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Tres Rios Environmental Restoration Phase 3B

Grading Design Analysis Report

Final Submittal
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US Army Corps of Engineers®
Los Angeles District

Kiewit

City of Phoenix

DESIGN ANALYSIS REPORT
TRES RIOS ENVIRONMENTAL RESTORATION PHASE 3B
GRADING
FINAL SUBMITTAL

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1 GENERAL DESCRIPTION

1.1 Project Description

This project is to design and construct the Tres Rios Phase 3B environmental restoration and related work. The project is located along the Gila River and Salt Rivers. This is the second phase of the Tres Rios Phase 3 project. Phase 3A has been designed and is currently under construction.

In general, the project includes the grading of open water, wetland marshes and other habitat areas along the project reach within the active stream system. Work includes plant removal within the project limits and re-vegetation with native plant materials. Incidental related work includes construction of storm drain culverts and removal and replacement of existing asphalt roadway along El Mirage Road.

2 HYDROLOGY AND HYDRAULICS

2.1 Water Requirements

Tres Rios Phase 3B is located downstream of Phase 3A on the Gila River and is assumed to have similar water supply and demand requirements.

The analysis conducted for the USACE Request for Proposal dated May 20, 2010 (90% RFP) DDR indicated that flows from the overbank wetlands (OBW), an average of 235 acre-feet per day diverted from the 91st Avenue Wastewater Treatment Plan (WWTP), would be the primary source of water for Tres Rios Phase 3. This volume of water would be more than sufficient to offset the peak water demand of 98.5 acre-feet per month for Phase 3A and 95.5 acre-feet per month for Phase 3B (RBF Consulting 2010, Table 3-13 and 3-14).

After work on the Phase 3A contract began, representatives from the USACE and the City of Phoenix (COP) indicated that neither flows from the OBW nor from the WWTP could be relied on to support the demands of the restored vegetation communities. Flows from the WWTP would likely continue at or near current rates, but these flows could not be used to support the project vegetation through either surface inundation or infiltration into the banks. The only reliable source available is the near-surface groundwater.

Additional flow will enter the site from the existing Interior Drainage Basin Outfall near El Mirage Road. Flow through this structure is a combination of irrigation runoff and storm water runoff. The irrigation runoff is expected to be highly variable and generally less than 5 cubic feet per second (cfs) during the March to October irrigation season, and does not represent a reliable source for water supply.

If the vegetation communities are established at elevations where they can use groundwater to supply their water demand, the peak demand for the Phase 3B project site would require approximately 6 inches of groundwater per month during June through August, and a total of 3.2 feet per year. Existing groundwater levels were explored at the Phase 3A project site by potholing in October 2010. The groundwater levels were found to be generally within one foot of the design low water levels for Phase 3A. Analyses conducted by Southwest Ground-water Consultants, Inc. suggest that the water levels were probably representative of conditions recovering from their summer low levels, but are likely to vary only a few feet, except during and immediately after flood events (see Appendix F of Phase 3A Design Analysis Report). These flood events would provide a source of water to the system; the area within the 2-year floodplain groundwater levels would be replenished on a regular basis by infiltrated overbank flows.

Because water supply and demand is similar for both sites, it is anticipated that the groundwater at the Phase 3B project site will perform similar to that of the Phase 3A project site. It should be noted that the 2000 Feasibility Study indicated that downstream of 115th Avenue, the Gila River is a gaining stream (groundwater table is at the ground surface of riverbed and contributes to the surface flow), but this was not included in the projects water budget.

2.2 Normal Water Conditions

Assuming that flow from the 91st Avenue treatment plant is the only water source for the Salt River at this point, the 90% RFP DDR indicates that a consistent flow of 95 cfs will be present throughout the year.

During the existing normal water conditions, the surface water for the Phase 3B site flows primarily through the nine existing CMP culverts located at Old 115th Avenue and then towards the southern channel with some flow directed to the large pond in the center of the site. Based on the contract documents, the southern channel is to be filled and abandoned in order to push the surface water flow back to the center channel, which is where its historical flows occurred. A portion of the southern channel just downstream of the 115th Ave. Bridge was utilized to pond water in the proposed conditions.

There are four large pools at the Phase 3B project site which will be conserved for the proposed site conditions and one more ponding area will be added. The existing ponds are created by natural check dams that occur between pools. These check dams consist primarily of cobbles that have cattails and other wetland species growing on them. Based on information collected in the field, the depth of water during normal conditions that flows over these check dams is approximately 1 inch due to their relatively large width. The surface water elevations in these ponds will be conserved as closely as possible during the proposed conditions.

Proposed surface water elevations for Phase 3B were set based on surface water level measurements taken during a site visit on September 18th, 2011 and

GPS measurements of the four existing major pools provided by Kiewit on October 4th, 2011 (Appendix A). These water surface elevations were used as the basis for design of the Phase 3B ponding areas in order to mimic existing surface water and groundwater conditions as closely as possible.

The existing pond located approximately between Old 115th Street and the 115th Ave. Bridge (Pond 1) will serve as the water surface control for the large pond upstream of Old 115th (Phase 3A) during normal flow conditions. It will split into two separate channels that will flow around the naturally high ground located in the center portion of the project site. The pond will be created by a combination of channel excavation and utilization of the existing natural check dams. The water surface for this pond is set at approximately 929 feet in order to maintain that elevation in the upstream Phase 3A pond, which is critical for hydraulics and the survival of the plant species in that phase. Additionally, the northern channel that was excavated for the Phase 3A tie in of the 2-30-inch HDPE pipes to Phase 3B was designed to pond water at an elevation of 929 feet and also utilizes a natural check dam located just downstream of the 115th Ave. Bridge.

The existing pond located on the north side of the high ground in the center of the site and approximately between the 115th Ave. Bridge and Phase 3B project stationing 38+00 (Pond 2A) has a surface water elevation at approximately 926 feet. For the proposed condition, Pond 2A will tie into the northern check dam of Pond 1 and the Phase 3A tie-in channel. Pond 2B will be added on the south side of the high ground and will tie into the southern check dam of Pond 1. Pond 2B will also have a surface water elevation of 926 feet, but will utilize a man-made check dam to tie into the downstream pond.

The large existing pond located approximately between Phase 3B stationing 38+00 and 12+00 (Pond 3) has a surface water elevation of approximately 924. Both Ponds 2A and 2B will tie into this pond on its east side. A relatively wide natural check dam vegetated with wetland species occurs on the west side of Pond 3, and will remain in place during construction. An outlet channel will be excavated for this pond just to the north of this existing check dam. The outlet channel will run to El Mirage Road, where 8-42-inch CMPs will be constructed in order to compensate for the surface water that currently flows through the southern channel (to be filled). The channel then ties into an existing ponding area within the Phase 3C project area (approximate water surface elevation of 918 feet).

A smaller existing pond (Pond 4) is located just downstream of the natural check for Pond 3 and is connected by three existing 66-inch CMPs that run under El Mirage Road. Pond 4 is located approximately between Phase 3B stationing 12+00 and 3+00, and straddles El Mirage Road. The natural check dam for this pond is located just downstream of El Mirage Road and near station 3+00. For the most part, this pond will remain unchanged by this project. The outlet channel for Pond 3 runs along the north side of this pond and ties into another pond just downstream.

Alterations to the 90% RFP grading plan were required to eliminate excavation of this existing natural channel constriction feature and to provide a constriction that maintains this hydraulic condition. HEC-RAS hydraulic modeling of the grading plan indicates that the desired water levels would be maintained during a flow of 95 cfs, as is the case during the existing conditions.

Conditions were modeled for flows of 95 cfs (daily minimum) and 118 cfs (daily average) as well as annual average and 5-year recurrence flows (Section 2.3). The low flow profiles generated are presented in Appendix B. The results are consistent with the design water surface elevations. Flow velocities in both channels would be low (less than 0.1 ft/s) under normal conditions, with velocities less than 2 ft/s at the check dams (and likely lower given the dense vegetation present). The annual average profile indicates that the areas within an elevation of 2 to 4 feet of the normal surface water elevation would be inundated with flows that would regularly recharge local groundwater levels.

Per the project requirements, the southern channel will be filled with on-site excavated material approximately from project station 41+00 westward to El Mirage Road. The filled-in southern channel will still provide conveyance during larger storm events, and the conveyance at El Mirage Road will remain in place.

2.3 High Water Conditions

The hydraulic function of the project under high flows was evaluated using the HEC-RAS models developed for the Phase 3A project. Flows used to evaluate function are shown in the table below. These values for the 5-year recurrence and larger are the instantaneous peak flows from Fuller (2010). The annual flow represents the normal daily average high flow as estimated by an analysis of several local gages, and is consistent with the 2-year flow estimated by extrapolating a plot of the Fuller peak flows performed during the Phase 3A analysis.

Recurrence	Flow (cfs)	
	Salt River Above Gila River	Gila River Below Salt River
Average annual max. daily	4,400	6,700
5-year	19,500	23,500
10-year	49,000	57,000
20-year	82,000	92,000
50-year	130,000	185,000
100-year	162,000	227,000

The intention of this modeling is to compare the project design to the models used for plan development. The Phase 3A "With Project" model was used as the foundation for the Phase 3B "With Project" model. Ground points were only modified in the areas where grading is occurring within the Phase 3B project site. The HEC-RAS output for the Phase 3B model is provided in Appendix B.

The final grading and landscape plans for Phase 3B were incorporated into the 3A "with project" model by changing cross-sections and roughness values in order to evaluate whether there would be any negative effects of the project on flood profiles. The design flow profiles for the Phase 3B "With Project" model demonstrate that water surface elevations only exceed the Pre-Project levels for the 100-year floods at a two locations and by very small amounts.

Although the southern channel will be filled in, it will still convey storm flows for events approximately greater than the typical peak year event. The HEC-RAS model was also configured to simulate the vertically-averaged velocities at various points across each cross-section.

3 EARTHWORK AND ENGINEERING

3.1 Introduction

As the purpose of this project is environmental restoration and redirection of the majority of flows away from the Phoenix International Raceway (PIR) overflow parking, grading will be performed as required to accommodate landscape features and to redirect the southern channel flows to the center of the project towards a new culvert crossing at El Mirage Road. This is accomplished by excavating new channels and embanking the excavated material into large earthen channel-plugs that channelize existing flows towards the center of the project.

The completed Quality Assurance / Quality Control Checklist for the Grading engineering is attached as Appendix C.

3.2 Survey

Existing ground survey for the project site has been developed using a combination of aerial light detection and ranging (LIDAR), photogrammetry, and bathymetric point shots. The survey originally performed for Phase 3B did not encompass the southern end of El Mirage Road. To supplement this data, ground and bathymetric point shots were taken to the east of El Mirage Road along the existing channel and banks to the limit of the original survey coverage. In addition to these channel and bank points, new shots were also taken along the portion of El Mirage Road that was displaced and out of service during the initial project survey, where the proposed culverts are designed.

3.3 Right Of Way

The current property owners within the project boundary limits and surrounding areas are identified on the Right Of Way Maps included in the construction drawings. The data contained on the Right Of Way Maps has been provided by Morrison-Maierle, Inc. contracted by the City of Phoenix for land surveying. The data contained on the Right Of Way Maps is deemed reliable, but not guaranteed. This data should be used for information only and does not constitute a legal document for the description of these properties. This material

may be slightly dated which would have an impact on the accuracy. The Maricopa County Assessor's Office and City of Phoenix Water Department disclaims any responsibility or liability for any direct or indirect damages resulting from the use of this data.

3.4 Existing Conditions

Several existing site features are located throughout the project and are noted throughout the construction drawings as to "protect in place." These features include flood control levees, gabion mattresses, dikes, culverts, an interior drainage basin outfall culvert, Phoenix International Raceway (PIR) berm and overflow parking lot, piers for the 115th Avenue Bridge, and project features installed during Phase 3A construction. No underground utilities are identified within the project limits. The existing soils on the project vary considerably, with silty sand mixed with river cobbles as the predominant soil type.

An existing historic landfill is present in the immediate vicinity of the project. The approximate limit of this landfill has been included in the construction drawings and was identified to be protected in place. No excavations or fills were designed in this area. Care was also taken during design to limit the work required adjacent to landfill, hence minimizing disturbance from anticipated construction operations. Limits of the existing landfill were developed by the Zonge Engineering and Research Organization for Weston Solutions, Inc. for the Phase II Targeted Brownfields Site Assessment, Tres Rios – 123rd Avenue Landfill Study prepared for USACE and the United States Environmental Protection Agency (EPA), September 2006.

3.5 Grading Design Assumptions

Cut and fill slopes will vary; however, 4:1 slopes are preferred. Steeper slopes and armored slopes may be used in some instances due to horizontal constraints. A geotechnical stability analysis was provided in the Phase 3A Design Analysis Report, Appendix E and confirmed that the design slopes have an acceptable factor of safety under the anticipated soil drainage conditions. Additional stability analyses for Phase 3B were deemed unnecessary due to similar existing and proposed project conditions and features to Phase 3A.

In general, the grading within a given river reach will be designed to maintain the hydraulic conveyance capacity of the river. Drastic changes to any river reach, either increasing or decreasing the conveyance capacity can have adverse effects on the stability of that reach and subsequent reaches, either upstream or downstream.

In general, project fills were designed within the limits of the existing southern channel to redirect flows towards the center of the project. Similar to Phase 3A, compaction requirements for the project were developed based on the properties of the in-situ material, for which proctors cannot be accurately developed. In lieu of proctors and density testing requirements, performance-based compaction was specified for the project, requiring the use of specifically-sized equipment coupled with a number of passes to achieve compaction. Within the limits of the existing southern channel, as well as other fills to be placed in an inundated condition, compaction was assumed unattainable underwater. In these areas, compaction methods were modified from those specified for Phase 3A and fill was required to be placed two feet above the localized water surface elevation prior to compaction.

The site was designed as a balance with no material leaving (waste) or entering (borrow) the site. This was accomplished by assuming a compaction factor of 10% to 15% based on the in-situ material properties and the specified compaction requirements. In the event a different compaction factor is achieved during construction, either greater or less than the assumed factor, changes in the project cuts and/or fills may be required to maintain the interests and intents of the project. Grades differing from those shown in the construction drawings may have adverse effects on the 100-year water surface elevation.

In addition to adverse effects on the 100-year water surface elevation, changes in grades may increase the frequency at which the existing PIR berm overtops if adequate freeboard is not maintained.

Grading design for the project is accomplished by implementing the typical sections shown in the construction drawings. Typical sections provide detailed information of the finished grade surface features by establishing finished grade break lines, grading limits, and relationship to the landscape zones. Project control line data from the previous designs were not included in the construction drawings as the contractor will utilize digital terrain model data for grading work. The old project control lines were shown in the 90% RFP drawings provided by USACE titled Tres Rios Environmental Restoration Project Phase 3, June 2010, 90% Submittal (90% RFP).

Near the downstream end of the project, a "right hook" channel was designed to convey flows towards the proposed El Mirage Road Culverts. The alignment of the channel was developed to maintain the natural constriction near this location and limit the disturbance to the existing wetlands in this area.

Beyond the proposed El Mirage Road Culverts, a channel connection was designed across a portion of the Phase 3C project limits to provide an outlet from the new culverts under El Mirage Road to the Gila River.

3.5.1 Horizontal Control

Horizontal controls for El Mirage Road centerline, project baseline, trench centerline at the new culverts under El Mirage Road, and maintenance roads centerlines are shown in the construction drawings.

The project baseline was established as a reference point near the approximate center of the project. Initially, the alignment of the project baseline followed the redirected river, similar to the Phase 3A North Channel baseline. Because of the large footprint of the project, cross section planimetrics overlapped and became problematic. Whereas the project cross sections are to convey the general cut and fill sections along the length of the project, and will not be used for measurement or payment during construction, the project baseline was established near the center of the project, as a straight alignment, with perpendicularly cut cross sections. It was assumed that the warping effect of existing and proposed surface cross section lines caused by cutting cross sections askew to the general alignment of channels within the project would be negligible. Cross section planimetrics were included in the drawings for reference.

The baseline for El Mirage Road was located on the approximate existing centerline of pavement.

The El Mirage culvert trench centerline was designed perpendicular to El Mirage Road.

The maintenance road centerlines were aligned to accommodate anticipated maintenance needs of the project. Similar to Phase 3A, the need for maintenance vehicles to traverse between project pools was assumed. For Phase 3A, a low-water crossing was designed using in-situ material just west of the existing natural constriction. For Phase 3B, the maintenance vehicles will utilize crossings at the various channel constrictions or "check dams." Should the check dams not provide sufficient access due to water velocities, low water crossings may be required for access as necessary.

3.5.2 Vertical Control

Elevation controls for the riparian corridors and wetland marshes are shown in the construction drawings on the typical sections. Three typical sections were established for the project as a result of field investigation conducted during a site visit September 28th and 29th, 2011. Four distinct existing pools at different elevations were observed on the project site along the to-be-improved reach of the Phase 3B channel. Similar to Phase 3A, the pools water elevations were maintained by natural constriction points in the channel where natural "check dams" exist. Design water elevations were selected for the project based on these existing constrictions.

- The Design Low Water Elevation of 929 feet was established immediately downstream of each set of Old 115th Avenue culverts between approximately project baseline stations 50+00 and 57+00, into two separate pools. The pool for the northern 3A-3B tie-in channel was originally designed as the Phase 3A connection v-ditch and was deepened and widened for the Phase 3B design. The southern pool was established using extents of the existing pool and was bifurcated into a channel flowing through the approximate center of the project and a channel flowing in the direction of PIR overflow parking lot.

- The Design Low Water Elevation of 926 feet was established for the two ponds located immediately downstream of the elevation 929 feet pools. Existing natural channel constrictions are used as described in Section 2.2 of this report to control the surface water elevation. This elevation controls the wetland marshes and local groundwater for the project west of the natural channel constriction.

- The Design Low Water Elevation of 924 feet was established immediately downstream of the elevation 926 feet pools. An existing natural channel constriction is used as described in Section 2.2 of this report to control the surface water elevation. This elevation controls the wetland marshes and local groundwater for the project west of the natural channel constriction.

The Maximum Riparian Ground Elevation is provided as four feet above the normal water level for each of the ponds. This elevation controls the maximum elevations of riparian corridors.

3.6 Roadway Culverts

The purpose of the proposed culverts was to convey low flows. Larger floods, including the annual flow, overtop the roadway and the culverts were not designed to handle the majority of the conveyance. The draft Drainage Design Manual for Maricopa County (Hydraulics: Culverts and Bridges) from April 2010 was used for hydraulic and structural design guidance for these culverts. The hydraulic procedures outlined in the manual were taken from the reference entitled Hydraulic Design Series #5, which was updated in 2005 by the USDOT, Federal Highway Administration. According to the design manual, a minimum velocity of 2.5 ft/s is necessary to maintain adequate flow to enable a culvert to self-clean during partial flow depth.

Peak flow capacity was not a concern for this application. Riprap at the outlet was sized based on overtopping events, which will have a significantly higher scour potential than the flows through the culvert.

The culvert design objectives were:

- Match the hydraulic capacity for El Mirage Road, between the existing and proposed condition, to accommodate the re-routing of flow as a result of the grading changes.
- Allow flow to pass through the Pond 3 outflow channel, promoting water movement and preventing stagnation.
- Provide self-cleaning velocities during frequent events to prevent sedimentation.
- Provide enough drop in elevation so that the low flows from the existing 5 – 5' x 3' RCB will drain towards the new 8 – 42" CMPs.

For the existing condition, three (3) sets of culverts convey the low flow of the Gila River floodplain under El Mirage Road:

- Southern 8 – 48" CMPs
- Middle 3 – 66" CMPs
- Northern 4 - 24" CMPs

Most of the flow to the existing southern 8 – 48" CMPs was designed to be re-routed to middle of the floodplain, as result of the southern floodplain channels being filled-in. The capacity of this set of culverts was analyzed, using a roadway spillover elevation of 919.85 feet, and a tailwater based on 917.67 feet (measured during a site visit September 28, 2011). The discharge capacity was found to be 510 cfs. These pipes were designed to be left in place to convey the flow coming from the 63.93 acres between the filled-in southern channel and El Mirage road.

The Flood Control District of Maricopa County (FCDMC) Drainage District has negligible base flow coming from an existing 5 – 5'x3' RCB under the levee on the north side of the floodplain, directed toward the existing northern 4 – 24" CMPs that have not performed well due to the lack of positive drainage at their outfall. For the channel between the 5 – 5'x'3 RCB and the northern 4 – 24" CMPs, an attempt was made by USACE to interconnect it to the pools near the middle of the floodplain, with a 10ft wide channel with approximately 3H:1V side slopes. This north to middle floodplain channel construction was terminated because its elevation is lower than the pool near the middle of the floodplain leading to the 3 – 66" CMPs.

The new channel was proposed immediately north of the existing 3 – 66" CMPs, which will receive the north to middle interconnection channel and to alleviate the elevation concern.

The existing northern 4 – 24" CMPs pipes were expected to be left in place, and an approximately 2 foot tall berm was proposed to divert the negligible base flow from the existing 5 – 5' x 3' RCB into a new channel and directed towards the new 8-42" culverts in the middle of the floodplain.

The re-routed flow from the southern culverts and the north to middle floodplain channel was designed to be directed into the proposed channel immediately north of the middle 3 – 66" CMPs. A new set of culverts was designed to pass this re-routed flow, using a roadway spillover elevation of 923.38 feet, a tailwater of 918.00 feet, and knowing flows in excess of 922.00 feet will spillover the crest between this channel and the existing middle 3 – 66 CMPs pool, resulting a need for 8 – 42" CMPs.

For the proposed condition, four (4) sets of culverts convey the low flow of the Gila River under El Mirage Road:

- Southern 8 – 48" CMPs (existing, receiving less flow downstream of the plugged pond)
- Middle 3 – 66" CMPs (existing, receiving overflow from the new middle channel)
- Middle 8 – 42" CMPs (new)
- Northern 4 - 4" RCPs (existing, only receiving overflow from the new north to south diversion channel)

The inlet and outlet of the proposed 8 – 42" CMPs consists of the pipes projecting into the channel with a CLSM backfill and a riprap face. 2.5:1 slopes were designed for the upstream and downstream roadway foreslopes using CLSM. This was initially designed using 4:1 slopes, but was changed to reduce the length of CMPs required to cross El Mirage. 2.5:1 are not considered "recoverable" slopes and typically warrant the use of guardrail or barrier to prevent vehicles that veer off the road from traveling down the slope. However, due to the condition of El Mirage Road's existing southern pipe crossing, which use no traffic safety devices and has a vertical face along the edge of roadway, no traffic safety devices were included in the design.

Bentley CulvertMaster was used to model the existing and proposed culverts. The results of this modeling can be found in Appendix B.

3.7 Stability Analysis

Slope stability analysis was provided by Terracon Consultants, Inc. The 26 January 2011 letter and titled "Engineering Services: Additional Slope Stability Analyses, Tres Rios Environmental Restoration – Phase 3A, Maricopa County, AZ, Terracon Project No. 65105240", along with its appendices is attached as Appendix F.

3.8 El Mirage Road

El Mirage Road is a two-lane, asphalt roadway. The existing roadway section appears to be 4 inches of asphalt constructed on cement treated base. The roadway section was observed during site the initial 3A site visit, during August 2010, when sections of El Mirage Road were exposed and the road was out of service as a result of a recent overtopping event.

At several locations along the existing roadway, a ten-inch wide by two feet tall concrete cut-off wall abuts the upstream edge of asphalt pavement. It was assumed the cut-off walls were placed to help prevent pavement uplift during overtopping events. As-builts of the existing cut-off wall were unavailable for review and dimensions of the wall were obtained upon field investigation. It was unknown if the concrete wall is steel-reinforced. To facilitate construction of the proposed culverts at El Mirage, removal of a portion of the existing cut-off wall was required. Replacement of the removed wall was proposed using a 10" wide x 18" high unreinforced concrete wall. 18" was proposed for the height due to the close proximity to the top of the propose 42" CMPs.

The existing culverts under the roadway were only capable of conveying low flows, and large storm flows overtop the roadway surface. The roadway surface and embankment have typically been maintained after each overtopping event to provide a semi-continuous level of service. Breaching of the existing roadway embankment could result in a drop in the upstream water surface elevations which would result in a reduction in the open water areas of the project.

3.8.1 General Parameters

During high flows, the roadway acts as broad-crested weir with essentially all river flows passing over the top of the roadway. Evaluation of the stability of the structure involves evaluation of flow conditions under both high flows and the flow situation in which overtopping is just commencing, where downstream water levels are low and water flows rapidly down the face of the downstream protective layer.

3.8.2 Design Objectives

The riprap protection was designed to provide the following:

- Protection against erosion due to overtopping flows; and
- Resist potential uplift forces.

3.8.3 Calculations

The gradation and extents of armoring the El Mirage Road downstream embankment slope was designed by analyzing various overtopping conditions. It was recognized that the Gila River HEC-RAS model's regular yearly peak flow (6,700 cfs) did not cause an erosive cascade, because the downstream and upstream water surface elevations were nearly equal and they were both higher than the roadway profile at the proposed primary channel. The yearly peak flow water surface was found overtop the road by 1.5 feet, so conservatively it was assumed a cascade would occur for a condition where the overtopping depth was 1.0 foot.

Determining an adequate riprap gradation for a roadway overtopping condition is unique and the Federal Highway Administration's HEC-11 Chapter 4 was deemed most appropriate for this analysis. The unit discharge conditions of a roadway overtopping are similar to a broad-crested weir, with the downstream edge of roadway surface and the embankment slope being the controlling location where erosion would occur, assuming the free flow along the relatively steep embankment slope is not tall because of a shallow fill height and the existence of a tailwater. This analysis requires input of the depth and velocity, along with the stone's specific gravity (2.5), angle of repose of riprap (1.4H:1V), and the channel bank side slope (transverse, but conservatively used 2.5H:1V). The depth and velocity was determined by using the assumed 1.0ft depth of overtopping to first find the critical depth that would occur before the cascade; then the brink depth was determined using the calculated critical depth. The brink depth was used for the depth input in the calculation, and it was also use to determine the velocity, by a continuity relationship of the known broad-crested weir discharge and the associated area from the unit width and the calculated brink depth.

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Determining an adequate riprap gradation for a roadway overtopping condition is unique and the Federal Highway Administration's HEC-11 Chapter 4 was deemed most appropriate for this analysis. The unit discharge conditions of a roadway overtopping are similar to a broad-crested weir, with the downstream edge of roadway surface and the embankment slope being the controlling location where erosion would occur, assuming the free flow along the relatively steep embankment slope is not tall because of a shallow fill height and the existence of a tailwater. This analysis requires input of the depth and velocity, along with the stone's specific gravity (2.5), angle of repose of riprap (1.4H:1V), and the channel bank side slope (transverse, but conservatively used 2.5H:1V). The depth and velocity was determined by using the assumed 1.0ft depth of overtopping to first find the critical depth that would occur before the cascade; then the brink depth was determined using the calculated critical depth. The brink depth was used for the depth input in the calculation, and it was also use to determine the velocity, by a continuity relationship of the known broad-crested weir discharge and the associated area from the unit width and the calculated brink depth.

The D50 stone of the riprap was found using the HEC-11 guidance based on various safety factors (SF), dependent upon the flow conditions (uniform or turbulent) and the confidence in the input parameters. Roadway overtopping is relatively uniform and the input parameters are based on some assumptions. The calculated D50 ranges between 7 inches and 14 inches for SF's of 1.0 and 1.6 respectively, so the use of the smaller of the two approved project gradations (D50 of 12 inches) was determined to be adequate. The extents of the stone (Sta. 19+20 to 22+10) was determined by finding the corresponding roadway locations that were 1.0ft higher than the sag elevation of the roadway at the primary crossing. The calculations are shown in Appendix B. The protection of the other two (2) sags at Sta. 4+40 and 30+40 were not part of the project, and the flow to Sta. 4+40 was expected to be decreased as a result of grading and re-routing flows.

3.9 Debris Removal

Significant amounts of debris exist within the project limits. The specifications for the site preparation task will define the limitations of removal and requirements for backfill or grading of the area of removal.

3.10 Waste Removal

Waste will be encountered during construction. Depending upon where it is found, for example beneath structures, reservoirs, etc., its depth and thickness will determine how much removal is required. The final decision on what to do during construction will need to be made by the USACE site construction staff in concert with the COP and other regulatory agencies.

3.11 Operations/ Maintenance Considerations

Care must be taken in the site grading to avoid steep slopes in areas subject to saturation. Embankment in the vicinity of the wetlands and canals will require regular inspection to evaluate slope stability. Erosion of soils around Project features adjacent to stormwater outfalls or river embankments may occur over time. Regular inspection of these facilities needs to occur. After flooding, removal of deposited sediment in the vicinity of the culverts, sump and downstream ditch may be required to maintain flow through the constructed channel.

Maintenance roads have been included to provide access to project features. Access to the maintenance road network is provided along El Mirage Road at approximately El Mirage centerline stations 6+20 and 30+35 and along Old 115th Avenue at approximately Old 115th Avenue baseline stations 51+00 and 57+30.

The maintenance roads are 14 feet wide with a maximum longitudinal slope of 10 percent and a maximum cross slope of 2 percent. Roads and low water crossings shall be constructed out of native in-situ material with a typical cross slope to promote drainage towards the channel. Sections and details for maintenance road construction are included in the construction drawings.

Maintenance road traffic is anticipated to include pickup trucks and on-road water trucks. At locations shown on the drawings, ramps from the maintenance roads to the edge of water have been designed to more easily access deep water for pumping. Details for constructing maintenance road ramps are included in the construction drawings.

4 REFERENCES

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Appendix A – Hydrologic Calculations

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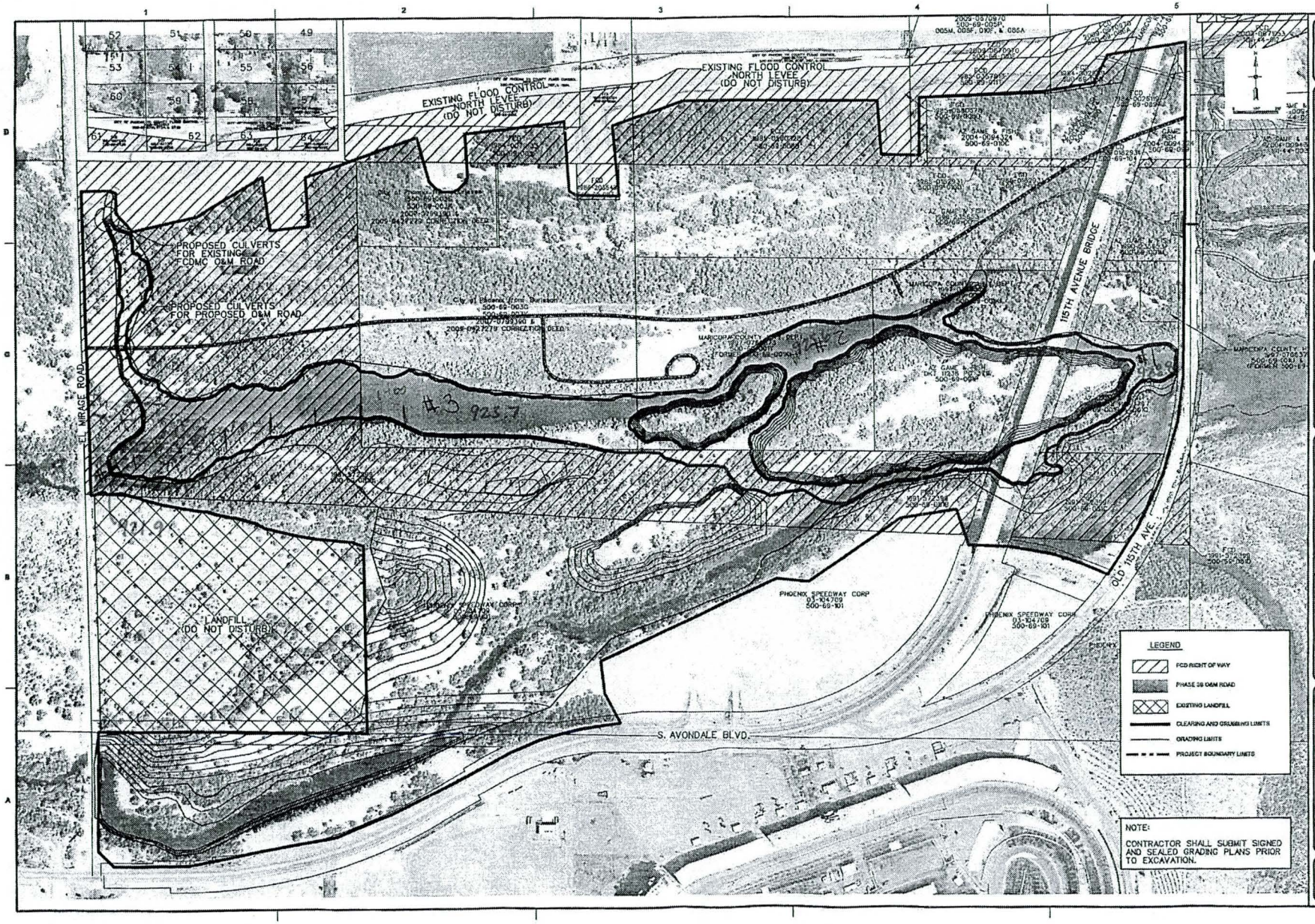
Additional Survey Shots 10/4/11

Pond #					
	edge rd tc	864754	576050.3	919.805	as built sc
	edge rd tc2	864797.2	576050	919.516	as built sc
	edge rd tc3	864828.3	576049.9	919.618	as built sc
	edge rd tc4	864846.6	576049.5	919.876	as built sc
	edge rd tc5	864870.7	576049.6	920.396	as built sc
#1	W. Old 115th top water	866722.7	581081.7	928.789	as built sc
#2	Hurricane Pump Pond top water2	866959.5	579556	925.629	as built sc
#3	Large Pool top water3	866597	578079.8	923.716	as built sc
#4	E El Mirage Pool top water4	866162.6	576037.5	921.919	as built sc

water surface elevations provided by Kewit


EXISTING FLOOD CONTROL NORTH LEVEE (DO NOT DISTURB)
PROPOSED CULVERTS FOR EXISTING COMC O&M ROAD
PROPOSED CULVERTS FOR PROPOSED O&M ROAD
LANDFILL (DO NOT DISTURB)
EL MIRAGE ROAD
15TH AVENUE BRIDGE
OLD 15TH AVE.
S. AVONDALE BLVD.
PHOENIX SPEEDWAY CORP
LEGEND
FCD RIGHT OF WAY
PHASE 3B O&M ROAD
EXISTING LANDFILL
CLEARING AND GRUBBING LIMITS
GRADING LIMITS
PROJECT BOUNDARY LIMITS
NOTE:
CONTRACTOR SHALL SUBMIT SIGNED AND SEALED GRADING PLANS PRIOR TO EXCAVATION.
US Army Corps of Engineers Los Angeles District
HNTB
Kiewit
DATE: 03-OCT-2011
U.S. ARMY CORPS OF ENGINEERS LOS ANGELES DISTRICT
THE RIOS RIVER, MARICOPA COUNTY, ARIZONA ENVIRONMENTAL RESTORATION - PHASE 3B
PHASE 3B GRADING
SHEET IDENTIFICATION
X-00

Calculations For	Tres Rios Water Demand	Job No.	49856	Sheet No.	1/1
Made by	JAD	Date	10/31/11		
Checked by	JMB	Date	11/1/11		
Backchecked by		Date			

HNTB

Phase 3B

Total Area = 197.4 acres (90% DDR, Table 3-4)

Total Demand = Peak Month = 95.5 acre-feet (90% DDR, Table 3-14

Annual = 636.5 acre-feet (90% DDR, Table 3-14

Peak monthly demand = $\frac{95.5 \text{ ac-ft}}{197.4 \text{ ac}}$ = 0.48 ft ⇒ ~6 in

Annual demand = $\frac{636.5 \text{ acre-ft}}{197.4 \text{ ac}}$ = 3.2 ft

TABLE 3-3 Project Water Demand Comparison (Area 3A)		
Habitat	Gal/Mo/Acre	Total Gal/Mo
Open Water	-	-
Wetland Marsh	317,850	5,717,849
Cotton Wood Willow	308,070	14,256,441
Mesquite Woodland	146,700	8,611,182
Salt Quail Burro Bush	97,800	3,533,575
Cobble Area	-	-
Total	870,420	32,119,047

TABLE 3-4 Peak Project Water Demand (Area 3B) For Month of July				
Habitat	Acres	et_{July} ac-ft/ac/mo	et_{July}* gal/ac/mo	Total V* gal
Open Water	53.7290	0	-	-
Wetland Marsh	29.7016	0.98	317,850	9,440,641
Cotton Wood Willow	42.4754	0.95	308,070	13,085,408
Mesquite Woodland	49.2204	0.45	146,700	7,220,631
Salt Quail Burro Bush	14.2618	0.30	97,800	1,394,802
Cobble Area	7.9965	0	-	-
Total	197.3845	2.67	870,420	31,141,481.16

* Volume, V_i (gal) = A (acre) * et_i * 326,000 (gal/ac-ft)

TABLE 3-5 Project Water Demand Comparison (Area 3B)		
Habitat	Gal/Mo/Acre	Total Gal/Mo
Open Water	-	-
Wetland Marsh	317,850	9,440,641
Cotton Wood Willow	308,070	13,085,408
Mesquite Woodland	146,700	7,220,631
Salt Quail Burro Bush	97,800	1,394,802
Cobble Area	-	-
Total	870,420	31,141,481

TABLE 3-13
Area 1 Total Water Demand (Monthly Rainfall and Evaporation)

Month	Wetland Marsh		Cottonwood		Mesquite		Salt Quail Burro		Total Demand (ac-ft)
	et_i	Demand (ac-ft)	et_i	Demand (ac-ft)	et_i	Demand (ac-ft)	et_i	Demand (ac-ft)	
January	0.33	5.8	0.32	14.6	0.15	8.8	0.10	3.6	32.8
February	0.33	5.8	0.32	14.6	0.15	8.8	0.10	3.6	32.8
March	0.33	5.8	0.32	14.6	0.15	8.8	0.10	3.6	32.8
April	0.65	11.7	0.63	29.2	0.30	17.6	0.20	7.2	65.7
May	0.65	11.7	0.63	29.2	0.30	17.6	0.20	7.2	65.7
June	0.98	17.5	0.95	43.7	0.45	26.4	0.30	10.8	98.5
July	0.98	17.5	0.95	43.7	0.45	26.4	0.30	10.8	98.5
August	0.98	17.5	0.95	43.7	0.45	26.4	0.30	10.8	98.5
September	0.33	5.8	0.32	14.6	0.15	8.8	0.10	3.6	32.8
October	0.33	5.8	0.32	14.6	0.15	8.8	0.10	3.6	32.8
November	0.33	5.8	0.32	14.6	0.15	8.8	0.10	3.6	32.8
December	0.33	5.8	0.32	14.6	0.15	8.8	0.10	3.6	32.8
Annual Total		**116.9**		**291.5**		**176.1**		**72.3**	**656.8**

TABLE 3-14
Area 2 Total Water Demand (Monthly Rainfall and Evaporation)

Month	Wetland Marsh		Cottonwood		Mesquite		Salt Quail Burro		Total Demand (ac-ft)
	et_i	Demand (ac-ft)	et_i	Demand (ac-ft)	et_i	Demand (ac-ft)	et_i	Demand (ac-ft)	
January	0.33	9.7	0.32	13.4	0.15	7.4	0.10	1.43	31.8
February	0.33	9.7	0.32	13.4	0.15	7.4	0.10	1.43	31.8
March	0.33	9.7	0.32	13.4	0.15	7.4	0.10	1.43	31.8
April	0.65	19.3	0.63	26.8	0.30	14.8	0.20	2.85	63.7
May	0.65	19.3	0.63	26.8	0.30	14.8	0.20	2.85	63.7
June	0.98	29.0	0.95	40.1	0.45	22.1	0.30	4.28	95.5
July	0.98	29.0	0.95	40.1	0.45	22.1	0.30	4.28	95.5
August	0.98	29.0	0.95	40.1	0.45	22.1	0.30	4.28	95.5
September	0.33	9.7	0.32	13.4	0.15	7.4	0.10	1.43	31.8
October	0.33	9.7	0.32	13.4	0.15	7.4	0.10	1.43	31.8
November	0.33	9.7	0.32	13.4	0.15	7.4	0.10	1.43	31.8
December	0.33	9.7	0.32	13.4	0.15	7.4	0.10	1.43	31.8
Annual Total		**193.5**		**267.7**		**147.7**		**28.6**	**636.5**

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Appendix B – Hydraulic Calculations

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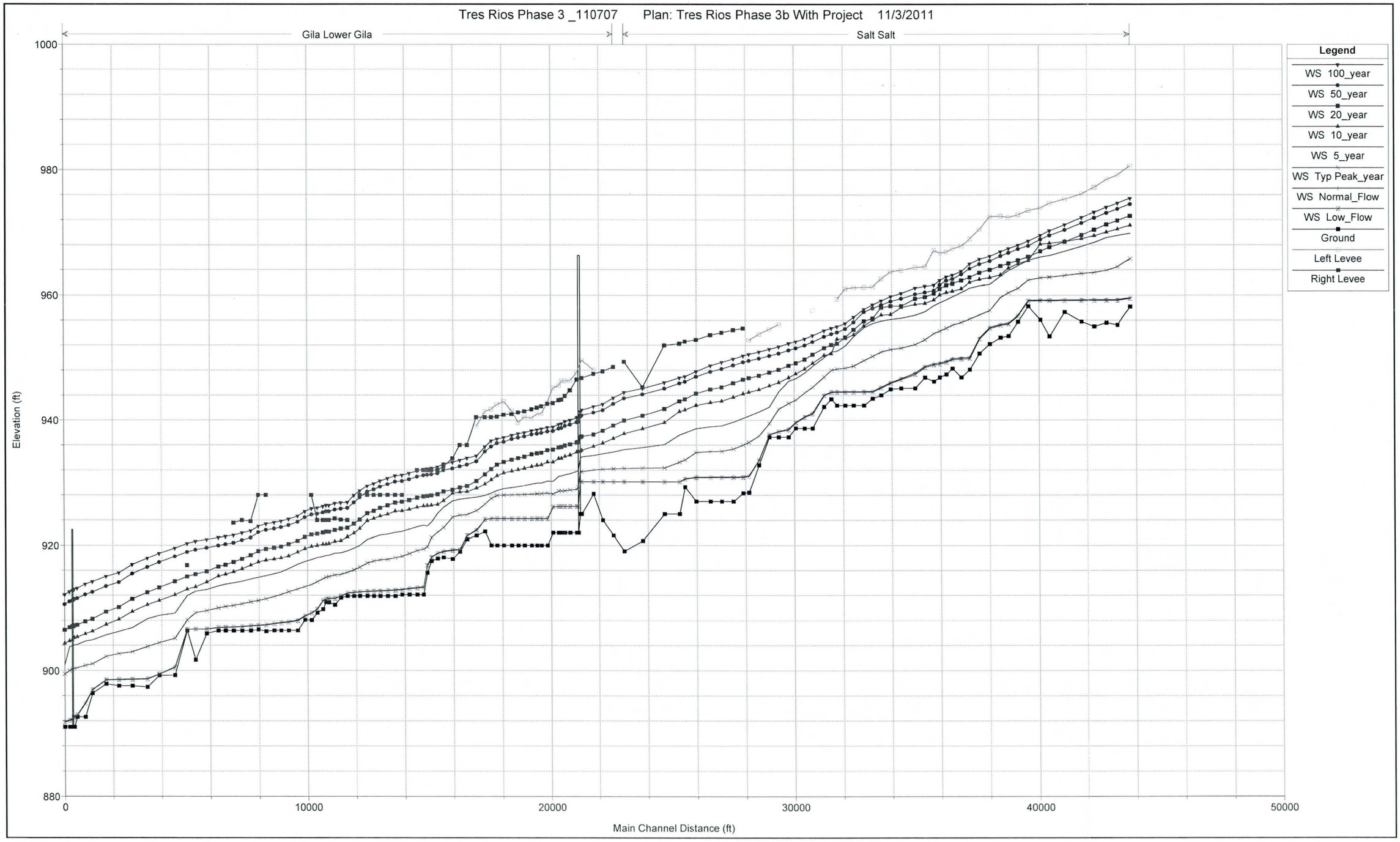
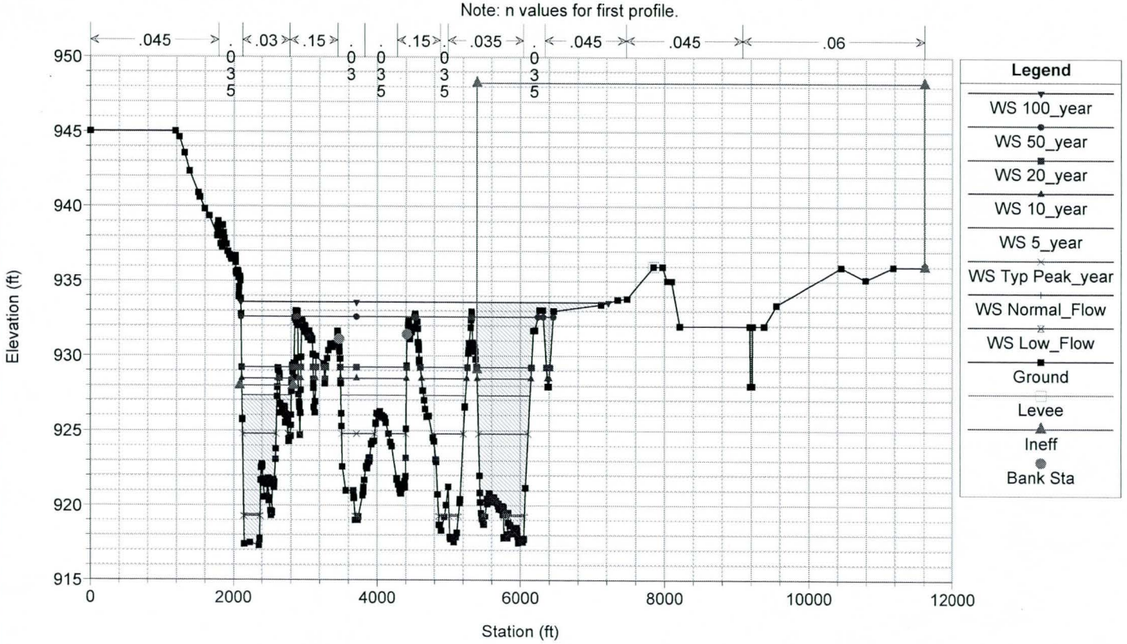

Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011
Gila Lower Gila
Salt Salt
Legend
WS 100_year
WS 50_year
WS 20_year
WS 10_year
WS 5_year
WS Typ Peak_year
WS Normal_Flow
WS Low_Flow
Ground
Left Levee
Right Levee
Elevation (ft)
1000
980
960
940
920
900
880
0
10000
20000
30000
40000
50000
Main Channel Distance (ft)

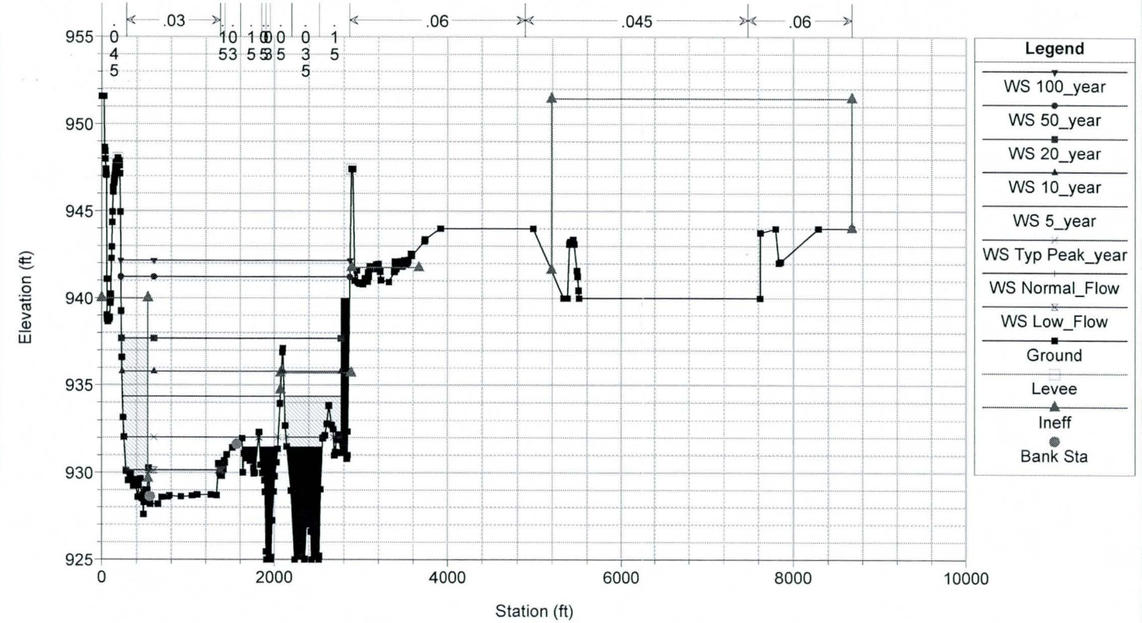
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Note: n values for first profile.



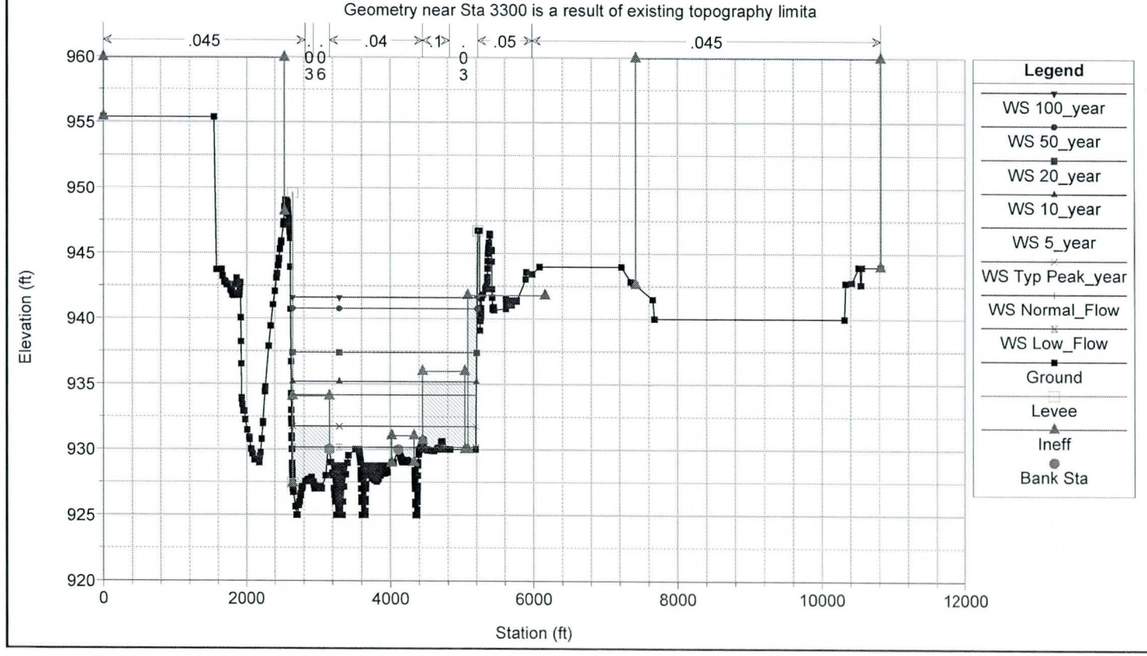
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee Alignment based on as-built and aerials Note: n values for first profile.



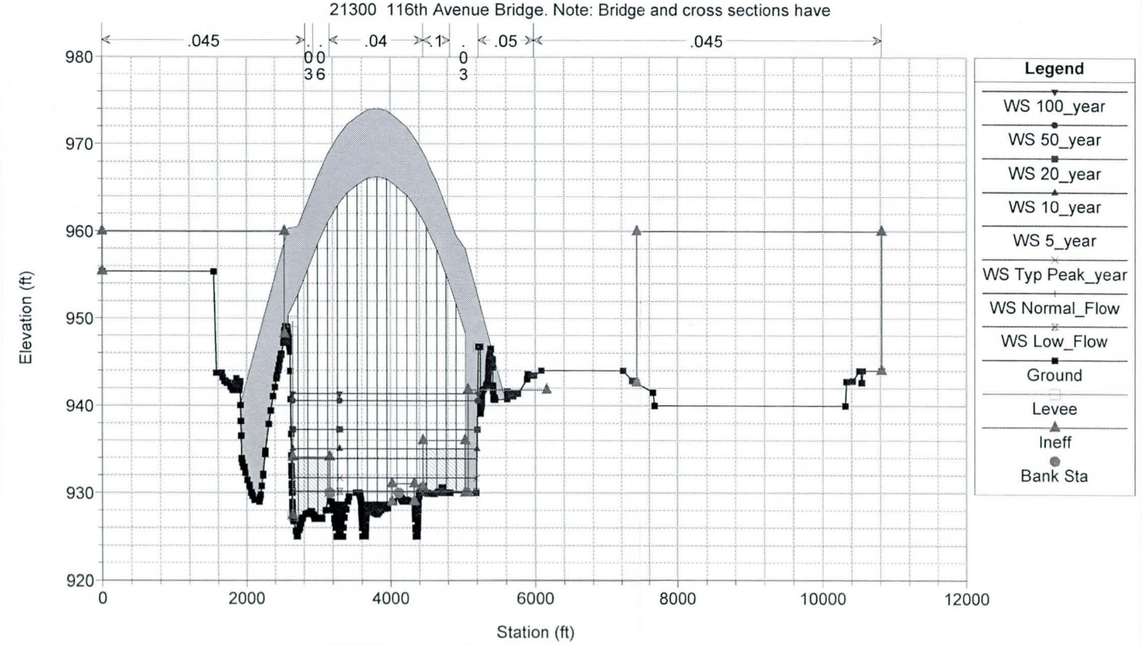
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Geometry near Sta 3300 is a result of existing topography limita



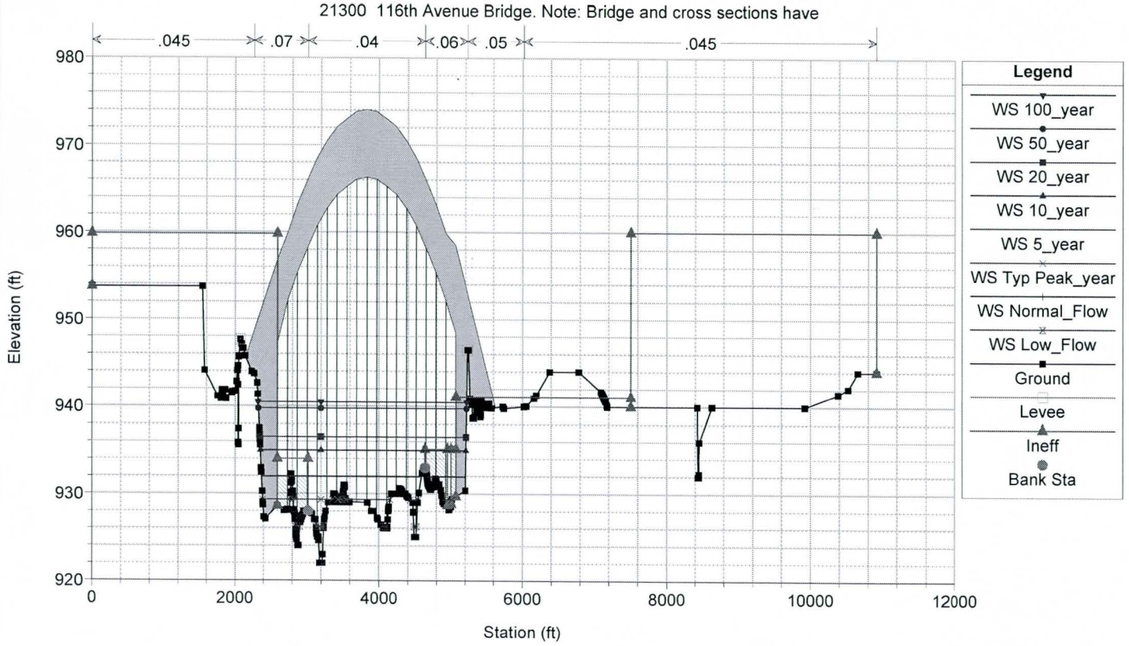
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

21300 116th Avenue Bridge. Note: Bridge and cross sections have



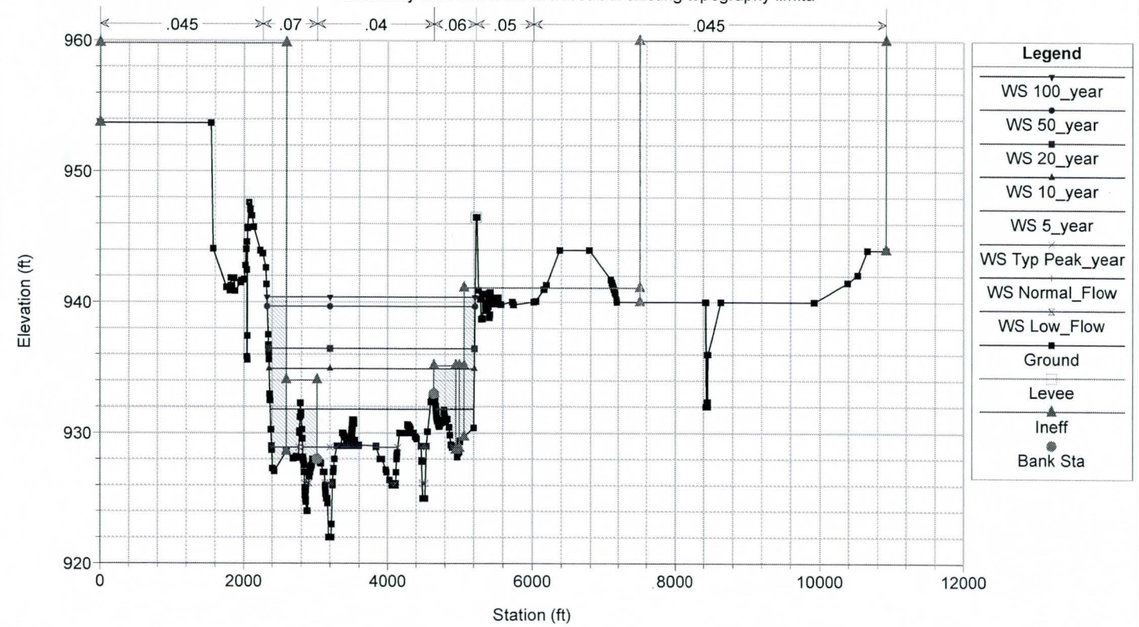
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

21300 116th Avenue Bridge. Note: Bridge and cross sections have



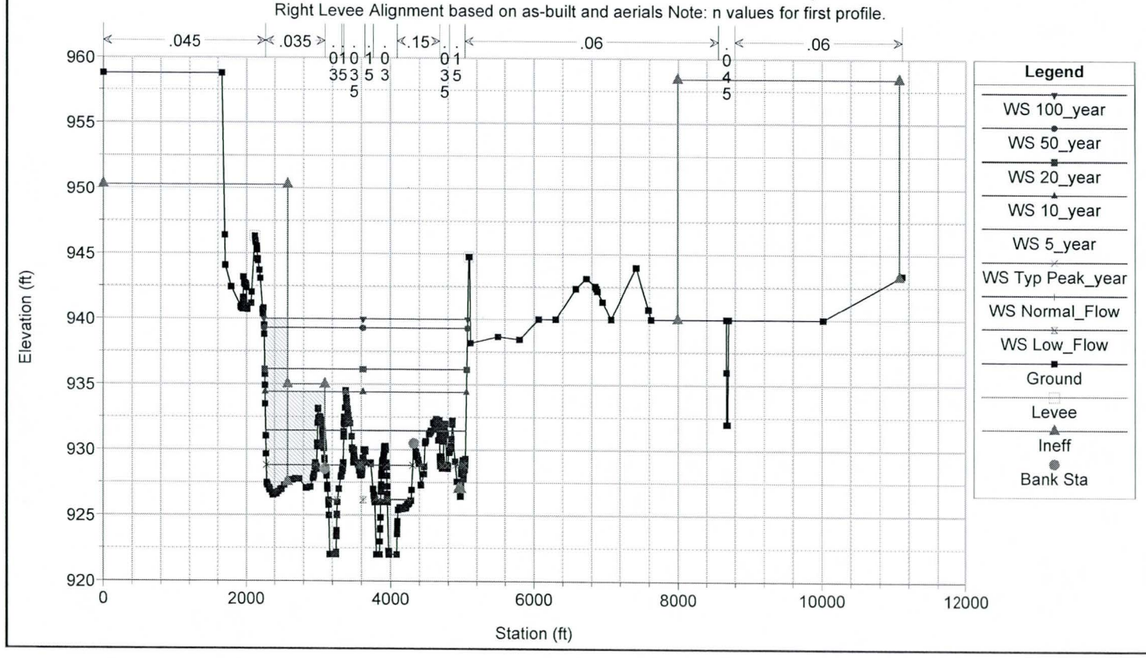
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Geometry near Sta 3300 is a result of existing topography limita



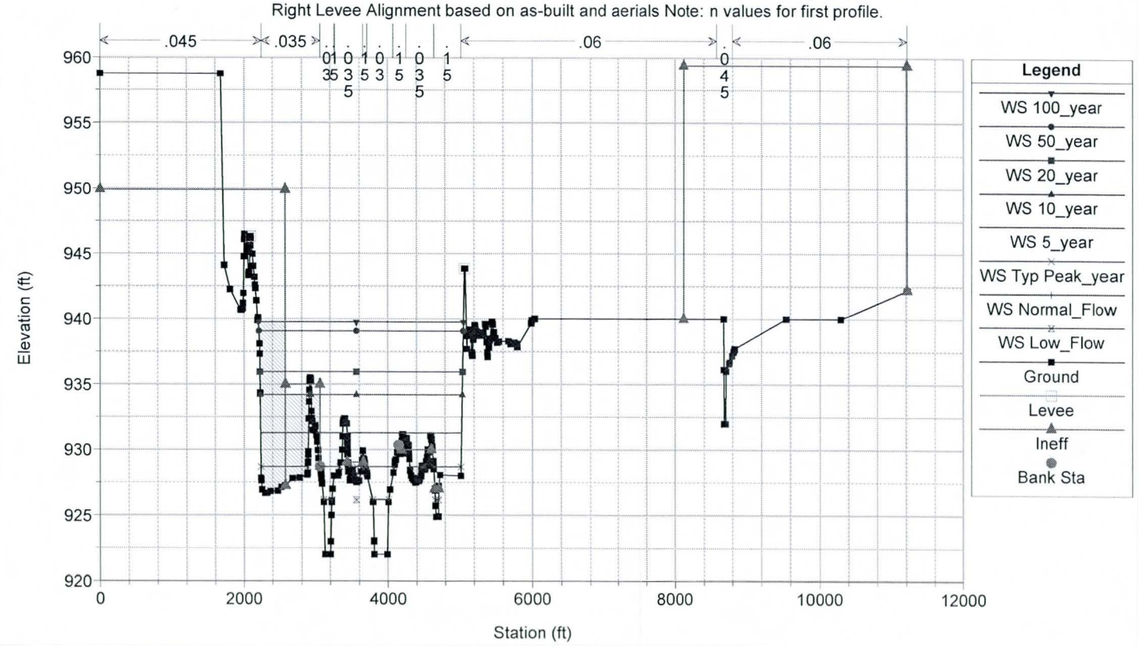
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee Alignment based on as-built and aerials Note: n values for first profile.



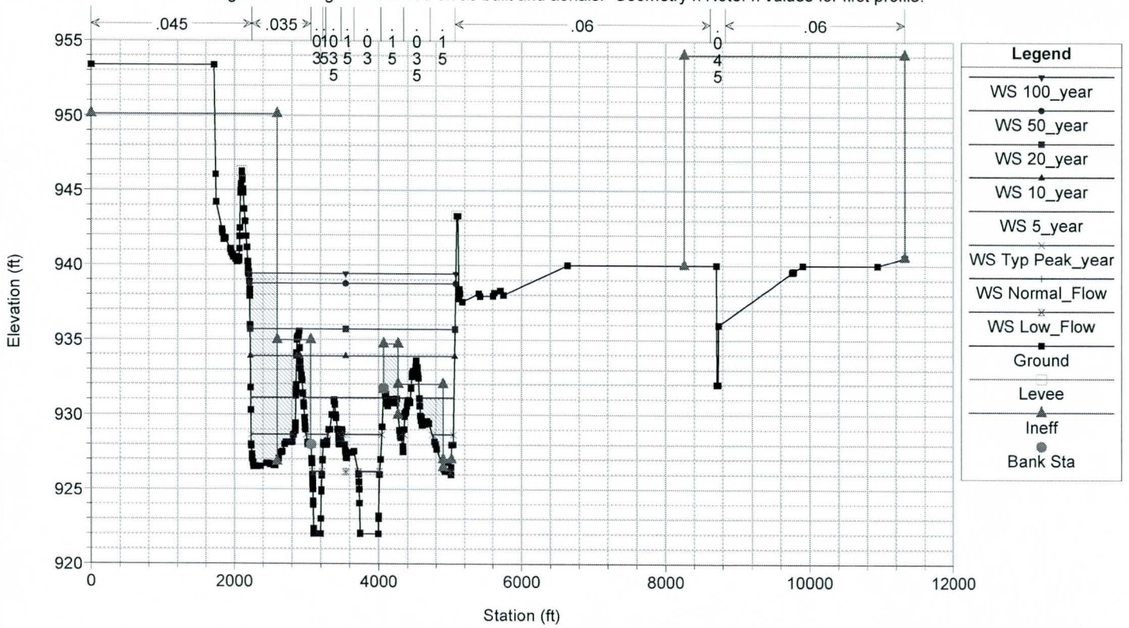
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee Alignment based on as-built and aerials Note: n values for first profile.



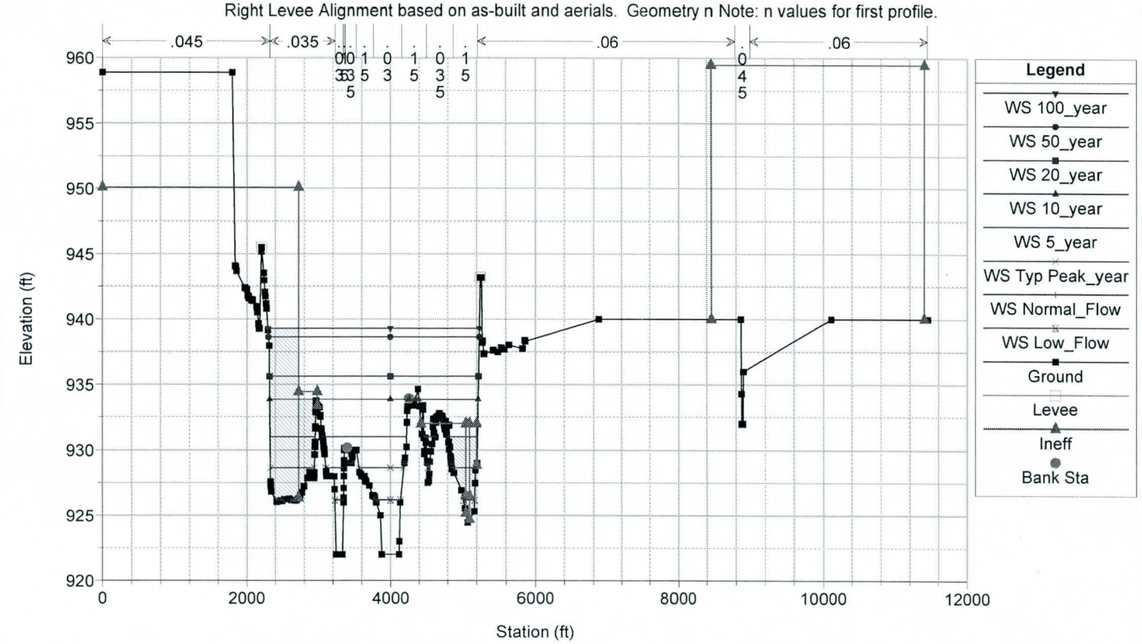
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee Alignment based on as-built and aerials. Geometry n Note: n values for first profile.



Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee Alignment based on as-built and aerials. Geometry n Note: n values for first profile.



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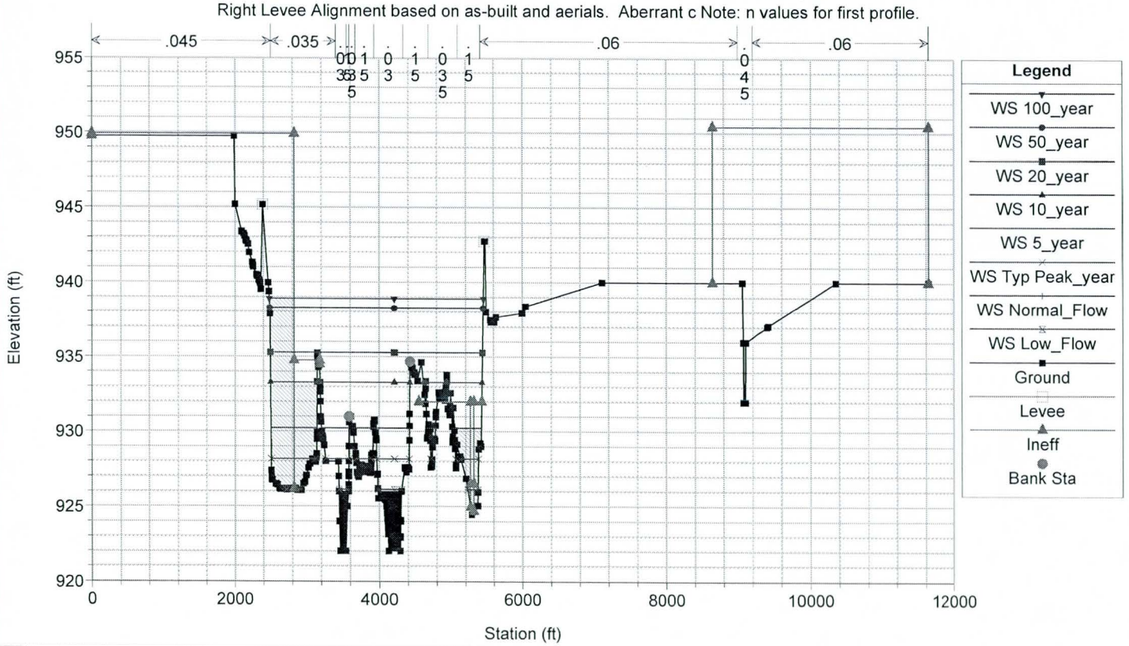

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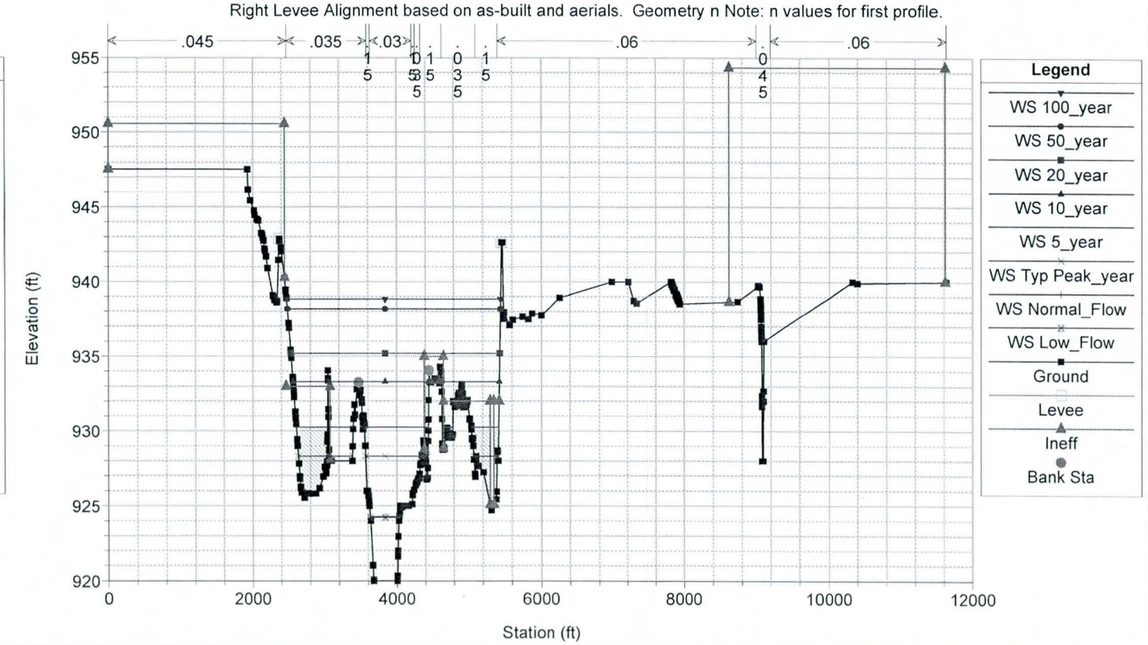
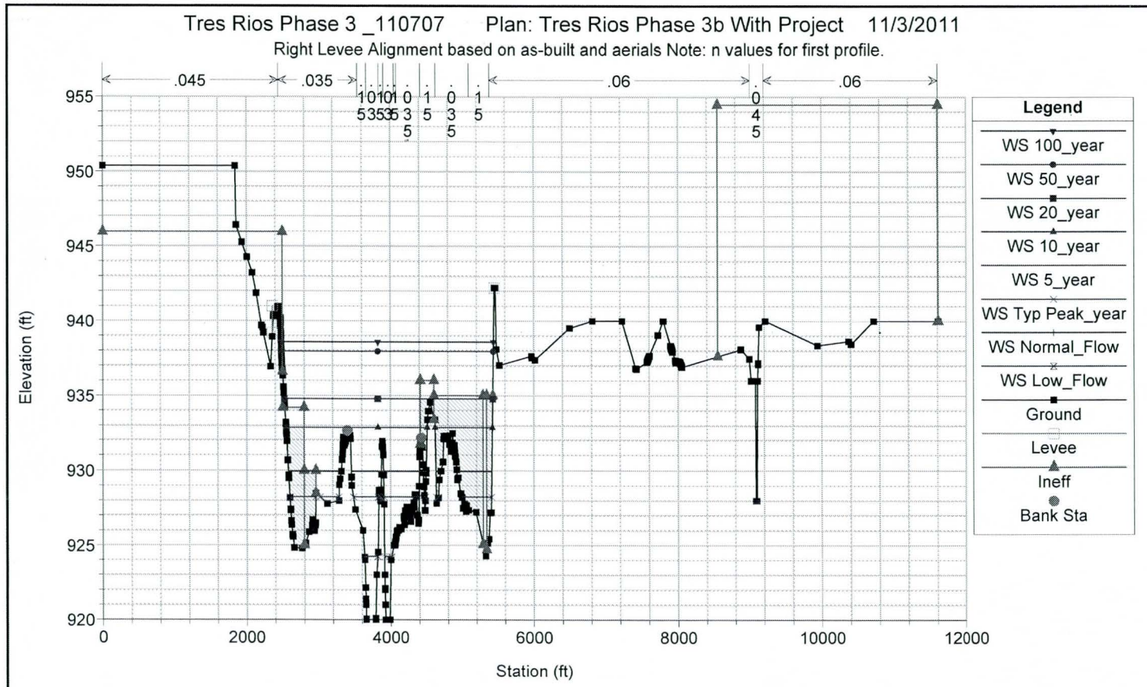
Right Levee Alignment based on as-built and aerials. Geometry n Note: n values for first profile.




Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011
Right Levee Alignment based on as-built and aerials Note: n values for first profile.
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Elevation (ft)
Station (ft)
Legend
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WS 10_year
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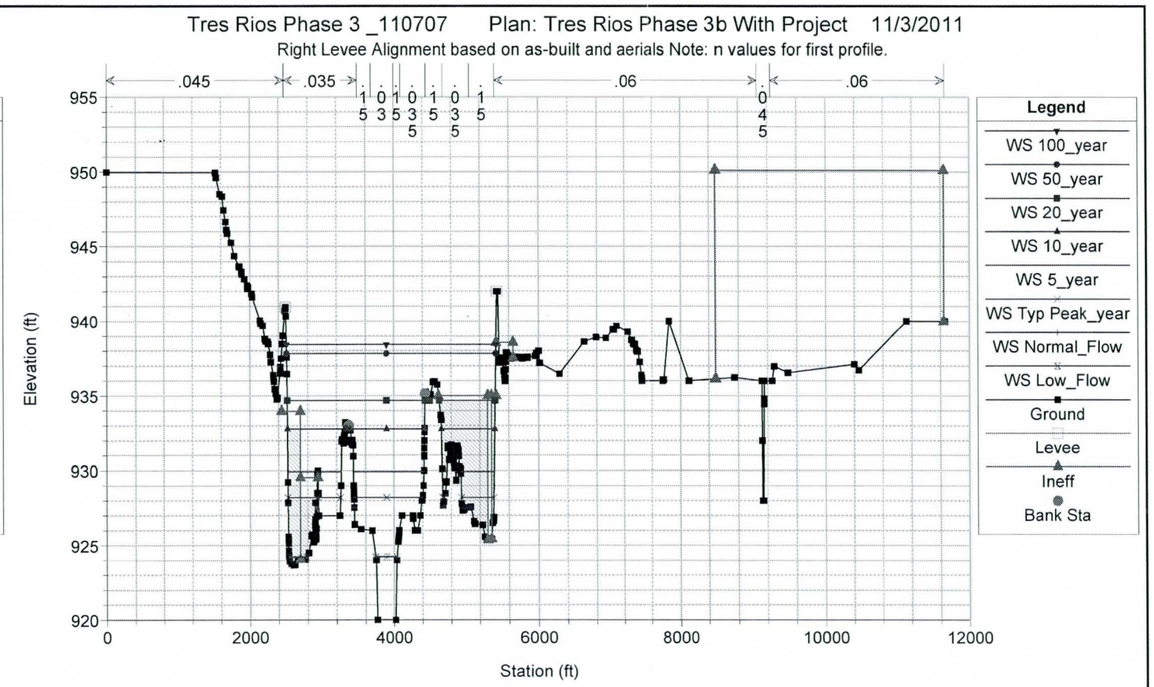
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011
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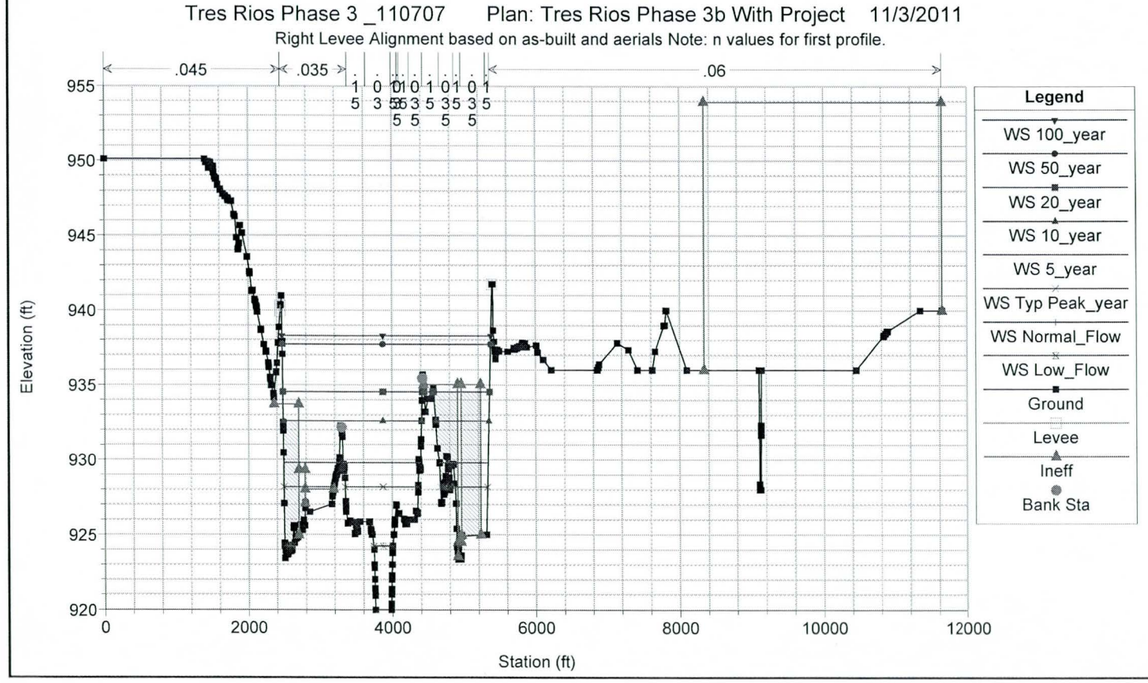
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011
Right Levee Alignment based on as-built and aerials Note: n values for first profile.
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Station (ft)
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WS 5_year
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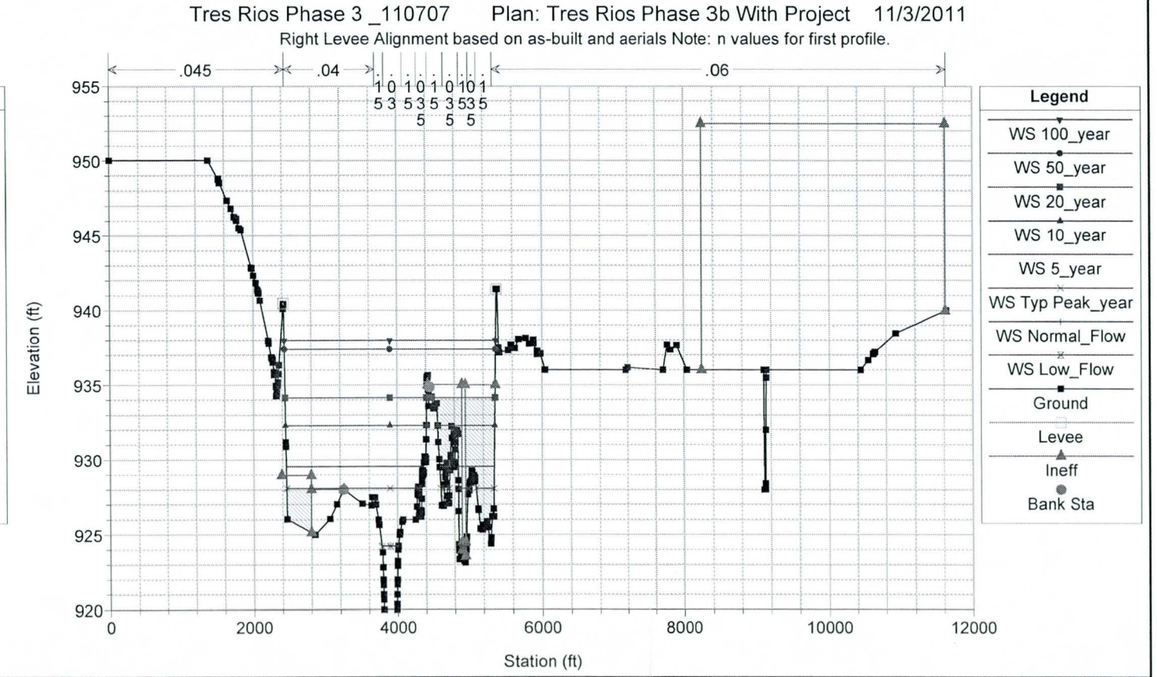
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011
Right Levee Alignment based on as-built and aerials Note: n values for first profile.
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.06
Elevation (ft)
Station (ft)
Legend
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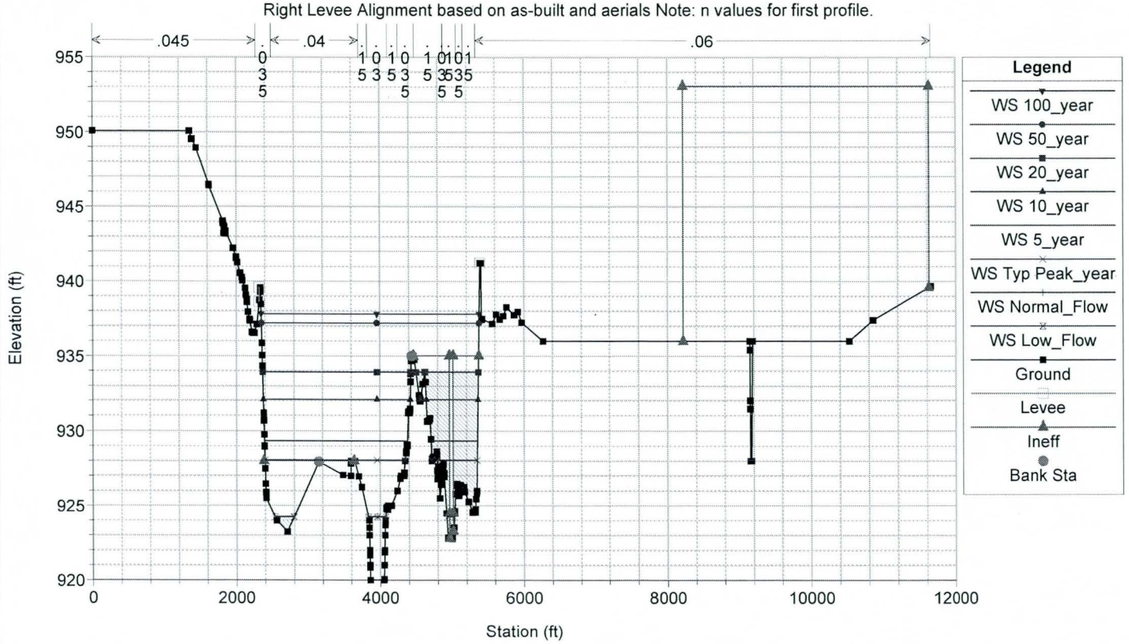
WS 50_year
WS 20_year
WS 10_year
WS 5_year
WS Typ Peak_year
WS Normal_Flow
WS Low_Flow
Ground
Levee
Ineff
Bank Sta

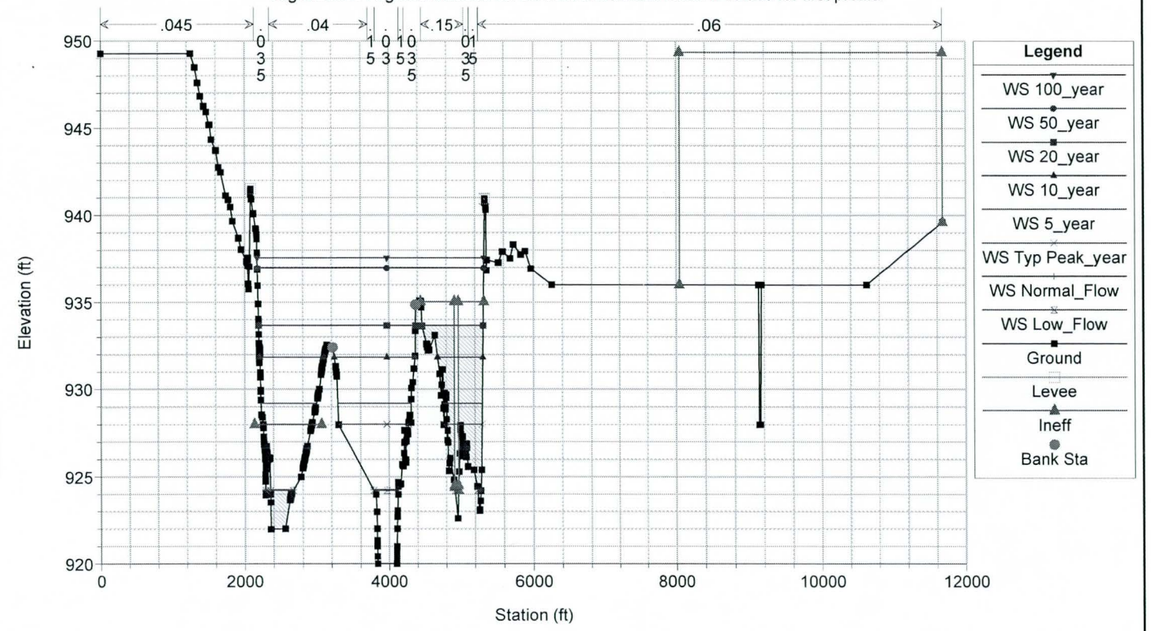
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee Alignment based on as-built and aerials Note: n values for first profile.



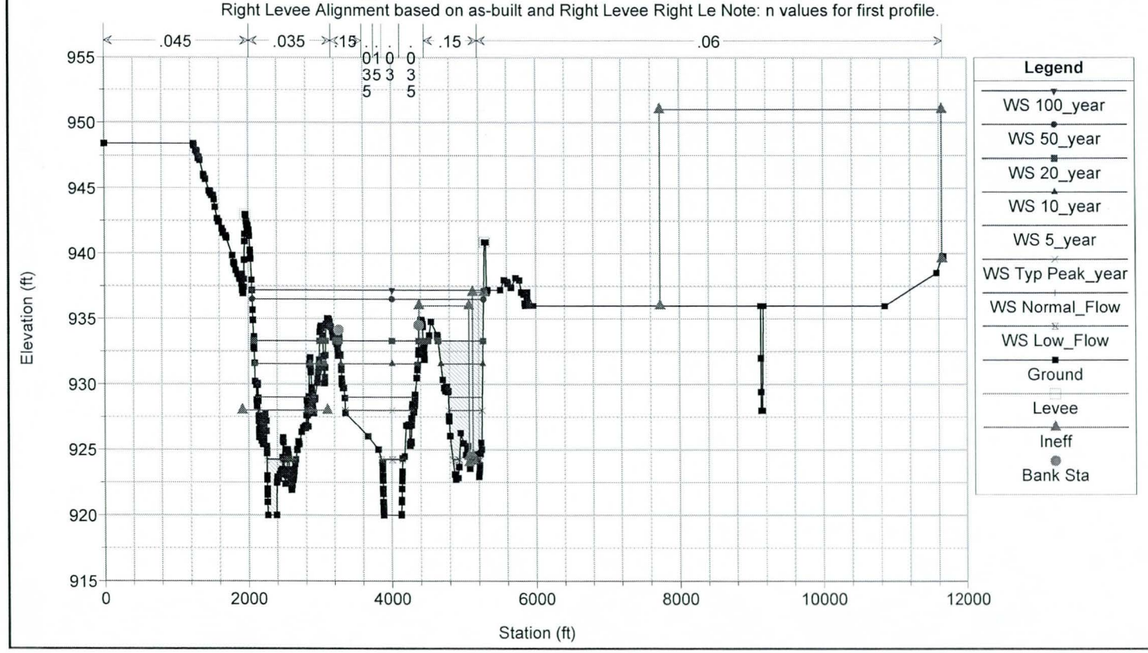
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee Alignment based on as-built and aerials Note: n values for first profile.



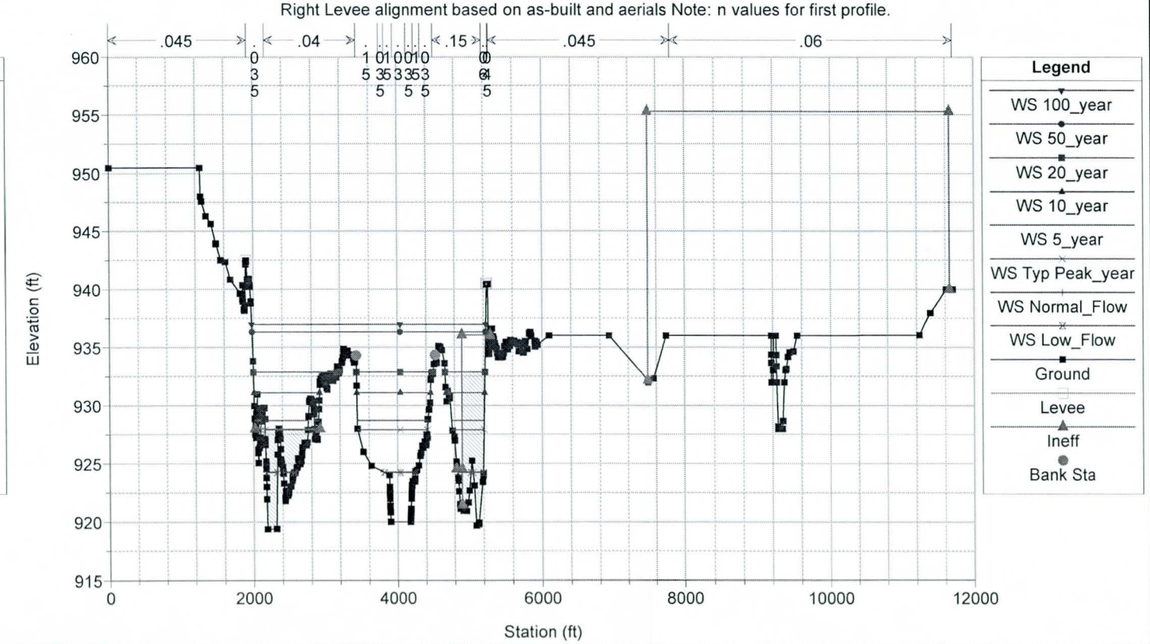
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee Alignment based on as-built and Right Levee Right Le Note: n values for first profile.



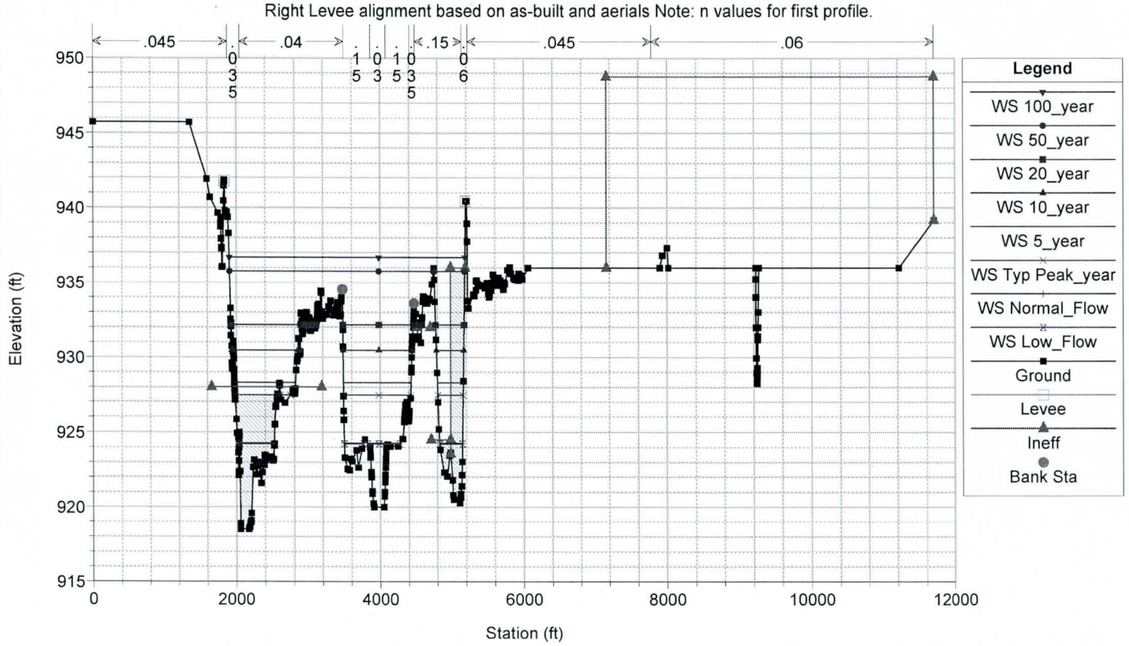
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee alignment based on as-built and aerials Note: n values for first profile.



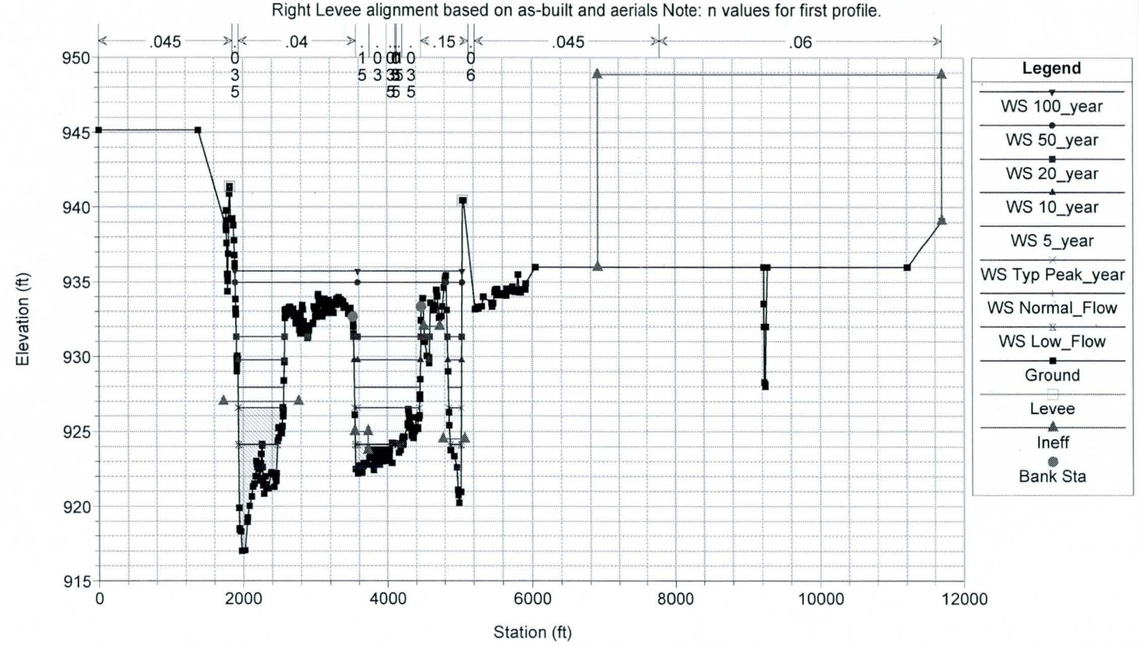
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee alignment based on as-built and aerials Note: n values for first profile.



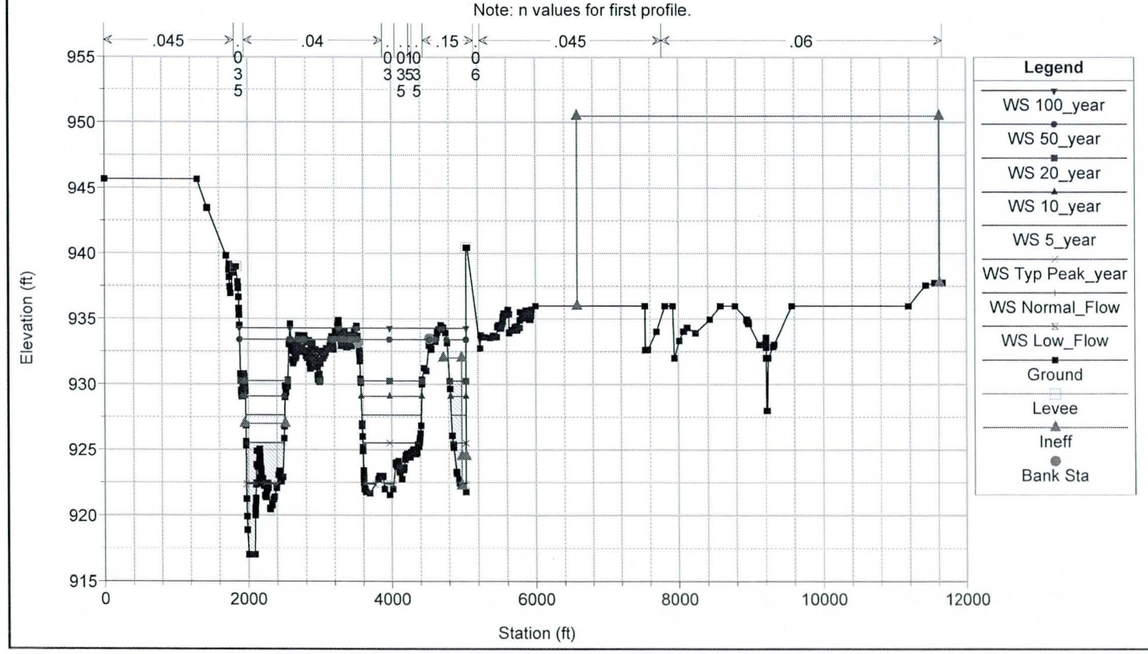
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Right Levee alignment based on as-built and aerials Note: n values for first profile.



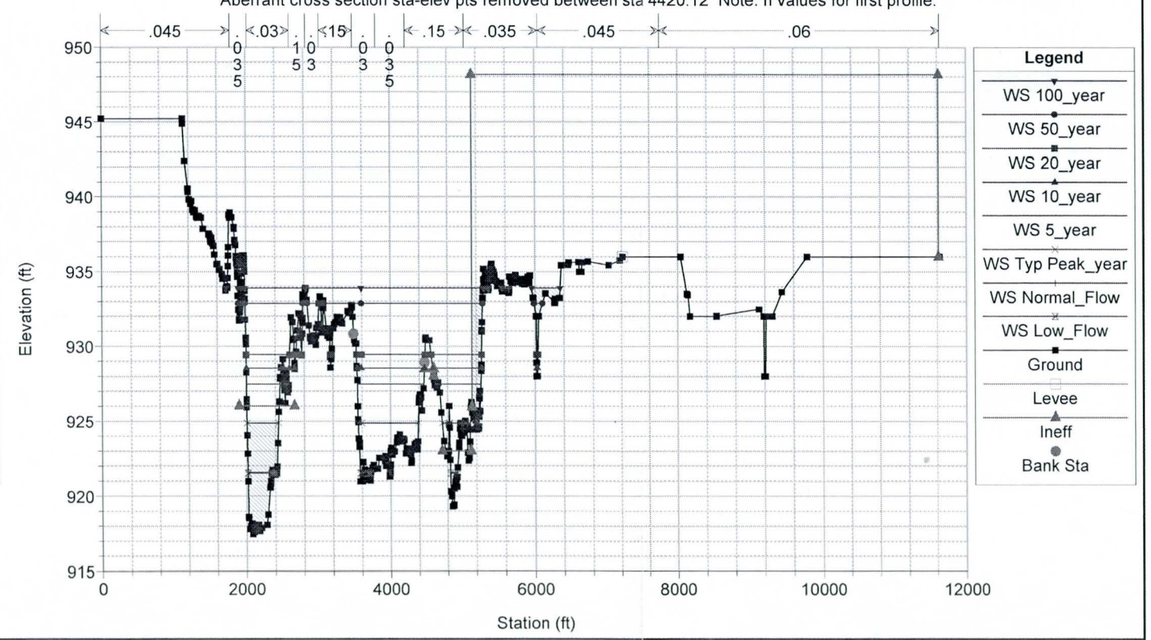
Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Note: n values for first profile.



Tres Rios Phase 3 _110707 Plan: Tres Rios Phase 3b With Project 11/3/2011

Aberrant cross section sta-elev pts removed between sta 4420.12 Note: n values for first profile.



HEC-RAS Plan: 3B

River	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)	
Salt	Salt	203.48	5_year	19500.00	958.17	969.83	966.62	970.08	0.000656	4.01	4858.35	1646.01	0.30
Salt	Salt	203.48	10_year	49000.00	958.17	971.12	968.83	971.56	0.000975	5.61	9990.63	2143.18	0.38
Salt	Salt	203.48	100_year	162000.00	958.17	975.41	971.82	976.48	0.001527	9.67	22126.26	3496.74	0.51
Salt	Salt	203.48	Typ Peak_year	4400.00	958.17	965.78	964.75	965.92	0.001569	3.01	1463.81	1010.30	0.38
Salt	Salt	203.48	20_year	80000.00	958.17	972.60	970.01	973.29	0.001254	7.24	13496.89	2527.90	0.44
Salt	Salt	203.48	50_year	130000.00	958.17	974.48	971.34	975.44	0.001477	8.98	18935.05	3362.13	0.49
Salt	Salt	203.48	Low_Flow	95.00	958.17	959.46	959.46	959.87	0.014182	5.09	18.68	67.99	0.99
Salt	Salt	203.48	Normal_Flow	118.00	958.17	959.59	959.59	960.05	0.013819	5.44	21.68	70.25	1.00
Salt	Salt	203.38	5_year	19500.00	955.24	969.50	966.58	969.74	0.000701	3.92	4972.20	1971.01	0.30
Salt	Salt	203.38	10_year	49000.00	955.24	970.51	968.64	970.98	0.001329	6.08	9567.92	2357.99	0.43
Salt	Salt	203.38	100_year	162000.00	955.24	974.63	972.22	975.67	0.001644	9.50	21564.26	3466.74	0.52
Salt	Salt	203.38	Typ Peak_year	4400.00	955.24	964.51	963.38	964.86	0.002839	4.75	925.48	473.43	0.54
Salt	Salt	203.38	20_year	80000.00	955.24	971.87	969.81	972.58	0.001566	7.54	12979.91	2651.24	0.48
Salt	Salt	203.38	50_year	130000.00	955.24	973.72	971.43	974.65	0.001609	8.84	18468.03	3307.76	0.51
Salt	Salt	203.38	Low_Flow	95.00	955.24	959.16	956.73	959.17	0.000096	0.85	111.71	47.09	0.10
Salt	Salt	203.38	Normal_Flow	118.00	955.24	959.29	956.87	959.30	0.000127	1.00	118.04	48.05	0.11
Salt	Salt	203.3	5_year	19500.00	955.59	969.15	965.23	969.39	0.000818	3.93	4963.02	2129.38	0.29
Salt	Salt	203.3	10_year	49000.00	955.59	970.03	968.00	970.38	0.001162	5.05	10754.97	2446.37	0.35
Salt	Salt	203.3	100_year	162000.00	955.59	973.99	971.01	974.85	0.001677	8.60	23059.43	3555.14	0.48
Salt	Salt	203.3	Typ Peak_year	4400.00	955.59	963.94	960.07	964.14	0.000925	3.56	1235.34	660.33	0.37
Salt	Salt	203.3	20_year	80000.00	955.59	971.25	970.01	971.81	0.001589	6.64	13965.57	2899.31	0.43
Salt	Salt	203.3	50_year	130000.00	955.59	973.08	970.22	973.84	0.001698	8.05	19847.67	3487.23	0.47
Salt	Salt	203.3	Low_Flow	95.00	955.59	959.15	956.29	959.15	0.000011	0.31	307.25	117.01	0.03
Salt	Salt	203.3	Normal_Flow	118.00	955.59	959.28	956.37	959.29	0.000014	0.37	322.77	117.63	0.04
Salt	Salt	203.2	5_year	19500.00	955.00	968.39	965.41	968.80	0.001739	5.14	3797.06	2324.45	0.40
Salt	Salt	203.2	10_year	49000.00	955.00	969.45	968.37	969.77	0.001210	4.66	11410.58	2916.77	0.34
Salt	Salt	203.2	100_year	162000.00	955.00	973.21	970.38	974.01	0.001599	7.82	23564.32	3420.96	0.44
Salt	Salt	203.2	Typ Peak_year	4400.00	955.00	963.56	959.03	963.79	0.000511	3.86	1139.70	633.18	0.29
Salt	Salt	203.2	20_year	80000.00	955.00	970.41	969.01	970.95	0.001816	6.45	14320.85	3103.88	0.43
Salt	Salt	203.2	50_year	130000.00	955.00	972.30	969.71	972.98	0.001591	7.22	20499.78	3357.66	0.43
Salt	Salt	203.2	Low_Flow	95.00	955.00	959.15	955.62	959.15	0.000004	0.21	444.18	132.70	0.02
Salt	Salt	203.2	Normal_Flow	118.00	955.00	959.28	955.69	959.28	0.000005	0.26	461.67	133.47	0.02
Salt	Salt	203.1	5_year	19500.00	955.78	967.76	963.02	968.01	0.001102	4.04	4828.90	2460.66	0.31
Salt	Salt	203.1	10_year	49000.00	955.78	968.98	966.74	969.19	0.000784	3.63	13791.93	2864.63	0.26
Salt	Salt	203.1	100_year	162000.00	955.78	972.34	968.84	973.10	0.001528	7.03	23917.24	3143.39	0.40
Salt	Salt	203.1	Typ Peak_year	4400.00	955.78	963.40	959.96	963.49	0.000448	2.45	1793.91	985.78	0.20
Salt	Salt	203.1	20_year	80000.00	955.78	969.56	968.01	970.00	0.001443	5.32	15466.97	2939.33	0.36
Salt	Salt	203.1	50_year	130000.00	955.78	971.47	968.04	972.09	0.001453	6.33	21222.41	3077.88	0.38
Salt	Salt	203.1	Low_Flow	95.00	955.78	959.14	956.64	959.15	0.000025	0.28	333.68	333.59	0.05
Salt	Salt	203.1	Normal_Flow	118.00	955.78	959.27	956.74	959.28	0.000030	0.32	369.78	342.06	0.05
Salt	Salt	202.97	5_year	19500.00	957.32	966.99	962.82	967.26	0.001011	4.20	4646.08	2806.40	0.34
Salt	Salt	202.97	10_year	49000.00	957.32	968.54	966.41	968.72	0.000582	3.78	15737.51	3008.82	0.26
Salt	Salt	202.97	100_year	162000.00	957.32	971.20	967.92	972.00	0.001599	8.04	24287.00	3305.92	0.47
Salt	Salt	202.97	Typ Peak_year	4400.00	957.32	963.10	959.95	963.19	0.000416	2.40	1834.14	1083.39	0.21
Salt	Salt	202.97	20_year	80000.00	957.32	968.49	967.51	968.97	0.001510	6.15	15605.13	2999.63	0.43
Salt	Salt	202.97	50_year	130000.00	957.32	970.38	967.51	971.05	0.001524	7.34	21590.57	3282.03	0.45
Salt	Salt	202.97	Low_Flow	95.00	957.32	959.12	957.86	959.12	0.000036	0.30	316.56	418.35	0.05
Salt	Salt	202.97	Normal_Flow	118.00	957.32	959.25	957.91	959.25	0.000039	0.33	355.68	430.09	0.05
Salt	Salt	202.85	5_year	19500.00	953.44	966.31	962.86	966.63	0.001018	4.54	4292.19	2737.33	0.35
Salt	Salt	202.85	10_year	49000.00	953.44	968.27	965.83	968.41	0.000430	3.60	18505.03	3085.95	0.24
Salt	Salt	202.85	100_year	162000.00	953.44	970.25	966.65	971.04	0.001601	8.24	24879.00	3313.68	0.48
Salt	Salt	202.85	Typ Peak_year	4400.00	953.44	962.84	958.06	962.93	0.000421	2.39	1838.97	1601.19	0.23
Salt	Salt	202.85	20_year	80000.00	953.44	967.64	966.51	968.10	0.001441	6.26	16591.50	2992.13	0.43
Salt	Salt	202.85	50_year	130000.00	953.44	969.51	966.51	970.15	0.001473	7.45	22460.85	3242.17	0.45
Salt	Salt	202.85	Low_Flow	95.00	953.44	959.12	954.36	959.12	0.000002	0.14	662.81	458.16	0.01
Salt	Salt	202.85	Normal_Flow	118.00	953.44	959.25	954.44	959.25	0.000002	0.17	686.69	488.90	0.02
Salt	Salt	202.78	5_year	19500.00	956.08	966.07	962.32	966.31	0.000616	3.95	4941.43	2952.90	0.27
Salt	Salt	202.78	10_year	49000.00	956.08	968.13	964.65	968.27	0.000335	3.46	18555.44	3195.72	0.21
Salt	Salt	202.78	100_year	162000.00	956.08	969.51	966.79	970.42	0.001712	8.80	23228.42	3519.43	0.49
Salt	Salt	202.78	Typ Peak_year	4400.00	956.08	962.73	959.42	962.78	0.000308	1.84	2389.99	1532.20	0.18
Salt	Salt	202.78	20_year	80000.00	956.08	966.99	966.21	967.54	0.001555	6.86	14941.13	3082.93	0.45
Salt	Salt	202.78	50_year	130000.00	956.08	968.88	966.21	969.60	0.001514	7.87	20999.82	3434.52	0.46
Salt	Salt	202.78	Low_Flow	95.00	956.08	959.12	956.66	959.12	0.000007	0.21	442.44	472.55	0.03
Salt	Salt	202.78	Normal_Flow	118.00	956.08	959.25	956.72	959.25	0.000009	0.25	469.09	483.65	0.03
Salt	Salt	202.69	5_year	19500.00	958.23	965.55	963.26	965.88	0.001280	4.61	4234.50	2735.41	0.39
Salt	Salt	202.69	10_year	49000.00	958.23	965.50	965.50	967.63	0.008416	11.72	4180.94	2715.51	1.00
Salt	Salt	202.69	100_year	162000.00	958.23	968.60	966.34	969.56	0.001969	8.19	21907.87	3538.40	0.53
Salt	Salt	202.69	Typ Peak_year	4400.00	958.23	962.36	960.83	962.50	0.001249	3.00	1466.98	1703.14	0.35
Salt	Salt	202.69	20_year	80000.00	958.23	966.12	966.01	966.75	0.001936	6.16	13712.18	2807.52	0.49
Salt	Salt	202.69	50_year	130000.00	958.23	967.87	966.01	968.78	0.002050	7.78	18057.68	2905.51	0.53
Salt	Salt	202.69	Low_Flow	95.00	958.23	959.07	958.72	959.10	0.002450	1.52	62.48	688.53	0.38
Salt	Salt	202.69	Normal_Flow	118.00	958.23	959.19	958.78	959.23	0.002504	1.47	80.15	738.47	0.38
Salt	Salt	202.61	5_year	19500.00	955.76	964.70	963.05	965.19	0.002199	5.59	3486.58	3382.13	0.51
Salt	Salt	202.61	10_year	49000.00	955.76	965.00	965.00	965.21	0.000847	3.65	13568.38	3414.76	0.32
Salt	Salt	202.61	100_year	162000.00	955.76	967.95	965.01	968.73	0.001820	7.71	23180.11	4586.62	0.51
Salt	Salt	202.61	Typ Peak_year	4400.00	955.76	961.09	960.52	961.54	0.005310	5.39	816.02	1638.51	0.70
Salt	Salt	202.61	20_year	80000.00	955.76	965.53	965.01	965.99	0.001572	5.41	14916.81	3449.90	0.44
Salt	Salt	202.61	50_year	130000.00	955.76	967.35	965.01	967.95	0.001587	6.78	21157.54	3951.51	0.47
Salt	Salt	202.61	Low_Flow	95.00	955.76	956.71	956.71	956.98	0.016352	4.18	22.74	356.71	1.00
Salt	Salt	202.61	Normal_Flow	118.00	955.76	956.81	956.81	957.10	0.015555	4.34	27.22	371.21	0.99

HEC-RAS Plan: 3B (Continued)

River	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)	
Salt	Salt	202.54	5_year	19500.00	953.49	963.89	961.65	964.32	0.002255	5.30	3678.31	2969.24	0.43
Salt	Salt	202.54	10_year	49000.00	953.49	964.30	964.30	964.50	0.000717	3.25	14386.39	3011.57	0.25
Salt	Salt	202.54	100_year	162000.00	953.49	967.41	964.31	968.07	0.001496	6.91	25485.24	3919.02	0.42
Salt	Salt	202.54	Typ Peak_year	4400.00	953.49	960.39	957.46	960.54	0.001339	3.19	1379.97	1636.62	0.28
Salt	Salt	202.54	20_year	80000.00	953.49	965.04	964.31	965.44	0.001286	4.92	16339.57	3069.01	0.36
Salt	Salt	202.54	50_year	130000.00	953.49	966.72	964.31	967.36	0.001539	6.53	20841.17	3535.84	0.42
Salt	Salt	202.54	Low_Flow	95.00	953.49	955.38	954.35	955.39	0.000538	0.68	138.94	474.44	0.12
Salt	Salt	202.54	Normal_Flow	118.00	953.49	955.54	954.53	955.55	0.000515	0.73	162.32	482.78	0.12
Salt	Salt	202.48	5_year	19500.00	953.23	962.97	961.37	963.49	0.002994	5.75	3392.79	2563.20	0.50
Salt	Salt	202.48	10_year	49000.00	953.23	963.20	963.20	963.48	0.000880	3.25	12081.74	2657.99	0.28
Salt	Salt	202.48	100_year	162000.00	953.23	966.91	963.64	967.58	0.001617	6.76	25001.36	4003.98	0.43
Salt	Salt	202.48	Typ Peak_year	4400.00	953.23	959.63	958.02	959.91	0.003022	4.25	1035.75	1605.64	0.50
Salt	Salt	202.48	20_year	80000.00	953.23	964.64	963.21	965.04	0.001377	4.89	15710.56	3295.61	0.37
Salt	Salt	202.48	50_year	130000.00	953.23	966.22	963.21	966.88	0.001726	6.49	20035.82	3646.12	0.43
Salt	Salt	202.48	Low_Flow	95.00	953.23	955.18	954.18	955.20	0.000609	1.21	78.21	455.09	0.21
Salt	Salt	202.48	Normal_Flow	118.00	953.23	955.34	954.28	955.37	0.000611	1.29	91.67	468.96	0.22
Salt	Salt	202.4	5_year	19500.00	952.19	961.69	959.31	962.09	0.003355	5.08	3839.65	2552.70	0.41
Salt	Salt	202.4	10_year	49000.00	952.19	962.77	961.76	963.01	0.001079	3.42	13223.94	2964.09	0.25
Salt	Salt	202.4	100_year	162000.00	952.19	966.17	962.75	966.84	0.001794	6.83	25530.00	3776.39	0.39
Salt	Salt	202.4	Typ Peak_year	4400.00	952.19	957.56	956.78	957.87	0.008561	4.44	990.87	1266.54	0.56
Salt	Salt	202.4	20_year	80000.00	952.19	964.01	962.21	964.39	0.001618	5.01	16627.35	3272.31	0.33
Salt	Salt	202.4	50_year	130000.00	952.19	965.42	962.21	966.07	0.001983	6.55	20700.26	3727.13	0.39
Salt	Salt	202.4	Low_Flow	95.00	952.19	954.70	953.47	954.72	0.002729	1.33	71.21	436.00	0.28
Salt	Salt	202.4	Normal_Flow	118.00	952.19	954.87	953.63	954.90	0.002521	1.29	91.49	480.98	0.27
Salt	Salt	202.32	5_year	19500.00	950.65	961.48	956.73	961.62	0.000431	2.92	6689.30	2894.10	0.19
Salt	Salt	202.32	10_year	49000.00	950.65	962.48	958.74	962.67	0.000561	3.71	14355.83	3335.79	0.23
Salt	Salt	202.32	100_year	162000.00	950.65	965.71	962.01	966.24	0.000984	6.64	28627.35	4270.45	0.35
Salt	Salt	202.32	Typ Peak_year	4400.00	950.65	956.85	955.13	956.91	0.000919	1.88	2342.46	1476.73	0.21
Salt	Salt	202.32	20_year	80000.00	950.65	963.53	960.45	963.88	0.000876	5.16	17223.96	3634.54	0.30
Salt	Salt	202.32	50_year	130000.00	950.65	964.93	962.01	965.44	0.001007	6.27	22998.93	3955.69	0.34
Salt	Salt	202.32	Low_Flow	95.00	950.65	952.99	951.58	953.01	0.006534	0.89	107.09	91.98	0.14
Salt	Salt	202.32	Normal_Flow	118.00	950.65	953.19	951.68	953.21	0.007199	0.93	127.15	110.99	0.15
Salt	Salt	202.24	5_year	19500.00	948.09	961.12	955.42	961.26	0.002686	3.05	6399.01	2719.23	0.20
Salt	Salt	202.24	10_year	49000.00	948.09	962.02	958.05	962.31	0.001531	2.82	13174.14	3727.74	0.18
Salt	Salt	202.24	100_year	162000.00	948.09	964.97	961.79	965.65	0.002339	6.50	24644.86	5371.09	0.35
Salt	Salt	202.24	Typ Peak_year	4400.00	948.09	956.20	952.92	956.25	0.003711	1.75	2513.78	1116.75	0.16
Salt	Salt	202.24	20_year	80000.00	948.09	962.82	960.17	963.33	0.002274	4.25	15225.88	4179.94	0.26
Salt	Salt	202.24	50_year	130000.00	948.09	964.20	964.00	964.82	0.002591	5.84	20949.09	5057.51	0.33
Salt	Salt	202.24	Low_Flow	95.00	948.09	949.87	948.97	949.88	0.009480	0.99	95.65	91.38	0.17
Salt	Salt	202.24	Normal_Flow	118.00	948.09	950.07	949.05	950.08	0.008470	1.04	113.99	94.03	0.17
Salt	Salt	202.18	5_year	19500.00	946.86	960.41	953.68	960.55	0.001628	3.01	6471.33	2708.85	0.17
Salt	Salt	202.18	10_year	49000.00	946.86	961.02	956.38	961.49	0.003892	5.82	9055.17	2941.28	0.33
Salt	Salt	202.18	100_year	162000.00	946.86	963.77	961.15	964.86	0.002014	9.60	20765.73	4908.10	0.48
Salt	Salt	202.18	Typ Peak_year	4400.00	946.86	955.66	950.16	955.69	0.000906	1.37	3206.11	1114.62	0.11
Salt	Salt	202.18	20_year	80000.00	946.86	962.32	958.52	962.71	0.001340	4.75	16716.99	4264.06	0.25
Salt	Salt	202.18	50_year	130000.00	946.86	963.30	961.11	964.05	0.001881	7.28	19415.11	4708.00	0.37
Salt	Salt	202.18	Low_Flow	95.00	946.86	949.78	947.52	949.78	0.000086	0.22	429.58	210.27	0.03
Salt	Salt	202.18	Normal_Flow	118.00	946.86	949.96	947.57	949.96	0.000102	0.25	468.48	215.49	0.03
Salt	Salt	202.11	5_year	19500.00	948.26	959.75	953.75	959.90	0.002042	3.08	6321.21	2817.80	0.19
Salt	Salt	202.11	10_year	49000.00	948.26	960.63	956.33	960.85	0.001135	2.72	14335.26	3079.50	0.16
Salt	Salt	202.11	100_year	162000.00	948.26	963.15	960.16	964.00	0.002427	6.77	22884.94	4048.59	0.35
Salt	Salt	202.11	Typ Peak_year	4400.00	948.26	955.22	950.93	955.26	0.001641	1.47	2992.99	1131.75	0.13
Salt	Salt	202.11	20_year	80000.00	948.26	961.84	958.36	962.21	0.001419	3.77	17629.19	3531.58	0.20
Salt	Salt	202.11	50_year	130000.00	948.26	962.53	959.91	963.30	0.002399	5.85	19542.20	3783.67	0.31
Salt	Salt	202.11	Low_Flow	95.00	948.26	949.70	948.69	949.70	0.001369	0.38	248.90	238.62	0.07
Salt	Salt	202.11	Normal_Flow	118.00	948.26	949.87	948.73	949.87	0.001321	0.41	290.51	246.42	0.07
Salt	Salt	202.06	5_year	19500.00	947.33	959.25	953.32	959.38	0.002041	2.88	6782.25	3091.15	0.18
Salt	Salt	202.06	10_year	49000.00	947.33	960.43	955.95	960.61	0.000698	2.08	17532.29	3323.34	0.12
Salt	Salt	202.06	100_year	162000.00	947.33	962.87	959.71	963.47	0.001320	4.92	28503.20	4211.02	0.26
Salt	Salt	202.06	Typ Peak_year	4400.00	947.33	954.74	950.65	954.77	0.002280	1.49	2955.27	1841.63	0.14
Salt	Salt	202.06	20_year	80000.00	947.33	961.58	957.85	961.90	0.000947	3.02	20791.83	3468.69	0.17
Salt	Salt	202.06	50_year	130000.00	947.33	962.30	959.71	962.79	0.001181	4.05	25902.28	3804.15	0.22
Salt	Salt	202.06	Low_Flow	95.00	947.33	949.27	948.03	949.27	0.002217	0.52	181.76	187.25	0.09
Salt	Salt	202.06	Normal_Flow	118.00	947.33	949.45	948.08	949.45	0.002149	0.53	220.72	236.86	0.10
Salt	Salt	202.01	5_year	19500.00	946.85	958.79	952.48	958.90	0.001475	2.73	7147.67	2904.86	0.17
Salt	Salt	202.01	10_year	49000.00	946.85	960.04	955.04	960.34	0.001263	3.09	14538.26	3105.02	0.18
Salt	Salt	202.01	100_year	162000.00	946.85	962.32	959.73	963.07	0.001355	5.24	26842.18	4235.20	0.27
Salt	Salt	202.01	Typ Peak_year	4400.00	946.85	954.27	949.82	954.30	0.001337	1.32	3329.32	1558.17	0.11
Salt	Salt	202.01	20_year	80000.00	946.85	960.99	956.91	961.51	0.001861	4.53	16847.37	3232.01	0.25
Salt	Salt	202.01	50_year	130000.00	946.85	961.62	959.02	962.38	0.001488	4.78	22742.02	3343.17	0.25
Salt	Salt	202.01	Low_Flow	95.00	946.85	948.96	947.37	948.96	0.000662	0.28	334.94	605.51	0.05
Salt	Salt	202.01	Normal_Flow	118.00	946.85	949.15	947.43	949.15	0.000654	0.30	392.08	627.84	0.05
Salt	Salt	201.96	5_year	19500.00	946.20	958.33	952.43	958.44	0.002659	2.64	7380.94	2552.24	0.17
Salt	Salt	201.96	10_year	49000.00	946.20	959.25	954.85	959.71	0.007952	5.61	9472.68	2772.39	0.34
Salt	Salt	201.96	100_year	162000.00	946.20	961.60	959.27	962.66	0.002116	5.39	23269.88	3446.43	0.29
Salt	Salt	201.96	Typ Peak_year	4400.00	946.20	953.87	949.48	953.90	0.002138	1.37	3212.20	1582.08	0.12
Salt	Salt	201.96	20_year	80000.00	946.20	960.25	956.63	961.00	0.002436	3.95	15492.19	3106.24	0.23
Salt	Salt	201.96	50_year	130000.00	946.20	960.73	959.18	961.89	0.002621	5.00	19074.27	3245.69	0.28
Salt	Salt	201.96	Low_Flow	95.00	946.20	948.83	946.87	948.83	0.000473	0.25	376.19	531.70	0.04

HEC-RAS Plan: 3B (Continued)

River	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)	
Salt	Salt	201.96	Normal_Flow	118.00	946.20	949.02	946.92	949.02	0.000489	0.27	433.53	563.13	0.04
Salt	Salt	201.89	5_year	19500.00	946.82	957.38	952.19	957.50	0.002327	2.86	6817.59	2796.81	0.19
Salt	Salt	201.89	10_year	49000.00	946.82	958.70	954.47	959.06	0.000710	2.00	15061.83	2992.30	0.12
Salt	Salt	201.89	100_year	162000.00	946.82	961.41	957.87	962.06	0.000879	3.93	29372.05	3530.60	0.21
Salt	Salt	201.89	Typ Peak_year	4400.00	946.82	952.90	950.14	952.94	0.003097	1.62	2724.04	2026.85	0.16
Salt	Salt	201.89	20_year	80000.00	946.82	959.72	956.20	960.37	0.001174	3.18	17192.04	3218.60	0.18
Salt	Salt	201.89	50_year	130000.00	946.82	960.44	957.58	961.17	0.001100	3.71	23545.18	3405.51	0.21
Salt	Salt	201.89	Low_Flow	95.00	946.82	948.45	947.40	948.46	0.003346	0.54	174.71	490.79	0.10
Salt	Salt	201.89	Normal_Flow	118.00	946.82	948.65	947.45	948.66	0.002801	0.55	213.56	524.10	0.09
Salt	Salt	201.81	5_year	19500.00	945.11	956.82	951.60	956.96	0.000896	2.97	6562.59	2879.00	0.19
Salt	Salt	201.81	10_year	49000.00	945.11	958.54	953.81	958.75	0.000591	2.94	15331.24	3211.87	0.17
Salt	Salt	201.81	100_year	162000.00	945.11	961.12	957.09	961.68	0.000862	5.09	30269.66	3773.94	0.26
Salt	Salt	201.81	Typ Peak_year	4400.00	945.11	952.09	949.42	952.14	0.001434	1.74	2534.56	1740.53	0.17
Salt	Salt	201.81	20_year	80000.00	945.11	959.44	955.66	959.86	0.001011	4.36	17316.91	3417.87	0.24
Salt	Salt	201.81	50_year	130000.00	945.11	960.15	957.08	960.71	0.000950	4.75	24107.05	3563.22	0.25
Salt	Salt	201.81	Low_Flow	95.00	945.11	947.32	945.63	947.33	0.002465	0.74	127.70	363.47	0.10
Salt	Salt	201.81	Normal_Flow	118.00	945.11	947.55	945.71	947.56	0.002772	0.82	143.75	389.05	0.10
Salt	Salt	201.7	5_year	19500.00	945.11	956.34	951.83	956.57	0.000513	3.86	5048.12	2845.83	0.27
Salt	Salt	201.7	10_year	49000.00	945.11	958.03	954.85	958.37	0.000659	5.12	11380.53	3287.42	0.32
Salt	Salt	201.7	100_year	162000.00	945.11	960.28	958.53	961.05	0.001240	8.27	25663.48	3545.40	0.45
Salt	Salt	201.7	Typ Peak_year	4400.00	945.11	951.53	949.30	951.63	0.000580	2.62	1682.44	1143.48	0.26
Salt	Salt	201.7	20_year	80000.00	945.11	958.26	956.36	959.10	0.001565	8.04	11811.18	3291.90	0.49
Salt	Salt	201.7	50_year	130000.00	945.11	959.45	957.21	960.09	0.001141	7.51	22917.84	3307.77	0.43
Salt	Salt	201.7	Low_Flow	95.00	945.11	946.53	945.77	946.57	0.000818	1.47	64.72	275.55	0.25
Salt	Salt	201.7	Normal_Flow	118.00	945.11	946.67	945.85	946.71	0.000910	1.61	73.18	300.33	0.27
Salt	Salt	201.62	5_year	19500.00	944.97	956.15	951.46	956.35	0.000436	3.60	5420.09	3092.07	0.24
Salt	Salt	201.62	10_year	49000.00	944.97	956.94	954.07	957.86	0.001813	7.85	7371.72	3252.48	0.50
Salt	Salt	201.62	100_year	162000.00	944.97	959.77	957.69	960.50	0.001124	7.65	27317.13	3374.12	0.41
Salt	Salt	201.62	Typ Peak_year	4400.00	944.97	951.31	948.86	951.39	0.000506	2.34	1878.02	1733.34	0.24
Salt	Salt	201.62	20_year	80000.00	944.97	958.27	956.29	958.55	0.000523	4.68	22510.43	3358.48	0.27
Salt	Salt	201.62	50_year	130000.00	944.97	959.01	957.32	959.59	0.000994	6.83	24864.24	3370.73	0.38
Salt	Salt	201.62	Low_Flow	95.00	944.97	945.91	945.56	945.96	0.002831	1.84	51.75	293.00	0.42
Salt	Salt	201.62	Normal_Flow	118.00	944.97	946.03	945.63	946.09	0.002539	1.87	63.09	318.88	0.41
Salt	Salt	201.54	5_year	19500.00	944.01	955.87	951.74	956.11	0.000958	3.92	4974.71	2759.78	0.27
Salt	Salt	201.54	10_year	49000.00	944.01	956.85	954.31	957.15	0.001010	4.42	11237.32	2887.59	0.28
Salt	Salt	201.54	100_year	162000.00	944.01	959.10	956.66	959.94	0.001661	7.31	25049.83	3298.28	0.41
Salt	Salt	201.54	Typ Peak_year	4400.00	944.01	950.91	949.35	951.06	0.001664	3.04	1449.33	1604.00	0.36
Salt	Salt	201.54	20_year	80000.00	944.01	958.01	955.95	958.30	0.000704	4.15	21594.54	3150.26	0.25
Salt	Salt	201.54	50_year	130000.00	944.01	958.43	955.95	959.10	0.001458	6.36	22928.63	3177.07	0.37
Salt	Salt	201.54	Low_Flow	95.00	944.01	945.17	944.63	945.22	0.001376	1.77	53.54	170.52	0.32
Salt	Salt	201.54	Normal_Flow	118.00	944.01	945.31	944.70	945.36	0.001384	1.92	61.43	187.10	0.33
Salt	Salt	201.48	5_year	19500.00	943.46	955.47	951.11	955.67	0.001576	3.56	5487.23	3078.01	0.25
Salt	Salt	201.48	10_year	49000.00	943.46	956.03	953.53	956.61	0.002418	4.88	8691.05	3189.45	0.33
Salt	Salt	201.48	100_year	162000.00	943.46	958.45	956.58	959.34	0.001766	6.20	24815.58	3926.94	0.36
Salt	Salt	201.48	Typ Peak_year	4400.00	943.46	950.22	948.65	950.37	0.002342	3.06	1439.48	1584.85	0.35
Salt	Salt	201.48	20_year	80000.00	943.46	956.31	955.72	957.67	0.005151	7.77	9125.23	3255.46	0.52
Salt	Salt	201.48	50_year	130000.00	943.46	957.91	956.47	958.58	0.001483	5.16	23019.61	3615.44	0.31
Salt	Salt	201.48	Low_Flow	95.00	943.46	944.52	944.11	944.59	0.002438	2.16	44.02	177.26	0.42
Salt	Salt	201.48	Normal_Flow	118.00	943.46	944.64	944.19	944.72	0.002554	2.34	50.46	182.93	0.43
Salt	Salt	201.41	5_year	19500.00	942.38	954.82	950.69	955.04	0.001954	3.77	5174.81	3035.93	0.29
Salt	Salt	201.41	10_year	49000.00	942.38	955.11	953.64	955.69	0.002814	4.89	8927.29	3084.52	0.37
Salt	Salt	201.41	100_year	162000.00	942.38	957.76	955.13	958.68	0.002028	6.47	24427.71	3567.89	0.40
Salt	Salt	201.41	Typ Peak_year	4400.00	942.38	949.56	947.32	949.72	0.001419	3.24	1357.35	1415.24	0.33
Salt	Salt	201.41	20_year	80000.00	942.38	955.86	954.98	956.45	0.001784	4.51	14302.36	3196.44	0.32
Salt	Salt	201.41	50_year	130000.00	942.38	957.34	955.13	958.03	0.001671	5.40	23017.54	3361.33	0.34
Salt	Salt	201.41	Low_Flow	95.00	942.38	944.51	942.75	944.52	0.000049	0.54	174.35	259.03	0.07
Salt	Salt	201.41	Normal_Flow	118.00	942.38	944.63	942.81	944.63	0.000063	0.64	184.20	260.89	0.08
Salt	Salt	201.33	5_year	19500.00	942.38	953.39	950.73	954.02	0.002872	6.38	3054.96	2658.32	0.58
Salt	Salt	201.33	10_year	49000.00	942.38	953.69	953.48	954.42	0.003159	7.00	8209.90	2720.72	0.62
Salt	Salt	201.33	100_year	162000.00	942.38	956.50	955.06	957.68	0.002711	9.00	21397.33	3347.06	0.62
Salt	Salt	201.33	Typ Peak_year	4400.00	942.38	948.67	945.90	949.02	0.001924	4.73	930.18	1150.66	0.46
Salt	Salt	201.33	20_year	80000.00	942.38	954.50	953.56	955.45	0.003078	7.62	11335.29	3006.04	0.62
Salt	Salt	201.33	50_year	130000.00	942.38	955.69	954.51	956.96	0.003781	9.73	16858.44	3316.08	0.72
Salt	Salt	201.33	Low_Flow	95.00	942.38	944.50	942.66	944.50	0.000023	0.38	251.46	374.40	0.05
Salt	Salt	201.33	Normal_Flow	118.00	942.38	944.61	942.71	944.61	0.000030	0.45	265.09	377.20	0.05
Salt	Salt	201.26	5_year	19500.00	942.38	951.87	950.44	952.79	0.004201	7.70	2533.88	2266.49	0.70
Salt	Salt	201.26	10_year	49000.00	942.38	953.12	952.25	953.51	0.001804	5.16	10920.46	3028.93	0.46
Salt	Salt	201.26	100_year	162000.00	942.38	955.48	954.21	956.66	0.003197	9.41	20810.85	3438.13	0.67
Salt	Salt	201.26	Typ Peak_year	4400.00	942.38	948.35	945.11	948.60	0.000731	4.00	1100.58	1227.95	0.31
Salt	Salt	201.26	20_year	80000.00	942.38	953.31	952.25	954.22	0.004019	7.95	11391.50	3123.39	0.70
Salt	Salt	201.26	50_year	130000.00	942.38	954.62	953.38	955.66	0.003351	8.74	17885.97	3377.84	0.67
Salt	Salt	201.26	Low_Flow	95.00	942.38	944.50	942.60	944.50	0.000010	0.26	367.69	478.53	0.03
Salt	Salt	201.26	Normal_Flow	118.00	942.38	944.60	942.63	944.61	0.000014	0.30	387.00	482.82	0.04
Salt	Salt	201.2	5_year	19500.00	942.38	951.05	948.89	951.64	0.002398	6.15	3173.01	2826.99	0.54
Salt	Salt	201.2	10_year	49000.00	942.38	953.00	951.35	953.15	0.000441	3.38	16795.15	3575.72	0.25
Salt	Salt	201.2	100_year	162000.00	942.38	954.98	952.58	955.75	0.001594	7.80	25365.44	3728.46	0.49
Salt	Salt	201.2	Typ Peak_year	4400.00	942.38	948.20	945.24	948.34	0.000613	2.95	1493.82	1662.60	0.27
Salt	Salt	201.2	20_year	80000.00	942.38	952.26	951.46	953.02	0.002665	7.62	12175.01	3349.22	0.59
Salt	Salt	201.2	50_year	130000.00	942.38	954.07	951.85	954.74	0.001616	7.23	22123.11	3689.51	0.48

HEC-RAS Plan: 3B (Continued)

River	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)	
Salt	Salt	201.2	Low_Flow	95.00	942.38	944.49	942.71	944.49	0.000016	0.27	356.68	753.39	0.04
Salt	Salt	201.2	Normal_Flow	118.00	942.38	944.60	942.76	944.60	0.000020	0.31	381.43	775.08	0.04
Salt	Salt	201.16	5_year	19500.00	943.39	950.92	948.67	951.20	0.001035	4.29	4548.43	3323.21	0.36
Salt	Salt	201.16	10_year	49000.00	943.39	950.62	950.62	952.69	0.008222	11.54	4245.38	3221.89	1.00
Salt	Salt	201.16	100_year	162000.00	943.39	954.74	951.72	955.39	0.001262	7.18	27751.92	3712.87	0.44
Salt	Salt	201.16	Typ Peak_year	4400.00	943.39	948.01	946.67	948.12	0.001433	2.69	1632.79	2224.44	0.36
Salt	Salt	201.16	20_year	80000.00	943.39	952.06	951.01	952.50	0.001342	5.69	16072.09	3656.30	0.43
Salt	Salt	201.16	50_year	130000.00	943.39	953.81	951.24	954.37	0.001279	6.67	24342.56	3703.69	0.43
Salt	Salt	201.16	Low_Flow	95.00	943.39	944.46	943.95	944.48	0.000770	1.06	89.43	648.00	0.23
Salt	Salt	201.16	Normal_Flow	118.00	943.39	944.56	944.00	944.58	0.000781	1.15	103.00	702.72	0.23
Salt	Salt	201.1	5_year	19500.00	942.17	950.01	948.89	950.67	0.003206	6.52	2992.58	3218.35	0.61
Salt	Salt	201.1	10_year	49000.00	942.17	950.39	950.21	950.87	0.001963	5.31	9806.53	3420.46	0.48
Salt	Salt	201.1	100_year	162000.00	942.17	954.35	951.29	954.99	0.001437	7.33	27043.35	3886.52	0.46
Salt	Salt	201.1	Typ Peak_year	4400.00	942.17	946.92	946.56	947.34	0.005830	5.20	845.50	1621.28	0.72
Salt	Salt	201.1	20_year	80000.00	942.17	951.54	950.21	952.04	0.001828	6.11	14726.71	3694.77	0.49
Salt	Salt	201.1	50_year	130000.00	942.17	953.40	951.18	953.97	0.001520	6.91	23380.55	3873.84	0.47
Salt	Salt	201.1	Low_Flow	95.00	942.17	943.93	943.47	944.01	0.005145	2.24	42.43	375.65	0.56
Salt	Salt	201.1	Normal_Flow	118.00	942.17	944.06	943.59	944.13	0.004375	2.17	54.50	402.84	0.52
Salt	Salt	201.01	5_year	19500.00	938.69	948.63	946.53	949.10	0.003261	5.50	3544.86	2704.40	0.47
Salt	Salt	201.01	10_year	49000.00	938.69	949.13	949.00	949.74	0.002938	5.46	9182.02	2956.76	0.45
Salt	Salt	201.01	100_year	162000.00	938.69	953.56	950.30	954.27	0.001594	6.78	26707.43	3738.34	0.41
Salt	Salt	201.01	Typ Peak_year	4400.00	938.69	945.28	944.00	945.48	0.002722	3.54	1244.48	1442.79	0.41
Salt	Salt	201.01	20_year	80000.00	938.69	950.51	949.18	951.07	0.002276	5.70	14685.41	3459.36	0.42
Salt	Salt	201.01	50_year	130000.00	938.69	952.55	950.11	953.20	0.001734	6.34	22979.43	3703.55	0.40
Salt	Salt	201.01	Low_Flow	95.00	938.69	941.00	939.47	941.02	0.007987	1.36	69.87	212.17	0.17
Salt	Salt	201.01	Normal_Flow	118.00	938.69	941.17	939.58	941.21	0.009508	1.55	76.28	219.32	0.20
Salt	Salt	200.95	5_year	19500.00	938.69	947.56	945.40	948.08	0.002909	5.76	3384.03	2469.82	0.47
Salt	Salt	200.95	10_year	49000.00	938.69	948.21	948.00	948.82	0.002582	5.98	8873.88	2837.75	0.46
Salt	Salt	200.95	100_year	162000.00	938.69	953.03	949.52	953.74	0.001537	7.57	27142.88	4197.81	0.43
Salt	Salt	200.95	Typ Peak_year	4400.00	938.69	944.38	942.87	944.55	0.002819	3.31	1329.25	1329.36	0.38
Salt	Salt	200.95	20_year	80000.00	938.69	949.74	948.01	950.34	0.002065	6.45	13952.89	3390.42	0.44
Salt	Salt	200.95	50_year	130000.00	938.69	951.97	949.00	952.63	0.001615	7.10	23229.84	4074.35	0.42
Salt	Salt	200.95	Low_Flow	95.00	938.69	940.45	939.28	940.45	0.000725	0.72	131.14	161.04	0.12
Salt	Salt	200.95	Normal_Flow	118.00	938.69	940.55	939.37	940.56	0.000806	0.82	143.30	203.42	0.13
Salt	Salt	200.88	5_year	19500.00	938.71	946.66	943.99	946.99	0.002779	4.63	4208.79	2265.25	0.38
Salt	Salt	200.88	10_year	49000.00	938.71	947.44	946.48	947.94	0.002152	4.70	8951.63	2568.35	0.35
Salt	Salt	200.88	100_year	162000.00	938.71	952.59	948.33	953.20	0.001339	6.57	27950.22	3876.89	0.36
Salt	Salt	200.88	Typ Peak_year	4400.00	938.71	943.24	941.92	943.37	0.003727	2.91	1512.15	1391.50	0.35
Salt	Salt	200.88	20_year	80000.00	938.71	949.14	947.01	949.62	0.001788	5.39	14518.07	3207.26	0.36
Salt	Salt	200.88	50_year	130000.00	938.71	951.51	948.13	952.05	0.001445	6.12	23854.07	3757.77	0.35
Salt	Salt	200.88	Low_Flow	95.00	938.71	939.57	939.44	939.63	0.037934	1.97	48.28	126.92	0.56
Salt	Salt	200.88	Normal_Flow	118.00	938.71	939.68	939.49	939.74	0.021047	1.89	62.50	181.43	0.48
Salt	Salt	200.83	5_year	19500.00	937.28	946.25	943.24	946.53	0.000964	4.24	4601.95	2560.09	0.33
Salt	Salt	200.83	10_year	49000.00	937.28	946.82	945.60	947.36	0.001922	6.36	8433.52	2812.04	0.47
Salt	Salt	200.83	100_year	162000.00	937.28	952.27	947.98	952.88	0.000946	7.09	29388.96	3962.96	0.38
Salt	Salt	200.83	Typ Peak_year	4400.00	937.28	942.71	940.76	942.82	0.001114	2.62	1681.71	1230.18	0.31
Salt	Salt	200.83	20_year	80000.00	937.28	948.74	946.51	949.20	0.001213	6.16	15075.69	3285.21	0.40
Salt	Salt	200.83	50_year	130000.00	937.28	951.19	947.77	951.72	0.000955	6.61	25230.65	3790.05	0.37
Salt	Salt	200.83	Low_Flow	95.00	937.28	938.46	937.83	938.51	0.001353	1.81	52.40	49.14	0.31
Salt	Salt	200.83	Normal_Flow	118.00	937.28	938.58	937.92	938.64	0.001503	2.02	58.43	57.39	0.33
Salt	Salt	200.75	5_year	19500.00	937.28	944.56	943.88	945.68	0.005606	8.47	2300.95	2028.24	0.80
Salt	Salt	200.75	10_year	49000.00	937.28	946.05	945.01	946.47	0.002225	5.92	9559.63	2568.50	0.52
Salt	Salt	200.75	100_year	162000.00	937.28	951.75	947.24	952.44	0.001208	7.47	27904.71	3649.90	0.42
Salt	Salt	200.75	Typ Peak_year	4400.00	937.28	941.80	940.70	942.15	0.002532	4.77	921.50	1186.19	0.54
Salt	Salt	200.75	20_year	80000.00	937.28	948.09	945.18	948.61	0.001636	6.40	13967.64	2965.68	0.46
Salt	Salt	200.75	50_year	130000.00	937.28	950.68	946.50	951.27	0.001216	6.91	24108.35	3493.93	0.41
Salt	Salt	200.75	Low_Flow	95.00	937.28	938.15	937.58	938.17	0.000570	1.05	90.10	208.15	0.20
Salt	Salt	200.75	Normal_Flow	118.00	937.28	938.23	937.63	938.25	0.000646	1.19	99.12	219.16	0.22
Salt	Salt	200.68	5_year	19500.00	937.28	942.13	941.81	943.18	0.007416	8.23	2368.32	1507.91	0.85
Salt	Salt	200.68	10_year	49000.00	937.28	945.52	943.01	945.86	0.000993	4.72	10482.44	2275.02	0.34
Salt	Salt	200.68	100_year	162000.00	937.28	951.35	945.93	952.00	0.000895	7.09	28738.78	3577.75	0.36
Salt	Salt	200.68	Typ Peak_year	4400.00	937.28	939.48	939.48	940.26	0.012334	7.09	620.72	852.86	1.00
Salt	Salt	200.68	20_year	80000.00	937.28	947.66	943.26	948.09	0.000925	5.56	15120.96	2954.67	0.34
Salt	Salt	200.68	50_year	130000.00	937.28	950.30	944.97	950.84	0.000847	6.43	25041.80	3381.08	0.34
Salt	Salt	200.68	Low_Flow	95.00	937.28	937.66	937.52	937.69	0.004090	1.43	66.43	581.14	0.46
Salt	Salt	200.68	Normal_Flow	118.00	937.28	937.70	937.55	937.74	0.004129	1.54	76.38	596.79	0.46
Salt	Salt	200.6	5_year	19500.00	932.82	941.36	938.76	941.69	0.001570	4.58	4253.09	1518.99	0.37
Salt	Salt	200.6	10_year	49000.00	932.82	944.90	941.16	945.36	0.001224	5.73	9636.41	2400.62	0.35
Salt	Salt	200.6	100_year	162000.00	932.82	950.92	945.68	951.59	0.000927	7.55	29294.34	3967.40	0.35
Salt	Salt	200.6	Typ Peak_year	4400.00	932.82	937.48	936.37	937.69	0.002619	3.67	1198.51	840.20	0.44
Salt	Salt	200.6	20_year	80000.00	932.82	947.13	942.40	947.65	0.001041	6.31	15006.52	3010.86	0.34
Salt	Salt	200.6	50_year	130000.00	932.82	949.88	943.98	950.45	0.000884	6.91	25744.46	3496.73	0.34
Salt	Salt	200.6	Low_Flow	95.00	932.82	933.59	933.59	933.76	0.035022	3.35	28.33	220.78	0.99
Salt	Salt	200.6	Normal_Flow	118.00	932.82	933.64	933.64	933.85	0.032633	3.61	32.73	221.61	0.99
Salt	Salt	200.52	5_year	19500.00	928.41	940.65	937.63	940.94	0.001991	4.32	4510.49	1347.51	0.34
Salt	Salt	200.52	10_year	49000.00	928.41	944.49	940.18	944.80	0.001154	4.77	11292.34	2320.67	0.29
Salt	Salt	200.52	100_year	162000.00	928.41	950.54	944.90	951.16	0.000970	6.99	29504.97	3830.18	0.32
Salt	Salt	200.52	Typ Peak_year	4400.00	928.41	936.47	935.17	936.65	0.002352	3.42	1287.62	554.30	0.40
Salt	Salt	200.52	20_year	80000.00	928.41	946.76	942.01	947.16	0.001018	5.47	17603.90	2789.27	0.29

HEC-RAS Plan: 3B (Continued)

River	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)	
Salt	Salt	200.52	50_year	130000.00	928.41	949.52	943.85	950.04	0.000919	6.28	25852.25	3114.25	0.30
Salt	Salt	200.52	Low_Flow	95.00	928.41	931.03	930.12	931.11	0.001426	2.22	42.77	32.63	0.34
Salt	Salt	200.52	Normal_Flow	118.00	928.41	931.17	930.27	931.27	0.001660	2.48	47.54	34.40	0.37
Salt	Salt	200.47	5_year	19500.00	928.32	940.30	937.27	940.57	0.001301	4.15	4698.48	1357.19	0.32
Salt	Salt	200.47	10_year	49000.00	928.32	944.25	939.57	944.56	0.000890	4.81	12340.48	2390.66	0.28
Salt	Salt	200.47	100_year	162000.00	928.32	950.29	944.69	950.93	0.000897	7.36	29947.17	3654.77	0.33
Salt	Salt	200.47	Typ Peak_year	4400.00	928.32	936.04	934.53	936.21	0.001500	3.34	1316.01	507.99	0.37
Salt	Salt	200.47	20_year	80000.00	928.32	946.52	941.34	946.93	0.000874	5.67	18314.47	2764.35	0.30
Salt	Salt	200.47	50_year	130000.00	928.32	949.28	943.60	949.82	0.000847	6.64	26390.99	3214.48	0.31
Salt	Salt	200.47	Low_Flow	95.00	928.32	930.88	929.68	930.90	0.000520	1.35	70.29	54.99	0.21
Salt	Salt	200.47	Normal_Flow	118.00	928.32	930.99	929.81	931.03	0.000627	1.54	76.67	57.43	0.23
Salt	Salt	200.4	5_year	19500.00	927.00	939.69	936.21	939.95	0.001808	4.19	4806.15	1162.09	0.29
Salt	Salt	200.4	10_year	49000.00	927.00	943.68	938.76	944.07	0.001601	5.40	11504.49	2145.74	0.31
Salt	Salt	200.4	100_year	162000.00	927.00	949.80	944.57	950.49	0.001185	8.12	30581.40	3836.04	0.36
Salt	Salt	200.4	Typ Peak_year	4400.00	927.00	935.40	931.88	935.53	0.001838	2.91	1512.23	485.68	0.29
Salt	Salt	200.4	20_year	80000.00	927.00	945.95	940.77	946.44	0.001590	6.41	17530.15	2921.05	0.33
Salt	Salt	200.4	50_year	130000.00	927.00	948.80	943.26	949.37	0.001312	7.33	26813.71	3671.04	0.34
Salt	Salt	200.4	Low_Flow	95.00	927.00	930.84	927.68	930.84	0.000063	0.30	315.16	138.03	0.04
Salt	Salt	200.4	Normal_Flow	118.00	927.00	930.94	927.77	930.94	0.000086	0.36	329.30	141.31	0.04
Salt	Salt	200.31	5_year	19500.00	927.00	939.09	934.76	939.34	0.000945	4.05	4944.78	1178.01	0.28
Salt	Salt	200.31	10_year	49000.00	927.00	943.07	937.95	943.46	0.001020	5.35	11423.53	2095.39	0.31
Salt	Salt	200.31	100_year	162000.00	927.00	949.27	943.86	949.95	0.001052	7.90	30169.61	3520.57	0.35
Salt	Salt	200.31	Typ Peak_year	4400.00	927.00	935.04	931.33	935.11	0.000488	2.22	1985.59	531.73	0.20
Salt	Salt	200.31	20_year	80000.00	927.00	945.29	939.96	945.80	0.001128	6.38	17117.12	2842.88	0.33
Salt	Salt	200.31	50_year	130000.00	927.00	948.22	942.64	948.81	0.001044	7.22	26512.40	3487.36	0.33
Salt	Salt	200.31	Low_Flow	95.00	927.00	930.83	927.42	930.83	0.000008	0.23	416.31	199.83	0.03
Salt	Salt	200.31	Normal_Flow	118.00	927.00	930.93	927.47	930.93	0.000011	0.27	436.28	206.36	0.03
Salt	Salt	200.22	5_year	19500.00	927.00	938.95	932.16	939.08	0.000291	2.93	6858.47	1267.58	0.20
Salt	Salt	200.22	10_year	49000.00	927.00	942.84	935.12	943.12	0.000469	4.37	12981.14	1999.61	0.23
Salt	Salt	200.22	100_year	162000.00	927.00	948.73	941.74	949.49	0.000841	7.87	28499.76	3131.49	0.34
Salt	Salt	200.22	Typ Peak_year	4400.00	927.00	934.99	929.51	935.02	0.000083	1.27	3476.83	621.81	0.09
Salt	Salt	200.22	20_year	80000.00	927.00	944.94	938.13	945.38	0.000658	5.70	17621.96	2406.72	0.28
Salt	Salt	200.22	50_year	130000.00	927.00	947.76	940.43	948.39	0.000762	6.99	25508.69	3096.24	0.31
Salt	Salt	200.22	Low_Flow	95.00	927.00	930.83	927.20	930.83	0.000001	0.08	1159.53	504.82	0.01
Salt	Salt	200.22	Normal_Flow	118.00	927.00	930.93	927.24	930.93	0.000002	0.10	1209.26	508.07	0.01
Salt	Salt	200.11	5_year	19500.00	927.00	938.64	934.94	938.80	0.000938	3.21	6155.47	1182.89	0.24
Salt	Salt	200.11	10_year	49000.00	927.00	942.38	937.18	942.70	0.001217	4.60	11286.53	1800.05	0.27
Salt	Salt	200.11	100_year	162000.00	927.00	947.79	941.94	948.78	0.001731	8.52	23167.37	2566.24	0.40
Salt	Salt	200.11	Typ Peak_year	4400.00	927.00	934.85	931.05	934.92	0.000435	2.14	2054.57	803.61	0.24
Salt	Salt	200.11	20_year	80000.00	927.00	944.28	938.71	944.80	0.001594	6.03	14868.60	1960.14	0.32
Salt	Salt	200.11	50_year	130000.00	927.00	946.98	940.85	947.74	0.001648	7.43	21078.58	2544.33	0.36
Salt	Salt	200.11	Low_Flow	95.00	927.00	930.83	927.42	930.83	0.000007	0.20	477.73	236.48	0.02
Salt	Salt	200.11	Normal_Flow	118.00	927.00	930.93	927.47	930.93	0.000010	0.24	501.04	242.16	0.03
Salt	Salt	200.02	5_year	19500.00	929.30	937.96	935.53	938.16	0.002202	3.61	5624.60	1368.10	0.30
Salt	Salt	200.02	10_year	49000.00	929.30	941.67	937.29	942.00	0.001827	4.70	10910.53	1676.29	0.29
Salt	Salt	200.02	100_year	162000.00	929.30	946.98	941.58	947.95	0.001761	8.38	21805.95	2451.83	0.40
Salt	Salt	200.02	Typ Peak_year	4400.00	929.30	933.66	933.66	934.32	0.009132	6.53	674.89	521.42	1.00
Salt	Salt	200.02	20_year	80000.00	929.30	943.37	938.68	943.92	0.002196	6.19	13951.70	2002.35	0.35
Salt	Salt	200.02	50_year	130000.00	929.30	946.16	940.57	946.91	0.001866	7.37	19907.94	2436.05	0.37
Salt	Salt	200.02	Low_Flow	95.00	929.30	930.59	930.59	930.80	0.016684	3.66	25.92	61.93	1.00
Salt	Salt	200.02	Normal_Flow	118.00	929.30	930.67	930.67	930.89	0.017356	3.76	31.37	73.13	1.01
Salt	Salt	199.98	5_year	19500.00	925.00	937.63	934.03	937.76	0.001303	2.90	6798.16	1459.73	0.23
Salt	Salt	199.98	10_year	49000.00	925.00	941.40	936.16	941.63	0.001240	3.97	13092.80	1896.87	0.24
Salt	Salt	199.98	100_year	162000.00	925.00	946.80	940.27	947.58	0.001110	7.50	24634.39	2422.40	0.35
Salt	Salt	199.98	Typ Peak_year	4400.00	925.00	933.30	930.17	933.41	0.001331	2.66	1654.75	547.30	0.27
Salt	Salt	199.98	20_year	80000.00	925.00	943.05	937.50	943.46	0.001574	5.33	16275.40	2011.37	0.29
Salt	Salt	199.98	50_year	130000.00	925.00	945.92	939.28	946.51	0.001288	6.48	22555.85	2396.92	0.31
Salt	Salt	199.98	Low_Flow	95.00	925.00	930.15	925.51	930.15	0.000007	0.20	478.98	185.23	0.02
Salt	Salt	199.98	Normal_Flow	118.00	925.00	930.16	925.59	930.16	0.000011	0.24	481.91	186.08	0.03
Salt	Salt	199.86	5_year	19500.00	925.00	936.11	933.88	936.56	0.003009	5.40	3613.85	1341.45	0.47
Salt	Salt	199.86	10_year	49000.00	925.00	939.61	936.59	940.41	0.003237	7.23	6939.02	1953.89	0.46
Salt	Salt	199.86	100_year	162000.00	925.00	946.03	941.14	946.83	0.001312	8.26	24684.08	2487.65	0.39
Salt	Salt	199.86	Typ Peak_year	4400.00	925.00	932.38	929.45	932.58	0.001310	3.66	1202.04	370.71	0.36
Salt	Salt	199.86	20_year	80000.00	925.00	941.83	938.44	942.39	0.001876	6.65	14550.23	2328.75	0.37
Salt	Salt	199.86	50_year	130000.00	925.00	945.08	940.48	945.70	0.001320	7.19	22347.35	2446.63	0.35
Salt	Salt	199.86	Low_Flow	95.00	925.00	930.14	925.40	930.14	0.000003	0.17	565.08	205.77	0.02
Salt	Salt	199.86	Normal_Flow	118.00	925.00	930.16	925.45	930.16	0.000004	0.21	568.06	207.47	0.02
Salt	Salt	199.69	5_year	19500.00	920.73	935.63	928.86	935.77	0.000356	3.03	6472.56	1294.15	0.19
Salt	Salt	199.69	10_year	49000.00	920.73	938.61	932.00	939.01	0.000817	5.23	9785.50	1818.24	0.31
Salt	Salt	199.69	100_year	162000.00	920.73	945.09	938.91	945.84	0.000934	8.05	25717.20	2338.42	0.36
Salt	Salt	199.69	Typ Peak_year	4400.00	920.73	932.35	925.56	932.36	0.000070	1.11	3940.58	793.31	0.08
Salt	Salt	199.69	20_year	80000.00	920.73	940.71	934.26	941.20	0.000975	6.36	16041.18	1995.47	0.34
Salt	Salt	199.69	50_year	130000.00	920.73	944.14	937.57	944.75	0.000886	7.22	23492.10	2312.74	0.34
Salt	Salt	199.69	Low_Flow	95.00	920.73	930.14	921.44	930.14	0.000000	0.04	2531.73	573.31	0.00
Salt	Salt	199.69	Normal_Flow	118.00	920.73	930.16	921.52	930.16	0.000000	0.05	2539.99	573.92	0.00
Salt	Salt	199.55	5_year	19500.00	919.08	935.29	927.16	935.39	0.000647	2.45	7800.54	1604.38	0.15
Salt	Salt	199.55	10_year	49000.00	919.08	937.84	930.99	938.16	0.001419	4.68	10854.78	1828.41	0.25
Salt	Salt	199.55	100_year	162000.00	919.08	944.45	937.23	945.13	0.000827	7.82	26487.77	2156.51	0.33
Salt	Salt	199.55	Typ Peak_year	4400.00	919.08	932.29	923.15	932.31	0.000073	0.92	5024.44	895.38	0.06

HEC-RAS Plan: 3B (Continued)

River	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)	
Salt	Salt	199.55	20_year	80000.00	919.08	939.93	933.06	940.31	0.001243	5.59	17199.17	1868.84	0.28
Salt	Salt	199.55	50_year	130000.00	919.08	943.50	935.89	944.03	0.000881	6.80	24456.79	2153.29	0.30
Salt	Salt	199.55	Low_Flow	95.00	919.08	930.14	919.75	930.14	0.000000	0.03	3368.71	650.15	0.00
Salt	Salt	199.55	Normal_Flow	118.00	919.08	930.16	919.82	930.16	0.000000	0.04	3378.08	651.07	0.00
Gila	Lower Gila	199.47	5_year	23500.00	921.58	934.90	928.65	935.10	0.000609	3.61	7163.10	2097.82	0.23
Gila	Lower Gila	199.47	10_year	57000.00	921.58	937.07	932.26	937.54	0.001357	5.88	12896.82	2722.38	0.34
Gila	Lower Gila	199.47	100_year	227000.00	921.58	943.56	939.43	944.58	0.001606	9.58	32023.83	3022.53	0.43
Gila	Lower Gila	199.47	Typ Peak_year	6700.00	921.58	932.22	925.81	932.26	0.000141	1.60	4177.60	1404.60	0.12
Gila	Lower Gila	199.47	20_year	92000.00	921.58	939.13	935.28	939.69	0.001472	6.77	18720.64	2989.75	0.36
Gila	Lower Gila	199.47	50_year	185000.00	921.58	942.61	938.47	943.45	0.001620	8.65	29169.16	3014.75	0.40
Gila	Lower Gila	199.47	Low_Flow	95.00	921.58	930.14	922.49	930.14	0.000000	0.03	2837.60	882.34	0.00
Gila	Lower Gila	199.47	Normal_Flow	118.00	921.58	930.16	922.57	930.16	0.000000	0.04	2845.73	883.96	0.00
Gila	Lower Gila	199.38	5_year	23500.00	923.99	934.62	929.26	934.84	0.000578	3.83	7087.20	2069.81	0.28
Gila	Lower Gila	199.38	10_year	57000.00	923.99	936.33	932.77	936.92	0.001527	6.51	11277.36	2372.42	0.42
Gila	Lower Gila	199.38	100_year	227000.00	923.99	942.56	939.08	943.84	0.002081	10.41	28106.57	2855.25	0.50
Gila	Lower Gila	199.38	Typ Peak_year	6700.00	923.99	932.15	926.67	932.20	0.000138	1.76	3802.31	1278.38	0.13
Gila	Lower Gila	199.38	20_year	92000.00	923.99	938.29	935.41	939.02	0.001738	7.52	16198.97	2660.46	0.44
Gila	Lower Gila	199.38	50_year	185000.00	923.99	941.61	938.18	942.71	0.002048	9.58	25423.56	2828.24	0.48
Gila	Lower Gila	199.38	Low_Flow	95.00	923.99	930.14	924.41	930.14	0.000000	0.04	2546.18	635.26	0.00
Gila	Lower Gila	199.38	Normal_Flow	118.00	923.99	930.16	924.46	930.16	0.000000	0.05	2553.97	635.86	0.00
Gila	Lower Gila	199.31	5_year	23500.00	928.19	934.34	931.71	934.58	0.000755	4.07	6741.90	2477.85	0.31
Gila	Lower Gila	199.31	10_year	57000.00	928.19	935.79	933.67	936.32	0.001407	6.48	11569.62	2506.55	0.44
Gila	Lower Gila	199.31	100_year	227000.00	928.19	942.17	937.93	943.16	0.001089	8.99	29778.81	2652.99	0.44
Gila	Lower Gila	199.31	Typ Peak_year	6700.00	928.19	932.03	929.93	932.10	0.000447	2.23	3206.91	2284.51	0.23
Gila	Lower Gila	199.31	20_year	92000.00	928.19	937.69	935.13	938.40	0.001400	7.60	15797.46	2537.66	0.46
Gila	Lower Gila	199.31	50_year	185000.00	928.19	941.22	937.17	942.06	0.001053	8.32	27258.46	2648.85	0.42
Gila	Lower Gila	199.31	Low_Flow	95.00	928.19	930.14	928.50	930.14	0.000001	0.08	1218.02	1088.63	0.01
Gila	Lower Gila	199.31	Normal_Flow	118.00	928.19	930.16	928.54	930.16	0.000002	0.10	1229.99	1090.95	0.01
Gila	Lower Gila	199.21	5_year	23500.00	928.99	934.15	931.38	934.23	0.000432	2.25	10085.10	2554.12	0.18
Gila	Lower Gila	199.21	10_year	57000.00	928.99	935.19	933.09	935.53	0.001434	4.64	11994.17	2556.20	0.33
Gila	Lower Gila	199.21	100_year	227000.00	928.99	941.62	935.97	942.49	0.001594	7.96	30697.98	2569.12	0.40
Gila	Lower Gila	199.21	Typ Peak_year	6700.00	928.99	931.75	930.34	931.81	0.000843	2.02	3342.48	2549.30	0.22
Gila	Lower Gila	199.21	20_year	92000.00	928.99	937.39	934.06	937.70	0.001011	4.80	20385.92	2560.62	0.30
Gila	Lower Gila	199.21	50_year	185000.00	928.99	940.76	935.50	941.42	0.001339	6.95	28595.80	2567.39	0.36
Gila	Lower Gila	199.21	Low_Flow	95.00	928.99	930.14	929.07	930.14	0.000008	0.10	925.20	2428.20	0.02
Gila	Lower Gila	199.21	Normal_Flow	118.00	928.99	930.16	929.08	930.16	0.000012	0.13	938.63	2430.94	0.02
Gila	Lower Gila	199.19		Mult Open									
Gila	Lower Gila	199.18	5_year	23500.00	922.00	931.81	930.14	932.08	0.002475	4.23	5611.66	2741.60	0.40
Gila	Lower Gila	199.18	10_year	57000.00	922.00	934.89	931.73	935.19	0.001281	4.59	13705.70	2852.54	0.32
Gila	Lower Gila	199.18	100_year	227000.00	922.00	940.37	935.39	941.46	0.002202	9.07	28922.89	2895.33	0.46
Gila	Lower Gila	199.18	Typ Peak_year	6700.00	922.00	928.89	927.85	929.22	0.005079	4.58	1479.46	1295.79	0.53
Gila	Lower Gila	199.18	20_year	92000.00	922.00	936.44	933.04	936.84	0.001403	5.54	19204.86	2864.66	0.35
Gila	Lower Gila	199.18	50_year	185000.00	922.00	939.65	934.76	940.47	0.001804	7.88	27146.77	2889.56	0.42
Gila	Lower Gila	199.18	Low_Flow	95.00	922.00	926.17	922.56	926.17	0.000037	0.30	321.70	271.53	0.04
Gila	Lower Gila	199.18	Normal_Flow	118.00	922.00	926.20	922.65	926.20	0.000055	0.36	327.36	275.35	0.05
Gila	Lower Gila	199.11	5_year	23500.00	922.00	931.44	927.72	931.66	0.000925	3.84	7097.22	2469.72	0.30
Gila	Lower Gila	199.11	10_year	57000.00	922.00	934.40	930.56	934.83	0.001223	5.48	12684.42	2788.33	0.35
Gila	Lower Gila	199.11	100_year	227000.00	922.00	939.98	934.99	940.99	0.001203	8.83	29604.16	2824.60	0.43
Gila	Lower Gila	199.11	Typ Peak_year	6700.00	922.00	928.81	924.77	928.88	0.000387	2.18	3244.65	1738.28	0.20
Gila	Lower Gila	199.11	20_year	92000.00	922.00	936.13	932.18	936.54	0.000927	5.43	20051.06	2800.57	0.31
Gila	Lower Gila	199.11	50_year	185000.00	922.00	939.28	934.99	940.07	0.001147	7.70	27868.52	2818.70	0.38
Gila	Lower Gila	199.11	Low_Flow	95.00	922.00	926.17	922.17	926.17	0.000000	0.07	1320.63	540.43	0.01
Gila	Lower Gila	199.11	Normal_Flow	118.00	922.00	926.20	922.18	926.20	0.000001	0.09	1335.01	542.67	0.01
Gila	Lower Gila	199.06	5_year	23500.00	922.00	931.27	928.02	931.49	0.000704	4.01	7630.73	2630.08	0.32
Gila	Lower Gila	199.06	10_year	57000.00	922.00	934.19	930.65	934.58	0.000878	5.48	13369.55	2781.36	0.35
Gila	Lower Gila	199.06	100_year	227000.00	922.00	939.74	935.00	940.72	0.001116	8.80	29488.65	2851.33	0.43
Gila	Lower Gila	199.06	Typ Peak_year	6700.00	922.00	928.68	924.68	928.79	0.000441	2.69	2882.11	2097.42	0.25
Gila	Lower Gila	199.06	20_year	92000.00	922.00	935.95	932.08	936.36	0.000791	5.83	20107.88	2817.97	0.34
Gila	Lower Gila	199.06	50_year	185000.00	922.00	939.06	934.46	939.83	0.001023	7.97	27787.00	2842.17	0.40
Gila	Lower Gila	199.06	Low_Flow	95.00	922.00	926.17	922.16	926.17	0.000000	0.08	1226.94	391.64	0.01
Gila	Lower Gila	199.06	Normal_Flow	118.00	922.00	926.20	922.19	926.20	0.000001	0.10	1236.07	394.35	0.01
Gila	Lower Gila	199.02	5_year	23500.00	922.00	931.09	927.48	931.38	0.000764	4.36	5925.88	2551.65	0.33
Gila	Lower Gila	199.02	10_year	57000.00	922.00	933.89	930.35	934.42	0.001110	6.19	11833.26	2787.50	0.38
Gila	Lower Gila	199.02	100_year	227000.00	922.00	939.41	934.98	940.53	0.001275	9.60	28176.98	2875.91	0.46
Gila	Lower Gila	199.02	Typ Peak_year	6700.00	922.00	928.66	924.25	928.73	0.000243	2.18	3323.62	1790.80	0.20
Gila	Lower Gila	199.02	20_year	92000.00	922.00	935.70	932.04	936.22	0.000983	6.47	19002.12	2846.19	0.36
Gila	Lower Gila	199.02	50_year	185000.00	922.00	938.74	934.86	939.65	0.001228	8.72	26518.11	2864.70	0.43
Gila	Lower Gila	199.02	Low_Flow	95.00	922.00	926.17	922.14	926.17	0.000000	0.06	1564.81	433.91	0.01
Gila	Lower Gila	199.02	Normal_Flow	118.00	922.00	926.20	922.16	926.20	0.000000	0.07	1576.07	437.74	0.01
Gila	Lower Gila	198.99	5_year	23500.00	922.00	931.02	927.29	931.28	0.000741	4.04	5969.27	2344.86	0.32
Gila	Lower Gila	198.99	10_year	57000.00	922.00	933.85	930.32	934.27	0.001022	5.47	12924.95	2844.91	0.35
Gila	Lower Gila	198.99	100_year	227000.00	922.00	939.29	934.71	940.37	0.001306	9.29	27984.97	2944.38	0.45
Gila	Lower Gila	198.99	Typ Peak_year	6700.00	922.00	928.64	924.31	928.70	0.000228	2.05	3346.14	1854.87	0.19
Gila	Lower Gila	198.99	20_year	92000.00	922.00	935.62	932.00	936.09	0.001002	5.99	18774.73	2910.69	0.35
Gila	Lower Gila	198.99	50_year	185000.00	922.00	938.63	934.44	939.50	0.001261	8.22	26330.08	2933.34	0.41
Gila	Lower Gila	198.99	Low_Flow	95.00	922.00	926.17	922.14	926.17	0.000000	0.06	1562.07	777.11	0.01
Gila	Lower Gila	198.99	Normal_Flow	118.00	922.00	926.20	922.16	926.20	0.000000	0.07	1574.47	815.20	0.01
Gila	Lower Gila	198.97	5_year	23500.00	926.00	930.22	929.36	930.86	0.005898	6.46	3781.49	2281.91	0.64

HEC-RAS Plan: 3B (Continued)

River	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)	
Gila	Lower Gila	198.97	10_year	57000.00	926.00	933.28	931.31	933.88	0.002853	6.30	10582.31	2699.96	0.46
Gila	Lower Gila	198.97	100_year	227000.00	926.00	938.88	934.80	940.02	0.001669	9.23	27027.74	2976.27	0.48
Gila	Lower Gila	198.97	Typ Peak_year	6700.00	926.00	928.16	927.78	928.52	0.006310	5.13	1477.74	1886.74	0.75
Gila	Lower Gila	198.97	20_year	92000.00	926.00	935.28	932.27	935.79	0.001621	5.79	17571.47	2949.17	0.36
Gila	Lower Gila	198.97	50_year	185000.00	926.00	938.24	934.76	939.15	0.001685	8.00	25353.99	2967.60	0.43
Gila	Lower Gila	198.97	Low_Flow	95.00	926.00	926.11	926.11	926.16	0.031468	2.00	50.01	680.31	1.07
Gila	Lower Gila	198.97	Normal_Flow	118.00	926.00	926.13	926.13	926.19	0.028786	2.12	58.55	700.21	1.05
Gila	Lower Gila	198.93	5_year	23500.00	920.00	930.26	925.59	930.48	0.000453	3.88	6707.93	2191.68	0.26
Gila	Lower Gila	198.93	10_year	57000.00	920.00	933.30	928.78	933.56	0.000463	4.65	16602.86	2724.70	0.27
Gila	Lower Gila	198.93	100_year	227000.00	920.00	938.83	933.74	939.66	0.000888	8.55	33106.09	2970.67	0.40
Gila	Lower Gila	198.93	Typ Peak_year	6700.00	920.00	928.31	922.31	928.35	0.000102	1.61	4401.06	1880.55	0.12
Gila	Lower Gila	198.93	20_year	92000.00	920.00	935.19	930.67	935.54	0.000556	5.42	22446.89	2900.65	0.29
Gila	Lower Gila	198.93	50_year	185000.00	920.00	938.17	932.98	938.83	0.000791	7.57	31155.45	2957.08	0.36
Gila	Lower Gila	198.93	Low_Flow	95.00	920.00	924.22	920.14	924.22	0.000000	0.06	1517.98	399.71	0.01
Gila	Lower Gila	198.93	Normal_Flow	118.00	920.00	924.26	920.16	924.26	0.000000	0.08	1534.97	401.36	0.01
Gila	Lower Gila	198.88	5_year	23500.00	920.00	929.95	927.34	930.29	0.001185	4.85	5406.00	2255.17	0.39
Gila	Lower Gila	198.88	10_year	57000.00	920.00	932.86	930.00	933.36	0.001253	6.03	10581.96	2763.70	0.40
Gila	Lower Gila	198.88	100_year	227000.00	920.00	938.58	934.36	939.42	0.001027	8.39	32140.14	2957.10	0.41
Gila	Lower Gila	198.88	Typ Peak_year	6700.00	920.00	928.23	923.30	928.31	0.000289	2.23	3216.04	1913.36	0.21
Gila	Lower Gila	198.88	20_year	92000.00	920.00	934.78	931.16	935.33	0.001067	6.43	15919.90	2904.40	0.38
Gila	Lower Gila	198.88	50_year	185000.00	920.00	937.95	934.08	938.61	0.000938	7.40	30297.29	2952.74	0.37
Gila	Lower Gila	198.88	Low_Flow	95.00	920.00	924.22	920.20	924.22	0.000001	0.10	930.58	275.05	0.01
Gila	Lower Gila	198.88	Normal_Flow	118.00	920.00	924.26	920.23	924.26	0.000001	0.13	942.29	278.15	0.01
Gila	Lower Gila	198.83	5_year	23500.00	920.00	929.93	927.14	930.09	0.000626	3.41	7548.84	2263.57	0.26
Gila	Lower Gila	198.83	10_year	57000.00	920.00	932.77	929.23	933.13	0.000924	5.01	12195.32	2598.70	0.32
Gila	Lower Gila	198.83	100_year	227000.00	920.00	938.43	933.96	939.23	0.000930	8.04	32761.30	2917.24	0.39
Gila	Lower Gila	198.83	Typ Peak_year	6700.00	920.00	928.21	922.73	928.25	0.000208	1.79	4073.49	2142.16	0.16
Gila	Lower Gila	198.83	20_year	92000.00	920.00	934.69	930.14	935.13	0.000861	5.59	17491.57	2711.46	0.32
Gila	Lower Gila	198.83	50_year	185000.00	920.00	937.82	933.02	938.43	0.000853	6.97	30977.07	2913.56	0.35
Gila	Lower Gila	198.83	Low_Flow	95.00	920.00	924.22	920.16	924.22	0.000001	0.08	1153.02	542.14	0.01
Gila	Lower Gila	198.83	Normal_Flow	118.00	920.00	924.26	920.19	924.26	0.000001	0.10	1165.67	549.74	0.01
Gila	Lower Gila	198.8	5_year	23500.00	920.00	929.78	926.94	929.94	0.000759	3.37	7751.26	2495.48	0.26
Gila	Lower Gila	198.8	10_year	57000.00	920.00	932.59	928.82	932.90	0.001026	4.69	12874.11	2669.23	0.30
Gila	Lower Gila	198.8	100_year	227000.00	920.00	938.30	933.70	939.01	0.000853	7.39	34003.77	2905.56	0.36
Gila	Lower Gila	198.8	Typ Peak_year	6700.00	920.00	928.17	923.02	928.21	0.000193	1.58	4784.29	2220.87	0.14
Gila	Lower Gila	198.8	20_year	92000.00	920.00	934.53	930.05	934.92	0.000884	5.05	18684.57	2837.71	0.29
Gila	Lower Gila	198.8	50_year	185000.00	920.00	937.71	932.61	938.23	0.000766	6.11	32296.32	2899.88	0.30
Gila	Lower Gila	198.8	Low_Flow	95.00	920.00	924.22	920.18	924.22	0.000001	0.09	1000.10	422.86	0.01
Gila	Lower Gila	198.8	Normal_Flow	118.00	920.00	924.26	920.21	924.26	0.000001	0.12	1011.28	428.27	0.01
Gila	Lower Gila	198.76	5_year	23500.00	920.00	929.53	927.71	929.69	0.000930	3.43	7708.23	2565.35	0.30
Gila	Lower Gila	198.76	10_year	57000.00	920.00	932.29	928.95	932.59	0.001025	4.45	13230.94	2756.87	0.30
Gila	Lower Gila	198.76	100_year	227000.00	920.00	937.98	933.06	938.75	0.000861	7.28	33156.02	2944.13	0.37
Gila	Lower Gila	198.76	Typ Peak_year	6700.00	920.00	928.08	923.37	928.13	0.000321	1.94	4034.90	2358.55	0.21
Gila	Lower Gila	198.76	20_year	92000.00	920.00	934.15	929.83	934.62	0.001083	5.43	16984.72	2863.81	0.33
Gila	Lower Gila	198.76	50_year	185000.00	920.00	937.38	932.14	937.98	0.000842	6.37	31390.27	2940.74	0.33
Gila	Lower Gila	198.76	Low_Flow	95.00	920.00	924.22	920.20	924.22	0.000001	0.11	851.30	328.84	0.01
Gila	Lower Gila	198.76	Normal_Flow	118.00	920.00	924.26	920.23	924.26	0.000002	0.14	861.13	333.74	0.01
Gila	Lower Gila	198.7	5_year	23500.00	920.00	929.34	927.23	929.48	0.000696	3.21	8149.54	2638.55	0.29
Gila	Lower Gila	198.7	10_year	57000.00	920.00	932.07	928.44	932.34	0.000844	4.24	13792.01	2773.99	0.30
Gila	Lower Gila	198.7	100_year	227000.00	920.00	937.81	932.64	938.52	0.000784	7.03	34478.41	3033.44	0.36
Gila	Lower Gila	198.7	Typ Peak_year	6700.00	920.00	928.04	923.30	928.07	0.000146	1.48	5536.15	2512.80	0.16
Gila	Lower Gila	198.7	20_year	92000.00	920.00	933.92	929.44	934.35	0.000920	5.21	17680.90	2925.42	0.32
Gila	Lower Gila	198.7	50_year	185000.00	920.00	937.20	931.72	937.76	0.000768	6.27	32615.41	3028.19	0.33
Gila	Lower Gila	198.7	Low_Flow	95.00	920.00	924.22	920.20	924.22	0.000001	0.11	880.15	607.99	0.01
Gila	Lower Gila	198.7	Normal_Flow	118.00	920.00	924.26	920.23	924.26	0.000001	0.13	890.26	619.43	0.01
Gila	Lower Gila	198.65	5_year	23500.00	920.00	929.19	926.29	929.32	0.000497	3.17	8582.09	2311.96	0.26
Gila	Lower Gila	198.65	10_year	57000.00	920.00	931.85	928.00	932.13	0.000762	4.58	13737.79	2643.10	0.31
Gila	Lower Gila	198.65	100_year	227000.00	920.00	937.56	932.54	938.30	0.000827	7.57	34073.04	3151.69	0.38
Gila	Lower Gila	198.65	Typ Peak_year	6700.00	920.00	928.02	922.66	928.04	0.000080	1.22	6497.87	2144.90	0.11
Gila	Lower Gila	198.65	20_year	92000.00	920.00	933.67	928.93	934.11	0.000903	5.70	17712.45	3026.94	0.34
Gila	Lower Gila	198.65	50_year	185000.00	920.00	936.96	931.50	937.56	0.000782	6.77	32193.78	3146.74	0.35
Gila	Lower Gila	198.65	Low_Flow	95.00	920.00	924.22	920.16	924.22	0.000000	0.08	1203.66	750.95	0.01
Gila	Lower Gila	198.65	Normal_Flow	118.00	920.00	924.26	920.18	924.26	0.000001	0.10	1218.05	765.21	0.01
Gila	Lower Gila	198.6	5_year	23500.00	920.00	929.01	926.71	929.15	0.000518	3.14	8093.94	2199.09	0.26
Gila	Lower Gila	198.6	10_year	57000.00	920.00	931.55	928.00	931.87	0.000802	4.40	12963.31	2554.77	0.30
Gila	Lower Gila	198.6	100_year	227000.00	920.00	937.20	932.54	937.99	0.000997	7.77	32797.31	3224.56	0.40
Gila	Lower Gila	198.6	Typ Peak_year	6700.00	920.00	928.00	922.82	928.02	0.000077	1.20	6330.50	2094.49	0.11
Gila	Lower Gila	198.6	20_year	92000.00	920.00	933.30	928.89	933.79	0.000941	5.40	16588.50	2794.73	0.34
Gila	Lower Gila	198.6	50_year	185000.00	920.00	936.51	931.57	937.24	0.001058	7.16	28885.65	3218.37	0.38
Gila	Lower Gila	198.6	Low_Flow	95.00	920.00	924.22	920.17	924.22	0.000000	0.09	1103.27	837.97	0.01
Gila	Lower Gila	198.6	Normal_Flow	118.00	920.00	924.26	920.19	924.26	0.000001	0.11	1115.47	850.28	0.01
Gila	Lower Gila	198.54	5_year	23500.00	920.00	928.71	925.66	928.91	0.001713	1.75	8809.94	2162.64	0.14
Gila	Lower Gila	198.54	10_year	57000.00	920.00	931.10	927.98	931.51	0.002316	3.07	13575.96	2463.88	0.20
Gila	Lower Gila	198.54	100_year	227000.00	920.00	936.97	931.96	937.69	0.001041	7.33	33667.73	3254.17	0.37
Gila	Lower Gila	198.54	Typ Peak_year	6700.00	920.00	927.92	922.56	927.95	0.001514	1.48	4721.80	2097.05	0.12
Gila	Lower Gila	198.54	20_year	92000.00	920.00	932.88	928.83	933.40	0.002364	4.38	17613.07	2794.31	0.26
Gila	Lower Gila	198.54	50_year	185000.00	920.00	936.30	930.83	936.87	0.001269	6.02	31488.44	3248.38	0.31
Gila	Lower Gila	198.54	Low_Flow	95.00	920.00	924.22	920.15	924.22	0.000003	0.07	1319.14	1064.73	0.01
Gila	Lower Gila	198.54	Normal_Flow	118.00	920.00	924.26	920.18	924.26	0.000005	0.09	1337.48	1092.84	0.01

HEC-RAS Plan: 3B (Continued)

River	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)	
Gila	Lower Gila	198.49	5_year	23500.00	920.00	928.30	925.52	928.49	0.001641	1.39	9420.92	2151.65	0.11
Gila	Lower Gila	198.49	10_year	57000.00	920.00	930.46	927.62	930.94	0.002304	2.49	13780.58	2256.66	0.17
Gila	Lower Gila	198.49	100_year	227000.00	920.00	936.68	931.09	937.43	0.001116	7.34	33296.73	3279.46	0.36
Gila	Lower Gila	198.49	Typ Peak_year	6700.00	920.00	927.46	923.74	927.50	0.002354	1.48	4654.76	2028.70	0.13
Gila	Lower Gila	198.49	20_year	92000.00	920.00	932.15	928.28	932.82	0.002269	3.54	17440.00	2521.03	0.21
Gila	Lower Gila	198.49	50_year	185000.00	920.00	935.75	930.43	936.50	0.001702	6.28	27632.24	3265.46	0.32
Gila	Lower Gila	198.49	Low_Flow	95.00	920.00	924.22	920.24	924.22	0.000026	0.09	1113.67	1512.27	0.01
Gila	Lower Gila	198.49	Normal_Flow	118.00	920.00	924.26	920.28	924.26	0.000039	0.10	1143.01	1527.81	0.01
Gila	Lower Gila	198.45	5_year	23500.00	922.19	927.93	926.34	928.15	0.001096	1.57	8444.49	1730.60	0.14
Gila	Lower Gila	198.45	10_year	57000.00	922.19	929.76	926.99	930.36	0.002077	3.24	11639.24	1781.27	0.24
Gila	Lower Gila	198.45	100_year	227000.00	922.19	935.72	931.56	937.00	0.002000	10.17	26149.87	3157.47	0.53
Gila	Lower Gila	198.45	Typ Peak_year	6700.00	922.19	926.55	925.00	926.63	0.005087	2.50	2888.06	1702.95	0.28
Gila	Lower Gila	198.45	20_year	92000.00	922.19	931.32	928.30	932.22	0.002249	4.75	14423.65	1885.23	0.31
Gila	Lower Gila	198.45	50_year	185000.00	922.19	934.97	930.75	935.97	0.002259	8.70	23774.07	3127.03	0.47
Gila	Lower Gila	198.45	Low_Flow	95.00	922.19	924.12	924.12	924.19	0.121535	2.02	47.07	1254.21	1.02
Gila	Lower Gila	198.45	Normal_Flow	118.00	922.19	924.14	924.14	924.21	0.109642	2.12	55.59	1257.35	0.99
Gila	Lower Gila	198.4	5_year	23500.00	921.56	927.65	926.04	927.82	0.000761	3.17	7334.45	1571.32	0.27
Gila	Lower Gila	198.4	10_year	57000.00	921.56	929.07	927.01	929.68	0.001845	6.05	9380.57	1603.19	0.45
Gila	Lower Gila	198.4	100_year	227000.00	921.56	934.28	932.01	936.16	0.002503	11.56	21114.43	3053.13	0.65
Gila	Lower Gila	198.4	Typ Peak_year	6700.00	921.56	925.51	924.12	925.68	0.001686	3.44	2086.46	1491.46	0.39
Gila	Lower Gila	198.4	20_year	92000.00	921.56	930.26	927.70	931.36	0.002579	8.41	11151.31	1713.79	0.57
Gila	Lower Gila	198.4	50_year	185000.00	921.56	933.40	930.91	935.07	0.002530	10.68	18551.30	2703.81	0.63
Gila	Lower Gila	198.4	Low_Flow	95.00	921.56	922.37	921.96	922.37	0.000587	0.66	143.41	690.34	0.17
Gila	Lower Gila	198.4	Normal_Flow	118.00	921.56	922.44	921.99	922.45	0.000586	0.71	166.47	717.75	0.17
Gila	Lower Gila	198.33	5_year	23500.00	920.97	927.47	925.25	927.62	0.000362	2.11	9705.65	2072.86	0.17
Gila	Lower Gila	198.33	10_year	57000.00	920.97	928.54	926.02	929.09	0.001254	4.39	11833.75	2192.75	0.33
Gila	Lower Gila	198.33	100_year	227000.00	920.97	933.91	930.38	935.14	0.001896	9.09	25927.42	3880.41	0.49
Gila	Lower Gila	198.33	Typ Peak_year	6700.00	920.97	924.88	923.54	925.01	0.001760	3.10	2703.32	1686.52	0.36
Gila	Lower Gila	198.33	20_year	92000.00	920.97	929.44	927.32	930.39	0.002296	6.55	13753.73	2320.00	0.46
Gila	Lower Gila	198.33	50_year	185000.00	920.97	932.87	929.71	934.04	0.002112	8.41	22667.38	3351.32	0.48
Gila	Lower Gila	198.33	Low_Flow	95.00	920.97	921.52	921.52	921.71	0.017465	3.50	27.12	533.11	1.00
Gila	Lower Gila	198.33	Normal_Flow	118.00	920.97	921.59	921.59	921.80	0.017080	3.65	32.37	560.13	1.01
Gila	Lower Gila	198.26	5_year	23500.00	919.00	927.33	923.25	927.48	0.000616	2.98	7649.73	2931.26	0.24
Gila	Lower Gila	198.26	10_year	57000.00	919.00	928.47	925.56	928.74	0.000666	3.51	14207.30	3069.36	0.26
Gila	Lower Gila	198.26	100_year	227000.00	919.00	933.58	929.18	934.56	0.001497	8.45	28771.45	5123.04	0.46
Gila	Lower Gila	198.26	Typ Peak_year	6700.00	919.00	924.79	921.22	924.83	0.000241	1.44	4161.43	2334.17	0.15
Gila	Lower Gila	198.26	20_year	92000.00	919.00	929.22	927.19	929.76	0.001318	5.35	15976.30	3218.23	0.37
Gila	Lower Gila	198.26	50_year	185000.00	919.00	932.60	928.32	933.43	0.001435	7.44	25553.50	4235.27	0.42
Gila	Lower Gila	198.26	Low_Flow	95.00	919.00	919.27	918.01	919.27	0.000088	0.17	229.21	826.87	0.06
Gila	Lower Gila	198.26	Normal_Flow	118.00	919.00	919.39	918.06	919.39	0.000099	0.23	260.89	858.34	0.07
Gila	Lower Gila	198.2	5_year	23500.00	917.83	927.04	924.48	927.24	0.000741	1.75	8169.89	3020.83	0.15
Gila	Lower Gila	198.2	10_year	57000.00	917.83	928.27	926.97	928.51	0.000695	2.08	16132.77	3197.15	0.16
Gila	Lower Gila	198.2	100_year	227000.00	917.83	933.26	928.38	934.06	0.001265	7.27	31605.41	5411.26	0.40
Gila	Lower Gila	198.2	Typ Peak_year	6700.00	917.83	924.49	922.47	924.62	0.003361	2.95	2269.60	2436.65	0.28
Gila	Lower Gila	198.2	20_year	92000.00	917.83	928.82	926.98	929.32	0.001322	3.51	17570.76	3262.35	0.25
Gila	Lower Gila	198.2	50_year	185000.00	917.83	932.26	928.09	932.94	0.001292	6.04	28096.35	5260.14	0.35
Gila	Lower Gila	198.2	Low_Flow	95.00	917.83	919.20	918.36	919.22	0.000383	1.03	92.55	832.38	0.17
Gila	Lower Gila	198.2	Normal_Flow	118.00	917.83	919.31	918.43	919.33	0.000438	1.16	101.81	860.02	0.19
Gila	Lower Gila	198.15	5_year	23500.00	918.06	926.04	924.29	926.56	0.006191	5.81	4042.52	2910.13	0.53
Gila	Lower Gila	198.15	10_year	57000.00	918.06	927.09	926.08	927.93	0.003196	5.00	8763.41	3018.86	0.41
Gila	Lower Gila	198.15	100_year	227000.00	918.06	933.00	927.62	933.61	0.000802	6.02	36386.18	7958.11	0.33
Gila	Lower Gila	198.15	Typ Peak_year	6700.00	918.06	922.80	921.77	923.18	0.004434	4.97	1347.47	2108.98	0.57
Gila	Lower Gila	198.15	20_year	92000.00	918.06	928.56	926.85	928.88	0.000700	3.08	21252.05	3206.84	0.22
Gila	Lower Gila	198.15	50_year	185000.00	918.06	931.99	927.26	932.50	0.000763	5.10	32692.08	3921.46	0.29
Gila	Lower Gila	198.15	Low_Flow	95.00	918.06	919.00	918.51	919.02	0.000786	1.09	87.15	1272.00	0.23
Gila	Lower Gila	198.15	Normal_Flow	118.00	918.06	919.09	918.56	919.11	0.000821	1.20	98.42	1276.50	0.24
Gila	Lower Gila	198.08	5_year	23500.00	917.90	925.09	923.16	925.68	0.002336	6.18	3801.90	2295.58	0.52
Gila	Lower Gila	198.08	10_year	57000.00	917.90	926.49	925.21	927.19	0.002494	6.95	8791.68	2708.85	0.55
Gila	Lower Gila	198.08	100_year	227000.00	917.90	932.48	928.25	933.34	0.001231	8.12	32409.01	8424.09	0.44
Gila	Lower Gila	198.08	Typ Peak_year	6700.00	917.90	922.10	920.70	922.38	0.002369	4.23	1582.79	1401.40	0.47
Gila	Lower Gila	198.08	20_year	92000.00	917.90	928.12	926.16	928.63	0.001267	5.91	16912.39	2946.30	0.41
Gila	Lower Gila	198.08	50_year	185000.00	917.90	931.50	927.47	932.24	0.001192	7.50	28648.72	4365.28	0.42
Gila	Lower Gila	198.08	Low_Flow	95.00	917.90	918.72	918.43	918.74	0.001775	1.17	80.87	372.52	0.31
Gila	Lower Gila	198.08	Normal_Flow	118.00	917.90	918.79	918.47	918.81	0.001911	1.25	94.47	408.45	0.33
Gila	Lower Gila	198.03	5_year	23500.00	917.47	923.66	922.76	924.78	0.004866	8.51	2763.01	2291.97	0.74
Gila	Lower Gila	198.03	10_year	57000.00	917.47	926.37	924.01	926.71	0.000943	4.14	14340.67	3072.55	0.34
Gila	Lower Gila	198.03	100_year	227000.00	917.47	932.32	927.16	933.01	0.000918	6.96	36572.24	8747.85	0.38
Gila	Lower Gila	198.03	Typ Peak_year	6700.00	917.47	921.25	920.40	921.65	0.003327	5.03	1332.14	1435.83	0.56
Gila	Lower Gila	198.03	20_year	92000.00	917.47	927.93	924.07	928.32	0.000915	4.87	20225.85	3280.39	0.35
Gila	Lower Gila	198.03	50_year	185000.00	917.47	931.33	926.78	931.93	0.000885	6.39	32577.14	4399.07	0.37
Gila	Lower Gila	198.03	Low_Flow	95.00	917.47	918.10	917.93	918.12	0.003400	1.25	75.73	493.32	0.39
Gila	Lower Gila	198.03	Normal_Flow	118.00	917.47	918.15	917.97	918.18	0.003281	1.34	87.98	498.93	0.39
Gila	Lower Gila	197.98	5_year	23500.00	915.60	923.08	922.22	923.91	0.004355	7.32	3208.66	2135.70	0.70
Gila	Lower Gila	197.98	10_year	57000.00	915.60	926.31	923.51	926.57	0.000494	3.23	15337.05	3038.39	0.25
Gila	Lower Gila	197.98	100_year	227000.00	915.60	932.23	926.92	932.85	0.000710	6.39	39358.43	9271.91	0.34
Gila	Lower Gila	197.98	Typ Peak_year	6700.00	915.60	919.75	919.75	920.64	0.011588	7.54	888.77	1121.34	1.00
Gila	Lower Gila	197.98	20_year	92000.00	915.60	927.84	923.51	928.18	0.000580	4.13	22031.65	3495.93	0.28
Gila	Lower Gila	197.98	50_year	185000.00	915.60	931.25	925.48	931.78	0.000651	5.75	35229.50	4714.70	0.32
Gila	Lower Gila	197.98	Low_Flow	95.00	915.60	916.77	916.77	916.96	0.018583	3.57	26.58	428.64	1.00
Gila	Lower Gila	197.98	Normal_Flow	118.00	915.60	916.84	916.84	917.06	0.018264	3.76	31.40	443.12	1.00

HEC-RAS Plan: 3B (Continued)

River	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)	
Gila	Lower Gila	197.95	5_year	23500.00	912.14	923.19	919.51	923.50	0.000860	4.44	5293.61	2311.63	0.33
Gila	Lower Gila	197.95	10_year	57000.00	912.14	926.25	922.40	926.48	0.000565	3.98	15267.73	3178.30	0.28
Gila	Lower Gila	197.95	100_year	227000.00	912.14	932.14	926.63	932.73	0.000739	7.00	40302.23	9291.49	0.35
Gila	Lower Gila	197.95	Typ Peak_year	6700.00	912.14	919.42	916.62	919.56	0.000806	3.06	2191.18	1220.59	0.30
Gila	Lower Gila	197.95	20_year	92000.00	912.14	927.77	923.51	928.08	0.000618	4.77	22925.61	3432.00	0.30
Gila	Lower Gila	197.95	50_year	185000.00	912.14	931.17	925.47	931.65	0.000680	6.35	36059.77	4688.97	0.34
Gila	Lower Gila	197.95	Low_Flow	95.00	912.14	913.26	912.56	913.27	0.000371	0.90	105.64	115.37	0.17
Gila	Lower Gila	197.95	Normal_Flow	118.00	912.14	913.37	912.60	913.39	0.000398	0.99	118.92	118.09	0.17
Gila	Lower Gila	197.92	5_year	23500.00	912.14	922.95	919.35	923.27	0.000870	4.57	5146.56	2221.88	0.34
Gila	Lower Gila	197.92	10_year	57000.00	912.14	926.05	922.13	926.32	0.000679	4.46	14503.25	2975.55	0.31
Gila	Lower Gila	197.92	100_year	227000.00	912.14	931.90	926.44	932.52	0.000817	7.31	38990.22	4939.39	0.37
Gila	Lower Gila	197.92	Typ Peak_year	6700.00	912.14	919.19	916.16	919.34	0.000878	3.11	2152.85	976.77	0.30
Gila	Lower Gila	197.92	20_year	92000.00	912.14	927.57	923.51	927.90	0.000711	5.10	21599.63	3312.15	0.32
Gila	Lower Gila	197.92	50_year	185000.00	912.14	930.96	925.97	931.47	0.000747	6.62	34734.37	4626.46	0.35
Gila	Lower Gila	197.92	Low_Flow	95.00	912.14	913.17	912.51	913.18	0.000337	0.80	118.21	136.93	0.15
Gila	Lower Gila	197.92	Normal_Flow	118.00	912.14	913.28	912.54	913.29	0.000359	0.89	133.10	139.32	0.16
Gila	Lower Gila	197.87	5_year	23500.00	912.14	922.56	919.73	922.92	0.001337	4.80	4900.22	1898.43	0.37
Gila	Lower Gila	197.87	10_year	57000.00	912.14	925.70	922.14	926.04	0.001002	5.08	13107.22	2864.25	0.34
Gila	Lower Gila	197.87	100_year	227000.00	912.14	931.47	926.79	932.20	0.001061	8.13	36776.42	7875.05	0.41
Gila	Lower Gila	197.87	Typ Peak_year	6700.00	912.14	918.69	916.14	918.92	0.001940	3.86	1734.13	710.20	0.38
Gila	Lower Gila	197.87	20_year	92000.00	912.14	927.18	923.51	927.61	0.001017	5.92	19116.32	3189.60	0.36
Gila	Lower Gila	197.87	50_year	185000.00	912.14	930.54	925.63	931.18	0.001008	7.49	32354.31	7023.36	0.39
Gila	Lower Gila	197.87	Low_Flow	95.00	912.14	913.04	912.49	913.05	0.000440	0.88	107.96	136.69	0.17
Gila	Lower Gila	197.87	Normal_Flow	118.00	912.14	913.14	912.53	913.16	0.000459	0.97	121.68	137.42	0.18
Gila	Lower Gila	197.81	5_year	23500.00	912.13	922.21	919.10	922.54	0.001180	4.61	5096.70	2070.33	0.36
Gila	Lower Gila	197.81	10_year	57000.00	912.13	925.46	921.75	925.79	0.000728	5.04	13740.99	2713.46	0.31
Gila	Lower Gila	197.81	100_year	227000.00	912.13	931.17	926.33	931.90	0.000981	8.41	38695.79	9316.61	0.40
Gila	Lower Gila	197.81	Typ Peak_year	6700.00	912.13	918.26	915.94	918.48	0.001189	3.81	1759.23	703.32	0.34
Gila	Lower Gila	197.81	20_year	92000.00	912.13	926.92	923.07	927.34	0.000821	6.00	20045.41	3090.64	0.34
Gila	Lower Gila	197.81	50_year	185000.00	912.13	930.25	925.53	930.89	0.000931	7.80	33758.48	9051.94	0.38
Gila	Lower Gila	197.81	Low_Flow	95.00	912.13	912.89	912.45	912.90	0.000607	0.91	104.10	159.60	0.20
Gila	Lower Gila	197.81	Normal_Flow	118.00	912.13	912.99	912.49	913.00	0.000586	0.98	119.97	160.12	0.20
Gila	Lower Gila	197.75	5_year	23500.00	911.90	922.04	918.21	922.28	0.000644	3.86	6089.28	2337.28	0.28
Gila	Lower Gila	197.75	10_year	57000.00	911.90	925.41	920.63	925.60	0.000377	3.95	18099.70	2860.81	0.23
Gila	Lower Gila	197.75	100_year	227000.00	911.90	931.08	925.31	931.62	0.000671	7.30	44770.81	9566.98	0.33
Gila	Lower Gila	197.75	Typ Peak_year	6700.00	911.90	918.03	914.99	918.16	0.000947	2.96	2261.77	872.80	0.30
Gila	Lower Gila	197.75	20_year	92000.00	911.90	926.79	922.51	927.12	0.000571	5.35	22378.45	3423.31	0.29
Gila	Lower Gila	197.75	50_year	185000.00	911.90	930.16	923.79	930.63	0.000629	6.76	39106.77	9507.06	0.32
Gila	Lower Gila	197.75	Low_Flow	95.00	911.90	912.81	912.11	912.81	0.000186	0.62	153.74	171.81	0.12
Gila	Lower Gila	197.75	Normal_Flow	118.00	911.90	912.90	912.15	912.91	0.000206	0.69	170.13	172.34	0.12
Gila	Lower Gila	197.7	5_year	23500.00	911.90	921.78	917.94	922.07	0.000668	4.33	5425.91	1812.59	0.32
Gila	Lower Gila	197.7	10_year	57000.00	911.90	924.95	920.74	925.41	0.000779	5.82	11801.10	2707.84	0.35
Gila	Lower Gila	197.7	100_year	227000.00	911.90	930.66	926.00	931.36	0.000898	8.44	41761.34	9594.21	0.39
Gila	Lower Gila	197.7	Typ Peak_year	6700.00	911.90	917.75	915.17	917.90	0.000765	3.14	2133.61	638.79	0.30
Gila	Lower Gila	197.7	20_year	92000.00	911.90	926.35	923.05	926.89	0.000872	6.71	18701.39	3664.46	0.37
Gila	Lower Gila	197.7	50_year	185000.00	911.90	929.73	925.53	930.38	0.000874	7.98	35847.91	9222.26	0.38
Gila	Lower Gila	197.7	Low_Flow	95.00	911.90	912.73	912.13	912.74	0.000294	0.74	127.63	155.44	0.14
Gila	Lower Gila	197.7	Normal_Flow	118.00	911.90	912.82	912.16	912.83	0.000326	0.84	141.13	155.95	0.15
Gila	Lower Gila	197.64	5_year	23500.00	911.90	921.63	916.39	921.89	0.000448	4.09	5750.77	1665.46	0.29
Gila	Lower Gila	197.64	10_year	57000.00	911.90	924.65	919.73	925.17	0.000742	6.02	11402.03	3053.20	0.37
Gila	Lower Gila	197.64	100_year	227000.00	911.90	930.27	925.96	931.06	0.000976	8.85	41132.78	9115.31	0.42
Gila	Lower Gila	197.64	Typ Peak_year	6700.00	911.90	917.66	914.10	917.75	0.000262	2.37	2826.82	601.55	0.19
Gila	Lower Gila	197.64	20_year	92000.00	911.90	925.94	922.35	926.60	0.000941	7.20	18171.50	3883.05	0.41
Gila	Lower Gila	197.64	50_year	185000.00	911.90	929.34	925.64	930.09	0.000953	8.42	35325.61	8675.51	0.41
Gila	Lower Gila	197.64	Low_Flow	95.00	911.90	912.69	912.07	912.69	0.000113	0.40	240.01	367.48	0.09
Gila	Lower Gila	197.64	Normal_Flow	118.00	911.90	912.77	912.09	912.77	0.000119	0.44	271.20	376.19	0.09
Gila	Lower Gila	197.58	5_year	23500.00	911.90	921.28	917.43	921.71	0.000962	5.26	4471.61	1794.15	0.40
Gila	Lower Gila	197.58	10_year	57000.00	911.90	924.24	921.21	924.92	0.001180	6.93	10388.71	2769.88	0.45
Gila	Lower Gila	197.58	100_year	227000.00	911.90	929.81	926.88	930.75	0.001311	9.75	37942.20	8774.32	0.48
Gila	Lower Gila	197.58	Typ Peak_year	6700.00	911.90	917.48	914.78	917.64	0.000631	3.22	2080.41	561.44	0.28
Gila	Lower Gila	197.58	20_year	92000.00	911.90	925.45	923.10	926.28	0.001445	8.21	16503.07	3540.71	0.50
Gila	Lower Gila	197.58	50_year	185000.00	911.90	928.88	924.83	929.78	0.001309	9.33	32376.84	8386.77	0.48
Gila	Lower Gila	197.58	Low_Flow	95.00	911.90	912.65	912.07	912.66	0.000141	0.48	196.35	263.57	0.10
Gila	Lower Gila	197.58	Normal_Flow	118.00	911.90	912.73	912.09	912.74	0.000155	0.54	217.54	264.07	0.11
Gila	Lower Gila	197.53	5_year	23500.00	911.90	920.95	918.17	921.40	0.001315	5.39	4358.94	1734.91	0.43
Gila	Lower Gila	197.53	10_year	57000.00	911.90	923.89	921.31	924.53	0.001651	6.74	10064.57	2710.89	0.46
Gila	Lower Gila	197.53	100_year	227000.00	911.90	929.45	925.21	930.36	0.001549	9.46	37360.33	8653.12	0.48
Gila	Lower Gila	197.53	Typ Peak_year	6700.00	911.90	917.14	914.78	917.40	0.001193	4.10	1634.88	593.32	0.39
Gila	Lower Gila	197.53	20_year	92000.00	911.90	925.08	922.83	925.82	0.001788	7.72	16144.84	3274.13	0.49
Gila	Lower Gila	197.53	50_year	185000.00	911.90	928.52	925.17	929.39	0.001571	9.02	31945.36	8225.31	0.47
Gila	Lower Gila	197.53	Low_Flow	95.00	911.90	912.61	912.07	912.61	0.000197	0.55	173.84	249.15	0.12
Gila	Lower Gila	197.53	Normal_Flow	118.00	911.90	912.68	912.09	912.69	0.000216	0.61	192.74	249.80	0.12
Gila	Lower Gila	197.48	5_year	23500.00	911.90	919.98	918.48	920.82	0.002516	7.34	3201.34	1590.84	0.67
Gila	Lower Gila	197.48	10_year	57000.00	911.90	922.65	921.48	923.80	0.003046	8.95	7934.92	2443.70	0.68
Gila	Lower Gila	197.48	100_year	227000.00	911.90	928.64	925.02	929.78	0.002055	10.57	34343.42	8330.54	0.55
Gila	Lower Gila	197.48	Typ Peak_year	6700.00	911.90	916.49	914.71	916.93	0.001864	5.33	1256.79	496.53	0.51
Gila	Lower Gila	197.48	20_year	92000.00	911.90	924.07	923.09	925.11	0.002656	9.19	14041.91	3073.23	0.62
Gila	Lower Gila	197.48	50_year	185000.00	911.90	927.63	924.86	928.78	0.002208	10.36	28592.00	5317.39	0.57
Gila	Lower Gila	197.48	Low_Flow	95.00	911.90	912.53	912.07	912.54	0.000301	0.61	155.62	249.15	0.14

HEC-RAS Plan: 3B (Continued)

River	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)	
Gila	Lower Gila	197.48	Normal_Flow	118.00	911.90	912.60	912.09	912.61	0.000330	0.68	172.65	249.74	0.14
Gila	Lower Gila	197.42	5_year	23500.00	911.90	919.55	917.93	920.20	0.002165	6.44	3649.41	1758.81	0.58
Gila	Lower Gila	197.42	10_year	57000.00	911.90	921.91	920.56	923.05	0.003155	8.82	8179.68	2416.73	0.67
Gila	Lower Gila	197.42	100_year	227000.00	911.90	927.93	925.41	929.23	0.002306	11.03	32566.63	7169.36	0.58
Gila	Lower Gila	197.42	Typ Peak_year	6700.00	911.90	916.07	914.40	916.47	0.001844	5.08	1318.33	460.95	0.49
Gila	Lower Gila	197.42	20_year	92000.00	911.90	923.44	922.34	924.46	0.002667	8.99	14054.47	2811.31	0.61
Gila	Lower Gila	197.42	50_year	185000.00	911.90	926.80	924.27	928.17	0.002601	10.98	26421.99	6163.10	0.61
Gila	Lower Gila	197.42	Low_Flow	95.00	911.90	912.46	912.05	912.46	0.000317	0.58	164.60	298.04	0.14
Gila	Lower Gila	197.42	Normal_Flow	118.00	911.90	912.52	912.07	912.53	0.000345	0.64	182.97	298.70	0.15
Gila	Lower Gila	197.38	5_year	23500.00	911.90	919.13	916.81	919.65	0.001653	5.78	4063.12	1819.53	0.51
Gila	Lower Gila	197.38	10_year	57000.00	911.90	921.34	919.77	922.25	0.002375	7.98	8546.56	2237.34	0.58
Gila	Lower Gila	197.38	100_year	227000.00	911.90	926.83	924.68	928.53	0.002694	12.22	28421.24	6492.56	0.64
Gila	Lower Gila	197.38	Typ Peak_year	6700.00	911.90	915.68	914.23	915.97	0.001629	4.31	1556.06	589.22	0.44
Gila	Lower Gila	197.38	20_year	92000.00	911.90	922.78	921.28	923.78	0.002370	8.88	13471.22	2363.36	0.58
Gila	Lower Gila	197.38	50_year	185000.00	911.90	925.93	923.46	927.45	0.002604	11.39	23854.32	5616.70	0.62
Gila	Lower Gila	197.38	Low_Flow	95.00	911.90	912.35	912.04	912.36	0.000484	0.64	149.24	333.13	0.17
Gila	Lower Gila	197.38	Normal_Flow	118.00	911.90	912.41	912.06	912.41	0.000515	0.71	167.01	334.06	0.18
Gila	Lower Gila	197.33	5_year	23500.00	911.65	918.81	916.01	919.24	0.001257	5.24	4487.85	2158.35	0.40
Gila	Lower Gila	197.33	10_year	57000.00	911.65	920.73	918.73	921.62	0.002285	7.90	8569.61	2474.42	0.59
Gila	Lower Gila	197.33	100_year	227000.00	911.65	926.76	922.55	927.76	0.001661	9.71	33928.65	6577.25	0.51
Gila	Lower Gila	197.33	Typ Peak_year	6700.00	911.65	915.35	913.70	915.56	0.001308	3.65	1836.37	1024.01	0.38
Gila	Lower Gila	197.33	20_year	92000.00	911.65	922.65	920.78	923.19	0.001298	6.72	17471.26	2745.37	0.44
Gila	Lower Gila	197.33	50_year	185000.00	911.65	925.81	921.74	926.73	0.001643	9.16	29278.58	6076.60	0.50
Gila	Lower Gila	197.33	Low_Flow	95.00	911.65	911.89	911.89	911.95	0.027436	1.98	47.95	596.91	1.02
Gila	Lower Gila	197.33	Normal_Flow	118.00	911.65	911.91	911.91	911.97	0.027578	2.11	55.89	621.56	1.03
Gila	Lower Gila	197.28	5_year	23500.00	910.50	918.75	914.55	918.97	0.000617	3.71	6341.28	2217.51	0.26
Gila	Lower Gila	197.28	10_year	57000.00	910.50	920.61	916.91	921.10	0.001225	5.98	11877.90	2466.09	0.38
Gila	Lower Gila	197.28	100_year	227000.00	910.50	926.66	921.49	927.36	0.001029	7.95	38113.71	7500.31	0.40
Gila	Lower Gila	197.28	Typ Peak_year	6700.00	910.50	915.27	912.55	915.34	0.000438	2.19	3055.74	1504.04	0.21
Gila	Lower Gila	197.28	20_year	92000.00	910.50	922.42	919.01	922.87	0.001073	6.19	19647.25	3026.65	0.38
Gila	Lower Gila	197.28	50_year	185000.00	910.50	925.67	921.09	926.32	0.001114	7.69	32783.41	6781.88	0.40
Gila	Lower Gila	197.28	Low_Flow	95.00	910.50	911.50	910.80	911.50	0.000064	0.28	341.01	610.08	0.06
Gila	Lower Gila	197.28	Normal_Flow	118.00	910.50	911.56	910.84	911.56	0.000072	0.31	375.87	618.28	0.07
Gila	Lower Gila	197.23	5_year	23500.00	910.88	918.41	915.47	918.75	0.001246	4.66	5045.46	2290.56	0.38
Gila	Lower Gila	197.23	10_year	57000.00	910.88	920.28	918.13	920.75	0.001608	6.01	11428.11	2610.63	0.44
Gila	Lower Gila	197.23	100_year	227000.00	910.88	926.35	920.99	927.07	0.001305	8.27	38624.27	7671.31	0.43
Gila	Lower Gila	197.23	Typ Peak_year	6700.00	910.88	914.99	913.14	915.17	0.001195	3.37	1985.55	1394.78	0.34
Gila	Lower Gila	197.23	20_year	92000.00	910.88	922.15	919.12	922.58	0.001252	6.08	19847.73	3382.77	0.39
Gila	Lower Gila	197.23	50_year	185000.00	910.88	925.38	920.74	926.02	0.001294	7.69	33213.14	6600.26	0.41
Gila	Lower Gila	197.23	Low_Flow	95.00	910.88	911.46	911.09	911.46	0.000403	0.56	169.12	534.96	0.14
Gila	Lower Gila	197.23	Normal_Flow	118.00	910.88	911.52	911.10	911.52	0.000429	0.62	190.03	541.52	0.15
Gila	Lower Gila	197.18	5_year	23500.00	910.95	918.38	915.09	918.59	0.000796	3.71	6334.52	2809.48	0.28
Gila	Lower Gila	197.18	10_year	57000.00	910.95	920.18	917.18	920.57	0.001155	5.40	12307.85	3128.56	0.36
Gila	Lower Gila	197.18	100_year	227000.00	910.95	926.35	920.73	926.89	0.000851	7.19	43100.26	6834.73	0.35
Gila	Lower Gila	197.18	Typ Peak_year	6700.00	910.95	914.89	913.29	915.01	0.001156	2.78	2410.79	1922.45	0.32
Gila	Lower Gila	197.18	20_year	92000.00	910.95	922.15	918.51	922.43	0.000676	4.91	23883.64	3339.41	0.29
Gila	Lower Gila	197.18	50_year	185000.00	910.95	925.37	920.50	925.85	0.000826	6.70	37735.77	6346.24	0.34
Gila	Lower Gila	197.18	Low_Flow	95.00	910.95	911.38	911.11	911.39	0.001048	0.88	107.96	408.48	0.24
Gila	Lower Gila	197.18	Normal_Flow	118.00	910.95	911.43	911.14	911.45	0.001087	0.97	121.79	415.35	0.25
Gila	Lower Gila	197.16	5_year	23500.00	909.80	918.23	915.19	918.48	0.000909	3.99	5889.49	2632.27	0.30
Gila	Lower Gila	197.16	10_year	57000.00	909.80	920.16	917.26	920.40	0.000767	4.51	16276.73	3048.08	0.30
Gila	Lower Gila	197.16	100_year	227000.00	909.80	926.18	919.93	926.77	0.000924	7.58	41342.64	6725.93	0.37
Gila	Lower Gila	197.16	Typ Peak_year	6700.00	909.80	914.66	913.41	914.82	0.001708	3.22	2077.77	1599.94	0.39
Gila	Lower Gila	197.16	20_year	92000.00	909.80	922.01	918.51	922.33	0.000769	5.30	22057.14	3169.41	0.31
Gila	Lower Gila	197.16	50_year	185000.00	909.80	925.22	919.86	925.73	0.000888	7.03	36137.79	6401.45	0.35
Gila	Lower Gila	197.16	Low_Flow	95.00	909.80	911.17	910.99	911.19	0.002481	1.05	90.40	382.71	0.31
Gila	Lower Gila	197.16	Normal_Flow	118.00	909.80	911.22	911.00	911.24	0.002573	1.15	103.05	385.78	0.32
Gila	Lower Gila	197.14	5_year	23500.00	909.26	918.04	914.56	918.24	0.001035	3.62	6496.05	2525.54	0.28
Gila	Lower Gila	197.14	10_year	57000.00	909.26	919.99	916.82	920.21	0.000826	4.10	15639.24	3055.79	0.27
Gila	Lower Gila	197.14	100_year	227000.00	909.26	925.95	920.09	926.55	0.000916	7.30	40733.46	6651.17	0.36
Gila	Lower Gila	197.14	Typ Peak_year	6700.00	909.26	914.18	912.66	914.33	0.002669	3.05	2195.57	1305.76	0.35
Gila	Lower Gila	197.14	20_year	92000.00	909.26	921.83	918.31	922.13	0.000827	4.92	21539.87	3383.65	0.29
Gila	Lower Gila	197.14	50_year	185000.00	909.26	925.01	919.93	925.52	0.000911	6.65	35708.55	6275.00	0.34
Gila	Lower Gila	197.14	Low_Flow	95.00	909.26	909.82	909.76	909.91	0.020323	2.43	39.04	213.02	0.75
Gila	Lower Gila	197.14	Normal_Flow	118.00	909.26	909.90	909.80	909.99	0.016371	2.37	49.74	223.80	0.67
Gila	Lower Gila	197.09	5_year	23500.00	908.08	917.71	914.14	917.99	0.001060	4.25	5535.84	2528.43	0.33
Gila	Lower Gila	197.09	10_year	57000.00	908.08	919.81	916.78	920.02	0.000690	4.11	16567.27	3230.94	0.28
Gila	Lower Gila	197.09	100_year	227000.00	908.08	925.84	919.75	926.31	0.000758	6.64	44780.57	7563.87	0.33
Gila	Lower Gila	197.09	Typ Peak_year	6700.00	908.08	913.73	911.68	913.89	0.001339	3.28	2039.68	1623.56	0.35
Gila	Lower Gila	197.09	20_year	92000.00	908.08	921.70	918.01	921.94	0.000623	4.62	24646.74	3637.27	0.28
Gila	Lower Gila	197.09	50_year	185000.00	908.08	924.89	918.94	925.29	0.000721	6.14	39554.22	6923.91	0.32
Gila	Lower Gila	197.09	Low_Flow	95.00	908.08	909.18	908.65	909.20	0.001121	0.97	98.44	243.12	0.24
Gila	Lower Gila	197.09	Normal_Flow	118.00	908.08	909.24	908.71	909.26	0.001233	1.08	109.65	246.82	0.25
Gila	Lower Gila	197.05	5_year	23500.00	908.12	917.39	913.35	917.65	0.001365	4.07	5769.52	2196.54	0.32
Gila	Lower Gila	197.05	10_year	57000.00	908.12	919.46	916.27	919.77	0.001189	4.85	13371.63	2835.09	0.32
Gila	Lower Gila	197.05	100_year	227000.00	908.12	925.37	920.49	926.03	0.001137	7.66	39753.96	7800.62	0.38
Gila	Lower Gila	197.05	Typ Peak_year	6700.00	908.12	913.40	910.98	913.53	0.001254	2.94	2281.53	1098.17	0.28
Gila	Lower Gila	197.05	20_year	92000.00	908.12	921.34	917.71	921.71	0.001053	5.48	20270.72	3442.66	0.33
Gila	Lower Gila	197.05	50_year	185000.00	908.12	924.45	919.57	925.03	0.001104	7.04	34603.93	7493.18	0.36

HEC-RAS Plan: 3B (Continued)

River	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)	
Gila	Lower Gila	197.05	Low_Flow	95.00	908.12	908.69	908.47	908.71	0.003074	1.22	77.85	216.61	0.36
Gila	Lower Gila	197.05	Normal_Flow	118.00	908.12	908.78	908.51	908.81	0.002371	1.19	98.88	286.44	0.32
Gila	Lower Gila	196.99	5_year	23500.00	906.40	916.96	912.98	917.24	0.001327	4.31	5450.77	1699.94	0.34
Gila	Lower Gila	196.99	10_year	57000.00	906.40	918.93	916.11	919.36	0.001499	5.62	11183.24	2354.22	0.38
Gila	Lower Gila	196.99	100_year	227000.00	906.40	924.65	921.10	925.59	0.001624	9.14	34766.82	8324.47	0.46
Gila	Lower Gila	196.99	Typ Peak_year	6700.00	906.40	913.03	910.35	913.17	0.001140	3.05	2195.76	807.86	0.28
Gila	Lower Gila	196.99	20_year	92000.00	906.40	920.72	917.51	921.31	0.001515	6.67	16015.94	2918.35	0.40
Gila	Lower Gila	196.99	50_year	185000.00	906.40	923.72	920.05	924.60	0.001612	8.53	29127.79	6128.13	0.44
Gila	Lower Gila	196.99	Low_Flow	95.00	906.40	907.95	907.00	907.98	0.002012	1.24	76.85	65.29	0.20
Gila	Lower Gila	196.99	Normal_Flow	118.00	906.40	908.09	907.08	908.12	0.002254	1.37	85.98	67.99	0.22
Gila	Lower Gila	196.94	5_year	23500.00	906.40	916.28	912.09	916.61	0.002183	4.65	5053.12	1632.58	0.35
Gila	Lower Gila	196.94	10_year	57000.00	906.40	918.31	915.71	918.74	0.001865	5.50	10840.22	2603.69	0.36
Gila	Lower Gila	196.94	100_year	227000.00	906.40	924.16	919.90	924.98	0.001497	8.80	37103.25	8144.50	0.43
Gila	Lower Gila	196.94	Typ Peak_year	6700.00	906.40	912.58	909.60	912.71	0.001332	2.90	2310.06	688.31	0.24
Gila	Lower Gila	196.94	20_year	92000.00	906.40	920.18	916.71	920.72	0.001626	6.41	16862.67	3264.52	0.38
Gila	Lower Gila	196.94	50_year	185000.00	906.40	923.21	919.50	923.98	0.001577	8.31	31174.03	6774.69	0.42
Gila	Lower Gila	196.94	Low_Flow	95.00	906.40	907.72	906.69	907.73	0.000316	0.48	197.00	187.79	0.08
Gila	Lower Gila	196.94	Normal_Flow	118.00	906.40	907.84	906.75	907.84	0.000347	0.54	218.71	189.27	0.09
Gila	Lower Gila	196.87	5_year	23500.00	906.40	915.73	912.22	916.06	0.001460	4.55	5165.19	1736.24	0.35
Gila	Lower Gila	196.87	10_year	57000.00	906.40	917.97	915.24	918.30	0.000987	4.66	12747.36	2494.24	0.31
Gila	Lower Gila	196.87	100_year	227000.00	906.40	923.84	919.41	924.54	0.001148	7.84	39718.19	6836.75	0.38
Gila	Lower Gila	196.87	Typ Peak_year	6700.00	906.40	912.15	909.45	912.30	0.001294	3.07	2180.37	952.70	0.29
Gila	Lower Gila	196.87	20_year	92000.00	906.40	919.80	916.01	920.27	0.001166	6.02	17909.85	3502.22	0.35
Gila	Lower Gila	196.87	50_year	185000.00	906.40	922.88	918.41	923.52	0.001155	7.41	33715.16	6344.68	0.38
Gila	Lower Gila	196.87	Low_Flow	95.00	906.40	907.61	906.67	907.62	0.000385	0.51	187.73	245.28	0.09
Gila	Lower Gila	196.87	Normal_Flow	118.00	906.40	907.72	906.71	907.72	0.000434	0.56	210.15	348.48	0.11
Gila	Lower Gila	196.81	5_year	23500.00	906.40	915.45	911.58	915.67	0.001092	3.74	6279.94	2088.50	0.28
Gila	Lower Gila	196.81	10_year	57000.00	906.40	917.80	914.01	918.04	0.000686	3.87	14646.88	2553.08	0.24
Gila	Lower Gila	196.81	100_year	227000.00	906.40	923.62	918.18	924.22	0.000922	6.99	42457.23	6760.88	0.33
Gila	Lower Gila	196.81	Typ Peak_year	6700.00	906.40	911.83	909.36	911.93	0.001186	2.60	2576.70	1240.36	0.26
Gila	Lower Gila	196.81	20_year	92000.00	906.40	919.62	915.71	919.97	0.000779	4.90	20405.16	3539.68	0.28
Gila	Lower Gila	196.81	50_year	185000.00	906.40	922.66	917.16	923.20	0.000908	6.53	36279.87	6284.65	0.32
Gila	Lower Gila	196.81	Low_Flow	95.00	906.40	907.47	906.65	907.48	0.000687	0.54	176.67	366.13	0.12
Gila	Lower Gila	196.81	Normal_Flow	118.00	906.40	907.56	906.69	907.57	0.000708	0.58	202.44	377.94	0.12
Gila	Lower Gila	196.75	5_year	23500.00	906.28	915.14	910.94	915.31	0.000972	3.36	6998.81	2244.07	0.25
Gila	Lower Gila	196.75	10_year	57000.00	906.28	917.62	913.27	917.81	0.000622	3.52	16629.94	3047.68	0.22
Gila	Lower Gila	196.75	100_year	227000.00	906.28	923.40	917.39	923.90	0.000822	6.43	45622.38	6680.52	0.30
Gila	Lower Gila	196.75	Typ Peak_year	6700.00	906.28	911.46	908.98	911.54	0.001137	2.28	2939.27	1339.02	0.23
Gila	Lower Gila	196.75	20_year	92000.00	906.28	919.43	914.99	919.70	0.000682	4.43	23144.24	3801.41	0.25
Gila	Lower Gila	196.75	50_year	185000.00	906.28	922.45	916.47	922.89	0.000802	5.95	39392.68	6317.77	0.29
Gila	Lower Gila	196.75	Low_Flow	95.00	906.28	907.28	906.64	907.29	0.000477	0.48	195.92	439.07	0.11
Gila	Lower Gila	196.75	Normal_Flow	118.00	906.28	907.36	906.67	907.37	0.000511	0.53	220.71	450.45	0.11
Gila	Lower Gila	196.69	5_year	23500.00	906.54	914.89	909.98	915.01	0.000841	2.77	8486.59	2258.58	0.19
Gila	Lower Gila	196.69	10_year	57000.00	906.54	917.32	911.90	917.55	0.001028	4.12	15878.92	2715.82	0.24
Gila	Lower Gila	196.69	100_year	227000.00	906.54	923.02	917.90	923.59	0.001049	7.14	44078.77	6575.12	0.33
Gila	Lower Gila	196.69	Typ Peak_year	6700.00	906.54	911.19	908.41	911.24	0.000734	1.65	4062.03	1218.36	0.15
Gila	Lower Gila	196.69	20_year	92000.00	906.54	919.08	913.55	919.43	0.001041	5.16	21493.45	4125.32	0.28
Gila	Lower Gila	196.69	50_year	185000.00	906.54	922.07	915.22	922.59	0.001076	6.67	37893.45	6297.55	0.32
Gila	Lower Gila	196.69	Low_Flow	95.00	906.54	907.19	906.72	907.19	0.000187	0.37	254.26	488.97	0.09
Gila	Lower Gila	196.69	Normal_Flow	118.00	906.54	907.27	906.74	907.27	0.000198	0.40	291.88	508.53	0.09
Gila	Lower Gila	196.63	5_year	23500.00	906.38	914.61	910.26	914.78	0.000609	3.32	7084.80	2271.77	0.23
Gila	Lower Gila	196.63	10_year	57000.00	906.38	916.82	912.34	917.21	0.001055	5.30	13064.06	2776.42	0.32
Gila	Lower Gila	196.63	100_year	227000.00	906.38	922.30	918.78	923.18	0.001458	9.05	38655.29	7681.38	0.43
Gila	Lower Gila	196.63	Typ Peak_year	6700.00	906.38	910.98	908.60	911.04	0.000535	2.03	3303.69	1646.10	0.20
Gila	Lower Gila	196.63	20_year	92000.00	906.38	918.43	914.13	919.04	0.001318	6.78	17105.89	3798.82	0.37
Gila	Lower Gila	196.63	50_year	185000.00	906.38	921.24	917.45	922.15	0.001590	8.89	31814.80	7378.13	0.43
Gila	Lower Gila	196.63	Low_Flow	95.00	906.38	907.12	906.68	907.13	0.000268	0.51	185.37	730.64	0.12
Gila	Lower Gila	196.63	Normal_Flow	118.00	906.38	907.19	906.70	907.20	0.000274	0.56	211.99	754.20	0.13
Gila	Lower Gila	196.57	5_year	23500.00	906.38	914.26	910.72	914.51	0.000900	3.99	5896.23	1854.38	0.29
Gila	Lower Gila	196.57	10_year	57000.00	906.38	916.24	912.99	916.75	0.001479	6.13	11421.64	2366.12	0.39
Gila	Lower Gila	196.57	100_year	227000.00	906.38	921.97	919.38	922.63	0.001234	8.28	41788.88	8068.28	0.40
Gila	Lower Gila	196.57	Typ Peak_year	6700.00	906.38	910.66	908.78	910.78	0.000991	2.75	2435.81	1021.34	0.29
Gila	Lower Gila	196.57	20_year	92000.00	906.38	917.83	914.68	918.50	0.001631	7.36	16593.54	3795.76	0.42
Gila	Lower Gila	196.57	50_year	185000.00	906.38	920.83	918.25	921.54	0.001430	8.35	34081.29	7695.44	0.42
Gila	Lower Gila	196.57	Low_Flow	95.00	906.38	907.00	906.59	907.01	0.000403	0.66	143.67	268.49	0.16
Gila	Lower Gila	196.57	Normal_Flow	118.00	906.38	907.07	906.61	907.07	0.000431	0.73	161.64	273.67	0.17
Gila	Lower Gila	196.5	5_year	23500.00	906.38	913.99	910.18	914.24	0.000691	4.00	5876.07	2139.61	0.29
Gila	Lower Gila	196.5	10_year	57000.00	906.38	915.76	912.55	916.29	0.001272	6.28	11034.46	2997.48	0.40
Gila	Lower Gila	196.5	100_year	227000.00	906.38	921.62	918.83	922.25	0.000999	8.04	42182.77	7866.21	0.39
Gila	Lower Gila	196.5	Typ Peak_year	6700.00	906.38	910.42	908.18	910.52	0.000587	2.54	2635.08	1011.26	0.25
Gila	Lower Gila	196.5	20_year	92000.00	906.38	917.31	914.42	918.00	0.001415	7.45	16750.21	4551.84	0.43
Gila	Lower Gila	196.5	50_year	185000.00	906.38	920.40	917.59	921.10	0.001194	8.25	34250.20	7598.72	0.42
Gila	Lower Gila	196.5	Low_Flow	95.00	906.38	906.94	906.49	906.94	0.000118	0.36	266.10	497.61	0.09
Gila	Lower Gila	196.5	Normal_Flow	118.00	906.38	907.00	906.51	907.00	0.000127	0.40	297.02	498.81	0.09
Gila	Lower Gila	196.44	5_year	23500.00	906.38	913.79	910.00	914.02	0.000625	3.91	6017.24	2167.70	0.28
Gila	Lower Gila	196.44	10_year	57000.00	906.38	915.37	912.30	915.88	0.001212	6.21	11530.50	3280.55	0.40
Gila	Lower Gila	196.44	100_year	227000.00	906.38	921.42	918.32	921.92	0.000773	7.24	46034.02	8573.70	0.35
Gila	Lower Gila	196.44	Typ Peak_year	6700.00	906.38	910.23	907.99	910.33	0.000567	2.50	2680.32	1136.97	0.25
Gila	Lower Gila	196.44	20_year	92000.00	906.38	916.87	914.01	917.54	0.001379	7.43	17439.20	5666.62	0.44

HEC-RAS Plan: 3B (Continued)

River	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)	
Gila	Lower Gila	196.44	50_year	185000.00	906.38	920.18	917.57	920.71	0.000914	7.38	37758.20	8309.87	0.37
Gila	Lower Gila	196.44	Low_Flow	95.00	906.38	906.90	906.48	906.90	0.000106	0.32	299.45	597.90	0.08
Gila	Lower Gila	196.44	Normal_Flow	118.00	906.38	906.96	906.49	906.96	0.000113	0.35	335.12	599.56	0.08
Gila	Lower Gila	196.38	5_year	23500.00	906.38	913.50	909.93	913.81	0.000847	4.43	5309.11	2635.97	0.33
Gila	Lower Gila	196.38	10_year	57000.00	906.38	915.08	912.59	915.52	0.001144	5.88	11262.29	3350.04	0.39
Gila	Lower Gila	196.38	100_year	227000.00	906.38	921.24	917.73	921.69	0.000709	6.84	46953.27	7933.20	0.33
Gila	Lower Gila	196.38	Typ Peak_year	6700.00	906.38	910.02	908.02	910.14	0.000726	2.81	2388.43	1232.33	0.27
Gila	Lower Gila	196.38	20_year	92000.00	906.38	916.59	914.01	917.12	0.001219	6.82	18401.75	5593.58	0.41
Gila	Lower Gila	196.38	50_year	185000.00	906.38	919.97	916.81	920.43	0.000835	6.95	38878.10	7321.87	0.35
Gila	Lower Gila	196.38	Low_Flow	95.00	906.38	906.85	906.50	906.86	0.000231	0.42	228.51	636.29	0.11
Gila	Lower Gila	196.38	Normal_Flow	118.00	906.38	906.91	906.52	906.91	0.000268	0.45	261.02	699.03	0.12
Gila	Lower Gila	196.32	5_year	23500.00	905.91	912.94	909.76	913.33	0.001146	4.98	4714.86	2774.15	0.37
Gila	Lower Gila	196.32	10_year	57000.00	905.91	914.12	912.52	914.76	0.001870	7.07	9564.51	3749.15	0.49
Gila	Lower Gila	196.32	100_year	227000.00	905.91	920.93	917.01	921.36	0.000684	6.69	46662.09	8048.14	0.33
Gila	Lower Gila	196.32	Typ Peak_year	6700.00	905.91	909.57	907.85	909.72	0.001041	3.11	2154.75	1128.30	0.31
Gila	Lower Gila	196.32	20_year	92000.00	905.91	915.83	913.49	916.43	0.001550	7.40	17624.10	5557.90	0.46
Gila	Lower Gila	196.32	50_year	185000.00	905.91	919.61	916.35	920.04	0.000792	6.71	38888.30	7477.52	0.34
Gila	Lower Gila	196.32	Low_Flow	95.00	905.91	906.63	906.48	906.63	0.001379	0.61	155.19	756.58	0.22
Gila	Lower Gila	196.32	Normal_Flow	118.00	905.91	906.66	906.49	906.67	0.001379	0.67	176.31	761.51	0.23
Gila	Lower Gila	196.23	5_year	23500.00	901.72	912.67	908.91	912.88	0.000644	3.74	6283.81	3736.49	0.27
Gila	Lower Gila	196.23	10_year	57000.00	901.72	913.35	911.14	913.89	0.001649	6.42	11154.19	4394.06	0.44
Gila	Lower Gila	196.23	100_year	227000.00	901.72	920.64	915.49	921.05	0.000609	6.32	48204.20	7743.92	0.30
Gila	Lower Gila	196.23	Typ Peak_year	6700.00	901.72	909.24	907.22	909.33	0.000644	2.38	2818.04	1667.42	0.24
Gila	Lower Gila	196.23	20_year	92000.00	901.72	915.37	912.71	915.77	0.001051	6.07	21826.96	5449.51	0.37
Gila	Lower Gila	196.23	50_year	185000.00	901.72	919.30	914.83	919.68	0.000673	6.19	41096.94	7257.59	0.31
Gila	Lower Gila	196.23	Low_Flow	95.00	901.72	906.62	902.56	906.62	0.000007	0.17	556.99	1215.80	0.04
Gila	Lower Gila	196.23	Normal_Flow	118.00	901.72	906.65	902.64	906.65	0.000011	0.20	578.89	1227.72	0.04
Gila	Lower Gila	196.14	5_year	23500.00	906.39	911.95	909.83	912.48	0.002224	5.84	4022.29	3498.95	0.46
Gila	Lower Gila	196.14	10_year	57000.00	906.39	912.99	912.30	913.28	0.001239	4.90	13553.91	3697.69	0.36
Gila	Lower Gila	196.14	100_year	227000.00	906.39	920.28	914.27	920.78	0.000795	6.82	41394.59	7558.34	0.34
Gila	Lower Gila	196.14	Typ Peak_year	6700.00	906.39	908.09	907.99	908.70	0.012058	6.25	1072.70	1544.56	0.90
Gila	Lower Gila	196.14	20_year	92000.00	906.39	915.01	912.31	915.36	0.001068	5.54	19744.35	4179.98	0.36
Gila	Lower Gila	196.14	50_year	185000.00	906.39	918.93	913.47	919.39	0.000864	6.57	35293.06	7122.51	0.34
Gila	Lower Gila	196.14	Low_Flow	95.00	906.39	906.55	906.55	906.60	0.048766	1.79	52.93	793.81	1.05
Gila	Lower Gila	196.14	Normal_Flow	118.00	906.39	906.57	906.57	906.63	0.044749	1.92	61.62	795.87	1.04
Gila	Lower Gila	196.08	5_year	23500.00	899.26	909.16	907.51	910.70	0.005469	9.94	2363.35	2719.13	0.76
Gila	Lower Gila	196.08	10_year	57000.00	899.26	912.08	909.86	912.52	0.001554	5.93	11715.07	3301.10	0.42
Gila	Lower Gila	196.08	100_year	227000.00	899.26	919.54	914.36	920.28	0.001007	7.33	33877.33	7103.96	0.36
Gila	Lower Gila	196.08	Typ Peak_year	6700.00	899.26	905.14	903.60	905.74	0.003423	6.26	1070.85	409.10	0.54
Gila	Lower Gila	196.08	20_year	92000.00	899.26	914.23	910.97	914.72	0.001296	6.20	17376.01	4292.72	0.39
Gila	Lower Gila	196.08	50_year	185000.00	899.26	918.22	913.41	918.88	0.001027	6.87	29672.22	6990.43	0.36
Gila	Lower Gila	196.08	Low_Flow	95.00	899.26	900.49	899.66	900.50	0.000467	0.93	101.74	101.59	0.16
Gila	Lower Gila	196.08	Normal_Flow	118.00	899.26	900.61	899.72	900.63	0.000511	1.03	115.05	128.38	0.19
Gila	Lower Gila	195.98	5_year	23500.00	899.24	908.82	904.23	909.10	0.000946	4.31	5456.51	2708.89	0.29
Gila	Lower Gila	195.98	10_year	57000.00	899.24	911.18	907.37	911.60	0.001083	5.61	11880.16	2866.59	0.32
Gila	Lower Gila	195.98	100_year	227000.00	899.24	918.70	912.80	919.52	0.000961	8.47	33160.73	6505.26	0.36
Gila	Lower Gila	195.98	Typ Peak_year	6700.00	899.24	904.44	901.78	904.58	0.000911	3.02	2220.95	1253.83	0.27
Gila	Lower Gila	195.98	20_year	92000.00	899.24	913.24	909.41	913.82	0.001164	6.69	16321.22	3312.50	0.35
Gila	Lower Gila	195.98	50_year	185000.00	899.24	917.30	911.71	918.07	0.001087	8.19	28155.12	6419.40	0.37
Gila	Lower Gila	195.98	Low_Flow	95.00	899.24	899.43	899.43	899.52	0.036739	2.37	40.08	228.93	1.00
Gila	Lower Gila	195.98	Normal_Flow	118.00	899.24	899.46	899.46	899.56	0.036507	2.58	45.82	229.77	1.02
Gila	Lower Gila	195.86	5_year	23500.00	897.39	908.27	904.69	908.64	0.000887	4.89	4805.76	1427.86	0.34
Gila	Lower Gila	195.86	10_year	57000.00	897.39	910.51	907.53	911.05	0.001138	6.39	10119.53	1929.44	0.40
Gila	Lower Gila	195.86	100_year	227000.00	897.39	917.93	913.33	918.98	0.001180	9.64	29532.72	4416.63	0.43
Gila	Lower Gila	195.86	Typ Peak_year	6700.00	897.39	903.83	900.98	904.07	0.001144	3.95	1697.47	626.26	0.40
Gila	Lower Gila	195.86	20_year	92000.00	897.39	912.49	909.00	913.22	0.001261	7.64	14355.06	2225.29	0.42
Gila	Lower Gila	195.86	50_year	185000.00	897.39	916.51	911.39	917.49	0.001214	9.21	25081.96	3953.63	0.43
Gila	Lower Gila	195.86	Low_Flow	95.00	897.39	898.64	897.72	898.65	0.000099	0.51	188.07	187.19	0.09
Gila	Lower Gila	195.86	Normal_Flow	118.00	897.39	898.73	897.75	898.74	0.000118	0.57	205.26	192.46	0.10
Gila	Lower Gila	195.77	5_year	23500.00	897.58	906.86	904.56	907.79	0.002042	7.74	3036.91	1438.85	0.62
Gila	Lower Gila	195.77	10_year	57000.00	897.58	909.44	907.79	910.20	0.001723	7.84	8785.80	1900.40	0.54
Gila	Lower Gila	195.77	100_year	227000.00	897.58	916.90	912.85	918.18	0.001485	10.58	26409.81	4432.00	0.50
Gila	Lower Gila	195.77	Typ Peak_year	6700.00	897.58	903.00	900.54	903.35	0.001131	4.79	1399.33	342.30	0.38
Gila	Lower Gila	195.77	20_year	92000.00	897.58	911.44	909.12	912.33	0.001680	8.66	13036.62	2116.24	0.52
Gila	Lower Gila	195.77	50_year	185000.00	897.58	915.48	911.87	916.66	0.001552	10.17	22514.52	3595.25	0.51
Gila	Lower Gila	195.77	Low_Flow	95.00	897.58	898.58	897.92	898.58	0.000116	0.46	207.46	256.98	0.09
Gila	Lower Gila	195.77	Normal_Flow	118.00	897.58	898.66	897.95	898.66	0.000131	0.52	228.07	257.42	0.10
Gila	Lower Gila	195.65	5_year	23500.00	897.58	906.21	902.48	906.84	0.001250	6.34	3704.92	1158.85	0.46
Gila	Lower Gila	195.65	10_year	57000.00	897.58	908.19	906.51	909.17	0.001951	8.65	7960.37	1695.34	0.59
Gila	Lower Gila	195.65	100_year	227000.00	897.58	915.59	912.06	917.24	0.001818	11.96	23942.38	2522.50	0.56
Gila	Lower Gila	195.65	Typ Peak_year	6700.00	897.58	902.69	899.72	902.87	0.000573	3.38	1980.86	594.46	0.27
Gila	Lower Gila	195.65	20_year	92000.00	897.58	910.13	907.85	911.30	0.002001	9.69	11597.82	1874.80	0.59
Gila	Lower Gila	195.65	50_year	185000.00	897.58	914.10	911.33	915.67	0.001944	11.60	20212.13	2466.61	0.58
Gila	Lower Gila	195.65	Low_Flow	95.00	897.58	898.55	897.71	898.55	0.000030	0.26	365.96	381.61	0.05
Gila	Lower Gila	195.65	Normal_Flow	118.00	897.58	898.63	897.73	898.63	0.000036	0.30	394.76	381.89	0.05
Gila	Lower Gila	195.55	5_year	23500.00	897.89	905.67	902.55	906.09	0.001365	5.17	4543.62	1591.42	0.37
Gila	Lower Gila	195.55	10_year	57000.00	897.89	907.38	905.24	908.07	0.001879	7.17	9052.38	1818.69	0.46
Gila	Lower Gila	195.55	100_year	227000.00	897.89	915.01	910.65	916.23	0.001521	10.21	26936.69	2852.48	0.46
Gila	Lower Gila	195.55	Typ Peak_year	6700.00	897.89	902.27	900.19	902.43	0.001291	3.22	2083.17	910.98	0.32

HEC-RAS Plan: 3B (Continued)

River	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)	
Gila	Lower Gila	195.55	20_year	92000.00	897.89	909.39	906.57	910.21	0.001740	8.06	13460.93	2135.23	0.46
Gila	Lower Gila	195.55	50_year	185000.00	897.89	913.47	909.22	914.59	0.001630	9.85	23113.30	2565.47	0.47
Gila	Lower Gila	195.55	Low_Flow	95.00	897.89	898.50	898.16	898.51	0.000863	0.70	135.76	369.14	0.19
Gila	Lower Gila	195.55	Normal_Flow	118.00	897.89	898.57	898.19	898.57	0.000865	0.75	158.17	391.21	0.19
Gila	Lower Gila	195.45	5_year	23500.00	896.41	904.87	902.26	905.28	0.001515	5.10	4604.65	1713.02	0.39
Gila	Lower Gila	195.45	10_year	57000.00	896.41	906.26	904.64	906.92	0.002169	7.11	9222.32	1890.22	0.48
Gila	Lower Gila	195.45	100_year	227000.00	896.41	914.19	909.53	915.36	0.001494	9.86	27408.43	2995.09	0.45
Gila	Lower Gila	195.45	Typ Peak_year	6700.00	896.41	901.08	900.07	901.36	0.003063	4.25	1575.02	804.02	0.48
Gila	Lower Gila	195.45	20_year	92000.00	896.41	908.25	905.44	909.12	0.002117	8.33	13162.37	2210.40	0.49
Gila	Lower Gila	195.45	50_year	185000.00	896.41	912.54	907.60	913.66	0.001671	9.64	23186.52	2771.69	0.47
Gila	Lower Gila	195.45	Low_Flow	95.00	896.41	896.95	896.95	897.11	0.025808	3.19	29.74	92.73	0.99
Gila	Lower Gila	195.45	Normal_Flow	118.00	896.41	897.01	897.01	897.19	0.024678	3.36	35.11	98.14	0.99
Gila	Lower Gila	195.34	5_year	23500.00	892.60	904.67	900.46	904.92	0.000784	3.99	5886.87	1696.42	0.28
Gila	Lower Gila	195.34	10_year	57000.00	892.60	905.83	903.13	906.36	0.001531	6.23	10270.74	1870.74	0.41
Gila	Lower Gila	195.34	100_year	227000.00	892.60	913.79	908.24	914.96	0.001343	9.54	27061.19	3543.83	0.43
Gila	Lower Gila	195.34	Typ Peak_year	6700.00	892.60	900.83	898.24	900.93	0.000700	2.59	2587.44	979.73	0.24
Gila	Lower Gila	195.34	20_year	92000.00	892.60	907.84	905.21	908.56	0.001535	7.33	14060.34	2031.21	0.42
Gila	Lower Gila	195.34	50_year	185000.00	892.60	912.14	907.41	913.20	0.001426	9.11	23336.22	2857.83	0.44
Gila	Lower Gila	195.34	Low_Flow	95.00	892.60	894.77	893.85	894.83	0.002135	1.97	48.27	47.48	0.34
Gila	Lower Gila	195.34	Normal_Flow	118.00	892.60	894.91	894.01	894.98	0.002243	2.14	55.25	49.84	0.36
Gila	Lower Gila	195.28	5_year	23500.00	892.60	904.13	900.89	904.56	0.001437	5.25	4476.68	1589.96	0.38
Gila	Lower Gila	195.28	10_year	57000.00	892.60	905.34	903.76	905.84	0.001623	5.84	10154.14	1766.52	0.41
Gila	Lower Gila	195.28	100_year	227000.00	892.60	913.13	907.82	914.47	0.001551	9.75	24647.66	3801.12	0.46
Gila	Lower Gila	195.28	Typ Peak_year	6700.00	892.60	900.43	897.70	900.61	0.001297	3.44	1948.85	1011.31	0.33
Gila	Lower Gila	195.28	20_year	92000.00	892.60	907.30	904.71	908.03	0.001680	7.12	13620.11	1961.16	0.44
Gila	Lower Gila	195.28	50_year	185000.00	892.60	911.53	906.69	912.69	0.001590	9.12	21591.81	2962.63	0.45
Gila	Lower Gila	195.28	Low_Flow	95.00	892.60	892.92	892.92	893.08	0.027118	3.22	29.48	94.08	1.01
Gila	Lower Gila	195.28	Normal_Flow	118.00	892.60	892.96	892.96	893.15	0.027047	3.51	33.64	94.30	1.04
Gila	Lower Gila	195.22	5_year	23500.00	891.00	904.06	900.33	904.38	0.001042	4.52	5193.48	1717.87	0.32
Gila	Lower Gila	195.22	10_year	57000.00	891.00	905.25	903.17	905.65	0.001105	5.26	11405.12	1772.45	0.34
Gila	Lower Gila	195.22	100_year	227000.00	891.00	912.98	906.86	914.28	0.001360	9.48	24956.68	3836.15	0.43
Gila	Lower Gila	195.22	Typ Peak_year	6700.00	891.00	900.32	896.69	900.46	0.000997	2.95	2274.82	1343.86	0.29
Gila	Lower Gila	195.22	20_year	92000.00	891.00	907.22	904.71	907.82	0.001225	6.50	14811.12	1812.61	0.38
Gila	Lower Gila	195.22	50_year	185000.00	891.00	911.41	905.82	912.50	0.001329	8.70	22155.68	2436.48	0.42
Gila	Lower Gila	195.22	Low_Flow	95.00	891.00	892.57	891.65	892.60	0.000870	1.25	76.18	76.40	0.22
Gila	Lower Gila	195.22	Normal_Flow	118.00	891.00	892.71	891.75	892.74	0.000882	1.36	86.96	77.56	0.23
Gila	Lower Gila	195.21		Bridge									
Gila	Lower Gila	195.2	5_year	23500.00	891.00	903.78	900.49	904.13	0.001140	4.72	4974.25	1721.31	0.34
Gila	Lower Gila	195.2	10_year	57000.00	891.00	904.72	903.07	905.16	0.001258	5.47	10901.86	1766.43	0.37
Gila	Lower Gila	195.2	100_year	227000.00	891.00	912.57	906.67	913.90	0.001406	9.58	24669.55	3273.95	0.44
Gila	Lower Gila	195.2	Typ Peak_year	6700.00	891.00	899.99	896.72	900.17	0.001667	3.39	1976.74	1335.17	0.36
Gila	Lower Gila	195.2	20_year	92000.00	891.00	906.90	904.56	907.52	0.001249	6.54	14678.64	1811.54	0.38
Gila	Lower Gila	195.2	50_year	185000.00	891.00	911.02	905.63	912.14	0.001375	8.79	21909.87	1959.04	0.43
Gila	Lower Gila	195.2	Low_Flow	95.00	891.00	892.03	891.40	892.06	0.001041	1.34	71.08	73.50	0.24
Gila	Lower Gila	195.2	Normal_Flow	118.00	891.00	892.14	891.46	892.18	0.001119	1.48	79.67	74.51	0.25
Gila	Lower Gila	195.16	5_year	23500.00	891.00	900.97	900.97	903.40	0.010602	12.53	1875.51	1275.51	1.00
Gila	Lower Gila	195.16	10_year	57000.00	891.00	904.32	903.01	904.85	0.001661	5.75	9868.50	1706.99	0.41
Gila	Lower Gila	195.16	100_year	227000.00	891.00	912.12	906.89	913.57	0.001663	9.97	23572.16	3636.47	0.47
Gila	Lower Gila	195.16	Typ Peak_year	6700.00	891.00	899.46	896.14	899.82	0.001661	4.84	1383.76	870.06	0.39
Gila	Lower Gila	195.16	20_year	92000.00	891.00	906.49	903.01	907.22	0.001660	7.04	13567.29	1846.59	0.43
Gila	Lower Gila	195.16	50_year	185000.00	891.00	910.58	905.82	911.82	0.001661	9.21	20805.79	2349.57	0.46
Gila	Lower Gila	195.16	Low_Flow	95.00	891.00	891.77	891.34	891.80	0.001660	1.42	66.93	89.76	0.29
Gila	Lower Gila	195.16	Normal_Flow	118.00	891.00	891.87	891.39	891.91	0.001661	1.54	76.46	90.40	0.30

Tres Rios - Phase 3B

El Mirage Road Culvert Calculations

CHECKING PRINT STAMP

HNTB	Initials	Date
Made	GTC	11/4/11
Checked	JMB	11/4/11
Back-Checked		
Drafted		
Verified		

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Culvert Designer/Analyzer Report
El Mirage Existing North Culverts

Analysis Component			
Storm Event	Design	Discharge	90.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	90.00 cfs	Check Discharge	105.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	920.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	4-24 inch Circular	90.00 cfs	923.47 ft	7.94 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
El Mirage Existing North Culverts

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	923.47	ft	Discharge	90.00	cfs
Inlet Control HW Elev.	923.01	ft	Tailwater Elevation	920.00	ft
Outlet Control HW Elev.	923.47	ft	Control Type	Outlet Control	
Headwater Depth/Height	2.27				

Grades					
Upstream Invert	918.94	ft	Downstream Invert	919.62	ft
Length	80.00	ft	Constructed Slope	-0.008500	ft/ft

Hydraulic Profile					
Profile	CompositeA2PressureProfile		Depth, Downstream	1.69	ft
Slope Type	Adverse		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.69	ft
Velocity Downstream	7.94	ft/s	Critical Slope	0.009390	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev.	923.47	ft	Upstream Velocity Head	0.80	ft
Ke	0.50		Entrance Loss	0.40	ft

Inlet Control Properties					
Inlet Control HW Elev.	923.01	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	12.6	ft^2
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Designer/Analyzer Report
El Mirage Existing South Culverts

Analysis Component			
Storm Event	Design	Discharge	510.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	510.00 cfs	Check Discharge	510.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	917.67 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	8-48 inch Circular	510.00 cfs	919.82 ft	8.06 ft/s
Weir	Not Considered	N/A	N/A	N/A

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Culvert Designer/Analyzer Report
El Mirage Existing South Culverts

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	919.82	ft	Discharge	510.00	cfs
Inlet Control HW Elev.	919.47	ft	Tailwater Elevation	917.67	ft
Outlet Control HW Elev.	919.82	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.08				

Grades					
Upstream Invert	915.50	ft	Downstream Invert	915.50	ft
Length	57.00	ft	Constructed Slope	0.000000	ft/ft

Hydraulic Profile					
Profile	H2		Depth, Downstream	2.41	ft
Slope Type	Horizontal		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.41	ft
Velocity Downstream	8.06	ft/s	Critical Slope	0.014705	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	4.00	ft
Section Size	48 inch		Rise	4.00	ft
Number Sections	8				

Outlet Control Properties					
Outlet Control HW Elev.	919.82	ft	Upstream Velocity Head	0.49	ft
Ke	0.90		Entrance Loss	0.44	ft

Inlet Control Properties					
Inlet Control HW Elev.	919.47	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	100.5	ft^2
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Designer/Analyzer Report
El Mirage Proposed Culverts

Analysis Component			
Storm Event	Design	Discharge	510.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	510.00 cfs	Check Discharge	510.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	510.00 cfs	Bottom Elevation	918.00 ft
Depth	2.16 ft	Velocity	3.25 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	8-42 inch Circular	439.31 cfs	922.70 ft	8.11 ft/s
Weir	Roadway	70.80 cfs	922.70 ft	N/A
Total	----------	510.11 cfs	922.70 ft	N/A

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Culvert Designer/Analyzer Report
El Mirage Proposed Culverts

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	922.70	ft	Discharge	439.31	cfs
Inlet Control HW Elev.	922.07	ft	Tailwater Elevation	920.16	ft
Outlet Control HW Elev.	922.70	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.31				

Grades					
Upstream Invert	918.10	ft	Downstream Invert	918.00	ft
Length	90.00	ft	Constructed Slope	0.001111	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	2.32	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.32	ft
Velocity Downstream	8.11	ft/s	Critical Slope	0.016797	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	3.50	ft
Section Size	42 inch		Rise	3.50	ft
Number Sections	8				

Outlet Control Properties					
Outlet Control HW Elev.	922.70	ft	Upstream Velocity Head	0.51	ft
Ke	0.90		Entrance Loss	0.46	ft

Inlet Control Properties					
Inlet Control HW Elev.	922.07	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	77.0	ft^2
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Designer/Analyzer Report
El Mirage Proposed Culverts

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	70.80	cfs	Allowable HW Elevation	922.70	ft
Roadway Width	12.00	ft	Overtopping Coefficient	3.00	US
Low Point	922.00	ft	Headwater Elevation	922.70	ft
Discharge Coefficient (Cr)	3.00		Submergence Factor (Kt)	1.00	
Tailwater Elevation	920.16	ft			

Sta (ft)	Elev. (ft)
0.00	923.38
15.00	922.00
50.00	922.00
65.00	923.38

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Culvert Analysis Report
Weir

Hydraulic Component(s): Roadway

Discharge	70.80	cfs	Allowable HW Elevation	922.70	ft
Roadway Width	12.00	ft	Overtopping Coefficient	3.00	US
Low Point	922.00	ft	Headwater Elevation	922.70	ft
Discharge Coefficient (Cr)	3.00		Submergence Factor (Kt)	1.00	
Tailwater Elevation	920.16	ft			

Sta (ft)	Elev. (ft)
0.00	923.38
15.00	922.00
50.00	922.00
65.00	923.38

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Tres Rios - Phase 3B

El Mirage Road Overtopping – Riprap Calculations

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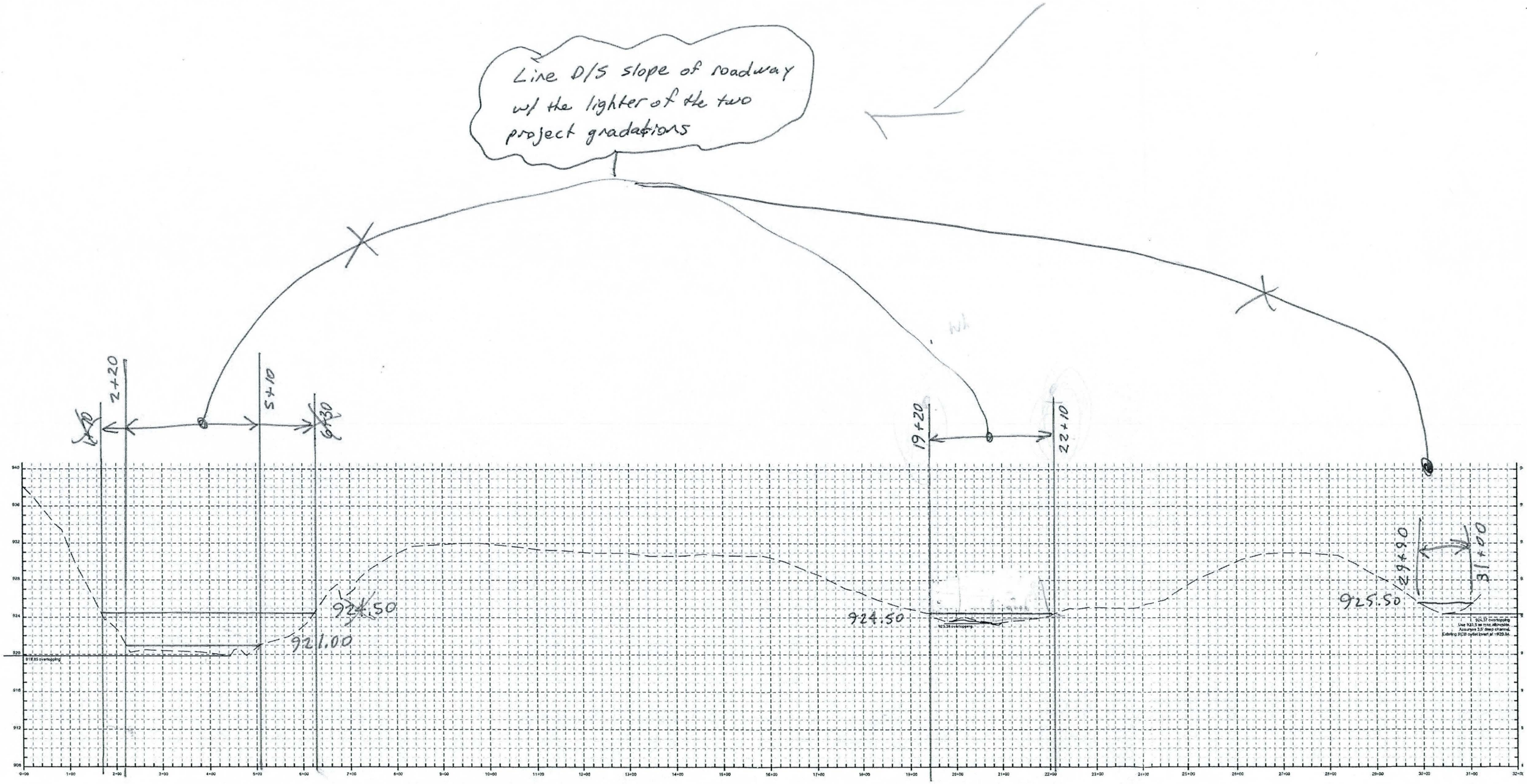
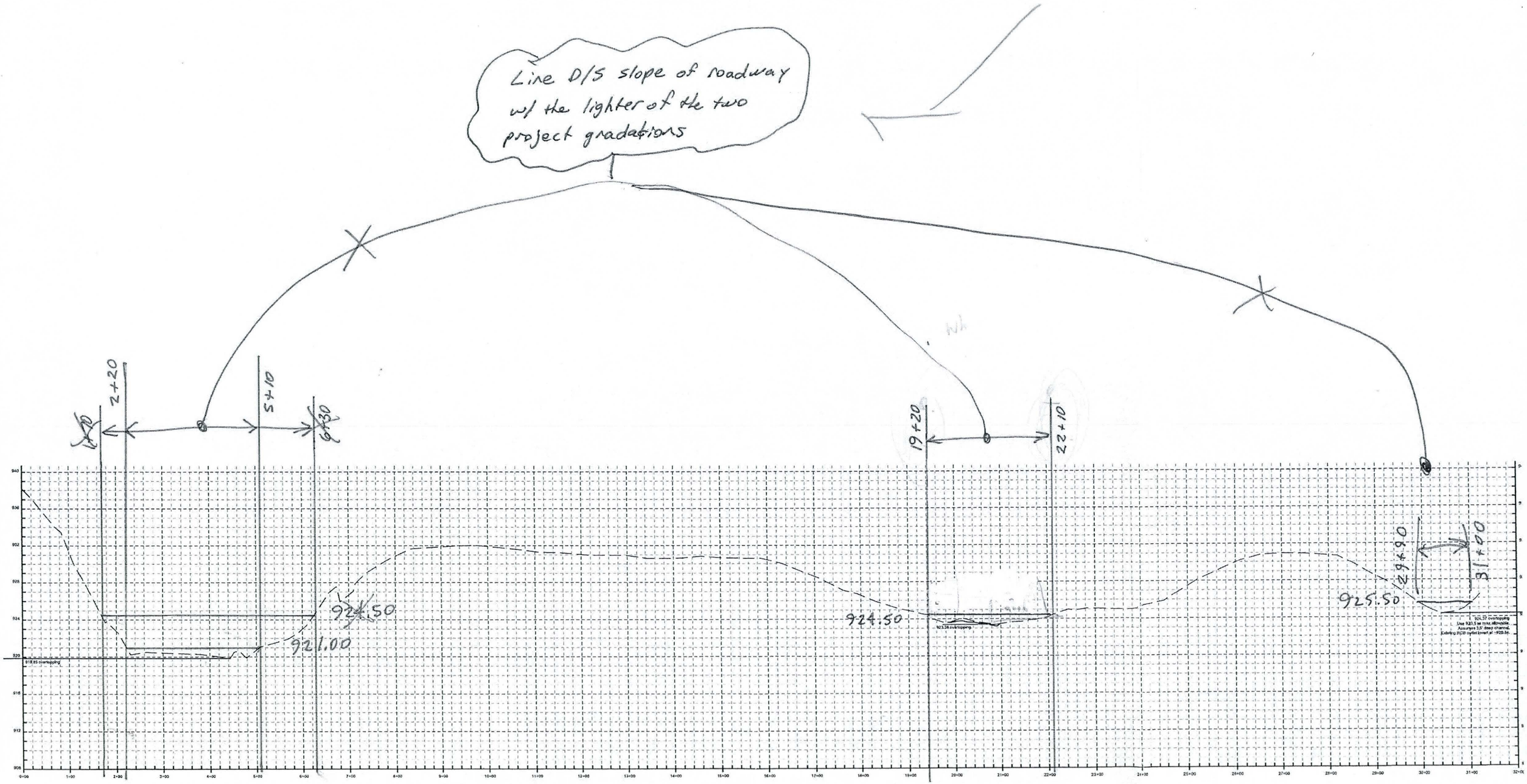
FOR TRES RIOS 3B



EL MIRAGE ROAD CENTERLINE PROFILE

CALCS BY JOHN PLANCETT
FOR TALES RIOS 3B



EL MIRAGE ROAD CENTERLINE PROFILE

HEC-11, Design of Riprap Revetment

Section 4.1.1.1

HECRAS XSEC 198.33 (El Mirage Road), 1-Year

INPUT						
	V_a	d_{avg}	Bank	Riprap	S_g	SF
	(ft/s)	(ft)	SLOPE	SLOPE		
	3.1	3.91	100.0:1	1.50:1	2.50	1.00
	avg	924.88	WSEL			1.60
		920.97	Min			2.00

OUTPUT							
θ	φ	K1	C_{eq}	C_{sf}		D_{50}	D_{50}
(degrees)	(degrees)					(ft)	(inches)
0.57	33.69	1.00	1.15		no Csg or Csf calc	0.02	0.18
				0.76	SF = 1.0	0.01	0.16
				1.54	SF = 1.6	0.03	0.32
				2.15	SF = 2.0	0.04	0.45

HECRAS XSEC 198.33 (El Mirage Road), 5-Year

INPUT						
	V_a	d_{avg}	Bank	Riprap	S_g	SF
	(ft/s)	(ft)	SLOPE	SLOPE		
	2.11	6.5	100.0:1	1.50:1	2.50	1.00
	avg	927.47	WSEL			1.60
		920.97	Min			2.00

OUTPUT							
θ	φ	K1	C_{eq}	C_{sf}		D_{50}	D_{50}
(degrees)	(degrees)					(ft)	(inches)
0.57	33.69	1.00	1.15		no Csg or Csf calc	0.00	0.04
				0.76	SF = 1.0	0.00	0.04
				1.54	SF = 1.6	0.01	0.08
				2.15	SF = 2.0	0.01	0.11

HECRAS XSEC 198.33 (El Mirage Road), 10-Year

INPUT						
	V_a	d_{avg}	Bank	Riprap	S_g	SF
	(ft/s)	(ft)	SLOPE	SLOPE		
	4.39	7.57	100.0:1	1.50:1	2.50	1.00
	avg	928.54	WSEL			1.60
		920.97	Min			2.00

OUTPUT							
θ	φ	K1	C_{eq}	C_{sf}		D_{50}	D_{50}
(degrees)	(degrees)					(ft)	(inches)
0.57	33.69	1.00	1.15		no Csg or Csf calc	0.03	0.37
				0.76	SF = 1.0	0.03	0.32
				1.54	SF = 1.6	0.05	0.66
				2.15	SF = 2.0	0.08	0.92

HEC-11, Design of Riprap Revetment

Section 4.1.1.1

HECRAS XSEC 198.33 (El Mirage Road), 1ft overtopping

INPUT						
	V_a	d_{avg}	Bank	Riprap	S_g	SF
	(ft/s)	(ft)	SLOPE	SLOPE		
	6.7	0.50	2.5:1	1.50:1	2.50	1.00
		brink depth ($0.715d_c$)				1.60
						2.00

OUTPUT							
θ	φ	K1	C_{eq}	C_{sf}		D_{50}	D_{50}
(degrees)	(degrees)					(ft)	(inches)
21.80	33.69	0.74	1.15		no Csg or Csf calc	0.66	7.97
				0.76	SF = 1.0	0.58	7.00
				1.54	SF = 1.6	1.18	14.17
				2.15	SF = 2.0	1.65	19.80

HECRAS XSEC 198.33 (El Mirage Road), 1.5ft overtopping

INPUT						
	V_a	d_{avg}	Bank	Riprap	S_g	SF
	(ft/s)	(ft)	SLOPE	SLOPE		
	8.2	0.75	2.5:1	1.50:1	2.50	1.00
		brink depth ($0.715d_c$)				1.60
						2.00

OUTPUT							
θ	φ	K1	C_{eq}	C_{sf}		D_{50}	D_{50}
(degrees)	(degrees)					(ft)	(inches)
21.80	33.69	0.74	1.15		no Csg or Csf calc	0.99	11.93
				0.76	SF = 1.0	0.87	10.48
				1.54	SF = 1.6	1.77	21.20
				2.15	SF = 2.0	2.47	29.63

HECRAS XSEC 198.33 (El Mirage Road), 2ft overtopping

INPUT						
	V_a	d_{avg}	Bank	Riprap	S_g	SF
	(ft/s)	(ft)	SLOPE	SLOPE		
	9.4	1.00	2.5:1	1.50:1	2.50	1.00
		brink depth ($0.715d_c$)				1.60
						2.00

OUTPUT							
θ	φ	K1	C_{eq}	C_{sf}		D_{50}	D_{50}
(degrees)	(degrees)					(ft)	(inches)
21.80	33.69	0.74	1.15		no Csg or Csf calc	1.30	15.57
				0.76	SF = 1.0	1.14	13.67
				1.54	SF = 1.6	2.31	27.66
				2.15	SF = 2.0	3.22	38.66

C	Correction Factor
V_a	Average Velocity in the Main Channel
d_{avg}	Average Flow Depth in the Main Flow Channel
Bank	Bank Slope with the Horizontal
Riprap	Riprap Material's Slope of Repose
S_g	Specific Gravity of the Rock Riprap
SF	Stability Factor to be Applied
θ	Bank Angle with the Horizontal
φ	Riprap Material's Angle of Repose
K1	Bank Angle Correction Factor
C_{eq}	Specific Gravity Correction Factor
C_{sf}	Stability Factor Correction Factor
D_{50}	Median Riprap Particle Size

HEC-RAS Plan: 3Bd River: Gila Reach: Lower Gila

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)	
Lower Gila	199.47	5_year	23500.00	921.58	934.73	928.65	934.94	0.000652	3.72	6857.10	2066.88	0.24
Lower Gila	199.47	10_year	57000.00	921.58	937.25	932.26	937.69	0.001260	5.70	13398.41	2750.39	0.33
Lower Gila	199.47	100_year	227000.00	921.58	943.60	939.43	944.61	0.001589	9.54	32141.90	3022.95	0.42
Lower Gila	199.47	Typ Peak_year	6700.00	921.58	931.92	925.81	931.96	0.000161	1.69	3960.20	1253.56	0.13
Lower Gila	199.47	20_year	92000.00	921.58	939.00	935.28	939.58	0.001544	6.90	18321.93	2889.65	0.37
Lower Gila	199.47	50_year	185000.00	921.58	942.60	938.47	943.45	0.001624	8.66	29141.56	3014.67	0.40
Lower Gila	199.38	5_year	23500.00	923.99	934.42	929.26	934.66	0.000629	3.99	6729.15	2021.54	0.29
Lower Gila	199.38	10_year	57000.00	923.99	936.60	932.77	937.12	0.001369	6.20	11913.25	2389.28	0.40
Lower Gila	199.38	100_year	227000.00	923.99	942.61	939.08	943.88	0.002048	10.35	28269.18	2855.68	0.50
Lower Gila	199.38	Typ Peak_year	6700.00	923.99	931.84	926.67	931.89	0.000160	1.87	3587.31	1099.09	0.14
Lower Gila	199.38	20_year	92000.00	923.99	938.08	935.41	938.86	0.001874	7.76	15651.46	2644.95	0.46
Lower Gila	199.38	50_year	185000.00	923.99	941.60	938.18	942.70	0.002056	9.60	25385.07	2827.85	0.48
Lower Gila	199.31	5_year	23500.00	925.00	934.26	930.09	934.45	0.000423	3.55	7488.81	2293.59	0.25
Lower Gila	199.31	10_year	57000.00	925.00	936.25	932.66	936.69	0.000802	5.76	12828.54	2478.46	0.35
Lower Gila	199.31	100_year	227000.00	925.00	942.25	937.94	943.26	0.000976	9.00	30197.32	2653.19	0.42
Lower Gila	199.31	Typ Peak_year	6700.00	925.00	931.78	928.15	931.82	0.000172	1.72	3984.03	1773.62	0.15
Lower Gila	199.31	20_year	92000.00	925.00	937.52	934.35	938.28	0.001193	7.69	15630.94	2534.24	0.43
Lower Gila	199.31	50_year	185000.00	925.00	941.22	937.13	942.10	0.000944	8.37	27488.55	2648.47	0.41
Lower Gila	199.21	5_year	23500.00	925.00	933.89	931.28	934.10	0.001238	3.70	6323.75	2553.59	0.30
Lower Gila	199.21	10_year	57000.00	925.00	936.06	932.99	936.24	0.000666	3.49	17288.54	2557.96	0.23
Lower Gila	199.21	100_year	227000.00	925.00	941.89	935.97	942.64	0.001310	7.34	32928.63	2569.65	0.36
Lower Gila	199.21	Typ Peak_year	6700.00	925.00	931.58	930.21	931.65	0.000925	2.06	3251.95	2548.97	0.23
Lower Gila	199.21	20_year	92000.00	925.00	937.25	934.06	937.58	0.001046	4.86	20170.45	2560.33	0.30
Lower Gila	199.21	50_year	185000.00	925.00	940.83	935.42	941.49	0.001293	6.89	28895.11	2567.53	0.35
Lower Gila	199.19		Mult Open									
Lower Gila	199.18	5_year	23500.00	922.00	931.81	930.13	932.09	0.002398	4.46	5604.45	2707.31	0.40
Lower Gila	199.18	10_year	57000.00	922.00	934.87	931.80	935.18	0.001309	4.87	13506.68	2852.41	0.33
Lower Gila	199.18	100_year	227000.00	922.00	940.74	935.48	941.75	0.002001	9.07	29687.04	2898.33	0.45
Lower Gila	199.18	Typ Peak_year	6700.00	922.00	928.86	927.83	929.19	0.005265	4.58	1452.67	1271.12	0.54
Lower Gila	199.18	20_year	92000.00	922.00	936.40	933.12	936.81	0.001442	5.84	18949.62	2864.16	0.35
Lower Gila	199.18	50_year	185000.00	922.00	939.87	934.93	940.65	0.001705	7.99	27531.95	2891.32	0.41
Lower Gila	199.11	5_year	23500.00	922.00	931.43	927.73	931.65	0.000936	3.86	7066.29	2490.71	0.30
Lower Gila	199.11	10_year	57000.00	922.00	934.37	930.56	934.79	0.001244	5.51	12608.25	2764.13	0.35
Lower Gila	199.11	100_year	227000.00	922.00	940.36	934.98	941.30	0.001077	8.50	30657.04	2828.14	0.41
Lower Gila	199.11	Typ Peak_year	6700.00	922.00	928.75	924.77	928.82	0.000398	2.22	3184.04	1751.04	0.20
Lower Gila	199.11	20_year	92000.00	922.00	936.08	932.20	936.48	0.000933	5.42	19994.69	2800.24	0.31
Lower Gila	199.11	50_year	185000.00	922.00	939.50	934.98	940.25	0.001068	7.50	28502.97	2820.22	0.37
Lower Gila	199.06	5_year	23500.00	922.00	931.22	928.30	931.46	0.000761	4.17	6597.43	2336.38	0.33
Lower Gila	199.06	10_year	57000.00	922.00	934.07	930.68	934.54	0.001001	5.85	11355.67	2488.01	0.38
Lower Gila	199.06	100_year	227000.00	922.00	939.77	935.10	941.01	0.001364	9.76	26138.32	2563.39	0.47
Lower Gila	199.06	Typ Peak_year	6700.00	922.00	928.62	924.68	928.73	0.000463	2.74	2644.11	1784.86	0.26
Lower Gila	199.06	20_year	92000.00	922.00	935.78	932.23	936.28	0.000921	6.26	17429.75	2525.78	0.36
Lower Gila	199.06	50_year	185000.00	922.00	939.03	935.00	939.99	0.001197	8.64	24518.26	2552.18	0.43
Lower Gila	199.02	5_year	23500.00	922.00	931.05	927.50	931.35	0.000776	4.39	5889.40	2545.27	0.34
Lower Gila	199.02	10_year	57000.00	922.00	933.83	930.35	934.37	0.001138	6.24	11727.42	2788.14	0.39
Lower Gila	199.02	100_year	227000.00	922.00	939.71	934.98	940.77	0.001175	9.34	28919.09	2883.34	0.44
Lower Gila	199.02	Typ Peak_year	6700.00	922.00	928.60	924.25	928.67	0.000254	2.21	3264.64	1772.99	0.20
Lower Gila	199.02	20_year	92000.00	922.00	935.60	932.04	936.13	0.001022	6.57	18751.09	2845.67	0.37
Lower Gila	199.02	50_year	185000.00	922.00	938.91	934.86	939.79	0.001170	8.57	26936.84	2867.14	0.42
Lower Gila	198.99	5_year	23500.00	922.00	930.99	927.28	931.26	0.000748	4.19	5925.19	2329.42	0.33
Lower Gila	198.99	10_year	57000.00	922.00	933.77	930.31	934.23	0.001040	5.77	12727.02	2787.28	0.37
Lower Gila	198.99	100_year	227000.00	922.00	939.57	934.90	940.63	0.001215	9.25	28626.83	2948.59	0.44
Lower Gila	198.99	Typ Peak_year	6700.00	922.00	928.57	924.30	928.64	0.000238	2.14	3286.84	1845.73	0.20
Lower Gila	198.99	20_year	92000.00	922.00	935.49	932.00	936.02	0.001062	6.46	18386.06	2910.05	0.37
Lower Gila	198.99	50_year	185000.00	922.00	938.77	934.45	939.65	0.001218	8.48	26623.90	2935.75	0.42
Lower Gila	198.97	5_year	23500.00	926.00	930.15	929.35	930.82	0.006234	6.65	3709.00	2272.64	0.67
Lower Gila	198.97	10_year	57000.00	926.00	933.23	931.33	933.83	0.002934	6.70	10464.22	2699.44	0.49
Lower Gila	198.97	100_year	227000.00	926.00	939.25	934.80	940.31	0.001485	8.94	28023.29	2981.31	0.46
Lower Gila	198.97	Typ Peak_year	6700.00	926.00	927.92	927.77	928.43	0.008917	5.86	1249.69	1605.00	0.89
Lower Gila	198.97	20_year	92000.00	926.00	935.18	932.26	935.70	0.001686	6.18	17330.00	2948.67	0.39
Lower Gila	198.97	50_year	185000.00	926.00	938.46	934.76	939.32	0.001565	8.06	25932.88	2970.49	0.43
Lower Gila	198.93	5_year	23500.00	920.00	930.20	925.59	930.43	0.000467	3.94	6612.19	2150.43	0.26
Lower Gila	198.93	10_year	57000.00	920.00	933.20	928.77	933.51	0.000527	5.03	15854.40	2684.95	0.28
Lower Gila	198.93	100_year	227000.00	920.00	939.16	934.05	940.00	0.000850	8.88	33608.03	2979.52	0.39
Lower Gila	198.93	Typ Peak_year	6700.00	920.00	928.17	922.31	928.21	0.000111	1.65	4236.70	1773.51	0.13
Lower Gila	198.93	20_year	92000.00	920.00	935.03	930.66	935.45	0.000634	6.10	21488.38	2896.99	0.31
Lower Gila	198.93	50_year	185000.00	920.00	938.33	932.99	939.03	0.000795	8.08	31148.61	2960.36	0.37

HEC-RAS Plan: 3Bd River: Gila Reach: Lower Gila (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)	
Lower Gila	198.33	100_year	227000.00	920.97	933.90	930.38	935.13	0.001879	9.25	25890.54	3876.92	0.50
Lower Gila	198.33	Typ Peak_year	6700.00	920.97	924.88	923.54	925.01	0.001760	3.10	2703.32	1686.52	0.36
Lower Gila	198.33	20_year	92000.00	920.97	929.44	927.32	930.39	0.002292	6.56	13751.08	2319.88	0.46
Lower Gila	198.33	50_year	185000.00	920.97	932.86	929.72	934.03	0.002082	8.57	22638.89	3349.62	0.48
Lower Gila	198.26	5_year	23500.00	919.00	927.33	923.25	927.48	0.000616	2.98	7649.73	2931.26	0.24
Lower Gila	198.26	10_year	57000.00	919.00	928.47	925.56	928.74	0.000665	3.51	14207.16	3069.35	0.26
Lower Gila	198.26	100_year	227000.00	919.00	933.57	929.18	934.56	0.001490	8.55	28746.89	5117.81	0.46
Lower Gila	198.26	Typ Peak_year	6700.00	919.00	924.79	921.22	924.83	0.000241	1.44	4161.43	2334.17	0.15
Lower Gila	198.26	20_year	92000.00	919.00	929.22	927.19	929.76	0.001314	5.37	15975.56	3218.17	0.37
Lower Gila	198.26	50_year	185000.00	919.00	932.59	928.34	933.42	0.001424	7.54	25533.66	4233.96	0.42
Lower Gila	198.2	5_year	23500.00	917.83	927.04	924.48	927.24	0.000741	1.75	8169.89	3020.83	0.15
Lower Gila	198.2	10_year	57000.00	917.83	928.27	926.97	928.51	0.000695	2.08	16132.77	3197.15	0.16
Lower Gila	198.2	100_year	227000.00	917.83	933.26	928.38	934.06	0.001255	7.34	31598.54	5411.02	0.40
Lower Gila	198.2	Typ Peak_year	6700.00	917.83	924.49	922.47	924.62	0.003361	2.95	2269.60	2436.65	0.28
Lower Gila	198.2	20_year	92000.00	917.83	928.82	926.98	929.32	0.001322	3.51	17570.92	3262.36	0.25
Lower Gila	198.2	50_year	185000.00	917.83	932.26	928.09	932.94	0.001282	6.10	28095.28	5260.07	0.35
Lower Gila	198.15	5_year	23500.00	918.06	926.04	924.29	926.56	0.006191	5.81	4042.52	2910.13	0.53
Lower Gila	198.15	10_year	57000.00	918.06	927.09	926.08	927.93	0.003196	5.00	8763.41	3018.86	0.41
Lower Gila	198.15	100_year	227000.00	918.06	933.00	927.62	933.61	0.000802	6.02	36386.18	7958.11	0.33
Lower Gila	198.15	Typ Peak_year	6700.00	918.06	922.80	921.77	923.18	0.004434	4.97	1347.47	2108.98	0.57
Lower Gila	198.15	20_year	92000.00	918.06	928.56	926.85	928.88	0.000700	3.08	21252.05	3206.84	0.22
Lower Gila	198.15	50_year	185000.00	918.06	931.99	927.26	932.50	0.000763	5.10	32692.08	3921.46	0.29
Lower Gila	198.08	5_year	23500.00	917.90	925.09	923.16	925.68	0.002336	6.18	3801.90	2295.58	0.52
Lower Gila	198.08	10_year	57000.00	917.90	926.49	925.21	927.19	0.002494	6.95	8791.68	2708.85	0.55
Lower Gila	198.08	100_year	227000.00	917.90	932.48	928.25	933.34	0.001231	8.12	32409.01	8424.09	0.44
Lower Gila	198.08	Typ Peak_year	6700.00	917.90	922.10	920.70	922.38	0.002369	4.23	1582.79	1401.40	0.47
Lower Gila	198.08	20_year	92000.00	917.90	928.12	926.16	928.63	0.001267	5.91	16912.39	2946.30	0.41
Lower Gila	198.08	50_year	185000.00	917.90	931.50	927.47	932.24	0.001192	7.50	28648.72	4365.28	0.42
Lower Gila	198.03	5_year	23500.00	917.47	923.66	922.76	924.78	0.004866	8.51	2763.01	2291.97	0.74
Lower Gila	198.03	10_year	57000.00	917.47	926.37	924.01	926.71	0.000943	4.14	14340.67	3072.55	0.34
Lower Gila	198.03	100_year	227000.00	917.47	932.32	927.16	933.01	0.000918	6.96	36572.24	8747.85	0.38
Lower Gila	198.03	Typ Peak_year	6700.00	917.47	921.25	920.40	921.65	0.003327	5.03	1332.14	1435.83	0.56
Lower Gila	198.03	20_year	92000.00	917.47	927.93	924.07	928.32	0.000915	4.87	20225.85	3280.39	0.35
Lower Gila	198.03	50_year	185000.00	917.47	931.33	926.78	931.93	0.000885	6.39	32577.14	4399.07	0.37
Lower Gila	197.98	5_year	23500.00	915.60	923.08	922.22	923.91	0.004355	7.32	3208.66	2135.70	0.70
Lower Gila	197.98	10_year	57000.00	915.60	926.31	923.51	926.57	0.000494	3.23	15337.05	3038.39	0.25
Lower Gila	197.98	100_year	227000.00	915.60	932.23	926.92	932.85	0.000710	6.39	39358.43	9271.91	0.34
Lower Gila	197.98	Typ Peak_year	6700.00	915.60	919.75	919.75	920.64	0.011588	7.54	888.77	1121.34	1.00
Lower Gila	197.98	20_year	92000.00	915.60	927.84	923.51	928.18	0.000580	4.13	22031.65	3495.93	0.28
Lower Gila	197.98	50_year	185000.00	915.60	931.25	925.48	931.78	0.000651	5.75	35229.50	4714.70	0.32
Lower Gila	197.95	5_year	23500.00	912.14	923.19	919.51	923.50	0.000860	4.44	5293.61	2311.63	0.33
Lower Gila	197.95	10_year	57000.00	912.14	926.25	922.40	926.48	0.000565	3.98	15267.73	3178.30	0.28
Lower Gila	197.95	100_year	227000.00	912.14	932.14	926.63	932.73	0.000739	7.00	40302.23	9291.49	0.35
Lower Gila	197.95	Typ Peak_year	6700.00	912.14	919.42	916.62	919.56	0.000806	3.06	2191.18	1220.59	0.30
Lower Gila	197.95	20_year	92000.00	912.14	927.77	923.51	928.08	0.000618	4.77	22925.61	3432.00	0.30
Lower Gila	197.95	50_year	185000.00	912.14	931.17	925.47	931.66	0.000680	6.35	36059.77	4688.97	0.34
Lower Gila	197.92	5_year	23500.00	912.14	922.95	919.35	923.27	0.000870	4.57	5146.56	2221.88	0.34
Lower Gila	197.92	10_year	57000.00	912.14	926.05	922.13	926.32	0.000679	4.46	14503.25	2975.55	0.31
Lower Gila	197.92	100_year	227000.00	912.14	931.90	926.44	932.52	0.000817	7.31	38990.22	4939.39	0.37
Lower Gila	197.92	Typ Peak_year	6700.00	912.14	919.19	916.16	919.34	0.000878	3.11	2152.85	976.77	0.30
Lower Gila	197.92	20_year	92000.00	912.14	927.57	923.51	927.90	0.000711	5.10	21599.63	3312.15	0.32
Lower Gila	197.92	50_year	185000.00	912.14	930.96	925.97	931.47	0.000747	6.62	34734.37	4626.46	0.35
Lower Gila	197.87	5_year	23500.00	912.14	922.56	919.73	922.92	0.001337	4.80	4900.22	1898.43	0.37
Lower Gila	197.87	10_year	57000.00	912.14	925.70	922.14	926.04	0.001002	5.08	13107.22	2864.25	0.34
Lower Gila	197.87	100_year	227000.00	912.14	931.47	926.79	932.20	0.001061	8.13	36776.42	7875.05	0.41
Lower Gila	197.87	Typ Peak_year	6700.00	912.14	918.69	916.14	918.92	0.001940	3.86	1734.13	710.20	0.38
Lower Gila	197.87	20_year	92000.00	912.14	927.18	923.51	927.61	0.001017	5.92	19116.32	3189.60	0.36
Lower Gila	197.87	50_year	185000.00	912.14	930.54	925.63	931.18	0.001008	7.49	32354.31	7023.36	0.39
Lower Gila	197.81	5_year	23500.00	912.13	922.21	919.10	922.54	0.001180	4.61	5096.70	2070.33	0.36
Lower Gila	197.81	10_year	57000.00	912.13	925.46	921.75	925.79	0.000728	5.04	13740.99	2713.46	0.31
Lower Gila	197.81	100_year	227000.00	912.13	931.17	926.33	931.90	0.000981	8.41	38695.79	9316.61	0.40
Lower Gila	197.81	Typ Peak_year	6700.00	912.13	918.26	915.94	918.48	0.001189	3.81	1759.23	703.32	0.34
Lower Gila	197.81	20_year	92000.00	912.13	926.92	923.07	927.34	0.000821	6.00	20045.41	3090.64	0.34
Lower Gila	197.81	50_year	185000.00	912.13	930.25	925.53	930.89	0.000931	7.80	33758.48	9051.94	0.38
Lower Gila	197.75	5_year	23500.00	911.90	922.04	918.21	922.28	0.000644	3.86	6089.28	2337.28	0.28
Lower Gila	197.75	10_year	57000.00	911.90	925.41	920.63	925.60	0.000377	3.95	18099.70	2860.81	0.23
Lower Gila	197.75	100_year	227000.00	911.90	931.08	925.31	931.62	0.000671	7.30	44770.81	9566.98	0.33
Lower Gila	197.75	Typ Peak_year	6700.00	911.90	918.03	914.99	918.16	0.000947	2.96	2261.77	872.80	0.30

4. DESIGN GUIDELINES FOR ROCK RIPRAP

As defined in chapter 2, rock riprap consists of a well graded mixture of rock, broken concrete, or other material, dumped or hand placed to prevent erosion, scour, or sloughing of a structure or embankment. In the context of this chapter, the term rock riprap is used to refer to both rock and rubble riprap.

Rock riprap is the most widely used and desirable type of revetment in the United States. The term "riprap" connotes rock riprap. The effectiveness of rock riprap has been well established where it is properly installed, of adequate size and suitable gradation. Riprap materials include quarry-run rock, rubble, or other locally available materials. Performance characteristics of rock and rubble riprap are reviewed in section 2.1.1.

This chapter contains design guidelines for the design of rock riprap. Guidelines are provided for rock size, rock gradation, riprap layer thickness, filter design, material quality, edge treatment, and construction considerations. In addition, typical construction details are illustrated. In most cases, the guidelines presented apply equally to rock and rubble riprap. Sample specifications for rock riprap are included in appendix A.

4.1 ROCK SIZE

The stability of a particular riprap particle is a function of its size, expressed either in terms of its weight or equivalent diameter. In the following sections, relationships are presented for evaluating the riprap size required to resist particle and wave erosion forces.

4.1.1 Particle Erosion

In chapter 1, riprap failure modes were identified as particle erosion, translational slide, modified slump, and slump. Translational slide, modified slump, and slump are slope or soils processes. Particle erosion is a hydraulic phenomenon which results when the tractive force exerted by the flowing water exceeds the riprap materials ability to resist motion. It is this process that the riprap design relationships presented in this section were developed for.

Two methods or approaches have been used historically to evaluate a materials resistance to particle erosion. These methods are the permissible velocity approach and the permissible tractive force (shear stress) approach. Under the permissible velocity approach the channel is assumed stable if the computed mean velocity is lower than the maximum permissible velocity. The tractive force (boundary shear stress) approach focuses on stresses developed at the interface between flowing water and materials forming the channel boundary. By Chow's definition, permissible tractive force is the maximum unit tractive force that will not cause serious erosion of channel bed material from a level channel bed (9). Permissible tractive force methods are generally considered to be more academically correct; however, critical velocity approaches are more readily embraced by the engineering community.

Equation 6 is based on a rock riprap specific gravity of 2.65, and a stability factor of 1.2. Equations 8 and 9 present correction factors for other specific gravities and stability factors.

$$C_{sg} = 2.12 / (S_s - 1)^{1.5} \tag{8}$$

where

S_s = the specific gravity of the rock riprap.

$$C_{sf} = (SF / 1.2)^{1.5} \tag{9}$$

where

SF = the stability factor to be applied.

The correction factors computed using equations 8 and 9 are multiplied together to form a single correction factor C. This correction factor, C, is then multiplied by the riprap size computed from equation 6 to arrive at a stable riprap size. Chart 2 in appendix C provides a solution to equations 8 and 9 using correction factor C.

The stability factor, SF, used in equations 6 and 9 requires additional explanation. The stability factor is defined as the ratio of the average tractive force exerted by the flow field and the riprap materials critical shear stress. As long as the stability factor is greater than 1, the critical shear stress of the material is greater than the flow induced tractive stress, the riprap is considered to be stable. As mentioned above, a stability factor of 1.2 was used in the development of equation 6.

The stability factor is used to reflect the level of uncertainty in the hydraulic conditions at a particular site. Equation 6 is based on the assumption of uniform or gradually varying flow. In many instances, this assumption is violated or other uncertainties come to bear. For example, debris and/or ice impacts, or the cumulative effect of high shear stresses and forces from wind and/or boat generated waves. The stability factor is used to increase the design rock size when these conditions must be considered. Table 1 presents guidelines for the selection of an appropriate value for the stability factor.

Table 1. Guidelines for the selection of stability factors

Condition	Stability Factor Range
Uniform flow; Straight or mildly curving reach (curve radius/ channel width > 30); Impact from wave action and floating debris is minimal; Little or no uncertainty in design parameters.	1.0 - 1.2
Gradually varying flow; Moderate bend curvature (30 > curve radius/channel width > 10); Impact from waves or floating debris moderate.	1.3 - 1.6
Approaching rapidly varying flow; Sharp bend curvature (10 > curve radius/channel width); Significant impact potential from floating debris and/or ice; Significant wind and/or boat generated waves (1 - 2 ft (.30 - .61 m)); High flow turbulence; Turbulently mixing flow at bridge abutments; Significant uncertainty in design parameters.	1.6 - 2.0

To calculate V, first determine the velocity of flow just upstream of the pier. This may be approximated by the velocity in the contracted section. Then multiply this value by a factor of 1.5 to 2.0 to approximate the velocity of flow at the base of the pier. Please note that preliminary research by FHWA indicates that a factor of about 1.5 may be a reasonable design value.

- o Provide a mat width that extends horizontally at least two times the pier width measured from the pier face.

- o Place the mat below the streambed a depth equivalent to the expected scour. The thickness should be three stone diameters or more.

Abutments: When applying equation 6 for riprap design at abutments a velocity in the vicinity of the abutment should be used instead of the average section velocity. The velocity in the vicinity of bridge abutments is a function of both the abutment type (vertical, wingwalled, or spillthrough), and the amount of constriction caused by the bridge. However, information documenting velocities in the vicinity of bridge abutments is currently unavailable. Until such information becomes available, it is recommended that equation 6 be used with a stability factor of 1.6 to 2.0 for turbulently mixing flow at bridge abutments.

Please take note that the average velocity and depth used in equation 6 for riprap design at bridge constrictions for abutment protection is the average velocity and depth in the constricted cross section at the bridge. Flow profiles at bridge sections are nonuniform as indicated in Figure 17. The recommended procedure for computing the average depth and velocity at bridge constrictions is:

1. Model the reach in the vicinity of the crossing using WSPRO (38), HEC-2 (39), or some other model with bridge loss routines.

2. Compute the average depth and velocity in the constriction as the average of the depth and velocity for modeled cross sections at the entrance to, and exit from the bridge constriction (in the vicinity of cross sections 2 and 3 as illustrated in Figure 18).

In instances where resources are not available to model flow conditions at the constriction as indicated above, normal depth and its associated flow velocity for the constricted section can be used.

As outlined above, the average section flow depth and velocity used in equation 6 are main channel values. The main channel is typically defined as the area between the channel banks (see Figure 17). However, when the bridge abutments are located on the floodplain a sufficient distance from the natural channel banks so as not to be influenced by main channel flows, the average depth and velocity on the floodplain within the constricted section should be used in the riprap design relationship. Most standard computerized bridge backwater routines provide the necessary depths and velocities as a part of their standard output. If hand normal depth computations are being used, the computations must consider conveyance weighted effects of both floodplain, and main channel flows. See reference 5 or standard open channel hydraulics texts for appropriate procedures.

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