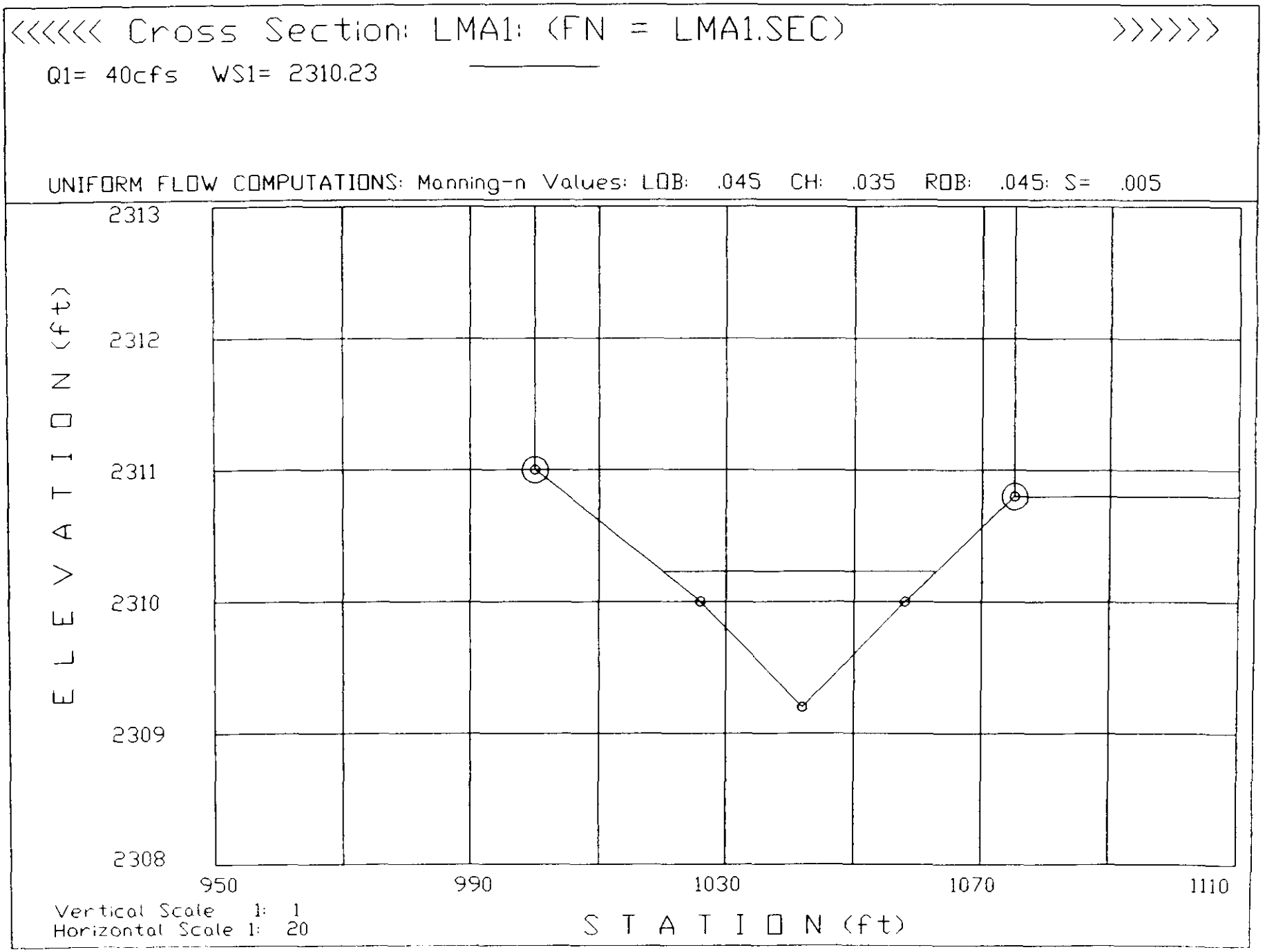
WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
2309.80	9.7	1.3	0.433	0.035	0.3	24.0	7.2	24.0
2310.00	20.8	1.6	0.454	0.035	0.4	32.0	12.8	32.0
2310.20	37.4	1.9	0.469	0.035	0.5	41.4	20.1	41.5
2310.40	61.1	2.1	0.482	0.035	0.6	50.9	29.4	51.0
2310.60	93.2	2.3	0.495	0.035	0.7	60.4	40.5	60.4
2310.80	134.5	2.5	0.506	0.035	0.8	69.8	53.5	69.9

NOTES:

x100 = 40 cfs

D_{max} = 0.5' < 1'

Zone X


<<<<<< Cross Section: LMA1: (FN = LMA1.SEC) >>>>>>
Q1= 40cfs WS1= 2310.23
UNIFORM FLOW COMPUTATIONS: Manning-n Values: LOB: .045 CH: .035 ROB: .045: S= .005
2313
2312
2311
2310
2309
2308
ELEVATION (ft)
950
990
1030
1070
1110
STATION (ft)
Vertical Scale 1: 1
Horizontal Scale 1: 20

Project NWLVFIS
Project No.
Sheet No. of
Calculated by Date

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

core / Rancho

CROSS SECTION PARAMETERS: FILENAME: LMA2.SEC

No. of Cross Section Points:	7	Bed Slope:	0.00900	Max Elev:	2307.0
Bank Stations.....Left:	1090.0	Right....:	1200.0	Min Elev:	2305.7
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.045	CHANNEL..:	0.035	ROB.....:	0.045

CROSS SECTION POINTS:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	2307.0	1000.0	2)	2306.0	1090.0	3)	2305.8	1110.0	4)	2305.7	1160.0
5)	2306.0	1200.0	6)	2306.0	1225.0	7)	2307.0	1310.0			

COMPUTED PARAMETERS:

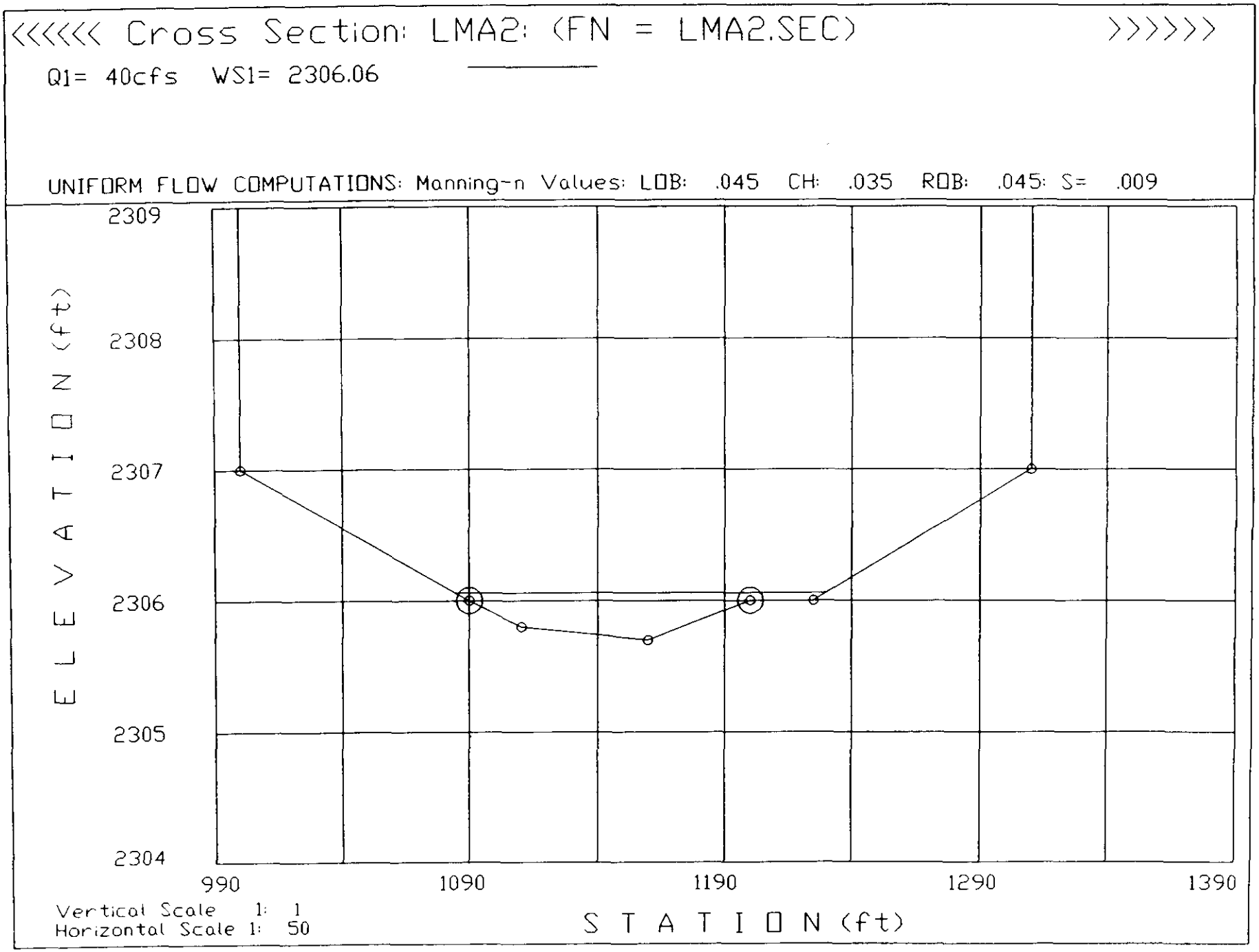
WSEL	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)
2305.90	9.6	1.0	0.496	0.035	0.1	86.1	10.0	86.1
2306.00	25.5	1.3	0.534	0.035	0.2	110.0	19.8	110.0
2306.10	49.5	1.4	0.537	0.036	0.2	152.5	34.2	152.5
2306.20	85.7	1.7	0.551	0.037	0.3	170.0	50.3	170.0
2306.30	131.2	1.9	0.562	0.037	0.4	187.5	68.2	187.5
2306.40	185.9	2.1	0.570	0.038	0.4	205.0	87.8	205.0

NOTES:

$Q_{100} = 40$ cfs

$D = 0.2 < 1'$

Zone X


<<<<<< Cross Section: LMA2: (FN = LMA2.SEC) >>>>>>
Q1= 40cfs WS1= 2306.06
UNIFORM FLOW COMPUTATIONS: Manning-n Values: LOB: .045 CH: .035 ROB: .045: S= .009
2309
2308
2307
2306
2305
2304
ELEVATION (ft)
990
1090
1190
1290
1390
STATION (ft)
Vertical Scale 1: 1
Horizontal Scale 1: 50

Project CHILVERS
Project No.
Sheet No. of
Calculated by Date

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Lone Mountain / Ranch 2

CROSS SECTION PARAMETERS: FILENAME: LMA3.SEC

No. of Cross Section Points:	12	Bed Slope:	0.00280	Max Elev.:	17.80
Bank Stations.....Left:	1100.0	Right....:	1430.0	Min Elev.:	15.35
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.055	CHANNEL..:	0.040	ROB.....:	0.055

CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	16.20	1000.00	2)	16.00	1100.00	3)	15.86	1212.00
4)	15.35	1250.00	5)	15.50	1295.00	6)	15.70	1365.00
7)	16.00	1430.00	8)	16.10	1440.00	9)	16.00	1450.00
10)	15.75	1505.00	11)	16.00	1560.00	12)	17.80	1650.00

COMPUTED PARAMETERS:

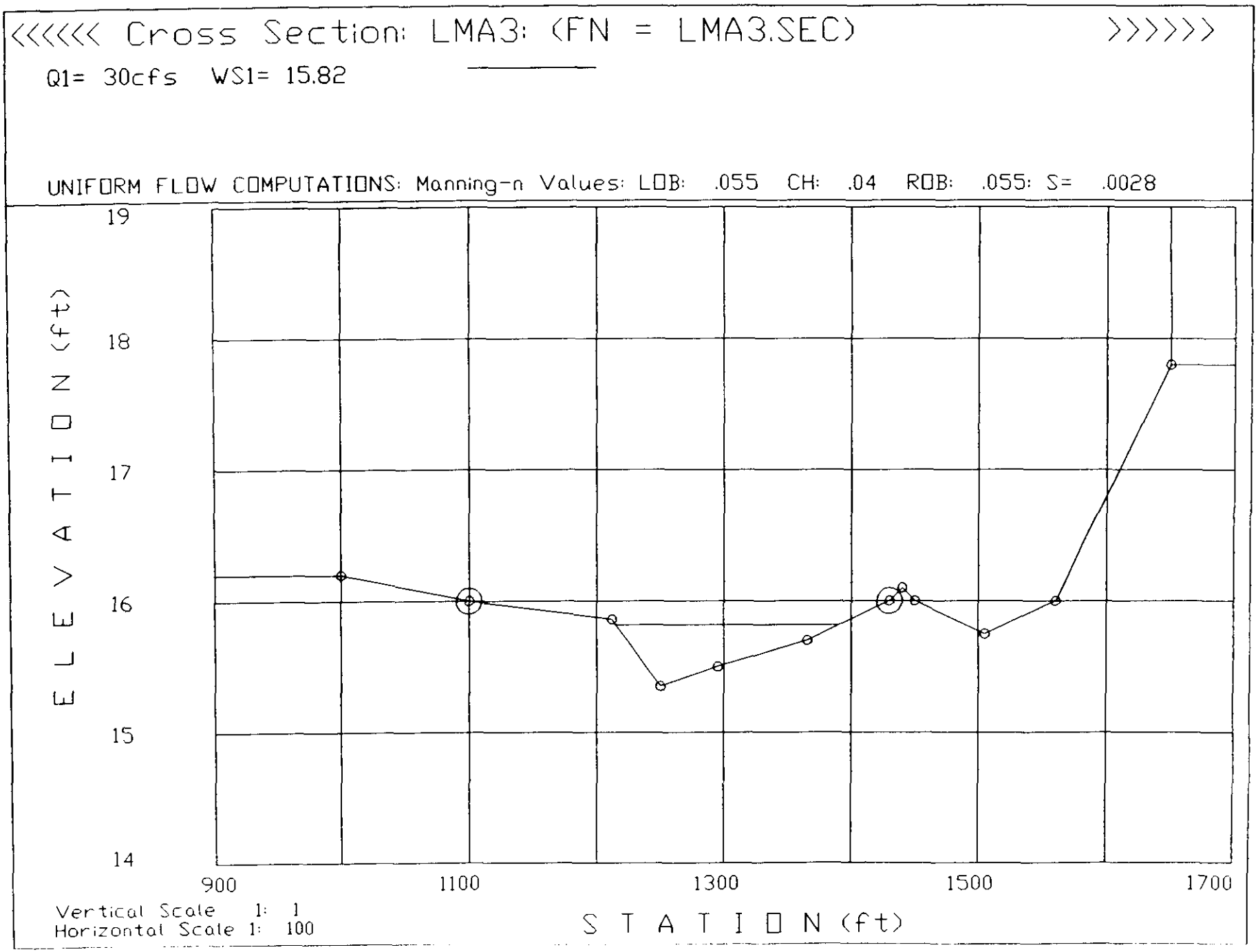
WSEL(ft)	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	CRWS(ft)
15.60	5.8	0.5	0.24	0.040	0.1	98.6	12.0	98.6	15.49
15.80	27.5	0.7	0.27	0.040	0.2	192.2	40.1	192.2	15.61
16.00	69.6	0.7	0.26	0.042	0.2	440.0	100.2	440.0	15.73

NOTES:

$Q_{100} = 30$ cfs

$D = 0.2' < 1'$

Fine X


<<<<<< Cross Section: LMA3: (FN = LMA3.SEC) >>>>>>
Q1= 30cfs WS1= 15.82
UNIFORM FLOW COMPUTATIONS: Manning-n Values: LOB: .055 CH: .04 ROB: .055: S= .0028
ELEVATION (ft)
19
18
17
16
15
14
900
1100
1300
1500
1700
STATION (ft)
Vertical Scale 1: 1
Horizontal Scale 1: 100

Project NWLVFIS
Project No.
Sheet No. of
Calculated by Date

UNIFORM FLOW COMPUTATIONS Lone Mtn / Rancho

LOCATION/DESCRIPTION:
Approximately 730' South of Rancho Dr.
— ditch along Lone Mtn road

CROSS SECTION PARAMETERS: FILENAME: LMA4.SEC

No. of Cross Section Points:	4	Bed Slope:	0.00250	Max Elev.:	14.30
Bank Stations.....Left:	1020.0	Right....:	1140.0	Min Elev.:	12.70
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.040	CHANNEL..:	0.035	ROB.....:	0.035

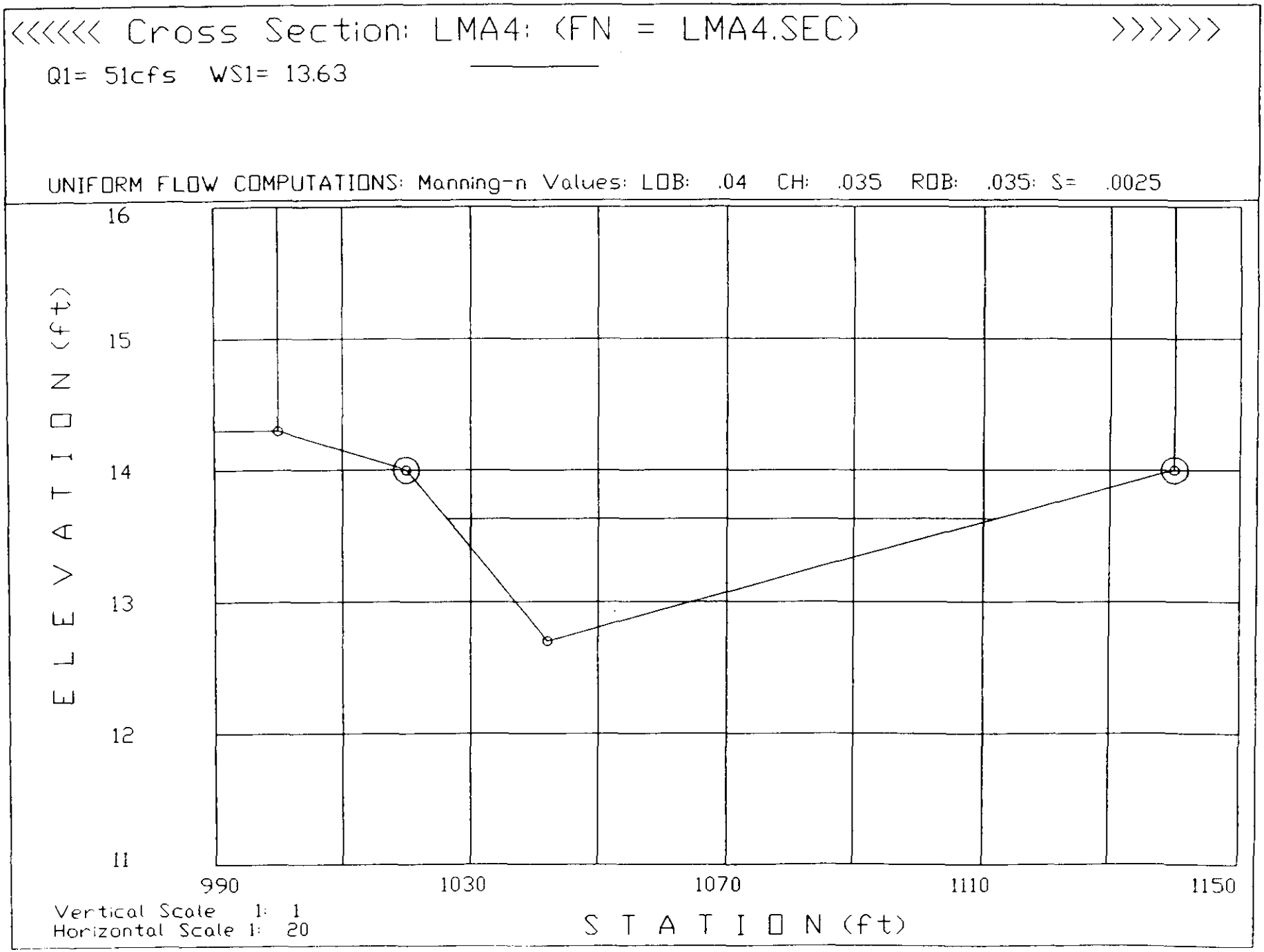
CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	14.30	1000.00	2)	14.00	1020.00	3)	12.70	1042.00
4)	14.00	1140.00						

COMPUTED PARAMETERS:

WSEL(ft)	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	CRWS(ft)
13.40	23.8	1.1	0.31	0.035	0.3	64.6	22.6	64.6	13.14
13.60	46.6	1.2	0.33	0.035	0.5	83.1	37.4	83.1	13.27
13.80	79.6	1.4	0.34	0.035	0.6	101.5	55.8	101.6	13.41
14.00	124.2	1.6	0.35	0.035	0.7	120.0	78.0	120.0	13.55

NOTES:
Q_{100} = 51 cfs
Avg D = 0.5' < 1'
Zone X


<<<<<< Cross Section: LMA4: (FN = LMA4.SEC) >>>>>>
Q1= 51cfs WS1= 13.63
UNIFORM FLOW COMPUTATIONS: Manning-n Values: LOB: .04 CH: .035 ROB: .035: S= .0025
ELEVATION (ft)
16
15
14
13
12
11
990
1030
1070
1110
1150
STATION (ft)
Vertical Scale 1: 1
Horizontal Scale 1: 20

Project 1/WLVFRS
Project No.
Sheet No. of
Calculated by Date

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Lone Mountain / Rancho

CROSS SECTION PARAMETERS: FILENAME: LMA5.SEC

No. of Cross Section Points:	21	Bed Slope:	0.01500	Max Elev.:	302.60
Bank Stations.....Left:	1000.0	Right....:	1995.0	Min Elev.:	299.40
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.055	CHANNEL..:	0.040	ROB.....:	0.055

CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	302.00	1000.00	2)	301.60	1090.00	3)	300.70	1180.00
4)	302.00	1260.00	5)	302.20	1285.00	6)	302.00	1320.00
7)	301.30	1390.00	8)	300.90	1470.00	9)	302.00	1495.00
10)	302.60	1530.00	11)	302.00	1560.00	12)	300.00	1610.00
13)	301.00	1640.00	14)	300.00	1670.00	15)	299.40	1715.00
16)	300.00	1760.00	17)	301.00	1780.00	18)	300.00	1795.00
19)	299.90	1805.00	20)	300.00	1820.00	21)	302.00	1995.00

COMPUTED PARAMETERS:

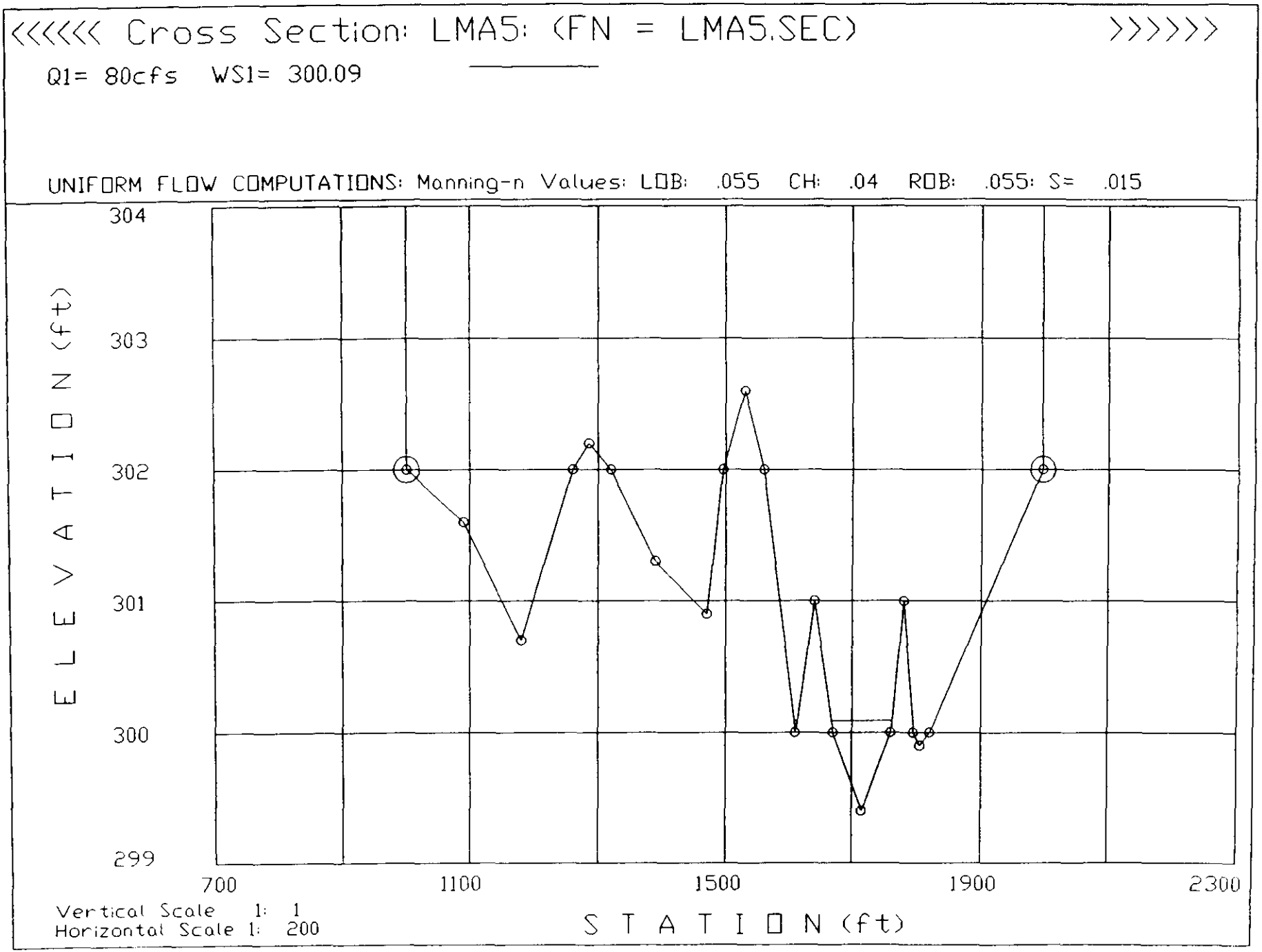
WSEL(ft)	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	CRWS(ft)
300.20	126.1	2.3	0.67	0.040	0.4	156.5	55.4	156.5	300.10
300.00	50.4	1.8	0.63	0.040	0.2	115.0	28.3	115.0	299.89
299.80	18.7	1.6	0.61	0.040	0.2	60.0	12.0	60.0	299.73

NOTES:

$Q_{100} = 80$

$\Delta = 0.3' < 1'$

Zone X


<<<<<< Cross Section: LMA5: (FN = LMA5.SEC) >>>>>>
Q1= 80cfs WS1= 300.09
UNIFORM FLOW COMPUTATIONS: Manning-n Values: LOB: .055 CH: .04 ROB: .055: S= .015
304
303
302
301
300
299
ELEVATION (ft)
700
1100
1500
1900
2300
STATION (ft)
Vertical Scale 1: 1
Horizontal Scale 1: 200

Project_____
Project No._____
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Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Lone Mountain / Rancho

CROSS SECTION PARAMETERS: FILENAME: LMA6.SEC

No. of Cross Section Points:	9	Bed Slope:	0.01500	Max Elev.:	80.00
Bank Stations.....Left:	1000.0	Right....:	1620.0	Min Elev.:	78.30
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.045	CHANNEL..:	0.045	ROB.....:	0.045

CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	80.00	1000.00	2)	79.30	1080.00	3)	79.50	1178.00
4)	79.20	1270.00	5)	79.60	1320.00	6)	79.75	1355.00
7)	78.30	1490.00	8)	78.80	1530.00	9)	80.00	1620.00

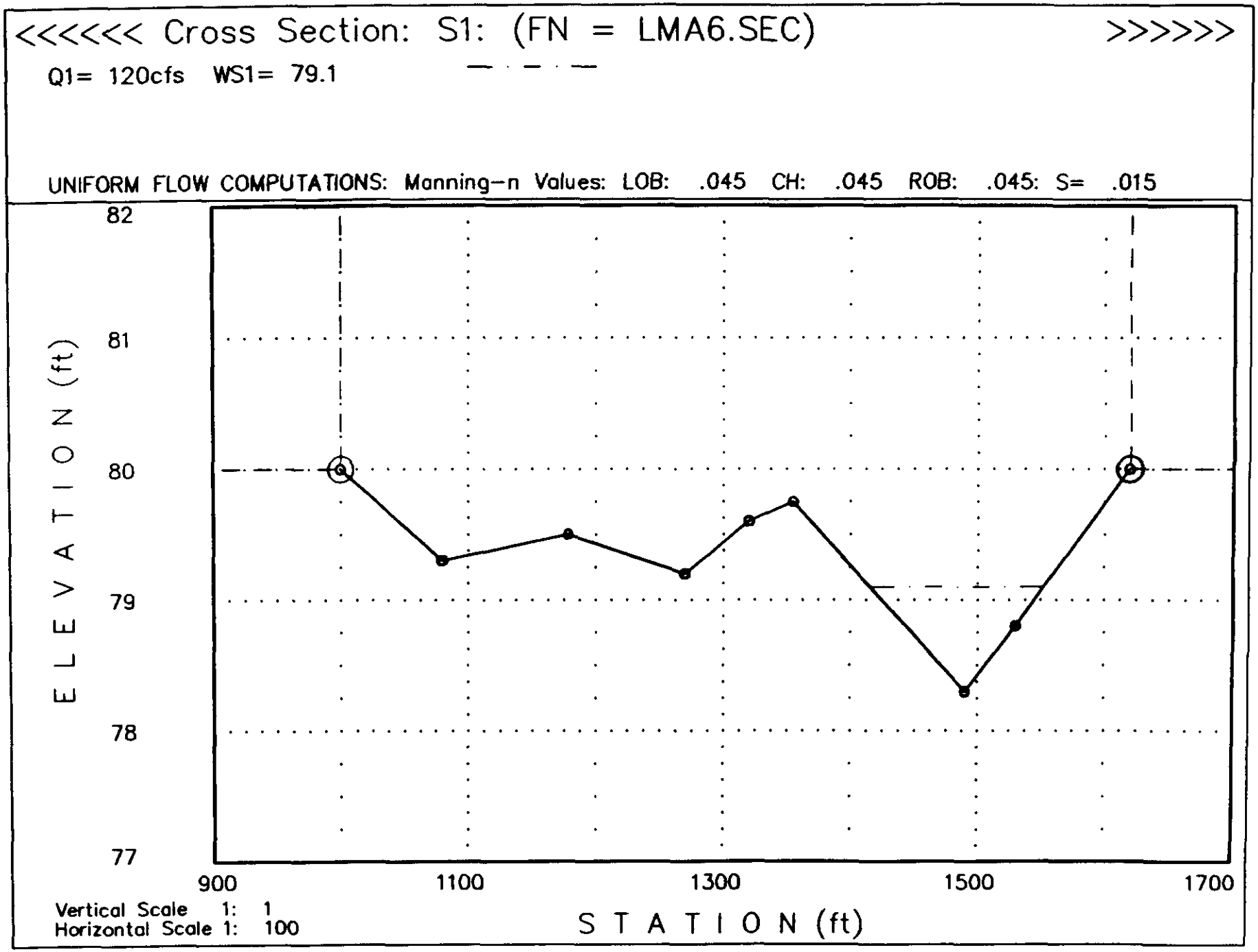
COMPUTED PARAMETERS:

WSEL(ft)	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	CRWS(ft)
78.91	60.0	1.8	0.59	0.045	0.3	105.6	32.5	105.6	78.62
78.98	80.0	2.0	0.60	0.045	0.3	117.3	40.3	117.4	78.72
79.04	100.0	2.1	0.60	0.045	0.4	127.4	47.6	127.4	78.79
79.10	120.0	2.2	0.61	0.045	0.4	136.3	54.6	136.3	78.85
79.14	140.0	2.3	0.62	0.045	0.4	144.3	61.3	144.3	78.91
79.19	160.0	2.4	0.62	0.045	0.4	151.6	67.7	151.6	78.95

NOTES:

$Q_{100} = 120$ cfs

$V_{max} = 2.4' < 1'$


<<<<<< Cross Section: S1: (FN = LMA6.SEC) >>>>>>
Q1= 120cfs WS1= 79.1
UNIFORM FLOW COMPUTATIONS: Manning-n Values: LOB: .045 CH: .045 ROB: .045: S= .015
82
81
80
79
78
77
ELEVATION (ft)
900
1100
1300
1500
1700
STATION (ft)
Vertical Scale 1: 1
Horizontal Scale 1: 100

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Cross Section LMA 7

Lone Mountain Road

CROSS SECTION PARAMETERS: FILENAME: STREET.SEC

No. of Cross Section Points:	13	Bed Slope:	0.00400	Max Elev.:	100.13
Bank Stations.....Left:	7.0	Right....:	93.0	Min Elev.:	99.47
Encroachment Stations..Left:	0.0	Right....:	100.0		
Manning-n Values.....LOB:	0.020	CHANNEL..:	0.018	ROB.....:	0.020

CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	100.00	0.00	2)	99.97	5.00	3)	99.97	5.50
4)	99.47	5.67	5)	99.47	7.00	6)	99.92	29.00
7)	100.13	50.00	8)	99.92	71.00	9)	99.47	93.00
10)	99.47	94.33	11)	99.97	94.50	12)	99.97	95.00
13)	100.00	100.00						

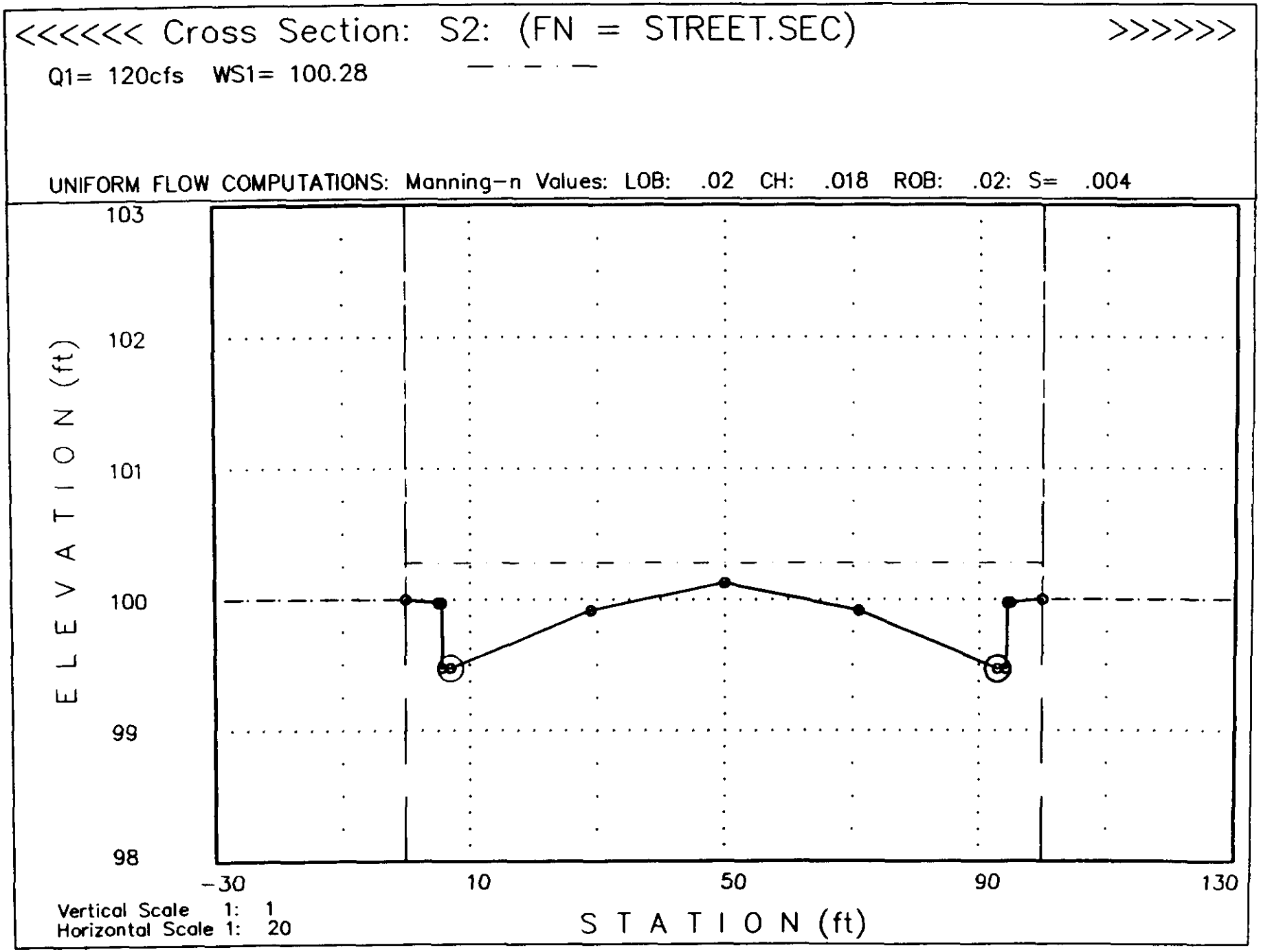
COMPUTED PARAMETERS:

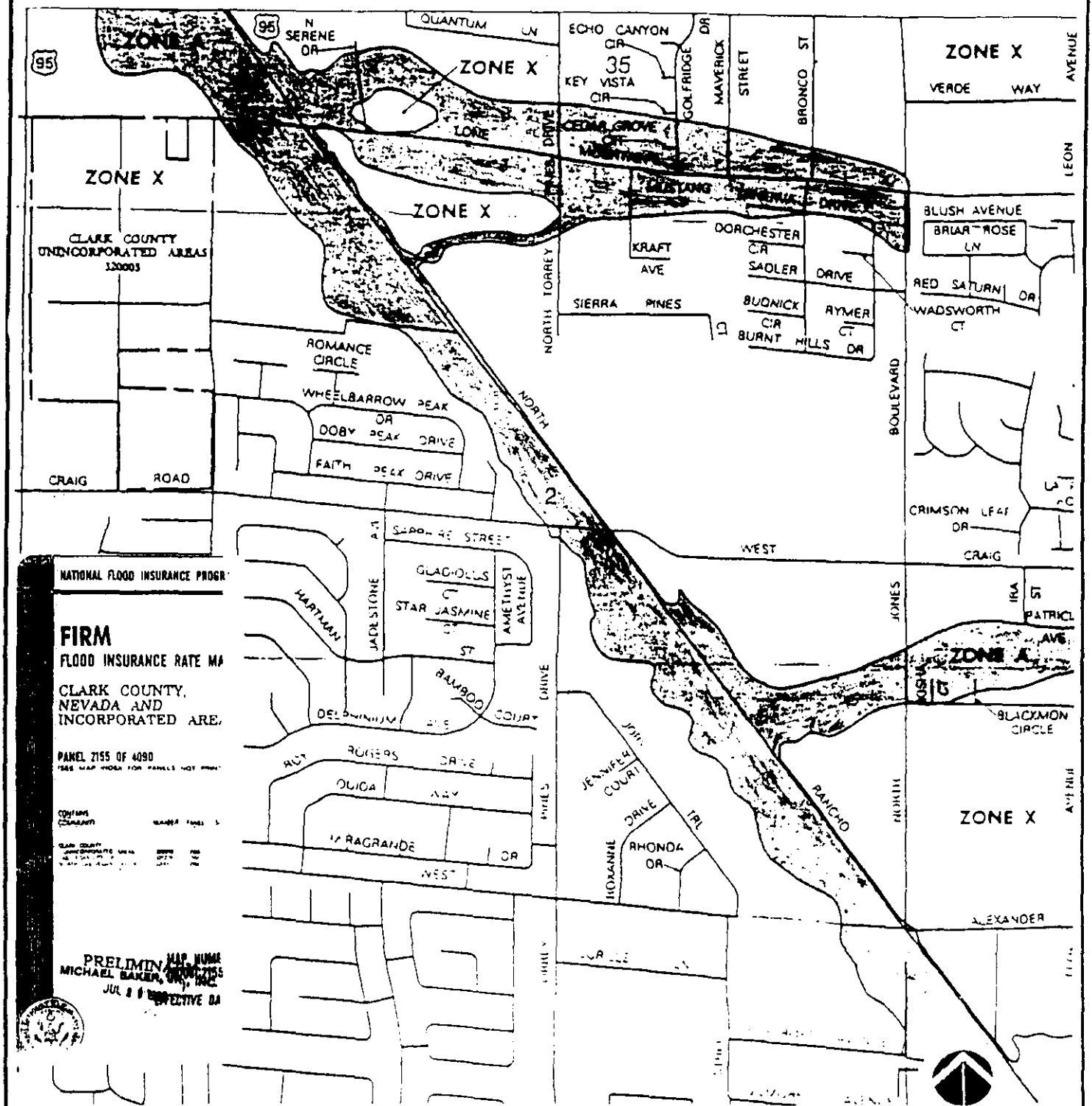
WSEL(ft)	Q(cfs)	V(fps)	Fr No.	ne	ALPHA	TW(ft)	A(sf)	WP(ft)	CRWS(ft)
100.28	120.0	2.9	0.78	0.018	1.0	100.0	41.9	100.7	100.22

NOTES:

Depth = 0.81'

Depth < 1' therefore zone "X"


<<<<<< Cross Section: S2: (FN = STREET.SEC) >>>>>>
Q1= 120cfs WS1= 100.28
UNIFORM FLOW COMPUTATIONS: Manning-n Values: LOB: .02 CH: .018 ROB: .02: S= .004
ELEVATION (ft)
103
102
101
100
99
98
-30
10
50
90
130
STATION (ft)
Vertical Scale 1: 1
Horizontal Scale 1: 20



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LANDSCAPE ARCHITECTURE

NORTHWEST LAS VEGAS
F.I.S. RESTUDY
D - FIRM

Section 9

Section 9
Craig Road/Rancho Drive

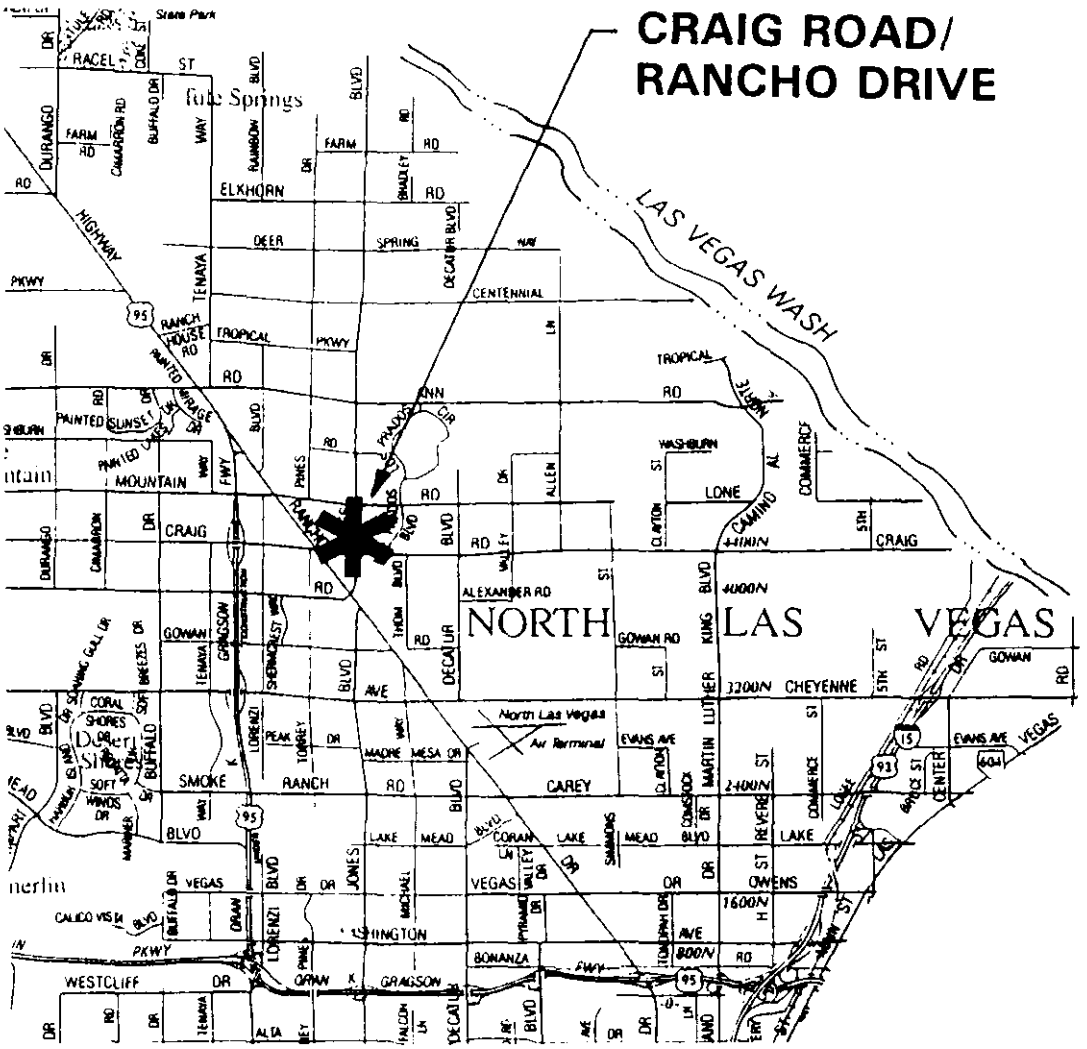
REQUEST FOR LOMR
Craig Road/Rancho Drive

The purpose of this revision is to eliminate an existing Zone "A", east of Rancho and Craig Road intersection. The Zone "A" is located in Sections 1 and 2, T20S, R60E, FIRM No. 325760015C.

The Craig Road storm drain system was constructed as a part of the Regional Transportation Commission's (RTC) Craig Road Project. The project was funded by RTC and sponsored by the City of Las Vegas and its purpose was to widen the existing road and to reduce flooding along Rancho Drive. The design was started and largely finished by Hefner Engineering but was finalized by the City of Las Vegas. The construction of the Craig Road storm drain system has recently been completed.

The Craig Road storm drain system intercepts and conveys the 100-year discharge at the intersection of Craig Road and Rancho Drive to east. No flow continues south along Rancho Drive past Craig Road. Only minor local runoff impacts the area along Rancho Drive between Craig Road and Alexander Road. Therefore, the flow which used to impact the subjected area, currently designated as Zone "A", has been eliminated.

Refer to the detailed hydraulic analysis in Appendix IV and the design related information for Craig Road storm drain contained in Appendix II - Section 6.



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LOCATION MAP

JOB # 930017 6/94

FEDERAL EMERGENCY MANAGEMENT AGENCY

REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148 Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*

- ☐ Physical change
  - ☐ Existing
  - ☐ Proposed
- ☐ Improved methodology
- ☒ Improved data
- ☐ Floodway revision
- ☒ Other Craig Road storm drain system has been constructed.

Explain _____

2. Flooding Source: Rancho Drive

3. Project Name/Identifier: Northwest Las Vegas FIS Restudy

4. FEMA zone designations affected: A

(example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)

5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	325276	City of Las Vegas	Clark	NV	325276	0015C	10/18/83

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding

- ☐ Riverine
- ☐ Coastal
- ☐ Alluvial Fan
- ☒ Shallow Flooding *(e.g. Zones AO and*
- ☐ Lakes

Affected by wind/wave action

- ☐ Yes
- ☒ No

- ☐ Other *(describe)* _____

Structures

- ☐ Channelization
- ☐ Levee/Floodwall
- ☐ Bridge/Culvert
- ☐ Dam
- ☐ Coastal
- ☐ Fill
- ☐ Pump Station
- ☐ None
- ☐ Channel Relocation
- ☐ Excavation
- ☒ Other *(describe)*

Storm drain

Disciplines*

- ☒ Water Resources
  - ☒ Hydrology
  - ☒ Hydraulics
  - ☐ Sediment Transport
  - ☐ Interior Drainage
- ☐ Structural
- ☐ Geotechnical
- ☐ Land Surveying
- ☐ Other *(describe)*

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ☐ Yes ☒ No

8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? ☐ Yes ☒ No

If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

☐ Yes ☒ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☐ Yes ☒ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☐ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☐ Yes ☒ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? ☐ Yes ☒ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? ☐ Yes ☒ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by _____ (entity)

_____ with a maximum interval of _____ months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by _____ (entity)

to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☐ has ☐ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☐ performing ☐ overseeing compliance with the maintenance and operation plans of the _____
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

_X_b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

17. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	☒ Hydrologic Analysis Form (Form 3) - Refer to Technical Notebook - Appendix III
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☐ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☐ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☐ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☐ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☐ Yes ☒ No

Initial fee amount: $ EXEMPT

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ VISA ☐ MASTERCARD **CARD NUMBER**

Check or money order only.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all *information submitted in support of this request is correct.*

Signature of Revision Requestor

Paul W.R. Hoskin, Vice President
Printed Name and Title of Revision Requestor

Coe & Van Loo Consultants, Inc.
Company Name

8/26/94
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

Signature of Community Official

Printed Name and Title of Community Official

Community Name

Date

Does this request impact any other communities? ☐ Yes ☒ No

yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148
Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in hydrology and hydraulics
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 14 years experience in the expertise listed above.
4. I have ☒ prepared ☐ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Hydrologic, hydraulic & floodplain analyses
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☐ Examined plans and specifications and compared with completed projects.
   d. ☒ Other Compiled and reviewed plans and design reports
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Paul W.R. Hoskin, P.E.
(please print or type)

Title: Vice President
(please print or type)

Registration No. 8845

Expiration Date:

State Nevada

Type of License Civil

Signature

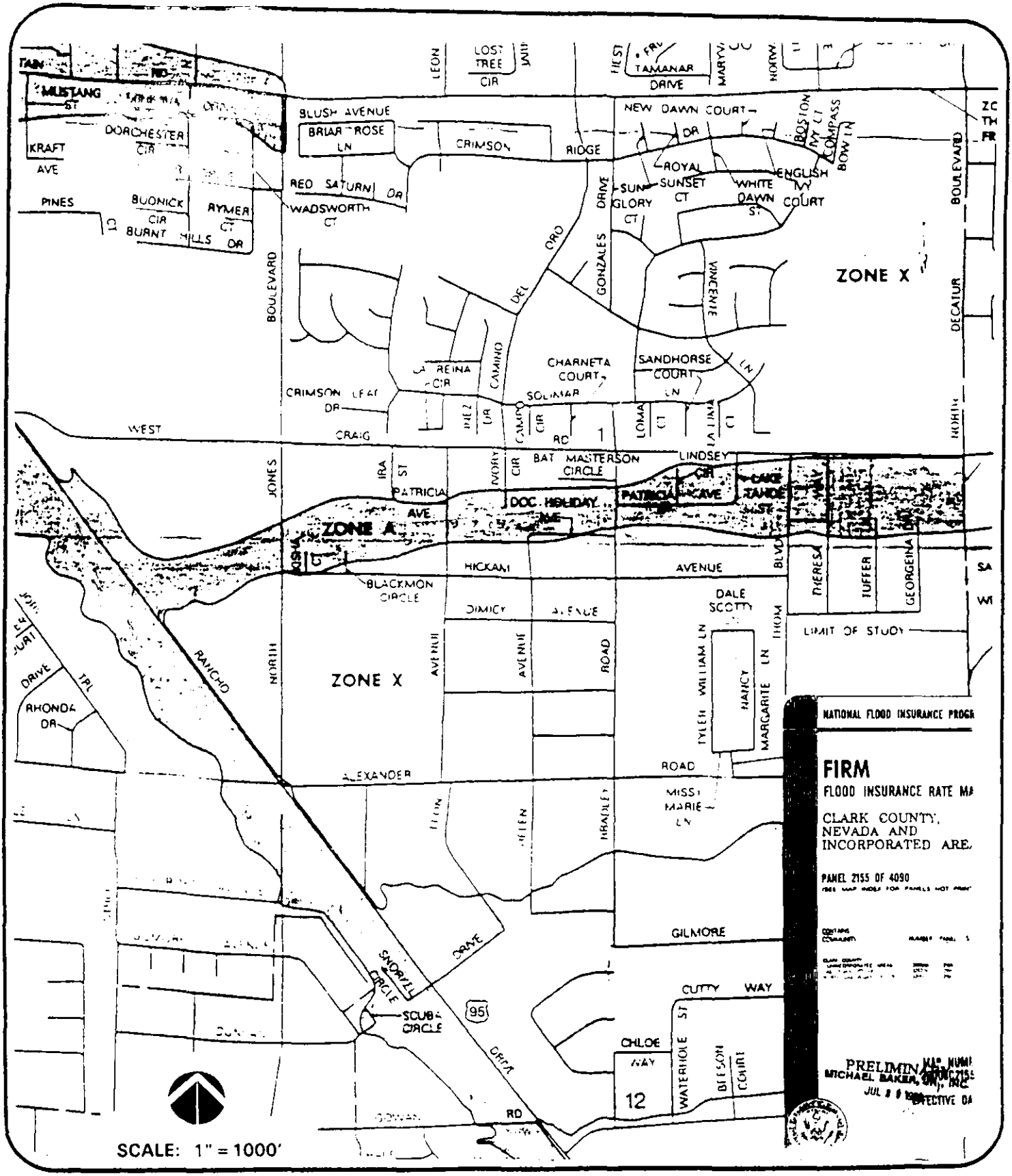
8/26/94
Date

REGISTERED PROFESSIONAL ENGINEER · STATE OF NEVADA
PAUL W.R. HOSKIN
CIVIL
No. 8845

Seal
(Optional)

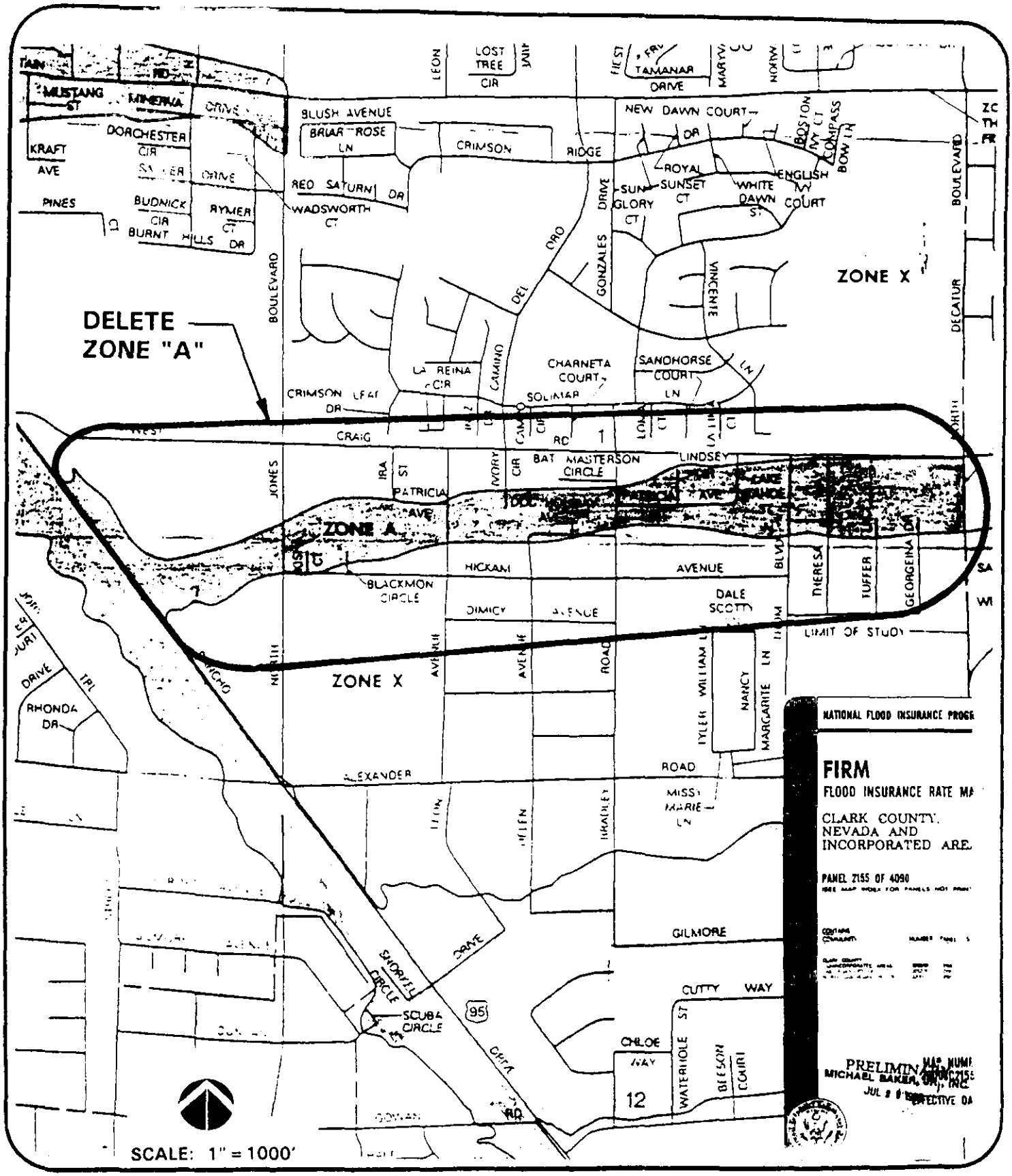
*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.



COE & VAN LOO
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

NORTHWEST LAS VEGAS
F.I.S. RESTUDY
D - FIRM



COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE

NORTHWEST LAS VEGAS
F.I.S. RESTUDY
ANNOTATED D - FIRM

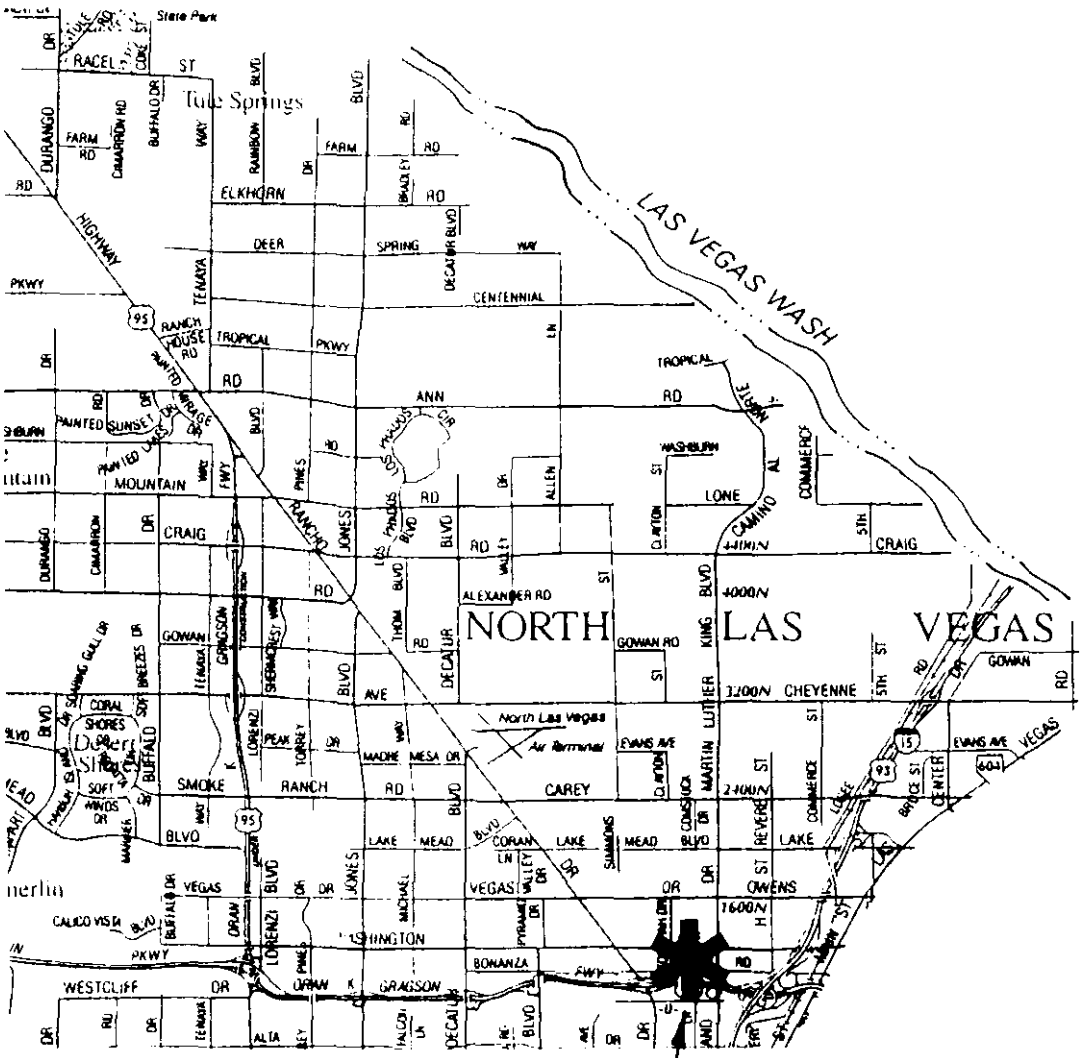
Section 10
Washington Avenue

REQUEST FOR LOMR
Washington Avenue

The existing Zone "AO" is located in Sections 20, 27, 28 and 29, Township 20 South, Range 61 East, D-Firm Numbers 2155, 2160, and 2170 as shown on enclosed maps. Rapid urban development and construction of upstream flood control facilities have resulted in a reduction of the magnitude of flooding in the subject area. The purpose of this revision is to redelineate and revise the flood zones within the area. Flow that collects west of Rancho Drive breaks out over Rancho Drive and flows to the east.

Two HEC-2 models were created to analyze the flood hazards in the area north of Highway 95 and south of Vegas Drive between Rancho Drive and Interstate 15. The first HEC-2 model analyzes the flow between Vegas Drive and Bonanza Road. This model is run using the tributary option to evaluate the separated flow north and south of Washington Avenue. This model indicates that the average depth in this area is less than one foot, and therefore should be delineated as a Zone "X". The second HEC-2 model analyzes the flow between Bonanza Drive and Highway 95.

Results from the HEC-2 analysis indicate that the flood zone, currently designated as Zone "AO" has an average depth of less than one foot. A change to Zone "X" is therefore requested with the boundary changes as indicated on the attached exhibit and annotated D-FIRM. South of Bonanza Drive, the results indicate that a new flood zone exists with average depths over one foot. It is requested that this area be designated as Zone "A".



N.T.S.

COE & VAN LOO
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

LOCATION MAP

JOB # 930017 6/94

FEDERAL EMERGENCY MANAGEMENT AGENCY

REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM

O.M.B. Burden No. 3067-0148 Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*

- ☐ Physical change
  - ☐ Existing
  - ☐ Proposed
- ☐ Improved methodology
- ☒ Improved data
- ☐ Floodway revision
- ☐ Other _____

Explain _____

2. Flooding Source: Rancho Drive
3. Project Name/Identifier: Northwest Las Vegas FIS Restudy
4. FEMA zone designations affected: A

(example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)

5. The NFIP map panel(s) affected for all impacted communities is (are):

	Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX:	480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
	480287	Harris County	Harris	TX	48201C	0220G	09/28/90
	325276	City of Las Vegas	Clark	NV	325276	0020C	10/18/83
	325276	City of Las Vegas	Clark	NV	325276	0025C	10/18/83
	320003	Clark County	Clark	NV	320003	1000B	9/29/89

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding

- ☐ Riverine
- ☐ Coastal
- ☐ Alluvial Fan
- ☒ Shallow Flooding *(e.g. Zones AO and*
- ☐ Lakes

Affected by wind/wave action

- ☐ Yes
- ☒ No

- ☐ Other *(describe)* _____

Structures

- ☐ Channelization
- ☐ Levee/Floodwall
- ☐ Bridge/Culvert
- ☐ Dam
- ☐ Coastal
- ☐ Fill
- ☐ Pump Station
- ☐ None
- ☐ Channel Relocation
- ☐ Excavation
- ☐ Other *(describe)*

Disciplines*

- ☒ Water Resources
  - ☒ Hydrology
  - ☒ Hydraulics
  - ☐ Sediment Transport
  - ☐ Interior Drainage
- ☐ Structural
- ☐ Geotechnical
- ☐ Land Surveying
- ☐ Other *(describe)*

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ☐ Yes ☒ No
8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM? ☐ Yes ☒ No

If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?

☐ Yes ☒ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☐ Yes ☒ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☐ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☐ Yes ☒ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)*? ☐ Yes ☐ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGEMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGEMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgement and/or notification is required for all requests as outlined in Section 65.4(b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g. levees, floodwalls, channelization, basins, dams)? ☒ Yes ☐ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by _____ (entity)

_____ with a maximum interval of _____ months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by _____ (entity)

to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☐ has ☐ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☐ performing ☐ overseeing compliance with the maintenance and operation plans of the _____
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A Guide for Community Officials," dated January 1990, this request is for a:

____a. CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.

__X__b. LOMR A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____c. PMR A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. 1, Parts 60 and 65.)*

____d. Other: Describe _____

8. FORMS INCLUDED

17. Form 2 entitled "Certification by Registered Professional Engineer And/Or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

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• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☐ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☐ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☐ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☐ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☐ Yes ☒ No

Initial fee amount: $ EXEMPT

METHOD OF PAYMENT (Check one box)

☐ **PAYMENT ENCLOSED** ☐ VISA ☐ MASTERCARD **CARD NUMBER**

Check or money order only. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Make payable to
National Flood Insurance Program

EXP. Date ☐☐☐☐

Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Signature of Revision Requestor

Paul W.R. Hoskin, Vice President
Printed Name and Title of Revision Requestor

Coe & Van Loo Consultants, Inc.
Company Name

8/26/94
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

Signature of Community Official

Printed Name and Title of Community Official

Community Name

Date

Does this request impact any other communities? ☐ Yes ☒ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY
CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM

O.M.B. Burden No. 3067-0148 Expires July 31, 1994

FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

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1. This certification is in accordance with 44 CFR Ch. I, Section 65.2.
2. I am licensed with an expertise in hydrology and hydraulics
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)**, structural, geotechnical, land surveying.]
3. I have 14 years experience in the expertise listed above.
4. I have ☒ prepared ☐ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and/or designs, is/are being certified:
   Hydrologic, hydraulic & floodplain analyses
7. Based upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☐ Examined plans and specifications and compared with completed projects.
   d. ☒ Other Compiled and reviewed plans and design reports
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Paul W.R. Hoskin, P.E.
(please print or type)

Title: Vice President
(please print or type)

Registration No. 8845

Expiration Date:

State Nevada

Type of License Civil

Signature

8/26/96
Date

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
PAUL W.R. HOSKIN
CIVIL
No. 8845

Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

H2WASH2.DAT

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*                                         *
   Version   4.6.0;  February 1991        *
                                          *
   RUN DATE     17AUG94     TIME    09:57:40  *
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*  U.S. ARMY CORPS OF ENGINEERS           *
*  HYDROLOGIC ENGINEERING CENTER          *
*  609 SECOND STREET, SUITE D             *
*  DAVIS, CALIFORNIA 95616-4687           *
*          (916) 756-1104                 *
*******************************************
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X     X  XXXXXXX   XXXXX              XXXXXXX
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THIS RUN EXECUTED 17AUG94 09:57:40

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HEC-2 WATER SURFACE PROFILES

Version 4.6.0; February 1991
****

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T2 BY COE & VAN LOO CONSULTANTS, INC DATE: AUG. 1994
T3 WASHINGTON AVE.

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J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
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J3 VARIABLE CODES FOR SUMMARY PRINTOUT

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	1	1010								
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GR	2013	1340	2012	1370	2011	1380	2011	1410	2012	1430
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GR	2013.5	2830	2012	2945	2010	2980	2009	3000	2009	3004
GR	2010	3020	2012	3065						
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GR	2034	1000	2033	1075	2033.8	1210	2033.2	1480	2033	1630
GR	2034	1740	2034.8	1780	2034	1830	2033.4	1925	2033.5	1990
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GR	2040.5	2100	2040	2140	2039.3	2170	2039.3	2205	2040	2235
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GR	2040	3335	2039.8	3360	2040	3400	2040.6	3470	2040	3585
GR	2040	3665	2039.6	3700	2039.6	3770	2040	3800	2040	3840
GR	2039.8	3930	2039.8	3965	2040	3980	2040.5	4055	2040	4140
GR	2040	4190	2040.5	4355	2040.5	4415	2040	4650	2039.7	4680
GR	2040	4710	2040.5	4790	2040	4880	2040	4940	2042	5120
NC	0.065	0.065	0.035	0.1	0.3					
QT	1	915								
X1	14	27	1000	4880	1700	1700	1700			
GR	2050.8	1000	2050.1	1280	2051.7	1580	2051.3	1840	2050	2230
GR	2048.7	2370	2049.3	2750	2050	2930	2052	3175	2052.1	3250
GR	2052	3300	2050	3410	2049.2	3430	2049	3475	2050	3735
GR	2050.6	3910	2050.6	4060	2050	4110	2049	4130	2048.8	4175
GR	2050	4190	2052	4230	2052.3	4320	2052	4435	2052	4700
GR	2051	4840	2052	4880						
QT	1	675								
ET		7.1					1700	3095		
NC	0.065	0.065	0.04	0.1	0.3					
X1	15	30	2365	2730	1600	1600	1600			
GR	2060	0	2059	75	2058.2	280	2058.5	340	2058.3	490
GR	2058.2	750	2058.5	865	2058	945	2059	1195	2059.8	1355
	2060	1450	2060.1	1565	2060.2	1635	2060.1	1685	2060.6	1700
	2060.6	1720	2060	1730	2059.8	1745	2060	1760	2060.5	1855
GR	2060.5	2040	2060.1	2180	2060.2	2270	2060	2365	2059.8	2425
GR	2059.9	2565	2059.8	2645	2060	2730	2060.8	2945	2061.5	3095
ET		7.1					2160	3640		
X1	16	24.0	2765	3100	1500	1500	1500			
GR	2075	1000	2074	1200	2072	1250	2070	1430	2068	1490
GR	2067.5	1580	2067.6	1755	2068	1890	2069	2030	2068.2	2140
GR	2068.2	2150	2069.3	2160	2069.3	2180	2068.9	2200	2068.9	2210
GR	2069.9	2345	2069.7	2565	2069.6	2765	2069.6	2950	2069.6	3100
GR	2069.4	3260	2070	3540	2071.2	3575	2071	3640		
ET		7.1					2360	3850		
X1	17	39.0	3230	3595	1200	1200	1200			
GR	2086.5	1000	2086	1140	2084.1	1155	2084.6	1175	2084	1190
GR	2083.8	1196	2084	1202	2085.2	1285	2085.6	1570	2086	1590
GR	2086.5	1635	2086	1670	2084	1680	2083	1700	2083	1730
GR	2084	1740	2084.6	1760	2084.5	2095	2084.8	2360	2084	2380
GR	2082.5	2390	2083.5	2420	2082.6	2450	2084	2600	2084.5	2660
GR	2084	2680	2082	2690	2084	2700	2086	2740	2082	2783
GR	2080	2955	2078.2	3230	2078	3360	2078.4	3480	2078.3	3595
GR	2078.6	3685	2078.6	3765	2079.8	3795	2079.8	3850		

QT	1	915								
NC	0.065	0.065	0.035	0.1	0.3					
X1	-14	27	1000	4880	1700	1700	1700			
GR	2050.8	1000	2050.1	1280	2051.7	1580	2051.3	1840	2050	2230
GR	2048.7	2370	2049.3	2750	2050	2930	2052	3175	2052.1	3250
GR	2052	3300	2050	3410	2049.2	3430	2049	3475	2050	3735
GR	2050.6	3910	2050.6	4060	2050	4110	2049	4130	2048.8	4175
GR	2050	4190	2052	4230	2052.3	4320	2052	4435	2052	4700
GR	2051	4840	2052	4880						
ET		7.1					0	1700		
QT	1	165								
NC	0.06	0.065	0.055	0.1	0.3					
X1	15.1	30	0	1450	1200	1200	1200			
GR	2060	0	2059	75	2058.2	280	2058.5	340	2058.3	490
GR	2058.2	750	2058.5	865	2058	945	2059	1195	2059.8	1355
GR	2060	1450	2061.1	1565	2060.2	1635	2060.1	1685	2060.2	1700
GR	2060.3	1720	2060	1730	2059.8	1745	2060	1760	2060.5	1855
GR	2060.5	2040	2060.1	2180	2060.2	2270	2060	2365	2059.8	2425
GR	2059.9	2565	2059.8	2645	2060	2730	2060.8	2945	2061.5	3095
NC	0.06	0.045	0.045	0.1	0.3					
ET		7.1					1000	2160		
X1	16.1	24.0	1490	1890	1600	1600	1600			
GR	2075	1000	2074	1200	2072	1250	2070	1430	2068	1490
GR	2067.5	1580	2067.6	1755	2068	1890	2069	2030	2068.2	2140
GR	2068.2	2150	2069.3	2160	2069.3	2180	2068.9	2200	2068.9	2210
	2069.9	2345	2069.7	2565	2069.6	2765	2069.6	2950	2069.6	3100
	2069.4	3260	2070	3540	2071.2	3575	2071	3640		
NC	0.065	0.065	0.035	0.1	0.3					
ET		7.1					1000	2360		
X1	17.1	39.0	1000	2360	1200	1200	1200			
GR	2086.5	1000	2086	1140	2084.1	1155	2084.6	1175	2084	1190
GR	2083.8	1196	2084	1202	2085.2	1285	2085.6	1570	2086	1590
GR	2086.5	1635	2086	1670	2084	1680	2083	1700	2083	1730
GR	2084	1740	2084.6	1760	2084.5	2095	2084.8	2360	2084	2380
GR	2082.5	2390	2083.5	2420	2082.6	2450	2084	2600	2084.5	2660
GR	2084	2680	2082	2690	2084	2700	2086	2740	2082	2783
GR	2080	2955	2078.2	3230	2078	3360	2078.4	3480	2078.3	3595
GR	2078.6	3685	2078.6	3765	2079.8	3795	2079.8	3850		
NC	0.05	0.05	0.04	0.1	0.3					
X1	18.1	13.0	1065	1545	920	920	920			
GR	2096	1000	2094	1065	2093.7	1120	2093.9	1165	2093.3	1235
GR	2093.3	1255	2094	1315	2094.3	1330	2094	1355	2093.6	1390
GR	2093.8	1455	2094	1545	2094.6	1620				

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 11.000

3265 DIVIDED FLOW

11.000	1.94	2010.94	.00	2011.00	2011.17	.22	.00	.00	2014.00
1010.0	.0	1010.0	.0	.0	267.4	.0	.0	.0	2012.00
.00	.00	3.78	.00	.000	.035	.000	.000	2009.00	1722.22
.013080	0.	0.	0.	0	0	5	.00	389.73	3041.25

CCHV= .100 CEHV= .300
*SECNO 12.000

3265 DIVIDED FLOW

12.000	.83	2033.83	.00	.00	2033.88	.05	22.69	.02	2034.00
1010.0	.0	1010.0	.0	.0	586.8	.0	17.7	45.4	2036.00
.29	.00	1.72	.00	.000	.045	.000	.000	2033.00	1012.65
.012160	1800.	1800.	1800.	6	0	0	.00	1805.92	4720.72

*SECNO 13.000

3265 DIVIDED FLOW

3280 CROSS SECTION 13.00 EXTENDED .09 FEET

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.37

13.000	1.69	2040.29	.00	.00	2040.31	.01	6.43	.00	2040.20
1010.0	.0	1010.0	.0	.0	1099.1	.0	46.7	117.4	2042.00
.74	.00	.92	.00	.000	.045	.000	.000	2038.60	1000.00
.002165	1500.	1500.	1500.	7	0	0	.00	2376.63	4966.00

CCHV= .100 CEHV= .300
*SECNO 14.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3265 DIVIDED FLOW

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14.000	.73	2049.43	2049.43	.00	2049.62	.19	8.37	.05	2050.80
915.0	.0	915.0	.0	.0	263.3	.0	73.3	177.8	2052.00
.88	.00	3.47	.00	.000	.035	.000	.000	2048.70	2291.18
.025481	1700.	1700.	1700.	6	18	0	.00	717.35	4182.90

CCHV= .100 CEHV= .300
*SECNO 15.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.34

3470 ENCROACHMENT STATIONS= 1700.0 3095.0 TYPE= 1 TARGET= 1395.000

15.000	2.67	2060.67	.00	.00	2060.70	.03	11.06	.02	2060.00
675.0	170.2	471.3	33.5	252.2	292.0	60.3	89.2	213.1	2060.00
1.22	.67	1.61	.56	.065	.040	.065	.000	2058.00	1700.00
.002541	1600.	1600.	1600.	12	0	0	.00	1210.03	2910.03

*SECNO 16.000

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .29

3470 ENCROACHMENT STATIONS= 2160.0 3640.0 TYPE= 1 TARGET= 1480.000

16.000	2.34	2069.84	.00	.00	2069.91	.07	9.20	.01	2069.60
675.0	310.2	196.3	168.5	141.2	78.9	98.0	105.1	255.1	2069.60
1.41	2.20	2.49	1.72	.065	.040	.065	.000	2067.50	2160.00
.030819	1500.	1500.	1500.	15	0	0	.00	1224.02	3463.34

*SECNO 17.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.02

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3470 ENCROACHMENT STATIONS= 2360.0 3850.0 TYPE= 1 TARGET= 1490.000

17.000	1.03	2079.03	.00	.00	2079.07	.05	9.16	.00	2078.20
675.0	38.6	561.6	74.8	52.3	297.7	88.4	115.5	281.2	2078.30
1.60	.74	1.89	.85	.065	.040	.065	.000	2078.00	3103.60
.003383	1200.	1200.	1200.	9	0	0	.00	672.09	3775.68

CCHV= .100 CEHV= .300
*SECNO -14.000
START TRIB COMP
-14.000 14.000 2049.432

3265 DIVIDED FLOW

3720 CRITICAL DEPTH ASSUMED

-14.000	.73	2049.43	2049.43	.00	2049.62	.19	14.30	-14.30	2050.80
915.0	.0	915.0	.0	.0	263.3	.0	129.2	308.3	2052.00
1.74	.00	3.47	.00	.000	.035	.000	.000	2048.70	2291.18
.025481	1700.	1700.	1700.	0	19	0	.00	717.35	4182.90

/= .100 CEHV= .300
CNO 15.100

15.100	.77	2058.77	.00	.00	2058.77	.00	9.14	.02	2060.00
165.0	.0	165.0	.0	.0	432.6	.0	138.8	332.1	2060.00
2.61	.00	.38	.00	.000	.055	.000	.000	2058.00	131.11
.000616	1200.	1200.	1200.	9	0	0	.00	1009.14	1140.25

CCHV= .100 CEHV= .300
*SECNO 16.100
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 1000.0 2160.0 TYPE= 1 TARGET= 1160.000

16.100	.31	2067.81	2067.81	.00	2067.92	.11	3.21	.03	2068.00
165.0	.0	165.0	.0	.0	62.5	.0	147.9	356.2	2068.00
2.78	.00	2.64	.00	.000	.045	.000	.000	2067.50	1523.66
.052547	1600.	1600.	1600.	20	18	0	.00	303.21	1826.87

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .100 CEHV= .300
*SECNO 17.100

3265 DIVIDED FLOW

3280 CROSS SECTION 17.10 EXTENDED 4.45 FEET

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.92

3470 ENCROACHMENT STATIONS= 1000.0 2360.0 TYPE= 1 TARGET= 1360.000

17.100	6.25	2084.25	.00	.00	2084.34	.09	16.41	.00	2136.50
165.0	.0	165.0	.0	.0	68.6	.0	149.7	361.9	100000.00
2.92	.00	2.40	.00	.000	.035	.000	.000	2078.00	1153.83
.006163	1200.	1200.	1200.	14	0	0	.00	111.91	1748.26

CCHV= .100 CEHV= .300
*SECNO 18.100

3265 DIVIDED FLOW

02 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .53

18.100	.62	2093.92	.00	.00	2093.99	.06	9.65	.00	2094.00
165.0	.0	165.0	.0	.0	82.6	.0	151.3	367.0	2094.00
3.05	.00	2.00	.00	.000	.040	.000	.000	2093.30	1079.90
.021658	920.	920.	920.	8	0	0	.00	374.42	1508.41

THIS RUN EXECUTED 17AUG94 09:57:41

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.0; February 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

WASHINGTON AVE.

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	QLOB	QCH	QROB	VCH	SSTA	ENDST	TOPWID	AREA
	11.000	1010.00	2010.94	.00	1010.00	.00	3.78	1722.22	3041.25	389.73	267.43
	12.000	1010.00	2033.83	.00	1010.00	.00	1.72	1012.65	4720.72	1805.92	586.84
*	13.000	1010.00	2040.29	.00	1010.00	.00	.92	1000.00	4966.00	2376.63	1099.14
*	14.000	915.00	2049.43	.00	915.00	.00	3.47	2291.18	4182.90	717.35	263.35
	15.000	675.00	2060.67	170.21	471.27	33.52	1.61	1700.00	2910.03	1210.03	604.56
	16.000	675.00	2069.84	310.16	196.34	168.50	2.49	2160.00	3463.34	1224.02	318.11
*	17.000	675.00	2079.03	38.60	561.64	74.76	1.89	3103.60	3775.68	672.09	438.45
*	-14.000	915.00	2049.43	.00	915.00	.00	3.47	2291.18	4182.90	717.35	263.35
	15.100	165.00	2058.77	.00	165.00	.00	.38	131.11	1140.25	1009.14	432.62
*	16.100	165.00	2067.81	.00	165.00	.00	2.64	1523.66	1826.87	303.21	62.48
*	17.100	165.00	2084.25	.00	165.00	.00	2.40	1153.83	1748.26	111.91	68.63
*	18.100	165.00	2093.92	.00	165.00	.00	2.00	1079.90	1508.41	374.42	82.64

ASHINGTON AVE.

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	11.000	.00	.00	.00	2009.00	1010.00	2010.94	.00	2011.17	130.80	3.78	267.43	88.31
	12.000	1800.00	.00	.00	2033.00	1010.00	2033.83	.00	2033.88	121.60	1.72	586.84	91.59
•	13.000	1500.00	.00	.00	2038.60	1010.00	2040.29	.00	2040.31	21.65	.92	1099.14	217.05
*	14.000	1700.00	.00	.00	2048.70	915.00	2049.43	2049.43	2049.62	254.81	3.47	263.35	57.32
*	15.000	1600.00	.00	.00	2058.00	675.00	2060.67	.00	2060.70	25.41	1.61	604.56	133.91
•	16.000	1500.00	.00	.00	2067.50	675.00	2069.84	.00	2069.91	308.19	2.49	318.11	38.45
•	17.000	1200.00	.00	.00	2078.00	675.00	2079.03	.00	2079.07	33.83	1.89	438.45	116.06
•	-14.000	1700.00	.00	.00	2048.70	915.00	2049.43	2049.43	2049.62	254.81	3.47	263.35	57.32
	15.100	1200.00	.00	.00	2058.00	165.00	2058.77	.00	2058.77	6.16	.38	432.62	66.45
*	16.100	1600.00	.00	.00	2067.50	165.00	2067.81	2067.81	2067.92	525.47	2.64	62.48	7.20
•	17.100	1200.00	.00	.00	2078.00	165.00	2084.25	.00	2084.34	61.63	2.40	68.63	21.02
	18.100	920.00	.00	.00	2093.30	165.00	2093.92	.00	2093.99	216.58	2.00	82.64	11.21

WASHINGTON AVE.

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	11.000	1010.00	2010.94	.00	.00	-.06	389.73	.00
	12.000	1010.00	2033.83	.00	22.89	.00	1805.92	1800.00
*	13.000	1010.00	2040.29	.00	6.46	.00	2376.63	1500.00
*	14.000	915.00	2049.43	.00	9.14	.00	717.35	1700.00
*	15.000	675.00	2060.67	.00	11.23	.00	1210.03	1600.00
*	16.000	675.00	2069.84	.00	9.17	.00	1224.02	1500.00
*	17.000	675.00	2079.03	.00	9.19	.00	672.09	1200.00
*	-14.000	915.00	2049.43	.00	-29.60	.00	717.35	1700.00
	15.100	165.00	2058.77	.00	9.34	.00	1009.14	1200.00
*	16.100	165.00	2067.81	.00	9.04	.00	303.21	1600.00
*	17.100	165.00	2084.25	.00	16.43	.00	111.91	1200.00
	18.100	165.00	2093.92	.00	9.68	.00	374.42	920.00

SUMMARY OF ERRORS AND SPECIAL NOTES

WARNING SECNO= 13.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 14.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 14.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

WARNING SECNO= 15.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 16.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

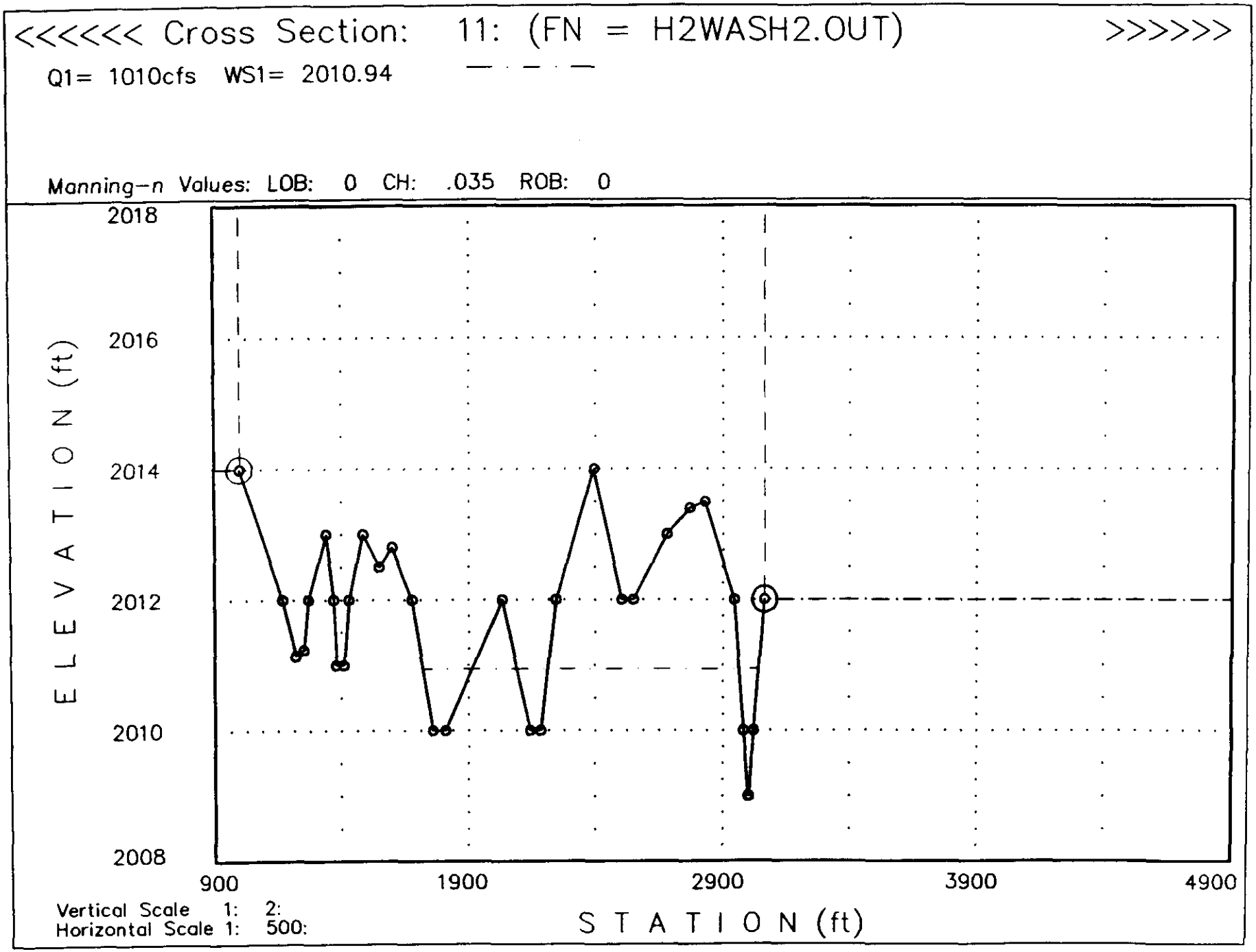
WARNING SECNO= 17.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

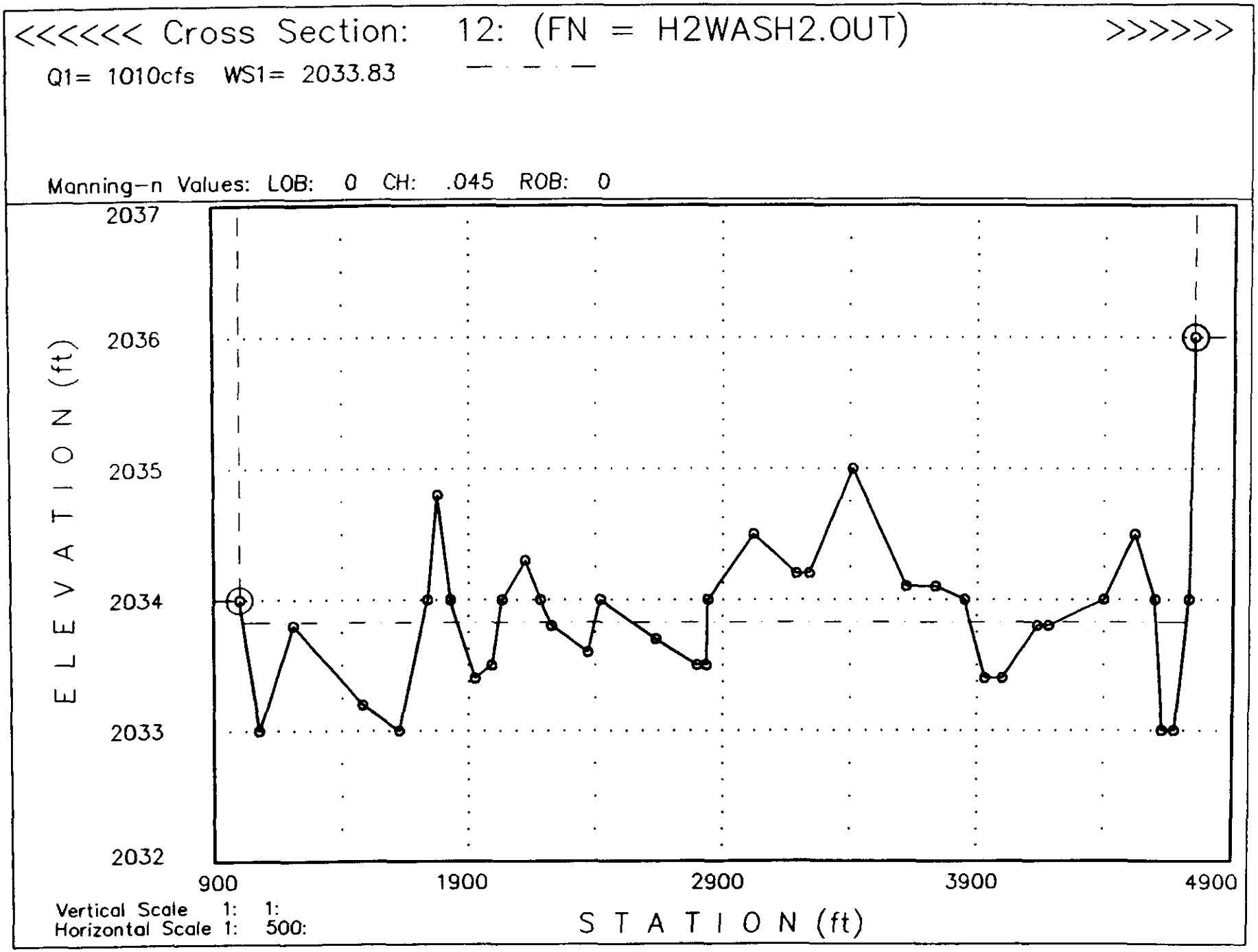
CAUTION SECNO= -14.000 PROFILE= 1 CRITICAL DEPTH ASSUMED

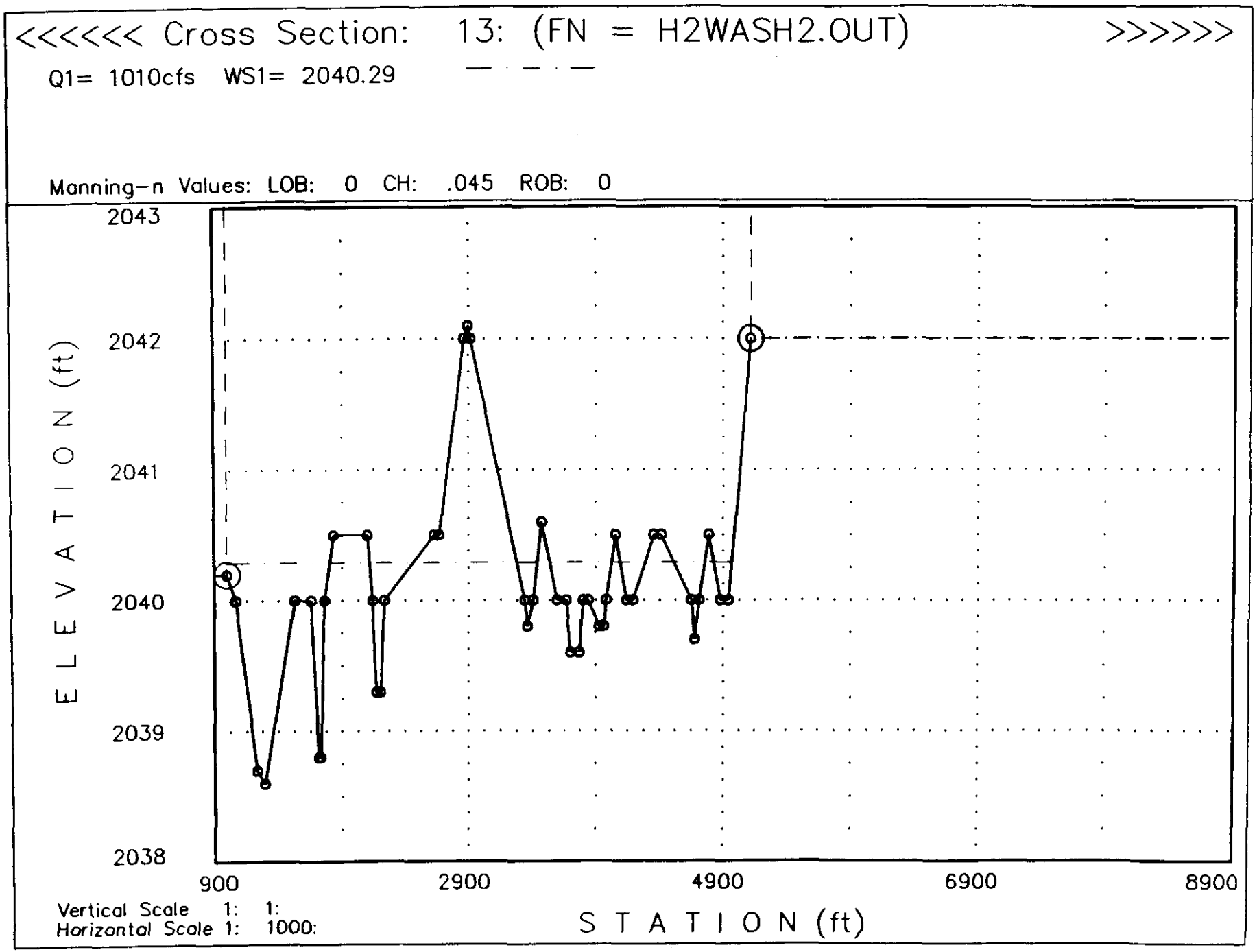
CAUTION SECNO= 16.100 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 16.100 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 16.100 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

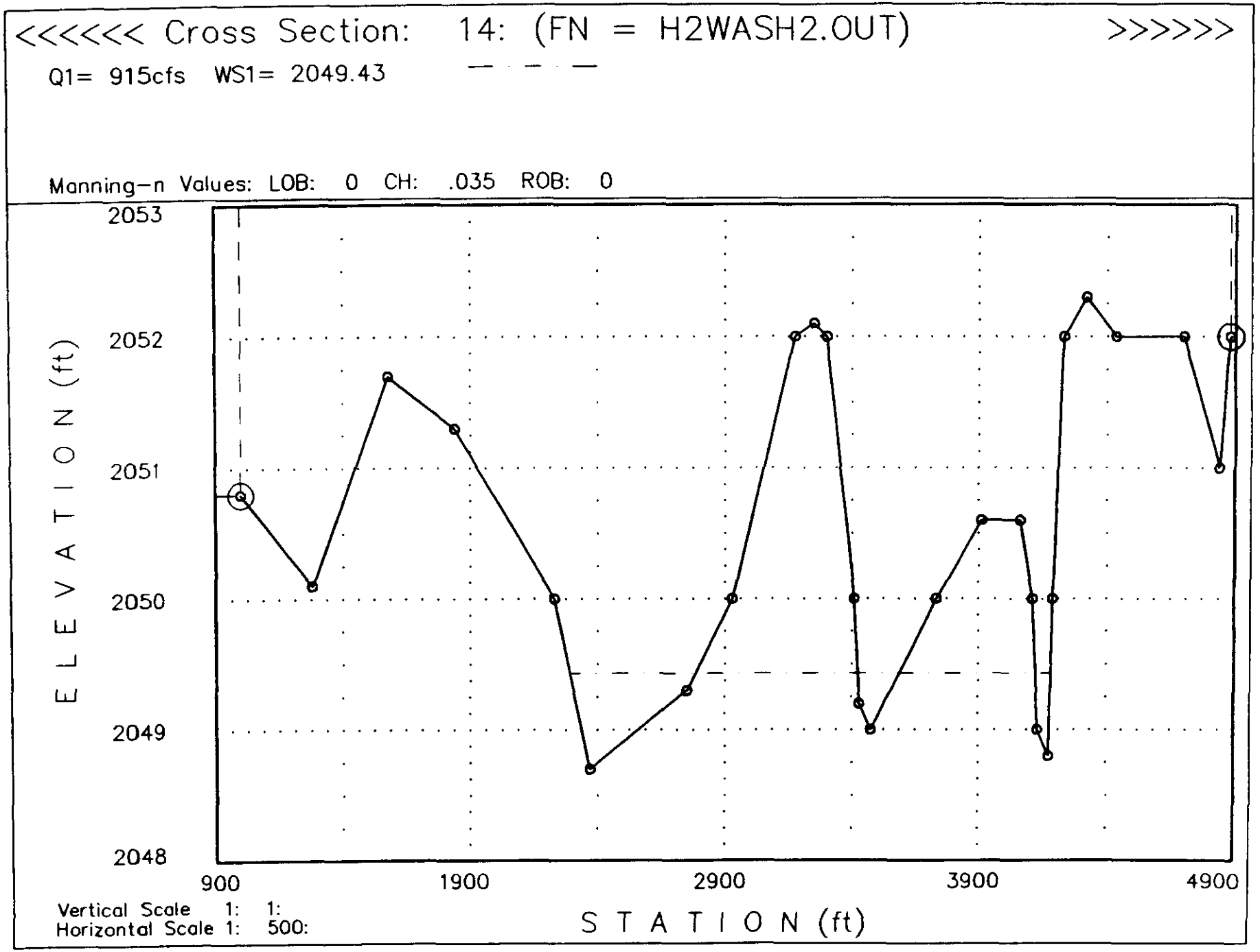
WARNING SECNO= 17.100 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

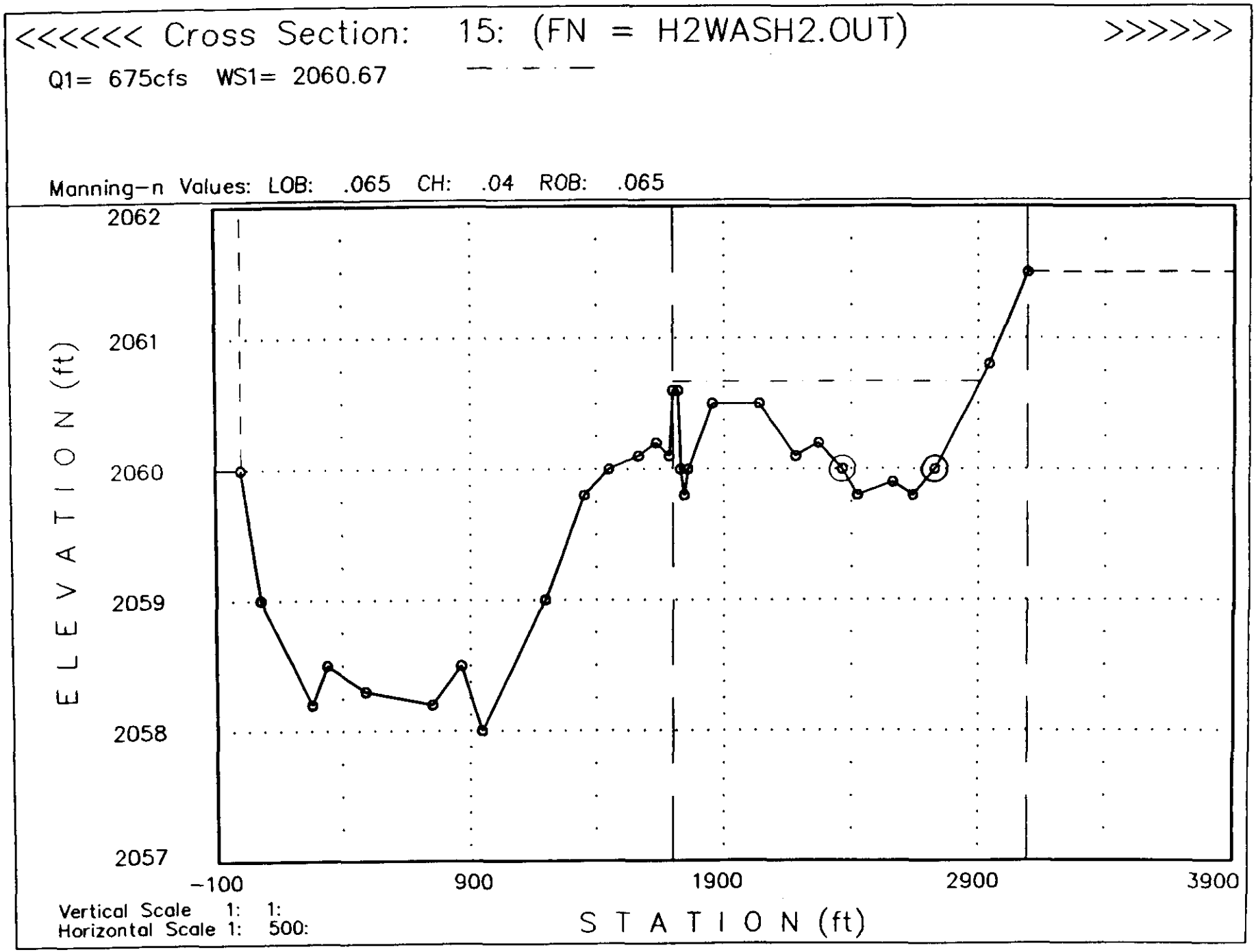
WARNING SECNO= 18.100 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

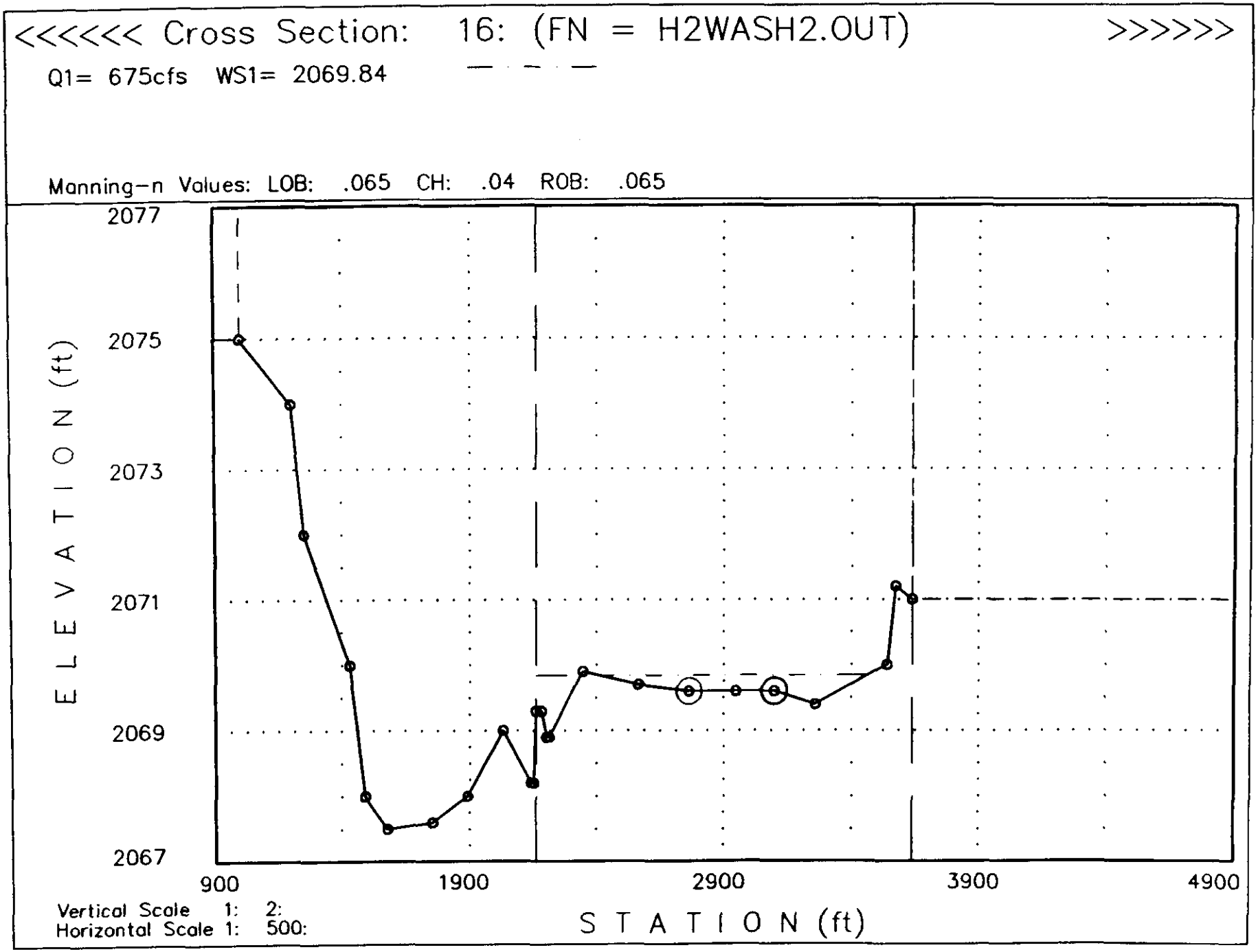

<<<<<< Cross Section: 11: (FN = H2WASH2.OUT) >>>>>>
Q1= 1010cfs WS1= 2010.94
Manning-n Values: LOB: 0 CH: .035 ROB: 0
2018
2016
2014
2012
2010
2008
ELEVATION (ft)
900
1900
2900
3900
4900
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 500:
08-17-1994

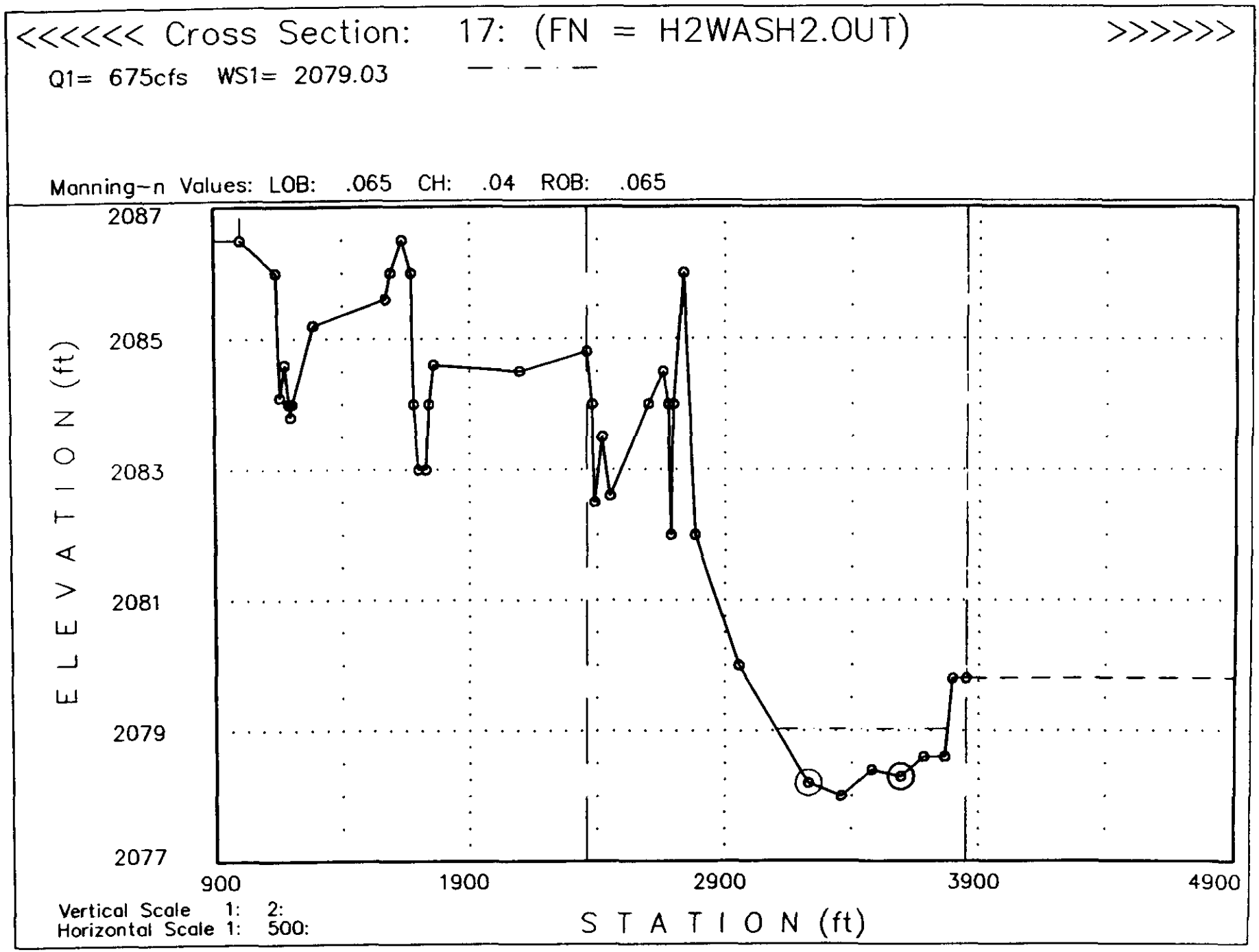

<<<<<< Cross Section: 12: (FN = H2WASH2.OUT) >>>>>>
Q1= 1010cfs WS1= 2033.83
Manning-n Values: LOB: 0 CH: .045 ROB: 0
2037
2036
2035
2034
2033
2032
ELEVATION (ft)
900
1900
2900
3900
4900
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 500:
08-17-1994

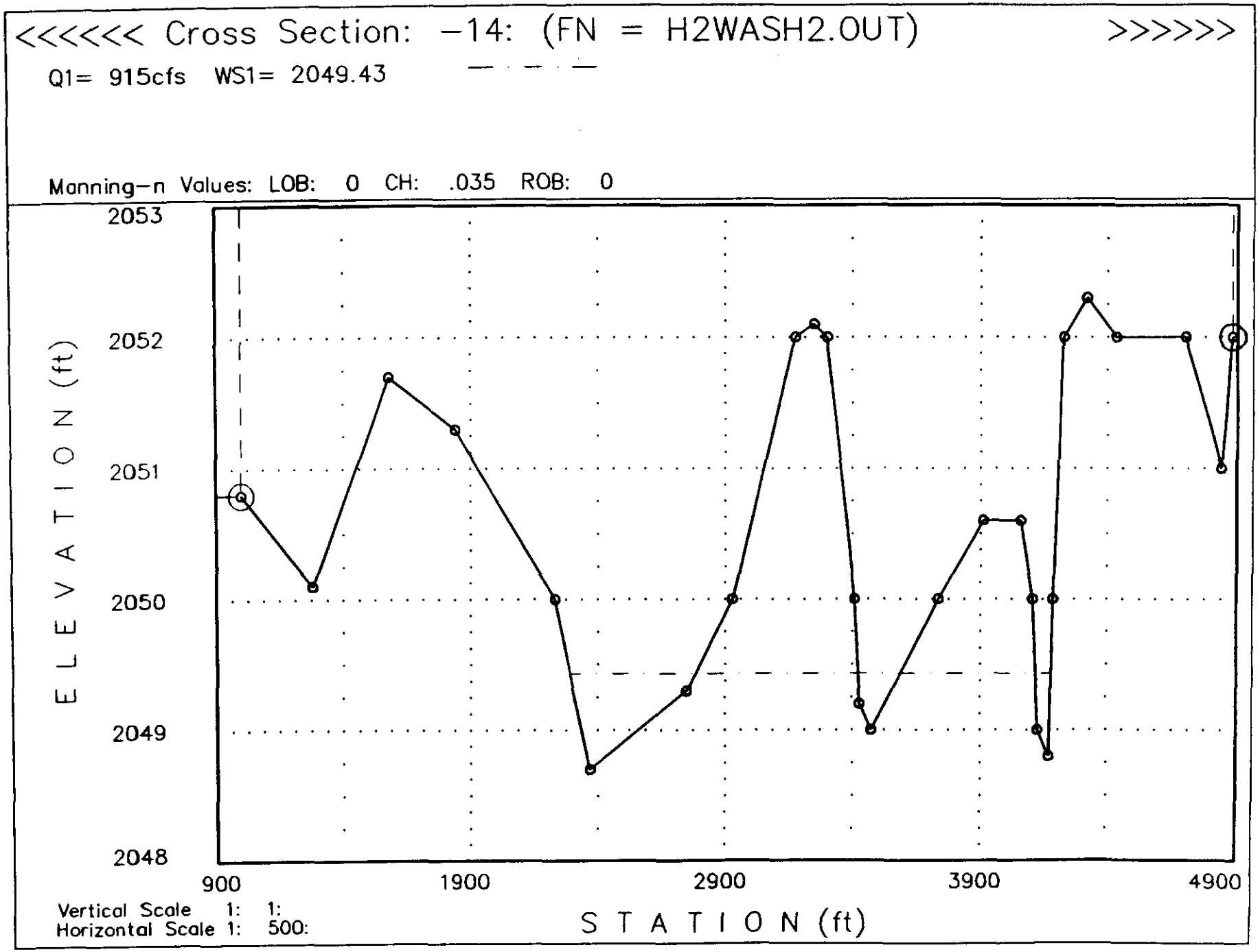

<<<<<< Cross Section: 13: (FN = H2WASH2.OUT) >>>>>>
Q1= 1010cfs WS1= 2040.29
Manning-n Values: LOB: 0 CH: .045 ROB: 0
2043
2042
2041
2040
2039
2038
ELEVATION (ft)
900
2900
4900
6900
8900
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 1000:
08-17-1994

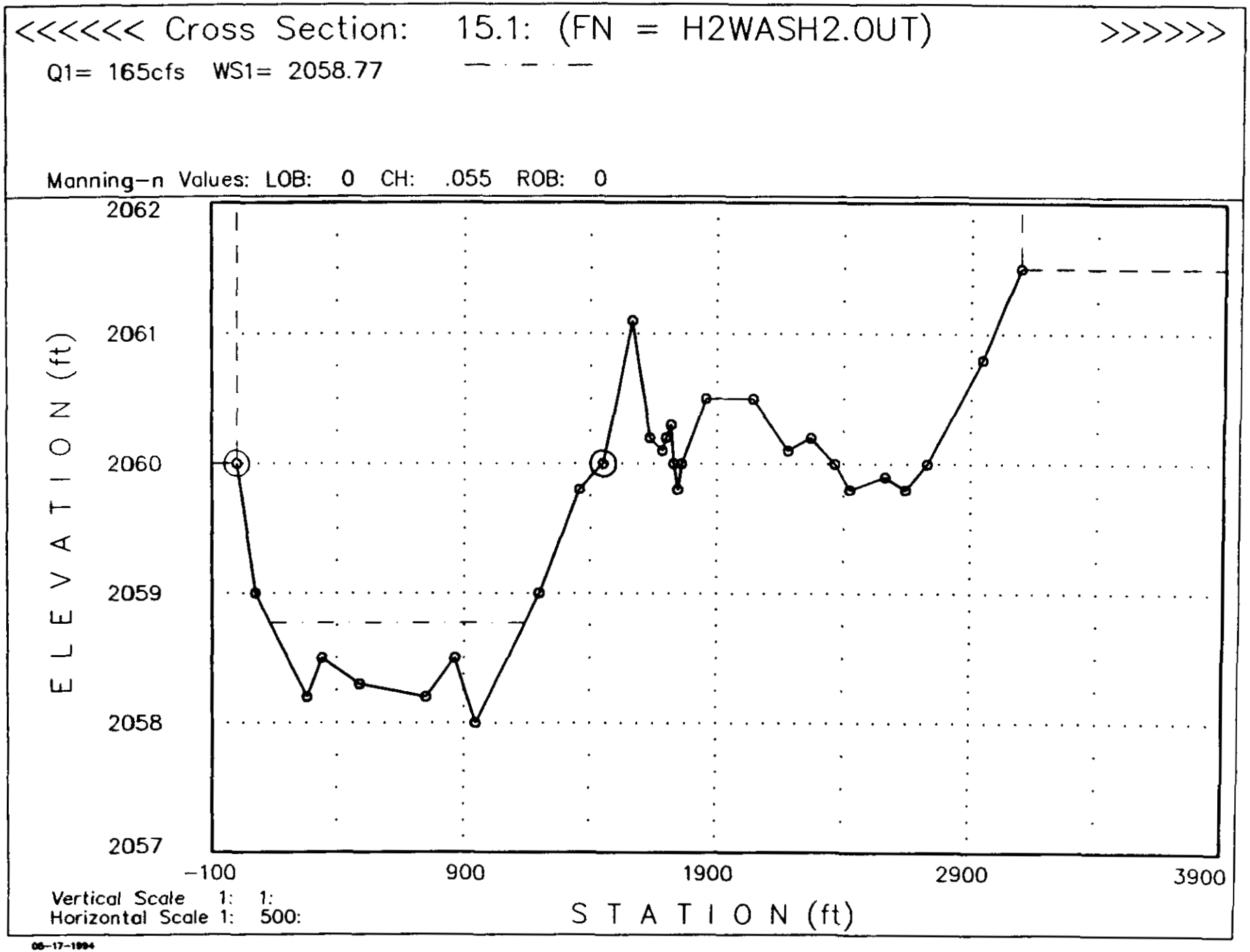

<<<<<< Cross Section: 14: (FN = H2WASH2.OUT) >>>>>>
Q1= 915cfs WS1= 2049.43
Manning-n Values: LOB: 0 CH: .035 ROB: 0
2053
2052
2051
2050
2049
2048
ELEVATION (ft)
900
1900
2900
3900
4900
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 500:
08-17-1994

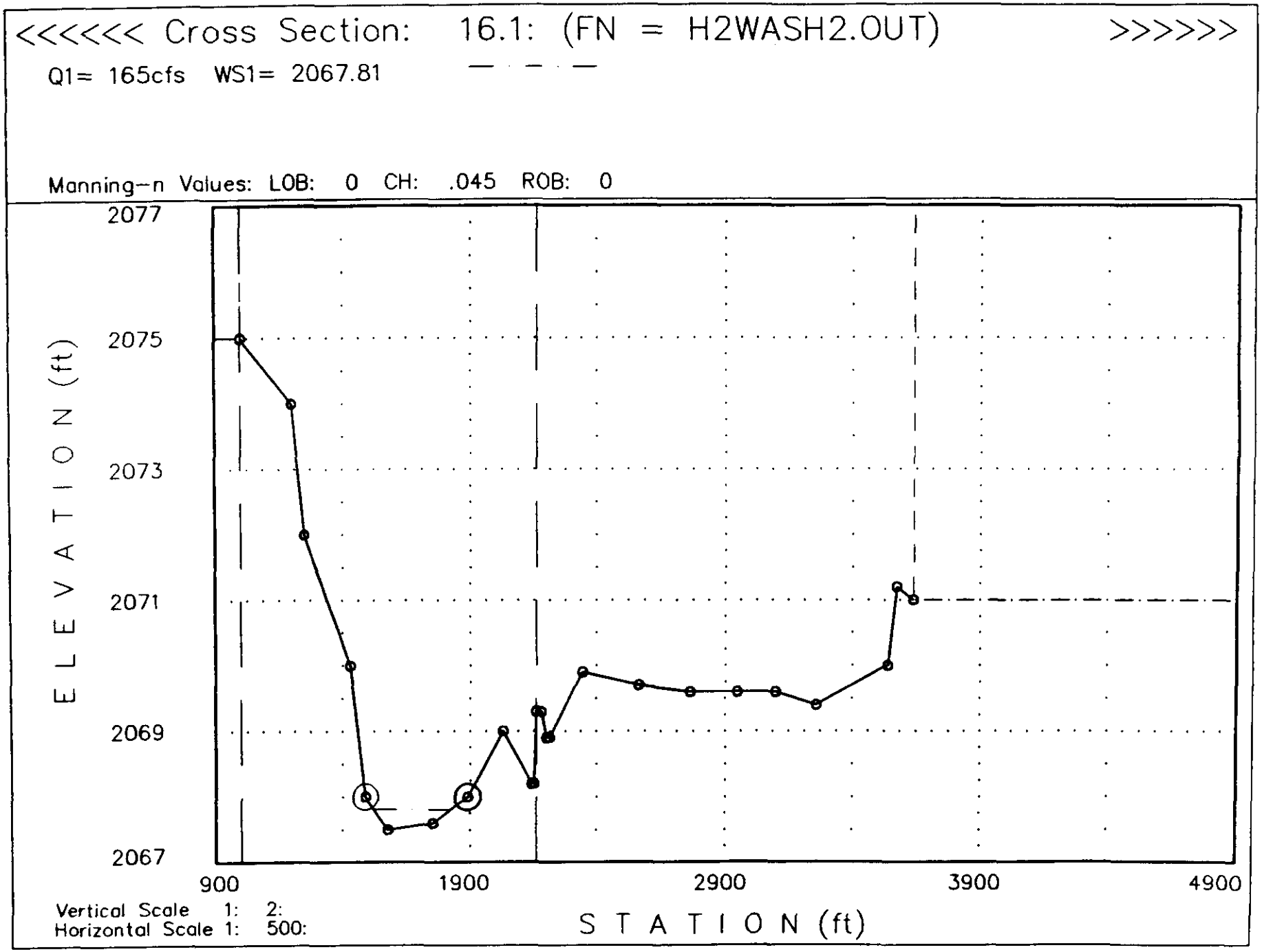

<<<<<< Cross Section: 15: (FN = H2WASH2.OUT) >>>>>>
Q1= 675cfs WS1= 2060.67
Manning-n Values: LOB: .065 CH: .04 ROB: .065
2062
2061
2060
2059
2058
2057
ELEVATION (ft)
-100
900
1900
2900
3900
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 500:
08-17-1994

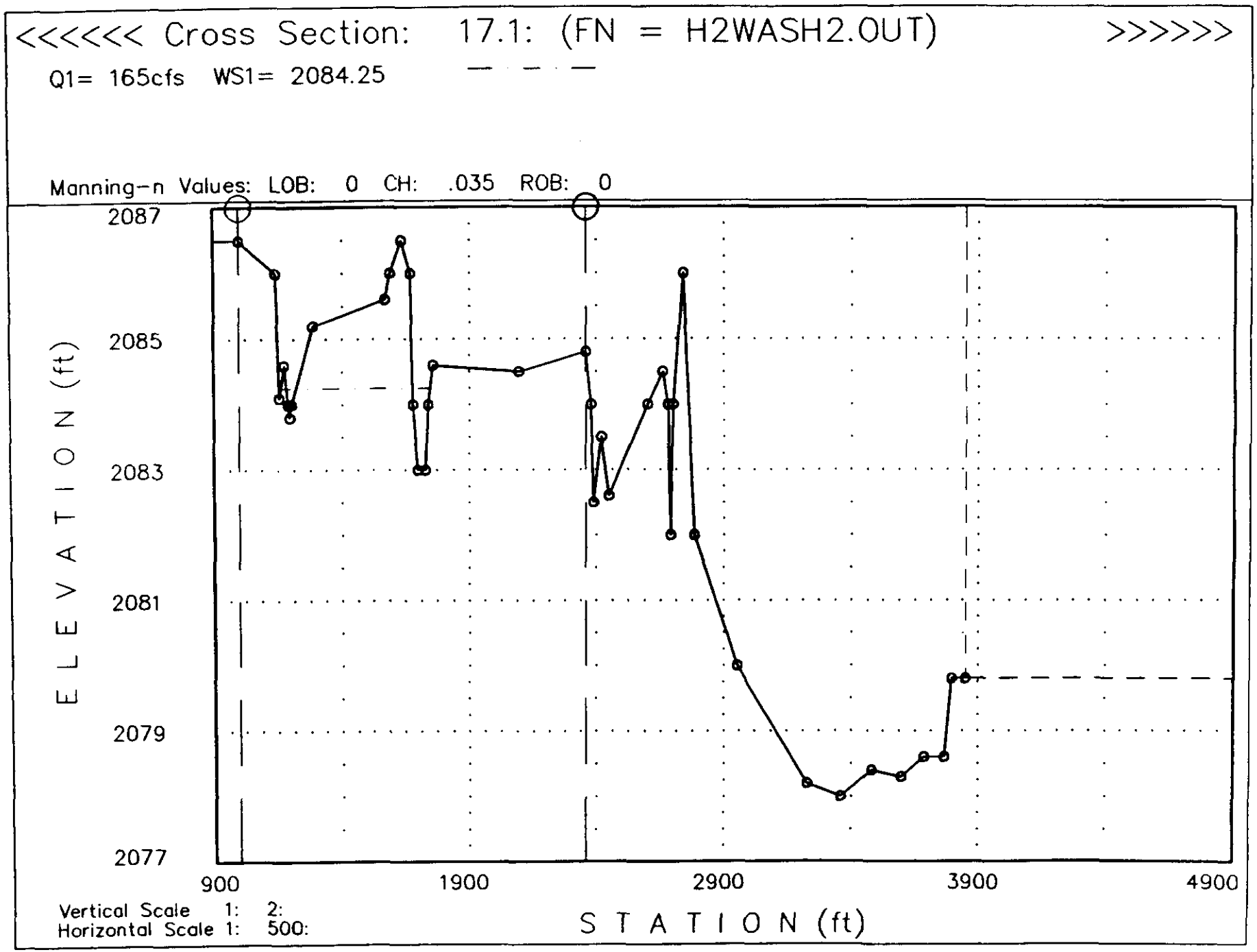

<<<<<< Cross Section: 16: (FN = H2WASH2.OUT) >>>>>>
Q1= 675cfs WS1= 2069.84
Manning-n Values: LOB: .065 CH: .04 ROB: .065
2077
2075
2073
2071
2069
2067
ELEVATION (ft)
900
1900
2900
3900
4900
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 500:
08-17-1994

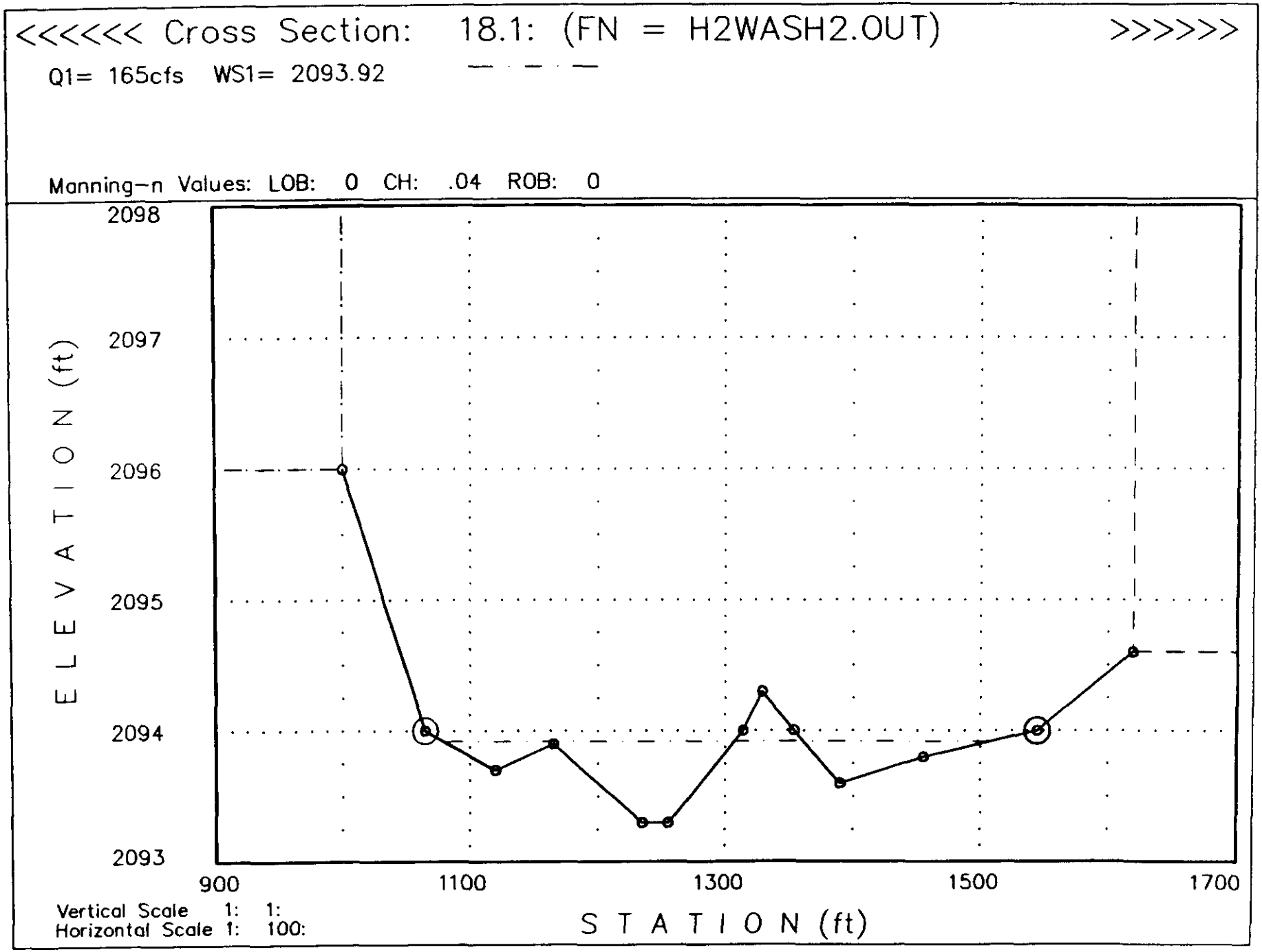

<<<<<< Cross Section: 17: (FN = H2WASH2.0UT) >>>>>>
Q1= 675cfs WS1= 2079.03
Manning-n Values: LOB: .065 CH: .04 ROB: .065
2087
2085
2083
2081
2079
2077
ELEVATION (ft)
900
1900
2900
3900
4900
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 500:
08-17-1994


<<<<<< Cross Section: -14: (FN = H2WASH2.OUT) >>>>>>
Q1= 915cfs WS1= 2049.43
Manning-n Values: LOB: 0 CH: .035 ROB: 0
2053
2052
2051
2050
2049
2048
ELEVATION (ft)
900
1900
2900
3900
4900
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 500:
08-17-1994


<<<<<< Cross Section: 15.1: (FN = H2WASH2.OUT) >>>>>>
Q1= 165cfs WS1= 2058.77
Manning-n Values: LOB: 0 CH: .055 ROB: 0
2062
2061
2060
2059
2058
2057
ELEVATION (ft)
-100
900
1900
2900
3900
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 500:
08-17-1994


<<<<<< Cross Section: 16.1: (FN = H2WASH2.OUT) >>>>>>
Q1= 165cfs WS1= 2067.81
Manning-n Values: LOB: 0 CH: .045 ROB: 0
2077
2075
2073
2071
2069
2067
ELEVATION (ft)
900
1900
2900
3900
4900
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 500:
08-17-1994


<<<<<< Cross Section: 17.1: (FN = H2WASH2.OUT) >>>>>>
Q1= 165cfs WS1= 2084.25
Manning-n Values: LOB: 0 CH: .035 ROB: 0
2087
2085
2083
2081
2079
2077
ELEVATION (ft)
900
1900
2900
3900
4900
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 500:
08-17-1994


<<<<<< Cross Section: 18.1: (FN = H2WASH2.OUT) >>>>>>
Q1= 165cfs WS1= 2093.92
Manning-n Values: LOB: 0 CH: .04 ROB: 0
2098
2097
2096
2095
2094
2093
ELEVATION (ft)
900
1100
1300
1500
1700
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 100:
08-17-1994

H2BONAN.DAT

```
**********************************************
*  HEC-2 WATER SURFACE PROFILES              *
*                                            *
*   ersion   4.6.0;  February 1991           *
*                                            *
*  RUN DATE     17AUG94     TIME    09:56:26 *
**********************************************
```

```
**************************************
*  U.S. ARMY CORPS OF ENGINEERS      *
*  HYDROLOGIC ENGINEERING CENTER     *
*  609 SECOND STREET, SUITE D        *
*  DAVIS, CALIFORNIA 95616-4687      *
*          (916) 756-1104            *
**************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

THIS RUN EXECUTED 17AUG94 09:56:26

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.0; February 1991
****

T1 NORTHWEST LAS VEGAS FIS RESTUDY FILE : H2BONAN.DAT
T2 BY COE & VAN LOO CONSULTANTS, INC. DATE: AUG. 1994
T3 BONANZA AVE.

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	2	0	0	.0084	0	0	0	2056	0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1	0	-1							

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

	150	38	43	1	13	14	15	26	53	54
	4	25								
	.065	.065	.045	0.1	0.3					
	1	488								
	1	13	425	540	0	0	0			
GR	2056	0	2056	45	2056.2	110	2056	150	2056	220
GR	2056.2	250	2056	285	2054	425	2052	515	2054	540
GR	2056	560	2058	575	2060	595				
X1	2	8	420	510	300	255	270			
GR	2058.2	0	2058.1	30	2056	240	2054	420	2052	450
GR	2052	490	2054	510	2060	570				
X1	3	9	300	445	715	705	710			
GR	2061	0	2061	30	2060	110	2059	300	2058.8	360
GR	2060	430	2062	445	2064	460	2068	475		
X1	4	10	360	420	1305	1300	1302			
GR	2071	0	2071	30	2070	75	2069	360	2068	400
GR	2068	410	2070	420	2072	430	2072	450	2072	490
X1	5	8	50	130	958	960	959			
GR	2090	0	2080	0	2078	50	2076	80	2076	100
GR	2078	130	2080	135	2084	190				

X1	6	9	20	80	250	250	250			
GR	2082	0	2078	1	2077.5	20	2076.2	40	2076.2	60
GR	2078	80	2080	120	2082	140	2084	190		
X1	7	9	1	55	130	135	133			
GR	2082	0	2078	1	2078	12	2077.5	25	2077.5	35
GR	2078	55	2080	110	2082	165	2082	185		
X1	8	8	70	140	65	69	66			
GR	2083	0	2079	1	2078.2	70	2078	90	2078	110
GR	2078.8	140	2080	190	2082	265				
X1	9	11	130	210	75	78	76			
GR	2083	0	2079.5	1	2079.4	50	2079.3	130	2079.1	155
GR	2079.1	178	2079.3	210	2079.4	260	2079.8	312	2080	332
GR	2082	333								

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300

*SECNO 1.000

1.000	2.22	2054.22	.00	2056.00	2054.41	.19	.00	.00	2054.00
488.0	.9	487.0	.1	1.8	140.7	.3	.0	.0	2054.00
.00	.49	3.46	.48	.065	.045	.065	.000	2052.00	409.35
.008403	0.	0.	0.	0	0	5	.00	132.89	542.24

*SECNO 2.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.68

2.000	3.03	2055.03	.00	.00	2055.09	.06	.67	.01	2054.00
488.0	24.2	461.1	2.7	48.0	222.9	5.3	1.3	1.0	2054.00
.04	.50	2.07	.50	.065	.045	.065	.000	2052.00	327.06
.001173	300.	270.	255.	4	0	0	.00	193.27	520.33

*SECNO 3.000

3685 20 TRIALS ATTEMPTED WSEL,CWSEL

1 PROBABLE MINIMUM SPECIFIC ENERGY

0 CRITICAL DEPTH ASSUMED

3.000	.97	2059.77	2059.77	.00	2060.03	.27	2.36	.06	2059.00
488.0	121.9	366.1	.0	55.9	79.3	.0	4.7	4.8	2062.00
.09	2.18	4.62	.00	.065	.045	.000	.000	2058.80	154.21
.032583	715.	710.	705.	20	17	0	.00	262.22	416.43

*SECNO 4.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.08

4.000	2.19	2070.19	.00	.00	2070.27	.07	10.21	.02	2069.00
488.0	208.6	279.4	.0	199.0	101.7	.1	11.2	14.0	2070.00
.27	1.05	2.75	.01	.065	.045	.065	.000	2068.00	66.22
.003439	1305.	1302.	1300.	8	0	0	.00	354.75	420.98

*SECNO 5.000

7185 MINIMUM SPECIFIC ENERGY

3720 CRITICAL DEPTH ASSUMED

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
5.000	1.75	2077.75	2077.75	.00	2078.31	.57	7.30	.15	2078.00
488.0	.0	488.0	.0	.0	80.7	.0	15.4	18.7	2078.00
.31	.00	6.05	.00	.000	.045	.000	.000	2076.00	53.80
.029106	958.	959.	960.	5	15	0	.00	72.39	126.20

*SECNO 6.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 4.04

6.000	3.20	2079.40	.00	.00	2079.51	.10	1.14	.05	2077.50
488.0	42.1	431.2	14.7	31.5	160.7	19.4	16.2	19.2	2078.00
.34	1.34	2.68	.76	.065	.045	.065	.000	2076.20	.65
.001781	250.	250.	250.	5	0	0	.00	107.24	107.89

*SECNO 7.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .55

7.000	2.22	2079.72	.00	.00	2079.94	.22	.40	.04	2078.00
488.0	.2	423.2	64.6	.4	105.9	40.5	16.8	19.5	2078.00
.35	.62	3.99	1.59	.065	.045	.065	.000	2077.50	.57
.005960	130.	133.	135.	3	0	0	.00	101.63	102.21

*SECNO 8.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.67

8.000	2.11	2080.11	.00	.00	2080.17	.06	.22	.02	2078.20
488.0	144.7	313.6	29.8	104.3	133.6	35.7	17.1	19.8	2078.80
.36	1.39	2.35	.83	.065	.045	.065	.000	2078.00	.72
.002134	65.	66.	69.	2	0	0	.00	193.35	194.07

*SECNO 9.000

9.000	1.24	2080.34	.00	.00	2080.38	.05	.21	.00	2079.30
488.0	163.8	206.3	117.9	122.5	93.3	96.5	17.6	20.2	2079.30
.37	1.34	2.21	1.22	.065	.045	.065	.000	2079.10	.76
.003658	75.	76.	78.	2	0	0	.00	331.41	332.17

THIS RUN EXECUTED 17AUG94 09:56:27

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.0; February 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

BONANZA AVE.

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	QLOB	QCH	QROB	VCH	SSTA	ENDST	TOPWID	AREA
	1.000	488.00	2054.22	.85	487.03	.12	3.46	409.35	542.24	132.89	142.72
*	2.000	488.00	2055.03	24.19	461.13	2.68	2.07	327.06	520.33	193.27	276.27
*	3.000	488.00	2059.77	121.87	366.12	.00	4.62	154.21	416.43	262.22	135.27
*	4.000	488.00	2070.19	208.64	279.36	.00	2.75	66.22	420.98	354.75	300.75
	5.000	488.00	2077.75	.00	488.00	.00	6.05	53.80	126.20	72.39	80.67
	6.000	488.00	2079.40	42.06	431.20	14.74	2.68	.65	107.89	107.24	211.61
*	7.000	488.00	2079.72	.23	423.22	64.55	3.99	.57	102.21	101.63	146.83
*	8.000	488.00	2080.11	144.65	313.58	29.77	2.35	.72	194.07	193.35	273.51
	9.000	488.00	2080.34	163.79	206.33	117.88	2.21	.76	332.17	331.41	312.28

ANZA AVE.

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	1.000	.00	.00	.00	2052.00	488.00	2054.22	.00	2054.41	84.03	3.46	142.72	53.24
*	2.000	270.00	.00	.00	2052.00	488.00	2055.03	.00	2055.09	11.73	2.07	276.27	142.47
*	3.000	710.00	.00	.00	2058.80	488.00	2059.77	2059.77	2060.03	325.83	4.62	135.27	27.03
*	4.000	1302.00	.00	.00	2068.00	488.00	2070.19	.00	2070.27	34.39	2.75	300.75	83.21
*	5.000	959.00	.00	.00	2076.00	488.00	2077.75	2077.75	2078.31	291.06	6.05	80.67	28.60
*	6.000	250.00	.00	.00	2076.20	488.00	2079.40	.00	2079.51	17.81	2.68	211.61	115.64
*	7.000	133.00	.00	.00	2077.50	488.00	2079.72	.00	2079.94	59.60	3.99	146.83	63.21
*	8.000	66.00	.00	.00	2078.00	488.00	2080.11	.00	2080.17	21.34	2.35	273.51	105.64
	9.000	76.00	.00	.00	2079.10	488.00	2080.34	.00	2080.38	36.58	2.21	312.28	80.69

ANZA AVE.

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	1.000	488.00	2054.22	.00	.00	-1.78	132.89	.00
*	2.000	488.00	2055.03	.00	.81	.00	193.27	270.00
*	3.000	488.00	2059.77	.00	4.74	.00	262.22	710.00
*	4.000	488.00	2070.19	.00	10.42	.00	354.75	1302.00
*	5.000	488.00	2077.75	.00	7.56	.00	72.39	959.00
*	6.000	488.00	2079.40	.00	1.66	.00	107.24	250.00
*	7.000	488.00	2079.72	.00	.31	.00	101.63	133.00
*	8.000	488.00	2080.11	.00	.39	.00	193.35	66.00
	9.000	488.00	2080.34	.00	.23	.00	331.41	76.00

SUMMARY OF ERRORS AND SPECIAL NOTES

WARNING SECNO= 2.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 3.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 3.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

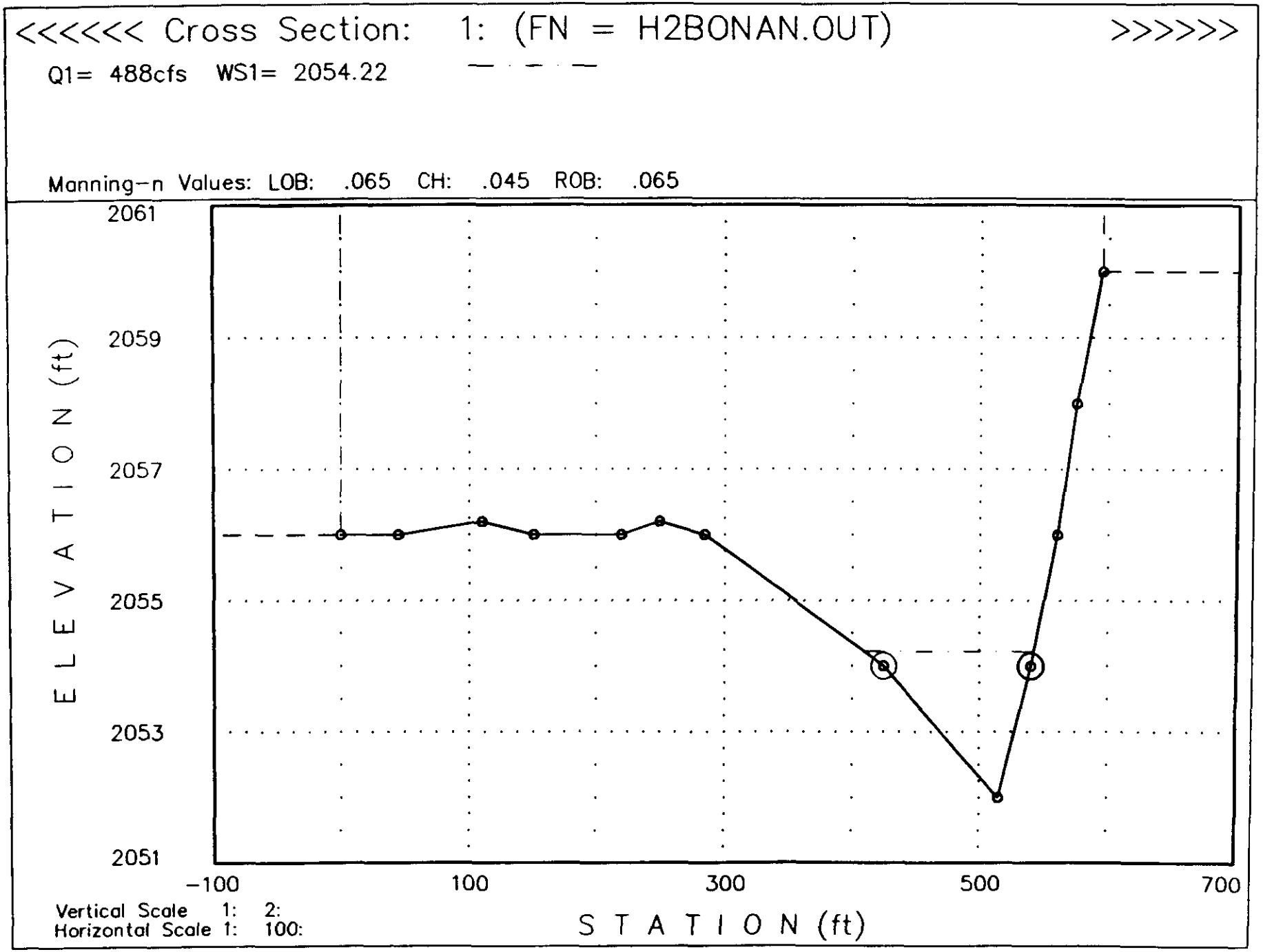
WARNING SECNO= 4.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

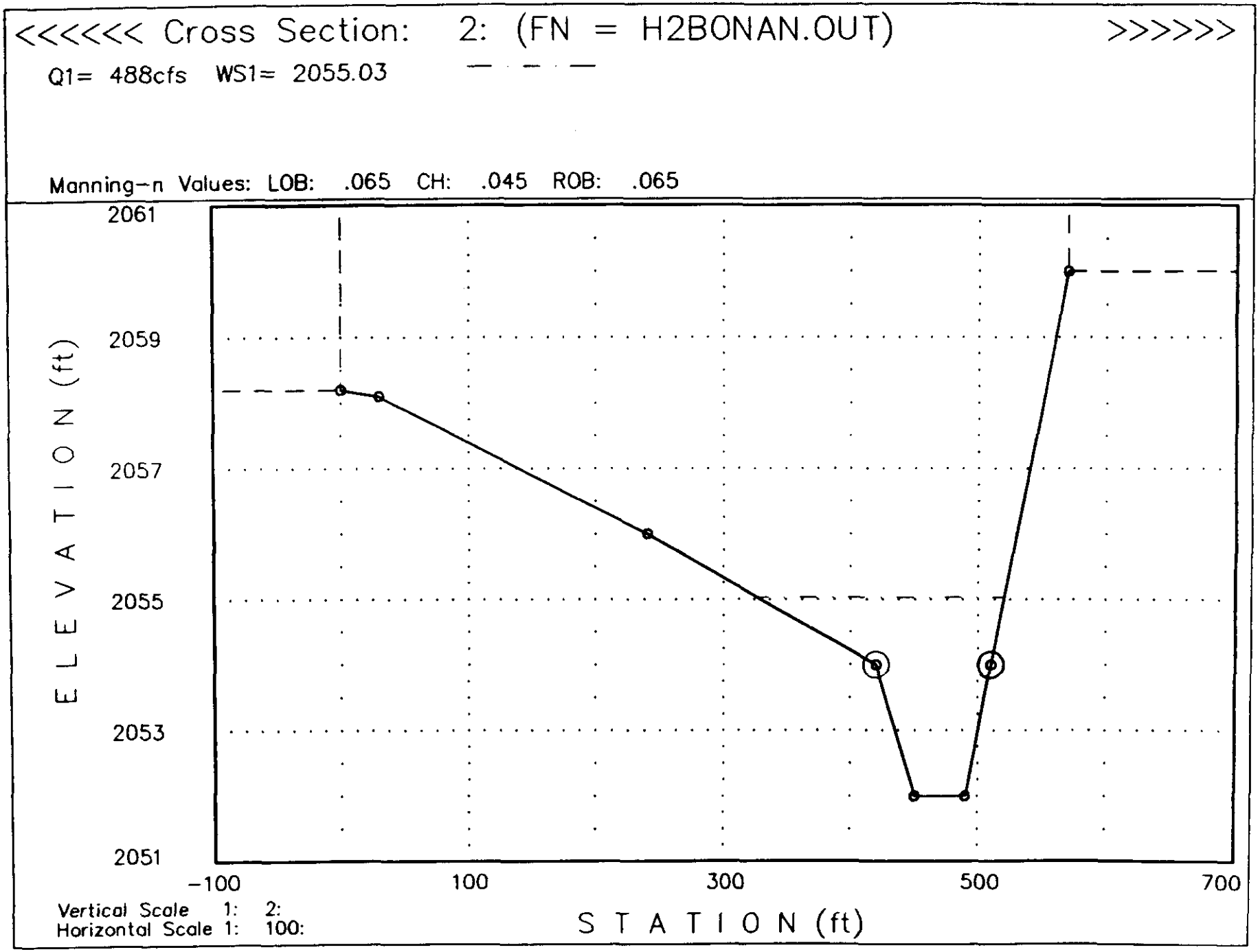
CAUTION SECNO= 5.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 5.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

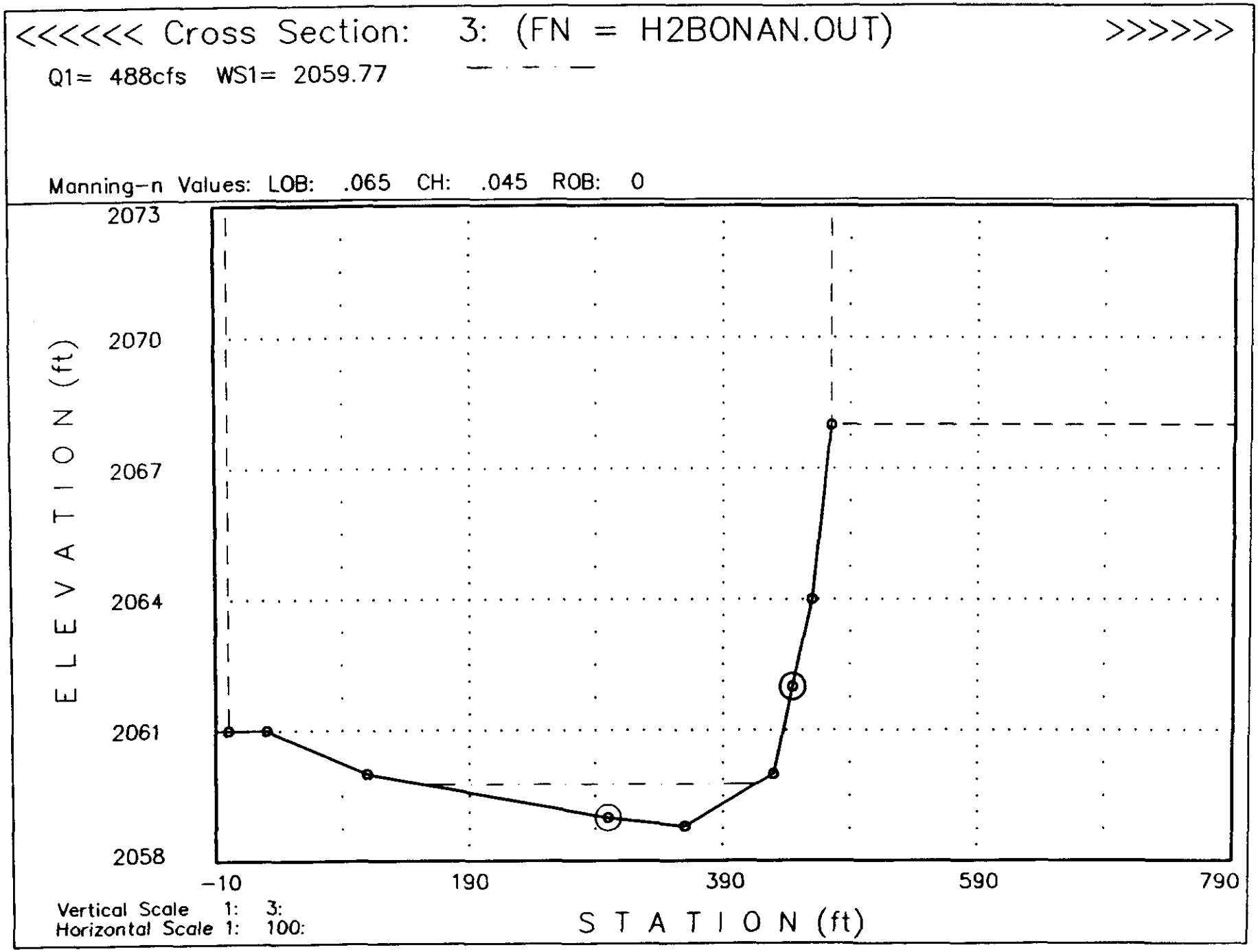
WARNING SECNO= 6.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

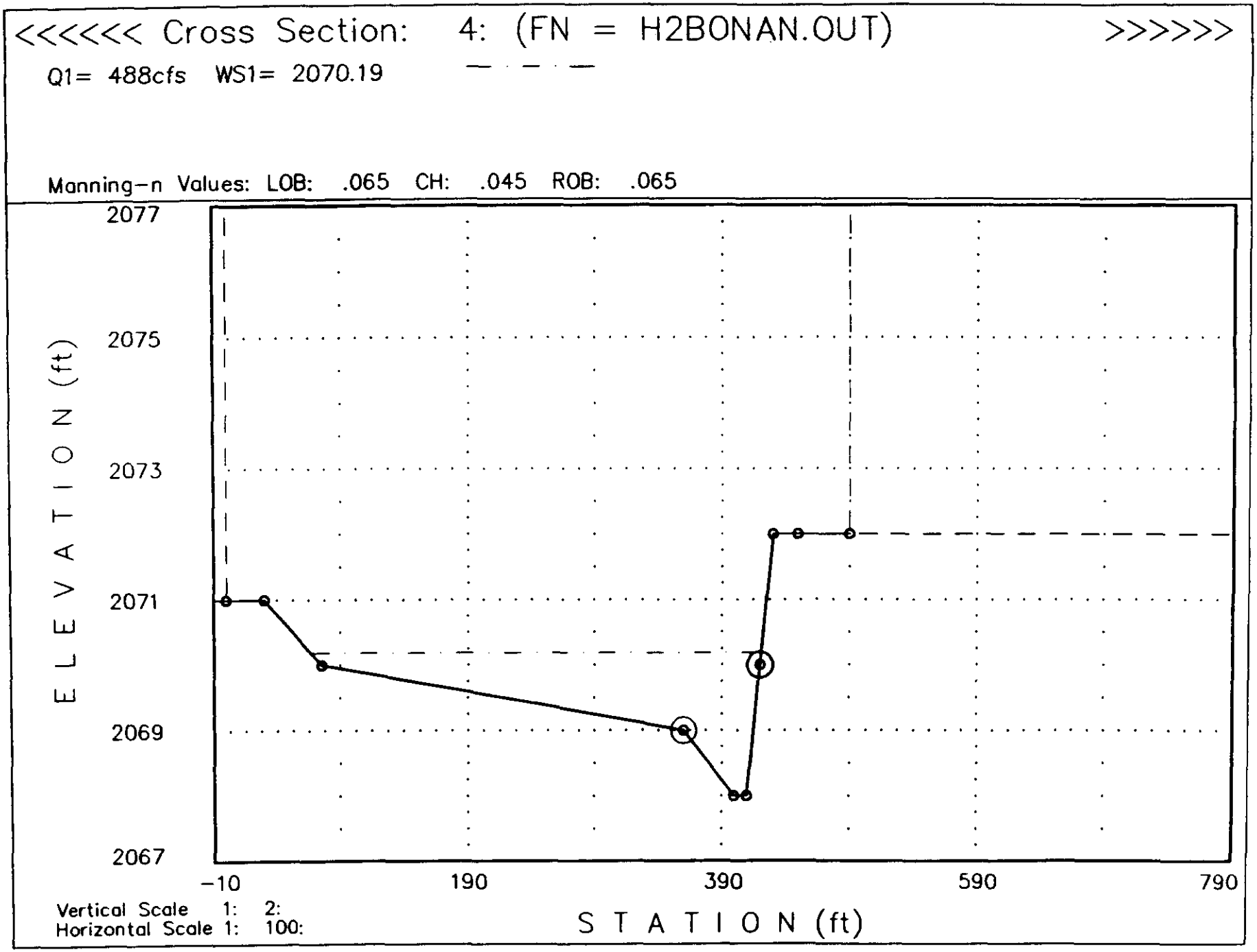
WARNING SECNO= 7.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

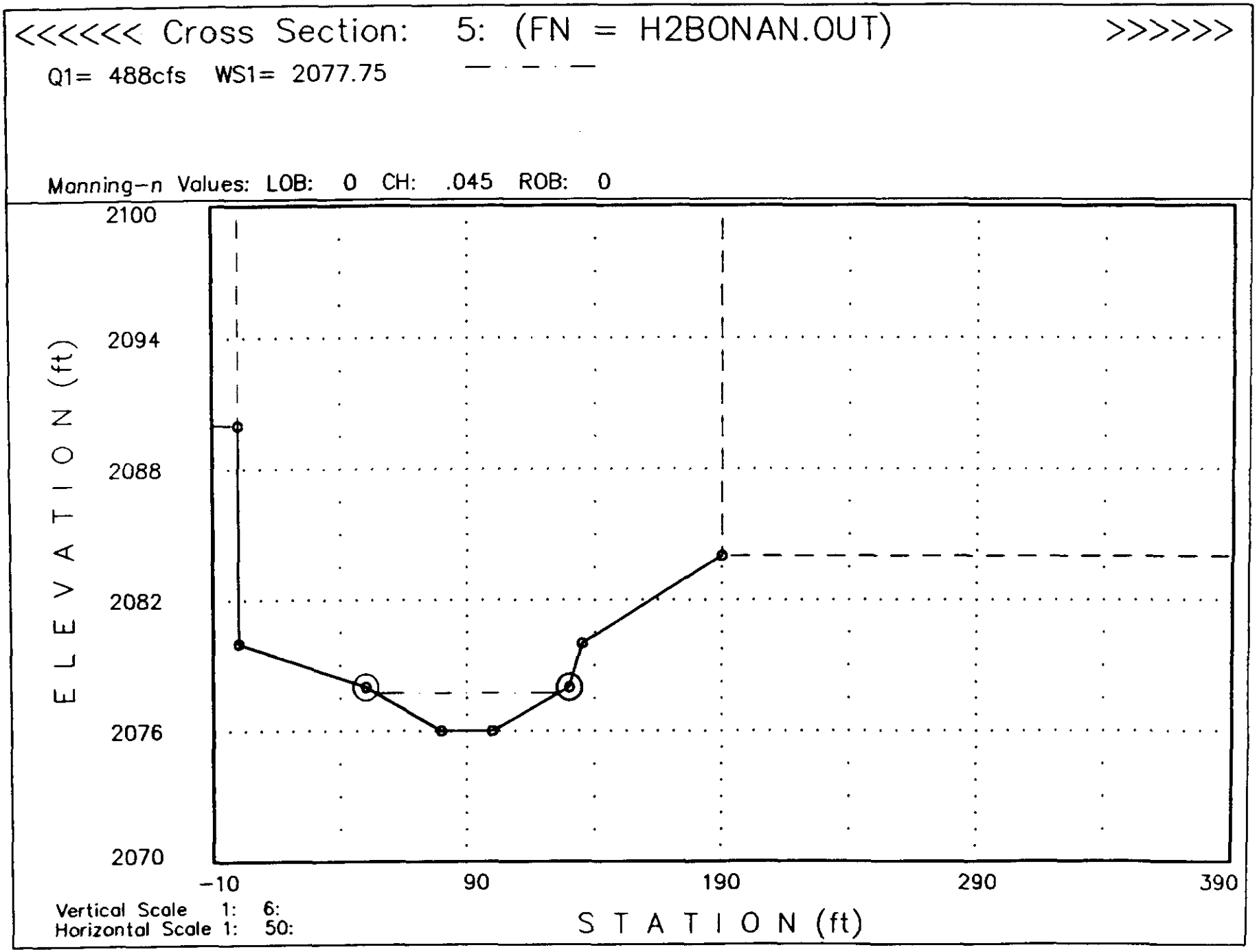
WARNING SECNO= 8.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

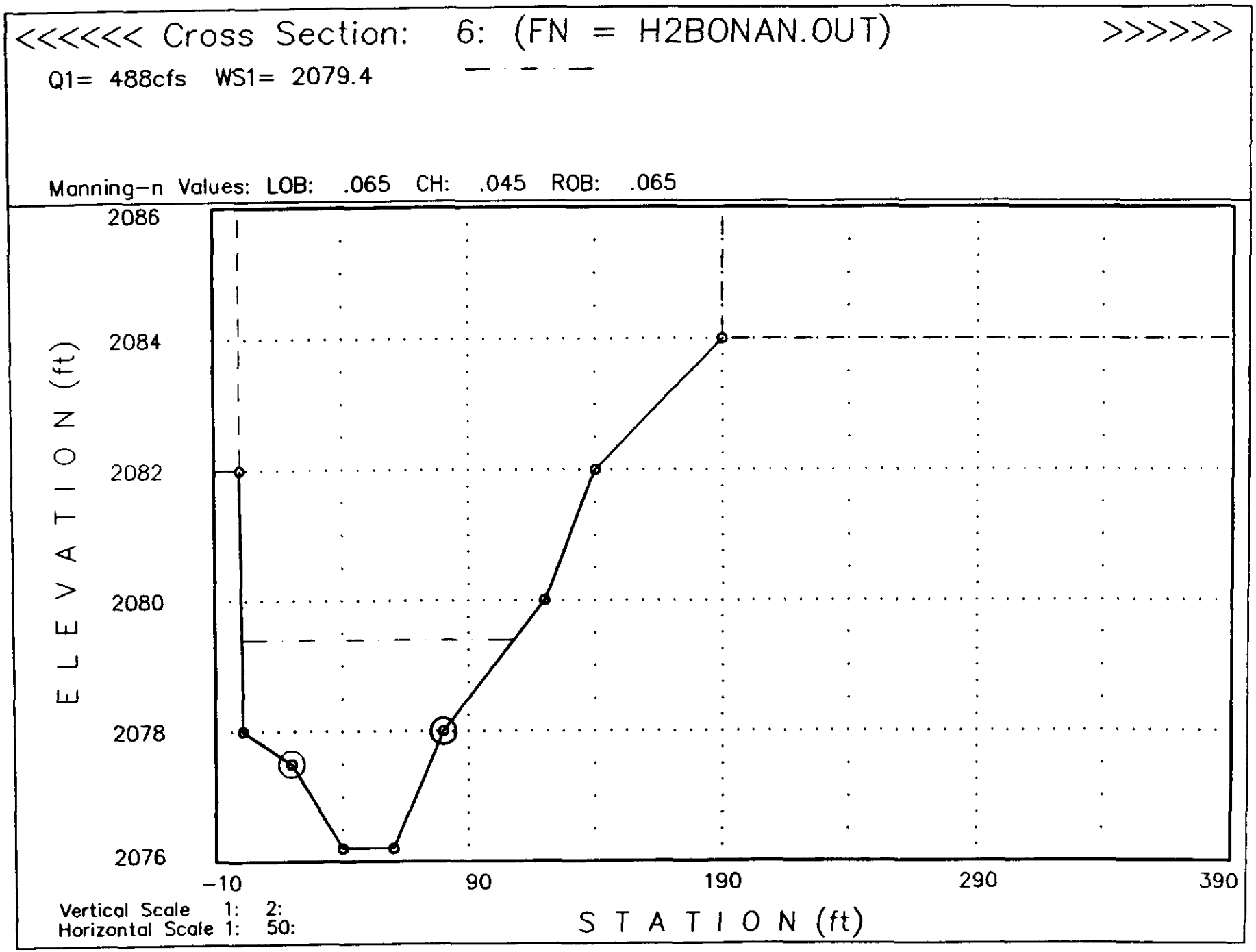

<<<<<< Cross Section: 1: (FN = H2BONAN.OUT) >>>>>>
Q1= 488cfs WS1= 2054.22
Manning-n Values: LOB: .065 CH: .045 ROB: .065
2061
2059
2057
2055
2053
2051
ELEVATION (ft)
-100
100
300
500
700
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 100:
08-17-1994

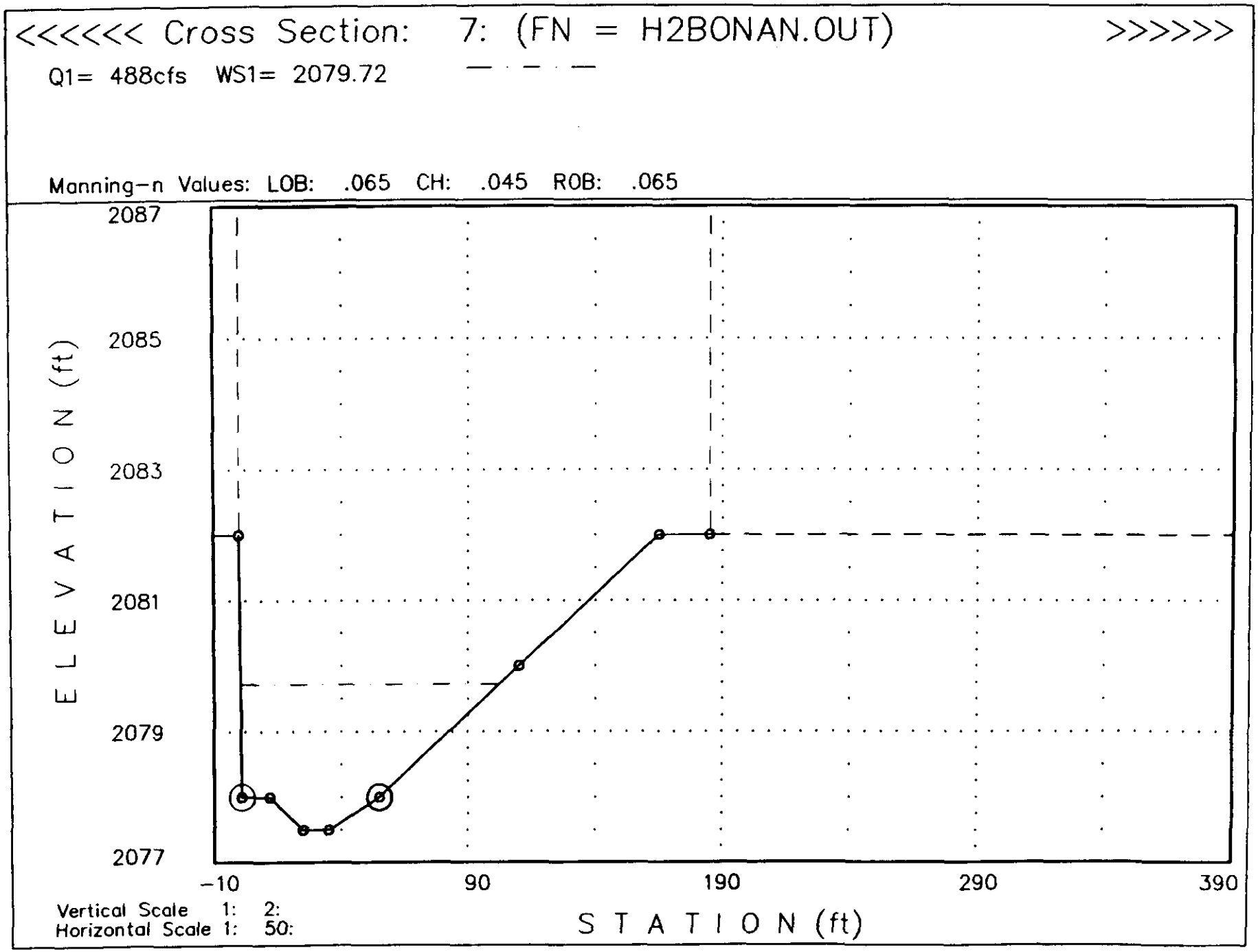

<<<<<< Cross Section: 2: (FN = H2BONAN.OUT) >>>>>>
Q1= 488cfs WS1= 2055.03
Manning-n Values: LOB: .065 CH: .045 ROB: .065
2061
2059
2057
2055
2053
2051
ELEVATION (ft)
-100
100
300
500
700
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 100:
08-17-1994

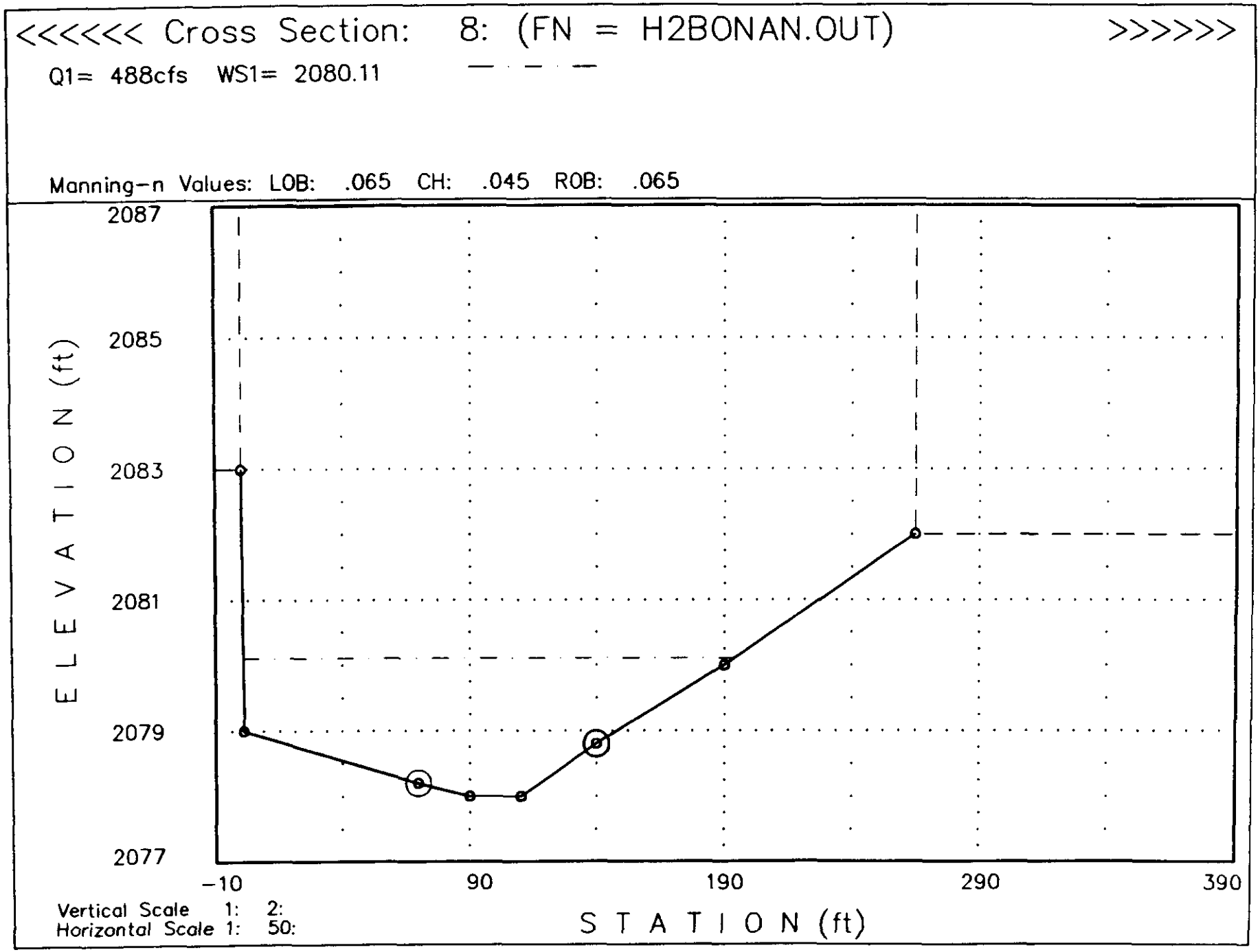

<<<<<< Cross Section: 3: (FN = H2BONAN.OUT) >>>>>>
Q1= 488cfs WS1= 2059.77
Manning-n Values: LOB: .065 CH: .045 ROB: 0
2073
2070
2067
2064
2061
2058
ELEVATION (ft)
-10
190
390
590
790
STATION (ft)
Vertical Scale 1: 3:
Horizontal Scale 1: 100:
08-17-1994

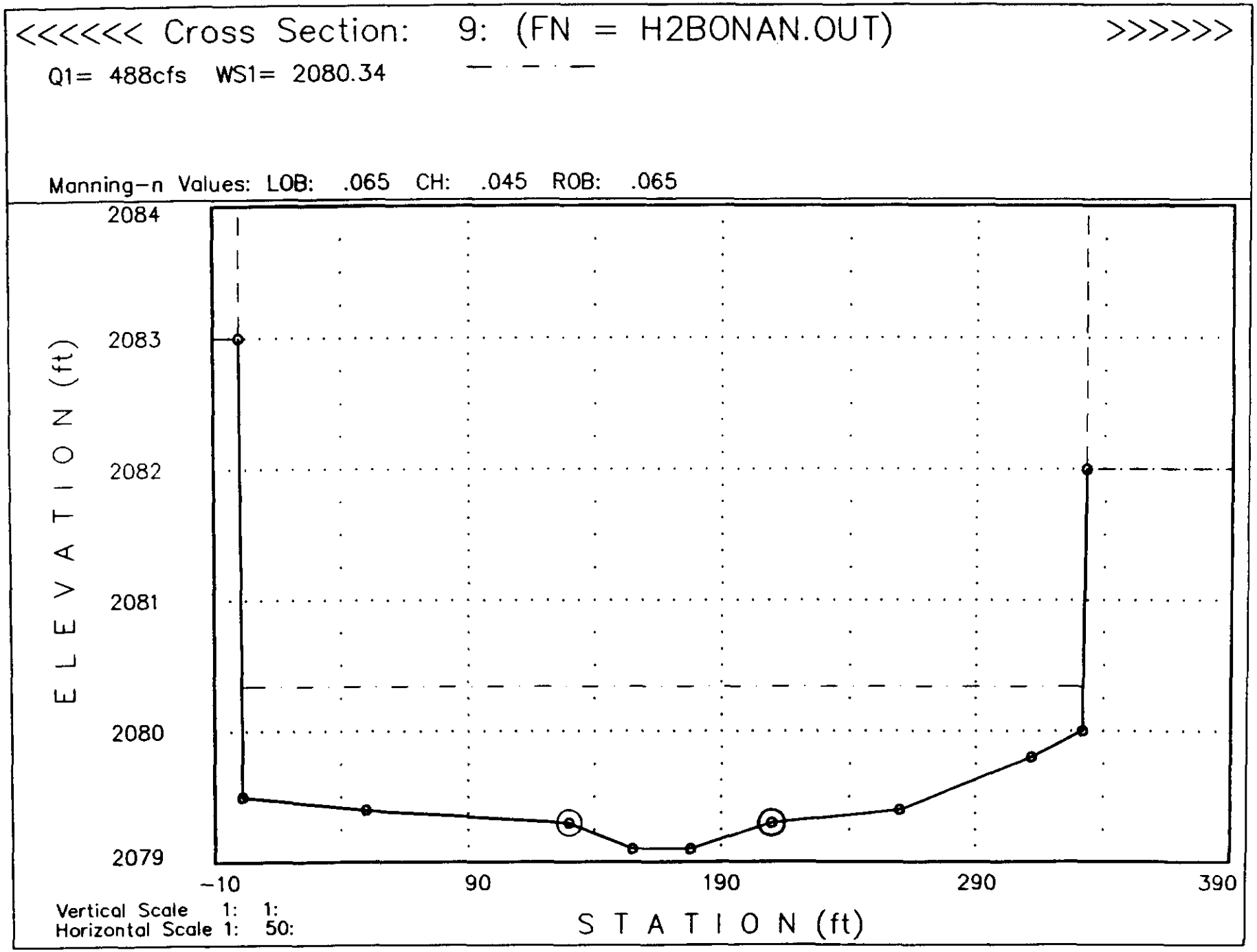

<<<<<< Cross Section: 4: (FN = H2BONAN.OUT) >>>>>>
Q1= 488cfs WS1= 2070.19
Manning-n Values: LOB: .065 CH: .045 ROB: .065
2077
2075
2073
2071
2069
2067
ELEVATION (ft)
-10
190
390
590
790
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 100:
08-17-1994


<<<<<< Cross Section: 5: (FN = H2BONAN.OUT) >>>>>>
Q1= 488cfs WS1= 2077.75
Manning-n Values: LOB: 0 CH: .045 ROB: 0
2100
2094
2088
2082
2076
2070
ELEVATION (ft)
-10
90
190
290
390
STATION (ft)
Vertical Scale 1: 6:
Horizontal Scale 1: 50:
08-17-1994


<<<<<< Cross Section: 6: (FN = H2BONAN.OUT) >>>>>>
Q1= 488cfs WS1= 2079.4
Manning-n Values: LOB: .065 CH: .045 ROB: .065
2086
2084
2082
2080
2078
2076
ELEVATION (ft)
-10
90
190
290
390
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 50:
08-17-1994


<<<<<< Cross Section: 7: (FN = H2BONAN.OUT) >>>>>>
Q1= 488cfs WS1= 2079.72
Manning-n Values: LOB: .065 CH: .045 ROB: .065
2087
2085
2083
2081
2079
2077
ELEVATION (ft)
-10
90
190
290
390
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 50:
08-17-1994


<<<<<< Cross Section: 8: (FN = H2BONAN.OUT) >>>>>>
Q1= 488cfs WS1= 2080.11
Manning-n Values: LOB: .065 CH: .045 ROB: .065
2087
2085
2083
2081
2079
2077
ELEVATION (ft)
-10
90
190
290
390
STATION (ft)
Vertical Scale 1: 2:
Horizontal Scale 1: 50:
08-17-1994


<<<<<< Cross Section: 9: (FN = H2BONAN.OUT) >>>>>>
Q1= 488cfs WS1= 2080.34
Manning-n Values: LOB: .065 CH: .045 ROB: .065
2084
2083
2082
2081
2080
2079
ELEVATION (ft)
-10
90
190
290
390
STATION (ft)
Vertical Scale 1: 1:
Horizontal Scale 1: 50:
08-17-1994

COE & VAN LOO
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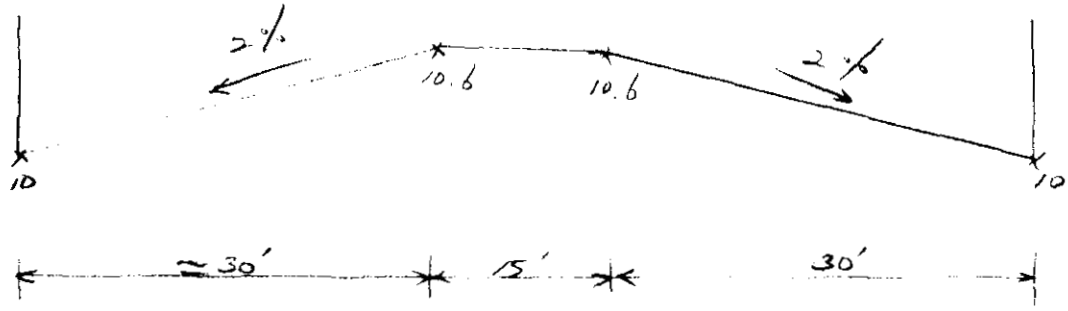
ISCAPE ARCHITECTURE

Project
Project No 23017
Sheet No. of
Calculated by JS Date 4/2/84
Checked by Date

Vejar. Drive Section A

360 feet east of Rancho Dr.



S: 0.01 ft/ft

12	10	10.6	10.6	10	12
1000,	1000.01,	1030,	1045,	1075	1075.01

Project_____
Project No._____
Sheet No._____of_____
Calculated by_____Date_____

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Vegas Dr. - Section A

-360 feet east of Rancho Dr.

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	6	Bed Slope:	0.01000	Max Elev.:	12.00
Bank Stations.....Left:	1000.0	Right....:	1075.0	Min Elev.:	10.00
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.016	CHANNEL..:	0.016	ROB.....:	0.016

CROSS SECTION POINTS - Elevations & Stations in feet:

No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	12.00	1000.00	2)	10.00	1000.01	3)	10.60	1030.00
4)	10.60	1045.00	5)	10.00	1075.00	6)	12.00	1075.01

COMPUTED PARAMETERS:

WSEL(ft)	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	CRWS(ft)
10.20	3.9	2.0	1.10	0.016	0.1	20.0	2.0	20.4	10.21
10.40	25.1	3.1	1.24	0.016	0.2	40.0	8.0	40.8	10.44
10.60	73.9	4.1	1.32	0.016	0.3	60.0	18.0	61.2	10.67
10.80	174.8	5.3	1.41	0.016	0.4	75.0	33.0	76.6	10.92
11.00	325.3	6.8	1.49	0.016	0.6	75.0	48.0	77.0	11.20

NOTES:

$Q_{100} = 164$

Max d = 0.78'

Avg d = 0.44' < 1'

Zone X

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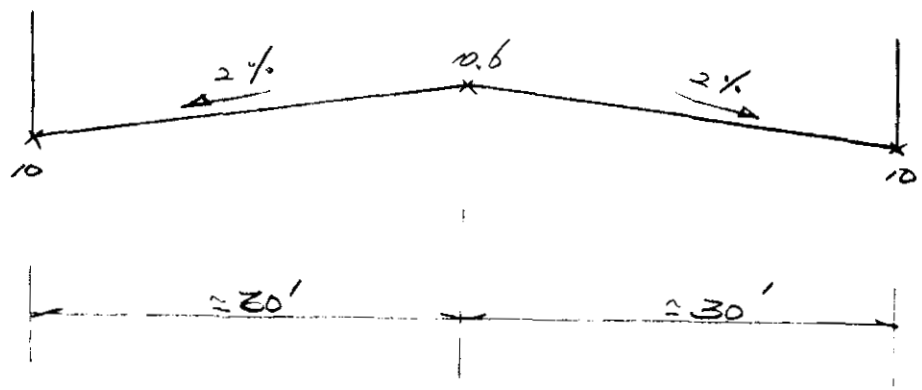
ISCAPE ARCHITECTURE

Project NWLVFS
Project No. 83001
Sheet No. ____ of ____
Calculated by YS Date 6/3/84
Checked by ____ Date ____

Washington Ave. - Section B

Approximately 495 feet east of Rancho Dr.



S = 0.006 ft/ft

12 / 1000, 10 / 1000.01, 10.6 / 1030, 10 / 1060, 12 / 1060.01

81;;17:;19:IN;SC;PU;PU;SP6;LT;VS36;PA2041,1276;PD;PA10209,1276;PA10209,6381;PA2041,6381;PA2041,1276;PU;PA4083,1276;PD;PA4083,1276;PA40

Project NWLVFLS
Project No.
Sheet No. of
Calculated by Date

UNIFORM FLOW COMPUTATIONS

LOCATION/DESCRIPTION:

Washington Ave. - Section B
495 feet east of Rancho Dr

CROSS SECTION PARAMETERS: FILENAME: .SEC

No. of Cross Section Points:	5	Bed Slope:	0.00600	Max Elev.:	12.00
Bank Stations.....Left:	1000.0	Right....:	1060.0	Min Elev.:	10.00
Encroachment Stations..Left:		Right....:			
Manning-n Values.....LOB:	0.016	CHANNEL..:	0.016	ROB.....:	0.016

CROSS SECTION POINTS - Elevations & Stations in feet:

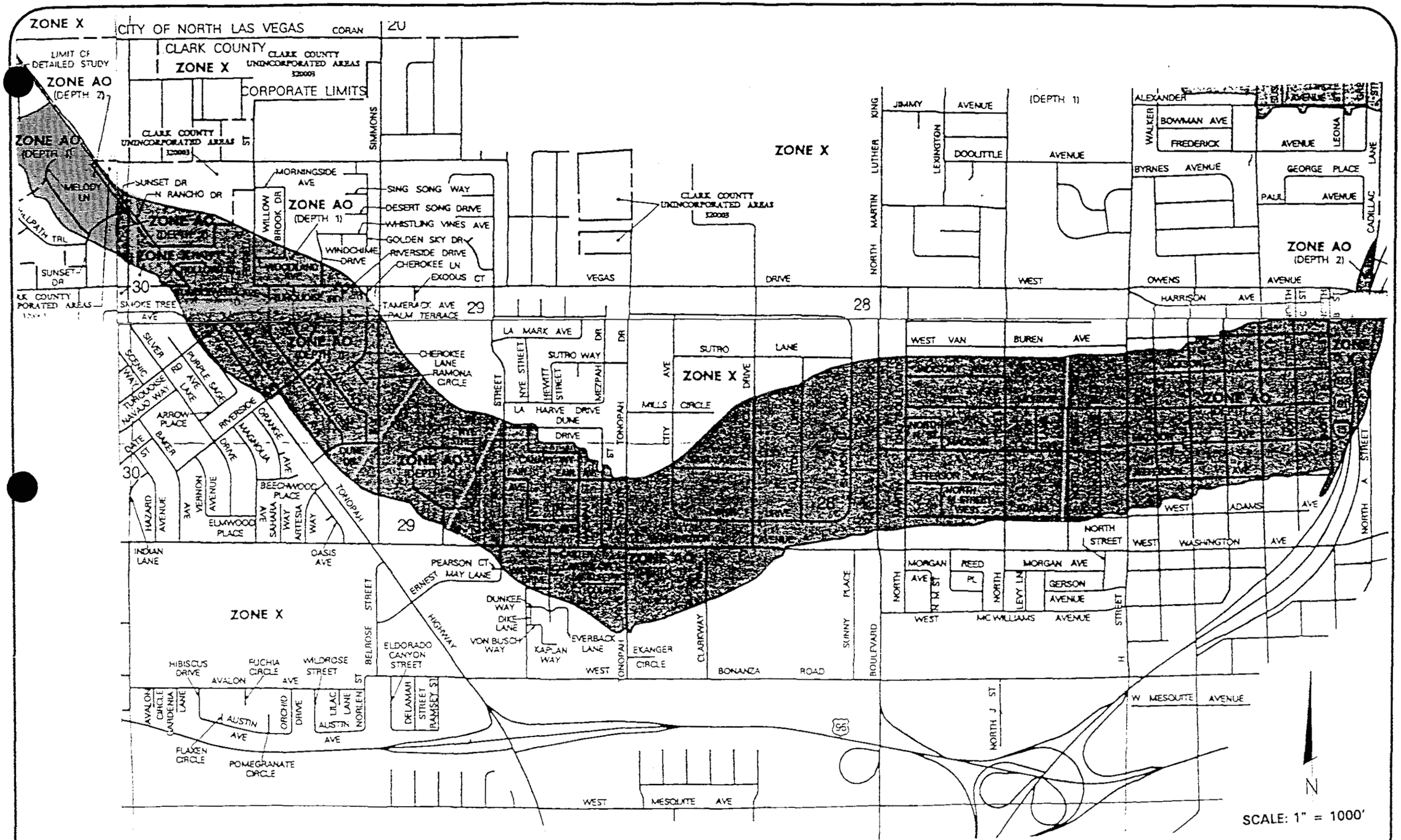
No.	Elev.	Sta.	No.	Elev.	Sta.	No.	Elev.	Sta.
1)	12.00	1000.00	2)	10.00	1000.01	3)	10.60	1030.00
4)	10.00	1060.00	5)	12.00	1060.01			

COMPUTED PARAMETERS:

WSEL(ft)	Q(cfs)	V(fps)	Fr No.	ne	D(ft)	TW(ft)	A(sf)	WP(ft)	CRWS(ft)
10.20	3.1	1.5	0.85	0.016	0.1	20.0	2.0	20.4	10.19
10.40	19.4	2.4	0.96	0.016	0.2	40.0	8.0	40.8	10.39
10.60	57.3	3.2	1.02	0.016	0.3	60.0	18.0	61.2	10.61
10.80	133.6	4.5	1.11	0.016	0.5	60.0	30.0	61.6	10.84
11.00	233.0	5.5	1.17	0.016	0.7	60.0	42.0	62.0	11.08
10.93	195.0	5.2	1.15	0.016	0.6	60.0	37.7	61.9	10.99

NOTES:

Q_{100} = 151
Avg d = 0.5' < 1'
Max d = 0.84'
Zone X



NORTHWEST LAS VEGAS
F.I.S. RESTUDY
D - FIRM

COE & VAN LOO
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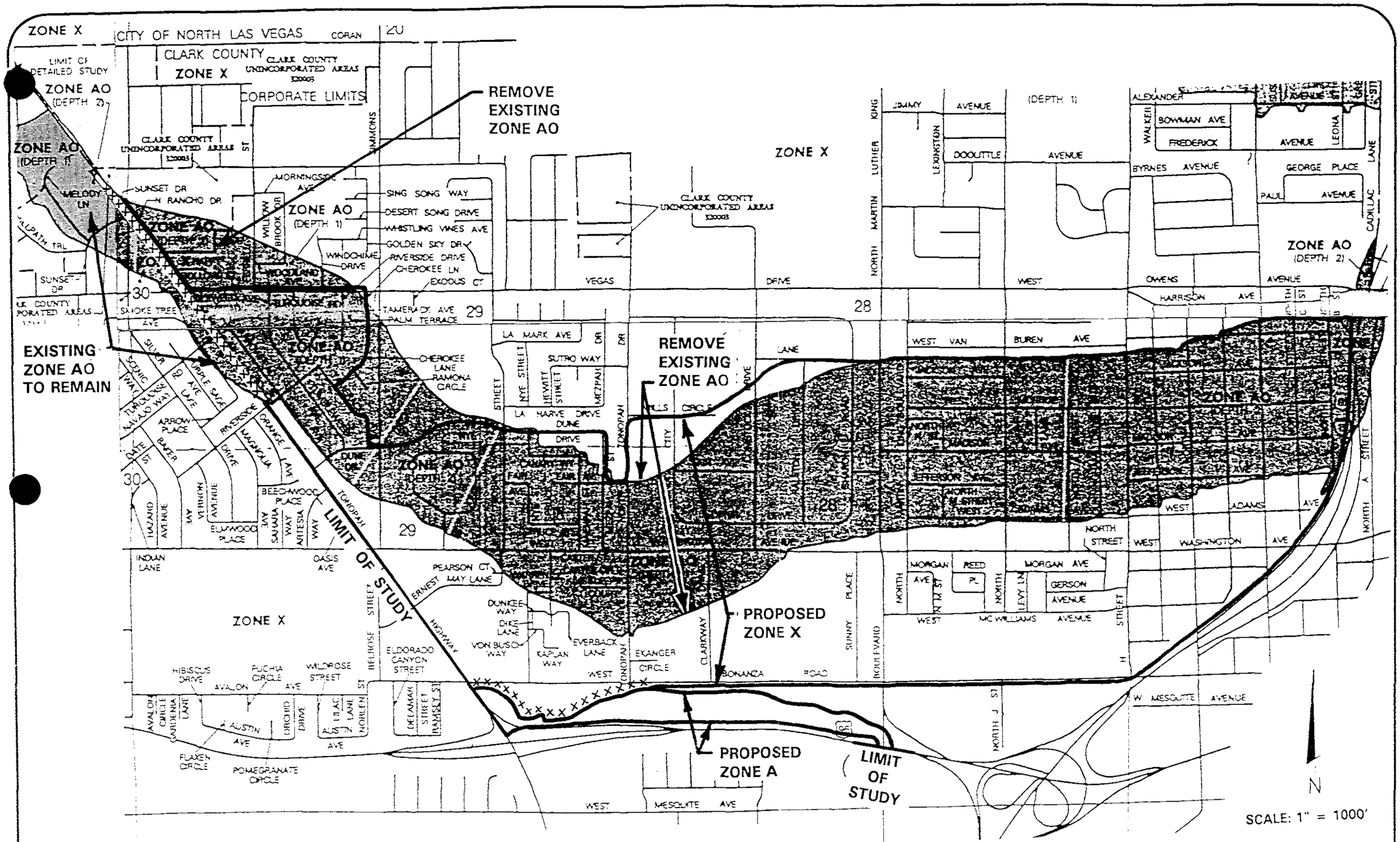
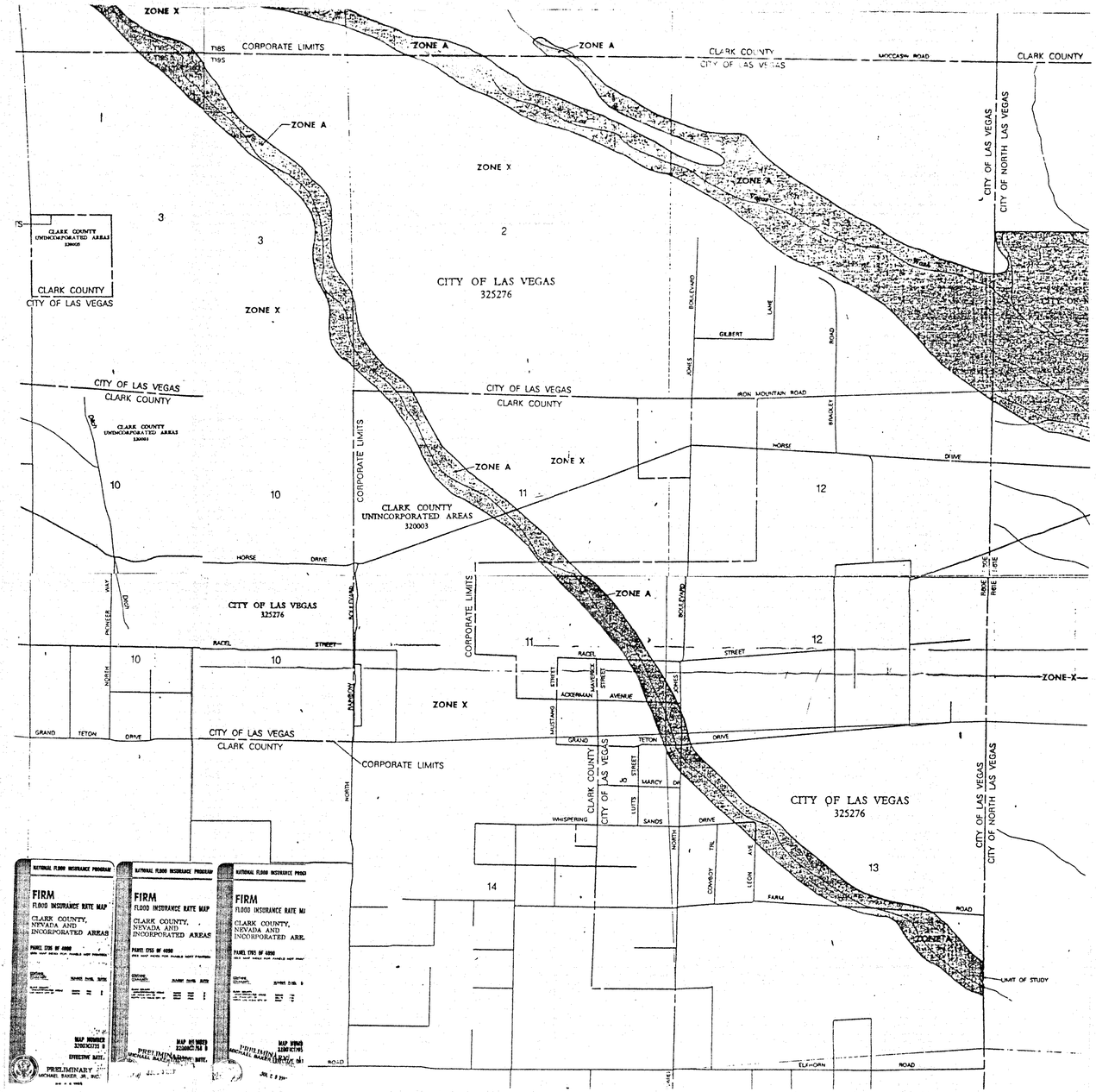
LANDSCAPE ARCHITECTURE



NORTHWEST LAS VEGAS
F.I.S. RESTUDY
ANNOTATED D - FIRM

COE & VAN LOO
PLANNING · ENGINEERING
LANDSCAPE ARCHITECTURE



1000 500 0 500

SCALE: 1"= 1000'

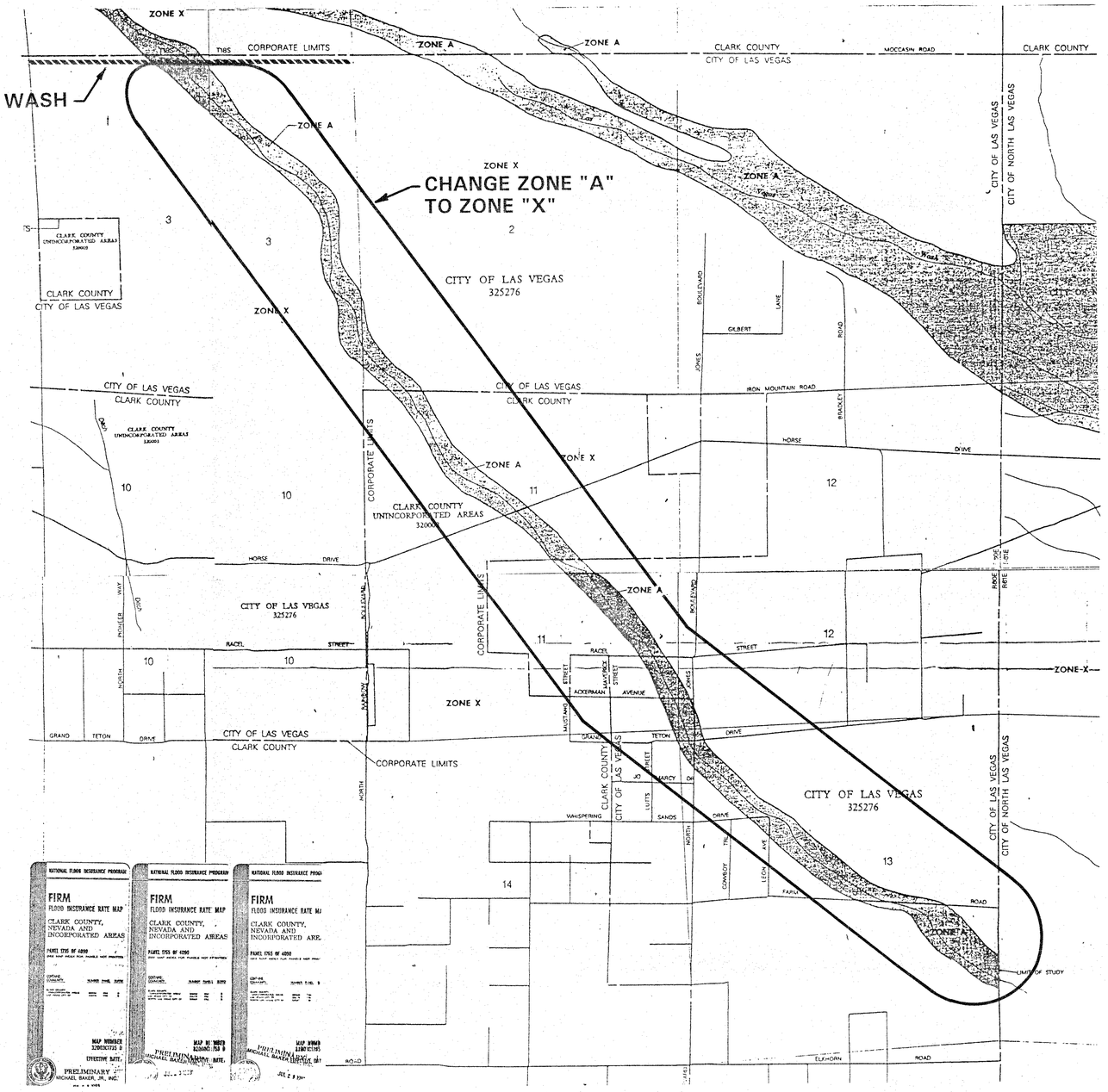
AUG 19 1994

NORTHWEST LAS VEGAS F.I.S. RESTUDY

D - FIRM

CVL

SD01BOP.DGN DATE: 05-03-94



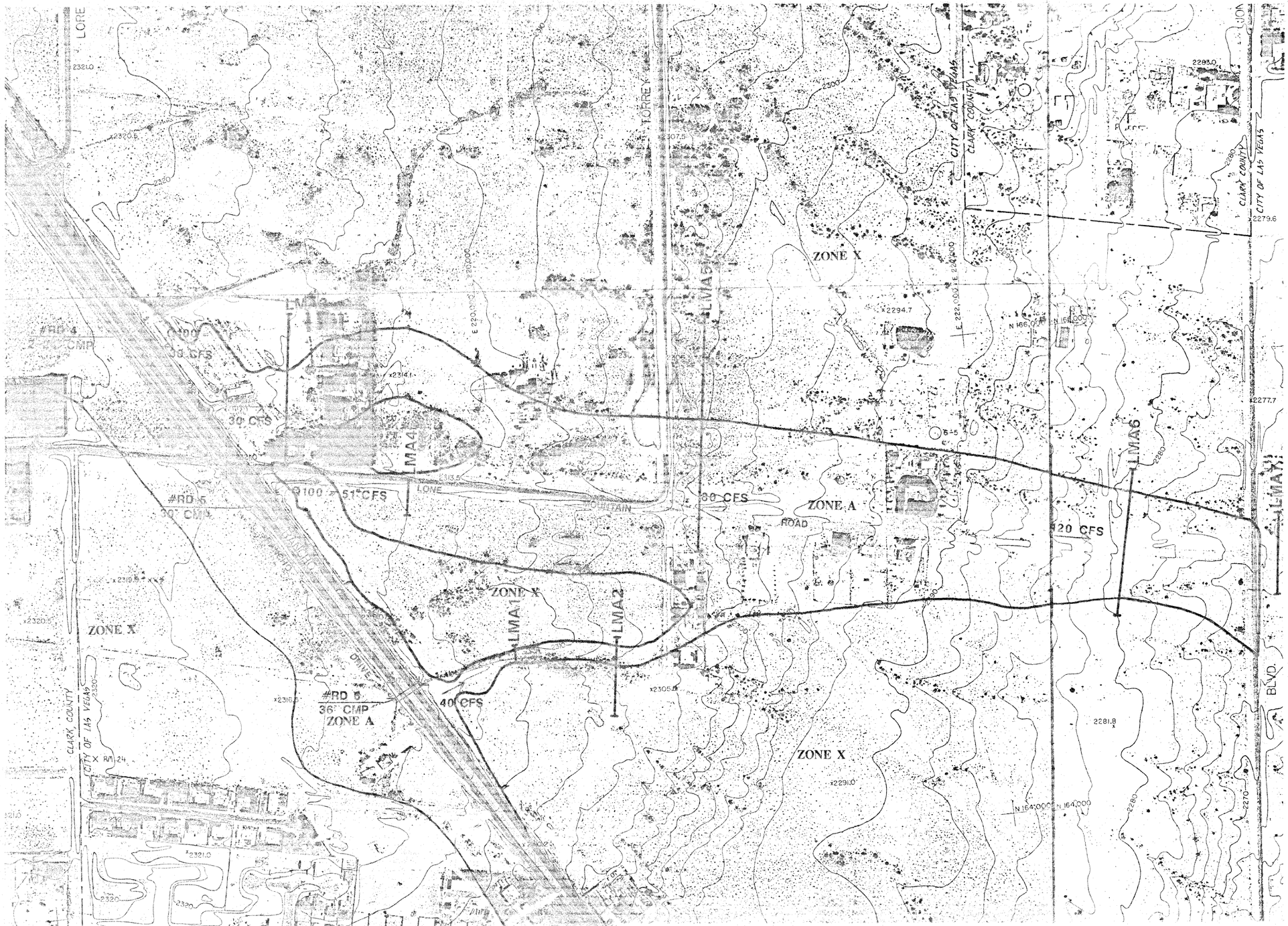
NORTHWEST LAS VEGAS
F.I.S. RESTUDY

ANNOTATED D - FIRM

CVL

DATE: 05-03-94

SD01BOP.DGN



NOTE: EXISTING ZONE 'A' CONTAINED WITHIN LONE MOUNTAIN ROAD RIGHT OF WAY

COOPER AERIAL OF NEVADA, INC.
3750 S. VALLEY VIEW NO.7, LAS VEGAS
PHOTO DATE: 7-7-84
NATIONAL GEODETIC VERTICAL DATUM
CONTOUR INTERVAL: 2 FEET

NORTHWEST LAS VEGAS F.I.S. RESTUDY

LONE MOUNTAIN/RANCHO DRIVE
CROSS-SECTION LOCATIONS

CVL

SD01BOP.DGN DATE: 05-03-94

REMOVE EXISTING ZONE A

EXISTING ZONE AO TO REMAIN

PROPOSED ZONE X

REMOVE EXISTING ZONE A

PROPOSED ZONE A

LIMIT OF STUDY

LIMIT OF STUDY

VEGAS DRIVE

BOULEVARD

RANCHO DRIVE

WASHINGTON AVENUE

BONANZA DRIVE

KING

LUTHER

MARTIN

HIGHWAY 95

INTERSTATE 15 (I-15)

11

12

13

14

15*
15.1

16*
16.1

17*
17.1

18.1

A

B

364 CFS

764 CFS

584 CFS

151 CFS

675 CFS

1199 CFS

488 CFS

36 CFS

STA. 1000

LEGEND

- 11 — CROSS SECTION LOCATION (H2 WASH 2. DAT)
- 1 — CROSS SECTION LOCATION (H2 BONAN. DAT)
- FLOODPLAIN BOUNDARY
- FLOOD ZONE CHANGE
- HEC-2 CROSS SECTION STATION
- A — CROSS SECTION LOCATION (HAND CALCULATIONS)
- DIRECTION OF FLOW

* THE FLOW AT SECTIONS 15, 16, AND 17 IS DIVIDED AND COMBINES AT SECTION 14. THE FLOW NORTH OF WASHINGTON AVENUE WAS MODELED AS A TRIBUTARY USING IDENTICAL CROSS SECTIONS WITH INEFFECTIVE FLOW AREAS ENCROACHED OUT.

N

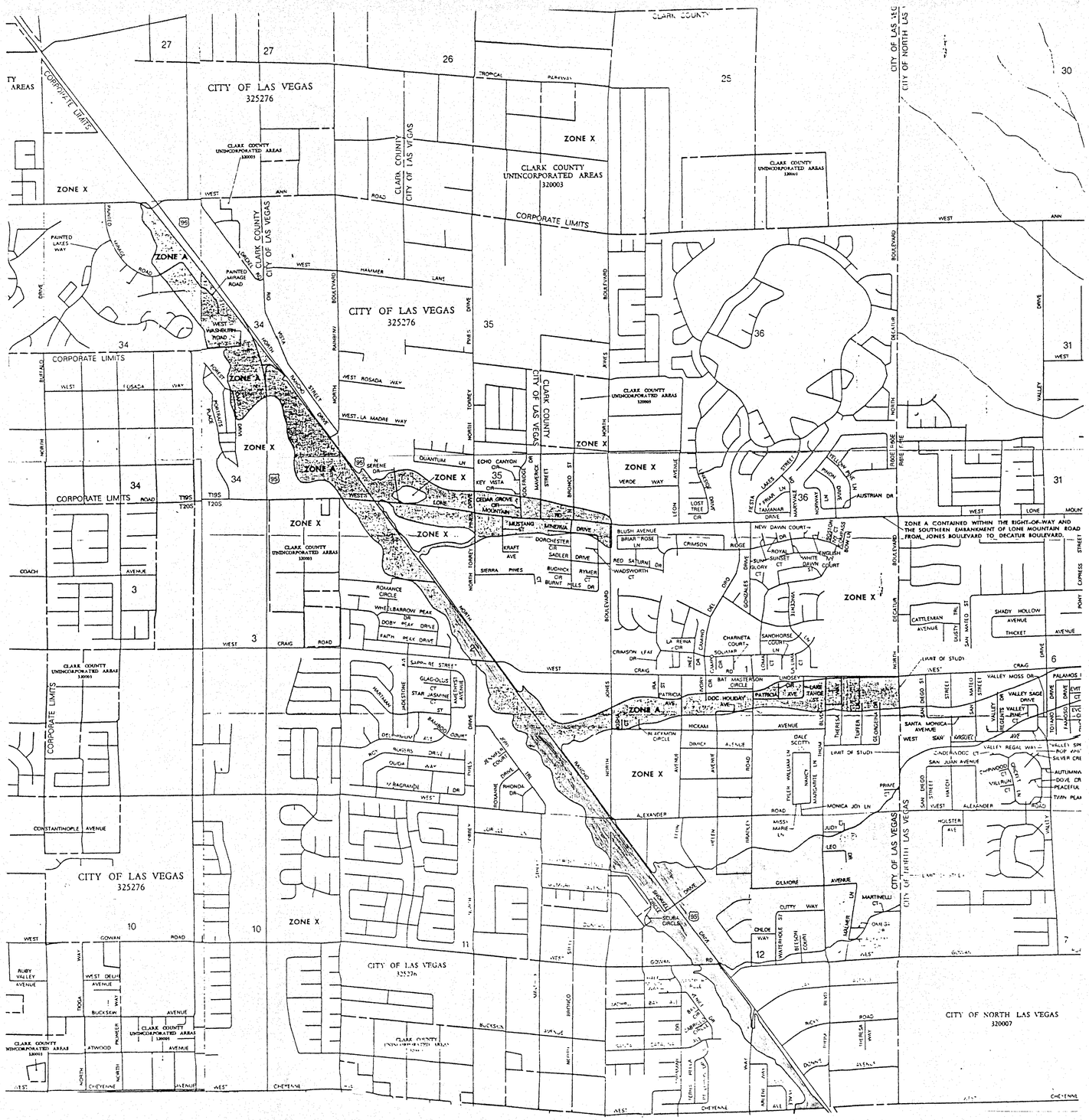
SCALE: 1" = 400'

NOTE: TOPOGRAPHY REDUCED FROM 1"=200', 2' CONTOUR INTERVAL MAPPING PRODUCED BY COOPER AERIAL OF NEVADA, FLOWN JULY 7,1984.

NORTHWEST LAS VEGAS FLOOD INSURANCE STUDY RESTUDY

WASHINGTON AVENUE AREA HEC-2 WORK MAP

CVL CONSULTANTS



JUN 17 1994

NORTHWEST LAS VEGAS F.I.S. RESTUDY

D - FIRM

CVL

SD01B0P.DGN DATE: 05-03-94

DESERT NATIONAL WILDLIFE RANGE

UPPER LAS VEGAS WASH
DIVERSION DIKE & DETENTION BASIN

KYLE CANYON
DETENTION BASIN

FLOYD R. LAMB STATE PARK

LAS VEGAS

CLARK COUNTY

NORTH LAS VEGAS

GOWAN NORTH
DETENTION BASIN

GOWAN OUTFALL

CHEYENNE CHANNEL

GOWAN SOUTH
DETENTION BASIN

SUMMERLIN
DESERT SHORES

BUFFALO
CHANNEL

ANGEL PARK
DETENTION BASIN

PIPE OUTFALL

GOWAN
OUTFALL
CHANNEL

CRAIG RANCH
GOLF COURSE

CAREY/LAKE MEAD
DETENTION BASIN

NORTH LAS VEGAS
REGIONAL PARK

MUNICIPAL
GOLF COURSE

AIR TERMINAL

ZONE A

RANCHO DRIVE

BUFFALO DRIVE

HIGHWAY 95

CAMINO EL NORTE

LAS VEGAS WASH (NOT IN STUDY)

INTERSTATE 15

ANN ROAD

LONE MOUNTAIN ROAD

CRAIG ROAD

WASHINGTON AVENUE

SUMMERLIN PARKWAY

NOTE: DISCONTINUITES IN FLOODPLAIN ALIGNMENTS AS SHOWN OCCUR ON THE FIRMS BETWEEN EACH OF THE COMMUNITIES

Northwest Las Vegas
Flood Insurance Study Restudy

Clark County, Nevada

EXISTING FLOODPLAINS WITHIN STUDY AREA

PLATE 1

SCALE: 1" = 2000'

LEGEND

- CURRENTLY DELINEATED FLOOD ZONE
- EXISTING DETENTION BASIN
- EXISTING IMPROVED CHANNEL
- EXISTING MAJOR STORM DRAIN
- DIVERSION DIKE

Prepared by:
CVL Consultants, Inc.
Pentacore Engineering, Inc.