RFCD

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Request for Letter of Map Revision

Water Reclamation Facility

City of Henderson, Nevada

Prepared for:

City of Henderson
Department of Utility Services
240 Water Street
Henderson, Nevada 89009
Phone No: (702)-267-2530
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City of Henderson

Prepared by:

PBS&J

2270 Corporate Circle, Suite 100
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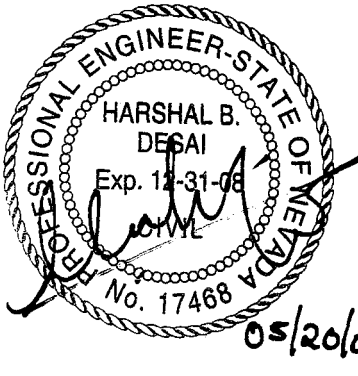

May, 2008
PBS&J Reference No: 100001342

CITY OF HENDERSON
240 Water Street
P. O. Box 95050
Henderson, NV 89009

May 20, 2008

FEMA Depot
3601 Eisenhower Avenue
Alexandria, VA 22304-6425

Attention: LOMR Depot

RE: Requests for Letter of Map Revision
Water Reclamation Facility, City of Henderson, NV

To whom it may concern:

The enclosed request is for a Letter of Map Revision for the City of Henderson's (COH) Water Reclamation Facility (WRF) and accompanying check for $4800 for the LOMR review fee. PBS&J has prepared the LOMR under contract with COH to address the needed revision to the existing FEMA flood zone delineation, through the WRF site.

Please accept these study documents certified by PBS&J to support this request for a Letter of Map Revision. If you should need further information, please call me at (702) 267-2547.

Sincerely,

James Okazaki, P.E.
Utility Services Engineer II

JSO:mas
Enclosure

cc: Sacha Tohme, Michael Baker, Jr., w/o enclosure
Dennis Fritz, COH Utility Services Technical Support Manager
Al Jankowiak, COH Project Engineer II
Matt Baird, PBS&J
Harshal Desai, PBS&J

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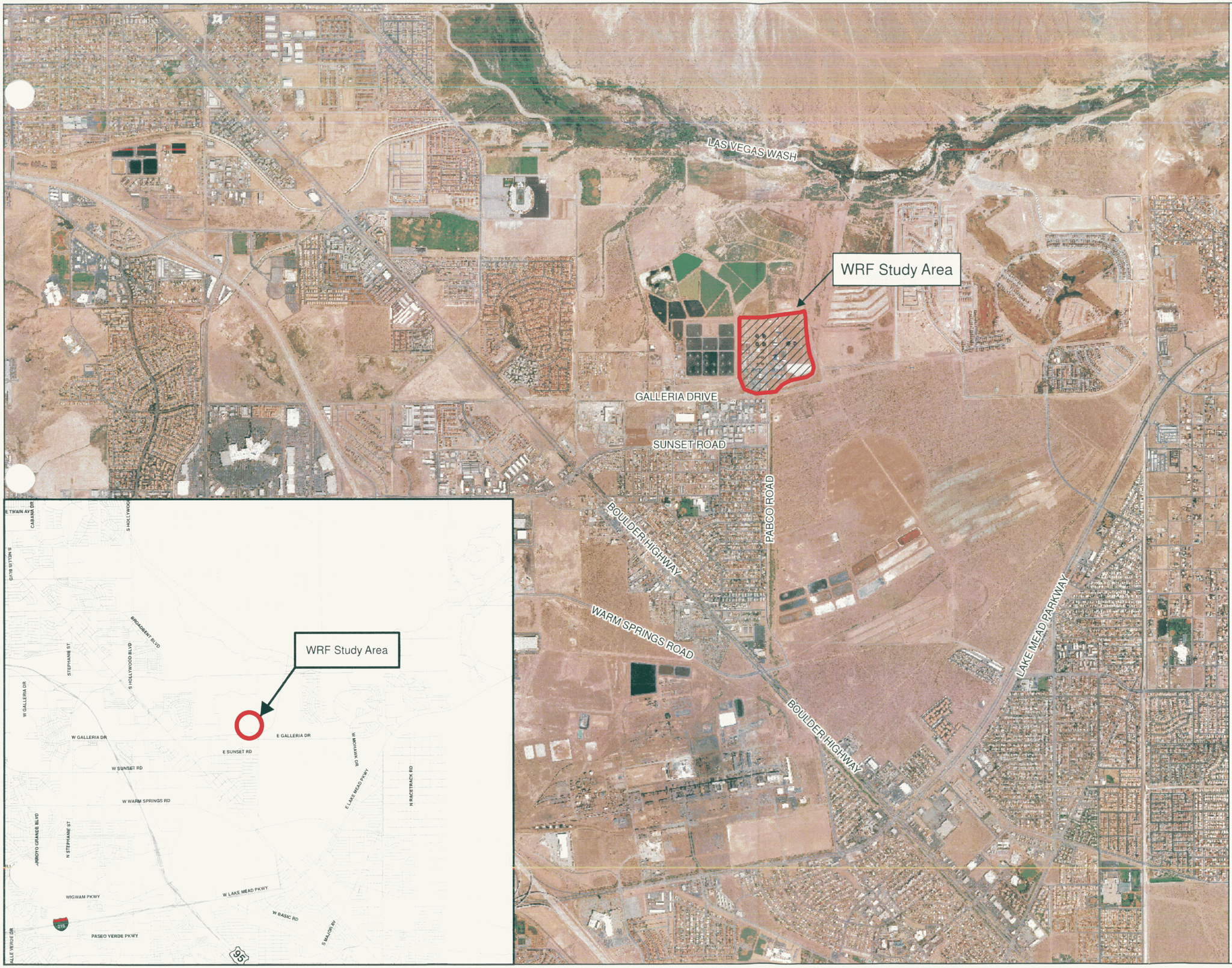
1.1 Project Background and Purpose

The Federal Emergency Management Agency (FEMA) performed a Community Assistance Visit to the City of Henderson's (COH) Water Reclamation Facility (WRF) on February 14, 2008. The existing WRF site is within an existing FEMA Zone A flood zone (Refer to **Section 2.3**). Based on this field visit, FEMA requested COH, in a letter dated February 21, 2008, to provide finish floor elevation data for the WRF site or demonstrate that existing drainage facilities eliminates the risk by via a Letter of Map Revision (LOMR) to ensure that a construction violation has not been permitted (Letter provided in **Appendix B**). This data must be submitted to FEMA by May 21, 2008.

PBS&J was contracted by COH to develop a LOMR to remove the portion of the WRF site from the effective FEMA flood zone by demonstrating that all offsite flow is contained within the existing drainage facilities to the west (WRF Channel) and to the south and east (Pabco Channel). As well as, to prove that all onsite flow (WRF site only) does not result in flow depths greater than 1-foot, which would then not warrant a FEMA flood zone..

This LOMR is intended to address the needed revision to the existing FEMA flood zone delineation, through the COH's WRF site, shown on the current effective Flood Insurance Rate Map (FIRM) for City of Henderson, NV (Community Number 320005), panel 2605 E. The general location of the project site is shown on **Figure 1.1**.



WATER RECLAMATION FACILITY

REQUEST FOR LETTER OF MAP REVISION

FIGURE 1.1: AREA/VICINITY MAP

AERIAL PHOTO SOURCE: CLARK COUNTY 2007 FALL

N

0 1,250 2,500 5,000 Feet

1 inch equal to 2,500 feet

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2.1 Location

The WRF study area is located within the portion of Section 31, Township 21 South, Range 63 East and Section 36, Township 21 South, Range 62 East M.D.M., City of Henderson, Clark County, Nevada. The Assessor's Parcel Numbers for this LOMR study are 161-36-701-003 and 160-31-201-001. **Figure 2.1: Site Map** shows an aerial photo of the site along with property ownership information in and adjacent to the WRF site as well as the location of existing drainage facilities.

The WRF study area is bounded by the existing Pabco Channel in the southeast, existing WRF Channel in the west, and Galleria Drive in the south. The Las Vegas Wash is located about 5,000 feet north of the WRF study area. The WRF study area is primarily comprised of operation buildings, and other wastewater treatment facilities. In addition to these facilities, the WRF study area includes paved streets and landscaping.

2.2 Existing Flood Control Facilities

As mentioned above, the WRF study area is bounded by two existing flood control facilities, WRF Channel and Pabco Channel. **Figure 2.1** shows the detailed information of existing flood control facilities located in the WRF study area.

The WRF Channel is located just west of the study area and collects the offsite flows from the subbasins west of Pabco Road and north of the Boulder Highway. The upstream portion of the WRF Channel (southwest of the study area) was recently constructed and is riprap lined with a concrete low flow channel in the bottom. Similarly, the downstream portion of the WRF channel, located just west of the study area is riprap lined with concrete low flow channel.

The Pabco Channel is located just south and east of the study area as shown on **Figure 2.1**. This channel collects the storm water runoff from the basins associated with Eastside Properties (south of Galleria Drive and east of Pabco Channel), and basins southwest of Boulder Highway. The Pabco Channel just downstream of Galleria Drive is riprap lined for approximately 300 feet and then transitions into an earthen trapezoidal channel. This channel terminates into a natural wash.

Please note that the analysis associated with the Pabco Channel was extended further upstream of the study area. This was necessary to evaluate the capacity of the Pabco Channel upstream of the WRF study area which in turn was used to determine the offsite flow reaching the Pabco Channel bordering the WRF study area.

2.3 FEMA Flood Zone Information

Figure 2.2: Effective FEMA Map is a reproduction of the FEMA Flood Insurance Rate Map (FIRM) for City of Henderson, Nevada, Map Number 32003C2605E with effective

date of November 6, 2003. The DFIRM flood zone delineation associated with the study area is shown on **Figure 2.3: Effective Flood Zone Overlaid on Aerial Photos**. As shown on both figures, majority of the site lies within the FEMA Flood Zone A, which is defined as a special flood hazard area inundated by the 100-year flood. Base Flood Elevations (BFEs) have not been determined for this area and are not shown on the FIRM.

2.4 Topographic Information

The existing topographic data used for the analysis, completed in this LOMR, study are as follows.

1. Aerial topography data completed by Aerotech Mapping Inc. (flight date: 08/2004; 1 foot contour interval)
2. Aerial topography data completed by Aerotech Mapping Inc. (flight date: 01/2008; 1 foot contour interval)
3. Recent supplementary field survey information completed by PBS&J (04/2008)
4. WRF Channel (upstream section) construction drawings issued on 08/14/2007.
5. Clark County 5' foot contours (1996).

Please note that the majority of the analysis uses Sources 1-3 listed above. The other data sources were reviewed but were not used in the hydraulic analysis. All of the above sources utilize the vertical datum of North American Vertical Datum (NAVD) 88, and English Units. All of the above mentioned data is included in the Data CD in **Appendix F**.

2.5 Previous Studies in Project Vicinity

The following studies were reviewed in preparation for this LOMR study. Reference material from each of these studies is included in the **Appendix E.**

- Technical Drainage Study for the WRF Flood Control Channel Re-Alignment (PBS&J, 2006)

  This study was carried out for technical hydrologic and hydraulic analysis along with the associated design of the above mentioned upstream section of the WRF conveyance system. This study presents the existing drainage conditions for the WRF flood control channel re-alignment. Portion of the study that are relevant to this study are included in **Appendix E-1**

- Request For Conditional Letter of Map Revision For C1-Channel-Lake Mead Channel Improvements (PBS&J, 2006)

This study was carried out to delineate the future floodplain within a portion of Eastside Properties. This study presents the hydrologic and hydraulic analysis of the Pabco Channel starting from just downstream of Boulder Highway to Las Vegas Wash floodplain. Material referenced from this study is included in **Appendix E-2.**

WATER RECLAMATION FACILITY

REQUEST FOR LETTER OF MAP REVISION

FIGURE 2.1: SITE MAP

Public R-O-W(160-31-399-002)
Existing 2: 10'x4' RCB
Riprap With Concrete Low Flow Channel
City of Henderson (APN 161-36-701-003)
City of Henderson (APN 160-31-201-001)
Water Reclamation Facility
WRF Channel
End of Trapezoidal Earthen Channel (Transition into Natural Flow Path)
City of Henderson (APN 160-31-301-003)
Future Aguila Road
Public R-O-W(160-31-499-002)
Riprap Channel With Low Flow Concrete Channel
End of Existing Culvert 2: 10'x4' RCB
Start of Earthen Channel
Pabco Channel
End of Grouted Riprap Channel With Low Flow Concrete Channel
Start of Grouted Riprap Channel With Low Flow Concrete Channel
Existing 4: 10'x3' RCB
Starting of Existing Culvert 2: 10'x4' RCB
Start of Riprap Channel
End of Riprap
5: 1'x1.5' Elliptical Pipe Culvert
City of Henderson (APN 161-36-801-001)
Earthen Channel
Public Right of Way (161-36-899-002)
Riprap ends
Riprap Starts
GALLERIA DRIVE
Basic Environmental CO LLC (160-31-401-004)
Trapezoidal Earth Channel
Vegetation Removed in Existing Condition [2]
Basic Environmental CO LLC (179-05-301-004)
PABCO ROAD
Nevada Power Company (179-06-101-002)
Eastside Properties

Legend

- PARCELS
- WRF Channel[1]
- Limits of Map Revision (WRF Study Area)

AERIAL PHOTO SOURCE: CLARK COUNTY 2007 FALL

N

0 250 500 1,000 Feet

1 inch equal to 500 feet

NOTE:
1. EXISTING WRF CHANNEL WAS RECENTLY BUILT AND IS NOT SHOWN ON THE LATEST AERIAL.
2. VEGETATION WAS RECENTLY REMOVED AND IS NOT SHOWN ON THE LATEST AERIAL.

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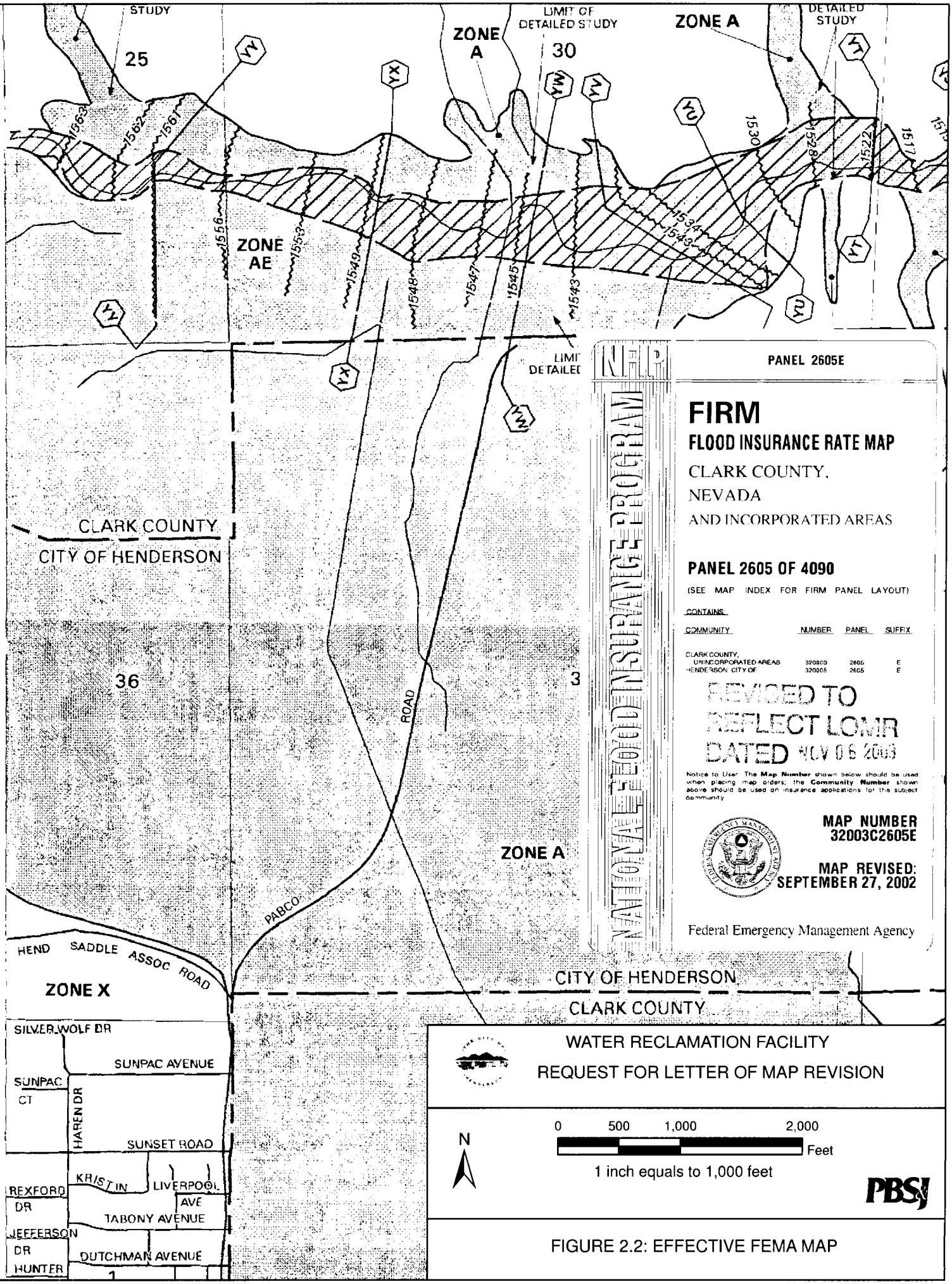


FIGURE 2.2: EFFECTIVE FEMA MAP

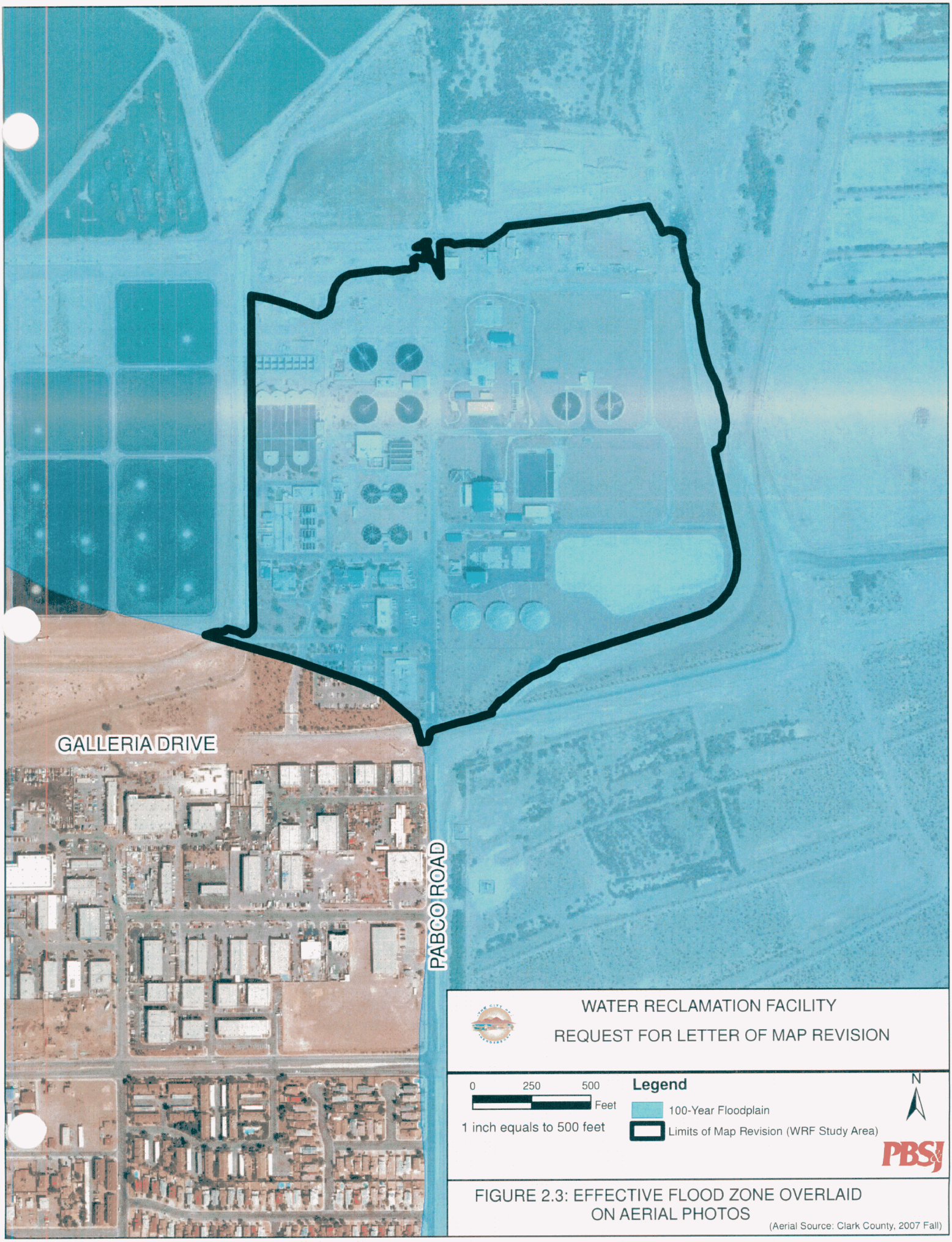


FIGURE 2.3: EFFECTIVE FLOOD ZONE OVERLAID ON AERIAL PHOTOS

(Aerial Source: Clark County, 2007 Fall)

The effective 100-year hydrologic analysis was carried out to determine the offsite flow reaching the WRF Channel and the Pabco Channel, as well as the flow produced by the onsite basins. The hydrologic parameters used within this study were developed in accordance with the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (HCDDM), which also includes the City of Henderson drainage criteria. The offsite basins and the associated hydrologic parameters were referenced from the approved *CLOMR for C-1 Channel/Lake Mead Channel Improvements* (PBS&J, 2006), and the approved *Technical Drainage Study (TDS) for the WRF Flood Control Channel Re-Alignment* (PBS&J, 2006). Necessary modifications were made to these offsite basins and the associated hydrologic parameters to represent the existing condition. All applicable reference material from the above studies, including their approval letters, is included in **Appendix E**. The basis for the onsite WRF hydrologic basins and associated hydrologic parameters were also referenced from the approved *TDS for the WRF Flood Control Channel Re-Alignment* (PBS&J, 2006) and updated accordingly to reflect existing conditions. Even though there are three systems (the existing WRF Channel, the existing Pabco Channel and the onsite basins), acting independently on the subject site, a single HEC-1 model was developed.

The hydrologic analysis provided in this study was developed for a storm with a 100-year return frequency. The 100-Year, 6 hour frequency flood event was used. The adjusted rainfall value of 2.86 inches was taken from the approved *CLOMR for C-1 Channel/Lake Mead Channel Improvements* (PBS&J, 2006). This rainfall depth was distributed over the 6-hour storm period using storm distribution number (SDN) 3[1]. Please refer to **Figure 3.1: Existing Drainage Basin Map** for all basin delineations, combination point locations, flow splits, and the associated flow summary table for the entire hydrologic analysis.

3.1 Existing WRF Channel Hydrology

All offsite flow tributary to the subject site from west of Pabco Road is collected and contained within the existing WRF Channel along the west side of the subject site. As mentioned above, the basis for all the hydrology associated with the WRF Channel was referenced from the approved *Technical Drainage Study (TDS) for the WRF Flood Control Channel Re-Alignment* (PBS&J, 2006). The referenced hydrology was updated to reflect the existing condition and to align with the referenced hydrology from the CLOMR. As a result, the basin delineations adjacent to the existing WRF Channel were modified/merged to represent the existing channel and the basins adjacent to the Pabco Road were extend to the west side of the road. All basins tributary to the WRF Channel have names starting with OFF and ending with W (Please refer to **Figure 3.1**).

Since majority of the basins tributary to the WRF Channel were directly referenced from the approved TDS, the same spreadsheet used to calculate the original curve numbers was used to calculate the values for the updated basins. The curve number calculations and

[1] Because the total tributary area is less than 8 sq. miles SDN3 storm distribution was used.

Standard Form 4 (time of concentration calculations) for the WRF Channel basins are provided in the **Appendix C-1**. The hydrologic model is included in **Appendix C-3**.

3.2 Existing Pabco Channel Hydrology

All offsite flow tributary to the subject site from and east of Pabco Road is collected and contained within the existing Pabco Channel along the south and east side of the subject site. The basis for all the hydrology associated with the Pabco Channel was referenced from the approved *CLOMR for C-1 Channel/Lake Mead Channel Improvements* (PBS&J, 2006). The referenced hydrology was updated to more accurately represent the hydrologic parameters and flow paths associated with the current condition of the watershed. Any basins referenced from the CLOMR, which had hydrologic parameters modified were label with an asterisk at the end of the basin name. All new basins tributary to the Pabco Channel have names starting with OFF and ending with N. In addition, any of the referenced concentration points whose position has been revised were labeled with the same name but with an asterisk at the end (Please refer to **Figure 3.1**).

In order to be consistent with the referenced hydrology from the CLOMR, all new curve numbers were calculated using the same methodology. The curve number calculations are supplied in detail in **Appendix C-2**. Standard Form 4 based on CCRFCD HCDDM was prepared in order to determine the time of concentration and basin lag time and is also included in **Appendix C-2**.

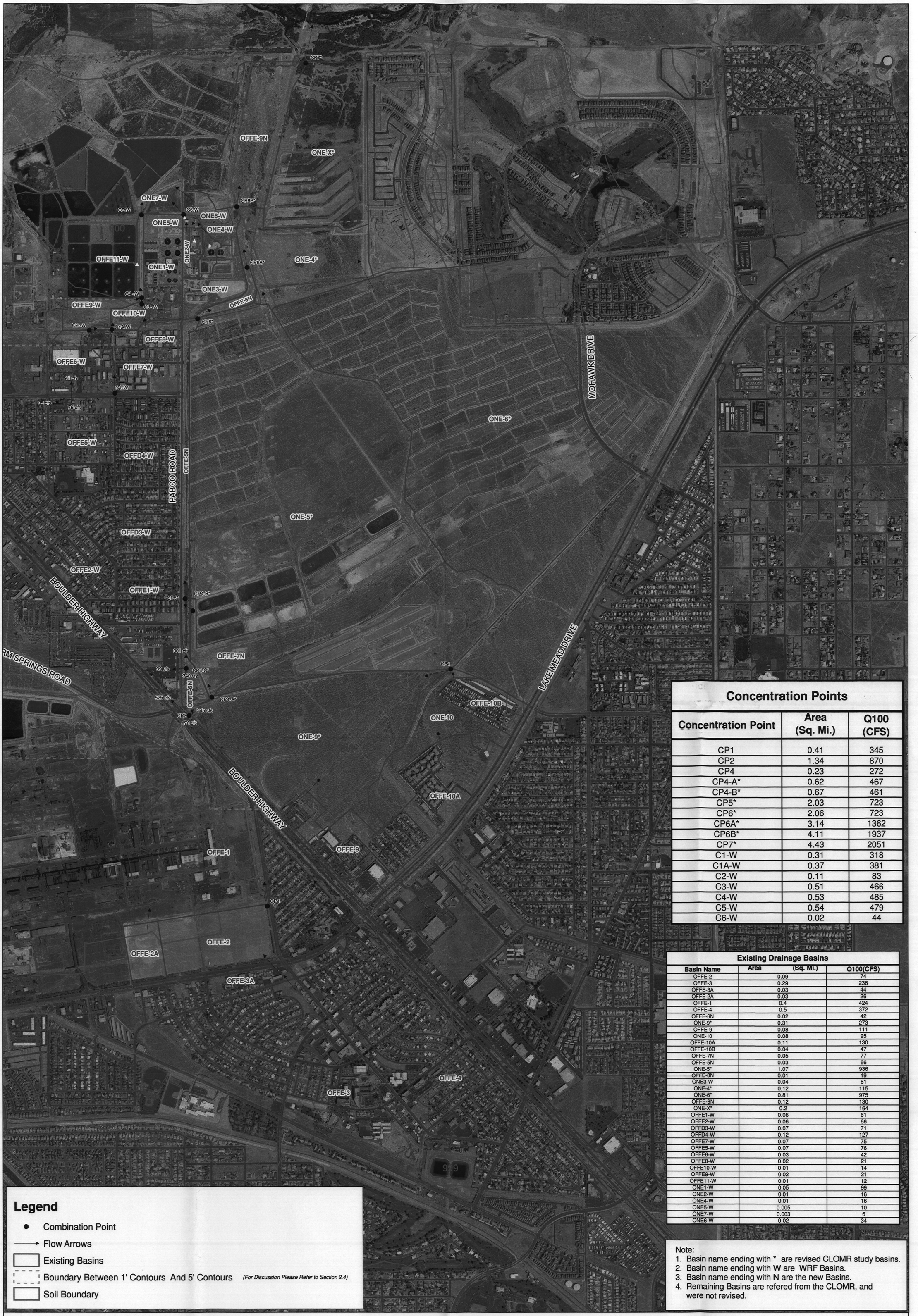
The major differences in the layout of the hydrologic model prepared for this LOMR verses the CLOMR model are the addition of a new flow split (located approximately 750 feet north of crossing of Pabco Road and Boulder Highway crossing) and Basin ONE-5* has been revised to combine at the downstream end of the existing channel (Combination Point CP6A*). For further discussion on the flow splits associated with the Pabco Channel please refer to **Section 4.2**. The hydrologic model is included in **Appendix C-3** and on the electronic CD in **Appendix F**.

3.3 Existing Onsite Hydrology

The onsite hydrology was developed from the approved *Technical Drainage Study (TDS) for the WRF Flood Control Channel Re-Alignment* (PBS&J, 2006) and updated to reflect the existing condition of the site. As mentioned above in **Section 3.1** the same methodology used by the TDS to calculate the curve numbers was used to calculate all new values for the onsite system (Refer to **Appendix C-1**). All the onsite basins have labels starting with ONE and ending in W (Please refer to **Figure 3.1**).

The onsite system outlets along the northern end of the WRF study area into the existing floodplain (comprised of undeveloped land). For the most part the western portion of the study area drains to the northwest and the east portion of the study area drains to the northeast. None of the flow produced by the onsite basins is collected or conveyed in the existing WRF Channel or the existing Pabco Channel, along the subject site.

The curve number calculations and Standard Form 4 for the onsite system is supplied in **Appendix C-1**. The hydrologic model is included in **Appendix C-3**.



Concentration Points

Concentration Point	Area (Sq. Mi.)	Q100 (CFS)
CP1	0.41	345
CP2	1.34	870
CP4	0.23	272
CP4-A*	0.62	467
CP4-B*	0.67	461
CP5*	2.03	723
CP6*	2.06	723
CP6A*	3.14	1362
CP6B*	4.11	1937
CP7*	4.43	2051
C1-W	0.31	318
C1A-W	0.37	381
C2-W	0.11	83
C3-W	0.51	466
C4-W	0.53	485
C5-W	0.54	479
C6-W	0.02	44

Existing Drainage Basins

Basin Name	Area (Sq. Mi.)	Q100(CFS)
OFFE-2	0.09	74
OFFE-3	0.29	236
OFFE-3A	0.03	44
OFFE-2A	0.03	26
OFFE-1	0.4	424
OFFE-4	0.5	372
OFFE-6N	0.02	42
ONE-9*	0.31	273
OFFE-9	0.08	111
ONE-10	0.08	95
OFFE-10A	0.11	130
OFFE-10B	0.04	47
OFFE-7N	0.05	77
OFFE-5N	0.03	66
ONE-5*	1.07	936
OFFE-8N	0.01	19
ONE3-W	0.04	61
ONE-4*	0.12	115
ONE-6*	0.81	975
OFFE-9N	0.12	130
ONE-X*	0.2	164
OFFE1-W	0.06	61
OFFE2-W	0.06	66
OFFD3-W	0.07	71
OFFD4-W	0.12	127
OFFE7-W	0.07	75
OFFE5-W	0.07	76
OFFE6-W	0.03	42
OFFE8-W	0.02	21
OFFE10-W	0.01	14
OFFE9-W	0.02	21
OFFE11-W	0.01	12
ONE1-W	0.05	99
ONE2-W	0.01	16
ONE4-W	0.01	16
ONE5-W	0.005	10
ONE7-W	0.003	6
ONE6-W	0.02	34

Note:
1. Basin name ending with * are revised CLOMR study basins.
2. Basin name ending with W are WRF Basins.
3. Basin name ending with N are the new Basins.
4. Remaining Basins are refered from the CLOMR, and were not revised.

Legend

- Combination Point
- Flow Arrows
- Existing Basins
- Boundary Between 1' Contours And 5' Contours *(For Discussion Please Refer to Section 2.4)*
- Soil Boundary

N

WATER RECLAMATION FACILITY
REQUEST FOR LETTER OF MAP REVISION
FIGURE 3.1: EXISTING CONDITION DRAINAGE BASIN MAP

0 800 1,600 3,200 Feet

1 inch equals to 800 feet

THE CITY OF HENDERSON

PBS&J

In order to analyze the hydraulics associated with the flow resulting from the offsite watershed two hydraulic models were developed for this LOMR: existing WRF Channel hydraulic model and an existing Pabco Channel hydraulic model. The results of the hydraulics modeling effort shows that none of the offsite flow tributary to the west, east, and south impacts the WRF study area (except for a minor breakout at the northwest corner – discussed below), the hydraulics associated with the flow resulting from the onsite watershed was analyzed by using a series of normal depth calculations. The analysis performed for each of the systems is thorough and accurate enough to a represent the hydraulics associated with a FEMA Zone A Flood Zone. Each of the above mentioned hydraulic analyses is discussed in detail below.

4.1 Existing WRF Channel Hydraulic Analysis

The hydraulic model for the WRF Channel was developed using the USACE (United States Army Corps of Engineers) HEC-RAS modeling system, Version 3.1.2. In order to accurately represent the existing condition of the WRF Channel field survey was obtained as part of this LOMR (Please refer to **Section 2.4**) and was the sole basis for the geometry used in the hydraulic model. However, the construction drawings for the upstream portion of the WRF Channel were reviewed to verify the survey point data. The existing WRF Channel hydraulic model is included on the electronic data CD in **Appendix F** and printouts are supplied in **Appendix D-1**.

The assumptions and parameters associated with the hydraulic model are discussed in detail below. Please refer to **Figure 4.1: Hydraulic Work Map** which shows the cross-section locations, and floodplain delineation based on the hydraulic model discussed below.

Geometry and Cross-Sections: The cross-section data is based on the existing field survey information discussed in **Section 2.4**. The modeling limits extend from approximately 900-feet upstream of the southwest corner of the subject WRF study area to approximately 500-feet downstream of the northwest corner of the subject WRF study area. The total channel length modeled is about 3,100-feet and includes three sets of culverts. First set of culverts is located just downstream of the start of the hydraulic model and is comprised of (4) 10'x3' RCBs (Refer to **Figure 4.1**). The second set of culverts is located at the southwest corner of the subject WRF study area and is comprised of (2) 10'x4' RCBs. The third set of culverts is located at the northwest corner of the subject WRF study area and consists of (2) 10'x4' RCBs.

Upstream of the third set of culverts the channel is comprised of a riprap or grouted riprap trapezoidal channel with a concrete low flow channel (Refer to **Figure 2.1**). Downstream of the third set of culverts the channel is an earthen lined trapezoidal channel which transitions into a V-Ditch.

A lateral structure was placed along the top of bank (right overbank) between cross-sections -2480.1* and -2570.35 (just upstream of third set of culverts), in order to model

the flow split from the WRF Channel into the northwest corner of the WRF study area. No lateral structure was placed on the left overbank because based on the existing 5-foot contours the flow would be contained if the cross-section was extended. The cross-section was not extended because the flow would be considered ineffective and not be part of the active conveyance of the main system and will not change the results of the analysis.

Boundary Conditions: HEC-RAS "Normal Depth" option with the slope of upstream and downstream 0.004 ft/ft and 0.01111 ft/ft were utilized as the upstream and downstream boundary conditions, respectively.

Roughness Coefficients: The Manning's roughness coefficient (n values) utilized in this model were based the recommendations provided in CCRFCD's Drainage Design Manual. Roughness values of 0.015, 0.025, 0.035 and 0.0376 were used for concrete, grouted riprap, 6-inch riprap, and 9-inch riprap, respectively. Additionally, an n value of 0.035 was applied to the entire natural channel located at the downstream end of the hydraulic model. Manning's n calculations for the 6-inch and 9-inch riprap are included in **Appendix D-4**.

Steady State Analysis and Results: The HEC-RAS model was simulated under mixed flow regime using the 100-year flows determined from the hydrologic model (Refer to **Section 3.1**). The results of the hydraulic model show the entire flow tributary to the WRF study area from the southwest will be contained and conveyed within the WRF Channel until approximately 67-feet upstream of the third set of culverts. Per the hydraulic model about 30 cfs will leave the channel and drain onto the northwestern portion of the WRF study area. Per the existing topography this flow will pond along the northern edge of the study area before flowing north and returning to the existing floodplain. Per the field investigation and the latest aerial photos the limits of inundation due to this breakout does not impact any existing structures and has not been removed from the limits of the existing floodplain. **Figure 4.1** shows the 100-year floodplain delineation based on the results of the above mentioned hydraulic analysis.

4.2 Existing Pabco Channel Hydraulic Analysis

The review of the existing condition hydraulic model for the Pabco Channel, developed for the approved CLOMR, revealed that the model did not accurately represent the existing topography or the existing hydraulics of the channel. As a result, the entire Pabco Channel model was updated using the most current topographic data and more detailed hydraulic modeling. The hydraulic model for the Pabco Channel was developed using the USACE (United States Army Corps of Engineers) HEC-RAS modeling system, Version 3.1.2. The geometric data used in the HEC-RAS model was generated in ArcGIS using HEC-GeoRAS, Version 4.0, developed by USACE, in conjunction with the Environmental Systems Research Institute, Inc. (ESRI). The existing Pabco Channel hydraulic model and all GIS files used to generate the geometric data used in the hydraulic model are included on the electronic CD included in **Appendix F**. Printouts of the hydraulic model are supplied in **Appendix D-2**.

The assumptions and parameters associated with the hydraulic model are discussed in detail below. Please refer to **Figure 4.1: Hydraulic Work Map** which shows the cross-section locations, and floodplain delineation based on the hydraulic model discussed below.

Geometry and Cross-Sections: The cross-section data is based on the existing composite topographic information discussed in **Section 2.4** (Source 1-3). As mentioned previously, HEC-GeoRAS was used to derive the geometry data used in the hydraulic model. The model was extended approximately 500-feet upstream in order to more accurately model the flow splits associated with the culverts under Boulder Highway. The downstream limit is located approximately 1,400-feet south of the Las Vegas Wash (the exact same limit as the CLOMR). The total channel length modeled is about 14,100-feet and includes six sets of culverts. The following is a description of all the culvert sets modeled:

- The first two sets of culvert are located approximately 300-feet downstream of the start of the hydraulic model (under Boulder Highway). Both sets of culverts are comprised of (2) 6'x4' RCBs, with the leftmost culvert partially blocked by concrete, utility pipelines, and sediment. The size specified within the hydraulic model for the leftmost culvert has been reduced to represent to have a flow conveyance area equal to the unobstructed portion of the culvert.

- The third set of culverts is located approximately 280-feet downstream of the above mentioned culverts (under Warm Springs Road) and consists of (1) 10'x5' RCB.

- The fourth set of culverts is located approximately 750-feet downstream of the Warm Springs Road and are (4) 48-inch RCPs. All four the culverts are partially blocked and this flow obstruction has been represented in the hydraulic model using the "Depth Blocked" option in HEC-RAS.

- The fifth set of culverts is located about 960-feet downstream of Warm Springs Road and is comprised of (1) 10'x5' RCB.

- The last set of culverts is located under Galleria Drive, just south of the WRF study area, and consists of (5) 1.5'x1' HERCP.

Upstream of Boulder Highway the Pabco Channel is a wide unlined trapezoidal channel; while downstream of Boulder Highway (south of Galleria Drive) it is a narrow earth channel which varies between trapezoidal and V-Ditch. Just upstream of Galleria Drive, the channel flares out and downstream of Galleria Drive the channel is riprap lined for approximately 300 feet and then transitions into an earthen trapezoidal channel (Refer to **Figure 2.1**). The Pabco Channel ends approximately 1,500-feet downstream of Galleria Drive and transition into the natural flow path.

A lateral structure was placed along the top of bank (left overbank) between cross-sections 3000 and 3100, in order to quantify the amount flow leaving the Pabco Channel into the undeveloped land west of Boulder Highway.

Boundary Conditions: HEC-RAS "Normal Depth" option with the slope of upstream and downstream 0.0198 ft/ft and 0.0094 ft/ft were utilized as the upstream and downstream boundary conditions, respectively.

Roughness Coefficients: The Manning's roughness coefficient (n values) utilized in this model were based the recommendations provided in CCRFCD's Drainage Design Manual. Roughness values of 0.015, 0.025, and 0.0423 were used for concrete, graded/bare earth, and 18-inch riprap, respectively. Additionally, an n value of 0.035 was applied to the entire natural channel located at the downstream end of the hydraulic model. Manning's n calculation for the 18-inch riprap is included in **Appendix D-4**.

Ineffective Flow Boundaries: Some areas of the cross-sections contain water that is not actively being conveyed. According to HEC-RAS hydraulic reference manual ineffective areas are often used to describe portions of the cross-section in which water will pond, but the velocity of that water in the downstream directions is effectively zero. These areas are not included as part of the active flow area. The ineffective flow boundaries are normally included where there is sudden expansion or contraction of the floodplain. The ineffective flow boundaries within this model were established using a contraction ratio of 1:1 and an expansion ratio of 4:1.

Steady State Analysis and Results: Since majority of the Pabco Channel is unlined the HEC-RAS model was simulated under subcritical flow regime using the 100-year flows determined from the hydrologic model (Refer to **Section 3.2**). Based on the hydraulic model, there are four flow splits located within the vicinity of Boulder Highway and Warm Springs Road. The first three flow splits occur in series and are a result of inadequate capacity of the existing culverts under Boulder Highway to convey the entire 100-year flow. The resulting backwater will cause both sets of culverts to overtop onto Boulder Highway, as well as, the existing left overbank of the Pabco Channel just upstream of the culverts. In order to quantify the amount of flow leaving the over the left bank of the channel, a lateral structure was specified between cross-sections 3000 and 3100 (as mentioned above) and the HEC-RAS flow "Optimization" option was used to balance the flow split. Based on the hydraulic model approximately 56 cfs spills over the left overbank and completely leaves the system (flowing northwest along Boulder Highway). It should be noted that the flow overtopping the Boulder Highway will spill in both northwest and east directions. The portion of the flow (northwest direction) will stay on Boulder Highway and leave the system due to the existing grades of the highway. Whereas, the remaining flow will continue east into the Pabco Channel. It should be noted that HEC-RAS can not calculate a flow split on the top of a culvert. Therefore, to model the two-directional spillage over the culverts, the top of road (deck) profile was extended to include the entire L shaped weir surface (which includes the cross-section of

the roadway and the crown profile along the top of the culverts). It was then assumed that any flow over the cross-section of the roadway (leftmost portion) would continue northwest in Boulder Highway, while the flow over the crown of the road would return to the system (Associated calculations are included in **Appendix D-4**). The flow leaving the system was deducted from the total flow and the change in flow was manually specified in the steady flow data editor. This procedure was completed several times (manual iteration) in order to optimize the system. Based on the final hydraulic model, approximately 284 cfs leaves the system at the first set of culverts and about 185 cfs leaves at the second set of culverts. All three of these flow splits (56 cfs, 284 cfs and 185 cfs) were combined and included with the hydrologic model as one flow diversion (Refer to **Section 3.2**).

The last flow split occurs at the (4) 48-inch RCPs and was modeled exactly the same as the boulder highway culverts. Based on this analysis, approximately 38 cfs will leave the system and ultimately flow east to the Boulder Highway. The calculation associated with this flow split is included in **Appendix D-4** and this flow split was incorporated into the hydrologic model.

Downstream of this flow split (south of Galleria Drive) the remaining flow is completely contained within the existing Pabco Channel. Once the flow reaches Galleria Drive, it will overtop the Galleria Drive and return into the existing Pabco Channel and be conveyed around the southeastern portion of the WRF study area and back into the natural flow path. **Figure 4.1** shows the 100-year floodplain delineation based on the results of the above mentioned hydraulic analysis.

4.3 Existing Onsite Hydraulic Analysis

The Haestad Methods computer program FlowMaster (Version 2005) was used for to perform normal depth calculations for the subject WRF study area. The FlowMaster cross-sections are shown on **Figure 4.2 Onsite Hydraulic Map** and the results are included in **Appendix D**.

A total of eleven cross-sections were analyzed for the onsite system. The cross-section data is based on the existing composite topographic information discussed in **Section 2.4** (Source 1). Manning's values of 0.015, 0.025, and 0.035 was utilized for concrete, bare/graded earth, and natural desert landscaping, respectively. The flow specified for each cross-section was selected to represent the worse case scenario flow impacting that section. The flow can be reduced to represent only the portion of the basin impacting the cross-section. However, even considering the entire worse case flow the maximum normal depth calculated for the onsite system is only 0.94-feet (Refer to **Figure 4.2**). Since none of the onsite flow has a depth greater than 1-foot, it does not warrant a FEMA flood zone.

Based on the results presented in **Section 4.1, 4.2 and 4.3** , the engineering site drainage facilities protect the WRF study area (between the WRF Channel and Pabco Channel)

from flooding and therefore this area should be removed from the flood zone and the revised100-year floodplain delineation is shown on **Figure 4.1**.

WRF CHANNEL CROSS SECTION LOCATIONS

N W E S

0 45 90 180 270

Feet

-3130.11
1590.654
1586.443
1583.943
1593.271

-2613.98
-2609.56
-2408.48
-2553.81
1594.419
1590.681
1590.745
1590.932
1595.205
1595.689
1590.842
1595.778
1595.746
1590.922
1590.905
1590.875
1595.912
1594.538
1594.229
1594.29
1593.941
1594.607
1592.018
1591.003
1591.183
1592.033
1591.014
1585.745
1586.196
1594.055
1593.604
1589.49
1589.597
1594.126
1594.615
1594.482
1594.941
1595.636

-2408.48
1596.339
1593.4
1592.693
1597.342
1593.415
1592.395
1592.398

-2116.11
1599.388
1598.245
1595.287
1599.781
1596.229

-1728.75
1602.956
1598.842
1603.454
1599.87
1598.87

-1343.36
1606.277
1603.645
1602.518
1607.185
1603.494
1602.857

-1021.37
1609.549
1608.55
1610.257
1608.555

STA 0+00.00
1611.657
1609.948
1607.892
1611.75
1614.221
1608.543
1608.715
1608.6
1615.494
1615.182
1614.693

-197.10
-198.07
-169.27
-127.24
-112.98
-99.55
0.00
1615.518
1610.458
1610.385
1610.359
1610.845
1610.335
1615.614
1616.922
1609.843
1609.864
1616.816
1616.665
-772.70
-801.49
-825.29
-850.03
1616.023
1612.709
1612.73
1612.312
1612.198
1612.442
1616.3
1613.161
1612.728
1612.639
1612.98
1613.2
1612.271
1616.557
1618.784
1612.61
1612.714
1615.329
1618.238
1618.866
1612.927
1612.967
1618.452
1613.626
1613.012
1617.171
1613.729
1613.289
1613.383
1613.781
1613.146
1617.453
1613.525
1613.915
1613.383
1613.626
1615.808
1611.134
1611.078
1611.089
1611.639
1611.831
1611.016
1611.158
1611.605
1611.625
1615.53
1615.783

2 4'x10' RCB

WRF CHANNEL

2 4'x10' RCB

4 3'x10' RCB

GALLERIA DR

PABCO CHANNEL

5 1.5'x1' HERCP

5'x10' RCB

4 48" RCP

5'x10' RCB

2 6'x4' RCB

SOUTHERN HIGHLAND PKWY

PABCO RD

0 50 100 200

Feet

1743.102
1745.546
1738.796
1743.071
1745.558
1744.008
1746.424
1747.914
1748.394
1747.701
1745.616
1746.729
1743.415
1748.806
1747.089
1748.029
1749.81
1744.795
1743.961
1749.628
1747.897
1749.246
1749.917
1750.668
1745.527
1745.339
1750.597
1749.879
1748.106
1751.355
1750.782
1750.851
1745.92
1745.599
1751.246
1749.449

FIGURE 4.1: HYDRAULIC WORKMAP

Water Reclamation Facility LOMR

LEGEND

- FLOOD ZONE A REMOVED (WRF STUDY AREA)
- FEMA FLOOD ZONE A
- PABCO CHANNEL HEC-RAS CROSS SECTIONS
- WRF CHANNEL HEC-RAS CROSS SECTIONS
- EXISTING CULVERTS
- BOUNDARY BETWEEN 1 FOOT CONTOURS AND 5 FOOT CONTOURS

CONTOURS

- 1 FOOT CONTOURS
- 5 FOOT CONTOURS
- SURVEY POINTS

Notes: The offsite flood flows impacting the WRF study area where the flood Zone A is removed are contained within the existing WRF Channel (west) and Pabco Channel (east).

The shapefiles for the the topographic data (contour data and survey points) is included on the data CD in Appendix F. Please refer to Section 2.4 in the report for more information on topographic data.

Aerial Source: Clark County, Spring 2007

I hereby certify that the topograhpic information used for the Hydraulic Modeling within this LOMR substantially confirms with the current condition.

05-20-08

Harshal B. Desai, P.E., CFM NV-17468

N W E S

0 200 400 800 1,200

Feet

1 inch equals 400 feet

THE CITY OF HENDERSON A Place To Call Home

PBS&J

WATER RECLAMATION FACILITY

REQUEST FOR LETTER OF MAP REVISION

FIGUE 4.2:
ONSITE HYDRAULIC MAP

Legend

- Normal Depth Sections
- Limits of Map Revision (WRF Study Area)
- 1 Foot Contour
- 5 Feet Contour

AERIAL PHOTO SOURCE: CLARK COUNTY 2007 FALL

N

0 150 300 Feet

1 inch equal to 300 feet

Note: HEC-1 node in the table were referenced from Hydrologic Analysis. Please refer to Figure 3.1 Summary Table for Onsite flows.

Summary Table

Section Nos.	100-Year Flow (cfs)	HEC-1 Node	Normal Depth (ft)
1	99	ONE1-W	0.76
2	61	ONE3-W	0.53
3	61	ONE3-W	0.35
4	16	ONE2-W	0.4
5	10	ONE5-W	0.22
6	16	ONE2-W	0.77
7	61	ONE3-W	0.76
8	34	ONE6-W	0.35
9	99	ONE1-W	0.96
10	99	ONE1-W	0.62
11	99	ONE1-W	0.94

Section 5
Conclusions

The analysis and the associated results presented in this LOMR demonstrate that all the offsite flow, impacting WRF study area, is contained within the existing drainage facilities to the west (WRF Channel) and to the south and east (Pabco Channel). As well as, all the onsite flow (WRF site only) does not result in flow depths greater than 1-foot. Therefore, it is justified that the WRF study area should be removed from the effective FEMA Flood Zone A. The warranted revisions to the FEMA Flood Zone A within the WRF facility are shown on **Figure 5.1: FEMA Annotated Flood Zone Map.**

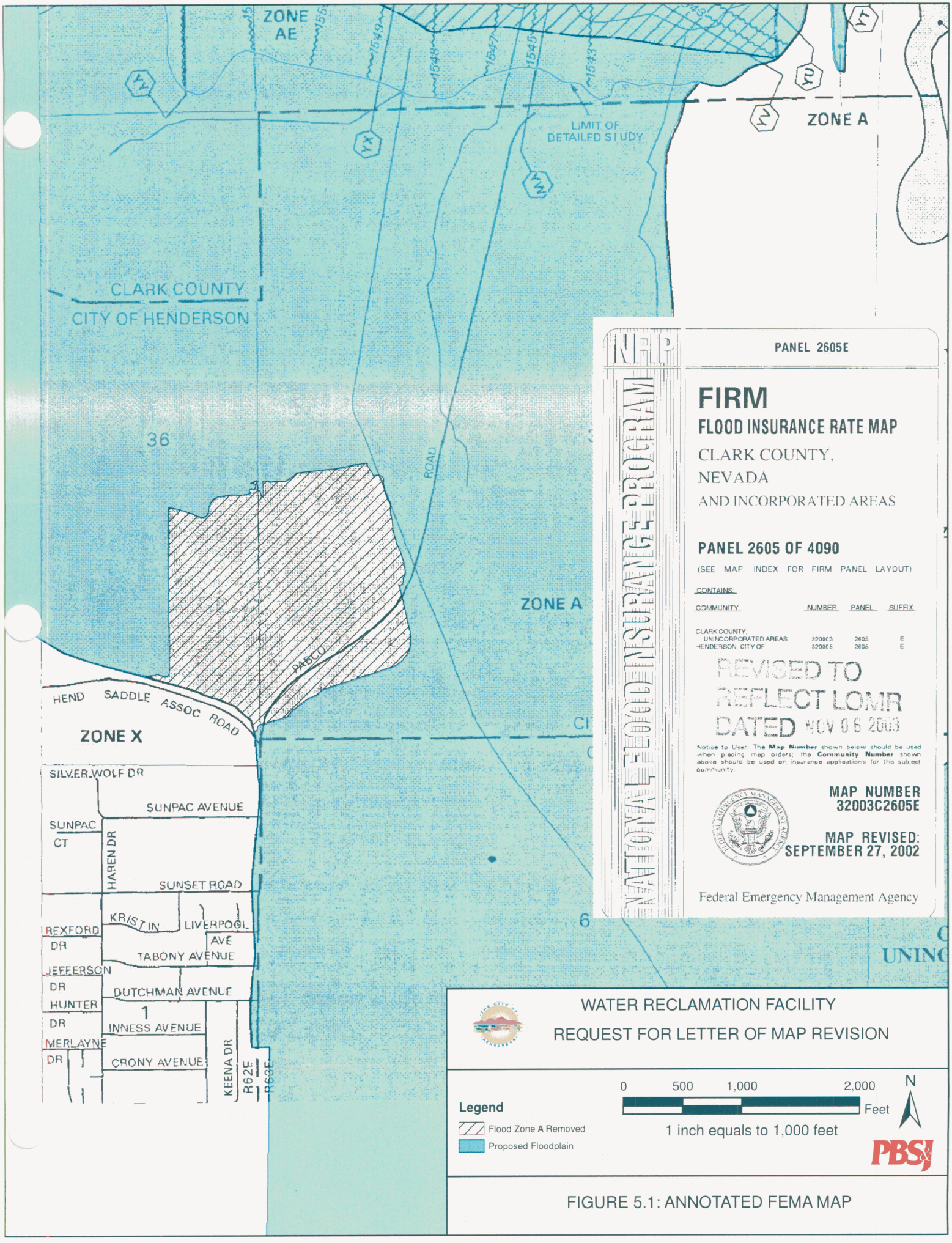


FIGURE 5.1: ANNOTATED FEMA MAP

1. Clark County Regional Flood Control District, Hydrologic Criteria and Drainage Manual, August 1999

2. FlowMaster Version 5.15, Haestad Methods, Inc., 2005

3. HEC-1 Flood Hydrograph Package Version 4.1. U.S. Army Corps of Engineers, Hydrologic Engineering Center, June 1998.

4. River Analysis System, Version 3.1.2, U.S. Army Corps of Engineers, Hydrologic Engineering Center, May 2005.

5. U.S. Army Corps of Engineers. 2004. HEC-GeoRAS GIS Tools for HEC-RAS using Arc-GIS User's Manual, Version 4 Beta, July 2005.

6. Technical Drainage Study for the WRF Flood Control Channel Re-Alignment (PBS&J, 2006)

7. Request for Conditional Letter of Map Revision for C1-Channel-Lake Mead Channel Improvements (Case no: 06-09-B306R)

Appendix A: FEMA Forms

MT-2 Form 1
MT-2 Form 2
MT-2 Form 3
Statement of Explanation

Appendix B: Correspondence

Appendix C: Hydrologic Analysis

Appendix C-1: Existing WRF Channel Hydrology
Curve Number Calculation
Standard Form 4

Appendix C-2: Existing Pabco Channel Hydrology
Curve Number Calculation
Standard Form 4

Appendix C-3: Hydrologic Model (HEC-1 Output)

Appendix D: Hydraulics

Appendix D-1: Existing WRF Channel Hydraulic Model (HEC-RAS Output)

Appendix D-2: Existing Pabco Channel Hydraulic Model (HEC-RAS Output)

Appendix D-3: Existing Onsite Hydraulic Analysis (Flowmaster Output)

Appendix D-4: Riprap Roughness Value Calculation

Appendix E: Reference Materials

Appendix E-1: Reference from Approved CLOMR for C1-Channel/Lake Mead Channel Improvements (PBS&J, 2006)

Appendix E-2: Reference from Approved Technical Drainage Study (TDS) for Flood Control Re-alignment (PBS&J, 2006)

Appendix F: Electronic Data on CD

Appendix A: FEMA Forms

MT-2 Form 1
MT-2 Form 2
MT-2 Form 3
Statement of Explanation

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	City of Katy	TX	480301	0005D	02/08/83
480287	Harris County	TX	48201C	0220G	09/28/90
320005	City of Henderson	NV	32003C	2605E	11/06/03

2. Flooding Source: WRF Channel and Pabco Channel

3. Project Name/Identifier: City of Henderson Water Reclamation Facility LOMR

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: $4,800

☐ 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: Michele D'Alessandro, E.I., CFM	Company: PBS&J	
Mailing Address: 2270 Corporate Circle Suite 100 Las Vegas, Nevada 89074	Daytime Telephone No.: 702-263-7275	Fax No.: 702-263-7200
	E-Mail Address: MD'Alessandro@pbsj.com	
Signature of Requester (required): Michele D'Alessandro		Date: 5-20-08

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: Curt Chandler, P.E., CFM, Land Development Manager		Telephone No.: 702-267-3020
Community Name: City of Henderson	Community Official's Signature (required): Curt Chandler	Date: 5/19/08

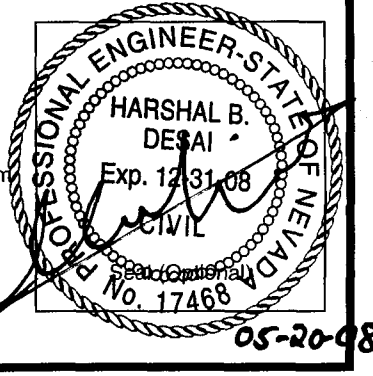
CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

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: Harshal B. Desai, P.E., CFM	License No.: NV 17468	Expiration Date: 12/31/08
Company Name: PBS&J	Telephone No.: 702-263-7275	Fax No.: 702-263-7200
Signature:		Date: 5-19-08

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



05-20-08

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: WRF Channel
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) ☒ No existing analysis ☐ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

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

Location	Drainage Area (Sq. Mi.)	FIS (cfs)	Revised (cfs)
WRF Channel	0.54	N/A	479

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

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

★ EXPLANATION ATTACHED

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit	About 3,800ft South of Las Vegas Wash	-3130.11	N/A	1587.79
Upstream Limit	Just North of Galleria Drive	-0.00	N/A	1615.74

2. Hydraulic Method Used

Hydraulic Analysis HEC-RAS [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:	
Corrected Effective Model*	Natural File Name:		Floodway File Name:	
Existing or Pre-Project Conditions Model	Natural File Name:	WRFCHANNEL.prj	Floodway File Name:	WRFCHANNEL.prj
Revised or Post-Project Conditions Model	Natural File Name:		Floodway File Name:	
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.

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: Pabco Channel
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) ☒ No existing analysis ☒ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

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

Location	Drainage Area (Sq. Mi.)	FIS (cfs)	Revised (cfs)
Pabco Channel	4.43	N/A	1917

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

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

★ EXPLANATION ATTACHED

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit	About 1,400ft South of Las Vegas Wash	50	N/A	1556.13
Upstream Limit	About 300ft Upstream of Boulder Highway	3500	N/A	1752.93

2. Hydraulic Method Used

Hydraulic Analysis HEC-RAS [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:
Corrected Effective Model*	Natural File Name:	Floodway File Name:
Existing or Pre-Project Conditions Model	Natural File Name: PABCO.prj	Floodway File Name: PABCO.prj
Revised or Post-Project Conditions Model	Natural File Name:	Floodway File Name:
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.

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

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

PAPERWORK REDUCTION ACT

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Flooding Source: WRF Channel
Note: Fill out one form for each flooding source studied

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam .....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport .....complete Section F (if required)

Description Of Structure

1. Name of Structure: Existing (4) 10'x3' RCBs

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Crossings About 130ft North of Galleria Drive

Downstream Limit/Cross Section: -183.27

Upstream Limit/Cross Section: -127.24

2. Name of Structure: Existing (2) 10'x4' RCBs (#1)

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Crossings located at the Southwest Corner of the WRF study area

Downstream Limit/Cross Section: -888.18

Upstream Limit/Cross Section: -766.83

3. Name of Structure: Existing (2) 10'x4' RCBs (#2)

Type (check one) ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Crossings located at the Northwest Corner of the WRF study area

Downstream Limit/Cross Section: -2609.56

Upstream Limit/Cross Section: -2570.35

NOTE: For more structures, attach additional pages as needed.

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☐ Superelevated sections
- ☐ Debris basin/detention basin
- ☒ Other (Describe):
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☒ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source: WRF Channel

Name of Structure: Existing (4) 10'x3' RCBs

1. This revision reflects (check one):

- ☒ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☒ Erosion Protection
- ☐ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

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

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☒ Superelevated sections
- ☐ Debris basin/detention basin
- ☐ Other (Describe):
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☒ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☒ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☒ Other locations (specify):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source: WRF Channel

Name of Structure: Existing (2) 10'x4' RCBs (#1)

1. This revision reflects (check one):

- ☒ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☒ Erosion Protection
- ☐ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

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

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☐ Superelevated sections
- ☐ Debris basin/detention basin
- ☐ Other (Describe):
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source: WRF Channel

Name of Structure: Existing (2) 10'x4' RCBs (#2)

1. This revision reflects (check one):

- ☒ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☒ Erosion Protection
- ☐ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

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

* EXPLANATION ATTACHED

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

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

PAPERWORK REDUCTION ACT

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Flooding Source: Pabco Channel
Note: Fill out one form for each flooding source studied

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam .....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Structure

1. Name of Structure: Existing (2) 6'x4' RCBs (Set 1)

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Crossings Under Boulder Highway (West Travel Lanes)

Downstream Limit/Cross Section: 2900

Upstream Limit/Cross Section: 3000

2. Name of Structure: Existing (2) 6'x4' RCBs (Set 2)

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Crossings Under Boulder Highway (East Travel Lanes)

Downstream Limit/Cross Section: 2700

Upstream Limit/Cross Section: 2800

3. Name of Structure: Existing 10'x5' RCB (#1)

Type (check one) ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Crossing Under Warm Springs Road

Downstream Limit/Cross Section: 2400

Upstream Limit/Cross Section: 2500

NOTE: For more structures, attach additional pages as needed.

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

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Flooding Source: Pabco Channel
Note: Fill out one form for each flooding source studied

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam .....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Structure

1. Name of Structure: Existing (4) 48" RCPs

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Crossings approximately 750-feet downstream of Warm Springs Road

Downstream Limit/Cross Section: 1850

Upstream Limit/Cross Section: 1950

2. Name of Structure: Existing 10'x5' RCB (#2)

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Crossing Under Pabco Road

Downstream Limit/Cross Section: 1700

Upstream Limit/Cross Section: 1800

3. Name of Structure: Existing (5) 1.5'x1' HERCPs

Type (check one) ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Crossings Under Galleria Drive

Downstream Limit/Cross Section: 735

Upstream Limit/Cross Section: 742

NOTE: For more structures, attach additional pages as needed.

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☒ Superelevated sections
- ☐ Debris basin/detention basin
- ☒ Other (Describe):
- ☒ Drop structures
- ☒ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☒ Subcritical flow ☐ Critical flow ☒ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source: Pabco Channel

Name of Structure: Existing (2) 6'x4' RCBs (Set 1)

1. This revision reflects (check one):

- ☒ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☐ Erosion Protection
- ☐ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

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

* EXPLANATION ATTACHED

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☐ Superelevated sections
- ☐ Debris basin/detention basin
- ☐ Other (Describe):
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source: Pabco Channel

Name of Structure: Existing (2) 6'x4' RCBs (Set 2)

1. This revision reflects (check one):

- ☒ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☐ Erosion Protection
- ☐ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

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

* EXPLANATION ATTACHED

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☒ Superelevated sections
- ☐ Debris basin/detention basin
- ☐ Other (Describe):
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☒ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source: Pabco Channel

Name of Structure: Existing 10'x5' RCB (#1)

1. This revision reflects (check one):

- ☒ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☐ Erosion Protection
- ☐ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

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

*EXPLANATION ATTACHED

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☐ Superelevated sections
- ☐ Debris basin/detention basin
- ☐ Other (Describe):
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☒ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☒ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source: Pabco Channel

Name of Structure: Existing (4) 48" RCPs

1. This revision reflects (check one):

- ☒ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☐ Erosion Protection
- ☐ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

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

★ EXPLANATION ATTACHED

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☐ Superelevated sections
- ☐ Debris basin/detention basin
- ☐ Other (Describe):
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source: Pabco Channel

Name of Structure: Existing 10'x5' RCB (#2)

1. This revision reflects (check one):

- ☒ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☐ Erosion Protection
- ☐ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

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

★ EXPLANATION ATTACHED

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☐ Superelevated sections
- ☐ Debris basin/detention basin
- ☒ Other (Describe):
- ☒ Drop structures
- ☐ Transitions in cross sectional geometry
- ☒ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry (cfs) and/or the -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☒ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source: Pabco Channel

Name of Structure: Existing (5) 1.5'x1' HERCPs

1. This revision reflects (check one):

- ☒ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Skew Angle
- ☒ Distances Between Cross Sections
- ☐ Erosion Protection
- ☐ Low Chord Elevations – Upstream and Downstream
- ☒ Top of Road Elevations – Upstream and Downstream
- ☒ Structure Invert Elevations – Upstream and Downstream
- ☒ Stream Invert Elevations – Upstream and Downstream
- ☒ Cross-Section Locations

4. Sediment Transport Considerations

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

* EXPLANATION ATTACHED

Statement of Explanation for following sections:

1. MT-2 Form 2 Page 1 of 2 Section A 5

   Explanation:

   WRF Channel: Sediment transport was not considered because the majority of the watershed tributary, to WRF Channel and the associated structures, is urbanized and there is no current evidence of sediment deposition through the channel. In addition to that the WRF channel is riprap lined and any sediment entering the channel will be transported to the Las Vegas Wash.

   Pabco Channel: Sediment transport was not considered because the majority of the watershed tributary, to Pabco Channel and the associated structures, is urbanized and there is no current evidence of sediment deposition/scour through the channel. It should be also noted that analysis completed for the Pabco Channel with the CLOMR did not consider sediment transport. Any sediment entering the channel will be transported downstream to the Las Vegas Wash.

2. MT-2 Form 3 Page 2 of 10 Section C 4

   Explanation:

   WRF Channel: Sediment transport was not considered because the majority of the watershed tributary, to WRF Channel and the associated structures, is urbanized and there is no current evidence of sediment deposition through the channel. In addition to that the WRF channel is riprap lined and any sediment entering the channel will be transported to the Las Vegas Wash.

   Pabco Channel: Sediment transport was not considered because the majority of the watershed tributary, to Pabco Channel and the associated structures, is urbanized and there is no current evidence of sediment deposition/scour through the channel. It should be also noted that analysis completed for the Pabco Channel with the CLOMR did not consider sediment transport. Any sediment entering the channel will be transported downstream to the Las Vegas Wash.

Appendix B: Correspondence

U.S. Department of Homeland Security
1111 Broadway, Suite 1200
Oakland, CA 94607-4052

FEMA

February 21, 2008

Ms. Mary Kay Peck
City Manager, Henderson, Nevada
240 Water Street, 4th Floor
P.O. Box 95050
Henderson, NV 89009-5050

Dear Ms. Peck:

Thank you for the courtesy extended by City staff during the Community Assistance Visit on February 14, 2008. The purpose of the meeting was to provide your staff with the most current information on the National Flood Insurance Program (NFIP), give them an opportunity to discuss concerns they might have had, and assess the City's enforcement of the local floodplain management ordinance that was adopted to meet requirements of the NFIP.

FEMA's evaluation of Henderson's floodplain management program indicates that the City is appropriately and effectively enforcing floodplain requirements. The City's administrative practices and procedures should effectively ensure full compliance with NFIP regulations. There is, however, one follow up action required to ensure a construction violation has not been permitted. Regarding the Water Reclamation Facility, FEMA requires elevation data for this facility or demonstration that engineered site drainage eliminates the risk via a LOMR by May 21, 2008.

Currently, there are 738 flood insurance policies in effect in Henderson, totaling $196,745,900 in coverage. Since joining the NFIP, there have been 27 paid losses totaling $215,086.87. Three substantial damage claims have been made in Henderson since joining the program. No structures have appeared on the repetitive loss report.

If you have any questions, or if I can be of any assistance, please call 510-627-7050.

Sincerely,

Sarah Cody Owen

Sarah Owen
Community Compliance
National Flood Insurance Program

Cc: Curt Chandler, Floodplain Administrator, Henderson, NV
Kelvin Hickenbottom, NV Division of Water Resources, Carson City, NV

FEDERAL EMERGENCY MANAGEMENT AGENCY
COMMUNITY ASSISTANCE VISIT REPORT

SECTION I

1. NAME OF COMMUNITY	2. STATE	3. COMMUNITY ID NUMBER	4. COUNTY
Henderson	NV	320005	Clark

5. VISIT CONDUCTED BY	6. AGENCY	7. DATE OF VISIT
Sarah Owen	FEMA	February 14, 2008

SECTION II

8. NAME OF LOCAL OFFICIAL	9. TELEPHONE NUMBER
Curt Chandler, Floodplain Administrator	(702) 267-3020

10. ADDRESS OF LOCAL OFFICIAL

240 Water Street, Henderson, NV 89015

SECTION III – FINDINGS

PART A

QUESTIONS – Select appropriate response	RESPONSE		
	Serious	Minor	None
1. Are there problems with the community's floodplain management regulations?			X
2. Are there problems with the community's administrative/enforcement procedures?			X
3. Are there engineering or other problems with the maps or Flood Insurance Study?			X
4. Are there any other problems in the community's floodplain management program?			X
5. Are there problems with the Biennial Report data?	___ YES	_X_ NO	
6. Are there any programmatic issues or problems identified?	___ YES	_X_ NO	

7. Are there any potential violations of the community's floodplain management regulations?

_X_ A potential violation or violations has/have been identified.

___ No violations have been identified.

___ Actions are being taken on the part of the community to remedy the violation(s) identified during the CAV.

LIST OF ATTENDEES

Sarah Owen – FEMA
Curt Chandler – Henderson Land Development Manager/Floodplain Administrator
Albert Jankowiak – Project Engineer II
Janet Kapke – Floodplain Technician
Janie Nihipali – Land Development Plans Examiner

BACKGROUND

Henderson first entered the National Flood Insurance Program on January 14, 1975 through the Emergency Program, then on June 15, 1982 through the Regular Program when the City's initial Flood Insurance Rate Maps (FIRMS) were issued. Currently, there are 738 flood insurance policies in effect in Henderson, totaling $196,745,900 in coverage. Since joining the NFIP, there have been 27 paid losses totaling $215,086.87. Three substantial damage claims have been made in Henderson since joining the program. No structures have appeared on the repetitive loss report.

FLOODPLAIN MANAGEMENT REGULATIONS

The City's floodplain management ordinance regulations are contained in ordinance number 2141, which adopts Clark County Regional Flood Control District's *Uniform Regulations for the Control of Drainage*, and became effective January 1, 2003. The City also follows CCRFCD's *Hydrologic Criteria and Drainage Design Manuel*, except for several stricter requirements. Henderson's ordinance doesn't contain an automatic adoption clause, so re-adoption of the Uniform Regulations is necessary when changes are made to those codes. Currently the Uniform Regulations are undergoing changes which the City will adopt. The City must provide an updated signed and dated copy of Ordinance No. 2141 to the FEMA Regional Office upon adoption.

ADMINISTRATIVE AND ENFORCEMENT PROCEDURES

All development, including commercial, residential, and subdivisions, must go through the entitlement process at Henderson's Community Development Department. The Public Works department determines whether or not a proposed project is in the SFHA, and if it is, conditions are attached to the application on their electronic database which must be met in order to final the permit. A drainage study, including technical hydrologic and hydraulic analysis, is required after the entitlement process. The drainage study determines BFEs and reveals if there has been an increase in them. If an increase of more than 1 foot occurs, a CLOMR is required before a permit is issued. If there is less than a 1 foot increase in BFE, the construction may start without a CLOMR. In all case, construction within the SFHAs requires a finalized LOMR before a final inspection occurs and the Certificate of Occupancy is issued. Final elevation data is also recorded at this point.

In order to catch substantial improvements, all construction and improvement permits are routed through Public Works, where it is determined whether or not it is in a SFHA and whether or not the cost meets FEMA's definition of 'substantial improvement'. This is also tracked through the City's electronic database and a hold or conditions will be placed on the permit if required. There have been approximately two substantial improvements in the City within the last few years.

OTHER PROBLEMS WITH THE COMMUNITY'S PROGRAM

There are none.

PROGRAMMATIC ISSUES OR PROBLEMS IDENTIFIED

There are none.

FLOOD MITIGATION PROJECTS, ISSUES OR CONCERNS

There are none.

FIELD REVIEW

A field inspection of the SFHAs of Henderson produced the following questions about development:

A Chevron station in an A zone on panel 2605 E at the intersection of Lake Mead Hwy and Olsen Street. LOMR # 04091382P removes this area from the SFHA.

Non-residential buildings under construction at Eaglerock Street and Nancy Jay Street on panel 2605 E in an A zone. LOMR # 04091382P removes this area from the SFHA.

Tuscany Residential Village residential subdivision in an A zone on Mohawk Street. LOMR # 04091382P removes this area from the SFHA.

The Water Reclamation Facility at the intersection of E. Galleria and Pabco Road in an A zone. There is no elevation data for this facility. Please see Community Action Needed section below.

ENGINEERING FLOOD MAPS AND STUDY

Flood Insurance Rate Maps were first issued on June 15, 1982; the current index is dated December 4, 2007. No issues were brought up regarding the FIRMs.

BIENNIAL REPORT

The 2007 Biennial Report is the latest report on file. It was filled out by the City and entered into FEMA's CIS database. The results show that there were 6 structures permitted and no variances approved in the SFHA during the previous year. The Biennial Report showed that there were changes to the base data on the County's FIRMs and that are no changes in flooding characteristics that warrant a floodplain restudy. The report also showed that the County has new material that may be incorporated into the FIRMS; significant man-made changes have been made which affect SFHAs; changes to the County's floodplain management ordinance have not been made and there is no need for assistance in improving local floodplain management.

COMMUNITY ACTION NEEDED

The City must provide an updated signed and dated copy of Ordinance No. 2141 to the FEMA Regional Office upon adoption. Elevation data is required for all post-FIRM structures built in the SFHA. Henderson must demonstrate that the Water Reclamation Facility, which is bigger than 5 acres or 50 lots, is built in compliance with NFIP regulations. Please provide elevation data for this facility or demonstrate that engineered site drainage eliminates the risk via a LOMR by May 21, 2008.

REQUESTED INFORMATION

No information was requested during this CAV meeting. If any information is needed in regards to this CAV report or compliance with the NFIP, please contact Sarah Owen at (510) 627-7050. If any information is needed in regards to technical questions about mapping, please contact Eric Simmons at (510) 627-7029.

Appendix C: Hydrologic Analysis

Appendix C-1: Existing WRF Channel Hydrology

Curve Number Calculation
Standard Form 4

Existing Condition Curve Number Calculations (WRF Offsite and Onsite Basins)

Insert | Delete

Basin Name	Soil Type	Hydrologic Group	Land Use	Curve No.	% of Composition	Composite Curve No.
OFFE1-W	184	0 %A 100 %B 0 %C 0 %D	Residential 7000 Sq. Ft Lot (63%Imp)	84.00	62.2%	--
	184	0 %A 100 %B 0 %C 0 %D	Townhouses/6000 Sq ft lots or less (69% Imp)	87.00	29.0%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	6.4%	--
	600	0 %A 0 %B 0 %C 100 %D	Residential 7000 Sq. Ft Lot (63%Imp)	91.00	2.4%	84.9
OFFE2-W	184	0 %A 100 %B 0 %C 0 %D	Commercial and Business (85% Imp)	92.00	21.9%	--
	184	0 %A 100 %B 0 %C 0 %D	Residential 7000 Sq. Ft Lot (63%Imp)	84.00	73.8%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	4.3%	85.7
OFFD3-W	184	0 %A 100 %B 0 %C 0 %D	Residential 7000 Sq. Ft Lot (63%Imp)	84.00	93.2%	--
	600	0 %A 0 %B 0 %C 100 %D	Residential 7000 Sq. Ft Lot (63%Imp)	91.00	6.8%	84.5
OFFD4-W	184	0 %A 100 %B 0 %C 0 %D	Townhouses/6000 Sq ft lots or less (69% Imp)	87.00	87.44%	--
	184	0 %A 100 %B 0 %C 0 %D	Residential 7000 Sq. Ft Lot (63%Imp)	84.00	7.80%	--
	600	0 %A 0 %B 0 %C 100 %D	Townhouses/6000 Sq ft lots or less (69% Imp)	92.00	4.76%	87.0
OFFE5-W	184	0 %A 100 %B 0 %C 0 %D	Townhouses/6000 Sq ft lots or less (69% Imp)	87.00	58.5%	--
	184	0 %A 100 %B 0 %C 0 %D	Commercial and Business (85% Imp)	92.00	11.5%	--
	184	0 %A 100 %B 0 %C 0 %D	Urban Open Space Fair Cond. Grass Cover	69.00	14.7%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	15.3%	84.2
OFFE6-W	184	0 %A 100 %B 0 %C 0 %D	Industrial (72% Imp)	88.00	83.1%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	16.9%	87.0
OFFE7-W	184	0 %A 100 %B 0 %C 0 %D	Industrial (72% Imp)	88.00	76.9%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	19.3%	--
	600	0 %A 0 %B 0 %C 100 %D	Industrial (72% Imp)	93.00	3.8%	87.0
OFFE8-W	184	0 %A 100 %B 0 %C 0 %D	Industrial (72% Imp)	88.00	60.0%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	28.7%	--
	600	0 %A 0 %B 0 %C 100 %D	Industrial (72% Imp)	93.00	11.3%	86.8
OFFE9-W	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	85.1%	--
	184	0 %A 100 %B 0 %C 0 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	9.3%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	4.4%	--
	600	0 %A 0 %B 0 %C 100 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	1.3%	84.0
OFFE10-W	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	76.5%	--

	184	0 %A 100 %B 0 %C 0 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	14.2%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	9.3%	84.9
ONE1-W	600	0 %A 0 %B 0 %C 100 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	71.4%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	23.8%	--
	184	0 %A 100 %B 0 %C 0 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	3.6%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	1.2%	95.7
ONE2-W	600	0 %A 0 %B 0 %C 100 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	75.0%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	25.0%	95.8
ONE3-W	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	25.0%	--
	600	0 %A 0 %B 0 %C 100 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	75.0%	95.8
ONE4-W	600	0 %A 0 %B 0 %C 100 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	75.0%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	25.0%	95.8
ONE5-W	600	0 %A 0 %B 0 %C 100 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	75.0%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	25.0%	95.8
ONE6-W	600	0 %A 0 %B 0 %C 100 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	35.0%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	45.0%	--
	600	0 %A 0 %B 0 %C 100 %D	Western Desert Urban Area - Natural Desert Landscaping	88.00	20.0%	92.0
ONE7-W	600	0 %A 0 %B 0 %C 100 %D	Impervious Area- Paved Parking Lots, Roofs, Driveways etc.	98.00	50.0%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	50.0%	93.5
OFFE11-W	600	0 %A 0 %B 0 %C 100 %D	Gravel (Incl. ROW)	91.00	50.0%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	50.0%	90.0

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

File: FORM4.XLS

WRF LOMR STUDY (WRF Offsite and Onsite Basins)
EXISTING CONDITION

BY: JT
DATE: 5/16/08

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag Basin <1 Mi^2	Tlag Basin >1 Mi^2
DESIG: (1)	DEV./EX. (D or E)	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	Tlag= 20*Kn*((L*Lc)/s^.5))^.33 Hours
OFFE1-W	D	84.9	0.7307	36.21	0.057	215	1.6	8.3	2267	1.3	2.3	3.5	12.0	20.2	23.8	0.202	-
OFFE2-W	D	85.7	0.7412	36.87	0.058	140	1.8	6.3	2556	1.3	2.3	3.5	13.3	19.6	25.0	0.196	-
OFFD3-W	D	84.5	0.7254	43.27	0.068	135	2.2	6.0	2752	1.2	2.2	3.3	15.1	21.1	26.0	0.211	-
OFFD4-W	D	87.0	0.7584	79.16	0.124	156	0.3	11.2	3329	1.1	2.1	3.2	18.8	30.0	29.4	0.294	-
OFFE5-W	D	84.2	0.7214	47.07	0.074	150	2.3	6.3	2650	1.0	2.1	3.1	15.5	21.8	25.6	0.218	-
OFFE6-W	D	87.0	0.7584	21.83	0.034	81	0.6	6.5	1822	0.9	1.9	2.9	12.1	18.6	20.6	0.186	-
OFFE7-W	D	87.0	0.7584	42.51	0.066	163	0.7	8.7	2217	0.8	1.8	2.8	15.0	23.7	23.2	0.232	-
OFFE8-W	D	86.8	0.7558	10.46	0.016	120	2.1	5.3	1180	0.5	1.4	2.2	11.1	16.4	17.2	0.164	-
OFFE9-W	E	84.0	0.7188	14.52	0.023	110	3.6	4.7	1670	0.2	0.7	1.4	25.1	29.8	N/A	0.298	-
OFFE10-W	E	84.9	0.7307	8.36	0.013	120	2.5	5.4	1380	0.4	0.9	1.9	16.8	22.2	N/A	0.222	-
ONE1-W	D	95.7	0.8732	34.98	0.055	100	5.0	2.4	2070	1.2	2.2	3.3	11.8	14.2	22.1	0.142	-
ONE2-W	D	95.8	0.8746	5.43	0.008	140	2.1	3.7	970	1.5	2.5	3.8	5.4	9.1	16.2	0.091	-
ONE3-W	D	95.8	0.8746	26.37	0.041	200	1.5	5.0	3060	0.8	1.8	2.7	20.4	25.4	28.1	0.254	-
ONE4-W	D	95.8	0.8746	5.14	0.008	140	14.3	2.0	915	1.0	2.0	3.0	6.4	8.4	15.9	0.084	-
ONE5-W	D	95.8	0.8746	2.89	0.005	100	5.0	2.4	525	0.4	1.2	1.9	6.9	9.3	13.5	0.093	-
ONE6-W	E	92.0	0.8244	13.54	0.021	120	3.3	3.6	1535	1.2	1.6	3.2	10.6	14.3	N/A	0.143	-
ONE7-W	E	93.5	0.8442	1.86	0.003	140	1.4	4.8	300	1.0	1.5	2.9	3.4	8.2	N/A	0.082	-
OFFE11-W	E	90.0	0.7980	5.29	0.008	100	2.1	4.2	1730	1.0	1.5	3.0	12.5	16.7	N/A	0.167	-

Tlag = 0.6 Tc (Basin <1 Mi^2)
Tlag =20*Kn*((L*Lc)/S^.5)^.33 (Basin >1 Mi^2)
Tc = Ti + Tt
Ti = 1.8 (1.1 - K) L^1/2 / S^1/3
K = 0.0132 (CN) - 0.39
Tc Check = L/180+10

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

Existing (Natural) V1 = 14.8*(S/100)^1/2 Developed (Urban) V1 = 20.2*(S/100)^1/2

Existing (Natural) V2 = 29.4*(S/100)^1/2 Developed (Urban) V2 = 30.6*(S/100)^1/2

REFERENCE : CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT HYDROLOGIC AND DRAINAGE DESIGN MANUAL 08/12/1999

Appendix C-2: Existing Pabco Channel Hydrology

Curve Number Calculation
Standard Form 4

EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
ONE-4*	B	184	67.57	Undeveloped Land, Open Desert	77.00	(67.57/77.65)*77	67.00
	D	600	10.08	Undeveloped Land, Open Desert	88.00	(10.08/77.65)*88	11.42
		Total ONE-4*	77.65			**COMPOSITE CURVE NUMBER**	**78.43**
ONE-5*	D	600	568.28	Undeveloped Land, Open Desert	88.00	(568.28/681.98)*88	73.33
	B	184	95.82	Undeveloped Land, Open Desert	77.00	(95.82/681.98)*77	10.82
	A	117	17.88	Undeveloped Land, Open Desert	63.00	(17.88/681.98)*63	1.65
		Total ONE-5*	681.98			**COMPOSITE CURVE NUMBER**	**85.80**
ONE-6*	A	117	72.15	Undeveloped Land, Open Desert	63.00	(72.15/518.19)*63	8.77
	C	610	7.36	Undeveloped Land, Open Desert	85.00	(7.36/518.19)*85	1.21
	D	600	417.68	Undeveloped Land, Open Desert	88.00	(417.68/518.19)*88	70.93
	B	184	13.26	Undeveloped Land, Open Desert	77.00	(13.26/518.19)*77	1.97
	B	182	7.74	Undeveloped Land, Open Desert	77.00	(7.74/518.19)*77	1.15
		Total ONE-6*	518.19			**COMPOSITE CURVE NUMBER**	**84.03**
ONE-9*	D	600	0.21	Undeveloped Land, Open Desert	88.00	(0.21/198.25)*88.00	0.09
	B	184	198.09	Undeveloped Land, Open Desert	77.00	(198.09/198.25)*77	76.92
		Total ONE-9*	198.30			**COMPOSITE CURVE NUMBER**	**77.01**
ONE-10	B	184	52.64	Undeveloped Land, Open Desert	83.94	(52.64/52.64)*83.94	83.94
		Total ONE-10	52.64			**COMPOSITE CURVE NUMBER**	**83.94**
ONE-X*	B	184	125.62	Undeveloped Land, Open Desert	77.00	(125.62/125.62)*77	77.00
		Total ONE-X*	125.62			**COMPOSITE CURVE NUMBER**	**77.00**
OFFE-1	B	184	113.67	High-Density Residential, 2-4 units per acre	83.94	(113.67/257.29)*83.94	37.08
	C	615	143.62	Rural	85.40	(143.62/257.29)*85.40	47.67
		Total OFFE-1	257.29			**COMPOSITE CURVE NUMBER**	**84.75**
OFFE-2	C	615	12.80	Undeveloped Land, Open Desert	85.00	(12.80/58.41)*85	18.63
	B	184	45.61	Undeveloped Land, Open Desert	77.00	(45.61/58.41)*77	60.13
		Total OFFE-2	58.41			**COMPOSITE CURVE NUMBER**	**78.75**
OFFE-2A	C	615	3.52	Undeveloped Land, Open Desert	85.00	(3.52/17.87)*85	16.74
	B	184	14.35	Undeveloped Land, Open Desert	77.00	(14.35/17.87)*77	61.83
		Total OFFE-2A	17.87			**COMPOSITE CURVE NUMBER**	**78.58**

EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
OFFE-3	B	184	160.02	High-Density Residential, 2-4 units per acre	83.94	(160.02/188.02)*83.94	71.44
	B	187	5.10	High-Density Residential, 2-4 units per acre	83.94	(5.10/188.02)*83.94	2.28
	A	117	15.83	High-Density Residential, 2-4 units per acre	76.72	(15.83/188.02)*76.72	6.46
	A	999	7.07	Parks, Golf Courses	30.00	(7.07/188.02)*30	1.13
		Total OFFE-3	188.02		**COMPOSITE CURVE NUMBER**		**81.30**
OFFE-3A	B	184	18.86	High-Density Residential, 2-4 units per acre	88.00	(18.86/18.86)*88	88.00
		Total OFFE-3A	18.86		**COMPOSITE CURVE NUMBER**		**88.00**
OFFE-4	A	117	14.59	Parks, Golf Courses	47.10	(14.59/318.93)*47.10	2.15
	B	184	31.75	Parks, Golf Courses	64.45	(31.75/318.93)*64.45	6.42
	B	187	0.77	Parks, Golf Courses	64.45	(0.77/318.93)*64.45	0.16
	A	117	1.71	High-Density Residential, 2-4 units per acre	76.72	(1.71/318.93)*76.72	0.41
	B	184	93.20	High-Density Residential, 2-4 units per acre	83.94	(93.20/318.93)*83.94	24.53
	B	187	87.61	High-Density Residential, 2-4 units per acre	83.94	(87.61/318.93)*83.94	23.06
	A	117	0.86	Multi-Family, 8 units per acre or more	82.32	(0.86/318.93)*82.32	0.22
	B	184	6.46	Multi-Family, 8 units per acre or more	87.64	(6.46/318.93)*87.64	1.78
	B	184	67.89	Commercial, Retail, Casino	94.30	(67.89/318.93)*94.30	20.07
	B	187	14.09	Commercial, Retail, Casino	94.30	(14.09/318.93)*94.30	4.17
		TOTAL OFFE-4	318.93		**COMPOSITE CURVE NUMBER**		**82.96**
OFFE-9	B	184	49.73	Multi-Family, 8 units per acre or more	87.64	(49.73/49.73)*87.64	87.64
		Total OFFE-9	49.73		**COMPOSITE CURVE NUMBER**		**87.64**
OFFE-10A	B	184	68.26	High-Density Residential, 2-4 units per acre	83.94	(68.26/68.26)*83.94	83.94
		Total OFFE-10A	68.26		**COMPOSITE CURVE NUMBER**		**83.94**
OFFE-10B	B	184	2.56	High-Density Residential, 2-4 units per acre	87.64	(2.56/24.12)*87.64	9.30
	B	187	21.56	High-Density Residential, 2-4 units per acre	83.94	(21.56/24.12)*83.94	75.03
		Total OFFE-10B	24.12		**COMPOSITE CURVE NUMBER**		**84.33**
OFFE-5N	D	600	5.02	Impervious Area-Paved Parking Lots, Roofs, Driveways etc.	98.00	(5.02/21.07)*98.00	23.35
	D	600	16.05	Dirt (Incl. ROW)	89.00	(16.05/21.07)*89.00	67.80
		Total OFFE-5N	21.07		**COMPOSITE CURVE NUMBER**		**91.14**
OFFE-6N	D	600	2.35	Impervious Area-Paved Parking Lots, Roofs, Driveways etc.	98.00	(2.35/15.37)*98.00	14.97
	D	600	8.80	Dirt (Incl. ROW)	89.00	(8.80/15.37)*89.00	50.96
	B	184	0.85	Impervious Area-Paved Parking Lots, Roofs, Driveways etc.	98.00	(0.85/15.37)*98.00	5.42
	B	184	3.37	Dirt (Incl. ROW)	82.00	(3.37/15.37)*82.00	17.98
		Total OFFE-6N	15.37		**COMPOSITE CURVE NUMBER**		**89.34**
OFFE-7N	D	600	31.78	Undeveloped Land, Open Desert	88.00	(31.78/31.78)*88.00	88.00
		Total OFFE-7N	31.78		**COMPOSITE CURVE NUMBER**		**88.00**

EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
OFFE-8N	D	600	1.29	Impervious Area-Paved Parking Lots, Roofs, Driveways etc.	98.00	(1.29/6.46)*98	19.59
	D	600	5.17	Dirt (including right-of-way)	89.00	(5.17/6.46)*89	71.21
		Total OFFE-8N	6.46		**COMPOSITE CURVE NUMBER**		**90.80**
OFFE-9N	D	600	25.42	Undeveloped Land, Open Desert	88.00	(25.42/78.74)*88	28.41
	B	184	53.32	Undeveloped Land, Open Desert	77.00	(53.36/78.74)*77	52.14
		Total OFFE-9N	78.74		**COMPOSITE CURVE NUMBER**		**80.55**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

CLARK COUNTY

WRF LOMR STUDY (Referred and Revised C1-CLOMR Study)

File: Existing Form 4.XLS — **Existing Condition**

BY: JT

DATE: 5/16/08

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag Basin <1 Mi^2	Tlag Basin >1 Mi^2
DESIG:	DEV./EX. (D or E)	CN	K	AREA Ac	AREA Mi^2	INITIAL LENGTH Feet	SLOPE %	Ti Min	TRAVEL LENGTH Feet	SLOPE %	V1 VELOCITY FPS	V2 VELOCITY FPS	Tt Min			Tlag= 0.6Tc/60	Tlag= 20*Kn*((L*Lc)/ s^.5))^.33
(1)			(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	Min (13)	Min (14)	Hours	Hours
ONE-4*	E	78.43	0.6453	77.65	0.121	150	1.33	9.1	3080	0.94	1.4	1.8	2.0	11.1	N/A	**0.111**	-
ONE-5*	E	85.80	0.7426	681.98	1.066	300	2.00	8.8	11104	1.16	1.6	1.9	2.0	10.9	N/A	Refer to Below	Refer to Below
ONE-6*	E	84.03	0.7192	518.19	0.810	300	2.66	8.6	7865	1.72	1.9	2.1	2.1	10.7	N/A	**0.107**	-
ONE-9*	E	77.01	0.6265	198.30	0.310	250	2.40	10.1	6350	0.70	1.2	1.6	1.9	12.0	N/A	**0.120**	-
ONE-10	E	83.94	0.7180	52.64	0.082	500	1.39	13.8	5693	1.44	1.8	2.0	2.1	15.9	N/A	**0.159**	-
ONE-X*	E	77.00	0.6264	125.62	0.196	300	1.66	12.5	3840	1.48	1.8	2.0	2.1	14.6	N/A	**0.146**	-
OFFE-1	E	84.75	0.7287	257.29	0.402	200	2.70	6.8	4033	3.00	2.6	5.1	14.8	21.6	N/A	**0.216**	-
OFFE-2	E	78.75	0.6495	58.41	0.091	150	2.00	7.9	2925	3.00	2.6	5.1	11.2	19.1	N/A	**0.191**	-
OFFE-2A	E	78.58	0.6473	17.87	0.028	150	2.00	7.9	1545	3.00	2.6	5.1	6.7	14.6	N/A	**0.146**	-
OFFE-3	E	81.30	0.6832	188.02	0.294	100	1.00	7.5	5489	2.70	2.4	4.8	20.6	28.1	N/A	**0.281**	-
OFFE-3A	E	88.00	0.7716	18.86	0.029	100	2.77	4.2	1154	3.00	2.6	5.1	5.4	9.6	N/A	**0.096**	-
OFFE-4	E	82.96	0.7051	318.93	0.498	100	1.00	7.1	8038	2.34	2.3	4.5	31.6	38.8	N/A	**0.388**	-
OFFE-9	E	87.64	0.7668	49.73	0.078	100	2.50	4.4	1600	2.43	2.3	4.6	7.6	12.0	N/A	**0.120**	-
OFFE-10A	E	83.94	0.7180	68.26	0.107	100	2.00	5.5	1600	2.22	2.2	4.4	8.0	13.4	N/A	**0.134**	-
OFFE-10B	E	84.33	0.7232	24.12	0.038	100	2.20	5.2	1350	1.78	2.0	3.9	7.8	13.0	N/A	**0.130**	-
OFFE-5N	E	91.14	0.8130	21.07	0.033	100	3.00	3.6	5635	1.45	1.8	2.0	2.1	5.7	N/A	**0.057**	-
OFFE-6N	E	89.34	0.7893	15.37	0.024	190	2.58	5.6	2420	1.69	1.9	2.1	2.1	7.7	N/A	**0.077**	-
OFFE-7N	E	88.00	0.7716	31.78	0.050	250	2.00	7.4	2840	0.95	1.4	1.8	2.0	9.4	N/A	**0.094**	-
OFFE-8N	E	90.80	0.8086	6.46	0.010	120	2.50	4.2	1675	0.60	1.1	1.6	1.9	6.1	N/A	**0.061**	-
OFFE-9N	E	80.55	0.6733	78.74	0.123	205	1.46	9.7	2980	1.37	1.7	1.9	2.1	11.8	N/A	**0.118**	-

* indicates that basins were refered from previous study

	Kn ROUGH	L LENGTH Mi	Lc CENTROID Mi	S SLOPE Ft/Mi	Tlag Hours
ONE-5*	0.030	1.72	0.79	79.0	0.323

Tlag = 0.6 Tc (Basin <1 Mi^2)

Tlag =20*Kn*((L*Lc)/S^.5)^.33 (Basin >1 Mi^2)

Tc = Ti + Tt

Ti = 1.8 (1.1 - K) L^1/2 / S^1/3

K = 0.0132 (CN) - 0.39

Tc Check = L/180+10

For the travel time (Tt) calculations,

V1 applies to the first 500 feet of travel distance;

V2 applies to the remaining travel distance.

Existing (Natural)	V1 = 14.8*(S/100)^1/2	Developed (Urban) V1 = 20.2*(S/100)^1/2
Existing (Natural)	V2 = 29.4*(S/100)^1/2	Developed (Urban) V2 = 30.6*(S/100)^1/2

REFERENCE : *CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT HYDROLOGIC AND DRAINAGE DESIGN MANUAL 08/12/1999*

* Indicates that basins are revised from CLOMR study

* Basins name ending with N are new basins

Appendix C-3: Hydrologic Model (HEC-1 Output)

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1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   16MAY08  TIME  14:46:33   *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


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

            1       ID   ********************************************
            2       ID   *
            3       ID   *    WRF LOMR (REFERENCE: CLOMR C-1 CHANNEL-LAKE MEAD CHANNEL AND WRF CHANNEL
            4       ID   *    IMPROVEMENTS
            5       ID   *    MODEL:EXISTING CONDITIONS
            6       ID   *    FILE NAME:EXISTING.PRN
            7       ID   *    DATE:4/29/2008
            8       ID   *    HYDROLOGIST: JANAK TIMILSENA, PBS&J
            9       ID   *    STORM DISTRIBUTION = SDN#3
           10       ID   *    DESIGN STORM = 100 YEAR, 6 HOUR
           11       ID   ********************************************
                    *DIAGRAM
*** FREE ***
           12       ID
           13       ID
           14       ID        DRAINAGE AREA
           15       ID        (SQUARE MILES)   DARF
           16       ID             0-0.5         .99
           17       ID            0.5-1         .975
           18       ID              1-2          .95
           19       ID              2-3         .925
           20       ID              3-4         .915
           21       ID              4-5         .908
           22       IT       5       0       0     300
           23       IO       5       0       0
           24       IN       5       0       0
           25       JR    PREC    0.99   0.975    0.95   0.925   0.915   0.908
                    *
           26       KK  OFFE-2
           27       BA   0.091
           28       PB    2.86
           29       PC       0    0.02   0.057    0.07   0.087   0.108   0.124    0.13    0.13    0.13
           30       PC    0.13    0.13    0.13   0.133    0.14   0.142   0.148   0.158   0.172   0.181
           31       PC    0.19   0.197   0.199     0.2   0.201   0.204   0.214   0.229   0.241   0.249
           32       PC   0.251   0.256    0.27   0.278   0.281   0.283   0.295   0.322   0.352   0.409
           33       PC   0.499    0.59    0.71   0.744   0.781   0.812   0.819   0.835   0.851   0.856
           34       PC    0.86   0.868   0.876   0.888    0.91   0.926   0.937    0.95    0.97   0.976
           35       PC   0.982   0.985   0.987   0.989    0.99   0.993   0.993   0.994   0.995   0.998
           36       PC   0.998   0.999       1
           37       LS       0   78.75
           38       UD   0.191
                    *
           39       KK  OFFE-3
           40       BA   0.294
           41       PB    2.86
           42       LS       0   81.30
           43       UD   0.281
                    *
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          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

           44       KK OFFE-3A
           45       BA   0.029
           46       PB    2.86
           47       LS       0      88
           48       UD   0.096
                    *
           49       KKROFFE-3A
```

```
50          KM   ROUTE OFFE-3A IN CHANNEL WEST ALONG LAKE MEAD DRIVE
51          RD    2200 0.00453   0.033       0    TRAP      12       4
            *

52          KK     CP1
53          KM   COMBINE ROFFE-3A, OFFE-3, AND OFFE-2
54          HC       3
            *

55          KK    RCP1
56          KM   ROUTE TO BOULDER HIGHWAY
57          RD    5000   0.025    0.03       0    TRAP      50       3
            *

58          KK OFFE-2A
59          BA   0.028
60          PB    2.86
61          LS       0   78.58
62          UD   0.146
            *

63          KK  OFFE-1
64          BA   0.402
65          PB    2.86
66          LS       0   84.75
67          UD   0.216
            *

68          KK  OFFE-4
69          BA   0.498
70          PB    2.86
71          LS       0   82.96
72          UD   0.388
            *

73          KK ROFFE-4
74          KM   ROUTE TO BOULDER HIGHWAY AT PABCO RD
75          RD   12600    0.03    0.03       0    TRAP       1       1
            *

76          KK     CP2
77          KM   COMBINE ALL BASINS AT BOULDER HIGHWAY
78          HC       4
            *
```



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

79          KK    OCP2
80          KM   FLOW SPLIT AT CULVERT UNDER BOULDER HIGHWAY AT PABCO ROAD
81          KM   DIVERT OUT FLOW ALONG BOULDER HIGHWAY(BASED ON THE WRF LOMR HEC-RAS ANALYSIS
82          DT    DCP2
83          DI       0     870
84          DQ       0  525.26
            *

85          KK   ROCP2
86          KM   ROUTE OCP2 TO OCP4-C*
87          RD    1045   0.016   0.025       0    TRAP      15       3
            *

88          KK OCP4-C*
89          KM   FLOW SPLIT AT CULVERT UNDER THE CULVERT OF PABCO CHANNEL
90          KM   DIVERT OUT FLOW ALONG THE PABCO ROAD (BASED ON THE WRF LOMR HEC-RAS ANALYSIS
91          DT DCP4-C*
92          DI       0     340
93          DQ       0    38.9
            *

94          KK RCP4-C*
95          KM   ROUTE OCP4-C* TO CP5*
96          RD    1375   0.016   0.025       0    TRAP      15       3
            *

97          KK OFFE-6N
98          BA   0.024
99          PB    2.86
100         LS       0   89.34
101         UD   0.077
            *

102         KK  ONE-9*
103         BA    0.31
104         PB    2.86
105         LS       0   77.01
106         UD   0.120
            *

107         KK  OFFE-9
108         BA   0.078
109         PB    2.86
110         LS       0   87.64
111         UD   0.120
            *

112         KK ROFFE-9
113         KM   ROUTE OFFE-9 TO CP4-A*
114         RD    4650  0.0109   0.035       0    TRAP      50       4
            *
```

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

 115          KK  ONE-10
 116          BA   0.082
 117          PB    2.86
 118          LS       0   83.94
 119          UD   0.159
              *

 120          KKOFFE-10A
 121          BA   0.107
 122          PB    2.86
 123          LS       0   83.94
 124          UD   0.134
              *

 125          KKOFFE-10B
 126          BA   0.038
 127          PB    2.86
 128          LS       0   84.33
 129          UD   0.130
              *

 130          KK     CP4
 131          KM   COMBINE ONE-10, OFFE-10A, OFFE-10B
 132          HC       3
              *

 133          KK    RCP4
 134          KM   ROUTE TO CP4-A*
 135          RD    4670  0.0047   0.035       0    TRAP      50       4
              *

 136          KK  CP4-A*
 137          KM   COMBINE ONE-9, ROFFE-9 AND RCP4
 138          HC       3
              *

 139          KK RCP4-A*
 140          KM  ROUTE CP4-A* TO CP4-B*
 141          RD    2010  0.0208   0.035       0    TRAP      50       4
              *

 142          KK OFFE-7N
 143          BA    0.05
 144          PB    2.86
 145          LS       0   88.00
 146          UD   0.094
              *

 147          KK  CP4-B*
 148          KM   COMBINE RCP4-A* AND OFFE-7N
 149          HC       2
              *
1                                        HEC-1 INPUT                                        PAGE  5

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

 150          KK    CP5*
 151          KM   COMBINE ROCP4-C*, OFFE-6N AND CP4-B*
 152          HC       3
              *

 153          KK   RCP5*
 154          KM  ROUTE CP5* TO CP6*
 155          RD    5635  0.0145   0.025       0    TRAP      15       3
              *

 156          KK OFFE-5N
 157          BA   0.033
 158          PB    2.86
 159          LS       0   91.14
 160          UD   0.057
              *

 161          KK    CP6*
 162          KM   COMBINE RCP5* AND OFFE-5N
 163          HC       2
              *

 164          KK   RCP6*
 165          KM   ROUTE CP6* TO CP6A*
 166          RD    1675   0.006   0.025       0    TRAP      80       3
              *

 167          KK  ONE-5*
 168          BA   1.066
 169          PB    2.86
 170          LS       0   85.80
 171          UD   0.323
              *

 172          KK RONE-5*
 173          KM   ROUTE TO CP6A
 174          RD     780   0.014   0.016       0    TRAP       0      40
              *

 175          KK OFFE-8N
```

```
176          BA   0.010
177          PB    2.86
178          LS       0   90.80
179          UD   0.061
             *

180          KK   CP6A*
181          KM   COMBINE RONE-5*, RCP6*  AND OFFE-8N
182          HC       3
             *
```



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

183          KK  RCP6A*
184          KM   ROUTE CP6A* TO CP6B*
185          RD    1210   0.014   0.016       0    TRAP       0      30
             *

186          KK  ONE3-W
187          KM   WRF ONSITE BASIN ONE3-W
188          BA   0.041
189          PB    2.86
190          LS       0    95.6
191          UD   0.255
             *

192          KK  ONE-4*
193          BA   0.121
194          PB    2.86
195          LS       0   78.43
196          UD   0.111
             *

197          KK  ONE-6*
198          BA    0.81
199          PB    2.86
200          LS       0   84.03
201          UD   0.107
             *

202          KK RONE-6*
203          KM   ROUTE TO CP6B
204          RD    2140   0.015   0.025       0    TRAP       0      30
             *

205          KK   CP6B*
206          KM   COMBINE RCP6A*, ONE3-W, ONE-4* AND RONE-6*
207          HC       4
             *

208          KK  RCP6B*
209          KM   ROUTE CP6B* TO CP7*
210          RD    2890  0.0145   0.035       0    TRAP     100       4
             *

211          KK OFFE-9N
212          BA   0.123
213          PB    2.86
214          LS       0   80.55
215          UD   0.118
             *
```



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

216          KK  ONE-X*
217          BA   0.196
218          PB    2.86
219          LS       0      77
220          UD   0.146
             *

221          KK    CP7*
222          KM   COMBINE AT RCP6B*, OFFE-9N AND ONE-X*
223          HC       3
             *

224          KK OFFE1-W
225          KM    Basin OFFE1-W
226          BA   0.057
227          PB    2.86
228          LS       0    84.9
229          UD   0.202
             *

230          KKROFFE1-W
231          KM    OFFE1-W routed to C1-W
232          RD    4320  0.0115   0.016       0    TRAP       0      50
             *

233          KK OFFE2-W
234          KM    Basin OFFE2-W
235          BA   0.058
236          LS       0    85.7
237          UD   0.196
             *

238          KKROFFE2-W
```

```
239          KM    OFFE2-W routed to C1-W
240          RD    3105  0.0114   0.016       0    TRAP       0      50
             *

241          KK OFFD3-W
242          KM    Basin OFFD3-W
243          BA   0.068
244          LS       0    84.5
245          UD   0.211
             *

246          KKROFFD3-W
247          KM    OFFD3 routed to C1
248          RD    3219  0.0096   0.016       0    TRAP       0      50
             *
```



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

249          KK OFFD4-W
250          KM    Basin OFFD4-W
251          BA   0.124
252          LS       0    87.0
253          UD   0.294
             *

254          KK    C1-W
255          KM   COMBINE OFFE1-W, OFFE2-W, OFFD3-W AND OFFD4-W
256          HC       4
             *

257          KK OFFE7-W
258          KM    Basin OFFE7
259          BA   0.066
260          LS       0    87.0
261          UD   0.232
             *

262          KK   C1A-W
263          KM   COMBINE C1-W AND OFFE7-W
264          HC       2
             *

265          KK  RC1A-W
266          KM   C1A-W routed to C3-W
267          RD     955   0.004   0.025       0    TRAP      40       2
             *

268          KK OFFE5-W
269          KM    Basin OFFE5-W
270          BA   0.074
271          LS       0    84.2
272          UD   0.218
             *

273          KKOOFFE5-W
274          KM   PROPORTION OF OFFE5-W FLOWING TO C2-W
275          DTDOFFE5-W
276          DI       0      41      80
277          DQ       0       0      39
             *

278          KK OFFE6-W
279          KM    Basin OFFE6-W
280          BA   0.034
281          LS       0    87.0
282          UD   0.186
             *
```



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

283          KK    C2-W
284          KM   COMBINE OOFFE5-W AND OFFE6-W
285          HC       2
             *

286          KK   RC2-W
287          KM   C2-W routed to C3-W
288          RD    1380   0.004   0.025       0    TRAP      40       2
             *

289          KK OFFE8-W
290          KM    Basin OFFE8-W
291          BA   0.016
292          LS       0    86.8
293          UD   0.164
             *

294          KKROFFE8-W
295          KM   OFFE8-W routed to C3-W
296          RD     480   0.016   0.035       0    TRAP      50      10
             *

297          KKOFFE10-W
298          KM   BASIN OFFE10-W
299          BA   0.013
300          LS       0    84.9
301          UD   0.222
```

```
                *
  302           KK    C3-W
  303           KM   COMBINE RC1A-W, RC2-W, ROFFE8-W AND OFFE10-W
  304           HC       4
                *
  305           KK OFFE9-W
  306           KM    Existing Basin OFFE9-W
  307           BA   0.023
  308           LS        0    84.0
  309           UD   0.298
                *
  310           KK    C4-W
  311           KM   COMBINE C3-W AND OFFE9-W
  312           HC       2
                *
  313           KK   RC4-WTO C5-W
  314           KM   C4-W routed to C5-W
  315           RD    1620  0.0092  0.0376       0    TRAP       4       7
                *
1                                        HEC-1 INPUT                                                    PAGE 10

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

  316           KKOFFE11-W
  317           KM    Basin OFFE11-W
  318           BA   0.008
  319           LS        0    90.0
  320           UD   0.167
                *
  321           KK    C5-W
  322           KM   COMBINE RC4-W AND ONE8-W
  323           HC       2
                *
  324           KK  ONE1-W
  325           KM   ONSITE BASIN ONE1-W
  326           BA   0.055
  327           LS        0    95.7
  328           UD   0.142
                *
  329           KK  ONE2-W
  330           KM   ONSITE BASIN ONE2-W
  331           BA   0.008
  332           LS        0    95.8
  333           UD   0.091
                *
  334           KK RONE2~W
  335           KM   ROUTE ONE2-W TO C6-W
  336           RD     250   0.016   0.035       0    TRAP      50      10
                *
  337           KK  ONE4~W
  338           KM   ONSITE BASIN ONE4-W
  339           BA   0.008
  340           LS        0    95.8
  341           UD   0.084
                *
  342           KK RONE4~W
  343           KM   ROUTE ONE4-W TO C6-W
  344           RD     455   0.013   0.035       0    TRAP      50      10
                *
  345           KK  ONE5~W
  346           KM   ONSITE BASIN ONE5-W
  347           BA   0.005
  348           LS        0    95.8
  349           UD   0.093
                *
1                                        HEC-1 INPUT                                                    PAGE 11

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

  350           KK RONE5-W
  351           KM   ROUTE ONE4-W TO ONE5-W
  352           RD     300    0.01   0.035       0    TRAP      50      10
                *
  353           KK  ONE7-W
  354           KM   ONSITE BASIN ONE7-W
  355           BA   0.003
  356           LS        0    93.5
  357           UD   0.082
                *
  358           KK    C6-W
  359           KM   COMBINE RONE2-W, RONE4-W, RONE5-W  AND ONE6-W
  360           HC       4
                *
  361           KK  ONE6-W
  362           KM   ONSITE BASIN ONE6-W
```

```
363           BA   0.021
364           LS       0    92.0
365           UD   0.143
              *
366           ZZ
```

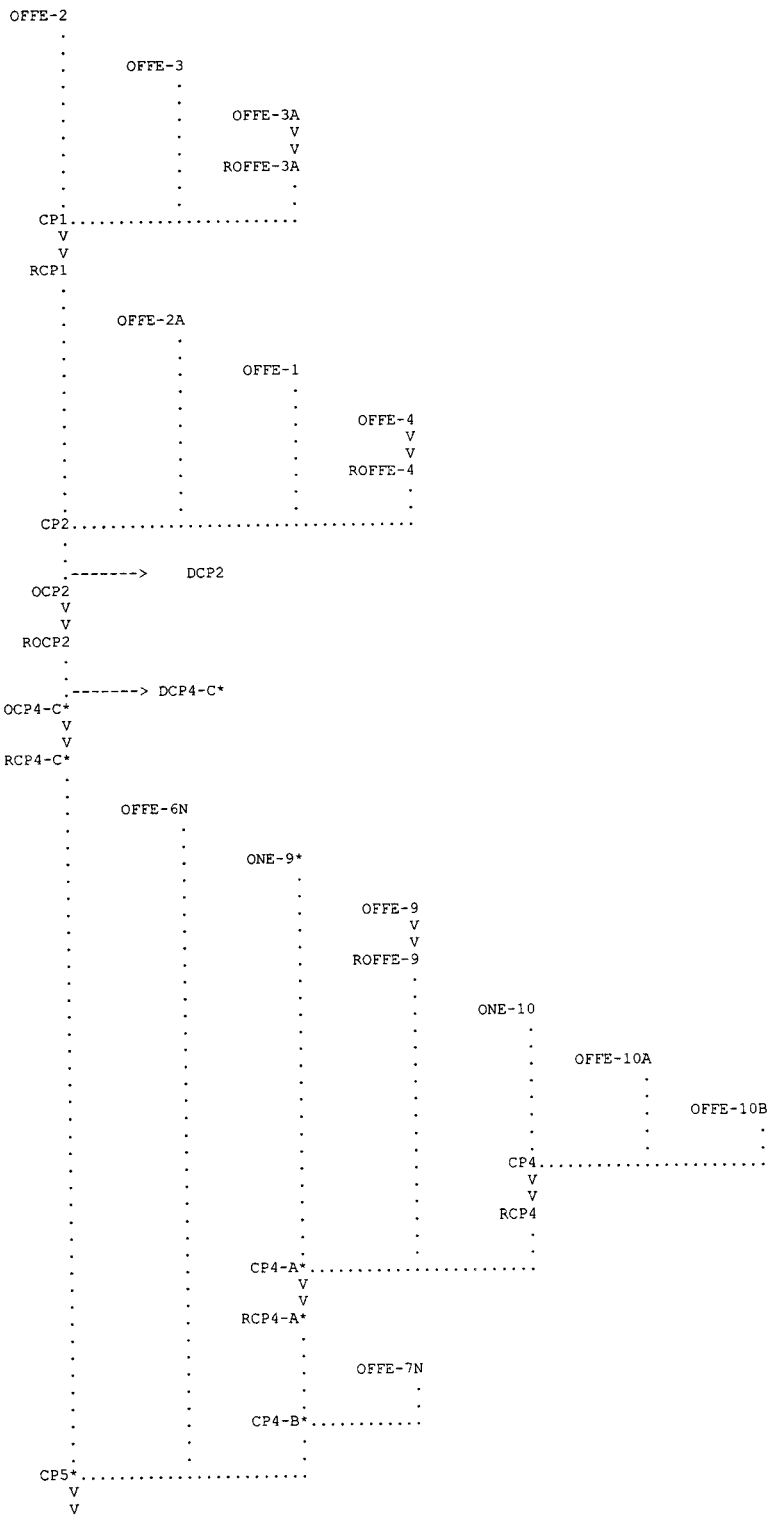
1

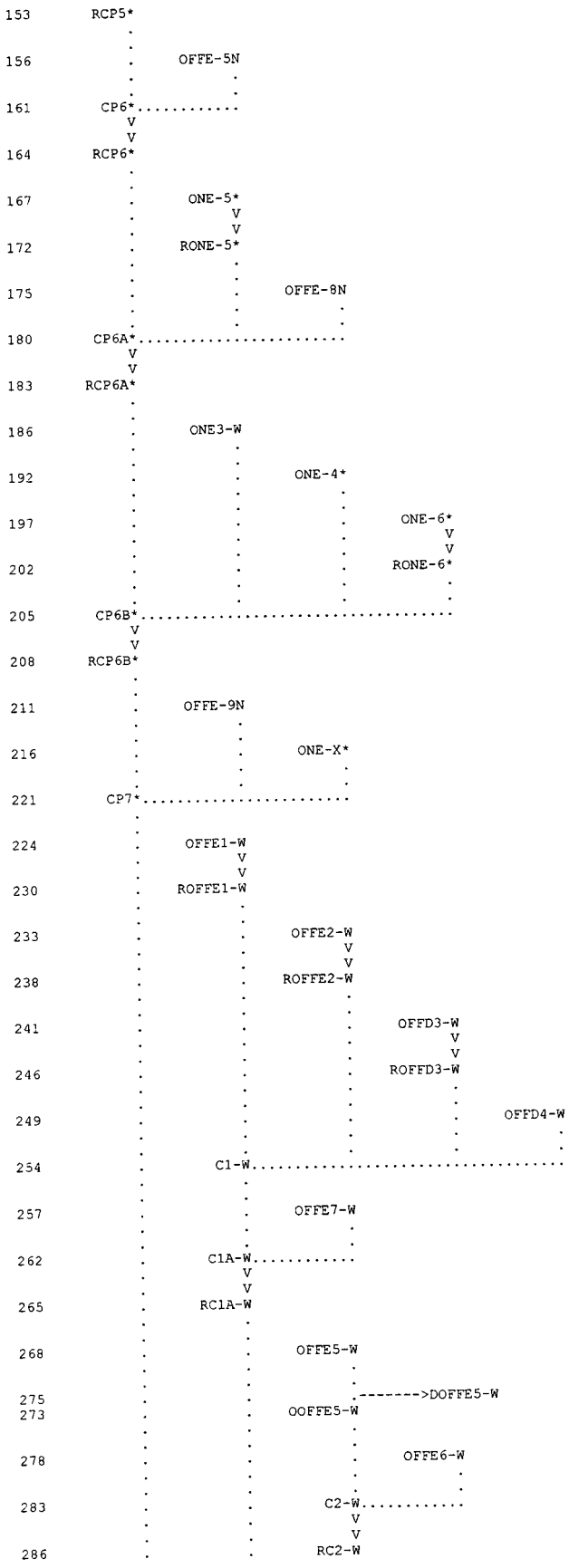
SCHEMATIC DIAGRAM OF STREAM NETWORK

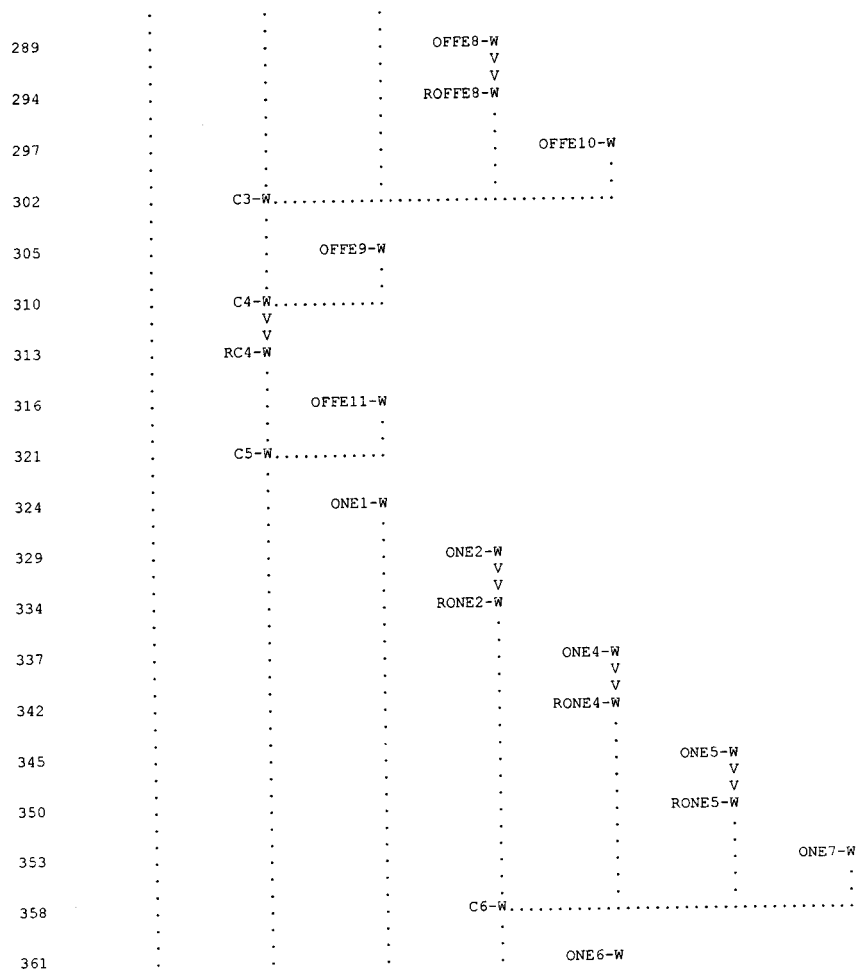
INPUT LINE NO.

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

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW




153 RCP5*
156 OFFE-5N
161 CP6*
164 RCP6*
167 ONE-5*
172 RONE-5*
175 OFFE-8N
180 CP6A*
183 RCP6A*
186 ONE3-W
192 ONE-4*
197 ONE-6*
202 RONE-6*
205 CP6B*
208 RCP6B*
211 OFFE-9N
216 ONE-X*
221 CP7*
224 OFFE1-W
230 ROFFE1-W
233 OFFE2-W
238 ROFFE2-W
241 OFFD3-W
246 ROFFD3-W
249 OFFD4-W
254 C1-W
257 OFFE7-W
262 C1A-W
265 RC1A-W
268 OFFE5-W
275 DOFFE5-W
273 OOFFE5-W
278 OFFE6-W
283 C2-W
286 RC2-W



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN   1998                *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   16MAY08  TIME  14:46:33   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
*********************************************
*
*    WRF LOMR (REFERENCE: CLOMR C-1 CHANNEL-LAKE MEAD CHANNEL AND WRF CHANNEL
*    IMPROVEMENTS
*    MODEL:EXISTING CONDITIONS
*    FILE NAME:EXISTING.PRN
*    DATE:4/29/2008
*    HYDROLOGIST: JANAK TIMILSENA, PBS&J
*    STORM DISTRIBUTION = SDN#3
*    DESIGN STORM = 100 YEAR, 6 HOUR
*********************************************
```

DRAINAGE AREA (SQUARE MILES)	DARF
0-0.5	.99
0.5-1	.975
1-2	.95
2-3	.925
3-4	.915
4-5	.908

```
 23 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
.99 .98 .95 .93 .92 .91

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .99	RATIO 2 .98	RATIO 3 .95	RATIO 4 .93	RATIO 5 .92	RATIO 6 .91
HYDROGRAPH AT	OFFE-2	.09	1	FLOW	74.	72.	68.	65.	64.	63.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT	OFFE-3	.29	1	FLOW	236.	229.	219.	209.	205.	202.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	OFFE-3A	.03	1	FLOW	44.	43.	42.	40.	40.	39.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
ROUTED TO	ROFFE-3A	.03	1	FLOW	40.	39.	38.	36.	36.	36.
				TIME	3.67	3.67	3.75	3.75	3.75	3.75
3 COMBINED AT	CP1	.41	1	FLOW	345.	336.	320.	305.	298.	294.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO	RCP1	.41	1	FLOW	353.	343.	328.	312.	306.	302.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	OFFE-2A	.03	1	FLOW	26.	25.	24.	22.	22.	22.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	OFFE-1	.40	1	FLOW	424.	414.	397.	381.	374.	369.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT	OFFE-4	.50	1	FLOW	372.	363.	347.	332.	325.	321.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO	ROFFE-4	.50	1	FLOW	372.	362.	346.	330.	324.	320.
				TIME	4.00	4.00	4.00	4.08	4.08	4.08
4 COMBINED AT	CP2	1.34	1	FLOW	938.	912.	870.	827.	810.	798.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
DIVERSION TO	DCP2	1.34	1	FLOW	566.	551.	525.	499.	489.	482.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	OCP2	1.34	1	FLOW	372.	361.	345.	328.	321.	316.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO	ROCP2	1.34	1	FLOW	365.	355.	340.	324.	318.	313.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
DIVERSION TO	DCP4-C*	1.34	1	FLOW	42.	41.	39.	37.	36.	36.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT	OCP4-C*	1.34	1	FLOW	323.	315.	301.	287.	281.	277.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92

ROUTED TO	RCP4-C*	1.34	1	FLOW	323.	316.	300.	287.	280.	277.
+				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT	OFFE-6N	.02	1	FLOW	42.	41.	39.	38.	37.	37.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	ONE-9*	.31	1	FLOW	273.	264.	251.	238.	233.	229.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	OFFE-9	.08	1	FLOW	111.	109.	105.	101.	99.	98.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO	ROFFE-9	.08	1	FLOW	107.	105.	103.	105.	104.	103.
-				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	ONE-10	.08	1	FLOW	95.	93.	89.	85.	83.	82.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	OFFE-10A	.11	1	FLOW	130.	127.	121.	116.	114.	113.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	OFFE-10B	.04	1	FLOW	47.	46.	44.	42.	42.	41.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT	CP4	.23	1	FLOW	272.	265.	254.	243.	239.	236.
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO	RCP4	.23	1	FLOW	260.	240.	230.	219.	219.	216.
+				TIME	3.83	3.83	3.83	3.83	3.83	3.83
3 COMBINED AT	CP4-A*	.62	1	FLOW	492.	467.	450.	435.	432.	427.
+				TIME	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO	RCP4-A*	.62	1	FLOW	465.	445.	445.	415.	423.	430.
+				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT	OFFE-7N	.05	1	FLOW	77.	75.	73.	70.	69.	68.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	CP4-B*	.67	1	FLOW	481.	461.	460.	430.	437.	444.
+				TIME	3.92	3.92	3.92	3.92	3.92	3.92
3 COMBINED AT	CP5*	2.03	1	FLOW	812.	784.	767.	723.	724.	728.
+				TIME	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO	RCP5*	2.03	1	FLOW	830.	795.	760.	714.	709.	708.
+				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	OFFE-5N	.03	1	FLOW	66.	64.	62.	60.	59.	59.
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	CP6*	2.06	1	FLOW	841.	805.	770.	723.	719.	717.
+				TIME	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	RCP6*	2.06	1	FLOW	814.	784.	758.	708.	703.	703.
+				TIME	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT	ONE-5*	1.07	1	FLOW	998.	975.	936.	898.	882.	872.
+				TIME	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO	RONE-5*	1.07	1	FLOW	984.	961.	923.	885.	871.	858.
+				TIME	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	OFFE-8N	.01	1	FLOW	19.	19.	18.	18.	18.	17.
-				TIME	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT	CP6A*	3.14	1	FLOW	1587.	1547.	1471.	1397.	1362.	1341.
+				TIME	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO	RCP6A*	3.14	1	FLOW	1573.	1531.	1452.	1376.	1342.	1322.
+				TIME	3.92	3.92	3.92	3.83	3.83	3.83
HYDROGRAPH AT	ONE3-W	.04	1	FLOW	61.	60.	58.	56.	56.	55.
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT										

-	ONE-4*	.12	1	FLOW	115.	112.	107.	101.	99.	98.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	ONE-6*	.81	1	FLOW	998.	975.	936.	897.	881.	870.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO										
+	RONE-6*	.81	1	FLOW	998.	942.	922.	858.	842.	831.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
4 COMBINED AT										
+	CP6B*	4.11	1	FLOW	2276.	2209.	2108.	2009.	1968.	1937.
				TIME	3.67	3.75	3.75	3.75	3.75	3.75
ROUTED TO										
+	RCP6B*	4.11	1	FLOW	2261.	2186.	2115.	1987.	1946.	1907.
				TIME	3.75	3.83	3.75	3.83	3.83	3.83
HYDROGRAPH AT										
+	OFFE-9N	.12	1	FLOW	130.	126.	121.	115.	113.	111.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	ONE-X*	.20	1	FLOW	164.	159.	151.	143.	140.	138.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT										
+	CP7*	4.43	1	FLOW	2452.	2371.	2292.	2155.	2103.	2051.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT										
+	OFFE1-W	.06	1	FLOW	61.	60.	57.	55.	54.	54.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO										
+	ROFFE1-W	.06	1	FLOW	63.	61.	59.	56.	55.	54.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	OFFE2-W	.06	1	FLOW	66.	64.	62.	59.	58.	57.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO										
+	ROFFE2-W	.06	1	FLOW	66.	64.	62.	59.	58.	58.
				TIME	3.75	3.75	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	OFFD3-W	.07	1	FLOW	71.	70.	67.	64.	63.	62.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO										
+	ROFFD3-W	.07	1	FLOW	73.	71.	68.	65.	64.	63.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	OFFD4-W	.12	1	FLOW	127.	124.	119.	115.	113.	112.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
4 COMBINED AT										
+	C1-W	.31	1	FLOW	318.	311.	299.	287.	282.	279.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	OFFE7-W	.07	1	FLOW	75.	73.	71.	68.	67.	66.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT										
+	C1A-W	.37	1	FLOW	381.	371.	356.	340.	334.	330.
				TIME	3.75	3.75	3.75	3.75	3.75	3.83
ROUTED TO										
+	RC1A-W	.37	1	FLOW	376.	369.	353.	340.	332.	329.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	OFFE5-W	.07	1	FLOW	76.	74.	71.	68.	67.	66.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
DIVERSION TO										
+	DOFFE5-W	.07	1	FLOW	35.	33.	30.	27.	26.	25.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT										
+	OOFFE5-W	.07	1	FLOW	41.	41.	41.	41.	41.	41.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT										
+	OFFE6-W	.03	1	FLOW	42.	41.	39.	38.	37.	37.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT										
+	C2-W	.11	1	FLOW	83.	82.	80.	79.	78.	78.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO										
+	RC2-W	.11	1	FLOW	82.	81.	81.	79.	79.	79.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT										
+	OFFE8-W	.02	1	FLOW	21.	20.	20.	19.	18.	18.

				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO +	ROFFE8-W	.02	1	FLOW	20.	19.	19.	18.	18.	18.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT +	OFFE10-W	.01	1	FLOW	14.	13.	13.	12.	12.	12.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
4 COMBINED AT +	C3-W	.51	1	FLOW	475.	466.	449.	434.	425.	422.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT +	OFFE9-W	.02	1	FLOW	21.	20.	19.	18.	18.	18.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT +	C4-W	.53	1	FLOW	494.	485.	467.	451.	442.	438.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO +	RC4-W	.53	1	FLOW	488.	473.	462.	437.	429.	426.
				TIME	3.83	3.83	3.83	3.92	3.83	3.83
HYDROGRAPH AT +	OFFE11-W	.01	1	FLOW	12.	11.	11.	11.	11.	10.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT +	C5-W	.54	1	FLOW	494.	479.	468.	442.	435.	432.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT +	ONE1-W	.05	1	FLOW	99.	98.	95.	92.	91.	90.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT +	ONE2-W	.01	1	FLOW	16.	16.	15.	15.	15.	15.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
ROUTED TO +	RONE2-W	.01	1	FLOW	15.	15.	14.	14.	14.	14.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT +	ONE4-W	.01	1	FLOW	16.	16.	16.	15.	15.	15.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
ROUTED TO +	RONE4-W	.01	1	FLOW	16.	15.	15.	14.	14.	14.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT +	ONE5-W	.00	1	FLOW	10.	10.	10.	9.	9.	9.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
ROUTED TO +	RONE5-W	.00	1	FLOW	9.	9.	9.	9.	9.	9.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT +	ONE7-W	.00	1	FLOW	6.	6.	6.	5.	5.	5.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
4 COMBINED AT +	C6-W	.02	1	FLOW	44.	44.	42.	41.	41.	40.
				TIME	3.50	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT +	ONE6-W	.02	1	FLOW	34.	34.	33.	31.	31.	31.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58

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SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .00									
ROFFE-3A MANE		3.50	41.41	224.00	1.67	5.00	40.42	220.00	1.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2585E+01 EXCESS= .0000E+00 OUTFLOW= .2582E+01 BASIN STORAGE= .3123E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00									
ROFFE-3A MANE		3.50	40.59	224.00	1.63	5.00	39.47	220.00	1.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2526E+01 EXCESS= .0000E+00 OUTFLOW= .2523E+01 BASIN STORAGE= .3097E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00									
ROFFE-3A MANE		3.75	39.25	221.25	1.57	5.00	38.46	225.00	1.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2430E+01 EXCESS= .0000E+00 OUTFLOW= .2427E+01 BASIN STORAGE= .2593E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

ROFFE-3A	MANE	4.00	37.26	224.00	1.50	5.00	36.23	225.00	1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2326E+01 EXCESS= .0000E+00 OUTFLOW= .2323E+01 BASIN STORAGE= .3167E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

ROFFE-3A	MANE	4.25	36.27	221.00	1.48	5.00	35.91	225.00	1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2287E+01 EXCESS= .0000E+00 OUTFLOW= .2285E+01 BASIN STORAGE= .3420E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROFFE-3A	MANE	4.25	35.84	221.00	1.46	5.00	35.54	225.00	1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2260E+01 EXCESS= .0000E+00 OUTFLOW= .2259E+01 BASIN STORAGE= .3406E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCP1	MANE	5.00	352.70	230.00	1.21	5.00	352.70	230.00	1.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2656E+02 EXCESS= .0000E+00 OUTFLOW= .2661E+02 BASIN STORAGE= .8578E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCP1	MANE	5.00	343.48	230.00	1.17	5.00	343.48	230.00	1.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2585E+02 EXCESS= .0000E+00 OUTFLOW= .2590E+02 BASIN STORAGE= .8493E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCP1	MANE	5.00	328.01	230.00	1.12	5.00	328.01	230.00	1.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2467E+02 EXCESS= .0000E+00 OUTFLOW= .2472E+02 BASIN STORAGE= .8490E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCP1	MANE	5.00	312.24	230.00	1.07	5.00	312.24	230.00	1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2350E+02 EXCESS= .0000E+00 OUTFLOW= .2355E+02 BASIN STORAGE= .8502E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCP1	MANE	5.00	305.80	230.00	1.05	5.00	305.80	230.00	1.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2304E+02 EXCESS= .0000E+00 OUTFLOW= .2308E+02 BASIN STORAGE= .8240E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCP1	MANE	5.00	301.52	230.00	1.03	5.00	301.52	230.00	1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2272E+02 EXCESS= .0000E+00 OUTFLOW= .2276E+02 BASIN STORAGE= .8198E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

ROFFE-4	MANE	5.00	371.64	240.00	1.31	5.00	371.64	240.00	1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3478E+02 EXCESS= .0000E+00 OUTFLOW= .3480E+02 BASIN STORAGE= .3979E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROFFE-4	MANE	5.00	361.88	240.00	1.28	5.00	361.88	240.00	1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3388E+02 EXCESS= .0000E+00 OUTFLOW= .3391E+02 BASIN STORAGE= .3801E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROFFE-4	MANE	5.00	345.66	240.00	1.22	5.00	345.66	240.00	1.22

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3240E+02 EXCESS= .0000E+00 OUTFLOW= .3242E+02 BASIN STORAGE= .3724E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROFFE-4	MANE	5.00	330.43	245.00	1.17	5.00	330.43	245.00	1.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3093E+02 EXCESS= .0000E+00 OUTFLOW= .3095E+02 BASIN STORAGE= .3646E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROFFE-4	MANE	5.00	324.46	245.00	1.14	5.00	324.46	245.00	1.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3034E+02 EXCESS= .0000E+00 OUTFLOW= .3037E+02 BASIN STORAGE= .3615E-02 PERCENT ERROR= -.1

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          FOR PLAN = 1  RATIO=  .00
           ROFFE-4  MANE          5.00    320.29    245.00       1.13       5.00    320.29    245.00         1.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2994E+02 EXCESS= .0000E+00 OUTFLOW= .2996E+02 BASIN STORAGE= .3593E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
             ROCP2  MANE          1.63    371.22    231.56        .52       5.00    364.62    235.00          .52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3711E+02 EXCESS= .0000E+00 OUTFLOW= .3711E+02 BASIN STORAGE= .7457E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             ROCP2  MANE          1.64    361.07    231.91        .51       5.00    355.33    235.00          .51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3615E+02 EXCESS= .0000E+00 OUTFLOW= .3615E+02 BASIN STORAGE= .7581E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             ROCP2  MANE          1.67    344.32    232.04        .48       5.00    339.85    235.00          .48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3457E+02 EXCESS= .0000E+00 OUTFLOW= .3457E+02 BASIN STORAGE= .6932E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             ROCP2  MANE          1.70    327.48    232.30        .46       5.00    324.13    235.00          .46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3300E+02 EXCESS= .0000E+00 OUTFLOW= .3300E+02 BASIN STORAGE= .6978E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             ROCP2  MANE          1.71    320.89    232.11        .45       5.00    317.82    235.00          .45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3238E+02 EXCESS= .0000E+00 OUTFLOW= .3238E+02 BASIN STORAGE= .6957E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             ROCP2  MANE          1.71    315.97    233.17        .45       5.00    313.32    235.00          .45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3195E+02 EXCESS= .0000E+00 OUTFLOW= .3195E+02 BASIN STORAGE= .7493E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP4-C*  MANE          2.24    323.38    233.09        .46       5.00    323.18    235.00          .46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3286E+02 EXCESS= .0000E+00 OUTFLOW= .3286E+02 BASIN STORAGE= .1061E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP4-C*  MANE          2.26    315.59    234.97        .45       5.00    315.54    235.00          .45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3201E+02 EXCESS= .0000E+00 OUTFLOW= .3202E+02 BASIN STORAGE= .1066E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP4-C*  MANE          2.29    300.67    233.66        .43       5.00    300.08    235.00          .43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3062E+02 EXCESS= .0000E+00 OUTFLOW= .3062E+02 BASIN STORAGE= .1044E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP4-C*  MANE          2.32    287.30    234.79        .41       5.00    287.05    235.00          .41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2923E+02 EXCESS= .0000E+00 OUTFLOW= .2923E+02 BASIN STORAGE= .9888E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP4-C*  MANE          2.34    280.24    233.89        .40       5.00    279.98    235.00          .40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2868E+02 EXCESS= .0000E+00 OUTFLOW= .2868E+02 BASIN STORAGE= .9105E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP4-C*  MANE          2.35    277.36    234.93        .40       5.00    277.28    235.00          .40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2829E+02 EXCESS= .0000E+00 OUTFLOW= .2829E+02 BASIN STORAGE= .9063E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           ROFFE-9  MANE          4.50    107.24    229.50       1.65       5.00    106.70    230.00         1.66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6821E+01 EXCESS= .0000E+00 OUTFLOW= .6872E+01 BASIN STORAGE= .9991E-02 PERCENT ERROR=   -.9

          FOR PLAN = 1  RATIO=  .00
           ROFFE-9  MANE          4.50    105.62    229.50       1.61       5.00    105.01    230.00         1.62
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .6666E+01 EXCESS= .0000E+00 OUTFLOW= .6716E+01 BASIN STORAGE= .9935E-02 PERCENT ERROR= -.9

FOR PLAN = 1 RATIO= .00

ROFFE-9	MANE	4.75	105.93	228.00	1.55	5.00	102.82	230.00	1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6411E+01 EXCESS= .0000E+00 OUTFLOW= .6457E+01 BASIN STORAGE= .9233E-02 PERCENT ERROR= -.9

FOR PLAN = 1 RATIO= .00

ROFFE-9	MANE	5.00	105.34	230.00	1.49	5.00	105.34	230.00	1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6158E+01 EXCESS= .0000E+00 OUTFLOW= .6209E+01 BASIN STORAGE= .8666E-02 PERCENT ERROR= -1.0

FOR PLAN = 1 RATIO= .00

ROFFE-9	MANE	5.00	104.19	230.00	1.47	5.00	104.19	230.00	1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6055E+01 EXCESS= .0000E+00 OUTFLOW= .6106E+01 BASIN STORAGE= .8631E-02 PERCENT ERROR= -1.0

FOR PLAN = 1 RATIO= .00

ROFFE-9	MANE	5.00	103.36	230.00	1.45	5.00	103.36	230.00	1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5984E+01 EXCESS= .0000E+00 OUTFLOW= .6034E+01 BASIN STORAGE= .8607E-02 PERCENT ERROR= -1.0

FOR PLAN = 1 RATIO= .00

RCP4	MANE	5.00	259.87	230.00	1.38	5.00	259.87	230.00	1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1670E+02 EXCESS= .0000E+00 OUTFLOW= .1673E+02 BASIN STORAGE= .1443E-01 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00

RCP4	MANE	4.75	246.08	232.75	1.35	5.00	240.05	230.00	1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1627E+02 EXCESS= .0000E+00 OUTFLOW= .1629E+02 BASIN STORAGE= .1537E-01 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCP4	MANE	4.75	236.00	232.75	1.29	5.00	230.49	230.00	1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1557E+02 EXCESS= .0000E+00 OUTFLOW= .1560E+02 BASIN STORAGE= .1309E-01 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00

RCP4	MANE	4.75	227.10	232.75	1.23	5.00	218.88	230.00	1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1488E+02 EXCESS= .0000E+00 OUTFLOW= .1491E+02 BASIN STORAGE= .1294E-01 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00

RCP4	MANE	4.50	219.23	234.00	1.21	5.00	219.07	230.00	1.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1461E+02 EXCESS= .0000E+00 OUTFLOW= .1464E+02 BASIN STORAGE= .1539E-01 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00

RCP4	MANE	4.50	216.69	234.00	1.19	5.00	216.04	230.00	1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1442E+02 EXCESS= .0000E+00 OUTFLOW= .1445E+02 BASIN STORAGE= .1533E-01 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .00

RCP4-A*	MANE	4.21	495.60	231.71	1.20	5.00	465.28	235.00	1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3943E+02 EXCESS= .0000E+00 OUTFLOW= .3945E+02 BASIN STORAGE= .3984E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP4-A*	MANE	4.29	460.28	231.63	1.17	5.00	445.22	235.00	1.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3837E+02 EXCESS= .0000E+00 OUTFLOW= .3838E+02 BASIN STORAGE= .3215E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP4-A*	MANE	4.35	448.95	234.68	1.12	5.00	444.88	235.00	1.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3661E+02 EXCESS= .0000E+00 OUTFLOW= .3662E+02 BASIN STORAGE= .4046E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCP4-A*	MANE	4.40	433.90	232.98	1.06	5.00	415.11	235.00	1.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3483E+02 EXCESS= .0000E+00 OUTFLOW= .3484E+02 BASIN STORAGE= .3887E-02 PERCENT ERROR= -.1

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          FOR PLAN = 1  RATIO=  .00
           RCP4-A*  MANE          4.41    444.74    233.57       1.04       5.00    422.95    235.00         1.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3422E+02 EXCESS= .0000E+00 OUTFLOW= .3423E+02 BASIN STORAGE= .3735E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RCP4-A*  MANE          4.43    435.65    234.59       1.03       5.00    429.61    235.00         1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3382E+02 EXCESS= .0000E+00 OUTFLOW= .3384E+02 BASIN STORAGE= .3193E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
             RCP5*  MANE          5.00    830.24    240.00        .73       5.00    830.24    240.00          .73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7904E+02 EXCESS= .0000E+00 OUTFLOW= .7908E+02 BASIN STORAGE= .3878E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCP5*  MANE          5.00    794.68    240.00        .71       5.00    794.68    240.00          .71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7699E+02 EXCESS= .0000E+00 OUTFLOW= .7703E+02 BASIN STORAGE= .5380E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
             RCP5*  MANE          5.00    760.29    240.00        .68       5.00    760.29    240.00          .68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7358E+02 EXCESS= .0000E+00 OUTFLOW= .7361E+02 BASIN STORAGE= .3897E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCP5*  MANE          5.00    713.89    240.00        .65       5.00    713.89    240.00          .65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7012E+02 EXCESS= .0000E+00 OUTFLOW= .7016E+02 BASIN STORAGE= .3914E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
             RCP5*  MANE          5.00    709.31    240.00        .64       5.00    709.31    240.00          .64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6882E+02 EXCESS= .0000E+00 OUTFLOW= .6886E+02 BASIN STORAGE= .5374E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
             RCP5*  MANE          5.00    708.16    240.00        .63       5.00    708.16    240.00          .63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6808E+02 EXCESS= .0000E+00 OUTFLOW= .6811E+02 BASIN STORAGE= .5376E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
             RCP6*  MANE          3.82    820.86    244.50        .75       5.00    814.21    245.00          .75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8247E+02 EXCESS= .0000E+00 OUTFLOW= .8248E+02 BASIN STORAGE= .4749E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCP6*  MANE          3.88    788.94    244.58        .73       5.00    784.20    245.00          .73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8035E+02 EXCESS= .0000E+00 OUTFLOW= .8036E+02 BASIN STORAGE= .5588E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCP6*  MANE          3.95    760.54    244.65        .70       5.00    757.56    245.00          .70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7684E+02 EXCESS= .0000E+00 OUTFLOW= .7685E+02 BASIN STORAGE= .5643E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCP6*  MANE          4.04    711.57    246.34        .66       5.00    707.60    245.00          .66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7317E+02 EXCESS= .0000E+00 OUTFLOW= .7319E+02 BASIN STORAGE= .5211E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCP6*  MANE          4.05    706.44    246.94        .65       5.00    703.17    245.00          .65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7184E+02 EXCESS= .0000E+00 OUTFLOW= .7185E+02 BASIN STORAGE= .4463E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCP6*  MANE          4.05    704.10    247.09        .65       5.00    702.71    245.00          .64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7107E+02 EXCESS= .0000E+00 OUTFLOW= .7108E+02 BASIN STORAGE= .4373E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RONE-5*  MANE          1.21    993.73    226.64       1.50       5.00    984.13    225.00         1.51
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .8553E+02 EXCESS= .0000E+00 OUTFLOW= .8553E+02 BASIN STORAGE= .3550E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-5*	MANE	1.22	970.16	226.76	1.47	5.00	960.84	225.00	1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8348E+02 EXCESS= .0000E+00 OUTFLOW= .8348E+02 BASIN STORAGE= .3348E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-5*	MANE	1.23	932.38	226.60	1.41	5.00	922.69	225.00	1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8009E+02 EXCESS= .0000E+00 OUTFLOW= .8009E+02 BASIN STORAGE= .3411E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-5*	MANE	1.24	894.46	226.50	1.35	5.00	884.85	225.00	1.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7672E+02 EXCESS= .0000E+00 OUTFLOW= .7672E+02 BASIN STORAGE= .3401E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-5*	MANE	1.25	879.86	226.23	1.33	5.00	871.03	225.00	1.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7538E+02 EXCESS= .0000E+00 OUTFLOW= .7538E+02 BASIN STORAGE= .3778E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-5*	MANE	1.25	867.27	226.92	1.31	5.00	858.11	225.00	1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7445E+02 EXCESS= .0000E+00 OUTFLOW= .7445E+02 BASIN STORAGE= .3533E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6A*	MANE	1.56	1585.23	232.18	1.01	5.00	1572.86	235.00	1.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1691E+03 EXCESS= .0000E+00 OUTFLOW= .1691E+03 BASIN STORAGE= .5147E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6A*	MANE	1.57	1545.47	232.10	.98	5.00	1530.97	235.00	.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1650E+03 EXCESS= .0000E+00 OUTFLOW= .1650E+03 BASIN STORAGE= .5419E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6A*	MANE	1.59	1469.58	231.88	.94	5.00	1451.71	235.00	.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1580E+03 EXCESS= .0000E+00 OUTFLOW= .1580E+03 BASIN STORAGE= .5664E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6A*	MANE	1.61	1395.81	231.69	.90	5.00	1375.69	230.00	.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1509E+03 EXCESS= .0000E+00 OUTFLOW= .1509E+03 BASIN STORAGE= .5328E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6A*	MANE	1.62	1361.53	231.51	.88	5.00	1341.65	230.00	.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1481E+03 EXCESS= .0000E+00 OUTFLOW= .1481E+03 BASIN STORAGE= .4927E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6A*	MANE	1.63	1337.38	232.43	.87	5.00	1322.23	230.00	.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1463E+03 EXCESS= .0000E+00 OUTFLOW= .1463E+03 BASIN STORAGE= .5699E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-6*	MANE	4.21	997.94	214.93	1.39	5.00	997.65	215.00	1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5984E+02 EXCESS= .0000E+00 OUTFLOW= .5986E+02 BASIN STORAGE= .2010E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-6*	MANE	4.24	975.47	216.22	1.34	5.00	941.76	215.00	1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5804E+02 EXCESS= .0000E+00 OUTFLOW= .5806E+02 BASIN STORAGE= .1436E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-6*	MANE	4.28	933.50	218.45	1.29	5.00	921.90	215.00	1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5581E+02 EXCESS= .0000E+00 OUTFLOW= .5584E+02 BASIN STORAGE= .1451E-02 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=  .00
           RONE-6*  MANE          4.25    895.24    216.75      1.23      5.00    858.08    215.00        1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5309E+02 EXCESS= .0000E+00 OUTFLOW= .5311E+02 BASIN STORAGE= .2154E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RONE-6*  MANE          4.25    879.45    216.75      1.21      5.00    842.38    215.00        1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5211E+02 EXCESS= .0000E+00 OUTFLOW= .5213E+02 BASIN STORAGE= .2137E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RONE-6*  MANE          4.25    868.42    216.75      1.19      5.00    831.40    215.00        1.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5143E+02 EXCESS= .0000E+00 OUTFLOW= .5145E+02 BASIN STORAGE= .2125E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP6B*  MANE          4.66   2267.15    228.14      1.10      5.00   2261.31    225.00        1.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2407E+03 EXCESS= .0000E+00 OUTFLOW= .2408E+03 BASIN STORAGE= .7592E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP6B*  MANE          4.71   2215.09    225.97      1.07      5.00   2186.04    230.00        1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2347E+03 EXCESS= .0000E+00 OUTFLOW= .2348E+03 BASIN STORAGE= .8793E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP6B*  MANE          4.79   2118.35    225.09      1.03      5.00   2115.03    225.00        1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2253E+03 EXCESS= .0000E+00 OUTFLOW= .2254E+03 BASIN STORAGE= .9449E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCP6B*  MANE          4.88   2000.76    229.13       .98      5.00   1986.75    230.00         .98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2144E+03 EXCESS= .0000E+00 OUTFLOW= .2145E+03 BASIN STORAGE= .9583E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RCP6B*  MANE          4.91   1965.69    225.95       .96      5.00   1945.74    230.00         .96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2106E+03 EXCESS= .0000E+00 OUTFLOW= .2107E+03 BASIN STORAGE= .9535E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RCP6B*  MANE          4.94   1931.40    227.30       .95      5.00   1907.49    230.00         .95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2080E+03 EXCESS= .0000E+00 OUTFLOW= .2081E+03 BASIN STORAGE= .7975E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          ROFFE1-W  MANE          5.00     63.00    230.00      1.44      5.00     63.00    230.00        1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4380E+01 EXCESS= .0000E+00 OUTFLOW= .4387E+01 BASIN STORAGE= .2758E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
          ROFFE1-W  MANE          5.00     61.42    230.00      1.41      5.00     61.42    230.00        1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4272E+01 EXCESS= .0000E+00 OUTFLOW= .4280E+01 BASIN STORAGE= .2729E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
          ROFFE1-W  MANE          5.00     58.78    230.00      1.35      5.00     58.78    230.00        1.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4094E+01 EXCESS= .0000E+00 OUTFLOW= .4102E+01 BASIN STORAGE= .2680E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
          ROFFE1-W  MANE          5.00     56.14    230.00      1.29      5.00     56.14    230.00        1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3918E+01 EXCESS= .0000E+00 OUTFLOW= .3925E+01 BASIN STORAGE= .2630E-02 PERCENT ERROR=   -.3

          FOR PLAN = 1  RATIO=  .00
          ROFFE1-W  MANE          5.00     55.09    230.00      1.27      5.00     55.09    230.00        1.27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3848E+01 EXCESS= .0000E+00 OUTFLOW= .3855E+01 BASIN STORAGE= .2610E-02 PERCENT ERROR=   -.3

          FOR PLAN = 1  RATIO=  .00
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         ROFFE1-W  MANE          5.00     54.35    230.00      1.25      5.00     54.35    230.00        1.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3799E+01 EXCESS= .0000E+00 OUTFLOW= .3806E+01 BASIN STORAGE= .2596E-02 PERCENT ERROR=   -.3

         FOR PLAN = 1  RATIO=  .00
         ROFFE2-W  MANE          5.00     65.87    225.00      1.50      5.00     65.87    225.00        1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4632E+01 EXCESS= .0000E+00 OUTFLOW= .4637E+01 BASIN STORAGE= .2030E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFE2-W  MANE          5.00     64.25    225.00      1.46      5.00     64.25    225.00        1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4521E+01 EXCESS= .0000E+00 OUTFLOW= .4526E+01 BASIN STORAGE= .2007E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFE2-W  MANE          5.00     61.74    230.00      1.40      5.00     61.74    230.00        1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4336E+01 EXCESS= .0000E+00 OUTFLOW= .4341E+01 BASIN STORAGE= .1946E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFE2-W  MANE          5.00     59.39    230.00      1.34      5.00     59.39    230.00        1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4153E+01 EXCESS= .0000E+00 OUTFLOW= .4158E+01 BASIN STORAGE= .1865E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFE2-W  MANE          5.00     58.44    230.00      1.32      5.00     58.44    230.00        1.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4080E+01 EXCESS= .0000E+00 OUTFLOW= .4086E+01 BASIN STORAGE= .1849E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFE2-W  MANE          5.00     57.78    230.00      1.30      5.00     57.78    230.00        1.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4030E+01 EXCESS= .0000E+00 OUTFLOW= .4035E+01 BASIN STORAGE= .1839E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFD3-W  MANE          5.00     72.67    230.00      1.41      5.00     72.67    230.00        1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5124E+01 EXCESS= .0000E+00 OUTFLOW= .5130E+01 BASIN STORAGE= .2255E-02 PERCENT ERROR=   -.1

         FOR PLAN = 1  RATIO=  .00
         ROFFD3-W  MANE          5.00     70.98    230.00      1.38      5.00     70.98    230.00        1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4997E+01 EXCESS= .0000E+00 OUTFLOW= .5003E+01 BASIN STORAGE= .2230E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFD3-W  MANE          5.00     68.16    230.00      1.32      5.00     68.16    230.00        1.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4787E+01 EXCESS= .0000E+00 OUTFLOW= .4792E+01 BASIN STORAGE= .2187E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFD3-W  MANE          5.00     65.34    230.00      1.26      5.00     65.34    230.00        1.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4578E+01 EXCESS= .0000E+00 OUTFLOW= .4584E+01 BASIN STORAGE= .2143E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFD3-W  MANE          5.00     64.21    230.00      1.24      5.00     64.21    230.00        1.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4495E+01 EXCESS= .0000E+00 OUTFLOW= .4500E+01 BASIN STORAGE= .2126E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
         ROFFD3-W  MANE          5.00     63.42    230.00      1.22      5.00     63.42    230.00        1.22

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4437E+01 EXCESS= .0000E+00 OUTFLOW= .4442E+01 BASIN STORAGE= .2113E-02 PERCENT ERROR=   -.2

         FOR PLAN = 1  RATIO=  .00
           RC1A-W  MANE          2.66    378.58    228.64      1.52      5.00    376.47    230.00        1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3028E+02 EXCESS= .0000E+00 OUTFLOW= .3028E+02 BASIN STORAGE= .2232E-02 PERCENT ERROR=    .0

         FOR PLAN = 1  RATIO=  .00
           RC1A-W  MANE          2.68    368.99    228.03      1.49      5.00    368.64    230.00        1.49
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2958E+02 EXCESS= .0000E+00 OUTFLOW= .2958E+02 BASIN STORAGE= .2538E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RC1A-W	MANE	2.72	354.49	228.87	1.43	5.00	352.93	230.00	1.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2837E+02 EXCESS= .0000E+00 OUTFLOW= .2837E+02 BASIN STORAGE= .2106E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RC1A-W	MANE	2.77	340.56	229.82	1.37	5.00	340.09	230.00	1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2719E+02 EXCESS= .0000E+00 OUTFLOW= .2719E+02 BASIN STORAGE= .2225E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RC1A-W	MANE	2.79	332.92	228.57	1.34	5.00	332.41	230.00	1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2672E+02 EXCESS= .0000E+00 OUTFLOW= .2672E+02 BASIN STORAGE= .2166E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RC1A-W	MANE	2.80	330.12	229.59	1.33	5.00	329.32	230.00	1.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2639E+02 EXCESS= .0000E+00 OUTFLOW= .2639E+02 BASIN STORAGE= .2291E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RC2-W	MANE	5.00	81.92	220.00	1.30	5.00	81.92	220.00	1.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7511E+01 EXCESS= .0000E+00 OUTFLOW= .7516E+01 BASIN STORAGE= .3986E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RC2-W	MANE	5.00	81.25	220.00	1.28	5.00	81.25	220.00	1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7369E+01 EXCESS= .0000E+00 OUTFLOW= .7374E+01 BASIN STORAGE= .3943E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RC2-W	MANE	5.00	80.56	220.00	1.24	5.00	80.56	220.00	1.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7133E+01 EXCESS= .0000E+00 OUTFLOW= .7137E+01 BASIN STORAGE= .3182E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RC2-W	MANE	5.00	79.37	220.00	1.20	5.00	79.37	220.00	1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6890E+01 EXCESS= .0000E+00 OUTFLOW= .6894E+01 BASIN STORAGE= .3127E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RC2-W	MANE	5.00	78.90	220.00	1.18	5.00	78.90	220.00	1.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6793E+01 EXCESS= .0000E+00 OUTFLOW= .6797E+01 BASIN STORAGE= .3105E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RC2-W	MANE	5.00	78.57	220.00	1.17	5.00	78.57	220.00	1.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6725E+01 EXCESS= .0000E+00 OUTFLOW= .6729E+01 BASIN STORAGE= .3089E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROFFE8-W	MANE	3.35	20.40	217.97	1.58	5.00	19.84	220.00	1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1347E+01 EXCESS= .0000E+00 OUTFLOW= .1347E+01 BASIN STORAGE= .7952E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROFFE8-W	MANE	3.38	19.61	219.52	1.54	5.00	19.40	220.00	1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1315E+01 EXCESS= .0000E+00 OUTFLOW= .1315E+01 BASIN STORAGE= .6055E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROFFE8-W	MANE	3.42	19.17	218.78	1.48	5.00	18.74	220.00	1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1263E+01 EXCESS= .0000E+00 OUTFLOW= .1263E+01 BASIN STORAGE= .7214E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROFFE8-W	MANE	3.46	18.45	218.09	1.42	5.00	17.96	220.00	1.42

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1211E+01 EXCESS= .0000E+00 OUTFLOW= .1212E+01 BASIN STORAGE= .6103E-03 PERCENT ERROR= -.1

```
          FOR PLAN = 1  RATIO=  .00
          ROFFE8-W  MANE          3.48     17.99    219.22      1.40      5.00     17.71    220.00        1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1190E+01 EXCESS= .0000E+00 OUTFLOW= .1191E+01 BASIN STORAGE= .6977E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
          ROFFE8-W  MANE          3.49     17.51    220.03      1.38      5.00     17.50    220.00        1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1176E+01 EXCESS= .0000E+00 OUTFLOW= .1177E+01 BASIN STORAGE= .6021E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
             RC4-W  MANE          4.35    492.14    230.55      1.47      5.00    487.61    230.00        1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4179E+02 EXCESS= .0000E+00 OUTFLOW= .4180E+02 BASIN STORAGE= .1491E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RC4-W  MANE          4.37    482.26    231.69      1.44      5.00    473.23    230.00        1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4085E+02 EXCESS= .0000E+00 OUTFLOW= .4085E+02 BASIN STORAGE= .1179E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RC4-W  MANE          4.41    463.43    233.96      1.38      5.00    461.58    230.00        1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3931E+02 EXCESS= .0000E+00 OUTFLOW= .3931E+02 BASIN STORAGE= .1178E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RC4-W  MANE          4.45    445.42    231.58      1.32      5.00    437.05    235.00        1.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3765E+02 EXCESS= .0000E+00 OUTFLOW= .3765E+02 BASIN STORAGE= .1197E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RC4-W  MANE          4.48    437.98    232.75      1.30      5.00    429.11    230.00        1.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3705E+02 EXCESS= .0000E+00 OUTFLOW= .3705E+02 BASIN STORAGE= .1430E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RC4-W  MANE          4.49    433.66    233.30      1.29      5.00    426.47    230.00        1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3664E+02 EXCESS= .0000E+00 OUTFLOW= .3664E+02 BASIN STORAGE= .1298E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RONE2-W  MANE          1.89     15.82    212.12      2.37      5.00     15.03    210.00        2.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1009E+01 EXCESS= .0000E+00 OUTFLOW= .1009E+01 BASIN STORAGE= .4041E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RONE2-W  MANE          1.90     15.38    211.33      2.33      5.00     14.74    210.00        2.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9918E+00 EXCESS= .0000E+00 OUTFLOW= .9921E+00 BASIN STORAGE= .3972E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RONE2-W  MANE          1.92     14.92    211.29      2.25      5.00     14.31    210.00        2.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9618E+00 EXCESS= .0000E+00 OUTFLOW= .9621E+00 BASIN STORAGE= .3161E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RONE2-W  MANE          1.94     14.48    211.30      2.18      5.00     13.89    210.00        2.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9317E+00 EXCESS= .0000E+00 OUTFLOW= .9320E+00 BASIN STORAGE= .3273E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RONE2-W  MANE          1.95     14.53    212.10      2.16      5.00     13.76    210.00        2.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9198E+00 EXCESS= .0000E+00 OUTFLOW= .9201E+00 BASIN STORAGE= .3582E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RONE2-W  MANE          1.95     14.26    212.66      2.14      5.00     13.59    210.00        2.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9112E+00 EXCESS= .0000E+00 OUTFLOW= .9114E+00 BASIN STORAGE= .4038E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RONE4-W  MANE          3.00     15.99    213.00      2.37      5.00     15.51    215.00        2.36
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1011E+01 EXCESS= .0000E+00 OUTFLOW= .1012E+01 BASIN STORAGE= .7587E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RONE4-W	MANE	3.00	15.72	213.00	2.33	5.00	15.26	215.00	2.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9928E+00 EXCESS= .0000E+00 OUTFLOW= .9942E+00 BASIN STORAGE= .7515E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RONE4-W	MANE	3.00	15.28	213.00	2.26	5.00	14.85	215.00	2.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9629E+00 EXCESS= .0000E+00 OUTFLOW= .9642E+00 BASIN STORAGE= .7394E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RONE4-W	MANE	3.00	14.83	213.00	2.19	5.00	14.43	215.00	2.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9330E+00 EXCESS= .0000E+00 OUTFLOW= .9343E+00 BASIN STORAGE= .7272E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RONE4-W	MANE	3.00	14.65	213.00	2.16	5.00	14.27	215.00	2.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9210E+00 EXCESS= .0000E+00 OUTFLOW= .9224E+00 BASIN STORAGE= .7223E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RONE4-W	MANE	3.00	14.52	213.00	2.14	5.00	14.15	215.00	2.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9126E+00 EXCESS= .0000E+00 OUTFLOW= .9140E+00 BASIN STORAGE= .7188E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RONE5-W	MANE	3.00	9.81	213.00	2.37	5.00	9.47	215.00	2.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6315E+00 EXCESS= .0000E+00 OUTFLOW= .6319E+00 BASIN STORAGE= .4348E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RONE5-W	MANE	3.00	9.64	213.00	2.33	5.00	9.32	215.00	2.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6202E+00 EXCESS= .0000E+00 OUTFLOW= .6207E+00 BASIN STORAGE= .6298E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RONE5-W	MANE	3.00	9.37	213.00	2.26	5.00	9.06	215.00	2.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6015E+00 EXCESS= .0000E+00 OUTFLOW= .6020E+00 BASIN STORAGE= .6195E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RONE5-W	MANE	3.00	9.10	213.00	2.19	5.00	8.81	215.00	2.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5828E+00 EXCESS= .0000E+00 OUTFLOW= .5833E+00 BASIN STORAGE= .6090E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RONE5-W	MANE	3.00	8.99	213.00	2.16	5.00	8.71	215.00	2.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5754E+00 EXCESS= .0000E+00 OUTFLOW= .5758E+00 BASIN STORAGE= .6047E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

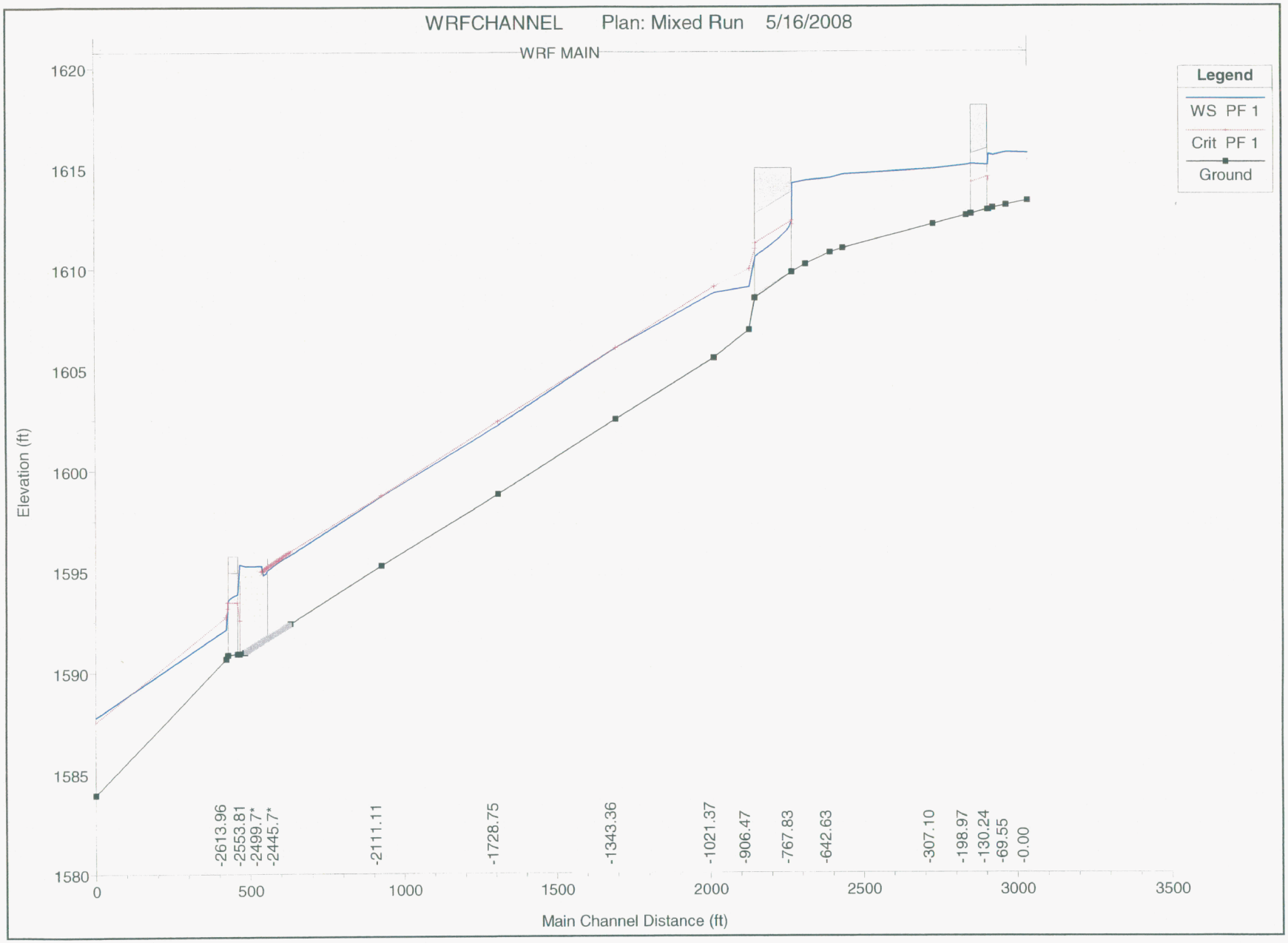
RONE5-W	MANE	3.00	8.91	213.00	2.14	5.00	8.64	215.00	2.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5701E+00 EXCESS= .0000E+00 OUTFLOW= .5706E+00 BASIN STORAGE= .6018E-03 PERCENT ERROR= -.2

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

Appendix D: Hydraulics

Appendix D-1: Existing WRF Channel Hydraulic Model (HEC-RAS Output)

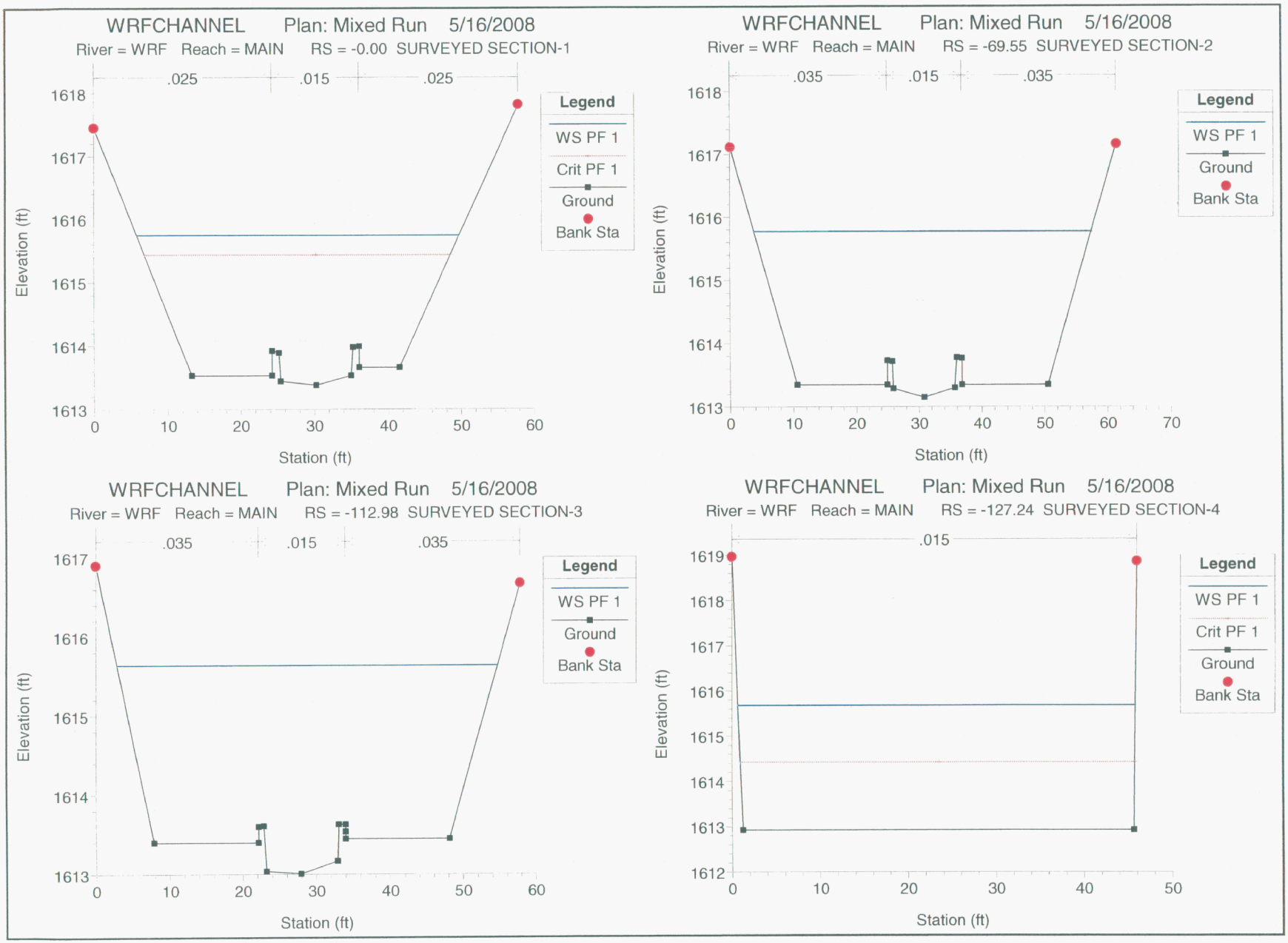

WRFCHANNEL Plan: Mixed Run 5/16/2008
WRF MAIN
Legend
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1620
1615
1610
1605
1600
1595
1590
1585
1580
-2613.96
-2553.81
-2499.7*
-2445.7*
-2111.11
-1728.75
-1343.36
-1021.37
-906.47
-767.83
-642.63
-307.10
-198.97
-130.24
-69.55
-0.00
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)

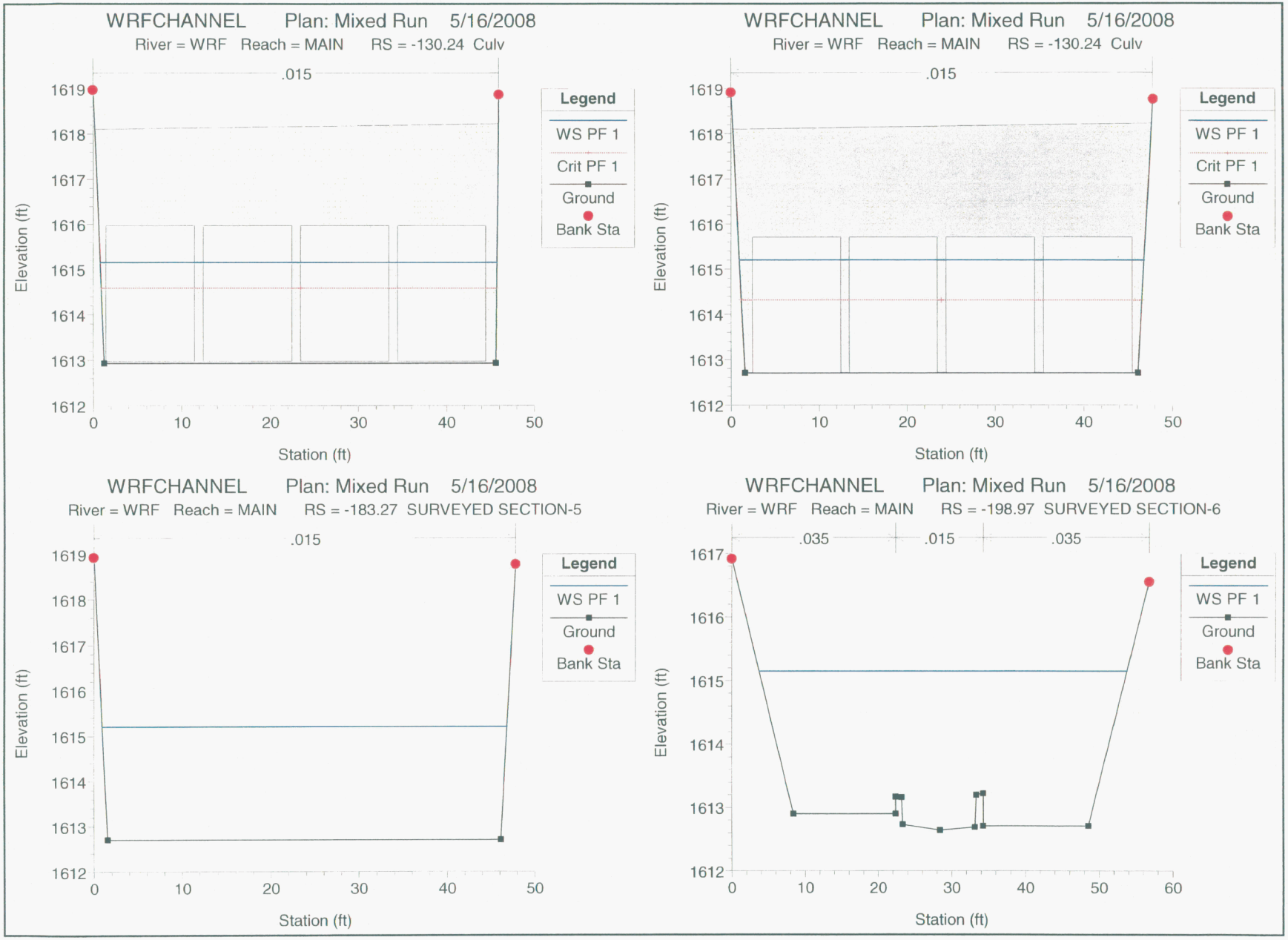
HEC-RAS Plan: Mix_Run River: WRF Reach: MAIN Profile: PF 1

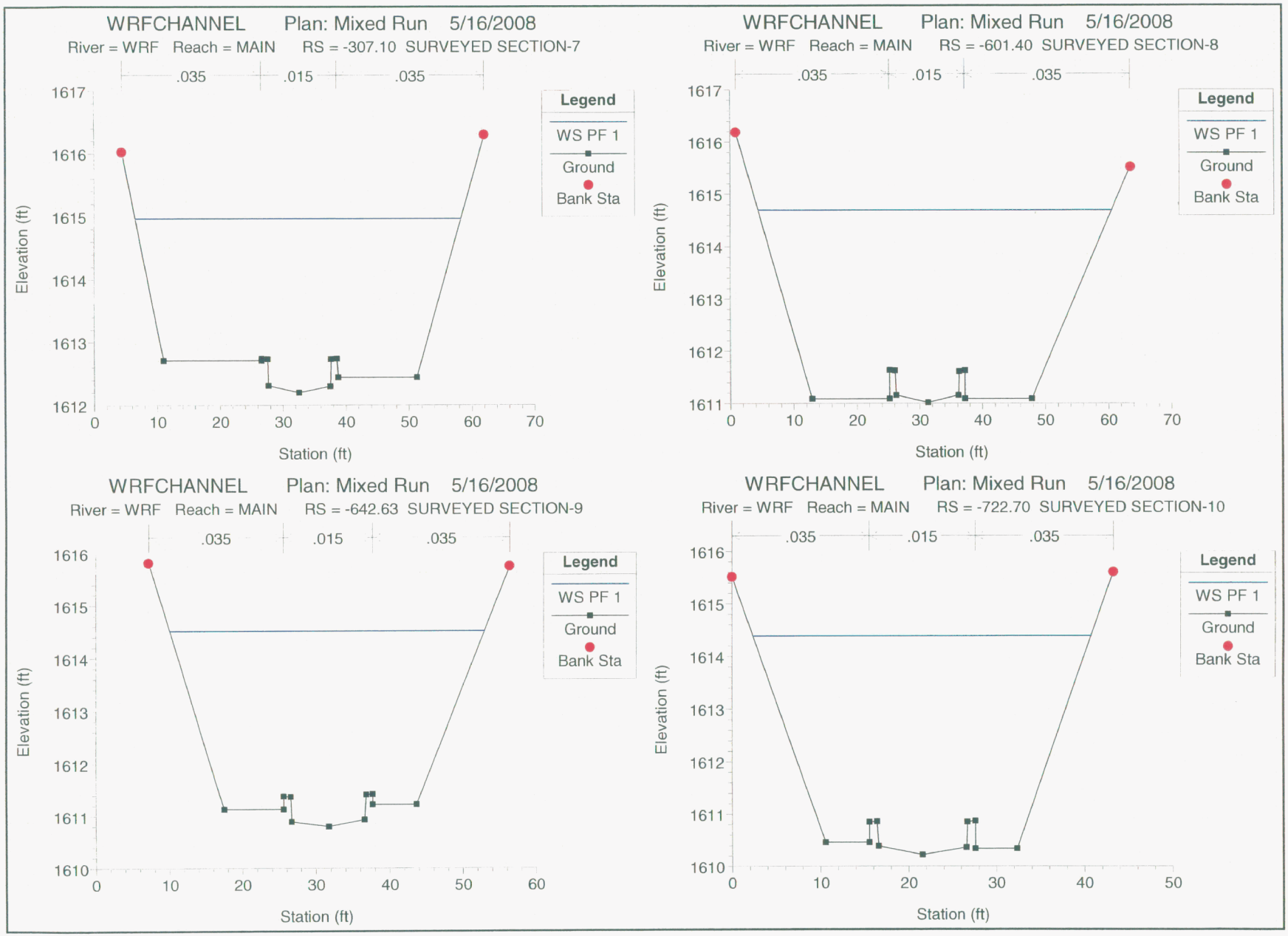
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MAIN	-0.00	PF 1	466.00	1613.38	1615.74	1615.43	1616.29	0.002975	5.91	78.79	43.94	0.78
MAIN	-69.55	PF 1	466.00	1613.15	1615.78		1616.04	0.001879	4.09	114.06	53.67	0.49
MAIN	-112.98	PF 1	466.00	1613.01	1615.64		1615.94	0.002170	4.43	105.20	51.89	0.55
MAIN	-127.24	PF 1	466.00	1612.93	1615.68	1614.43	1615.91	0.000437	3.78	123.30	45.12	0.40
MAIN	-130.24		Culvert									
MAIN	-183.27	PF 1	466.00	1612.71	1615.21		1615.47	0.000583	4.13	112.81	45.87	0.46
MAIN	-198.97	PF 1	466.00	1612.64	1615.15		1615.45	0.002155	4.38	106.42	50.06	0.53
MAIN	-307.10	PF 1	466.00	1612.20	1614.97		1615.23	0.001747	4.14	112.55	51.74	0.49
MAIN	-601.40	PF 1	466.00	1611.02	1614.70		1614.82	0.000937	2.86	163.06	56.13	0.30
MAIN	-642.63	PF 1	466.00	1610.80	1614.52		1614.76	0.001772	3.94	118.31	42.92	0.42
MAIN	-722.70	PF 1	466.00	1610.22	1614.40		1614.63	0.001464	3.87	120.27	38.40	0.39
MAIN	-766.83	PF 1	466.00	1609.84	1614.25	1612.22	1614.58	0.000464	4.65	100.25	23.31	0.39
MAIN	-767.83		Culvert									
MAIN	-888.18	PF 1	466.00	1608.54	1610.61	1611.01	1612.37	0.005618	10.65	43.77	21.57	0.39
MAIN	-906.47	PF 1	485.00	1606.95	1609.09	1610.00	1612.09	0.013890	13.89	34.91	27.44	2.17
MAIN	-1021.37	PF 1	485.00	1605.56	1608.79	1609.11	1609.99	0.013230	8.79	55.16	41.23	1.34
MAIN	-1343.36	PF 1	485.00	1602.52	1606.04	1606.04	1606.77	0.008111	6.87	70.57	48.21	1.00
MAIN	-1728.75	PF 1	485.00	1598.83	1602.22	1602.41	1603.21	0.010413	7.99	60.70	42.93	1.18
MAIN	-2111.11	PF 1	485.00	1595.27	1598.70	1598.76	1599.53	0.008696	7.29	66.57	46.06	1.07
MAIN	-2406.46	PF 1	485.00	1592.40	1595.80	1595.97	1596.78	0.009892	7.94	61.11	42.59	1.17
MAIN	-2411.3*	PF 1	485.00	1592.35	1595.75	1595.91	1596.72	0.009819	7.88	61.54	42.89	1.16
MAIN	-2416.2*	PF 1	485.00	1592.31	1595.71	1595.86	1596.66	0.009757	7.82	62.01	43.29	1.15
MAIN	-2421.1*	PF 1	485.00	1592.26	1595.66	1595.81	1596.61	0.009734	7.79	62.26	43.49	1.15
MAIN	-2426.1*	PF 1	485.00	1592.21	1595.62	1595.76	1596.55	0.009726	7.76	62.51	43.75	1.14
MAIN	-2431.0*	PF 1	485.00	1592.17	1595.58	1595.70	1596.49	0.009612	7.68	63.14	44.20	1.13
MAIN	-2435.9*	PF 1	485.00	1592.12	1595.53	1595.65	1596.43	0.009562	7.63	63.53	44.51	1.13
MAIN	-2440.8*	PF 1	485.00	1592.07	1595.48	1595.60	1596.38	0.009603	7.62	63.63	44.72	1.13
MAIN	-2445.7*	PF 1	485.00	1592.03	1595.44	1595.55	1596.32	0.009459	7.53	64.42	45.22	1.11
MAIN	-2450.6*	PF 1	485.00	1591.98	1595.37	1595.51	1596.27	0.021610	7.60	63.81	45.20	1.13
MAIN	-2455.5*	PF 1	485.00	1591.93	1595.31	1595.46	1596.22	0.009993	7.66	63.35	45.23	1.14
MAIN	-2460.4*	PF 1	485.00	1591.89	1595.27	1595.40	1596.16	0.009835	7.57	64.08	45.69	1.13
MAIN	-2465.4*	PF 1	485.00	1591.84	1595.21	1595.35	1596.11	0.022119	7.61	63.71	45.77	1.14
MAIN	-2470.3*	PF 1	485.00	1591.79	1595.14	1595.30	1596.05	0.010327	7.67	63.23	45.82	1.15
MAIN	-2475.2*	PF 1	485.00	1591.75	1595.10	1595.24	1595.99	0.010113	7.58	63.99	46.39	1.14
MAIN	-2480.1*	PF 1	485.00	1591.70	1595.04	1595.19	1595.94	0.022557	7.60	63.77	46.51	1.14
MAIN	-2481.00		Lat Struct									
MAIN	-2485.0*	PF 1	485.00	1591.65	1594.88	1595.14	1595.93	0.012319	8.19	59.21	44.92	1.26
MAIN	-2489.9*	PF 1	485.00	1591.61	1594.84	1595.08	1595.86	0.012143	8.09	59.97	45.52	1.24
MAIN	-2494.8*	PF 1	485.00	1591.56	1594.79	1595.01	1595.80	0.012139	8.05	60.26	45.90	1.24
MAIN	-2499.7*	PF 1	485.00	1591.51	1595.26	1594.98	1595.75	0.005359	5.57	87.02	55.12	0.78
MAIN	-2504.6*	PF 1	485.00	1591.47	1595.26		1595.71	0.004884	5.37	90.28	54.98	0.74
MAIN	-2509.6*	PF 1	485.00	1591.42	1595.26		1595.68	0.004489	5.20	93.35	54.85	0.70
MAIN	-2514.5*	PF 1	484.99	1591.37	1595.26		1595.65	0.004141	5.03	96.37	54.71	0.67
MAIN	-2519.4*	PF 1	484.83	1591.33	1595.25		1595.62	0.003790	4.86	99.70	54.57	0.63
MAIN	-2524.3*	PF 1	484.44	1591.28	1595.25		1595.60	0.003526	4.73	102.40	54.44	0.61
MAIN	-2529.2*	PF 1	483.74	1591.23	1595.25		1595.57	0.003242	4.58	105.56	54.30	0.58
MAIN	-2534.1*	PF 1	482.67	1591.19	1595.25		1595.55	0.002984	4.44	108.73	54.17	0.55
MAIN	-2539.0*	PF 1	481.18	1591.14	1595.25		1595.53	0.002753	4.31	111.75	54.03	0.53
MAIN	-2543.9*	PF 1	479.23	1591.09	1595.24		1595.52	0.002540	4.18	114.76	53.89	0.50
MAIN	-2548.8*	PF 1	476.77	1591.05	1595.24		1595.50	0.002344	4.05	117.77	53.76	0.48
MAIN	-2553.81	PF 1	473.75	1591.00	1595.24		1595.48	0.002138	3.92	120.96	53.62	0.46
MAIN	-2570.35	PF 1	454.81	1590.92	1595.33	1592.56	1595.44	0.000129	2.67	170.39	39.25	0.23
MAIN	-2576.85		Culvert									
MAIN	-2609.56	PF 1	454.81	1590.87	1593.13	1593.13	1594.25	0.003152	8.48	53.62	24.00	1.00
MAIN	-2613.96	PF 1	454.81	1590.68	1592.12	1592.73	1594.12	0.057941	11.36	40.05	33.75	1.84
MAIN	-3130.11	PF 1	454.81	1583.94	1587.79	1587.55	1588.60	0.011112	7.22	62.95	29.62	0.87

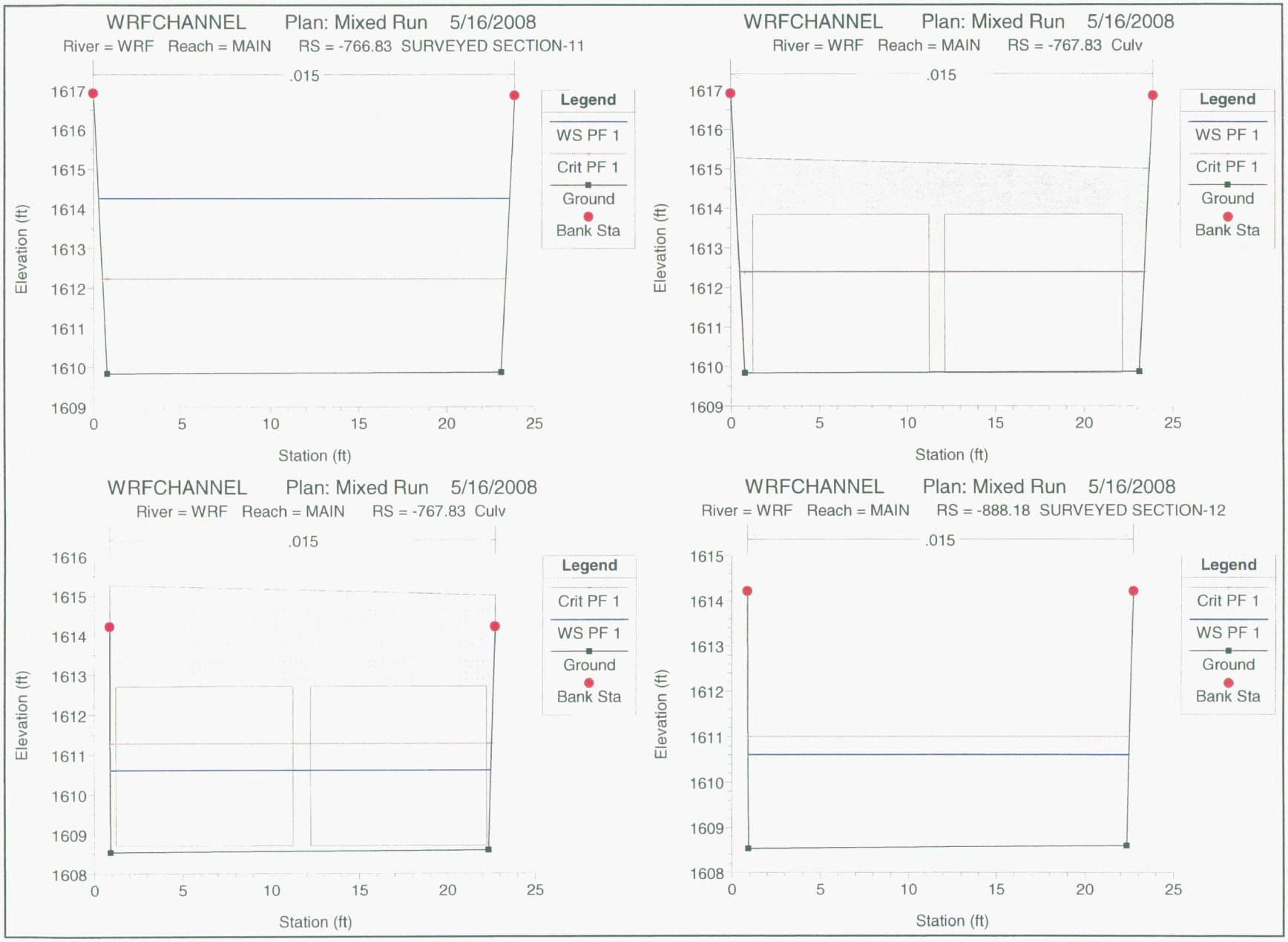
HEC-RAS Plan: Mix_Run River: WRF Reach: MAIN Profile: PF 1

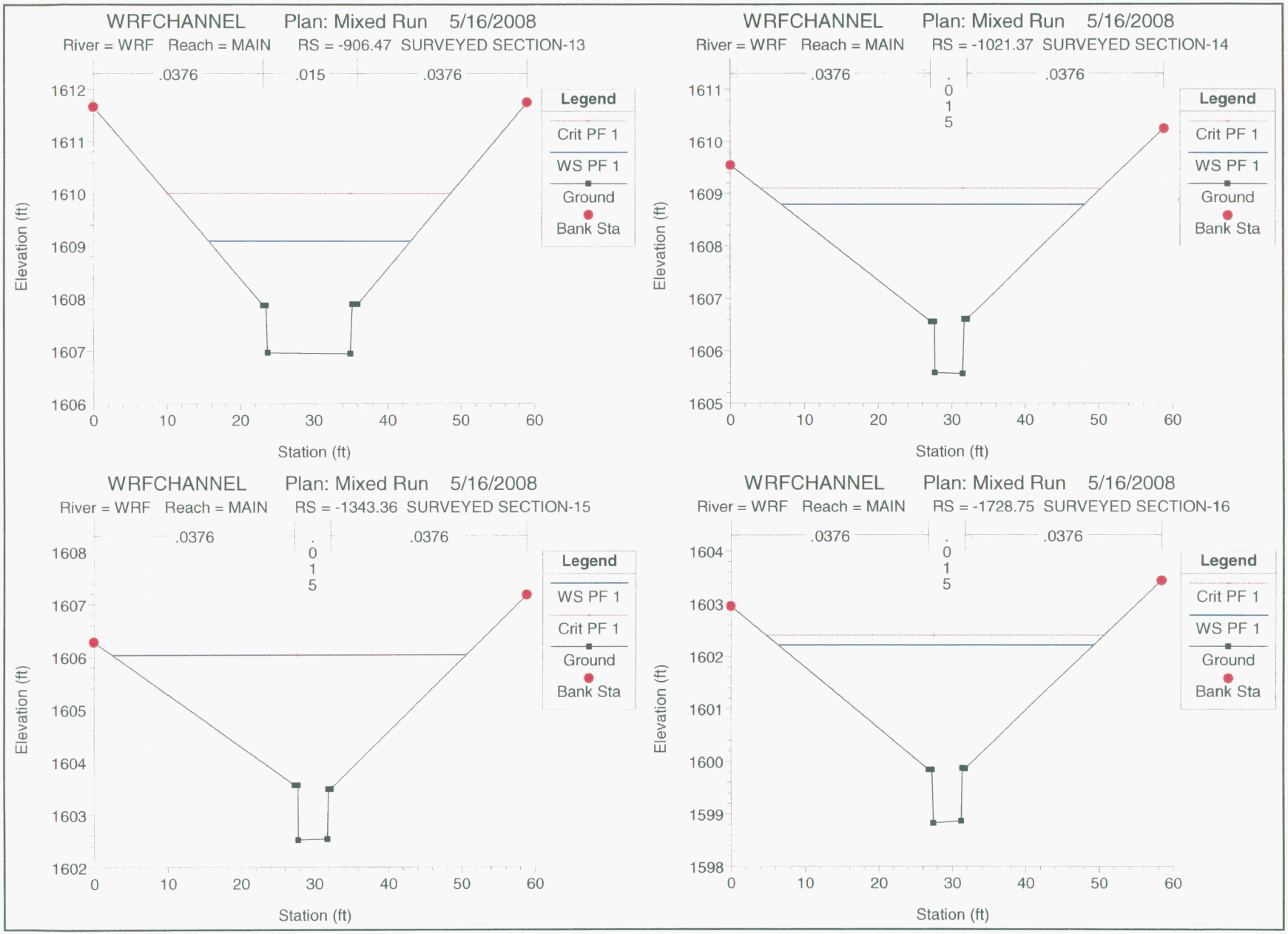
Reach	River Sta	Profile	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Width	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US.	W.S. US.	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
MAIN	-2481.00	PF 1	485.00	29.64	454.81	29.64		59.48	0.79	0.36	1594.54	1595.94	1595.04	1595.44	1595.33

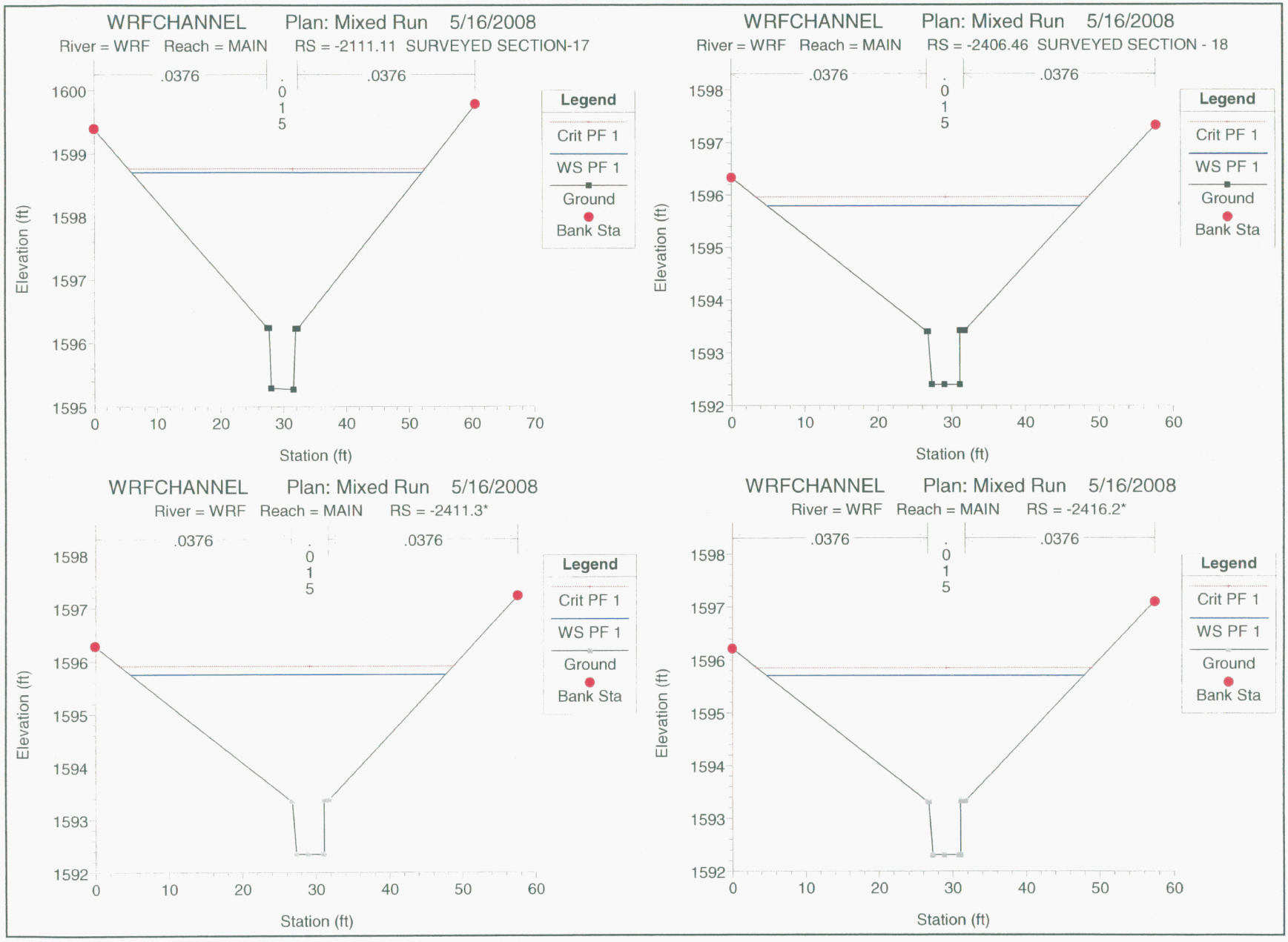

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -0.00 SURVEYED SECTION-1
.025
.015
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -69.55 SURVEYED SECTION-2
.035
.015
.035
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -112.98 SURVEYED SECTION-3
.035
.015
.035
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -127.24 SURVEYED SECTION-4
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

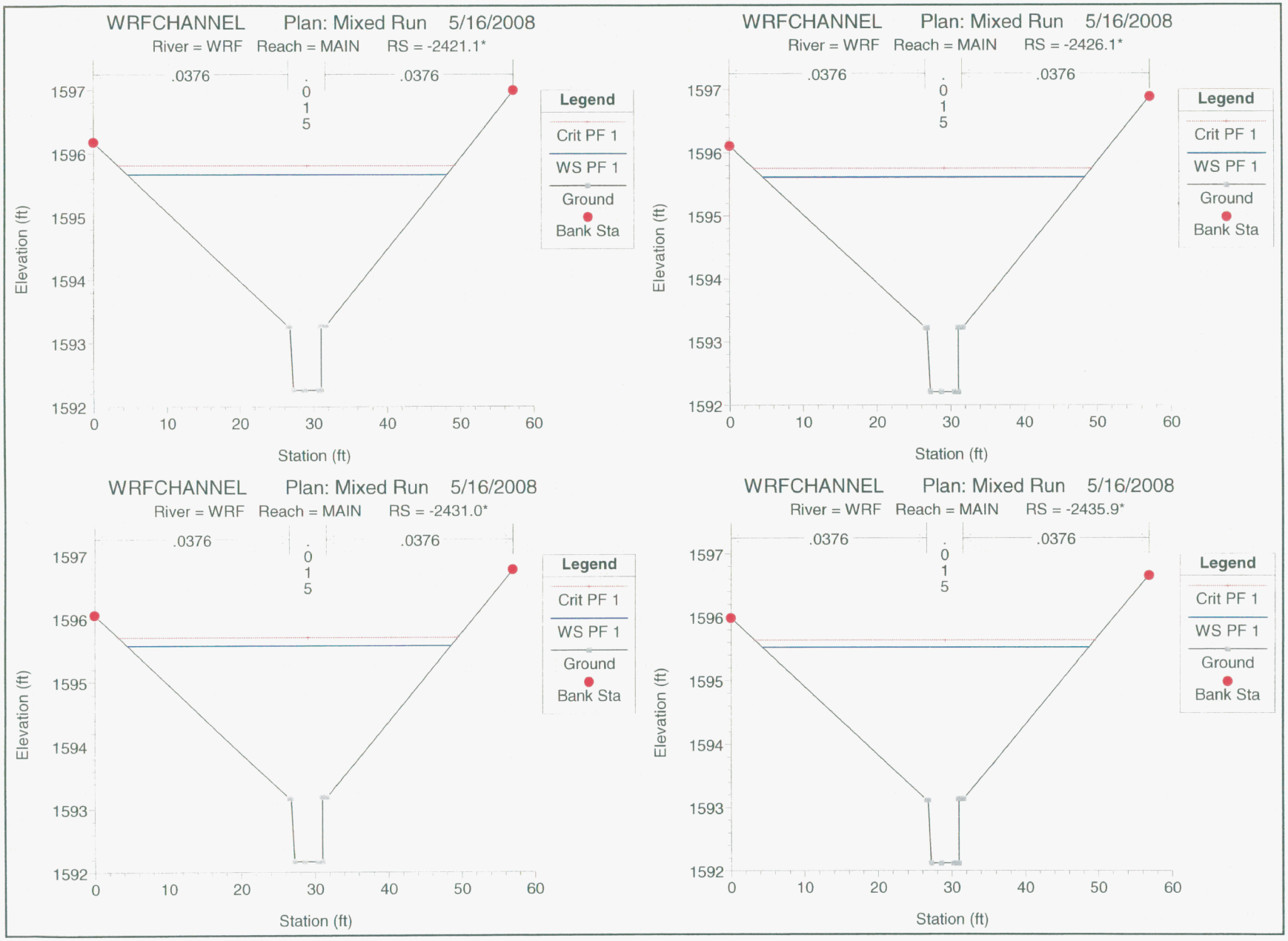

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -130.24 Culv
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -130.24 Culv
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -183.27 SURVEYED SECTION-5
.015
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -198.97 SURVEYED SECTION-6
.035
.015
.035
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

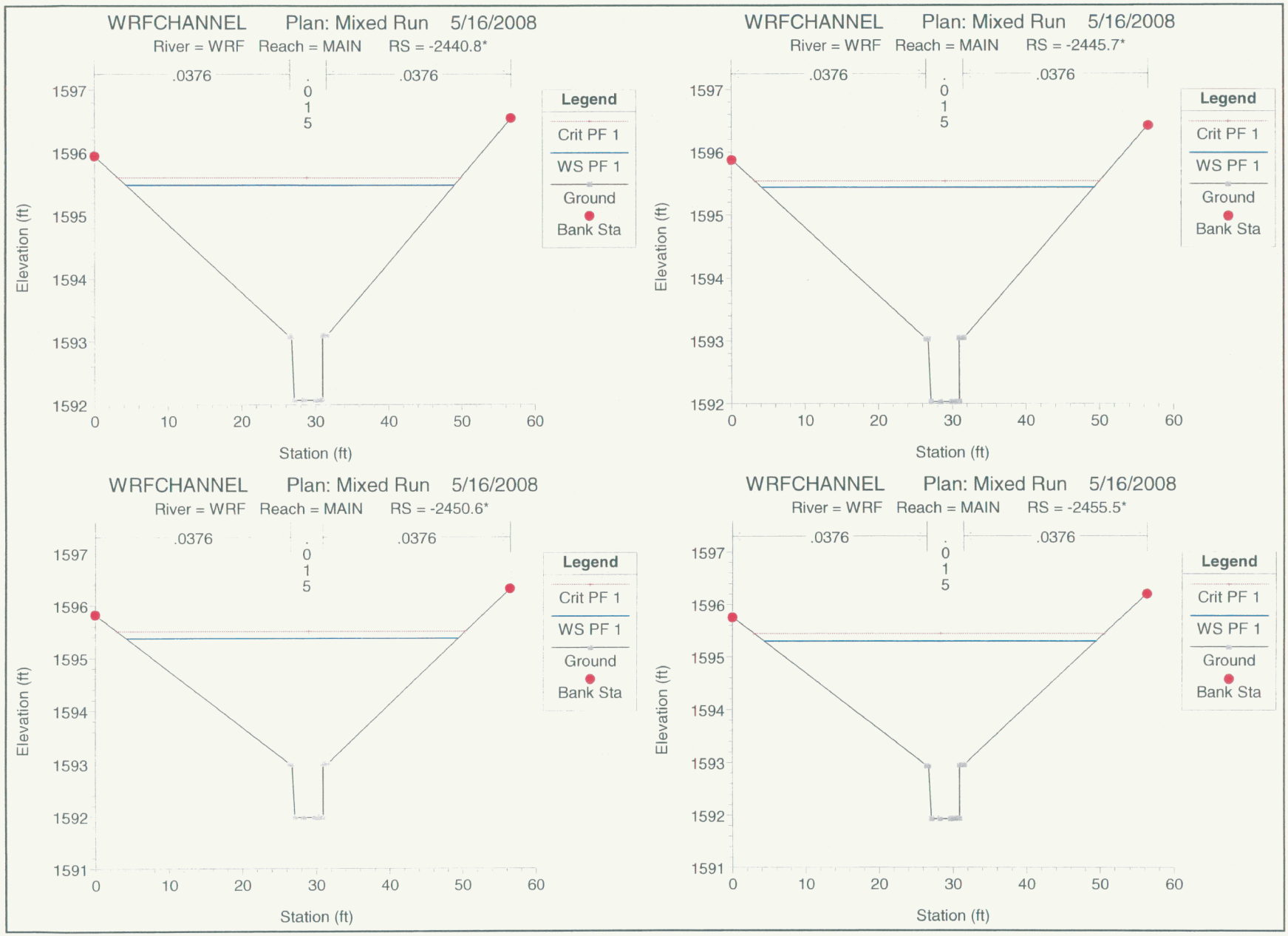

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -307.10 SURVEYED SECTION-7
.035 .015 .035
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -601.40 SURVEYED SECTION-8
.035 .015 .035
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -642.63 SURVEYED SECTION-9
.035 .015 .035
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -722.70 SURVEYED SECTION-10
.035 .015 .035
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

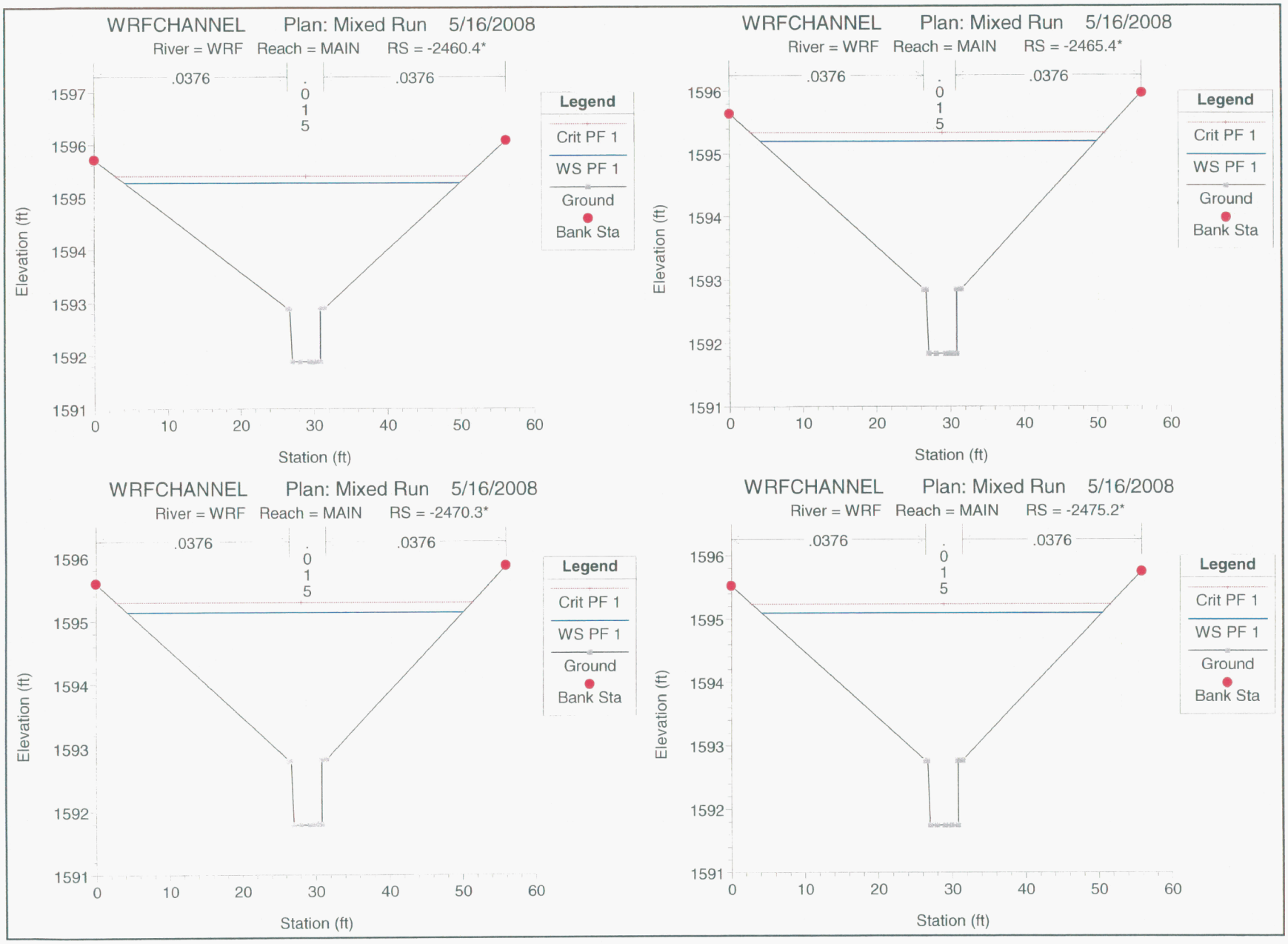

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -766.83 SURVEYED SECTION-11
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -767.83 Culv
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -767.83 Culv
.015
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -888.18 SURVEYED SECTION-12
.015
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

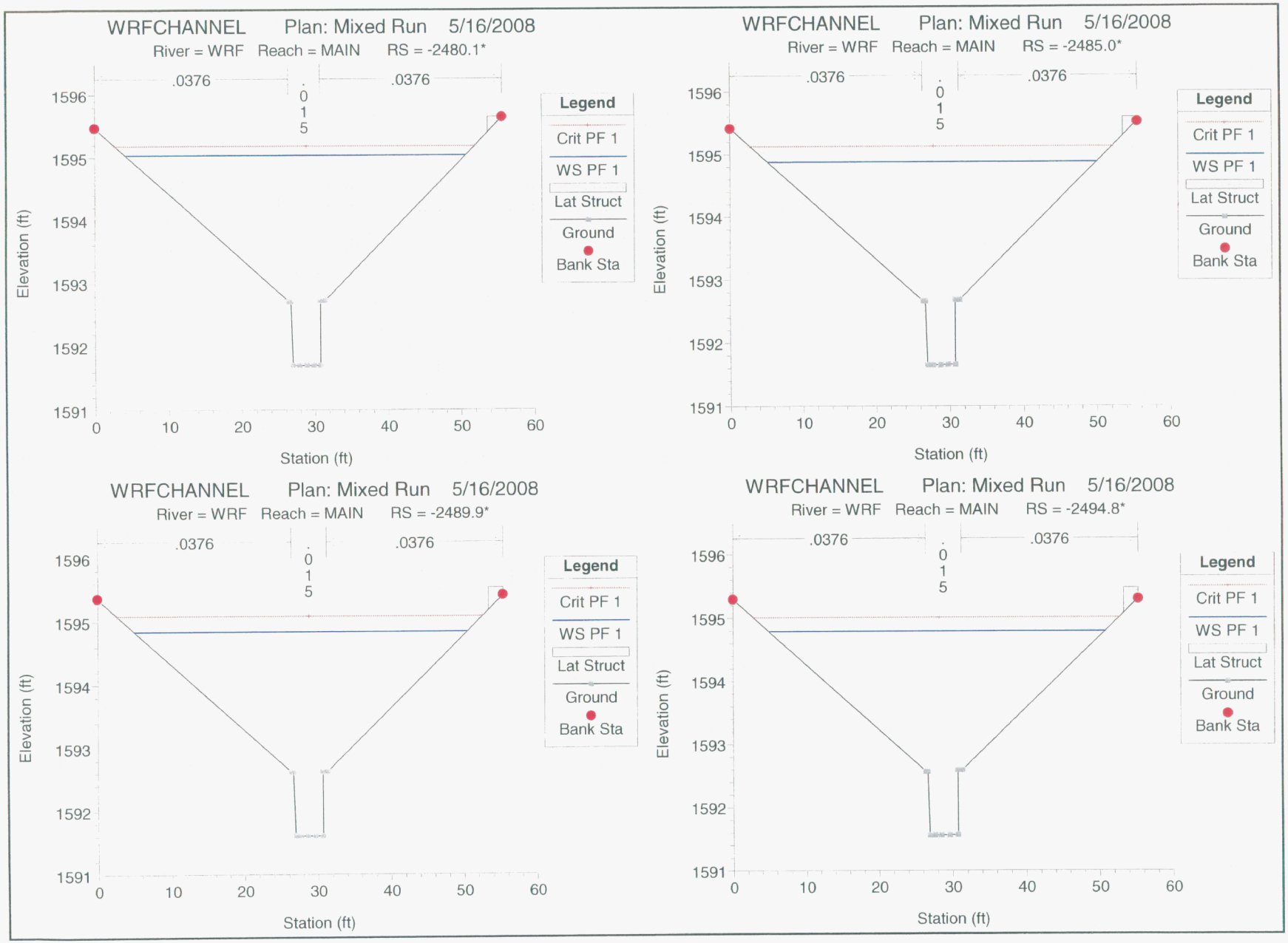

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -906.47 SURVEYED SECTION-13
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -1021.37 SURVEYED SECTION-14
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -1343.36 SURVEYED SECTION-15
.0376
.015
.0376
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -1728.75 SURVEYED SECTION-16
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

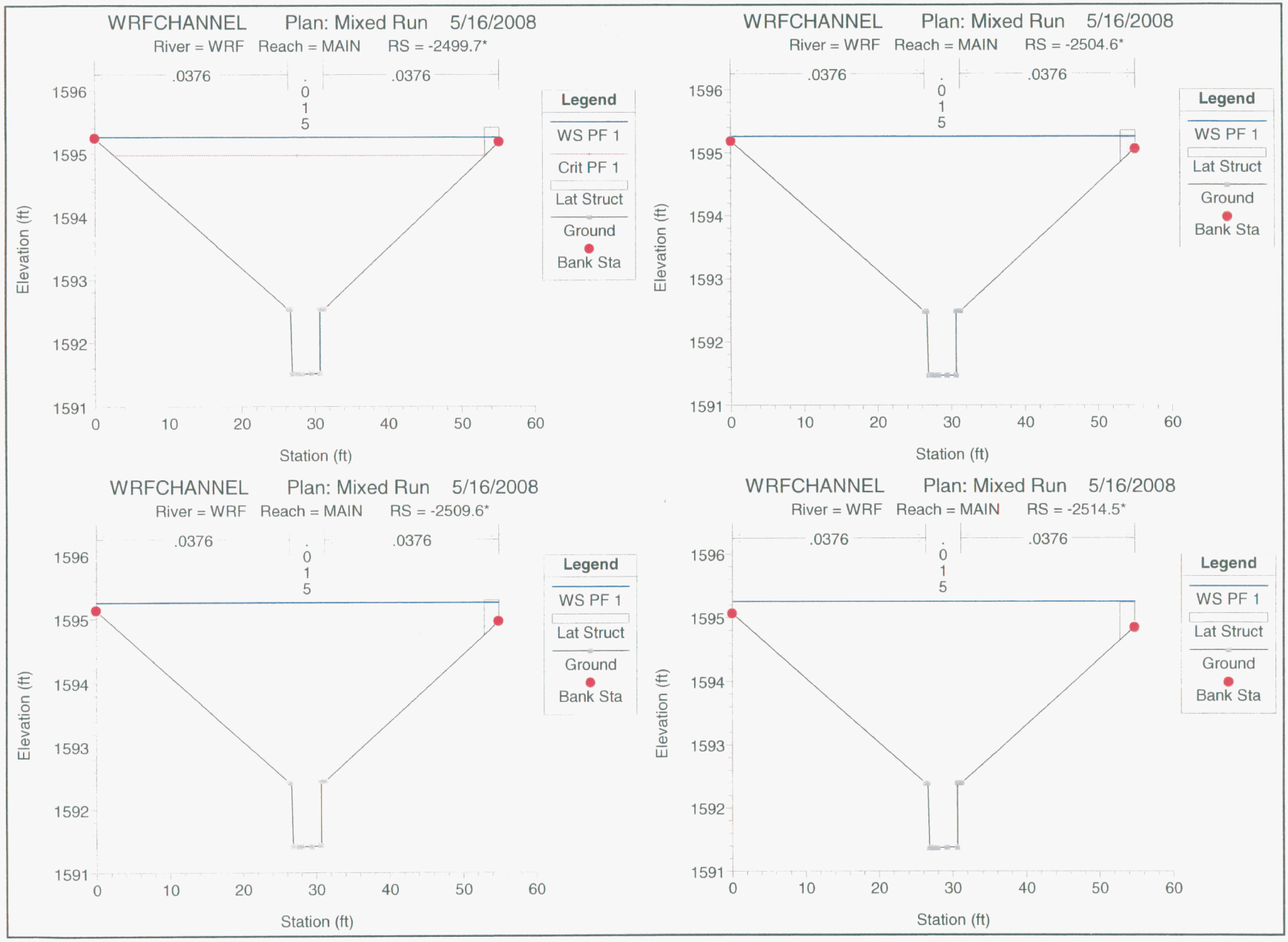

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2111.11 SURVEYED SECTION-17
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2406.46 SURVEYED SECTION - 18
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2411.3*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2416.2*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

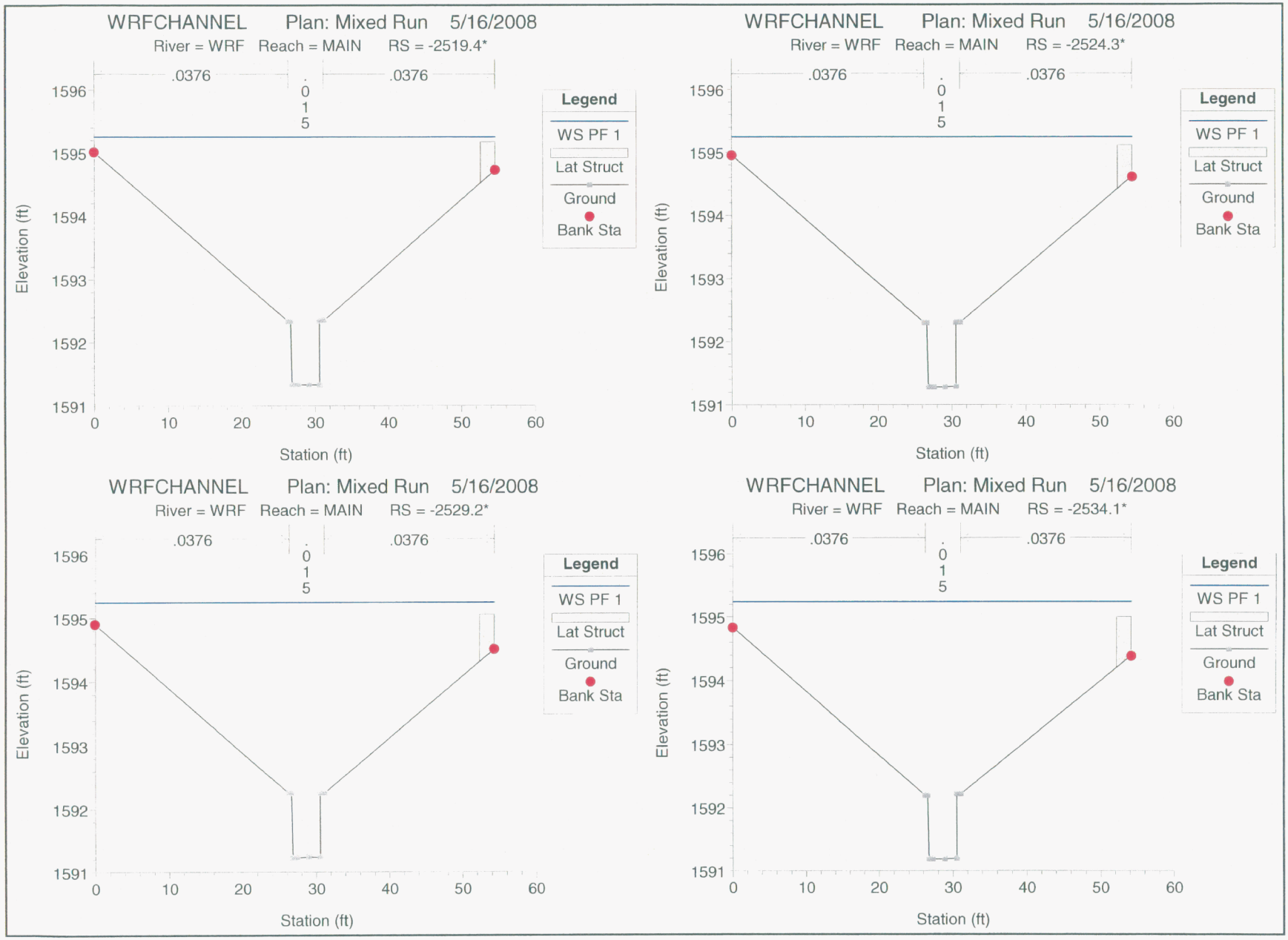

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2421.1*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2426.1*
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2431.0*
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2435.9*

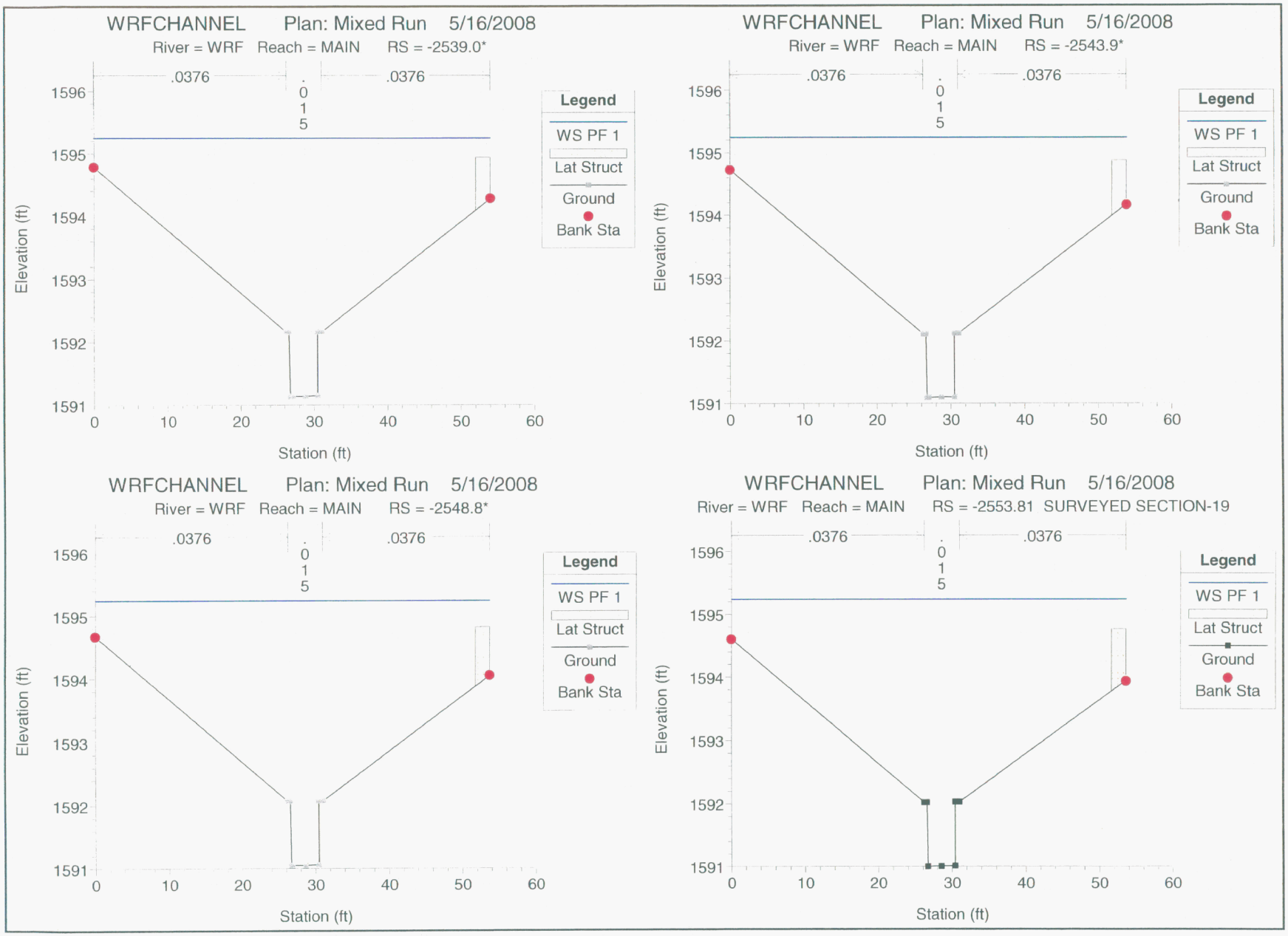

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2440.8*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2445.7*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2450.6*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2455.5*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

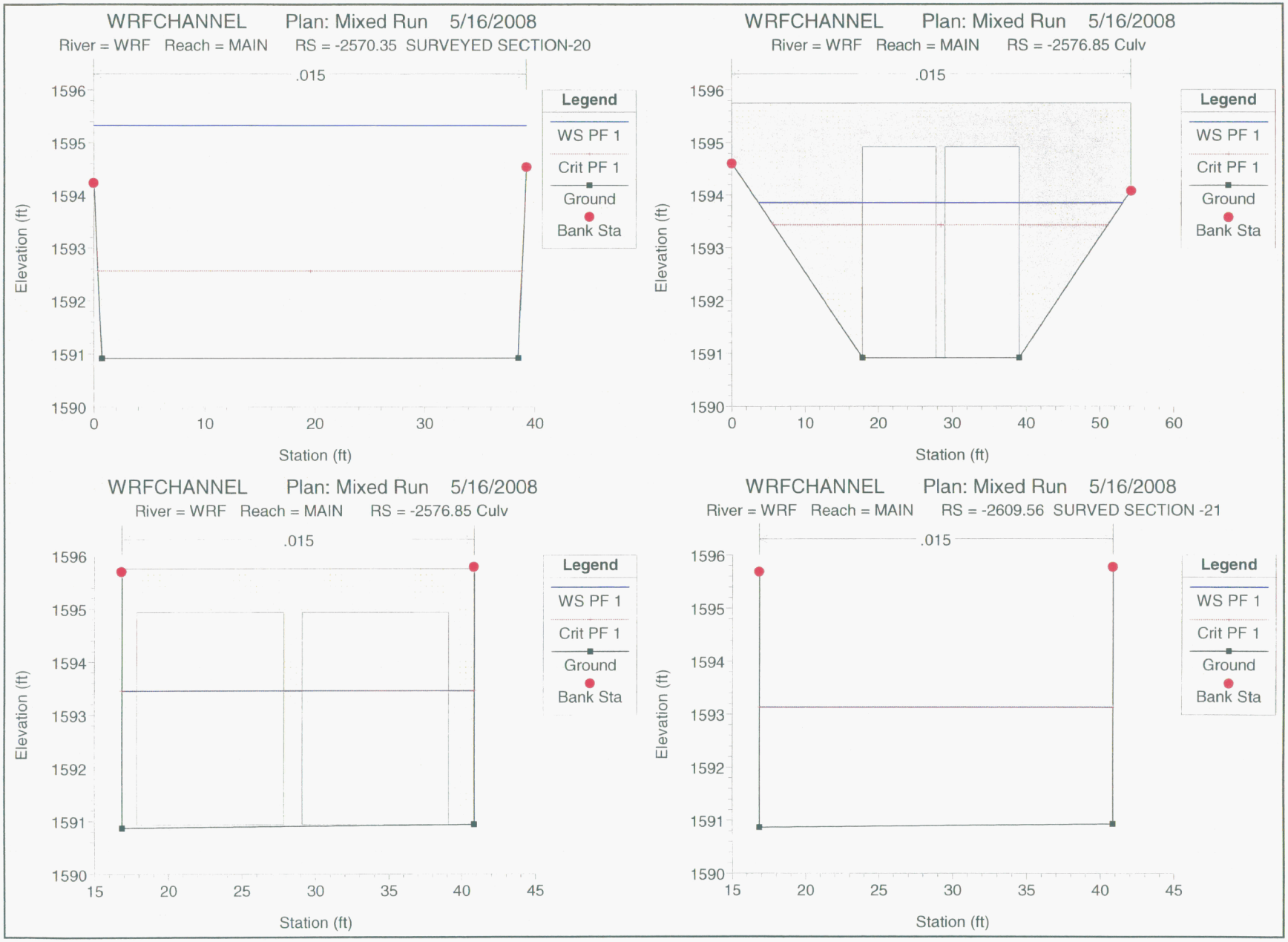

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2460.4*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2465.4*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2470.3*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2475.2*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

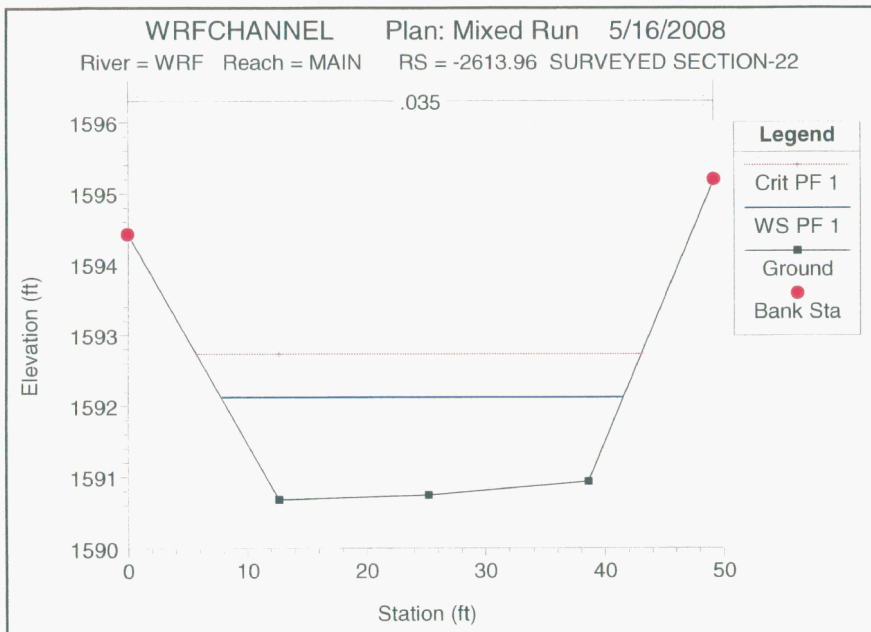

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2480.1*
.0376
.015
.0376
Elevation (ft)
Station (ft)
Legend
Crit PF 1
WS PF 1
Lat Struct
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2485.0*
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2489.9*
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2494.8*

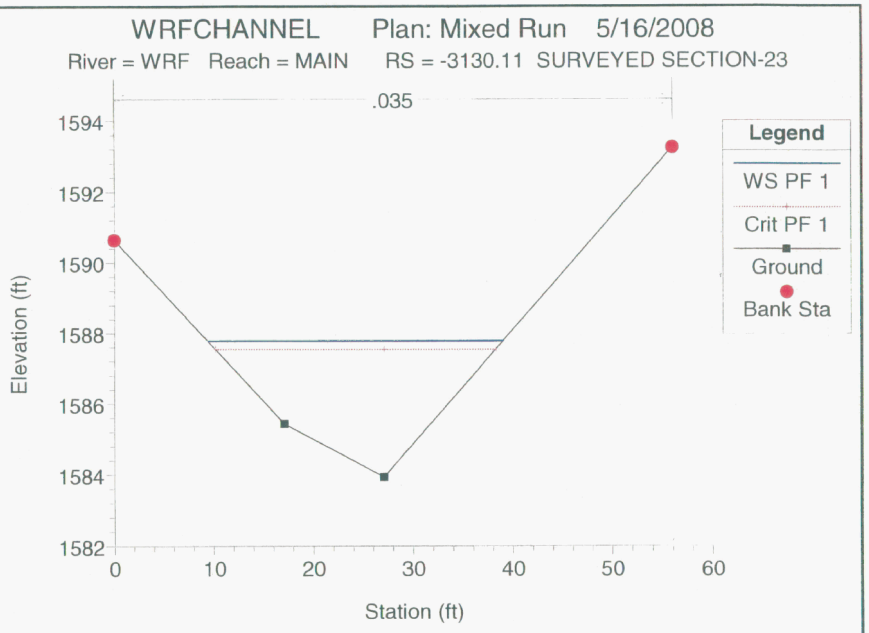

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2499.7*
.0376
.015
.0376
Legend
WS PF 1
Crit PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2504.6*
.0376
.015
.0376
Legend
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2509.6*
.0376
.015
.0376
Legend
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2514.5*
.0376
.015
.0376
Legend
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)


WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2519.4*
.0376
.015
.0376
Legend
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2524.3*
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2529.2*
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2534.1*

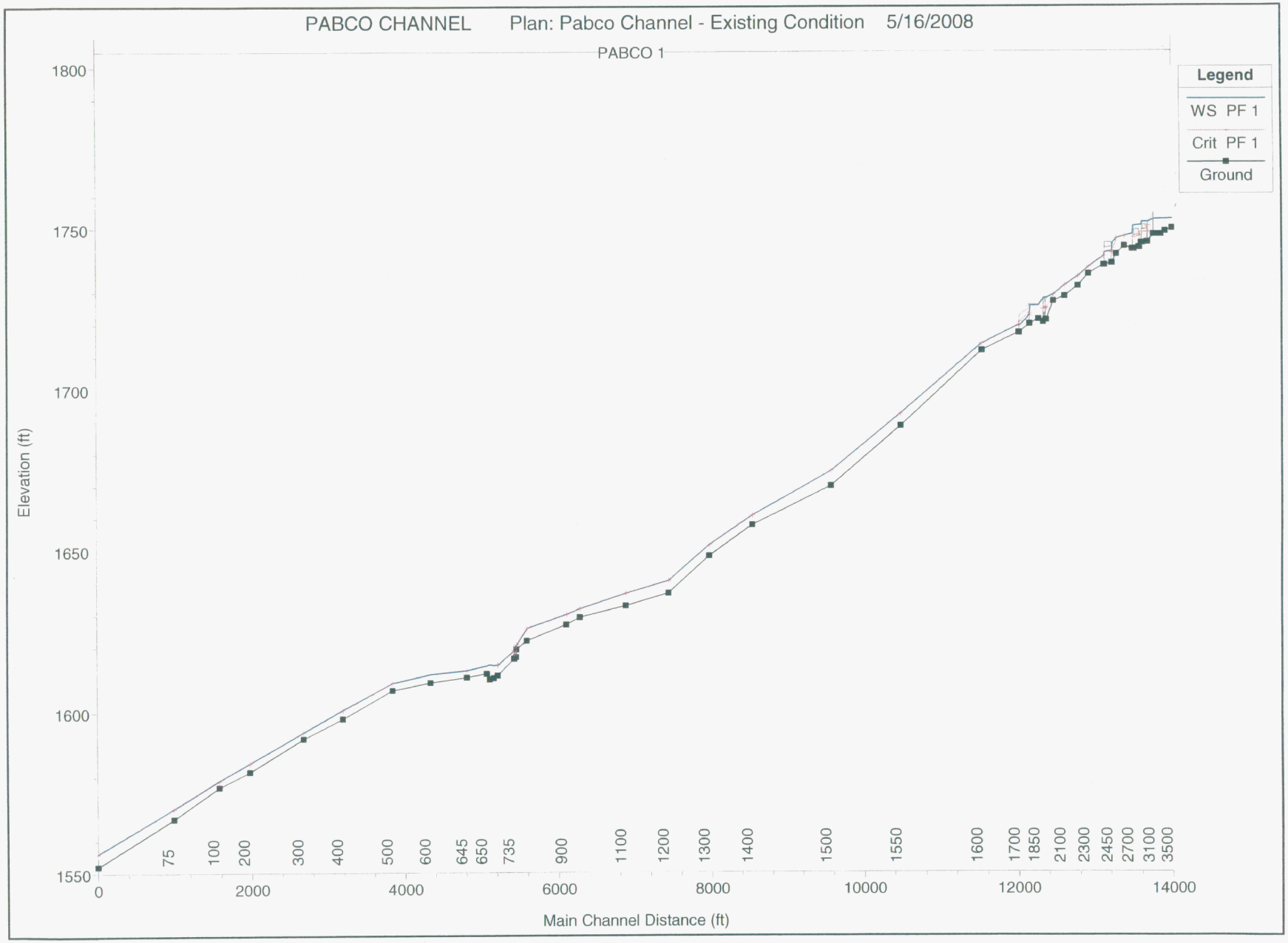

WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2539.0*
.0376
.015
.0376
Legend
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2543.9*
.0376
.015
.0376
Legend
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2548.8*
.0376
.015
.0376
Legend
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2553.81 SURVEYED SECTION-19
.0376
.015
.0376
Legend
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)


WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2570.35 SURVEYED SECTION-20
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2576.85 Culv
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2576.85 Culv
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2609.56 SURVED SECTION -21
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -2613.96 SURVEYED SECTION-22
.035
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1596
1595
1594
1593
1592
1591
1590
0
10
20
30
40
50


WRFCHANNEL Plan: Mixed Run 5/16/2008
River = WRF Reach = MAIN RS = -3130.11 SURVEYED SECTION-23
.035
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1594
1592
1590
1588
1586
1584
1582
0
10
20
30
40
50
60

Appendix D-2: Existing Pabco Channel Hydraulic Model (HEC-RAS Output)


PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
PABCO 1
Legend
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1800
1750
1700
1650
1600
1550
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)
75
100
200
300
400
500
600
645
650
735
900
1100
1200
1300
1400
1500
1550
1600
1700
1850
2100
2300
2450
2700
3100
3500

HEC-1 Node

HEC-RAS Plan: Pabco River: PABCO Reach: 1 Profile: PF 1

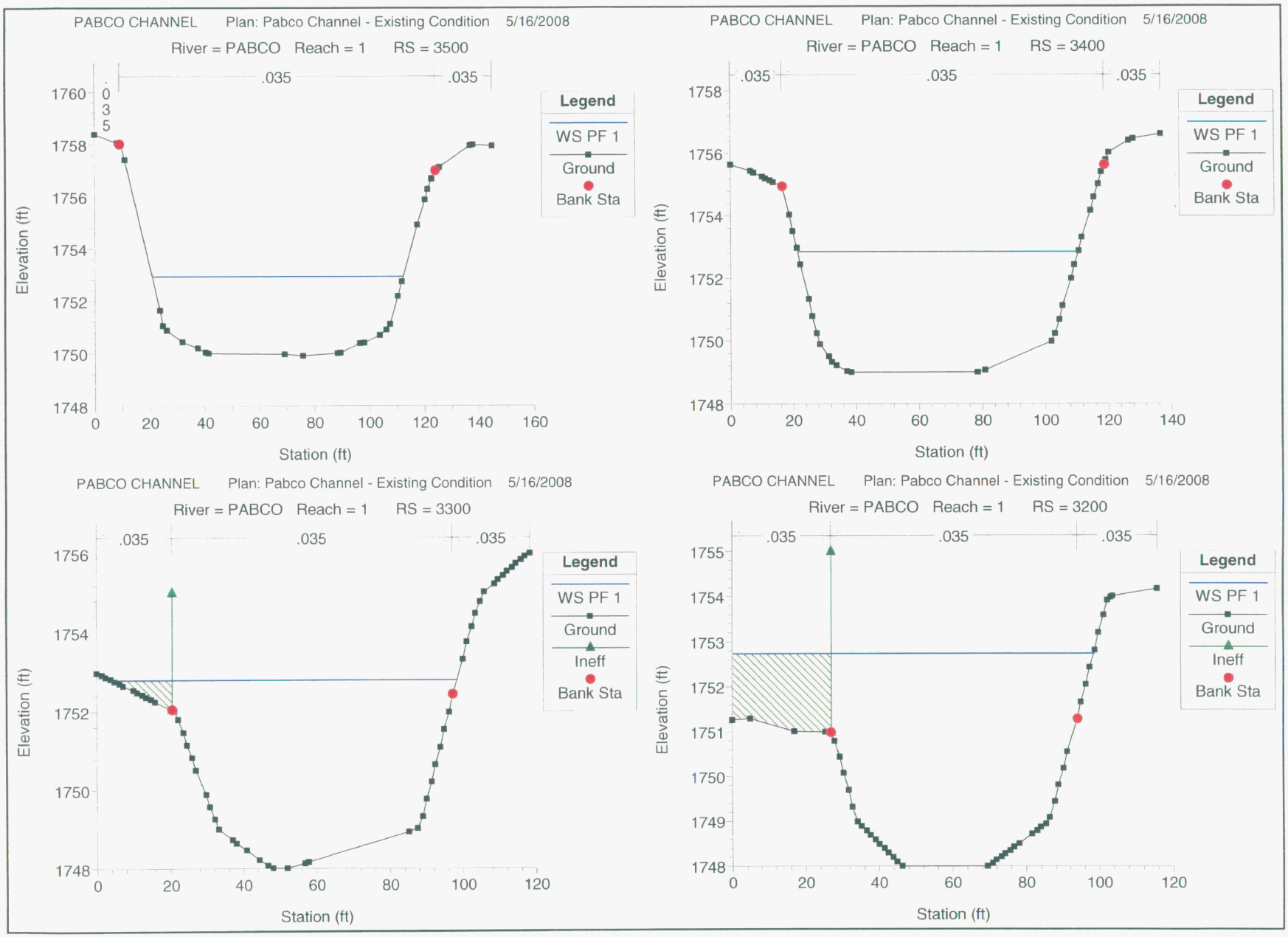
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
CP2 → 1	3500	PF 1	870.00	1749.91	1752.93		1753.14	0.002136	3.68	236.59	91.36	0.40
1	3400	PF 1	870.00	1749.00	1752.86		1753.00	0.001020	2.97	292.87	89.15	0.29
1	3300	PF 1	870.00	1748.01	1752.80		1752.94	0.000916	3.05	285.08	94.22	0.28
1	3200	PF 1	870.00	1748.00	1752.74		1752.90	0.000883	3.19	275.17	98.56	0.28
1	3100	PF 1	870.00	1747.99	1752.74		1752.86	0.000571	2.82	334.45	135.66	0.23
1	3050		Lat Struct									
1	3000	PF 1	813.30	1745.60	1751.97	1750.77	1752.70	0.004193	7.10	128.64	45.13	0.57
1	2950		Culvert									
1	2900	PF 1	585.74	1745.34	1750.80		1751.07	0.002132	4.26	149.36	74.16	0.41
1	2800	PF 1	585.74	1743.96	1750.89	1747.97	1751.00	0.000588	2.86	247.76	112.20	0.23
1	2750		Culvert									
1	2700	PF 1	400.97	1743.42	1748.18		1748.75	0.006657	6.09	65.89	26.71	0.67
1	2600	PF 1	400.97	1744.37	1747.56	1747.56	1748.12	0.005673	6.59	71.94	103.04	0.86
1	2590	PF 1	400.97	1741.87	1746.80	1746.80	1747.38	0.003743	6.31	76.30	149.40	0.71
1	2500	PF 1	400.97	1739.09	1745.38	1742.39	1745.50	0.000496	2.80	143.03	129.19	0.27
1	2450		Culvert									
1	2400	PF 1	400.97	1738.43	1741.38	1741.38	1742.37	0.007746	7.97	50.30	25.74	1.00
1	2300	PF 1	400.97	1735.63	1737.95	1737.95	1738.80	0.007992	7.42	54.06	32.18	1.01
1	2200	PF 1	400.97	1731.88	1735.05	1735.05	1735.87	0.007998	7.28	55.10	33.80	1.00
1	2100	PF 1	400.97	1728.68	1732.19	1732.19	1733.13	0.008186	7.79	51.47	28.05	1.01
1	2000	PF 1	400.97	1727.12	1729.30	1729.30	1729.96	0.008562	6.53	61.41	47.23	1.01
1	1950	PF 1	400.97	1721.26	1728.19	1724.94	1728.27	0.000266	2.18	183.58	52.50	0.21
1	1900		Culvert									
1	1850	PF 1	362.07	1721.50	1725.86		1726.18	0.002183	4.58	79.04	36.28	0.55
1	1800	PF 1	362.07	1720.00	1725.87	1722.75	1726.02	0.000577	3.07	117.82	33.68	0.29
1	1750		Culvert									
1	1700	PF 1	362.07	1717.38	1719.82	1719.82	1720.73	0.008036	7.66	47.29	26.29	1.01
CP5 → 1	1600	PF 1	722.67	1711.77	1714.00	1714.00	1714.90	0.007745	7.63	94.73	53.19	1.01
1	1550	PF 1	722.67	1688.51	1692.43	1692.43	1693.22	0.008151	7.12	101.47	65.24	1.00
1	1500	PF 1	722.67	1669.92	1674.60	1674.60	1675.98	0.007121	9.42	76.74	27.98	1.00
1	1400	PF 1	722.67	1657.83	1660.94	1660.94	1662.06	0.007343	8.46	85.42	39.06	1.01
1	1300	PF 1	722.67	1648.23	1651.73	1651.73	1652.88	0.007290	8.61	83.90	36.92	1.01
1	1200	PF 1	722.67	1636.62	1640.60	1640.60	1642.04	0.007111	9.63	75.04	26.20	1.00
1	1100	PF 1	722.67	1632.76	1636.62	1636.62	1637.80	0.007212	8.70	83.03	35.53	1.00
1	1000	PF 1	722.67	1629.23	1631.89	1631.89	1632.97	0.007473	8.37	86.33	40.40	1.01
1	900	PF 1	722.67	1627.02	1630.14	1630.10	1631.07	0.007078	7.73	93.45	47.99	0.98
1	800	PF 1	722.67	1622.03	1625.83	1625.83	1627.28	0.007487	9.65	74.86	25.98	1.00
1	742	PF 1	722.67	1619.41	1620.75	1620.75	1621.23	0.008958	5.60	128.96	413.69	0.99
1	740		Culvert									

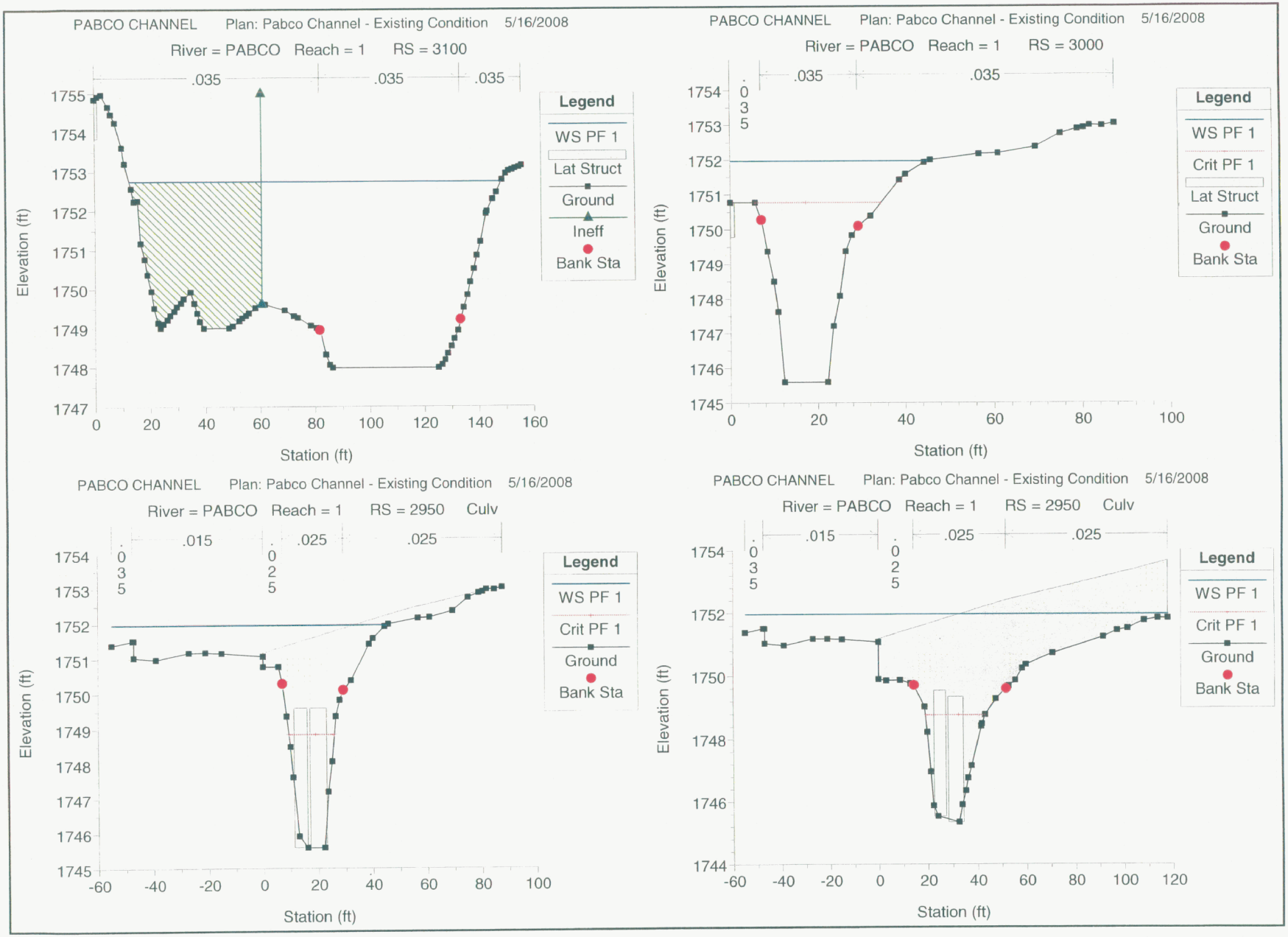
HEC-RAS Plan: Pabco River: PABCO Reach: 1 Profile: PF 1 (Continued)

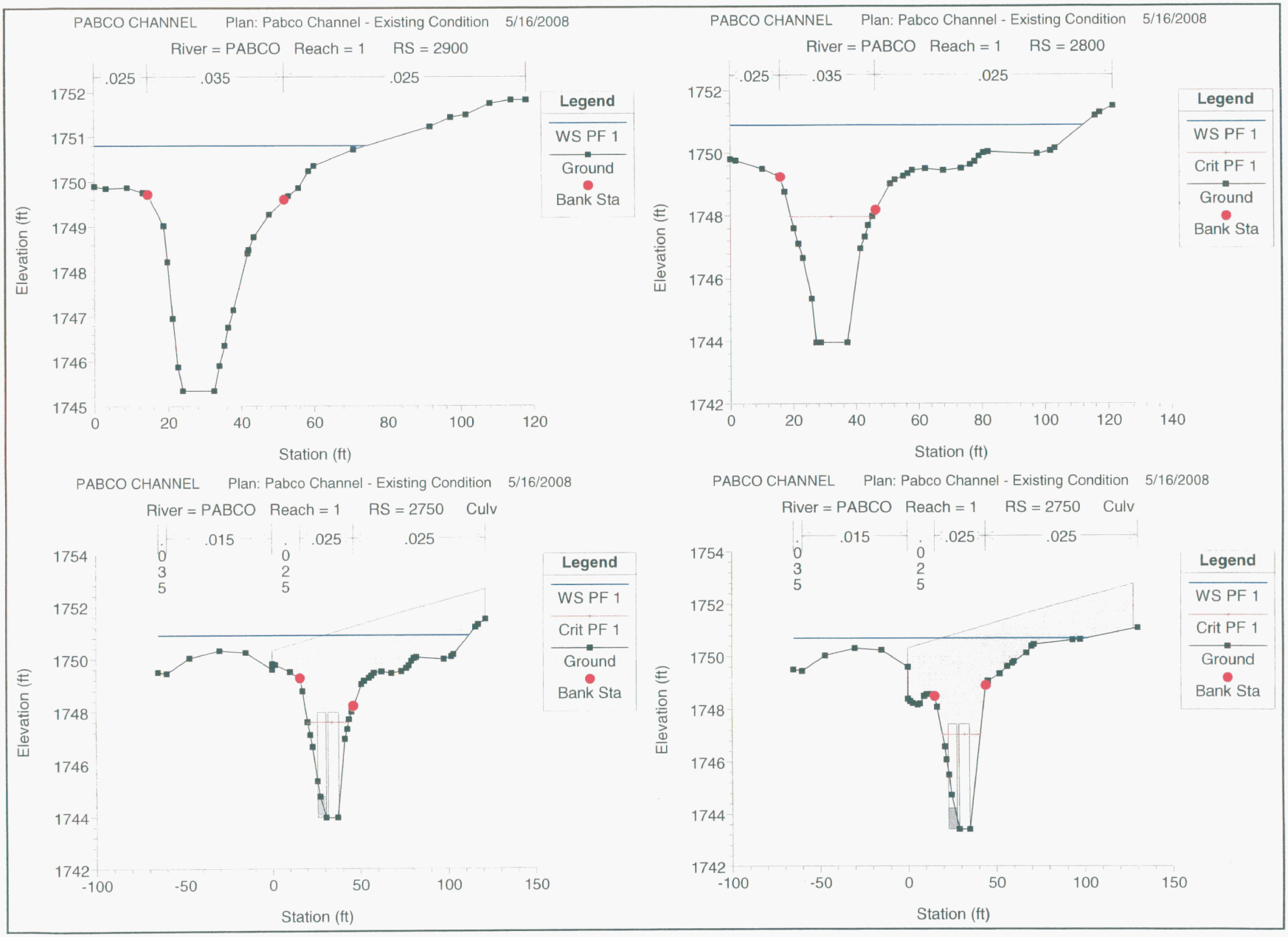
	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
	1	735	PF 1	722.67	1616.50	1618.96	1618.96	1619.82	0.007823	7.45	97.05	57.12	1.01
	1	700	PF 1	722.67	1611.35	1614.49	1614.49	1615.60	0.021024	8.48	85.17	38.77	1.01
	1	680	PF 1	722.67	1610.48	1614.38		1614.86	0.006842	5.60	128.97	47.04	0.60
	1	670	PF 1	722.67	1610.15	1614.55		1614.63	0.000966	2.32	311.37	99.67	0.23
	1	660	PF 1	722.67	1611.81	1614.38		1614.56	0.003643	3.42	211.37	102.58	0.42
	1	650	PF 1	722.67	1611.88	1614.27		1614.54	0.002399	4.19	172.29	99.32	0.56
	1	645	PF 1	722.67	1610.73	1612.80	1612.78	1613.47	0.008012	6.53	110.72	81.19	0.98
	1	600	PF 1	722.67	1609.08	1611.59		1611.82	0.001692	3.83	188.82	96.00	0.48
CP6A →	1	500	PF 1	1361.67	1606.75	1608.88	1608.88	1609.80	0.007625	7.69	177.09	97.80	1.01
	1	400	PF 1	1361.67	1597.96	1600.63	1600.54	1601.21	0.014249	6.12	222.57	166.23	0.93
CP6b →	1	300	PF 1	1936.67	1591.82	1593.74	1593.68	1594.21	0.013402	5.56	363.00	541.95	0.89
	1	200	PF 1	1936.67	1581.54	1584.20	1584.13	1584.92	0.013072	6.89	285.96	332.68	0.93
	1	100	PF 1	1936.67	1576.76	1578.82	1578.77	1579.48	0.014061	6.53	296.44	340.25	0.95
	1	75	PF 1	1936.67	1566.86	1570.07	1570.07	1570.61	0.015980	5.92	331.48	424.00	0.97
CP7 →	1	50	PF 1	2050.67	1552.18	1556.18	1555.96	1556.50	0.009402	4.57	448.43	979.27	0.74

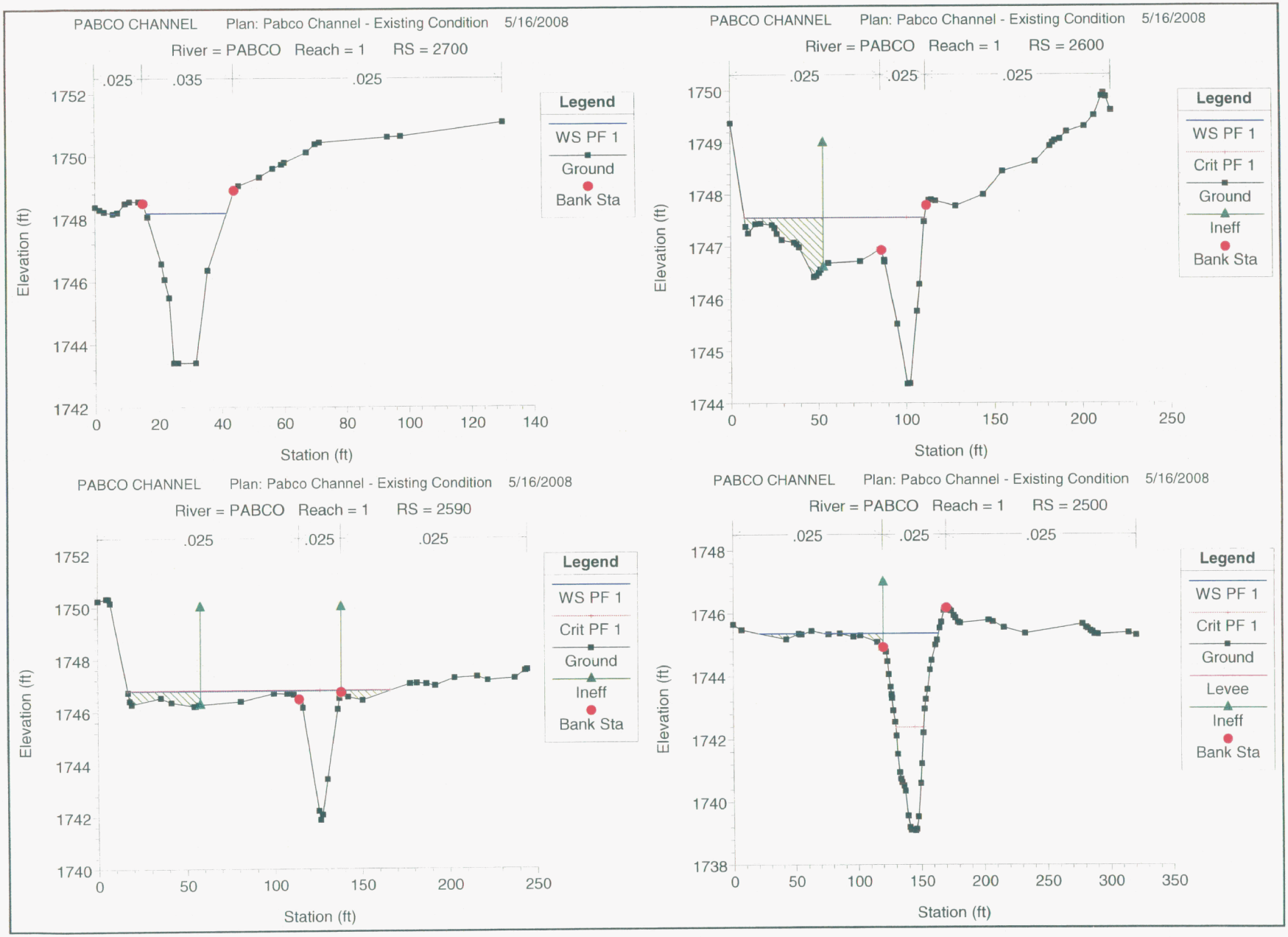
HEC-RAS Plan: Pabco River: PABCO Reach: 1 Profile: PF 1

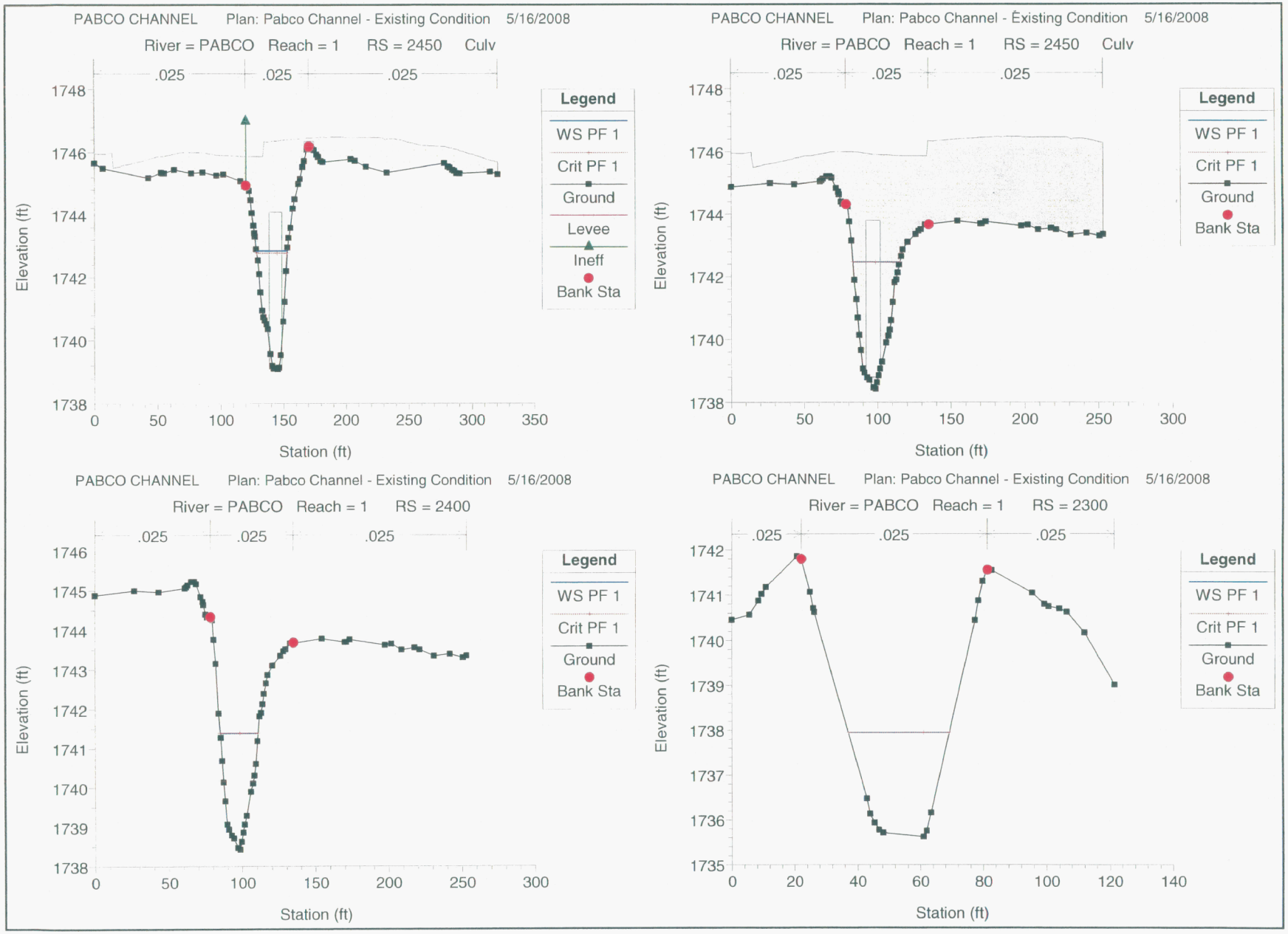
Reach	River Sta	Profile	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US.	W.S. US.	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
1	3050	PF 1	870.00	57.59	813.30	57.59		37.22	1.18	0.59	1750.78	1752.86	1752.74	1752.70	1751.97

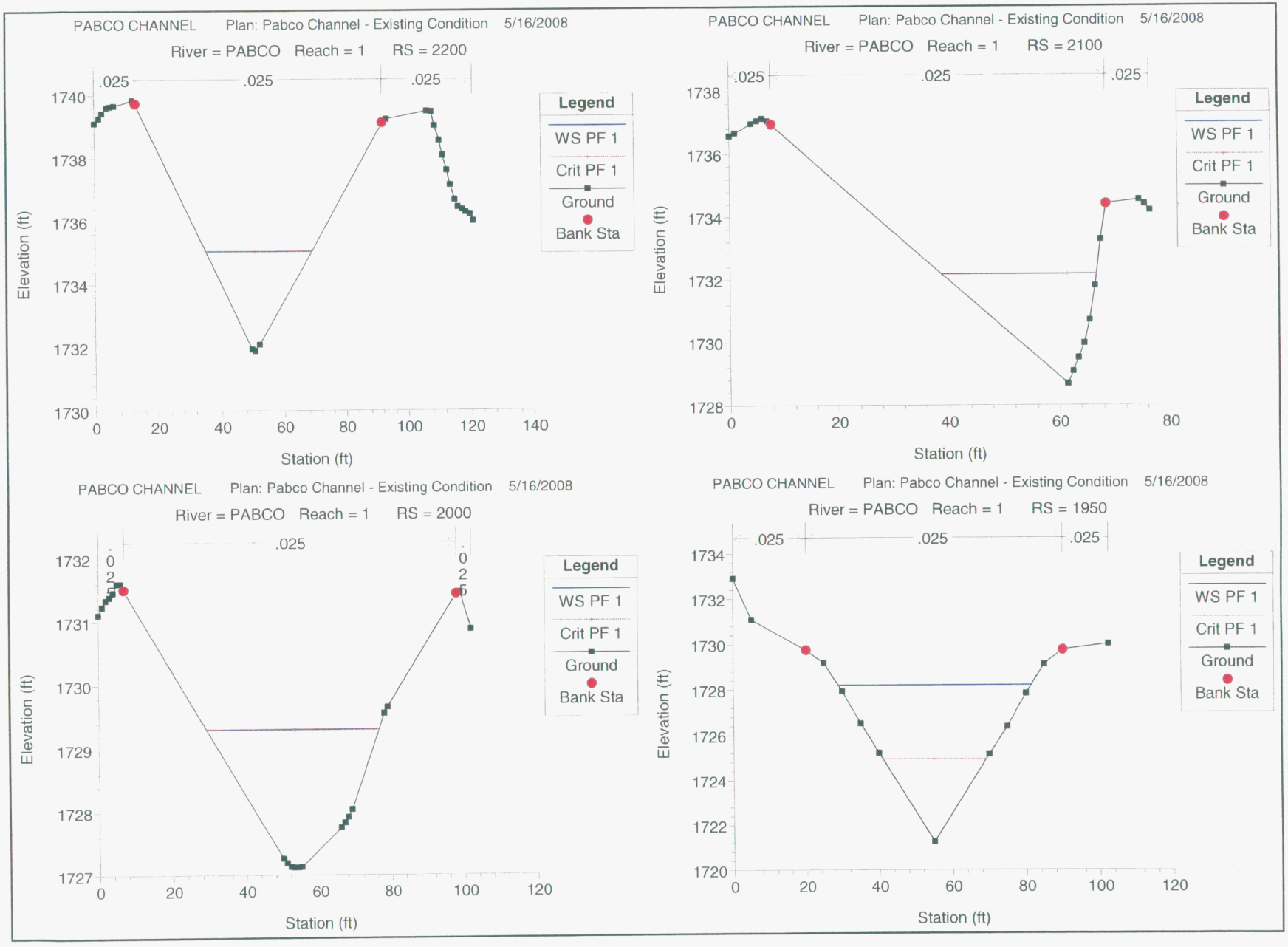

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 3500
.035
.035
.035
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 3400
.035
.035
.035
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 3300
.035
.035
.035
Legend
WS PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 3200
.035
.035
.035
Legend
WS PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

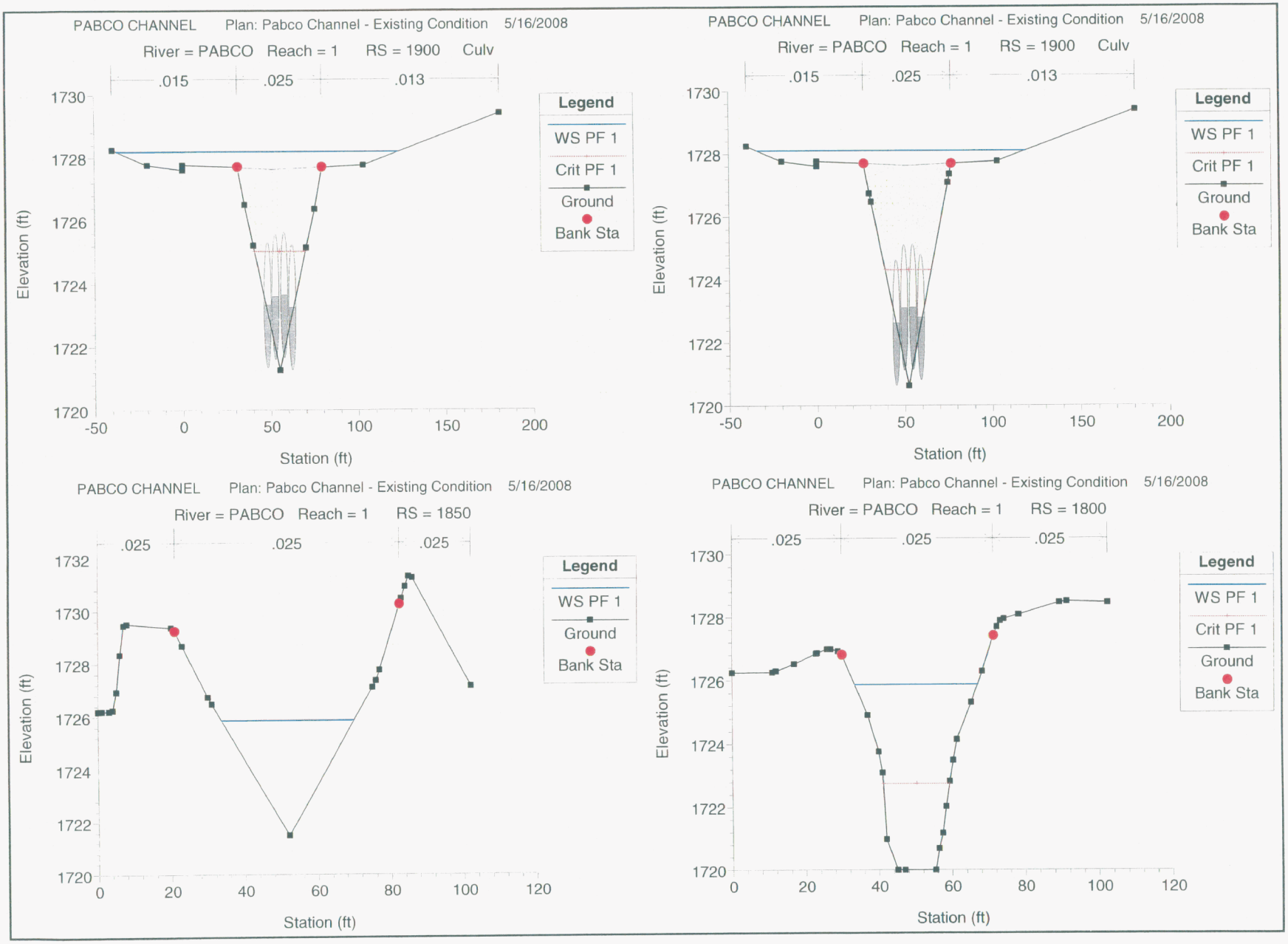

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 3100
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS PF 1
Lat Struct
Ground
Ineff
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 3000
.035 .035
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Lat Struct
Ground
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2950 Culv
.035 .015 .025 .025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2950 Culv
.035 .015 .025 .025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta

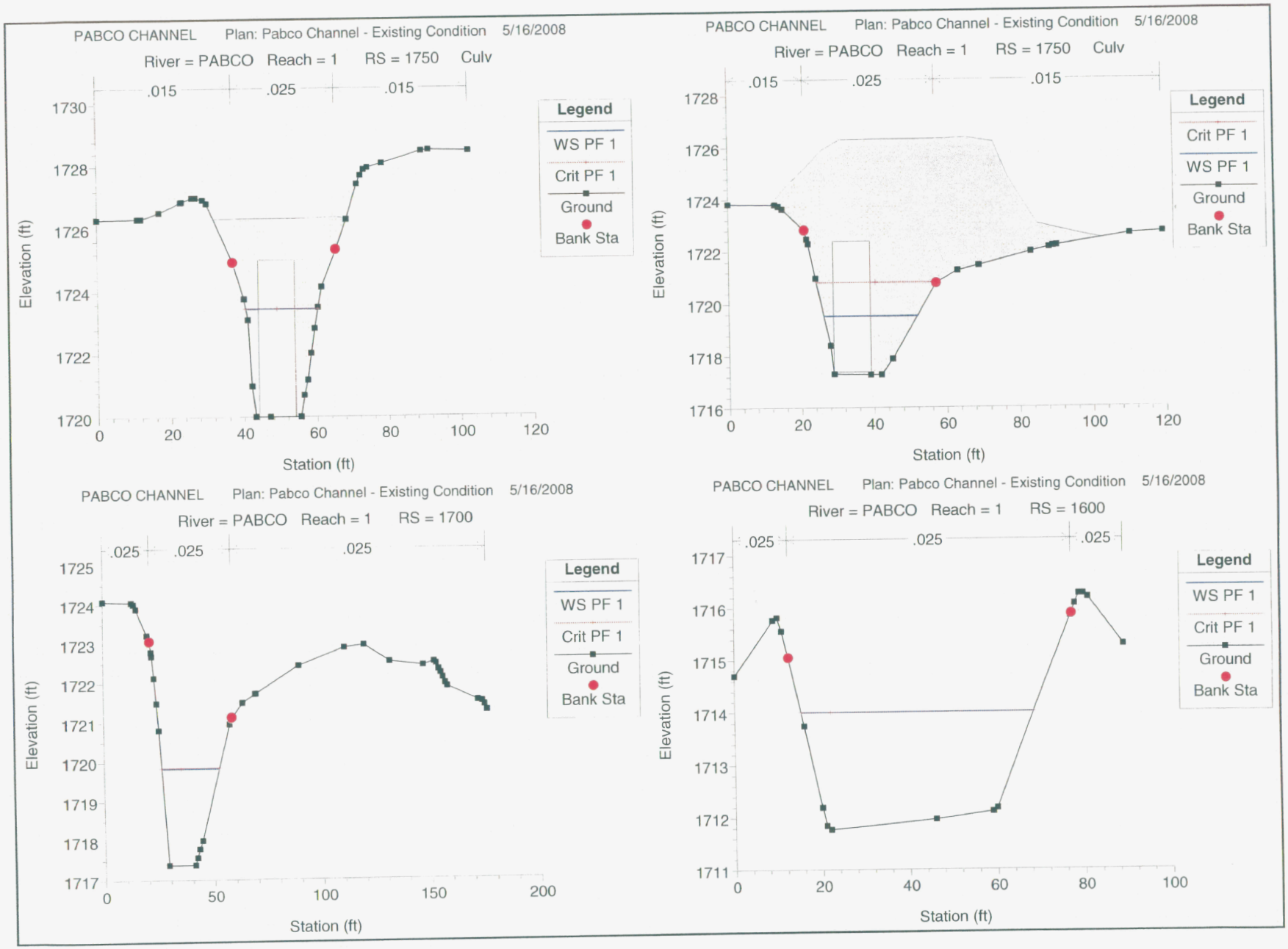

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2900
.025 .035 .025
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2800
.025 .035 .025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2750 Culv
.015 .025 .025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2750 Culv
.015 .025 .025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

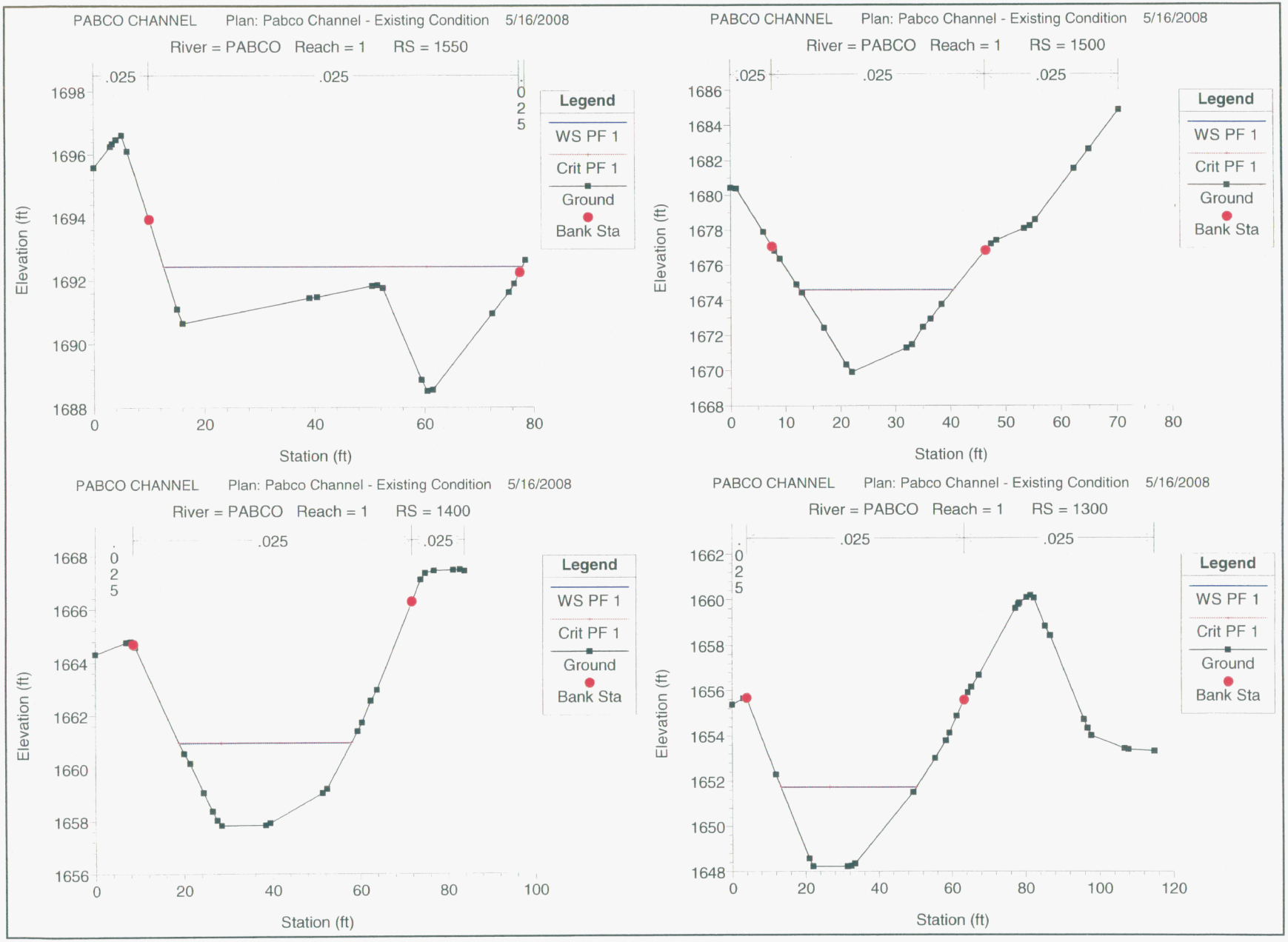

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2700
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2600
.025 .025 .025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2590
.025 .025 .025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2500
.025 .025 .025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Levee
Ineff
Bank Sta

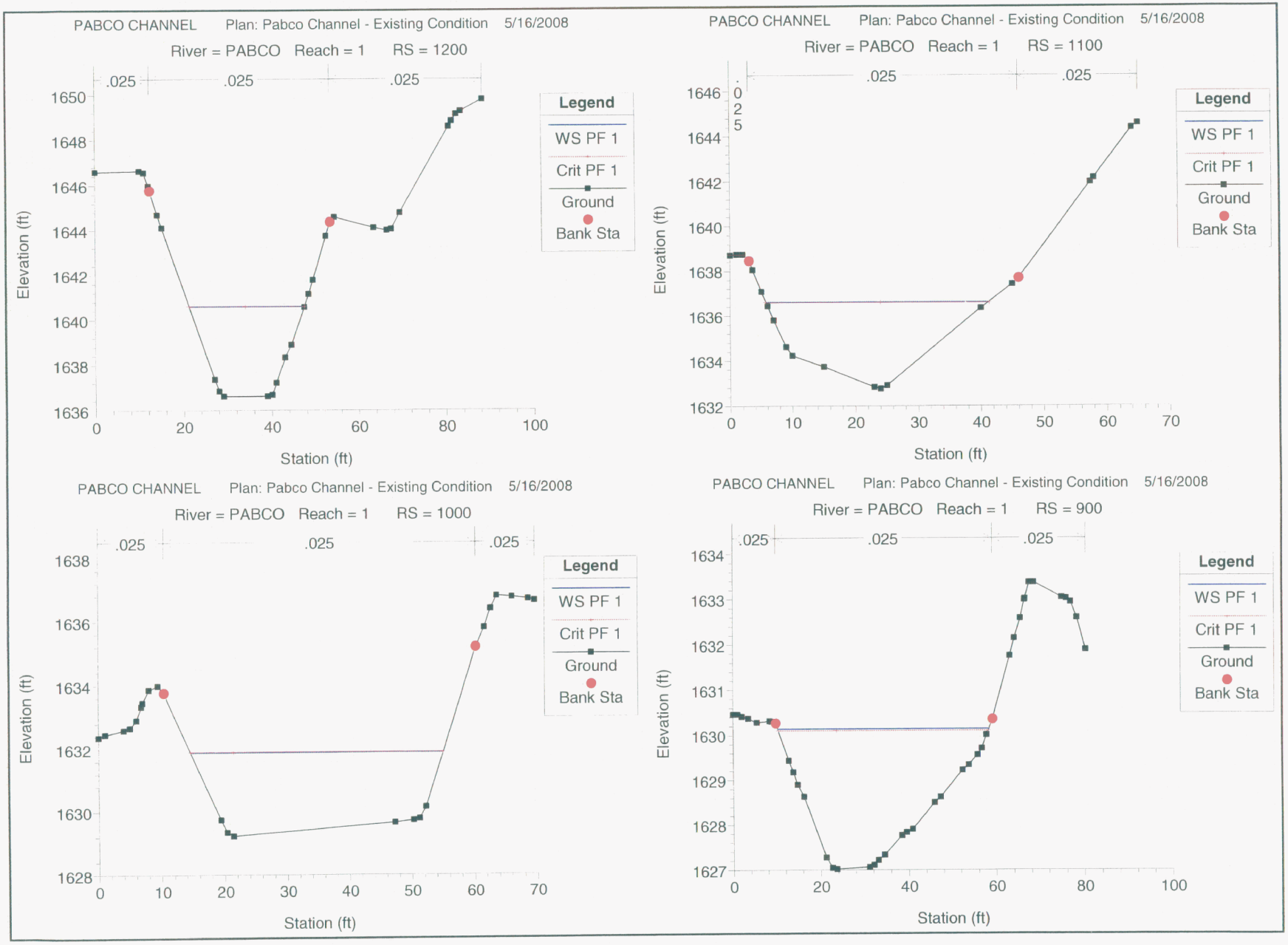

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2450 Culv
.025 .025 .025
Legend
WS PF 1
Crit PF 1
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2450 Culv
.025 .025 .025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2400
.025 .025 .025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2300
.025 .025 .025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

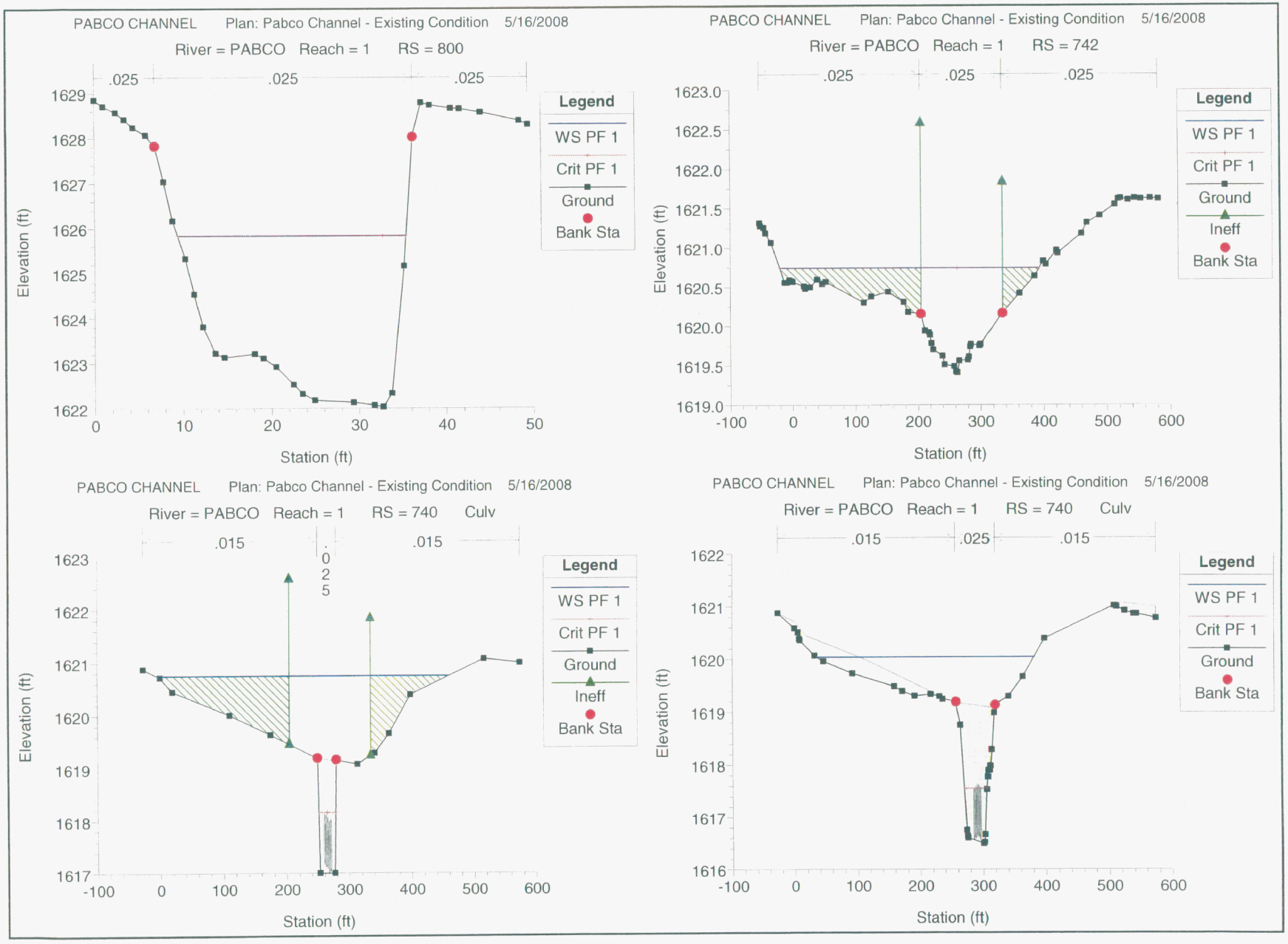

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2200
.025
.025
.025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2100
.025
.025
.025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2000
.025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1950
.025
.025
.025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta

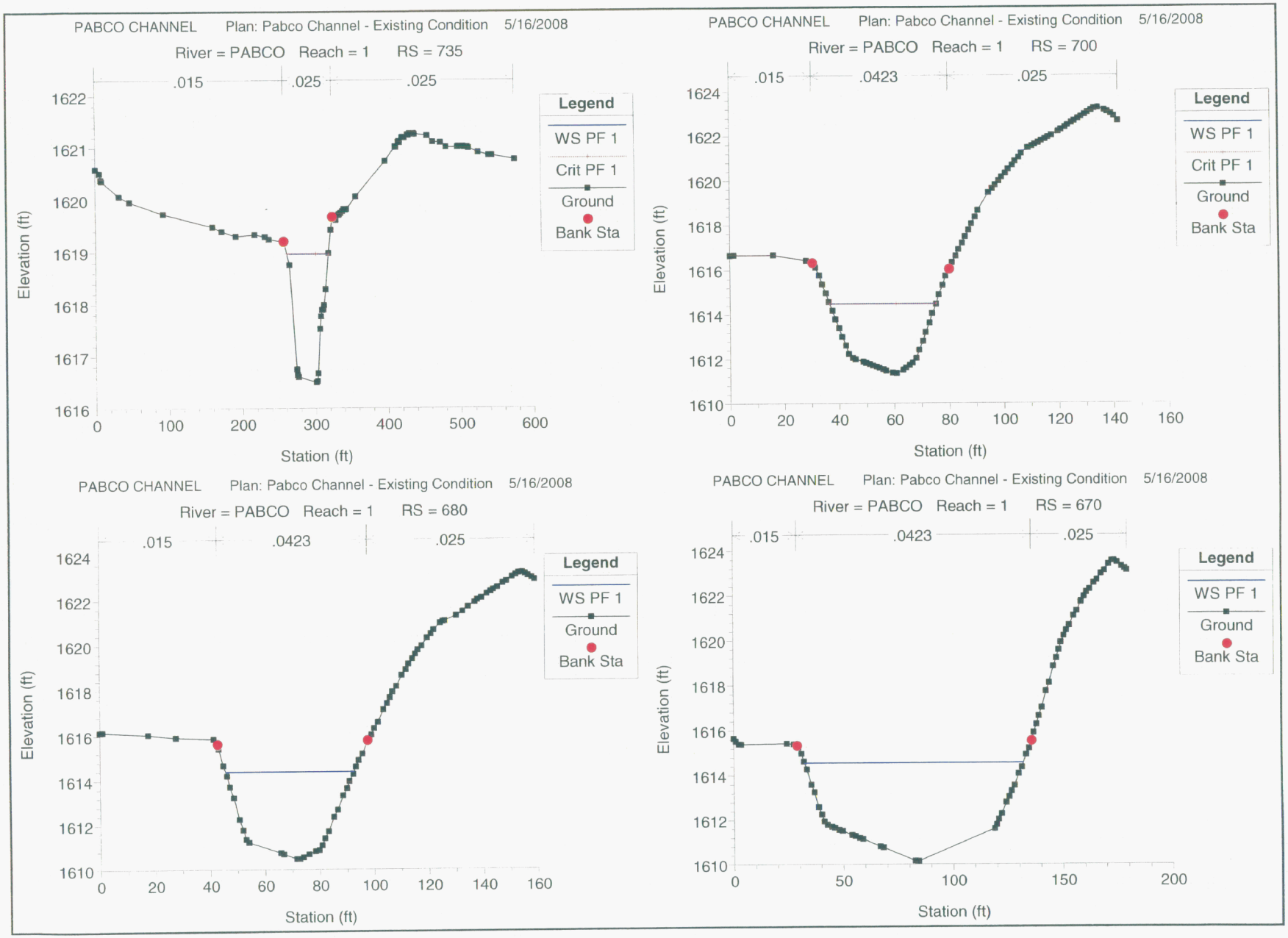

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1900 Culv
.015 .025 .013
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1850
.025 .025 .025
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1800
.025 .025 .025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

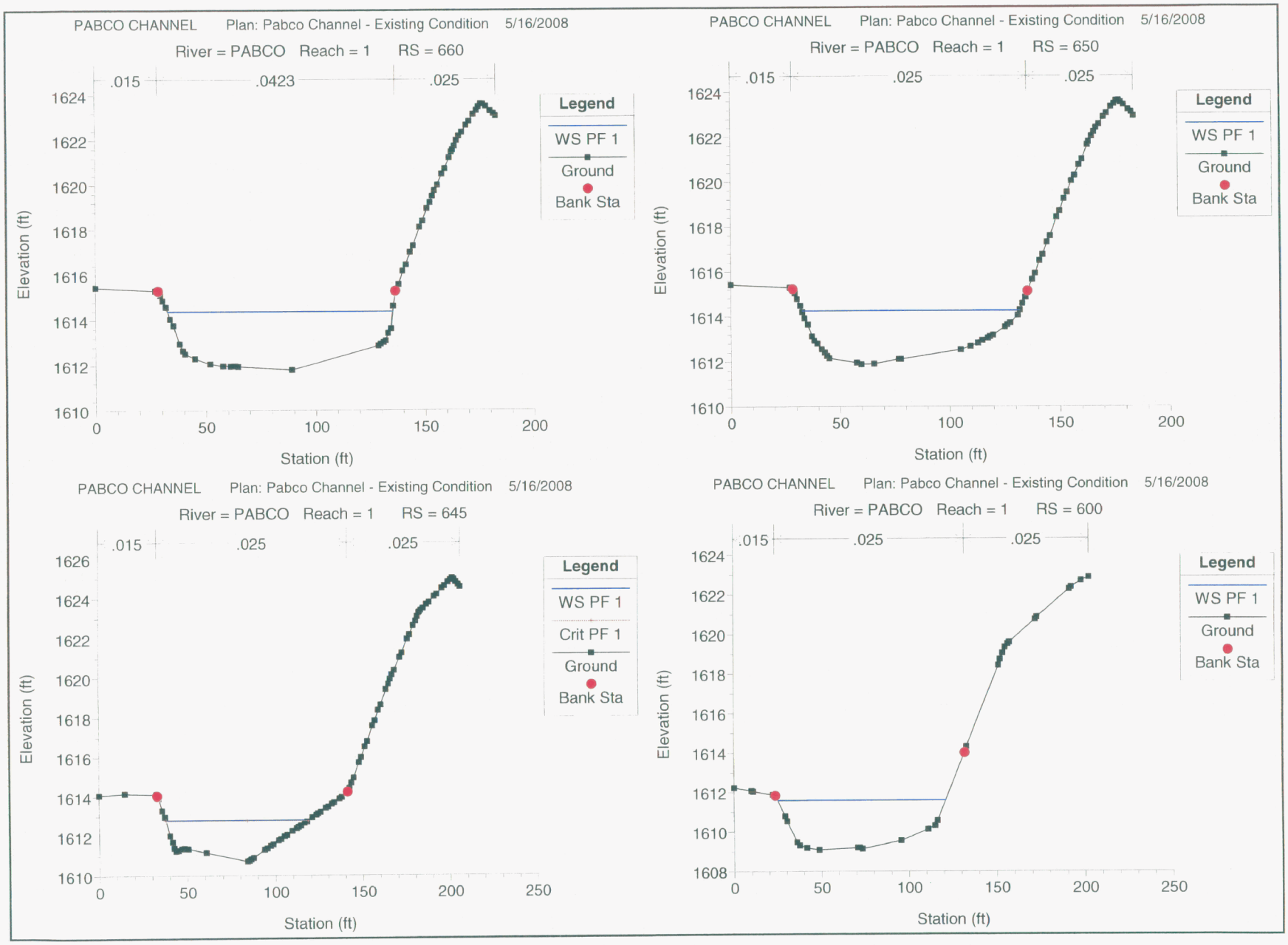

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1750 Culv
.015 .025 .015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1700
.025 .025 .025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1600
.025 .025 .025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1550
.025
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1500
.025
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1400
.025
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1300
.025
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1200
.025
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1100
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 1000
.025
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 900
.025
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 800
.025 .025 .025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 742
.025 .025 .025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 740 Culv
.015 .025 .015
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 740 Culv
.015 .025 .015
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta

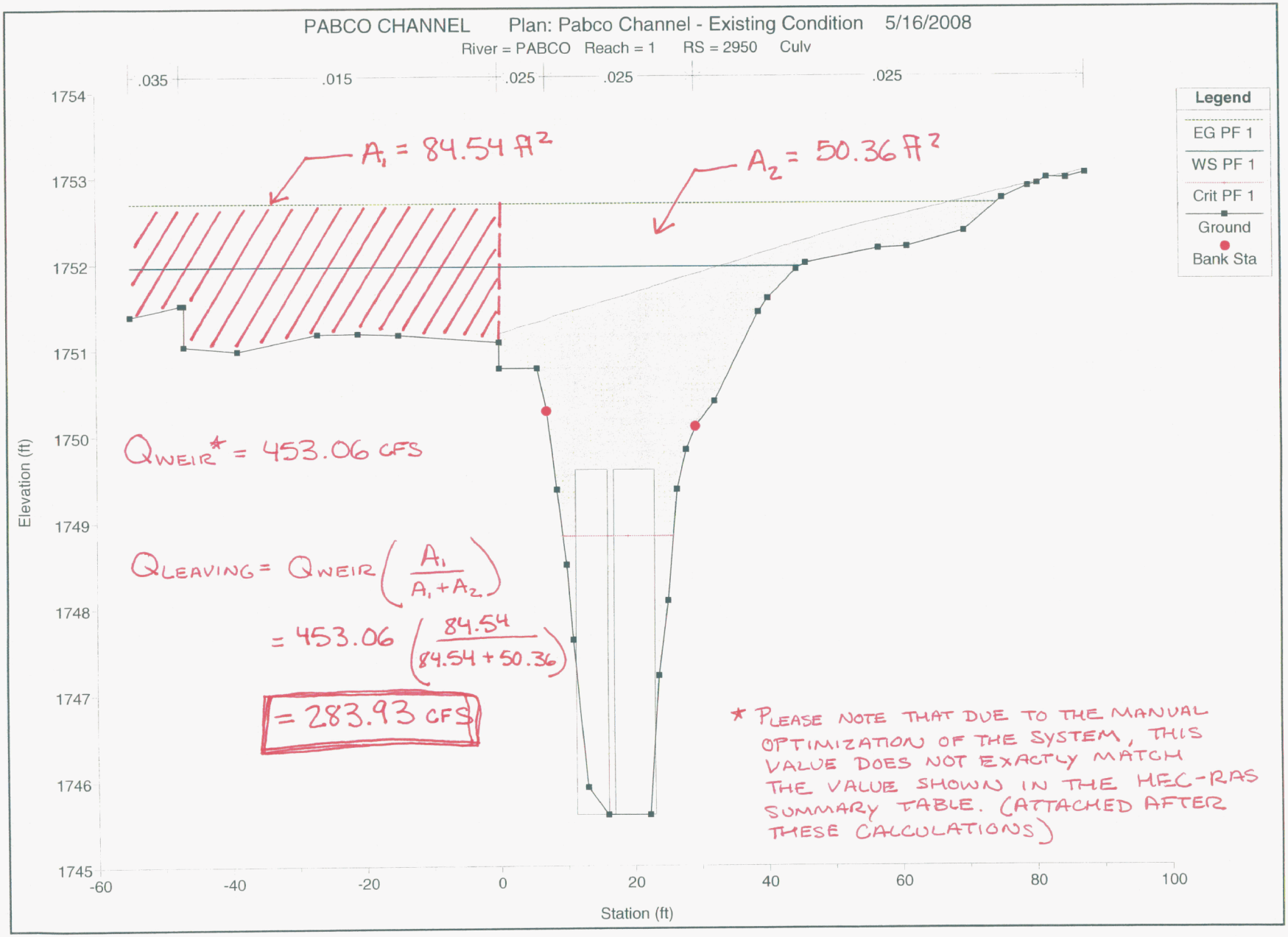

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 735
.015
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 700
.015
.0423
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 680
.015
.0423
.025
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 670
.015
.0423
.025
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 660
.015
.0423
.025
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 650
.015
.025
.025
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 645
.015
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 600
.015
.025
.025
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

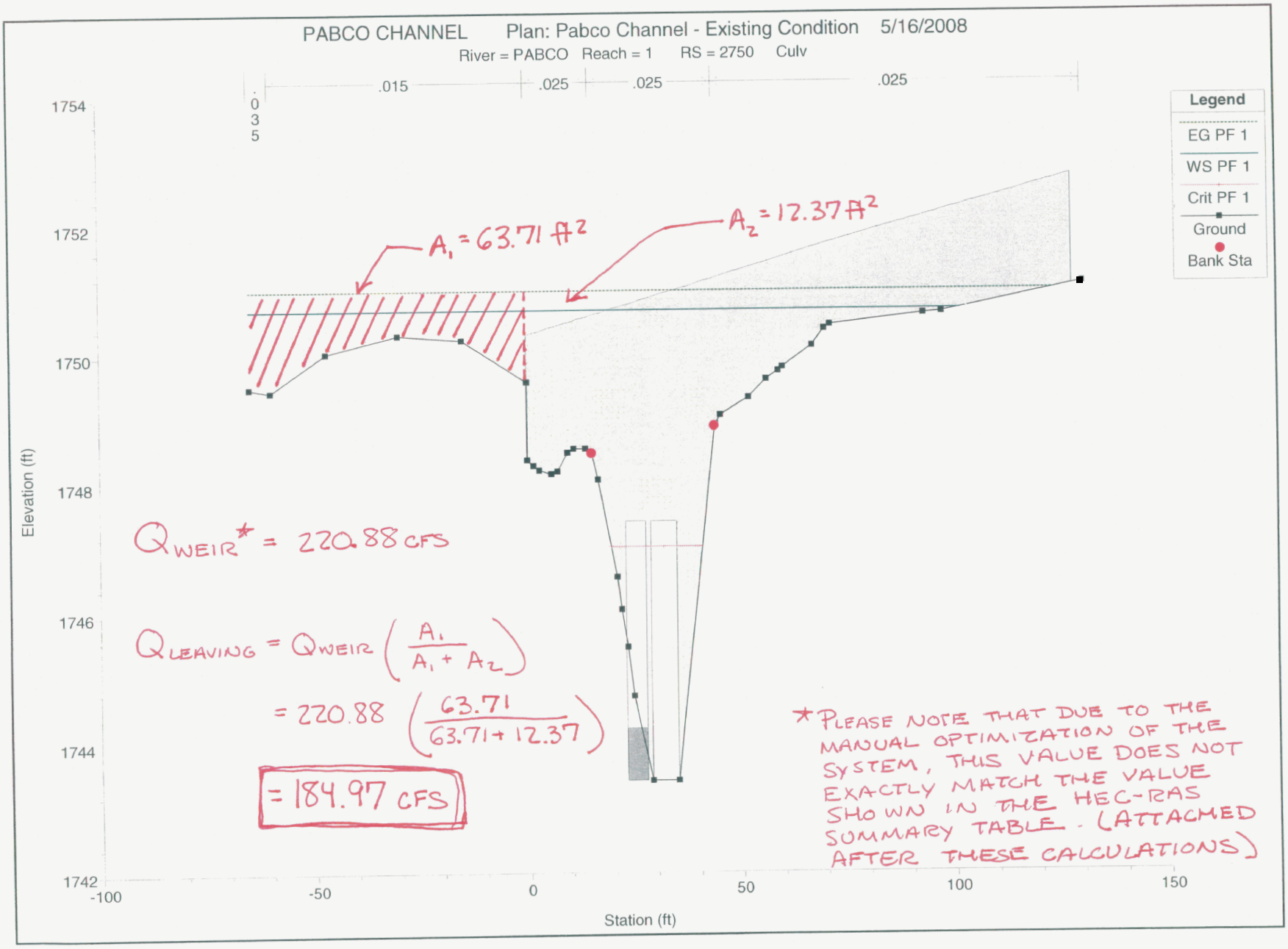
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 500
.015
.025
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 400
.035
.035
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 300
.035
.035
.035
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 200
.035
.035
.035
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 100
.0235
.035
.035
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 75
.035
.035
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 50
.035
.035
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

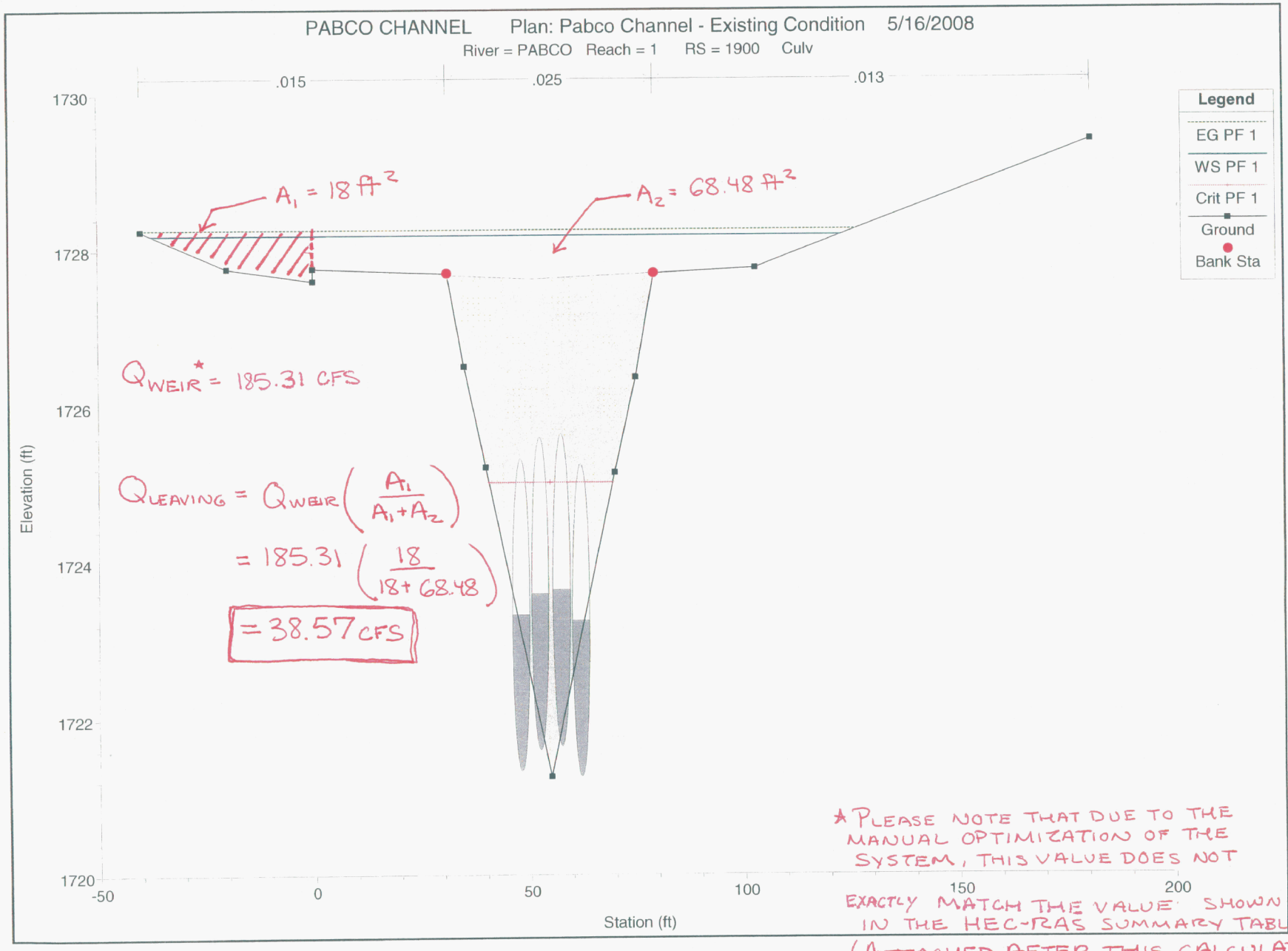
FLOW SPLIT #1


PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2950 Culv
.035
.015
.025
.025
.025
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
$A_1 = 84.54\ ft^2$
$A_2 = 50.36\ ft^2$
$Q_{WEIR}^{*} = 453.06\ CFS$
$Q_{LEAVING} = Q_{WEIR}\left(\frac{A_1}{A_1 + A_2}\right)$
$= 453.06\left(\frac{84.54}{84.54 + 50.36}\right)$
$= 283.93\ CFS$
* PLEASE NOTE THAT DUE TO THE MANUAL OPTIMIZATION OF THE SYSTEM, THIS VALUE DOES NOT EXACTLY MATCH THE VALUE SHOWN IN THE HEC-RAS SUMMARY TABLE. (ATTACHED AFTER THESE CALCULATIONS)
Elevation (ft)
1754
1753
1752
1751
1750
1749
1748
1747
1746
1745
-60
-40
-20
0
20
40
60
80
100
Station (ft)

FLOW SPLIT #2


PABCO CHANNEL Plan: Pabco Channel - Existing Condition 5/16/2008
River = PABCO Reach = 1 RS = 2750 Culv
.015
.025
.025
.025
0
3
5
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
$A_1 = 63.71\ ft^2$
$A_2 = 12.37\ ft^2$
Elevation (ft)
1754
1752
1750
1748
1746
1744
1742
-100
-50
0
50
100
150
Station (ft)
$Q_{WEIR}^{*} = 220.88\ CFS$
$Q_{LEAVING} = Q_{WEIR}\left(\frac{A_1}{A_1 + A_2}\right)$
$= 220.88\left(\frac{63.71}{63.71 + 12.37}\right)$
$= 184.97\ CFS$
*PLEASE NOTE THAT DUE TO THE MANUAL OPTIMIZATION OF THE SYSTEM, THIS VALUE DOES NOT EXACTLY MATCH THE VALUE SHOWN IN THE HEC-RAS SUMMARY TABLE. (ATTACHED AFTER THESE CALCULATIONS)

FLOW SPLIT #3



*PLEASE NOTE THAT DUE TO THE MANUAL OPTIMIZATION OF THE SYSTEM, THIS VALUE DOES NOT EXACTLY MATCH THE VALUE SHOWN IN THE HEC-RAS SUMMARY TABLE. (ATTACHED AFTER THIS CALCULATION)

HEC-RAS Plan: Pabco River: PABCO Reach: 1 Profile: PF 1

Reach	River Sta		Profile	E.G. US. (ft)	W.S. US. (ft)	E.G. IC (ft)	E.G. OC (ft)	Min El Weir Flow (ft)	Q Culv Group (cfs)	Q Weir (cfs)	Delta WS (ft)	Culv Vel US (ft/s)	Culv Vel DS (ft/s)
1	2950	Culvert #1	PF 1	1752.70	1751.97	1751.40	1752.71	1751.00	156.63	457.66	1.16	8.24	8.24
1	2950	Culvert #2	PF 1	1752.70	1751.97	1751.42	1752.69	1751.00	199.00	457.66	1.16	8.29	8.29
1	2750	Culvert #1	PF 1	1751.00	1750.89	1749.91	1751.01	1749.45	126.23	219.97	2.72	8.33	8.33
1	2750	Culvert #2	PF 1	1751.00	1750.89	1750.84	1751.00	1749.45	239.54	219.97	2.72	9.98	9.98
1	2450	Culvert #1	PF 1	1745.50	1745.38	1745.17	1745.50	1745.88	400.97		3.99	10.67	10.89
1	1900	Culvert #1	PF 1	1728.27	1728.19	1727.08	1728.27	1727.62	54.59	182.66	2.33	8.69	8.69
1	1900	Culvert #2	PF 1	1728.27	1728.19	1727.36	1728.27	1727.62	54.58	182.66	2.33	8.69	8.69
1	1900	Culvert #3	PF 1	1728.27	1728.19	1727.41	1728.27	1727.62	54.60	182.66	2.33	8.69	8.69
1	1900	Culvert #4	PF 1	1728.27	1728.19	1727.01	1728.26	1727.62	54.54	182.66	2.33	8.68	8.68
1	1750	Culvert #1	PF 1	1726.02	1725.87	1725.53	1726.02	1726.31	362.07		6.05	10.52	16.92
1	740	Culvert #1	PF 1	1620.65	1620.75	1619.76	1620.65	1619.09	9.17	675.00	1.79	7.78	7.78
1	740	Culvert #2	PF 1	1620.65	1620.75	1619.72	1620.65	1619.09	9.17	675.00	1.79	7.78	7.78
1	740	Culvert #3	PF 1	1620.65	1620.75	1619.68	1620.65	1619.09	9.17	675.00	1.79	7.79	7.79
1	740	Culvert #4	PF 1	1620.65	1620.75	1619.60	1620.65	1619.09	9.17	675.00	1.79	7.78	7.78
1	740	Culvert #5	PF 1	1620.65	1620.75	1619.64	1620.65	1619.09	9.18	675.00	1.79	7.79	7.79

Flow Split #1

Flow Split #2

Flow Split #3

Appendix D-3: Existing Onsite Hydraulic Analysis (Flowmaster Output)

Worksheet for Normal Depth Section-2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04160	ft/ft
Discharge	61.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1611.00
0+02.16	1610.00
0+04.56	1609.00
0+14.63	1608.00
0+59.44	1607.00
0+62.56	1607.00
0+69.72	1608.00
0+82.02	1608.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1611.00)	(0+14.63, 1608.00)	0.035
(0+14.63, 1608.00)	(0+62.56, 1607.00)	0.016
(0+62.56, 1607.00)	(0+82.02, 1608.00)	0.035

Results

Normal Depth	0.53	ft
Elevation Range	1607.00 to 1611.00 ft	
Flow Area	8.90	ft²
Wetted Perimeter	30.62	ft
Top Width	30.58	ft
Normal Depth	0.53	ft
Critical Depth	0.75	ft
Critical Slope	0.00745	ft/ft

Worksheet for Normal Depth Section-2

Results

Velocity		6.85	ft/s
Velocity Head		0.73	ft
Specific Energy		1.26	ft
Froude Number		2.24	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.53	ft
Critical Depth	0.75	ft
Channel Slope	0.04160	ft/ft
Critical Slope	0.00745	ft/ft

Cross Section for Normal Depth Section-2

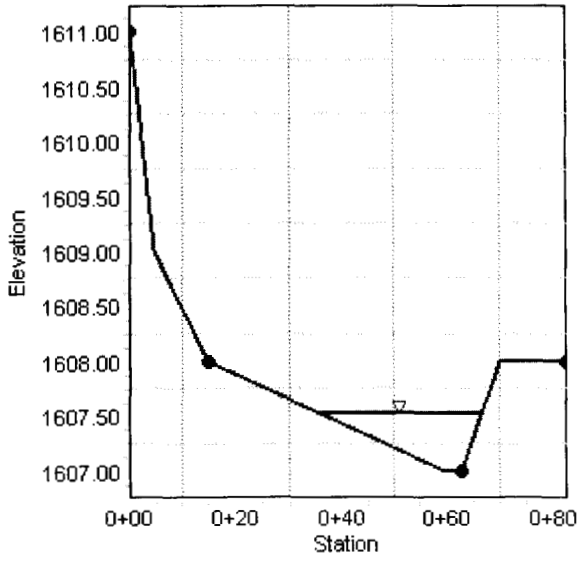
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04160	ft/ft
Normal Depth	0.53	ft
Discharge	61.00	ft^3/s

Cross Section Image



Worksheet for Normal Depth Section-3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02520	ft/ft
Discharge	61.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1609.00
0+23.55	1608.00
0+44.93	1607.00
0+57.37	1606.00
0+69.39	1605.00
0+99.17	1605.00
1+04.49	1606.00
1+09.45	1607.00
1+20.99	1608.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1609.00)	(0+69.39, 1605.00)	0.035
(0+69.39, 1605.00)	(0+99.17, 1605.00)	0.016
(0+99.17, 1605.00)	(1+20.99, 1608.00)	0.035

Results

Normal Depth	0.35	ft
Elevation Range	1605.00 to 1609.00 ft	
Flow Area	11.38	ft^2
Wetted Perimeter	35.85	ft
Top Width	35.80	ft
Normal Depth	0.35	ft
Critical Depth	0.48	ft

Worksheet for Normal Depth Section-3

Results

Critical Slope		0.00813	ft/ft
Velocity		5.36	ft/s
Velocity Head		0.45	ft
Specific Energy		0.79	ft
Froude Number		1.68	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.48	ft
Channel Slope	0.02520	ft/ft
Critical Slope	0.00813	ft/ft

Cross Section for Normal Depth Section-3

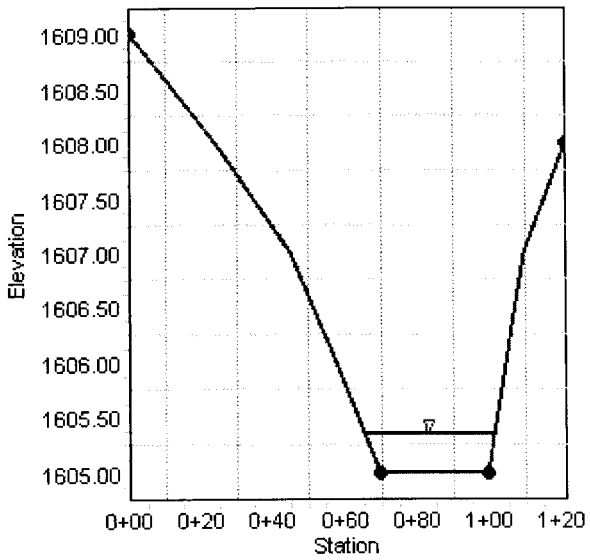
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02520	ft/ft
Normal Depth	0.35	ft
Discharge	61.00	ft^3/s

Cross Section Image



Worksheet for Normal Depth Section-4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01600	ft/ft
Discharge	16.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1608.00
0+19.94	1607.00
0+29.54	1606.00
0+42.10	1606.00
0+45.79	1607.00
0+54.48	1608.00
0+74.67	1608.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1608.00)	(0+74.67, 1608.00)	0.035

Results

Normal Depth		0.40	ft
Elevation Range	1606.00 to 1608.00 ft		
Flow Area		6.11	ft²
Wetted Perimeter		17.97	ft
Top Width		17.90	ft
Normal Depth		0.40	ft
Critical Depth		0.35	ft
Critical Slope		0.02680	ft/ft
Velocity		2.62	ft/s
Velocity Head		0.11	ft
Specific Energy		0.51	ft

Worksheet for Normal Depth Section-4

Results

Froude Number	0.79	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.40	ft
Critical Depth	0.35	ft
Channel Slope	0.01600	ft/ft
Critical Slope	0.02680	ft/ft

Cross Section for Normal Depth Section-4

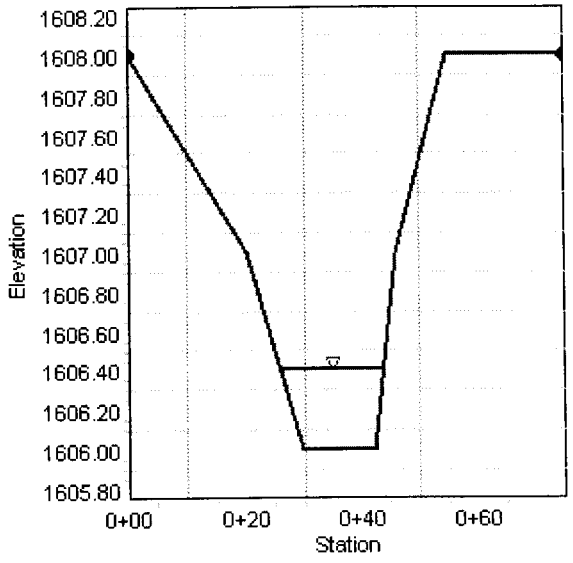
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01600	ft/ft
Normal Depth	0.40	ft
Discharge	16.00	ft³/s

Cross Section Image



Worksheet for Normal Depth Section-5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03200	ft/ft
Discharge	10.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1600.00
0+02.20	1599.00
0+49.26	1598.00
0+67.56	1597.00
0+84.08	1596.00
1+00.03	1595.00
1+14.75	1595.00
1+34.60	1596.00
1+57.00	1597.00
1+72.87	1598.00
1+86.45	1599.00
1+96.75	1601.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1600.00)	(1+96.75, 1601.00)	0.035

Results

Normal Depth		0.22	ft
Elevation Range	1595.00 to 1601.00 ft		
Flow Area		4.10	ft^2
Wetted Perimeter		22.60	ft
Top Width		22.59	ft
Normal Depth		0.22	ft

Worksheet for Normal Depth Section-5

Results

Critical Depth		0.22	ft
Critical Slope		0.03150	ft/ft
Velocity		2.44	ft/s
Velocity Head		0.09	ft
Specific Energy		0.31	ft
Froude Number		1.01	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.22	ft
Critical Depth		0.22	ft
Channel Slope		0.03200	ft/ft
Critical Slope		0.03150	ft/ft

Cross Section for Normal Depth Section-5

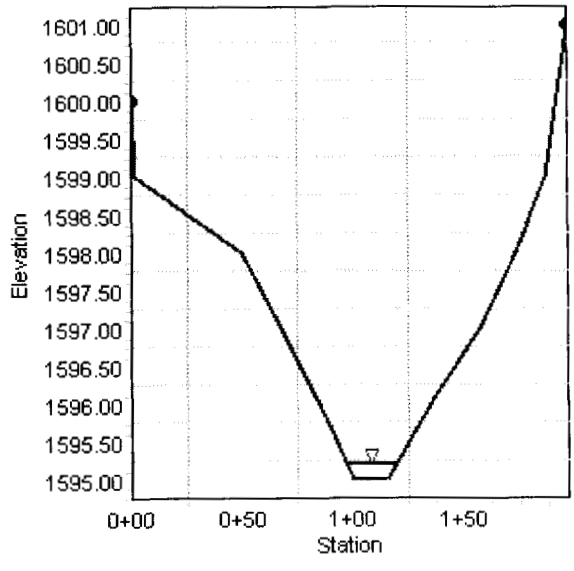
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03200	ft/ft
Normal Depth	0.22	ft
Discharge	10.00	ft³/s

Cross Section Image



Worksheet for Normal Depth Section-6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00760	ft/ft
Discharge	16.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1601.00
0+38.23	1600.00
0+44.33	1599.00
0+47.78	1598.00
0+51.44	1597.00
0+56.72	1596.00
0+62.21	1596.00
0+64.24	1597.00
0+65.86	1598.00
1+35.61	1599.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1601.00)	(1+35.61, 1599.00)	0.035

Results

Normal Depth	0.77	ft
Elevation Range	1596.00 to 1601.00 ft	
Flow Area	6.36	ft²
Wetted Perimeter	11.35	ft
Top Width	11.10	ft
Normal Depth	0.77	ft
Critical Depth	0.56	ft
Critical Slope	0.02403	ft/ft

Worksheet for Normal Depth Section-6

Results

Velocity		2.52	ft/s
Velocity Head		0.10	ft
Specific Energy		0.87	ft
Froude Number		0.59	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.77	ft
Critical Depth	0.56	ft
Channel Slope	0.00760	ft/ft
Critical Slope	0.02403	ft/ft

Cross Section for Normal Depth Section-6

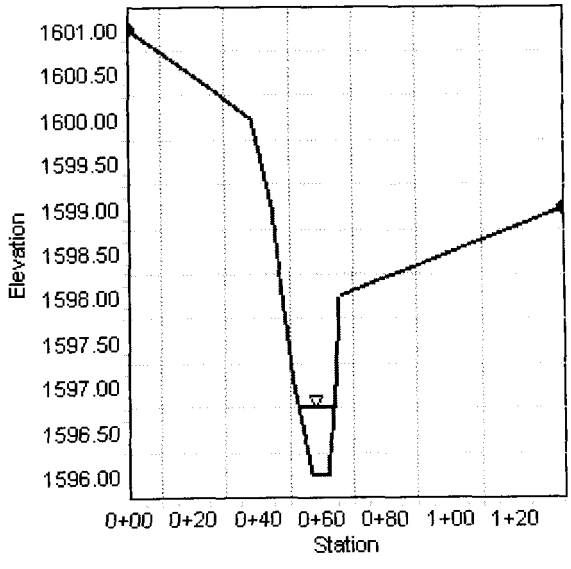
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00760	ft/ft
Normal Depth	0.77	ft
Discharge	16.00	ft^3/s

Cross Section Image



Worksheet for Normal Depth Section-7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00733	ft/ft
Discharge	61.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1605.00
0+28.79	1604.00
0+43.97	1603.00
0+65.68	1603.00
0+78.30	1604.00
0+87.39	1605.00
0+97.50	1606.00
1+10.12	1607.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1605.00)	(1+10.12, 1607.00)	0.035

Results

Normal Depth		0.76	ft
Elevation Range	1603.00 to 1607.00 ft		
Flow Area		24.41	ft²
Wetted Perimeter		42.81	ft
Top Width		42.76	ft
Normal Depth		0.76	ft
Critical Depth		0.55	ft
Critical Slope		0.02353	ft/ft
Velocity		2.50	ft/s
Velocity Head		0.10	ft

Worksheet for Normal Depth Section-7

Results

Specific Energy		0.85	ft
Froude Number		0.58	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.76	ft
Critical Depth	0.55	ft
Channel Slope	0.00733	ft/ft
Critical Slope	0.02353	ft/ft

Cross Section for Normal Depth Section-7

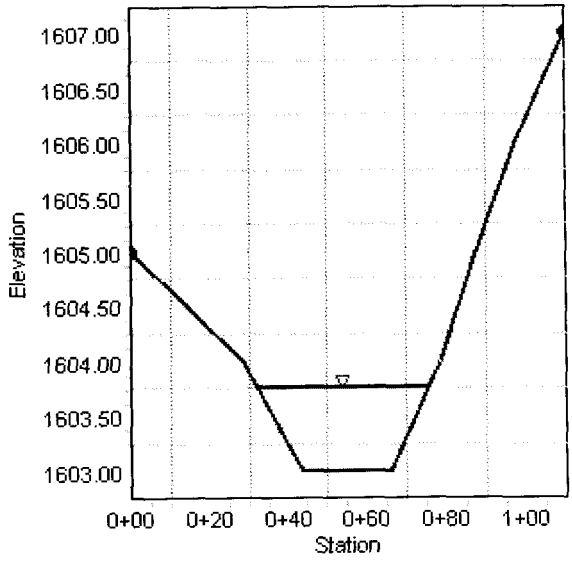
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00733	ft/ft
Normal Depth	0.76	ft
Discharge	61.00	ft³/s

Cross Section Image



Worksheet for Normal Depth Section-8

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00580	ft/ft
Discharge	34.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1590.00
0+53.50	1589.00
1+03.02	1589.00
1+67.03	1590.00
1+74.46	1591.00
1+79.52	1592.00
1+86.00	1593.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1590.00)	(1+86.00, 1593.00)	0.035

Results

Normal Depth		0.35	ft
Elevation Range	1589.00 to 1593.00 ft		
Flow Area		24.95	ft²
Wetted Perimeter		91.20	ft
Top Width		91.20	ft
Normal Depth		0.35	ft
Critical Depth		0.22	ft
Critical Slope		0.03137	ft/ft
Velocity		1.36	ft/s
Velocity Head		0.03	ft
Specific Energy		0.38	ft

Worksheet for Normal Depth Section-8

Results

Froude Number	0.46	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.22	ft
Channel Slope	0.00580	ft/ft
Critical Slope	0.03137	ft/ft

Cross Section for Normal Depth Section-8

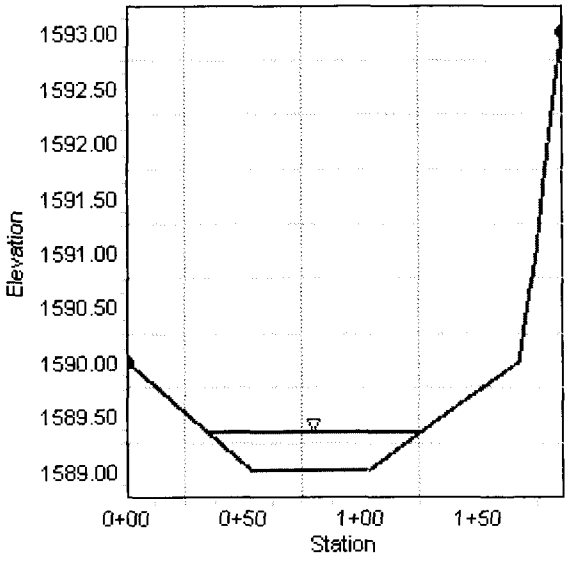
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00580	ft/ft
Normal Depth	0.35	ft
Discharge	34.00	ft^3/s

Cross Section Image



Worksheet for Normal Depth Section-9

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00670	ft/ft
Discharge	99.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1606.00
0+18.12	1605.00
0+35.07	1605.00
0+54.36	1606.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1606.00)	(0+18.12, 1605.00)	0.035
(0+18.12, 1605.00)	(0+35.07, 1605.00)	0.016
(0+35.07, 1605.00)	(0+54.36, 1606.00)	0.035

Results

Normal Depth		0.96	ft
Elevation Range	1605.00 to 1606.00 ft		
Flow Area		33.41	ft²
Wetted Perimeter		52.84	ft
Top Width		52.79	ft
Normal Depth		0.96	ft
Critical Depth		0.77	ft
Critical Slope		0.01652	ft/ft
Velocity		2.96	ft/s
Velocity Head		0.14	ft
Specific Energy		1.09	ft
Froude Number		0.66	

Worksheet for Normal Depth Section-9

Results

Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.96	ft
Critical Depth	0.77	ft
Channel Slope	0.00670	ft/ft
Critical Slope	0.01652	ft/ft

Cross Section for Normal Depth Section-9

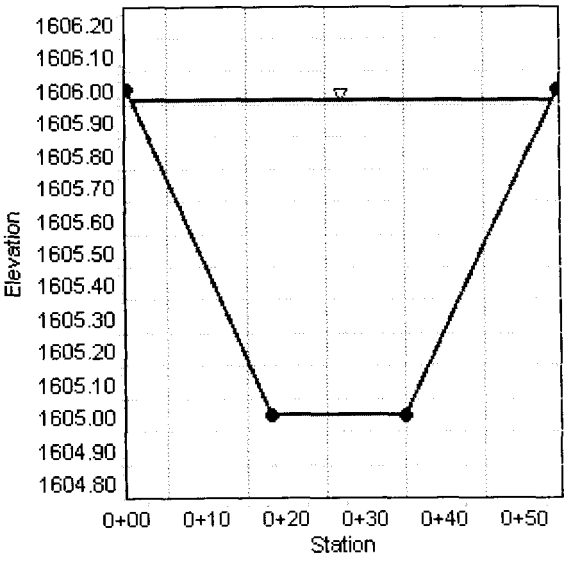
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00670	ft/ft
Normal Depth	0.96	ft
Discharge	99.00	ft^3/s

Cross Section Image



Worksheet for Normal Depth Section-10

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00670	ft/ft
Discharge	99.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1604.00
0+17.33	1603.00
0+52.03	1603.00
0+73.24	1603.00
1+10.70	1604.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1604.00)	(1+10.70, 1604.00)	0.035

Results

Normal Depth		0.62	ft
Elevation Range	1603.00 to 1604.00 ft		
Flow Area		45.10	ft^2
Wetted Perimeter		89.85	ft
Top Width		89.82	ft
Normal Depth		0.62	ft
Critical Depth		0.43	ft
Critical Slope		0.02500	ft/ft
Velocity		2.19	ft/s
Velocity Head		0.07	ft
Specific Energy		0.69	ft
Froude Number		0.55	
Flow Type	Subcritical		

Worksheet for Normal Depth Section-10

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.43	ft
Channel Slope	0.00670	ft/ft
Critical Slope	0.02500	ft/ft

Cross Section for Normal Depth Section-10

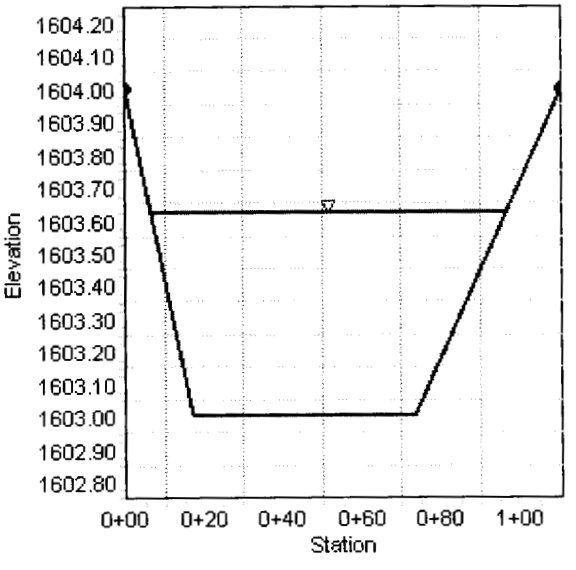
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00670	ft/ft
Normal Depth	0.62	ft
Discharge	99.00	ft³/s

Cross Section Image



Worksheet for Normal Depth Section-11

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01580	ft/ft
Discharge	99.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1595.00
0+15.53	1595.00
0+65.53	1594.20
0+70.13	1595.00
0+70.98	1596.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1595.00)	(0+70.98, 1596.00)	0.035

Results

Normal Depth		0.94	ft
Elevation Range	1594.20 to 1596.00 ft		
Flow Area		31.65	ft²
Wetted Perimeter		70.53	ft
Top Width		70.25	ft
Normal Depth		0.94	ft
Critical Depth		0.88	ft
Critical Slope		0.02441	ft/ft
Velocity		3.13	ft/s
Velocity Head		0.15	ft
Specific Energy		1.09	ft
Froude Number		0.82	
Flow Type	Subcritical		

Worksheet for Normal Depth Section-11

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.94	ft
Critical Depth	0.88	ft
Channel Slope	0.01580	ft/ft
Critical Slope	0.02441	ft/ft

Cross Section for Normal Depth Section-11

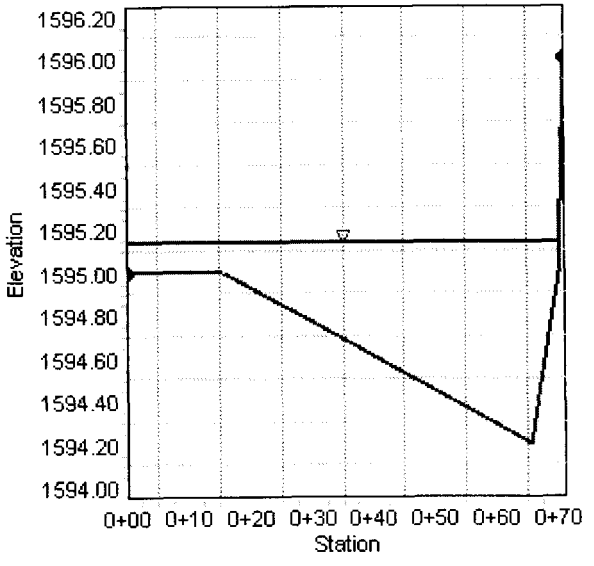
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01580	ft/ft
Normal Depth	0.94	ft
Discharge	99.00	ft^3/s

Cross Section Image



Appendix D-4: Riprap Roughness Value Calculation

Riprap Roughness Value Calculation

Roughness Coefficient of Riprap was determined based Clark County Regional Flood Control District, Hydrologic Criteria and Drainage Manual, August 1999.

For the Grouted Riprap n = 0.025 was utilized.

For the Loose Riprap, the following formula (equation 732 of design manual) was used,

$n = 0.0395\ (d_{50})^{1/6}$

Where: d_{50} = Mean stone size, in ft.

For the loose riprap at the WRF Re-aligned Channel $\mathbf{d_{50} = 6"}$ (Reference: WRF Channel Improvements Plans Issued for Construction)

$\mathbf{n} = 0.0395(0.5)^{1/6}$

n = 0.035

For the Loose Riprap downstream of the WRF Re-aligned Channel, $\mathbf{d_{50} = 9"}$ (Reference: Update #2 to the Technical Drainage Study for the City of Henderson, WRF Expansion)

$\mathbf{n} = 0.0395(0.75)^{1/6}$

n = 0.0376

For the Loose Riprap at Pabco Channel, $\mathbf{d_{50} = 18"}$

Therefore $n = 0.0395(1.5)^{1/6}$

n = 0.0423

Appendix E: Reference Materials

Appendix E-1: Reference from Approved CLOMR for C1-Channel/Lake Mead Channel Improvements (PBS&J, 2006)

Federal Emergency Management Agency

Washington, D.C. 20472

DEC 21 2006

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 06-09-B306R

The Honorable James B. Gibson
Mayor, City of Henderson
240 Water Street, Fourth Floor
Henderson, NV 89009-5050

Community: City of Henderson, NV
Community No.: 320005

104

Dear Mayor Gibson:

This responds to a request that the Department of Homeland Security's Federal Emergency Management Agency (FEMA) comment on the effects that a proposed project would have on the effective Flood Insurance Rate Map (FIRM) for Clark County, Nevada and Incorporated Areas (the effective FIRM for your community), in accordance with Part 65 of the National Flood Insurance Program (NFIP) regulations. In a letter dated January 31, 2006, Padinare Unnikrishna, Ph.D., P.E., CFM, Drainage Project Manager, PBS&J, requested that FEMA evaluate the effects that updated topographic information and a proposed project would have on the flood hazard information shown on the effective FIRM. The proposed projecte includes grading along an unnamed tributary to Las Vegas Wash from approximately 600 feet upstream of the confluence with Las Vegas Wash to just downstream of Tuna Avenue and proposed channelization, existing and proposed culverts, and a proposed storm drain along an unnamed tributary to C-1 Channel from just upstream of the confluence with C-1 Channel to approximately 1,200 feet upstream of Country Club Drive

All data required to complete our review of this request for a Conditional Letter of Map Revision (CLOMR) were submitted with letters from Dr. Unnikrishna.

Because this revision request also affects the unincorporated areas of Clark County, a separate CLOMR for that community was issued on the same date as this CLOMR.

We reviewed the submitted data and the data used to prepare the effective FIRM for your community and determined that the proposed project meets the minimum floodplain management criteria of the NFIP. The submitted existing conditions HEC-RAS hydraulic computer model, prepared by PBS&J, dated October 6, 2006, based on updated topographic information, was used as the base conditions model in our review of the proposed conditions model for this CLOMR request. We believe that, if the proposed project is constructed as shown on the plans entitled "C-1 Channel – Lake Mead Channel Improvements," dated September 16, 2005, and "Proposed Condition Floodplain Workmap," dated January 2006, and as described in the submitted report entitled "Request for Conditional Letter of Map Revision for C-1 Channel – Lake Mead Channel Improvements," dated January 2006, all prepared by PBS&J, and the data listed below are received, a revision to the FIRM would be warranted.

Unnamed Tributary to Las Vegas Wash

As a result of the proposed grading, the water-surface elevations (WSELs) associated with the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) will increase in some areas and decrease in other areas compared to the existing conditions base flood WSELs along the unnamed

tributary to Las Vegas Wash, from approximately 600 feet upstream to approximately 6,700 upstream of the confluence with Las Vegas Wash and from approximately 1,100 feet downstream to just downstream of North Boulder Highway. The maximum increase in base flood WSEL, 0.4 foot, will occur approximately 200 feet downstream of North Boulder Highway. The maximum decrease in base flood WSEL, 2.4 feet, will occur approximately 6,500 feet upstream of the confluence with Las Vegas Wash.

As a result of the proposed grading and updated topographic information, the width of the Special Flood Hazard Area (SFHA), the area that would be inundated by the base flood, will decrease compared to the effective SFHA width along the unnamed tributary to Las Vegas Wash from approximately 600 feet upstream to approximately 6,300 feet upstream of the confluence with Las Vegas Wash and from approximately 1,300 feet downstream of North Boulder Highway to just downstream of Tuna Avenue. The maximum decrease in SFHA width, approximately 4,800 feet, will occur approximately 6,300 feet upstream of the confluence with Las Vegas Wash. The base flood will be contained in the Pabco Road right-of-way from approximately 400 feet upstream of Dutchman Avenue to just downstream of Sellers Place. An area that had been designated Zone A, an SFHA with no Base Flood Elevations determined, will be redesignated Zone X, an area outside the SFHA with average flood depths less than 1 foot. This area is located along the unnamed tributary to Las Vegas Wash from approximately 600 feet upstream to approximately 6,300 feet upstream of the confluence with Las Vegas Wash and from approximately 1,300 feet downstream of North Boulder Highway to just downstream of Tuna Avenue.

Unnamed Tributary to C-1 Channel

As a result of the proposed project, the effective SFHA along the unnamed tributary to C-1 Channel from approximately 3,700 feet downstream of Warm Springs Road to approximately 1,200 feet upstream of Country Club Drive and from just upstream to approximately 3,300 feet upstream of the confluence with C-1 Channel will be removed. The maximum decrease in SFHA width, approximately 400 feet, will occur approximately 2,500 feet downstream of Warm Springs Road. The entire base flood will be contained in the proposed channel, proposed culverts, and proposed storm drain along the unnamed tributary to C-1 Channel from just upstream of the confluence with C-1 Channel to approximately 1,200 feet upstream of Country Club Drive.

Upon completion of the project, your community may submit the data listed below and request that we make a final determination on revising the effective FIRM.

- Detailed application and certification forms must be used for requesting final revisions to the maps. Therefore, when the map revision request for the area covered by this letter is submitted, Form 1, entitled "Overview & Concurrence Form," must be included. (A copy of this form is enclosed.)

- The detailed application and certification forms listed below may be required if as-built conditions differ from the preliminary plans. If required, please submit new forms (copies of which are enclosed) or annotated copies of the previously submitted forms showing the revised information.

  Form 2, entitled "Riverine Hydrology & Hydraulics Form"

  Form 3, entitled "Riverine Structures Form"

  Hydraulic analyses of the base flood under as-built conditions, together with a topographic work map showing the revised floodplain boundaries, must be submitted with Form 2.

- Effective October 30, 2005, FEMA revised the fee schedule for reviewing and processing requests for conditional and final modifications to published flood information and maps. In accordance with this schedule, the current fee for this map revision request is $4,000 and must be received before we can begin processing the request. Please note, however, that the fee schedule is subject to change, and requesters are required to submit the fee in effect at the time of the submittal. Payment of this fee shall be made in the form of a check or money order, made payable in U.S. funds to the National Flood Insurance Program, or by credit card. The payment must be forwarded to the following address:

  Federal Emergency Management Agency
  Fee-Charge System Administrator
  P.O. Box 22787
  Alexandria, VA 22304

- As-built plans, certified by a registered professional engineer, of all proposed project elements

- Community acknowledgment of the map revision request

After receiving appropriate documentation to show that the project has been completed, FEMA will initiate a revision to the FIRM.

The basis of this CLOMR is, in whole or in part, a channel-modification/culvert project. NFIP regulations, as cited in Paragraph 60.3(b)(7), require that communities assure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management regulations. Consequently, the ultimate responsibility for maintenance of the modified channel and culverts rests with your community.

This CLOMR is based on minimum floodplain management criteria established under the NFIP. Your community is responsible for approving all floodplain development and for ensuring all necessary permits required by Federal or State law have been received. State, county, and community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction in the SFHA. If the State, county, or community has adopted more restrictive or comprehensive floodplain management criteria, these criteria take precedence over the minimum NFIP criteria.

If you have any questions regarding floodplain management regulations for your community or the NFIP in general, please contact the Consultation Coordination Officer (CCO) for your community. Information on the CCO for your community may be obtained by calling the Director, Federal Insurance and Mitigation Division of FEMA in Oakland, California, at (510) 627-7175. If you have any questions regarding this CLOMR, please call our Map Assistance Center, toll free, at 1-877-FEMA MAP (1-877-336-2627).

Sincerely,

Kevin C Long

Kevin C. Long, CFM, Project Engineer
Engineering Management Section
Mitigation Division

For: William R. Blanton Jr., CFM, Chief
Engineering Management Section
Mitigation Division

Enclosures

cc: The Honorable Rory Reid
Chair, Clark County Board
of Commissioners

Mr. Curt Chandler, P.E., CFM
Land Development Manager
City of Henderson

Mr. W. Layne Weber, P.E., CFM
Principal Engineer
Civil Engineering Division
Development Services
Clark County

Mr. Kevin Eubanks, P.E., CFM
Assistant General Manager
Clark County Regional Flood Control District

Padinare Unnikrishna, Ph.D., P.E., CFM
Drainage Project Manager
PBS&J

Federal Emergency Management Agency

Washington, D.C. 20472

DEC 21 2006

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 06-09-B306R

The Honorable Rory Reid
Chair, Clark County Board
of Commissioners
500 South Grand Central Parkway
Las Vegas, NV 89106

Community: Clark County, NV
Community No.: 320003

104

Dear Mr. Reid:

This responds to a request that the Department of Homeland Security's Federal Emergency Management Agency (FEMA) comment on the effects that a proposed project would have on the effective Flood Insurance Rate Map (FIRM) for Clark County, Nevada and Incorporated Areas, in accordance with Part 65 of the National Flood Insurance Program (NFIP) regulations. In a letter dated January 31, 2006, Padinare Unnikrishna, Ph.D., P.E., CFM, Drainage Project Manager, PBS&J, requested that FEMA evaluate the effects that updated topographic information and a proposed project would have on the flood hazard information shown on the effective FIRM. The proposed project includes grading along an unnamed tributary to Las Vegas Wash from approximately 600 feet upstream of the confluence with Las Vegas Wash to just downstream of Tuna Avenue and proposed channelization, existing and proposed culverts, and a proposed storm drain along an unnamed tributary to C-1 Channel from just upstream of the confluence with C-1 Channel to approximately 1,200 feet upstream of Country Club Drive.

All data required to complete our review of this request for a Conditional Letter of Map Revision (CLOMR) were submitted with letters from Dr. Unnikrishna.

Because this revision request also affects the City of Henderson, a separate CLOMR for that community was issued on the same date as this CLOMR.

We reviewed the submitted data and the data used to prepare the effective FIRM for your community and determined that the proposed project meets the minimum floodplain management criteria of the NFIP. The submitted existing conditions HEC-RAS hydraulic computer model, prepared by PBS&J, dated October 6, 2006, based on updated topographic information, was used as the base conditions model in our review of the proposed conditions model for this CLOMR request. We believe that, if the proposed project is constructed as shown on the plans entitled "C-1 Channel – Lake Mead Channel Improvements," dated September 16, 2005, and "Proposed Condition Floodplain Workmap," dated January 2006, and as described in the submitted report entitled "Request for Conditional Letter of Map Revision for C-1 Channel – Lake Mead Channel Improvements," dated January 2006, all prepared by PBS&J, and the data listed below are received, a revision to the FIRM would be warranted.

Unnamed Tributary to Las Vegas Wash

As a result of the proposed grading, the water-surface elevations (WSELs) associated with the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) will increase compared to the existing conditions base flood WSELs along the unnamed tributary to Las Vegas Wash from

approximately 7,800 feet downstream to approximately 1,000 feet downstream of North Boulder Highway. The maximum increase in base flood WSEL, 0.9 foot, will occur approximately 1,100 feet downstream of North Boulder Highway.

As a result of the proposed grading and updated topographic information, the width of the Special Flood Hazard Area (SFHA), the area that would be inundated by the base flood, will decrease compared to the effective SFHA width along the unnamed tributary to Las Vegas Wash from approximately 6,300 feet upstream of the confluence with Las Vegas Wash to approximately 1,300 feet downstream of North Boulder Highway. The maximum decrease in SFHA width, approximately 9,100 feet, will occur approximately 7,800 feet upstream of the confluence with Las Vegas Wash. The base flood will be contained in the Pabco Road right-of-way from approximately 400 feet upstream of Dutchman Avenue to just downstream of Sellers Place. An area that had been designated Zone A, an SFHA with no Base Flood Elevations determined, will be redesignated as Zone X, an area outside the SFHA with average flood depths less than 1 foot. This area is located along the unnamed tributary to Las Vegas Wash from approximately 6,300 feet upstream of the confluence with Las Vegas Wash to approximately 1,300 feet downstream of North Boulder Highway.

Unnamed Tributary to C-1 Channel

As a result of the proposed project, the effective SFHA along the unnamed tributary to C-1 Channel from approximately 2,000 feet upstream of the confluence with C-1 Channel to approximately 3,700 feet downstream of Warm Springs Road will be removed. The maximum decrease in SFHA width, approximately 300 feet, will occur approximately 3,500 feet upstream of the confluence with C-1 Channel. The entire base flood will be contained in the proposed channel, proposed culverts, and proposed storm drain along the unnamed tributary to C-1 Channel from just upstream of the confluence with C-1 Channel to approximately 1,200 feet upstream of Country Club Drive.

Upon completion of the project, your community may submit the data listed below and request that we make a final determination on revising the effective FIRM.

- Detailed application and certification forms must be used for requesting final revisions to the maps. Therefore, when the map revision request for the area covered by this letter is submitted, Form 1, entitled "Overview & Concurrence Form," must be included. (A copy of this form is enclosed.)

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  Hydraulic analyses of the base flood under as-built conditions, together with a topographic work map showing the revised floodplain boundaries, must be submitted with Form 2.

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before we can begin processing the request. Please note, however, that the fee schedule is subject to change, and requesters are required to submit the fee in effect at the time of the submittal. Payment of this fee shall be made in the form of a check or money order, made payable in U.S. funds to the National Flood Insurance Program, or by credit card. The payment must be forwarded to the following address:

Federal Emergency Management Agency
Fee-Charge System Administrator
P.O. Box 22787
Alexandria, VA 22304

- As-built plans, certified by a registered professional engineer, of all proposed project elements
- Community acknowledgment of the map revision request

After receiving appropriate documentation to show that the project has been completed, FEMA will initiate a revision to the FIRM.

The basis of this CLOMR is, in whole or in part, a channel-modification/culvert project. NFIP regulations, as cited in Paragraph 60.3(b)(7), require that communities assure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management regulations. Consequently, the ultimate responsibility for maintenance of the modified channel and culverts rests with your community.

This CLOMR is based on minimum floodplain management criteria established under the NFIP. Your community is responsible for approving all floodplain development and for ensuring all necessary permits required by Federal or State law have been received. State, county, and community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction in the SFHA. If the State, county, or community has adopted more restrictive or comprehensive floodplain management criteria, these criteria take precedence over the minimum NFIP criteria.

If you have any questions regarding floodplain management regulations for your community or the NFIP in general, please contact the Consultation Coordination Officer (CCO) for your community. Information on the CCO for your community may be obtained by calling the Director, Federal Insurance and Mitigation Division of FEMA in Oakland, California, at (510) 627-7175. If you have any questions regarding this CLOMR, please call our Map Assistance Center, toll free, at 1-877-FEMA MAP (1-877-336-2627).

Sincerely,

Kevin C Long

Kevin C. Long, CFM, Project Engineer
Engineering Management Section
Mitigation Division

For: William R. Blanton Jr., CFM, Chief
Engineering Management Section
Mitigation Division

Enclosures

cc: The Honorable James B. Gibson
Mayor, City of Henderson

Mr. W. Layne Weber, P.E., CFM
Principal Engineer
Civil Engineering Division
Development Services
Clark County

Mr. Curt Chandler, P.E., CFM
Land Development Manager
City of Henderson

Mr. Kevin Eubanks, P.E., CFM
Assistant General Manager
Clark County Regional Flood Control District

Padinare Unnikrishna, Ph.D., P.E., CFM
Drainage Project Manager
PBS&J

PBS&J

An employee-owned company

October 7, 2006

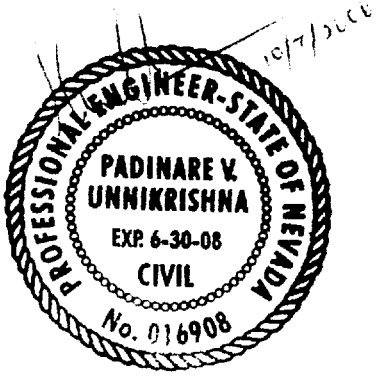
To,
Ms. Sheila M. Norlin, CFM
Michael Baker Jr., Inc.
3601 Eisenhower Avenue
Alexandria, Virginia 22304-6425

RE: Response to comments dated July 11, 2006 for a Conditional Letter of Map Revision (CLOMR) for C-1 Channel- Lake Mead Channel Improvements, City of Henderson, Clark County, NV. **(Case # 06-09-B306R)**

Dear Ms. Norlin:

This submittal would serve as a response to your request in letter dated July 11, 2006, Please accept this data to support our request for a Conditional Letter of Map Revision. If you need further information or have any questions, please call (702) 263-7275.

Sincerely,



Mahesh Kumar V. Panatula, CFM
Hydrologist

Padinare Unnikrishna, Ph.D., P.E., CFM
Sr. Project Manager

2270 Corporate Circle, Suite 100, Henderson, Nevada 89074-6382 • Telephone 702.263.7275 • Fax 702.263.7200 • www.pbsj.com

EXISTING CONDITION HEC-1 ANALYSIS

EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
ONE-1	B	326	16.27	Undeveloped Land, Open Desert	77.00	(16.27/45.92)*77	27.28
	B	187	29.65	Undeveloped Land, Open Desert	77.00	(29.65/45.92)*77	49.72
		Total ONE-1	45.92			**COMPOSITE CURVE NUMBER**	**77.00**
ONE-2**	B	326	2.33	Undeveloped Land, Open Desert	77.00	(2.33/105.96)*77	1.69
	B	187	72.03	Undeveloped Land, Open Desert	77.00	(72.03105.96)*77	52.34
	C	600	7.62	Undeveloped Land, Open Desert	85.00	(7.62/105.96)*85	6.11
	B	184	23.96	Undeveloped Land, Open Desert	77.00	(23.96/105.96)*77	17.41
	A	999	0.02	Undeveloped Land, Open Desert	30.00	(0.02/105.96)*30	0.01
		Total ONE-2	105.96			**COMPOSITE CURVE NUMBER**	**77.57**
ONE-3	C	600	148.79	Undeveloped Land, Open Desert	85.00	(148.79/173.38)*85	72.94
	B	326	24.59	Undeveloped Land, Open Desert	77.00	(24.59/173.38)*77	10.92
		Total ONE-3	173.38				**83.87**
ONE-4	B	278	0.15	Undeveloped Land, Open Desert	77.00	(0.15/137.07)*77	0.10
	B	184	101.22	Undeveloped Land, Open Desert	77.00	(101.22/137.07)*77	65.00
	C	600	18.53	Undeveloped Land, Open Desert	85.00	(18.53/137.07)*85	13.14
		Total ONE-4	119.90			**COMPOSITE CURVE NUMBER**	**78.24**
ONE-5	C	600	498.86	Undeveloped Land, Open Desert	85.00	(498.86/556.81)*85	76.15
	B	184	57.95	Undeveloped Land, Open Desert	77.00	(57.95/556.81)*77	8.01
		Total ONE-5	556.81			**COMPOSITE CURVE NUMBER**	**84.17**
ONE-6	A	117	89.42	Undeveloped Land, Open Desert	65.00	(89.42/646.96)*65	8.98
	C	610	6.01	Undeveloped Land, Open Desert	85.00	(6.01/646.96)*85	0.79
	C	600	507.91	Undeveloped Land, Open Desert	85.00	(507.91/646.96)*85	66.73
	B	184	35.77	Undeveloped Land, Open Desert	77.00	(35.77/646.96)*77	4.26
	B	182	7.85	Undeveloped Land, Open Desert	77.00	(7.85/646.96)*77	0.93
		Total ONE-6	646.96			**COMPOSITE CURVE NUMBER**	**81.70**
ONE-7	A	112	0.58	Undeveloped Land, Open Desert	66.00	(0.58/133.21)*66	0.29
	B	184	2.66	Undeveloped Land, Open Desert	77.00	(2.66/133.21)*77	1.54
	C	600	57.50	Undeveloped Land, Open Desert	85.00	(57.50/133.21)*85	36.69
	B	182	72.47	Undeveloped Land, Open Desert	77.00	(72.47/133.21)*77	41.89
		Total ONE-7	133.21			**COMPOSITE CURVE NUMBER**	**80.41**

* Indicates the basins referenced from the Conceptual Drainage Study for the City of Henderson WRF Phase 1B Expansion. REFER TO APPENDIX D.

** Indicates the basin CNs that have been modified to reflect the correct basin delineation.

EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
ONE-8**	B	184	9.86	Undeveloped Land, Open Desert	77.00	(9.86/130.56)*77	5.82
	B	182	40.56	Undeveloped Land, Open Desert	77.00	(40.56/130.56)*77	23.92
	A	117	78.35	Undeveloped Land, Open Desert	65.00	(78.35/130.56)*65	39.01
	B	187	1.79	Undeveloped Land, Open Desert	77.00	(1.79/130.56)*77	1.06
		Total ONE-8	130.56		**COMPOSITE CURVE NUMBER**		**69.80**
ONE-9	C	600	4.67	Undeveloped Land, Open Desert	85.40	(4.67/215.04)*85.40	1.85
	B	184	210.37	Undeveloped Land, Open Desert	78.00	(210.37/215.04)*78	76.31
		Total ONE-9	215.04		**COMPOSITE CURVE NUMBER**		**78.16**
ONE-10	B	184	57.60	Undeveloped Land, Open Desert	83.94	(57.6/57.6)*83.94	83.94
		Total ONE-10	57.60		**COMPOSITE CURVE NUMBER**		**83.94**
ONE-X**	B	278	3.80	Undeveloped Land, Open Desert	77.00	(3.8/143.36)*77	2.04
	B	184	139.56	Undeveloped Land, Open Desert	77.00	(139.56/143.36)*77	74.96
		Total ONE-1	143.36		**COMPOSITE CURVE NUMBER**		**77.00**
CRLME	A	117	14.56	Undeveloped Land, Open Desert	65.00	(14.56/28.53)*65	33.17
	A	117	1.14	High-Density Residential, 2-4 units per acre	76.72	(1.14/28.53)*76.72	3.06
	A	117	0.01	Multi-Family, 8 units per acre or more	82.32	(0.01/28.53)*82.32	0.03
	A	117	12.82	Commercial, Retail, Casino	92.40	(12.82/28.53)*92.40	41.54
		TOTAL CRLME	28.53		**COMPOSITE CURVE NUMBER**		**77.80**
BKLME	B	184	11.44	Undeveloped Land, Open Desert	77.00	(11.44/220.79)*77	3.99
	B	187	17.36	Undeveloped Land, Open Desert	77.00	(17.36/220.79)*77	6.05
	B	184	1.91	Parks, Golf Courses	64.45	(1.91/220.79)*64.45	0.56
	B	187	45.70	Parks, Golf Courses	64.45	(45.70/220.79)*64.45	13.34
	B	184	1.57	High-Density Residential, 2-4 units per acre	83.94	(1.57/220.79)*83.94	0.60
	B	187	2.19	High-Density Residential, 2-4 units per acre	83.94	(2.19/220.79)*83.94	0.83
	B	184	6.40	Multi-Family, 8 units per acre or more	87.64	(6.40/220.79)*87.64	2.54
	B	187	29.91	Multi-Family, 8 units per acre or more	87.64	(29.91/220.79)*87.64	11.87
	B	184	60.38	Commercial, Retail, Casino	94.30	(60.38/220.79)*94.30	25.75
	B	187	43.94	Commercial, Retail, Casino	94.30	(43.94220.79)*94.30	18.77
		TOTAL PWLME	220.79		**COMPOSITE CURVE NUMBER**		**84.30**

* Indicates the basins referenced from the Conceptual Drainage Study for the City of Henderson WRF Phase 1B Expansion.

** Indicates the basin CNs that have been modified to reflect the correct basin delineation.

EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
BKMJE	B	187	0.05	Undeveloped Land, Open Desert	77.00	(0.05/21.46)*77	0.17
	B	187	12.69	High-Density Residential, 2-4 units per acre	83.94	(12.69/21.46)*83.94	49.64
	B	187	8.64	Multi-Family, 8 units per acre or more	87.64	(8.64/21.46)*87.64	35.29
	B	187	0.08	Commercial, Retail, Casino	94.30	(0.08/21.46)*94.30	0.40
		TOTAL BKMJE	21.46			**COMPOSITE CURVE NUMBER**	**85.50**
BKPVE	A	117	0.38	High-Density Residential, 2-4 units per acre	76.72	(0.38/88.97)*76.72	0.33
	B	187	32.66	High-Density Residential, 2-4 units per acre	83.94	(32.66/88.97)*83.94	30.81
	B	187	7.13	Multi-Family, 8 units per acre or more	87.64	(7.13/88.97)*87.64	7.03
	B	187	11.84	Commercial, Retail, Casino	94.30	(11.84/88.97)*94.30	12.55
	A	117	0.26	Schools	70.00	(0.26/88.97)*70	0.20
	B	187	36.70	Schools	79.50	(36.70/88.97)*79.50	32.78
		TOTAL BKPVE	88.97			**COMPOSITE CURVE NUMBER**	**83.70**
PWLME	A	112	0.05	Undeveloped Land, Open Desert	66.00	(0.05/188.22)*66	0.02
	A	117	0.88	Undeveloped Land, Open Desert	65.00	(0.88/188.22)*65	0.30
	B	182	11.09	Undeveloped Land, Open Desert	77.00	(11.09/188.22)*77	4.54
	A	112	0.04	High-Density Residential, 2-4 units per acre	77.10	(0.04/188.22)*77.10	0.02
	A	117	21.09	High-Density Residential, 2-4 units per acre	76.72	(21.09/188.22)*76.72	8.60
	B	182	115.79	High-Density Residential, 2-4 units per acre	83.56	(115.79/188.22)*83.56	51.40
	A	117	22.85	Multi-Family, 8 units per acre or more	82.32	(22.85/188.22)*82.32	9.99
	B	182	3.13	Multi-Family, 8 units per acre or more	87.36	(3.13/188.22)*87.36	1.45
	A	117	5.95	Commercial, Retail, Casino	92.40	(5.95/188.22)*92.40	2.92
	B	182	7.34	Commercial, Retail, Casino	94.20	(7.34/188.22)*94.20	3.65
		TOTAL PWLME	188.22			**COMPOSITE CURVE NUMBER**	**82.90**
CRMJE	B	187	27.88	Undeveloped Land, Open Desert	77.00	(27.88/132.06)*77	16.25
	B	187	7.60	Parks, Golf Courses	64.45	(7.60/132.06)*64.45	3.71
	B	187	39.08	High-Density Residential, 2-4 units per acre	83.94	(39.08/132.06)*83.94	24.84
	B	187	17.59	Multi-Family, 8 units per acre or more	87.64	(17.59/132.06)*87.64	11.67
	B	187	39.91	Commercial, Retail, Casino	94.30	(39.91/132.06)*94.30	28.52
		TOTAL CRMJE	132.06			**COMPOSITE CURVE NUMBER**	**85.00**

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EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
DE**	B	182	5.36	Undeveloped Land, Open Desert	77.00	(5.36/45.85)*77	11.73
	B	182	18.17	High-Density Residential, 2-4 units per acre	83.56	(25.78/45.85)*83.56	43.13
	B	182	4.09	Multi-Family, 8 units per acre or more	87.36	(4.96/45.85)*87.36	10.15
	B	182	7.58	Commercial, Retail, Casino	94.20	(9.74/45.85)*94.20	20.28
		TOTAL DE	35.20		**COMPOSITE CURVE NUMBER**		**85.29**
EE	B	182	5.24	Undeveloped Land, Open Desert	77.00	(5.24/20.16)*77	20.01
	B	182	14.29	High-Density Residential, 2-4 units per acre	83.56	(14.29/20.16)*83.56	59.21
	B	182	0.64	Commercial, Retail, Casino	94.20	(0.64/20.16)*94.20	2.98
		TOTAL EE	20.16		**COMPOSITE CURVE NUMBER**		**82.20**
FE**	B	182	8.56	Undeveloped Land, Open Desert	77.00	(10.88/11.28)*77	73.56
	B	182	0.40	Commercial, Retail, Casino	94.20	(0.40/11.28)*94.20	4.21
		TOTAL FE	8.96		**COMPOSITE CURVE NUMBER**		**77.77**
GE	B	182	7.05	Undeveloped Land, Open Desert	77.00	(7.05/9.82)*77	55.32
	B	182	0.62	High-Density Residential, 2-4 units per acre	83.56	(0.62/9.82)*83.56	5.29
	B	182	2.14	Commercial, Retail, Casino	94.20	(2.14/9.82)*94.20	20.59
		TOTAL GE	9.82		**COMPOSITE CURVE NUMBER**		**81.20**
WSCRE	B	187	1.90	Undeveloped Land, Open Desert	77.00	(1.90/102.80)*77	1.43
	B	187	0.004	Parks, Golf Courses	64.45	(0.004/102.80)*64.45	0.00
	A	117	72.78	High-Density Residential, 2-4 units per acre	76.72	(72.78/102.80)*76.72	54.32
	B	187	12.87	High-Density Residential, 2-4 units per acre	83.94	(12.87/102.80)*83.94	10.51
	A	117	0.36	Multi-Family, 8 units per acre or more	82.32	(0.36/102.80)*82.32	0.29
	B	187	13.86	Multi-Family, 8 units per acre or more	87.64	(13.86/102.80)*87.64	11.82
	B	187	1.01	Commercial, Retail, Casino	94.30	(1.01/102.80)*94.30	0.94
		TOTAL WSCRE	102.80		**COMPOSITE CURVE NUMBER**		**79.30**

* Indicates the basins referenced from the Conceptual Drainage Study for the City of Henderson WRF Phase 1B Expansion.

** Indicates the basin CNs that have been modified to reflect the correct basin delineation.

EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
WSLME	A	117	0.41	Undeveloped Land, Open Desert	65.00	(0.41/183.06)*65	0.15
	B	184	0.48	Parks, Golf Courses	64.45	(0.48/183.06)*64.45	0.17
	B	187	2.04	Parks, Golf Courses	64.45	(2.04/183.06)*64.45	0.72
	A	117	26.66	High-Density Residential, 2-4 units per acre	76.72	(26.66/183.06)*76.72	11.17
	B	187	122.99	High-Density Residential, 2-4 units per acre	83.94	(122.99/183.06)*83.94	56.39
	A	117	0.02	Multi-Family, 8 units per acre or more	82.32	(0.02/183.06)*82.32	0.01
	B	184	0.33	Multi-Family, 8 units per acre or more	87.64	(0.33/183.06)*87.64	0.16
	B	187	0.12	Multi-Family, 8 units per acre or more	87.64	(0.12/183.06)*87.64	0.06
	A	117	0.46	Commercial, Retail, Casino	92.40	(0.46/183.06)*92.40	0.23
	B	184	2.95	Commercial, Retail, Casino	94.30	(2.95/183.06)*94.30	1.52
	B	187	14.89	Commercial, Retail, Casino	94.30	(14.89/183.06)*94.30	7.67
	A	117	10.00	Schools	70.00	(10/183.06)*70	3.83
	B	187	1.71	Schools	79.50	(1.71/183.06)*79.50	0.73
		TOTAL WSLME	183.06		**COMPOSITE CURVE NUMBER**		**82.80**
WSPVE	A	117	4.49	Undeveloped Land, Open Desert	65.00	(4.49/169.40)*65	1.72
	B	182	2.01	Undeveloped Land, Open Desert	77.00	(2.01/169.40)*77	0.91
	B	187	0.35	Undeveloped Land, Open Desert	77.00	(0.35/169.40)*77	0.16
	A	112	2.26	High-Density Residential, 2-4 units per acre	77.10	(2.26/169.40)77.10	1.03
	A	117	113.51	High-Density Residential, 2-4 units per acre	76.72	(113.51/169.40)*76.72	51.41
	B	182	0.78	High-Density Residential, 2-4 units per acre	83.56	(0.78/169.40)*83.56	0.38
	B	187	18.67	High-Density Residential, 2-4 units per acre	83.94	(18.67/169.40)*83.94	9.25
	A	117	1.01	Multi-Family, 8 units per acre or more	82.32	(1.01/169.40)*82.32	0.49
	B	187	26.02	Multi-Family, 8 units per acre or more	87.64	(26.02/169.40)*87.64	13.46
	B	187	0.30	Commercial, Retail, Casino	94.30	(0.30/169.40)*94.30	0.18
		TOTAL WSPVE	169.40		**COMPOSITE CURVE NUMBER**		**79.00**
OFFE-1	B	184	116.02	High-Density Residential, 2-4 units per acre	83.94	(135.06/300.49)*83.94	37.11
	C	615	146.38	Rural	85.40	(165.43/300.49)*85.40	47.64
		Total OFFE-1	262.40		**COMPOSITE CURVE NUMBER**		**84.75**
OFFE-2	C	615	12.80	Undeveloped Land, Open Desert	85.00	(12.80/58.87)*85	18.48
	B	184	46.07	Undeveloped Land, Open Desert	77.00	(46.07/58.87)*77	60.26
		Total OFFE-2	58.87		**COMPOSITE CURVE NUMBER**		**78.74**

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** Indicates the basin CNs that have been modified to reflect the correct basin delineation.

EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
OFFE-2A	C	615	2.52	Undeveloped Land, Open Desert	85.00	(2.52/14.62)*85	14.65
	B	184	12.1	Undeveloped Land, Open Desert	77.00	(12.10/14.62)*77	63.73
		Total OFFE-2A	14.62		**COMPOSITE CURVE NUMBER**		**78.38**
OFFE-2B**	B	184	43.81	Undeveloped Land, Open Desert	77.00	(43.81/58.72)*77	57.45
	B	187	13.44	Undeveloped Land, Open Desert	77.00	(13.44/58.72)*77	17.62
	A	999	1.47	Undeveloped Land, Open Desert	30.00	(1.47/58.72)*30	0.75
		Total OFFE-2B	58.72		**COMPOSITE CURVE NUMBER**		**75.82**
OFFE-3	B	184	161.52	High-Density Residential, 2-4 units per acre	83.94	(161.52/190.08)*83.94	71.33
	B	187	5.10	High-Density Residential, 2-4 units per acre	83.94	(5.10/190.08)*83.94	2.25
	A	117	16.39	High-Density Residential, 2-4 units per acre	76.72	(16.39/190.08)*76.72	6.62
	A	999	7.07	High-Density Residential, 2-4 units per acre	30.00	(7.07/190.08)*30	1.12
		Total OFFE-3	190.08		**COMPOSITE CURVE NUMBER**		**81.31**
OFFE-3A	B	184	19.20	High-Density Residential, 2-4 units per acre	88.00	(19.20/19.20)*88	88.00
		Total OFFE-3A	19.20		**COMPOSITE CURVE NUMBER**		**88.00**
OFFE-4	A	117	6.63	Parks, Golf Courses	47.10	(6.63/302.74)*47.10	1.01
	B	184	31.25	Parks, Golf Courses	64.45	(31.25/302.74)*64.45	6.49
	B	187	0.77	Parks, Golf Courses	64.45	(0.77/302.74)*64.45	0.16
	A	999	7.96	Parks, Golf Courses	30.00	(7.96/302.74)*30	0.77
	A	117	1.71	High-Density Residential, 2-4 units per acre	76.72	(1.71/302.74)*76.72	0.42
	B	184	90.20	High-Density Residential, 2-4 units per acre	83.94	(90.20/302.74)*83.94	24.39
	B	187	84.61	High-Density Residential, 2-4 units per acre	83.94	(84.61/302.74)*83.94	22.88
	A	117	0.86	Multi-Family, 8 units per acre or more	82.32	(0.86/302.74)*82.32	0.23
	B	184	5.91	Multi-Family, 8 units per acre or more	87.64	(5.91/302.74)*87.64	1.67
	B	184	66.89	Commercial, Retail, Casino	94.30	(66.89/302.74)*94.30	20.32
	B	187	13.61	Commercial, Retail, Casino	94.30	(13.61/302.74)*94.30	4.13
		TOTAL OFFE-4	310.40		**COMPOSITE CURVE NUMBER**		**82.47**
OFFE-9	B	184	40.34	Multi-Family, 8 units per acre or more	87.64	(40.34/40.34)*87.64	87.64
		Total OFFE-9	40.34		**COMPOSITE CURVE NUMBER**		**87.64**
OFFE-10A	B	184	61.26	High-Density Residential, 2-4 units per acre	83.94	(61.26/61.26)*83.94	83.94
		Total OFFE-10A	61.26		**COMPOSITE CURVE NUMBER**		**83.94**

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** Indicates the basin CNs that have been modified to reflect the correct basin delineation.

EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
OFFE-10B	A	184	3.12	High-Density Residential, 2-4 units per acre	87.64	(3.12/27.18)*87.64	10.06
	B	187	24.06	High-Density Residential, 2-4 units per acre	83.94	(24.06/27.18)*83.94	74.30
		Total OFFE-10B	27.18			**COMPOSITE CURVE NUMBER**	**84.36**
OND7*	C	600	6.74	Light Industrial	92.50	(6.74/6.74)*92.5	92.50
		TOTAL OND-2	6.74			**COMPOSITE CURVE NUMBER**	**92.50**
OND8*	C	600	2.64	Light Industrial	92.50	(2.64/13.90)*92.5	17.57
	B	184	11.26	Light Industrial	89.30	(11.26/13.90)*89.3	72.34
		Total OND-2A	13.90			**COMPOSITE CURVE NUMBER**	**89.91**

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for the City of Henderson WRF Phase 1B Expansion.
** Indicates the basin CNs that have been modified to reflect the correct basin delineation.

Existing Conditions Curve Number Calculations

BASIN	SOIL TYPE	SOIL #	ACRES	EXISTING LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
ONE-X	B	278	3.73	Undeveloped Land, Open Desert	77.00	(3.73/143.22)*77	2.01
	B	184	139.49	Undeveloped Land, Open Desert	77.00	(139.49/143.22)*77	74.99
		Total ONE-1	143.22		COMPOSITE CURVE NUMBER		77.00

WRF Modified Basin: Curve Number Calculation

BASIN	SOIL TYPE	SOIL #	ACRES	PROPOSED LANDUSE	LAND USE CN	CN CALC	COMPOSITE CN
OND2*	B	184	23.7	Light Industrial	89.30	(23.7/29.32)*89.30	72.18
	A	999	5.62	Light Industrial	30.00	(5.62/29.32)*30.00	5.75
		Total OND-2A	29.32			**COMPOSITE CURVE NUMBER**	**77.93**
OND7*	C	600	6.74	Light Industrial	92.50	(6.74/6.74)*92.5	92.50
		TOTAL OND-2	6.74			**COMPOSITE CURVE NUMBER**	**92.50**
OND8*	C	600	2.64	Light Industrial	92.50	(2.64/13.90)*92.5	17.57
	B	184	11.26	Light Industrial	89.30	(11.26/13.90)*89.3	72.34
		Total OND-2A	13.90			**COMPOSITE CURVE NUMBER**	**89.91**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

CLARK COUNTY

CLOMR FOR C-1 CHANNEL-LAKE MEAD CHANNEL IMPROVEMENTS

File: FORM4.XLS — Existing Condition — BY: K.L. — DATE: 10/6/06

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag Basin <1 Mi^2	Tlag Basin >1 Mi^2
DESIG	DEV./EX. (D or E)	CN	K	AREA Ac	AREA Mi^2	INITIAL LENGTH Feet	SLOPE %	Ti Min	TRAVEL LENGTH Feet	SLOPE %	V1 VELOCITY FPS	V2 VELOCITY FPS	Tt Min	Min	Min	Tlag= 0.6Tc/60	Tlag= 20*Kn*((L*Lc)/ s^.5))^.33
(1)			(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	(13)	(14)	Hours	Hours
ONE-1	E	77.00	0.6264	45.92	0.072	100	0.87	8.9	2932	0.68	1.2	1.6	1.9	10.8	N/A	0.108	-
ONE-2	E	77.57	0.6339	105.96	0.166	500	0.70	21.1	6149	0.81	1.3	1.7	1.9	23.1	N/A	0.231	-
ONE-3	E	83.87	0.7171	173.38	0.271	300	1.39	10.7	4095	1.09	1.5	1.8	2.0	12.7	N/A	0.127	-
ONE-4	E	78.24	0.6428	119.90	0.187	500	1.39	16.5	5935	1.26	1.7	1.9	2.0	18.5	N/A	0.185	-
ONE-5	E	84.17	0.7210	556.81	0.870	500	1.75	12.7	8080	1.49	1.8	2.0	2.1	14.7	N/A	0.147	-
ONE-6	E	81.70	0.6884	646.96	1.011	500	2.00	13.1	7865	2.18	2.2	2.2	2.2	15.3	N/A	Refer to Below	Refer to Below
ONE-7	E	80.41	0.6714	133.21	0.208	100	2.33	5.8	2431	2.67	2.4	2.3	2.2	8.1	N/A	0.081	-
ONE-8	E	69.80	0.5314	130.56	0.204	500	1.06	22.4	7293	0.69	1.2	1.6	1.9	24.3	N/A	0.243	-
ONE-9	E	78.16	0.6417	215.04	0.336	500	1.59	15.8	6980	1.57	1.9	2.0	2.1	17.9	N/A	0.179	-
ONE-10	E	83.94	0.7180	57.60	0.090	500	1.39	13.8	5693	1.44	1.8	2.0	2.1	15.9	N/A	0.159	-
ONE-X	E	77.00	0.6264	143.36	0.224	500	1.00	19.1	4480	1.45	1.8	2.0	2.1	21.1	N/A	0.211	-
BKPVE	E	83.70	0.7148	88.97	0.139	300	2.50	6.8	4940	2.40	2.3	4.6	19.9	28.7	N/A	0.287	-
BKLME	E	84.30	0.7228	220.79	0.345	200	1.80	7.9	6138	2.09	2.1	4.3	26.0	33.9	N/A	0.339	-
CRMJE	E	85.00	0.7320	132.06	0.206	170	2.35	6.5	5520	2.08	2.1	4.2	23.6	30.1	N/A	0.301	-
BKMJE	E	85.50	0.7386	21.46	0.034	150	1.00	8.0	1850	1.89	2.0	4.0	9.7	17.6	N/A	0.176	-
WSPVE	E	79.00	0.6528	169.40	0.265	100	1.00	8.0	6495	1.36	1.7	3.4	34.0	42.0	N/A	0.420	-
WSCRE	E	79.30	0.6568	102.80	0.161	150	1.50	8.5	4085	2.08	2.1	4.2	18.0	26.5	N/A	0.265	-
WSLME	E	82.80	0.7030	183.06	0.286	100	1.00	7.1	5100	1.77	2.0	3.9	23.8	31.0	N/A	0.310	-
CRLME	E	77.80	0.6370	28.53	0.045	100	1.00	8.3	1600	1.88	2.0	4.0	8.7	17.0	N/A	0.170	-
PWLME	E	82.90	0.7043	188.22	0.294	100	1.47	6.3	4800	1.56	1.8	3.7	24.0	30.3	N/A	0.303	-
DE	E	85.29	0.7358	35.20	0.055	100	1.67	5.5	1450	1.00	1.5	2.9	11.0	16.5	N/A	0.165	-
EE	E	82.20	0.6950	20.16	0.032	100	1.43	6.5	1400	2.14	2.2	4.3	7.3	13.8	N/A	0.138	-
FE	E	77.77	0.6366	8.96	0.014	100	1.67	7.0	800	1.88	2.0	4.0	5.3	12.4	N/A	0.124	-
GE	E	81.20	0.6818	9.82	0.015	100	1.43	6.7	700	2.14	2.2	4.3	4.6	11.3	N/A	0.113	-
OFFE-1	E	84.75	0.7287	262.40	0.410	200	2.70	6.8	4033	3.00	2.6	5.1	14.8	21.6	N/A	0.216	-
OFFE-2	E	78.74	0.6494	58.87	0.092	150	2.00	7.9	2925	3.00	2.6	5.1	11.2	19.1	N/A	0.191	-
OFFE-2A	E	78.38	0.6446	14.62	0.023	150	2.00	8.0	1545	3.00	2.6	5.1	6.7	14.6	N/A	0.146	-
OFFE-2B	E	75.82	0.6108	58.72	0.092	100	1.28	8.1	2925	1.19	1.6	3.2	17.8	25.9	N/A	0.259	-
OFFE-3	E	81.31	0.6833	190.08	0.297	100	1.00	7.5	5489	2.70	2.4	4.8	20.6	28.1	N/A	0.281	-
OFFE-3A	E	88.00	0.7716	19.20	0.030	100	2.77	4.2	1154	3.00	2.6	5.1	5.4	9.6	N/A	0.096	-
OFFE-4	E	82.47	0.6986	310.40	0.485	100	1.00	7.2	8038	2.34	2.3	4.5	31.6	38.9	N/A	0.389	-
OFFE-9	E	87.64	0.7668	40.34	0.063	100	2.50	4.4	1600	2.43	2.3	4.6	7.6	12.0	N/A	0.120	-
OFFE-10A	E	83.94	0.7180	61.26	0.096	100	2.00	5.5	1600	2.22	2.2	4.4	8.0	13.4	N/A	0.134	-
OFFE-10B	E	84.36	0.7236	27.18	0.042	100	2.20	5.2	1350	1.78	2.0	3.9	7.8	13.0	N/A	0.130	-
OND7*	D	92.50	0.8310	6.74	0.011	125	1.00	5.4	1600	1.00	2.0	2.1	2.1	7.6	19.6	0.076	-
OND8*	D	89.91	0.7968	13.90	0.022	180	1.00	7.3	2700	1.00	2.0	2.1	2.1	9.5	26.0	0.095	-

	Kn ROUGH	L LENGTH Mi	Lc CENTROID Mi	S SLOPE Ft/Mi	Tlag Hours
ONE-6	0.050	1.49	0.48	82.0	0.433

Tlag = 0.6 Tc (Basin <1 Mi^2)

Tlag =20*Kn*((L*Lc)/S^.5)^.33 (Basin >1 Mi^2)

Tc = Ti + Tt

Ti = 1.8 (1.1 - K) L^1/2 / S^1/3

K = 0.0132 (CN) - 0.39

Tc Check = L/180+10

For the travel time (Tt) calculations

V1 applies to the first 500 feet of travel distance

V2 applies to the remaining travel distance

Existing (Natural): V1 = 14.8*(S/100)^1/2

Developed (Urban): V1 = 20.2*(S/100)^1/2

Existing (Natural): V2 = 29.4*(S/100)^1/2

Developed (Urban): V2 = 30.6*(S/100)^1/2

REFERENCE : CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT HYDROLOGIC AND DRAINAGE DESIGN MANUAL 08/12/1999

* Indicates that basins are referenced from the Conceptual Drainage Study for the City of Henderson WRF Phase 1B Expansion. Please refer Appendix D-4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

CLARK COUNTY

File: FORM4.XLS

Existing Conditions

BY: K.L.

DATE: 10/6/06

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag Basin <1 Mi^2	Tlag Basin >1 Mi^2
DESIG:	DEV./EX. (D or E)	CN	K	AREA Ac	AREA Mi^2	INITIAL LENGTH Feet	SLOPE %	Ti Min	TRAVEL LENGTH Feet	SLOPE %	V1 VELOCITY FPS	V2 VELOCITY FPS	Tt Min	Min	Min	Tlag= 0.6Tc/60	Tlag= 20*Kn*((L*Lc)/ s^.5))^.33
(1)			(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	(13)	(14)	Hours	Hours
ONE-X	E	77.00	0.6264	143.22	0.224	500	1.00	19.1	4480	1.45	1.8	2.0	2.1	21.1	N/A	0.211	-

	Kn ROUGH	L LENGTH Mi	Lc CENTROID Mi	S SLOPE Ft/Mi	Tlag Hours
ONE-6	0.050	1.49	0.48	82.0	0.433

Tlag = 0.6 Tc (Basin <1 Mi^2)

Tlag =20*Kn*((L*Lc)/S^.5)^.33 (Basin >1 Mi^2)

Tc = Ti + Tt

Ti = 1.8 (1.1 - K) L^1/2 / S^1/3

K = 0.0132 (CN) - 0.39

Tc Check = L/180+10

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

Existing (Natural) V1 = 14.8*(S/100)^1/2 Developed (Urban) V1 = 20.2*(S/100)^1/2

Existing (Natural) V2 = 29.4*(S/100)^1/2 Developed (Urban) V2 = 30.6*(S/100)^1/2

REFERENCE : CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT HYDROLOGIC AND DRAINAGE DESIGN MANUAL 08/12/1999

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

CLARK COUNTY

File: FORM4.XLS

CLOMR FOR C-1 CHANNEL-LAKE MEAD CHANNEL IMPROVEMENTS
WRF Modified Basins

BY: K.L
DATE: 10/6/06

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag Basin <1 Mi^2	Tlag Basin >1 Mi^2
DESIG:	DEV./EX. (D or E)	CN	K	AREA Ac	AREA Mi^2	INITIAL LENGTH Feet	SLOPE %	Ti Min	TRAVEL LENGTH Feet	SLOPE %	V1 VELOCITY FPS	V2 VELOCITY FPS	Tt Min	Min	Min	Tlng= 0.6Tc/60	Tlng= 20*Kn*((L*Lc)/ s^.5))^.33
(1)			(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	(13)	(14)	Hours	Hours
OND2*	D	77.93	0.6387	29.32	0.046	325	1.00	15.0	2200	1.00	2.0	2.1	2.1	17.1	24.0	0.171	-
OND7*	D	92.50	0.8310	6.74	0.011	125	1.00	5.4	1600	1.00	2.0	2.1	2.1	7.6	19.6	0.076	-
OND8*	D	89.91	0.7968	13.90	0.022	180	1.00	7.3	2700	1.00	2.0	2.1	2.1	9.5	26.0	0.095	-

	Kn ROUGH	L LENGTH Mi	Lc CENTROID Mi	S SLOPE Ft/Mi	Tlag Hours
ONE-6	0.050	1.49	0.48	82.0	0.433

Tlag = 0.6 Tc (Basin <1 Mi^2)
Tlag =20*Kn*((L*Lc)/S^.5)^.33 (Basin >1 Mi^2)
Tc = Ti + Tt
Ti = 1.8 (1.1 - K) L^1/2 / S^1/3
K = 0.0132 (CN) - 0.39
Tc Check = L/180+10

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

Existing (Natural) V1 = 14.8*(S/100)^1/2 Developed (Urban) V1 = 20.2*(S/100)^1/2

Existing (Natural) V2 = 29.4*(S/100)^1/2 Developed (Urban) V2 = 30.6*(S/100)^1/2

REFERENCE : CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT HYDROLOGIC AND DRAINAGE DESIGN MANUAL 08/12/1999

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1*************************************
*                                   *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998             *
*          VERSION 4.1              *
*                                   *
*  RUN DATE   30AUG05  TIME  14:18:58   *
*                                   *
*************************************
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*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*  HYDROLOGIC ENGINEERING CENTER    *
*        609 SECOND STREET          *
*      DAVIS, CALIFORNIA 95616      *
*          (916) 756-1104           *
*                                   *
*************************************
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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X         XXXXX  X
X     X  X        X                X
X     X  X        X     Y          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

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

            1       ID   ******************************************
            2       ID   *                                        *
            3       ID   *    CLOMP FOR C-1 CHANNEL-LAKE MEAD CHANNEL *
            4       ID   *    IMPROVEMENTS                        *
            5       ID   *    MODEL:EXISTING CONDITIONS           *
            6       ID   *    FILE NAME:C1CLEX.DAT                *
            7       ID   *    DATE:8/28/2005                      *
            8       ID   *    HYDROLOGIST: MAHESH KUMAR,PBS&J     *
            9       ID   *    STORM DISTRIBUTION = SDN#3          *
           10       ID   *    DESIGN STORM = 100 YEAR, 6 HOUR     *
           11       ID   *                                        *
           12       ID   ******************************************
                    *DIAGRAM
*** FREE ***
           13       ID
           14       ID
           15       ID        DRAINAGE AREA
           16       ID        (SQUARE MILES)    DARF
           17       ID             0-0.5          .99
           18       ID             0.5-1         .975
           19       ID              1-2           .95
           20       ID              2-3          .925
           21       ID              3-4          .915
           22       ID              4-5          .908
           23       IT       5        0        0      300
           24       IO       5        0        0
           25       IN       5        0        0
           26       JR     PREC    0.99   0.975    0.95   0.925   0.915   0.908
                    *
           27       KK   ONE-1
           28       BA   0.072
           29       PB    2.86
           30       PC       0    0.02   0.057    0.07   0.087   0.108   0.124    0.13   0.13    0.13
           31       PC    0.13    0.13    0.13   0.133    0.14   0.142   0.148   0.158   0.172   0.181
           32       PC    0.19   0.197   0.199     0.2   0.201   0.204   0.214   0.229   0.241   0.249
           33       PC   0.251   0.256    0.27   0.278   0.281   0.283   0.295   0.322   0.352   0.409
           34       PC   0.499    0.59    0.71   0.744   0.781   0.812   0.819   0.835   0.851   0.856
           35       PC    0.86   0.868   0.876   0.888    0.91   0.926   0.937    0.95    0.97   0.976
           36       PC   0.982   0.985   0.987   0.989    0.99   0.993   0.993   0.994   0.995   0.998
           37       PC   0.998   0.999       1
           38       LS       0   77.00
           39       UD   0.108
                    *
           40       KK   ONE-2
           41       BA   0.166
           42       PB    2.86
           43       LS       0   77.57
           44       UD   0.231
                    *
```

1 HEC-1 INPUT PAGE 2

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

           45       KK OFFE-2B
           46       BA   0.092
           47       PB    2.86
           48       LS       0   75.82
           49       UD   0.259
```

```
                *
  50            KKOFFE-2B
  51            KM   ROUTE OFFE-2B
  52            RD    3580   0.019   0.035       0    TRAP
                *
  53            KK     CP8
  54            KM   COMBINE ONE-1, ONE-2  POFFE-2B
  55            HC       3
                *
  56            KK   ONE-3
  57            BA   0.271
  58            PB    2.86
  59            LS       0   83.87
  60            UD   0.127
                *
  61            KK   ONE-9
  62            BA   0.036
  63            PB    2.86
  64            LS       0   78.16
  65            UD   0.179
                *
  66            KK  OFFE-9
  67            BA   0.063
  68            PB    2.86
  69            LS       0   80.67
  70            UD   0.120
                *
  71            KK     CP3
  72            KM   COMBINE ONE-9, OFFE-9
  73            HC       2
                *
  74            KK  ONE-10
  75            BA   0.090
  76            PB    2.86
  77            LS       0   83.94
  78            UD   0.159
                *
1                                        HEC-1 INPUT                                        PAGE   3

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

  79            KKOFFE-10A
  80            BA   0.096
  81            PB    2.86
  82            LS       0   83.94
  83            UD   0.134
                *
  84            KKOFFE-10B
  85            BA   0.042
  86            PB    2.86
  87            LS       0   84.36
  88            UD   0.130
                *
  89            KK     CP4
  90            KM   COMBINE ONE-10, OFFE-10A, OFFE-10B
  91            HC       3
                *
  92            KK    RCP4
  93            KM   ROUTE TO ONE-9
  94            RD    4940  0.0144   0.035       0    TRAP
                *
  95            KK     CP5
  96            KM   COMBINE CP3 AND RCP4
  97            HC       2
                *
  98            KK     RC5
  99            KM   ROUTE TO BASIN ONE-5
 100            RD    7000   0.015   0.035       0    TRAP
                *
 101            KK   ONE-5
 102            BA   0.870
 103            PB    2.86
 104            LS       0   84.17
 105            UD   0.147
                *
 106            KK  OFFE-2
 107            BA   0.092
 108            PB    2.86
 109            LS       0   78.74
 110            UD   0.191
                *
 111            KK  OFFE-3
 112            BA   0.297
```

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 113          PB    2.86
 114          LS       0   81.31
 115          UD   0.281
              *
1                                        HEC-1 INPUT                                        PAGE  4

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

 116          KK OFFE-3A
 117          BA   0.030
 118          PB    2.86
 119          LS       0      99
 120          UD   0.096
              *

 121          KKROFFE-3A
 122          KM   ROUTE OFFE-3A IN CHANNEL WEST ALONG LAKE MEAD DRIVE
 123          RD    2200 0.00453   0.033       0    TRAP      12       4
              *

 124          KK     CP1
 125          KM   COMBINE ROFFE-3A, OFFE-3, AND OFFE-2
 126          HC       2
              *

 127          KK     RC1
 128          KM   ROUTE TO BOULDER HIGHWAY
 129          RD    5000   0.025    0.03       0    TRAP
              *

 130          KK OFFE-2A
 131          BA   0.023
 132          PB    2.86
 133          LS       0   78.38
 134          UD   0.146
              *

 135          KK  OFFE-1
 136          BA   0.410
 137          PB    2.86
 138          LS       0   84.75
 139          UD   0.216
              *

 140          KK  OFFE-4
 141          BA   0.485
 142          PB    2.86
 143          LS       0   82.47
 144          UD   0.389
              *

 145          KK ROFFE-4
 146          KM   ROUTE TO BOULDER HIGHWAY AT PABCO RD
 147          RD   12600    0.03    0.03       0    TRAP       1       1
              *

 148          KK     CP2
 149          KM   COMBINE ALL BASINS AT BOULDER HIGHWAY
 150          HC       4
              *
1                                        HEC-1 INPUT                                        PAGE  5

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

 151          KK    OCP2
 152          KM   FLOW SPLIT AT CULVERT UNDER BOULDER HIGHWAY AT PABCO ROAD
 153          KM   DIVERT OUT FLOW ALONG BOULDER HIGHWAY
 154          DT    DCP2
 155          DI       0     364     410     992    1108
 156          DQ       0       0      48     266     324
              *

 157          KK     CP6
 158          KM   COMBINE ALL BASINS AT ATHENS
 159          HC       3
              *

 160          KK    RCP6
 161          KM   ROUTE TO BASIN OND7
 162          RD    1588   0.006   0.035       0    TRAP
              *

 163          KK   OND7*
 164          KM   MODIFIED WRF ONSITE BASIN OND7*
 165          BA   0.011
 166          PB    2.77
 167          LS       0    92.5
 168          UD   0.076
              *

 169          KK    CP6A
 170          KM   COMBINE RCP6 AND OND7*
 171          HC       2
              *

 172          KK   RCP6A
 173          KM   ROUTE TO OND6*
```

```
174          RD    1266   0.013   0.035       0    TRAP
             *

175          KK   OND6*
176          KM   WRF ONSITE BASIN OND6*
177          BA  0.0627
178          PB    2.77
179          LS       0      91
180          UD   0.237
             *

181          KK    CP6E
182          KM   COMBINE OND6* AND RCP6E
183          HC       2
             *
```

1 HEC-1 INPUT PAGE 6

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

184          KK   RCP6E
185          KM   ROUTE TO OND8*
186          RD    1445   0.012   0.035       0    TRAP
             *

187          KK   OND8*
188          KM   MODIFIED WRF ONSITE BASIN OND8*
189          BA   0.032
190          PB    2.77
191          LS       0    85.51
192          UD   0.095
             *

193          KK    CP6C
194          KM   ROUTE TO CP7
195          HC       2
             *

196          KK   RCP6C
197          KM   ROUTE TO CP7
198          RD    1750   0.012   0.035       0    TRAP
             *

199          KK   ONE-6
200          BA   1.011
201          PB    2.86
202          LS       0    81.7
203          UD   0.433
             *

204          KK  RONE-6
205          KM   ROUTE TO ONE-4
206          RD    5300   0.014   0.035       0    TRAP
             *

207          KK   ONE-4
208          BA   0.187
209          PB    2.86
210          LS       0   78.24
211          UD   0.185
             *

212          KK   ONE-X
213          BA   0.224
214          PB    2.86
215          LS       0      77
216          UD   0.211
             *
```

1 HEC-1 INPUT PAGE 7

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

217          KK     CP7
218          KM   COMBINE ALL BASINS TRIBUTARY TO PABCC
219          HC       4
             *

220          KK   BKPVE
221          BA   0.139
222          PB    2.86
223          LS       0    83.5
224          UD   0.287
             *

225          KK  RBKPVE
226          KM   PALO VERDE
227          RD    5140   0.013    .015       0    TRAP      60       0
             *

228          KK   BKMJE
229          BA   0.034
230          PB    2.86
231          LS       0    85.5
232          UD   0.176
             *

233          KK  RBKMJE
234          KM   MAJOR THEN PALO VERDE
```

```
 235          RD    4720   0.016    .015       0    TRAP      80       0
              *

 236          KK   CRMJE
 237          BA   0.206
 238          PB    2.86
 239          LS       0    85.0
 240          UD   0.301
              *

 241          KK  OCRMJE
 242          KM   FLOW SPLIT AT MAJOR AND CENTER
 243          KM   DIVERT OUT FLOW IN CENTER STREET
 244          DT  DCRMJE
 245          DI       0      50     300
 246          DQ       0      25     150
              *

 247          KK ROCRMJE
 248          KM   MAJOR
 249          RD    5125   0.017    .015       0    TRAP      80       0
              *
```



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

 250          KK     CP9
 251          KM   COMBINE RBEPVE, RBRMJE, AND ROCRMJE
 252          HC       3
              *

 253          KK   WSPVE
 254          BA   0.265
 255          PB    2.86
 256          LS       0    79.0
 257          UD   0.420
              *

 258          KK    CP10
 259          KM   COMBINE CP9, AND WSPVE
 260          KM   AT WARM SPRINGS AND PALO VERDE
 261          HC       2
              *

 262          KK   OCP10
 263          KM   OVERFLOW AT WARM SPRINGS AND PALO VERDE
 264          KM   DIVERT OUT FLOW IN STORM DRAIN
 265          DT   DCP10
 266          DI       0     428     600
 267          DQ       0     125     125
              *

 268          KK  ROCP10
 269          KM   WARM SPRINGS
 270          RD    1200   0.009     015       0    TRAP     100       0
              *

 271          KK  DCRMJE
 272          KM   RECALL FLOW FROM MAJOR AND CENTER, FLOW IN CENTER STREET
 273          DR  DCRMJE
              *

 274          KK RDCRMJE
 275          KM   CENTER
 276          RD    4860   0.020    .015       0    TRAP     100       0
              *

 277          KK   WSCRE
 278          BA   0.161
 279          PB    2.86
 280          LS       0    79.3
 281          UD   0.265
              *

 282          KK    CP11
 283          KM   COMBINE ROCP10, RDCRMJE, AND WSCRE
 284          KM   AT WARM SPRINGS AND CENTER
 285          HC       3
              *
```



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

 286          KK   OCP11
 287          KM   OVERFLOW AT WARM SPRINGS AND CENTER
 288          KM   DIVERT OUT FLOW IN STORM DRAIN
 289          DT   DCP11
 290          DI       0     491     600
 291          DQ       0     138     138
              *

 292          KK  ROCP11
 293          KM   CENTER
 294          RD    3050   0.018    .015       0    TRAP     100       0
              *

 295          KK   BELME
```

```
 296          BA   0.345
 297          PB    2.86
 298          LS       0    84.3
 299          UD   0.339
              *

 300          KK  RBKLME
 301          KM   LAKE MEAD  EARTH CHANNEL
 302          RD    3070   0.013    .030       0    TRAP       40        3
              *

 303          KK   WSLME
 304          BA   0.286
 305          PB    2.86
 306          LS       0    82.8
 307          UD   0.310
              *

 308          KK    CP12
 309          KM   COMBINE RBKLM AND WSLM
 310          KM   AT WARM SPRINGS AND LAKE MEAD
 311          HC       2
              *

 312          KK   OCP12
 313          KM   OVERFLOW AT WARM SPRINGS AND LAKE MEAD
 314          KM   DIVERT OUT FLOW IN CULVERT
 315          DT   DCP12
 316          DI       0      171      234    450.5      560
 317          DQ       0      171      234    240.5      251
              *

 318          KK   CRLME
 319          BA   0.045
 320          PB    2.86
 321          LS       0    79.8
 322          UD   0.170
              *
```



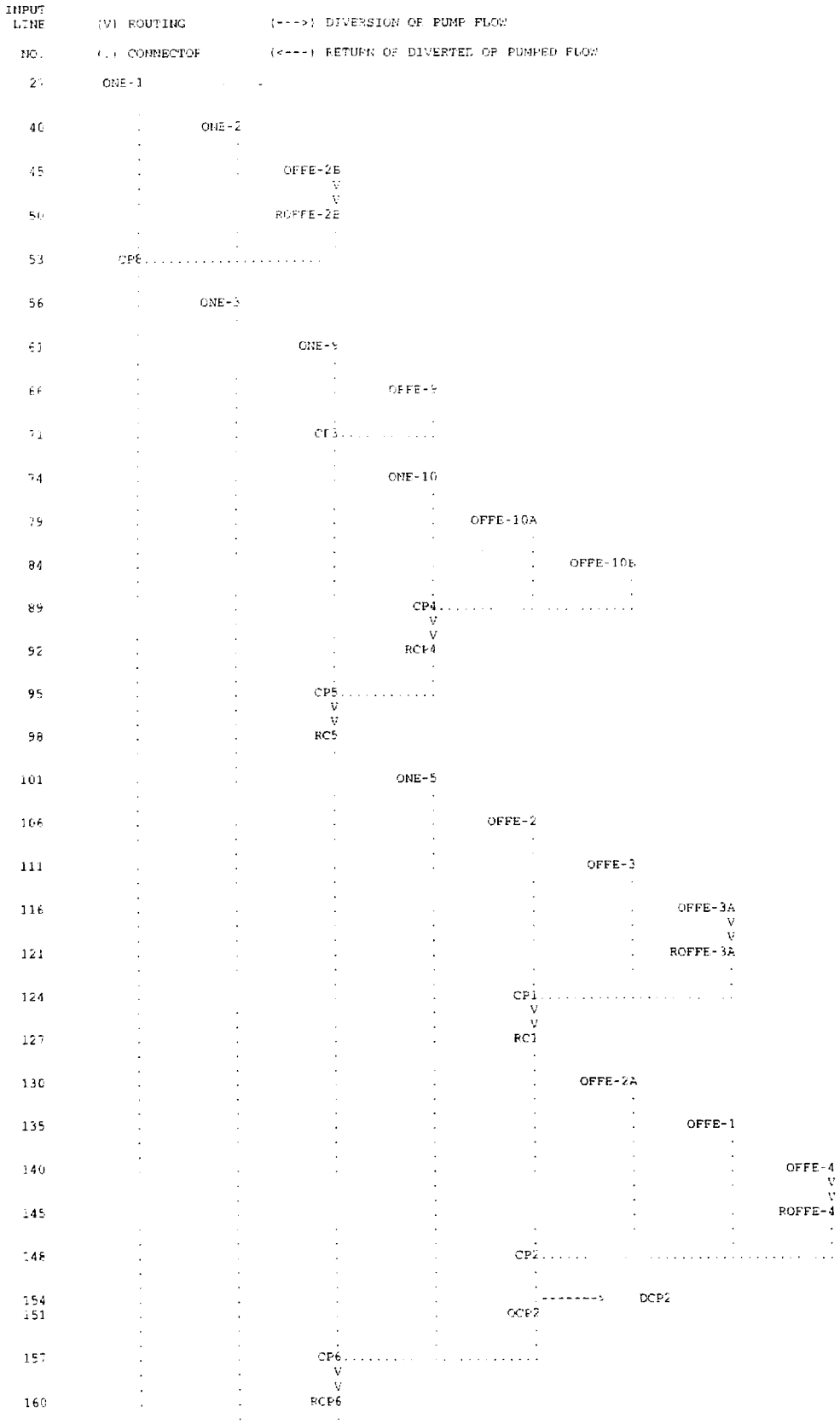
```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 323          KK   DCP11
 324          KM   RECALL FLOW FROM WARM SPRINGS AND CENTER
 325          KM   FLOW IN STORM DRAIN, THEN EARTH CHANNEL
 326          DF   DCP11
              *

 327          KK  RDCP11
 328          KM   STORM DRAIN IN WARM SPRINGS
 329          RD    1200   0.013    .013       0    TRAP       8        0
              *

 330          KK    CP13
 331          KM   COMBINE OCP12, CRLM, AND RDCP11
 332          HC       3
              *

 333          KK   OCP13
 334          KM   OVERFLOW AT CENTER AND LAKE MEAD
 335          KM   FLOW FROM CRLM
 336          KM   DIVERT OUT FLOW IN 24" CMP CULVERT UNDER LM
 337          DT   DCP13
 338          DI       0       17     1000
 339          DQ       0       17       17
              *

 340          KK   PWLME
 341          BA   0.294
 342          PB    2.86
 343          LS       0    82.9
 344          UD   0.303
              *

 345          KK   DCP10
 346          KM   RECALL FLOW FROM WARM SPRINGS AND PALO VERDE, FLOW IN STORM DRAIN
 347          DF   DCP10
              *

 348          KK  RDCP10
 349          KM   CONCRETE CHANNEL, CENTER STREET, EARTH CHANNEL IN LAKE MEAD
 350          RD    4200   0.013    .015       0    TRAP     100        0
              *

 351          KK    CP14
 352          KM   COMBINE RDCP11, OCP13, PWLME, AND RDCP10
 353          KM   AT PAWNEE AND LAKE MEAD (UPSTREAM OF 10X3 CULVERT)
 354          HC       4
              *

 355          KK   OCP14
 356          KM   DIVERT FLOW UNDER LAKE MEAD THROUGH A 3'x10' RCB
 357          DT   DCP14
 358          DI       0      230     1000
 359          DQ       0      230      230
              *
```

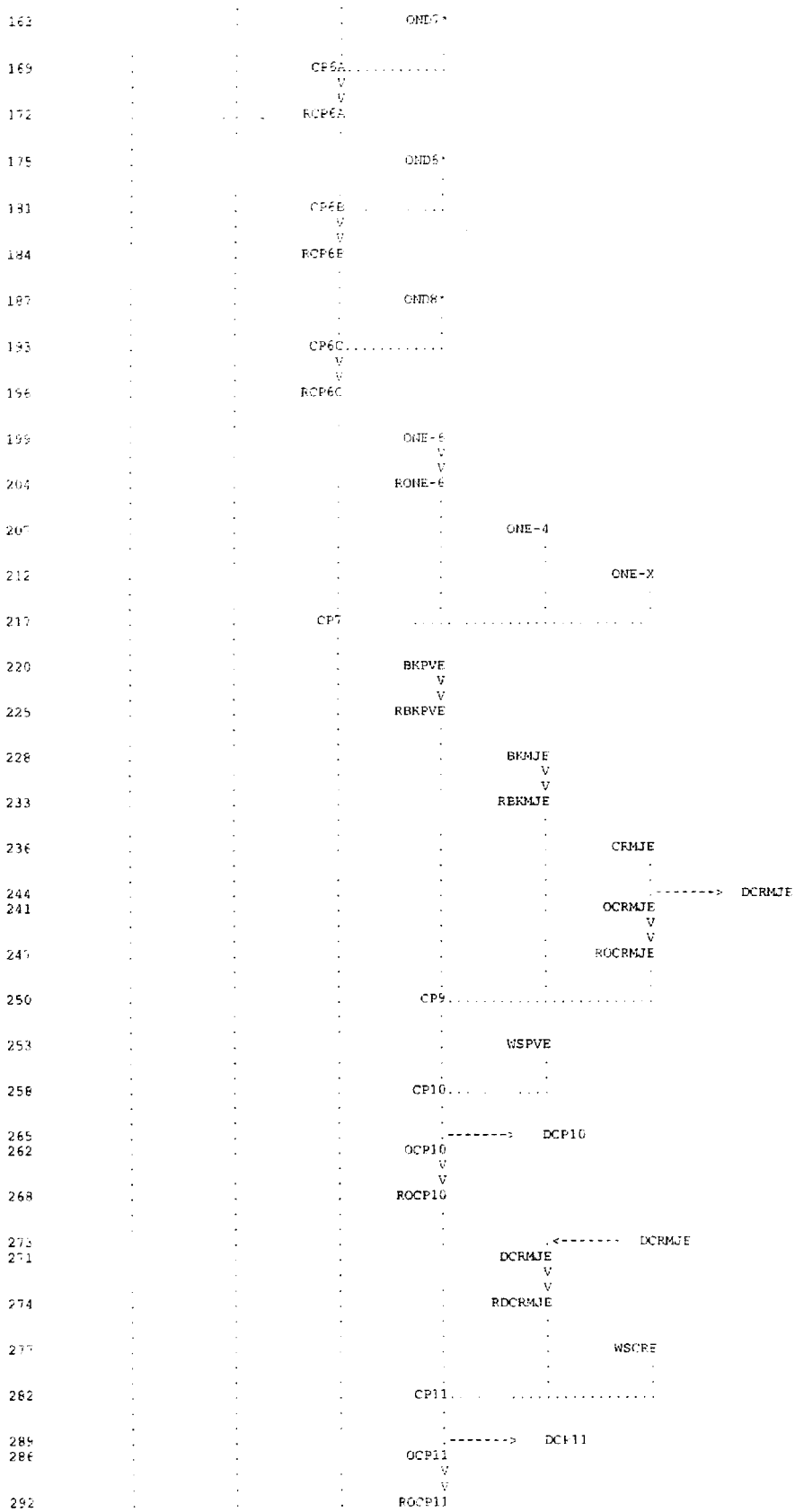
```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 360          KK      DE
 361          BA   0.055
 362          PB    2.86
 363          LS     0   86.29
 364          UD   0.165
              *

 365          KK    CP15
 366          KM   COMBINE OCP14 AND DE
 367          KM   TOTAL FLOW ON SOUTH SIDE OF LAKE MEAD PARKWAY
 368          HC       2
              *

 369          KK   DCP12
 370          KM   RECALL FLOW FROM WS AND LM
 371          KM   FLOW ON SOUTH SIDE OF LM
 372          DR   DCP12
              *

 373          KK   DCP13
 374          KM   RECALL FLOW FROM CENTER AND LAKE MEAD, FLOW FROM 24' CMP CULVERT
 375          DR   DCP13
              *

 376          KK   DCP14
 377          KM   RECALL FLOW FROM CP14
 378          DR   DCP14
              *

 379          KK    CP16
 380          KM   COMBINE DCP12,DCP13, AND DCP14
 381          KM   FLOW ON NORTH SIDE OF LAKE MEAD
 382          HC       3
              *

 383          KK    CP17
 384          KM   COMBINE ALL FLOWS UPSTREAM OF MOHAWK DRIVE
 385          KM   ALL FLOW DRAINS OVER LAKE MEAD PARKWAY TO THE NORTH SIDE
 386          HC       2
              *

 387          KK   RCP17
 388          KM   NATURAL CHANNEL ALONG EARTH BERM
 389          RD    2300   0.011     .03       0    TRAP      20       0
              *

 390          KK      EE
 391          BA   0.032
 392          PB    2.86
 393          LS       0    82.2
 394          UD   0.138
              *
```

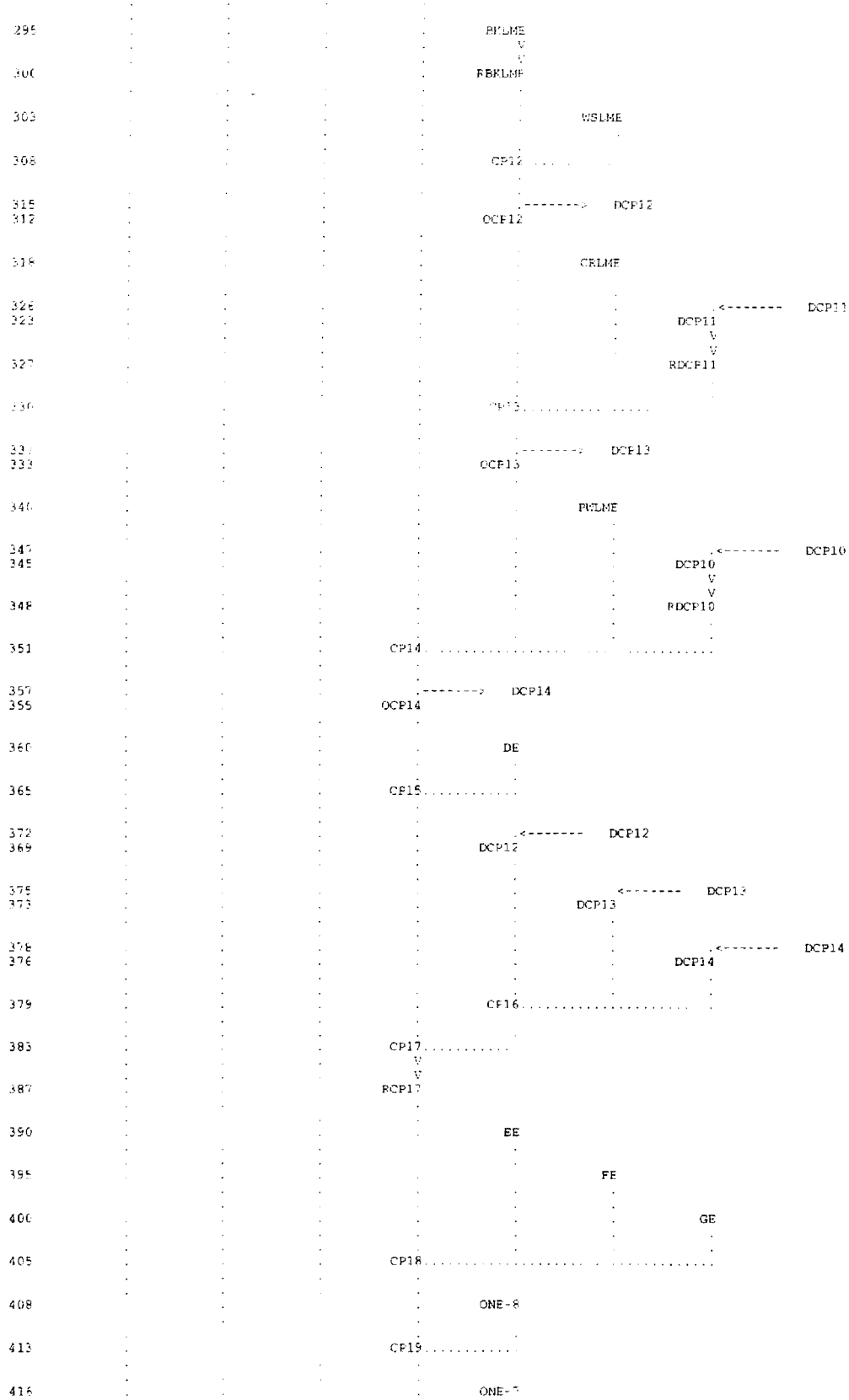


```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 395          KK      FE
 396          BA   0.014
 397          PB    2.86
 398          LS       0   77.77
 399          UD   0.124
              *

 400          KK      GE
 401          BA   0.015
 402          PB    2.86
 403          LS       0   81.20
 404          UD   0.113
              *

 405          KK    CP18
 406          KM   COMBINE ALL FLOWS ON THE NORTH SIDE OF LAKE MEAD PARKWAY
 407          HC       4
              *

 408          KK   ONE-8
 409          BA   0.204
 410          PB    2.86
 411          LS       0    69.8
 412          UD   0.243
              *

 413          KK    CP19
 414          KM   COMBINE CP18 WITH ONE-8
 415          HC       2
              *

 416          KK   ONE-9
 417          BA   0.208
 418          PB    2.86
 419          LS       0   80.41
 420          UD   0.081
              *

 421          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK




163 ONE-5*
169 CP5A
172 ROCP5A
175 ONE-8*
181 CP6B
184 ROCP6B
187 ONE-9*
193 CP6C
196 ROCP6C
199 ONE-6
204 RONE-6
207 ONE-4
212 ONE-X
217 CP7
220 BKPVE
225 RBKPVE
228 BKMJE
233 RBKMJE
236 CRMJE
244 DCRMJE
241 OCRMJE
240 ROCRMJE
250 CP9
253 WSPVE
258 CP10
265 DCP10
262 OCP10
268 ROCP10
270 DCRMJE
271 DCRMJE
274 RDCRMJE
277 WSCRE
282 CP11
289 DCP11
286 OCP11
292 ROCP11


295 RWLME
300 RBRLME
303 WSLME
308 CP12
315 DCP12
312 OCP12
318 CRLME
326 DCP11
323 DCP11
327 RDCP11
330 CP13
337 DCP13
333 OCP13
340 RWLME
347 DCP10
345 DCP10
348 RDCP10
351 CP14
357 DCP14
355 OCP14
360 DE
365 CP15
372 DCP12
369 DCP12
375 DCP13
373 DCP13
378 DCP14
376 DCP14
379 CP16
383 CP17
387 RCP17
390 EE
395 FE
400 GE
405 CP18
408 ONE-8
413 CP19
416 ONE-7

```
 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   30AUG05  TIME  14:18:56   *
*                                       *
*****************************************

*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*         (916) 756-1104                *
*                                       *
*****************************************

*******************************************
*                                         *
*    CLOMR FOR C-1 CHANNEL-LAKE MEAD CHANNEL *
*    IMPROVEMENTS                         *
*    MODEL:EXISTING CONDITIONS            *
*    FILE NAME:C1CLEX.DAT                 *
*    DATE:8/28/2005                       *
*    HYDROLOGIST: MAHESH KUMAR,PBS&J      *
*    STORM DISTRIBUTION = SDN#3           *
*    DESIGN STORM = 100 YEAR, 6 HOUR      *
*                                         *
*******************************************

                        DRAINAGE AREA
                        (SQUARE MILES)   DARF
                             0-0.5         .99
                             0.5-1         .975
                              1-2          .95
                              2-3          .925
                              3-4          .915
                              4-5          .908

  24 IC          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
                    .99       .98       .95       .93       .92       .91
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  RATIO 3  RATIO 4  RATIO 5  RATIO 6
                                                             .99      .98      .95      .93      .92      .91

 HYDROGRAPH AT
 -                ONE-1        .07     1   FLOW             64.      62.      59.      56.      55.      54.
                                              TIME           3.58     3.58     3.58     3.58     3.58     3.58

 HYDROGRAPH AT
 -                ONE-2        .17     1   FLOW            119.     116.     110.     104.     102.     100.
                                              TIME           3.67     3.67     3.67     3.67     3.67     3.67

 HYDROGRAPH AT
 +                OFFE-2E      .09     1   FLOW             56.      55.      52.      49.      48.      47.
                                              TIME           3.75     3.75     3.75     3.75     3.75     3.75

 ROUTED TO
 -                ROFFE-2E     .09     1   FLOW             56.      54.      52.      49.      48.      47.
                                              TIME           3.83     3.83     3.83     3.83     3.83     3.83

   3 COMBINED AT
 .                CP8          .33     1   FLOW            204.     198.     187.     176.     172.     169.

                                                                                                  Page 11
```

				TIME	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT										
+	ONE-3	.27	1	FLOW	331.	323.	309.	296.	291.	287.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	ONE-9	.34	1	FLOW	273.	265.	251.	238.	232.	229.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	OFFE-9	.06	1	FLOW	90.	88.	85.	82.	80.	79.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT										
+	CP3	.40	1	FLOW	363.	353.	336.	319.	313.	308.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	ONE-10	.09	1	FLOW	104.	102.	97.	93.	91.	90.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	OFFE-10A	.10	1	FLOW	116.	114.	109.	104.	102.	101.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	OFFE-10B	.04	1	FLOW	52.	51.	49.	47.	46.	45.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT										
+	CP4	.23	1	FLOW	273.	266.	255.	244.	240.	237.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO										
+	RCP4	.23	1	FLOW	263.	257.	247.	226.	222.	225.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT										
+	CP5	.63	1	FLOW	589.	574.	548.	513.	503.	498.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO										
+	RC5	.63	1	FLOW	593.	578.	553.	518.	508.	504.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	ONE-5	.87	1	FLOW	1044.	1018.	977.	935.	919.	907.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	OFFE-2	.09	1	FLOW	75.	73.	69.	66.	64.	63.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT										
+	OFFE-3	.30	1	FLOW	238.	232.	222.	211.	207.	204.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT										
+	OFFE-3A	.03	1	FLOW	46.	45.	43.	42.	41.	40.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
ROUTED TO										
+	ROFFE-3A	.03	1	FLOW	42.	41.	40.	37.	37.	37.
				TIME	3.67	3.67	3.75	3.75	3.75	3.75
3 COMBINED AT										
+	CP1	.42	1	FLOW	350.	340.	324.	305.	302.	298.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO										
+	RC1	.42	1	FLOW	349.	340.	324.	309.	304.	299.
				TIME	3.75	3.75	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	OFFE-2A	.02	1	FLOW	21.	20.	19.	18.	18.	18.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	OFFE-1	.41	1	FLOW	432.	422.	405.	388.	381.	377.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT										
+	OFFE-4	.49	1	FLOW	354.	345.	329.	314.	308.	304.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO										
+	ROFFE-4	.49	1	FLOW	352.	343.	328.	314.	308.	304.
				TIME	4.00	4.08	4.08	4.08	4.08	4.08
4 COMBINED AT										
+	CP2	1.34	1	FLOW	917.	892.	851.	810.	794.	782.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
DIVERSION TO										
-	DCP2	1.34	1	FLOW	238.	229.	213.	198.	192.	187.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										

+	OCP2	1.34	1	FLOW	679.	664.	638.	612.	602.	595.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
3 COMBINED AT										
+	CP6	2.83	1	FLOW	1913.	1864.	1785.	1700.	1669.	1647.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO										
+	RCP6	2.83	1	FLOW	1907.	1856.	1773.	1691.	1657.	1636.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT										
+	OND7*	.01	1	FLOW	20.	20.	19.	19.	19.	18.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT										
+	CP6A	2.85	1	FLOW	1915.	1864.	1781	1699.	1664	1643
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO										
+	RCP6A	2.85	1	FLOW	1899	1848.	1764.	1681.	1647.	1626.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT										
+	OND6*	.06	1	FLOW	79.	78.	75.	73.	72.	71.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT										
+	CP6B	2.91	1	FLOW	1972.	1920.	1832.	1747.	1713.	1691.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO										
+	RCP6B	2.91	1	FLOW	1940.	1889.	1806.	1725.	1691	1669.
				TIME	3.75	3.75	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	OND8*	.02	1	FLOW	35.	34.	33.	32	31.	31.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT										
+	CP6C	2.93	1	FLOW	1956.	1905.	1817.	1734.	1701.	1679.
				TIME	3.75	3.75	3.75	3.83	3.83	3.83
ROUTED TO										
+	RCP6C	2.93	1	FLOW	1952.	1900	1819.	1732.	1701.	1679.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	ONE-6	1.01	1	FLOW	668.	650.	621.	592.	581.	573.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO										
+	RONE-6	1.01	1	FLOW	670.	652.	623.	594.	582.	574.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT										
+	ONE-4	.19	1	FLOW	149.	145.	138.	130.	128.	126.
				TIME	3.58	3.58	3.58	3.67	3.67	3.67
HYDROGRAPH AT										
+	ONE-X	.22	1	FLOW	161.	157.	148.	140.	137.	135.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
4 COMBINED AT										
+	CP7	4.35	1	FLOW	2740.	2666.	2546.	2422.	2376.	2343.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	BKPVE	.14	1	FLOW	124.	121.	116.	111.	109.	108.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO										
+	RBKPVE	.14	1	FLOW	125.	122.	117.	112.	110.	109.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
+	BKMJE	.03	1	FLOW	40.	39.	38.	36.	36.	35.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO										
+	RBKMJE	.03	1	FLOW	42.	42.	41.	39.	41.	40.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	CRMJE	.21	1	FLOW	192.	187.	180.	172	169.	167.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
DIVERSION TO										
+	DCRMJE	.21	1	FLOW	96.	94.	90.	86.	85.	84
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT										
+	OCRMJE	21	1	FLOW	96	94.	90.	86.	85.	84.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO										
+	ROCRMJE	.21	1	FLOW	97.	95.	91.	87.	85.	84.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92

3 COMBINED AT										
+	CP9	.38	1	FLOW	260.	253.	243.	233.	228.	225.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
-	WSPVE	26	1	FLOW	154.	150.	143.	136.	133.	131.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
2 COMBINED AT										
+	CP10	.64	1	FLOW	414.	403.	386.	369.	361.	356.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
DIVERSION TO										
-	DCP10	.64	1	FLOW	121.	118.	113.	108.	105.	104.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
+	OCP10	.64	1	FLOW	293.	286.	273.	261.	255.	252.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO										
-	ROCP10	64	1	FLOW	293.	286.	272.	261.	257.	251.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
+	OCRMJE	.00	1	FLOW	96.	94.	90.	86.	85.	84.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO										
+	ROCRMJE	00	1	FLOW	9.	95.	9.	87.	85.	84.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
+	WSCRE	.16	1	FLOW	119.	115.	110.	104.	102.	101.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
3 COMBINED AT										
+	CP11	.81	1	FLOW	479.	468.	446.	426.	420.	412.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
DIVERSION TO										
-	DCP11	.81	1	FLOW	135.	131.	125.	120.	118.	116.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
+	OCP11	.81	1	FLOW	344.	336.	321.	307.	302.	296.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO										
+	ROCP11	.81	1	FLOW	350.	340.	323.	306.	301.	297.
				TIME	3.92	3.92	3.92	3.92	4.00	4.00
HYDROGRAPH AT										
+	BKLME	.34	1	FLOW	294.	286.	274.	263.	258.	254.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO										
+	RBKLME	.34	1	FLOW	293.	286.	274.	262.	257.	254.
				TIME	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT										
+	WSLME	.29	1	FLOW	238.	232.	222.	212.	208.	205.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT										
-	CP12	63	1	FLOW	520.	507.	485.	464.	455.	450.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
DIVERSION TO										
-	DCP12	.63	1	FLOW	247.	246.	244.	242.	241.	240.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	OCP12	.63	1	FLOW	273.	261.	242.	222.	215.	209.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	CRLME	.05	1	FLOW	37.	36.	34.	32.	31.	31.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
-	DCP11	.00	1	FLOW	135.	131.	125.	120.	118.	116.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO										
-	RDCP11	.00	1	FLOW	134.	131.	125.	119.	117.	115.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
3 COMBINED AT										
+	CP13	.68	1	FLOW	424.	408.	380.	353.	343.	335.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
DIVERSION TO										
+	DCP13	.68	1	FLOW	17.	17.	17.	17.	17.	17.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42
HYDROGRAPH AT										
-	OCP13	.68	1	FLOW	407.	391.	363.	336.	326.	318.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83

HYDROGRAPH AT										
-	PWLME	.29	1	FLOW	248.	242.	231.	221.	217.	214.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT										
+	DCP10	.00	1	FLOW	121.	118.	113.	108.	105.	104.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO										
+	RDCP10	.00	1	FLOW	131.	127.	120.	113.	111.	110.
				TIME	4.00	4.00	4.00	4.00	4.08	4.08
4 COMBINED AT										
+	CP14	1.78	1	FLOW	1024.	989.	928.	871.	849.	831.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
DIVERSION TO										
+	DCP14	1.78	1	FLOW	230.	230.	230.	230.	230.	230.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	OCP14	1.78	1	FLOW	794.	759.	699.	641.	619.	601.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
-	DE	.05	1	FLOW	61.	65.	63.	60.	59.	58.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT										
+	CP15	1.82	1	FLOW	820.	785.	724.	666.	643.	625.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
	DCP17	.00	1	FLOW	247.	246.	244.	242.	241.	240.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	DCP13	.00	1	FLOW	17.	17.	17.	17.	17.	17.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42
HYDROGRAPH AT										
+	DCP14	.00	1	FLOW	230.	230.	230.	230.	230.	230.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT										
+	CP16	.00	1	FLOW	494.	493.	491.	489.	488.	487.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT										
+	CP17	1.83	1	FLOW	1312.	1275.	1213.	1151.	1127.	1108.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO										
+	RCP17	1.83	1	FLOW	1294.	1255.	1189.	1126.	1101.	1083.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
+	EE	.03	1	FLOW	36.	35.	33.	32.	31.	31.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	FE	.01	1	FLOW	13.	12.	12.	11.	11.	11.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT										
+	GE	.01	1	FLOW	16.	16.	15.	15.	14.	14.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
4 COMBINED AT										
+	CP18	1.89	1	FLOW	1314.	1275.	1208.	1145.	1119.	1101.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
+	ONE-8	.20	1	FLOW	85.	82.	76.	71.	69.	68.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT										
+	CP19	2.10	1	FLOW	1379.	1337.	1266.	1200.	1172.	1153.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT										
+	ONE-7	.21	1	FLOW	241.	235.	224.	213.	209.	206.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	INTERPOLATED TO COMPUTATION INTERVAL PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .00									
ROUTE-2E	MANE	4.75	55.72	228.00	.89	5.00	55.56	230.00	.89

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4382E+01 EXCESS= .0000E+00 OUTFLOW= .4385E+01 BASIN STORAGE= .1369E-02 PERCENT ERROR= -.1

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          FOR PLAN = 1  RATIO=  .00
          ROFFE-2E  MANE          4.75     53.88    228.00       .87       5.00     53.78    230.00          .86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4246E+01 EXCESS= .0000E+00 OUTFLOW= .4249E+01 BASIN STORAGE= .1348E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
          ROFFE-2E  MANE          4.50     52.20    229.50       .82       5.00     52.02    230.00          .82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4032E+01 EXCESS= .0000E+00 OUTFLOW= .4035E+01 BASIN STORAGE= .1322E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
          ROFFE-2E  MANE          4.25     48.84    229.50       .78       5.00     48.74    230.00          .78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3806E+01 EXCESS= .0000E+00 OUTFLOW= .3809E+01 BASIN STORAGE= .1519E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
          ROFFE-2E  MANE          4.25     47.66    229.50       .76       5.00     47.57    230.00          .76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3779E+01 EXCESS= .0000E+00 OUTFLOW= .3782E+01 BASIN STORAGE= .1501E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
          ROFFE-2E  MANE          4.25     46.85    229.50       .75       5.00     46.75    230.00          .75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3659E+01 EXCESS= .0000E+00 OUTFLOW= .3661E+01 BASIN STORAGE= .1456E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCP4  MANE          5.00    262.93    225.00      1.38       5.00    262.93    225.00         1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1678E+02 EXCESS= .0000E+00 OUTFLOW= .1680E+02 BASIN STORAGE= .2236E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCP4  MANE          5.00    256.95    225.00      1.35       5.00    256.95    225.00         1.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1636E+02 EXCESS= .0000E+00 OUTFLOW= .1637E+02 BASIN STORAGE= .2211E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCP4  MANE          5.00    246.97    225.00      1.29       5.00    246.97    225.00         1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1566E+02 EXCESS= .0000E+00 OUTFLOW= .1568E+02 BASIN STORAGE= .2170E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCP4  MANE          4.75    234.43    223.25      1.23       5.00    225.91    225.00         1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1496E+02 EXCESS= .0000E+00 OUTFLOW= .1497E+02 BASIN STORAGE= .2770E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCP4  MANE          4.75    230.28    223.25      1.21       5.00    222.06    225.00         1.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1468E+02 EXCESS= .0000E+00 OUTFLOW= .1469E+02 BASIN STORAGE= .2748E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCP4  MANE          4.50    225.05    225.00      1.19       5.00    225.05    225.00         1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1450E+02 EXCESS= .0000E+00 OUTFLOW= .1451E+02 BASIN STORAGE= .2376E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
               RC5  MANE          5.00    593.19    230.00      1.21       5.00    593.19    230.00         1.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4058E+02 EXCESS= .0000E+00 OUTFLOW= .4060E+02 BASIN STORAGE= .3331E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
               RC5  MANE          5.00    577.96    230.00      1.18       5.00    577.96    230.00         1.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3950E+02 EXCESS= .0000E+00 OUTFLOW= .3952E+02 BASIN STORAGE= .3302E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
               RC5  MANE          5.00    552.58    230.00      1.13       5.00    552.58    230.00         1.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3771E+02 EXCESS= .0000E+00 OUTFLOW= .3773E+02 BASIN STORAGE= .3254E-02 PERCENT ERROR=   -.1
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FOR PLAN = 1 RATIO= .00
RC5 MANE 5.00 518.06 230.00 1.07 5.00 518.08 230.00 1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3591E+02 EXCESS= .0000E+00 OUTFLOW= .3593E+02 BASIN STORAGE= .2943E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RC5 MANE 5.00 508.16 230.00 1.05 5.00 508.16 230.00 1.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3521E+02 EXCESS= .0000E+00 OUTFLOW= .3523E+02 BASIN STORAGE= .2925E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RC5 MANE 5.00 503.77 230.00 1.04 5.00 503.77 230.00 1.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3480E+02 EXCESS= .0000E+00 OUTFLOW= .3482E+02 BASIN STORAGE= .2886E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
ROFFE-3A MANE 3.50 42.76 220.50 1.67 5.00 41.94 220.00 1.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2674E+01 EXCESS= .0000E+00 OUTFLOW= .2671E+01 BASIN STORAGE= .3172E-02 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .00
ROFFE-3A MANE 3.50 41.90 224.00 1.64 5.00 40.95 220.00 1.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2614E+01 EXCESS= .0000E+00 OUTFLOW= .2611E+01 BASIN STORAGE= .3145E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
ROFFE-3A MANE 3.75 40.67 221.25 1.57 5.00 39.68 225.00 1.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2514E+01 EXCESS= .0000E+00 OUTFLOW= .2511E+01 BASIN STORAGE= .2633E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
ROFFE-3A MANE 4.00 38.49 224.00 1.50 5.00 37.39 225.00 1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2406E+01 EXCESS= .0000E+00 OUTFLOW= .2403E+01 BASIN STORAGE= .3214E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
ROFFE-3A MANE 4.25 37.60 221.00 1.48 5.00 37.06 225.00 1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2366E+01 EXCESS= .0000E+00 OUTFLOW= .2364E+01 BASIN STORAGE= .3474E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
ROFFE-3A MANE 4.25 37.15 221.00 1.46 5.00 36.69 225.00 1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2338E+01 EXCESS= .0000E+00 OUTFLOW= .2337E+01 BASIN STORAGE= .3459E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RC1 MANE 5.00 349.32 225.00 1.20 5.00 349.32 225.00 1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2691E+02 EXCESS= .0000E+00 OUTFLOW= .2692E+02 BASIN STORAGE= .1473E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RC1 MANE 5.00 339.62 225.00 1.17 5.00 339.62 225.00 1.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2619E+02 EXCESS= .0000E+00 OUTFLOW= .2620E+02 BASIN STORAGE= .1453E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RC1 MANE 5.00 324.13 230.00 1.12 5.00 324.13 230.00 1.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2499E+02 EXCESS= .0000E+00 OUTFLOW= .2501E+02 BASIN STORAGE= .1445E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RC1 MANE 5.00 309.41 230.00 1.07 5.00 309.41 230.00 1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2381E+02 EXCESS= .0000E+00 OUTFLOW= .2382E+02 BASIN STORAGE= .1622E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RC1 MANE 5.00 303.51 230.00 1.04 5.00 303.51 230.00 1.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2334E+02 EXCESS= .0000E+00 OUTFLOW= .2335E+02 BASIN STORAGE= .1568E-02 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=   .00
               RC1  MANE          5.00    299.46    230.00       1.02       5.00    299.46    230.00         1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW=  2301E+02 EXCESS= .0000E+00 OUTFLOW= .2302E+02 BASIN STORAGE= .1557E-02 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=   .00
           ROFFE-4  MANE          5.00    352.08    240.00       1.28       5.00    352.08    240.00         1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3305E+02 EXCESS= .0000E+00 OUTFLOW= .3307E+02 BASIN STORAGE= .3609E-02 PERCENT ERROR=    -.1

          FOR PLAN = 1  RATIO=   .00
           ROFFE-4  MANE          5.00    343.01    245.00       1.25       5.00    343.01    245.00         1.25

CONTINUITY SUMMARY (AC-FT) - INFLOW=  3219E+02 EXCESS=  0000E+00 OUTFLOW= .3221E+02 BASIN STORAGE= .3763E-02 PERCENT ERROR=    -.1

          FOR PLAN = 1  RATIO=   .00
           ROFFE-4  MANE          5.00    328.47    245.00       1.19       5.00    328.47    245.00         1.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3076E+02 EXCESS= .0000E+00 OUTFLOW= .3078E+02 BASIN STORAGE= .3666E-02 PERCENT ERROR=    -.1

          FOR PLAN = 1  RATIO=   .00
           ROFFE-4  MANE          5.00    313.97    245.00       1.14       5.00    313.97    245.00         1.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2934E+02 EXCESS= .0000E+00 OUTFLOW= .2937E+02 BASIN STORAGE= .3608E-02 PERCENT ERROR=    -.1

          FOR PLAN = 1  RATIO=   .00
           ROFFE-4  MANE          5.00    308.19    245.00       1.11       5.00    308.19    245.00         1.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2878E+02 EXCESS= .0000E+00 OUTFLOW= .2881E+02 BASIN STORAGE= .3577E-02 PERCENT ERROR=    -.1

          FOR PLAN = 1  RATIO=   .00
           ROFFE-4  MANE          5.00    304.15    245.00       1.10       5.00    304.15    245.00         1.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2839E+02 EXCESS=  0000E+00 OUTFLOW= .2841E+02 BASIN STORAGE= .3554E-02 PERCENT ERROR=    -.1

          FOR PLAN = 1  RATIO=   .00
              RCP6  MANE          2.45   1907.79    225.44       1.23       5.00   1906.85    225.00         1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1857E+03 EXCESS= .0000E+00 OUTFLOW= .1857E+03 BASIN STORAGE= .9924E-03 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=   .00
              RCP6  MANE          2.47   1857.59    224.43       1.20       5.00   1856.33    225.00         1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1812E+03 EXCESS= .0000E+00 OUTFLOW= .1811E+03 BASIN STORAGE=  9043E-03 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=   .00
              RCP6  MANE          2.49   1773.98    224.46       1.15       5.00   1773.35    225.00         1.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1736E+03 EXCESS= .0000E+00 OUTFLOW= .1736E+03 BASIN STORAGE= .8246E-03 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=   .00
              RCP6  MANE          2.52   1691.64    224.63       1.10       5.00   1691.09    225.00         1.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1663E+03 EXCESS= .0000E+00 OUTFLOW=  1662E+03 BASIN STORAGE=  9109E-03 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=   .00
              RCP6  MANE          2.54   1658.98    225.71       1.08       5.00   1656.81    225.00         1.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1633E+03 EXCESS= .0000E+00 OUTFLOW= .1633E+03 BASIN STORAGE= .9079E-03 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=   .00
              RCP6  MANE          2.54   1637.61    226.39       1.07       5.00   1635.87    225.00         1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1614E+03 EXCESS= .0000E+00 OUTFLOW=  1614E+03 BASIN STORAGE= .9887E-03 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=   .00
             RCP6A  MANE          1.46   1908.35    226.53       1.23       5.00   1899.08    225.00         1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1868E+03 EXCESS= .0000E+00 OUTFLOW= .1868E+03 BASIN STORAGE= .4965E-03 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=   .00
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RCP6A	MANE	1.47	1857.68	226.58	1.20	5.00	1848.27	225.00	1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1823E+03 EXCESS= .0000E+00 OUTFLOW= .1823E+03 BASIN STORAGE= .5653E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

RCP6A	MANE	1.49	1774.23	226.21	1.15	5.00	1763.56	225.00	1.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1747E+03 EXCESS= .0000E+00 OUTFLOW= .1747E+03 BASIN STORAGE= .5586E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6A	MANE	1.51	1689.64	225.89	1.10	5.00	1680.93	225.00	1.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1673E+03 EXCESS= .0000E+00 OUTFLOW= .1673E+03 BASIN STORAGE= .5923E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6A	MANE	1.51	1656.18	227.05	1.08	5.00	1647.15	225.00	1.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1644E+03 EXCESS= .0000E+00 OUTFLOW= .1644E+03 BASIN STORAGE= .5472E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6A	MANE	1.52	1636.99	226.26	1.07	5.00	1628.84	225.00	1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1624E+03 EXCESS= .0000E+00 OUTFLOW= .1624E+03 BASIN STORAGE= .5274E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6B	MANE	1.71	1964.20	226.96	1.24	5.00	1939.81	225.00	1.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1930E+03 EXCESS= .0000E+00 OUTFLOW= .1930E+03 BASIN STORAGE= .6648E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6B	MANE	1.72	1913.28	226.77	1.21	5.00	1888.62	225.00	1.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1884E+03 EXCESS= .0000E+00 OUTFLOW= .1884E+03 BASIN STORAGE= .6614E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6B	MANE	1.74	1824.35	227.68	1.16	5.00	1805.82	230.00	1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1805E+03 EXCESS= .0000E+00 OUTFLOW= .1805E+03 BASIN STORAGE= .5700E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6B	MANE	1.76	1742.35	226.88	1.12	5.00	1723.41	230.00	1.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1729E+03 EXCESS= .0000E+00 OUTFLOW= .1729E+03 BASIN STORAGE= .6308E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6B	MANE	1.77	1705.37	226.02	1.10	5.00	1691.34	230.00	1.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1699E+03 EXCESS= .0000E+00 OUTFLOW= .1699E+03 BASIN STORAGE= .6853E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6B	MANE	1.77	1685.94	226.98	1.08	5.00	1669.20	230.00	1.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1679E+03 EXCESS= .0000E+00 OUTFLOW= .1679E+03 BASIN STORAGE= .6795E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6C	MANE	2.07	1953.28	227.78	1.25	5.00	1951.76	230.00	1.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1951E+03 EXCESS= .0000E+00 OUTFLOW= .1951E+03 BASIN STORAGE= .6866E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6C	MANE	2.08	1906.39	229.30	1.22	5.00	1900.09	230.00	1.22

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1904E+03 EXCESS= .0000E+00 OUTFLOW= .1904E+03 BASIN STORAGE= .7357E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6C	MANE	2.11	1819.64	229.90	1.17	5.00	1818.91	230.00	1.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1825E+03 EXCESS= .0000E+00 OUTFLOW= .1825E+03 BASIN STORAGE= .7372E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6C	MANE	2.13	1735.40	228.36	1.12	5.00	1732.48	230.00	1.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1748E+03 EXCESS= .0000E+00 OUTFLOW= .1748E+03 BASIN STORAGE= .7334E-03 PERCENT ERROR= 0

FOR PLAN = 1 RATIO= .00

RCP6C	MANE	2.14	1704.90	229.44	1.10	5.00	1701.25	230.00	1.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1717E+03 EXCESS= .0000E+00 OUTFLOW= .1717E+03 BASIN STORAGE= .7008E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCP6C	MANE	2.15	1679.29	230.19	1.09	5.00	1679.09	230.00	1.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1697E+03 EXCESS= .0000E+00 OUTFLOW= .1697E+03 BASIN STORAGE= .7228E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-6	MANE	5.00	669.70	240.00	1.23	5.00	669.70	240.00	1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6625E+02 EXCESS= .0000E+00 OUTFLOW= .6626E+02 BASIN STORAGE= .2547E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-6	MANE	5.00	652.01	240.00	1.20	5.00	652.01	240.00	1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6449E+02 EXCESS= .0000E+00 OUTFLOW= .6450E+02 BASIN STORAGE= .2512E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-6	MANE	5.00	622.68	240.00	1.14	5.00	622.68	240.00	1.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6157E+02 EXCESS= .0000E+00 OUTFLOW= .6158E+02 BASIN STORAGE= .2454E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-6	MANE	5.00	593.53	240.00	1.09	5.00	593.53	240.00	1.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5868E+02 EXCESS= .0000E+00 OUTFLOW= .5869E+02 BASIN STORAGE= .2394E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-6	MANE	5.00	581.92	240.00	1.07	5.00	581.92	240.00	1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5753E+02 EXCESS= .0000E+00 OUTFLOW= .5755E+02 BASIN STORAGE= .2371E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RONE-6	MANE	5.00	573.82	240.00	1.05	5.00	573.82	240.00	1.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5673E+02 EXCESS= .0000E+00 OUTFLOW= .5675E+02 BASIN STORAGE= .2354E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RBKPVE	MANE	5.00	124.98	235.00	1.36	5.00	124.98	235.00	1.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1007E+02 EXCESS= .0000E+00 OUTFLOW= .1010E+02 BASIN STORAGE= .1000E-01 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .00

RBKPVE	MANE	5.00	122.08	235.00	1.33	5.00	122.08	235.00	1.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9816E+01 EXCESS= .0000E+00 OUTFLOW= .9843E+01 BASIN STORAGE= .9912E-02 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .00

RBKPVE	MANE	5.00	117.22	235.00	1.27	5.00	117.22	235.00	1.27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9394E+01 EXCESS= .0000E+00 OUTFLOW= .9421E+01 BASIN STORAGE= .9761E-02 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .00

RBKPVE	MANE	5.00	112.33	235.00	1.21	5.00	112.33	235.00	1.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8976E+01 EXCESS= .0000E+00 OUTFLOW= .9003E+01 BASIN STORAGE= .9608E-02 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .00

RBKPVE	MANE	5.00	110.36	235.00	1.19	5.00	110.36	235.00	1.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8810E+01 EXCESS= .0000E+00 OUTFLOW= .8837E+01 BASIN STORAGE= .9545E-02 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .00

RBKPVE	MANE	5.00	108.98	235.00	1.18	5.00	108.98	235.00	1.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9694E+01 EXCESS= .0000E+00 OUTFLOW= .9722E-01 BASIN STORAGE= .9502E-02 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .00

RBRMJE	MANE	5.00	42.25	230.00	1.50	5.00	42.25	230.00	1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2689E+01 EXCESS= .0000E+00 OUTFLOW= .2711E+01 BASIN STORAGE= .1078E-01 PERCENT ERROR= -1.2

FOR PLAN = 1 RATIO= .00

RBRMJE	MANE	5.00	41.65	230.00	1.46	5.00	41.65	230.00	1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2624E+01 EXCESS= .0000E+00 OUTFLOW= .2646E+01 BASIN STORAGE= .1070E-01 PERCENT ERROR= -1.2

FOR PLAN = 1 RATIO= .00

RBRMJE	MANE	5.00	40.59	230.00	1.40	5.00	40.59	230.00	1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2517E+01 EXCESS= .0000E+00 OUTFLOW= .2539E+01 BASIN STORAGE= .1058E-01 PERCENT ERROR= -1.2

FOR PLAN = 1 RATIO= .00

RBRMJE	MANE	5.00	39.47	230.00	1.34	5.00	39.47	230.00	1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2410E+01 EXCESS= .0000E+00 OUTFLOW= .2431E+01 BASIN STORAGE= .1046E-01 PERCENT ERROR= -1.2

FOR PLAN = 1 RATIO= .00

RBRMJE	MANE	5.00	40.53	230.00	1.32	5.00	40.53	230.00	1.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2368E+01 EXCESS= .0000E+00 OUTFLOW= .2390E+01 BASIN STORAGE= .1161E-01 PERCENT ERROR= -1.5

FOR PLAN = 1 RATIO= .00

RBRMJE	MANE	5.00	40.15	230.00	1.30	5.00	40.15	230.00	1.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2338E+01 EXCESS= .0000E+00 OUTFLOW= .2361E+01 BASIN STORAGE= .1158E-01 PERCENT ERROR= -1.5

FOR PLAN = 1 RATIO= .00

ROCRMJE	MANE	5.00	97.17	235.00	.73	5.00	97.17	235.00	.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7953E+01 EXCESS= .0000E+00 OUTFLOW= .7977E+01 BASIN STORAGE= .9940E-02 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .00

ROCRMJE	MANE	5.00	94.86	235.00	.71	5.00	94.86	235.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7758E+01 EXCESS= .0000E+00 OUTFLOW= .7783E+01 BASIN STORAGE= .9852E-02 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .00

ROCRMJE	MANE	5.00	90.95	235.00	.68	5.00	90.95	235.00	.68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7436E+01 EXCESS= .0000E+00 OUTFLOW= .7460E+01 BASIN STORAGE= .1140E-01 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .00

ROCRMJE	MANE	5.00	86.99	235.00	.65	5.00	86.99	235.00	.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7116E+01 EXCESS= .0000E+00 OUTFLOW= .7141E+01 BASIN STORAGE= .1123E-01 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .00

ROCRMJE	MANE	5.00	85.40	235.00	.64	5.00	85.40	235.00	.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6989E+01 EXCESS= .0000E+00 OUTFLOW= .7014E+01 BASIN STORAGE= .1117E-01 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .00

ROCRMJE	MANE	5.00	84.28	235.00	.63	5.00	84.28	235.00	.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6900E+01 EXCESS= .0000E+00 OUTFLOW= .6925E+01 BASIN STORAGE= .1112E-01 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .00

ROCP10	MANE	2.68	294.53	235.91	.74	5.00	292.85	235.00	.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2539E+02 EXCESS= .0000E+00 OUTFLOW= .2539E+02 BASIN STORAGE= .3285E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

ROCP10	MANE	2.71	287.84	235.64	.72	5.00	266.29	235.00	.72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2473E+02 EXCESS= .0000E+00 OUTFLOW= .2473E+02 BASIN STORAGE= .3365E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

ROCP10	MANE	2.76	272.84	234.34	.69	5.00	272.46	235.00	.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2360E+02 EXCESS= .0000E+00 OUTFLOW= .2361E+02 BASIN STORAGE= .3550E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

ROCP10	MANE	2.81	262.79	233.92	.66	5.00	260.69	235.00	.66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2253E+02 EXCESS= .0000E+00 OUTFLOW= .2253E+02 BASIN STORAGE= .3189E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

ROCP10	MANE	2.83	257.62	235.16	.64	5.00	257.08	235.00	.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2209E+02 EXCESS= .0000E+00 OUTFLOW= .2209E+02 BASIN STORAGE= .2871E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

ROCP10	MANE	2.85	253.48	236.45	.63	5.00	251.47	235.00	.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2179E+02 EXCESS= .0000E+00 OUTFLOW= .2179E+02 BASIN STORAGE= .2909E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCRMJE	MANE	5.00	97.17	235.00	-1.00	5.00	97.17	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCRMJE	MANE	5.00	94.87	235.00	-1.00	5.00	94.87	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCRMJE	MANE	5.00	91.03	235.00	-1.00	5.00	91.03	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCRMJE	MANE	5.00	87.08	235.00	-1.00	5.00	87.08	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCRMJE	MANE	5.00	85.50	235.00	-1.00	5.00	85.50	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCRMJE	MANE	5.00	84.39	235.00	-1.00	5.00	84.39	235.00	-1.00

FOR PLAN = 1 RATIO= .00

ROCP11	MANE	5.00	349.85	235.00	.71	5.00	349.85	235.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3066E+02 EXCESS= .0000E+00 OUTFLOW= .3068E+02 BASIN STORAGE= .7691E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROCP11	MANE	5.00	340.06	235.00	.70	5.00	340.06	235.00	.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2987E+02 EXCESS= .0000E+00 OUTFLOW= .2989E+02 BASIN STORAGE= .7643E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROCP11	MANE	5.00	323.25	235.00	.66	5.00	323.25	235.00	.66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2852E+02 EXCESS= .0000E+00 OUTFLOW= .2854E+02 BASIN STORAGE= .6653E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROCP11	MANE	5.00	306.26	235.00	.63	5.00	306.26	235.00	.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2720E+02 EXCESS= .0000E+00 OUTFLOW= .2725E+02 BASIN STORAGE= .7100E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROCP11	MANE	5.00	301.20	240.00	.62	5.00	301.20	240.00	.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2669E+02 EXCESS= .0000E+00 OUTFLOW= .2671E+02 BASIN STORAGE= .7295E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

ROCP11	MANE	5.00	296.62	240.00	.61	5.00	296.62	240.00	.61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2630E+02 EXCESS= .0000E+00 OUTFLOW= .2632E+02 BASIN STORAGE= .7274E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RBKLME	MANE	5.00	293.46	230.00	1.40	5.00	293.46	230.00	1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2574E+02 EXCESS= .0000E+00 OUTFLOW= .2576E+02 BASIN STORAGE= .3204E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RBKLME	MANE	5.00	286.12	230.00	1.36	5.00	286.12	230.00	1.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2510E+02 EXCESS= .0000E+00 OUTFLOW= .2512E+02 BASIN STORAGE= .3168E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RBKLME	MANE	5.00	273.93	230.00	1.31	5.00	273.93	230.00	1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2404E+02 EXCESS= .0000E+00 OUTFLOW= .2405E+02 BASIN STORAGE= .3106E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RBKLME	MANE	5.00	261.79	230.00	1.25	5.00	261.79	230.00	1.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2299E+02 EXCESS= .0000E+00 OUTFLOW= .2300E+02 BASIN STORAGE= .3044E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RBKLME	MANE	5.00	256.95	230.00	1.23	5.00	256.95	230.00	1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2257E+02 EXCESS= .0000E+00 OUTFLOW= .2258E+02 BASIN STORAGE= .3019E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RBKLME	MANE	5.00	253.78	235.00	1.21	5.00	253.78	235.00	1.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2228E+02 EXCESS= .0000E+00 OUTFLOW= .2229E+02 BASIN STORAGE= .3001E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RDCP11	MANE	1.10	134.18	234.38	-1.00	5.00	134.07	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP11	MANE	1.11	130.90	234.40	-1.00	5.00	130.85	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP11	MANE	1.13	124.75	235.49	-1.00	5.00	124.65	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP11	MANE	1.19	119.26	235.16	-1.00	5.00	119.12	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP11	MANE	1.15	117.28	235.51	-1.00	5.00	117.01	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP11	MANE	1.16	115.31	236.12	-1.00	5.00	115.11	235.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP10	MANE	5.00	130.57	240.00	-1.00	5.00	130.57	240.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP10	MANE	5.00	126.73	240.00	-1.00	5.00	126.73	240.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP10	MANE	5.00	120.24	240.00	-1.00	5.00	120.24	240.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP10	MANE	5.00	112.64	240.00	-1.00	5.00	112.64	240.00	-1.00

FOR PLAN = 1 RATIO= .00

RDCP10	MANE	5.00	111.17	245.00	-1.00	5.00	111.17	245.00	-1.00

```
          FOR PLAN = 1  RATIO=  .00
            RDCP10  MANE          5.00    110.33    245.00      -1.00       5.00    110.33    245.00       -1.00


          FOR PLAN = 1  RATIO=  .00
             RCP17  MANE          2.32   1301.19    236.90       1.29       5.00   1293.90    235.00        1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1259E+03 EXCESS= .0000E+00 OUTFLOW= .1259E+03 BASIN STORAGE= .4657E-02 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .00
             RCP17  MANE          2.14   1263.60    237.45       1.26       5.00   1255.25    235.00        1.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1227E+03 EXCESS= .0000E+00 OUTFLOW= .1227E+03 BASIN STORAGE= .5008E-02 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .00
             RCP17  MANE          2.18   1198.94    237.91       1.20       5.00   1188.61    235.00        1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1173E+03 EXCESS= .0000E+00 OUTFLOW= .1173E+03 BASIN STORAGE= .4482E-02 PERCENT ERROR=      0

          FOR PLAN = 1  RATIO=  .00
             RCP17  MANE          2.23   1137.04    236.21       1.15       5.00   1126.38    235.00        1.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1119E+03 EXCESS= .0000E+00 OUTFLOW= .1119E+03 BASIN STORAGE= .4541E-02 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .00
             RCP17  MANE          2.25   1115.49    238.24       1.13       5.00   1100.96    235.00        1.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1098E+03 EXCESS= .0000E+00 OUTFLOW= .1098E+03 BASIN STORAGE= .4630E-02 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .00
             RCP17  MANE          2.26   1100.70    237.62       1.11       5.00   1083.21    235.00        1.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1083E+03 EXCESS= .0000E+00 OUTFLOW= .1083E+03 BASIN STORAGE= .4121E-02 PERCENT ERROR=      0


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

Existing Condition Basin Flow Summary

Basin Name	CN	Area (Sq. Mi.)	Q100 (CFS)
ONE-1	77.00	0.072	64
ONE-2	77.57	0.166	119
ONE-3	83.87	0.271	331
ONE-4	78.24	0.187	149
ONE-5	84.17	0.870	1018
ONE-6	81.70	1.011	621
ONE-7	80.41	0.208	241
ONE-8	69.80	0.204	85
ONE-9	78.16	0.336	273
ONE-10	83.94	0.090	104
ONE-X	77.00	0.224	161
OND6*	91.00	0.063	79
OND7*	88.80	0.011	20
OND8*	90.80	0.022	35
BKPVE	83.70	0.139	124
BKLME	84.30	0.345	294
CRMJE	85.00	0.206	192
BKMJE	85.50	0.034	40
WSPVE	79.00	0.265	154
WSCRE	79.30	0.161	119
WSLME	82.80	0.286	238
CRLME	77.80	0.045	37
PWLME	82.90	0.294	248
DE	85.29	0.055	67
EE	82.20	0.032	36
FE	77.77	0.014	13
GE	81.20	0.015	16
OFFE-1	84.75	0.410	432
OFFE-2	78.74	0.092	75
OFFE-2A	78.38	0.023	21
OFFE-2B	75.82	0.092	56
OFFE-3	81.31	0.297	238
OFFE-3A	88.00	0.030	46
OFFE-4	84.47	0.485	354
OFFE-9	87.64	0.063	90
OFFE-10A	83.94	0.096	116
OFFE-10B	84.36	0.042	52

Existing Condition Combination Point Flow Summary

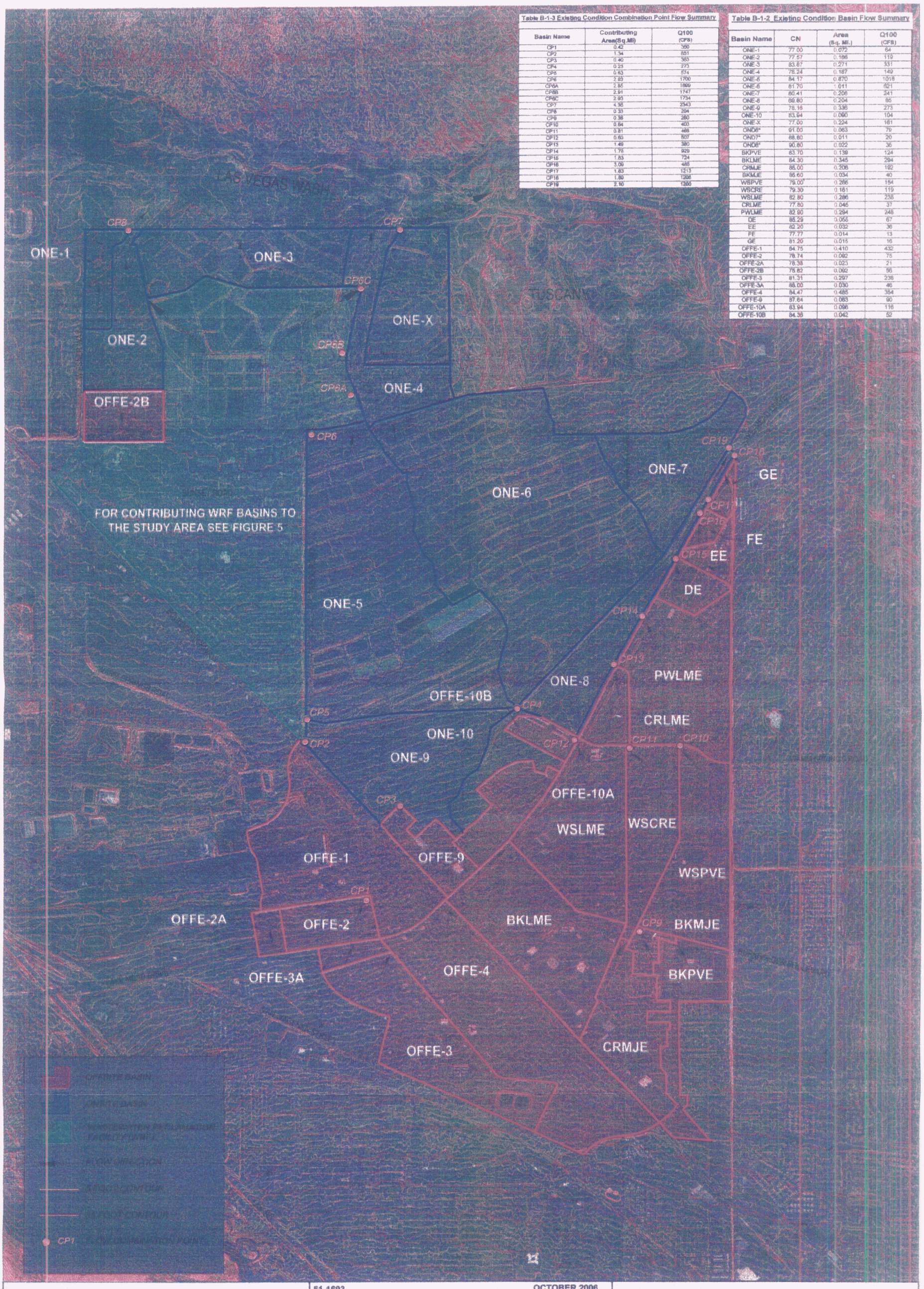
Basin Name	Contributing Area(Sq.Mi)	Q100 (CFS)
CP1	0.42	350
CP2	1.34	851
CP3	0.40	363
CP4	0.23	273
CP5	0.63	574
CP6	2.83	1700
CP6A	2.85	1699
CP6B	2.91	1747
CP6C	2.93	1734
CP7	4.35	2343
CP8	0.33	204
CP9	0.38	260
CP10	0.64	403
CP11	0.81	468
CP12	0.63	507
CP13	1.49	380
CP14	1.78	929
CP15	1.83	724
CP16	3.09	488
CP17	1.83	1213
CP18	1.89	1208
CP19	2.10	1200

Table B-1-3 Existing Condition Combination Point Flow Summary

Basin Name	Contributing Area(Sq.Mi)	Q100 (CFS)
CP1	0.42	350
CP2	1.34	851
CP3	0.40	363
CP4	0.23	273
CP5	0.63	574
CP6	2.83	1700
CP6A	2.85	1899
CP6B	2.91	1747
CP6C	2.93	1734
CP7	4.36	2343
CP8	0.33	204
CP9	0.38	260
CP10	0.64	403
CP11	0.81	488
CP12	0.83	507
CP13	1.49	880
CP14	1.78	929
CP15	1.83	724
CP16	3.09	485
CP17	1.83	1213
CP18	1.89	1208
CP19	2.10	1280

Table B-1-2 Existing Condition Basin Flow Summary

Basin Name	CN	Area (Sq. Mi.)	Q100 (CFS)
ONE-1	77.00	0.072	64
ONE-2	77.57	0.186	119
ONE-3	83.87	0.271	331
ONE-4	78.24	0.187	149
ONE-5	84.17	0.870	1018
ONE-6	81.70	1.011	621
ONE-7	80.41	0.206	241
ONE-8	89.80	0.204	85
ONE-9	78.16	0.336	273
ONE-10	83.94	0.060	104
ONE-X	77.00	0.224	161
OND6*	91.00	0.063	79
OND7*	88.80	0.011	20
OND8*	90.80	0.022	35
BKPVE	83.70	0.139	124
BKLME	84.30	0.345	294
CRMJE	85.00	0.206	192
BKMJE	85.60	0.034	40
WSPVE	79.00	0.266	154
WSCRE	79.30	0.161	119
WSLME	82.80	0.266	238
CRLME	77.80	0.046	37
PWLME	82.90	0.294	248
DE	85.29	0.055	67
EE	82.20	0.032	36
FE	77.77	0.014	13
GE	81.20	0.015	16
OFFE-1	84.75	0.410	432
OFFE-2	78.74	0.092	75
OFFE-2A	78.38	0.023	21
OFFE-2B	75.82	0.092	56
OFFE-3	81.31	0.297	238
OFFE-3A	88.00	0.030	46
OFFE-4	84.47	0.485	354
OFFE-9	87.64	0.083	90
OFFE-10A	83.94	0.096	116
OFFE-10B	84.35	0.042	52



GRAPHIC SCALE

1000 0 800 1600 2000 4000

(IN FEET)

1 inch = 1000ft.

51-1693

OCTOBER 2006

EXISTING CONDITION DRAINAGE BASIN MAP

CLOMR FOR C-1 CHANNEL-LAKE MEAD CHANNEL IMPROVEMENTS

PBS&J

2270 Corporate Circle
Suite 100
Henderson, Nevada 89074-6382
Telephone 702/263-7275
Fax 702/263-1200

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

L:\PROJECTS\51-1693\CLOMR\3RD_SUBMISSION\Hydrology\Existing\Figures\Fig Existing Basin_Drainage Map.dwg Apr 18, 2007 - 8:22am 17625

Appendix E-2: Reference from Approved Technical Drainage Study (TDS) for Flood Control Re-alignment (PBS&J, 2006)

CITY OF HENDERSON
240 Water Street
P.O. Box 95050
Henderson, NV 89009

February 22, 2007

Matthew Wilkinson, P.E.
PBS&J
2270 Corporate Circle, Suite 100
Henderson, NV 89074

Re: Addendum #2 to the T. D. S. for WDF Flood Control Chan Re-Alignment
Permit Number: FHYD 20067801 44

Dear Mr. Wilkinson:

This letter provides comments on the above referenced drainage study dated February 15, 2007. The City of Henderson reviewed this study and based on the documents submitted, **the subject study is approved**. The following items are part of the approved study:

1. Clark County Regional Flood Control District concurrence is required.

Any work within washes or channels conveying jurisdictional Waters of the United States (e.g. Lower Las Vegas Wash), regardless of whether the flow is ephemeral or perennial, may require concurrence from the U.S. Army Corps of Engineers.

Projects that disturb over one (1) acre or any area adjacent to a water way must submit to the Nevada Division of Environmental Protection: (1) a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site. (2) a request for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until paving, building construction or planting has covered all stripped or disturbed surface areas. For more information, including forms and applications contact the Nevada Division of Environmental Protection at http://ndep.nv.gov/bwpc/storm01.htm or call (775) 687-9429.

Please be aware that as additional information becomes available and/or restudies of Flood Insurance Studies are performed, the information submitted by the above named engineering firm may be superseded. Compliance with the regulatory elements and design standards specified in the Uniform Regulations for the Control of Drainage does not imply a guarantee that properties will be free from flooding or flood damage.

Please contact me if you have any questions concerning these comments.

Sincerely,

FOR STEVE,

Stephen E. Casmus, P.E.
Project Engineer II

cc: CCRFCD

PBS&J

ENGINEERING · PLANNING
CONSTRUCTION SERVICES
SURVEYING

August 7, 2006

Mr. Albert Jankowiak, P.E.
City of Henderson Flood Control
240 Water Street
Henderson, NV 89009

RE: TECHNICAL DRAINAGE STUDY FOR THE WRF FLOOD CONTROL CHANNEL RE-ALIGNMENT
PBS&J PROJECT NO.: 51-1894.00

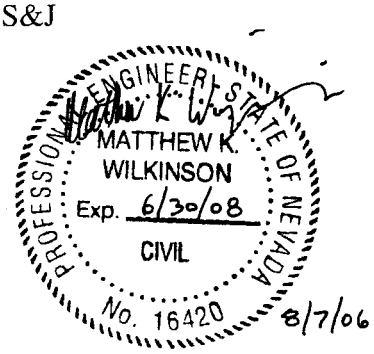
Dear Mr. Jankowiak:

Submitted for your review and approval are two copies of the *Technical Drainage Study for the WRF Flood Control Channel Re-Alignment*

If you have any questions regarding this study, please contact our office at (702) 263-7275.

Sincerely,

PBS&J



Matthew K. Wilkinson, P.E., CFM
Project Manager

2270 Corporate Circle · Suite 100 · Henderson, Nevada 89074-6382 · Telephone 702/263-7275 · Fax 702/263-7200

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: **WRF Flood Control Channel Re-alignment Project** Date: **August 7, 2006**

Location of Development: a) Descriptive (Cross Streets) **N/S- Pabco Road E/W- Galleria Drive**

b) Sect. **36** Twn. **21 S** Rng. **62 E**

Name of Owner: **City of Henderson, Department of Utility Services** Assessors Parcel No: Pt of 161-36-801-001, 161-36-701-003 Pt of 161-36-899-001

Telephone No: **(702) 267-2530** Facsimile No: **(702) 267-2531**

Address: **240 Water Street**

Henderson, NV 89009

Contact Person Name: **Matthew K. Wilkinson P.E., CFM** Telephone No: **(702) 263-7275**

Firm: **P B S & J**

Address: **2270 Corporate Circle, Suite 100** **Henderson, Nevada 89074**

Type of Land Development/Land Disturbance Process:

	Rezoning		Subdivision Map		Clearing and Grading Only
	Parcel Map		Planned Unit Development	X	Other (Please specify below)
	Large Parcel Map		Building Permit		**Flood Control Channel**

1. Total Owned Land Area: At Site: **196.92 +/- acres** Being Developed/Disturbed: **1.09 +/- acres**

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]

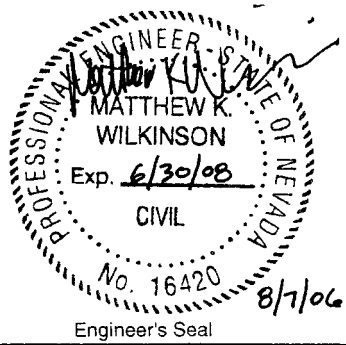
4. Proposed type of development (Residential, Commercial, Etc.)? **Flood Control Channel**

5. Approximate upstream land area which drains to the subject site? **330 +/- acres**

6. Has the site drainage been evaluated in the past? [YES] NO If yes, please identify documentation:
Conceptual Drainage Study for the City of Henderson WRF Phase 1B Expansion by PBS&J dated May 1999

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site:
Approximately 700 feet west of Pabco Rd. and 520 feet north of Galleria Dr. to the existing 2 - 10' x 4' RCBs under the WRF service road

8. Briefly describe your proposed schedule for the subject project: **ASAP**



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

PBS&J Job Number: **51-1894.00** **STANDARD FORM 1**

Appendix A-2: Existing Condition Hydrology

- Table A2-1: Existing Condition Curve Number Calculations
- Standard Form 4: Existing Condition
- Existing Condition HEC-1 Model Output

Table A2-1: Existing Condition Curve Number Calculations

Table A2-1 : Existing Condition Curve Number Calculations

Basin Name	Soil Type	Hydrologic Group	Land Use	Curve No.	% of Composition	Composite Curve No.
OFFE1	184	0 %A 100 %B 0 %C 0 %D	Residential 7000 Sq. Ft Lot (63%Imp)	84.00	63.7%	--
	184	0 %A 100 %B 0 %C 0 %D	Townhouses/6000 Sq ft lots or less (69% Imp)	87.00	29.7%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	6.6%	84.8
OFFE2	184	0 %A 100 %B 0 %C 0 %D	Commercial and Business (85% Imp)	92.00	21.9%	--
	184	0 %A 100 %B 0 %C 0 %D	Residential 7000 Sq. Ft Lot (63%Imp)	84.00	73.8%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	4.3%	85.7
OFFD3	184	0 %A 100 %B 0 %C 0 %D	Residential 7000 Sq. Ft Lot (63%Imp)	84.00	100.0%	84.0
OFFD4	184	0 %A 100 %B 0 %C 0 %D	Townhouses/6000 Sq ft lots or less (69% Imp)	87.00	92.2%	--
	184	0 %A 100 %B 0 %C 0 %D	Residential 7000 Sq. Ft Lot (63%Imp)	84.00	7.8%	86.8
OFFE5	184	0 %A 100 %B 0 %C 0 %D	Townhouses/6000 Sq ft lots or less (69% Imp)	87.00	58.5%	--
	184	0 %A 100 %B 0 %C 0 %D	Commercial and Business (85% Imp)	92.00	11.5%	--
	184	0 %A 100 %B 0 %C 0 %D	Urban Open Space Fair Cond. Grass Cover	69.00	14.7%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	15.3%	84.2
OFFE6	184	0 %A 100 %B 0 %C 0 %D	Industrial (72% Imp)	88.00	83.1%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	16.9%	87.0
OFFE7	184	0 %A 100 %B 0 %C 0 %D	Industrial (72% Imp)	88.00	76.9%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	23.1%	86.6
OFFE8	184	0 %A 100 %B 0 %C 0 %D	Industrial (72% Imp)	88.00	55.6%	--
	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	44.4%	85.3

EX1	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	100.0%	82.0
EX2	184	0 %A 100 %B 0 %C 0 %D	Dirt (Incl. ROW)	82.00	88.7%	--
	600	0 %A 0 %B 0 %C 100 %D	Dirt (Incl. ROW)	89.00	11.3%	82.8

Standard Form 4: Existing Condition

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

File: FORM4.XLS

WRF CHANNEL REALIGNMENT PROJECT
Existing Condition

BY: RG
DATE: 8/2/06

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag Basin <1 MI^2	Tlag Basin >1 MI^2
DESIG: (1)	DEV./EX. (D or E)	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	Tlag= 20*Kn*((L*Lc)/ s^.5))^.33 Hours
OFFE1	D	84.8	0.7294	36.29	0.057	215	1.6	8.3	2267	1.3	2.3	3.5	12.0	20.3	23.8	**0.203**	-
OFFE2	D	85.7	0.7412	36.8	0.058	140	1.8	6.3	2556	1.3	2.3	3.5	13.3	19.6	25.0	**0.196**	-
OFFD3	D	84.0	0.7188	43.06	0.067	135	2.2	6.1	2752	1.2	2.2	3.3	15.1	21.2	26.0	**0.212**	-
OFFD4	D	86.8	0.7558	78.31	0.122	156	0.3	11.3	3329	1.1	2.1	3.2	18.8	30.1	29.4	**0.294**	-
OFFE5	D	84.2	0.7214	47.06	0.074	150	2.3	6.3	2650	1.0	2.1	3.1	15.5	21.8	25.6	**0.218**	-
OFFE6	D	87.0	0.7584	21.84	0.034	81	0.6	6.5	1822	0.9	1.9	2.9	12.1	18.6	20.6	**0.186**	-
OFFE7	D	86.6	0.7531	41.78	0.065	163	0.7	8.8	2217	0.8	1.8	2.8	15.0	23.8	23.2	**0.232**	-
OFFE8	D	85.3	0.7360	10.15	0.016	120	2.1	5.6	1660	0.6	1.6	2.4	13.5	19.1	19.9	**0.191**	-
EX1	E	82.0	0.6924	9.05	0.014	120	2.1	6.3	1130	0.4	0.9	1.7	15.5	21.8	N/A	**0.218**	-
EX2	E	82.8	0.7030	5.82	0.009	130	0.4	11.2	701	0.7	1.2	2.5	8.0	19.2	N/A	**0.192**	-

Tlag = 0.6 Tc (Basin <1 Mi^2)
Tlag =20*Kn*((L*Lc)/S^.5)^.33 (Basin >1 Mi^2)
Tc = Ti + Tt
Ti = 1.8 (1.1 - K) L^1/2 / S^1/3
K = 0.0132 (CN) - 0.39
Tc Check = L/180+10

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

Existing (Natural) V1 = 14.8*(S/100)^1/2 Developed (Urban) V1 = 20.2*(S/100)^1/2

Existing (Natural) V2 = 29.4*(S/100)^1/2 Developed (Urban) V2 = 30.6*(S/100)^1/2

REFERENCE : CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT HYDROLOGIC AND DRAINAGE DESIGN MANUAL 08/12/1999

Existing Condition HEC-1 Model Output

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   02AUG06  TIME  11:36:45   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*         (916) 756-1104                *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

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

                    *DIAGRAM
 *** FREE ***
               1    ID              WRF FLOOD CONTROL CHANNEL RE-ALIGNMENT PROJECT
               2    ID              CITY OF HENDERSON
               3    ID              EXISTING CONDITIONS
               4    ID              INPUT FILE = WRF_Exist.DAT
               5    ID              INPUT FILE DATE = August, 2006
               6    ID              DESIGN STORM = 100 and 10-YEAR 6-HR STORM
               7    ID              STORM DISTRIBUTION = SDN #3
               8    ID              MODELED BY = Ritu Gupta(PBS&J)
               9    ID              NO STORM CENTERING
              10    ID
              11    ID
              12    ID
              13    IT       5       0       0     300
              14    IO       5       0       0
              15    IN       5       0       0
              16    JR    PREC    1.00    0.57
                    *

              17    KK   OFFE1
              18    KM    Basin OFFE1
              19    BA   0.057
              20    PB    2.77
              21    PC    .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
              22    PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
              23    PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
              24    PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
              25    PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
              26    PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
              27    PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
              28    PC    .998    .999   1.00
              29    LS       0   84.8
              30    UD   0.203
                    *

              31    KK ROFFE1
              32    KM    OFFE1 routed to C1
              33    RD    4320  0.0115   0.016       0    TRAP       0      50
                    *

              34    KK   OFFE2
              35    KM    Basin OFFE2
              36    BA   0.058
              37    LS       0   85.7
              38    UD   0.196
                    *

              39    KK  ROFFE2
              40    KM    OFFE2 routed to C1
              41    RD    3105  0.0114   0.016       0    TRAP       0      50
                    *
```

1 HEC-1 INPUT PAGE 2

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

              42    KK   OFFD3
              43    KM    Basin OFFD3
              44    BA   0.067
              45    LS       0   84.0
```

```
 46          UD   0.212
             *

 47          KK  ROFFD3
 48          KM    OFFD3 routed to C1
 49          RD     3219  0.0096   0.016       0    TRAP       0      50
             *

 50          KK   OFFD4
 51          KM    Developed Basin OFFD4
 52          BA   0.122
 53          LS       0    86.8
 54          UD   0.294
             *

 55          KK      C1
 56          KM   COMBINE OFFE1 OFFE2 OFFD3 AND OFFD4
 57          HC       4
             *

 58          KK   OFFE7
 59          KM    Basin OFFE7
 60          BA   0.065
 61          LS       0    86.6
 62          UD   0.232
             *

 63          KK     C1A
 64          KM   COMBINE C1 AND OFFE7
 65          HC       2
             *

 66          KK   OFFE5
 67          KM    Basin OFFE5
 68          BA   0.074
 69          LS       0    84.2
 70          UD   0.218
             *

 71          KK  OOFFE5
 72          KM   PROPORTION OF OFFE5 FLOWING TO C2
 73          DT    DOC1
 74          DI       0      41      80
 75          DQ       0       0      39
             *
```

1 HEC-1 INPUT PAGE 3

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

 76          KK   OFFE6
 77          KM    Basin OFFE6
 78          BA   0.034
 79          LS       0    87.0
 80          UD   0.186
             *

 81          KK      C2
 82          KM   COMBINE OOFFE5 AND OFFE6
 83          HC       2
             *

 84          KK   OFFE8
 85          KM    Basin OFFE8
 86          BA   0.016
 87          LS       0    85.3
 88          UD   0.191
             *

 89          KK      C3
 90          KM   COMBINE C1A C2 AND OFFE8
 91          HC       3
             *

 92          KK     EX1
 93          KM    Existing Basin EX1
 94          BA   0.014
 95          LS       0    82.0
 96          UD   0.218
             *

 97          KK     EX2
 98          KM    Existing Basin EX2
 99          BA   0.009
100          LS       0    82.8
101          UD   0.192
             *

102          KK      C4
103          KM   COMBINE C3 EX1 AND EX2
104          HC       3
             *
105          ZZ
```

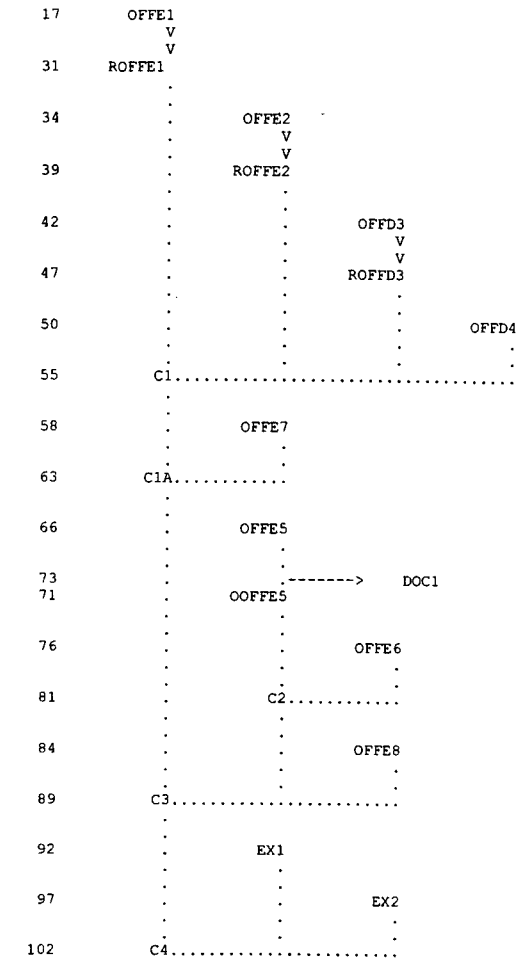
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

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

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   02AUG06  TIME  11:36:45   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

WRF FLOOD CONTROL CHANNEL RE-ALIGNMENT PROJECT
CITY OF HENDERSON
EXISTING CONDITIONS
INPUT FILE = WRF_Exist.DAT
INPUT FILE DATE = August, 2006
DESIGN STORM = 100 and 10-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY = Ritu Gupta(PBS&J)
NO STORM CENTERING

```
  14 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 .57
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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 1.00	RATIO 2 .57
HYDROGRAPH AT						
+	OFFE1	.06	1	FLOW	59.	21.
				TIME	3.67	3.67
ROUTED TO						
+	ROFFE1	.06	1	FLOW	60.	21.
				TIME	3.83	3.92
HYDROGRAPH AT						
+	OFFE2	.06	1	FLOW	64.	24.
				TIME	3.58	3.67
ROUTED TO						
+	ROFFE2	.06	1	FLOW	64.	24.
				TIME	3.75	3.83
HYDROGRAPH AT						
+	OFFD3	.07	1	FLOW	66.	23.
				TIME	3.67	3.67
ROUTED TO						
+	ROFFD3	.07	1	FLOW	68.	23.
				TIME	3.83	3.92
HYDROGRAPH AT						
+	OFFD4	.12	1	FLOW	120.	47.
				TIME	3.75	3.75
4 COMBINED AT						
+	C1	.30	1	FLOW	302.	106.
				TIME	3.83	3.83
HYDROGRAPH AT						
+	OFFE7	.06	1	FLOW	70.	27.
				TIME	3.67	3.67
2 COMBINED AT						
+	C1A	.37	1	FLOW	358.	128.
				TIME	3.75	3.83
HYDROGRAPH AT						
+	OFFE5	.07	1	FLOW	73.	26.
				TIME	3.67	3.67
DIVERSION TO						
+	DOC1	.07	1	FLOW	32.	0.
				TIME	3.67	.00
HYDROGRAPH AT						
+	OOFFE5	.07	1	FLOW	41.	26.
				TIME	3.50	3.67
HYDROGRAPH AT						
+	OFFE6	.03	1	FLOW	41.	16.
				TIME	3.58	3.58
2 COMBINED AT						
+	C2	.11	1	FLOW	82.	41.
				TIME	3.58	3.67
HYDROGRAPH AT						
+	OFFE8	.02	1	FLOW	17.	6.
				TIME	3.58	3.67
3 COMBINED AT						
+	C3	.49	1	FLOW	446.	163.
				TIME	3.75	3.83
HYDROGRAPH AT						

```
+                    EX1       .01     1   FLOW          12.       4.
                                           TIME         3.67      3.67

 HYDROGRAPH AT
+                    EX2       .01     1   FLOW           9.       3.
                                           TIME         3.58      3.67

  3 COMBINED AT
+                     C4       .52     1   FLOW         465.     169.
                                           TIME         3.75      3.83
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                INTERPOLATED TO
                                                                              COMPUTATION INTERVAL
          ISTAQ    ELEMENT       DT        PEAK     TIME TO      VOLUME       DT        PEAK     TIME TO      VOLUME
                                                       PEAK                                          PEAK

                                (MIN)       (CFS)      (MIN)       (IN)      (MIN)       (CFS)      (MIN)        (IN)

          FOR PLAN = 1  RATIO=  .00
           ROFFE1        MANE          5.00     60.27    230.00       1.39       5.00     60.27    230.00         1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4205E+01 EXCESS= .0000E+00 OUTFLOW= .4213E+01 BASIN STORAGE= .2746E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
           ROFFE1        MANE          4.25     21.43    238.00        .50       5.00     21.04    235.00          .49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1502E+01 EXCESS= .0000E+00 OUTFLOW= .1507E+01 BASIN STORAGE= .2853E-02 PERCENT ERROR=   -.5

          FOR PLAN = 1  RATIO=  .00
            ROFFE2  MANE          5.00     63.55    225.00       1.45       5.00     63.55    225.00         1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4473E+01 EXCESS= .0000E+00 OUTFLOW= .4478E+01 BASIN STORAGE= .1997E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
            ROFFE2  MANE          4.25     23.67    229.50        .53       5.00     23.62    230.00          .53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1645E+01 EXCESS= .0000E+00 OUTFLOW= .1647E+01 BASIN STORAGE= .2040E-02 PERCENT ERROR=   -.3

          FOR PLAN = 1  RATIO=  .00
            ROFFD3  MANE          5.00     67.60    230.00       1.33       5.00     67.60    230.00         1.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4750E+01 EXCESS= .0000E+00 OUTFLOW= .4755E+01 BASIN STORAGE= .2215E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
            ROFFD3  MANE          4.00     23.10    232.00        .46       5.00     22.89    235.00          .46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1653E+01 EXCESS= .0000E+00 OUTFLOW= .1657E+01 BASIN STORAGE= .1682E-02 PERCENT ERROR=   -.3



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

L:\PROJECTS\511894\500-WRF\TDS\Figures\FIG 4_Existing_Map.dwg Aug 05, 2006 - 10:29am 17626

LEGEND

- OFFSITE BASIN BOUNDARY
- FLOW DIRECTION
- HEC-1 COMBINATION POINT
- ONSITE CHANNEL ALIGNMENT

Table A-1: Flow Summary Table for Existing Conditions

Basin Name	CN	Area (acres)	Flow (100yr)	Flow (10yr)
OFFE1	84.6	36.29	59	21
OFFE2	85.7	36.8	64	24
OFFD3	84.0	43.06	66	23
OFFD4	86.8	78.31	120	47
OFFE5	84.2	47.06	73	26
OFFE6	87.0	21.84	41	16
OFFE7	86.6	41.78	70	27
OFFE8	85.3	10.15	17	6
EX1	82.0	9.05	12	4
EX2	82.8	5.82	9	3
C1 (Sunset)	N/A	N/A	302	106
C1A (Athens)	N/A	N/A	358	128
C2 (Athens)	N/A	N/A	87	41
C3 (Athens)	N/A	N/A	446	163
C4 (d/s)	N/A	N/A	465	169

N

GRAPHIC SCALE

300 0 150 300

(IN FEET)

1 inch = 300 ft.

51-1894

FIGURE 4
EXISTING CONDITION DRAINAGE BASIN MAP

AUGUST 2006

TECHNICAL DRAINAGE STUDY FOR THE WRF FLOOD CONTROL CHANNEL RE-ALIGNMENT

PBS&J
2270 Corporate Circle
Suite 100
Henderson, Nevada 89074-7847
Telephone 702/269-2270
Fax 702/263-7200
ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Appendix F: Electronic Data on CD

Response to FEMA Comments for the Request for Letter of Map Revision
Water Reclamation Facility
City of Henderson, Nevada

RFCD
2008 SEP -4 PM 4:10

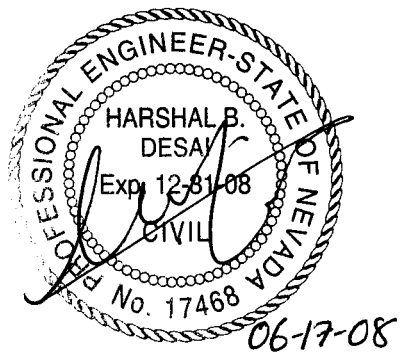
Prepared for:

City of Henderson,
Department of Utility Services
240 Water Street
Henderson, Nevada 89009
Phone No: (702)-267-2530
Fax No: (702)-267-2531
City of Henderson

Prepared by:

PBS&J

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



June, 2008
PBS&J Reference No: 100001342

PBS&J

RFCD

2008 SEP -4 PM 4:18

June 17, 2008

Emily Hill, CFM
FEMA MAPMOD Team
3601 Eisenhower Avenue
Alexandria, VA 22304

RE: RESPONSE TO FEMA COMMENTS FOR THE REQUEST FOR LETTER OF MAP REVISION, WATER RECLAMATION FACILITY, CITY OF HENDERSON, NEVADA
FEMA CASE #: 08-09-1157P
PBS&J PROJECT NO.: 100001342

Dear Ms. Hill,

This letter and the attached documents are in response to the Federal Emergency Management Agency (FEMA) comments provided in a letter dated June 3, 2008 concerning the *Request for Letter of Map Revision (LOMR) for the Water Reclamation Facility, City of Henderson, Nevada*, which was submitted on May 20, 2008. The information included herein is intended to supersede information provided in the original LOMR.

The comments received from FEMA and PBS&J's responses are listed below. Please refer to **APPENDIX A** for a copy of the comment letter.

Comment 1: Our preliminary review revealed that the submitted report entitled "Request for Letter of Map Revision, Water Reclamation Facility," prepared by your firm, dated May 20, 2008, did not include "as-built" plans for the WRF Channel located just west of the water reclamation facility site. Please provide "as-built" plans for the WRF Channel, certified by a registered engineer.

Response 1: All the surveyed points obtained and used within the hydraulic models were shown on **FIGURE 4.1: HYDRAULIC WORKMAP** in the original submittal. These surveyed data points were certified by a registered professional engineer. Per email correspondence dated 06/11/2008 with FEMA's Mapping Coordinator Contractor (Emily Hill) attached in **APPENDIX B,** the supplied certified survey points are adequate for the hydraulic analysis. Additionally, as requested, pictures of the existing WRF channel looking downstream and upstream are included in the **APPENDIX E.**

Comment 2: The submitted undated site plan entitled " Figure 2.1," prepared by your firm, shows an earthen channel directly upstream of Cross Section 0.00 as shown on the topographic work map entitled "Figure 4.1: Hydraulic Workmap," prepared by your firm, dated May 20, 2008. However, the

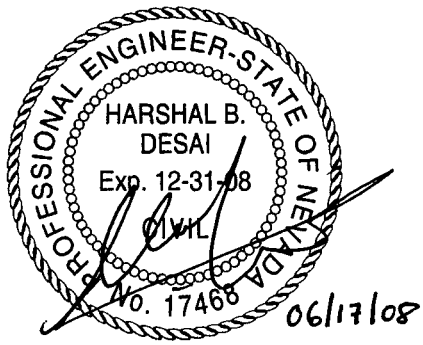
above-referenced channel was not included in the existing conditions HEC-RAS hydraulic analysis. Please extend the existing conditions HEC-RAS hydraulic analysis upstream to include the earthen channel. In addition, please submit a topographic work map, certified by a registered professional engineer or licensed land surveyor that includes all cross sections used in the revised existing conditions HEC-RAS hydraulic analysis.

Response 2: As shown on **FIGURE 4.1: HYDRAULIC WORKMAP** in **APPENDIX C** of this submittal, the HEC-RAS hydraulic model was extended upstream in order to accurately represent the current hydraulic conditions. The HEC-RAS hydraulic model was extended to include two additional reaches. The first reach (River: WRF, Reach: 1) extends west along the existing development to the south. This includes the earthen channel improvements constructed along with the WRF Channel Improvements. The second reach (River: Existing Channel, Reach: 1) flowing northwest ties into the existing WRF Channel improvements between two stations (115.73 and 61.50). This reach represents the outlet channel for the 12' x 2.9' RCB which was incorporated into the WRF Channel Improvement. The **FIGURE 4.1** was updated to show the additional HEC-RAS stations and additional survey points. The HEC-RAS results are presented in **APPENDIX D**. Electronic copies of the HEC-RAS and additional survey points are located in **APPENDIX F**.

PBS&J appreciates your consideration of this matter. If you have any further questions regarding this project, please contact our office at (702) 263 -7275.

Sincerely,

PBS&J



Michele D'Alessandro, EI, CFM
Hydrologist

Harshal Desai, P.E., CFM
Project Manager

2008 SEP -4 PM 4:

RFCD

APPENDIX A: FEMA COMMENT LETTER

APPENDIX B: CORRESPONDENCE EMAIL

APPENDIX C: UPDATED FIGURE 4.1

APPENDIX D: UPDATED HYDRAULIC MODEL

APPENDIX E: PHOTOS

APPENDIX F: ELECTRONIC DATA CD

APPENDIX A: FEMA COMMENT LETTER

NATIONAL FLOOD INSURANCE PROGRAM

FEMA NATIONAL SERVICE PROVIDER

June 3, 2008

Mr. Harshal B. Desai, P.E., CFM
Project Manager
PBS&J
2270 Corporate Circle, Suite 100
Las Vegas, NV 89074

IN REPLY REFER TO:
Case No.: 08-09-1157P
Community: City of Henderson, NV
Community No.: 320005

316-AD

Dear Mr. Desai:

This responds to your request dated May 20, 2008, that the Department of Homeland Security's Federal Emergency Management Agency (FEMA) issue a revision to the Flood Insurance Rate Map (FIRM) for Clark County, Nevada and Incorporated Areas. Pertinent information about the request is listed below.

Identifier:	Water Reclamation Facility
Flooding Source:	Unnamed Tributary to Las Vegas Wash
FIRM Panel(s) Affected:	32003C2605 E

The data required to complete our review, which must be submitted within 90 days of the date of this letter, are listed on the enclosed summary.

If we do not receive the required data within 90 days, we will suspend our processing of your request. Any data submitted after 90 days will be treated as an original submittal and will be subject to all submittal/payment procedures, including the flat review and processing fee for requests of this type established by the current fee schedule. A copy of the notice summarizing the current fee schedule, which was published in the *Federal Register,* is enclosed for your information.

FEMA receives a very large volume of requests and cannot maintain inactive requests for an indefinite period of time. Therefore, we are unable to grant extensions for the submission of required data/fee for revision requests. If a requester is informed by letter that additional data are required to complete our review of a request, the data/fee **must** be submitted within 90 days of the date of the letter. Any fees already paid will be forfeited for any request for which the requested data are not received within 90 days.

If you have general questions about your request, FEMA policy, or the National Flood Insurance Program, please call the FEMA Map Assistance Center, toll free, at 1-877-FEMA MAP (1-877-336-2627). If you have specific questions concerning your request, please contact your case reviewer, Ms. Emily Hill, by

e-mail at emily.hill@mapmodteam.com or by telephone at (703) 960-8800, or the Revisions Coordinator for your State, Mr. Sacha Tohme, P.E., CFM, at sacha.tohme@mapmodteam.com or at (703) 317-6250.

Sincerely,

Syed Qayum

Syed Qayum, CFM
National LOMR Technical Manager
Michael Baker Jr., Inc.

Enclosures

cc: Mr. Curt Chandler, P.E., CFM
Land Development Manager
Department of Public Works
City of Henderson

Mr. James Okazaki, P.E.
Utility Services Engineer II
City of Henderson

Mr. Kevin Eubanks, P.E., CFM
Assistant General Manager
Clark County Regional Flood Control District

Ms. Michele D'Alessandro, E.I., CFM
PBS&J

NATIONAL FLOOD INSURANCE PROGRAM

FEMA NATIONAL SERVICE PROVIDER

Summary of Additional Data Required to Support a
Letter of Map Revision

Case No.: 08-09-1157P

Requester: Mr. Harshal Desai, P.E., CFM

Community: City of Henderson, NV

Community No.: 320005

The issues listed below must be addressed before we can continue the review of your request.

1. Our preliminary review revealed that the submitted report entitled "Request for Letter of Map Revision, Water Reclamation Facility," prepared by your firm, dated May 20, 2008, did not include "as-built" plans for the WRF Channel located just west of the water reclamation facility site. Please provide "as-built" plans for the WRF Channel, certified by a registered professional engineer.

2. The submitted undated site plan entitled "Figure 2.1," prepared by your firm, shows an earthen channel directly upstream of Cross Section 0.00 as shown on the topographic work map entitled "Figure 4.1: Hydraulic Workmap," prepared by your firm, dated May 20, 2008. However, the above-referenced channel was not included in the existing conditions HEC-RAS hydraulic analysis. Please extend the existing conditions HEC-RAS hydraulic analysis upstream to include the earthen channel. In addition, please submit a topographic work map, certified by a registered professional engineer or licensed land surveyor, that includes all cross sections used in the revised existing conditions HEC-RAS hydraulic analysis.

Please send the required data and/or fee directly to us at the address shown at the bottom of this page. For identification purposes, please include the case number referenced above on all correspondence.

APPENDIX B: CORRESPONDENCE EMAIL

From: Emily Hill [mailto:EmilyHill@mapmodteam.com]
Sent: Wednesday, June 11, 2008 5:19 AM
To: Desai, Harshal
Cc: D'Alessandro, Michele
Subject: Case Number 08-09-1157P

Harshal and Michele,

Sorry for not getting back to you yesterday. I talked with Sacha and he said that we can accept the survey data. I'm not sure the work map shows only a portion of the survey data or if all survey points were provided. If there is more survey data available, please submit the additional certified data. Also, please submit the pictures of the WRF channel we spoke about on the phone. If you have any more questions, please feel free to contact me.

Thanks,
Emily

Emily Hill, CFM
Civil Associate II
FEMA Map Mod Team
3601 Eisenhower Avenue
Alexandria, VA 22304
Phone: (703) 960-8800 ext. 5315
emily.hill@mapmodteam.com

APPENDIX C: UPDATED FIGURE 4.1

WRF CHANNEL CROSS SECTION LOCATIONS

N W E S

0 50 100 200 300
Feet

2 4'x10' RCB

WRF CHANNEL

2 4'x10' RCB

4 3'x10' RCB

GALLERIA DR

PABCO CHANNEL

5 1.5'x1' HERCP

PABCO RD

BOULDER HWY

5'x10' RCB

4 48" RCP

5'x10' RCB

2 6'x4' RCB

FIGURE 4.1: HYDRAULIC WORKMAP

Water Reclamation Facility LOMR

LEGEND

- FLOOD ZONE A REMOVED (WRF STUDY AREA)
- FEMA FLOOD ZONE A
- PABCO CHANNEL HEC-RAS CROSS SECTIONS
- WRF CHANNEL HEC-RAS CROSS SECTIONS
- EXISTING CULVERTS
- BOUNDARY BETWEEN 1 FOOT CONTOURS AND 5 FOOT CONTOURS

CONTOURS

- 1 FOOT CONTOURS
- 5 FOOT CONTOURS
- SURVEY POINTS

Notes: The offsite flood flows impacting the WRF study area where the flood Zone A is removed are contained within the existing WRF Channel (west) and Pabco Channel (east).

The shapefiles for the the topographic data (contour data and survey points) is included on the data CD in Appendix F. Please refer to Section 2.4 in the report for more information on topographic data.

Aerial Source: Clark County, Spring 2007

I hereby certify that the topograhpic information used for the Hydraulic Modeling within this LOMR substantially confirms with the current condition.

06-17-08

Harshal B. Desai, P.E., CFM NV-17468

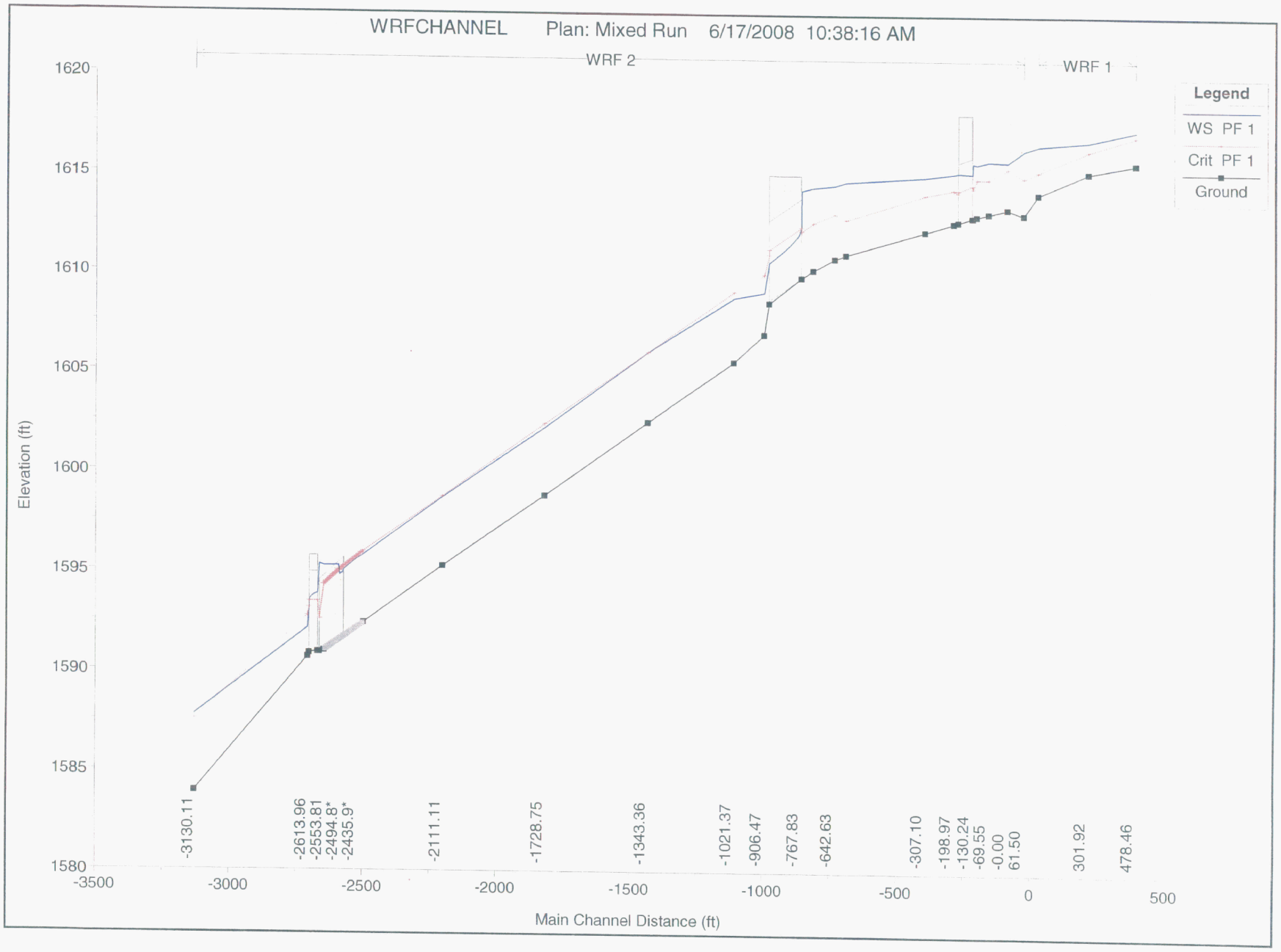
N W E S

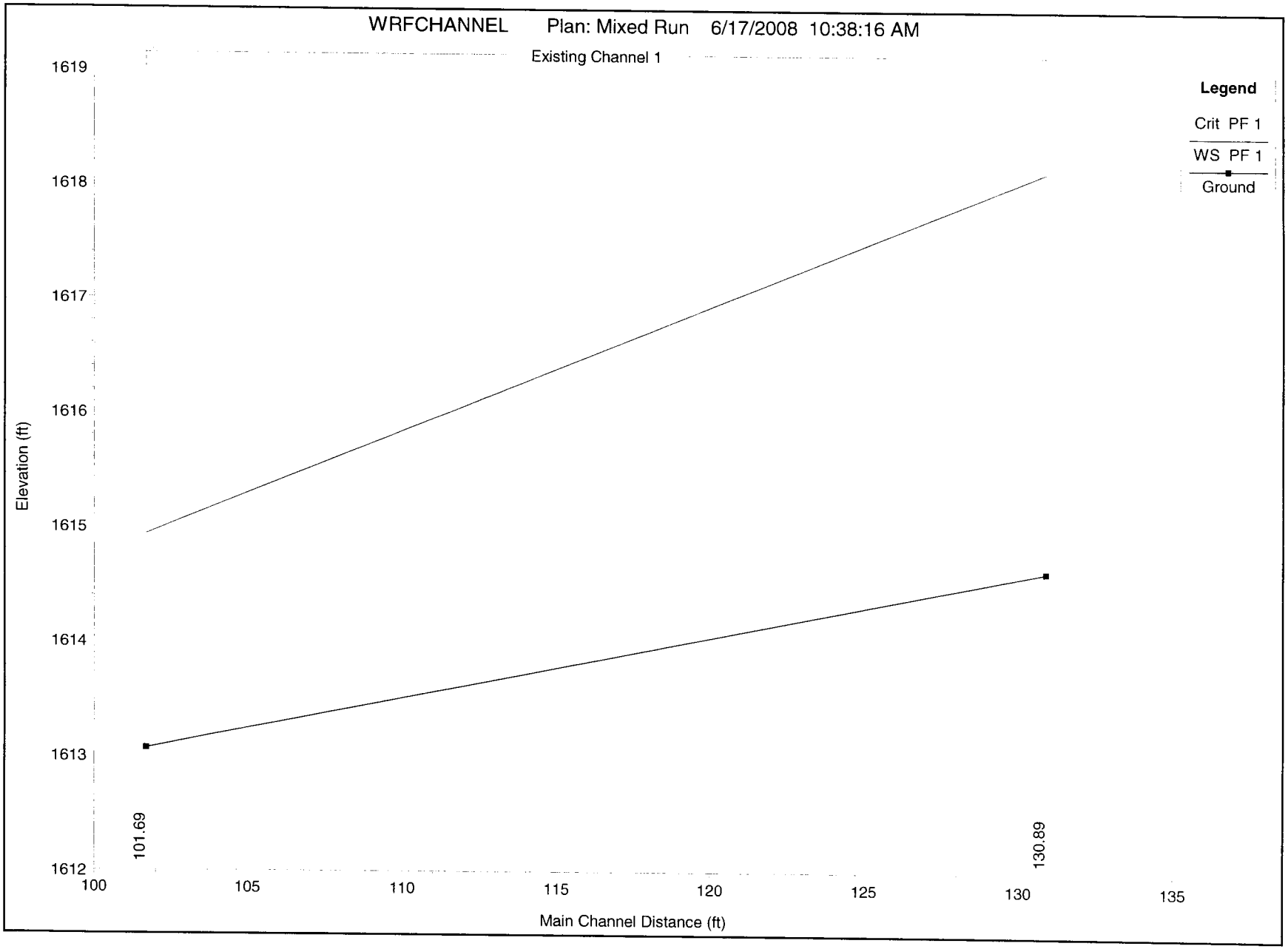
0 200 400 800 1,200
Feet

1 inch equals 400 feet

PBS&J

APPENDIX D: UPDATED HYDRAULIC MODEL


WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
WRF 2
WRF 1
Legend
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1620
1615
1610
1605
1600
1595
1590
1585
1580
-3130.11
-2613.96
-2553.81
-2494.8*
-2435.9*
-2111.11
-1728.75
-1343.36
-1021.37
-906.47
-767.83
-642.63
-307.10
-198.97
-130.24
-69.55
-0.00
61.50
301.92
478.46
-3500
-3000
-2500
-2000
-1500
-1000
-500
0
500
Main Channel Distance (ft)

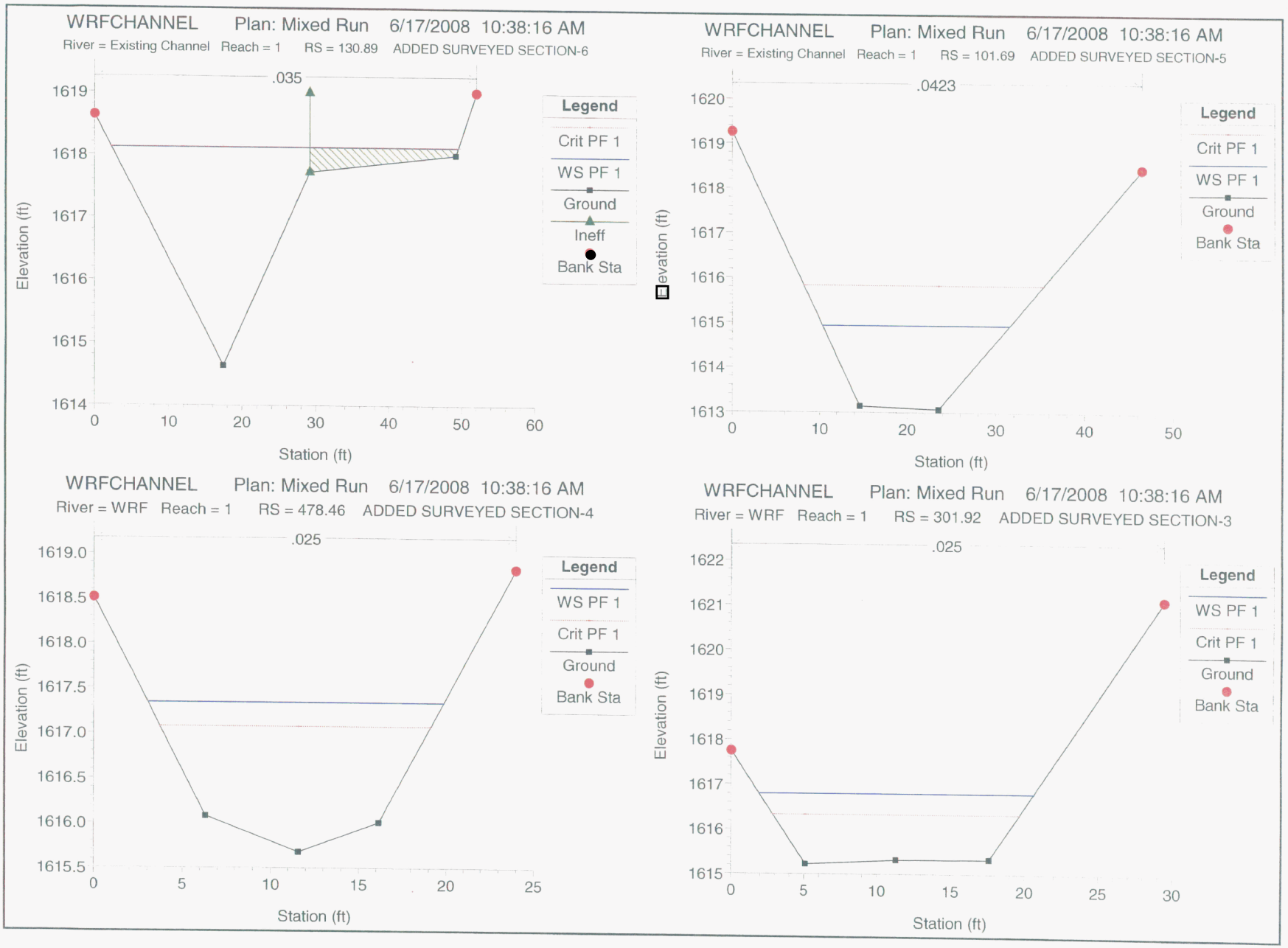

WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
Existing Channel 1
Legend
Crit PF 1
WS PF 1
Ground
Elevation (ft)
1619
1618
1617
1616
1615
1614
1613
1612
101.69
130.89
100
105
110
115
120
125
130
135
Main Channel Distance (ft)

HEC-RAS Plan: Mix_Run Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	478.46	PF 1	83.00	1615.68	1617.35	1617.08	1617.64	0.004638	4.33	19.18	16.84	0.71
1	301.92	PF 1	83.00	1615.22	1616.81	1616.33	1617.00	0.002694	3.51	23.63	18.73	0.55
1	115.73	PF 1	83.00	1614.13	1616.57	1615.28	1616.64	0.001191	2.09	39.69	22.32	0.28
2	61.50	PF 1	466.00	1613.09	1616.34	1614.97	1616.50	0.002777	3.24	143.73	61.38	0.37
2	0.00	PF 1	466.00	1613.38	1615.74	1615.42	1616.29	0.002975	5.91	78.79	43.94	0.78
2	-69.55	PF 1	466.00	1613.15	1615.78	1614.89	1616.04	0.001879	4.09	114.06	53.67	0.49
2	-112.98	PF 1	466.00	1613.01	1615.64	1614.90	1615.94	0.002170	4.43	105.20	51.89	0.55
2	-127.24	PF 1	466.00	1612.93	1615.68	1614.43	1615.91	0.000437	3.78	123.30	45.12	0.40
2	-130.24		Culvert									
2	-183.27	PF 1	466.00	1612.71	1615.21	1614.20	1615.47	0.000583	4.13	112.81	45.87	0.46
2	-198.97	PF 1	466.00	1612.64	1615.15	1614.35	1615.45	0.002155	4.38	106.42	50.06	0.53
2	-307.10	PF 1	466.00	1612.20	1614.97	1614.07	1615.23	0.001747	4.14	112.55	51.74	0.49
2	-601.40	PF 1	466.00	1611.02	1614.70	1612.79	1614.82	0.000937	2.86	163.06	56.13	0.30
2	-642.63	PF 1	466.00	1610.80	1614.52	1613.08	1614.76	0.001772	3.94	118.31	42.92	0.42
2	-722.70	PF 1	466.00	1610.22	1614.40	1612.64	1614.63	0.001464	3.87	120.27	38.40	0.39
2	-766.83	PF 1	466.00	1609.84	1614.25	1612.22	1614.58	0.000464	4.65	100.25	23.31	0.39
2	-767.83		Culvert									
2	-888.18	PF 1	466.00	1608.54	1610.61	1611.01	1612.37	0.005618	10.65	43.77	21.57	0.39
2	-906.47	PF 1	485.00	1606.95	1609.09	1610.00	1612.09	0.013890	13.89	34.91	27.44	2.17
2	-1021.37	PF 1	485.00	1605.56	1608.79	1609.11	1609.99	0.013230	8.79	55.16	41.23	1.34
2	-1343.36	PF 1	485.00	1602.52	1606.04	1606.04	1606.77	0.008111	6.87	70.57	48.21	1.00
2	-1728.75	PF 1	485.00	1598.83	1602.22	1602.41	1603.21	0.010413	7.99	60.70	42.93	1.18
2	-2111.11	PF 1	485.00	1595.27	1598.70	1598.76	1599.53	0.008696	7.29	66.57	46.06	1.07
2	-2406.46	PF 1	485.00	1592.40	1595.80	1595.97	1596.78	0.009892	7.94	61.11	42.59	1.17
2	-2411.3*	PF 1	485.00	1592.35	1595.75	1595.91	1596.72	0.009819	7.88	61.54	42.89	1.16
2	-2416.2*	PF 1	485.00	1592.31	1595.71	1595.86	1596.66	0.009757	7.82	62.01	43.29	1.15
2	-2421.1*	PF 1	485.00	1592.26	1595.66	1595.81	1596.61	0.009734	7.79	62.26	43.49	1.15
2	-2426.1*	PF 1	485.00	1592.21	1595.62	1595.76	1596.55	0.009726	7.76	62.51	43.75	1.14
2	-2431.0*	PF 1	485.00	1592.17	1595.58	1595.70	1596.49	0.009612	7.68	63.14	44.20	1.13
2	-2435.9*	PF 1	485.00	1592.12	1595.53	1595.65	1596.43	0.009562	7.63	63.53	44.51	1.13
2	-2440.8*	PF 1	485.00	1592.07	1595.48	1595.60	1596.38	0.009603	7.62	63.63	44.72	1.13
2	-2445.7*	PF 1	485.00	1592.03	1595.44	1595.55	1596.32	0.009459	7.53	64.42	45.22	1.11
2	-2450.6*	PF 1	485.00	1591.98	1595.37	1595.51	1596.27	0.021610	7.60	63.81	45.20	1.13
2	-2455.5*	PF 1	485.00	1591.93	1595.31	1595.46	1596.22	0.009993	7.66	63.35	45.23	1.14
2	-2460.4*	PF 1	485.00	1591.89	1595.27	1595.40	1596.16	0.009835	7.57	64.08	45.69	1.13
2	-2465.4*	PF 1	485.00	1591.84	1595.21	1595.35	1596.11	0.022119	7.61	63.71	45.77	1.14
2	-2470.3*	PF 1	485.00	1591.79	1595.14	1595.30	1596.05	0.010327	7.67	63.23	45.82	1.15
2	-2475.2*	PF 1	485.00	1591.75	1595.10	1595.24	1595.99	0.010113	7.58	63.99	46.39	1.14
2	-2480.1*	PF 1	485.00	1591.70	1595.04	1595.19	1595.94	0.022557	7.60	63.77	46.51	1.14
2	-2481.00		Lat Struct									
2	-2485.0*	PF 1	485.00	1591.65	1594.88	1595.14	1595.93	0.012369	8.21	59.10	44.88	1.26
2	-2489.9*	PF 1	485.00	1591.61	1594.84	1595.08	1595.86	0.012192	8.10	59.86	45.48	1.24
2	-2494.8*	PF 1	485.00	1591.56	1594.79	1595.01	1595.80	0.012188	8.06	60.15	45.85	1.24
2	-2499.7*	PF 1	485.00	1591.51	1595.26	1594.98	1595.75	0.005359	5.57	87.02	55.12	0.78
2	-2504.6*	PF 1	485.00	1591.47	1595.26	1594.92	1595.71	0.004884	5.37	90.28	54.98	0.74
2	-2509.6*	PF 1	485.00	1591.42	1595.26	1594.85	1595.68	0.004489	5.20	93.35	54.85	0.70
2	-2514.5*	PF 1	484.99	1591.37	1595.26	1594.79	1595.65	0.004141	5.03	96.37	54.71	0.67
2	-2519.4*	PF 1	484.83	1591.33	1595.25	1594.73	1595.62	0.003790	4.86	99.70	54.57	0.63
2	-2524.3*	PF 1	484.44	1591.28	1595.25	1594.67	1595.60	0.003526	4.73	102.40	54.44	0.61
2	-2529.2*	PF 1	483.74	1591.23	1595.25	1594.62	1595.57	0.003242	4.58	105.56	54.30	0.58
2	-2534.1*	PF 1	482.67	1591.19	1595.25	1594.56	1595.55	0.002984	4.44	108.73	54.17	0.55
2	-2539.0*	PF 1	481.18	1591.14	1595.25	1594.49	1595.53	0.002753	4.31	111.75	54.03	0.53
2	-2543.9*	PF 1	479.23	1591.09	1595.24	1594.43	1595.52	0.002540	4.18	114.76	53.89	0.50
2	-2548.8*	PF 1	476.77	1591.05	1595.24	1594.36	1595.50	0.002344	4.05	117.77	53.76	0.48
2	-2553.81	PF 1	473.75	1591.00	1595.24	1594.29	1595.48	0.002138	3.92	120.96	53.62	0.46
2	-2570.35	PF 1	454.81	1590.92	1595.33	1592.56	1595.44	0.000129	2.67	170.39	39.25	0.23
2	-2576.85		Culvert									
2	-2609.56	PF 1	454.81	1590.87	1593.13	1593.13	1594.25	0.003153	8.48	53.62	24.00	1.00
2	-2613.96	PF 1	454.81	1590.68	1592.12	1592.73	1594.12	0.057941	11.36	40.05	33.75	1.84
2	-3130.11	PF 1	454.81	1583.94	1587.79	1587.55	1588.60	0.011112	7.22	62.95	29.62	0.87

HEC-RAS Plan: Mix_Run Profile: PF 1

Reach	River Sta	Profile	Q US (cfs)	Q Leaving Total (cfs)	Q DS (cfs)	Q Weir (cfs)	Q Gates (cfs)	Wr Top Width (ft)	Weir Max Depth (ft)	Weir Avg Depth (ft)	Min El Weir Flow (ft)	E.G. US (ft)	W.S. US (ft)	E.G. DS (ft)	W.S. DS (ft)
2	-2481.00	PF 1	485.00	29.64	454.81	29.64		59.48	0.79	0.36	1594.54	1595.94	1595.04	1595.44	1595.33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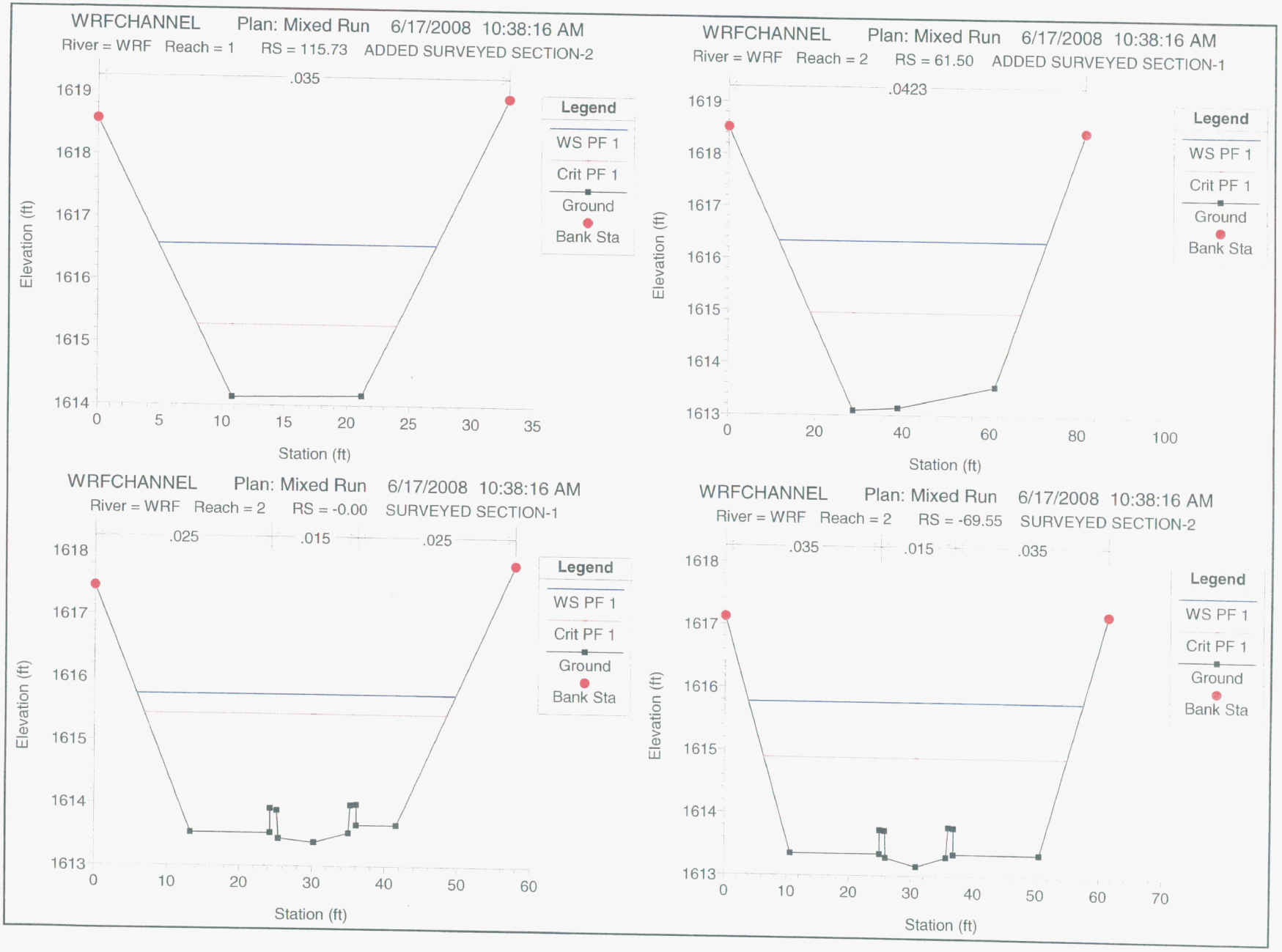
River = Existing Channel Reach = 1 RS = 130.89 ADDED SURVEYED SECTION-6
.035
Elevation (ft)
Station (ft)
Legend
Crit PF 1
WS PF 1
Ground
Ineff
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = Existing Channel Reach = 1 RS = 101.69 ADDED SURVEYED SECTION-5
.0423
Elevation (ft)
Station (ft)
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 1 RS = 478.46 ADDED SURVEYED SECTION-4
.025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 1 RS = 301.92 ADDED SURVEYED SECTION-3
.025
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta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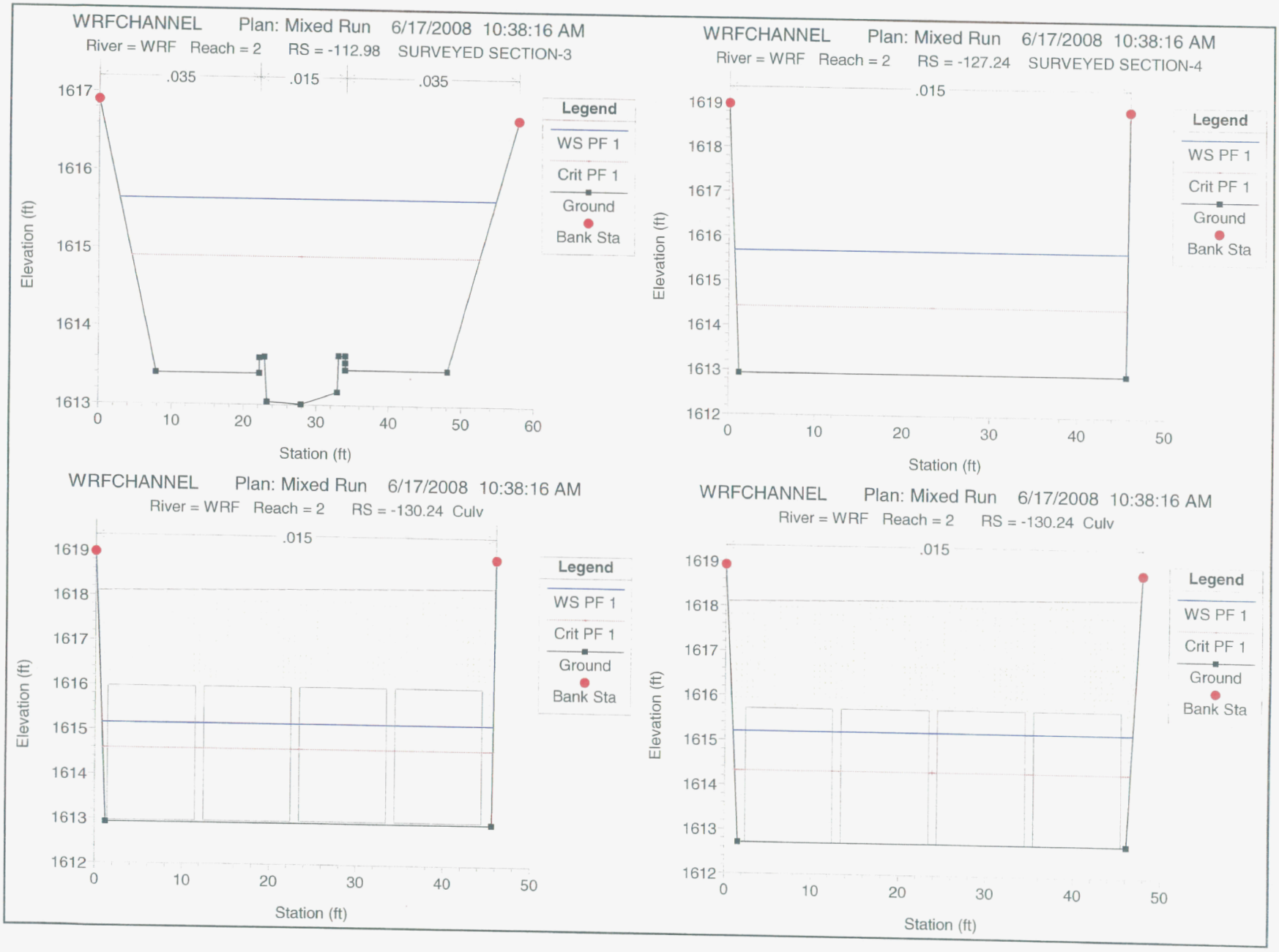
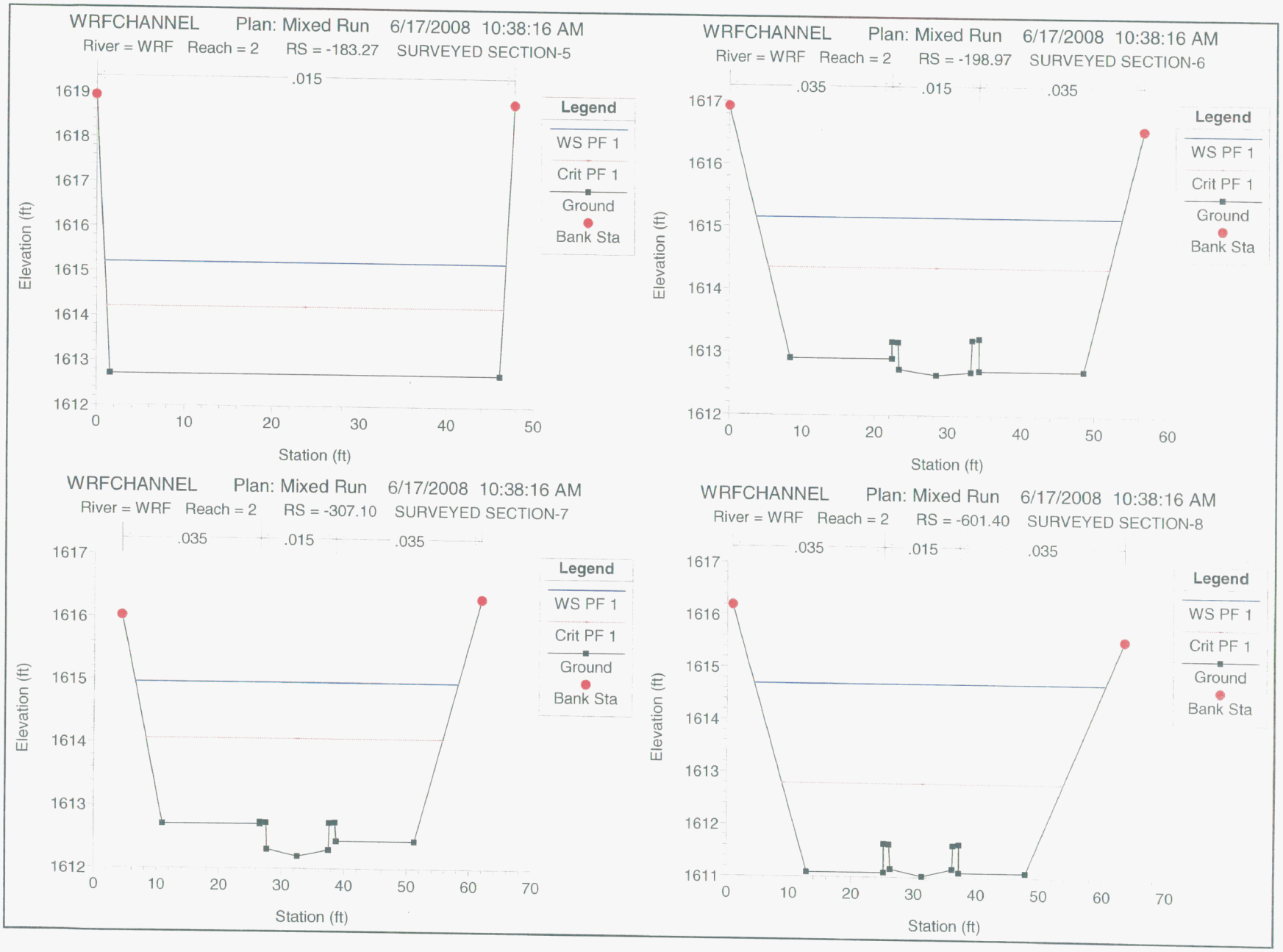
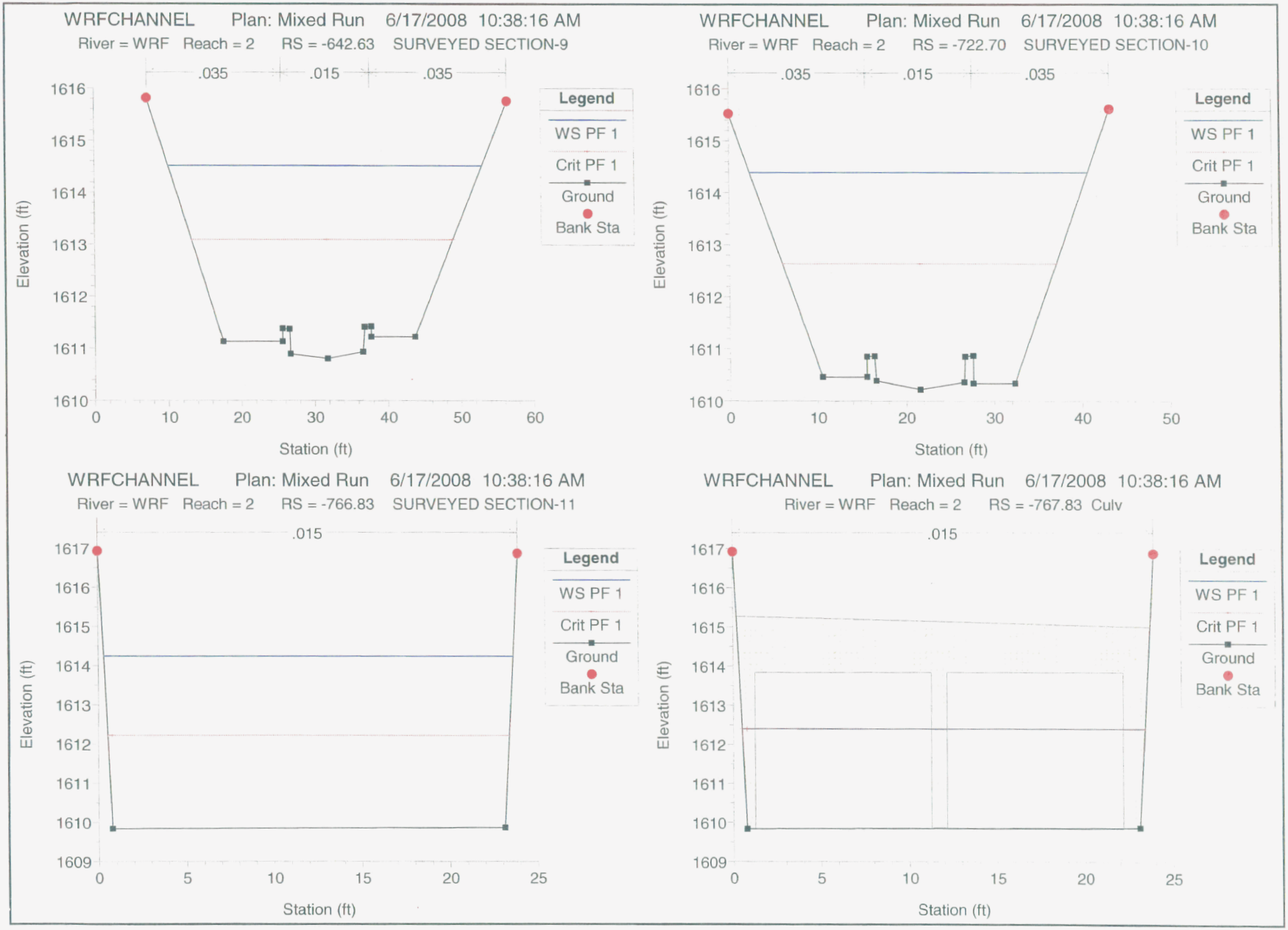
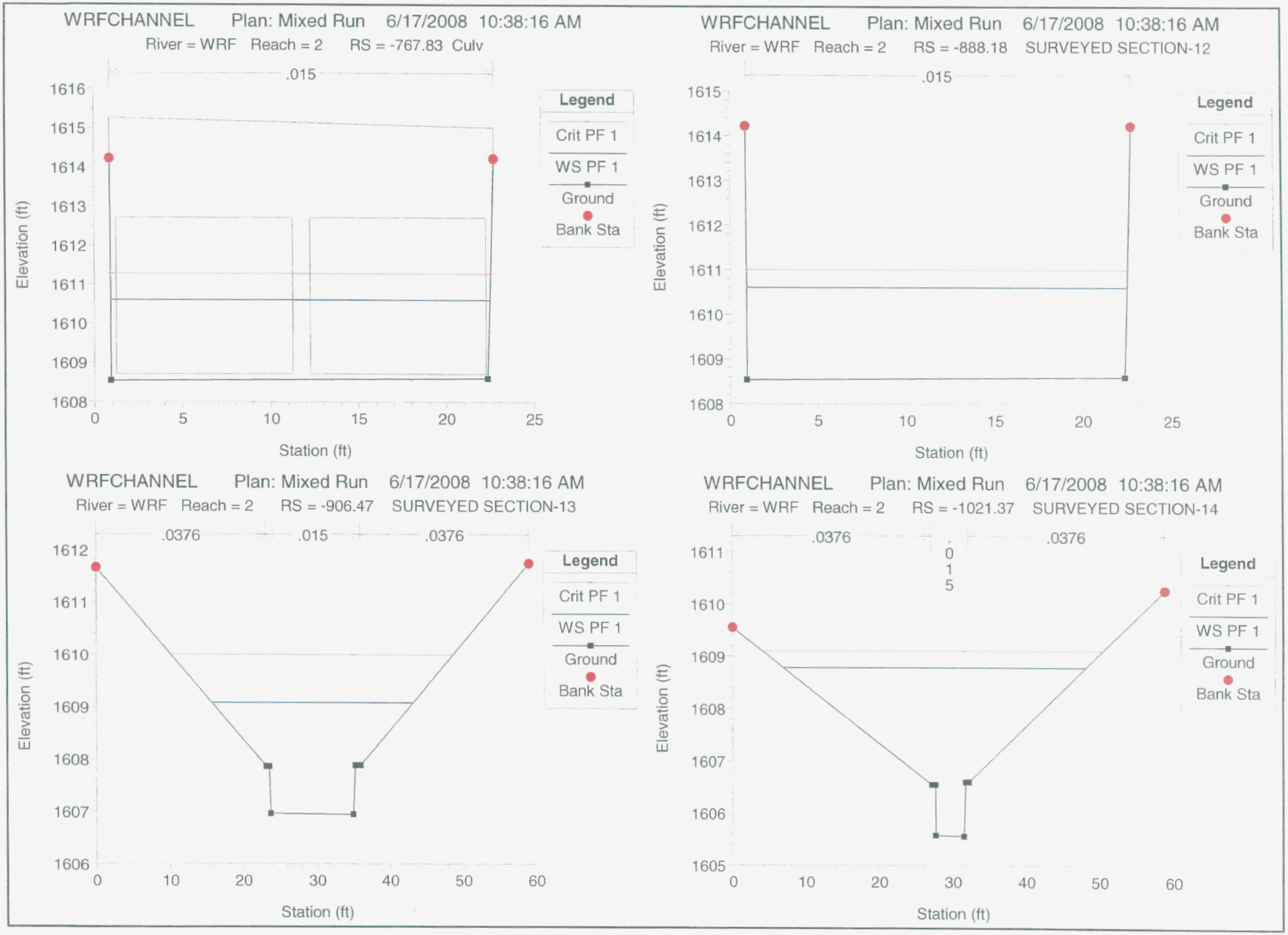
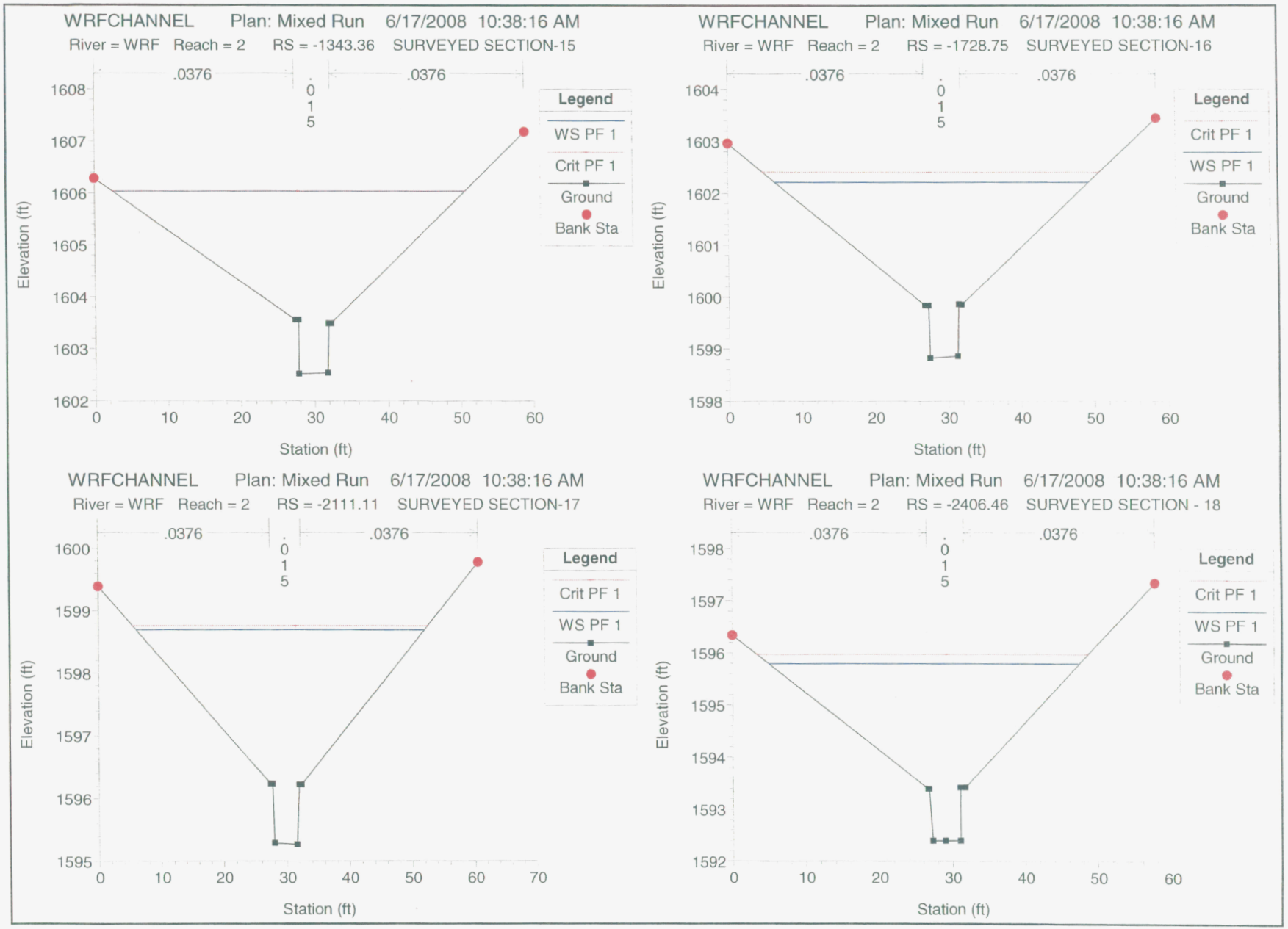
River = WRF Reach = 1 RS = 115.73 ADDED SURVEYED SECTION-2
.035
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = 61.50 ADDED SURVEYED SECTION-1
.0423
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -0.00 SURVEYED SECTION-1
.025
.015
.025
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -69.55 SURVEYED SECTION-2
.035
.015
.035
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -112.98 SURVEYED SECTION-3
.035
.015
.035
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -127.24 SURVEYED SECTION-4
.015
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -130.24 Culv
.015
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -130.24 Culv
.015
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta


WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -183.27 SURVEYED SECTION-5
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -198.97 SURVEYED SECTION-6
.035
.015
.035
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -307.10 SURVEYED SECTION-7
.035
.015
.035
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -601.40 SURVEYED SECTION-8
.035
.015
.035
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -642.63 SURVEYED SECTION-9
.035
.015
.035
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -722.70 SURVEYED SECTION-10
.035
.015
.035
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -766.83 SURVEYED SECTION-11
.015
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -767.83 Culv
.015
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta


WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -767.83 Culv
.015
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -888.18 SURVEYED SECTION-12
.015
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -906.47 SURVEYED SECTION-13
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -1021.37 SURVEYED SECTION-14
.0376
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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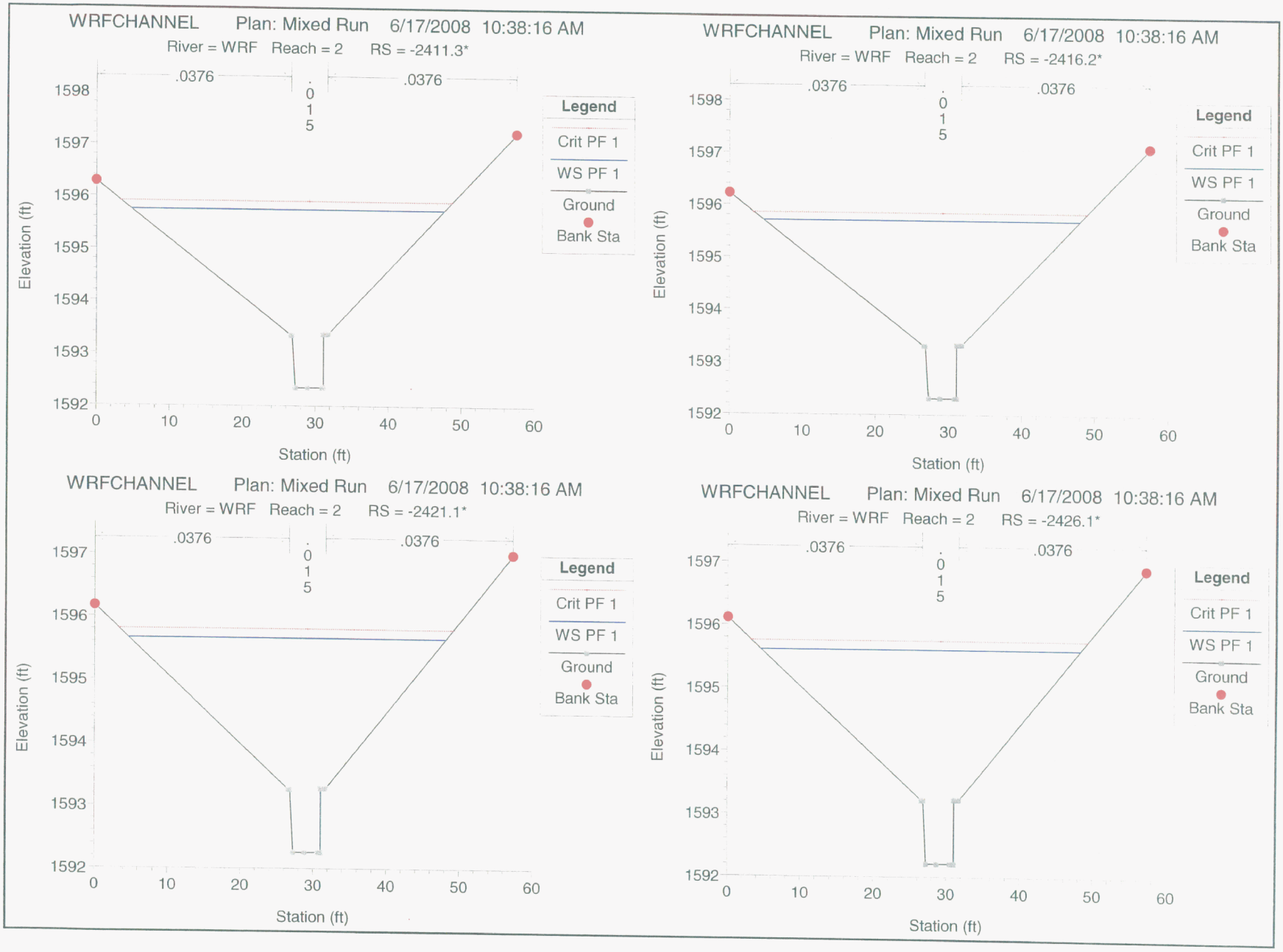
River = WRF Reach = 2 RS = -1343.36 SURVEYED SECTION-15
.0376
.015
.0376
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -1728.75 SURVEYED SECTION-16
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2111.11 SURVEYED SECTION-17
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2406.46 SURVEYED SECTION - 18
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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Crit PF 1
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Bank Sta
Elevation (ft)
Station (ft)
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Bank Sta
Elevation (ft)
Station (ft)
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Ground
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Station (ft)
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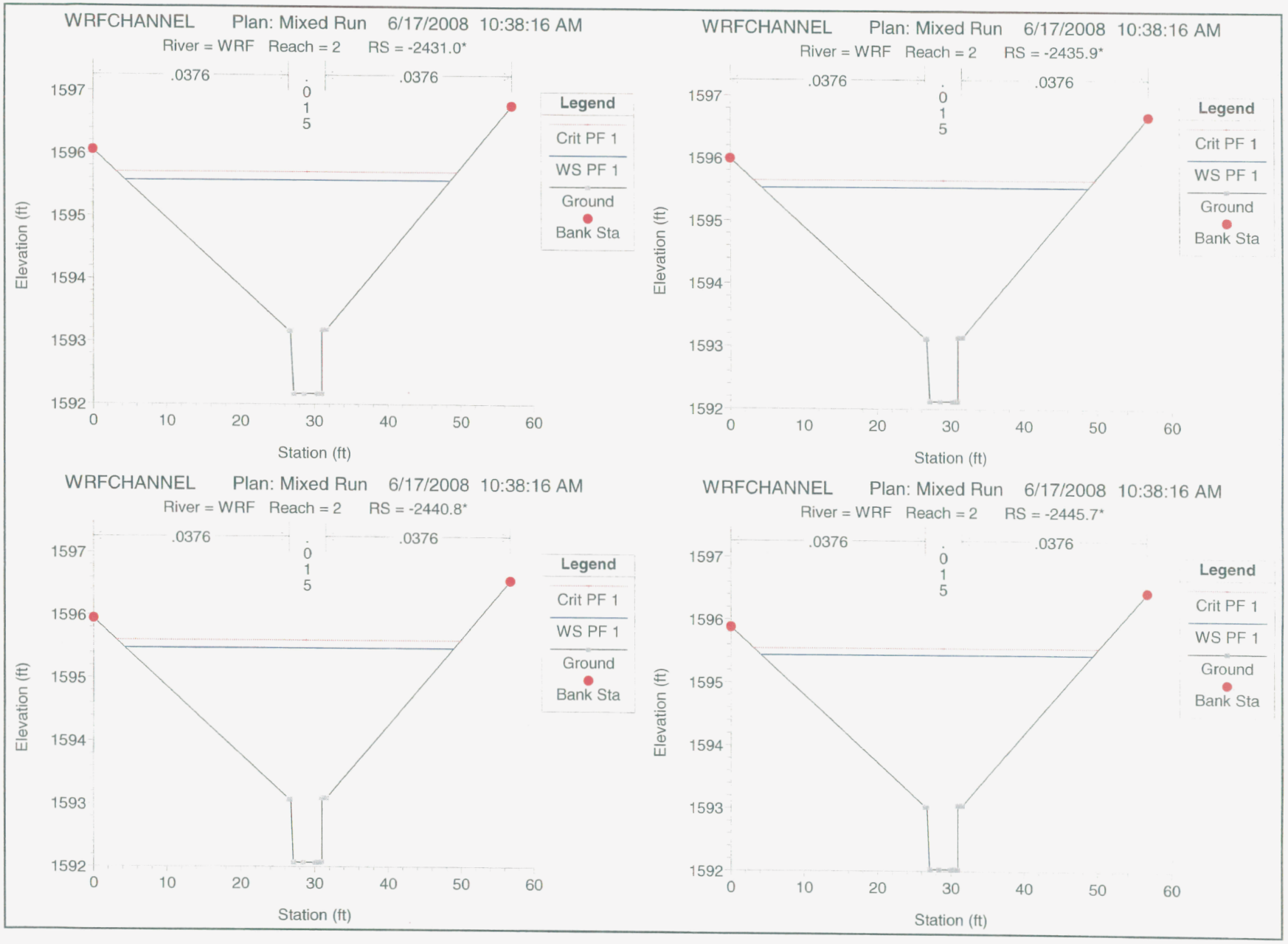
Station (ft)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Ground
Bank Sta
Elevation (ft)
Station (ft)
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.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2440.8*
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.015
.0376
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2445.7*
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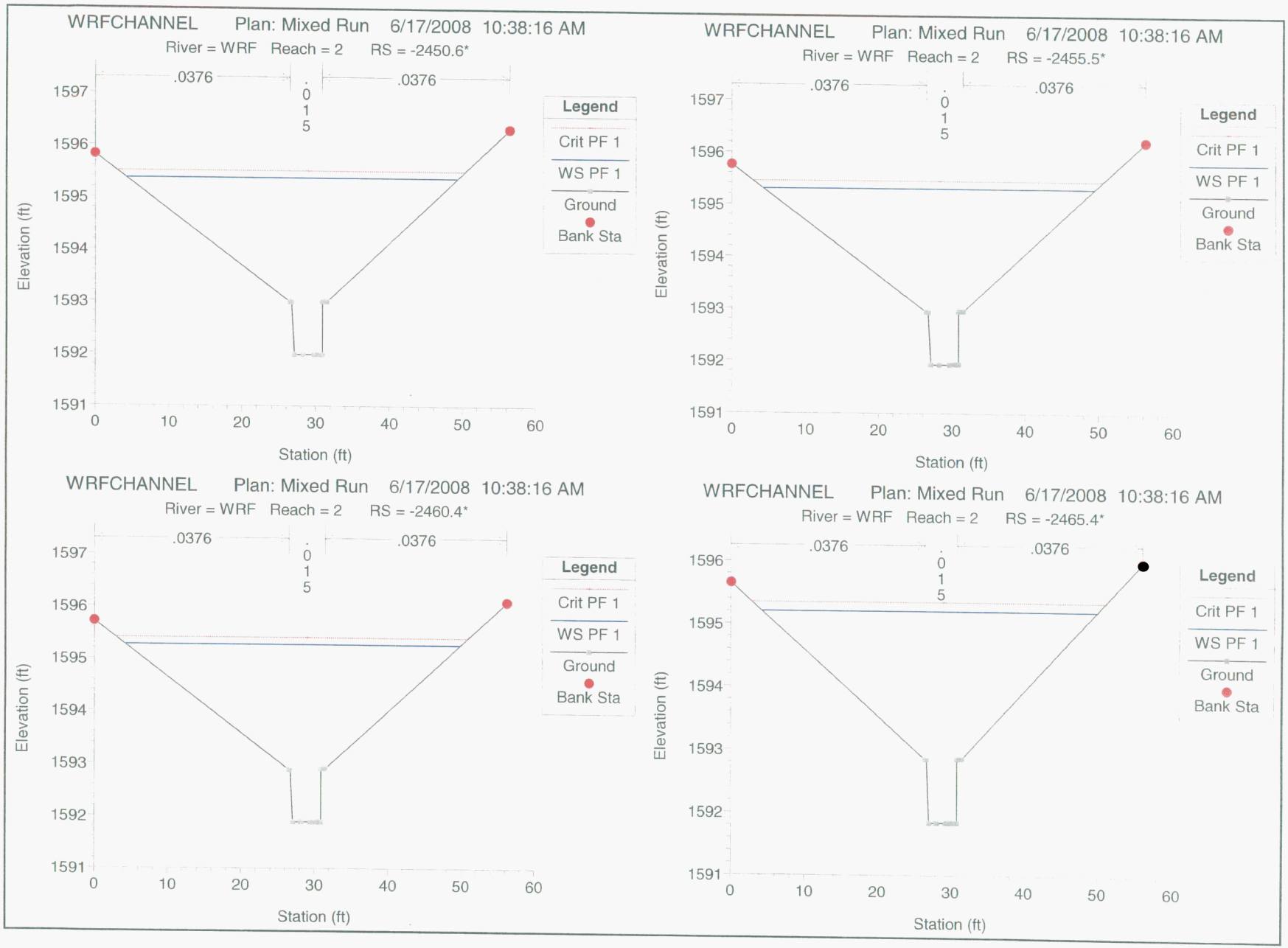
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
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Crit PF 1
WS PF 1
Ground
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Station (ft)
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Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2465.4*
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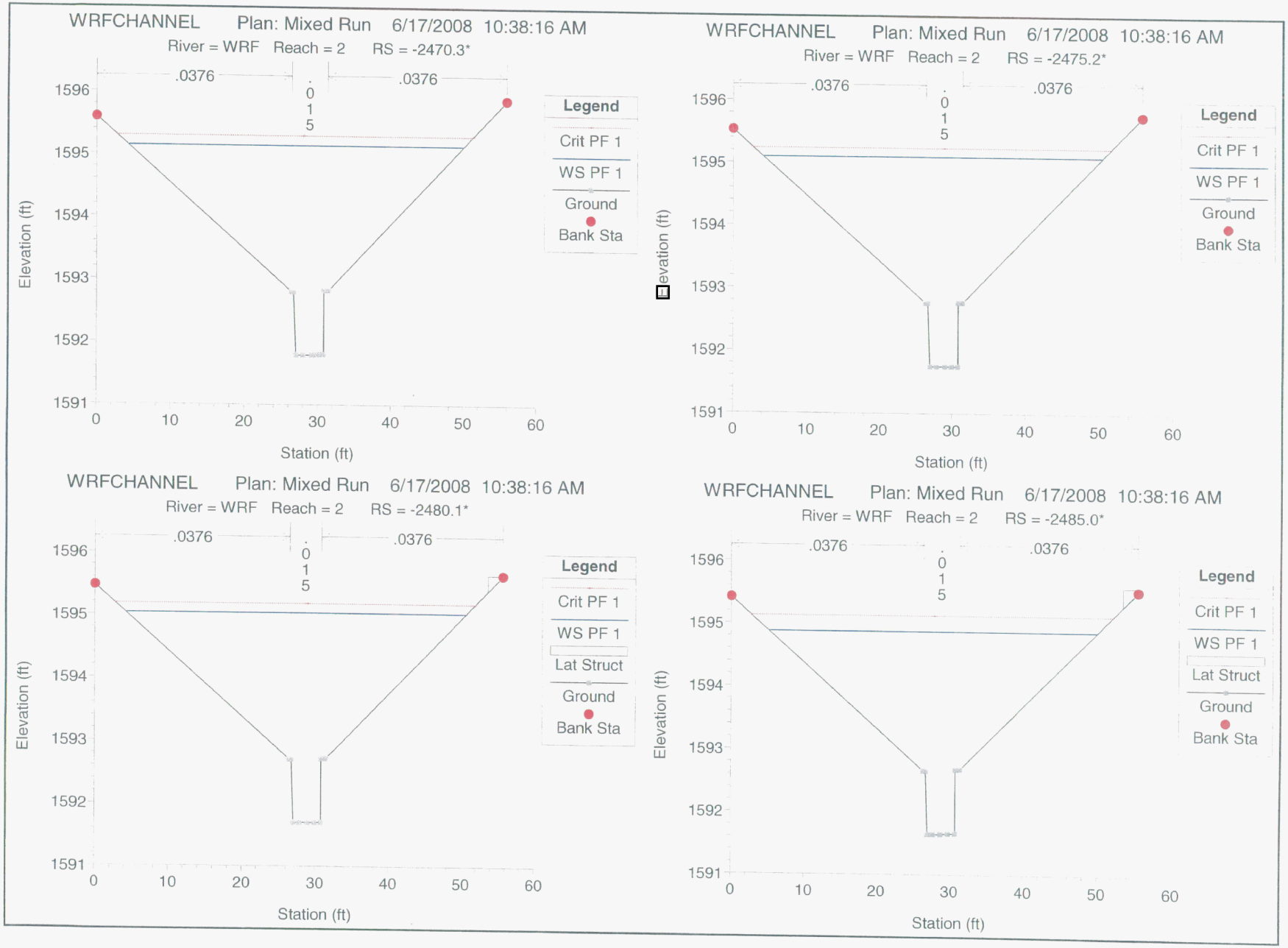
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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Crit PF 1
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Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2475.2*
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.015
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Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2480.1*
.0376
.015
.0376
Legend
Crit PF 1
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2485.0*
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Lat Struct
Ground
Bank Sta
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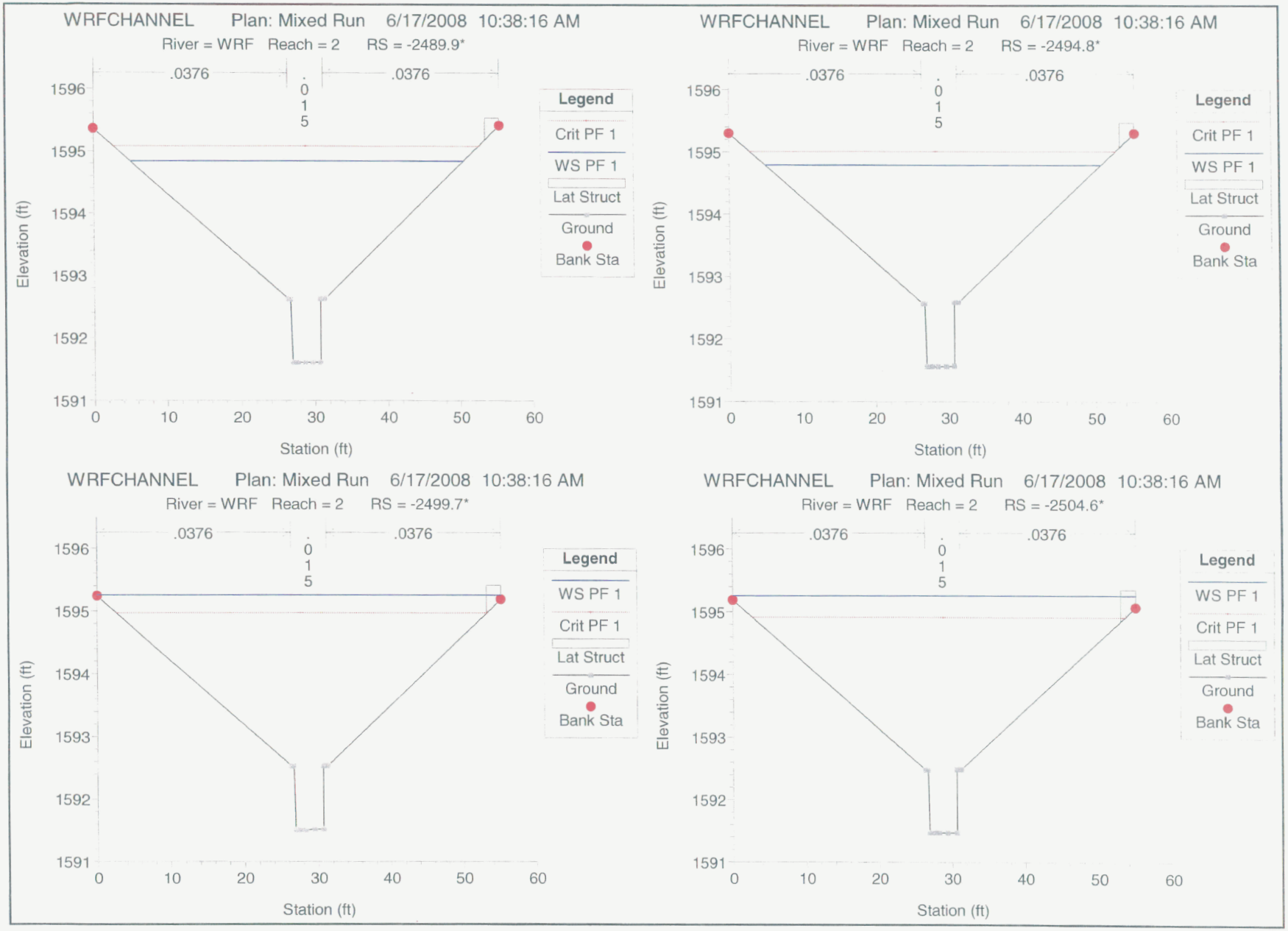
Station (ft)


WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
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.015
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Legend
Crit PF 1
WS PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2494.8*
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
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WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
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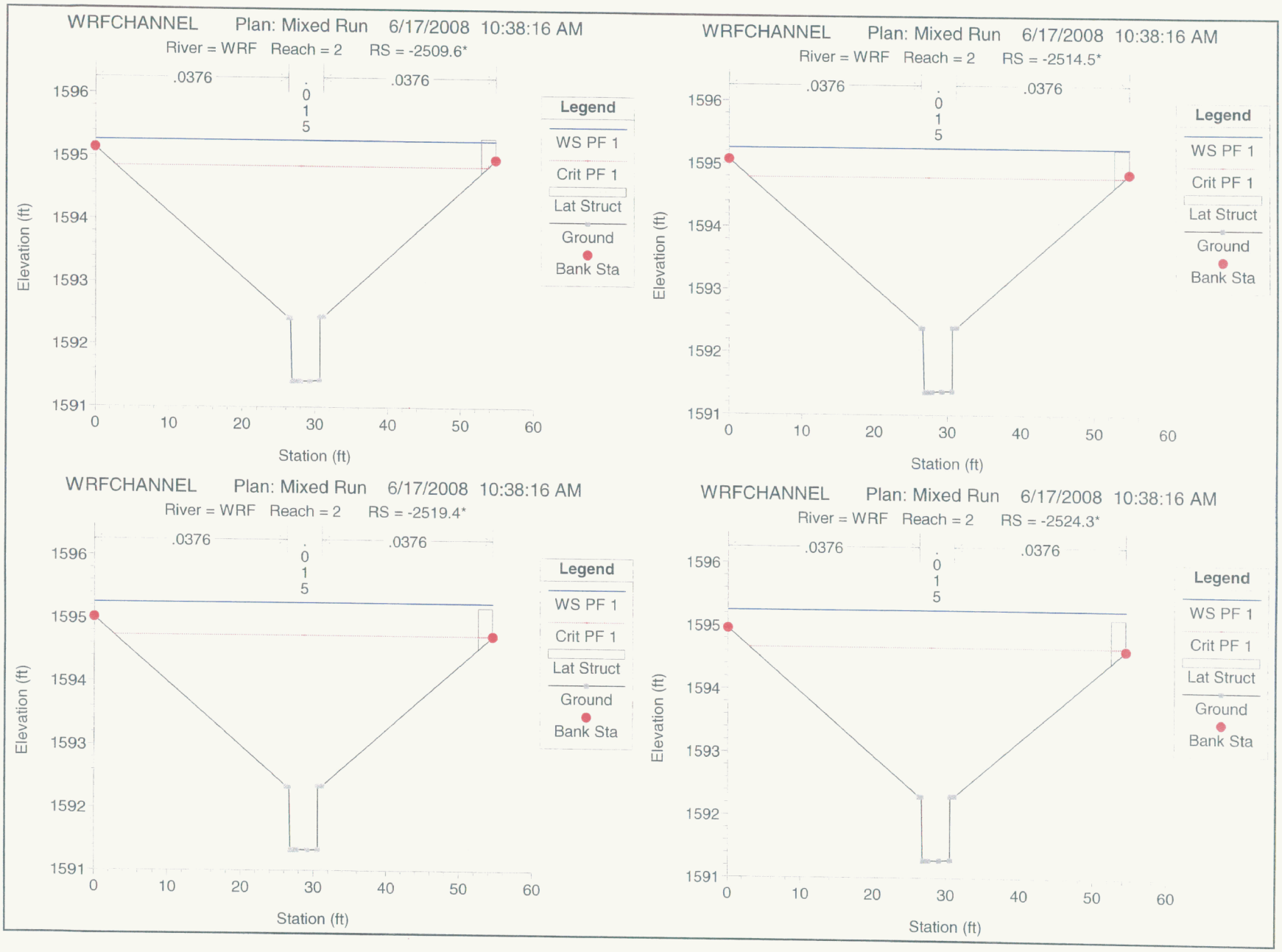
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.015
.0376
Legend
WS PF 1
Crit PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
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WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2519.4*
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
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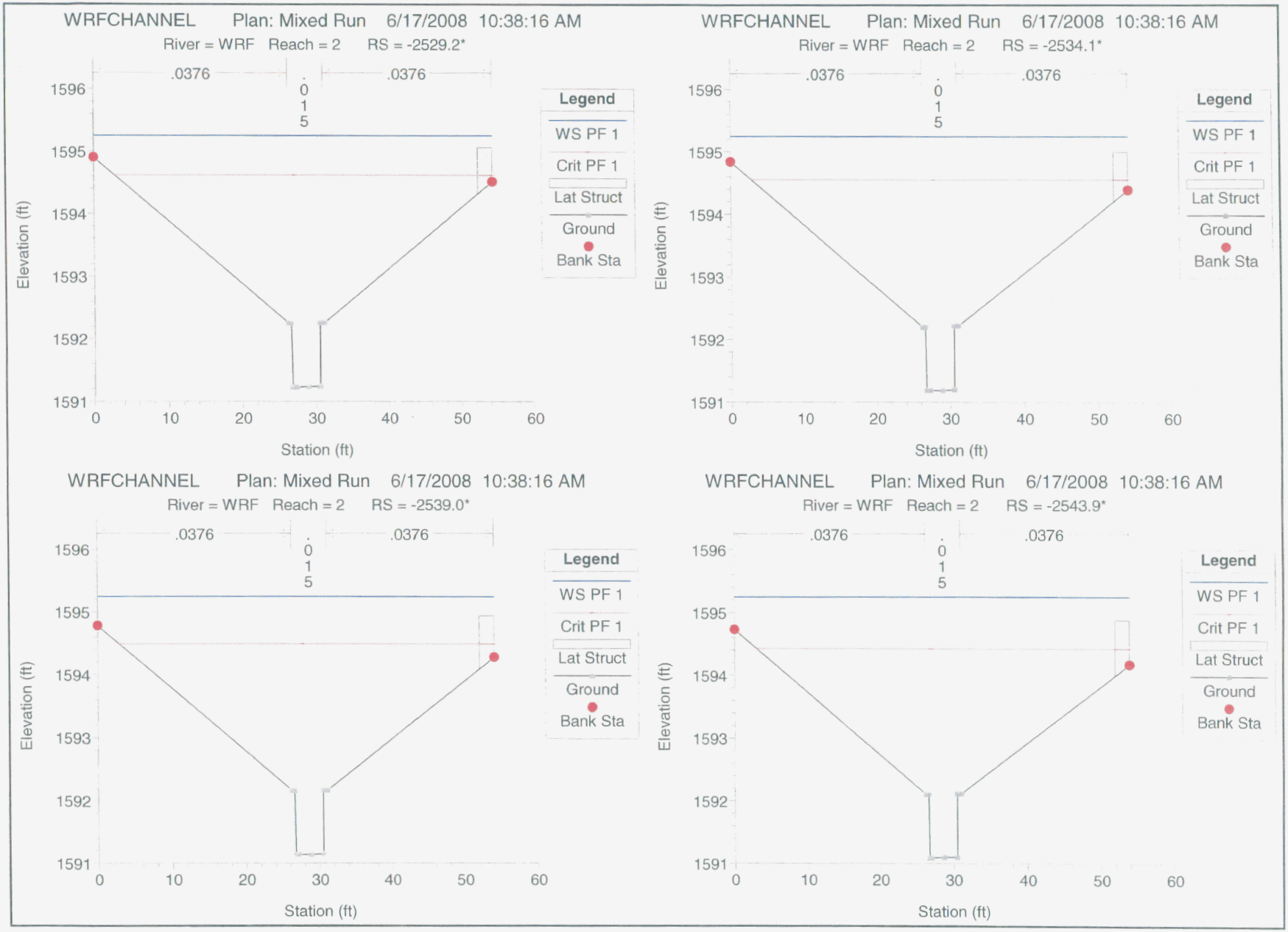
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.015
.0376
Legend
WS PF 1
Crit PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2534.1*
.0376
.015
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Legend
WS PF 1
Crit PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2539.0*
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Legend
WS PF 1
Crit PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2543.9*
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.015
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Lat Struct
Ground
Bank Sta
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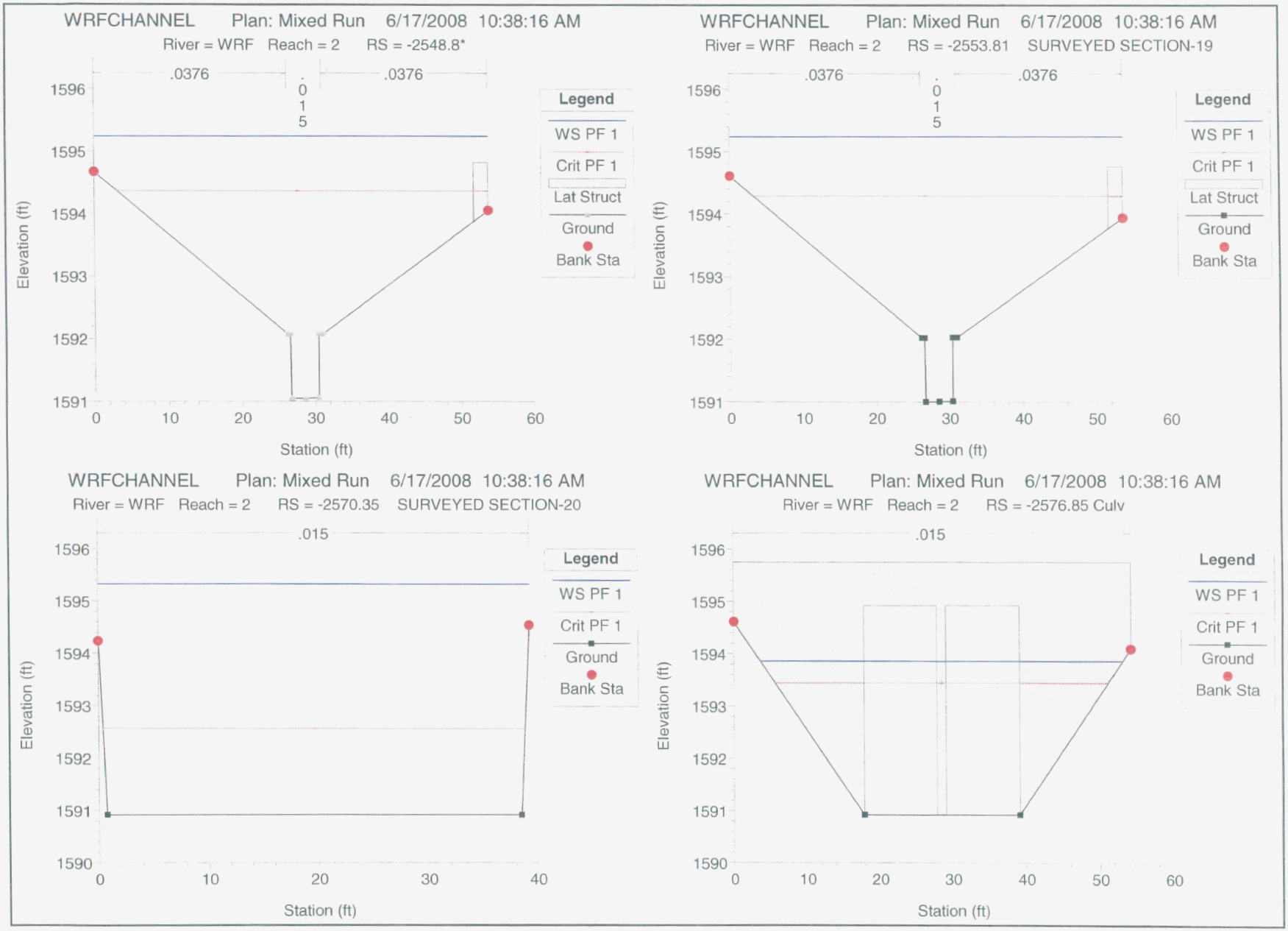
Station (ft)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.015
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Legend
WS PF 1
Crit PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2553.81 SURVEYED SECTION-19
.0376
.015
.0376
Legend
WS PF 1
Crit PF 1
Lat Struct
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2570.35 SURVEYED SECTION-20
.015
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2576.85 Culv
.015
Legend
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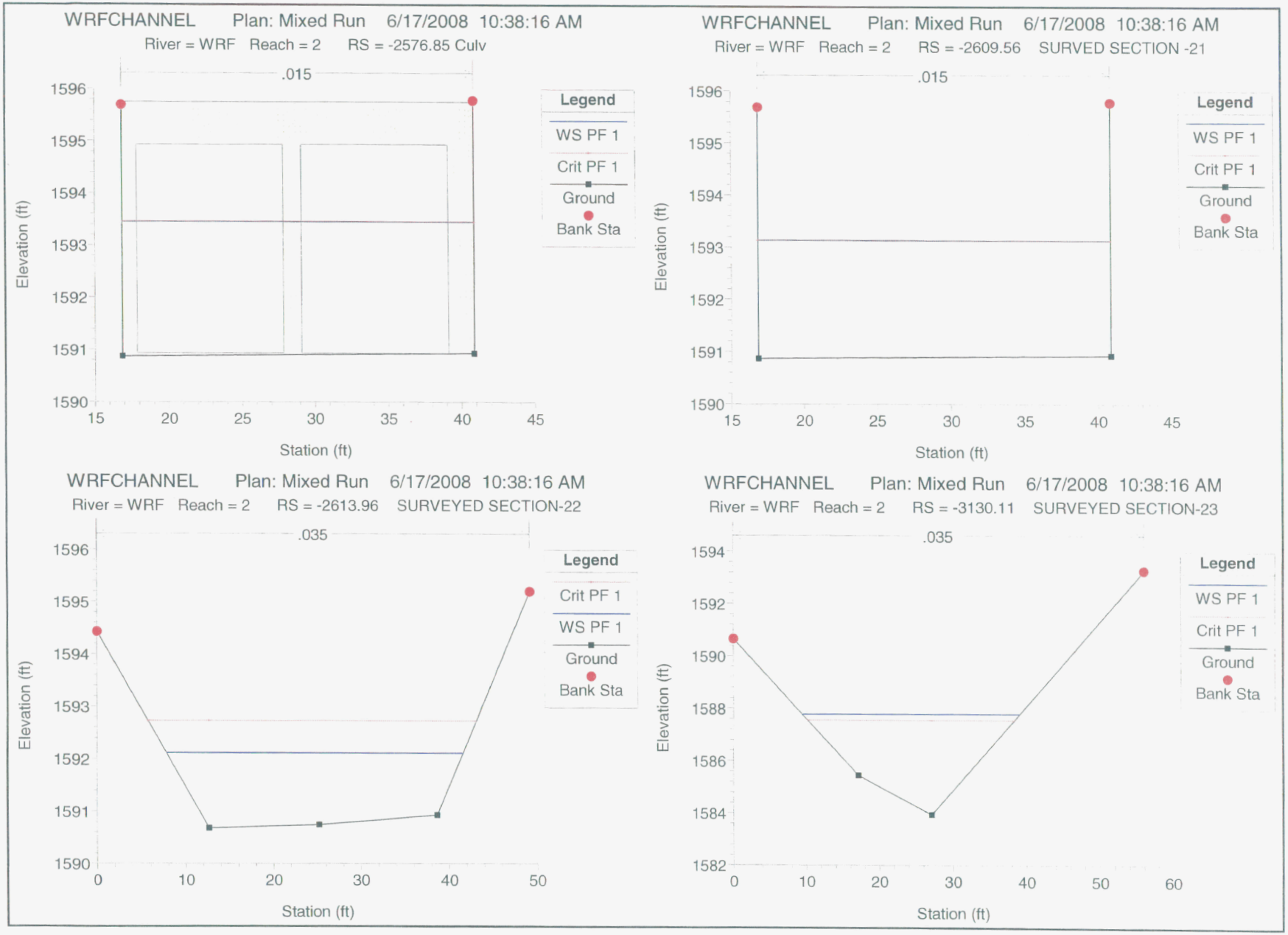
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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River = WRF Reach = 2 RS = -2576.85 Culv
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Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2609.56 SURVED SECTION -21
.015
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -2613.96 SURVEYED SECTION-22
.035
Elevation (ft)
Station (ft)
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
WRFCHANNEL Plan: Mixed Run 6/17/2008 10:38:16 AM
River = WRF Reach = 2 RS = -3130.11 SURVEYED SECTION-23
.035
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta

APPENDIX E: PHOTOS

Photo 1: Existing WRF Channel (Looking Downstream)

Photo 2: Existing WRF Channel (Looking Upstream)

APPENDIX F: ELECTRONIC DATA CD

Federal Emergency Management Agency

Washington, D.C. 20472

August 15, 2008

RFCD

2008 SEP -4 PM 4:10

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 08-09-1157P
Community Name: City of Henderson, NV
Community No.: 320005
Effective Date of
This Revision: **August 15, 2008**

The Honorable James B. Gibson
Mayor, City of Henderson
240 South Water Street
Henderson, NV 89015

Dear Mayor Gibson:

The Flood Insurance Rate Map for your community has been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Oakland, California, at (510) 627-7175, or the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Sincerely,

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

For: William R. Blanton Jr., CFM, Chief
Engineering Management Branch
Mitigation Directorate

List of Enclosures:

Letter of Map Revision Determination Document
Annotated Flood Insurance Rate Map

List of Courtesy Copies

Mr. Curt Chandler, P.E., CFM
Land Development Manager
Department of Public Works
City of Henderson

Mr. James Okazaki, P.E.
Utility Services Engineer II
City of Henderson

Mr. Kevin Eubanks, P.E., CFM
Assistant General Manager
Clark County Regional Flood Control District

Mr. Harshal B. Desai, P.E., CFM
Project Manager
PBS&J

Ms. Michele D'Alessandro, E.I.T., CFM
PBS&J

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	City of Henderson Clark County Nevada	Channelization Fill	Hydraulic Analysis Hydrologic Analysis New Topographic Data
	COMMUNITY NO.: 320005		
IDENTIFIER	Water Reclamation Facility	APPROXIMATE LATITUDE & LONGITUDE: 36.074, -114.996 SOURCE: USGS QUADRANGLE DATUM: NAD 83	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 32003C2605 E DATE: September 27, 2002	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Unnamed Tributary to Las Vegas Wash - from approximately 2,400 feet downstream of Hend Saddle Association Road to approximately 100 feet downstream

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Unnamed Tributary to Las Vegas Wash	Zone A	Zone X (unshaded)	NONE	YES
	Zone X (unshaded)	Contained	NONE	NONE
	Zone A	Contained	NONE	YES

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

112553 10.3.1.08091157 102-D

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the base (1-percent-annual-chance) flood discharges computed in the submitted hydrologic model. Future development of projects upstream could cause increased discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This revision has met our criteria for removing an area from the base floodplain to reflect the placement of fill. However, we encourage you to require that the lowest adjacent grade and lowest floor (including basement) of any structure placed within the subject area be elevated to or above the Base Flood Elevation.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Sally M. Ziolkowski
Director, Mitigation Division
Federal Emergency Management Agency, Region IX
1111 Broadway Street, Suite 1200
Oakland, CA 94607-4052
(510) 627-7175

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency

Washington, D.C. 20472

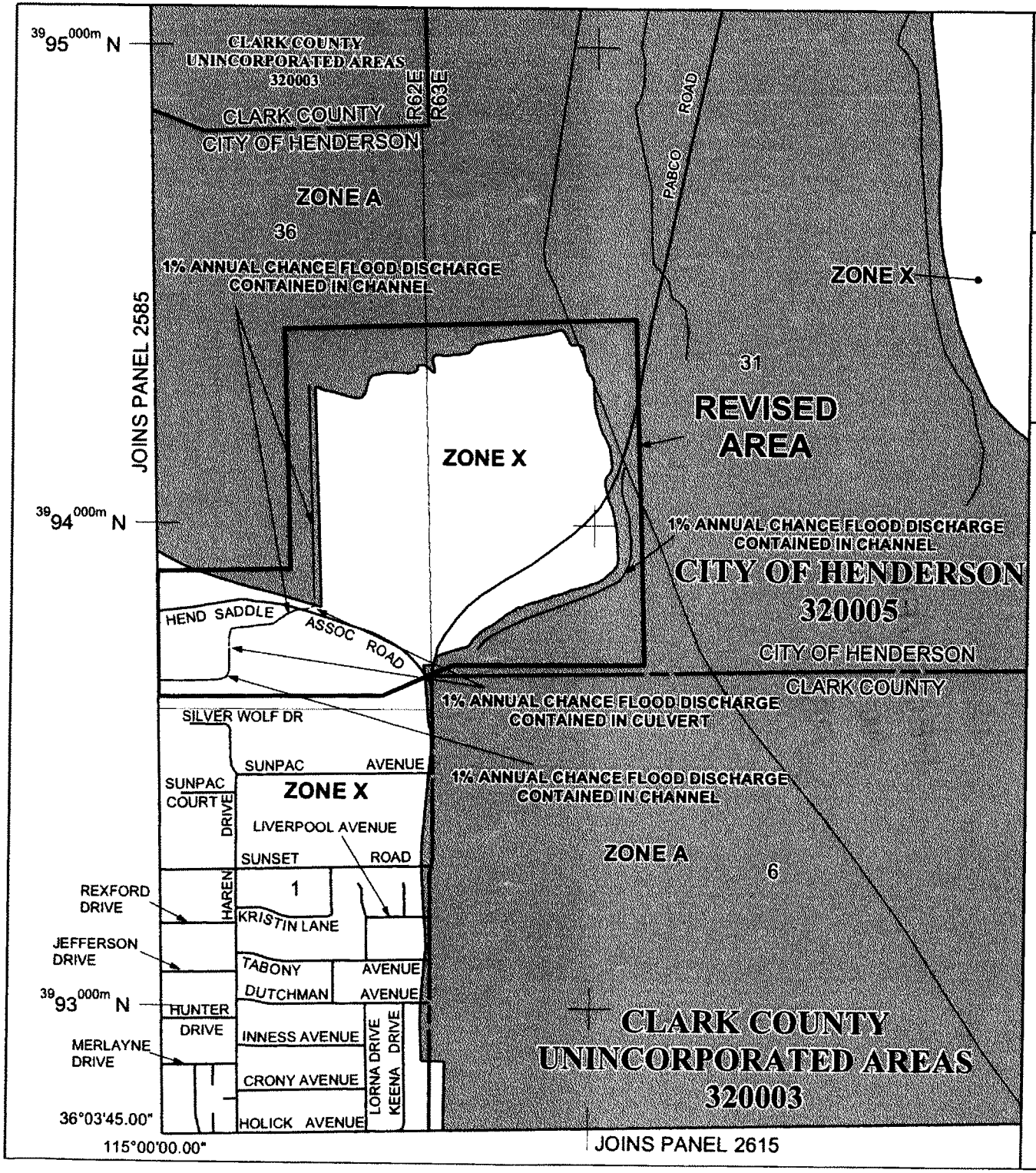
LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

This revision is effective as of the date of this letter. Any requests to review or alter this determination should be made within 30 days and must be based on scientific or technical data.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate



Legend

- 1% annual chance (100-Year) Floodplain
- 1% annual chance (100-Year) Floodway
- 0.2% annual chance (500-Year) Floodplain

MAP SCALE 1" = 1000'

500 0 1000 FEET

300 0 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2605E

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA

AND INCORPORATED AREAS

PANEL 2605 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2605	E
HENDERSON, CITY OF	320005	2605	E

REVISED TO REFLECT LOMR EFFECTIVE: August 15, 2008

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
32003C2605E

MAP REVISED
SEPTEMBER 27, 2002

Federal Emergency Management Agency