Request for Letter of Map Revision
Robindale-Royal Oaks
Clark County, Nevada

Prepared for:

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT
600 South Grand Central Parkway
Las Vegas, NV 89155

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

Prepared by:

PBS&J
2270 Corporate Circle, Suite 100
Henderson, Nevada 89074
(702) 263-7275

PBS&J

July 2006

1.0 INTRODUCTION

The purpose of this Letter of Map Revision (LOMR) is to address a needed revision to a remnant Zone A flood zone in unincorporated Clark County, Nevada. The area in which the Zone A flood zone is located is fully urbanized and characterized by mixed density residential and commercial developments. The majority of the project area was developed between the mid 1970's and early 1990's. Note that technical drainage studies and/or civil improvement plans for many of the developments were not readily available from the local entity due to the age of the project area. The historic flood source to the subject flood zone has been substantially reduced based on urbanization and the implementation of upstream flood control facilities. In particular are the Duck Creek Channel improvements and the I-215 Beltway to the south and southwest of the subject flood zone. As a result of the flow reduction to the project area this LOMR request will analyze the current tributary area and demonstrate that the current conditions no longer warrant the flood zone delineation as shown on the current effective FIRM Panel 2590 dated September 27, 2002, revised to reflect LOMR dated August 13, 2003. Note that the LOMR dated August 13, 2003 does not affect the project area. Please refer to **Figure 1 Area/Vicinity Map** for an overall view of the project area. Also refer to **Figure 2 CCRFCD Flood Control Facilities Map** that shows existing and proposed facilities within and adjacent to the project area.

2.0 HYDROLOGY

The hydrologic model utilized to calculate runoff is the HEC-1 Flood Hydrograph Package, Version 4.1, developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center. The methodology and calculations used to determine the hydrologic parameters in the HEC-1 modeling are included in Appendix C. The local parameters for computing runoff have been developed in accordance with the Clark County Regional Flood Control District's Hydrologic Criteria and Drainage Design Manual. The hydrologic input parameters are located in Appendix C. Soils information and curve number calculations can also be found in Appendix C.

2.1 PREVIOUS HYDROLOGIC STUDIES

As previously mentioned in the introduction the area was developed between 12 and 30 years ago. As a result, only limited information was made available through the local entity (Clark County). Also, the upstream land use was significantly different than what is existing today making the studies obsolete. Therefore, a new hydrologic model based on existing conditions was prepared for this report. However, reference material from two subdivisions (Horizon Vista Estates and Wishing Well Ranch) can be found in Appendix E. The reference material will be discussed in detail in Section 2.3 below.

2.2 HYDROLOGIC PARAMETERS

According to Figure 513 of the CCRFCD Criteria Manual the site is located inside the McCarran Airport Rainfall area. The 100-year, 6-hour rainfall depth duration frequency values for areas located inside the McCarran Airport Rainfall area were obtained from Table 505 of the Criteria Manual. According to Table 505, the rainfall depth for the 100-year 6-hour event is 2.77 inches. Table 501 adjustments are not required for areas located inside the McCarran Airport Rainfall area.

Soils information for the drainage basins was obtained from the Soil Conservation Service (SCS) Soil Survey of Las Vegas Valley Area, Nevada, 1985. The subject watershed is depicted on a SCS survey map and is included in Appendix C, see **Soils Map**. The hydrologic group classification for each soil in the soil composite was read from Table 15 of the SCS survey, included herein. The soil types were matched to the corresponding SCS Curve Number (CN) for use in the Standard Form 4 and the HEC-1 analysis. The corresponding CN's for these soils are found on Table 602 of the Criteria Manual. Table 1, Curve Number Calculations summarizes the computation of the Curve Numbers for the basins. Please refer to Appendix C for Table 1.

Hydrologic Computations

All subbasins within the Robindale-Royal Oaks Watershed are less than 1 square mile. For subbasins less than 1 square mile, the time of concentration (velocity method) is used to compute lag time. This method is explained below:

Time of Concentration Method

For drainage basins with less than one square mile, the time of concentration is calculated as follows:

$$T_c = T_i + T_t$$

Where:

T_c = Time of concentration (minutes)
T_i = Initial, inlet or overland flow time (minutes)
T_t = Travel time in the ditch, gutter, etc. (minutes)

The Lag time for basins less than one square mile is calculated as follows:

$$T_{lag} = 0.6T_c \text{ (hours)}$$

Initial flow time is calculated as follows:

$$T_i = 1.8(1.1 - K)L_o^{1/2}/S^{1/3}$$

Where:

T_i = Initial overland flow time (minutes)
K = 0.0132 * CN - 0.39
CN = Curve Number
L_o = Length of overland flow (max. 500 ft)
S = Average basin slope (percent)

Travel time is calculated as follows:

$$T_t = 500/(60\ V_1) + (L_t\text{-}500)/(60\ V_2)$$

Where:

T_t = Travel time in the ditch, gutter, etc. (minutes)
L_t = Travel Length (feet)
V_1 = Average velocity of flow for the first 500 feet of travel distance (ft/s)
V_2= Average velocity of flow for the remaining travel distance (ft/s)

V1 and V2 are calculated as follows:

$$V_1 = C_1 * (S/100)^{1/2}$$

$$V_2 = C_2 * (S/100)^{1/2}$$

Where:

C_1= 20.2 for developed areas and 14.8 for undeveloped areas
C_2= 30.6 for developed areas and 29.4 for undeveloped areas
S = Average slope for the flow path (percent)

In urbanized areas, the time of concentration calculated above should not exceed the time of concentration calculated by the following equation:

$$tc = (L / 180) + 10$$

Where:

tc = Time of concentration at the first design point in an urban watershed (min)
L = Watershed length (ft)

The smaller of the two calculations for time of concentration will control. Minimum T_c for any watershed is limited to 5 minutes.

2.3 MODEL DESCRIPTION

The Robindale-Royal Oaks watershed has been subdivided into 10 basins (ROB1 through ROB10) that contribute flow to the flood zone (see Figure 5). Basin ROB1 (19 cfs) is 22.1 acres and consists of single-family residential. Flow from basin ROB1 drains north through Martingale Lane and discharges to Branding Iron Lane. Basin ROB2 (35 cfs) is 15.82 acres and consists of single-family residential. Flow from basin ROB2 drains north through Wishing Well Road and discharges to Branding Iron Lane. Basin ROB3 (2 cfs) is 2.2 acres and consists of single-family residential. Flow from basin ROB3 drains northwest through Branding Iron Lane and combines with the flow from ROB1 and ROB2. Note that a portion of the flow from the Horizon Vista Estates contributes flow to the subject watershed. The reference drainage study for Horizon Vista Estates shows 107 cfs in Spencer Street at the intersection with Windmill Lane. The study shows the 107 cfs remains in Spencer Street and is conveyed north where it ultimately drains to the Duck Creek Channel. A field review confirmed this flow pattern as the crown in Windmill Lane is depressed at Spencer Street. Also, Windmill Lane was constructed such that a sag was created at the intersection of Spencer Street. A high point in Windmill Lane (approximately 250 east of Spencer Street) is shown on the referenced grading plans for Wishing Well Ranch Unit 6 and confirmed with a field visit. Also, 29 cfs is discharged to

Windmill Lane at the northeast corner of the Horizon Vista Estates subdivision via a drainage easement. The reference study shows the south half street capacity of Windmill Lane is 8 cfs and is based on a 0.51% cross-grade. The typical cross-grade for a street section is 2%. The remaining flow of 21 cfs weirs over the crown and into the north half street of Windmill Lane. As a conservative assumption it was assumed all of the 21 cfs drains to the subject watershed. The HEC-1 model includes a Base Flow card to account for the 21 cfs. Please refer to Appendix E for the reference drainage study and grading plans discussed above. Basins ROB1, ROB2, ROB3 and the 21 cfs from the Horizon Vista subdivision combine at combination point CP1 for a total 100-year flow of 55 cfs. Flow from CP1 is then conveyed north in Branding Iron Lane and discharged to Robindale Road.

Basin ROB4 (6 cfs) is 8.4 acres and consists of single-family residential. Flow from basin ROB4 drains north through Royal Oaks Road and discharges to Robindale Road. Basin ROB9 (7 cfs) is 9.67 acres and consists of single-family residential. Flow from basin ROB9 drains north through Branding Iron Lane and discharges to Robindale Road. Basin ROB10 (5 cfs) is 1.55 acres and consists of fully improved paved right-of-way for a portion of Robindale Road. Basins ROB4, ROB9, ROB10 and CP1 combine at combination point CP2 for a total 100-year flow of 72 cfs in Robindale Road. A FlowMaster cross-section of the south half-street of Robindale Road (see Appendix D) shows a capacity of 54 cfs. The remainder of the flow at CP2 will weir over the crown into the north half-street of Robindale Road. As a conservative assumption it is assumed the 18 cfs will drain north through basin ROB8 and combine with the flow at CP3. Note that several drop inlets are located within Robindale Road as shown in the project photos located in Appendix F. However, any flows collected by these drop inlets were not accounted for in the hydraulic calculations at CP2.

Basin ROB5 (15 cfs) is 4.57 acres and consists of a commercial development. Flow from ROB5 is conveyed east through the development and discharged to Burnham Avenue. Basin ROB6 (9 cfs) is 5.3 acres and consists of single-family residential. Flow from basin ROB6 is discharged to Sur Este Avenue and conveyed east to Burnham Avenue. Basin ROB7 (3 cfs) is 0.83 acres and consists of fully improved paved right-of-way for a portion of Burnham Avenue. Flow in Burnham Avenue is conveyed north. Basin ROB8 (28 cfs) is 4.86 acres and consists of single-family residential. Flow from basin ROB8 is discharged to Burnham Avenue through a drainage easement and conveyed north. Basins ROB5, ROB6, ROB7 and ROB8 combine at combination point CP3 at the intersection of Burnham Avenue and Sur Este Avenue for a total 100-year flow of 55 cfs. Note that a small area inlet collects a portion of the flow at CP3 while the remainder is conveyed north in Burnham Avenue where it ultimately drains to the Duck Creek Channel. Please refer to Appendix F for the intersection photographs for Burnham Avenue and Sur Este Avenue. Note that any flow collected by the area inlet at the intersection of Burnham and Sur Este was not accounted for in the hydraulic calculations at CP3.

Below is a flow summary table for the HEC-1 model. Also, refer to Figure 5 for the subbasin delineations and hydrologic/hydraulic results.

Basin Flow Summary **Existing Conditions - 100 Year**		
BASIN NAME/ COMBINATION POINT	**BASIN AREA (acres)**	**Q_{100} (cfs)**
ROB1	22.10	19
ROB2	15.82	35
ROB3	2.20	2
ROB4	8.40	6
ROB5	4.57	15
ROB6	5.30	9
ROB7	0.83	3
ROB8	4.86	28
ROB9	9.67	7
ROB10	1.55	5
C1	NA	55
C2	NA	72
C3	NA	55

3.0 HYDRAULICS

Cross-sections within the subject flood zone have been cut to establish the depth of flow. Please refer to **Figure 5 Work Map** for the location of the cross-sections. Note that the slope used for each cross-section was obtained from the Clark County GIS 5' Contours as shown on Figure 5. Cross-section A-A is located in Branding Iron Lane (40' right-of-way) and shows a normal depth of 0.65' feet based on the flow of 55 cfs at combination point CP1. Cross-section B-B is located in Royal Oaks Road (40' right-of-way) and shows a normal depth of 0.35' feet based on the flow of 6 cfs from basin ROB4. Cross-section C-C is located in Robindale Road (80' right-of-way) and the half-street section shows a normal depth of 0.83' feet based on the flow of 54 cfs. Cross-section D-D is located in Burnham Avenue (60' right-of-way) and shows a normal depth of 0.63' feet based on the flow of 55 cfs from combination point CP3. Please refer to Appendix D for the FlowMaster cross-section worksheets. Please refer to the following table for a summary of the hydraulic calculations.

100-Year Street Flow Depth Summary Table

Cross Section	Location	ROW Width	Street Slope (%)	Normal Depth (ft)	Hydraulic Depth (ft)
A-A	Branding Iron Ln	40'	1.10	0.65	0.30
B-B	Royal Oaks Rd	40'	1.10	0.35	0.12
C-C	Robindale Rd	80'	0.70	0.83	0.34
D-D	Burnham Ave	60'	1.50	0.63	0.22

4.0 CONCLUSION

These cross-sections demonstrate that the depth of flow is less than 1-foot and the drainage area is less than one square mile, thus the subject flood zone warrants exclusion from the FIRM panel. Please refer to **Figures 3 and 4, FEMA Flood Zone Map and Annotated FEMA Flood Zone Map**.

5.0 REFERENCES

Criteria Manual	*Clark County Regional Flood Control District Hydrologic Criteria and Drainage Design Manual*. Prepared for: Clark County Regional Flood Control District. Adopted August 12, 1999.
FlowMaster	FlowMaster Version 2005, Haestad Methods, Inc. 2004.
HEC-1	HEC-1 Flood Hydrograph Package Version 4.0. U.S. Army Corps of Engineers, Hydrologic Engineering Center, September 1990.
MPU 02	*CCRFCD Master Plan Update of the Las Vegas Valley 2002*. Prepared for Clark County Regional Flood Control District. Prepared by PBS&J, 2002.
GCW	*Wishing Well Ranch Unit 6 Grading Plan*. Prepared by G.C. Wallace, dated August 10, 1976.
Delta	Technical Drainage Study for Horizon Vista Unit 1b. Prepared by Delta Engineering Inc., dated January 11, 1993.
SCS	*Soil Survey of Las Vegas Valley Area Nevada 1985*. United States Department of Agriculture, Soil Conservation Service.

APPENDIX A

FEMA MT-2 Forms

MT-2 Form 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 3067-0148
Expires September 30, 2005

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this 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, SW, Washington DC 20472, Paperwork Reduction Project (3067-0148). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

A. REQUESTED RESPONSE FROM FEMA

This request is for a (check one):

☐ CLOMR: A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☒ LOMR: A letter from FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See Parts 60 & 65 of the NFIP Regulations.)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Ex: 480301 480287	City of Katy Harris County	TX TX	480301 48201C	0005D 0220G	02/08/83 09/28/90
320007	Clark County, Unincorporated Areas	NV	32003C	2590E	09/27/02

2. Flooding Source: Urbanized watershed

3. Project Name/Identifier: Robindale-Royal Oaks Letter of Map Revision

4. FEMA zone designations affected: A (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

a. The basis for this revision request is (check all that apply)

☒ Physical Change ☒ Improved Methodology/Data

☐ Regulatory Floodway Revision ☐ Other (Attach Description)

Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following types of flooding and structures (check all that apply)

Types of Flooding:	☐ Riverine	☐ Coastal	☐ Shallow Flooding (e.g., Zones AO and AH)
	☐ Alluvial fan	☐ Lakes	☒ Other (Attach Description)
Structures:	☐ Channelization	☐ Levee/Floodwall	☐ Bridge/Culvert
	☐ Dam	☐ Fill	☐ Other, Attach Description

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☐ Yes Fee amount: $_____

☒ No, Attach Explanation

Please see the FEMA Web site at http://www.fema.gov/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are 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: Brian K. Loffman	Company: PBS&J	
Mailing Address: 2270 Corporate Circle Drive Suite 100 Henderson, NV 89074-7755	Daytime Telephone No.: 702-263-7275 E-Mail Address: bloffman@pbsj.com	Fax No.: 702-263-7200
Signature of Requester (required):		Date: 7/10/06

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirement that no fill be placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: Dave Betley, PE, Principal Engineer, Civil Engineering Division		Telephone No.: 702-455-4808
Community Name: Clark County	Community Official's Signature (required):	Date:

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information. All documents submitted in support of this request are 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.

Certifier's Name: Matthew S. Baird	License No.: NV 13684	Expiration Date: 12/31/06
Company Name: PBS&J	Telephone No.: 702-263-7275	Fax No.: 702-263-7200
Signature: Matthew S Baird		Date: 7/18/06

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	**Required if ...**
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☐ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

MATTHEW S. BAIRD
Exp. 12/31/06
CIVIL
No. 13684
7/18/06

Seal (Optional)

EXPLANATIONS

MT-2 Form 1

Section B, 5b. Types of Flooding: Flooding type is characterized by fully urbanized runoff consisting of residential and commercial land use. Flow is primarily contained and conveyed within private and public right-of-ways.

Section C: Clark County Regional Flood Control District will submit fee upon receiving an invoice from FEMA.

MT-2 Form 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 3067-0148
Expires September 30, 2005

PAPERWORK REDUCTION ACT

Public reporting burden for this form is estimated to average 3 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this 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, SW, Washington DC 20472, Paperwork Reduction Project (3067-0148). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

Flooding Source: Urban Runoff
Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☐ Not revised (skip to section 2)
☐ Alternative methodology
☐ No existing analysis
☐ Proposed Conditions (CLOMR)
☒ Improved data
☒ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	FIS (cfs)	Revised (cfs)
Robindale @ Royal Oaks	0.12	n/a	109

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records
☐ Regional Regression Equations
☒ Precipitation/Runoff Model HEC-1 [TR-20, HEC-1, HEC-HMS etc.]
☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters) and documentation to support the new analysis. The document, "Numerical Models Accepted by FEMA for NFIP Usage" lists the models accepted by FEMA. This document can be found at: http://www.fema.gov/fhm/en_modl.shtm.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Was sediment transport considered? ☐ Yes ☒ No If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.) Effective	Water-Surface Elevations (ft.) Proposed/Revised
Downstream Limit				
Upstream Limit				

2. Hydraulic Method Used

Hydraulic Analysis FlowMaster [HEC-2 , HEC-RAS, Other (Attach description)]

B. HYDRAULICS (CONTINUED)

3. Pre-Submittal Review of Hydraulic Models

FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. These review programs verify that the hydraulic estimates and assumptions in the model data are in accordance with NFIP requirements, and that the data are comparable with the assumptions and limitations of HEC-2/HEC-RAS. CHECK-2 and CHECK-RAS identify areas of potential error or concern. These tools do not replace engineering judgment. CHECK-2 and CHECK-RAS can be downloaded from http://www.fema.gov/fhm/frm_soft.shtm. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS. If you disagree with a message, please attach an explanation of why the message is not valid in this case. Review of your submittal and resolution of valid modeling discrepancies will result in reduced review time.

HEC-2/HEC-RAS models reviewed with CHECK-2/CHECK-RAS? ☐ Yes ☒ No

4. Models Submitted

Duplicate Effective Model*	Natural File Name:	Floodway File Name: N/A
Corrected Effective Model*	Natural File Name:	Floodway File Name: N/A
Existing or Pre-Project Conditions Model	Natural File Name: robin.dat	Floodway File Name: N/A
Revised or Post-Project Conditions Model	Natural File Name:	Floodway File Name: N/A
Other - (attach description)	Natural File Name:	Floodway File Name:

*Not required for revisions to approximate 1%-annual-chance floodplains (Zone A) – for details, refer to the corresponding section of the instructions.

The document "Numerical Models Accepted by FEMA for NFIP Usage" lists the models accepted by FEMA. This document can be found at: http://www.fema.gov/fhm/en_modl.shtm.

C. MAPPING REQUIREMENTS

A **certified topographic map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM,** annotated to show the boundaries of the revised 1%- and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%- and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area of revision.

D. COMMON REGULATORY REQUIREMENTS

1. For CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ☐ No

For CLOMR requests, if either of the following is true, please submit evidence of compliance with Section 65.12 of the NFIP regulations:

- The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot.
- The proposed project encroaches upon a SFHA with BFEs established and would result in increases above 1.00 foot.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(a)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☒ No

If Yes, attach evidence of regulatory floodway revision notification. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being added. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For LOMR requests, does this request require property owner notification and acceptance of BFE increases? ☐ Yes ☒ No

If Yes, please attach proof of property owner notification and acceptance (if available). Elements of and examples of property owner notification can be found in the MT-2 Form 2 Instructions.

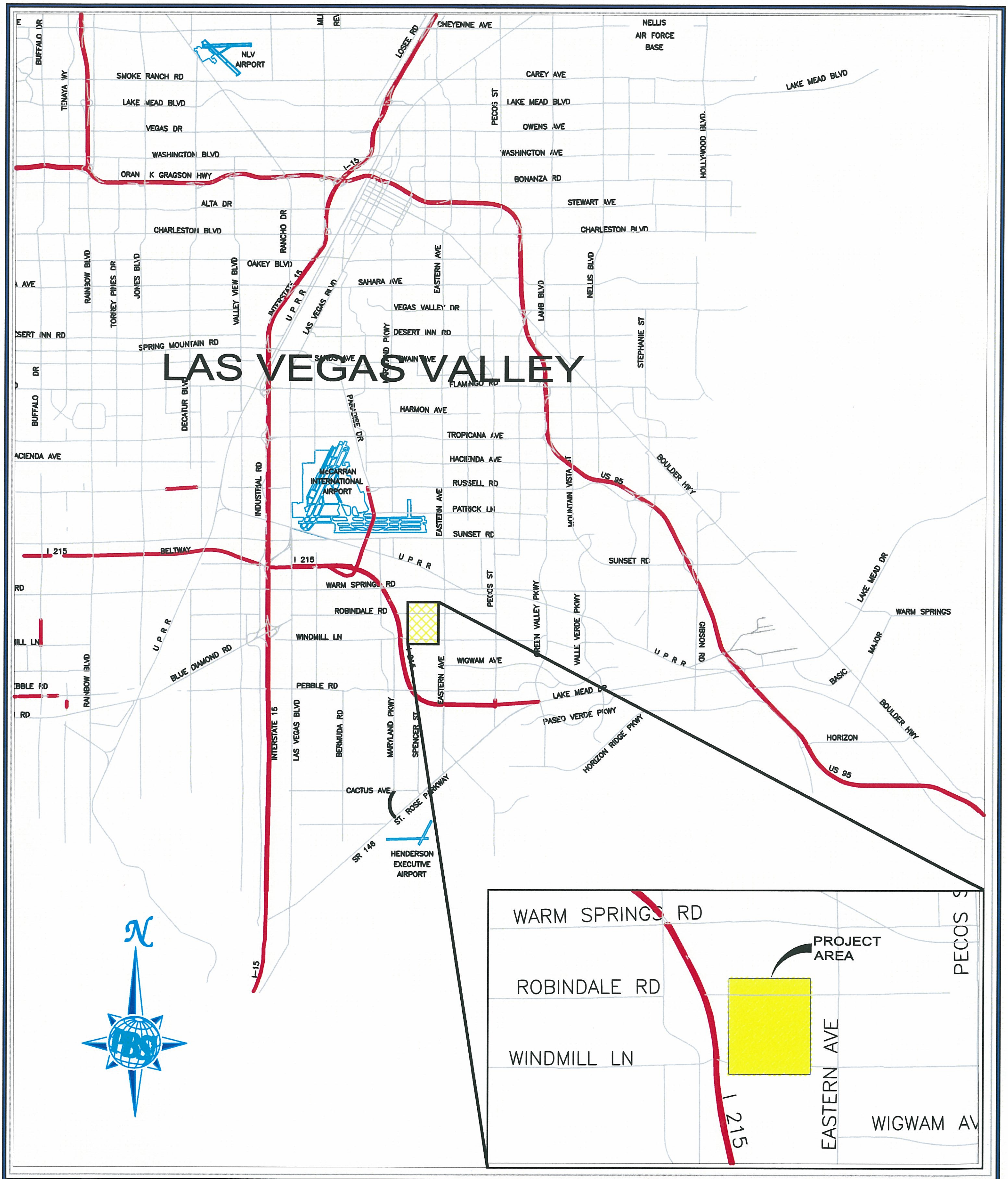
EXPLANATIONS

MT-2 Form 2

Section A: Sediment transport was not considered as the upstream watershed is predominantly developed.

APPENDIX B

Figures


LAS VEGAS VALLEY
CHEYENNE AVE
NELLIS AIR FORCE BASE
NLV AIRPORT
SMOKE RANCH RD
LAKE MEAD BLVD
VEGAS DR
WASHINGTON BLVD
ORAN K GRAGSON HWY
ALTA DR
CHARLESTON BLVD
OAKEY BLVD
SAHARA AVE
VEGAS VALLEY DR
DESERT INN RD
SPRING MOUNTAIN RD
SANDS AVE
TWAIN AVE
FLAMINGO RD
HARMON AVE
TROPICANA AVE
HACIENDA AVE
RUSSELL RD
PATRICK LN
SUNSET RD
McCARRAN INTERNATIONAL AIRPORT
I 215
BELTWAY
UPRR
WARM SPRINGS RD
ROBINDALE RD
WINDMILL LN
WIGWAM AVE
PEBBLE RD
BLUE DIAMOND RD
LAKE MEAD DR
PASEO VERDE PKWY
HORIZON RIDGE PKWY
CACTUS AVE
ST. ROSE PARKWAY
SR 146
HENDERSON EXECUTIVE AIRPORT
I-15
INTERSTATE 15
LAS VEGAS BLVD
BERMUDA RD
MARYLAND PKWY
SPENCER ST
EASTERN AVE
PECOS ST
GREEN VALLEY PKWY
VALLE VERDE PKWY
GIBSON RD
US 95
BOULDER HWY
LAKE MEAD DR
WARM SPRINGS
MAJOR
BASIC
HORIZON
CAREY AVE
OWENS AVE
WASHINGTON AVE
BONANZA RD
STEWART AVE
CHARLESTON BLVD
HOLLYWOOD BLVD
LAKE MEAD BLVD
NELLIS BLVD
LAMB BLVD
STEPHANIE ST
MOUNTAIN VISTA ST
SUNSET RD
LOSEE RD
BUFFALO DR
TENAYA WY
RAINBOW BLVD
TORREY PINES DR
JONES BLVD
VALLEY VIEW BLVD
RANCHO DR
DECATUR BLVD
INDUSTRIAL RD
PARADISE RD
N
PBSJ
WARM SPRINGS RD
ROBINDALE RD
WINDMILL LN
PROJECT AREA
PECOS
EASTERN AVE
I 215
WIGWAM AV

PBSJ

2270 Corporate Circle
Suite 100
Henderson, Nevada 89074
Telephone: 702.263.7275
Fax: 702.263.7200

VICINITY MAP
NTS

FIGURE 1
ROBINDALE-ROYAL OAKS
LETTER OF MAP REVISION

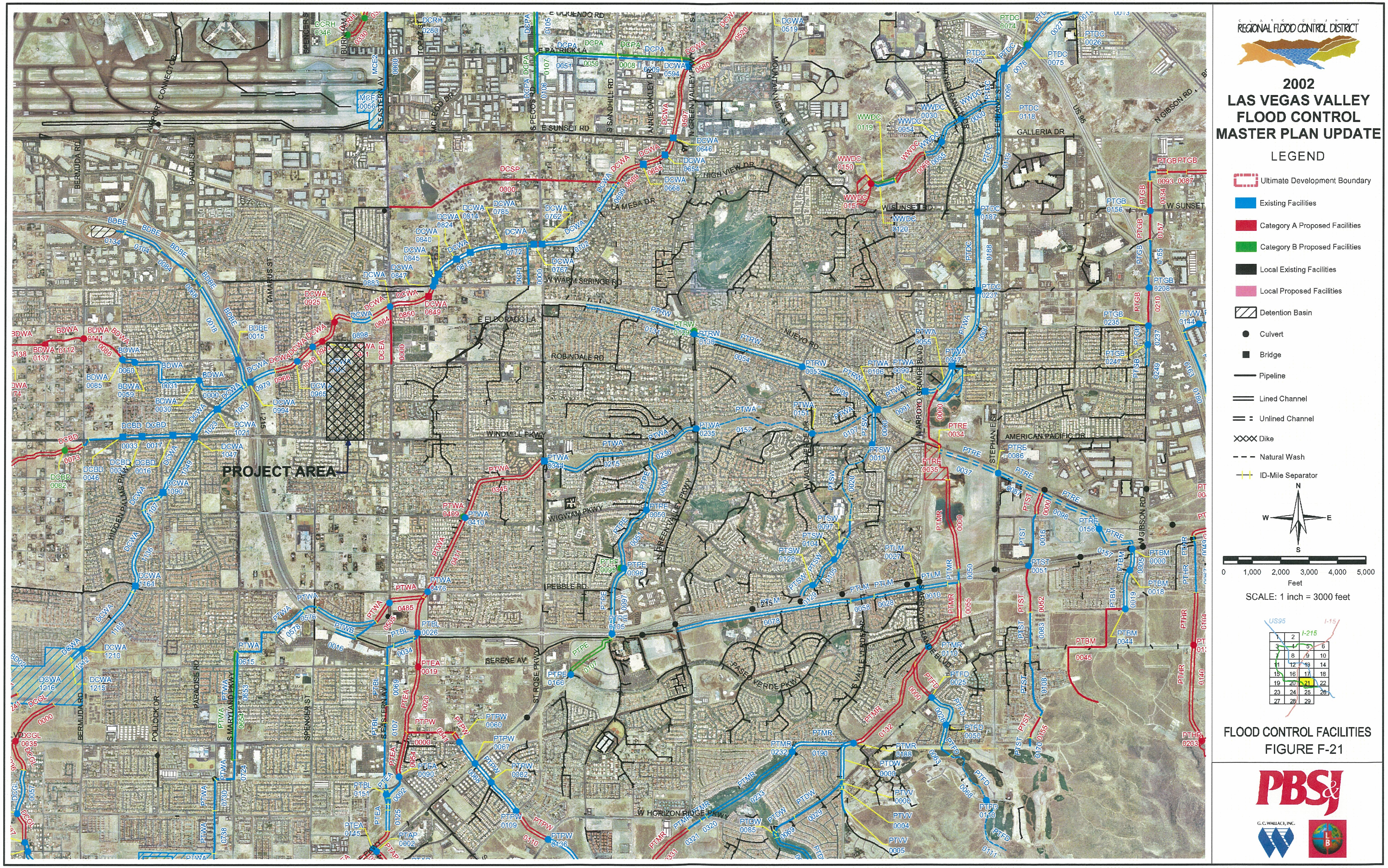

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
2002
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE
LEGEND
Ultimate Development Boundary
Existing Facilities
Category A Proposed Facilities
Category B Proposed Facilities
Local Existing Facilities
Local Proposed Facilities
Detention Basin
Culvert
Bridge
Pipeline
Lined Channel
Unlined Channel
Dike
Natural Wash
ID-Mile Separator
N
W
E
S
0
1,000
2,000
3,000
4,000
5,000
Feet
SCALE: 1 inch = 3000 feet
US95
I-15
I-215
FLOOD CONTROL FACILITIES
FIGURE F-21
PBSJ
G.C. WALLACE, INC.
PROJECT AREA
E SUNSET RD
E PATRICK LA
E QUIENDO RD
GALLERIA DR
W SUNSET
W WARM SPRINGS RD
E ELDORADO LA
ROBINDALE RD
NUEVO RD
WINDMILL PKWY
AMERICAN PACIFIC DR
WIGWAM PKWY
PEBBLE RD
SERENE AV
PASEO VERDE PKWY
W HORIZON RIDGE PKWY
BERMUDA RD
PARADISE RD
AIRPORT CONNECTOR
EASTERN AV
S PECOS RD
S SANDHILL RD
ANNIE OAKLEY DR
MOUNTAIN VISTA ST
TAMARUS ST
POLLOCK DR
S MARYLAND PKWY
SPENCER ST
S EASTERN AV
ST ROSE PKWY
N GREEN VALLEY PKWY
VALLE VERDE DR
STEPHANIE ST
N GIBSON RD
US 95
HIDDEN PALMS PKWY
I-215
LA MESA DR

FIGURE 2

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
BDBE		**BLUE DIAMOND AT BELTWAY**						
0000	E	Conc Chnl 20'W 6'D 2:1 SS	860	969	CDCC140	DUCK3	3.70	0.77
0015	E	2: 10' X 4' RCBC @ Robindale	140	969	CDCC140	DUCK3	3.70	0.60
0018	E	Conc Chnl 20'W 6'D 2:1 SS	2760	969	CDCC140	DUCK3	3.70	0.77
0068	E	2: 7' X 3' RCBC @ Paradise/Warm Springs	350	785	CDCC135	DUCK3	3.35	0.77
0074	E	Conc Chnl 15'W 3'D 2:1 SS	510	565	CDCC135N	DUCK3	2.96	0.77
0084	E	10' X 4' RCB	1050	565	CDCC135N	DUCK3	2.96	0.77
0104	E	Conc Chnl 10'W 3'D 2:1 SS	1430	518	CDCACDB	DUCK3	2.76	0.77
0134	E	2: 60" RCP @ Airport Connector	290	518	CDCACDB	DUCK3	2.76	1.48
BDWA		**BLUE DIAMOND WASH**						
0000	E	Conc Chnl 20'W 6'D 0:1 SS	1520	1331	CDCC070W	DUCK3	2.52	1.00
0030	E	3: 10' X 5.5' RCBC @ Paradise	150	1331	CDCC070W	DUCK3	2.52	1.30
0031	E	Conc Chnl 10'W 8'D 0-1:1 SS	2725	1331	CDCC070W	DUCK3	2.52	0.63
0059	E	3: 8' X 4' RCBC @ Robindale	150	1331	CDCC070W	DUCK3	2.52	1.40
0060	E	Conc Chnl 20'W 8'D 0:1 SS	380	1331	CDCC070W	DUCK3	2.52	2.72
0085	E	2: 10' X 4' RCBC @ Amigo	50	1073	CBUB310	DUCK3	2.12	1.80
0086	E	Natural Wash	1570	1073	CBUB310	DUCK3	2.12	
0086	P1	10' X 5' RCB	1570	1073	CBUB310	DUCK3	2.12	3.00
0111	E	36" CMP @ Bermuda	50	1073	CBUB310	DUCK3	2.12	1.60
0111	P1	Replace with 10' X 6' RCB	50	1073	CBUB310	DUCK3	2.12	1.60
0112	E	Natural Wash	1310	1073	CBUB310	DUCK3	2.12	
0112	P1	10' X 5' RCB	1310	1073	CBUB310	DUCK3	2.12	3.00
0137	E	24", 36", and 54" CMP @ Placid	50	1073	CBUB310	DUCK3	2.12	1.40
0137	P1	Replace with 10' X 6' RCB	50	1073	CBUB310	DUCK3	2.12	1.40
0138	E	Natural Wash	1880	881	CBUB300	DUCK3	1.64	
0138	P1	10' X 5' RCB	1880	881	CBUB300	DUCK3	1.64	2.50
DCBD		**DUCK CREEK / BLUE DIAMOND**						
0000	E	Conc Chnl 10'W 5'D 1.6:1 SS	770	1976	CBUB360W	DUCK4	11.11	1.73
0016	E	Single Span Bridge 26'W 8.5'D @ Vision	60	1976	CBUB360W	DUCK4	11.11	2.10
0017	E	Conc Chnl 10'W 5'D 1.6:1 SS	1015	1976	CBUB360W	DUCK4	11.11	1.73
0032	E	Single Span Bridge 26'W 8.5'D @ Vista Twilight	40	1976	CBUB360W	DUCK4	11.11	1.80
0033	E	Conc Chnl 10'W 5'D 1.6:1 SS	615	1976	CBUB360W	DUCK4	11.11	1.73
0046	E	Single Span Bridge 26'W 8.5'D @ Amigo	50	1976	CBUB360W	DUCK4	11.11	2.20
0047	E	12' X 10' RCB	1160	1976	CBUB360W	DUCK4	11.11	2.50
0065	E	1: 12' X 10' RCBC @ Bermuda	310	1892	CBUB350	DUCK4	10.85	2.23
0073	E	Natural Wash	630	1892	CBUB350	DUCK4	10.85	
0073	P1	Conc Chnl 25'W 5'D 2:1 SS	630	1892	CBUB350	DUCK4	10.85	1.40
0082	E	4: 48" RCP @ Fairfield	80	1892	CBUB350	DUCK4	10.85	1.10
0082	P0	Replace with 2: 14' X 6' RCBC @ Fairfield	80	1892	CBUB350	DUCK4	10.85	1.10
0083	E	Natural Wash	4750	1892	CBUB350	DUCK4	10.85	
0083	P1	Conc Chnl 20'W 5.5'D 2:1 SS	4750	1892	CBUB350	DUCK4	10.85	1.10
DCEA		**DUCK CREEK - EASTERN BRANCH**						
0000	P1	1: 8' X 5' RCB	2000	645	CDCC280S	DUCK3	1.01	1.50
DCGL		**DUCK CREEK GILESPIE CHANNEL**						
0000	E	Natural Wash	1900	1811	CDLD460	DUCK3	2.56	
0000	P2	Conc Chnl 32'W 6'D 0:1 SS	1900	1811	CDLD460	DUCK3	2.56	0.80
0035	P2	2: 16' X 4' RCBC @ Silverado Ranch	60	1811	CDLD460	DUCK3	2.56	0.90
0036	E	Natural Wash	1111	1811	CDLD460	DUCK3	2.56	
0036	P1	Conc Chnl 35'W 4'D 0:1 SS	1111	1811	CDLD460	DUCK3	2.56	0.80
0057	E	Conc Chnl 32'W 9.0'D 3:1 SS	1580	841	CDLD460S	DUCK3	1.10	0.20
0086	E	4: 8' X 5' RCBC @ E Pyle Ave	60	841	CDLD460S	DUCK3	1.10	1.20
0087	E	Natural Wash	1080	841	CDLD460S	DUCK3	1.10	
0087	P1	Conc Chnl 32'W 3.5'D 3:1 SS	1080	841	CDLD460S	DUCK3	1.10	0.90
0106	E	3: 8' X 4' RCBC @ La Cienega	80	841	CDLD460S	DUCK3	1.10	0.50
0107	E	Conc Chnl 12'W 7'D 2:1 SS	310	567	CDLD450	DUCK3	0.75	1.30
0112	E	2: 10' X 4' RCBC @ E Frias Ave	60	567	CDLD450	DUCK3	0.75	0.50
0113	E	Conc Chnl 12'W 7'D 2:1 SS	490	567	CDLD450	DUCK3	0.75	2.40
DCPA		**DUCK CREEK - PATRICK COLLECTOR**						
0000	E	Parallel 78" & 66" RCP	450	1333	CDCC340W	DUCK3	1.57	1.50
0001	P0	Add 1: 66" RCP	450	1333	CDCC340W	DUCK3	1.57	1.50
0008	P0	Add 1: 11' X 6' RCB	2210	1333	CDCC340W	DUCK3	1.57	1.00
0009	E	Parallel 54" & 66" RCP	2210	1333	CDCC340W	DUCK3	1.57	1.00
0050	P0	Add 1: 14' X 5' RCB	2860	1333	CDCC340W	DUCK3	1.57	0.80
0051	E	66" RCP	2860	1333	CDCC340W	DUCK3	1.57	0.80
0104	P0	Add 1: 6' X 5' RCB	2650	406	DCC370	DUCK3	0.53	0.40
0105	E	60" RCP	2650	406	DCC370	DUCK3	0.53	0.40
0106	E	48" RCP	1360	449	DCC330	DUCK3	0.51	0.50
0107	P0	Add 1: 9' X 4' RCB	1360	449	DCC330	DUCK3	0.51	0.50
DCPI		**DUCK CREEK PINE STREET**						
0000	E	1: 12' X 4' RCB	1360	785	CDCC310S	DUCK3	1.21	0.60
DCRH		**DUCK CREEK - RAWHIDE CHANNEL**						
0306	E	Earth Chnl 15'W 4.6'D 1:1 SS	1090	535	CDMC060	DUCK3SC	0.60	0.70
0306	P1	Conc Chnl 12'W 4.5'D 1.5:1 SS	1090	535	CDMC060	DUCK3SC	0.60	0.70
0329	E	2: 36" RCP @ Oquendo Rd	60	535	CDMC060	DUCK3SC	0.60	0.60
0329	P0	Replace with 3: 7' X 5' RCBC @ Oquendo Rd	60	535	CDMC060	DUCK3SC	0.60	0.60
0330	E	Earth Chnl 4.6'D 15'W 1:1 SS	860	535	CDMC060	DUCK3SC	0.60	0.70
0330	P1	Conc Chnl 12'W 4.5'D 1.5:1 SS	860	535	CDMC060	DUCK3SC	0.60	0.70
0346	E	3: 18" RCP @ Burnham Rd	60	535	CDMC060	DUCK3SC	0.60	0.60
0346	P0	Repalce with 1: 10' X 7' RCBC @ Burnham Rd	60	535	CDMC060	DUCK3SC	0.60	0.60
DCSP		**DUCK CREEK - SUNSET PARK**						
0000	P1	1: 11' X 6' RCB	8200	784	CDCC230	DUCK3	1.47	0.70
DCWA		**DUCK CREEK WASH**						
0520	E	Natural Wash	3660	5826	CDCC360	DUCK5SC	21.47	
0520	P1	Gabion Chnl 75'W 6.5'D 2:1 SS	3660	5826	CDCC360	DUCK5SC	21.47	1.80
0580	P1	Conc Chnl 50'W 6.5'D 2:1 SS	230	5743	CDCC190*	DUCK5SC	19.15	0.76
0594	E	2 Span Bridge 130'W 15'D @ GVP/Patrick	70	5743	CDCC190*	DUCK5SC	19.15	1.40
0597	E	Natural Wash	2500	5743	CDCC190*	DUCK5SC	19.15	
0597	P1	Gabion Chnl 65'W 7'D 2:1 SS	2500	5743	CDCC190*	DUCK5SC	19.15	1.60
0646	E	3 Span Bridge 45'W 15'D @ Sunset	100	5743	CDCC190	DUCK5SC	19.15	1.70
0647	E	Earth Chnl 50'W 15'D 2:1 SS	600	5743	CDCC190	DUCK5SC	19.15	1.00
0647	P1	Conc Chnl 50'W 6.5'D 2:1 SS	600	5743	CDCC190	DUCK5SC	19.15	1.00
0654	E	Free Span Bridge 40'W 15'D 3:1 SS	50	5743	CDCC190	DUCK5SC	19.15	1.00
0655	E	Earth Chnl 50'W 15'D 2:1 SS	790	5743	CDCC190	DUCK5SC	19.15	0.60
0655	P1	Conc Chnl 50'W 7.5'D 2:1 SS	790	5743	CDCC190	DUCK5SC	19.15	0.60
0668	E	Free Span Bridge 40'W 15'D 3:1 SS @ Sunfire	40	5743	CDCC190	DUCK5SC	19.15	1.00
0669	E	Natural Wash	1120	5743	CDCC190	DUCK5SC	19.15	
0669	P1	Conc Chnl 28'W 8'D 2:1 SS	1120	5743	CDCC190	DUCK5SC	19.15	1.29
0695	E	Drop Structure		5416	CDCC240	DUCK5SC	17.96	
0696	E	Conc Chnl 28'W 8'D 2:1 SS	150	5416	CDCC240	DUCK5SC	17.96	1.29
0698	E	Drop Structure		5416	CDCC240	DUCK5SC	17.96	
0699	E	Conc Chnl 28'W 8'D 2:1 SS	150	5416	CDCC240	DUCK5SC	17.96	1.29
0701	E	Drop Structure		4982	CDCC240S	DUCK5SC	16.49	
0702	E	Conc Chnl 28'W 8'D 2:1 SS	3340	4982	CDCC240S	DUCK5SC	16.49	1.20
0762	E	Single Span Bridge 42'W 8'D @ Pecos	100	4923	CDCC310	DUCK5SC	16.09	1.10
0763	E	Earth/Conc Chnl 32'W 8'D 0:1 SS	220	4923	CDCC310	DUCK5SC	16.09	1.10
0763	P1	Conc Chnl 32'W 8'D 0:1 SS	220	4923	CDCC310	DUCK5SC	16.09	1.10
0767	E	2 Span Bridge 32'W 7.0'D	20	4923	CDCC310	DUCK5SC	16.09	1.98
0768	E	Conc Chnl 32'W 10'D 0:1 SS	200	4923	CDCC310	DUCK5SC	16.09	1.50
0772	E	Conc Chnl 30'W 6.5'D 0:1 SS	800	4831	CDCC285	DUCK5SC	14.88	2.00
DCWA		**DUCK CREEK WASH -- continued**						
0785	E	2 Span Bridge 50'W 8'D @ Tomiyasu	60	4831	CDCC285	DUCK5SC	14.88	1.30
0786	E	Conc Chnl 50'W 7.0'D 0:1 SS	1150	4831	CDCC285	DUCK5SC	14.88	0.80
0814	E	Single Span Bridge 50'W 7.5'D @ Miravista	50	4831	CDCC285	DUCK5SC	14.88	1.30
0815	E	Conc Chnl 50'W 7.0'D 0:1 SS	480	4831	CDCC285	DUCK5SC	14.88	1.15
0824	E	Single Span Bridge 50'W 7.5'D @ La Casita	50	4831	CDCC285	DUCK5SC	14.88	1.30
0825	E	Conc Chnl 50'W 7.0'D 0:1 SS	780	4831	CDCC285	DUCK5SC	14.88	0.60
0840	E	2 Span Bridge 50'W 8.0'D	50	4831	CDCC285	DUCK5SC	14.88	1.20
0841	E	Conc Chnl 50'W 7.0'D 0:1 SS	230	4831	CDCC285	DUCK5SC	14.88	1.90
0845	E	3 Span Bridge 90'W 7'D @ UPRR	20	4831	CDCC285	DUCK5SC	14.88	1.50
0846	E	Natural Wash	130	4831	CDCC285	DUCK5SC	14.88	
0846	P1	Gabion Chnl 70'W 8'D 2:1 SS	130	4831	CDCC285	DUCK5SC	14.88	0.80
0847	E	4: 14.5' X 9.5' RCBC @ Warm Springs	100	4831	CDCC285	DUCK5SC	14.88	0.60
0848	E	Natural Wash	300	4831	CDCC285	DUCK5SC	14.88	
0848	P1	Gabion Chnl 60'W 9'D 2:1 SS	300	4831	CDCC285	DUCK5SC	14.88	0.70
0849	E	Dip Section @ Topaz	60	4831	CDCC285	DUCK5SC	14.88	
0849	P1	2 Span Bridge 100'W 7.5'D @ Topaz	60	4831	CDCC285	DUCK5SC	14.88	0.60
0850	P1	Gabion Chnl 65'W 8.5'D 2:1 SS	1320	4831	CDCC285	DUCK5SC	14.88	0.70
0883	E	4: 14' X 10' RCBC @ Eastern	100	4800	CDCC280	DUCK5SC	14.69	0.70
0884	E	Earth Chnl 65'W 5'D 3:1 SS	720	4800	CDCC280	DUCK5SC	14.69	0.68
0884	P1	Gabion Chnl 60'W 9'D 2:1 SS	720	4800	CDCC280	DUCK5SC	14.69	0.68
0898	E	Conc Chnl 100'W 10'D 0:1 SS	710	4467	CDCC280W	DUCK5SC	13.68	0.60
0912	E	Earth Chnl 55'W 5'D 4:1 SS	700	4467	CDCC280W	DUCK5SC	13.68	0.70
0912	P1	Gabion Chnl 60'W 8.5'D 2:1 SS	700	4467	CDCC280W	DUCK5SC	13.68	0.65
0925	P1	4: 14' X 7' RCBC @ Eldorado Lane	70	4467	CDCC280W	DUCK5SC	13.68	0.65
0926	E	Earth Chnl 45'W 5'D 4:1 SS	815	4467	CDCC280W	DUCK5SC	13.68	0.68
0926	P1	Gabion Chnl 60'W 8.5'D 2:1 SS	815	4467	CDCC280W	DUCK5SC	13.68	0.65
0941	P1	4: 14' X 8' RCBC @ Sur Este Ave	70	4445	CDCC270	DUCK5SC	13.57	0.60
0942	E	Earth Chnl 45'W 5'D 4:1 SS	300	4445	CDCC270	DUCK5SC	13.57	0.68
0942	P1	Conc Chnl 45'W 6.5'D 2:1 SS	300	4445	CDCC270	DUCK5SC	13.57	0.60
0948	E	7: 10' X 6' RCBC @ Spencer	80	4445	CDCC270	DUCK5SC	13.57	0.60
0949	E	Earth/Conc Chnl 70'W 6'D 2:1 SS	650	4445	CDCC270	DUCK5SC	13.57	0.68
0949	P1	Conc Chnl 70'W 5.5'D 2:1 SS with Concrete Bottom	650	4445	CDCC270	DUCK5SC	13.57	0.68
0965	E	6: 14' X 6' RCBC @ Robindale	80	4445	CDCC270	DUCK5SC	13.57	1.00
0966	E	Earth/Conc Chnl 70'W 6'D 2:1 SS	820	4445	CDCC270	DUCK5SC	13.57	0.53
0966	P1	Conc Chnl 70'W 5.5'D 2:1 SS with Concrete Bottom	820	4445	CDCC270	DUCK5SC	13.57	0.53
0979	E	Conc Chnl 70'W 6'D 2:1 SS	880	4445	CDCC270	DUCK5SC	13.57	1.00
0994	E	Single Span Bridge @ Beltway	170	4375	CDCC070S*	DUCK3SC	7.03	1.30
0997	E	Conc Chnl 70'W 6'D 2:1 SS	80	4375	CDCC070S*	DUCK3SC	7.03	1.00
0999	E	Conc Chnl 70'W 6'D 2:1 SS	140	4375	CDCC070S*	DUCK3SC	7.03	1.00
1003	E	Conc Chnl 70'W 6'D 2:1 SS	1140	4375	CDCC070S*	DUCK3SC	7.03	1.00
1021	E	3 Span Bridge 80'W 8'D @ Paradise/Maryland Pkwy	100	4375	CDCC070S	DUCK3SC	7.03	1.40
1023	E	Conc Chnl 70'W 6'D 2:1 SS	1130	4375	CDCC070S	DUCK3SC	7.03	1.10
1045	E	Conc Chnl 70'W 6'D 2:1 SS	30	4375	CDCC070S	DUCK3SC	7.03	1.10
1047	E	Single Span Bridge 45'W 10'D @ Windmill	120	4196	CBUB360	DUCK3SC	6.51	1.20
1049	E	Conc Chnl 12'W 15'D 1:1 SS	2150	2015	CBUB360S	DUCK3SC	3.07	1.50
1090	E	2 Span Bridge 80'W 25'D @ Pollock	80	2015	CBUB360S	DUCK3SC	3.07	2.10
1091	E	Conc Chnl 12'W 15'D 3:1 SS; 3:5' d/s	200	2015	CBUB360S	DUCK3SC	3.07	1.51
1102	E	Drop Structure		2015	CBUB360S	DUCK3SC	3.07	
1103	E	Conc Chnl 12'W 15'D 3:1 SS	200	2015	CBUB360S	DUCK3SC	3.07	1.51
1106	E	Drop Structure		2015	CBUB360S	DUCK3SC	3.07	
1107	E	Conc Chnl 12'W 15'D 3:1 SS	590	2015	CBUB360S	DUCK3SC	3.07	1.51
1121	E	Drop Structure		1833	CDCC050	DUCK3SC	2.74	
1122	E	Conc Chnl 20'W 20'D 3:1 SS	480	1833	CDCC050	DUCK3SC	2.74	0.50
1136	E	Conc Chnl 20'W 20'D 3:1 SS	2400	1833	CDCC050	DUCK3SC	2.74	1.51
1164	E	2 Span Bridge 100'W 9'D @ Pebble	100	1247	CDCC030	DUCK3SC	1.83	0.70
1165	E	Conc Chnl 30'W 8'D 2:1 SS	180	1247	CDCC030	DUCK3SC	1.83	1.51
1169	E	Conc Chnl 46'W 10'D 1.5:1 SS	2680	1247	CDCC030	DUCK3SC	1.83	0.90
1210	E	5: 15' X 8.5' RCBC @ Bermuda	100	725	CDCC02B	DUCK3SC	1.00	0.52
1212	E	Conc Chnl 80'W 8'D 0:1 SS	300	725	CDCC02B	DUCK3SC	1.00	0.86
1214	E	121,300 cfs PMF Spillway		121300	CDLDCDB	DUCK5SC	16.16	
1215	E	54" RCP Outlet	20	355	LDCDB	DUCK5SC	16.16	
1216	E	1,235 ac-ft Lower Duck Creek Detention Basin		5259	CDLDCDB	DUCK5SC	16.16	
1241	E	Natural Wash	540	4271	CDLD37B*	DUCK3SC	6.41	
1241	P2	2: 20' X 7' RCB	540	4271	CDLD37B*	DUCK3SC	6.41	1.94
MCE2		**MCCARRAN - EAST BRANCH 2**						
0000	E	48" RCP Outlet	3560	75	CDMCDB	DUCK3	1.78	0.70
0056	E	100-ac ft McCarran Detention Basin		1190	CDMC050	DUCK3	1.78	
PTAP		**PITTMAN ANTHEM PARKWAY**						
0000	P1	Conc Chnl 20'W 4.5'D 2:1 SS	100	1901	CPPE140	PIT3	2.18	5.00
0002	E	2: 8' X 8' RCBC @ St. Rose Pkwy	150	1901	CPPE140	PIT3	2.18	1.50
0005	E	Rip Rap Chnl 30'W 5'D 3:1 SS	525	1901	CPPE140	PIT3	2.18	1.30
0005	P1	Conc Chnl 20'W 5'D 2:1 SS	525	1901	CPPE140	PIT3	2.18	1.90
PTBL		**PITTMAN WASH - BELTWAY**						
0000	P1	Conc Chnl 50'W 6.5'D 2:1 SS	1000	5519	CPWA090	PIT3SC	7.93	0.70
0026	E	4: 12' X 8' RCBC @ I-215	360	5519	CPWA090	PIT3SC	7.93	1.00
0028	E	6: 12' X 8' and 1: 8' X 8' RCBC @ I-215	160	2224	CPWA085	PIT3SC	5.15	1.00
0034	E	Conc Chnl 12'W 6'D 2:1 SS	730	2224	CPWA085	PIT3SC	5.15	1.00
0053	E	12' X 6' RCB	860	2224	CPWA085	PIT3SC	5.15	1.70
0069	E	2: 13' X 6' RCB	1400	2224	CPWA085	PIT3SC	5.15	1.00
0095	P1	2: 13' X 6' RCB	590	1979	CPPE195	PIT3SC	5.39	1.00
0107	E	4: 72" RCP @ Silverado Ranch	600	1979	CPPE195	PIT3SC	5.39	2.00
0118	E	2: 11' X 6.2' Concrete Arch	1380	1979	CPPE195	PIT3SC	5.39	1.10
0144	E	Conc Chnl 25'W 6'D 0:1 SS	100	1979	CPPE195	PIT3SC	5.39	1.00
0146	E	2: 12' X 8' RCB	240	1768	NORTH	PIT3SC	5.15	1.00
0150	E	Conc Chnl 25'W 5.5'D 0:1 SS	40	1768	NORTH	PIT3SC	5.15	1.00
0151	E	2: 14' X 6' RCBC @ St. Rose Pkwy	40	1768	NORTH	PIT3SC	5.15	1.00
0157	E	Conc Chnl 25'W 5.5'D 0:1 SS	310	1768	NORTH	PIT3SC	5.15	1.00
PTBM		**PITTMAN WASH - BLACK MOUNTAIN**						
0000	E	2: 10' X 8' RCBC @ I-215	290	1589	CPRE060	PIT3	1.38	1.70
0005	E	Conc Chnl 20'W 4.5'D 2:1 SS	570	1589	CPRE060	PIT3	1.38	3.70
0018	E	2: 8' X 6' RCBC @ Las Palmas	50	1589	CPRE060	PIT3	1.38	3.70
0019	E	Conc. Chnl. 20'W 6'D 2:1 SS	1330	1589	CPRE060	PIT3	1.38	3.70
0044	E	2: 8' X 6' RCBC @ Paseo Verde	80	1166	CPRE050	PIT3	0.85	2.00
0045	P1	14' X 4' RCB	5700	1166	CPRE040	PIT3SC	0.85	4.00
PTDC		**PITTMAN WASH - DUCK CREEK**						
0027	E	Conc Chnl 60'W 7.9'D 0:1 SS	2000	6774	CPDC160	PIT5SC	23.80	0.85
0074	P0	Add 3: 10' X 8' RCBC @ I-515	160	6724	CPDC150	PIT5SC	23.54	0.80
0075	E	4: 10' X 8' RCBC @ I-515	160	6724	CPDC150	PIT5SC	23.54	0.80
0076	E	Conc Chnl 25'W 9'D 2:1 SS	960	6724	CPDC150	PIT5SC	23.54	1.20
0095	E	Single Span Bridge 75'W 8'D @ Stephanie	170	6299	CPDC120	PIT5SC	22.45	0.80
0096	E	Conc Chnl 30'W 8'D 2:1 SS	1150	6299	CPDC120	PIT5SC	22.45	0.80
0104	E	Conc Chnl 30'W 8'D 2:1 SS	520	5945	CPDC100	PIT5SC	19.63	0.80
0118	E	4 Span Bridge 60'W 8'D	70	5945	CPDC100	PIT5SC	19.63	1.30
0119	E	Conc. Chnl 30'W 8'D 2:1 SS	3430	5945	CPDC100	PIT5SC	19.63	0.80
0187	E	2 Span Bridge 42'W 8'D @ Sunset Road	100	5945	CPDC100	PIT5SC	19.63	1.40
0188	E	Conc Chnl 30'W 8'D 2:1 SS	2630	5777	CPDC030	PIT5SC	19.12	3.00
0237	E	2 Span Bridge 42'W 8'D @ Warm Springs	100	5777	CPDC030	PIT5SC	19.12	1.30
PTDW		**PITTMAN DESERT WILLOW**						
0000	E	Conc Chnl 29'W 5.5' D 2:1 SS	1550	1121	CPMR090	PIT3	2.19	2.20
0029	E	72" RCP	2140	568	DETB	PIT3	1.42	3.20
0069	E	78" RCP with 66" Orifice Plate Outlet	840	568	DETB	PIT3	1.42	1.40
0085	E	15 ac-ft Desert Willows Golf Course Detention Basin		1143	CPMR070	PIT3	1.42	
0088	E	Grass Chnl 100'W 5:1 SS	2090	1143	CPMR070	PIT3	1.42	2.20
PTEA		**PITTMAN WASH - EASTERN**						
0000	P2	Conc Chnl 24'W 8'D 0:1 SS	1000	3225	CPPE200	PIT3SC	6.71	1.60
0019	P2	2: 12' X 8' RCBC @ Serene	50	3225	CPPE200	PIT3SC	6.71	1.60
0020	P2	Conc Chnl 24'W 8'D 0:1 SS	2350	3225	CPPE200	PIT3SC	6.71	1.60
0054	P2	Conc Chnl 24'W 8'D 0:1 SS	1500	2284	CPPE205	PIT3SC	5.38	1.60
0090	E	3: 12' X 6' RCBC @ Eastern	200	2099	EAST	PIT3SC	5.15	1.70
0092	E	3: 10' X 6' RCB	820	2099	EAST	PIT3SC	5.15	2.40
0119	E	Conc Chnl 22'W 5'D 0:1 SS	200	2099	EAST	PIT3SC	5.15	2.00
0124	E	Splitter Structure		3892	CPPE155	PIT3SC	5.15	
0125	E	Conc Chnl 30'W 8'D 0:1 SS	740	3892	CPPE155	PIT3SC	5.15	1.20
0139	E	Earth Chnl 50'W 3:1 SS	800	3892	CPPE155	PIT3SC	5.15	1.20
0139	P3	Conc Chnl 30'W 8'D 0:1 SS	800	3892	CPPE155	PIT3SC	5.15	1.20
0145	E	3: 12' X 10' RCBC @ St. Rose Pkwy	80	2152	CPPE130	PIT3SC	2.97	0.90
0146	P3	Conc Chnl 20'W 6'D 2:1 SS	2100	2152	CPPE130	PIT3SC	2.97	1.00
PTFD		**PITTMAN FOOTHILLS DRIVE**						
0000	P1	Conc Chnl 15'W 4.5'D 2:1 SS	1330	1114	CPMR120	PIT3SC	1.32	3.00
0025	E	5: 12' X 4' RCBC @ Horizon Ridge Pkwy	70	1114	CPMR120	PIT3SC	1.32	10.00
0026	E	Conc Chnl 20'W 8'D 0:1 SS	1350	1114	CPMR120	PIT3SC	1.32	2.60
0050	E	20' X 10' RCAC @ Amador Ln	60	1114	CPMR120	PIT3SC	1.32	1.20
0051	E	Conc Chnl 13'W 6'D 1:1 SS	680	1114	CPMR120	PIT3SC	1.32	1.30
0063	E	16' X 6' RCAC @ Foothills Village Dr	550	1114	CPMR120	PIT3SC	1.32	2.60
0068	E	Natural Wash	2250	1114	CPMR120	PIT3SC	1.32	
0110	E	2: 14' X 10' RCBC @ MacDonald Ranch Dr	50	865	CPMR110	PIT3SC	1.00	3.10
0111	E	Natural Wash	2300	865	CPMR110	PIT3SC	1.00	
PTGB		**PITTMAN WASH - GIBSON**						
0058	P1	Conc Chnl 15'W 5.5'D 2:1 SS	1560	1532	CPBR080	PIT3SC	1.76	1.50
0087	P3	2: 10' X 6' RCB	660	1532	CPBR080	PIT3SC	1.76	0.50
0093	E	Earth/Conc Chnl 8'W 5'D 2:1 SS	550	1532	CPBR080	PIT3SC	1.76	1.50
0093	P1	Conc Chnl 30'W 5'D 0:1 SS	550	1532	CPBR080	PIT3SC	1.76	1.50
0133	E	3: 9' X 5' RCBC @ Cornucopia Ave	500	1532	CPBR080	PIT3SC	1.76	1.30
0134	E	Earth Chnl 15'W 6'D 2:1 SS	1270	1532	CPBR080	PIT3SC	1.76	0.80
0134	P1	Conc Chnl 13'W 6'D 2:1 SS	964	1532	CPBR080	PIT3SC	1.76	0.80
0156	E	2: 8' X 8' RCBC @ Sunset	280	1532	CPBR080	PIT3SC	1.76	1.10
0157	E	Earth Chnl 15'W 6'D 2:1 SS	820	1532	CPBR080	PIT3SC	1.76	0.80
0157	P1	2: 9' X 6' RCB	820	1532	CPBR080	PIT3SC	1.76	0.80
0165	E	2: 9' X 6' RCB	1270	1383	CPBR075	PIT3SC	1.60	1.30
0185	E	2: 9' X 6' RCB	330	879	CPBR055	PIT3SC	0.88	1.30
0208	E	2: 9' X 4' RCBC @ Warm Springs	110	879	CPBR055	PIT3SC	0.88	1.87
0210	E	Rip Rap Chnl 25'W 5'D 2:1 SS	1250	879	CPBR055	PIT3SC	0.88	1.60
0210	P2	2: 9' X 4' RCB	1250	879	CPBR055	PIT3SC	0.88	1.30
0235	E	2: 8' X 4' RCBC @ Kelso Dunes Ave	90	631	CPBR050	PIT3SC	0.65	1.50
0237	E	Conc Chnl 9'W 5'D 0:1 SS	550	631	CPBR050	PIT3SC	0.65	1.50
0247	E	2: 8' X 4' RCB	100	631	CPBR050	PIT3SC	0.65	1.50
0249	E	Conc Chnl 9'W 3.5'D 0:1 SS	700	631	CPBR050	PIT3SC	0.65	1.50
PTHR		**PITTMAN HORIZON RIDGE**						
0044	P1	Conc Chnl 15'W 5.5'D 2:1 SS	1250	1371	CPPD165	PIT3SC	1.25	1.20
0049	E	12' X 5' RCBC @ Lake Mead Dr	150	1345	CPPD160	PIT3SC	1.20	1.20
0067	E	8' X 5' RCB	1800	1345	CPPD160	PIT3SC	1.20	2.60
0104	P1	Conc Chnl 15'W 4.5'D 2:1 SS	1825	1345	CPPD160	PIT3SC	1.20	4.90
0139	E	36" RCP @ Horizon Ridge Pkwy	100	1065	CPPD135	PIT3SC	0.89	7.00
0139	P1	12' X 6' RCBC @ Horizon Ridge Pkwy	100	1065	CPPD135	PIT3SC	0.89	7.00
0140	P1	Conc Chnl 15'W 4'D 2:1 SS	3425	1065	CPPD135	PIT3SC	0.89	4.00
0203	P1	84" RCP Outlet	200	882	CPPD125	PIT3SC	0.72	4.00
0204	P1	882 cfs Spillway		882	CPPD125	PIT3SC	0.72	
0205	P1	2.5 ac-ft Pittman Horizon Ridge Debris Basin		882	CPPD125	PIT3SC	0.72	
PTLM		**PITTMAN LAKE MEAD**						
0000	E	12' X 6' RCBC @ I-215	350	888	CPMR200	PIT3	1.13	0.60
0010	E	Conc Chnl 18.5'W 5'D 0:1 SS	950	888	CPMR200	PIT3	1.13	1.00
0027	E	2: 12' X 5' RCBC @ Arroyo Grande	120	888	CPMR200	PIT3	1.13	1.00
0028	E	Conc Chnl 10'W 5'D 1.5:1 SS	1530	888	CPMR200	PIT3	1.13	1.00
0058	E	2: 12' X 5' RCBC @ Valle Verde	830	888	CPMR200	PIT3	1.13	1.00
0078	E	Conc Chnl 15'W 4.5'D 2:1 SS	6160	888	CPMR200	PIT3	1.13	1.00
PTMR		**PITTMAN MAC DONALD RANCH**						
0000	P1	Conc Chnl 30'W 6'D 2:1 SS	3180	4319	CPRE140	PIT4	11.82	2.20
0050	E	5: 12' X 6' RCBC @ I-215	480	4173	CPMR160	PIT4	11.52	0.60
0055	P1	Conc Chnl 25'W 6'D 2:1 SS	1250	3600	CPMR155	PIT4	10.40	2.00
0093	E	Earth Chnl	1500	3600	CPMR155	PIT4	10.40	2.00
0093	P1	Conc Chnl 25'W 6'D 2:1 SS	1500	3600	CPMR155	PIT4	10.40	2.00
0110	E	6: 11.5' X 5' RCBC @ Arroyo Grande	60	3297	CPMR164	PIT4	9.70	2.00
0111	E	Earth Chnl	730	3297	CPMR164	PIT4	9.70	2.00
0111	P1	Conc Chnl 25'W 6'D 2:1 SS	730	3297	CPMR164	PIT4	9.70	2.00
0132	P1	Conc Chnl 25'W 5.5'D 2:1 SS	3520	2776	CPMR165	PIT4	8.38	2.20
0188	E	24.5' X 8' RCAC @ Valle Verde	270	2749	CPMR130	PIT4	8.20	2.00
0190	E	Conc Chnl 31'W 6'D 2:1 SS	2080	2389	CPMR135	PIT3	5.66	1.00
0232	E	2: 20' X 8' RCAC @ High Mesa	70	2389	CPMR135	PIT3	5.66	0.50
0233	E	Grass Chnl 100'W 4'D 5:1 SS	3750	2389	CPMR135	PIT3	5.66	0.85
0320	E	4: 20' X 8.75' RCAC @ Horizon Ridge	190	2350	CPMR040	PIT3	5.31	1.90
0321	E	28' X 7.2' Concrete Arch	500	2350	CPMR040	PIT3	5.31	1.30
0331	P1	Conc Chnl 18'W 5.5'D 2:1 SS	2100	2350	CPMR040	PIT3	5.31	2.20
PTPE		**PITTMAN PECOS**						
0000	E	Grass Chnl 100'W 4'D 4:1 SS	2130	1547	CPWA210*	PIT3	1.81	2.00
0050	E	20' X 10' RCAC @ Wigwam	140	1547	CPWA210	PIT3	1.81	2.60
0051	E	Grass Chnl 50'W 4'D 4:1 SS	2350	1547	CPWA210	PIT3	1.81	2.00
0095	P0	Add 1: 10' X 4' RCBC @ Pebble	120	1547	CPWA210	PIT3	1.81	2.00
0096	E	6: 48" RCPC @ Pebble	120	1547	CPWA210	PIT3	1.81	2.00
0097	E	Rip Rap Chnl 38'W 6'D 2.5:1 SS	2200	1547	CPWA210	PIT3	1.81	2.60
0105	E	3: 10' X 7' RCBC @ I-215	230	1235	CPWA195	PIT3	1.25	2.50
0106	E	2: 6' X 6' RCBC @ I-215	180	580	CPWA190	PIT3	0.58	7.63
0107	P0	Conc Chnl 18'W 4'D 1.5:1 SS	1770	580	CPWA190	PIT3	0.58	0.70
0166	E	1: 10' X 6' RCBC @ Paseo Verde	330	580	CPWA190	PIT3	0.58	2.95
PTPW		**PITTMAN PECOS WEST**						
0000	P2	8' X 8' RCB	1650	1094	CPPE190	PIT3SC	1.33	1.20
0041	P2	Conc Chnl 24'W 4'D 2:1 SS	350	1094	CPPE190	PIT3SC	1.33	2.00
0060	E	2: 8' X 6' RCBC @ Ivanpah	50	1094	CPPE190	PIT3SC	1.33	2.00
0062	E	Conc Chnl 24'W 4.5'D 2:1 SS	900	1094	CPPE190	PIT3SC	1.33	0.70
0067	E	9' X 8' RCBC @ St. Rose Parkway	50	1094	CPPE190	PIT3SC	1.33	3.00
0068	E	Conc Chnl 40'W 4.5'D 2:1 SS	820	1094	CPPE190	PIT3SC	1.33	2.30
0082	E	2: 12' X 6' RCBC & 1: 10' X 6' RCBC @ Siena Heights	70	1094	CPPE190	PIT3SC	1.33	2.10
0083	E	Conc Chnl 40'W 4.5'D 2:1 SS	1270	1094	CPPE190	PIT3SC	1.33	2.30
0109	E	3: 12' X 6' RCBC & 1: 10' X 6' RCBC @ Coronado Ctr	50	698	CPPE180	PIT3SC	0.82	1.40
PTPW		**PITTMAN PECOS WEST -- continued**						
0110	P1	Conc Chnl 15'W 4.5'D 2:1 SS	1500	698	CPPE180	PIT3SC	0.82	0.70
0136	E	4: 12' X 6' RCBC @ Horizon Ridge Pkwy	120	698	CPPE180	PIT3SC	0.82	2.00
0137	E	Conc Chnl 50'W 2:1 SS	3450	698	CPPE180	PIT3SC	0.82	2.00
PTRE		**PITTMAN RAILROAD EAST**						
0000	P1	60" RCP	2100	147	CPRE130	PIT5	15.79	0.50
0033	P2	57,800 cfs PMF Spillway		57800	CPRE130	PIT5	15.79	
0034	P2	54" RCP Outlet	150	147	PTRE0035	PIT5	15.79	
0035	P2	1,285 acre-ft Pittman Railroad East Detention Basin		5779	CPRE130	PIT5	15.79	
0037	E	Earth Chnl 50'W 10'D 2:1 SS	2100	3800	CPRE125	PIT3	3.97	0.07
0086	E	5: 10' X 8' RCBC @ Stephanie	110	3593	CPRE120	PIT3	3.60	0.07
0087	E	Earth Chnl 50'W 10'D 2:1 SS	1675	3593	CPRE120	PIT3	3.60	0.07
0098	E	Earth Chnl 25'W 10'D 2:1 SS	2475	1841	CPRE070	PIT3	1.64	0.10
0156	E	2: 10' X 8' RCBC @ Wigwam	190	1841	CPRE070	PIT3	1.64	0.10
0157	E	Earth Chnl 25'W 10'D 2:1 SS	1600	1841	CPRE070	PIT3	1.64	0.10
PTRW		**PITTMAN RAILROAD WEST**						
0000	E	Conc Chnl 10'W 5'D 2:1 SS	2950	702	CPWA280	PIT3	0.98	1.20
0053	E	14' X 5' RCBC @ Valle Verde	90	702	CPWA280	PIT3	0.98	0.60
0054	E	Conc Chnl 10'W 5.5'D 2:1 SS	3820	702	CPWA280	PIT3	0.98	0.90
0129	P0	Add 2: 6' X 4' RCBC @ Green Valley Pkwy	120	532	CPWA270	PIT3	0.73	0.38
0130	E	6' X 4' RCBC @ Green Valley Pkwy	120	532	CPWA270	PIT3	0.73	0.38
0131	E	Conc Chnl 10'W 5'D 2:1 SS	3850	532	CPWA270	PIT3	0.73	1.10
PTST		**PITTMAN STEPHANIE**						
0000	P1	Conc Chnl 34'W 5.5'D 2:1 SS	750	1955	CPRE110	PIT3	1.96	0.30
0016	E	16' X 6.5' RCAC	1660	1955	CPRE110	PIT3	1.96	3.60
0051	E	2: 12' X 6' RCBC @ Lake Mead	330	1955	CPRE110	PIT3	1.96	1.00
0052	P1	12' X 6.5' Concrete Arch	1380	1955	CPRE110	PIT3	1.96	3.00
0083	E	12' X 6.5' Concrete Arch	1280	1955	CPRE110	PIT3	1.96	3.40
0108	E	11' X 7' RCB	2480	1439	CPRE100	PIT3	1.43	3.70
0155	P1	11' X 5' RCB	830	1439	CPRE100	PIT3	1.43	3.60
0170	E	16' X 6' RCAC @ Quiet River	270	1439	CPRE100	PIT3	1.43	2.60
PTSW		**PITTMAN SANDWEDGE CHANNEL**						
0000	E	Conc Chnl 7'W 4.5'D 2:1 SS	1050	1438	CPWA250	PIT3	1.53	1.00
0019	E	3: 12' X 6' RCBC @ Windmill	120	1438	CPWA250	PIT3	1.53	1.20
0020	E	Natural Wash	3200	1438	CPWA250	PIT3	1.53	
0086	E	2: 66" RCP	690	611	CPWA235	PIT3	0.59	1.60
0092	E	Rip Rap Chnl 10'W 5'D 2:1 SS	330	611	CPWA235	PIT3	0.59	1.00
0097	E	2: 72" RCP @ Sandwedge	30	611	CPWA235	PIT3	0.59	3.00
0099	E	Rip Rap Chnl 32'W 5'D 2:1 SS	530	611	CPWA235	PIT3	0.59	3.10
0104	E	2: 72" RCP @ Bogey	50	611	CPWA235	PIT3	0.59	1.60
0105	E	Rip Rap Chnl 32'W 5'D 2:1 SS	1150	611	CPWA235	PIT3	0.59	3.10
0128	E	10' X 5' RCBC @ Bogey	90	611	CPWA235	PIT3	0.59	3.00
0129	E	Rip Rap Chnl 32'W 5'D 2:1 SS	530	340	PMR180	PIT3	0.32	3.10
PTVV		**PITTMAN VALLEY VERDE**						
0000	E	12' X 7' RCAC @ Horizon Ridge Pkwy	200	500	PMR090	PIT3	0.54	2.53
0004	E	Rip Rap Chnl 20'W 5'D 3:1 SS	140	500	PMR090	PIT3	0.54	0.50
0005	E	2: 60" RCP	840	500	PMR090	PIT3	0.54	3.60
PTVW		**PITTMAN WASH - VAN WAGENEN**						
0130	E	90" RCP	750	840	CPBR020	PIT3	0.71	1.07
0144	E	8' X 5' RCBC @ Commercial Way	70	840	CPBR020	PIT3	0.71	1.32
0145	E	84" RCP	620	553	CPBR010	PIT3	0.46	1.32
0157	E	90" RCP	300	553	CPBR010	PIT3	0.46	1.29
0163	E	72" RCP	2030	444	PTVW0185	PIT3SC	7.66	0.95
PTWA		**PITTMAN WASH**						
0000	E	Conc Chnl 30'W 7.5'D 2:1 SS	2850	5570	CPDC030	PIT5SC	19.12	3.00
0047	E	Single Span Bridge 70'W 12'D @ Santiago	80	5252	CPWA315	PIT5SC	18.00	0.50
0048	E	42" RCP Outlet	180	45	PTWA0050	PIT5SC	18.00	
0050	E	41 ac-ft Pittman Park Detention Basin		5252	CPWA315	PIT5SC	18.00	
0055	E	Conc Chnl 30'W 7.5'D 2:1 SS	920	6545	CPWA130*	PIT4SC	11.96	1.00
0077	E	Conc Chnl 30'W 8.5'D 2:1 SS	420	6545	CPWA130*	PIT4SC	11.96	2.10
0090	E	Single Span Bridge 60'W 12'D @ Arroyo Grande	80	6545	CPWA130*	PIT4SC	11.96	2.00
0091	E	Natural Wash	1740	6545	CPWA130*	PIT4SC	11.96	
0106	E	5 Span Bridge 181'W 31'D @ UPRR	110	6545	CPWA130*	PIT4SC	11.96	2.20
0107	E	Natural Wash	2400	6545	CPWA130*	PIT4SC	11.96	
0151	E	7: 10' X 8' RCBC @ Valley Verde	80	6545	CPWA130*	PIT4SC	11.96	1.70
0152	E	Natural Wash	4050	6545	CPWA130*	PIT4SC	11.96	1.00
0235	E	6: 10' X 8' RCBC @ Green Valley Prkwy	90	6545	CPWA130*	PIT4SC	11.96	1.10
0236	E	Gabion Chnl 60'W 10'D 3:1 SS	1800	6545	CPWA130*	PIT4SC	11.96	1.20
0275	E	Gabion Chnl 60'W 10'D 3:1 SS	3900	6545	CPWA130*	PIT4SC	11.96	1.20
0344	E	4 Span Bridge 120'W 10'D @ Pecos	100	6545	CPWA130	PIT4SC	11.96	1.00
0345	P1	Conc Chnl 30'W 8'D 2:1 SS	3750	6545	CPWA130	PIT4SC	11.96	1.11
0409	P0	Add 4: 10' X 5' RCBC @ Wigwam	80	6339	CPWA110	PIT4SC	11.17	1.00
0410	E	6: 10' X 5' RCBC @ Wigwam	80	6339	CPWA110	PIT4SC	11.17	1.00
0411	E	Earth Chnl 30'W 10'D 2:1 SS	2800	6339	CPWA110	PIT4SC	11.17	1.20
0411	P1	Conc Chnl 30'W 8'D 2:1 SS	2800	6339	CPWA110	PIT4SC	11.17	1.10
0476	E	6: 12' X 10' RCBC @ Pebble	120	6307	CPWA080	PIT4SC	10.93	1.20
0477	E	Earth Chnl 30'W 10'D 2:1 SS	170	6307	CPWA080	PIT4SC	10.93	1.20
0477	P1	Conc Chnl 30'W 8'D 2:1 SS	170	6307	CPWA080	PIT4SC	10.93	1.20
0485	E	Earth Chnl 30'W 10'D 2:1 SS	1150	1976	CPWA095	PIT3SC	2.85	0.80
0485	P1	Conc Chnl 15'W 6.5' D 2:1 SS	1150	1976	CPWA095	PIT3SC	2.85	0.80
0489	E	6: 12' X 8' & 1: 8' X 8' RCBC @ Eastern	160	1975	CPWA100	PIT3SC	2.80	1.20
0505	P1	Conc Chnl 12'W 6.5'D 2:1 SS	750	1975	CPWA100	PIT3SC	2.80	1.40
0540	E	Conc Chnl 15'W 5.5'D 2:1 SS	2250	1200	CPWA040	PIT3SC	1.35	0.50
0576	E	4: 13' X 8' RCBC @ I-215	700	1200	CPWA040	PIT3SC	1.35	1.00
0578	E	Conc Chnl 27.5'W 8.8'D 2:1 SS	1250	1200	CPWA040	PIT3SC	1.35	0.60
0615	E	3: 72" RCP	2000	1200	CPWA040	PIT3SC	1.35	0.50
0653	E	60" RCP	3770	1020	CPWA030	PIT3SC	1.05	0.80
0654	P0	Add Parallel 12' X 6' RCB	3770	1020	CPWA030	PIT3SC	1.05	0.80
0724	E	54" RCP	1330	81	PTWA0740	PIT3SC	5.76	0.30
0730	E	48" RCP	1100	81	PTWA0740	PIT3SC	5.76	0.30
0738	E	42" RCP Outlet	1500	81	PTWA0740	PIT3SC	5.76	0.30
0740	P0	Upgrade to 2,220 ac-ft Cactus Detention Basin		5151	CPCD150	PIT3SC	5.76	
0741	E	1,300 ac-ft Cactus Detention Basin		5151	CPCD150	PIT3SC	6.00	
PTWB		**PITTMAN WASH - WEST BELTWAY**						
0000	E	4: 10' X 6' RCBC @ I-215	800	729	CPWA070	PIT3SC	1.00	1.15
0016	E	Conc Chnl 20'W 6.5'D 2:1 SS	750	729	CPWA070	PIT3SC	1.00	2.30
WWDC		**WHITNEY WASH - DUCK CREEK**						
0000	E	Conc Chnl 15'W 6.5'D 2:1 SS	1400	1224	CPDC125	PIT3	2.59	0.80
0030	E	14' X 8.75' RCAC @ Whitney Ranch Rd	150	1224	CPDC125	PIT3	2.59	1.00
0033	E	Conc Chnl 15'W 6'D 2:1 SS	1000	1224	CPDC125	PIT3	2.59	0.60
0054	E	19' X 14' RCAC @ Galleria	70	1000	CPDC080	PIT3	2.33	0.90
0055	E	Conc Chnl 15'W 6.5'D 2:1 SS	750	1000	CPDC080	PIT3	2.33	0.80
0069	P1	Conc Chnl 15'W 5'D 2:1 SS	1470	1000	CPCD080	PIT3	2.33	0.60
0119	P0	Add 1: 14' X 4' RCB	890	1000	CPDC080	PIT3	2.33	0.60
0120	E	11' X 4' RCB	890	1000	CPDC080	PIT3	2.33	0.60
0149	P1	8,900 cfs PMF Spillway		8900	CPDC075	PIT3	1.26	
0150	P1	6' X 6' RCB Outlet	200	552	WWDC0151	PIT3	1.26	
0151	P1	35 ac-ft Whitney Wash Detention Basin		1077	CPDC075	PIT3	1.26	

**The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.*

***As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.*

FLOOD CONTROL FACILITIES INVENTORY TO ACCOMPANY FIGURE 2

REGIONAL FLOOD CONTROL DISTRICT

2002 LAS VEGAS VALLEY
FLOOD CONTROL MASTER PLAN UPDATE
FACILITY INVENTORY
FIGURE F-21

LEGEND

Street Name Designator AA BB
Parent Stream Name
Stream Name
ID / River Mile 00 00
Distance above confluence
With parent stream
Miles in tenths

Existing Facility .... E
Proposed or Modified Facility .... P
Contingency Level
Category B P0
Master Plan P1
Preliminary Design P2
Design P3

Bottom Width .... W
Depth .... D
Side Slope, H:V .... SS

Construction Features
Cast in Place Concrete Pipe .... CIPCP
Corrugated Metal Arch Pipe Culvert .... CMAP
Corrugated Metal Pipe Culvert .... CMP
High Density Polyethylene .... HDPE
Helical Elliptical Reinforced Concrete Pipe .... HERCP
Reinforced Concrete Arch Pipe .... RCAC
Reinforced Concrete Box .... RCB
Reinforced Concrete Box Culvert .... RCBC
Reinforced Concrete Pipe .... RCP
Reinforced Concrete Pipe Culvert .... RCPC
Storm Sewer Pipe .... SSP

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G. C. WALLACE, INC.

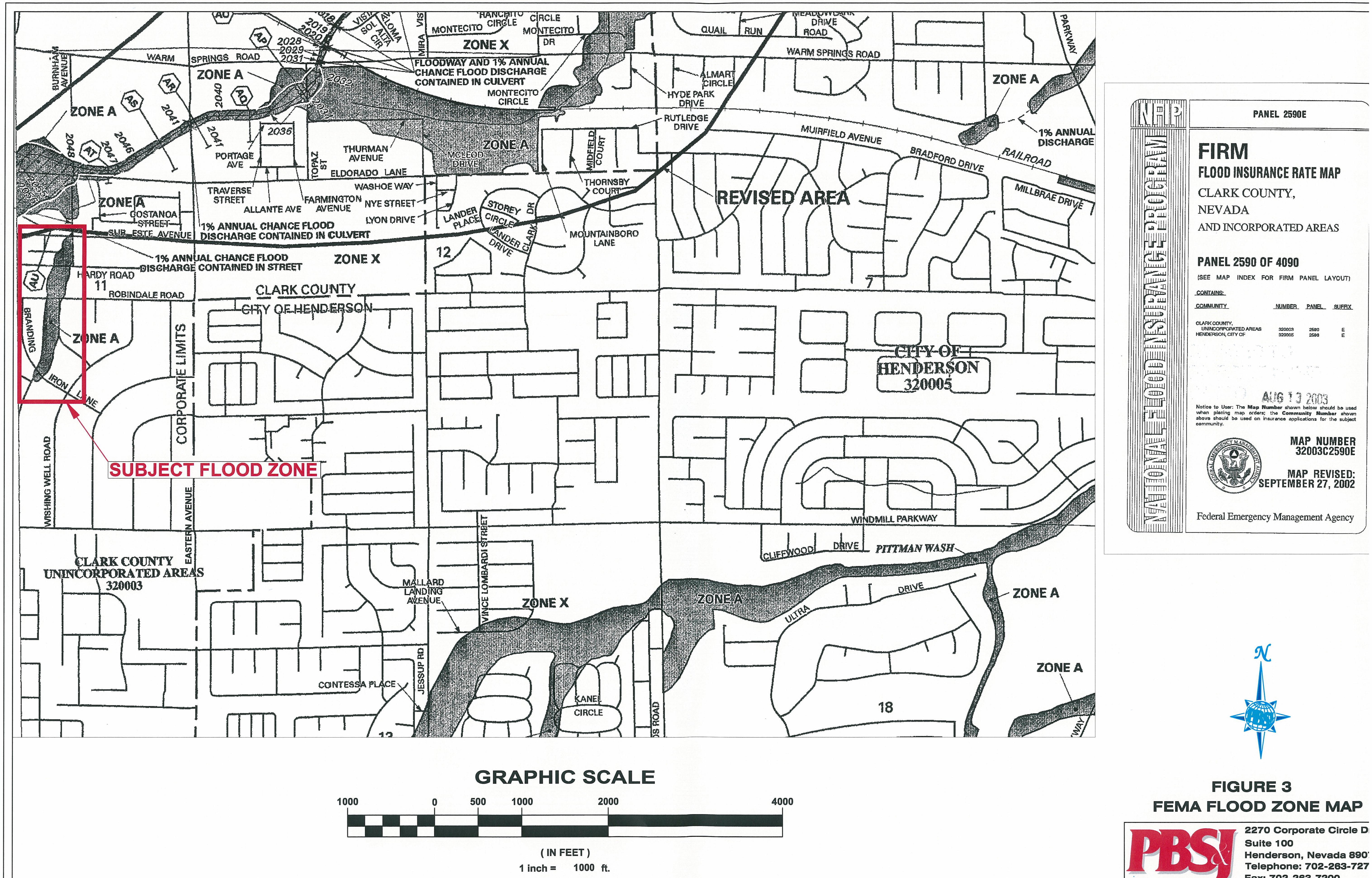
ZONE A
ZONE X
ZONE A
FLOODWAY AND 1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CULVERT
WARM SPRINGS ROAD
MONTECITO CIRCLE
RANCHITO CIRCLE
MONTECITO DR
QUAIL RUN
MEADOWLARK DRIVE ROAD
ALMART CIRCLE
HYDE PARK DRIVE
RUTLEDGE DRIVE
MUIRFIELD AVENUE
BRADFORD DRIVE
RAILROAD
MILLBRAE DRIVE
PARKWAY
1% ANNUAL DISCHARGE
BURNHAM AVENUE
PORTAGE AVE
TOPAZ ST
THURMAN AVENUE
MCLEOD DRIVE
ELDORADO LANE
MIDFIELD COURT
THORNSBY COURT
TRAVERSE STREET
FARMINGTON AVENUE
ALLANTE AVE
NYE STREET
WASHOE WAY
LYON DRIVE
LANDER PLACE
STOREY CIRCLE
LANDER DRIVE
CLARK DR
MOUNTAINBORO LANE
REVISED AREA
COSTANOA STREET
SUR ESTE AVENUE
1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CULVERT
1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN STREET
HARDY ROAD
ROBINDALE ROAD
BRANDING IRON LANE
CLARK COUNTY
CITY OF HENDERSON
CORPORATE LIMITS
CITY OF HENDERSON 320005
SUBJECT FLOOD ZONE
WISHING WELL ROAD
EASTERN AVENUE
CLARK COUNTY UNINCORPORATED AREAS 320003
MALLARD LANDING AVENUE
VINCE LOMBARDI STREET
WINDMILL PARKWAY
CLIFFWOOD DRIVE
PITTMAN WASH
ULTRA DRIVE
CONTESSA PLACE
JESSUP RD
KANEL CIRCLE
11
12
7
13
18
AU
AP
AQ
AR
AS
AT
AO
2019
2020
2028
2029
2031
2032
2034
2036
2040
2041
2046
2047
2048
2055
2056
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 2590E
FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA AND INCORPORATED AREAS
PANEL 2590 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
CLARK COUNTY, UNINCORPORATED AREAS 320003 2590 E
HENDERSON, CITY OF 320005 2590 E
AUG 13 2003
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER 32003C2590E
MAP REVISED: SEPTEMBER 27, 2002
Federal Emergency Management Agency
N
GRAPHIC SCALE
1000
0
500
1000
2000
4000
(IN FEET)
1 inch = 1000 ft.

FIGURE 3
FEMA FLOOD ZONE MAP

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Suite 100
Henderson, Nevada 890
Telephone: 702-263-727
Fax: 702-263-7200

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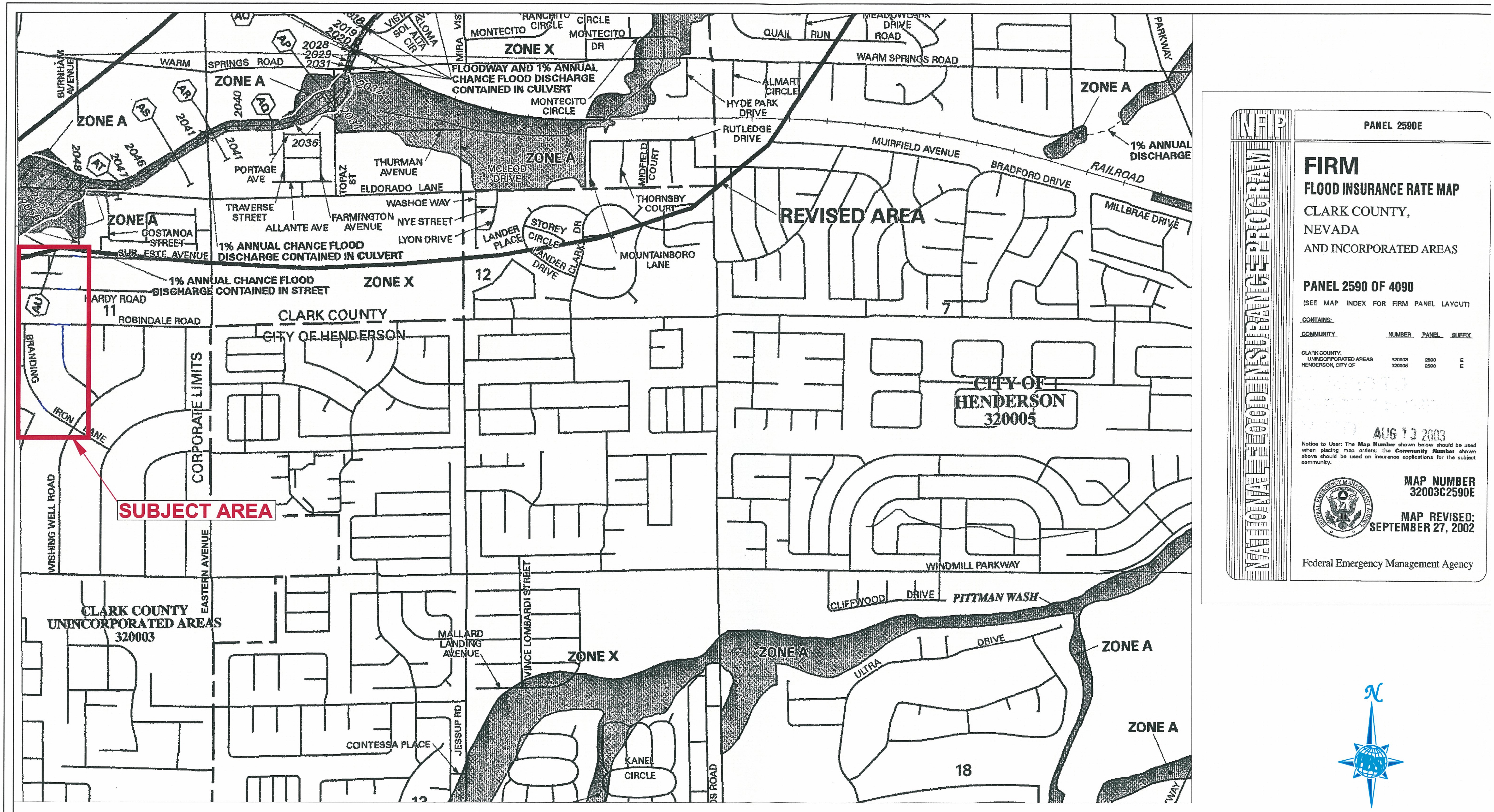

ZONE A
ZONE A
ZONE A
ZONE A
ZONE A
ZONE A
ZONE A
ZONE X
ZONE X
ZONE X
WARM SPRINGS ROAD
BURNHAM AVENUE
FLOODWAY AND 1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CULVERT
1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CULVERT
1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN STREET
1% ANNUAL DISCHARGE
MONTECITO CIRCLE
THURMAN AVENUE
MCLEOD DRIVE
ELDORADO LANE
WASHOE WAY
NYE STREET
LYON DRIVE
TRAVERSE STREET
FARMINGTON AVENUE
ALLANTE AVE
PORTAGE AVE
TOPAZ ST
COSTANOA STREET
SUR ESTE AVENUE
HARDY ROAD
ROBINDALE ROAD
BRANDING IRON LANE
WISHING WELL ROAD
EASTERN AVENUE
CORPORATE LIMITS
CLARK COUNTY
CITY OF HENDERSON
CITY OF HENDERSON 320005
CLARK COUNTY UNINCORPORATED AREAS 320003
REVISED AREA
MUIRFIELD AVENUE
BRADFORD DRIVE
RAILROAD
MILLBRAE DRIVE
RUTLEDGE DRIVE
HYDE PARK DRIVE
ALMART CIRCLE
QUAIL RUN ROAD
MEADOWLARK DRIVE
PARKWAY
MIDFIELD COURT
THORNSBY COURT
MOUNTAINBORO LANE
STOREY CIRCLE
LANDER PLACE
LANDER DRIVE
CLARK DR
WINDMILL PARKWAY
CLIFFWOOD DRIVE
PITTMAN WASH
ULTRA DRIVE
MALLARD LANDING AVENUE
VINCE LOMBARDI STREET
JESSUP RD
CONTESSA PLACE
KANEL CIRCLE
AU
AP
AQ
AR
AS
AT
2019
2020
2028
2029
2031
2032
2036
2040
2041
2046
2047
2048
7
11
12
18
SUBJECT AREA
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 2590E
FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA
AND INCORPORATED AREAS
PANEL 2590 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
CLARK COUNTY, UNINCORPORATED AREAS 320003 2590 E
HENDERSON, CITY OF 320005 2590 E
AUG 13 2003
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER 32003C2590E
MAP REVISED: SEPTEMBER 27, 2002
Federal Emergency Management Agency
N

GRAPHIC SCALE

1000 0 500 1000 2000 4000

(IN FEET)
1 inch = 1000 ft.

FIGURE 4
ANNOTATED
FEMA FLOOD ZONE MAP

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Fax: 702-263-7200
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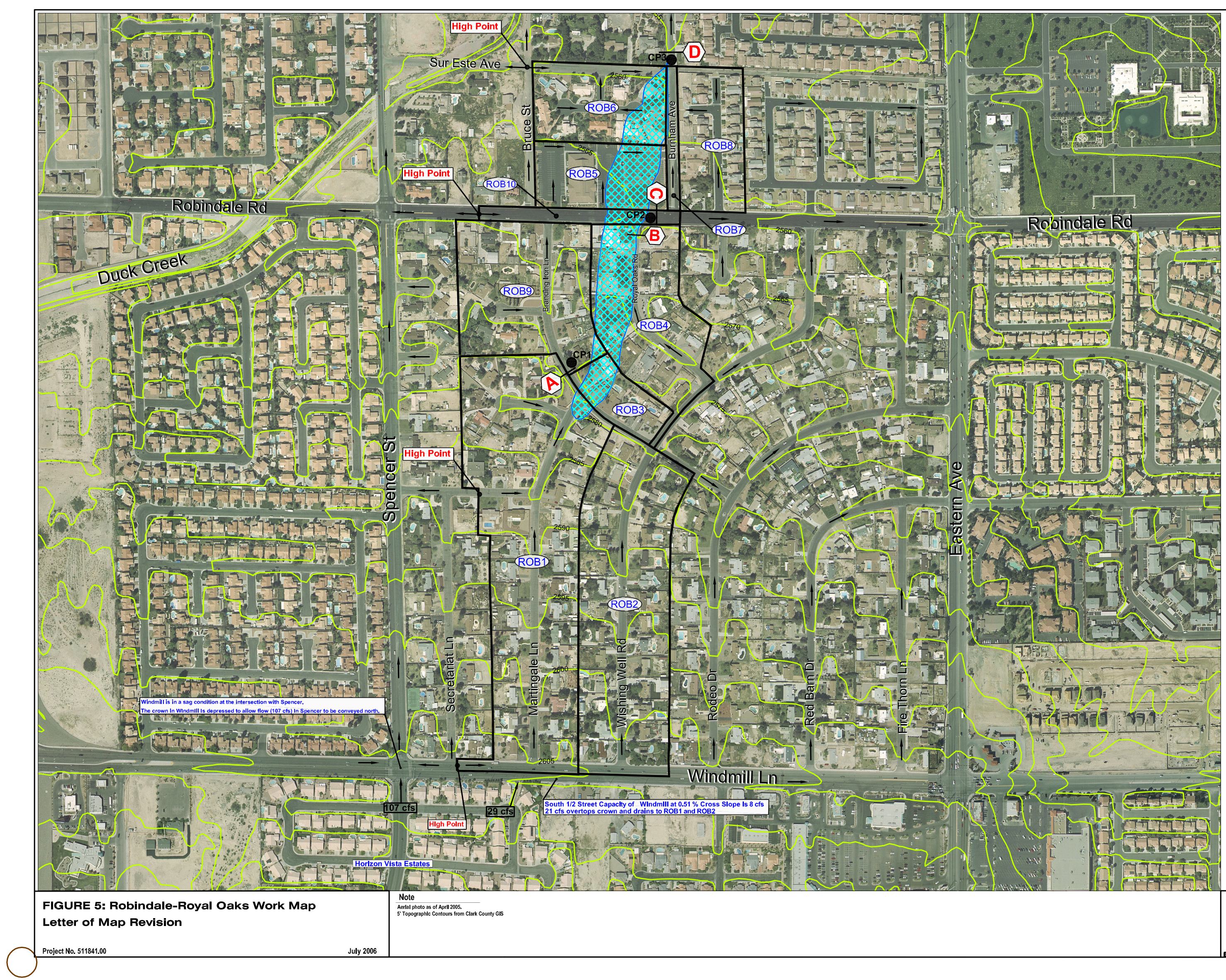
High Point
Sur Este Ave
Bruce St
Burnham Ave
CP3
D
ROB6
ROB5
ROB8
ROB10
C
CP2
B
ROB7
High Point
Robindale Rd
Robindale Rd
Duck Creek
Spencer St
ROB9
Branding Iron Ln
Royal Oaks Rd
ROB4
CP1
A
ROB3
High Point
Eastern Ave
ROB1
ROB2
Secretariat Ln
Martingale Ln
Wishing Well Rd
Rodeo Dr
Red Barn Dr
Fire Thorn Ln
Windmill Ln
2560
2565
2570
2575
2580
2585
2590
2595
2600
2605
107 cfs
29 cfs
High Point
Horizon Vista Estates

Windmill is in a sag condition at the intersection with Spencer.
The crown in Windmill is depressed to allow flow (107 cfs) in Spencer to be conveyed north.

South 1/2 Street Capacity of Windmill at 0.51 % Cross Slope is 8 cfs
21 cfs overtops crown and drains to ROB1 and ROB2

Basin Flow Summary

Existing Conditions - 100 Year

BASIN NAME/ COMBINATION POINT	BASIN AREA (acres)	Q_{100} (cfs)
ROB1	22.10	19
ROB2	15.82	35
ROB3	2.20	2
ROB4	8.40	6
ROB5	4.57	15
ROB6	5.30	9
ROB7	0.83	3
ROB8	4.86	28
ROB9	9.67	7
ROB10	1.55	5
CP1	NA	55
CP2	NA	72
CP3	NA	55

100-Year Street Flow Depth Summary Table

Cross Section	Location	ROW Width	Street Slope (%)	Normal Depth (ft)	Hydraulic Depth (ft)
A-A	Branding Iron Ln	40'	1.10	0.65	0.30
B-B	Royal Oaks Rd	40'	1.10	0.35	0.12
C-C	Robindale Rd	80'	0.70	0.83	0.34
D-D	Burnham Ave	60'	1.50	0.63	0.22

Legend

A ——	Cross-Section Location
━━	Basin Delineation
ROB1	Basin Identifier
⟶	Flow Direction
● C1	Combination Point
▨	Zone A Flood Zone
2500 ～	5' Contour

The hydrologic & hydraulic analyses completed for this LOMR are based on topographic information shown on this map and supplemental information from existing residential developments.

I herby certify that this information substantially conforms with current conditions.

Matthew S. Baird, NV 13684 Date

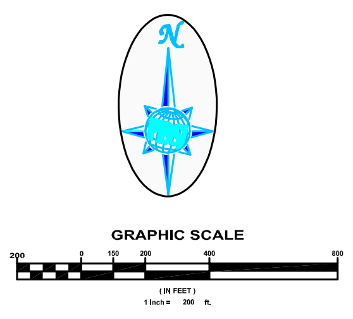
N
GRAPHIC SCALE
200
0
150
200
400
800
(IN FEET)
1 Inch = 200 ft.

FIGURE 5: Robindale-Royal Oaks Work Map
Letter of Map Revision

Project No. 511841.00 July 2006

Note

Aerial photo as of April 2005.
5' Topographic Contours from Clark County GIS

PBSJ
2270 Corporate Circle
Suite 100 Henderson,
Nevada 89014
Telephone: 702/263-7275
Fax: 702/263-7200
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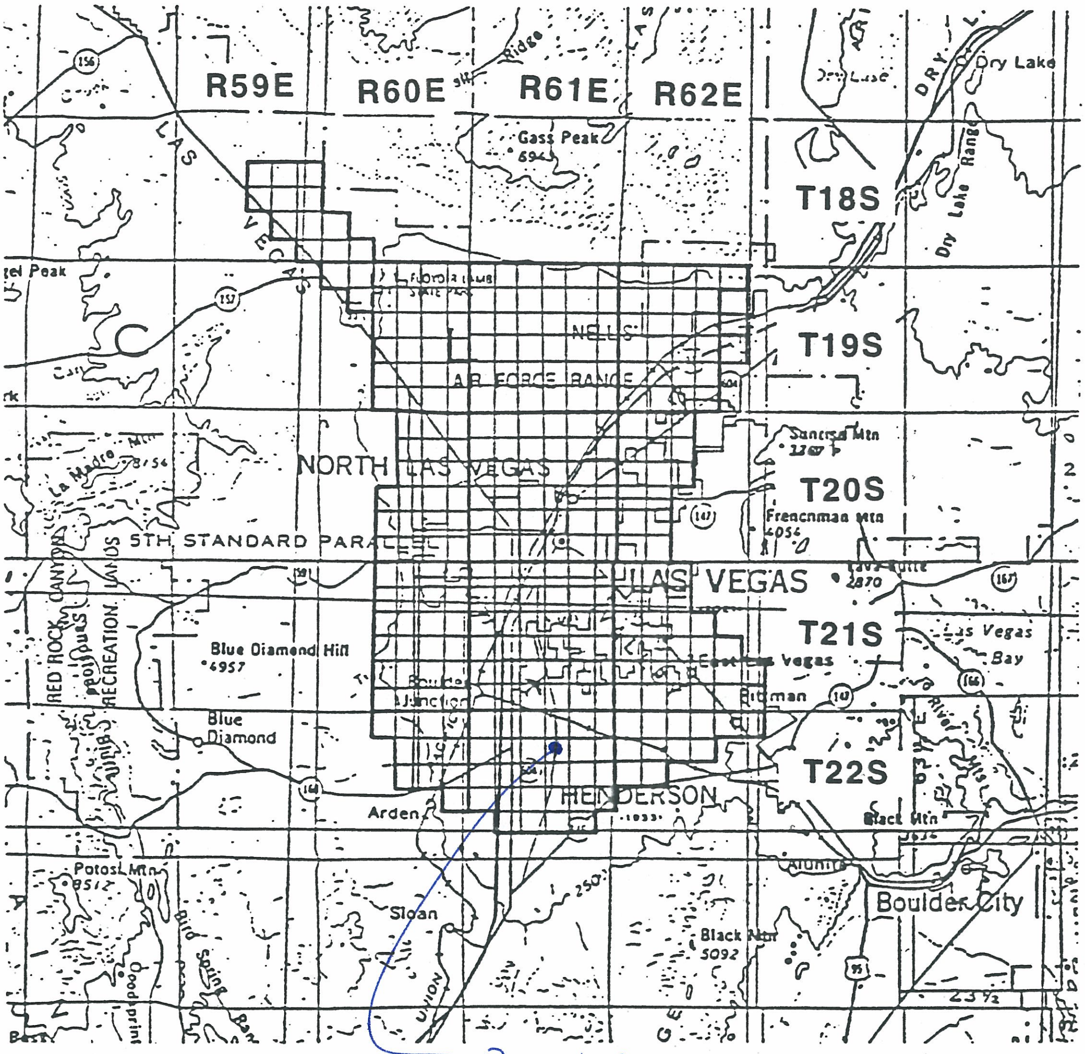
FIGURE 5

APPENDIX C

Hydrology

Hydrologic Parameters

McCARRAN AIRPORT RAINFALL AREA


R59E
R60E
R61E
R62E
T18S
T19S
T20S
T21S
T22S
Gass Peak 6943
Dry Lake
Dry Lake Range
NELLIS
AIR FORCE RANGE
NORTH LAS VEGAS
LAS VEGAS
5TH STANDARD PARALLEL
Blue Diamond Hill 6957
Blue Diamond
Sunrise Mtn
Frenchman Mtn 4056
Las Vegas Bay
East Las Vegas
Pittman
HENDERSON
Arden
Sloan
Potosi Mtn 8512
Black Mtn 5092
Boulder City
RED ROCK CANYON RECREATION LANDS
LAS VEGAS
UNION PACIFIC

Project Area

TOWNSHIP	RANGE	SECTIONS
18 South	59 East	13-15,22-26,36
18 South	60 East	30-32
19 South	60 East	1-6,8-16,21-28,33-36
19 South	61 East	ALL SECTIONS
19 South	62 East	2-11,14-23,27-34
20 South	60 East	1-3,10-15,21-28,33-36*
20 South	61 East	ALL SECTIONS
20 South	62 East	4-9,16-20,29-32
21 South	60 East	1-4,9-16,21-28,33-36
21 South	61 East	ALL SECTIONS
21 South	62 East	4-9,15-23, 25-36
22 South	60 East	1-4,10-15,24
22 South	61 East	1-24,26-29
22 South	62 East	1-10,17-18

Notes:

1. Refer to Table 505 and Figure 516 Depth-Duration- Frequency values in the McCarran Airport Rainfall Area.
2. Refer to Table 506 and Figure 517 for Time-Intensity-Frequency values on the McCarran Airport Rainfall Area.

Revision	Date

WRC ENGINEERING

REFERENCE: USACE, Los Angeles District, 1988

FIGURE 513

SIX-HOUR STORM DISTRIBUTIONS

Storm Time (In Minutes)	Percent of Total Storm Depth SDN3	SDN4	SDN5
0	0.0	0.0	0.0
5	2.0	2.0	2.0
10	5.7	5.8	5.9
15	7.0	7.5	8.0
20	8.7	9.9	11.0
25	10.8	12.6	14.4
30	12.4	13.7	15.0
35	13.0	14.5	16.0
40	13.0	14.9	16.8
45	13.0	15.1	17.1
50	13.0	15.5	18.0
55	13.0	15.6	18.2
60	13.0	15.9	18.7
65	13.3	16.2	19.0
70	14.0	16.9	19.7
75	14.2	17.2	20.2
80	14.8	17.9	21.0
85	15.8	18.9	22.0
90	17.2	20.1	23.0
95	18.1	21.1	24.1
100	19.0	22.0	25.0
105	19.7	22.8	25.9
110	19.9	23.2	26.5
115	20.0	24.0	28.0
120	20.1	24.6	29.0
125	20.4	25.2	30.0
130	21.4	26.0	30.5
135	22.9	26.9	30.9
140	24.1	27.6	31.0
145	24.9	28.3	31.7
150	25.1	28.6	32.1
155	25.6	29.2	32.7
160	27.0	30.2	33.3
165	27.8	31.2	34.6
170	28.1	32.1	36.1
175	28.3	33.2	38.1
180	29.5	35.2	40.8
185	32.2	37.6	43.0
190	35.2	41.5	47.7
195	40.9	46.2	51.4
200	49.9	53.0	56.1
205	59.0	61.0	63.0
210	71.0	71.0	71.0
215	74.4	73.2	72.0
220	78.1	75.6	73.1
225	81.2	78.2	75.2
230	81.9	79.9	77.9
235	83.5	81.3	79.0
240	85.1	82.3	79.5
245	85.6	83.0	80.4
250	86.0	83.5	81.0
255	86.8	84.4	82.0
260	87.6	85.1	82.6
265	88.8	86.4	84.0
270	91.0	88.5	85.9
275	92.6	90.8	88.9
280	93.7	92.4	91.0
285	95.0	94.4	93.8
290	97.0	96.8	96.6
295	97.6	97.3	97.0
300	98.2	97.8	97.4
305	98.5	98.2	97.9
310	98.7	98.4	98.1
315	98.9	98.6	98.3
320	99.0	98.8	98.5
325	99.3	99.1	98.9
330	99.3	99.2	99.0
335	99.4	99.3	99.2
340	99.5	99.4	99.3
345	99.8	99.7	99.6
350	99.8	99.8	99.7
355	99.9	99.9	99.9
360	100.0	100.0	100.0

Notes:
1. For drainage areas less than 8 square miles in size, use SDN 3.
2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
4. A graphical representation of these values is presented on **Figure 515.**

Revision	Dat

REFERENCE:

TABLE 503

DEPTH-DURATION-FREQUENCY VALUES FOR McCARRAN AIRPORT RAINFALL AREA

(IN INCHES)

	RECURRENCE INTERVAL					
TIME	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5 min.	0.15	0.27	0.35	0.46	0.54	0.63
10 min.	0.25	0.44	0.57	0.74	0.89	1.02
15 min.	0.33	0.57	0.74	0.97	1.15	1.32
30 min.	0.44	0.78	1.01	1.31	1.55	1.79
1 hour	0.52	0.89	1.15	1.50	1.78	2.06
2 hour	0.59	1.01	1.30	1.70	2.01	2.30
3 hour	0.64	1.08	1.39	1.82	2.15	2.48
* 6 hour	0.72	1.22	1.58	2.05	2.41	2.77
24 hour (TR-55)	1.20	1.60	1.80	2.40	2.70	2.96

NOTE:
1. Refer to Figure 513 for a description and drawing of the area included in the McCarran Airport Rainfall Area.
2. The 24 hour values presented above are for use with TR-55 only.
3. Table 501 adjustments not required.

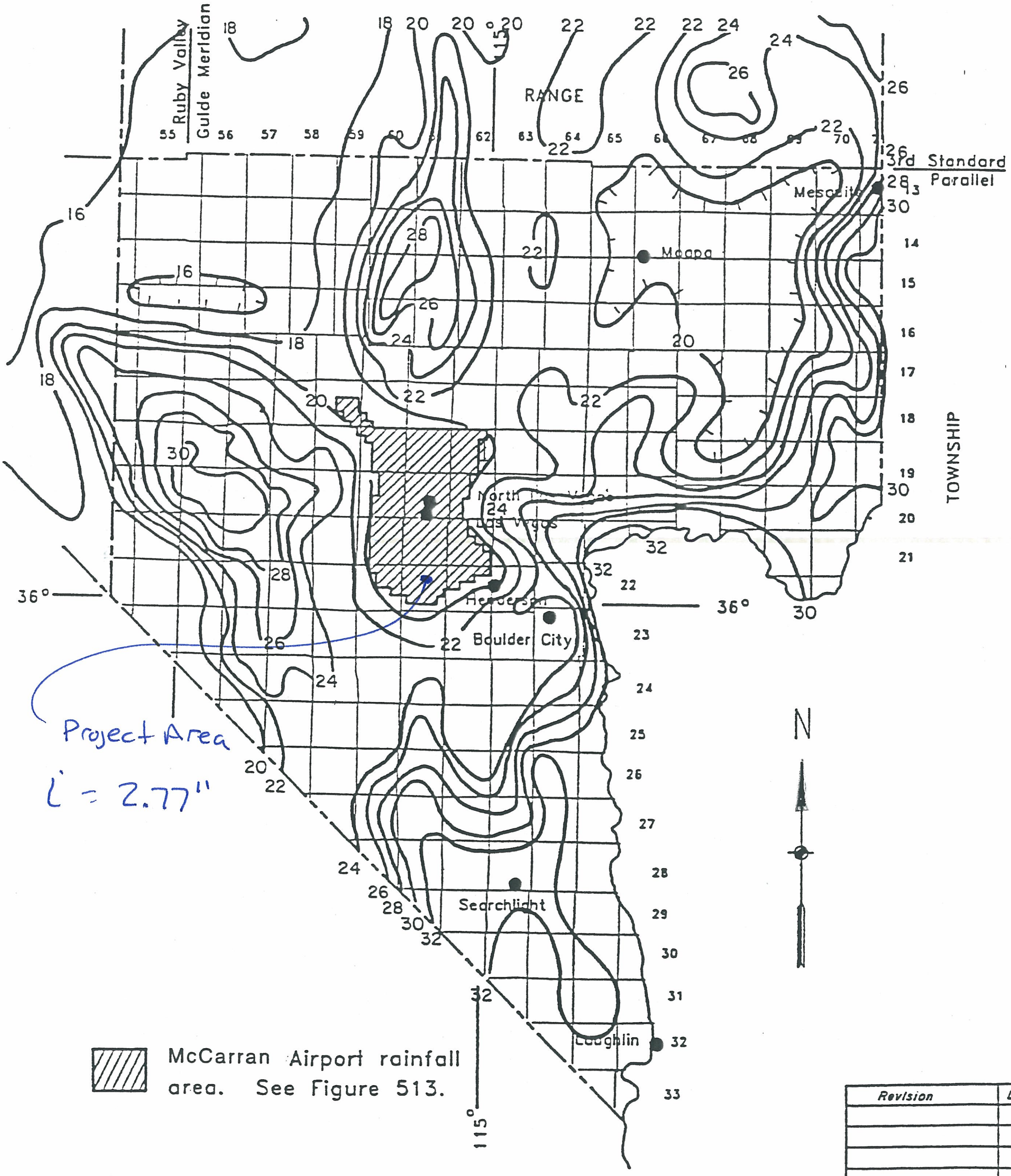
Revision	Date

REFERENCE:

USACE, Los Angeles District, 1988

TABLE 505

RAINFALL DEPTH-DURATION-FREQUENCY
100-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)


Ruby Valley
Guide Meridian
RANGE
55 56 57 58 59 60 62 63 64 65 66 67 68 69 70
3rd Standard Parallel
TOWNSHIP
13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
Mesquite
Moapa
North Las Vegas
Henderson
Boulder City
Searchlight
Laughlin
36°
115°
N
18 20 20 20 22 22 22 24 24 26 26 22 22 26 28 30 16 16 18 18 22 28 26 24 22 20 20 22 20 22 30 30 24 32 32 28 26 22 24 30 20 22 24 26 28 30 32 32

Project Area
i = 2.77"

▨ McCarran Airport rainfall area. See Figure 513.

Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 506

RUNOFF CURVE NUMBERS
(URBAN AREAS[1])

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
See Table 602A					
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94

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[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	*Date*

REFERENCE:
SCS TR-55, USDA, June 1986.

RUNOFF CURVE NUMBERS - RESIDENTIAL DISTRICTS

Average Lot Size or Usage[1]	Percent Impervious[2]	Curve Number for Hydrologic Soil Groups			
		A	B	C	D
Apartments/Condos	72	81	88	91	93
* Townhouses/6,000 sq ft lots or less[3]	69	80	87	90	92
7,000 sq ft lots	63	76	84	89	91
8,000 sq ft lots	58	73	82	88	90
10,000 sq ft lots	38	61	75	83	87
14,000 sq ft lots	30	57	72	81	86
* 20,000 sq ft lots	25	54	70	80	85
40,000 sq ft lots	20	51	68	79	84
80,000 sq ft lots	12	46	65	77	82

[1] Lot size should represent the size of the average lot and not the gross acreage divided by the number of lots.

[2] Actual percent impervious value should be compared to selected land use type.

[3] In cases where average residential lots are smaller than 6,000 sq ft, commercial/business/industrial land use should be used.

Revision	Date

REFERENCE:

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding		High water table		Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Months	Depth	Months	Depth	Thickness	Depth	Hardness	Uncoated steel	Concrete
				Ft		In		In			
182*:											
Caliza-----------	B	None--------	---	>6.0	---	>60	---	---	---	High------	Low.
Pittman----------	C	None--------	---	>6.0	---	>60	---	20-30	Thick	High------	Low.
Arizo------------	A	Occasional	Mar-Sep	>6.0	---	>60	---	---	---	High------	Low.
183-------------- Caliza	B	None--------	---	>6.0	---	>60	---	---	---	High------	Low.
184-------------- Caliza	B	Rare--------	---	>6.0	---	>60	---	---	---	High------	Low.
187-------------- Caliza	B	None--------	---	>6.0	---	>60	---	---	---	High------	Low.
190-------------- Dalian	B	None--------	---	>6.0	---	>60	---	---	---	High------	Low.
191-------------- Dalian	B	Rare--------	---	>6.0	---	>60	---	---	---	High------	Low.
192*:											
Dalian-----------	B	Rare--------	---	>6.0	---	>60	---	---	---	High------	Low.
McCullough-------	B	Rare--------	---	>6.0	---	>60	---	---	---	High------	Low.
200-------------- Glencarb	B	Rare--------	---	>6.0	---	>60	---	---	---	High------	Moderate.
206-------------- Glencarb	C	Occasional	Jul-Sep	3.0-5.0	Jul-Jun	>60	---	---	---	High------	High.
222-------------- Glencarb	C	Rare--------	---	3.0-5.0	Jul-Jun	>60	---	---	---	High------	High.
236-------------- Glencarb	B	Rare--------	---	>6.0	---	>60	---	---	---	High------	High.
237-------------- Glencarb	B	Rare--------	---	>6.0	---	>60	---	40-60	Thick	High------	Low.
240-------------- Goodsprings	D	None--------	---	>6.0	---	>60	---	9-20	Thick	High------	Low.
252, 255--------- Grapevine	B	Rare--------	---	>6.0	---	>60	---	---	---	High------	High.
260-------------- Jean	A	Rare--------	---	>6.0	---	>60	---	---	---	High------	Low.
262*:											
Jean-------------	A	Rare--------	---	>6.0	---	>60	---	---	---	High------	Low.
Jean-------------	A	Occasional	Jun-Sep	>6.0	---	>60	---	---	---	High------	Low.
Goodsprings------	D	Rare--------	---	>6.0	---	>60	---	9-20	Thick	High------	Low.
263*:											
Jean-------------	A	Rare--------	---	>6.0	---	>60	---	---	---	High------	Low.
Jean-------------	A	Occasional	Jun-Sep	>6.0	---	>60	---	---	---	High------	Low.
264-------------- Jean	A	Rare--------	---	>6.0	---	>60	---	---	---	High------	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding		High water table		Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Months	Depth	Months	Depth	Thick-ness	Depth	Hard-ness	Uncoated steel	Concrete
				Ft		In		In			
270 Land	B	Rare	---	3.5-6.0	Mar-Sep	>60	---	---	---	High	High.
278 Land	D	Rare	---	1.5-3.0	Jan-Dec	>60	---	---	---	High	High.
282 Land	C	Rare	---	3.0-3.5	Jan-Dec	>60	---	---	---	High	High.
300, 301 Las Vegas	D	Rare	---	>6.0	---	>60	---	3-14	Thick	High	High.
302*:											
Las Vegas	D	Rare	---	>6.0	---	>60	---	3-14	Thick	High	High.
McCarran	B	Rare	---	>6.0	---	>60	---	---	---	High	High.
Grapevine	B	Rare	---	>6.0	---	>60	---	---	---	High	High.
305*:											
Las Vegas	D	Rare	---	>6.0	---	>60	---	3-14	Thick	High	High.
Destazo	B	Rare	---	>6.0	---	>60	---	---	---	High	High.
307*:											
Las Vegas	D	Rare	---	>6.0	---	>60	---	3-14	Thick	High	High.
Skyhaven	C	Rare	---	>6.0	---	>60	---	24-40	Thick	High	High.
325, 326 McCarran	B	Rare	---	>6.0	---	>60	---	---	---	High	High.
341 Paradise	C	Rare	---	3.0-5.0	Dec-Mar	>60	---	---	---	High	Low.
360*: Rock outcrop.											
St. Thomas	D	None	---	>6.0	---	4-20	Hard	---	---	High	Low.
380 Skyhaven	C	Rare	---	>6.0	---	>60	---	24-40	Thick	High	High.
390 Spring	C	Rare	---	>6.0	---	>60	---	---	---	High	High.
400 Tencee	D	None	---	>6.0	---	>60	---	7-20	Thick	High	Low.
415 Aztec	B	None	---	>6.0	---	>60	---	---	---	High	High.
417*:											
Aztec	B	None	---	>6.0	---	>60	---	---	---	High	High.
Rock outcrop.											
418*:											
Aztec	B	None	---	>6.0	---	>60	---	---	---	High	High.
Nickel	B	None	---	>6.0	---	40-60	Hard	---	---	High	Low.
Knob Hill	B	None	---	>6.0	---	>60	---	---	---	High	Low.

See footnote at end of table.

moderate if the surface is disturbed. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

The McCullough soil is very deep and well drained. It formed in alluvium derived from various kinds of rock. Typically, about 75 percent of the surface is covered with a desert pavement of pebbles. The surface layer is pale brown very gravelly very fine sandy loam about 5 inches thick. The subsoil and upper part of the substratum to a depth of 30 inches are light yellowish brown, stratified loam to sandy loam, the next 10 inches or more is light yellowish brown, stratified coarse sand to loamy fine sand, and the lower part to a depth of 60 inches or more is light yellowish brown extremely gravelly loamy sand.

Permeability of the McCullough soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high if the surface is disturbed. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

This unit is used mainly as habitat for desert wildlife and for recreation. It is also used for urban development.

The main limitation for construction of dwellings is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding.

If the McCullough soil is used for septic tank absorption fields, the limitation of restricted permeability can be overcome by increasing the size of the absorption field.

Channeling and deposition can be minimized and maintenance costs reduced by protecting roads from flooding.

The main limitation for lawns and landscaping in areas of the Dalian soil is the pebbles on the surface and throughout the soil. Topsoil is needed for best results when landscaping, particularly in areas used for lawns. Lawn grasses, shrubs, and trees that are not sensitive to lime-induced chlorosis are well suited to use in landscaping. Annual applications of iron chelates reduce the effects of chlorosis.

This map unit is in capability subclasses IVs, irrigated, and VIIs, nonirrigated. It is in horticultural group 2.

200—Glencarb silt loam. This very deep, well drained soil is on recent alluvial flats. It formed in alluvium derived from various kinds of rock. Slope is 0 to 2 percent.

Typically, the surface layer is pale brown silt loam about 6 inches thick. The upper 10 inches of the underlying material is very pale brown clay loam, and the next 35 inches is very pale brown silty clay loam. The next layer to a depth of 54 inches is very pale brown very fine sandy loam. The lower part to a depth of 60 inches or more is a very pale brown silty clay loam.

Included in this unit are about 3 percent Bluepoint soils on sand sheets, 9 percent Land soils intermingled with the Glencarb soils on recent alluvial flats, and 3 percent McCarran soils on relict alluvial flats. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Glencarb soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. This soil is slightly affected by salts below a depth of 6 inches.

This unit is used as habitat for desert wildlife and for recreation and urban development.

The main limitation for construction of dwellings is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding.

The main limitation for septic tank absorption fields is restricted permeability of the soil. Poor permeability increases the possibility of failure of septic tank absorption fields. Using long absorption lines and backfilling the trench with sandy material help to compensate for the restricted permeability.

Channeling and deposition can be minimized and maintenance costs reduced by protecting roads from flooding. Trafficability of roads can be improved by providing a stable base and an adequate wearing surface.

Most climatically adapted plants can be used for lawns and landscaping in this unit.

This map unit is in capability subclasses IIs, irrigated, and VIIc, nonirrigated. It is in horticultural group 1.

206—Glencarb silt loam, flooded. This very deep, well drained soil is on flood plains. The drainage has been altered by seepage. The soil formed in alluvium derived from various kinds of rock. Slope is 0 to 2 percent.

Typically, the surface layer is very pale brown silt loam about 8 inches thick. The underlying material to a depth of 60 inches or more is pink silt loam and silty clay loam.

Included in this unit are about 5 percent Aztec soils on erosional fan remnants and 5 percent Land soils on the flood plains. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Glencarb soil is moderately slow. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 3 to 5 feet from July through June. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to occasional periods of brief, high velocity flooding from July through September. This soil is slightly affected by salts to a depth of 8 inches, and it is moderately affected below this depth.

This unit is used mainly as habitat for desert wildlife and for recreation. It is also used for urban development.

The main limitations for construction of dwellings is the hazard of flooding. Flooding can be controlled only by use of major flood control structures.

The main limitations for septic tank absorption fields are the hazard of flooding, the high water table, and the restricted permeability. Flooding can be controlled only by use of major flood control structures. Restricted permeability and the high water table increase the possibility of failure of septic tank absorption fields.

This unit is limited for roads because of low soil strength and the hazard of flooding. Roads and streets should be designed to compensate for the instability of the soil. Flooding can be controlled only by use of major flood control structures.

The main limitation for lawns and landscaping is the excess salts in the soil. Because of the content of gypsum and other salts in the soil, salt-tolerant plants should be selected. Lawn grasses, shrubs, and trees that are not sensitive to lime-induced chlorosis are well suited to use in landscaping. Annual applications of iron chelates reduce the effects of chlorosis.

This map unit is in capability subclasses IIIw, irrigated, and VIw, nonirrigated. It is in horticultural group 5.

222—Glencarb silty clay loam, wet. This very deep, well drained soil is on recent alluvial flats. The drainage has been altered by seepage. The soil formed in alluvium derived from various kinds of rock. Slope is 0 to 2 percent.

Typically, the surface layer is very pale brown silty clay loam about 6 inches thick. The underlying material to a depth of 60 inches or more is pink silt loam and silty clay loam.

Included in this unit are about 5 percent Bluepoint soils on sand sheets and 5 percent Land soils on recent alluvial flats. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Glencarb soil is moderately slow. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 3 to 5 feet from July through June. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. This soil is slightly affected by salts to a depth of 8 inches, and it is moderately affected below this depth.

This unit is used mainly as habitat for desert wildlife and for recreation. It is also used for urban development.

The main limitation for construction of dwellings is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding.

The main limitation for septic tank absorption fields is the high water table and the restricted permeability. Restricted permeability and the high water table increase the possibility of failure of septic tank absorption fields.

This unit is limited for roads because of low soil strength. Roads and streets should be designed to compensate for the instability of the soil.

The main limitation for lawns and landscaping is the excess salts in the soil. Because of the content of gypsum and other salts in the soil, salt-tolerant plants should be selected. Lawn grasses, shrubs, and trees tha are not sensitive to lime-induced chlorosis are well suite to use in landscaping. Annual applications of iron chelates reduce the effects of chlorosis.

This map unit is in capability subclasses IIIw, irrigated, and VIw, nonirrigated. It is in horticultural group 5.

236—Glencarb very fine sandy loam, saline. This very deep, well drained soil is on recent alluvial flats. It formed in alluvium derived from various kinds of rock. Slope is 0 to 2 percent.

Typically, the surface layer is light brownish gray very fine sandy loam about 6 inches thick. The underlying material to a depth of 60 inches or more is grayish brown, stratified clay loam to very fine sandy loam and contains some crystalline gypsum. In some areas of similar included soils, the surface layer is silty clay loam.

Included in this unit on relict alluvial flats are about 5 percent McCarran soils and on recent alluvial flats 10 percent Land soils that are affected by sodium sulfate.

Permeability of this Glencarb soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazar of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. This soil is slightly affected by salts to a depth of 6 inches, and it is moderately affected by salts below this depth.

Most areas of this unit are used for urban development. A few areas are used for irrigated cropland, desert wildlife habitat, or recreation.

The main limitation for construction of dwellings is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding. Gypsum and other sulfates in the soil can induce electrochemical action that corrodes concrete. This limitation can be overcome by using cement that is resistant to sulfate corrosion.

The main limitation for septic tank absorption fields is the restricted permeability of the soil. Poor permeability increases the possibility of failure of septic tank absorption fields. Using long absorption lines and

Included in this unit are about 10 percent Weiser soils, 2 to 8 percent slopes, on erosional fan remnants.

The Las Vegas soil is shallow and well drained. It formed in alluvium derived dominantly from limestone, dolomite, and lacustrine sediment that has a high content of lime. Typically, about 25 percent of the surface is covered with a desert pavement of pebbles and hardpan fragments. The surface layer is very pale brown gravelly fine sandy loam about 1 inch thick. The upper 6 inches of the underlying material is very pale brown fine sandy loam, and the next 4 inches is very pale brown gravelly sandy clay loam. A white, indurated, lime-cemented hardpan is at a depth of about 11 inches. Depth to the hardpan ranges from 3 to 14 inches.

Permeability of the Las Vegas soil is moderately slow above the hardpan. Available water capacity is very low. Effective rooting depth is 3 to 14 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

The Skyhaven soil is moderately deep and well drained. It formed in alluvium derived dominantly from limestone, dolomite, and other rock that has a high content of lime. Typically, about 20 percent of the surface is covered with a desert pavement of pebbles and hardpan fragments. The surface layer is pink very fine sandy loam about 1 inch thick. The subsoil is light brown clay loam about 7 inches thick. The upper 29 inches of the underlying material is white gravelly loam and gravelly clay loam, and the lower part to a depth of 60 inches or more is an indurated, lime-cemented hardpan. Depth to the hardpan ranges from 24 to 40 inches.

Permeability of this Skyhaven soil is moderately slow above the hardpan. Available water capacity is moderate. Effective rooting depth is 24 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. This soil is slightly affected by salts to a depth of 8 inches, and it is moderately affected by salts below this depth.

This unit is used as habitat for desert wildlife and for recreation.

This unit is limited for roads because of the depth to an indurated hardpan in the Las Vegas soil. Roads should be designed to minimize cuts. Heavy equipment is needed for excavation. Gypsum in the Skyhaven soil can induce electrochemical action that corrodes concrete. This limitation can be overcome by using cement that is resistant to sulfate corrosion.

This map unit is in capability subclass VIIs, nonirrigated, and in horticultural group 6.

325—McCarran fine sandy loam, 0 to 4 percent slopes. This very deep, well drained soil is on relict alluvial flats. It formed in alluvium derived dominantly from limestone and lacustrine sediment that has a high content of gypsum.

Typically, about 20 percent of the surface is covered with a desert pavement of pebbles. The upper 4 inches of the soil is very pale brown and pink fine sandy loam. The next 5 inches is pink gravelly fine sandy loam. The average texture of the top 9 inches is fine sandy loam. The next layer to a depth of 48 inches is pinkish white or pink sandy loam. The lower part to a depth of 62 inches or more is pinkish white gravelly loam that is weakly cemented with gypsum and lime. In some areas of similar included soils, the surface layer is clay loam.

Included in this unit are about 5 percent Bluepoint soils on small sand sheets, 5 percent Bracken soils on pediment remnants, and 5 percent Las Vegas soils on relict alluvial flats. Also included are small areas of McCarran soils that have a hardpan at a depth of 40 to 60 inches or more. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this McCarran soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. This soil is slightly affected by salts to a depth of 9 inches, and it is moderately affected below this depth.

Most areas of this unit are used for urban development, desert wildlife habitat, and recreation. A few areas are used for irrigated agriculture.

The main limitations for construction of dwellings are the hazard of flooding and the gypsum in the soil. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding. Application of excess water may dissolve enough gypsum in the soil to cause subsidence. Subsidence caused by the dissolution of gypsum in the McCarran soil can be prevented by using foundation drains, gutters, and downspouts that discharge directly into the sewer system. Gypsum in the soil can induce electrochemical action that corrodes concrete. This limitation can be overcome by using cement that is resistant to sulfate corrosion.

The main limitation for septic tank absorption fields is restricted permeability of the soil. Using long absorption lines and backfilling the trench with sandy material help to compensate for the restricted permeability.

Channeling and deposition can be minimized and maintenance costs reduced by protecting roads from flooding. Concentrated runoff in drainage ditches can dissolve gypsum in the subsurface layers and cause subsidence.

Because of the content of gypsum and other salts in the soil, salt-tolerant plants should be selected for lawns and landscaping. Application of excess water may dissolve enough gypsum in the soil to cause soil subsidence. Excessive irrigation can dissolve gypsum in the soil and cause subsidence.

Irrigation water for other crops and pasture should be applied at a rate that insures optimum production without increasing deep percolation, runoff, and erosion. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Crops respond to nitrogen and phosphorus. Content of toxic salts is reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. The average yield is 6 tons per acre for alfalfa hay grown under a high level of management.

This map unit is in capability subclasses IIIs, irrigated, and VIIs, nonirrigated. It is in horticultural group 4.

326—McCarran very cobbly fine sandy loam, 2 to 8 percent slopes. This very deep, well drained soil is on relict alluvial flats. It formed in alluvium derived dominantly from limestone and lacustrine sediment that has a high content of gypsum.

Typically, about 60 percent of the surface is covered with a desert pavement of cobbles and pebbles. The surface layer is pink very cobbly fine sandy loam about 9 inches thick. The upper 39 inches of the underlying material is pinkish white sandy loam that generally is weakly cemented with gypsum and lime. The lower part to a depth of 62 inches is pinkish white gravelly loam that is weakly cemented with gypsum and lime.

Included in this unit are about 5 percent Bracken soils on pediment remnants, 5 percent Glencarb soils on recent alluvial flats, and 5 percent Caliza soils on erosional fan remnants. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this McCarran soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is high if the surface is disturbed. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. This soil is slightly affected by salts to a depth of 9 inches, and it is moderately affected by salts below this depth.

This unit is used as habitat for desert wildlife and for recreation. It can be used for urban development.

The main limitations for construction of dwellings are the hazard of flooding and the gypsum in the soil. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding. Subsidence caused by the dissolution of gypsum in the McCarran soil can be prevented by using foundation drains, gutters, and downspouts that discharge directly into the sewer system. Gypsum in the soil can induce electrochemical action that corrodes concrete. This limitation can be overcome by using cement that is resistant to sulfate corrosion.

The main limitation for septic tank absorption fields is the restricted permeability of the soil. Using long absorption lines and backfilling the trench with sandy material help to compensate for the restricted permeability.

Channeling and deposition can be minimized and maintenance costs reduced by protecting roads from flooding.

The main limitation for lawns and landscaping is the desert pavement. The desert pavement interferes with the use of equipment. Because of the content of gypsum and other salts in the soil, salt-tolerant plants should be selected. Excessive irrigation can dissolve gypsum in the soil and cause subsidence.

This map unit is in capability subclass VIIs, nonirrigated, and in horticultural group 4.

341—Paradise silt loam. This very deep, poorly drained soil is on recent alluvial flats. The drainage has been altered through pumping. The soil formed in alluvium derived from various kinds of rock that has a high content of lime. Slope is 0 to 2 percent.

Typically, the surface layer is gray silt loam and loam, averaging silt loam, about 10 inches thick. The upper 29 inches of the underlying material is light gray and gray sandy loam, fine sandy loam, and loam, averaging loam, and the lower part to a depth of 61 inches is white and light gray silt loam.

Permeability of the Paradise soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 3 to 5 feet from December through March. The water table provides supplemental moisture for plants. Runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. This soil is moderately affected by salts to a depth of 10 inches, and it is not affected by salts below this depth.

This unit is used mainly for urban development. It is also used as habitat for desert wildlife and for recreation.

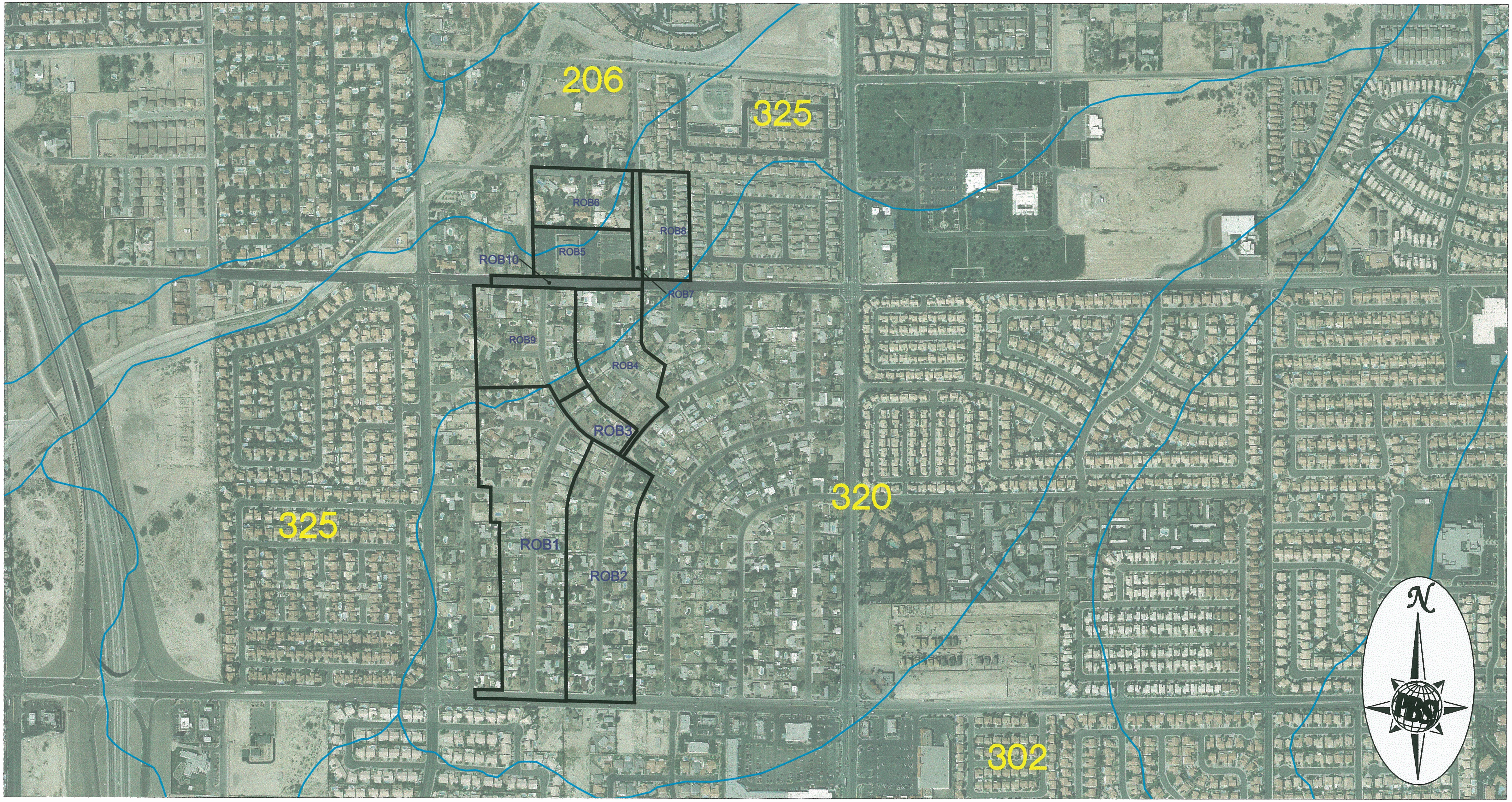
The main limitation for construction of dwellings is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding.

The main limitation for septic tank absorption fields is depth to the water table. The seasonal high water table increases the possibility of failure of septic tank absorption fields. Special design of septic tank absorption fields is needed.

Table 1 : Curve Number Calculations

Existing Condition

Basin Name	Soil Type	Hydrologic Group	Land Use	Curve No.	% of Composition	Composite Curve No.
ROB1	325	5 %A 90 %B 0 %C 5 %D	Residential 20000 Sq. Ft Lot (25% Imp)	69.95	90.0%	--
	325	5 %A 90 %B 0 %C 5 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	10.0%	**72.8**
ROB2	325	5 %A 90 %B 0 %C 5 %D	Residential 20000 Sq. Ft Lot (25% Imp)	69.95	90.0%	--
	325	5 %A 90 %B 0 %C 5 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	10.0%	**72.8**
ROB3	325	5 %A 90 %B 0 %C 5 %D	Residential 20000 Sq. Ft Lot (25% Imp)	69.95	85.0%	--
	325	5 %A 90 %B 0 %C 5 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	15.0%	**74.2**
ROB4	325	5 %A 90 %B 0 %C 5 %D	Residential 20000 Sq. Ft Lot (25% Imp)	69.95	90.0%	--
	325	5 %A 90 %B 0 %C 5 %D	Residential 20000 Sq. Ft Lot (25% Imp)	69.95	10.0%	**70.0**
ROB5	325	5 %A 90 %B 0 %C 5 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	70.0%	--
	206	0 %A 10 %B 90 %C 0 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	30.0%	**98.0**
ROB6	206	0 %A 10 %B 90 %C 0 %D	Residential 20000 Sq. Ft Lot (25% Imp)	79.00	85.0%	--
	325	5 %A 90 %B 0 %C 5 %D	Residential 20000 Sq. Ft Lot (25% Imp)	69.95	5.0%	--
	206	0 %A 10 %B 90 %C 0 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	10.0%	**80.4**
ROB7	325	5 %A 90 %B 0 %C 5 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	100.0%	**98.0**
ROB8	325	5 %A 90 %B 0 %C 5 %D	Townhouses/6000 Sq ft lots or less (69% Imp)	86.90	85.0%	--
	325	5 %A 90 %B 0 %C 5 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	69.95	15.0%	**84.4**
ROB9	325	5 %A 90 %B 0 %C 5 %D	Residential 20000 Sq. Ft Lot (25% Imp)	69.95	100.0%	**70.0**
ROB10	325	5 %A 90 %B 0 %C 5 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	100.0%	**98.0**


206
325
ROB6
ROB8
ROB5
ROB10
ROB7
ROB9
ROB4
ROB3
325
320
ROB1
ROB2
302
N
PBS

GRAPHIC SCALE

600 0 300 600 1200 2400

(IN FEET)

1 inch = 600 ft.

SOILS MAP

Robindale - Royal Oaks LOMR

▬	Basin Boundary
―	Soil Type Boundary
325	Soil Type Indentifier

PBSJ

2270 Corporate Circle
Suite 100
Henderson, Nevada 89074
Tele: 702-263-7275
Fax: 702-263-7200

ENGINEERING · PLANNING · SURVEYING · CONSTRUCTION SERVICES

HEC-1 Model

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION FOR SMALL WATERSHEDS (LESS THAN 1 SQUARE MILE)

PBS&J
File: TDS-Standard Form 4.xls

Existing Condition Model

BY: KRISHNAN A
DATE: 7/17/06

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag
DESIG: (1)	DEV./UN. (D or U)	CN	K (2)	AREA Ac (3)	AREA Mi^2	INITIAL LENGTH Feet (4)	SLOPE % (5)	Ti Min (6)	TRAVEL LENGTH Feet (7)	SLOPE % (8)	V1 VELOCITY FPS (9a)	V2 VELOCITY FPS (9b)	Tt Min (10)	Min (13)	Min (14)	Tlag= 0.6Tc/60 Hours
ROB1	D	72.8	0.5710	22.10	0.0345	220	2.0	11.2	1760	1.7	2.6	4.0	8.4	19.6	21.0	**0.196**
ROB2	D	72.8	0.5710	15.82	0.0247	220	2.3	10.7	1550	1.6	2.6	3.9	7.8	18.5	19.8	**0.185**
ROB3	D	74.2	0.5894	2.20	0.0034	210	2.3	10.1	450	2.2	3.0	4.5	2.5	12.6	13.7	**0.126**
ROB4	D	70.0	0.5340	8.40	0.0131	210	2.1	11.5	1100	1.4	2.4	3.6	6.2	17.8	17.3	**0.173**
ROB5	D	98.0	0.9036	4.57	0.0071	200	1.4	4.5	610	1.6	2.6	3.9	3.7	8.2	14.5	**0.082**
ROB6	D	80.4	0.6713	5.30	0.0083	30	1.0	4.2	800	1.5	2.5	3.7	4.7	8.9	14.6	**0.089**
ROB7	D	98.0	0.9036	0.83	0.0013	25	2.0	1.4	660	1.5	2.5	3.7	4.1	5.5	13.8	**0.055**
ROB8	D	84.4	0.7241	4.86	0.0076	30	1.4	3.3	820	1.2	2.2	3.4	5.4	8.7	14.7	**0.087**
ROB9	D	70.0	0.5340	9.67	0.0151	220	1.0	15.1	700	1.1	2.1	3.2	5.0	20.1	15.1	**0.151**
ROB10	D	98.0	0.9036	1.55	0.0024	40	2.0	1.8	950	0.7	1.6	2.5	8.2	9.9	15.5	**0.099**

Tc = Ti + Tt **Eqn. 601**
Ti = 1.8 (1.1 - K) L^1/2 / S^ **Eqn. 602**
K = 0.0132 (CN) - 0.39 **Eqn. 603**
Tc Check = L/180+10 **Eqn. 604**
Tlag = 0.6 Tc **Eqn. 612**
Tt = 500/V1+ ((7)-500)/V2

For the travel time (Tt) calculations (**Sec. 602.1**),
V1 applies to the first 500 feet of travel distance;
V2 applies to the remaining travel distance.

Min Tc = 10 mins for undeveloped basins
Min Tc = 5 mins for developed basins

Undevelopec V1 = 14.8*(S/100)^1/2
Undevelopec V2 = 29.4*(S/100)^1/2

Developed V1 = 20.2*(S/100)^1/2
Developed V2 = 30.6*(S/100)^1/2

REFERENCE :

STANDARD FORM 4

```
1*****************************************                              ***************************************
 *                                       *                              *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *   U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998               *                              *   HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                 *                              *         609 SECOND STREET           *
 *                                       *                              *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   18JUL06  TIME  07:11:11   *                              *          (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


1                                         HEC-1 INPUT                                            PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 *** FREE ***
                        *DIAGRAM
             1          ID    ROBINDALE ROYAL OAKS LOMR
             2          ID    EXISTING CONDITION MODEL
             3          ID    INPUT FILE = ROBIN.DAT
             4          ID    JULY 2006
             5          ID    DESIGN STORM = 100-YEAR 6-HR STORM
             6          ID    STORM DISTRIBUTION = SDN #3
             7          ID    MODELED BY KRISHNAN A(PBS&J)
             8          ID
             9          IT       5       0       0     300
            10          IN       5       0       0
            11          IO       5
            12          JR    PREC    1.00
                        *

            13          KK    ROB1
            14          KM   DEVELOPED BASIN
            15          BA  0.0345
            16          PB    2.77
            17          PC    .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
            18          PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
            19          PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
            20          PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
            21          PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
            22          PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
            23          PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
            24          PC    .998    .999    1.00
            25          LS       0    72.8
            26          UD   0.196
                        *

            27          KK    ROB2
            28          KM   DEVELOPED BASIN
            29          BF      21
            30          BA  0.0247
            31          LS       0    72.8
            32          UD   0.185
                        *
                        *
                        *  BASE FLOW CARD INSERTED TO ACCOUNT FOR 21 CFS
                        *  FROM THE HORIZON VISTA ESTATES AS SHOWN ON FIGURE 5
                        *

            33          KK    ROB3
            34          KM   DEVELOPED BASIN
            35          BF       0
            36          BA  0.0034
            37          LS       0    74.2
            38          UD   0.126
                        *
1                                         HEC-1 INPUT                                            PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            39          KK     CP1
            40          KM   COMBINE ROB1,ROB2 AND ROB3
            41          HC       3
                        *

            42          KK    ROB4
            43          KM   DEVELOPED BASIN
            44          BA  0.0131
            45          LS       0    70.0
            46          UD   0.173
                        *
             47           KK    ROB9
             48           KM   DEVELOPED BASIN
             49           BA  0.0151
             50           LS       0      70
             51           UD   0.151
                          *

             52           KK   ROB10
             53           KM   DEVELOPED BASIN
             54           BA  0.0024
             55           LS       0      98
             56           UD   0.099
                          *

             57           KK     CP2
             58           KM   COMBINE ROB4,ROB9 AND ROB10
             59           HC       4
                          *

             60           KK    ROB5
             61           KM   DEVELOPED BASIN
             62           BA  0.0071
             63           LS       0      98
             64           UD   0.082
                          *

             65           KK    ROB6
             66           KM   DEVELOPED BASIN
             67           BA  0.0083
             68           LS       0    80.4
             69           UD   0.089
                          *

             70           KK    ROB7
             71           KM   DEVELOPED BASIN
             72           BA  0.0013
             73           LS       0      98
             74           UD   0.055
                          *
                          *  BASE FLOW CARD INSERTED TO ACCOUNT FOR 18 CFS
                          *  THAT OVERTOPS CROWN IN WINDMILL FROM CP2
                          *
1                                                       HEC-1 INPUT                                                     PAGE  3

           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


             75           KK    ROB8
             76           KM   DEVELOPED BASIN
             77           BF      18
             78           BA  0.0076
             79           LS       0    84.4
             80           UD   0.087
                          *

             81           KK     CP3
             82           KM   COMBINE ROB5,ROB6 ROB7 AND ROB8
             83           HC       4
                          *
             84           ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    13        ROB1
                 .
                 .
    27           .        ROB2
                 .           .
                 .           .
    33           .           .        ROB3
                 .           .           .
                 .           .           .
    39         CP1........................
                 .
                 .
    42           .        ROB4
                 .           .
                 .           .
    47           .           .        ROB9
                 .           .           .
                 .           .           .
    52           .           .           .       ROB10
                 .           .           .           .
                 .           .           .           .
    57         CP2....................................
                 .
                 .
    60           .        ROB5
                 .           .
                 .           .
    65           .           .        ROB6
                 .           .           .
                 .           .           .
    70           .           .           .        ROB7
                 .           .           .           .
                 .           .           .           .
    75           .           .           .           .        ROB8
                 .           .           .           .           .
                 .           .           .           .           .
    81           .         CP3....................................

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
1****************************************                                                ***************************************
 *                                      *                                                *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                *   U.S. ARMY CORPS OF ENGINEERS      *
 *             JUN   1998               *                                                *   HYDROLOGIC ENGINEERING CENTER     *
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 *  RUN DATE   18JUL06  TIME  07:11:11  *                                                *        (916) 756-1104               *
 *                                      *                                                *                                     *
 ****************************************                                                ***************************************




                            ROBINDALE ROYAL OAKS LOMR
                            EXISTING CONDITION MODEL
                            INPUT FILE = ROBIN.DAT
                            JULY 2006
                            DESIGN STORM = 100-YEAR 6-HR STORM
                            STORM DISTRIBUTION = SDN #3
                            MODELED BY KRISHNAN A(PBS&J)

   11 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
                        NPLAN          1  NUMBER OF PLANS

      JR          MULTI-RATIO OPTION
                      RATIOS OF PRECIPITATION
                     1.00
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
                                                       1.00

 HYDROGRAPH AT
+                   ROB1       .03      1   FLOW         19.
                                            TIME        3.67

 HYDROGRAPH AT
+                   ROB2       .02      1   FLOW         35.
                                            TIME        3.67

 HYDROGRAPH AT
+                   ROB3       .00      1   FLOW          2.
                                            TIME        3.58

  3 COMBINED AT
+                    CP1       .06      1   FLOW         55.
                                            TIME        3.67

 HYDROGRAPH AT
+                   ROB4       .01      1   FLOW          6.
                                            TIME        3.67

 HYDROGRAPH AT
+                   ROB9       .02      1   FLOW          7.
                                            TIME        3.58

 HYDROGRAPH AT
+                  ROB10       .00      1   FLOW          5.
                                            TIME        3.50

  4 COMBINED AT
+                    CP2       .09      1   FLOW         72.
                                            TIME        3.58

 HYDROGRAPH AT
+                   ROB5       .01      1   FLOW         15.
                                            TIME        3.50

 HYDROGRAPH AT
+                   ROB6       .01      1   FLOW          9.
                                            TIME        3.50
 HYDROGRAPH AT
+                   ROB7       .00      1    FLOW          3.
                                             TIME        3.50

 HYDROGRAPH AT
+                   ROB8       .01      1    FLOW         28.
                                             TIME        3.50

  4 COMBINED AT
+                    CP3       .02      1    FLOW         55.
                                             TIME        3.50


 *** NORMAL END OF HEC-1 ***
```

APPENDIX D

Hydraulics

Flowmaster Cross-Sections

Worksheet for 40' ROW FOR SECTION A (BRANDING IRON LANE)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.10000	%
Discharge	55.00	ft³/s

CP1

Section Definitions

Station (ft)	Elevation (ft)
0+00	2.00
0+00	0.60
0+06	0.50
0+06	0.00
0+07	0.13
0+07	0.17
0+20	0.43
0+33	0.17
0+33	0.13
0+35	0.00
0+35	0.50
0+40	0.60
0+40	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2.00)	(0+07, 0.17)	0.015
(0+07, 0.17)	(0+33, 0.17)	0.016
(0+33, 0.17)	(0+40, 2.00)	0.015

Results

Normal Depth		0.65	ft
Elevation Range	0.00 to 2.00 ft		
Flow Area		12.12	ft²
Wetted Perimeter		41.21	ft
Top Width		40.00	ft
Normal Depth		0.65	ft
Critical Depth		0.74	ft
Critical Slope		0.00483	ft/ft
Velocity		4.54	ft/s
Velocity Head		0.32	ft
Specific Energy		0.97	ft

hydraulic depth

$$\frac{A}{TW} = \frac{12.12}{40} = 0.30'$$

Cross Section for 40' ROW FOR SECTION A (BRANDING IRON LANE)

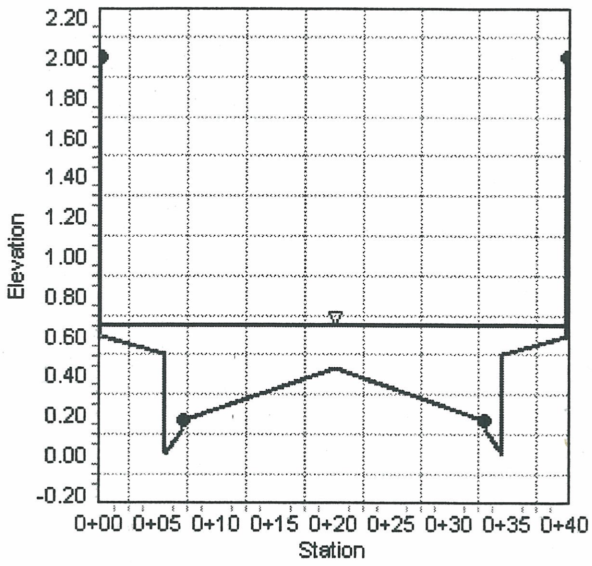
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.10000	%
Normal Depth	0.65	ft
Discharge	55.00	ft³/s

Cross Section Image



Worksheet for 40' ROW FOR SECTION B (ROYAL OAKS RD)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.10000	%
Discharge	6.00	ft³/s
Section Definitions		

Basin ROB4

Station (ft)	Elevation (ft)
0+00	2.00
0+00	0.60
0+06	0.50
0+06	0.00
0+07	0.13
0+07	0.17
0+20	0.43
0+33	0.17
0+33	0.13
0+35	0.00
0+35	0.50
0+40	0.60
0+40	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2.00)	(0+07, 0.17)	0.015
(0+07, 0.17)	(0+33, 0.17)	0.016
(0+33, 0.17)	(0+40, 2.00)	0.015

Results

Normal Depth	0.35	ft
Elevation Range	0.00 to 2.00 ft	
Flow Area	2.57	ft²
Wetted Perimeter	22.25	ft
Top Width	21.45	ft
Normal Depth	0.35	ft
Critical Depth	0.37	ft
Critical Slope	0.00760	ft/ft
Velocity	2.33	ft/s
Velocity Head	0.08	ft
Specific Energy	0.44	ft

hydraulic depth

$$\frac{A}{Tw} = \frac{2.57}{21.45} = 0.12'$$

Cross Section for 40' ROW FOR SECTION B (ROYAL OAKS RD)

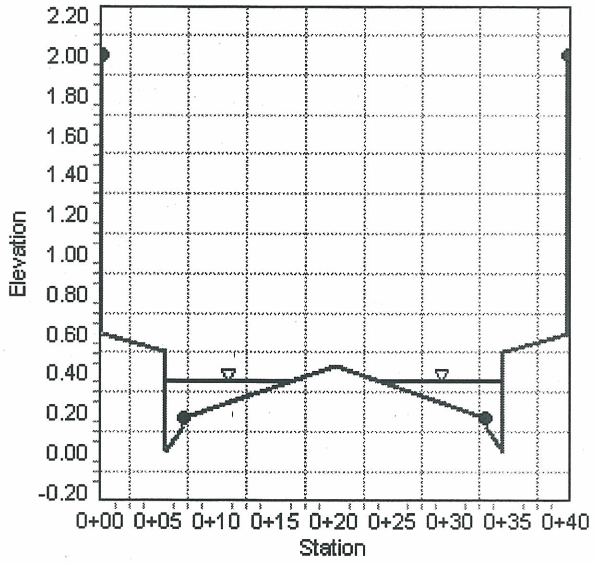
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.10000	%
Normal Depth	0.35	ft
Discharge	6.00	ft³/s

Cross Section Image



Worksheet for 80' ROW HALF STREET CAPACITY FOR ROBINDALE RD AT CP2

Project Description

Section C

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.70000	%
Discharge	54.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+40	2.00
0+40	0.83
0+73	0.17
0+73	0.13
0+75	0.00
0+75	0.50
0+80	0.60
0+80	2.00

Total Flow at CP2 = 72cfs

This worksheet shows that the half street of Robindale can hold 54cfs to the top of crown.

thus, the remainder (18cfs) over tops to the north ½ street.

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+40, 2.00)	(0+73, 0.13)	0.016
(0+73, 0.13)	(0+80, 2.00)	0.013

Results

Normal Depth	0.83	ft
Elevation Range	0.00 to 2.00 ft	
Flow Area	13.72	ft²
Wetted Perimeter	40.79	ft
Top Width	40.00	ft
Normal Depth	0.83	ft ← top of crown elevation
Critical Depth	0.87	ft
Critical Slope	0.00482	ft/ft
Velocity	3.94	ft/s
Velocity Head	0.24	ft
Specific Energy	1.07	ft
Froude Number	1.18	
Flow Type	Supercritical	

hydraulic depth

$$\frac{A}{TW} = \frac{13.72}{40} = 0.34$$

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft

Cross Section for 80' ROW HALF STREET CAPACITY FOR ROBINDALE

Project Description

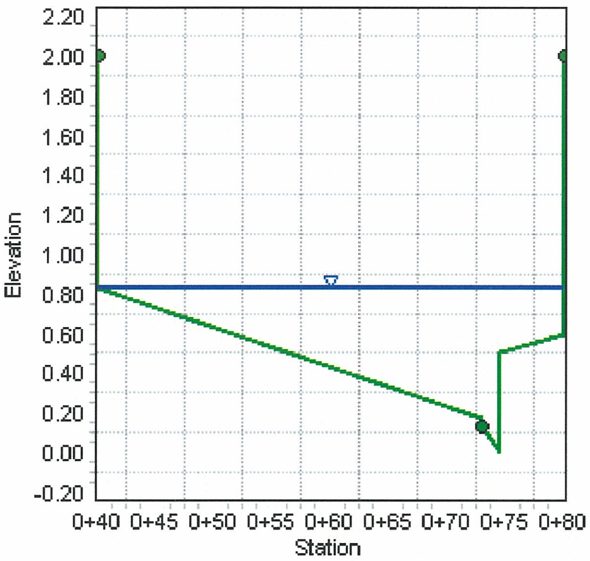
Section c

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.70000	%
Normal Depth	0.83	ft
Discharge	54.00	ft³/s

Cross Section Image



Worksheet for 60' ROW FOR SECTION D (BURNHAM AVE)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.50000	%
Discharge	55.00	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00	2.00
0+00	0.60
0+06	0.50
0+06	0.00
0+07	0.13
0+07	0.17
0+30	0.63
0+53	0.17
0+53	0.13
0+55	0.00
0+55	0.50
0+60	0.60
0+60	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2.00)	(0+07, 0.13)	0.015
(0+07, 0.13)	(0+53, 0.13)	0.016
(0+53, 0.13)	(0+60, 2.00)	0.015

Results

Normal Depth	0.63	ft
Elevation Range	0.00 to 2.00 ft	
Flow Area	13.17	ft²
Wetted Perimeter	61.16	ft
Top Width	60.00	ft
Normal Depth	0.63	ft
Critical Depth	0.71	ft
Critical Slope	0.00554	ft/ft
Velocity	4.17	ft/s
Velocity Head	0.27	ft
Specific Energy	0.90	ft

hydraulic depth

$$\frac{A}{TW} = \frac{13.17}{60} = 0.22'$$

Cross Section for 60' ROW FOR SECTION D (BURNHAM AVE)

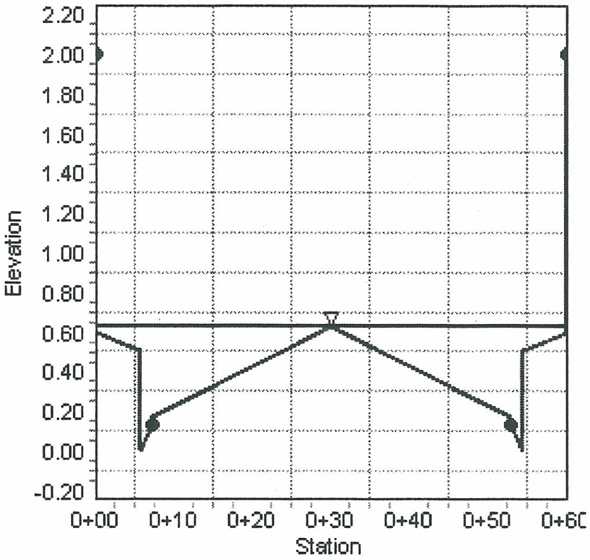
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.50000	%
Normal Depth	0.63	ft
Discharge	55.00	ft³/s

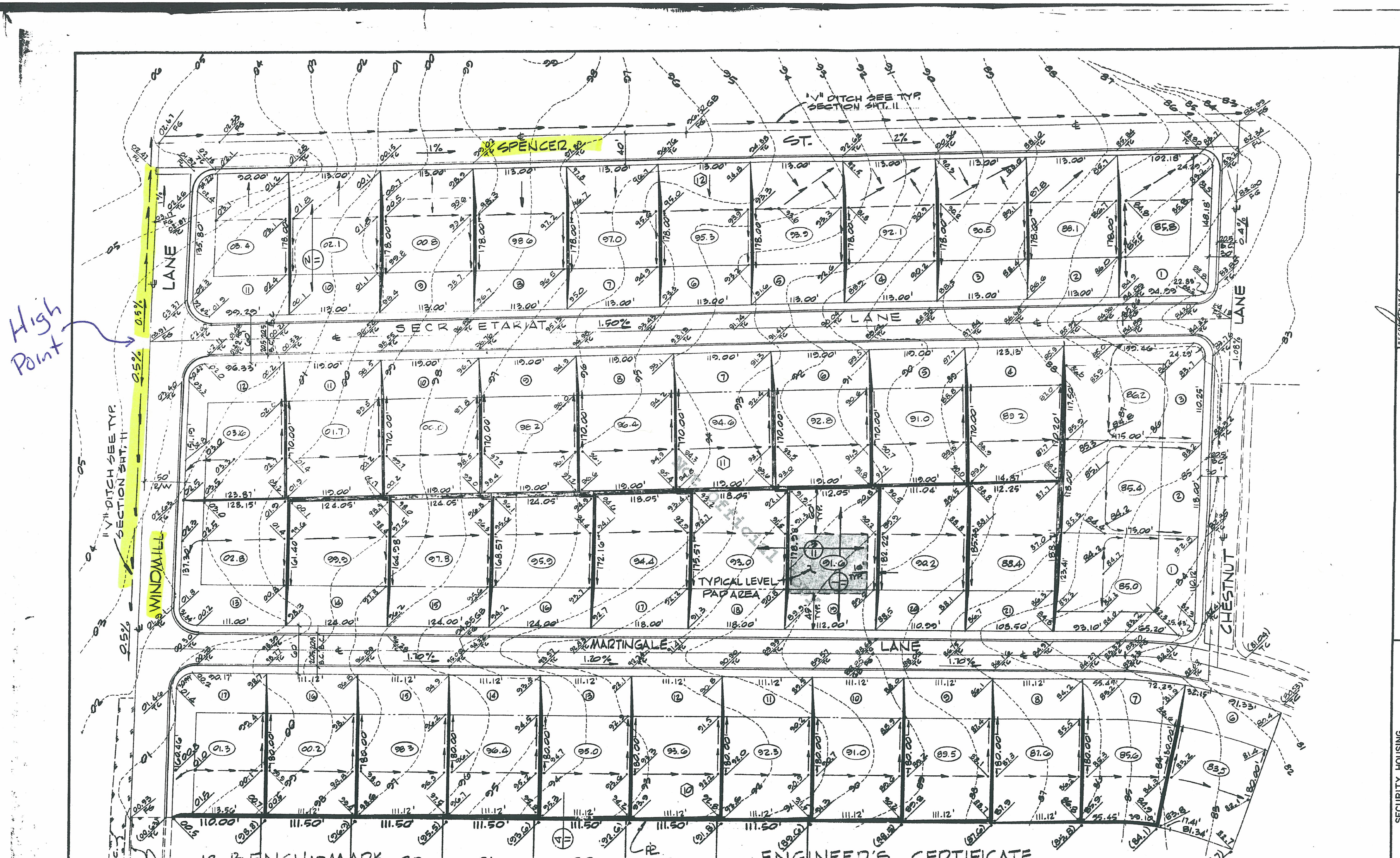
Cross Section Image



APPENDIX E

Reference Material

Wishing Well Ranch Unit 6 Grading Plans


High Point
SPENCER ST.
WINDMILL LANE
SECRETARIAT LANE
MARTINGALE LANE
CHESTNUT LANE
"V" DITCH SEE TYP. SECTION SHT. 11
TYPICAL LEVEL PAD AREA
0.5%
1%
2%
1.50%
1.70%
1.20%
1.08%
0.4%
50' R/W
EXIST. A.C.
343.010

18 BENCHMARK 20 21 22 23 24

C.C.F.D. B.M. # C2111144, - 1/4 COR. - OF - BRASS CAP
ELEV. 2105.34

ALL LOTS ARE F.H.A. TYPE "A" DRAINAGE

EXCAVATION = 28200 C.Y.

ENGINEER'S CERTIFICATE

I HEREBY CERTIFY THAT THESE PLANS AND/OR SPECIFICATIONS COMPLY WITH F.H.A. OBJECTIVES, MINIMUM PROPERTY STANDARDS, LOCALLY ACCEPTABLE STANDARDS & REQUIREMENTS AND REPRESENTS THE BEST OF MY PROFESSIONAL JUDGEMENT.

NORTH 1"=50'

WISHING WELL RANCH Nº 5

George C. Wallace

GEORGE C. WALLACE - R.P.E. Nº 1815

8/10/76
DATE

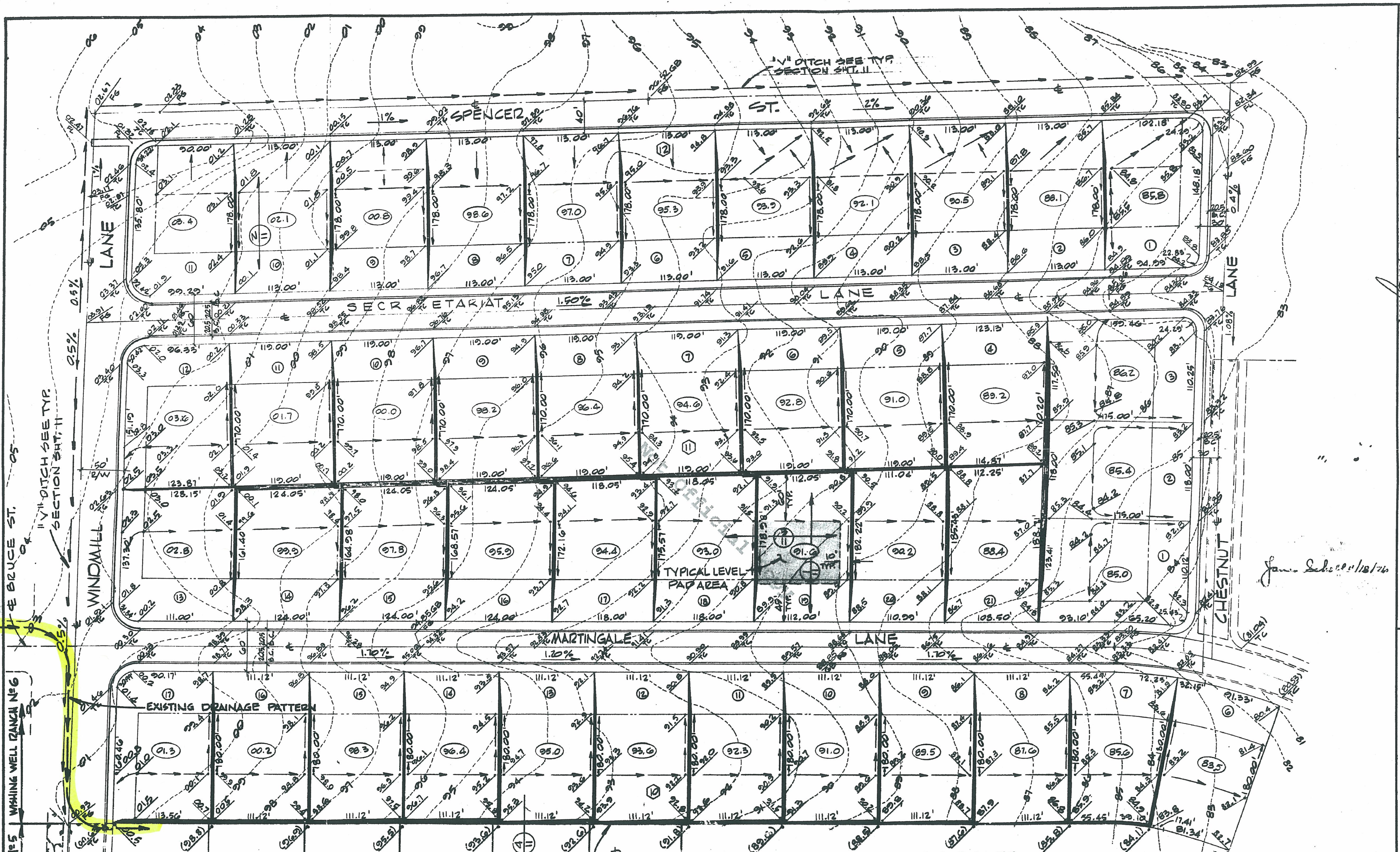
REV	DATE	DESCRIPTION
1	9/28/76	LOWERED GRADES

RECOMMENDED G. C. Wallace
G. C. WALLACE 1915 8/10/76
R.E. NO. DATE

G. C. WALLACE
Consulting Engineers, Inc.
1100 East Sahara Ave. • Las Vegas, Nevada 89104 • 732-3330

SECURITY HOUSING
WISHING WELL RANCH UNIT NO.6
GRADING PLAN I

SHEET
10
OF 13 SHEETS


SPENCER ST.
SECRETARIAT LANE
MARTINGALE LANE
WINDMILL LANE
CHESTNUT LANE
℄ BRUCE ST.
"V" DITCH SEE TYP. SECTION SHT. 11
TYPICAL LEVEL PAD AREA
EXISTING DRAINAGE PATTERN
WISHING WELL RANCH Nº 6
WISHING WELL RANCH Nº 5
EXIST. A.C.
345.010

BENCH MARK

C.C.S.D. B.M. # C2||1144, - 1/4 COR. -
OF -℄- BRASS CAP
ELEV. 2105.34

FLOODED LOTS WITHIN
WISHING WELL RANCH UNIT Nº 5

EXCAVATION = 28,200 C.Y.

ENGINEER'S CERTIFICATE

I HEREBY CERTIFY THAT THESE PLANS AND/OR SPECIFICATIONS COMPLY WITH F.H.A. OBJECTIVES, MINIMUM PROPERTY STANDARDS, LOCAL ACCEPTABLE STANDARDS & REQUIREMENTS AND REPRESENTS THE BEST OF MY PROFESSIONAL JUDGEMENT.

George C. Wallace
GEORGE C. WALLACE – R.P.E. Nº 1815

8/10/76
DATE

NORTH 1"=50'

REV	DATE	DESCRIPTION
1	9/28/76	LOWERED GRADES
1	8/23/77	MISC. REV.

RECOMMENDED
G. C. WALLACE
1815 8/10/76
R.E. NO. DATE

G.C. WALLACE
Consulting Engineers, Inc.
1100 East Sahara Ave. • Las Vegas, Nevada 89104 • 732-3330

SECURITY HOUSING
WISHING WELL RANCH UNIT NO.6
GRADING PLAN I

SHEET
10
OF 13 SHEETS

Horizon Vistas Estates

HORIZON VISTAS IB

DRAINAGE

DRAINAGE STUDY NUMBER:

NAME:

HORIZON VISTAS No 1 B

SECTION / TOWNSHIP/ RANGE:

SEC 14 T22S R61E

CROSS STREETS:

WINDMILL / SPENCER

ASSESSOR'S PARCEL NUMBER:

160-860-012

NEW ASSESSOR'S PARCEL NUMBERS:

ACREAGE:

± 9.02

SUBMITTAL DATE:

1-11-93

A:\WORK\DRAINAGE

Not Official Copy

6

Clark County
Public Works, Improving Our Community

Department of Public Works
M. J. MANNING
DIRECTOR
6655 WEST SAHARA AVENUE
BUILDING C-204
LAS VEGAS, NEVADA 89102
(702) 455-7777

DEPUTY DIRECTORS
URBAN C. LIVENGOOD, JR.
Professional Services
MICHAEL O. PULLEN
Field Services
MANAGEMENT TEAM
Maintenance Management
DENIS CEDERBURG
Design Engineering
LESLIE R. HENLEY
Construction Management
CHARLES R. JENNER
Environmental Control
BRETT N. LANE
County Surveyor
CARLA J. PEARSON
Community Development
NALLIAH T. RAJAH
Administration & Programs
RICHARD T. ROMER
Traffic Management

February 17, 1993

Delta Engineering, Inc.
4500 West Oakey Boulevard
Las Vegas, NV 89102

Gentlemen:

Re: Willdan/Clark County Public Works Plan Review Contract
Technical Drainage Study for Horizon Vistas Unit No. 1B (977)
Study Dated: January 11, 1993
First Addendum Dated: February 3, 1993
Location: Southwest corner of Windmill Lane and Spencer Street
(Sec. 14, T. 22 S., R. 61 E.)
AN-93-730 FM-145-92 ZC-65-92
Prepared by Delta Engineering, Inc.

The referenced **Technical Drainage Study** has been reviewed and is accepted as complying with minimum improvement standards. As set forth in the subject drainage study, the following measures will be taken to mitigate flood hazard.

1. The site shall be graded with respect to drainage as shown on "Horizon Vistas Unit No. 1B - Grading & Paving Plan," signed and sealed by William S. Crockett, P.E. on February 5, 1993;
2. The following drainage facilities shall be constructed:
   a. Eight-foot-wide valley gutters along Spencer Street at Golden Horizon Drive, Horizon Sunset Drive, and Golden Vista Drive.
   b. Roadside ditch along the south side of Golden Vista Drive. Dimensions: 1 foot deep, 6H:1V sideslopes, 12 feet wide.
3. A Bond estimate must be submitted to Clark County Public Works for the above-mentioned stormwater management facilities;
4. The minimum finished floor elevations for the proposed structures shall be constructed as shown on the above-referenced plans;

---

5. The subject site is located within Zone X, as shown on FIRM Community-Panel Number 320003 1225B, revised September 29, 1989. Zone X is determined to be outside the 500-year flood plain by FEMA;
6. All work performed within public right of way and outside of the project boundary shall be performed under a separate encroachment permit issued by the controlling authority;
7. All work performed outside of the project boundary and on private property shall not be performed until written permission and easement have been obtained from the offsite owner;
8. Right-of-way dedication must be verified;
9. At the request of Clark County Public Works, Grading Plans for the proposed development have been reviewed for compliance to permitting requirements according to Section 34.030 of the "Uniform Regulations for the Control of Drainage," revised November 12, 1990. **As a condition of final approval, the grading plans submitted for this project require the following modifications to meet the minimum standards outlined in the above regulation:**
   a. Roadside ditch on Golden Vista Drive must be shown.
   b. Valley gutter across Golden Vista Drive must cross the full-width of the street.
   c. Finished contour (2113) on Horizon Sunset Drive must be revised.
   d. Walls must be shown along the sides of Lots 19, 33, and 38.
10. Non-County standard retaining walls are shown on the plans. Structural calculations and soils report must be submitted to Clark County Building Department for review and approval prior to issuance of a wall construction permit. The following note shall be added to the plan:

    Note: The specified retaining walls are a nonstandard Clark County retaining wall design. Structural calculations and soils report shall be submitted to Clark County Building Department for review and approval prior to wall construction permit issuance.

No liability is assumed by the County for information, data, and conclusions of the consulting engineer.

Yours truly,

Robert Thompson, P.E.
Civil Engineer, III

RT/ws

cc: Barbara Ginoulias

03205/0717-977
L0212931.rt1/03205

WILLDAN ASSOCIATES ☐ ENGINEERS & PLANNERS
Professional Consulting Services Since 1964

MEMORANDUM

TO: Manny G. Gomez, P.E.

FROM: Stephen L. Weatherman, P.E.
Thomas F. Brady, III TFB

OFFICE: Las Vegas

DATE: January 20, 1993

SUBJECT: Willdan/Clark County Public Works Plan Review Contract
Technical Drainage Study for Horizon Vistas Unit No. 1B (977)
Study Dated: January 11, 1993
Location: Southwest corner of Windmill Lane and Spencer Street
(Sec. 14, T. 22 S., R. 61 E.)
AN-93-730
Prepared by Delta Engineering, Inc.

We have completed our initial review of the above-referenced **Technical Drainage Study** and have the following comments:

1. Flow calculations which address flow depth, velocity, and flow in Spencer Street, Windmill Lane, Golden Horizon Drive, Horizon Sunset Drive, and Golden Vista Drive must be submitted;
2. The inlet capacity and ponding depth for the 18-inch RCP lateral at the corner of Spencer Street and Windmill Lane must be addressed;
3. The impact of overland and offsite flows on Golden Vista Drive and the lots facing the street, must be addressed. A detail which clearly represents the planned activity at the location of the phase line must be provided;
4. At the request of Clark County Public Works, Grading Plans for the proposed development have been reviewed for compliance to permitting requirements according to Section 34.030 of the "Uniform Regulations for the Control of Drainage," revised November 12, 1990. **The plans submitted do not meet the minimum requirements and must be revised prior to Drainage Study approval, to address the following:**

---

a. Engineer's seal, signature, and date.
b. Legal description of the projects location.
c. Existing contours must extend 100 feet beyond the property lines.
d. Existing improvements must be shown (i.e., driveway entrances, streets, etc.).
e. Proposed contours.
f. Elevations at back lot and lot lines or descriptive pad detail.
g. Lot swales must drain to front of lot or block wall openings must be provided.
h. Lot swales must be 2-percent away from the proposed building pad elevations.
i. Detail at the edge of phase development.
j. Retaining wall adjacent to Windmill must show depth of retaining, and a detail must be provided.

The grading plan has been red-lined and is being returned to the engineer. The red-lined grading plan must be resubmitted with the revised drawings. Failure to resubmit the red-lined grading plan will prevent further review of the project.

All addenda must be submitted directly to Clark County Public Works. Any drainage studies or addenda submitted directly to Willdan will be returned to Clark County for the necessary log-in procedures.

The items listed herein must be thoroughly addressed and submitted for review prior to acceptance of this study.

A study review workshop with Willdan Associates may be scheduled if there are questions concerning the above listed comments

CONCURRENCE BY CLARK COUNTY PUBLIC WORKS:

Signature ______________ Date 1/21/93

COMMENTS: ______________

03205/0717-977/073
M0119932.mg2/03205

Willdan

DELTA ENGINEERING INC.
ENGINEERING • LAND SURVEYING • LAND PLANNING • SUBDIVISIONS
4500 WEST OAKEY BLVD • PHONE (702) 877-0955 FAX (702) 877-9270 • LAS VEGAS, NEVADA 89102

February 3, 1993

WILLDAN ASSOCIATES #977 TFB
FEB 9 1993
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LAS VEGAS

Clark County Public Works Dept.
401 S. Fourth Street
Las Vegas, NV 89101

ATTN: Mr. Robert Thompson

RE: Horizon Vistas Unit 1B

Gentlemen:

We have reviewed the Willdan memo and its comments dated January 20, 1993, copy attached, and have the following responses:

1. Attached copy of approved "Drainage Study for Horizon Hills and Horizon Vistas, Revised October, 1991."

   The Study shows 10- and 100-year return flows for Golden Horizon Drive and Horizon Sunset Drive (SS-1 flows). The maximum street flows of 9 CFS (10-year) is less than the 14.5 CFS street flow at top of curb for these streets with a slope of 0.0040 See calculation in October, 1991 Study.

   The study addresses the developed flows on Golden Vista Drive (SS-2 flows). The developed flows are higher and more conservative than the undeveloped flows which would impact this street. An analysis of the 1/2 street development was not provided in the October, 1991 Study; therefore, a new calculation sheet is attached which addresses the situation.

   The flows and calculations for Spencer Street, both at the intersection of Golden Vista Drive (Point SC-2) and north of Windmill (Point SC-3), are provided in the October, 1991 Study.

   An analysis for Windmill Lane was not provided in the October, 1991 Study. The 100- and 10-year return flows are 20 and 84 CFS respectively (Point RSPNC, see HEC-1 analysis in October, 1991 Study). Attached is a copy of Figure 905 from the CCRFCD manual which addresses the flows in Windmill Lane.

It should be noted that this development slightly reduces the flows in Spencer Street, and the impact of the flows in Windmill Lane to existing improvements is reduced.

2. The 18-inch storm drain and inlet at Spencer Street and Windmill Lane is not a part of this project. Its construction was approved as part of Unit 1. This is a nuisance drain only and has no storm capacity. Per my January 28, 1993 telephone conversation with Mr. Robert Thompson, CCPW, an analysis of this facility is not required.
3. An analysis of Golden Vista Drive is attached. A detail is provided on the improvement plans.
4. a. Done.
   b. Provided.
   c. Done.
   d. Done.
   e. Done.
   f. Done.
   g. Done.
   h. Done.
   i. Done.
   j. FG's at lot lines provided and TC's along Windmill. Detail of retaining wall provided.

If you have further questions, please contact us.

Sincerely,

DELTA ENGINEERING, INC.

William S. Crockett
WILLIAM S. CROCKETT, P.E.
Vice President

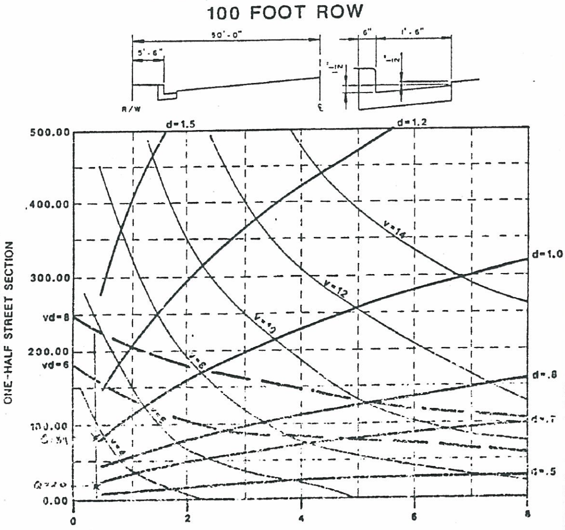
WSC:rdl
Attachments a/s

WILLIAM S. CROCKETT
CIVIL
6777
2/3/93

2/2/93 wsc

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

STREET CAPACITY CURVES
100 FOOT ROW



WINDMILL WEST OF SPENCER
LONGITUDINAL STREET SLOPE (PERCENT)
S = 0.0040 Q100 = 84 CFS
Q10 = 20 CFS

EXPLANATION
v velocity (feet per second)
d depth (feet)

$d_{100} = 1.05'$ $V_{100} = 4$ fps vd = 4
$d_{10} = 0.70'$ $V_{10} < 4$ fps vd < 4

Revision	Date

WRC ENGINEERING
REFERENCE: TC=2.00 QFG=2.53
PL=1.50 d_{CL} = 1.03' ∴ some slight
overflow to north 1/2 windmill on 100YR storm

FIGURE 905

Not Official Copy

NOT LEGIBLE FOR MICROFILMIN

DRAINAGE STUDY FOR

HORIZON HILLS AND HORIZON VISTAS

REVISED OCTOBER 1991

W #977 TFG
FEB 9 1993
RECEIVED

DELTA ENGINEERING INC.

ENGINEERING • LAND SURVEYING • LAND PLANNING • SUBDIVISIONS
4500 WEST OAKEY BLVD. • PHONE (702) 877-0955 FAX (702) 877-9270 • LAS VEGAS, NEVADA 89102

October 18, 1991

Willdan Associates
2325-A Renaissance Drive
Las Vegas, NV 89119

SUBJ: Drainage Study for Horizon Hills and Horizon Vistas
(Sec. 14, T22S, R61E)
PN#91-09-13-02

Gentlemen:

Attached you will find a copy of a revised analysis which should answer all of your comments. Our response to your comments is as follows:

1. Depth area reduction factors are valid only for basins greater than one-half square mile. Precipitation values should be adjusted, accordingly.

   We disagree with this item. The complete basin is about 0.8 square miles and grouped together. This would make our 0.97 adjustment correct. It is hard to imagine a 25 square mile storm impacting these basins separately.

   To speed our review process we used a 0.99 adjustment factor in the revised analysis.

2. The urban basin calculations for time of concentration were ignored for the developed SS basins. An explanation must be submitted that addresses why the most conservative estimation was not used.

   This item was done verbatim per Section 602-1. To speed the review, we did revise the calculations per out meeting.

3. All drainage easements which drain street flows must be at least 10 feet wide, and concrete-lined with vertical sidewalls. Legal descriptions must be submitted to Clark County Public Works.

   We agree and as the project is completed this will be done.

Willdan Associates
October 18, 1991
Page 2

4. Portions of the west property line encroach upon the existing natural wash. As it is unlawful to divert these flows onto the adjacent property, a method of accommodating them must be submitted.

   This has been analyzed in the revised submittal.

5. The velocities calculated for channel flow in offsite basins do not accurately represent the potential flows in those washes. An iterative process must be used to determine the velocity in each wash, or the velocity resulting from full flow should be used. Cross-sections must be submitted for both onsite and offsite channels and washes.

   This has been done in the revised submittal.

6. Flows from the site cannot be expected to flow east along Windmill Lane to Red Barn without a majority of those flows turning north at the four intermediate cross streets. The historical drainage pattern results in flows crossing Windmill Lane and entering the Wishing Well Subdivision at all cross streets. An analysis of the flow path and flow rates must be submitted.

   This has been re-analyzed in the revised submittal.

7. The RK records used in the Kinematic Wave Routing of the HEC-1 model do not accurately represent hydraulic parameters of the streets.

   These have been revised.

8. The assumptions made for Eastern Avenue must be clarified. The cross-section submitted does not accurately reflect the average street conditions between the site and the Duck Creek Wash. The slope should be re-analyzed.

   This section is south of Wigwam.

Hopefully the above and the attached revised study will take care of your concerns. If you have further questions, please contact us.

Sincerely,

DELTA ENGINEERING, INC.

William S Crockett
WILLIAM S. CROCKETT, P.E.
Vice President

WSC:rdl
Attachments

XC: Robert Thompson w/attachments

DRAINAGE STUDY FOR

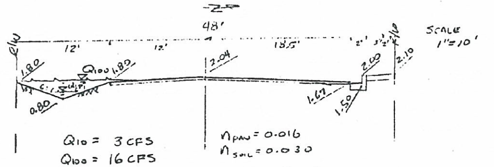
HORIZON HILLS AND HORIZON VISTAS

REVISED OCTOBER 1991

WILLIAM S. CROCKETT
CIVIL
No. 6777
10/18/91

DELTA ENGINEERING INC.

BY WSC DATE 2/2/93 SUBJECT Horizon Vista 1 B SHEET NO. OF
CHKD BY DATE Golden Vista Drive JOB NO.



$Q_{10} = 3$ CFS
$Q_{100} = 16$ CFS

$n_{pav} = 0.016$
$n_{soil} = 0.030$

$S = 0.0050$ $Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

"V" DITCH $A = 6y^2$ $P = 2y\sqrt{37}$ $WS = 1.80$

$y = 1$ $Q = \frac{1.486}{0.03}(6)\left(\frac{6}{2\sqrt{37}}\right)^{2/3}(0.0050)^{1/2} = \underline{13.1 \text{ CFS}}$

$n_c = \frac{\left[\sum_1^N P_n n_n^2\right]^{1/2}}{P_T^{1/2}}$ "COMPOSITE n"

FLOW AT ℄ SOUTHSIDE ONLY WS = 2.04

$P_{soil} = 2\sqrt{37} = 12.16'$ $P_{AC} = 12'$ $P_T = 24.16'$

$n_c = \frac{\left[12.16(0.03)^2 + 12(0.016)^2\right]^{1/2}}{24.16^{1/2}} = 0.024$

$Q = \frac{1.486}{0.024}(6 + 0.24(12)\tfrac{1}{2} + 12(0.24))\left[\frac{(\ldots)}{24.16}\right]^{2/3}(0.0050)^{1/2} = \underline{25.6 \text{ CFS}}$

$WS_{10} \Rightarrow 3$ CFS by interpolation $WS_{10} = 1.03$

$WS_{100} \Rightarrow 16$ CFS by interpolation $WS_{100} = 1.86$

HORIZON VISTAS UNIT #1B #977

Revised August 6, 1992

GRADING PLAN REVIEW GUIDELINES

ITEM COMPLETED 1ST	2ND	3RD	
✓			Sheet size: 24"x36"
✓			All sheets must be legible
✓			Project Name
✓			Engineer's name, address, phone number
○	✓		Engineer's original seal, signature, date
✓			Revision box
✓			Vicinity map
✓			Owner's name, address, phone number (Recommended)
○	✓		Legal description of project location
✓			Legend identifying grades or symbols
✓			Abbreviations
✓			North Arrow and bar scale (on each sheet)
✓			Right–of–Way lines
✓			Property Lines
✓			Existing pavement
✓			Sawcut and replace – show areas
✓			Pavement transitions
✓			Elevation datum and benchmarks
✓			Existing contours, spot elevations, drainage arrows, grade breaks
○	✓		Existing contours must extend at least 100 ft beyond property lines
○	✓		Proposed contours
✓			Minimum finish floor elevations
–			Base Flood Elevations in Zone A, AE, AH, AO
○	✓		Elevations at back lot and lot lines
✓			Top of curb and crown elevations at extension of lot lines
✓			Top of curb and crown elevations at lot lines
✓			Spot elevations on adjacent properties sufficient to depict existing conditions affecting drainage of property to be developed
○	✓		Existing driveway locations and elevations must be shown
–			Proposed driveway locations not required, unless there are special considerations
○	✓		Details at property lines, fences, berms, wall openings, etc.
○	✓		Details of walls and footings (for floodwall or retaining wall only)
○	✓		Existing utilities, P.U.E.'s, and notes indicating if they are to be moved
✓			Cut and fill quantities (Recommended, but not required)
✓			Drainage swales must be shown on grading plan and indicated on review memo
✓			Other major and minor subdivision requirements according to Title 28

DELTA ENGINEERING INC.

ENGINEERING • LAND SURVEYING • LAND PLANNING • SUBDIVISIONS
4500 WEST OAKEY BLVD. • PHONE (702) 877-0955 FAX (702) 877-9270 • LAS VEGAS, NEVADA 89102

January 11, 1993

JAN 13 1993

Clark County Public Works
401 South Fourth Street
Las Vegas, NV 89101

ATTN: Robert Thompson

SUBJ: Horizon Vistas No. 1B, Drainage

Gentlemen:

This project is included in the Clark County approved Master Drainage Study for Horizon Hills and Horizon Vistas (PN#91-09-13-02). The drainage area is designated SS-1.

Horizon Vistas No. 1B complies with the approved drainage study, and no revision to the study is required. The finish floors/finish pads are set such that the finish floors are a minimum of 18" above the top of curb or water surface, whichever is highest. Attached is a "Standard Form 1" for this project.

If further information is required, please contact us.

Sincerely,

DELTA ENGINEERING, INC.

William S Crockett
WILLIAM S. CROCKETT, P.E.
Vice President

WSC:rdl
Attachment: 1 set Improvement Plans

WILLIAM S. CROCKETT
CIVIL
No. 6777
1/11/93

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Horizon Vistas No 1B Date: 1/11/93

Location of Development: a) Descriptive SOUTHWEST CORNER OF WINDMILL AND SPENCER
b) Sect. 14 Twn. 22S. Rng. 61E.

Name of Owner: HORIZON SPENCER Assessors Parcel No: 052 0057 PARCEL 2

Contact Person-Name: WILLIAM S. CROCKETT Telephone No: 877-0955

Firm: DELTA ENGINEERING, INC.

Address: 4500 W. OAKEY BLVD
LAS VEGAS, NV 89102

Type of Land Development/Land Disturbance Process:

☐ Rezoning
☐ Parcel Map
☐ Large Parcel Map
☐ Subdivision Map
☐ Planned Unit Development
☐ Building Permit
☐ Clearing and Grading Only
☐ Other (Please specify below)

1. Total Owned Land Area: At Site: 9.02 AC Being Developed/Disturbed: 9.02 AC
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? YES* [✓ NO]
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? YES* [✓ NO]
4. Proposed type of development (Residential, Commercial, Etc.)? RESIDENTIAL
5. Approximate upstream land area which drains to the subject site? 210± AC
6. Has the site drainage been evaluated in the past? [✓ YES] NO. If yes, please identify documentation: HORIZON HILLS AND HORIZON VISTAS MASTER DRAINAGE STUDY (PN#91-09-13-02)
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: WINDMILL AND SPENCER
8. Briefly describe your proposed schedule for the subject project: START FEB 93 COMPLETE DEC 94

WILLIAM S. CROCKETT
CIVIL
No. 6777
Engineer's Seal
1/11/93

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

* Review and concurrence of the Clark County Regional Flood Control District is required.

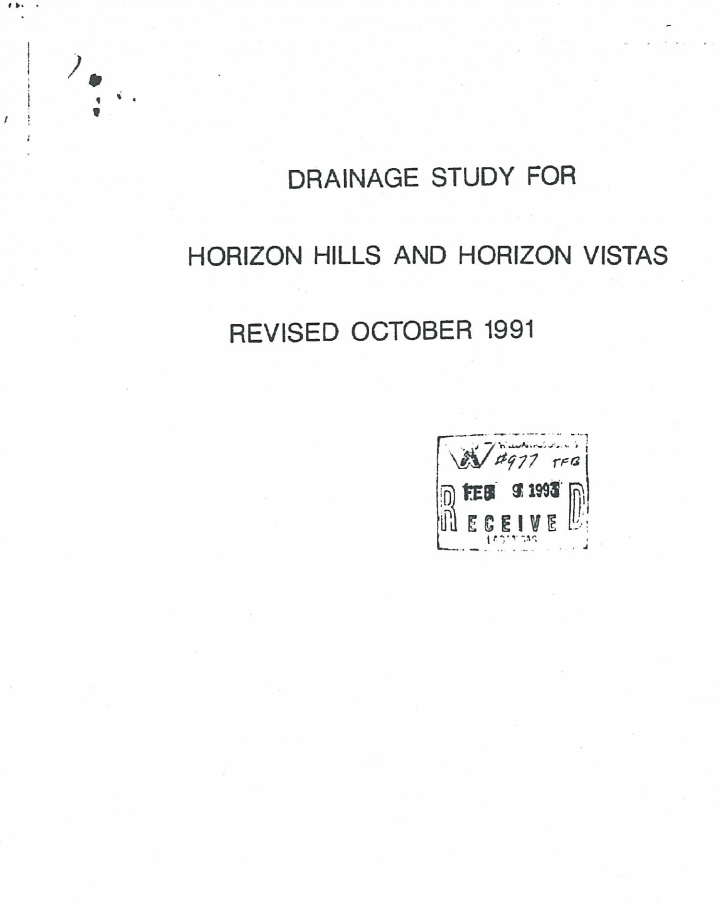
Revision	Date

Local Entity File No.

REFERENCE: AN-93-730

STANDARD FORM 1

Not Official Copy

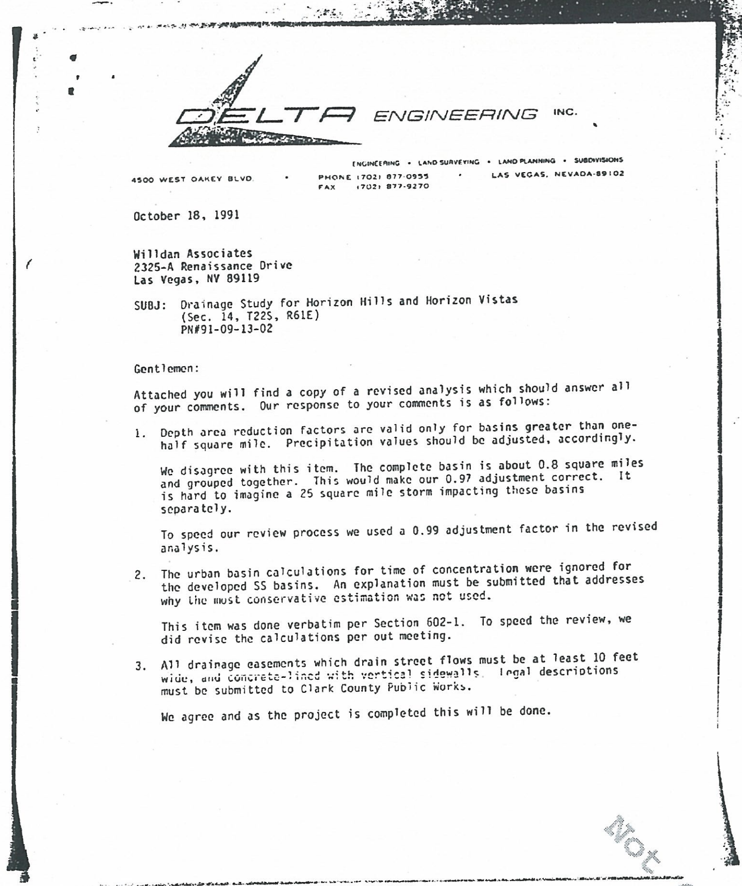


DRAINAGE STUDY FOR

HORIZON HILLS AND HORIZON VISTAS

REVISED OCTOBER 1991

#977 TFB
FEB 9 1993
RECEIVED



DELTA ENGINEERING INC.
ENGINEERING • LAND SURVEYING • LAND PLANNING • SUBDIVISIONS
4500 WEST OAKEY BLVD. • PHONE (702) 877-0955 FAX (702) 877-9270 • LAS VEGAS, NEVADA 89102

October 18, 1991

Willdan Associates
2325-A Renaissance Drive
Las Vegas, NV 89119

SUBJ: Drainage Study for Horizon Hills and Horizon Vistas
(Sec. 14, T22S, R61E)
PN#91-09-13-02

Gentlemen:

Attached you will find a copy of a revised analysis which should answer all of your comments. Our response to your comments is as follows:

1. Depth area reduction factors are valid only for basins greater than one-half square mile. Precipitation values should be adjusted, accordingly.

   We disagree with this item. The complete basin is about 0.8 square miles and grouped together. This would make our 0.97 adjustment correct. It is hard to imagine a 25 square mile storm impacting these basins separately.

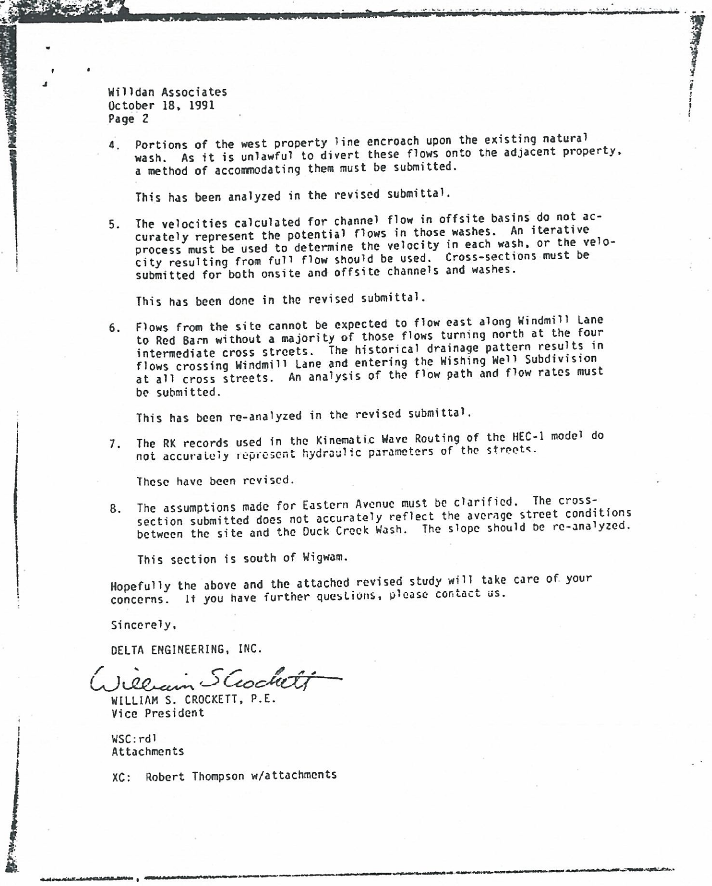
   To speed our review process we used a 0.99 adjustment factor in the revised analysis.

2. The urban basin calculations for time of concentration were ignored for the developed SS basins. An explanation must be submitted that addresses why the most conservative estimation was not used.

   This item was done verbatim per Section 602-1. To speed the review, we did revise the calculations per out meeting.

3. All drainage easements which drain street flows must be at least 10 feet wide, and concrete-lined with vertical sidewalls. Legal descriptions must be submitted to Clark County Public Works.

   We agree and as the project is completed this will be done.



Willdan Associates
October 18, 1991
Page 2

4. Portions of the west property line encroach upon the existing natural wash. As it is unlawful to divert these flows onto the adjacent property, a method of accommodating them must be submitted.

   This has been analyzed in the revised submittal.

5. The velocities calculated for channel flow in offsite basins do not accurately represent the potential flows in those washes. An iterative process must be used to determine the velocity in each wash, or the velocity resulting from full flow should be used. Cross-sections must be submitted for both onsite and offsite channels and washes.

   This has been done in the revised submittal.

6. Flows from the site cannot be expected to flow east along Windmill Lane to Red Barn without a majority of those flows turning north at the four intermediate cross streets. The historical drainage pattern results in flows crossing Windmill Lane and entering the Wishing Well Subdivision at all cross streets. An analysis of the flow path and flow rates must be submitted.

   This has been re-analyzed in the revised submittal.

7. The RK records used in the Kinematic Wave Routing of the HEC-1 model do not accurately represent hydraulic parameters of the streets.

   These have been revised.

8. The assumptions made for Eastern Avenue must be clarified. The cross-section submitted does not accurately reflect the average street conditions between the site and the Duck Creek Wash. The slope should be re-analyzed.

   This section is south of Wigwam.

Hopefully the above and the attached revised study will take care of your concerns. If you have further questions, please contact us.

Sincerely,

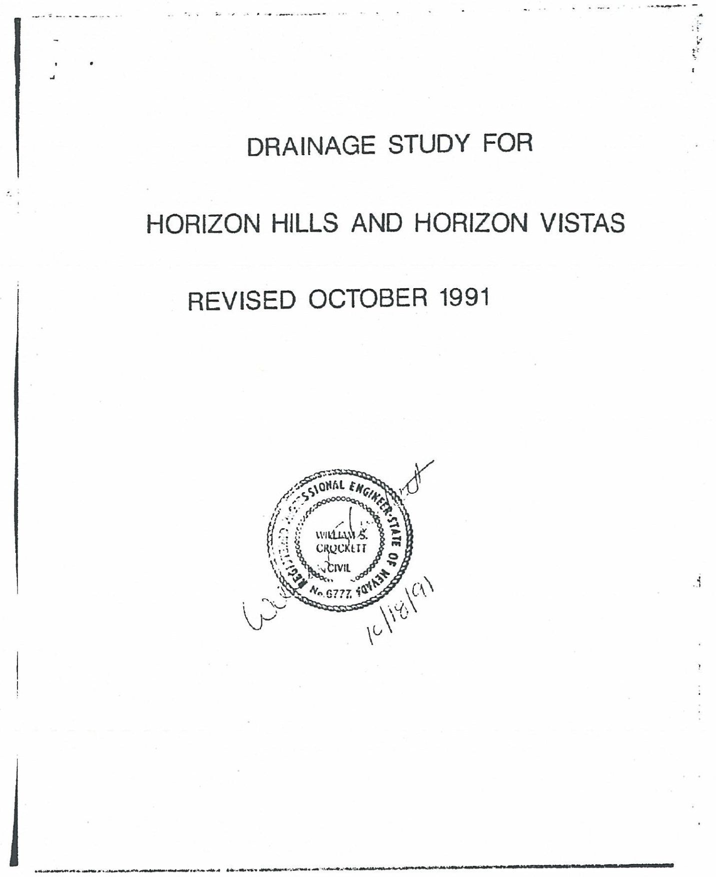
DELTA ENGINEERING, INC.

William S Crockett

WILLIAM S. CROCKETT, P.E.
Vice President

WSC:rdl
Attachments

XC: Robert Thompson w/attachments



DRAINAGE STUDY FOR

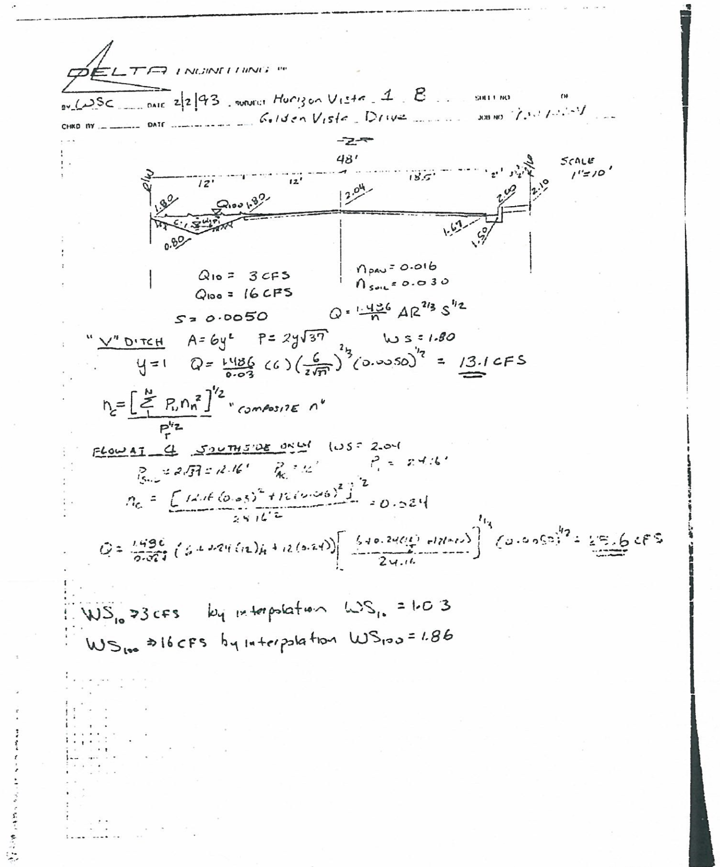
HORIZON HILLS AND HORIZON VISTAS

REVISED OCTOBER 1991

WILLIAM S. CROCKETT
CIVIL
No. 6777

10/18/91

Not Official Copy



DELTA ENGINEERING INC.

BY WSC DATE 2/2/93 SUBJECT Horizon Vista 1B SHEET NO. OF
Golden Vista Drive JOB NO. [illegible]
CHKD BY DATE

$Q_{10} = 3$ CFS
$Q_{100} = 16$ CFS

$n_{PAV} = 0.016$
$n_{SOIL} = 0.030$

$S = 0.0050$

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

"V" DITCH $A = 6y^2$ $P = 2y\sqrt{37}$ $WS = 1.80$

$y = 1$ $Q = \frac{1.486}{0.03}(6)\left(\frac{6}{2\sqrt{37}}\right)^{2/3}(0.0050)^{1/2} = 13.1$ CFS

$n_c = \frac{\left[\sum_{1}^{N} P_n n_n^2\right]^{1/2}}{P_T^{1/2}}$ "COMPOSITE n"

FLOW AT ℄ SOUTHSIDE ONLY $WS = 2.04$

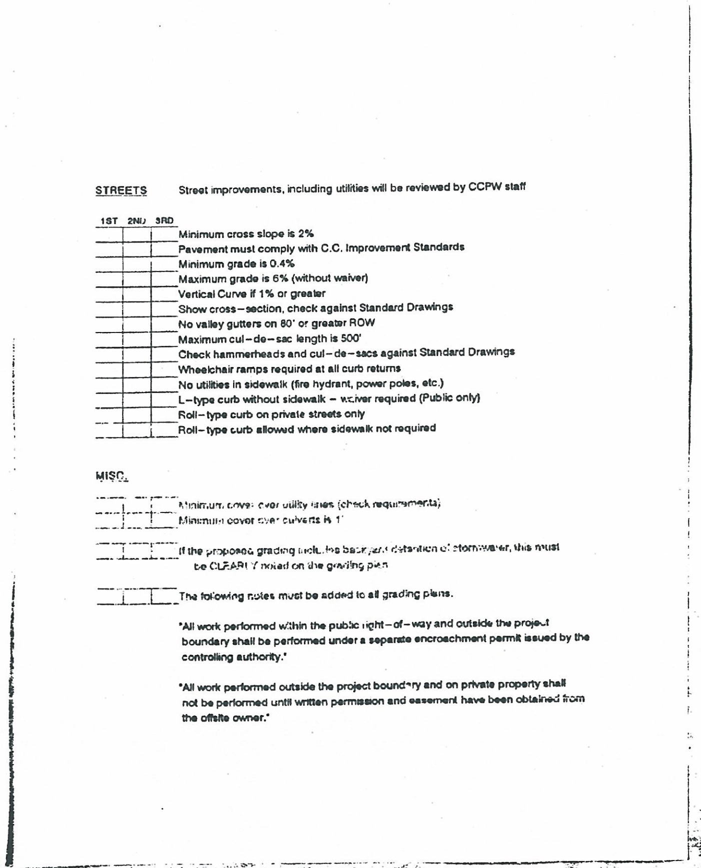
$P_{SOIL} = 2\sqrt{37} = 12.16'$ $P_{AC} = 12'$ $P_T = 24.16'$

$n_c = \frac{\left[12.16(0.03)^2 + 12(0.016)^2\right]^{1/2}}{24.16^{1/2}} = 0.024$

$Q = \frac{1.486}{0.024}\left(6 \cdot 0.24(12)/2 + 12(0.24)\right)\left[\frac{[illegible]}{24.16}\right]^{2/3}(0.0050)^{1/2} = 15.6$ CFS

$WS_{10} \Rightarrow 3$ CFS by interpolation $WS_{10} = 1.03$

$WS_{100} \Rightarrow 16$ CFS by interpolation $WS_{100} = 1.86$



STREETS Street improvements, including utilities will be reviewed by CCPW staff

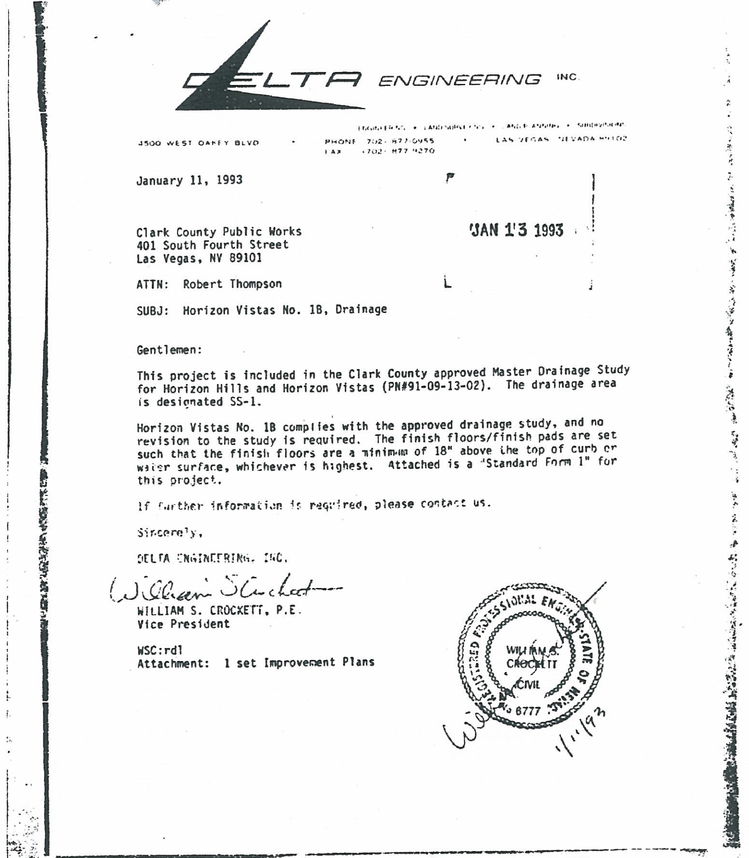
1ST	2ND	3RD	
			Minimum cross slope is 2%
			Pavement must comply with C.C. Improvement Standards
			Minimum grade is 0.4%
			Maximum grade is 6% (without waiver)
			Vertical Curve if 1% or greater
			Show cross-section, check against Standard Drawings
			No valley gutters on 80' or greater ROW
			Maximum cul-de-sac length is 500'
			Check hammerheads and cul-de-sacs against Standard Drawings
			Wheelchair ramps required at all curb returns
			No utilities in sidewalk (fire hydrant, power poles, etc.)
			L-type curb without sidewalk - waiver required (Public only)
			Roll-type curb on private streets only
			Roll-type curb allowed where sidewalk not required

MISC.

			Minimum cover over utility lines (check requirements)
			Minimum cover over culverts is 1'
			If the proposed grading includes backyard detention of stormwater, this must be CLEARLY noted on the grading plan
			The following notes must be added to all grading plans.

"All work performed within the public right-of-way and outside the project boundary shall be performed under a separate encroachment permit issued by the controlling authority."

"All work performed outside the project boundary and on private property shall not be performed until written permission and easement have been obtained from the offsite owner."



DELTA ENGINEERING INC.
ENGINEERING • LAND SURVEYING • LAND PLANNING • SUBDIVISIONS
4500 WEST OAKEY BLVD. • PHONE (702) 877-0955 FAX (702) 877-9270 • LAS VEGAS, NEVADA 89102

January 11, 1993

JAN 13 1993

Clark County Public Works
401 South Fourth Street
Las Vegas, NV 89101

ATTN: Robert Thompson

SUBJ: Horizon Vistas No. 1B, Drainage

Gentlemen:

This project is included in the Clark County approved Master Drainage Study for Horizon Hills and Horizon Vistas (PN#91-09-13-02). The drainage area is designated SS-1.

Horizon Vistas No. 1B complies with the approved drainage study, and no revision to the study is required. The finish floors/finish pads are set such that the finish floors are a minimum of 18" above the top of curb or water surface, whichever is highest. Attached is a "Standard Form 1" for this project.

If further information is required, please contact us.

Sincerely,

DELTA ENGINEERING, INC.

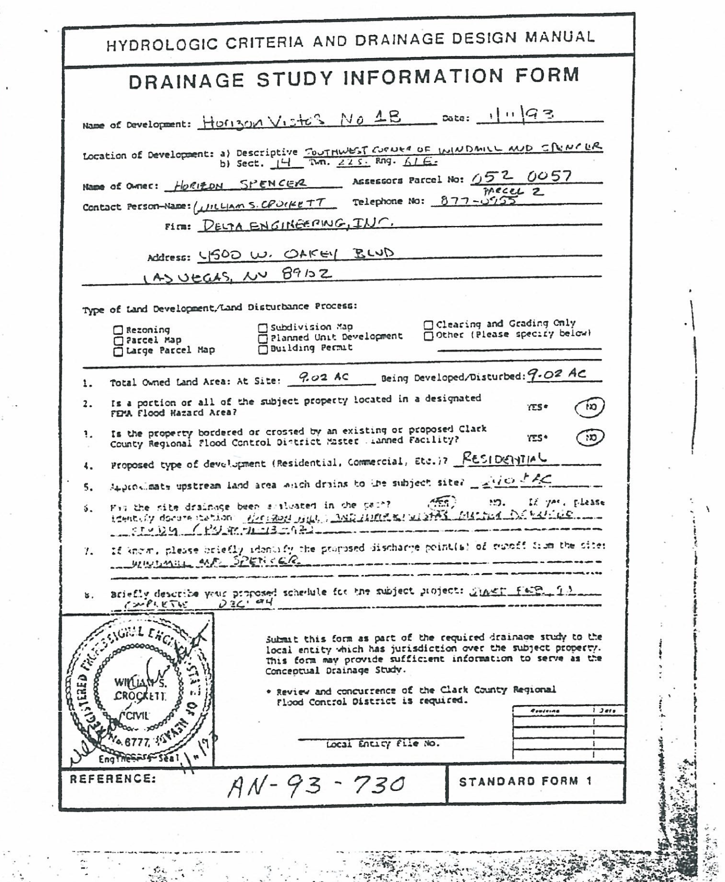
William S Crockett

WILLIAM S. CROCKETT, P.E.
Vice President

WSC:rdl
Attachment: 1 set Improvement Plans

WILLIAM S. CROCKETT
CIVIL
No. 6777

1/11/93



HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Horizon Vistas No 1B Date: 1/11/93

Location of Development: a) Descriptive Southwest corner of Windmill and Spencer
b) Sect. 14 Twn. 22S. Rng. 61E.

Name of Owner: Horizon Spencer Assessors Parcel No: 052 0057 Parcel 2

Contact Person-Name: William S. Crockett Telephone No: 877-0955

Firm: Delta Engineering, Inc.

Address: 4500 W. Oakey Blvd
Las Vegas, NV 89102

Type of Land Development/Land Disturbance Process:

☐ Rezoning
☐ Parcel Map
☐ Large Parcel Map
☐ Subdivision Map
☐ Planned Unit Development
☐ Building Permit
☐ Clearing and Grading Only
☐ Other (Please specify below)

1. Total Owned Land Area: At Site: 9.02 AC Being Developed/Disturbed: 9.02 AC
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? YES* [✓ NO]
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? YES* [✓ NO]
4. Proposed type of development (Residential, Commercial, Etc.)? Residential
5. Approximate upstream land area which drains to the subject site? 200 ± AC
6. Has the site drainage been evaluated in the past? [✓ YES] NO. If yes, please identify documentation: Horizon Hills and Horizon Vistas Master Drainage Study (PN#91-09-13-02)
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Windmill and Spencer
8. Briefly describe your proposed schedule for the subject project: Start Feb 93 Complete Dec 94

WILLIAM S. CROCKETT
CIVIL
No. 6777
Engineers Seal
1/11/93

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

* Review and concurrence of the Clark County Regional Flood Control District is required.

Reviewer	Date

Local Entity File No.

REFERENCE: AN-93-730

STANDARD FORM 1

INTRODUCTION

The purpose of this report is to provide a stormwater analysis for the Horizon Hills/Horizon Vistas project. The results and recommendations presented herein are based on existing conditions as of September 2, 1991.

Neither the owner, Horizon Spencer, the developer, Horizon Communities, Inc., nor the engineer, Delta Engineering, Inc., is responsible or accountable for any future development of adjacent properties or alteration of drainage areas which affect the findings or recommendations of this report.

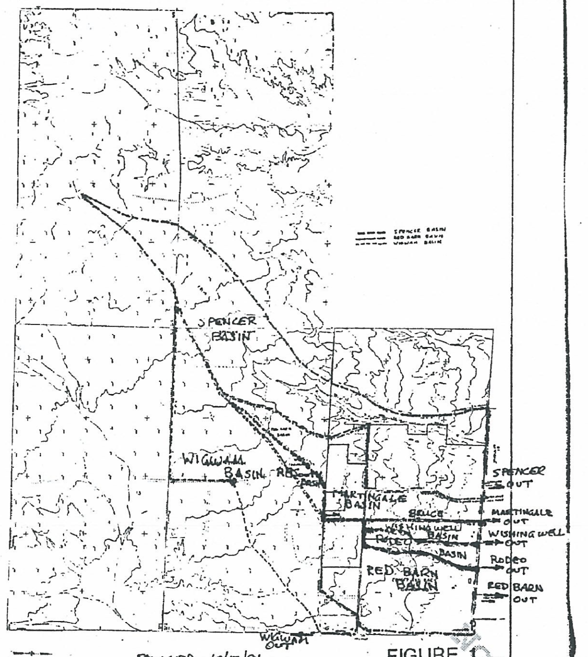
EXISTING CONDITIONS

The project is located along Spencer Street between Windmill Lane and Wigwam Road. The Aspendale Subdivision is at the northwest corner of Spencer and Windmill, and the Wishing Well Estates Subdivision is north of Windmill from Spencer to Eastern. The area around the project site is dotted with existing single 2-acre ranch-type developments. The road improvements in the area are as follows.

1. Spencer - full street north of Windmill.
2. Windmill - half street.
3. Eastern - half street.
4. Red Barn - full street north of windmill.
5. Camero - 24' paved access per Clark County Standards.
6. Bruce - 24' gravel access per Clark County Standards.
7. Wigwam west of Eastern - 24' gravel access per Clark County Standards.

Along the west edge of the project is an area of the Duck Creek Wash which presently drains north in Spencer. Through the site and along Windmill and Eastern the existing flows are taken north through Wishing Well Estates in Red Barn, Rodeo, Wishing Well and Martingale. East of the site from Wigwam the drainage is to Eastern and then South. Figure 1 shows the existing drainage basins. Normally dirt roads are not considered to affect the drainage;

EXISTING


SPENCER BASIN
WIGWAM BASIN
RED BARN BASIN
MARTINGALE BASIN
WISHING WELL BASIN
BRUCE
RODEO BASIN
SPENCER OUT
MARTINGALE OUT
WISHING WELL OUT
RODEO OUT
RED BARN OUT
WIGWAM OUT

REVISED 10/17/91

FIGURE 1

however, in this area the existing 24' gravel and paved access roads with their associated "V" ditches do change the flow patterns.

FIRM Community Panel No. 320003-1225B dated 9/29/89 shows the site and its associated drainage basins are not within the 100-year flood plain but are in Zone "X" which is a non-flood hazard area. There are no Regional Flood Control District facilities planned or existing.

The soils are in the Hydrologic Soils Group "B".

PROPOSED DEVELOPMENT

Horizon Vistas is a 200-lot R-1 project which encompasses the northern portion of this project. Horizon Hills is a 134-lot RE-PUD project which encompasses the southern portion of this project. It is to be constructed in phases over the next two to three years. Figure 2 shows the site and its interior drainage basins. Figure 3 shows the overall proposed developed drainage basins.

The Spencer basin is maintained as it exists west of the site and is taken into account for its combined flow in Spencer north of Windmill. Onsite basins SS-1, SS-2 and SS-3 and offsite basin WWS, which is a part of the Martingale basin, drain to Windmill and Spencer where they combine with the Spencer basin and flow north in Spencer to Duck Creek.

*

The Martingale Basin is revised significantly. Onsite basins RBS-1, RBS-2, RBS-3 and RBS-4 discharge to Windmill west of Martingale. Presently, the basin discharges across Windmill to Martingale. To maintain the existing flow patterns and not adversely affect the roads through Wishing Well Estates to the east of Martingale, Windmill is designed with a 0.51% cross grade on its south half. This allows 8 CFS to continue to the east while major storm flows will cross to the north half of Windmill and continue north on Martingale as they presently do.

The Wishing Well Basin is reduced in size; however, up to 8 CFS are diverted from Martingale into this basin. This has minimal impact.

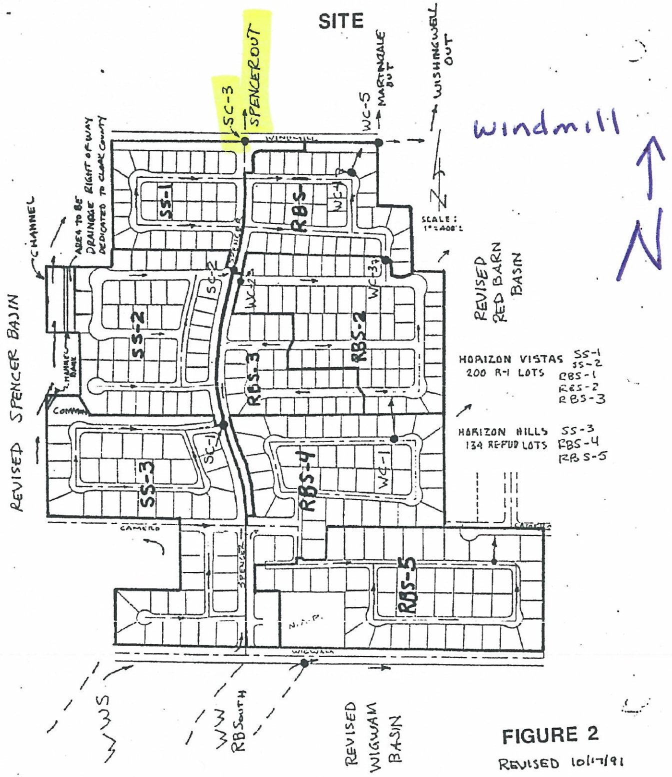
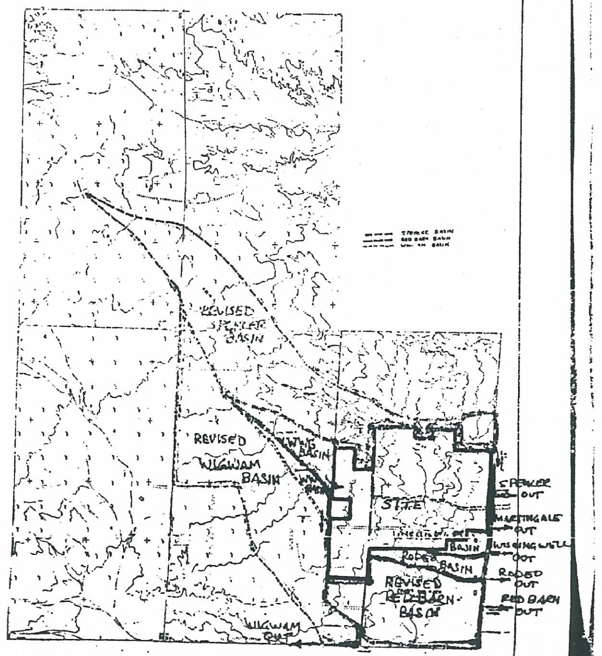

SITE
SC-3
SPENCER OUT
WC-5
MARTINGALE OUT
WISHING WELL OUT
Windmill
N
SCALE: 1"=400'±
CHANNEL
AREA TO BE DRAINAGE RIGHT OF WAY DEDICATED TO CLARK COUNTY
REVISED SPENCER BASIN
SS-1
SS-2
SS-3
SC-2
SC-1
SPENCER
RBS-1
RBS-2
RBS-3
RBS-4
RBS-5
WC-4
WC-3
WC-2
WC-1
REVISED RED BARN BASIN
HORIZON VISTAS 200 R-1 LOTS SS-1 SS-2 RBS-1 RBS-2 RBS-3
HORIZON HILLS 134 REPUD LOTS SS-3 RBS-4 RBS-5
CAMERO
N.A.P.
WIGWAM
WWS
WW RBSOUTH
REVISED WIGWAM BASIN

FIGURE 2

REVISED 10/17/91

DEVELOPED


REVISED SPENCER BASIN
REVISED WIGWAM BASIN
WWS BASIN
SITE
MARTINGALE BASIN
RODEO BASIN
REVISED RED BARN BASIN
SPENCER OUT
MARTINGALE OUT
WISHING WELL OUT
RODEO OUT
RED BARN OUT
WIGWAM OUT

REVISED 10/17/91

FIGURE 3

The Rodeo basin is reduced in size.

The Wigwam basin is changed slightly by the addition of a portion of the Red Barn basin south of Wigwam (WW).

METHODOLOGY

This analysis was prepared to meet the requirements of the Clark County Regional Flood Control District's "Hydrologic Criteria and Drainage Design Manual."

The quantitative storm flows were determined using the U.S. Army Corps of Engineers February, 1985 version of HEC-1. The SCS unit hydrograph method was used with kinematic wave routing. Per the manual, a 6-hour storm was used with the SDN3 storm distribution of drainage basins less than 10 square miles. Table 503's five minute duration was adjusted for a two minute duration due to the fairly small site basins (duration <0.29 TLAG). Precipitation was obtained from Table 505 and adjusted per Table 502 for depth Area (0.99).

The delineation of the contribution runoff areas was based on 40-, 50-, and 400-scale topographic maps, U.S.G.S. quadrangle maps, and site inspections. The drainage/runoff characteristics of the basin's soils were based on "Soil Survey of the Las Vegas Valley Area, Nevada" by SCS dated July, 1985.

SITE DESIGN

The site grading plan will be designed to insure finish floor elevations, which are normally 10 inches above finish pad elevations, are a minimum of 18 inches above the top of curb or 100-year flood water surface, whichever is higher. Street sections for critical points and calculations for cross flot drains are in the Appendix.

The existing natural channel east of the site which is directed down Spencer to Duck Creek does encroach into this project. Per the proposed analysis, the channel will remain in its natural state without encroachment. The bank and both leading and trailing edges of the development will be protected with gabions to prevent the channel from migrating into the development

The proposed flow rates are slightly lower than the existing ones for Spencer, Martingale and Rodeo. The proposed flow on Wigwam is higher than the existing flow but will not cause any problems (increased depth of flow: Wigwam - 0.02').

The roadway sections, both within the site and off, show the development will not cause adverse impact. The calculated flows meet the criteria of Clark County for both the 10- and 100-year storms.

	Existing		Developed	
	Q10 CFS	Q100 CFS	Q10 CFS	Q100 CFS
Spencer out	26	112	25	107
Red Barn out	13	54	12	54
Wigwam/Eastern	18	75	19	82
Martingale out	11	48	0	29
Wishing Well out	3	13	6 (5)*	13 (8)*
Rodeo out	4	17	3	12

* Diverted from Martingale

CONCLUSION

The proposed development will be adequately protected from storm flows, does not increase the storm flows north in Spencer, Martingale or Red Barn, and causes only a slight increase to storm flows in Eastern south of Wigwam.

APPENDIX

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HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: HORIZON HILLS AND HORIZON VISTAS Date: Sept 13, 1991

Location of Development: a) Descriptive ALONG SPENCER BETWEEN WINDMILL AND WIGWAM
b) Sect. 11 Twn. 22 S Rng. 61E 160-S10-[illegible]5, 0[illegible], 035, 036, 082, 06[illegible] 160-[illegible]-001, 015, & 019

Name of Owner: HORIZON [illegible] Assessors Parcel No: 160-8[illegible]-012, 160-[illegible]70-001[illegible]

Contact Person—Name: WILLIAM [illegible] CRAVETT Telephone No: 877-0955

Firm: DELTA ENGINEERING, INC.

Address: 4500 W. OAKEY BLVD LAS VEGAS, NV 89102

Type of Land Development/Land Disturbance Process:

☐ Rezoning
☐ Parcel Map
☐ Large Parcel Map
☒ Subdivision Map
☐ Planned Unit Development
☐ Building Permit
☐ Clearing and Grading Only
☐ Other (Please specify below)

1. Total Owned Land Area: At Site: 109 AC Being Developed/Disturbed: 109 ± AC
2. Is a portion or all of the subject property located in a designated FIMA Flood Hazard Area? YES* [✓ NO]
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? YES* [✓ NO]
4. Proposed type of development (Residential, Commercial, Etc.)? RESIDENTIAL
5. Approximate upstream land area which drains to the subject site? 240 ± AC
6. Has the site drainage been evaluated in the past? [✓ YES] NO. If yes, please identify documentation: [illegible] 03205/0717-403
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: [illegible]
8. Briefly describe your proposed schedule for the subject project: FIRST UNIT 1991 WITH [illegible] 199[illegible]

6777
Engineer's Seal

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

* Review and concurrence of the Clark County Regional Flood Control District is required.

Local Entity File No.

Revision	Date

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS
(URBAN AREAS[1])

Cover description: Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
* CUT GRASS Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
* EXIST Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
* R-1 1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
* R-E 1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94

Curve numbers for hydrologic soil group—

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 603

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figure 603 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 603 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

WRC ENGINEERING

REFERENCE: SCS TR-55, USDA, June 1986.

TABLE 602
1 of 4

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HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

DEVELOPMENT HH/HV EXISTING
CACULATED BY WSC DATE 10/9/91

SUB-BASIN DATA: DESIG: (1)	K (2)	AREA Ac (3)	INITIAL/OVERLAND TIME (t_i): LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	TRAVEL TIME (t_t): LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	t_c CHECK (URBANIZED BASINS): TOTAL LENGTH Ft (11)	t_c = (L/180)+10 Min (12)	FINAL t_c Min (13)	REMARKS TLAG (HRS)
RED BARN	0.6264	80.06	300	0.5	18.6	1400	2.0	4.2	5.6	NA			
REVISED		[illegible]				2770	0.5	2.5	18.5				
Q=55 CFS						1600	0.8	2.1	12.7			55.4	0.55
MARTINGALE	0.6264	65.12	300	0.5	18.6	4200	0.8	2.0	35.0	NA			
		[illegible]				1100	2.0	3.9	4.7				
Q=40 CFS						600	1.0	3.0	3.3			61.6	0.62
WISHING WELL	0.6264	13.0	100	0.5	10.7	800	1.0	2.0	6.7	NA			
Q=15 CFS		0.0203 mi²				750	2.0	3.0	4.2				
						700	1.0	2.3	5.1			26.7	0.27
RODEO	0.6264	7.4	150	0.5	13.2	750	1.0	2.1	6.0	NA			
Q=20 CFS		0.0172 mi²				650	2.0	3.3	3.3				
						1000	1.0	2.5	6.7			29.2	0.29
RED BARN [illegible]	0.6264	2.12	300	0.5	18.6	3100	0.8	1.4	36.9	NA		55.5	0.56
Q=10 CFS		[illegible]											

$t_i = 1.8\,(1.1 - K)\,L^{1/2}/S^{1/3}$ $t_c = t_i + t_t$

Revision	Date

REFERENCE:

STANDARD FORM 4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

DEVELOPMENT HH/HV EXIST
CACULATED BY WSC DATE 10/9/91

SUB-BASIN DATA: DESIG: (1)	K (2)	AREA Ac (3)	INITIAL/OVERLAND TIME (t_i): LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	TRAVEL TIME (t_t): LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	t_c CHECK (URBANIZED BASINS): TOTAL LENGTH Ft (11)	t_c = (L/180)+10 Min (12)	FINAL t_c Min (13)	REMARKS TLAG (HRS)
SPNCR	0.6264	13.4	300	0.5	13.6	4300	0.8	2.5	28.7		NA		
		[illegible]				1600	1.2	4.2	18.3				
	Q=110 CFS					600	0.4	3.3	3.0			68.6	0.69
WIGWAM	0.6264	129.3	300	0.5	13.6	6400	0.6	2.1	50.8			69.4	0.69
Q=75 CFS		0.202 mi²											

$t_i = 1.8\,(1.1 - K)\,L^{1/2}/S^{1/3}$ $t_c = t_i + t_t$

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DELTA ENGINEERING

BY WJC DATE 10/9/91 SUBJECT EXISTING TLAG SHEET NO ___ OF ___
CHKD BY ___ DATE ___ REVISED JOB NO ___

(S-1)
SPENCER $Q_{100} \approx 110\ \text{cfs} = \frac{1.486}{n} AR^{2/3} S^{1/2}$
$n = 0.032$

① $S = 0.003$ $z = 50$
$110 = \frac{1.486}{0.032} AR^{2/3}(0.003)^{1/2}$ ∴ $AR^{2/3} = 26.48 = 50y^2\left(\frac{50y}{2\sqrt{1+50^2}}\right)^{2/3}$

y	1	0.7	0.8	0.9	1.0	
$AR^{2/3}$	31.49	12.17	17.37	23.78	31.49	$y_n \approx 0.94'$

$Q = VA = 110 = V \times 50(0.94)^2$ ∴ $V \approx 2.5$ fps

② $S = 0.012$ $z = 12$
$AR^{2/3} = 21.63 = 12y^2\left(\frac{12y}{2\sqrt{145}}\right)^{2/3}$

y	1.3	1.4	1.5	
$AR^{2/3}$	15.18	18.50	22.24	$y_n \approx 1.48'$

$V \approx 4.2$ fps

③ $S = 0.004$ $z = 6$
$AR^{2/3} = 37.46 = 6y^2\left(\frac{6y}{2\sqrt{37}}\right)^{2/3}$

y	2	2.1	2.2	2.3	2.4	
$AR^{2/3}$	23.78	27.09	30.66	34.52	38.67	$y_n \approx 2.37$

$V \approx 3.3$ fps

DELTA ENGINEERING

BY WSC DATE 10/9/91 SUBJECT TLAG SHEET NO ___ OF ___
CHKD BY ___ DATE ___ REVISED JOB NO ___

(WIGWM) $Q \approx 75$ cfs
WIGWAM

ⓐ ROUTE 3100 LF $S = 0.0056$ $Z = 6$
1100 LF $S = 0.004$ $Z = 6$
3100 LF $S = 0.006$ $Z = 50$

① $75 = \frac{1.486}{0.032} AR^{2/3}(0.0056)^{1/2}$, $AR^{2/3} = 21.58 = 6y^2\left(\frac{6y}{2\sqrt{37}}\right)^{2/3}$

y	2	1.5	1.8	1.9	2.0	
$AR^{2/3}$	23.78	11.04	17.96	20.74	23.78	$y_n \approx 1.93$

$V \approx 3.4$ fps

② $75 = \frac{1.486}{0.032} AR^{2/3}(0.004)^{1/2}$, $AR^{2/3} = 25.54$

y	1.9	2.0	2.1	
$AR^{2/3}$	20.74	23.78	27.09	$y_n \approx 2.05'$ $V \approx 3.0$ fps

③ $75 = \frac{1.486}{0.032} AR^{2/3}(0.006)^{1/2}$, $AR^{2/3} = 20.85 = 50y^2\left(\frac{50y}{2\sqrt{1+50^2}}\right)^{2/3}$

y	1	0.6	0.8	0.9	
$AR^{2/3}$	31.49	8.06	17.37	23.78	$y_n \approx 0.85$ $V \approx 2.1$ fps

$T_t = \frac{3100}{3.4(60)} + \frac{1100}{3.0(60)} + \frac{3100}{2.1(60)} = 45.91$ min

ⓑ ROUTE 6400' $S = 0.006$ $Z = 50$ $V \approx 2.1$
$T_t = \frac{6400}{2.1(60)} = 50.79$ min ∴ ROUTE B

DELTA ENGINEERING

BY WSC DATE 10/9/91 SUBJECT TLAG EXIST SHEET NO ___ OF ___
CHKD BY ___ DATE ___ REVISED JOB NO ___

RED BARN REVISED $Q \approx 55$ CFS

① $S \approx 0.020$ (1400') $Z \approx 12$ $AR^{2/3} = 8.37 = 12y^2\left(\frac{12y}{2\sqrt{145}}\right)^{2/3}$

y	1.1	1.0	
$AR^{2/3}$	9.72	7.54	$y_n \approx 1.04'$ $V \approx 4.2$ fps $t \approx 5.6$ min

② $S = 0.005$ $Z = 12$ $L = 2770'$ $AR^{2/3} = 16.75$

y	1.5	1.4	1.3	
$AR^{2/3}$	22.24	18.50	15.18	$y_n \approx 1.35'$ $V \approx 2.5$ fps $t \approx 18.5$ min

③ 1600' $S = 0.0080$ $Z = 50$
$AR^{2/3} = 13.24 = 50y^2\left(\frac{50y}{2(50^2+1)^{1/2}}\right)^{2/3}$

y	0.7	0.6	0.8	
$AR^{2/3}$	12.17	8.06	17.37	$y_n \approx 0.72'$ $V \approx 2.1$ fps $t = 12.7$ min

RODEO $Q \approx 20$ CFS

① $S \approx 1.0$ $Z = 25$ $AR^{2/3} = 4.31$

y	0.6	0.7	
$AR^{2/3}$	4.03	6.08	$y_n \approx 0.61'$ $V \approx 2.1$ fps

② $S \approx 2.0$ $Z = 12$ $AR^{2/3} = 3.04$

y	0.7	0.8	
$AR^{2/3}$	2.91	4.16	$y_n \approx 0.71'$ $V \approx 3.3$ fps

③ $S \approx 1.0$ $Z = 12$ $AR^{2/3} = 4.31$

y	0.8	0.9	
$AR^{2/3}$	4.16	5.69	$y_n \approx 0.81'$ $V \approx 2.5$ fps

DELTA ENGINEERING

BY WSC DATE 10/9/91 SUBJECT TLAG EXIST SHEET NO ___ OF ___
CHKD BY ___ DATE ___ REVISED JOB NO ___

MARTINGALE $Q \approx 40$ CFS

① 4200' $S \approx 0.008$ $Z \approx 50$ $AR^{2/3} = 9.63 = 50y^2\left(\frac{50y}{2(1+50^2)^{1/2}}\right)^{2/3}$

y	0.5	0.6	0.7	
$AR^{2/3}$	4.96	8.06	12.17	$y_n \approx 0.64$ $V \approx 2.0$ fps $t \approx 35.0$ min

② 1100 $S \approx 0.02$ $Z \approx 12$ $AR^{2/3} = 6.09 = 12y^2\left(\frac{12y}{2\sqrt{145}}\right)^{2/3}$

y	0.9	1.0	
$AR^{2/3}$	5.69	7.54	$y_n \approx 0.92'$ $V \approx 3.9$ fps $t \approx 4.7$ min

③ 600' $S \approx 0.01$ $Z \approx 12$ $AR^{2/3} = 8.61 = 12y^2\left(\frac{12y}{12\sqrt{145}}\right)^{2/3}$

y	1.1	
$AR^{2/3}$	9.72	$y_n \approx 1.05'$ $V \approx 3.0$ fps $t \approx 3.3$ min

KESMITH $Q \approx 10$ CFS (ALSO [illegible])
3100' $S \approx 0.0080$ $Z \approx 50$ $AR^{2/3} = 2.41 = 50y^2\left(\frac{50y}{2(50^2+1)^{1/2}}\right)^{2/3}$

y	0.3	0.4	
$AR^{2/3}$	1.27	2.74	$y_n \approx 0.38$ $V \approx 1.4$ fps $t \approx 36.9$ min

WISHING WELL $Q \approx 15$ CFS

① $S \approx 1.0$ $Z \approx 25$ $AR^{2/3} = 3.23$

y	0.4	0.5	0.6	
$AR^{2/3}$	1.37	2.48	4.03	$y_n \approx 0.55'$ $V \approx 2.0$ fps

② $S \approx 2.0$ $Z \approx 12$ $AR^{2/3} = 2.28 = 12y^2\left(\frac{12y}{2(145)^{1/2}}\right)^{2/3}$

y	0.5	0.6	0.7	
$AR^{2/3}$	1.19	1.93	2.91	$y_n \approx 0.64'$ $V \approx 3.0$ fps

③ $S \approx 1.0$ $Z \approx 12$ $AR^{2/3} = 3.23$

y	0.8	
$AR^{2/3}$	4.16	$y_n \approx 0.73'$ $V \approx 2.3$ fps

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HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

DEVELOPMENT HH/HV DEVELOPED - [illegible]
CACULATED BY WSC DATE 10/10/91

SUB-BASIN DATA DESIG: (1)	K (2)	AREA Ac (3)	INITIAL/OVERLAND TIME (t_i) LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	TRAVEL TIME (t_t) LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	t_c CHECK (URBANIZED BASINS) TOTAL LENGTH Ft (11)	t_c=(L/180)+10 Min (12)	FINAL t_c Min (13)	REMARKS TLAG HOURS
SPNCR	0.6264	49.47	300	0.5	8.6	4300	0.3	2.4	29.9	NA			
	Q=85CFS					4600	1.2	3.9	19.7				
						600	2.5	4.0	2.5			70.7	0.71
SS-3	0.5208	9.76	240	0.75	17.3	300	0.4	1.9	2.6	540	13.6*		
	Q=[illegible]CFS					300	1.6	3.3	1.3				
						700	0.4	1.9	6.1	TOTAL	27.8	13.6*	0.19
SS-2	0.5208	15.46	180	0.75	15.4	750	0.5	2.1	5.6	1400	17.8*	17.8	
	Q=15CFS					620	1.3	3.4	3.0				
						150	0.4	1.9	1.3	TOTAL	23.3		0.18
SS-1	0.5208	3.32	130	0.75	15.4	250	2.4	4.7	0.9	1130	16.6*	16.6	
	Q=10CFS					550	0.4	1.9	4.8				
						200	2.6	4.9	0.7	TOTAL	21.8		0.17
NWS	0.6264	10.71	300	0.5	13.6	2700	0.8	1.5	30.0	NA		43.6	0.49
	Q=15CFS												

$t_i = 1.8\,(1.1 - K)\,L^{1/2}/S^{1/3}$ $t_c = t_i + t_t$

K = 0.0132 CN - 0.39
REPUD CN = 71 K = 0.5472
R1 CN = 76 K = 0.6132
NATURAL CN = 77 K = 0.6264
GRASS (CUT) CN = 69 K = 0.5208

* FIRST TC IN BASIN URBANIZED

REFERENCE:

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HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

DEVELOPMENT HH/HV DEVELOPED - RED BARN
CACULATED BY WSC DATE 10/10/91

SUB-BASIN DATA DESIG: (1)	K (2)	AREA Ac (3)	INITIAL/OVERLAND TIME (t_i) LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	TRAVEL TIME (t_t) LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	t_c CHECK (URBANIZED BASINS) TOTAL LENGTH Ft (11)	t_c=(L/180)+10 Min (12)	FINAL t_c Min (13)	REMARKS TLAG HRS
RBS-5	0.5208	19.43	240	0.75	17.8	1150	0.4	1.9	10.1	1390	17.7*		
	Q=15CFS									TOTAL	27.9	17.7*	0.18
RBS-4	0.5208	5.24	240	0.75	17.8	600	1.1	3.0	3.3	2180	22.7*		
	Q=	12CFS				270	0.4	1.9	2.4				
						170	0.6	2.3	1.2				
						600	0.4	1.9	5.3				
						300	1.6	3.8	1.3				
						100	0.4	.9	0.9	TOTAL	32.2	22.7*	0.23
RBS-3	0.5208	7.09	130	0.75	15.4	650	0.4	1.9	5.7	1680	19.3*		
	Q=12CFS					300	1.7	3.9	1.3				
						150	0.4	1.9	1.3				
						400	3.75	5.8	1.2	TOTAL	24.9	19.3*	0.19
RBS-2	0.5208	13.99	180	0.75	15.4	1200	0.5	2.1	9.5	1380 TOTAL	17.7* 24.9	17.7*	0.18
RBS-1	0.5208	10.47	130	0.75	15.4	800	0.5	2.1	6.3	980 TOTAL	15.4* 21.7	15.4*	0.15

$t_i = 1.8\,(1.1 - K)\,L^{1/2}/S^{1/3}$ $t_c = t_i + t_t$

* FIRST TC IN BASIN URBANIZED

REFERENCE:

STANDARD FORM 4

Revision | Date

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

DEVELOPMENT HH/HV DEVELOPED
CACULATED BY WSC DATE 10/10/91

SUB-BASIN DATA DESIG: (1)	K (2)	AREA Ac (3)	INITIAL/OVERLAND TIME (t_i) LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	TRAVEL TIME (t_t) LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	t_c CHECK (URBANIZED BASINS) TOTAL LENGTH Ft (11)	t_c=(L/180)+10 Min (12)	FINAL t_c Min (13)	REMARKS
DRED BARN	0.6264	60.60	300	0.5	18.6	1400	0.2	4.1	5.7	NA			
		0.0947				2770	0.5	2.4	19.2				
	Q=45CFS					850	0.8	2.0	7.1	50.6		50.6	0.51
DEV WISHING WELL	0.6264	4.52	100	0.5	10.7	100	2.0	2.4	7.6	NA			
		0.0071 ~~5CFS~~								18.3		18.3	0.18
DEV RODEO	0.6264	3.11	150	0.5	13.2	700	0.8	1.4	8.3	NA			
		0.0265				2000	2.0	2.9	11.5	33.0		33.0	0.33
	Q=10CFS												

$t_i = 1.8\,(1.1 - K)\,L^{1/2}/S^{1/3}$ $t_c = t_i + t_t$

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DELTA ENGINEERING INC

BY WSC DATE 10/10/91 SUBJECT DEVELOPED TLAG SHEET NO ___ OF ___
CHKD BY ___ DATE ___ REVISED JOB NO ___

✓ ESPINCER Q≈85CFS

① L=4300' S=0.0030 Z=50 $AR^{2/3} = 20.46 = 504^2\left(\frac{504}{2(50^2+1)^{1/2}}\right)^{2/3}$

y	0.8	0.9
$AR^{2/3}$	17.37	23.78

yn ≈ 0.85' V≈2.4fps

② L=4600' S=0.012 Z=12 $AR^{2/3}$ = 16.71

y	1.3	1.4
$AR^{2/3}$	15.18	18.50

yn ≈ 1.35' V≈3.9fps

③ 600' 100R/W S≈0.005 Q½≈85CFS V≈4fps
SEE FIG 905 HC&DD MANUAL

✓ WWS Q≈15CFS L=2700 S=0.008 Z=50
$AR^{2/3}$ = 3.61

y	0.4	0.5
$AR^{2/3}$	2.74	4.96

yn ≈ 0.44' V≈1.5fps

✓ DREDBARN Q≈45CFS

① 1400' S=0.02 Z=12 $AR^{2/3}$=6.85

y	1.0	0.9
$AR^{2/3}$	7.54	5.69

yn ≈ 0.96' V≈4.1fps

② 2770' S=0.005 Z=12 $AR^{2/3}$ = 13.70

y	1.3	1.2
$AR^{2/3}$	15.18	12.26

yn ≈ 1.25' V≈2.4fps

③ 8 S=0.008 Z=50 $AR^{2/3}$= 10.83

y	0.6	0.7
$AR^{2/3}$	8.06	12.17

yn ≈ 0.67' V≈2.0fps

DELTA ENGINEERING INC

BY WSC DATE 10/10/91 SUBJECT DEV TLAG SHEET NO ___ OF ___
CHKD BY DATE REVISED JOB NO ___

✓ DEV WISH WELL S=0.02 Z=12 Q=5CFS
$AR^{2/3}$=0.76

y	0.4	0.5
$AR^{2/3}$	0.66	1.19

yn ≈ 0.42' V≈2.4fps

✓ DEV RODEO

① S=0.008 Z=50 Q=10CFS $AR^{2/3}$=2.41

y	0.3	0.4
$AR^{2/3}$	1.27	2.74

yn ≈ 0.38' V≈1.4fps

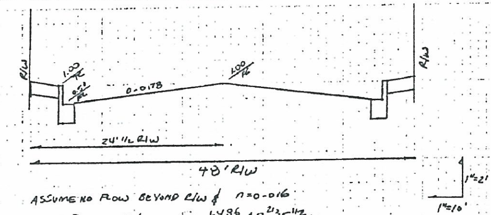
② S=0.02 Z=12 Q=10CFS $AR^{2/3}$=1.52

y	0.5	0.6
$AR^{2/3}$	1.11	1.93

yn ≈ 0.54' V≈2.9fps

DELTA ENGINEERING INC

BY WSC DATE 10/10/91 SUBJECT TC STREETS SHEET NO ___ OF ___
CHKD BY ___ DATE ___ JOB NO ___



ASSUME NO FLOW BEYOND R/W & n=0.016

½ A_{TC} = 3.80SF P= 20.50' $Q = \frac{1.486}{n} AR^{2/3}S^{1/2}$

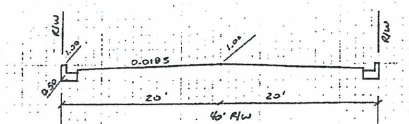
TC

S	0.004	0.005	0.006	0.011	0.013	0.016
Q BOTH SIDES CFS	14.5	16.2	17.8	24.1	26.2	29.0
V fps	1.9	2.1	2.3	3.2	3.4	3.8

0.017	0.0375	0.024
29.9	44.4	35.5
3.9	5.8	4.7

DELTA ENGINEERING INC

BY WSC DATE 10/10/91 SUBJECT TC STREETS SHEET NO ___ OF ___
CHKD BY ___ DATE ___ JOB NO ___



n=0.016

A_{TC} = 3.72SF P = 20.0'

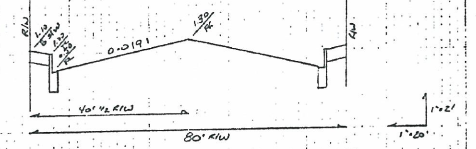
TC

S	0.004	0.005	0.006	0.01	0.013	0.016
Q½ CFS	7.1	8.0	8.7	11.2	12.8	14.2
V fps	1.9	2.1	2.3	3.0	3.4	3.8

0.024
7.4
4.7

DELTA ENGINEERING INC

BY WSC DATE 10/10/91 SUBJECT TC STREETS SHEET NO ___ OF ___
CHKD BY ___ DATE ___ JOB NO ___



ASSUME NO FLOW BEYOND R/W & n=0.016

TC

A_{TC}= 3.60SF P= 19.3'

S	0.004	0.005	0.010	0.011	0.0255	0.026
Q½ CFS	6.9	7.7	10.9	11.4	17.4	17.6
V fps	1.9	2.1	3.0	3.2	4.8	4.9

0.006
8.4
2.3

TO TOP R/S CL.
A= 13.00SF P= 40.5'

S	0.004	0.005	0.006	0.010	0.011	0.0255
Q½	35.8	40.0	43.8	56.6	59.4	90.4
V fps	2.8	3.1	3.4	4.4	4.6	7.0

0.026
91.2
7.0

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DELTA ENGINEERING INC.

BY WSC DATE 10/11/91 SUBJECT ROUTING SHEET NO __ OF __
CHKD BY DATE REVISED JOB NO

	FROM	TO	LENGTH FT	SLOPE FT/FT	n	SHAPE	CHANNEL WIDTH FT	Z SIDE SLOPE
✓	WW	WINDMILL ST	2300	0.005	0.032	TRAP	0	6
✓	EBS-5	FEDERADOR	150	0.01	0.013	TRAP	10 (2)	0
			250	0.005	0.016	TRAP	25 (4)	0
			500	0.005	0.032	TRAP	0	6
			2000	0.02	0.032	TRAP	0	12
✓	WC-1	WC-3	220	0.01	0.013	TRAP	10 (2)	0
			200	0.005	0.016	TRAP	41 (3)	0
✓	WC-2	WC-3	330	0.004	0.016	TRAP	41 (3)	0
✓	WC-3	WC-4	360	0.004	0.016	TRAP	41 (3)	0
✓	WC-4	WC-5	110	0.005	0.013	TRAP	10 (2)	0
✓	SC-1	SC-2	500	0.021	0.016	TRAP	35 (1)	0
			400	0.0375	0.016	TRAP	35 (1)	0
✓	SC-2	SC-3	270	0.012	0.016	TRAP	35 (1)	0
			450	0.026	0.016	TRAP	35 (1)	0
✓	WWS	SC-1	700	0.01	0.016	TRAP	35 (1)	0
			600	0.022	0.016	TRAP	35 (1)	0
✓	RBS	MARTINGALE (UNDEVELOPED)	1000	0.01	0.032	TRAP	0	6
			1100	0.02	0.032	TRAP	0	6

(1) 80' R/W ½ STREET 25' B/C
(2) CROSS LOT CHANNEL
(3) 48' R/W 41' B/C
(4) 60' R/W ½ STREET 25' B/C

DELTA ENGINEERING INC.

BY WSC DATE 10/16/91 SUBJECT SPENCER CHANNEL SHEET NO 1 OF 3
CHKD BY DATE WEST OF PROJECT JOB NO
WANT NATURAL UNENCROACHED CHANNEL

$Q_{100} \approx 85 CFS$ natural

$n \approx 0.032$ $Z = 3$ $80 < b < 40$ $2 < Z < 4$

$S = 0.015$ $1.0 < S < 2.0$

$Q = \frac{1.486}{0.032} AR^{2/3} (0.015)^{1/2} = 85$ ∴ $AR^{2/3} = 14.94$

$b = 66'$ $A = (66+3y)y$ $P = 66 + 2\sqrt{10}\,y$

y	0.4'	0.5'
$AR^{2/3}$	14.40	20.92

$y_n = 0.41'$ $V = 3.08 fps$

$T = b + 2zy = 68.46$ $D = A/T = 0.403$

$Fr = V/(gD)^{1/2} = 0.855 < 0.86$ ∴ OK SUBCRITICAL FLOW

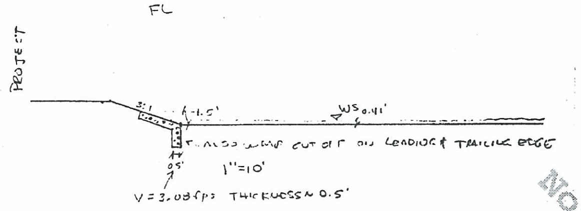
$V = 3.08 fps$

Freeboard $> 0.5 + V^2/2g = 0.65' + y_n^{0.41'}$

Channel depth $= 1.06'$

Using 3'

SOILS – SILTS TABLE 702 MAX V = 2.0 fps < 3.08
LINE CHANNEL SLOPE TOWARDS PROJECT
WITH GABION'S 1½' TALL EXTEND 3' BELOW
FL



DELTA ENGINEERING INC.

BY WSC DATE 10/16/91 SUBJECT SPENCER CHANNEL SHEET NO 2 OF 3
CHKD BY DATE WEST OF PROJECT JOB NO

$Q_{10} = 20 CFS$ $AR^{2/3} = 3.52$

y	0.2	0.1
$AR^{2/3}$	4.52	1.42

$y_n = 0.168'$ $V = 1.79 fps < 2.0$

∴ non erosive

$Z = Q/g^{1/2} = 84/32.2^{1/2} = 14.80$

$b = 66'$

$Z/b^{2.5} = 0.000413$

$\frac{V^2}{2g} = \frac{D}{2}$ $V = \frac{28}{y(y+22)}$ $D = \frac{y(y+22)}{2y+22}$

$\frac{28^2}{2g\,[y(y+22)]^2} = \frac{y(y+22)}{2y+22}$ ∴ $24.35 = \frac{[y(y+22)]^3}{2y+22}$

y	0.4	0.3
	31.55	13.25

$d_c = 0.36'$

$\frac{y_n}{d_c} = 1.14 > 1.1$ ∴ OK

MACCAFERRI 3 of 3

f) Reno Mattress placed in situ.

It has already been said that the advantages offered by the Reno Mattress as a channel lining are that it is both flexible and permeable. It is also a relatively thin lining which has no ability to support, or retain, earth behind it. Hence it is essential, when it is placed on an earth slope, that the slope is basically stable, and not steep enough to induce the mattress to slide down it. Notwithstanding this restriction it should be added that the mattress is capable of resisting or conforming to small local failures occuring underneath it.

The mattress unit should be placed with its diaphragms lying perpendicular to the direction in which the stone filling will tend to move, either under the influence of flowing water, or down a slope. The purpose is to restrict as far as possible the migration of the stones inside the wire netting and thus to prevent the formation of voids through which fine material could leach from under the mattress. On steep slopes therefore, units should be positioned with the diaphragms running horizontally, and on the beds of fast flowing channels with them at right angles to the current. It is not always expedient to follow this rule meticulously during construction and a compromise may have to be made, for example in a very small channel or in one with steep sides and an invert less than 1 m wide all the units would be laid with diaphragms parallel to the flow. Conversely if the cross-section has gentle side slopes, and the water velocity is high, the diaphragms would all be perpendicular to the flow. See (fig. 7-8).

One of the most vulnerable parts of a channel lining is the upstream edge. It should not cause undue turbulence and it must be sufficiently well anchored to resist uplift and movement.

One method of anchoring, is to lay the upstream end of the mattress in a trench excavated in the bed and side slopes. The downstream side of the trench is sloped so that the mattress lies on a smooth vertical radius and emerges with its top flush with the surface of the channel. The trench is backfilled and compacted after the mattress has been laid and filled. Another method is to form a cut-off wall with a 1 m × 1 m course of gabions sunk in below the surface across the section with the Reno Mattress wired down securely to it.

The growth of vegetation has a beneficial effect in canals lined with Reno Mattress in that the roots will bind the stone filling and further reduce any tendency in soil leaching. At some stage however, it must be cleared to prevent too great a reduction in capacity, using a herbicide, (one which will *not* corrode the wire netting) or mechanical equipment.

The soil conditions along the course of a canal will vary and there will always be small localised pockets of unstable material such as soft clays, running sand, fine silts etc. The Reno Mattress alone may not be adequate as a revetment at these points and may have to be replaced or reinforced with 500 mm or 1000 mm thick gabions on the lower part of the side slope and at the toe to provide sufficient support (fig. 10).

In mountainous areas, canals, constructed as part of hydro-electric power schemes, or training works, will pro-

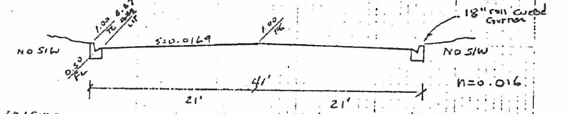
Table n. 3 - Thickness of Reno Mattress related to water velocity.

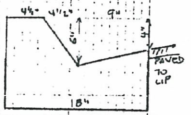
Water Velocity m/sec	FT/SEC	Mattress Thickness m	FT
0.9 - 1.8	2.95 - 5.90	0.15	0.49
1.8 - 3.6	5.90 - 11.81	0.15 - 0.25	0.49 - 0.82
3.6 - 4.5	11.81 - 14.76	0.25 - 0.30	0.82 - 0.98
4.5 - 5.4	14.76 - 17.72	0.30 - 0.50 and greater	0.98 - 1.64

DELTA ENGINEERING INC.

BY WSC DATE 10/11/91 SUBJECT WISHING WELL EST SHEET NO 1 OF 3
CHKD BY DATE ROADWAYS JOB NO 900902

TYPICAL ALL





FOR SIDE

TC $A_{TC} = \frac{0.33+0.5}{2}(\frac{3}{4}) + \frac{0.5}{2}(\frac{3}{8}) + \frac{0.33}{2}(19.5) = 3.62 SF$

$P = (4.5^2+6^2)^{1/2} + 0.75 + 19.5 = 20.6'$

S	0.01	0.0125	0.015	0.020
$Q_{1/2}$ CFS	10.5	11.8	12.9	14.9

TC+0.1' A = 5.72 SF P = 21.0'

S	0.01	0.0125	0.015	0.020
$Q_{1/2}$ CFS	22.3	25.0	27.3	31.6

TC+0.2' A = 7.82 SF P = 21.0

S	0.01	0.0125	0.015	0.020
$Q_{1/2}$ CFS	37.6	42.0	46.0	53.2

DELTA ENGINEERING INC.

BY WSC DATE 10/11/91 SUBJECT WISHING WELL EST SHEET NO 2 OF 3
CHKD BY DATE ROADWAYS JOB NO 900902

SLOPES JUST NORTH OF WINDMILL

MARTINGALE – OFFSITE @ WINDMILL S≈0.0125

	EXIST	DEV
Q_{10} CFS	11	0
Q_{100} CFS	48	29

FLOODS BOTH SIDES OF STREET

Q_{10} EX < TC V ≈ 3.2 d ≈ 0.5 Vd ≈ 1.6

Q_{10} DEV NA

Q_{100} EX WS ≈ 1.09 d ≈ 0.59' V ≈ 4.3 fps Vd ≈ 2.5

Q_{100} dev WS ≈ 1.02 d ≈ 0.52' V ≈ 3.5 fps Vd ≈ 1.8

developed helps area

WISHING WELL S≈0.0125

	EXIST	DEV	diverted* from Mart	TOTAL DEV
Q_{10} CFS	3	1	5	6
Q_{100} CFS	13	5	8	13

* MAX NOT ROUTED

Q_{10} EX & DEV < TC V ≈ 3.2 d ≈ 0.5 Vd ≈ 1.6

Q_{100} DEV & EX < TC V ≈ 3.2 d ≈ 0.5 Vd ≈ 1.6

NO ADVERSE EFFECT

RODEO S≈0.020

	EXIST	DEV
Q_{10} CFS	4	3
Q_{100} CFS	17	12

Q_{10} EX & DEV < TC V ≈ 4.1 fps d ≈ 0.5 Vd ≈ 2.

Q_{100} EX & DEV < TC V ≈ 4.1 fps d ≈ 0.5 Vd ≈ 2.0

DELTA ENGINEERING INC.

BY WSC DATE 10/11/91 SUBJECT WISHING WELL EST SHEET NO 3 OF 3
CHKD BY DATE ROADWAYS JOB NO 900902

RED BARN S≈0.020 (JUST NORTH OF WINDMILL)

	EXIST	DEV
Q_{10} CFS	13	12
Q_{100} CFS	54	54

Q_{10} EX & DEV < TC V ≈ 4.1 fps d ≈ 0.5 Vd ≈ 2.0

Q_{100} EX & DEV

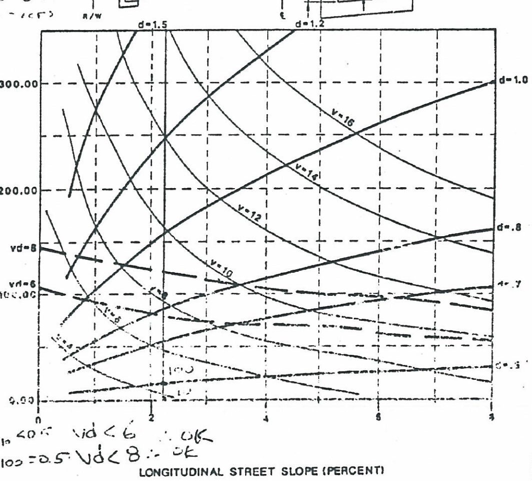
WS ≈ 1.07 V ≈ 5.1 fps d ≈ 0.57' Vd ≈ 2.9

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

STREET CAPACITY CURVES
48 FOOT ROW

WC-4 BEFORE RBS-1 S=0.0225
Q_{100} = 30 cfs
Q_{10} = 4 cfs
Q/2
Q_{100} = 15 cfs
Q_{10} = 2 cfs

10/11/91



$d_{10} < 0.5$ Vd < 6 ∴ OK
$d_{100} = 0.5$ Vd < 8 ∴ OK

EXPLANATION

v velocity (feet per second)
d depth (feet)

Revision	Date

WRC ENGINEERING | REFERENCE: | FIGURE 901

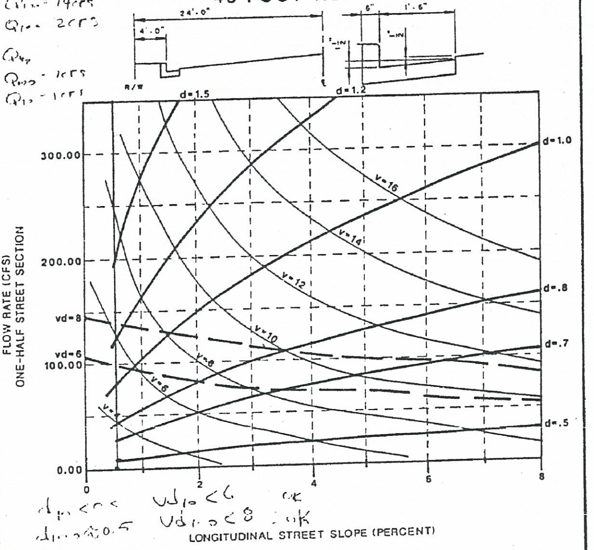
Not Official Copy

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

STREET CAPACITY CURVES
48 FOOT ROW

RBS-5
S=0.005 OUTLET
Q_{100} = 14 cfs
Q_{10} = 2 cfs
$Q_{4\%}$
Q_{100} = 1 cfs
Q_{10} = 1 cfs

10/11/91



d_{10} < 0.5 vd_{10} < 6 ok
d_{100} ≈ 0.5 vd_{100} < 8 ∴ ok

EXPLANATION

v velocity (feet per second)
d depth (feet)

Revision	Date

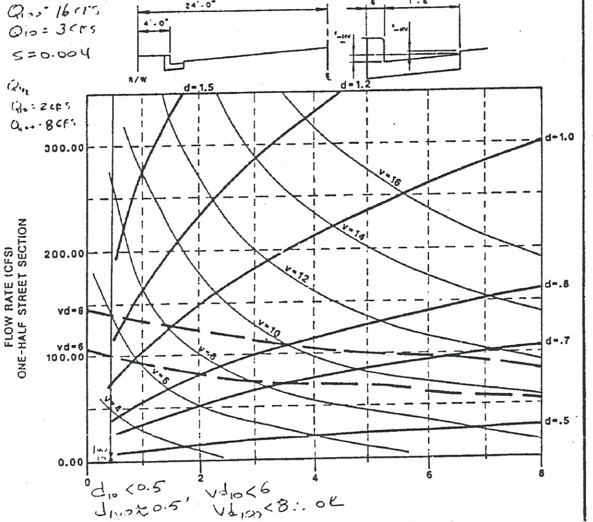
WRC ENGINEERING	REFERENCE:	FIGURE 901

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

STREET CAPACITY CURVES
48 FOOT ROW

SS-2 OUT
UPSTREAM SC-2
Q_{100} = 16 cfs
Q_{10} = 3 cfs
S=0.004
$Q_{1/2}$
Q_{10} = 2 cfs
Q_{100} = 8 cfs

10/11/91



d_{10} < 0.5 vd_{10} < 6
d_{100} ≈ 0.5' vd_{100} < 8 ∴ ok

EXPLANATION

v velocity (feet per second)
d depth (feet)

Revision	Date

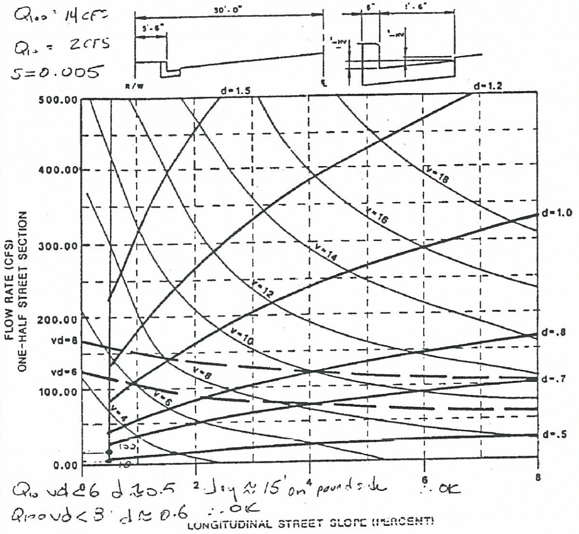
WRC ENGINEERING	REFERENCE:	FIGURE 901

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

STREET CAPACITY CURVES
60 FOOT ROW

CAMERO
1/2 STREET IMPROVEMENT
Q_{100} = 14 cfs
Q_{10} = 2 cfs
S=0.005

10/11/91



Q_{10} vd < 6 d ≈ 0.5 dry ≈ 15' on pound side ∴ ok
Q_{100} vd < 3 d ≈ 0.6 ∴ ok

EXPLANATION

v velocity (feet per second)
d depth (feet)

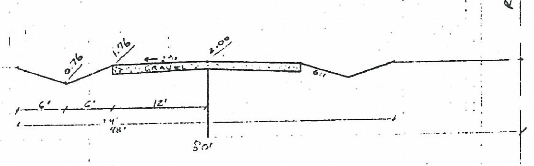
Revision	Date

WRC ENGINEERING	REFERENCE:	FIGURE 903

DELTA ENGINEERING INC

BY WSC DATE 10/11/91 SUBJECT HH/HV SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ JOB NO. 900902

WIGWAM S≈0.005
R/W = 80'
FILLS EVENLY



$Q_{100\,EX}$ = 75 CFS $Q_{100\,DEV}$ = 82 cfs
$Q_{10\,EX}$ = 18 CFS $Q_{10\,DEV}$ = 19 cfs

$Q = \frac{1.486}{n} AR^{2/3} S^{1/2} = \frac{1.486}{0.032} AR^{2/3} (0.005)^{1/2}$

$Q(0.3045) = AR^{2/3}$

$Q_{V\,DITCH} = \frac{1.486}{0.032} 6(1)^2 \left[\frac{6(1)}{2(37)}\right]^{2/3} (0.005)^{1/2} = 12.3$ CFS

V = 12.3/6 = 2.0 fps
d = 1.0
vd = 2.0 < 6 ∴ ok

① Q_{10}'s contained in "V" DITCH BOTH EXIST & DEVELOPED

$Q_{TOP\,ROAD}$

A = 2[28(0.24) + 12/2 + 12/2(0.24)] = 28.32 SF
P = 2[16 + 2(1² + 6²)^{1/2} + (0.24² + 12²)^{1/2}] = 80.34 FT
R = A/P = 0.3525 FT

$Q = \frac{1.486}{0.032}(28.32)(0.3525)^{2/3}(0.005)^{1/2} = 46.4$ CFS

d = TOP ROAD + 0.1'
A = 28.32 + 80 × 0.1 = 36.32 FT²
P = 80.34 R = 0.4521 Q = 70.2 cfs V = 1.9 fps

d = TOP ROAD + 0.15'
A = 40.32 SF R = 0.5019 Q = 83.6 cfs V = 2.1 fps

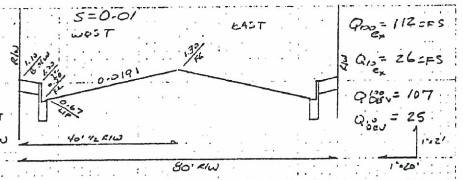
$Q_{100\,EX}$ ≈ TOP + 0.12' $Q_{100\,DEV}$ ≈ TOP + 0.14' Δ ≈ 0.02'

DELTA ENGINEERING INC

BY WSC DATE 10/11/91 SUBJECT HH/HV SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ SPENCER NORTH OF WINDMILL JOB NO. 900902

S=0.01

FILLS EAST 1/2 FIRST PER EX DESIGN MATCH



$Q_{100\,ex}$ = 112 cfs
$Q_{10\,ex}$ = 26 cfs
Q_{DEV}^{100} = 107
Q_{DEV}^{10} = 25

ASSUME NO FLOW BEYOND R/W & n=0.016

$Q_{TC/SIDE}$ A = 1.5(0.5) + 0.33/0.0191 (0.33/2) = 3.60 SF
P = 2 + [(0.33/0.0191)² + 0.33²]^{1/2} = 19.28 R = 0.1867

$Q = \frac{1.486}{0.016}(3.60)(0.1867)^{2/3}(0.01)^{1/2} = 10.92$ CFS V = 3.03 fps

$Q_{B/SW/SIDE}$ A = 1.5(0.6) + 0.5(0.1) + 5(0.1/2) + 0.43/0.0191 (0.43/2) = 6.04 SF
P = 5 + 7.5 + [(0.43/0.0191)² + 0.43²]^{1/2} = 30.02 R = 0.2012

Q = 19.26 CFS V = 3.19 fps

$Q_{TOP\,R/W\,SIDE}$ A = 5(0.2 ...) + 0.5(...) + 1.5(0.8) + 0.67/2 (33) = 13.66 SF
P = 5 + 25 + (33² + 0.67²)^{1/2} = 40.51 R = 0.3372

Q = 61.46 CFS V = 4.50 fps

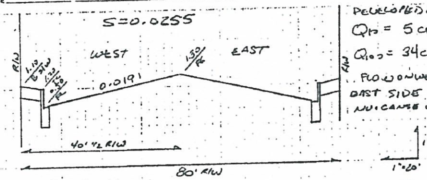
ENTIRE R/W
Q_{10} = 25 CFS WS ≈ 1.13 ON EAST HALF ONLY ∴ WEST DRY 18.9' DRY WEST
V ≈ 3.3 fps d = 0.63 vd ≈ 2.1 < 6 ∴ OK

Q_{100} = 107 CFS EAST FULL 61.46 cfs ∴ 45.54 cfs ON WEST
WS WEST ≈ 1.22 V ≈ 3.8 fps d ≈ 0.72' Vd = 2.7 < 8 ∴ OK
DRY WEST ONLY ≈ 4.2'

DELTA ENGINEERING INC

BY WSC DATE 10/11/91 SUBJECT HH/HV SHEET NO. ____ OF ____
CHKD BY ____ DATE ____ SPENCER @ SC-2 JOB NO. 900902

S=0.0255



DEVELOPED FLOWS
Q_{10} = 5 cfs
Q_{100} = 34 cfs
∴ FLOW ON WEST SIDE
EAST SIDE NUISANCE ONLY

ASSUME NO FLOW BEYOND R/W & n=0.016

$Q_{TC/SIDE}$ A = 3.6 SF P = 19.28 R = 0.1867
$Q = \frac{1.486}{0.016}(3.60)(0.1867)^{2/3}(0.0255)^{1/2} = 17.44$ CFS V = 4.84 fps

$Q_{B/SW/SIDE}$ A = 6.04 SF P = 30.02 R = 0.2012
Q = 30.76 CFS V = 5.09 fps

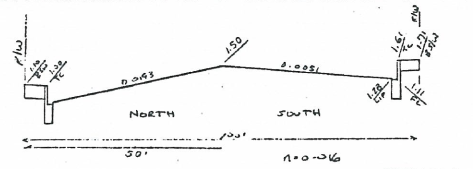
$Q_{TOP\,R/W\,SIDE}$ A = 13.66 SF P = 40.51 R = 0.3372
Q = 78.15 CFS V = 7.13 fps

Q_{10} < TC V ≈ 4.8 d < 0.5 vd < 6 ∴ OK
DRY > 15.7' ON WEST SIDE

Q_{100} WS ≈ 1.11 dry ≈ 9.9' ON WEST SIDE
d = 0.61' V ≈ 5.2 fps vd ≈ 3.2 < 8 ∴ OK

DELTA ENGINEERING INC

BY WSC DATE 10/11/91 SUBJECT WINDMILL NEAR MARTINGALE SHEET NO ____ OF ____
CHKD BY ____ DATE ____ JOB NO 900902



Q_{10} = 5 CFS
Q_{100} = 37 CFS

S = 0.0051 SOUTH & NORTH

OK TO ALLOW STORM FLOW ACROSS WINDMILL PER TCON ROBERT THOMPSON 1/1/91

Q @ WS = 1.50
A = 0.39(1.5) + 0.22/2 (0.22/0.0051) = 5.33 SF
P = 0.39 + 1.5 + 43 = 44.9'
$Q = \frac{1.486}{0.016}(5.33)\left(\frac{5.33}{44.9}\right)^{2/3}(0.0051)$ = 8.5 CFS ≈ 8 CFS
V ≈ 1.6 fps

∴ EAST ON WINDMILL ≈ 8 CFS
ACROSS TO NORTH SIDE 37 − 8 = 29 CFS Q_{100}
5 − 8 = 0 CFS Q_{10}

SOUTH Vd_{100} = 1.6(0.39) = 0.6

NORTH 29 CFS @ Q_{100}
TC A = 0.5(1.5) + 0.33/2 (0.33/0.0193) = 3.57 SF P = 19.1'
Q = 7.7 CFS V = 2.2 fps

B S/W A = 5.99 SF P = 29.78'
WS=1.1 Q = 13.6 CFS V = 2.3 fps vd = 1.4

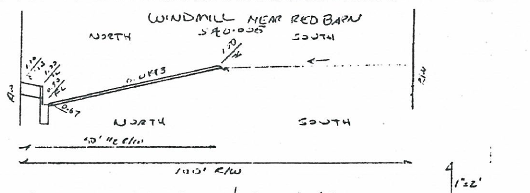
WS=1.50 A = 21.84 SF P = 50.51'
Q = 82.8 CFS V = 3.8 fps vd = 3.8

Q_{100} = 29 CFS
WS ≈ 1.2 V ≈ 2.6 fps vd ≈ 1.8

DELTA ENGINEERING INC

BY WSC DATE 10/11/91 SUBJECT HH/HV SHEET NO ____ OF ____
CHKD BY ____ DATE ____ JOB NO 900902

WINDMILL NEAR RED BARN
S≈0.005



ASSUME NO FLOW BEYOND R/W & n=0.016 AC
1/2 STREET IN NORTH HALF ONLY

	EXIST	DEVELOPED
Q10	13 cfs	12 cfs
Q100	54 cfs	54 cfs

TC A = 1.5(0.5) + 1/2 0.33 × 0.33/0.0193 = 3.57 SF P = 2 + 0.33/0.0193 = 19.1'
$Q = \frac{1.486}{0.016}(3.57)\left(\frac{3.57}{19.1}\right)^{2/3}(0.005)^{1/2} = 7.7$ CFS

B/SW A = 1.5(0.6) + 5(0.1/2) + 1/2 0.43 × 0.43/0.0193 = 5.94 SF P = 2 + 5.5 + 0.43/0.0193 = 29.8
Q = 13.3 CFS V = 2.2 fps

FG (1.50) A = 1.5(1) + 0.5(...) + 5(0.45) + 45(...) = 21.75 SF P = 50.5'
Q = 81.3 CFS V = 3.7 fps

d_{10} ≈ B/SW d ≈ 0.6 V ≈ 2.2 fps Vd ≈ 1.3

d_{100} ≈ WS ≈ 1.34 d ≈ 0.84' V ≈ 3.1 fps

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BY WSC DATE 10/11/91 SUBJECT AH/HV SHEET NO. ___ OF ___

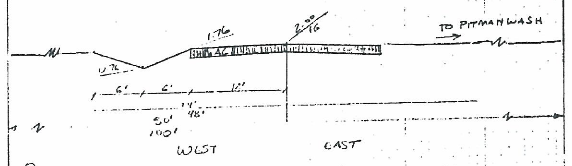
CHKD BY ___ DATE ___ JOB NO. 900902

EASTERN S=0.0050 (MIN). SOUTH OF WIGWAM

RW = 100'

	Q_{100}	Q_{10}
EXIST	75	18
DEVELOP	82	19

FILLS WEST UP FIRST


1.76
2.0%
16
AC
TO PITMAN WASH
6'
6'
12'
14'
48'
50'
100'
WEST
EAST

Q_{10}

$Q_{V\text{-DITCH (WIGWAM)}} = 12.3$ CFS V = 2 fps

Q_{10} TO CL WEST ½ =

$A = \frac{12}{2} + \frac{12}{2}(0.24) + 38(0.24) = 16.56$ SF

$P = 26 + 2(1^2+6^2)^{1/2} + (0.24^2+12^2)^{1/2} = 50.17$ R = 0.3301

$Q = \frac{1.486}{0.032}(16.56)(0.3301)^{2/3}(0.005)^{1/2} = 26.0$ CFS V = 1.6 fps

Q_{10} UNDER FILL LOT WEST HALF LEAVES EAST DRY

Q_{100} FULL ROAD TO 16 @ CL REST OVERFLOWS

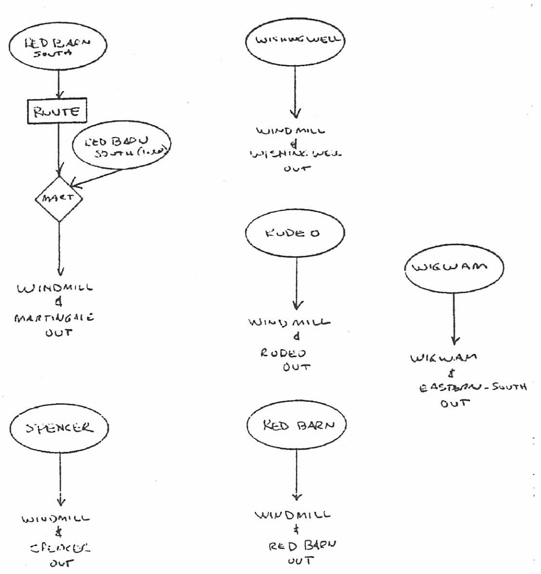
	EXIST	DEVELOPED
OVERFLOW	49 CFS	56 CFS

THIS FLOW SPREADS SOUTH OF AND AWAY FROM EXIST DEVELOPMENT

DELTA ENGINEERING INC.

BY WSC DATE 10/11/91 SUBJECT FLOW CHART EXIST SHEET NO. 1 OF 1

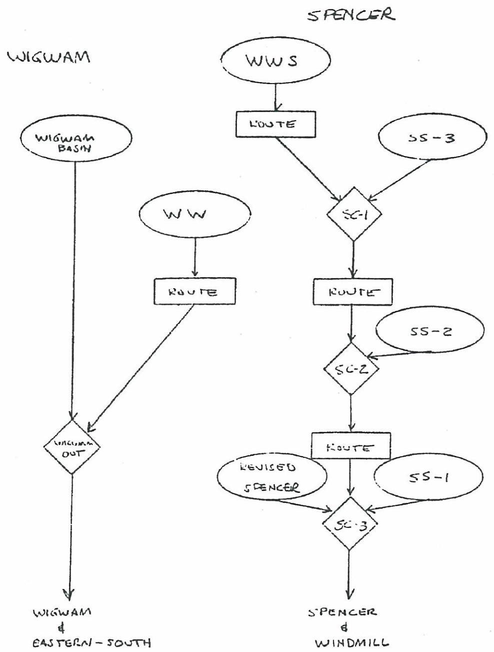
CHKD BY DATE JOB NO. 900902


RED BARN SOUTH
ROUTE
RED BARN SOUTH (100)
MART
WINDMILL & MARTINGALE OUT
WISHING WELL
WINDMILL & WISHING WELL OUT
RODEO
WINDMILL & RODEO OUT
WIGWAM
WIGWAM & EASTERN-SOUTH OUT
SPENCER
WINDMILL & SPENCER OUT
RED BARN
WINDMILL & RED BARN OUT

DELTA ENGINEERING INC.

BY WSC DATE 10/11/91 SUBJECT FLOW CHART-PROPOSED DEVELOPED SHEET NO. 1 OF 2

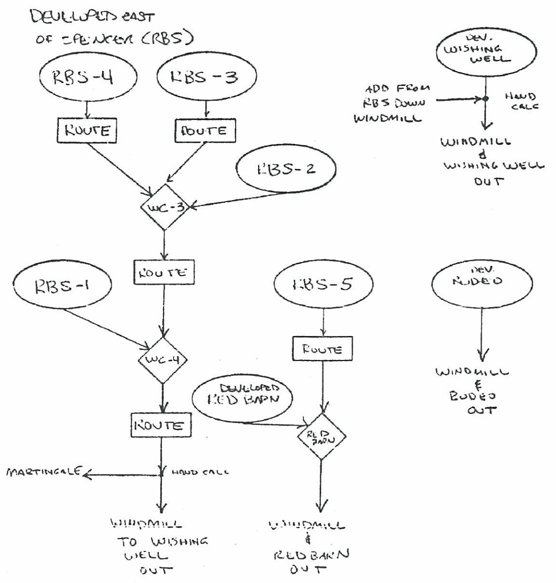
CHKD BY ___ DATE ___ JOB NO. 900902


SPENCER
WIGWAM
WWS
ROUTE
SS-3
SC-1
WIGWAM BASIN
WW
ROUTE
ROUTE
SS-2
SC-2
WIGWAM OUT
ROUTE
REVISED SPENCER
SS-1
SC-3
WIGWAM & EASTERN-SOUTH
SPENCER & WINDMILL

DELTA ENGINEERING INC.

BY WSC DATE 10/11/91 SUBJECT FLOW CHART PROPOSED DEVELOPED SHEET NO. 2 OF 2

CHKD BY ___ DATE ___ JOB NO. 900902


DEVELOPED EAST OF SPENCER (RBS)
RBS-4
RBS-3
ROUTE
ROUTE
RBS-2
WC-3
ROUTE
RBS-1
WC-4
ROUTE
MARTINGALE
HAND CALC
WINDMILL TO WISHING WELL OUT
RBS-5
ROUTE
DEVELOPED RED BARN
RED BARN
WINDMILL & RED BARN OUT
DEV. WISHING WELL
ADD FROM RBS DOWN WINDMILL
HAND CALC
WINDMILL & WISHING WELL OUT
DEV. RODEO
WINDMILL & RODEO OUT

DELTA ENGINEERING INC.

BY WSC DATE 10/11/91 SUBJECT HH/HV SHEET NO. ___ OF ___

CHKD BY DATE JOB NO. 900902

Extension lot channels n≈0.013 W=10 Z=0

CONC LINED

RBS-5 S=0.01

Q_{100} = 14 CFS

WC-1 S=0.01

Q_{100} = 11 CFS

WC-4 S=0.005

Q_{100} = 37 CFS

$$Q = \frac{1.486}{0.013} AR^{2/3} (0.01)^{1/2}$$

$$A = 10y$$

$$R = \frac{10y}{10+2y}$$

$\overset{S=0.01}{Q}=11,\ AR^{2/3}=1.27$ $\overset{S=0.01}{Q}=11,\ AR^{2/3}=0.96$ $\overset{S=0.005}{Q}=37,\ AR^{2/3}=4.58$

y	0.5	0.6	0.2	0.3	0.6	0.7
$AR^{2/3}$	2.96	3.96	0.67	1.29	3.96	5.06

RBS-5 Q_{100} = 14 CFS

$y_n = 0.29'$

WC-1 Q_{100} = 11 CFS

$y_n = 0.25'$

WC-4 Q_{100} = 37 CFS

$y_n = 0.66'$

10/9/91
EX.OUT

EXIST
1 of 4

```
1                                      ****
                FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
    U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                       ****


 THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3


1                                 HEC-1 INPUT                                     PAGE  1

 LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1        ID
   2        ID
   3        ID               HORIZON HILLS/VISTAS
   4        ID
            ID
   5        ID
   6        ID           EXISTING
   7        ID           RATIO 1=10 YEAR
   8        ID           RATIO 2=100 YEAR
   9        ID
  10        ID
  11        IT      2       0       0     300
  12        IO      5       0       0
  13        IN      2       0       0
  14        JR   PREC    .565     .99

  15        KK   SPNCR
  16        BA   .5021
  17        PB    2.77
  18        PC    0.00    .008    .016    .027    .042    .057    .062    .067    .073    .080
  19        PC    .087   .0954    .101    .111    .118    .124    .126    .129    .130    .130
  20        PC    .130    .130    .130    .130    .130    .130    .130    .130    .130    .130
  21        PC    .130    .131    .132    .134    .137    .140    .141    .142    .143    .146
  22        PC    .148    .152    .156    .161    .166    .172    .176    .179    .183    .186
  23        PC    .190    .193    .196    .197    .198    .199    .199    .200    .200    .201
  24        PC    .201    .202    .203    .206    .210    .214    .220    .226    .231    .236
  25        PC    .241    .244    .247    .249    .250    .251    .253    .255    .259    .264
  26        PC    .270    .273    .276    .279    .280    .281    .282    .283    .283    .284
  27        PC    .295    .306    .317    .328    .340    .352    .375    .398    .427    .463
  28        PC    .499    .535    .572    .614    .662    .710    .724    .737    .751    .766
  29        PC    .781    .793    .806    .813    .816    .819    .825    .832    .838    .845
  30        PC    .851    .857    .855    .857    .858    .860    .863    .866    .870    .873
```

---

2 of 4

```
  31        PC    .876    .881    .886    .892    .901    .919    .916    .923    .928    .933
  32        PC    .937    .942    .947    .954    .962    .970    .972    .975    .977    .980
  33        PC    .982    .983    .984    .985    .986    .987    .988    .989    .989    .990
  34        PC    .990    .991    .992    .993    .993    .993    .993    .994    .994    .995
  35        PC    .995    .995    .997    .996    .998    .998    .998    .999    .999    .999
  36        PC    1.00
  37        LS       0      77
  38        UD     .69

  39        KK  RBSouth
  40        BA   .0189
  41        LS       0      77
  42        UD     .56

  43        KK  RT RBS-1
  44        RK    1600     .01    .032            TRAP       0       6

  45        KK  RT RBS-2
  46        RK    1100     .02    .032            TRAP       0       6
1                                 HEC-1 INPUT                                     PAGE  2

 LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  47        KK  MARTINGALE
  48        BA   .1018
  49        LS       0      77
  50        UD     .62

  51        KK  MARTOUT
  52        HC       2

  53        KK  WISHING WELL
  54        BA   .0203
  55        LS       0      77
  56        UD     .27

  57        KK  RODEO
  58        BA   .0277
  59        LS       0      77
  60        UD     .29

  61        KK  RED BARN
  62        BA   .1251
  63        LS       0      77
  64        UD     .55

  65        KK  WIGWAM
  66        BA   .2021
  67        LS       0      77
  68        UD     .69
  69        ZZ
1
             SCHEMATIC DIAGRAM OF STREAM NETWORK

 INPUT
 LINE     (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

  15      SPNCR
            .
            .
  39        .      RBSou
            .        V
```

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3 of 4

```
  43      .      RT RB
          .        V
          .        V
  45      .      RT RB
          .        .
          .        .
  47      .        .        MARTI
          .        .          .
          .        .          .
  51      .      MARTO..........
          .        .
          .        .
  53      .        .        WISHI
          .        .          .
          .        .          .
  57      .        .          .        RODEO
          .        .          .          .
          .        .          .          .
  61      .        .          .          .        RED B
          .        .          .          .          .
          .        .          .          .          .
  65      .        .          .          .          .        WIGWA

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
                                       ****
1               FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
    U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                       ****



                             HORIZON HILLS/VISTAS


                          EXISTING
                          RATIO 1=10 YEAR
                          RATIO 2=100 YEAR


 10 IO        OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                    NMIN          2  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       0958  ENDING TIME

               COMPUTATION INTERVAL     .03 HOURS
                    TOTAL TIME BASE    9.97 HOURS

       ENGLISH UNITS

   JP         MULTI-PLAN OPTION
                   NPLAN          1  NUMBER OF PLANS

   JR         MULTI-RATIO OPTION
```

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```
     JR      MULTI-RATIO OPTION
               RATIOS OF PRECIPITATION
              .56      .99
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
                                                         .56      .99

HYDROGRAPH AT
+                SFNCR       .30      1   FLOW          26.     112.
                                          TIME         4.27     4.20

HYDROGRAPH AT
+                RESOU       .02      1   FLOW           2.       8.
                                          TIME         4.13     4.07

ROUTED TO
+                RT RB       .02      1   FLOW           2.       8.
                                          TIME         4.30     4.17

ROUTED TO
+                RT RB       .02      1   FLOW           2.       8.
                                          TIME         4.37     4.20

HYDROGRAPH AT
+                MARTI       .10      1   FLOW          10.      40.
                                          TIME         4.20     4.10

 2 COMBINED AT
+                MARTO       .12      1   FLOW          11.      48.
                                          TIME         4.23     4.13

HYDROGRAPH AT
+                WISHI       .02      1   FLOW           3.      13.
                                          TIME         3.77     3.73

HYDROGRAPH AT
+                RDNEG       .03      1   FLOW           4.      17.
                                          TIME         3.80     3.73

HYDROGRAPH AT
+                RED B       .13      1   FLOW          13.      54.
                                          TIME         4.10     4.03

HYDROGRAPH AT
+                WIGWA       .20      1   FLOW          15.      73.
                                          TIME         4.27     4.20


*** NORMAL END OF HEC-1 ***
```

HH2-OUT
10/1/91

DEVELOPED

1of9

```
                                          ****
             FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM AT 512K VERSION) -FEB 1,1985
   U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                          ****



 THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3


                                       HEC-1 INPUT                                        PAGE  1
1
  LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

    1           ID
    2           ID
    3           ID                HORIZON HILLS/VISTAS
    4           ID
               *DIAGRAM
    5           ID
    6           ID             DEVELOPED
    7           ID             RATIO 1=10 YEAR
    8           ID             RATIO 2=100 YEAR
    9           ID
   10           ID
   11           IT       2       0       0     300
   12           IO       5       0       0
   13           IN       2       0       0
   14           JR    PREC    .565     .99

   15           KK  RSFNCR
   16           BA   .2971
   17           PB    2.77
   18           PC    0.00    .008    .016    .027    .042    .057    .062    .067    .073    .080
   19           PC    .087   .0954    .101    .111    .118    .124    .126    .129    .130    .130
   20           PC    .130    .130    .130    .130    .130    .130    .130    .130    .130    .130
   21           PC    .130    .131    .132    .134    .137    .140    .141    .142    .143    .146
   22           PC    .148    .152    .156    .161    .166    .172    .176    .179    .183    .186
   23           PC    .190    .193    .196    .197    .198    .199    .199    .200    .200    .201
   24           PC    .201    .202    .203    .206    .210    .214    .220    .226    .231    .236
   25           PC    .241    .244    .247    .249    .250    .251    .253    .255    .259    .264
   26           PC    .270    .273    .276    .279    .280    .281    .282    .283    .283    .284
   27           PC    .295    .306    .317    .328    .340    .352    .375    .398    .427    .463
   28           PC    .499    .533    .572    .614    .662    .710    .724    .737    .751    .766
   29           PC    .781    .793    .806    .813    .816    .819    .825    .832    .838    .845
   30           PC    .851    .853    .855    .857    .858    .860    .863    .866    .870    .873
```

2of9

```
   28           PC    .499    .533    .572    .614    .662    .710    .724    .737    .751    .766
   29           PC    .781    .793    .806    .813    .816    .819    .825    .832    .838    .845
   30           PC    .851    .853    .855    .857    .858    .860    .863    .866    .870    .873
   31           PC    .876    .881    .886    .892    .901    .910    .916    .923    .928    .933
   32           PC    .937    .942    .947    .954    .962    .970    .972    .975    .977    .980
   33           PC    .982    .983    .984    .985    .986    .987    .988    .989    .989    .990
   34           PC    .990    .991    .992    .993    .993    .993    .993    .994    .994    .995
   35           PC    .995    .996    .997    .998    .998    .998    .998    .999    .999    .999
   36           PC    1.00
   37           LS       0      77
   38           UD     .71

   39           KK     WWS
   40           BA   .0261
   41           LS       0      77
   42           UD     .49

   43           KK  RT WWS1.1
   44           RK     700     .01    .016            TRAP      35       0

   45           KK  RT WWS1.2
   46           RK     600    .022    .016            TRAP      35       0
                                       HEC-1 INPUT                                        PAGE  2
1
  LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


   47           KK    SS-3
   48           BA   .0308
   49           LS       0      70
   50           UD     .19

   51           KK    SC-1
   52           HC       2

   53           KK  RT SC2-1
   54           RK     500    .021    .016            TRAP      35       0

   55           KK  RT SC2-2
   56           RK     400   .0075    .016            TRAP      35       0

   57           KK    SS-2
   58           BA   .0242
   59           LS       0      75
   60           UD     .18

   61           KK    SC-2
   62           HC       2

   63           KK  RT SC3-1
   64           RK     270    .012    .016            TRAP      35       0

   65           KK  RT SC3-2
   66           RK     450    .026    .016            TRAP      35       0

   67           KK    SS-1
   68           BA   .0138
   69           LS       0      75
   70           UD     .17

   71           KK    SC-3
   72           HC       3

   73           KK   RBS-4
   74           BA   .0254
   75           LS       0      70
```

3of9

```
   75           LS       0      70
   76           UD     .23

   77           KK  RT WC3-1.1
   78           RK     220     .01    .013            TRAP      10       0

   79           KK  RT WC3-1.2
   80           RK    1000    .005    .016            TRAP      41       0

   81           KK   RBS-3
   82           BA   .0111
   83           LS       0      75
   84           UD     .19
                                       HEC-1 INPUT                                        PAGE  3
1
  LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


   85           KK  RT WC3-2
   86           RK     800    .004    .016            TRAP      41       0

   87           KK   RBS-2
   88           BA   .0219
   89           LS       0      75
   90           UD     .15

   91           KK    WC-3
   92           HC       3

   93           KK  RT WC-4
   94           RK     850    .004    .016            TRAP      41       0

   95           KK   RBS-1
   96           BA   .0164
   97           LS       0      75
   98           UD     .15

   99           KK    WC-4
  100           HC       2

  101           KK  RT WC5-4.1
  102           RK     110    .005    .013            TRAP      10       0

  103           KK   RBS-5
  104           BA   .0304
  105           LS       0      70
  106           UD     .18

  107           KK  RT RBS5.1
  108           RK     150     .01    .013            TRAP      10       0

  109           KK  RT RBS5.2
  110           RK     250    .005    .016            TRAP      25       0

  111           KK  RT RBS5.3
  112           RK     500    .005    .032            TRAP       0       5

  113           KK  RT RBS5.4
  114           RK    2000     .02    .032            TRAP       0      12

  115           KK  DESDEAPN
  116           BA   .0947
  117           LS       0      77
  118           UD     .51
```

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```
  119           KK  RB OUT
  120           HC       2
1                                      HEC-1 INPUT                                        PAGE  4

  LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  121           KK  DWISHWELL
  122           BA   .0071
  123           LS       0      77
  124           UD     .18

  125           KK  DRODED
  126           BA   .0205
  127           LS       0      77
  128           UD     .33

  129           KK    WWEX
  130           BA   .2021
  131           LS       0      77
  132           UD     .69

  133           KK      WW
  134           BA   .0189
  135           LS       0      77
  136           UD     .56

  137           KK   RT WW
  138           RK    2300    .005    .032            TRAP       0       6

  139           KK  WW OUT
  140           HC       2
  141           ZZ
1
          SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

  15    RSFNC
          .
          .
  39      .      WWS
          .        V
          .        V
  43      .      RT WW
          .        V
          .        V
  45      .      RT WW
          .        .
          .        .
  47      .        .       SS-3
          .        .          .
          .        .          .
  51      .      SC-1 ..........
          .        V
          .        V
  53      .      RT SC
          .        V
          .        V
  55      .      RT SC
          .        .
          .        .
```

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```
  55      .      RT SC
          .        .
          .        .
  57      .        .       SS-2
          .        .          .
          .        .          .
  61      .      SC-2 ..........
          .        V
          .        V
  63      .      RT SC
          .        V
          .        V
  65      .      RT SC
          .        .
          .        .
  67      .        .       SS-1
          .        .          .
          .        .          .
  71    SC-3 ......................
          .
          .
  73      .      RBS-4
          .        V
          .        V
  77      .      RT WC
          .        V
          .        V
  79      .      RT WC
          .        .
          .        .
  81      .        .       RBS-3
          .        .          V
          .        .          V
  85      .        .       RT WC
          .        .          .
          .        .          .
  87      .        .          .       RBS-2
          .        .          .          .
          .        .          .          .
  91      .      WC-3 .....................
          .        V
          .        V
  93      .      RT WC
          .        .
          .        .
  95      .        .       RBS-1
          .        .          .
          .        .          .
  99      .      WC-4 ..........
          .        V
          .        V
 101      .      RT WC
          .        .
          .        .
 103      .        .       RBS-5
          .        .          V
          .        .          V
 107      .        .       RT RB
          .        .          V
          .        .          V
 109      .        .       RT RB
          .        .          V
          .        .          V
 111      .        .       RT RB
                              V
```

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```
                        V
                        V
  113      .     .    RT RB
           .     .      .
  115      .     .      .     DREDB
           .     .      .       .
           .     .      .       .
  119      .     .    RB OU.........
           .     .      .
           .     .      .
  121      .     .      .     DWISH
           .     .      .       .
           .     .      .       .
  125      .     .      .       .      BRODE
           .     .      .       .        .
  129      .     .      .       .        .      ANEX
           .     .      .       .        .        .
           .     .      .       .        .        .
  133      .     .      .       .        .        .      WW
           .     .      .       .        .        .       V
           .     .      .       .        .        .       V
  137      .     .      .       .        .        .     RT WW
           .     .      .       .        .        .       .
           .     .      .       .        .        .       .
  139      .     .      .       .        .      WW OU.........

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
                                        ****
1
                    FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM AT SIDL VERSION) -FEB 1,1985
          U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                        ****



                              HORIZON HILLS/VISTAS


                           DEVELOPED
                           RATIO 1=10 YEAR
                           RATIO 2=100 YEAR



  12 IO        OUTPUT CONTROL VARIABLES
                    IPRNT            5  PRINT CONTROL
                    IPLOT            0  PLOT CONTROL
                    QSCAL           0.  HYDROGRAPH PLOT SCALE

    IT         HYDROGRAPH TIME DATA
                    NMIN             2  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         0958  ENDING TIME

                COMPUTATION INTERVAL     .03 HOURS
                     TOTAL TIME BASE    9.97 HOURS

          ENGLISH UNITS
```

---

7 of 9

```
          ENGLISH UNITS

      JP         MULTI-PLAN OPTION
                    NPLAN         1  NUMBER OF PLANS

      JR         MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                     .56     .99
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
                                                          .56      .99

 HYDROGRAPH AT
+                RSPNC        .23      1    FLOW        20.      84.
                                            TIME       4.30     4.20

 HYDROGRAPH AT
+                WWS          .03      1    FLOW         3.      12.
                                            TIME       4.03     3.97

 ROUTED TO
+                RT WW        .03      1    FLOW         3.      12.
                                            TIME       4.10     4.03

 ROUTED TO
+                RT WW        .03      1    FLOW         3.      12.
                                            TIME       4.17     4.07

 HYDROGRAPH AT
+                SS-3         .03      1    FLOW         2.      14.
                                            TIME       3.77     3.63

  2 COMBINED AT
+                SC-1         .06      1    FLOW         4.      20.
                                            TIME       4.10     3.83

 ROUTED TO
+                RT SC        .06      1    FLOW         4.      20.
                                            TIME       4.13     3.87

 ROUTED TO
+                RT SC        .06      1    FLOW         4.      20.
                                            TIME       4.17     3.87

 HYDROGRAPH AT
+                SS-2         .02      1    FLOW         2.      16.
                                            TIME       3.67     3.63

  2 COMBINED AT
+                SC-2         .08      1    FLOW         5.      34.
                                            TIME       4.00     3.70

 ROUTED TO
+                RT SC        .08      1    FLOW         5.      34.
                                            TIME       4.03     3.70

 ROUTED TO
+                RT SC        .08      1    FLOW         5.      33.
```

---

8 of 9

```
+                RT SC        .08      1    FLOW         5.      33.
                                            TIME       4.07     3.73

 HYDROGRAPH AT
+                SS-1         .01      1    FLOW         2.       9.
                                            TIME       3.67     3.60

  3 COMBINED AT
+                SC-3         .33      1    FLOW        25.     107.
                                            TIME       4.23     4.13

 HYDROGRAPH AT
+                RBS-4        .03      1    FLOW         1.      11.
                                            TIME       3.83     3.70

 ROUTED TO
+                RT NC        .03      1    FLOW         1.      11.
                                            TIME       3.83     3.70

 ROUTED TO
+                RT NC        .03      1    FLOW         1.      10.
                                            TIME       4.07     3.77

 HYDROGRAPH AT
+                RBS-3        .01      1    FLOW         1.       7.
                                            TIME       3.70     3.63

 ROUTED TO
+                RT NC        .01      1    FLOW         1.       7.
                                            TIME       3.87     3.70

 HYDROGRAPH AT
+                RBS-2        .02      1    FLOW         3.      15.
                                            TIME       3.67     3.63

  3 COMBINED AT
+                NC-3         .06      1    FLOW         4.      30.
                                            TIME       4.07     3.70

 ROUTED TO
+                RT NC        .06      1    FLOW         4.      30.
                                            TIME       4.10     3.77

 HYDROGRAPH AT
+                RBS-1        .02      1    FLOW         2.      12.
                                            TIME       3.63     3.60

  2 COMBINED AT
+                NC-4         .07      1    FLOW         5.      38.
                                            TIME       3.90     3.73

 ROUTED TO
+                RT NC        .07      1    FLOW         5.      37.
                                            TIME       3.90     3.73

 HYDROGRAPH AT
+                RBS-5        .03      1    FLOW         2.      14.
                                            TIME       3.77     3.63

 ROUTED TO
+                RT RB        .03      1    FLOW         2.      14.
                                            TIME       3.80     3.63

 ROUTED TO
                 RT RB        .03      1    FLOW         2.      14.
```

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9 of 9

```
                                            TIME       3.77     3.63

 ROUTED TO
+                RT RB        .03      1    FLOW         2.      14.
                                            TIME       3.80     3.63

 ROUTED TO
+                RT RB        .03      1    FLOW         2.      14.
                                            TIME       3.83     3.67

 ROUTED TO
+                RT RB        .03      1    FLOW         2.      14.
                                            TIME       3.87     3.70

 ROUTED TO
+                RT RB        .03      1    FLOW         2.      13.
                                            TIME       4.13     3.83

 HYDROGRAPH AT
+                DREDB        .09      1    FLOW        10.      43.
                                            TIME       4.07     4.00

  2 COMBINED AT
+                RB OU        .13      1    FLOW        12.      54.
                                            TIME       4.10     3.93

 HYDROGRAPH AT
+                DWISH        .01      1    FLOW         1.       5.
                                            TIME       3.67     3.63

 HYDROGRAPH AT
+                BRODE        .02      1    FLOW         3.      12.
                                            TIME       3.87     3.80

 HYDROGRAPH AT
+                ANEX         .30      1    FLOW        18.      75.
                                            TIME       4.27     4.20

 HYDROGRAPH AT
+                WW           .02      1    FLOW         2.       9.
                                            TIME       4.13     4.07

 ROUTED TO
+                RT WW        .02      1    FLOW         2.       9
                                            TIME       4.50     4.27

  2 COMBINED AT
+                WW OU        .22      1    FLOW        19.      82.
                                            TIME       4.33     4.20


*** NORMAL END OF HEC-1 ***
```

Not Official Copy

NOT LEGIBLE FOR MICROFILM

NOTICE TO THE CONTRACTOR

1. ALL CONSTRUCTION AND MATERIALS SHALL CONFORM WITH THE LATEST EDITION OF THE "UNIFORM STANDARD SPECIFICATIONS AND DRAWINGS FOR PUBLIC WORKS CONSTRUCTION, CLARK COUNTY AREA, CLARK COUNTY, NEVADA", EXCEPT AS NOTED.
2. ALL WORK DONE WITHIN THE PUBLIC RIGHT-OF-WAY AND OUTSIDE OF THE PROJECT BOUNDARIES REQUIRES A SEPARATE ENCROACHMENT PERMIT ISSUED BY THE CLARK COUNTY DEPARTMENT OF PUBLIC WORKS. TRENCH AND PAVEMENT REPLACEMENT CONDITIONS SHALL BE AS PER THE PERMIT.
3. POWER POLES AND/OR OTHER EXISTING FACILITIES NOT SHOWN IN PROPER LOCATION BASED ON PROPOSED IMPROVEMENTS SHOWN HEREON WILL BE RELOCATED AT NO EXPENSE TO CLARK COUNTY.
4. EXACT LOCATION OF ALL SAWCUT LINES SHALL BE DETERMINED IN THE FIELD BY A CLARK COUNTY INSPECTOR.
5. WHEELCHAIR RAMPS SHALL BE CONSTRUCTED IN EACH QUADRANT OF AN INTERSECTION PER STANDARD DRAWING NO. 118. EXACT LOCATION OF THE RAMPS SHALL BE DETERMINED IN THE FIELD BY A CLARK COUNTY INSPECTOR.
6. PRIVATE STREETS AND/OR DRIVEWAYS REFLECTED ON THESE PLANS ARE TO BE INSPECTED BY A CLARK COUNTY INSPECTOR.
7. FINAL ASPHALTIC CONCRETE (AC) PAVEMENT SURFACES SHALL BE ONE-HALF INCH ABOVE THE LIP OF THE GUTTER (INCLUDING OPEN GRADE).
8. EXISTING UTILITIES ARE LOCATED ON PLANS FOR THE CONVENIENCE OF THE CONTRACTOR ONLY. THE CONTRACTOR SHALL BEAR FULL RESPONSIBILITY FOR THE PROTECTION OF UTILITIES. NEITHER THE ENGINEER NOR CLARK COUNTY SHALL BEAR ANY RESPONSIBILITY FOR UTILITIES NOT SHOWN ON THE PLANS OR NOT IN THE LOCATION SHOWN ON THE PLANS.
9. CONTRACTOR SHALL PROVIDE ALL NECESSARY HORIZONTAL AND VERTICAL TRANSITION BETWEEN NEW CONSTRUCTION AND EXISTING SURFACE TO PROVIDE FOR PROPER DRAINAGE AND FOR INGRESS AND EGRESS TO SAID CONSTRUCTION. EXTENT OF TRANSITIONS TO BE DETERMINED BY THE COUNTY ENGINEER.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR AVOIDING DAMAGE TO PROPERTY EITHER PUBLIC OR PRIVATE, AND IN THE EVENT OF SUCH DAMAGE SHALL MAKE SATISFACTORY REPAIRS AT HIS OWN EXPENSE.
11. THE QUANTITIES SHOWN HEREON ARE ESTIMATES ONLY AND ARE NOT TO BE USED FOR BIDDING PURPOSES.
12. THESE PLANS WERE PREPARED WITH THAT DEGREE OF CARE AND SKILL ORDINARILY EXERCISED UNDER SIMILAR CIRCUMSTANCES BY OTHER REPUTABLE ENGINEERS PRACTICING IN THE CLARK COUNTY AREA. NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS MADE.

CLARK COUNTY TRAFFIC NOTES

1. BEFORE ANY WORK IS STARTED IN THE RIGHT-OF-WAY, THE CONTRACTOR SHALL INSTALL ALL ADVANCE WARNING SIGNS FOR THE CONSTRUCTION ZONE. THE CONTRACTOR SHALL INSTALL TEMPORARY STOP SIGNS AT ALL NEW STREET ENCROACHMENTS INTO EXISTING STREETS IMMEDIATELY AFTER FIRST GRADING WORK IS ACCOMPLISHED, AND SHALL MAINTAIN SAID SIGNS UNTIL PERMANENT SIGNS ARE INSTALLED.
2. ALL CONSTRUCTION SIGNING, BARRICADING, AND TRAFFIC DELINEATION SHALL CONFORM TO THE "NEVADA WORK ZONE TRAFFIC CONTROL HANDBOOK - 1985" AND TO THE "MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES - 1988".
3. IF THE IMPROVEMENTS NECESSITATE THE OBLITERATION, TEMPORARY OBSTRUCTION, TEMPORARY REMOVAL, OR RELOCATION OF ANY EXISTING TRAFFIC PAVEMENT MARKING, SUCH PAVEMENT MARKING SHALL BE RESTORED OR REPLACED WITH LIKE MATERIALS TO THE SATISFACTION OF THE COUNTY TRAFFIC ENGINEER.
4. THE DEVELOPER SHALL BE RESPONSIBLE TO PROVIDE AND INSTALL ALL PERMANENT SIGNS SHOWN ON THE PLANS. STREET NAME SIGNS SHALL CONFORM IN THEIR ENTIRETY TO CLARK COUNTY STANDARDS. ALL OTHER SIGNS SHALL BE STANDARD SIZE UNLESS OTHERWISE SPECIFIED ON THE PLANS. ALL SIGN POSTS SHALL BE INSTALLED IN ACCORDANCE WITH CLARK COUNTY STANDARDS.
5. IF A PROPOSED STREET LIGHT STANDARD IS FIELD LOCATED TO WITHIN FIVE (5) FEET OF ANY SIGN SHOWN HEREON TO BE MOUNTED ON A SIGN POST, THEN CHANGE SIGN MOUNTING TO BE ON THE STREET LIGHT STANDARD.
6. ALL PERMANENT TRAFFIC CONTROL DEVICES CALLED FOR HEREON SHALL BE IN PLACE AND IN FINAL POSITION PRIOR TO ALLOWING ANY PUBLIC TRAFFIC ONTO THE PORTIONS OF THE ROAD(S) BEING IMPROVED HEREUNDER, REGARDLESS OF THE STATUS OF COMPLETION OF PAVING OR OTHER OFFSITE IMPROVEMENTS CALLED FOR BY THESE PLANS.
7. PRIOR TO CONSTRUCTING THE STREET SIGNS, CONTRACTOR SHALL OBTAIN STREET NAMES AND BLOCK NUMBERING FROM THE ZONING DIVISION OF THE DEPARTMENT OF COMPREHENSIVE PLANNING.

STATE OF NEVADA
DEPARTMENT OF HUMAN RESOURCES
HEALTH DIVISION

WATER/SEWER LINE CROSSINGS

UNIFORM STANDARDS FOR WATER AND SEWER LINE CROSSINGS REQUIREMENTS SHALL BE FOLLOWED:

WHERE THE WATER LINE IS LESS THAN 18 INCHES OVER THE SEWER LINE, WHERE THE WATER LINE IS UNDER THE SEWER LINE, AND WHERE THE HORIZONTAL SEPARATION, AS REQUIRED BY THE WATER SUPPLY REGULATIONS, CANNOT BE MAINTAINED BECAUSE OF PHYSICAL OBSTRUCTIONS (BUILDINGS), THE WATER LINE SHALL BE PROTECTED BY CONSTRUCTION OF THE SEWER LINE WITH:

1) EXTRA HEAVY CAST IRON PIPE;
2) WATER SUPPLY QUALITY MATERIALS;
3) ENCASEMENT WITH 4 INCHES, MINIMUM, OF CONCRETE OR SLEEVING WITH WATER SUPPLY QUALITY PIPE.

EACH OF THESE PROVISIONS SHALL ALSO BE EXTENDED (OTHER THAN 90 DEGREE CROSSINGS) TO THE POINT AT WHICH THE TEN-FOOT SEPARATION BETWEEN THE WATER AND SEWER LINES IS ACHIEVED.

LAS VEGAS VALLEY WATER DISTRICT NOTES

1. NO WORK SHALL BEGIN ON THE 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 (870-4194) 48 HOURS PRIOR TO ACTUAL CONSTRUCTION, AND 24 HOURS PRIOR TO AN 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 EDITION 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 SPECIFICATION AND STANDARD PLATES.
7. THE MAXIMUM ALLOWABLE JOINT DEFLECTION FOR ACP AND DUCTILE IRON PIPE SHALL BE AS FOLLOWS:

PIPE SIZE	ACP	DUCTILE IRON SLIP JOINT	DUCTILE IRON MECHANICAL JOINT
6 INCHES	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 MANUFACTURER'S 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 5 FEET BACK FROM CURB.
    B) OVER ALL SERVICE LATERALS NOT INSTALLED AT RIGHT ANGLES TO MAIN.
11. ALL WATER MAINS SHALL BE PRESSURE TESTED AT 200 PSI 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
13. CONTRACTOR TO OBTAIN ALL METERS 2" AND SMALLER FROM LVVWD CENTRAL STORES. TELEPHONE 258-3152 FORTY-EIGHT (48) HOURS PRIOR TO PICKUP.

[illegible]

Call before you Dig.
1-800-227-2600
UNDERGROUND SERVICE (USA)

SANITATION DISTRICT GENERAL NOTES

1. All construction and materials shall be in accordance with the latest edition of the Design & Construction Standards For Wastewater Collection Systems and the Uniform Standard Specifications for Public Works' Construction Off-Site Improvements, Clark County Area, Nevada, as amended. In all cases, these Standards shall supersede the Uniform Standard Specifications. It will be the responsibility of the Contractor to be aware of the contents of the above specification books.
2. These Standards shall apply to all construction.
3. Sewer mains only to be laid in sewer trenches.
4. All laterals to be laid at not less than minimum slopes as shown in these Standards.
5. It shall be the Contractor's responsibility to perform construction as per plans. Any additions, deletions, or changes shall first meet with the approval of the controlling Agency.
6. Soil testing shall be in accordance with Section 3.11 of these Standards.
7. All exfiltration, infiltration, air testing and televising of lines shall be in accordance with these Standards.
8. Cut sheets must be submitted to the Agency before construction will be permitted to start.
9. All Contractors installing sewer mains that will be under the jurisdiction of the controlling Agency must be Class "A" Contractors.

CLARK COUNTY FIRE DEPARTMENT

1. ALL WORK SHALL BE DONE IN STRICT ACCORDANCE WITH APPENDIX III-B OF THE CLARK COUNTY CODE.
2. ON ANY BUILDING CONSTRUCTION, ACCESSIBLE FIRE HYDRANTS SHALL BE INSTALLED BEFORE COMBUSTIBLE MATERIALS ARE DELIVERED TO THE SITE AND CONSTRUCTION COMMENCES. SAID FIRE HYDRANTS SHALL BE IN GOOD WORKING ORDER WITH REQUIRED WATER SUPPLY.
3. IF DURING CONSTRUCTION IT BECOMES NECESSARY TO CLOSE ANY CONTROL VALVE OR PLACE A HYDRANT OUT OF SERVICE, THE CLARK COUNTY FIRE DEPARTMENT MUST BE CONTACTED.
4. PAINTING OF CURBS AND/OR STRIPING OF ASPHALT AREAS AND PROTECTION OF HYDRANTS FROM PHYSICAL INJURY PER FIRE INSTALLATION SPECIFICATIONS OF THE CLARK COUNTY CODE.
5. NO FIRE HYDRANT SHALL BE LOCATED WITHIN 25 FEET OF ANY STRUCTURE, SIX FEET OF A DRIVEWAY, POWER POLE, LIGHT STANDARD OR ANY OTHER OBSTRUCTION. FOR WALL, FENCE AND PLANTER LOCATIONS, A PERIMETER AROUND THE HYDRANT MEASURING A MINIMUM OF THREE FEET FROM ITS CENTER SHALL BE MAINTAINED CLEAR OF ALL OBSTRUCTIONS AT ALL TIMES.
6. AT ALL TIMES DURING CONSTRUCTION, SUITABLE EMERGENCY VEHICLE ACCESS ROADS MUST BE MAINTAINED. ROADWAYS MUST BE SMOOTH, COMPACTED AND CAPABLE OF SUPPORTING THE IMPOSED LOADS OF ALL EMERGENCY VEHICLES.
7. PRIOR TO ACCEPTANCE OF ANY PRIVATE FIRE SERVICE MAIN, A SATISFACTORY HYDROSTATIC TEST WITH PIPING JOINTS UNCOVERED MUST BE CONDUCTED. APPROVED PLANS AND A CONTRACTOR'S MATERIALS AND TEST CERTIFICATE MUST BE PROVIDED AT TIME OF INSPECTION.
8. BLUE REFLECTIVE MARKERS INSTALLED PER SECTION 13.04.130 (d) OF CLARK COUNTY ORDINANCE #1167 MUST BE PROVIDED BEFORE FINAL HYDRANT ACCEPTANCE CAN BE ATTAINED.

CLARK COUNTY STREET LIGHT NOTES

ALL STREET LIGHTING INSTALLATIONS EXCEPT AS NOTED ON THE STREET LIGHTING PLANS SHALL CONFORM TO THE IMPROVEMENT STANDARDS, DEPARTMENT OF PUBLIC WORKS, CLARK COUNTY, NEVADA, AND THE UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA. POLES TO BE GALVANIZED.
NEW SERVICE REQUIRED.

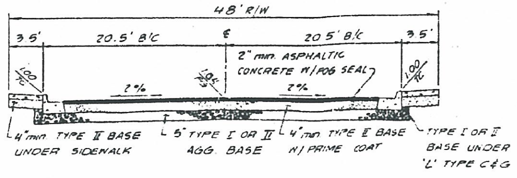
SPECIAL NOTE

EXISTING UTILITIES SHOWN ON THESE PLANS WERE LOCATED FROM THE BEST INFORMATION AVAILABLE AT THE TIME. THE ENGINEER BEARS NO RESPONSIBILITY FOR EXISTING UTILITIES NOT SHOWN OR FOR UTILITIES NOT IN THE LOCATION SHOWN ON THESE PLANS. THE CONTRACTOR SHALL BEAR FULL RESPONSIBILITY FOR NOTIFYING ALL UTILITY COMPANIES BEFORE STARTING CONSTRUCTION, AND PHYSICALLY LOCATING ALL UTILITIES PRIOR TO COMMENCING CONSTRUCTION.

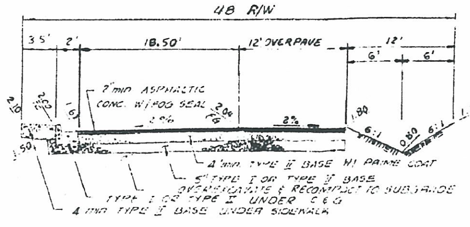
ABANDON VALVE AND CUT AND CAP WITHIN RIGHT-OF-WAY

ALL VALVES TO BE ABANDONED SHALL BE ABANDONED 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 WITHIN THE RIGHT-OF-WAY OR EASEMENT BOUNDARY AND INSTALL A CAP. WHERE A JOINT OR COUPLING IN THE EXISTING PIPE IS UNCOVERED AT THE CUT AND CAP LOCATION, THE INSTALLATION OF A PLUG MAY BE 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.

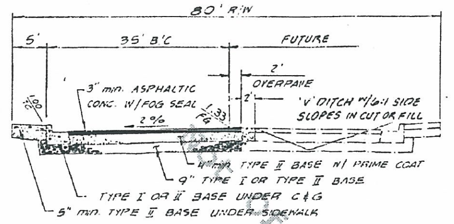

48' R/W
3.5'
20.5' B/C
20.5' B/C
3.5'
2" min. ASPHALTIC CONCRETE W/FOG SEAL
2%
2%
4" min. TYPE II BASE UNDER SIDEWALK
6" TYPE I OR II AGG. BASE
4" min. TYPE II BASE W/ PRIME COAT
TYPE I OR II BASE UNDER 'L' TYPE C&G

TYPICAL STREET SECTION


48' R/W
3.5'
2'
18.50'
12' OVERPAVE
12'
6'
6'
2" min. ASPHALTIC CONC. W/FOG SEAL
2%
4" min. TYPE II BASE W/ PRIME COAT
6" TYPE I OR TYPE II BASE
SCARIFY & RECOMPACT TO SUBGRADE
TYPE I OR TYPE II UNDER C&G
4" min. TYPE II BASE UNDER SIDEWALK

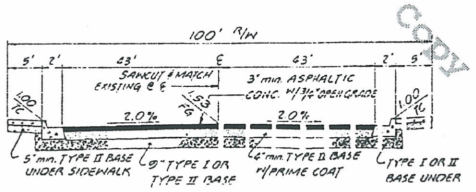
TYPICAL 48' R/W HALF STREET

GOLDEN VISTA DRIVE - LOOKING WEST

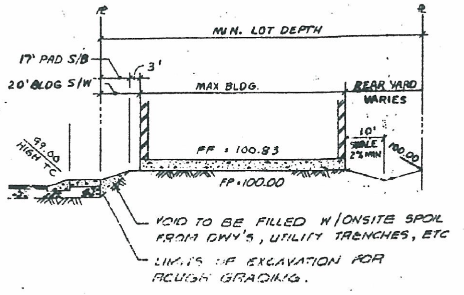

80' R/W
5'
35' B/C
FUTURE
2'
OVERPAVE
3" min. ASPHALTIC CONC. W/FOG SEAL
2%
'V' DITCH W/6:1 SIDE SLOPES IN CUT OR FILL
4" min. TYPE II BASE W/ PRIME COAT
9" TYPE I OR TYPE II BASE
TYPE I OR II BASE UNDER C&G
5" min. TYPE II BASE UNDER SIDEWALK

TYPICAL 80' R/W HALF STREET

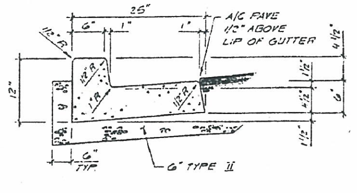
SPENCER STREET - LOOKING SOUTH


100' R/W
5'
2'
43'
43'
2'
5'
SAWCUT & MATCH EXISTING @ ℄
3" min. ASPHALTIC CONC. W/1/2" OPEN GRADE
2.0%
2.0%
5" min. TYPE II BASE UNDER SIDEWALK
9" TYPE I OR TYPE II BASE
6" min. TYPE II BASE W/PRIME COAT
TYPE I OR II BASE UNDER

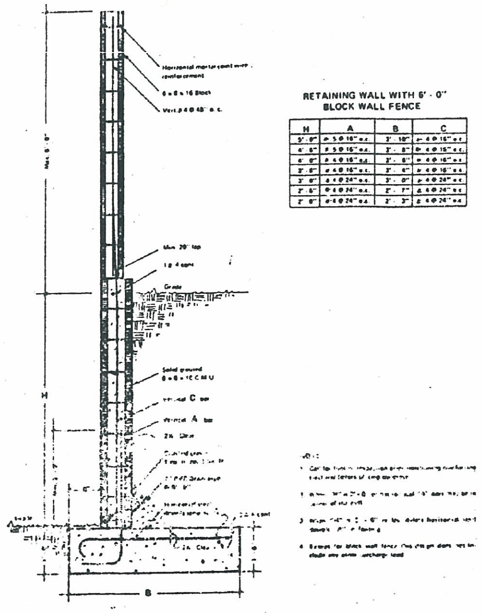
TYPICAL 100' R/W


MIN. LOT DEPTH
17' PAD S/B
20' BLDG S/B
3'
MAX BLDG.
REAR YARD VARIES
PF = 100.83
FP = 100.00
10' SIDE
VOID TO BE FILLED W/ONSITE SPOIL FROM DWY'S, UTILITY TRENCHES, ETC
LIMITS OF EXCAVATION FOR ROUGH GRADING.

ROUGH GRADING TYPICAL



'L' TYPE CURB AND GUTTER



RETAINING WALL DETAIL

OWNER

HORIZON SPENCER
16959 BERNARDO CENTER DRIVE #202
SAN DIEGO, CA 92128

DEVELOPER

HORIZON COMMUNITIES, INC.
16959 BERNARDO CENTER DRIVE #202
SAN DIEGO, CA 92128

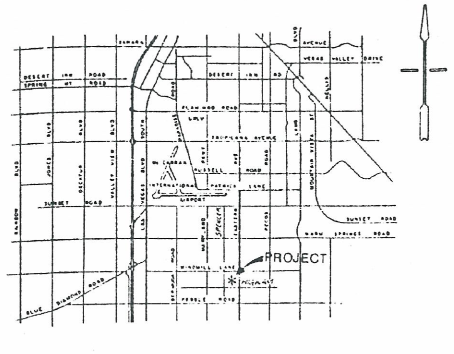
UTILITY SERVICES

EXISTING ZONING R-1
THIS SUBDIVISION WILL BE SERVICED BY:

PUBLIC WATER SUPPLY:
LAS VEGAS VALLEY WATER DISTRICT
SEWER DISPOSAL:
CLARK COUNTY SANITATION DISTRICT
SOLID WASTE:
SILVER STATE DISPOSAL
ELECTRIC POWER:
NEVADA POWER COMPANY
TELEPHONE SERVICE:
CENTRAL TELEPHONE COMPANY
NATURAL GAS:
SOUTHWEST GAS CORPORATION

SHEET INDEX

1	COVER SHEET
2	GRADING & PAVING PLAN
3	MASTER UTILITY & TRAFFIC CONTROL PLAN
4	STREET & SEWER PLAN/PROFILE
5	STREET & SEWER PLAN/PROFILE



VICINITY MAP

DESCRIPTION

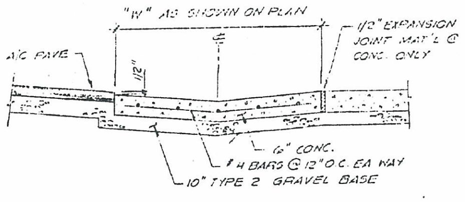
A PORTION OF THE NORTHEAST QUARTER (NE¼) OF SECTION 14, T.22S., R.61E.

GEOTECH REFERENCE

CONSTRUCTION SHALL CONFORM TO THE RECOMMENDATIONS SET FORTH IN THE GEOTECHNICAL INVESTIGATION BY KLEINFELDER PROJECT NO. 31-185801-001 DATED 22 JULY 1991 AND ALL SUBSEQUENT REVISIONS THERETO.

BENCHMARK

BM 8C2113W4
2" X 2" ALUM. PLATE @ NE COR. WIGWAM & EASTERN
ELEV. = 2140.093


"W" AS SHOWN ON PLAN
A/C PAVE
1/2" EXPANSION JOINT MAT'L @ CONC. ONLY
6" CONC.
# 4 BARS @ 12" O.C. EA WAY
10" TYPE 2 GRAVEL BASE

CONC. VALLEY GUTTER

TRAFFIC MANAGEMENT DIVISION
CLARK COUNTY PUBLIC WORKS

BY _______________ DATE

APPROVAL OF THESE PLANS SHALL NOT BE CONSTRUED TO BE A PERMIT FOR, OR AN APPROVAL OF, ANY VIOLATION OF STATE OR COUNTY LAW, SPECIFICATIONS OR THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.

PRINTED
FEB 1993
DELTA ENGINEERING

NO. DATE BY

SCALE: AS SHOWN
DESIGNED: M.E.F.
DRAWN: M.E.F.
CHECKED: (W)
DATE: MAY, 1992
900902

DELTA ENGINEERING INC
ENGINEERING • LANDSURVEYING • PLANNING
4500 WEST OAKEY BLVD • LAS VEGAS NEVADA 89102
PHONE (702) 877-0955

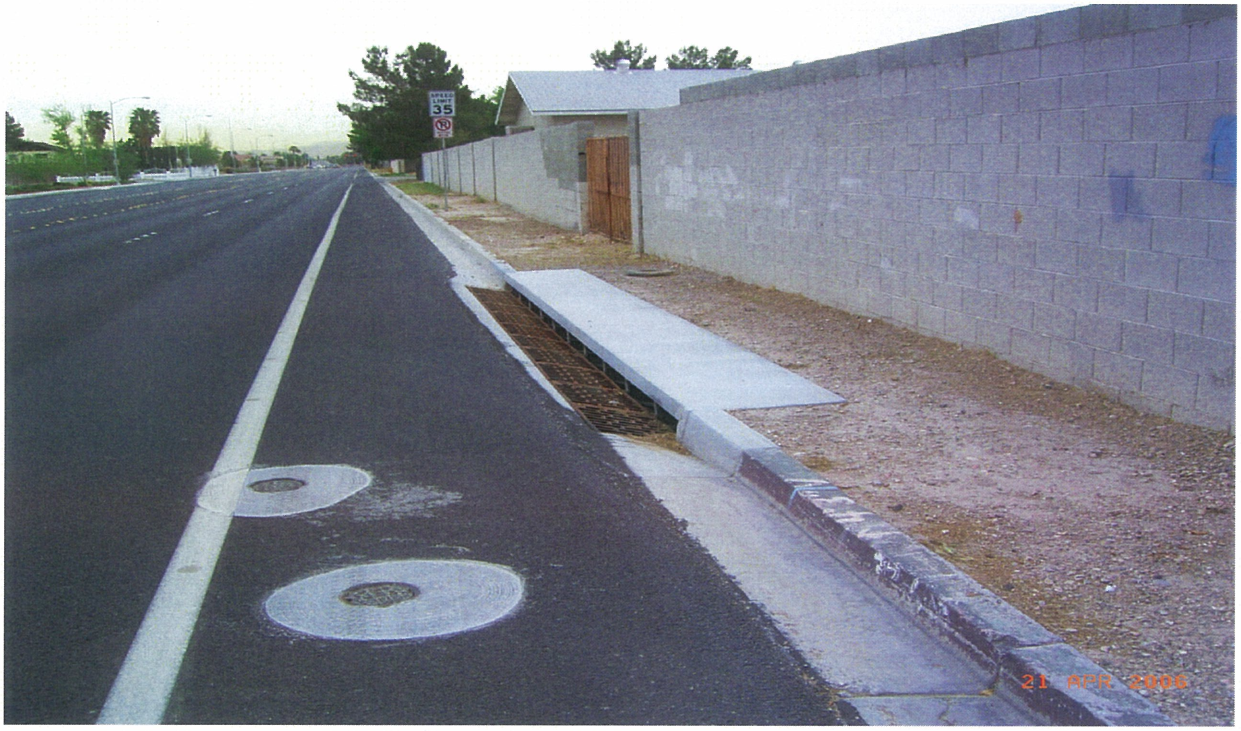
COVER SHEET
FOR
HORIZON VISTA UNIT 1B
(38 LOTS ON 9.02± ACRES)
CLARK COUNTY, NEVADA

SHEET No
1 OF 5

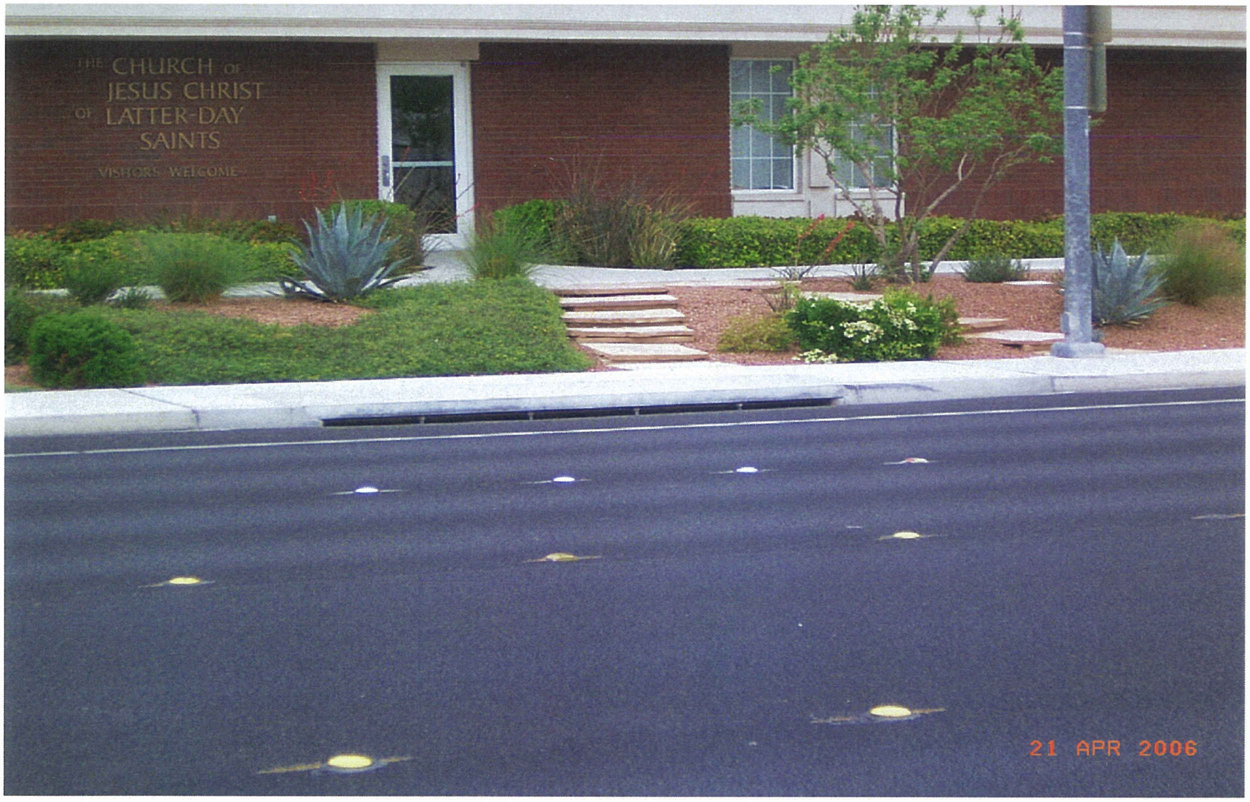
Unofficial Copy

APPENDIX F

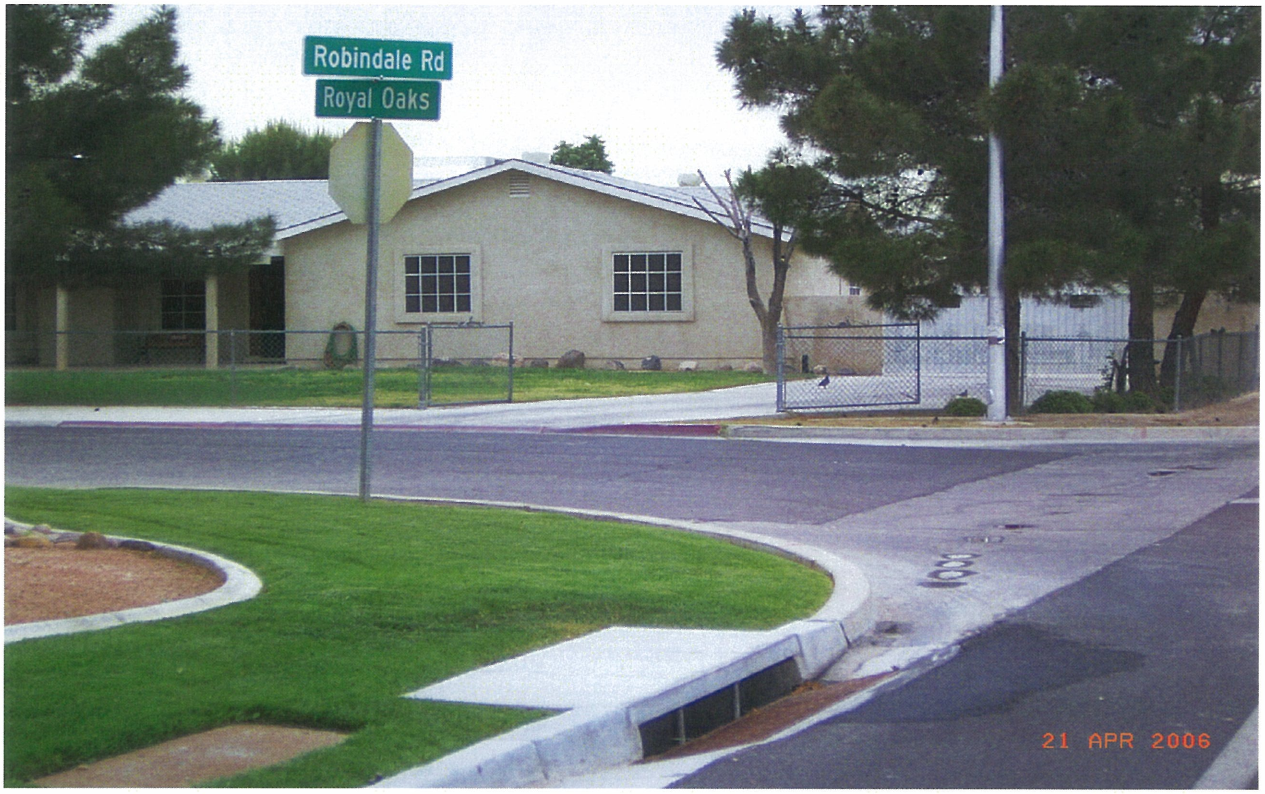
Project Photos


SPEED LIMIT 35
21 APR 2006

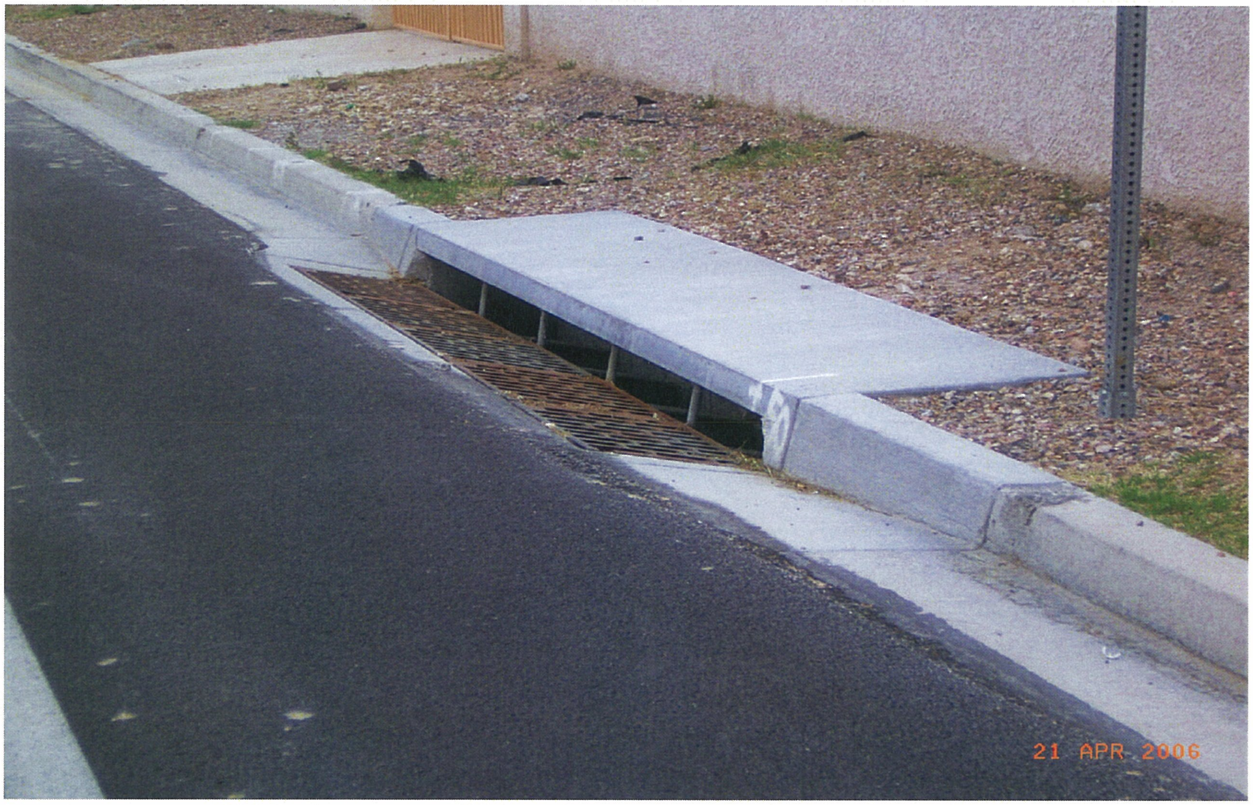
Picture 1. 15' drop inlet on south side of Robindale Road (approximately 150' east of Branding Iron Lane).


THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
VISITORS WELCOME
21 APR 2006

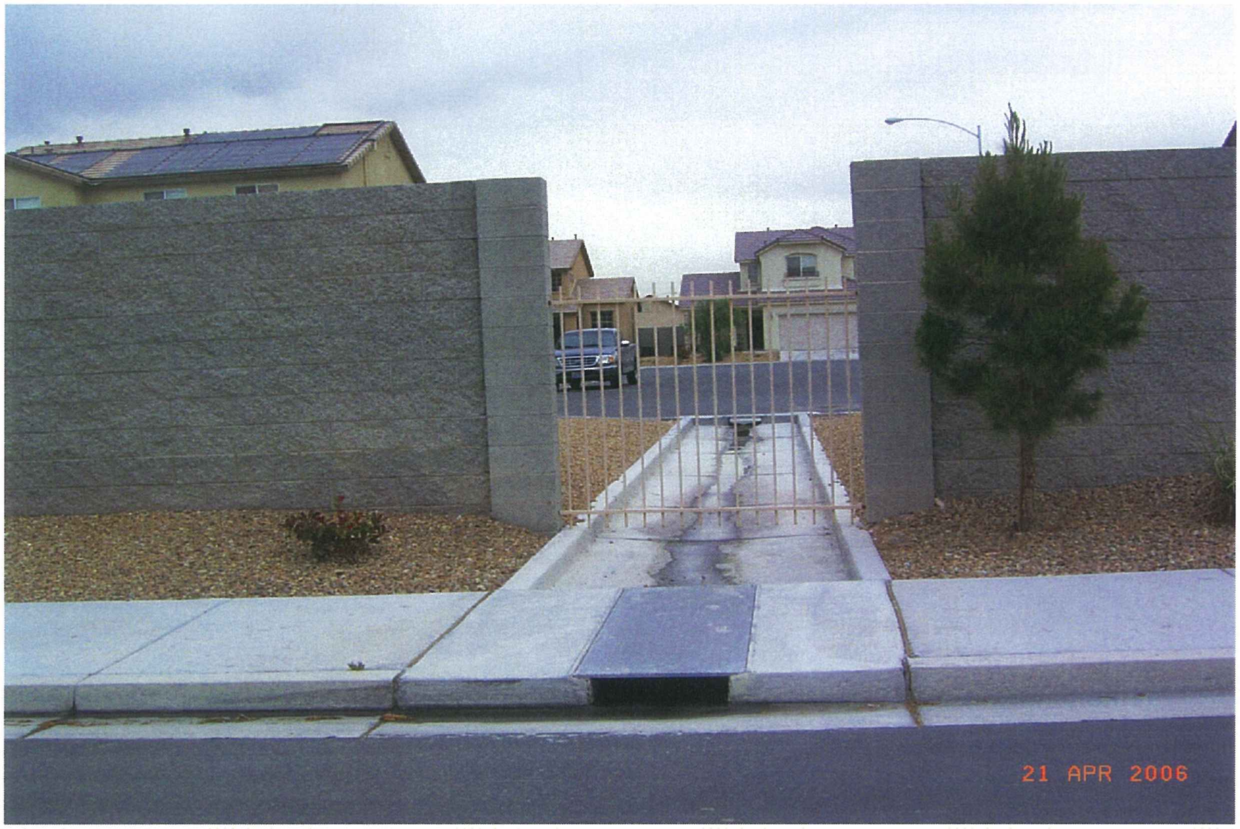
Picture 2. 10' drop inlet on north side of Robindale Road (approximately 150' east of Branding Iron Lane).


Robindale Rd
Royal Oaks
21 APR 2006

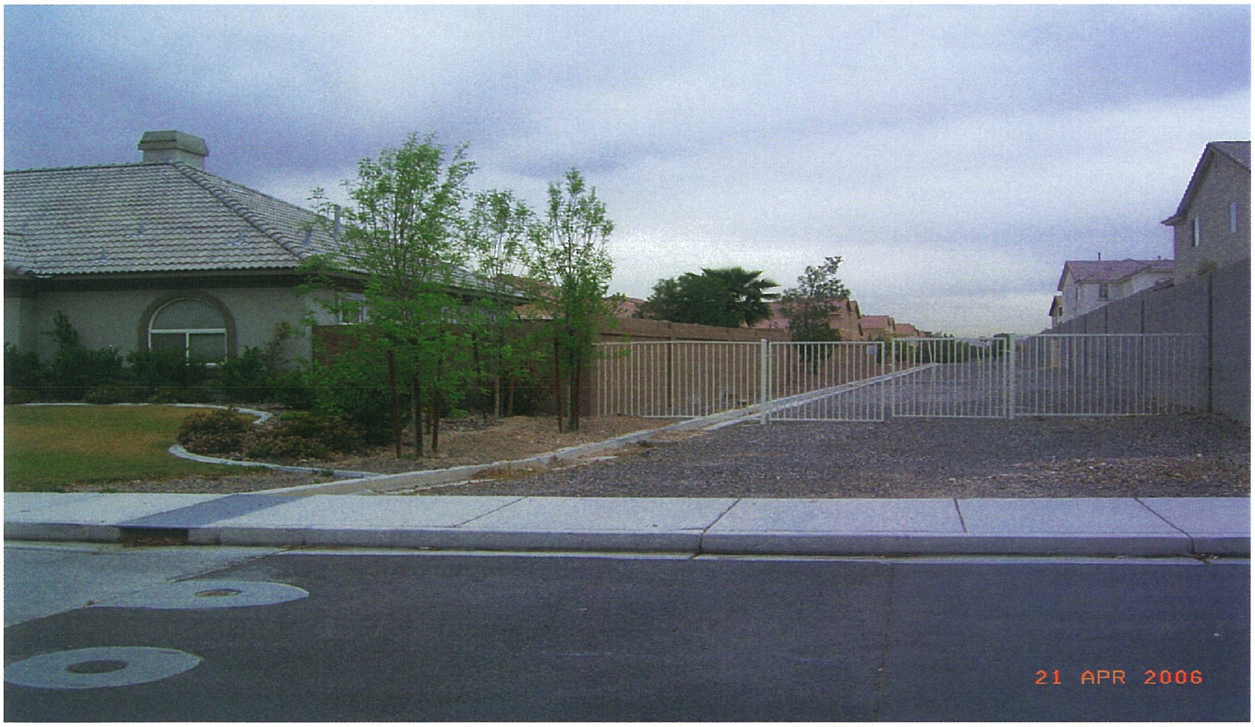
Picture 3. 5' drop inlet at southeast corner of Robindale Road and Royal Oaks.



Picture 4. 7.5' drop inlet located approximately 100 feet east of drop inlet in Picture 3 above.



Picture 5. 5’ drainage easement that drains flow from Basin ROB8 to Burnham Avenue.



Picture 6. Access Easement north of Basin ROB8. A portion of the easement drains to the intersection of Burnham Avenue and Sur Este Avenue.

Picture 7. Area inlet located within a valley gutter at the intersection of Burnham Avenue and Sur Este Avenue.