DESERT DRIVE AREA STUDY
VOLUME II

Existing Conditions
Inundation and Sedimentation Analysis
for PVR Structures

Book 1 – Main Report

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ENCLOSED DATA CD

- **Digital Copy of Report and Maps in PDF Format**
- **GIS Shapefile Coverages of FLO-2D Project Elements**
- **FLO-2D Model Input and Output Files**
- **Inflow HEC-1 Model Input and Output Files**
- **Emergency Spillway HEC-RAS Data Files**

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SECTION 1: INTRODUCTION

1.1 General

The Desert Drive Area (DDA) is State Trust Land (STL) that is generally located within Pinal County, south of Apache Junction, and bounded by Elliot Road on the North, U.S. Highway 60 on the East, Germann Road on the South, and Meridian Drive on the West. Figure 1.1 depicts the DDA boundaries in context with the surrounding area. The total DDA encompasses approximately 43 square miles and is primarily undeveloped desert. The western two-thirds of the site is leased to cattle ranchers and stock tanks are numerous across the entire project area. A portion of the eastern DDA, known as the Desert Wells Multi-Use Area, is leased by the Arizona Game and Fish Department and is comprised of a network of trails for off-road vehicles, horseback riding, mountain biking and hiking. A small portion of land at the extreme southeast corner of the DDA is home the Renaissance Festival. The Central Arizona Project Canal transects the middle portion of DDA in a northwest-southeast alignment. Three Flood Retarding Structures (FRS): Powerline, Vineyard and Rittenhouse, are located upland of the CAP and are owned and maintained by the Flood Control District of Maricopa County (District). The prevailing drainage pattern across the site is from the northeast to the southwest.

1.2 Study Purpose and Scope

The purpose of the Desert Drive Area Study is to identify key drainage, environmental, and geotechnical constraints for the evaluation of potential land-uses of DDA, and for providing existing conditions, baseline watershed hydrology and inundation information for the Powerline, Vineyard, and Rittenhouse FRS (PVR Structures). This work was performed in two phases. The first phase involved acquiring new two-foot contour interval mapping for DDA and preparing new HEC-1 watershed models using current land-use and District methodologies. The second phase of work included: updating and refining the new watershed hydrology to reflect diversions at Weekes Wash and the Superstition Freeway, new topography and survey information for the PVR Structures, fully dynamic, two-dimensional modeling of the discharges that enter the PVR Structures, sediment yield analysis for the FRS, environmental evaluations, and a geotechnical assessment.

The drainage analyses are presented in two volumes. Volume I (under separate cover) documents the existing conditions HEC-1 modeling, including the Weekes Wash breakout and Superstition Freeway diversions, and updated stage-discharge relations for the PVR structures. Volume I also supersedes the previous draft existing conditions hydrology report submitted to ASLD in December 2006 entitled;

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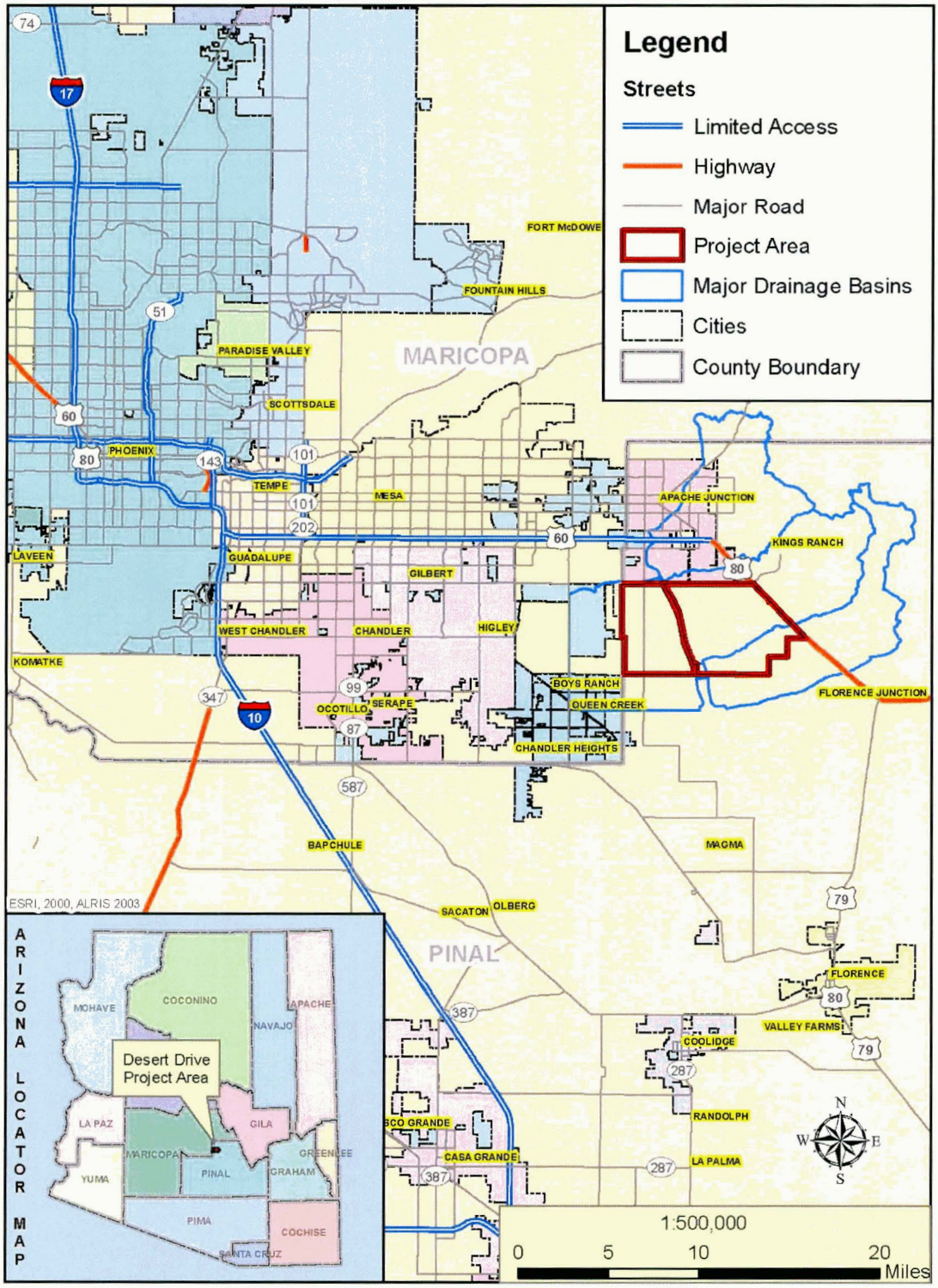

Figure 1.1

Project vicinity map

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Desert Drive Area Study – Phase 1- Hydrologic Report - PRELIMINARY FINAL. Volume II (this report) documents the sediment yield and two-dimensional modeling results, as described below:

1.2.1 Sediment Yield

Sediment yield is the volume of soil material and stream sediment transported from a watershed through its stream network. Sediment yield is an important design parameter for flood control structures because sediment deposition in dams, reservoirs, or floodways reduces the storage or hydraulic capacity. Reduced capacity of flood control structures increases the likelihood of overtopping during floods which increases the chance of injuries, damage to the structure itself, downstream property damage, and even loss of human life. The objective of the sediment yield analysis for this study is to provide annual yield volumes that can be used for future alternative analyses.

1.2.2 Two-Dimensional Inundation Analysis

Runoff approaching and flowing along the PVR Structures is difficult to accurately model using hydrologic routing techniques that cannot take into account the hydraulic properties of momentum and diffusion that occur along structures like these. Also, the interconnected character of the PVR Structures further complicates analyses. In response, ASLD elected to develop a two-dimensional, fully dynamic flood routing model of all three structures to determine the existing condition inundation limits and to evaluate the operational characteristics of the PVR Structures for the 100-year, 24-hour, and 72-hour, full and half PMF events.

1.3 Project Authorization

The project work summarized in this report was prepared as a part of the Desert Drive Area Phase II contract authorized by the Arizona State Land Department and dated December 26, 2006.

1.4 Previous Studies

Several prior hydrologic studies have been completed for the watershed area. These include:

- U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS) (Natural Resources Conservation Service (NRCS)), 1963, *Design of Powerline, Vineyard and Rittenhouse FRS- Watershed Work Plans for Apache Junction-Gilbert and Williams-Chandler Watersheds.* (NRCS, 1963)
- Soil Conservation Service (Natural Resources Conservation Service (NRCS)), 1985, *Study for Weekes Wash.* (NRCS, November, 1985)

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- A-N West, 1987, *Superstition Freeway Comprehensive Offsite Drainage Plan.* (A-N West, 1987)
- Tudor Engineering Company, 1989, *Final Drainage Study Report for Superstition Freeway (SR360) – Ironwood Drive to U.S. 60.*
- Plasencia, D., Rice. V., FCDMC, 1989, *Hydrologic Analysis of the Powerline FRS*
- James M. Montgomery (JMM) Consulting Engineers, 1989, *Dambreak Analyses for Powerline, Vineyard, and Rittenhouse Flood Retarding Structures,* FCD 88-37.
- Flood Control District of Maricopa County, 1998, *East Mesa Area Drainage Master Plan-Hydrologic Analysis.*
- Kimley-Horn and Associates, Inc., 2000, *Individual Structures Assessment Reports, Cave Buttes Dam, Powerline FRS, Vineyard Road FRS, Rittenhouse FRS,* Structures Assessment Program-Phase I, Flood Control District of Maricopa County, FCD 98-41.
- Michael Baker Jr., Inc., 2002, *Spillway Inundation Study for Powerline, Vineyard and Rittenhouse FRS.*
- J.E. Fuller Hydrology & Geomorphology, Inc., 2006, *Emergency Action Plan Final Report for Powerline, Vineyard and Rittenhouse Flood Retarding Structures*, FCD-2004C044.

Several documents were supplied by the Arizona State Land Department (ASLD) for review and background to this project. These include:

- HydroLogic Consultants, 2004, *The City of Apache Junction Comprehensive Plan water Resources Element, Technical Background Report, Hydrogeologic Conditions.*
- Kimley-Horn & Associates, 2002, *Stormwater Master Plan City of Apache Junction Hydrology Report Volume One and Volume Two.*
- Kirkham Michael, 2004, *Small Area Transportation Study*, City of Apache Junction.
- Maricopa Association of Governments (MAG), 2003, *Southeastern Maricopa/North Pinal County Area Transportation Study, Final Report.*
- URS, 2006, *Draft Drainage Master Plan Report for Lost Dutchman Heights, Parcel A,* Arizona State Land Department.
- Kimley-Horn & Associates, 2006,*Final Drainage Report-Ironwood Drive/Ocotillo Road/US 60 Phase A,* Pinal County Department of Public Works.

1.5 Hydrologic Modeling Background and History

The original design of the PVR Structures was based on the Watershed Work Plans for the Apache Junction-Gilbert Watersheds and Williams-Chandler Watersheds dated 1963. Subsequent changes were made to the original locations based on planning of the Central Arizona Project (CAP) Canal alignment. The Powerline FRS was constructed in March 1967 followed by Vineyard FRS in July

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1968 and the completion of Rittenhouse FRS in 1969. The dams were constructed to provide flood and erosion protection to the agricultural and urban areas downstream. The original hydrology for the dams was developed using TR20, and to-date, no electronic version of the original hydrologic model is known to exist. Paper copies of the TR20 models are available at the District.

In 1985, the SCS (now NRCS) conducted a hydrologic analysis of the existing Powerline FRS as a part of an alternatives analysis, using TR20. The SCS concluded that the Powerline FRS would not safely pass the design freeboard storm, even if a dam were constructed on Weekes Wash. In 1989, the District converted the SCS TR20 model to HEC-1 and included modeling parameters to reflect the breakout from Weekes Wash and the newly constructed Superstition Freeway drainage facilities.

In 1989, James M. Montgomery Consulting Engineers, Inc. (JMM) performed HEC-1 modeling for the watersheds contributing to each of the three FRSs. The models for Vineyard and Rittenhouse were originals developed by JMM for the study. The Powerline model was adapted from earlier work by the District (Rice & Plasencia, 1989). All of the models used SCS methods for computation of rainfall losses and unit hydrographs. Channel routings were performed using the Muskingum method. Storage reservoirs were modeled for the area along the upstream side of U.S. 60. Existing condition hydrologic models (as of 1989) were developed for the 25-year, 50-year, 100-year, and 6-hour and 72-hour PMF. Stage-storage-discharge data for the FRSs was reported to have been taken from SCS as-builts though no presentation of the as-built data is provided in the report.

In 2000, Kimley-Horn & Associates, Inc. (KHA) revisited the 1989 JMM modeling as a part of their structural assessment work and also prepared digital mapping of the watershed basin boundary.

In 2005 and under contract to the District, JEF performed a review and analysis of the 1989 JMM modeling as it pertained to developing an emergency action plan for the areas downstream of the PVR Structures. The following is a summary of the JEF review comments:

- The total drainage areas were similar to GIS digitized versions from the USGS quadrangles.
- Storage upstream of culverts under U.S. 60 was modeled using a composite approach which for a PMF model, will have little effect. Impacts on the 100-year are also not expected to provide much attenuation, since the actual volumes are so small.
- The 100-year rainfall depth used for Powerline FRS is significantly different than at Vineyard and Rittenhouse. Also, the point value used does not appear to reflect any areal reduction.
- The channel routing method used resulted in routing times that seemed a little long and especially for a PMF model

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- The stage versus elevation data for Vineyard and Rittenhouse FRS are insufficient to cover the elevations during an overtopping event and HEC was extrapolating from last two data points.
- The PMF models reflected an empty storage basin.
- Considerable development has occurred in the watersheds since 1989 and the models should be updated to reflect those changes.

Based on the JEF review, the following items were updated or revised in the JMM models for the EAP analysis:

- **Precipitation** – Point rainfall, area reduction factors and temporal distributions were all modified to reflect current District methodologies.
- **FRS Reservoir Routing** – The JMM stage-storage-discharge relations for each of the PVR Structures were updated by JEF using available data sets developed by the District. Stage-storage relations were developed from 10-foot contour interval mapping with flight dates of January 22, 2002, and February 19 and 21, 2002, and 2004 survey data of the dam crest, emergency spillway crest and principal outlet invert elevations provided by the District. The stage-discharge rating curves are based upon HY8 culvert analyses (primary outlet) performed by the District Flood Warning Branch in 1992 and step-backwater analyses (emergency spillways) performed in the mid 1990s using available topography.

The results of the JEF EAP analyses indicated that none of the three PVR Structures experience emergency spillway flows during the 100-year, 6-hour duration event. For a 100-year, 72-hour storm, all three PVR Structures experience emergency spillway discharges. For the 100-year, 24-hour storm, the EAP analyses indicated that the maximum water surface at Powerline FRS remains below the emergency spillway by about 2 feet while both Vineyard and Rittenhouse FRS experience emergency spillway discharges.

All three flood retarding structures are overtopped during the PMF and simplified FLO-2D models were created for the EAP Report by JEF to identify potential downstream inundation areas for emergency spillway flows and dam failure events.

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SECTION 2: MAPPING AND SURVEY INFORMATION

2.1 General

Mapping and survey information for the DDA, and more specifically the PVR Structures, was developed as a part of both the first and second phases of work. In addition, work on the Lost Dutchman Heights Urban Planning Permit (LDH) included a component to produce new mapping. All of the new mapping is produced at a two-foot contour interval and covers all of the PVR Structures. Supplemental survey data was acquired with the Phase 2 work to document in detail the current FRS crest, primary spillway, and emergency spillway locations and elevations.

2.2 Field Survey Information

Field surveys for the Desert Drive Project included supplemental structure and ground surveys of the PVR Structure's crest, emergency spillway, and primary outlet facilities. All horizontal coordinates were referenced to North American Datum of 1983 (NAD 83) Arizona State Plane, Central Zone, International Feet. All vertical coordinates were tied to both the North American Vertical Datum of 1988 (NAVD 88).

The supplemental structure surveying was performed by Brady Aulerich & Associates, Inc. under the direction of Christopher Aulerich, R.L.S. (Arizona Registration No. 19809). The surveys were performed using RTK-GPS and the control was derived from the same three NGS benchmarks used in the mapping control survey.

2.3 Mapping

Three separate sources of two-foot contour mapping meeting National Standard for Spatial Data Accuracy (NSSDA) Class I mapping requirements were used for this analysis, as follows:

- Mapping for the DDA was prepared by Stewart Geo Technologies, Inc. and is based on April 13, 2006 aerial photography.
- Mapping for the LDH project was prepared by Cooper Aerial Company, Inc. under contract to Carter-Burgess and is based on early May 2007 aerial photography.
- Mapping that extends the DDA mapping southerly to include the Rittenhouse FRS and surrounding areas was prepared by Stewart Geo Technologies, Inc. and is based on April 26, 2007 aerial photography.

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SECTION 3: SEDIMENT YIELD ANALYSIS

3.1 General

Sediment yield is the amount of solid material moved by water past a particular point in a stream system, or alternately, the amount of material deposited in an enclosed basin. Sediment yield includes both particles small enough to be carried in suspension by the supporting action of turbulence (suspended load), and particles moved close to, or at the bottom of, the channel by rolling, sliding, or bouncing (bedload). When water is trapped behind flood retention structures, its velocity is reduced and the sediment that it carries is deposited. Sediment yield is a major concern for public officials in charge of maintaining the effectiveness of flood control structures, because sedimentation behind dams or in floodways reduces the volume of water that can be stored or transported by the system. A reduction in the available storage volume increases the likelihood of overtopping during a storm event, which in turn increases the chance of injuries, loss of human life, or property damage to downstream areas or the structure itself.

Sediment yield can be estimated on either an average annual or event-based premise. Average annual sediment yield, which is the volume of sediment delivered to a point on average every year. Computations of average annual sediment yield take into account sediment yields from all possible runoff events. Therefore, if large events have not occurred for some time in the basin then the average annual sediment yield may overpredict the actual sediment yield observed by direct measurements, since it is taking into account sediment yields from events that have not occurred. Conversely, average annual sediment yields are much less than yields for large single events. Event-based sediment yields are the sediment yields that are generated by runoff events of various frequencies, such as the 2-year flood versus the 100-year flood. These predictions can be useful in estimating sediment yields during a particular design event.

3.2 Methodology

The Modified Universal Soil Loss Equation (MUSLE) was used as the basis for this analysis and was developed by the U.S. Soil Conservation Service to predict rates of soil erosion. MUSLE is also commonly used to predict the sediment yield in the semiarid Southwest (Renard and Stone, 1981; ADWR, 1985). MUSLE can be used to estimate sediment supplied from individual design storms as well as for average annual sediment production. A revised Universal Soil Loss Equation (RUSLE) was

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developed using more data from the semiarid and arid southwest. However, RUSLE was designed to estimate soil loss, not sediment yield (Renard, 1997).

In some literature, (Simons et al. 1982), the calculation of the total sediment load is reported to include sediment yield results (supposedly representing only wash load) plus the bed load, wherein bed load is predicted using sediment transport methodologies. This approach to estimating total sediment load is also standard current policy for the District, who currently owns and operates the PVR Structures. In order to satisfy District policy, an adjustment to the MUSLE results will be required. Performing sediment transport analyses for all channels entering the PVR Structures is beyond this project's scope of work. Instead, a correction factor, based on information provided in Table A.3 of the U.S. Bureau of Reclamation's *Design of Small Dams* (USBR, 1987), is used to estimate the total sediment load.

3.2.1 MUSLE Analysis

MUSLE can be used to estimate sediment supplied from individual design storms as well as for average annual sediment production. The equation developed for MUSLE is:

$$\mathbf{Y_S = R_W\ K\ LS\ C\ P} \qquad \textbf{(1)}$$

where:
Y_S = sediment yield in tons for the storm event,
R_W = storm runoff energy factor,
K = soil erodibility factor,
LS = slope length and gradient factor,
C = cover and management factor,
P = erosion control.

Guidelines for using MUSLE are presented in Appendix B of the *Design Manual for Engineering Analysis of Fluvial Systems* (SLA, 1985). The sediment yield calculated with MUSLE for each probability storm event was then probability weighted and averaged to determine average annual sediment yield in tons. A density of 110 lbs/cubic foot (1.77 g/cm^3) estimated from data presented in the *Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona* (Camp, 1986) was used to convert tons to acre-feet. Calculation sheets for the average annual and event-based sediment yield for each subbasin are provided in Appendix G. The following are descriptions for each parameter of equation 1.

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Storm Runoff Energy Factor (R_W) – the storm runoff energy factor is determined by the equation:

$$R_W = \alpha\,(V^{*}q_p)^{\beta} \qquad (2)$$

where: R_W = storm runoff energy factor,

α, β = coefficients,

V = storm event runoff volume in acre-feet,

q_p = storm event peak flow in cfs.

The Arizona Department of Water Resources (SLA, 1985) recommends values for α and β of 95 and 0.56 respectively. The peak discharge volumes for the 100-year 24-hour and 6-hour events were obtained from the HEC-1 model results and the maximum of the two values was used in the sediment yield calculations. The Q2, Q5, Q10, Q25, and Q50 were determined by applying discharge-ratios to the peak flows for all the subbasins. These discharge ratios were based on the Hydrology Design Manual of the Flood Control District of Maricopa County (FCDMC, 2003).

Soil Erodibility Factor (K) – the soil erodibility factor (K) for each soil was obtained from the NRCS soils database for the following soil surveys:

- *Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona.*
- *Soil Survey of Eastern Pinal and Southern Gila Counties, Arizona*
- *General Arizona*

The erodibility factors for each soil series are summarized in Appendix G. The soil survey described the composition of each map unit as a percentage of each soil series. The map unit K was based on a weighted average of the soil series percentages. Further, several map units covered each sub-basin. Thus, the subbasin K is a weighted average of the weighted map unit K-values occurring in the basin. See Table 3.1 for an example of the weighting procedure. The remaining calculations can be found in Appendix G.

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Slope Length and Gradient Factor (LS) – the topography of the basin is represented by the slope length and gradient factor. The equation relating length and gradient to determine the LS factor is:

$$LS = (\lambda / 72.6)^n (0.065 + 0.0454 S + 0.0065 S^2) \quad (3)$$

where: LS = slope/length factor

λ = slope length

S = percent slope

n = exponent based on slope (0.3 for slope < 3%; 0.4 for slope = 4%; 0.5 for slope > 5%).

Table 3.1

Example of K-value weighting procedure

Weighted Erodibility Factor (K)				
Map Unit	**Soil**	**Percent of Map Unit**	**Erosion Factor (K)**	**Percent of Subbasin**
3	Antho	35	0.20	
	Carrizo	30	0.10	
	Maripo	20	0.20	
	Weighted Map Unit K:		**0.16**	2.4
44	Ebon	100	0.10	
	Weighted Map Unit K:		**0.10**	2.6
48	Ebon	45	0.10	
	Pinamt	35	0.05	
	Weighted Map Unit K:		**0.08**	25.8
98	Pinamt	45	0.05	
	Tremant	35	0.32	
	Weighted Map Unit K:		**0.17**	69.2
			Weighted Sub-basin K:	**0.22**

The slope length is defined in the MUSLE guidelines as the distance from the origination point of overland flow to the point where either slope decreases to the extent that deposition occurs or the runoff enters a channel.

The slope length and slope angle calculations were performed using the GIS based procedure presented in Hickey, 2000. The calculations were performed on a rectangular point

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grid overlapping the subbasin area. The procedure can be briefly described by the following steps:

1) Obtain elevation data in a grid format.
2) Eliminate sinks in the elevation data.
3) Determine flow directions at each grid point using maximum downhill slope to adjacent grid point.
4) Identify high points as grid points with no net inflow (this was done using the flow directions at the adjacent grid points).
5) Estimate a non-cumulative slope length at each grid point which is the slope length contributed by the cell area of the particular grid point.
6) Track the flow path in the downstream direction from a high point using the flow directions. The tracking stops when the flow path reaches a pour point or the slope break is greater than 50%.
7) Determine the slope length using the flow path and summing the non-cumulative slope lengths.

The elevation data was obtained from the following sources:

- A triangulated network (tin) generated using the new 2-ft topographic data obtained for DDA, Lost Dutchman Heights UPP, and the Rittenhouse FRS.
- A triangulated network (tin) generated using the Maricopa County 10-ft topographic data
- USGS 24K Digital Elevation Model (DEM) data.

In the areas where these data sets overlap, the elevation model created from the most detailed set of topographic data was used.

The elevation data on the rectangular grid requires some smoothing to eliminate sinks which disrupt accurate computation of the slope lengths. The elimination of the sinks was performed using the algorithm provided in Planchon and Darboux (2001). Using the "adjusted" elevation data and the procedure outlined above, the slope length and slope angle calculations were performed for all the points that fall inside the subbasin area. Using these values, average values of the slope length and slope angle were obtained for all the subbasins. These values were then used in Equation 3 to estimate LS.

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Cover and Management Practice (C) – the cover and management practice factor is the product of three factors:

$$C = C_I \times C_{II} \times C_{III} \quad (4)$$

where: C_I = canopy cover
C_{II} = mulch cover
C_{III} = root cover.

Values for these three factors were estimated using the percent vegetation for varying land uses within the study area, field observation, and reasonable assumptions. The percent vegetation cover was divided into percent canopy and percent mulch. Canopy cover includes leaves and branches that do not directly touch the ground. Mulch cover includes plants that are low to the ground such as grasses, as well as litter and in some cases rock (i.e. xeriscaped lawns). For desert and open areas it was assumed that 80% of the vegetation cover was in the form of canopy and 20% in the form of mulch based on field observations. It was assumed that residential areas would have slightly higher proportions of mulch due to the increased probability of grass and rock lawns. Thus 66.7% and 33.3% percent of the vegetation cover was assigned to canopy and mulch respectively. For industrial, commercial, and park area it was assumed that mulch would be more prominent than canopy cover. Thus 33.3% and 66.7% percent of the vegetation cover was assigned to canopy and mulch respectively. For the root factor it was assumed that rooting percentages would equal vegetation cover percentages. Figures B.2., B.3., and B.4. in Appendix B of the *Design Manual for Engineering Analysis of Fluvial Systems* (ADWR, 1985) were used to assign factor values. The results are presented in Table 3.2.

Many of the subbasins are characterized by multiple land use divisions that comprise a percentage of the total subbasin area. These percentages were used to develop a weighted average C factor. Table 3.3 presents an example of the weighting procedure used.

Erosion Control Practice Factor (P) – this factor accounts for conservation practices such as contouring and terracing. In desert and open areas it can be reasonably assumed that no such activities have taken place, and the factor can be assigned a value of 1.0.

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Table 3.2

Land use vegetation cover and associated MUSLE C factors

Land Use	Percent Vegetative Cover	Percent Canopy	Canopy Factor C_I	Percent Mulch	Mulch Factor C_{II}	Percent Rooting	Root Factor C_{III}	C Factor
Sonoran Desert	25	20	0.85	5	0.90	25	0.42	0.32
Open	10	8	0.95	2	1.00	10	0.44	0.42
Very Low Density Residential	30	20	0.85	10	0.76	30	0.40	0.26
Low Density Residential	50	33	0.78	17	0.63	50	0.37	0.18
Medium Density Residential	50	33	0.78	17	0.63	50	0.20	0.10
Multi-Family Residential	50	33	0.78	17	0.63	50	0.20	0.10
Industrial	60	20	0.85	40	0.39	60	0.17	0.06
Commercial	75	25	0.82	30	0.31	75	0.12	0.03
Park	90	30	0.78	60	0.25	90	0.10	0.02

Table 3.3

Example of C factor weighting procedure

Land Use	C_I	C_{II}	C_{III}	C Factor	Percentage of Subbasin
Sonoran Desert	0.85	0.90	0.42	0.32	39.1
Very Low Density Residential	0.85	0.76	0.40	0.26	60.9
				Weighted Subbasin C:	**0.28**

3.2.2 Total Load Correction Factor

Table A.3 on page 539 of the USBR *Design of Small Dams* (USBR, 1987) presents a list of bed load correction factors for use in adjusting suspended load measurements to account for bed load transport in field based sediment yield estimations. The factors are reported as a percentage of the suspended load estimated and are correlated to suspended sediment concentration, streambed material and texture of the suspended material. Assuming a suspended sediment concentration that is between 1,000 and 7,500 mg/L, the USBR recommends a correction factor of 10 to 35 percent. Field reconnaissance of the washes in the area indicate that

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most washes lose significant sediment transport capacity as they transition from the foothill areas onto the relatively flat alluvial plain upon which the FRS structures are located. There are also numerous stock tanks in the area downstream of US 60 that trap sediment from the tributary watercourse. Accordingly, to apply the 35 percent correction for bed load seems reasonably conservative for the level of analysis being presented with this project. Accordingly, all the MUSLE derived values will be adjusted by multiplying the MUSLE estimated sediment yield by a factor of 1.35.

3.3 Results and Discussions

3.3.1 MUSLE

MUSLE calculations were performed for all the subbasins modeled in the Phase I hydrology, but only subbasins that are tributary to the Powerline, Vineyard, and Rittenhouse Flood Retarding Structures (PVR Structures) were included in estimating the sediment yield. Additionally, runoff from Subbasins P6, P7, P8, and P10 is intercepted and detained in large detention basins along the north side of the freeway and therefore, the transported sediment from these basins is not expected to reach the Powerline FRS.

The initial sediment yield computations resulted in large sediment yield estimates for the subbasins representing the mountain headwater locations of the PVR Structure watersheds. These subbasins were identified as P1, P2, P3, R1, R4, V1 and V12. The sediment yield values computed for these subbasins range from 3 to 44 acre-feet per year, and are attributable to the generally steep slopes in these regions. While such high sediment production can be expected from these mountainous areas due to the presence of the extremely steep slopes, it is not realistic to expect that those same volumes of sediment can be transported downstream en-masse to the PVR Structures. Significant changes in slope and transport capacity of the conveyance watercourse(s) occur as the drainage transitions form the steep mountainsides to the generally flat alluvial plain surface at the PVR Structures, causing deposition of the heavy sediment loads prior to reaching the PVR Structure forebays (see Foster, 2005 and Hickey, 2000). Accordingly, an adjustment was incorporated in the *sediment yield for Subbasins* P1, P2, P3, R1, R4, V1 and V12 by developing a watershed-average, unit value of sediment yield that is calculated exclusive the of the mountainous subbasin values, and then applying that value to the mountainous subbasins instead of MUSLE computed values. Figure 3.1 shows the subbasins used in arriving at the sediment yield.

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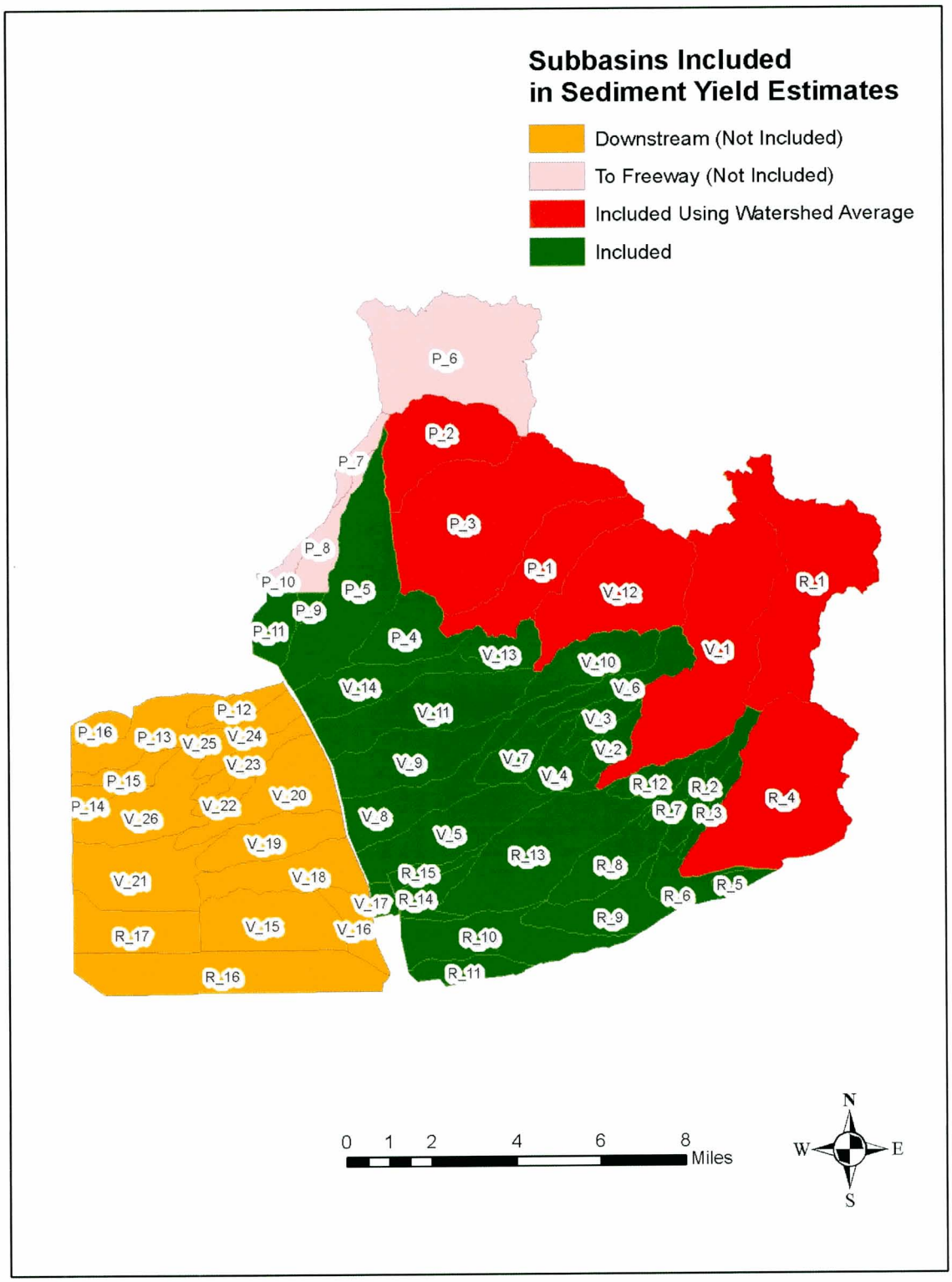

Figure 3.1

Map of subbasins used in the MUSLE analysis

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A summary of the final sediment yield results are presented in Table 3.4 and the computation details for each subbasin are presented in Appendix G. The results indicate that average sediment yield values of 0.60, 0.61 and 0.53 acre-feet per year for the Powerline, Vineyard and Rittenhouse FRS watersheds, respectively.

Table 3.4

Summary of final sediment yield results

Subbasin ID	Drainage Area	Peak Flow	Slope Length	Slope Percent	Sediment Yield	Sediment Yield	Estimated Sediment Yield
	sq. miles	cfs	feet	%	tons	ac-ft/sq. mile	ac-ft/sq. mile
P_1	5.2	3363	631	20.75	30883	12.89	***0.61***
P_2	4.9	4160	564	18.48	25901	10.81	***0.61***
P_3	12.27	9143	873	19.00	102000	42.57	***0.61***
P_11	1.44	1710	1053	1.13	714	0.30	0.30
P_4	2.78	2518	703	2.23	1290	0.54	0.54
P_5	7.09	4149	432	1.74	1556	0.65	0.65
P_9	0.36	846	453	1.22	1290	0.54	0.54
Powerline FRS Watershed Average Sediment Yield = 0.60 ac-ft/sq. mile							
R_1	9.73	4177	272	9.55	13393	5.59	***0.53***
R_4	10.52	7456	272	4.44	7969	3.33	***0.53***
R_10	4.35	2796	534	1.29	1127	0.47	0.47
R_11	1.28	1204	1000	1.28	419	0.17	0.29
R_12	1.13	1521	168	2.27	482	0.20	0.20
R_13	7.08	5216	315	2.37	2636	1.10	1.10
R_14	1.3	1558	312	2.02	371	0.16	0.16
R_15	0.67	742	343	2.13	177	0.07	0.07
R_2	1.67	2067	224	1.60	525	0.22	0.22
R_3	0.67	1133	265	0.98	192	0.08	0.08
R_5	0.53	1105	321	0.38	152	0.06	0.06
R_6	1.55	2467	263	1.16	559	0.23	0.23
R_7	0.89	1226	206	1.75	339	0.14	0.14
R_8	2.9	3306	299	1.47	1175	0.49	0.49
R_9	3	2900	531	1.06	1016	0.42	0.42
Rittenhouse FRS Watershed Average Sediment Yield = 0.53 ac-ft/sq. mile							
V_1	11.84	5320	276	5.53	7659	3.20	***0.61***
V_12	7.77	5010	404	19.10	40004	16.70	***0.61***
V_10	2.91	2992	220	7.38	2677	1.12	1.12
V_11	5.24	4740	294	3.10	2582	1.08	1.08

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Table 3.4

Summary of final sediment yield results

Subbasin ID	Drainage Area	Peak Flow	Slope Length	Slope Percent	Sediment Yield	Sediment Yield	Estimated Sediment Yield
	sq. miles	cfs	feet	%	tons	ac-ft/sq. mile	ac-ft/sq. mile
V_13	1.5	2879	322	9.48	861	0.36	0.36
V_14	3.15	2586	814	1.26	944	0.39	0.39
V_2	1.05	1672	200	2.26	524	0.22	0.22
V_3	1.1	1699	165	2.84	520	0.22	0.22
V_4	1.77	2548	149	4.63	1248	0.52	0.52
V_5	4.45	2866	327	2.42	1213	0.51	0.51
V_6	1.97	1771	206	5.01	1070	0.45	0.45
V_7	1.71	2352	178	4.01	1094	0.46	0.46
V_8	4.08	2597	338	2.33	1146	0.48	0.48
V_9	4.11	3337	293	2.69	1455	0.61	0.61
V_17	0.46	665	231	2.76	167	0.07	0.07
Vineyard FRS Watershed Average Sediment Yield = 0.61 ac-ft/sq. mile							

Note: Majenta colored values represent use of watershed-average values

3.3.2 Total Sediment Load

Table 3.5 summarizes the adjusted, average total sediment load for each FRS watershed based on the USBR correction factor of 1.35.

Table 3.5

Summary of final total sediment load results

FRS Watershed	Average Annual MUSLE Sediment Yield (ac-ft/sq. mile)	Average Annual Total Sediment Load (ac-ft/sq. mile)
Powerline	0.60	0.81
Rittenhouse	0.53	0.72
Vineyard	0.61	0.82

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SECTION 4: TWO-DIMENSIONAL INUNDATION ANALYSIS

4.1 Methodology

The FLO-2D computer program[1], version 2006.10, was used to perform the two-dimensional modeling summarized herein. Existing condition models were developed for the 100-year, 24-hour and the 6- and 72-hour, full and half PMF events for a total of 5 simulations. Inflow hydrographs for the FLO-2D models were obtained from the HEC-1 analyses summarized in Volume I, with slight adjustments to the HEC-1 models to provide inflow data for the FLO-2D model. Base topography is obtained from the new two-foot contour interval mapping produced for DDA, LDH, and the Rittenhouse Extension. Structure details are based on the 2007 survey data compiled by Brady Aulerich & Associates, Inc. The rating relations developed for the JEF EAP report are used to model the primary outlet pipes of each structure. The U.S. Army Corps of Engineers' HEC-RAS model[2] was used to develop stage discharge rating relations for the existing emergency spillways.

The constitutive equations governing the FLO-2D model's numerical solutions are the continuity equation and the two-dimensional equations of motion (dynamic wave equation). The differential form of the governing equations used by the FLO-2D model is solved with a central, finite difference numerical integration method. The computations involve calculating the discharge across each of the eight(8) flow directions for each grid, while checking volume conservation. Selection of tolerance values such as the maximum change in depth incremental time-step is critical to the accuracy and numerical stability of the model computations. There are several time-step criteria that can be set by the user to facilitate efficiency in the modeling computations, however, if the tolerances and numerical stability criteria are not met, the model will automatically decrement the time step until those parameters are satisfied.

4.2 Modeling Area Boundary

The extent of the FLO-2D model working area with reference to the watershed is shown in Figure 4.1. The modeling extents were chosen to allow sufficient room for the model to:

1. Adequately distribute the flows approaching the PVR Structures to replicate existing conditions at the structure forebay as much as possible;

[1] Program developed by Dr. Jim O'Brien , President of FLO-2D Software, Inc, executable file date of 05/07/2007.

[2] HEC-RAS version 3.1.3

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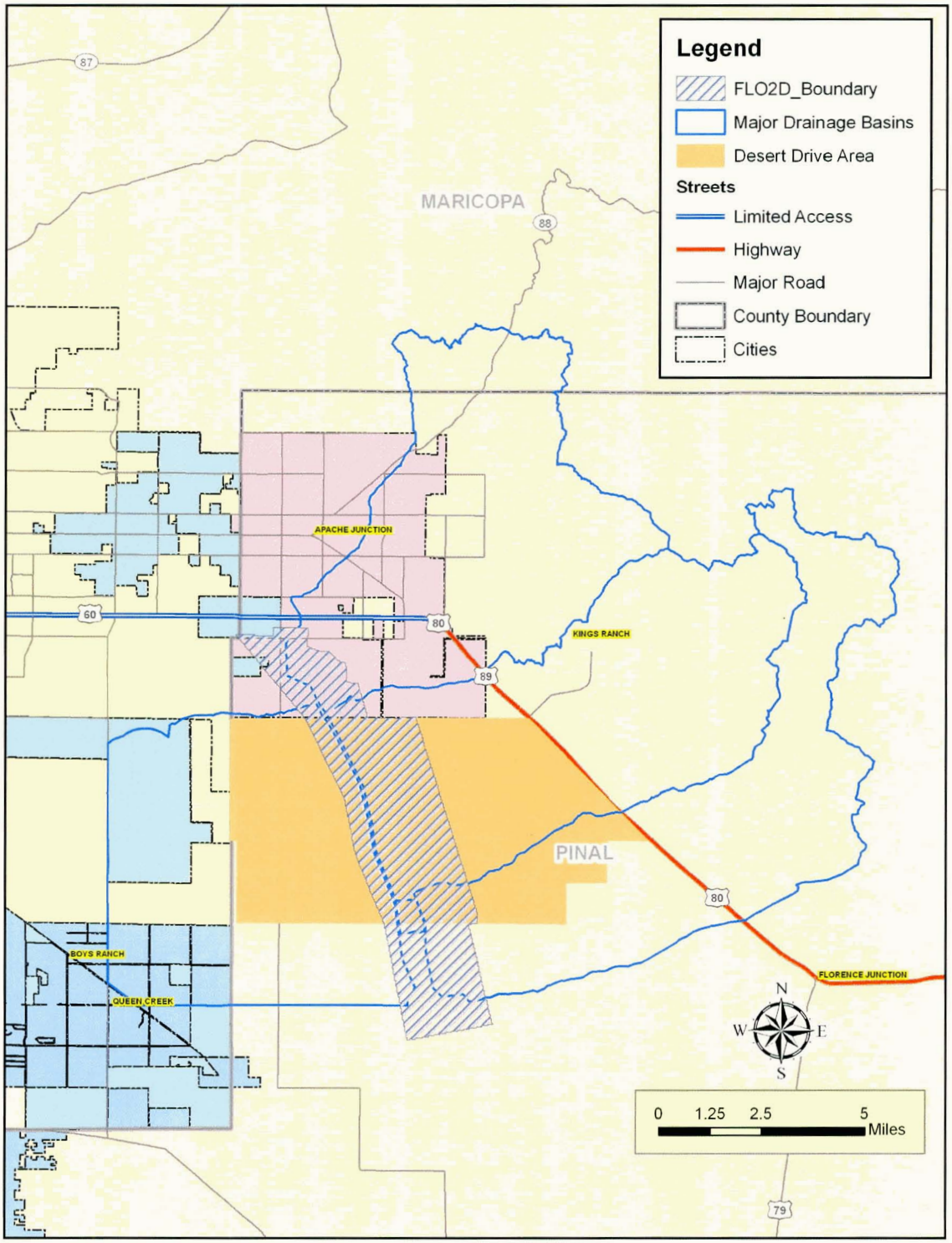

Figure 4.1

FLO-2D modeling limits

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2. Provide a sufficient buffer on the north and south project ends to ensure that all simulations reasonably depict the amount of runoff that enters, exits, and bypasses the PVR Structures, and;
3. Provide sufficient model space downstream of the PVR Structures and CAP Canal to assess the impacts of overtopping.

4.3 Model Assumptions and Limitations

The modeling results presented herein are predicated by some basic assumptions and limitations regarding the watershed conditions and modeling capabilities. Some of those assumptions and limitations include, but are not limited to the following:

- The two-dimensional modeling is based on an assigned grid element size and is therefore limited in its accuracy to the grid resolution. The intended result of this modeling is to provide a better depiction of the two-dimensional flow characteristics within the modeled area and to support the development and evaluation of alternatives to the PVR Structures. To that end, the model is considered as a planning level model and is not intended for detailed analysis of flooding conditions beyond the resolution of the grid element size.
- No sediment transport or other moveable bed modeling techniques were employed in the modeling. It is assumed that each grid's elevation is fixed and that no significant erosion or deposition occurs that could substantially alter the grid's geometry. Sediment transport modeling was beyond the scope of work for this analysis.
- All grid and resultant water surface elevations reported herein are based on the best and most recent topographic mapping that was available at the time of the model development. Accordingly, the modeling results are subject to the mapping accuracy from which the base geometry data was compiled. See Section 4.4.1 for more detailed discussions on the development of base grid elevations.

4.4 Modeling Parameters

4.4.1 Floodplain Grid Network

The foundation of the FLO-2D model is a network of square, contiguous grid elements that are used to approximate the floodplain ground surface. Each element is assigned an elevation and a Manning's roughness value. The model allows flow to pass in any or all of eight (8) directions through the element sides and diagonals. The grid element size is primarily dictated by the resolution required to adequately model the floodplain, and the resolution of the source mapping. The selection of the grid size is also moderated by computational speed and project budget. The smaller the grid element is, the "better" the model resolution becomes. However, smaller grid elements significantly increase both computational time and the amount of data input and manipulation.

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The grid size selected for this project is 150-feet, which is considered adequate to provide the planning level analyses required for routing the flood flows through the PVR Structures. At that resolution, the 10.64 square mile modeling area required 26,911 grid elements.

Grid Element Elevations – The floodplain grid elevations for this model were developed using the FLO-2D Grid Developer System (GDS) utility, the three sources of two-foot contour interval mapping referenced in Section 2, and the supplemental ground survey data. The digital terrain model (DTM) mass point data for each mapping source was entered into the GDS and a generalized surface model was constructed. Given the 150-foot grid size, the modeling strategy for this project was to assign grid elevations that depicted the average floodplain elevation for that grid element, and then use the channel module to estimate the flow characteristics of the major incised washes such as Siphon Draw, and the levee module to simulate the dam embankments and spillway protection levees. In order to accomplish this, the 2-foot mapping breakline data were purposely excluded from the surface model development. Also, the GDS uses an internal algorithm that calculates an average of all elevation points within the grid boundary for assignment to that element. The resultant interpolated elevations were then checked against the contour mapping at key locations throughout the modeling area and manually adjusted up or down as needed using engineering judgment. Typical areas closely scrutinized included the primary outlet pipe inlet and discharge locations, emergency spillways and the reaches to be modeled with channels.

Special consideration was given to the elements along the earthen outlet channels that connect the Powerline and Vineyard FRS primary outlets to the CAP overchute. These conveyances were originally modeled as channels, however, due to numerical surging, the channels were removed and the grid element base elevation was adjusted downward to represent the invert of the channel. Area reduction factors were then set for each element to approximate the conveyance capacity of the channel. The hydraulics of these channels are not critical to the inundation modeling, therefore, the above mentioned approach was deemed acceptable and provides a reasonable approximation of the channels in this area.

Manning's n Roughness Values – Average n-values were assigned to individual grid elements based on 2004 and 2007 aerial orthophotography, field observations, and engineering judgment. During the debugging phase of the modeling, the n-values for elements within the flood-pool area that exhibited exceedingly high velocities from initial runs were adjusted higher to prevent model surging and improve the model stability. This was especially critical for the forebay locations

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where heavy concentrations of inflow are being distributed. Figure 4.2 is the FLO-2D modeling area with a spatial depiction of the n-values assigned to individual elements. Table 4.1 summarizes the range of roughness values assigned to various categories.

It is noted that the values presented in Table 4.1 represent an assumed roughness for floodplain depths greater than 3.0 feet. In the FLO-2D model, when depths are less than 0.5 feet, the Manning's roughness is dictated by the SHALLOWN variable in the *CONT.DAT* file, which is separate from those reported in Table 4.1. This value has been set to 0.20 for all elements.

Table 4.1

Summary of existing condition Manning's n roughness values

Manning's n-Value	Description of Areas Covered
0.035 to 0.040	Barren ground entirely void of vegetation in sheet flow and non-ponding areas (i.e. – emergency spillway corridors)
0.040 to 0.055	Natural desert areas with very sparse to moderate vegetation densities and generally flat terrain. Values in this range are also used to model the open space areas in the deepest portion of floodpool (i.e. – the main low flow corridor)
0.055 to 0.065	Natural desert areas with moderate vegetation densities in the flat areas and heavier strips of vegetation along the washes. Areas of rural development with densities of less than 1 dwelling unit per acre.
0.065 to 0.080	Mesquite bosque areas within the floodpool and other areas of heavy vegetation.
0.080 to 0.100	Areas of medium density residential development with fences, houses, and other roughness elements.

According to the FLO-2D Manual[1], when flow depths are less than 0.2 feet, the roughness value is set to SHALLOWN (which in this case is equal to 0.20) to approximate shallow sheet flow conditions. When flow depths range between 0.2 and 0.5 feet, the roughness value is set to half

[1] O'Brien, J. S., 2006, *FLO-2D User's Manual* and *FLO-2D Data Input Manual*, version 2006.01

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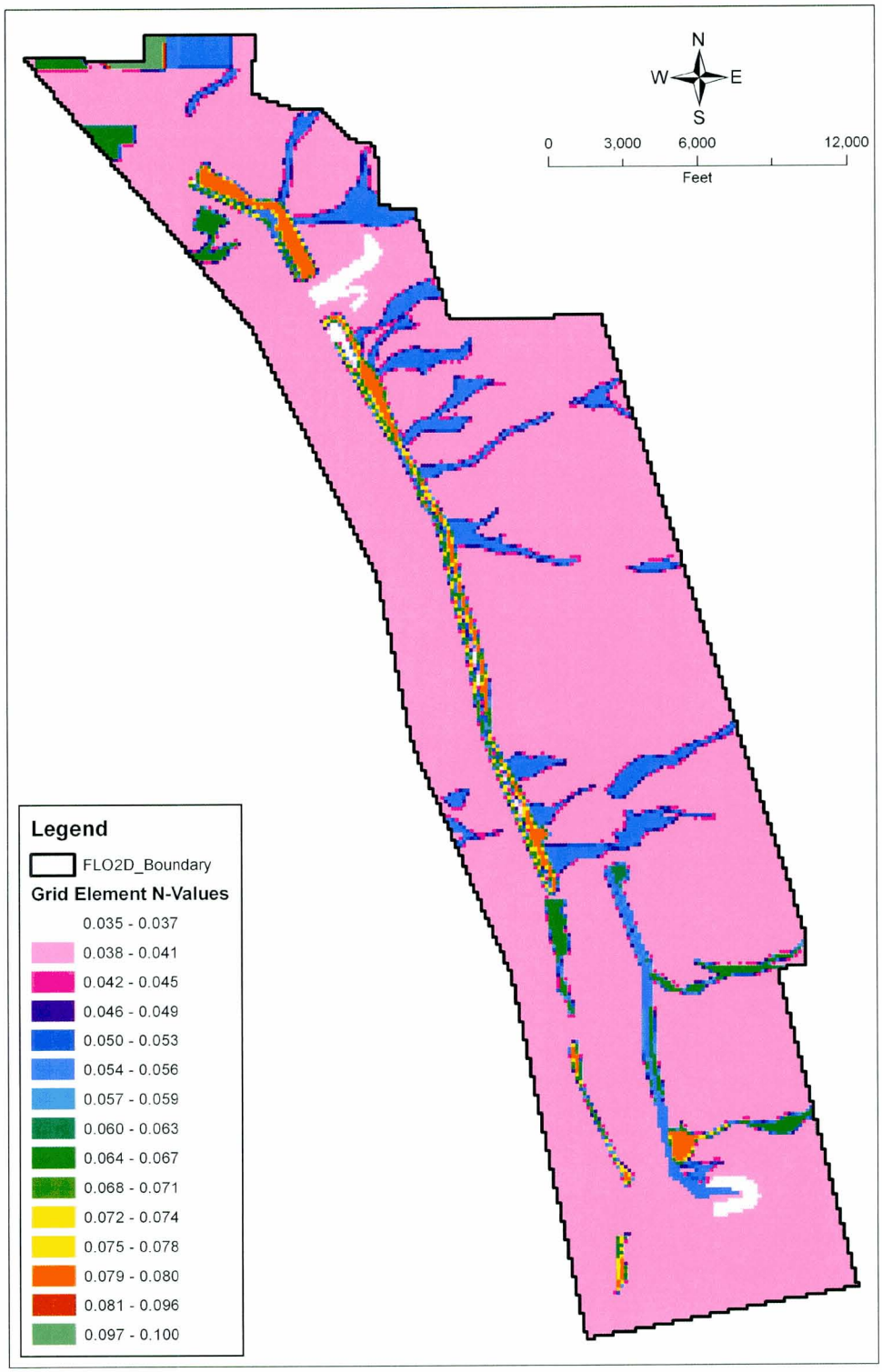

Figure 4.2

Grid element Manning's n roughness values

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of the SHALLOWN value (0.100) unless the values set in the *FPLAIN.DAT* are higher. For depths between 0.5 and 3.0 feet, the model prorates between the half SHALLOWN value (0.100) and the values set in the *FPLAIN.DAT* file using an exponential rating function. Roughness for all depths over 3.0 feet are controlled by the values set in the *FPLAIN.DAT* file.

4.4.2 Channels

Channels are input to the model on an element by element basis. Elements with similar routing characteristics and geometries are typically lumped together into reaches. Several reaches of wash and channel are modeled using the channel module within FLO-2D. The wash or channel geometry for each cross section was simulated using a trapezoidal approximation of the natural geometry below the prevailing floodplain. The reaches modeled with channels include Siphon Draw from the eastern model limit to the floodpool of Powerline FRS, the Powerline Floodway downstream of the CAP overchute to western limit of the model, and the Rittenhouse FRS primary outlet channel from the outlet of the pipe to the Vineyard FRS floodpool. The general location of channel reach is graphically depicted on Figure 4.3.

4.4.3 Levees

The levee module of FLO-2D is used to model the PVR Structure embankments and emergency spillway protection levees. The general locations of levees coded into the model are shown on Figure 4.3. The levee elevations were set using the 2007 survey data for the tops of the embankments. Powerline FRS elevations range between 1589.3 and 1591.5 feet. Vineyard FRS elevations range between 1580.4 and 1581.8 feet. Rittenhouse FRS elevations range between 1602.9 and 1604.3 feet.

4.4.4 Hydraulic Structures

The principal outlet pipes (PO) and emergency spillways for each structure were coded into the model using the hydraulic structures module. Stage versus discharge curves for each structure were developed and coded into the model. All structures were coded to convey discharge between two flooplain elements, as the floodplain-to-channel algorithm is not working for the version of the model used to do the analyis.

Principal Outlet Pipes – the rating relations for the POs summarized in the Volume I report were used in the FLO-2D models as well. See Appendix B for printouts of the stage versus discharge relations.

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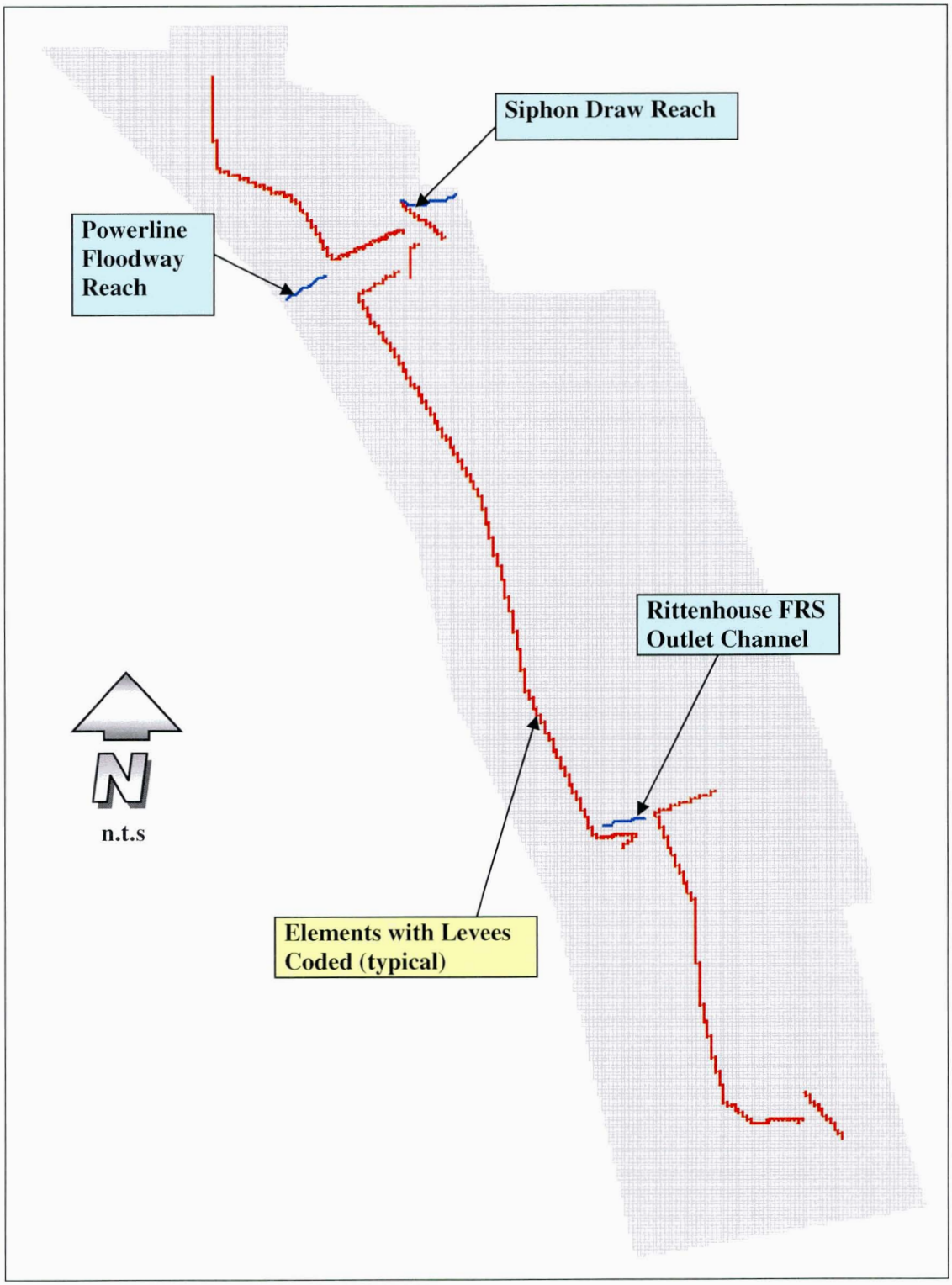

Figure 4.3

FLO-2D model channel and levee locations

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Emergency Spillways – the emergency spillways are modeled as hydraulic structures. HEC-RAS was used to develop stage versus discharge rating curves. The HEC-RAS models of each spillway were developed using Geo-RAS and the new mapping and survey data. The inflow elements were located at the entrance to the spillway and the outflow elements were located downstream of the spillway crest at locations where the spillway is less defined. As shown in Figure 4.4, the upstream cross-section was set at the mouth of the spillway, which is upstream of spillway crest, to calculate a water surface elevation at the mouth for entry into the FLO-2D model. The inflow grid base elevations were then set to the average crest elevation so that spillway flows would not begin until flood-pool elevations reached the spillway crest elevation. The depths in the depth versus discharge rating are based on the water surface elevation at the upstream cross section minus the average crest elevation for each given discharge. This relationship is illustrated in Figure 4.5, which is a typical profile along an emergency spillway. The discharges in the rating relations were then split between four inflow/outflow grid pairs for the Powerline FRS and Rittenhouse FRS spillways and two inflow/outflow grid pairs for the Vineyard FRS north and south spillways. Supporting HEC-RAS model data and spreadsheet calculations for each spillway are provided in Appendices C-F.

4.4.5 Area Reduction Factors

Area reduction factors were used for several elements to accomplish varied modeling goals. As stated previously in Section 4.4.1, the grid elements along the channels draining the Powerline and Vineyard FRS principal outlets to the CAP overchute, were set at the invert elevation of the channel and then coded with a 50 percent area reduction factor (ARF) to simulate the channel conveyance. The channels are nearly flat and were causing numerical surging when modeled using the channel module.

The grids immediately downstream of the emergency spillway inflow elements were coded to be completely blocked (ARF = 1.0), to force the model to route emergency spillway flows using the hydraulic structure rating relations. This was necessary to keep the model from exchanging flows with the grid elements in the emergency spillway and routing flows through the hydraulic structures (i.e. – double accounting for flows into the spillway). The concept is

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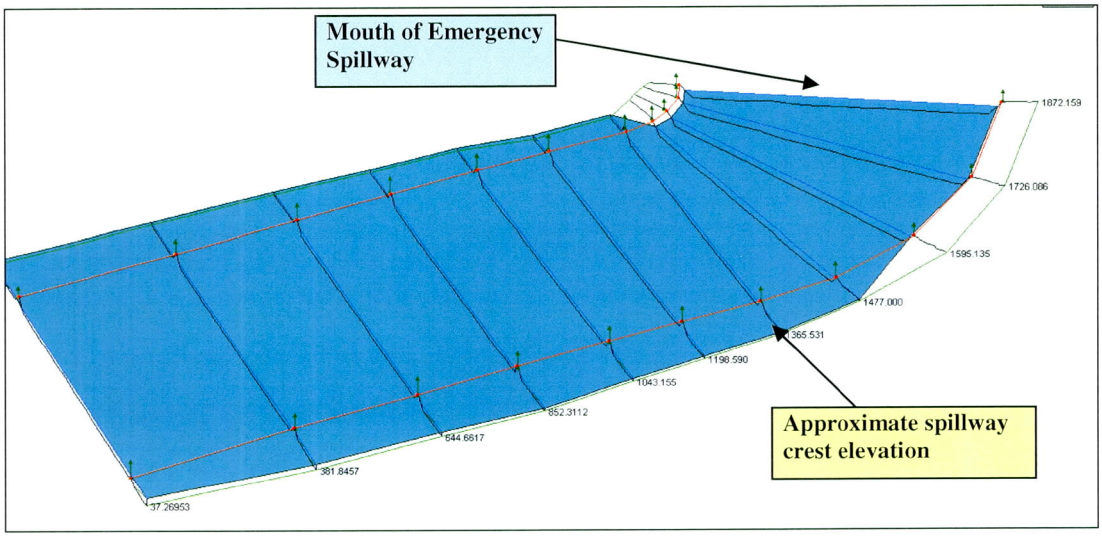

Figure 4.4

Typical emergency spillway features

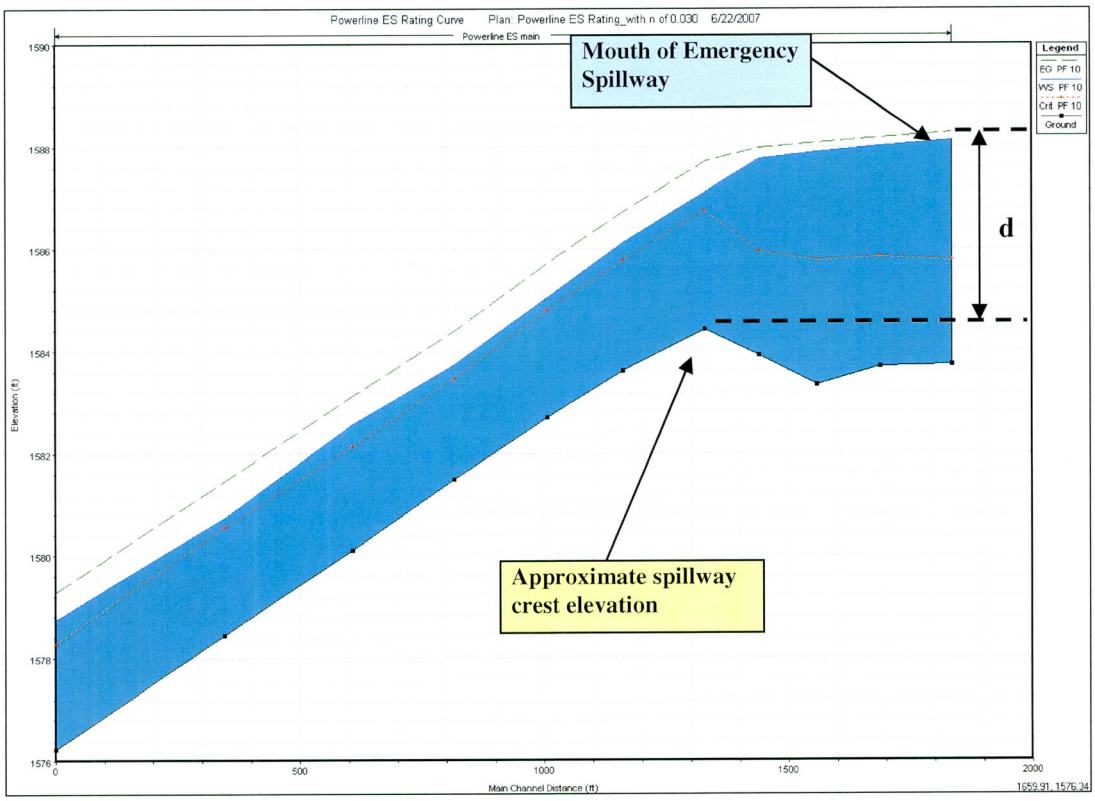

Figure 4.5

Typical emergency spillway profile

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illustrated in Figure 4.6, which is a depiction of the Powerline and Vineyard North emergency spillways. The green hatched elements are the inflow/outflow elements and the solid gray elements are completely blocked.

4.4.6 Inflow Hydrographs

The USACE HEC-1 model was used to develop inflow hydrographs to the FLO-2D model. A total of 21 hydrographs are read into the model, with 20 entering at floodplain elements and one entering a channel. The base HEC-1 modeling was taken from the results documented in

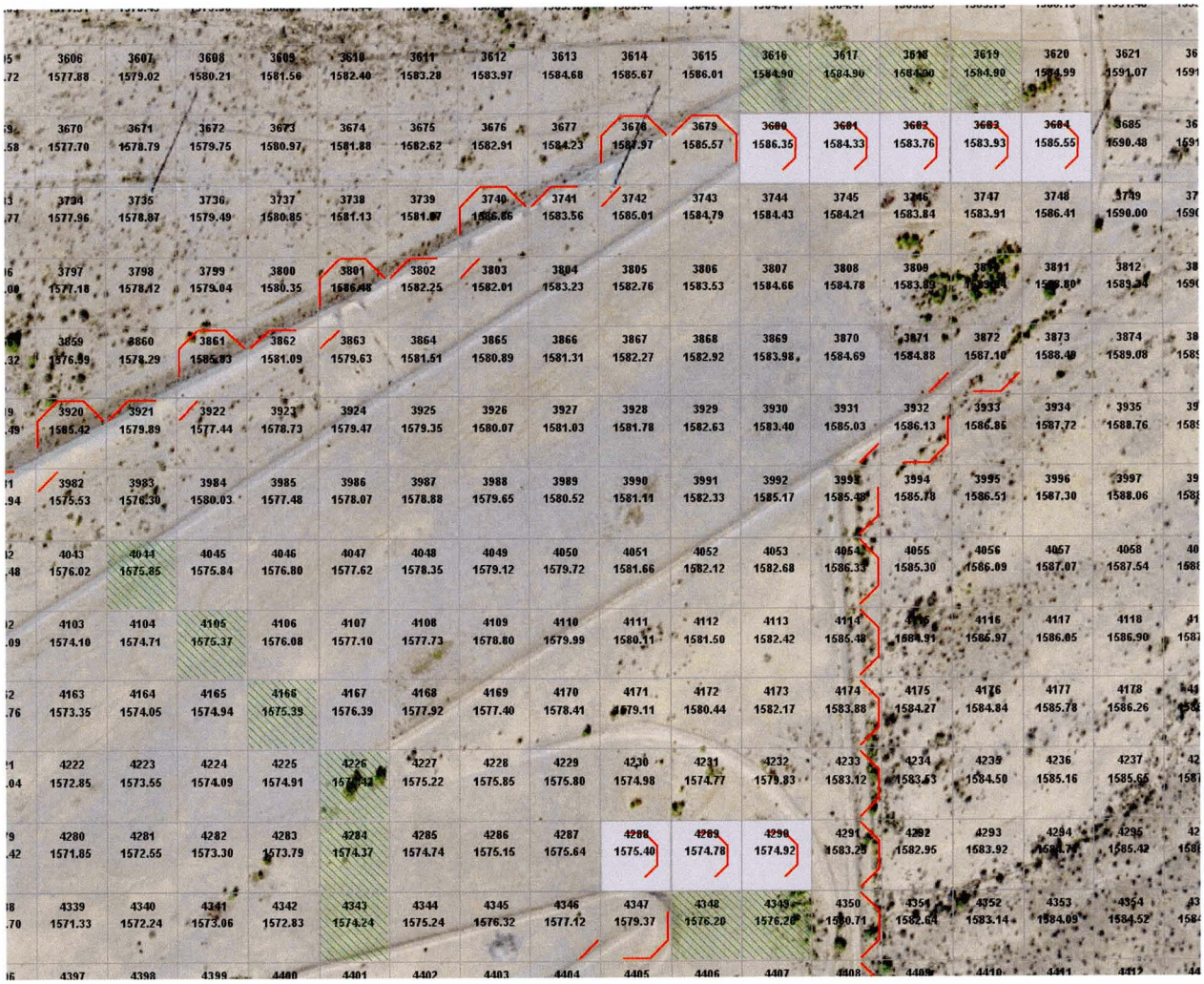

Figure 4.6

Typical configuration of blocked grid elements versus the hydraulic structure inflow/outflow locations

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the Volume I report[1], and manipulated slightly to produce the required hydrographs needed for entry into the FLO-2D model. For the 100-year, 24-hour event, each watershed model for Powerline, Vineyard, and Rittenhouse was coded with a single rainfall amount that represents an areally reduced point rainfall depth for the tributary watershed to that FRS. The FLO-2D modeling area represents a portion of each watershed, however, the inflow hydrographs account for the area within the FLO-2D grid. The HEC-1 input and output models are provided digitally on the enclosed CD. Table 4.2 summarizes the hydrograph inflow elements, the source HEC-1 operation, and the peak discharge and time to peak for each storm simulated. Plate A shows the HEC-1 modeling subbasin, routing paths, and points of concentration with reference to the FLO-2D and inflow node locations.

4.6 Model Results

The five storm simulations provide a reasonable depiction of the flood routing characteristics for each of the PVR Structures. The maximum water surface elevation and depth of flow for each element are shown on Plates A through C for the 100-year, 24-hour, 72-hour Full and 72-hour Half PMF simulations, respectively. No maps of 6-hour PMF models are provided as the 72-hour storms provide the worst case scenario. Approximate station locations for each FRS are shown on Figures 4.7 – 4.9 for reference.

The FLO-2D model generates very large output files with massive amounts of data. Accordingly, input and output files for each storm simulation are provided in digital format on the enclosed CD and the following sections will be used to summarize the results.

4.6.1 Powerline FRS

Select results for each storm simulation are summarized for the Powerline FRS in Tables 4.3 and 4.4. In Table 4.3, residual and maximum dynamic water surface elevations are reported for the flood-pool. The residual elevation is the average approximation of the "level pool" elevation throughout most of the forebay. In locations where large discharges enter the flood-pool, a "mounding" effect occurs wherein the momentum of the flood wave is dynamically translated and distributed to other areas of the forebay. The maximum elevation in this transition area is reported as the maximum dynamic water surface elevation.

[1] The hydrographs used for this analysis were derived from the June 2007 version of the Volume I report, and are slightly different than the final December 2007 version. For the purposes of this analysis however, the hydrographs were considered acceptable to ASLD and the District. Any future updates of the 2D analysis should incorporate the December 2007 hydrology.

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Table 4.2

Summary of hydrograph inflow elements, peak discharges, and times to peak

FLO-2D Element	Inflow Grid Type	HEC-1 ID	100-Year, 24-Hour		6-Hour Full PMF		6-Hour Half PMF		72-Hour Full PMF		72-Hour Half PMF	
			Peak Discharge (cfs)	Time to Peak (hours)	Peak Discharge (cfs)	Time to Peak (hours)	Peak Discharge (cfs)	Time to Peak (hours)	Peak Discharge (cfs)	Time to Peak (hours)	Peak Discharge (cfs)	Time to Peak (hours)
24	Floodplain	DP10S	1,013	12.17	1,378	4.25	1,039	3.50	1,241	48.17	474	48.17
345	Floodplain	DP20S	0	0.00	5,124	4.25	1,845	4.50	3,110	48.25	735	48.42
1024	Floodplain	P11	1,940	12.25	4,762	3.58	2,381	3.58	1,903	48.00	951	48.00
1032	Floodplain	CP9	2,824	13.50	5,187	4.33	3,763	4.67	4,419	48.00	3,692	48.17
1584	Floodplain	P5	3,874	12.92	12,446	4.33	6,223	4.33	8,444	48.33	4,222	48.33
2961	Channel	CP4	13,266	13.00	44,578	4.25	21,544	4.33	29,469	48.25	14,644	48.33
4071	Floodplain	CV13	3,847	12.83	15,331	4.17	7,470	4.17	10,393	48.08	5,169	48.08
4803	Floodplain	V14	2,214	12.42	7,684	3.83	3,842	3.83	3,861	48.00	1,931	48.00
6319	Floodplain	V11	4,213	12.50	12,883	3.92	6,442	3.92	6,914	48.08	3,457	48.08
7233	Floodplain	V10	2,624	12.33	7,664	3.67	3,832	3.67	3,767	48.00	1,883	48.00
10719	Floodplain	V9	2,876	12.50	9,852	3.83	4,926	3.83	5,139	48.00	2,570	48.00
11555	Floodplain	V8	2,223	12.67	8,302	4.08	4,151	4.08	4,963	48.17	2,482	48.17
12744	Floodplain	CV7	2,228	12.33	6,580	4.17	3,133	3.67	4,687	48.08	2,329	48.08
14399	Floodplain	CV4	4,789	13.50	19,622	4.75	9,846	4.75	16,023	48.33	7,937	48.33
16159	Floodplain	V5	2,458	12.58	9,403	4.00	4,702	4.00	5,103	48.17	2,551	48.17
17542	Floodplain	R15	626	12.25	1,998	3.58	999	3.58	760	48.00	380	48.00
17970	Floodplain	R14	1,345	12.25	4,075	3.58	2,038	3.58	1,528	48.00	764	48.00
19732	Floodplain	CR13	4,677	12.58	14,640	3.92	7,332	3.92	9,786	48.25	4,888	48.25
21568	Floodplain	CR9	10,615	13.25	39,021	4.50	18,496	4.58	32,102	48.58	15,922	48.58
22888	Floodplain	R10	2,469	12.75	8,482	4.17	4,241	4.17	5,371	48.25	2,686	48.25
23625	Floodplain	R11	1,029	12.33	3,407	3.67	1,703	3.67	1,468	48.00	734	48.00

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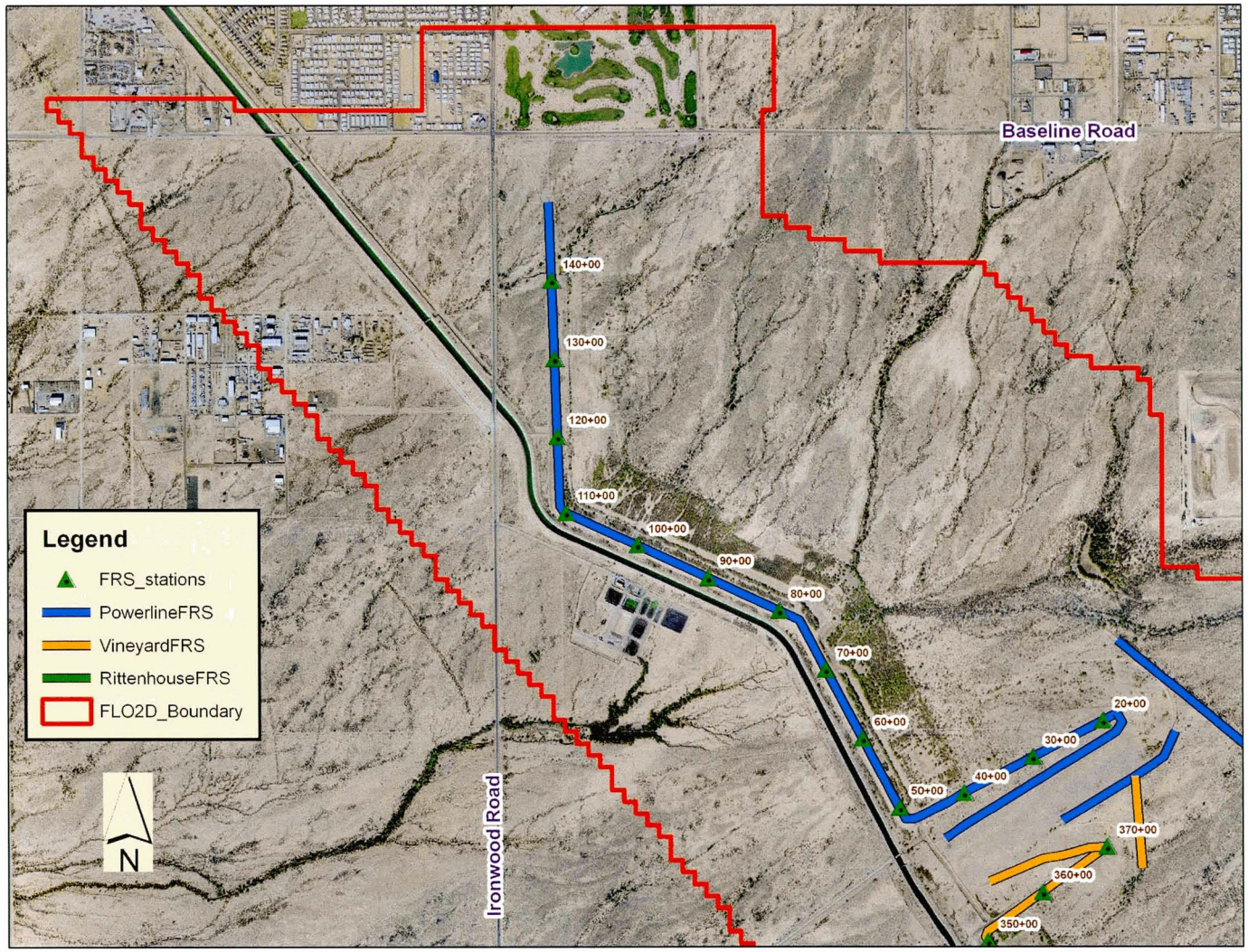

Figure 4.7

Approximate station locations for the Powerline FRS

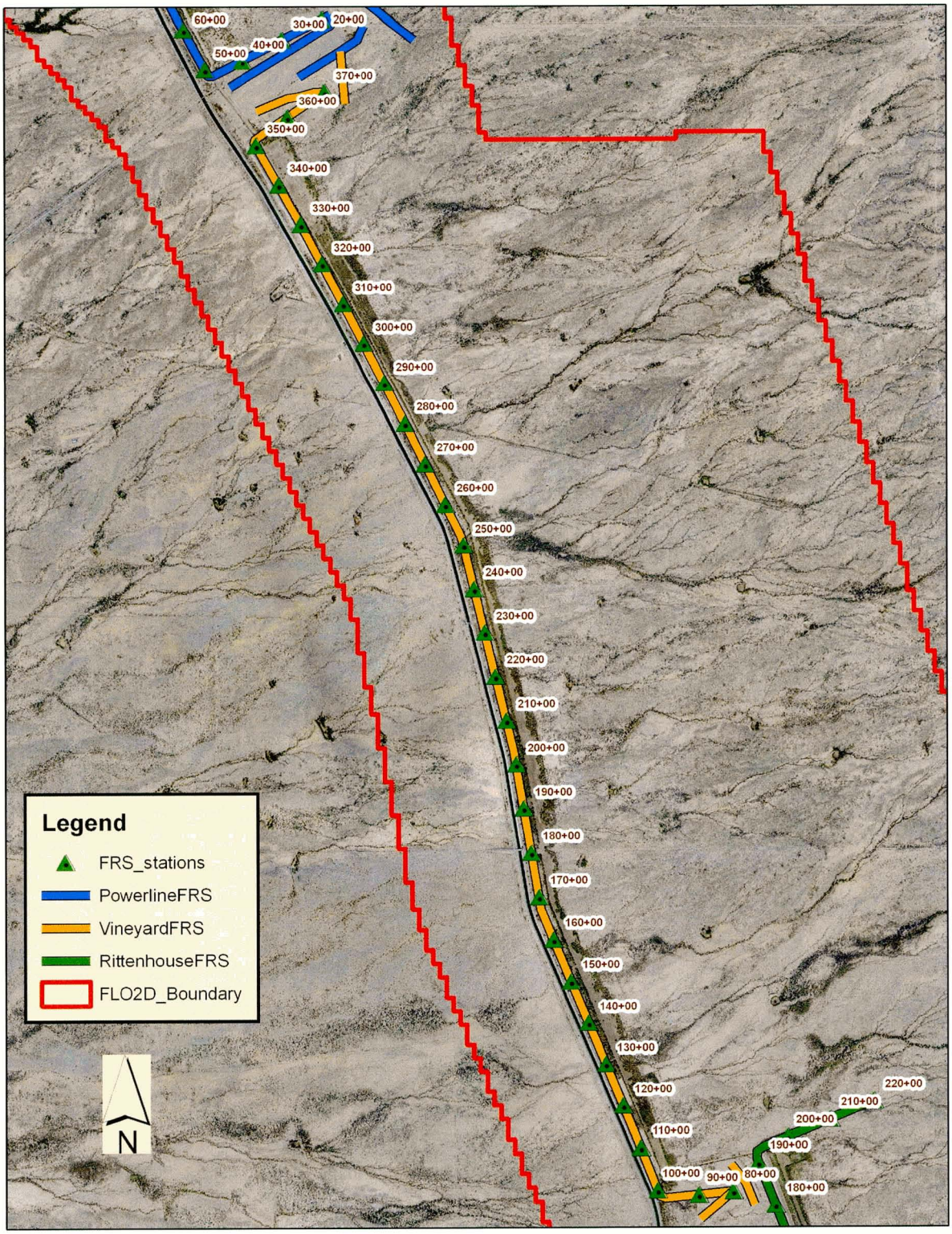

Figure 4.8

Approximate station locations for the Vineyard FRS

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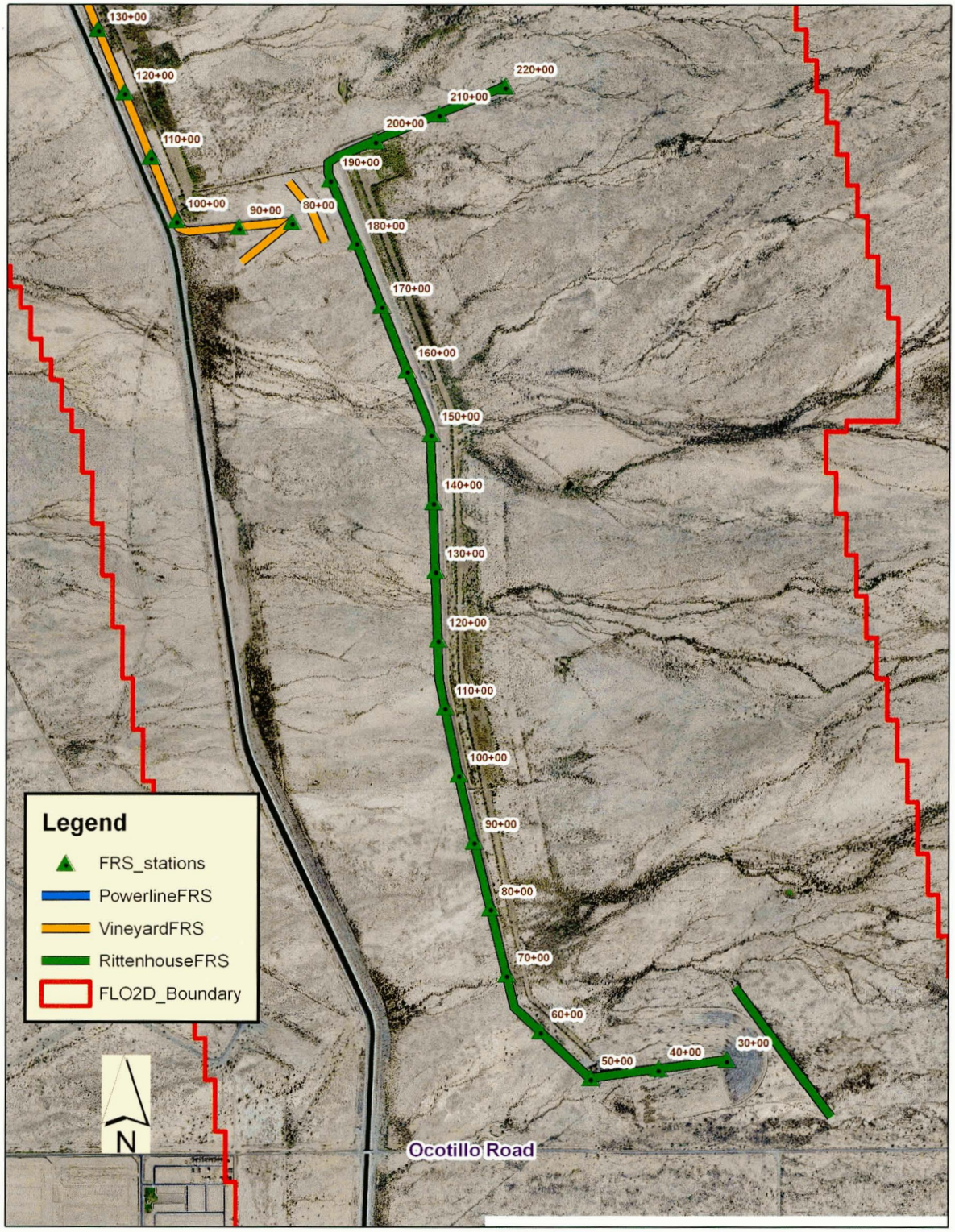

Figure 4.9

Approximate station locations for the Rittenhouse FRS

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Table 4.3

Summary of flood-pool elevations and peak principal outlet and emergency spillway discharges from the Powerline FRS

Storm Simulation	Flood-pool Elevations (ft)		Maximum Discharge (cfs)	
	Residual	Maximum Dynamic[a]	Principal Outlet	Emergency Spillway
100-Year, 24-Hour	1580.6	1581.5	153	435[b]
6-Hour Full PMF	1590.1	1590.8	202	11,188
6-Hour Half PMF	1585.7	1586.8	187	1,038
72-Hour Full PMF	1591.7	1591.9	204	23,478
72-Hour Half PMF	1589.3	1590.2	201	7,953

Notes:
a – Areas of local "mounding" due to floodwave dynamics and movement of water within the dam forebay.
b – Flows entering spillway are due to the spillway protection levee being overtopped and are not from the flood-pool

Table 4.4

Summary of dam crest overtopping results for the Powerline FRS

Storm Simulation	Maximum Cumulative Overtopping Discharge (cfs)	Maximum Overtopping Element [a]				
		Grid No.	Approximate Station	Discharge (cfs)	Depth (feet)	Duration (hours)
100-Year, 24-Hour	None	None	None	None	None	None
6-Hour Full PMF	900	665 (1063)	151+00 (140+00)	427 (102)	1.8 (0.4)	7.8 (1.5)
6-Hour Half PMF	19	665	150+00	19	0.2	1.2
72-Hour Full PMF	19,060	665 (1063)	150+00 (140+00)	897 (735)	2.7 (1.3)	2.2 (5.0)
72-Hour Half PMF	279	665	150+00	279	1.5	6.5

a – Powerline FRS has a small bench that is located at the extreme north end of the dam. The crest elevation for this bench is approximately 2.5 feet lower than the rest of the dam, and therefore, this portion overtops before the rest. The values in parenthesis are overtopping results for the rest of the structure in general.

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100-Year, 24-Hour Simulation – There is no overtopping of the dam crest, however the model indicates that the northern end of the dike protecting the emergency spillway is overtopped as the flows from Siphon Draw are constricted and redirected to the north. Approximately 1,700 cfs overtops the dike (assuming the dike does not fail) with depths exceeding one foot in some locations nearest Siphon Draw. The average duration of overtopping for the protection dike is typically less than one hour. The model indicates that approximately 435 cfs of the protection dike overtopping flows will bypass the flood-pool and enter the emergency spillway directly. The impact of these flows downstream is minimal as they will be either captured by the channels draining the Powerline and Vineyard POs or attenuated in the storage area on the upstream side of the CAP Canal or the canal freeboard itself.

6-Hour PMF Simulations – With the exception of a small bench at the extreme north end of the dam, the only overtopping for the 6-hour PMF events occur during the full PMF. The overtopping primarily occurs at the north portion of the dam between station 137+00 and the end. For both events, an area of local mounding occurs between stations 70+00 to 80+00.

72-Hour PMF Simulations – With the exception of a small bench at the extreme north end of the dam, the only overtopping for the 72-hour PMF events occur during the full PMF, wherein most of the dam is overtopped. For both events, an area of local mounding occurs between stations 70+00 to 80+00.

4.6.2 Vineyard FRS

Select results for each storm simulation are summarized for the Vineyard FRS in Tables 4.5 and 4.6. The results are discussed in the following paragraphs.

100-Year, 24-Hour Simulation – There is no overtopping of the dam crest and no emergency spillway flows for the 100-year storm. The maximum flood-pool water surface elevations generally slope from south to north with an elevation change of 1.6 feet in 25,400 linear feet of flood-pool (less than 0.006 percent).

6-Hour PMF Simulations – No overtopping occurs for the 6-hour half PMF. For the 6-hour full PMF, most of the southern half and a few isolated locations in the northern half of the dam are overtopped. The maximum residual flood-pool water surface elevations generally slope to the north and south from a high point around station 136+00, where a large tributary discharges to the flood-pool.

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Table 4.5

Summary of flood-pool elevations and peak principal outlet and emergency spillway discharges from the Vineyard FRS

Storm Simulation	Flood-pool Elevations (ft)		Maximum Discharge (cfs)	
	Residual	Maximum Dynamic[a]	Principal Outlet	Emergency Spillway
100-Year, 24-Hour	1572.9 (N) to 1574.5 (S)	---[b]	186	0
6-Hour Full PMF	1579.8 (N) to 1581.3 (S)	1581.7	276	3,245 (North ES) 8,368 (South ES)
6-Hour Half PMF	1576.1 (N) to 1578.2 (S)	1578.5	237	0 (North) 1,436 (South)
72-Hour Full PMF	1580.9 (N) to 1581.6 (S)	1582.2	282	6,650 (North) 10,199 (South)
72-Hour Half PMF	1578.3 (N) to 1580.6 (S)	1581.6	265	1,034 (North) 6,133 (South)

Notes:
a – Areas of local "mounding" due to floodwave dynamics and movement of water within the dam forebay.
b – No significant change from residual elevations

Table 4.6

Summary of dam crest overtopping results for the Vineyard FRS

Storm Simulation	Maximum Cumulative Overtopping Discharge (cfs)	Maximum Overtopping Element				
		Grid No.	Approximate Station	Discharge (cfs)	Depth (feet)	Duration (hours)
100-Year, 24-Hour	None	None	None	None	None	None
6-Hour Full PMF	10,173	16440	135+30	620	1.1	3.2
6-Hour Half PMF	None	None	None	None	None	None
72-Hour Full PMF	40,430	16700	130+70	1,016	1.6	5.8
72-Hour Half PMF	467	16700	130+70	128	0.5	2.3

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72-Hour PMF Simulations – Overtopping for the 72-hour half PMF occurs between stations 130+00 and 140+00 and a few spots located around station 190+00. Overtopping for the 72-hour full PMF event occurs over most of the dam. The maximum residual flood-pool water surface elevations generally slope to the north and south from a high point around station 136+00, where a large tributary discharges to the flood-pool.

4.6.3 Rittenhouse FRS

Select results for each storm simulation are summarized for the Rittenhouse FRS in Tables 4.7 and 4.8. The results are discussed in the following paragraphs.

100-Year, 24-Hour Simulation – There is no overtopping of the dam crest and no emergency spillway flows for the 100-year storm. The maximum residual flood-pool water surface elevation for the flood-pool is approximately 1597.3 feet. A small area of mounding occurs in the area around the PO.

6-Hour PMF Simulations – The extreme northeastern limit of the dam crest is minimally overtopped during the 6-hour half PMF. For the 6-hour full PMF, most of the southern half and a few isolated locations in the northern half of the dam are overtopped.

72-Hour PMF Simulations – Overtopping for both of the 72-hour PMF events occurs over most of the dam crest. The maximum residual flood-pool water surface elevations generally slopes from north to south with an elevation change of 0.4 and 0.7 feet in 14,000 linear feet of flood-pool (less than 0.003 and 0.005 percent) for the 72-hour full and half PMF events, respectively.

4.7 Dam Safety Considerations

The purpose of this section is to discuss the FLO-2D results as they relate to the current Emergency Action Plan documented in the JEF EAP Report. The EAP specifically addresses emergency spillway inundation and dam failure scenarios for each PVR Structure.

4.7.1 Emergency Spillway Inundation

The maximum peak discharge used in the EAP for the emergency spillway inundation analysis was derived using a 6-hour PMF HEC-1 model and the simplified assumption of no overtopping of the dam and an initial flood-pool elevation that is equal to the emergency spillway crest at the beginning of the storm. For the purposes of comparison, the FLO-2D results for the

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Table 4.7

Summary of flood-pool elevations and peak principal outlet and emergency spillway discharges from the Rittenhouse FRS

Storm Simulation	Flood-pool Elevations (ft)		Maximum Discharge (cfs)	
	Residual	Maximum Dynamic[a]	Principal Outlet	Emergency Spillway
100-Year, 24-Hour	1597.3	1598.1	145	0
6-Hour Full PMF	1603.9 (N) to 1603.4 (S)	1604.8	166	9,727
6-Hour Half PMF	1601.6 (N) to 1601.0 (S)	1602.3	161	2,173
72-Hour Full PMF	1604.1 (N) to 1603.7 (S)	1605.1	167	11,689
72-Hour Half PMF	1603.8 (N) to 1603.1 (S)	1604.6	166	7,945

Notes:
a – Areas of local "mounding" due to floodwave dynamics and movement of water within the dam forebay.
b – Flows entering spillway are due to the spillway protection levee being overtopped and are not from the flood-pool

Table 4.8

Summary of dam crest overtopping results for the Rittenhouse FRS

Storm Simulation	Maximum Cumulative Overtopping Discharge (cfs)	Maximum Overtopping Element				
		Grid No.	Approximate Station	Discharge (cfs)	Depth (feet)	Duration (hours)
100-Year, 24-Hour	None	None	None	None	None	None
6-Hour Full PMF	20,861	22111	107+20	834	1.3	3.5
6-Hour Half PMF	50	17254	218+40	32	0.2	0.8
72-Hour Full PMF	39,008	22111	107+20	1,236	1.6	6.8
72-Hour Half PMF	7,531	21746	115+00	404	1.0	4.6

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either the 6-hour or 72-hour, Half PMF simulations were used since those simulations are the closest approximation of the assumptions used by the EAP. The EAP and FLO-2D values for each emergency spillway are summarized in Table 4.9.

Table 4.9

Comparison of EAP and FLO-2D emergency spillway inundation peak discharges

	Estimated Peak Spillway Inundation Discharge, in cfs	
Emergency Spillway	**JEF EAP**	**FLO-2D**
Powerline	21,300	7,953 [a]
Vineyard North	9,000	1,034 [a]
Vineyard South	9,000	6,133 [a]
Rittenhouse	18,300	2,173 [b]
a – 72-hour, Half PMF b – 6-hour, Half PMF		

The peak discharges used in the EAP are much larger than those reported by the FLO-2D model. The primary reason for the differences between the two models are:

- HEC-1 assumes a level pool when routing the flood flows versus the fully dynamic flood wave routing performed by FLO-2D. As noted in tables 4.3, 4.5, and 4.7, the water surface across the length of the structures is not level during the movement of the peak discharges through the flood-pool.
- The FLO-2D model started with a dry flood-pool. Pre-filling the flood-pool up to an elevation that is near the emergency spillway crest prior to adding in a simulated storm will likely increase the flows through the emergency spillway.
- The stage-discharge rating curves for each spillway were updated based on recent topographic mapping and detailed survey and may be slightly different than those used in the HEC-1 models.
- The FLO-2D model reflects a significantly greater level of dam crest elevation data than what was used to create the HEC-1 models.

In summary, the EAP emergency spillway inundation analysis is considered to be conservative in the estimation of peak discharges through the emergency spillway and their downstream impacts relative to the FLO-2D results.

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4.7.2 Dam Failure Assessment

Failure of earthen dams typically occurs by either piping through the dam embankment or breaching of the dam crest through overtopping. The EAP process typically examines both dam failure modes and then uses the worst case scenario. The maximum outflow from the "worst case" scenario used in the EAP was about 82,600 cfs for Powerline FRS, 68,900 cfs for Vineyard and 71,400 cfs for Rittenhouse FRS. The failure locations selected in the EAP were based on a low point in the dam crest profile and/or a main tributary entry point to flood-pool.

The FLO-2D model can only approximate overtopping dam failure internally by representing the dam embankment with levees and coding in breach parameters to the levee module. Dam failure by piping can only be routed through the model using an externally derived piping failure hydrograph. No dam failure modeling was performed for this project using FLO-2D, however, the model results presented herein provide an accurate location of initial overtopping for each structure, which may not always be the lowest point in the dam. The initial overtopping location typically is also the most likely location for an overtopping failure. Tables 4.10 – 4.12 summarize the initial overtopping elements for each FRS and PMF storm simulation.

Table 4.10

Summary of the initial dam crest overtopping results for the Powerline FRS

Storm Simulation	Initially Overtopped Grid No. [a]	Time of Initial Overtopping (hrs)	Approximate Station	Maximum Discharge (cfs)	Maximum Depth (feet)	Duration of Overtopping (hours)
6-Hour, Full PMF	665 (880)	3.56 (6.11)	150+00 (144+60)	427 (94)	1.8 (0.4)	7.8 (1.6)
6-Hour, Half PMF	665 (None)	3.75 (None)	150+00 (None)	19 (None)	0.2 (None)	1.2 (None)
72-Hour, Full PMF	665 (880)	46.57 (47.71)	150+00 (144+60)	897 (691)	2.7 (1.3)	2.2 (5.0)
72-Hour, Half PMF	665 (None)	49.40 (None)	150+00 (None)	279 (None)	1.5 (None)	6.5 (None)

a – Powerline FRS has a small bench that is located at the extreme north end of the dam in Grid No. 665. The crest elevation for this bench is approximately 2.5 feet lower than the rest of the dam. Although this location overtops before the rest, it is not likely to be the most critical location for a dam failure given its proximity in reference to the main part of the flood-pool. The values in parenthesis are overtopping results for the rest of the structure in general

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Table 4.11

Summary of the initial dam crest overtopping results for the Vineyard FRS

Storm Simulation	Initially Overtopped Grid No.	Time of Initial Overtopping (hrs)	Approximate Station	Maximum Discharge (cfs)	Maximum Depth (feet)	Duration of Overtopping (hours)
6-Hour Full PMF	16700	5.35	130+70	618	1.2	3.4
6-Hour Half PMF	None	None	None	None	None	None
72-Hour Full PMF	16700	47.74	130+70	1,016	1.6	5.8
72-Hour Half PMF	16700	50.13	130+70	128	0.5	2.3

Table 4.12

Summary of the initial dam crest overtopping results for the Rittenhouse FRS

Storm Simulation	Initially Overtopped Grid No.	Time of Initial Overtopping (hrs)	Approximate Station	Maximum Discharge (cfs)	Maximum Depth (feet)	Duration of Overtopping (hours)
6-Hour Full PMF	17254	3.92	218+40	202	0.6	6.6
6-Hour Half PMF	17254	3.99	218+40	32	0.2	0.8
72-Hour Full PMF	17254	46.66	218+40	333	0.9	9.3
72-Hour Half PMF	21746	49.2	115+00	404	1.0	4.6

In summary, the FLO-2D overtopping results generally support the dam failure location decisions made in the EAP and provide no reason to suggest a revision to the EAP.

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Appendix A

Bibliography

A-N West, 1987, *Superstition Freeway Comprehensive Offsite Drainage Plan.*

Arizona Department of Water Resources (ADWR), 1985, *Design Manual for Engineering Analysis of Fluvial Systems..*

Camp, P.D., 1986, *Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona*: U.S. Soil Conservation Service Report, 306 p., 53 maps, scale 1:24,000.

Flood Control District of Maricopa County, 1998, *East Mesa Area Drainage Master Plan-Hydrologic Analysis.*

Flood Control District of Maricopa County, 2003, *Drainage Design Manual for Maricopa County, Hydrology.*

Foster, George R., 2005, *Revised Universal Soil Loss Equation, Version 2, User's Manual* Prepared for USDA-Agricultural Research Service, January 1, 2005.

Foster, George R., 2005, *Revised Universal Soil Loss Equation, Version 2, Science Documentation*, Prepared for USDA-Agricultural Research Service, January 1, 2005.

Garrett, J.M. and Gellenbeck, D.J., 1991, *Basin Characteristics and Streamflow Statistics in Arizona as of 1989*, U.S. Geological Survey, Water-Resources Investigations Report 91-4041, Denver, Colorado, 612 p.

Hickey, R., 2000, *Slope angle and slope length solutions for GIS*, Vol. 29, no. 1, pp. 1-8.

HydroLogic Consultants, 2004, *The City of Apache Junction Comprehensive Plan Water Resources Element, Technical Background Report, Hydrogeologic Conditions.*

James M. Montgomery (JMM) Consulting Engineers, 1989, *Dambreak Analyses for Powerline, Vineyard, and Rittenhouse Flood Retarding Structures*, FCD 88-37.

JE Fuller/ Hydrology & Geomorphology, Inc., 2006, *Emergency Action Plan Final Report for Powerline, Vineyard and Rittenhouse Flood Retarding Structures*, FCD-2004C044.

Kimley-Horn and Associates, Inc., 2000, *Individual Structures Assessment Reports, Cave Buttes Dam, Powerline FRS, Vineyard Road FRS, Rittenhouse FRS, Structures Assessment Program-Phase I, Flood Control District of Maricopa County*, FCD 98-41.

Kimley-Horn & Associates, 2002, *Stormwater Master Plan, City of Apache Junction, Hydrology Report Volume One and Volume Two.*

Kimley-Horn & Associates, 2006, *Final Drainage Report-Ironwood Drive/Ocotillo Road/US 60 Phase A*, Pinal County Department of Public Works.

Maricopa County, 2007, *Maricopa County Drainage Policies and Standards.*

Michael Baker Jr., Inc., 2002, *Spillway Inundation Study for Powerline, Vineyard and Rittenhouse FRS.*

O'Brien, J.S., 2006, *FLO-2D Data Input Manual.*

O'Brien, J.S., 2006, *FLO-2D User's Manual.*

O'Brien, J.S., 2006, *FLO-2D GDS Manual.*

Planchon O., Darboux F., 2001, *A fast, simple and versatile algorithm to fill the depressions of digital elevation models*, Catena (Journal), 2001, 46: p159- 176, Elsevier Science.

Plasencia, D., Rice. V., FCDMC, 1989, *Hydrologic Analysis of the Powerline FRS.*

Renard, K.G. and J.J. Stone, 1981, *Sediment yield from small semiarid rangeland watersheds*, Proceedings of the Workshop on Estimating Erosion and Sediment Yield on Rangelands. Tucson, Arizona. p. 129-144.

Renard, K.G. et al., 1997, *Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE).* Agriculture Handbook 703. USDA, Agricultural Research Service.

Simons, Li & Associates, 1982, *Engineering Analysis of Fluvial Systems*, SLA, Fort Collins, CO.

Simons, Li & Associates, 1985, *Design Manual for Engineering Analysis of Fluvial Systems*, prepared for the Arizona Department of Water Recources.

Soil Conservation Service, 1974, *Analysis: Sedimentation Data East Maricopa County Watersheds*, NRCS Archives, Phoenix, Arizona.

Soil Conservation Service (Natural Resources Conservation Service (NRCS)), 1985, *Study for Weekes Wash.*

Thomas, B.E., Hjalmarson, H.W., and Waltemeyer, S.D., 1997, *Methods for Estimating Magnitude and Frequency of Floods in the Southwest United States,* U.S. Geological Survey, Water Supply Paper 2433, Open File Report 93-419, 195 p

Tudor Engineering Company, 1989, *Final Drainage Study Report for Superstition Freeway - (SR360) – Ironwood Drive to U.S. 60*, ADOT Project No. F-028-1-314PE-514C.

URS, 2006, *Draft Drainage Master Plan Report for Lost Dutchman Heights, Parcel A, Arizona State Land Department.*

U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS) (Natural Resources Conservation Service (NRCS)), 1963, *Design of Powerline, Vineyard and Rittenhouse FRS-Watershed Work Plans for Apache Junction-Gilbert and Williams-Chandler Watersheds.*

U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS) (Natural Resources Conservation Service (NRCS)), 1983, National Engineering Handbook, Section 3, NEH-3.

U.S. Department of Interior, Bureau of Reclamation, 1987, *Design of Small Dams*, Third Edition.

Williams, J.R. and H.D. Berndt, 1977, *Sediment yield prediction based on watershed hydrology*, Transactions, ASAE, ser. 20, v. 6, p. 1100-1104.

Appendix B

Principal Outlet Rating Curves

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 South Kyrene Road, Suite 201, Tempe, Arizona 85284
Phone: 480-752-2124 Fax: 480-839-2193

Powerline FRS Stage-Storage-Discharge Curves for Use in EAP 100-year Flood Evaluation
August, 2005

Elevation (feet) (NAVD 88)	Gage Height* (feet)	PO Q (cfs)	ES Q (cfs)	Q Total (cfs)	Volume (acre-feet)	Area (acres)	
1556	-7.5	0	0	0	0	0	
1563.5	0.0	0	0	0	14	7	EAP PO Elev
1564	0.5	5	0	5	17	10	
1565	1.5	15	0	15	39	39	
1566	2.5	30	0	30	98	81	
1567	3.5	46	0	46	192	105	
1568	4.5	60	0	60	306	122	
1569	5.5	70	0	70	433	132	
1570	6.5	82	0	82	570	141	
1571	7.5	90	0	90	716	153	
1572	8.5	98	0	98	876	166	
1573	9.5	105	0	105	1049	182	
1574	10.5	112	0	112	1241	201	
1575	11.5	120	0	120	1452	222	
1576	12.5	128	0	128	1686	247	
1577	13.5	135	0	135	1945	272	
1578	14.5	140	0	140	2229	297	
1579	15.5	145	0	145	2538	322	
1580	16.5	150	0	150	2873	346	
1581	17.5	155	0	155	3232	373	
1582	18.5	162	0	162	3619	402	
1583	19.5	170	0	170	4040	439	
1584	20.5	178	0	178	4494	469	
1584.6	21.1	180	0	180	4784	485	EAP Spillway
1585	21.5	182	418	600	4977	496	
1586	22.5	187	1713	1900	5486	522	
1587	23.5	191	3009	3200	6021	549	
1588	24.5	195	5105	5300	6582	574	
1589	25.5	200	10300	10500	7169	599	
1590	26.5	202	16800	17000	7780	624	
1590.5	27	203	20000	20200	8100	640	EAP min TOD
1591.5	28.5	204		27500	8800		

Does not match Rating tables

Same for next pages

Sources: Data from ALERT System files. Discharge rating is Rating #2 which is based on an HY8 culvert analysis for the PO by T. Donaldson in 1992 and a HECRAS analysis by ALERT Branch personnel in 1997. Storage curve is based on Rating # 3 which is from a GIS analysis by FCD personnel of the same DTM used to devleop the Countywide 10-ft contour mapping from flight dates of Jan/Feb. 2001.

* = Note that the gage height reported here is based on 2004 survey elevation of the principal outlet invert which is used here as 0 ft gage height.

NOTE:		Data presented is used in FLO-2D
		Data is NOT used FLO-2D

Vineyard FRS Stage-Storage-Discharge Curves for Use in EAP 100-year Flood Evaluation
August, 2005

Elevation (feet) (NAVD 88)	Gage Height* (feet)	PO Q (cfs)	North ES Q (cfs)	South ES Q (cfs)	Q Total (cfs)	Volume (acre-feet)	Area (acres)	
1562	-1.7	0	0	0	0	0	0	
1563.7	0	0	0	0	0	4	6	EAP PO
1565	1.3	12	0	0	12	22	29	
1567	3.3	61	0	0	61	176	134	
1569	5.3	115	0	0	115	553	239	
1571	7.3	157	0	0	157	1181	384	
1573	9.3	188	0	0	188	2074	511	
1575	11.3	222	0	0	222	3236	657	
1575.4	11.7	228	0	0	228	3516	693	EAP S ES Crest
1576	12.3	236	0	96	332	3935	740	EAP N ES Crest
1577	13.3	249	123	781	1153	4716	821	
1578	14.3	262	856	2382	3500	5577	902	
1579	15.3	272	2318	4878	7468	6519	980	
1580	16.3	280	3945	7418	11643	7535	1054	
1580.2	16.5	281	4518	8562	13361	7755	1065	EAP TOD
1581.2	17.5	282			25000	8750		

Sources: Data from ALERT System files. Discharge rating is Rating #4 which is based on an HY8 culvert analysis for the PO by RW Cruff in 1992 and a HECRAS analysis by ALERT Branch personnel in 1997. Storage curve is based on Rating # 3 which is from a GIS analysis by FCD personnel of the same DTM used to devleop the Countywide 10-ft contour mapping from flight dates of Jan/Feb. 2001.
* = Note that the gage height reported here is based on 2004 survey elevation of the principal outlet invert

NOTE:		Data presented is used in FLO-2D
		Data is NOT used FLO-2D

Rittenhouse FRS Stage-Storage-Discharge Curves for Use in EAP 100-year Flood Evaluatio
August, 2005

Elevation (feet) (NAVD 88)	Gage Height (feet)	PO Q (cfs)	ES Q (cfs)	Q Total (cfs)	Volume (acre-feet)	Area (acres)	
1579	0.0	0	0	0	0	0	EAP PO Elev
1580	1.0	6	0	6	0	0	
1581	2.0	21	0	21	0	0	
1582	3.0		0		1	3	
1583	4.0	55	0	55	5	5	
1584	5.0		0		13	11	
1585	6.0	79	0	79	30	27	
1586	7.0		0		70	57	
1587	8.0	93	0	93	146	92	
1588	9.0		0		254	123	
1589	10.0	106	0	106	393	154	
1590	11.0		0		565	190	
1591	12.0	117	0	117	774	228	
1592	13.0		0		1024	273	
1593	14.0	126	0	126	1321	322	
1594	15.0		0		1669	375	
1595	16.0	135	0	135	2071	429	
1596	17.0		0		2527	482	
1597	18.0	143	0	143	3035	534	
1598	19.0	147	0		3595	587	
1598.4	19.4	149	0	149	3840	607	EAP Spillway
1598.6	19.6	150	50	200	3963	617	
1599	20.0	151	250	401	4208	637	
1600	21.0	155	1810	1965	4869	686	
1601	22.0	160	4750	4910	5580	736	
1602	23.0	160	8500	8660	6343	790	
1603	24.0	160	13300	13460	7161	845	
1603.1	24.1	160	13800	13960	7248	850	EAP min TOD
1604.1	25.1	161.0		20000	8200		

Sources: Data from ALERT System files. Discharge rating is Rating #3 which is based on an HY8 culvert analysis for the PO by RW Cruff in 1992 and a HECRAS analysis by ALERT Branch personnel in 1997. Storage curve is based on Rating # 2 which is from a GIS analysis by FCD personnel of the same DTM used to develop the Countywide 10-ft contour mapping from flight dates of Jan/Feb. 2001.

NOTE:		Data presented is used in FLO-2D
		Data is NOT used FLO-2D

Appendix C

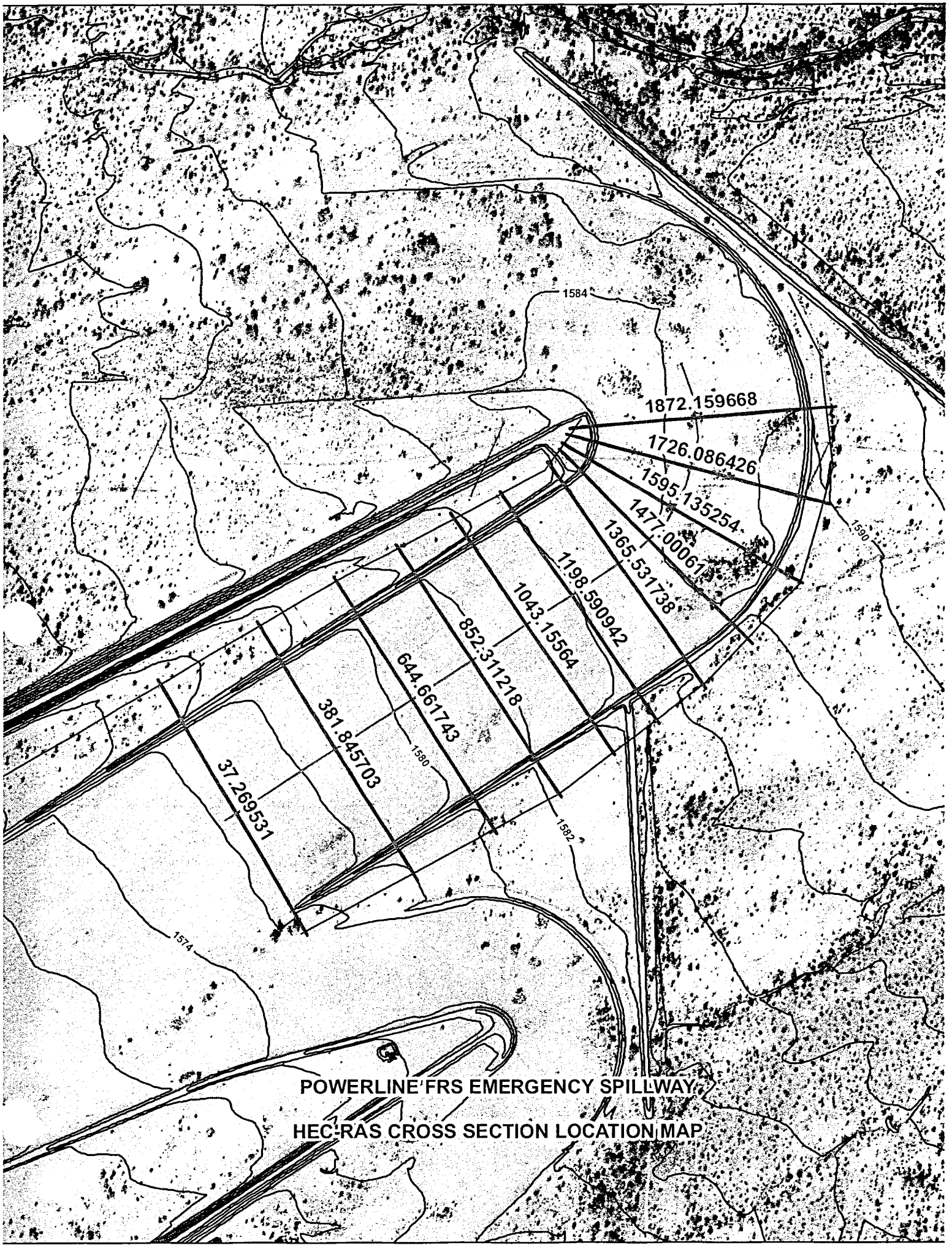
Powerline FRS Emergency Spillway HEC-RAS Model

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 South Kyrene Road, Suite 201, Tempe, Arizona 85284
Phone: 480-752-2124 Fax: 480-839-2193

HEC-RAS Plan: P_ES_030 River: Powerline ES Reach: main												
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 # C
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
main	1872.159	PF 1	200	1583.73	1585.27	1584.02	1585.27	0.000021	0.27	750.83	599.38	0.04
main	1872.159	PF 2	500	1583.73	1585.53	1584.18	1585.53	0.000072	0.55	906.18	601.76	0.08
main	1872.159	PF 3	1000	1583.73	1585.85	1584.4	1585.86	0.000151	0.91	1101.39	604.73	0.12
main	1872.159	PF 4	2000	1583.73	1586.34	1584.69	1586.37	0.000275	1.43	1399.92	609.24	0.17
main	1872.159	PF 5	3000	1583.73	1586.73	1584.94	1586.78	0.000368	1.83	1639.02	613.07	0.2
main	1872.159	PF 6	4000	1583.73	1587.07	1585.12	1587.14	0.000444	2.17	1845.44	616.17	0.22
main	1872.159	PF 7	5000	1583.73	1587.37	1585.29	1587.46	0.000508	2.46	2030.33	618.7	0.24
main	1872.159	PF 8	6000	1583.73	1587.64	1585.48	1587.76	0.000563	2.73	2199.21	621.01	0.26
main	1872.159	PF 9	7000	1583.73	1587.89	1585.63	1588.03	0.000611	2.97	2356.78	623.15	0.27
main	1872.159	PF 10	8000	1583.73	1588.13	1585.79	1588.29	0.000655	3.19	2504.44	625.15	0.28
main	1872.159	PF 11	9000	1583.73	1588.35	1585.93	1588.53	0.000694	3.4	2644.45	627.04	0.29
main	1872.159	PF 12	10000	1583.73	1588.57	1586.07	1588.77	0.00073	3.6	2778.14	628.84	0.3
main	1872.159	PF 13	15000	1583.73	1589.51	1586.71	1589.82	0.000874	4.45	3374.49	636.8	0.34
main	1872.159	PF 14	20000	1583.73	1590.31	1587.26	1590.72	0.000979	5.14	3890.75	656.78	0.37
main	1872.159	PF 15	25000	1583.73	1591.03	1587.8	1591.54	0.001057	5.75	4356.18	762.63	0.39 ?
main	1872.159	PF 16	30000	1583.73	1591.68	1588.28	1592.29	0.001117	6.28	4782.41	776.8	0.41
main	1872.159	PF 17	35000	1583.73	1592.29	1588.74	1593	0.001169	6.77	5178.04	776.8	0.42
main	1872.159	PF 18	40000	1583.73	1592.86	1589.18	1593.67	0.001214	7.22	5549.21	776.8	0.43
main	1872.159	PF 19	45000	1583.73	1593.4	1589.59	1594.3	0.001253	7.64	5901.33	776.8	0.45
main	1872.159	PF 20	50000	1583.73	1593.91	1590	1594.91	0.001287	8.04	6237.67	776.8	0.46

WSEL	Q Total	Depth	Q * 0.25
1584.9	0	0	0 Set Grid Nos. 3616-3619 to this elevation, which is the 2007 surveyed elevation
1585.27	200	0.37	50
1585.53	500	0.63	125
1585.85	1000	0.95	250
1586.34	2000	1.44	500
1586.73	3000	1.83	750
1587.07	4000	2.17	1000
1587.37	5000	2.47	1250
1587.64	6000	2.74	1500
1587.89	7000	2.99	1750
1588.13	8000	3.23	2000
1588.35	9000	3.45	2250
1588.57	10000	3.67	2500
1589.51	15000	4.61	3750
1590.31	20000	5.41	5000
1591.03	25000	6.13	6250
1591.68	30000	6.78	7500
1592.29	35000	7.39	8750
1592.86	40000	7.96	10000
1593.4	45000	8.5	11250
1593.91	50000	9.01	12500

This is divided by 4 to assign Q to each grid.



POWERLINE FRS EMERGENCY SPILLWAY

HEC-RAS CROSS SECTION LOCATION MAP

```
                    HEC-RAS Version 3.1.3 May 2005
                     U.S. Army Corp of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California


          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX


PROJECT DATA
Project Title: Powerline ES Rating Curve
Project File : Powerline_ES.prj
Run Date and Time: 6/22/2007 1:58:49 PM

Project in English units


PLAN DATA

Plan Title: Powerline ES Rating_with n of 0.030
Plan File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Powerline_ES.p01

          Geometry Title: Powerline ES with n of 0.030
          Geometry File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Powerline_ES.g01

          Flow Title    : ES Rating Curve
          Flow File     : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Powerline_ES.f01

Plan Summary Information:
Number of:  Cross Sections =   11    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


FLOW DATA

Flow Title: ES Rating Curve
Flow File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Powerline_ES.f01

Flow Data (cfs)

  River          Reach          RS                PF 1          PF 2          PF 3          PF 4          PF 5          PF 6          PF 7          PF 8
  Powerline ES   main           1872.159           200           500          1000          2000          3000          4000          5000          6000
```

River	Reach	RS	PF 9	PF 10	PF 11	PF 12	PF 13	PF 14	PF 15	PF 16
Powerline ES	main	1872.159	7000	8000	9000	10000	15000	20000	25000	30000

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Powerline ES	main	PF 1		Normal S = 0.005
Powerline ES	main	PF 2		Normal S = 0.005
Powerline ES	main	PF 3		Normal S = 0.005
Powerline ES	main	PF 4		Normal S = 0.005
Powerline ES	main	PF 5		Normal S = 0.005
Powerline ES	main	PF 6		Normal S = 0.005
Powerline ES	main	PF 7		Normal S = 0.005
Powerline ES	main	PF 8		Normal S = 0.005
Powerline ES	main	PF 9		Normal S = 0.005
Powerline ES	main	PF 10		Normal S = 0.005
Powerline ES	main	PF 11		Normal S = 0.005
Powerline ES	main	PF 12		Normal S = 0.005
Powerline ES	main	PF 13		Normal S = 0.005
Powerline ES	main	PF 14		Normal S = 0.005
Powerline ES	main	PF 15		Normal S = 0.005
Powerline ES	main	PF 16		Normal S = 0.005
Powerline ES	main	PF 17		Normal S = 0.005
Powerline ES	main	PF 18		Normal S = 0.005
Powerline ES	main	PF 19		Normal S = 0.005
Powerline ES	main	PF 20		Normal S = 0.005

GEOMETRY DATA

Geometry Title: Powerline ES with n of 0.030
Geometry File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Powerline_ES.g01

CROSS SECTION

RIVER: Powerline ES
REACH: main RS: 1872.159

INPUT
Description:
Station Elevation Data num= 54

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1591.09	7.75	1591.06	17.51	1590.6	18.35	1590.56	18.87	1590.61
25.05	1591.05	30.2	1590.91	56.31	1590.36	58.13	1590.33	58.72	1590.31
59.1	1590.3	72.58	1590.05	73.17	1589.93	74.84	1589.59	97.91	1584.27
98.89	1584.05	99.17	1583.99	99.67	1583.99	135.99	1583.94	157.85	1583.76
186.14	1583.79	212.39	1583.78	236.3	1583.8	266.93	1583.97	286.45	1583.95
321.47	1583.79	336.6	1583.74	376.01	1583.74	386.76	1583.73	395.9	1583.74
436.91	1583.75	442.32	1583.76	487.07	1583.78	488.74	1583.81	510.29	1584.24
535.27	1584.73	537.22	1584.78	581.48	1584.25	587.37	1584.21	594.29	1584.24
637.52	1584.23	662.7	1584.48	687.97	1584.61	690.95	1584.85	698.31	1586.37
701.34	1586.92	713.56	1589.89	715.88	1590.43	717.07	1590.45	722.17	1590.57
737.84	1590.81	748.48	1590.96	760.72	1590.83	776.8	1591.11		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	73.17	.03	717.07	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
73.17	717.07	280.05	146.07	25.22	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	69.18	1595	F
721.95	776.8	1595	F

CROSS SECTION

RIVER: Powerline ES
REACH: main RS: 1726.086

INPUT
Description:
Station Elevation Data num= 56

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1589.96	3	1589.94	14.01	1589.38	14.13	1589.37	14.46	1589.39
19.03	1589.69	19.63	1589.69	27.75	1589.69	58.84	1589.65	60.68	1589.75
61.84	1589.75	73.87	1589.86	75.73	1589.88	76.17	1589.89	76.19	1589.89
76.92	1589.71	97.27	1584.8	101.55	1584.57	102.79	1584.5	108.47	1584.43
118.16	1584.32	123.07	1584.23	161.66	1584.27	174.8	1584.28	179.54	1584.24
226.52	1583.87	253.78	1583.94	278.24	1583.96	294.65	1583.96	329.97	1583.9
356.42	1583.86	381.69	1583.81	390.83	1583.81	433.42	1583.7	458.13	1583.8
485.15	1583.87	531.68	1584.42	536.87	1584.47	539.87	1584.46	551.2	1584.36
588.58	1584.14	602.11	1584.2	651.88	1584.29	681.01	1584.42	693.16	1584.59
698.62	1586	701.89	1586.88	710.36	1588.8	715.15	1589.92	717.18	1589.96
743.15	1590.55	743.78	1590.58	745.69	1590.56	773.35	1590.42	782.36	1590.64
792.55	1590.81								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	73.87	.03	717.18	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
73.87	717.18	241.6	130.95	31.77	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	74.5	1595	F
721.06	792.55	1595	F

CROSS SECTION

RIVER: Powerline ES
REACH: main RS: 1595.135

INPUT
Description:
Station Elevation Data num= 70

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1588.76	5.22	1588.78	8.81	1588.91	11.84	1588.93	16.24	1588.75
23.79	1588.5	23.81	1588.5	31.81	1589.15	44.13	1588.84	44.44	1588.83
46.56	1588.8	67.99	1588.57	68.63	1588.58	71.01	1588.68	79.29	1589.03
81.39	1589.06	83.41	1589.09	87.69	1589.15	95.96	1587.09	106.69	1584.39
116.79	1583.85	117.1	1583.84	117.22	1583.82	145.97	1583.47	162.09	1583.35
191.58	1583.58	219.96	1583.63	228.14	1583.68	242.16	1583.78	277.82	1583.97
301.25	1583.9	335.69	1583.86	337.81	1583.85	341.44	1583.85	374.36	1583.85
393.55	1583.84	440.72	1583.93	447.48	1583.93	451.41	1583.93	466.35	1584.11
512.37	1584.5	526.41	1584.45	583.42	1584.2	585.29	1584.21	586.24	1584.21
589.16	1584.22	642.63	1584.35	667.18	1584.24	692.13	1584.52	695.8	1584.5
698.03	1584.54	705.42	1584.62	705.46	1584.63	705.58	1584.67	713.48	1587.04
720.19	1588.81	725.43	1589.96	726.53	1590.09	729.45	1590.45	733.59	1590.52
738.68	1590.5	739.48	1590.53	739.52	1590.54	739.8	1590.57	740.75	1590.6
742	1590.59	781.45	1590.42	801.56	1590.43	805.93	1590.48	812.13	1590.53

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	83.41	.03	726.53	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
83.41	726.53	226.65	118.14	19.87	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	83	1594	F
733.92	812.13	1594	F

CROSS SECTION

RIVER: Powerline ES
REACH: main RS: 1477.000

INPUT
Description:
Station Elevation Data num= 66

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1587.21	.46	1587.21	11.66	1587.27	27.5	1587.37	38.97	1587.32
39.98	1587.33	41.5	1587.34	62.7	1587.48	63.74	1587.49	67.65	1587.85
70.52	1588.16	74.81	1588.59	78.46	1588.65	83.21	1588.72	83.35	1588.68
91.95	1586.44	98.4	1584.77	98.93	1584.78	137.01	1584.11	140.73	1584.06
158.91	1583.94	196.62	1583.96	207.45	1583.92	232.71	1583.96	246.97	1583.95
249.9	1583.96	289.54	1584.1	301.75	1584.07	321.34	1584.09	352.99	1584.07
373.59	1584.09	403.96	1584.07	450.83	1584.02	455.12	1584.03	457.85	1584.03
470.83	1584.1	500.14	1584.29	506.31	1584.31	515.86	1584.29	557.25	1584.32
581.59	1584.33	608.64	1584.35	626.01	1584.41	659.78	1584.41	665.8	1584.34
687.08	1584.7	693.02	1584.66	695.24	1584.18	700.79	1585.6	703.98	1586.33
705.14	1586.71	709.56	1587.7	718.51	1589.62	721.14	1590.18	722.26	1590.19
722.74	1590.19	723.89	1590.25	730.32	1590.42	734.82	1590.5	738.08	1590.54
747.12	1590.54	764.69	1590.48	778.77	1590.32	787.38	1590.28	792.32	1590.2
801.46	1590.31								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	83.35	.03	718.51	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
83.35	718.51	184.09	111.47	50.87	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	84	1595	F
723.95	801.46	1595	F

CROSS SECTION

RIVER: Powerline ES
REACH: main RS: 1365.531

INPUT
Description:
Station Elevation Data num= 66

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1586.16	20.7	1586.15	33.49	1586.11	37.2	1586.07	37.58	1586.07
47.01	1586.03	53	1586.07	59.97	1586.06	70.55	1586.13	74.32	1586.46
81.39	1587.04	89.12	1588.54	91.34	1588.98	94.92	1589.03	99.75	1589.1
101.48	1588.68	111.01	1586.37	114.45	1585.53	118.54	1585.4	130.55	1585
163.39	1584.86	180.66	1584.78	200.46	1584.81	230.93	1584.95	254.4	1585.01
280.74	1584.88	303.8	1584.95	330.79	1585.03	361.8	1585.02	380.81	1585.05
397.45	1585.03	430.91	1585.06	469.35	1585.13	481.1	1585.16	523.2	1585.04
530.98	1585.01	537.83	1585.02	580.97	1584.94	629.97	1584.95	631.1	1584.95
632.09	1584.95	646.1	1584.92	681.49	1584.84	682.62	1584.85	704.18	1585.04
710.35	1584.42	710.38	1584.42	710.71	1584.5	717.51	1586.32	719.78	1586.69
726.85	1588.21	729.76	1588.83	732.6	1589.44	733.89	1589.44	737.41	1589.44
738.92	1589.59	741.37	1589.44	743.38	1589.41	743.72	1589.4	750.21	1587.1
752.03	1586.46	752.27	1586.38	752.76	1586.37	782.18	1585.95	805.99	1585.88
807.97	1585.87								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	101.48	.03	729.76	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
101.48	729.76	170.6	166.94	166.44	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent

```
      0   98.67    1595       F
 737.25  807.97    1595       F

CROSS SECTION


RIVER: Powerline ES
REACH: main                RS: 1198.590

INPUT
Description:
Station Elevation Data     num=       60
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  1584.9   13.29 1584.93   27.62 1584.76   37.58  1584.6   39.87 1584.59
   54.69 1584.47   55.24 1584.46   55.98 1584.47   70.01 1584.64   88.67 1584.87
   96.19 1586.76  103.71 1588.65  105.61 1588.61  111.75 1588.55   111.9 1588.55
  117.24 1586.97  124.33 1584.92  126.91 1584.76  130.43 1584.66  148.39 1584.28
  188.28 1584.21  218.83  1584.2  220.51  1584.2  243.33 1584.01  264.29 1584.08
  290.73 1584.03  313.89 1584.12  347.97 1584.07  378.77 1584.02  396.93 1583.93
  399.65 1583.92  401.52 1583.92  437.53 1583.84  459.27 1583.62  477.45 1583.66
   513.4 1583.86  540.53 1583.79  573.49 1583.91  583.48 1583.94  598.38 1583.92
  634.63 1583.97   647.8 1584.01  661.77 1583.99  687.27 1583.94   704.8 1583.98
  724.28 1584.07   725.7 1584.07  727.76 1584.75  732.56  1586.4   739.1 1587.82
   742.6 1588.56  743.58 1588.56  746.03 1588.56  751.37 1588.56  753.64 1587.89
  762.58 1585.35  764.31 1584.95  774.51 1584.78  800.16 1584.37  821.09 1584.35

Manning's n Values         num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03  111.75     .03  743.58     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        111.75  743.58            157.94  155.43  154.44              .1       .3
Ineffective Flow     num=        2
   Sta L   Sta R    Elev  Permanent
       0  110.86    1595       F
  747.23  821.09    1595       F

CROSS SECTION


RIVER: Powerline ES
REACH: main                RS: 1043.155

INPUT
Description:
Station Elevation Data     num=       58
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1583.56      13 1583.42   25.72  1583.4   82.59 1583.49   86.99 1583.53
   89.16 1583.62   97.48 1583.98  100.08 1583.94  100.62 1583.93  101.72 1584.28
  112.54 1587.63  119.57 1587.61  120.28  1587.6  120.31 1587.59  121.18  1587.3
  128.19 1584.92  131.87 1583.75  149.43 1583.23  170.97 1583.09  208.31 1583.09
  229.19 1583.01  259.94 1583.21  265.18 1583.23  268.75 1583.22  287.42 1583.21
  329.19  1583.1  337.16 1583.14  348.89 1583.12  389.62 1583.08  437.85 1582.75
  450.07  1582.7  481.11 1582.87   510.5 1583.06   517.1 1583.12  526.81 1583.04
  553.09 1582.91  570.94 1583.02  589.05 1583.13  615.77 1582.95  631.38 1582.88
  661.05 1582.93  691.82 1582.91  703.85 1582.93   733.4 1583.04  735.46 1583.52
  740.72  1584.9  743.48 1585.69  751.52 1587.93  751.92 1587.93  758.98 1587.93
  760.29 1587.93  763.07 1587.03  770.21 1584.71  772.33 1583.96  798.38 1583.82
   812.7 1583.74     853 1583.92  853.29 1583.93

Manning's n Values         num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03  120.31     .03  751.92     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        120.31  751.92            199.42  190.84   184.9              .1       .3
Ineffective Flow     num=        2
   Sta L   Sta R    Elev  Permanent
       0  116.41    1594       F
  754.99  853.29    1594       F
```

CROSS SECTION

RIVER: Powerline ES
REACH: main RS: 852.3112

INPUT
Description:
Station Elevation Data num= 57

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1582.41	22.48	1582.38	53.54	1582.29	60.05	1582.27	70.01	1582.24
109.33	1582.12	115.51	1582.21	118.97	1582.64	120.93	1582.85	127.02	1584.76
131.56	1586.17	135.6	1586.13	139.01	1586.1	139.77	1586.09	146.89	1583.25
149.92	1582.06	158.59	1582	166.76	1581.97	172.98	1581.95	194.82	1581.84
232.7	1581.67	252.78	1581.6	292.43	1581.59	312.88	1581.61	344.18	1581.9
349	1581.94	352.14	1581.96	367.18	1581.9	411.87	1581.74	421.23	1581.75
435.56	1581.74	471.59	1581.73	526.94	1581.6	531.31	1581.58	539.56	1581.57
591.03	1581.51	601.82	1581.54	618.32	1581.5	650.84	1581.55	709.71	1581.71
710.17	1581.71	710.47	1581.71	710.91	1581.71	752.11	1581.88	752.98	1582.14
758.74	1583.8	761.62	1584.55	769.6	1586.63	770.75	1586.63	773.94	1586.63
778.36	1586.62	783.02	1584.8	789.01	1582.47	806.37	1582.5	829.91	1582.56
876.37	1582.79	880.35	1582.81						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	139.01	.03	770.75	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
139.01	770.75	216.53	207.65	200.93	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	134.15	1593	F
776.05	880.35	1593	F

CROSS SECTION

RIVER: Powerline ES
REACH: main RS: 644.6617

INPUT
Description:
Station Elevation Data num= 56

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1580.65	.84	1580.65	4.23	1580.61	59.87	1580.04	95.86	1580.21
100.2	1580.19	100.69	1580.24	102.03	1580.4	107.83	1581.1	112.85	1582.31
120.68	1584.23	125.21	1584.09	126.4	1584.06	128.44	1584.02	134.15	1582.56
142.16	1580.57	174.09	1580.55	177.92	1580.53	186.88	1580.5	236.95	1580.36
280.91	1580.36	295.97	1580.34	326.43	1580.49	355	1580.5	374.93	1580.48
398.95	1580.48	414.03	1580.54	468.96	1580.34	473.05	1580.33	507.52	1580.49
531.79	1580.49	544	1580.42	562.98	1580.36	591.11	1580.24	638.55	1580.16
650.14	1580.15	652.78	1580.15	657	1580.13	709.16	1580.1	736.38	1580.34
740.91	1580.38	741.96	1580.8	746.42	1582.52	751.47	1583.78	757.31	1585.24
759.19	1585.35	760.72	1585.45	762.72	1585.24	766.07	1585.24	771.34	1583.37
776.81	1581.49	810.45	1581.23	827.22	1581.12	834.1	1581.13	845.06	1581.17
882.37	1581.19								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	125.21	.03	759.19	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
125.21	759.19	266.59	262.82	259.64	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	124.17	1592	F
759.42	882.37	1592	F

CROSS SECTION

RIVER: Powerline ES
REACH: main RS: 381.8457

INPUT
Description:
Station Elevation Data num= 62

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1578.02	39.98	1578.04	44.34	1578.05	52.65	1578.25	92.83	1579.03
98.94	1579.21	100.31	1579.25	103.15	1579.94	114.87	1582.79	117.1	1582.74
118.83	1582.68	122.31	1582.56	131.51	1580.06	135.68	1578.91	140.52	1578.87
161.83	1578.69	187.98	1578.53	220.58	1578.44	224.31	1578.43	230.36	1578.46
260.64	1578.66	279.32	1578.71	296.97	1578.77	325.57	1578.88	333.29	1578.9
338.06	1578.89	369.62	1578.92	396.81	1578.84	405.95	1578.8	420.76	1578.86
442.28	1578.89	455.55	1578.9	511.62	1578.74	514.3	1578.73	514.93	1578.73
515.96	1578.74	551.26	1578.83	573.04	1578.77	582.57	1578.72	611.16	1578.87
623.91	1578.96	631.78	1578.92	665.02	1578.88	690.53	1578.8	700.23	1578.86
711.44	1578.92	731.77	1579.02	735.94	1580	739.24	1580.76	744.45	1582
750.3	1583.41	752.73	1583.41	755.01	1583.41	759.06	1583.41	764.91	1581.34
770.24	1579.43	797.6	1579.24	804.12	1579.22	808.02	1579.2	841.88	1579.26
866.76	1579.34	885.47	1579.53						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	118.83	.03	752.73	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
118.83	752.73	352.74	344.58	336.02	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	115.3	1589	F
754.99	885.47	1589	F

CROSS SECTION

RIVER: Powerline ES
REACH: main RS: 37.26953

INPUT
Description:
Station Elevation Data num= 69

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1575.49	1.43	1575.47	4.92	1575.49	7.52	1575.41	11.47	1575.25
21.89	1575.25	52.66	1575.21	57.75	1575.18	61.97	1575.31	65.47	1575.16
69.19	1575.6	73.13	1575.77	73.18	1575.77	73.33	1575.8	75.25	1576.18
75.85	1576.31	76.2	1576.37	85.52	1577.44	85.9	1577.45	86.46	1577.44
92.41	1577.36	95.8	1576.83	102.85	1576.23	110.22	1576.23	110.95	1576.24
113.34	1576.25	148.16	1576.31	171.35	1576.29	184.72	1576.45	207.28	1576.38
229.46	1576.43	261.44	1576.38	287.51	1576.37	305.59	1576.43	330.73	1576.55
345.57	1576.64	403.24	1576.51	403.63	1576.51	403.9	1576.51	461.69	1576.64
502.22	1576.53	513.22	1576.49	519.75	1576.53	545.04	1576.48	577.81	1576.55
586.24	1576.53	600.53	1576.57	622.75	1576.73	635.86	1576.64	686.81	1576.97
693.92	1576.98	695.87	1577.01	698.43	1577.07	701.35	1577.8	705.99	1578.95
711.63	1580.17	716.77	1581.29	719.22	1581.29	724.53	1581.29	725.53	1581.29
726.58	1580.93	734.86	1577.98	749.32	1577.74	751.98	1577.65	797.16	1577.37
805.26	1577.34	810.04	1577.32	841.76	1577.13	865.48	1577.1		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	86.46	.03	719.22	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
86.46	719.22	11.99	37.27	1190.87	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	86	1585	F
720	865.48	1585	F

SUMMARY OF MANNING'S N VALUES

River:Powerline ES

Reach	River Sta.	n1	n2	n3
main	1872.159	.03	.03	.03
main	1726.086	.03	.03	.03
main	1595.135	.03	.03	.03
main	1477.000	.03	.03	.03
main	1365.531	.03	.03	.03
main	1198.590	.03	.03	.03
main	1043.155	.03	.03	.03
main	852.3112	.03	.03	.03
main	644.6617	.03	.03	.03
main	381.8457	.03	.03	.03
main	37.26953	.03	.03	.03

SUMMARY OF REACH LENGTHS

River: Powerline ES

Reach	River Sta.	Left	Channel	Right
main	1872.159	280.05	146.07	25.22
main	1726.086	241.6	130.95	31.77
main	1595.135	226.65	118.14	19.87
main	1477.000	184.09	111.47	50.87
main	1365.531	170.6	166.94	166.44
main	1198.590	157.94	155.43	154.44
main	1043.155	199.42	190.84	184.9
main	852.3112	216.53	207.65	200.93
main	644.6617	266.59	262.82	259.64
main	381.8457	352.74	344.58	336.02
main	37.26953	11.99	37.27	1190.87

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Powerline ES

Reach	River Sta.	Contr.	Expan.
main	1872.159	.1	.3
main	1726.086	.1	.3
main	1595.135	.1	.3
main	1477.000	.1	.3
main	1365.531	.1	.3
main	1198.590	.1	.3
main	1043.155	.1	.3
main	852.3112	.1	.3
main	644.6617	.1	.3
main	381.8457	.1	.3
main	37.26953	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
main	1872.159	PF 10	8000.00	1583.73	1588.13	1585.79	1588.29	0.000655	3.19	2504.44	625.15	0.28
main	1726.086	PF 10	8000.00	1583.70	1588.01	1585.85	1588.18	0.000765	3.35	2386.65	622.90	0.30

main	1595.135	PF 10	8000.00	1583.35	1587.91	1585.78	1588.08	0.000775	3.36	2379.41	624.09	0.30
main	1477.000	PF 10	8000.00	1583.92	1587.77	1585.96	1587.98	0.001026	3.66	2185.90	689.76	0.34
main	1365.531	PF 10	8000.00	1584.42	1587.11	1586.75	1587.71	0.005880	6.22	1286.67	753.28	0.76
main	1198.590	PF 10	8000.00	1583.62	1586.12	1585.77	1586.72	0.005938	6.24	1281.04	766.37	0.76
main	1043.155	PF 10	8000.00	1582.70	1585.03	1584.80	1585.71	0.007088	6.58	1216.17	801.57	0.82
main	852.3112	PF 10	8000.00	1581.50	1583.73	1583.46	1584.38	0.006716	6.47	1235.67	831.16	0.80
main	644.6617	PF 10	8000.00	1580.10	1582.57	1582.13	1583.13	0.005203	6.00	1333.83	835.19	0.72
main	381.8457	PF 10	8000.00	1578.43	1580.74	1580.55	1581.46	0.007824	6.79	1178.17	835.53	0.86
main	37.26953	PF 10	8000.00	1576.23	1578.74	1578.28	1579.28	0.005007	5.91	1354.64	837.88	0.70

Profile Output Table - Standard Table 2

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
main	1872.159	PF 10	1588.29	1588.13	0.16	0.10	0.00		8000.00		625.15
main	1726.086	PF 10	1588.18	1588.01	0.17	0.10	0.00		8000.00		622.90
main	1595.135	PF 10	1588.08	1587.91	0.18	0.10	0.00		8000.00		624.09
main	1477.000	PF 10	1587.98	1587.77	0.21	0.23	0.04		8000.00		689.76
main	1365.531	PF 10	1587.71	1587.11	0.60	0.99	0.00		8000.00		753.28
main	1198.590	PF 10	1586.72	1586.12	0.61	1.01	0.01		8000.00		766.37
main	1043.155	PF 10	1585.71	1585.03	0.67	1.32	0.01		8000.00		801.57
main	852.3112	PF 10	1584.38	1583.73	0.65	1.22	0.03		8000.00		831.16
main	644.6617	PF 10	1583.13	1582.57	0.56	1.66	0.02		8000.00		835.19
main	381.8457	PF 10	1581.46	1580.74	0.72	2.13	0.05		8000.00		835.53
main	37.26953	PF 10	1579.28	1578.74	0.54			2.48	7997.53		837.88

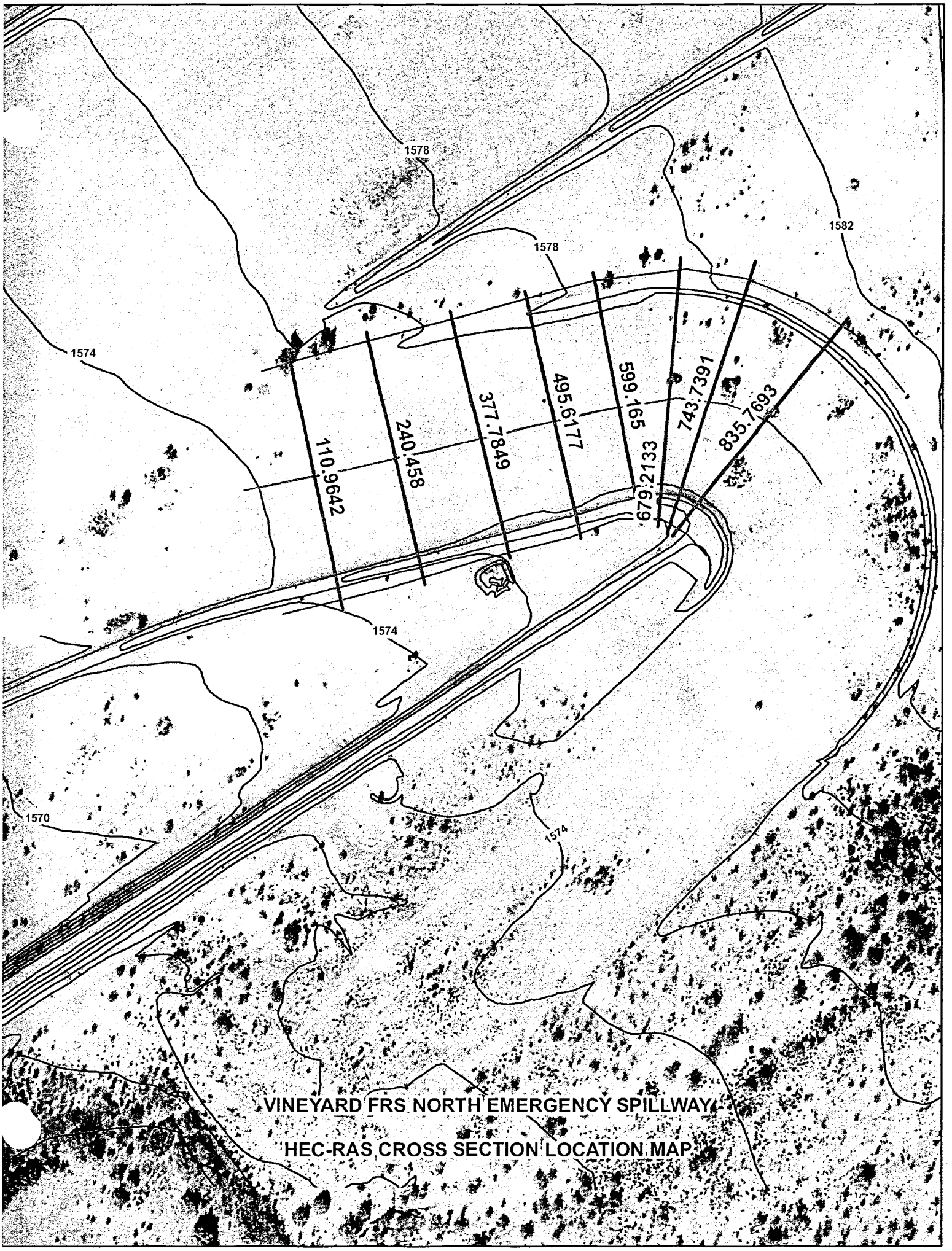
Appendix D

Vineyard FRS North Emergency Spillway HEC-RAS Model

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 South Kyrene Road, Suite 201, Tempe, Arizona 85284
Phone: 480-752-2124 Fax: 480-839-2193

HEC-RAS Plan: V_ES_N_030 River: Vineyard_ES_N Reach: Main												
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 # C
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main	835.7693	PF 1	250	1574.74	1576.75		1576.75	0.000043	0.47	532.04	306	0.06
Main	835.7693	PF 2	500	1574.74	1577.06		1577.07	0.000101	0.8	627.32	309.32	0.1
Main	835.7693	PF 3	1000	1574.74	1577.52		1577.55	0.000206	1.3	771.89	313.9	0.15
Main	835.7693	PF 4	2000	1574.74	1578.2		1578.27	0.000371	2.02	988.36	319.3	0.2
Main	835.7693	PF 5	3000	1574.74	1578.75		1578.85	0.000494	2.58	1162.87	323.66	0.24
Main	835.7693	PF 6	4000	1574.74	1579.21		1579.36	0.000593	3.04	1314.8	327.45	0.27
Main	835.7693	PF 7	5000	1574.74	1579.63		1579.81	0.000675	3.44	1451.76	330.82	0.29
Main	835.7693	PF 8	7000	1574.74	1580.36		1580.63	0.000807	4.13	1696.54	336.48	0.32
Main	835.7693	PF 9	8000	1574.74	1580.69		1581	0.000856	4.43	1807.25	336.52	0.34
Main	835.7693	PF 10	9000	1574.74	1581		1581.35	0.0009	4.71	1911.92	336.52	0.35
Main	835.7693	PF 11	10000	1574.74	1581.3		1581.68	0.00094	4.97	2011.7	336.52	0.36
Main	835.7693	PF 12	15000	1574.74	1582.63		1583.2	0.001095	6.1	2458.72	336.52	0.4
Main	835.7693	PF 13	20000	1574.74	1583.78		1584.55	0.001204	7.02	2847.04	336.52	0.43
Main	835.7693	PF 14	25000	1574.74	1584.82		1585.77	0.001287	7.82	3198.35	336.52	0.45
Main	835.7693	PF 15	30000	1574.74	1585.79		1586.91	0.001354	8.52	3522.02	336.52	0.46

WSEL	Q Total	Depth	Q * 0.5	
1576.2	0	0	0	Set Grid Nos. 4348-4349 to this elevation, which is the 2007 surveyed elevation
1576.75	250	0.55	125	
1577.06	500	0.86	250	
1577.52	1000	1.32	500	
1578.2	2000	2	1000	
1578.75	3000	2.55	1500	
1579.21	4000	3.01	2000	
1579.63	5000	3.43	2500	
1580.36	7000	4.16	3500	
1580.69	8000	4.49	4000	
1581	9000	4.8	4500	
1581.3	10000	5.1	5000	
1582.63	15000	6.43	7500	
1583.78	20000	7.58	10000	
1584.82	25000	8.62	12500	
1585.79	30000	9.59	15000	



VINEYARD FRS NORTH EMERGENCY SPILLWAY

HEC-RAS CROSS SECTION LOCATION MAP

```
HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X      XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X       X
X     X  X        X    X      X   X    X    X       X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX


PROJECT DATA
Project Title: Vineyard ES North Rating Curve
Project File : Vineyard_ES_N.prj
Run Date and Time: 6/22/2007 2:48:02 PM

Project in English units


PLAN DATA

Plan Title: Vineyard ES North with n=0.030
Plan File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_N.p01

          Geometry Title: Vineyard Northe ES - n=0.030
          Geometry File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_N.g01

          Flow Title    : Vineyard ES North Rating Curve
          Flow File     : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_N.f01

Plan Summary Information:
Number of:  Cross Sections =    8    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


FLOW DATA

Flow Title: Vineyard ES North Rating Curve
Flow File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_N.f01

Flow Data (cfs)

  River          Reach          RS                PF 1          PF 2          PF 3          PF 4          PF 5          PF 6          PF 7          PF 8
  Vineyard_ES_N  Main           835.7693           250           500          1000          2000          3000          4000          5000          7000
```

River	Reach	RS	PF 9	PF 10	PF 11	PF 12	PF 13	PF 14	PF 15
Vineyard_ES_N	Main	835.7693	8000	9000	10000	15000	20000	25000	30000

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Vineyard_ES_N	Main	PF 1		Normal S = 0.005
Vineyard_ES_N	Main	PF 2		Normal S = 0.005
Vineyard_ES_N	Main	PF 3		Normal S = 0.005
Vineyard_ES_N	Main	PF 4		Normal S = 0.005
Vineyard_ES_N	Main	PF 5		Normal S = 0.005
Vineyard_ES_N	Main	PF 6		Normal S = 0.005
Vineyard_ES_N	Main	PF 7		Normal S = 0.005
Vineyard_ES_N	Main	PF 8		Normal S = 0.005
Vineyard_ES_N	Main	PF 9		Normal S = 0.005
Vineyard_ES_N	Main	PF 10		Normal S = 0.005
Vineyard_ES_N	Main	PF 11		Normal S = 0.005
Vineyard_ES_N	Main	PF 12		Normal S = 0.005
Vineyard_ES_N	Main	PF 13		Normal S = 0.005
Vineyard_ES_N	Main	PF 14		Normal S = 0.005
Vineyard_ES_N	Main	PF 15		Normal S = 0.005

GEOMETRY DATA

Geometry Title: Vineyard Northe ES - n=0.030
Geometry File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_N.g01

CROSS SECTION

RIVER: Vineyard_ES_N
REACH: Main RS: 835.7693

INPUT
Description:
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
56.88	1580.37	64.94	1578.45	69.33	1577.36	72.7	1576.78	79.68	1575.43
96.96	1575.37	100.98	1575.37	104.01	1575.26	107.44	1575.1	135.76	1574.79
155.54	1574.88	160.56	1574.84	186.53	1574.74	215.2	1574.78	219.64	1574.78
235.87	1574.85	283.73	1575.01	288.98	1575.03	295.52	1574.92	347.83	1574.94
367.79	1575.45	372.81	1575.58	377.76	1576.52	382.09	1577.39	385.62	1578.3
392.9	1580.16	393.4	1580.18						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
56.88	.03	56.88	.03	393.4	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
56.88	393.4	14.32	92.03	161.55	.1	.3

CROSS SECTION

RIVER: Vineyard_ES_N
REACH: Main RS: 743.7390

INPUT
Description:
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
51.89	1580.49	53.78	1580.4	54.07	1580.11	55.05	1579.84	65.49	1577.09
73.21	1576.02	77.33	1575.42	95.29	1575.28	126.32	1575.22	136.32	1575.08

```
  148.92 1575.01  149.53 1574.93  178.92 1574.94  206.87 1574.97  228.22  1574.9
   246.6 1574.71  280.74 1574.91  303.66 1574.96  326.05 1574.93  333.26 1574.92
  364.31 1575.35  371.94 1575.43  379.05 1577.08  380.08 1577.31  381.12  1577.6
  389.22 1579.68  392.65 1580.55

Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   51.89     .03   51.89     .03  392.65     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          51.89  392.65            19.99   64.53  110.02             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_N
REACH: Main                 RS: 679.2133

INPUT
Description:
Station Elevation Data      num=      27
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    44.9 1580.12   45.56 1579.92   53.93 1577.33    65.6 1576.04   68.99 1575.69
   88.72 1575.86    93.1 1575.94   96.25 1575.93  105.17 1575.81  139.86 1575.41
  148.13 1575.38  148.14 1575.39  171.47 1575.27  203.94 1575.11  239.16  1575.1
   239.3 1575.11   256.4 1575.07  256.53  1575.1  266.52 1575.16  308.07 1574.96
  330.21  1574.7  354.95 1575.19  363.21 1575.64  365.07 1576.04  370.17  1577.1
  373.23 1578.41  376.06 1579.62

Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    44.9     .03    44.9     .03  376.06     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           44.9  376.06            29.09   80.05  135.51             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_N
REACH: Main                 RS: 599.1649

INPUT
Description:
Station Elevation Data      num=      27
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   37.08 1579.64   37.57 1579.51   52.26 1577.34   53.25 1577.29   60.97  1575.8
   68.36 1576.23   71.92 1576.34  103.77 1576.22  122.66 1576.25  156.05 1576.18
  172.95 1576.17  182.51 1576.14  217.21  1576.2  222.59 1576.18   224.1 1576.19
  226.72  1576.2  274.69 1576.41  297.75 1576.36  325.46 1576.16  332.24 1575.83
   334.1 1575.76  338.73 1576.05  347.22 1576.65  350.36 1576.86  352.69 1576.84
  358.13 1578.57  361.06 1579.53

Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   37.08     .03   37.08     .03  361.06     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          37.08  361.06            99.83  103.55  109.33             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_N
REACH: Main                 RS: 495.6177

INPUT
Description:
Station Elevation Data      num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

```
    34.8 1579.05   39.21 1577.68   43.99 1576.21   57.42 1575.58   59.31  1575.5
   75.44 1575.46   80.85 1575.48    92.1 1575.51  121.82 1575.63  128.59 1575.61
  139.34 1575.63  175.41 1575.75  201.37 1575.81  225.79 1575.67  249.54 1575.75
  277.61 1575.87   295.9 1575.91  317.93 1576.04  322.93 1576.21   350.8 1576.74
  353.35 1576.73   353.7  1576.8  354.21 1576.91  355.87 1577.29  359.78 1578.23
  359.99 1578.22

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    34.8     .03    34.8     .03  359.78     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          34.8  359.78           114.33  117.83  121.78             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_N
REACH: Main                RS: 377.7849

INPUT
Description:
Station Elevation Data     num=      23
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   37.21 1578.73   44.32 1576.42   44.98  1576.2   48.95 1576.14   54.98 1576.05
   57.65 1575.96   62.39 1575.92  109.17 1575.02   137.3 1575.19  160.68  1575.2
  178.56  1575.1   212.2 1575.07  219.81 1575.11  250.45 1575.36  261.07 1575.45
  263.71 1575.46  302.33 1575.62  315.22 1575.67   352.2 1575.83  354.44 1575.84
  354.77 1575.88  358.32 1576.34  359.51 1576.49

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   37.21     .03   37.21     .03  359.51     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         37.21  359.51           140.23  137.33  134.52             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_N
REACH: Main                RS: 240.4580

INPUT
Description:
Station Elevation Data     num=      20
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   43.24 1578.57   46.72  1577.3    51.9 1575.43   94.33 1574.76   99.15 1574.67
  114.65 1574.77  143.82 1575.04   150.6 1575.05  161.52 1574.95  201.93 1574.86
  227.06 1574.86  253.26 1574.94   295.4 1574.87   304.6 1574.81  320.51 1574.89
  334.84 1575.02  355.66 1575.18  358.85 1575.18  362.89 1575.62  363.64 1575.71

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   43.24     .03   43.24     .03  363.64     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         43.24  363.64           133.96  129.49  125.55             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_N
REACH: Main                RS: 110.9642

INPUT
Description:
Station Elevation Data     num=      22
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   51.28 1577.96   53.56 1577.14   60.55 1574.66   71.29  1574.5   89.31 1574.31
```

115.98	1574.37	140.39	1574.29	156.33	1574.52	191.47	1574.62	232.24	1574.51
242.56	1574.49	282.98	1574.55	293.64	1574.7	309.96	1574.64	344.72	1574.78
362.33	1574.94	368.03	1574.99	370.33	1574.97	370.96	1574.97	372.98	1575.02
375.4	1575.09	378.69	1575.17						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
51.28	.03	51.28	.03	378.69	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
51.28	378.69	91	110.96	46.7	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Vineyard_ES_N

Reach	River Sta.	n1	n2	n3
Main	835.7693	.03	.03	.03
Main	743.7390	.03	.03	.03
Main	679.2133	.03	.03	.03
Main	599.1649	.03	.03	.03
Main	495.6177	.03	.03	.03
Main	377.7849	.03	.03	.03
Main	240.4580	.03	.03	.03
Main	110.9642	.03	.03	.03

SUMMARY OF REACH LENGTHS

River: Vineyard_ES_N

Reach	River Sta.	Left	Channel	Right
Main	835.7693	14.32	92.03	161.55
Main	743.7390	19.99	64.53	110.02
Main	679.2133	29.09	80.05	135.51
Main	599.1649	99.83	103.55	109.33
Main	495.6177	114.33	117.83	121.78
Main	377.7849	140.23	137.33	134.52
Main	240.4580	133.96	129.49	125.55
Main	110.9642	91	110.96	46.7

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Vineyard_ES_N

Reach	River Sta.	Contr.	Expan.
Main	835.7693	.1	.3
Main	743.7390	.1	.3
Main	679.2133	.1	.3
Main	599.1649	.1	.3
Main	495.6177	.1	.3
Main	377.7849	.1	.3
Main	240.4580	.1	.3
Main	110.9642	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl

Main	835.7693	PF 1	250.00	1574.74	1576.75	1576.75	0.000043	0.47	532.04	306.00	0.06
Main	835.7693	PF 2	500.00	1574.74	1577.06	1577.07	0.000101	0.80	627.32	309.32	0.10
Main	835.7693	PF 3	1000.00	1574.74	1577.52	1577.55	0.000206	1.30	771.89	313.90	0.15
Main	835.7693	PF 4	2000.00	1574.74	1578.20	1578.27	0.000371	2.02	988.36	319.30	0.20
Main	835.7693	PF 5	3000.00	1574.74	1578.75	1578.85	0.000494	2.58	1162.87	323.66	0.24
Main	835.7693	PF 6	4000.00	1574.74	1579.21	1579.36	0.000593	3.04	1314.80	327.45	0.27
Main	835.7693	PF 7	5000.00	1574.74	1579.63	1579.81	0.000675	3.44	1451.76	330.82	0.29
Main	835.7693	PF 8	7000.00	1574.74	1580.36	1580.63	0.000807	4.13	1696.54	336.48	0.32
Main	835.7693	PF 9	8000.00	1574.74	1580.69	1581.00	0.000856	4.43	1807.25	336.52	0.34
Main	835.7693	PF 10	9000.00	1574.74	1581.00	1581.35	0.000900	4.71	1911.92	336.52	0.35
Main	835.7693	PF 11	10000.00	1574.74	1581.30	1581.68	0.000940	4.97	2011.70	336.52	0.36
Main	835.7693	PF 12	15000.00	1574.74	1582.63	1583.20	0.001095	6.10	2458.72	336.52	0.40
Main	835.7693	PF 13	20000.00	1574.74	1583.78	1584.55	0.001204	7.02	2847.04	336.52	0.43
Main	835.7693	PF 14	25000.00	1574.74	1584.82	1585.77	0.001287	7.82	3198.35	336.52	0.45
Main	835.7693	PF 15	30000.00	1574.74	1585.79	1586.91	0.001354	8.52	3522.02	336.52	0.46
Main	743.7390	PF 1	250.00	1574.71	1576.74	1576.74	0.000048	0.48	517.24	309.58	0.07
Main	743.7390	PF 2	500.00	1574.71	1577.04	1577.06	0.000112	0.82	611.80	313.08	0.10
Main	743.7390	PF 3	1000.00	1574.71	1577.50	1577.53	0.000226	1.33	754.48	316.81	0.15
Main	743.7390	PF 4	2000.00	1574.71	1578.16	1578.23	0.000403	2.07	967.21	321.90	0.21
Main	743.7390	PF 5	3000.00	1574.71	1578.69	1578.80	0.000535	2.63	1138.67	325.97	0.25
Main	743.7390	PF 6	4000.00	1574.71	1579.15	1579.30	0.000641	3.11	1287.92	329.47	0.28
Main	743.7390	PF 7	5000.00	1574.71	1579.56	1579.75	0.000728	3.51	1422.53	332.60	0.30
Main	743.7390	PF 8	7000.00	1574.71	1580.27	1580.55	0.000866	4.21	1663.20	337.65	0.33
Main	743.7390	PF 9	8000.00	1574.71	1580.60	1580.91	0.000926	4.51	1772.65	340.76	0.35
Main	743.7390	PF 10	9000.00	1574.71	1580.90	1581.26	0.000971	4.80	1876.89	340.76	0.36
Main	743.7390	PF 11	10000.00	1574.71	1581.19	1581.59	0.001012	5.06	1976.39	340.76	0.37
Main	743.7390	PF 12	15000.00	1574.71	1582.50	1583.10	0.001166	6.19	2423.10	340.76	0.41
Main	743.7390	PF 13	20000.00	1574.71	1583.65	1584.43	0.001273	7.11	2812.28	340.76	0.44
Main	743.7390	PF 14	25000.00	1574.71	1584.68	1585.65	0.001351	7.90	3165.23	340.76	0.46
Main	743.7390	PF 15	30000.00	1574.71	1585.64	1586.78	0.001414	8.59	3490.85	340.76	0.47
Main	679.2133	PF 1	250.00	1574.70	1576.74	1576.74	0.000080	0.56	442.95	309.11	0.08
Main	679.2133	PF 2	500.00	1574.70	1577.03	1577.05	0.000174	0.93	535.25	313.22	0.13
Main	679.2133	PF 3	1000.00	1574.70	1577.47	1577.51	0.000329	1.48	674.23	317.57	0.18
Main	679.2133	PF 4	2000.00	1574.70	1578.12	1578.20	0.000549	2.27	880.54	321.17	0.24
Main	679.2133	PF 5	3000.00	1574.70	1578.63	1578.76	0.000705	2.87	1045.94	324.02	0.28
Main	679.2133	PF 6	4000.00	1574.70	1579.07	1579.25	0.000825	3.36	1189.58	326.48	0.31
Main	679.2133	PF 7	5000.00	1574.70	1579.47	1579.69	0.000923	3.79	1318.82	328.68	0.33
Main	679.2133	PF 8	7000.00	1574.70	1580.16	1580.48	0.001072	4.52	1548.84	331.16	0.37
Main	679.2133	PF 9	8000.00	1574.70	1580.48	1580.84	0.001132	4.84	1652.21	331.16	0.38
Main	679.2133	PF 10	9000.00	1574.70	1580.77	1581.18	0.001184	5.14	1750.64	331.16	0.39
Main	679.2133	PF 11	10000.00	1574.70	1581.06	1581.51	0.001231	5.42	1844.67	331.16	0.40
Main	679.2133	PF 12	15000.00	1574.70	1582.33	1583.01	0.001411	6.62	2265.21	331.16	0.45
Main	679.2133	PF 13	20000.00	1574.70	1583.43	1584.33	0.001535	7.60	2631.62	331.16	0.48
Main	679.2133	PF 14	25000.00	1574.70	1584.44	1585.54	0.001626	8.44	2963.83	331.16	0.50
Main	679.2133	PF 15	30000.00	1574.70	1585.36	1586.67	0.001699	9.17	3270.09	331.16	0.51
Main	599.1649	PF 1	250.00	1575.76	1576.65	1576.71	0.005719	2.08	120.23	290.58	0.57
Main	599.1649	PF 2	500.00	1575.76	1576.89	1577.00	0.004938	2.60	192.27	297.54	0.57
Main	599.1649	PF 3	1000.00	1575.76	1577.26	1577.43	0.004482	3.32	301.27	300.57	0.58
Main	599.1649	PF 4	2000.00	1575.76	1577.79	1578.08	0.004346	4.30	464.58	306.50	0.62
Main	599.1649	PF 5	3000.00	1575.76	1578.23	1578.62	0.004282	5.01	598.56	310.81	0.64
Main	599.1649	PF 6	4000.00	1575.76	1578.61	1579.09	0.004239	5.58	717.04	314.56	0.65
Main	599.1649	PF 7	5000.00	1575.76	1578.95	1579.52	0.004213	6.06	824.82	317.91	0.66
Main	599.1649	PF 8	7000.00	1575.76	1579.56	1580.29	0.004159	6.86	1020.72	323.67	0.68
Main	599.1649	PF 9	8000.00	1575.76	1579.83	1580.64	0.004129	7.21	1109.37	323.98	0.69
Main	599.1649	PF 10	9000.00	1575.76	1580.09	1580.98	0.004095	7.54	1194.32	323.98	0.69
Main	599.1649	PF 11	10000.00	1575.76	1580.35	1581.30	0.004068	7.84	1275.59	323.98	0.70
Main	599.1649	PF 12	15000.00	1575.76	1581.47	1582.77	0.004007	9.15	1638.81	323.98	0.72
Main	599.1649	PF 13	20000.00	1575.76	1582.45	1584.07	0.003969	10.22	1957.84	323.98	0.73
Main	599.1649	PF 14	25000.00	1575.76	1583.35	1585.27	0.003940	11.12	2248.05	323.98	0.74
Main	599.1649	PF 15	30000.00	1575.76	1584.17	1586.38	0.003928	11.93	2515.24	323.98	0.75
Main	495.6177	PF 1	250.00	1575.46	1576.23	1576.28	0.003187	1.77	141.20	280.26	0.44
Main	495.6177	PF 2	500.00	1575.46	1576.50	1576.58	0.003205	2.29	218.16	295.19	0.47
Main	495.6177	PF 3	1000.00	1575.46	1576.88	1577.02	0.003387	3.01	332.67	312.23	0.51
Main	495.6177	PF 4	2000.00	1575.46	1577.43	1577.67	0.003396	3.95	506.60	316.42	0.55
Main	495.6177	PF 5	3000.00	1575.46	1577.87	1578.21	0.003415	4.63	647.82	319.71	0.57

Main	495.6177	PF 6	4000.00	1575.46	1578.26		1578.68	0.003424	5.18	771.97	322.65	0.59
Main	495.6177	PF 7	5000.00	1575.46	1578.61		1579.10	0.003419	5.65	884.30	323.76	0.60
Main	495.6177	PF 8	7000.00	1575.46	1579.23		1579.87	0.003408	6.45	1085.56	325.19	0.62
Main	495.6177	PF 9	8000.00	1575.46	1579.51		1580.23	0.003408	6.80	1176.50	325.19	0.63
Main	495.6177	PF 10	9000.00	1575.46	1579.77		1580.56	0.003407	7.13	1263.16	325.19	0.64
Main	495.6177	PF 11	10000.00	1575.46	1580.03		1580.89	0.003408	7.43	1345.92	325.19	0.64
Main	495.6177	PF 12	15000.00	1575.46	1581.16		1582.35	0.003443	8.75	1713.99	325.19	0.67
Main	495.6177	PF 13	20000.00	1575.46	1582.15		1583.65	0.003455	9.82	2037.27	325.19	0.69
Main	495.6177	PF 14	25000.00	1575.46	1583.06		1584.85	0.003457	10.73	2331.38	325.19	0.71
Main	495.6177	PF 15	30000.00	1575.46	1583.89		1585.96	0.003465	11.54	2601.71	325.19	0.72
Main	377.7849	PF 1	250.00	1575.02	1575.84		1575.89	0.003449	1.79	139.44	288.13	0.45
Main	377.7849	PF 2	500.00	1575.02	1576.10		1576.19	0.003432	2.31	216.56	305.12	0.48
Main	377.7849	PF 3	1000.00	1575.02	1576.48		1576.62	0.003391	3.00	333.82	315.28	0.51
Main	377.7849	PF 4	2000.00	1575.02	1577.03		1577.27	0.003365	3.93	508.68	317.07	0.55
Main	377.7849	PF 5	3000.00	1575.02	1577.47		1577.81	0.003393	4.62	648.74	318.43	0.57
Main	377.7849	PF 6	4000.00	1575.02	1577.86		1578.27	0.003420	5.19	770.67	319.61	0.59
Main	377.7849	PF 7	5000.00	1575.02	1578.20		1578.70	0.003447	5.68	880.56	320.66	0.60
Main	377.7849	PF 8	7000.00	1575.02	1578.81		1579.46	0.003496	6.50	1076.25	322.30	0.63
Main	377.7849	PF 9	8000.00	1575.02	1579.08		1579.81	0.003513	6.87	1165.05	322.30	0.64
Main	377.7849	PF 10	9000.00	1575.02	1579.34		1580.15	0.003534	7.21	1248.93	322.30	0.65
Main	377.7849	PF 11	10000.00	1575.02	1579.59		1580.47	0.003545	7.52	1330.06	322.30	0.65
Main	377.7849	PF 12	15000.00	1575.02	1580.70		1581.93	0.003642	8.89	1687.29	322.30	0.68
Main	377.7849	PF 13	20000.00	1575.02	1581.68		1583.23	0.003686	9.99	2002.67	322.30	0.71
Main	377.7849	PF 14	25000.00	1575.02	1582.56		1584.42	0.003729	10.93	2286.53	322.30	0.72
Main	377.7849	PF 15	30000.00	1575.02	1583.38		1585.53	0.003764	11.77	2548.60	322.30	0.74
Main	240.4580	PF 1	250.00	1574.67	1575.44		1575.48	0.002573	1.60	156.65	309.42	0.40
Main	240.4580	PF 2	500.00	1574.67	1575.69		1575.76	0.002779	2.15	232.89	312.29	0.44
Main	240.4580	PF 3	1000.00	1574.67	1576.05		1576.18	0.003032	2.90	344.59	313.45	0.49
Main	240.4580	PF 4	2000.00	1574.67	1576.58		1576.81	0.003286	3.91	511.19	314.92	0.54
Main	240.4580	PF 5	3000.00	1574.67	1577.00		1577.34	0.003445	4.66	644.14	316.08	0.57
Main	240.4580	PF 6	4000.00	1574.67	1577.36		1577.79	0.003561	5.27	759.34	317.09	0.60
Main	240.4580	PF 7	5000.00	1574.67	1577.69		1578.21	0.003650	5.79	863.07	317.98	0.62
Main	240.4580	PF 8	7000.00	1574.67	1578.27		1578.96	0.003787	6.68	1047.48	319.57	0.65
Main	240.4580	PF 9	8000.00	1574.67	1578.53		1579.31	0.003842	7.07	1131.37	320.29	0.66
Main	240.4580	PF 10	9000.00	1574.67	1578.78		1579.64	0.003890	7.43	1210.60	320.40	0.67
Main	240.4580	PF 11	10000.00	1574.67	1579.01		1579.95	0.003934	7.78	1285.97	320.40	0.68
Main	240.4580	PF 12	15000.00	1574.67	1580.07		1581.40	0.004085	9.22	1626.04	320.40	0.72
Main	240.4580	PF 13	20000.00	1574.67	1580.99		1582.68	0.004200	10.41	1920.59	320.40	0.75
Main	240.4580	PF 14	25000.00	1574.67	1581.82		1583.85	0.004292	11.44	2185.84	320.40	0.77
Main	240.4580	PF 15	30000.00	1574.67	1582.58		1584.95	0.004379	12.35	2428.45	320.40	0.79
Main	110.9642	PF 1	250.00	1574.29	1574.97	1574.81	1575.03	0.005004	1.96	127.67	305.52	0.53
Main	110.9642	PF 2	500.00	1574.29	1575.19	1574.98	1575.29	0.005003	2.54	197.06	319.62	0.57
Main	110.9642	PF 3	1000.00	1574.29	1575.50	1575.24	1575.68	0.005004	3.34	299.15	320.52	0.61
Main	110.9642	PF 4	2000.00	1574.29	1575.99	1575.63	1576.29	0.005000	4.40	454.62	321.88	0.65
Main	110.9642	PF 5	3000.00	1574.29	1576.38	1575.96	1576.79	0.005001	5.16	580.92	322.99	0.68
Main	110.9642	PF 6	4000.00	1574.29	1576.72	1576.26	1577.24	0.005001	5.78	691.52	323.95	0.70
Main	110.9642	PF 7	5000.00	1574.29	1577.03	1576.53	1577.65	0.005003	6.32	791.71	324.82	0.71
Main	110.9642	PF 8	7000.00	1574.29	1577.58	1577.02	1578.39	0.005001	7.21	971.51	326.36	0.74
Main	110.9642	PF 9	8000.00	1574.29	1577.84	1577.25	1578.73	0.005000	7.59	1053.87	327.06	0.75
Main	110.9642	PF 10	9000.00	1574.29	1578.07	1577.46	1579.06	0.005002	7.95	1131.95	327.41	0.75
Main	110.9642	PF 11	10000.00	1574.29	1578.30	1577.67	1579.37	0.005001	8.29	1206.48	327.41	0.76
Main	110.9642	PF 12	15000.00	1574.29	1579.33	1578.64	1580.80	0.005007	9.73	1542.05	327.41	0.79
Main	110.9642	PF 13	20000.00	1574.29	1580.23	1579.48	1582.07	0.005004	10.89	1836.84	327.41	0.81
Main	110.9642	PF 14	25000.00	1574.29	1581.04	1580.25	1583.24	0.005002	11.88	2104.30	327.41	0.83
Main	110.9642	PF 15	30000.00	1574.29	1581.80	1581.00	1584.33	0.005002	12.76	2351.86	327.41	0.84

Profile Output Table - Standard Table 2

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
Main	835.7693	PF 1	1576.75	1576.75	0.00	0.00	0.00		250.00		306.00
Main	835.7693	PF 2	1577.07	1577.06	0.01	0.01	0.00		500.00		309.32
Main	835.7693	PF 3	1577.55	1577.52	0.03	0.02	0.00		1000.00		313.90
Main	835.7693	PF 4	1578.27	1578.20	0.06	0.04	0.00		2000.00		319.30
Main	835.7693	PF 5	1578.85	1578.75	0.10	0.05	0.00		3000.00		323.66

Main	835.7693	PF 6	1579.36	1579.21	0.14	0.06	0.00	4000.00		327.45
Main	835.7693	PF 7	1579.81	1579.63	0.18	0.06	0.00	5000.00		330.82
Main	835.7693	PF 8	1580.63	1580.36	0.26	0.08	0.00	7000.00		336.48
Main	835.7693	PF 9	1581.00	1580.69	0.30	0.08	0.00	8000.00		336.52
Main	835.7693	PF 10	1581.35	1581.00	0.34	0.09	0.00	9000.00		336.52
Main	835.7693	PF 11	1581.68	1581.30	0.38	0.09	0.00	10000.00		336.52
Main	835.7693	PF 12	1583.20	1582.63	0.58	0.10	0.00	15000.00		336.52
Main	835.7693	PF 13	1584.55	1583.78	0.77	0.11	0.00	20000.00		336.52
Main	835.7693	PF 14	1585.77	1584.82	0.95	0.12	0.00	25000.00		336.52
Main	835.7693	PF 15	1586.91	1585.79	1.13	0.13	0.00	30000.00		336.52
Main	743.7390	PF 1	1576.74	1576.74	0.00	0.00	0.00	250.00		309.58
Main	743.7390	PF 2	1577.06	1577.04	0.01	0.01	0.00	500.00		313.08
Main	743.7390	PF 3	1577.53	1577.50	0.03	0.02	0.00	1000.00		316.81
Main	743.7390	PF 4	1578.23	1578.16	0.07	0.03	0.00	2000.00		321.90
Main	743.7390	PF 5	1578.80	1578.69	0.11	0.04	0.00	3000.00		325.97
Main	743.7390	PF 6	1579.30	1579.15	0.15	0.05	0.00	4000.00		329.47
Main	743.7390	PF 7	1579.75	1579.56	0.19	0.05	0.00	5000.00		332.60
Main	743.7390	PF 8	1580.55	1580.27	0.28	0.06	0.00	7000.00		337.65
Main	743.7390	PF 9	1580.91	1580.60	0.32	0.07	0.00	8000.00		340.76
Main	743.7390	PF 10	1581.26	1580.90	0.36	0.07	0.01	9000.00		340.76
Main	743.7390	PF 11	1581.59	1581.19	0.40	0.07	0.01	10000.00		340.76
Main	743.7390	PF 12	1583.10	1582.50	0.60	0.08	0.01	15000.00		340.76
Main	743.7390	PF 13	1584.43	1583.65	0.79	0.09	0.01	20000.00		340.76
Main	743.7390	PF 14	1585.65	1584.68	0.97	0.10	0.01	25000.00		340.76
Main	743.7390	PF 15	1586.78	1585.64	1.15	0.10	0.02	30000.00		340.76
Main	679.2133	PF 1	1576.74	1576.74	0.00	0.02	0.01	250.00		309.11
Main	679.2133	PF 2	1577.05	1577.03	0.01	0.04	0.01	500.00		313.22
Main	679.2133	PF 3	1577.51	1577.47	0.03	0.07	0.01	1000.00		317.57
Main	679.2133	PF 4	1578.20	1578.12	0.08	0.10	0.02	2000.00		321.17
Main	679.2133	PF 5	1578.76	1578.63	0.13	0.11	0.03	3000.00		324.02
Main	679.2133	PF 6	1579.25	1579.07	0.18	0.13	0.03	4000.00		326.48
Main	679.2133	PF 7	1579.69	1579.47	0.22	0.14	0.03	5000.00		328.68
Main	679.2133	PF 8	1580.48	1580.16	0.32	0.15	0.04	7000.00		331.16
Main	679.2133	PF 9	1580.84	1580.48	0.36	0.16	0.04	8000.00		331.16
Main	679.2133	PF 10	1581.18	1580.77	0.41	0.16	0.05	9000.00		331.16
Main	679.2133	PF 11	1581.51	1581.06	0.46	0.16	0.05	10000.00		331.16
Main	679.2133	PF 12	1583.01	1582.33	0.68	0.18	0.06	15000.00		331.16
Main	679.2133	PF 13	1584.33	1583.43	0.90	0.19	0.07	20000.00		331.16
Main	679.2133	PF 14	1585.54	1584.44	1.10	0.19	0.08	25000.00		331.16
Main	679.2133	PF 15	1586.67	1585.36	1.31	0.20	0.09	30000.00		331.16
Main	599.1649	PF 1	1576.71	1576.65	0.07	0.43	0.01	250.00		290.58
Main	599.1649	PF 2	1577.00	1576.89	0.11	0.41	0.01	500.00		297.54
Main	599.1649	PF 3	1577.43	1577.26	0.17	0.40	0.01	1000.00		300.57
Main	599.1649	PF 4	1578.08	1577.79	0.29	0.40	0.01	2000.00		306.50
Main	599.1649	PF 5	1578.62	1578.23	0.39	0.39	0.02	3000.00		310.81
Main	599.1649	PF 6	1579.09	1578.61	0.48	0.39	0.02	4000.00		314.56
Main	599.1649	PF 7	1579.52	1578.95	0.57	0.39	0.02	5000.00		317.91
Main	599.1649	PF 8	1580.29	1579.56	0.73	0.39	0.03	7000.00		323.67
Main	599.1649	PF 9	1580.64	1579.83	0.81	0.39	0.03	8000.00		323.98
Main	599.1649	PF 10	1580.98	1580.09	0.88	0.39	0.03	9000.00		323.98
Main	599.1649	PF 11	1581.30	1580.35	0.95	0.38	0.03	10000.00		323.98
Main	599.1649	PF 12	1582.77	1581.47	1.30	0.38	0.03	15000.00		323.98
Main	599.1649	PF 13	1584.07	1582.45	1.62	0.38	0.04	20000.00		323.98
Main	599.1649	PF 14	1585.27	1583.35	1.92	0.38	0.04	25000.00		323.98
Main	599.1649	PF 15	1586.38	1584.17	2.21	0.38	0.04	30000.00		323.98
Main	495.6177	PF 1	1576.28	1576.23	0.05	0.39	0.00	250.00		280.26
Main	495.6177	PF 2	1576.58	1576.50	0.08	0.39	0.00	500.00		295.19
Main	495.6177	PF 3	1577.02	1576.88	0.14	0.40	0.00	1000.00		312.23
Main	495.6177	PF 4	1577.67	1577.43	0.24	0.40	0.00	2000.00		316.42
Main	495.6177	PF 5	1578.21	1577.87	0.33	0.40	0.00	3000.00		319.71
Main	495.6177	PF 6	1578.68	1578.26	0.42	0.40	0.00	4000.00	0.00	322.65
Main	495.6177	PF 7	1579.10	1578.61	0.50	0.40	0.00	4999.94	0.06	323.76
Main	495.6177	PF 8	1579.87	1579.23	0.65	0.41	0.00	6999.81	0.19	325.19
Main	495.6177	PF 9	1580.23	1579.51	0.72	0.41	0.00	7999.75	0.25	325.19
Main	495.6177	PF 10	1580.56	1579.77	0.79	0.41	0.00	8999.70	0.30	325.19
Main	495.6177	PF 11	1580.89	1580.03	0.86	0.41	0.00	9999.64	0.36	325.19

Main	495.6177	PF 12	1582.35	1581.16	1.19	0.42	0.00	14999.40	0.60	325.19
Main	495.6177	PF 13	1583.65	1582.15	1.50	0.42	0.01	19999.18	0.82	325.19
Main	495.6177	PF 14	1584.85	1583.06	1.79	0.42	0.01	24998.99	1.01	325.19
Main	495.6177	PF 15	1585.96	1583.89	2.07	0.43	0.01	29998.80	1.20	325.19
Main	377.7849	PF 1	1575.89	1575.84	0.05	0.41	0.00	250.00		288.13
Main	377.7849	PF 2	1576.19	1576.10	0.08	0.42	0.00	500.00		305.12
Main	377.7849	PF 3	1576.62	1576.48	0.14	0.44	0.00	1000.00		315.28
Main	377.7849	PF 4	1577.27	1577.03	0.24	0.46	0.00	2000.00		317.07
Main	377.7849	PF 5	1577.81	1577.47	0.33	0.47	0.00	3000.00		318.43
Main	377.7849	PF 6	1578.27	1577.86	0.42	0.48	0.00	4000.00		319.61
Main	377.7849	PF 7	1578.70	1578.20	0.50	0.49	0.00	5000.00		320.66
Main	377.7849	PF 8	1579.46	1578.81	0.66	0.50	0.00	7000.00		322.30
Main	377.7849	PF 9	1579.81	1579.08	0.73	0.50	0.00	8000.00		322.30
Main	377.7849	PF 10	1580.15	1579.34	0.81	0.51	0.01	9000.00		322.30
Main	377.7849	PF 11	1580.47	1579.59	0.88	0.51	0.01	10000.00		322.30
Main	377.7849	PF 12	1581.93	1580.70	1.23	0.53	0.01	15000.00		322.30
Main	377.7849	PF 13	1583.23	1581.68	1.55	0.54	0.01	20000.00		322.30
Main	377.7849	PF 14	1584.42	1582.56	1.86	0.55	0.02	25000.00		322.30
Main	377.7849	PF 15	1585.53	1583.38	2.15	0.56	0.02	30000.00		322.30
Main	240.4580	PF 1	1575.48	1575.44	0.04	0.45	0.00	250.00		309.42
Main	240.4580	PF 2	1575.76	1575.69	0.07	0.47	0.00	500.00		312.29
Main	240.4580	PF 3	1576.18	1576.05	0.13	0.50	0.00	1000.00		313.45
Main	240.4580	PF 4	1576.81	1576.58	0.24	0.52	0.01	2000.00		314.92
Main	240.4580	PF 5	1577.34	1577.00	0.34	0.53	0.01	3000.00		316.08
Main	240.4580	PF 6	1577.79	1577.36	0.43	0.54	0.01	4000.00		317.09
Main	240.4580	PF 7	1578.21	1577.69	0.52	0.55	0.01	5000.00		317.98
Main	240.4580	PF 8	1578.96	1578.27	0.69	0.56	0.01	7000.00		319.57
Main	240.4580	PF 9	1579.31	1578.53	0.78	0.57	0.01	8000.00		320.29
Main	240.4580	PF 10	1579.64	1578.78	0.86	0.57	0.01	9000.00		320.40
Main	240.4580	PF 11	1579.95	1579.01	0.94	0.57	0.01	10000.00		320.40
Main	240.4580	PF 12	1581.40	1580.07	1.32	0.58	0.01	15000.00		320.40
Main	240.4580	PF 13	1582.68	1580.99	1.68	0.59	0.02	20000.00		320.40
Main	240.4580	PF 14	1583.85	1581.82	2.03	0.60	0.02	25000.00		320.40
Main	240.4580	PF 15	1584.95	1582.58	2.37	0.61	0.02	30000.00		320.40
Main	110.9642	PF 1	1575.03	1574.97	0.06			250.00		305.52
Main	110.9642	PF 2	1575.29	1575.19	0.10			500.00		319.62
Main	110.9642	PF 3	1575.68	1575.50	0.17			1000.00		320.52
Main	110.9642	PF 4	1576.29	1575.99	0.30			2000.00		321.88
Main	110.9642	PF 5	1576.79	1576.38	0.41			3000.00		322.99
Main	110.9642	PF 6	1577.24	1576.72	0.52			4000.00		323.95
Main	110.9642	PF 7	1577.65	1577.03	0.62			5000.00		324.82
Main	110.9642	PF 8	1578.39	1577.58	0.81			7000.00		326.36
Main	110.9642	PF 9	1578.73	1577.84	0.89			8000.00		327.06
Main	110.9642	PF 10	1579.06	1578.07	0.98			9000.00		327.41
Main	110.9642	PF 11	1579.37	1578.30	1.07			10000.00		327.41
Main	110.9642	PF 12	1580.80	1579.33	1.47			15000.00		327.41
Main	110.9642	PF 13	1582.07	1580.23	1.84			20000.00		327.41
Main	110.9642	PF 14	1583.24	1581.04	2.19			25000.00		327.41
Main	110.9642	PF 15	1584.33	1581.80	2.53			30000.00		327.41

Appendix E

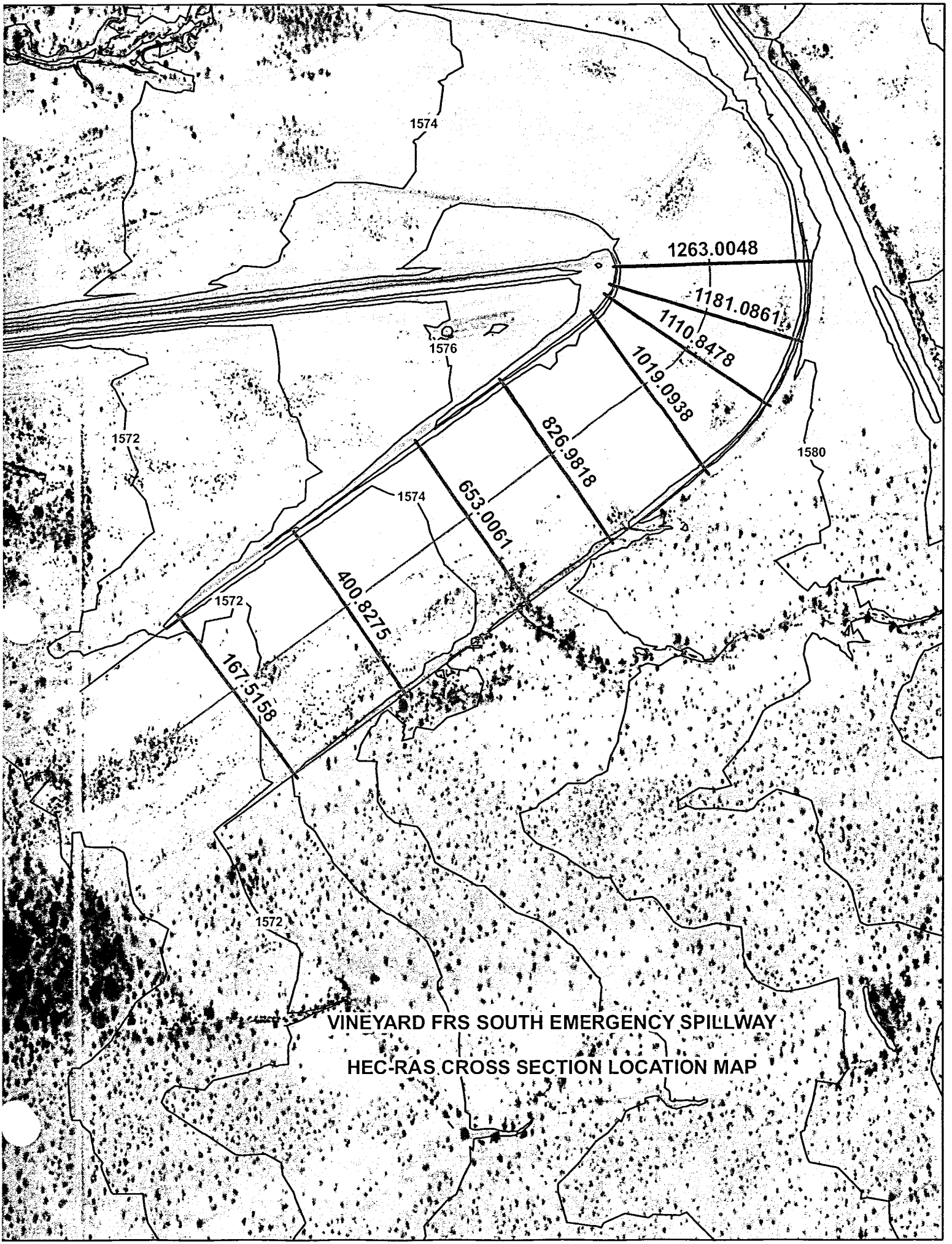
Vineyard FRS ~~North~~ South Emergency Spillway HEC-RAS Model

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 South Kyrene Road, Suite 201, Tempe, Arizona 85284
Phone: 480-752-2124 Fax: 480-839-2193

HEC-RAS Plan: V_ES_S_030 River: Vineyard_ES_S Reach: Main

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main	1263.004	PF 1	250	1574.83	1576.16		1576.17	0.0002	0.76	330.19	293.74	0.13
Main	1263.004	PF 2	500	1574.83	1576.49		1576.52	0.000341	1.17	429.06	297.89	0.17
Main	1263.004	PF 3	1000	1574.83	1576.98		1577.02	0.00053	1.74	574.1	303.83	0.22
Main	1263.004	PF 4	2000	1574.83	1577.67		1577.77	0.000756	2.54	786.87	307.97	0.28
Main	1263.004	PF 5	3000	1574.83	1578.21		1578.37	0.000906	3.14	954.59	311.22	0.32
Main	1263.004	PF 6	4000	1574.83	1578.68		1578.88	0.00102	3.64	1099.23	314.08	0.34
Main	1263.004	PF 7	5000	1574.83	1579.09		1579.35	0.001107	4.07	1230	319.16	0.36
Main	1263.004	PF 8	6000	1574.83	1579.46		1579.77	0.001185	4.45	1348.97	321.39	0.38
Main	1263.004	PF 9	7000	1574.83	1579.8		1580.16	0.001255	4.8	1458.98	323.42	0.4
Main	1263.004	PF 10	8000	1574.83	1580.12		1580.53	0.001326	5.13	1562.49	326.97	0.41
Main	1263.004	PF 11	9000	1574.83	1580.42		1580.88	0.001376	5.43	1659.6	326.97	0.42
Main	1263.004	PF 12	10000	1574.83	1580.7		1581.21	0.00142	5.72	1752.16	326.97	0.43
Main	1263.004	PF 13	15000	1574.83	1581.96		1582.71	0.001595	6.95	2163.67	326.97	0.48
Main	1263.004	PF 14	20000	1574.83	1583.05		1584.03	0.001717	7.96	2519.73	326.97	0.5
Main	1263.004	PF 15	25000	1574.83	1584.03		1585.24	0.001807	8.83	2841.19	326.97	0.53
Main	1263.004	PF 16	30000	1574.83	1584.93		1586.36	0.001881	9.6	3136.15	326.97	0.55

WSEL	Q Total	Depth	Q * 0.5	
1575.7	0	0	0	Set Grid Nos. 18257-18258 to this elevation, which is the 2007 surveyed elevation
1576.16	250	0.46	125	
1576.49	500	0.79	250	
1576.98	1000	1.28	500	
1577.67	2000	1.97	1000	
1578.21	3000	2.51	1500	
1578.68	4000	2.98	2000	
1579.09	5000	3.39	2500	
1579.46	6000	3.76	3000	
1579.8	7000	4.1	3500	
1580.12	8000	4.42	4000	
1580.42	9000	4.72	4500	
1580.7	10000	5	5000	
1581.96	15000	6.26	7500	
1583.05	20000	7.35	10000	
1584.03	25000	8.33	12500	
1584.93	30000	9.23	15000	



VINEYARD FRS SOUTH EMERGENCY SPILLWAY

HEC-RAS CROSS SECTION LOCATION MAP

```
                    HEC-RAS Version 3.1.3 May 2005
                     U.S. Army Corp of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California

          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX


PROJECT DATA
Project Title: Vineyard ES South Rating Curve
Project File : Vineyard_ES_S.prj
Run Date and Time: 6/22/2007 3:55:02 PM

Project in English units


PLAN DATA

Plan Title: Vineyard ES_South Rating  with n=0.030
Plan File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_S.p01

          Geometry Title: Vineyard ES_South with n=0.030
          Geometry File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_S.g01

          Flow Title    : Vineyard ES_South Rating Curve Flows
          Flow File     : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_S.f01

Plan Summary Information:
Number of:  Cross Sections =    8    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


FLOW DATA

Flow Title: Vineyard ES_South Rating Curve Flows
Flow File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_S.f01

Flow Data (cfs)

  River          Reach          RS                PF 1          PF 2          PF 3          PF 4          PF 5          PF 6          PF 7          PF 8
  Vineyard_ES_S  Main           1263.004           250           500          1000          2000          3000          4000          5000          6000
```

River	Reach	RS	PF 9	PF 10	PF 11	PF 12	PF 13	PF 14	PF 15	PF 16
Vineyard_ES_S	Main	1263.004	7000	8000	9000	10000	15000	20000	25000	30000

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Vineyard_ES_S	Main	PF 1		Normal S = 0.005
Vineyard_ES_S	Main	PF 2		Normal S = 0.005
Vineyard_ES_S	Main	PF 3		Normal S = 0.005
Vineyard_ES_S	Main	PF 4		Normal S = 0.005
Vineyard_ES_S	Main	PF 5		Normal S = 0.005
Vineyard_ES_S	Main	PF 6		Normal S = 0.005
Vineyard_ES_S	Main	PF 7		Normal S = 0.005
Vineyard_ES_S	Main	PF 8		Normal S = 0.005
Vineyard_ES_S	Main	PF 9		Normal S = 0.005
Vineyard_ES_S	Main	PF 10		Normal S = 0.005
Vineyard_ES_S	Main	PF 11		Normal S = 0.005
Vineyard_ES_S	Main	PF 12		Normal S = 0.005
Vineyard_ES_S	Main	PF 13		Normal S = 0.005
Vineyard_ES_S	Main	PF 14		Normal S = 0.005
Vineyard_ES_S	Main	PF 15		Normal S = 0.005

GEOMETRY DATA

Geometry Title: Vineyard ES_South with n=0.030
Geometry File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Vineyard_ES_S.g01

CROSS SECTION

RIVER: Vineyard_ES_S
REACH: Main RS: 1263.004

INPUT
Description:
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1579.98	.45	1579.97	3.33	1579.84	4.15	1579.7	8.04	1579.05
8.27	1579.01	8.78	1578.85	15.38	1576.97	23.17	1576.19	26.08	1575.9
28.4	1575.65	53	1574.86	54.46	1574.83	56.16	1574.84	105.03	1574.96
108.71	1574.95	154.51	1574.94	159.39	1574.95	198.4	1575.03	204.53	1575.07
210.9	1575.07	254.55	1575.03	262.48	1574.94	300.4	1574.93	308.46	1575.52
316.55	1575.89	321.73	1578.02	322.62	1578.36	323.96	1578.86	326.97	1578.91

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	323.96	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	323.96	133.38	81.92	31.11	.1	.3

CROSS SECTION

RIVER: Vineyard_ES_S
REACH: Main RS: 1181.086

INPUT
Description:
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1580	.57	1579.98	2.15	1579.79	5.7	1579.35	6	1579.31
14.03	1576.47	14.1	1576.45	18.81	1575.55	22.41	1575.03	24.3	1574.94
41.35	1574.57	83.8	1574.74	93.52	1574.77	98.78	1574.77	116.48	1574.83

```
  145.68  1574.9   179.2 1574.97  197.84 1575.11  238.06 1574.94  250.99 1574.98
  260.42 1574.82  279.84 1574.88  305.13 1574.85  307.54 1574.88   309.6 1575.02
  314.73 1575.45  317.47 1575.76  322.76 1577.62  326.64  1578.9   329.7  1579.9

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03       0     .03   329.7     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   329.7           119.66   70.24   20.67             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_S
REACH: Main               RS: 1110.847

INPUT
Description:
Station Elevation Data    num=      28
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1579.16    5.78 1578.79    9.72 1577.58   12.67 1576.61   15.68 1576.14
   23.14 1574.83   41.59 1574.77   59.42 1574.77    76.4 1574.82  107.72  1574.8
  118.22 1574.74  118.28  1574.7  158.17 1574.49  159.99 1574.48   161.1 1574.48
  192.86  1574.7   214.4 1574.71  226.36 1574.72  245.25 1574.92  267.45 1575.14
  289.68 1575.27  313.17 1575.29  315.78 1575.57   317.8 1575.76  328.14 1579.16
  329.46 1579.56  330.28 1579.81  331.22 1579.89

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03       0     .03  331.22     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  331.22           148.75   91.75   38.84             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_S
REACH: Main               RS: 1019.093

INPUT
Description:
Station Elevation Data    num=      27
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1579.18    1.41 1579.01    9.65 1578.17   12.68 1577.79   12.77 1577.78
   15.48 1577.18   20.57    1576    23.1 1575.81    25.2 1575.71   73.83  1575.5
   82.68  1575.5   124.4 1575.45  132.56 1575.43  173.71 1575.56  182.58 1575.58
  191.63 1575.53  232.72 1575.47  274.17 1575.41  282.66  1575.4  303.82 1575.48
  310.26 1575.55  319.39    1576  319.54    1576  320.08 1576.15  325.73 1577.71
  332.26 1579.57  332.32 1579.58

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03       0     .03  332.32     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  332.32           196.17  192.11  188.81             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_S
REACH: Main               RS: 826.9817

INPUT
Description:
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1577.62    4.92 1577.48    6.48 1577.43    7.01 1577.44    9.78 1576.75
```

```
   12.22 1576.09   15.93 1575.68   18.17 1575.43   21.17 1575.39   48.38 1575.71
   70.05 1575.14   85.11 1575.07  135.99 1574.97   141.9 1574.98     146    1575
  168.82 1575.02  206.89 1575.05  213.74  1575.1  223.59  1575.1  267.78    1575
  295.41 1574.98  316.06 1575.28  319.62 1575.96  326.92 1577.91  329.44  1578.5
  330.25 1578.51

Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03       0     .03  329.44     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  329.44            174.32  173.98  173.63             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_S
REACH: Main                 RS: 653.0061

INPUT
Description:
Station Elevation Data      num=      20
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1576.99    6.62 1576.82   10.66 1576.73   15.77 1575.32   17.11 1574.83
   28.64 1574.74   67.22 1574.33   90.86 1574.14  117.13 1574.14  151.66 1574.13
  155.09 1574.16     189 1574.59  212.47 1574.52  242.97 1574.36  260.88 1574.26
  273.27  1574.3   295.9 1574.39   316.9 1574.45  322.78 1575.74  331.37 1577.79

Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03       0     .03  331.37     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  331.37            253.03  252.18   251.4             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_S
REACH: Main                 RS: 400.8275

INPUT
Description:
Station Elevation Data      num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1575.39    6.99 1575.32     8.2  1575.3   15.66 1573.95   18.24 1573.48
    21.5 1573.46   36.89 1573.42   61.54 1573.12   79.09 1572.94    91.1 1573.02
  150.06 1572.62  151.03 1572.61  151.69 1572.61  155.22 1572.63  212.28 1572.88
  238.47 1573.05  272.76 1573.15  305.51 1573.29  317.01 1573.35  330.04 1575.66
   331.3 1575.89  331.76  1575.9  332.48  1575.9  336.27 1575.97

Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03     8.2     .03   331.3     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             8.2  331.3            227.39  233.31   238.4             .1       .3

CROSS SECTION


RIVER: Vineyard_ES_S
REACH: Main                 RS: 167.5157

INPUT
Description:
Station Elevation Data      num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1574.15    7.95  1574.1    9.16 1574.09    9.63 1574.01   13.48  1573.5
   19.76 1572.42    65.3  1572.3   77.05 1572.23   82.64 1572.18   90.24 1572.18
```

139.12	1571.69	154.17	1571.53	174.63	1571.51	201.18	1571.64	225.7	1571.67
259.03	1571.87	263.25	1571.87	311.18	1572.08	318.25	1572.21	322.22	1572.84
330.71	1574.06	333.3	1574.19	333.59	1574.21	338.11	1574.52		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	9.16	.03	338.11	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9.16	338.11	146.12	167.52	204.16	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Vineyard_ES_S

Reach	River Sta.	n1	n2	n3
Main	1263.004	.03	.03	.03
Main	1181.086	.03	.03	.03
Main	1110.847	.03	.03	.03
Main	1019.093	.03	.03	.03
Main	826.9817	.03	.03	.03
Main	653.0061	.03	.03	.03
Main	400.8275	.03	.03	.03
Main	167.5157	.03	.03	.03

SUMMARY OF REACH LENGTHS

River: Vineyard_ES_S

Reach	River Sta.	Left	Channel	Right
Main	1263.004	133.38	81.92	31.11
Main	1181.086	119.66	70.24	20.67
Main	1110.847	148.75	91.75	38.84
Main	1019.093	196.17	192.11	188.81
Main	826.9817	174.32	173.98	173.63
Main	653.0061	253.03	252.18	251.4
Main	400.8275	227.39	233.31	238.4
Main	167.5157	146.12	167.52	204.16

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Vineyard_ES_S

Reach	River Sta.	Contr.	Expan.
Main	1263.004	.1	.3
Main	1181.086	.1	.3
Main	1110.847	.1	.3
Main	1019.093	.1	.3
Main	826.9817	.1	.3
Main	653.0061	.1	.3
Main	400.8275	.1	.3
Main	167.5157	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl

Main	1263.004	PF 1	250.00	1574.83	1576.16	1576.17	0.000200	0.76	330.19	293.74	0.13
Main	1263.004	PF 2	500.00	1574.83	1576.49	1576.52	0.000341	1.17	429.06	297.89	0.17
Main	1263.004	PF 3	1000.00	1574.83	1576.98	1577.02	0.000530	1.74	574.10	303.83	0.22
Main	1263.004	PF 4	2000.00	1574.83	1577.67	1577.77	0.000756	2.54	786.87	307.97	0.28
Main	1263.004	PF 5	3000.00	1574.83	1578.21	1578.37	0.000906	3.14	954.59	311.22	0.32
Main	1263.004	PF 6	4000.00	1574.83	1578.68	1578.88	0.001020	3.64	1099.23	314.08	0.34
Main	1263.004	PF 7	5000.00	1574.83	1579.09	1579.35	0.001107	4.07	1230.00	319.16	0.36
Main	1263.004	PF 8	6000.00	1574.83	1579.46	1579.77	0.001185	4.45	1348.97	321.39	0.38
Main	1263.004	PF 9	7000.00	1574.83	1579.80	1580.16	0.001255	4.80	1458.98	323.42	0.40
Main	1263.004	PF 10	8000.00	1574.83	1580.12	1580.53	0.001326	5.13	1562.49	326.97	0.41
Main	1263.004	PF 11	9000.00	1574.83	1580.42	1580.88	0.001376	5.43	1659.60	326.97	0.42
Main	1263.004	PF 12	10000.00	1574.83	1580.70	1581.21	0.001420	5.72	1752.16	326.97	0.43
Main	1263.004	PF 13	15000.00	1574.83	1581.96	1582.71	0.001595	6.95	2163.67	326.97	0.48
Main	1263.004	PF 14	20000.00	1574.83	1583.05	1584.03	0.001717	7.96	2519.73	326.97	0.50
Main	1263.004	PF 15	25000.00	1574.83	1584.03	1585.24	0.001807	8.83	2841.19	326.97	0.53
Main	1263.004	PF 16	30000.00	1574.83	1584.93	1586.36	0.001881	9.60	3136.15	326.97	0.55
Main	1181.086	PF 1	250.00	1574.57	1576.15	1576.16	0.000132	0.66	378.77	302.90	0.10
Main	1181.086	PF 2	500.00	1574.57	1576.47	1576.49	0.000246	1.05	477.70	305.48	0.15
Main	1181.086	PF 3	1000.00	1574.57	1576.94	1576.98	0.000414	1.61	621.70	308.14	0.20
Main	1181.086	PF 4	2000.00	1574.57	1577.62	1577.71	0.000638	2.40	832.45	312.00	0.26
Main	1181.086	PF 5	3000.00	1574.57	1578.15	1578.29	0.000792	3.00	998.99	315.11	0.30
Main	1181.086	PF 6	4000.00	1574.57	1578.61	1578.80	0.000910	3.50	1142.84	317.77	0.33
Main	1181.086	PF 7	5000.00	1574.57	1579.02	1579.26	0.001004	3.93	1272.54	320.16	0.35
Main	1181.086	PF 8	6000.00	1574.57	1579.38	1579.67	0.001089	4.32	1390.03	322.66	0.37
Main	1181.086	PF 9	7000.00	1574.57	1579.72	1580.06	0.001171	4.67	1499.01	326.39	0.38
Main	1181.086	PF 10	8000.00	1574.57	1580.03	1580.42	0.001244	5.00	1601.59	329.70	0.40
Main	1181.086	PF 11	9000.00	1574.57	1580.32	1580.76	0.001298	5.30	1698.38	329.70	0.41
Main	1181.086	PF 12	10000.00	1574.57	1580.60	1581.09	0.001346	5.58	1790.75	329.70	0.42
Main	1181.086	PF 13	15000.00	1574.57	1581.85	1582.57	0.001535	6.81	2202.07	329.70	0.46
Main	1181.086	PF 14	20000.00	1574.57	1582.93	1583.88	0.001669	7.82	2558.93	329.70	0.49
Main	1181.086	PF 15	25000.00	1574.57	1583.91	1585.08	0.001768	8.68	2881.75	329.70	0.52
Main	1181.086	PF 16	30000.00	1574.57	1584.81	1586.20	0.001850	9.44	3178.41	329.70	0.54
Main	1110.847	PF 1	250.00	1574.48	1576.14	1576.15	0.000120	0.64	390.19	303.27	0.10
Main	1110.847	PF 2	500.00	1574.48	1576.46	1576.47	0.000232	1.03	486.92	306.27	0.14
Main	1110.847	PF 3	1000.00	1574.48	1576.92	1576.95	0.000403	1.59	627.88	309.57	0.20
Main	1110.847	PF 4	2000.00	1574.48	1577.58	1577.67	0.000636	2.40	834.60	313.60	0.26
Main	1110.847	PF 5	3000.00	1574.48	1578.10	1578.24	0.000800	3.00	998.34	316.87	0.30
Main	1110.847	PF 6	4000.00	1574.48	1578.54	1578.73	0.000925	3.51	1140.07	319.68	0.33
Main	1110.847	PF 7	5000.00	1574.48	1578.94	1579.18	0.001032	3.94	1268.21	324.06	0.35
Main	1110.847	PF 8	6000.00	1574.48	1579.30	1579.59	0.001128	4.33	1385.64	328.60	0.37
Main	1110.847	PF 9	7000.00	1574.48	1579.63	1579.97	0.001201	4.68	1494.24	329.69	0.39
Main	1110.847	PF 10	8000.00	1574.48	1579.94	1580.33	0.001270	5.01	1595.63	331.22	0.40
Main	1110.847	PF 11	9000.00	1574.48	1580.23	1580.67	0.001326	5.32	1691.29	331.22	0.41
Main	1110.847	PF 12	10000.00	1574.48	1580.50	1580.99	0.001377	5.61	1782.67	331.22	0.43
Main	1110.847	PF 13	15000.00	1574.48	1581.73	1582.46	0.001575	6.85	2190.10	331.22	0.47
Main	1110.847	PF 14	20000.00	1574.48	1582.80	1583.76	0.001714	7.86	2544.37	331.22	0.50
Main	1110.847	PF 15	25000.00	1574.48	1583.77	1584.95	0.001818	8.73	2864.23	331.22	0.52
Main	1110.847	PF 16	30000.00	1574.48	1584.66	1586.06	0.001901	9.49	3159.63	331.22	0.54
Main	1019.093	PF 1	250.00	1575.40	1576.08	1576.12	0.001886	1.47	169.75	299.62	0.34
Main	1019.093	PF 2	500.00	1575.40	1576.36	1576.42	0.001990	1.97	253.96	301.84	0.38
Main	1019.093	PF 3	1000.00	1575.40	1576.77	1576.88	0.002177	2.66	376.34	305.04	0.42
Main	1019.093	PF 4	2000.00	1575.40	1577.36	1577.55	0.002398	3.59	557.61	309.75	0.47
Main	1019.093	PF 5	3000.00	1575.40	1577.82	1578.10	0.002542	4.27	702.52	313.67	0.50
Main	1019.093	PF 6	4000.00	1575.40	1578.22	1578.58	0.002647	4.82	829.77	318.39	0.53
Main	1019.093	PF 7	5000.00	1575.40	1578.59	1579.02	0.002726	5.29	946.04	323.22	0.54
Main	1019.093	PF 8	6000.00	1575.40	1578.91	1579.42	0.002807	5.70	1051.94	327.56	0.56
Main	1019.093	PF 9	7000.00	1575.40	1579.21	1579.79	0.002869	6.08	1151.23	331.00	0.57
Main	1019.093	PF 10	8000.00	1575.40	1579.49	1580.13	0.002909	6.43	1244.06	331.99	0.59
Main	1019.093	PF 11	9000.00	1575.40	1579.76	1580.47	0.002942	6.76	1331.83	332.32	0.59
Main	1019.093	PF 12	10000.00	1575.40	1580.01	1580.78	0.002968	7.06	1415.92	332.32	0.60
Main	1019.093	PF 13	15000.00	1575.40	1581.14	1582.23	0.003074	8.37	1791.77	332.32	0.64
Main	1019.093	PF 14	20000.00	1575.40	1582.13	1583.51	0.003141	9.43	2120.60	332.32	0.66
Main	1019.093	PF 15	25000.00	1575.40	1583.03	1584.69	0.003188	10.34	2418.80	332.32	0.68
Main	1019.093	PF 16	30000.00	1575.40	1583.86	1585.78	0.003221	11.13	2695.22	332.32	0.69
Main	826.9817	PF 1	250.00	1574.97	1575.57	1575.63	0.003590	1.83	136.98	284.00	0.46
Main	826.9817	PF 2	500.00	1574.97	1575.82	1575.91	0.003709	2.37	211.36	304.28	0.50

Main	826.9817	PF 3	1000.00	1574.97	1576.17		1576.32	0.003926	3.16	316.71	308.46	0.55
Main	826.9817	PF 4	2000.00	1574.97	1576.68		1576.96	0.004102	4.20	476.18	312.29	0.60
Main	826.9817	PF 5	3000.00	1574.97	1577.10		1577.48	0.004159	4.94	607.38	315.51	0.63
Main	826.9817	PF 6	4000.00	1574.97	1577.46		1577.94	0.004225	5.54	722.38	319.76	0.65
Main	826.9817	PF 7	5000.00	1574.97	1577.80		1578.36	0.004242	6.01	832.01	326.51	0.66
Main	826.9817	PF 8	6000.00	1574.97	1578.10		1578.75	0.004242	6.45	929.92	327.73	0.68
Main	826.9817	PF 9	7000.00	1574.97	1578.37		1579.10	0.004276	6.87	1019.45	328.89	0.69
Main	826.9817	PF 10	8000.00	1574.97	1578.63		1579.44	0.004298	7.25	1103.97	330.25	0.70
Main	826.9817	PF 11	9000.00	1574.97	1578.87		1579.77	0.004315	7.60	1183.91	330.25	0.71
Main	826.9817	PF 12	10000.00	1574.97	1579.10		1580.08	0.004333	7.94	1260.06	330.25	0.72
Main	826.9817	PF 13	15000.00	1574.97	1580.14		1581.50	0.004393	9.36	1603.17	330.25	0.75
Main	826.9817	PF 14	20000.00	1574.97	1581.05		1582.77	0.004424	10.51	1903.67	330.25	0.77
Main	826.9817	PF 15	25000.00	1574.97	1581.88		1583.93	0.004441	11.50	2176.31	330.25	0.79
Main	826.9817	PF 16	30000.00	1574.97	1582.64		1585.01	0.004450	12.36	2429.00	330.25	0.80
Main	653.0061	PF 1	250.00	1574.13	1574.76	1574.62	1574.83	0.006081	2.12	118.20	291.66	0.59
Main	653.0061	PF 2	500.00	1574.13	1574.97	1574.80	1575.08	0.006144	2.76	181.24	302.51	0.63
Main	653.0061	PF 3	1000.00	1574.13	1575.29		1575.49	0.005963	3.60	278.07	304.84	0.66
Main	653.0061	PF 4	2000.00	1574.13	1575.78		1576.11	0.005713	4.66	429.23	308.82	0.70
Main	653.0061	PF 5	3000.00	1574.13	1576.17		1576.63	0.005632	5.43	552.06	311.92	0.72
Main	653.0061	PF 6	4000.00	1574.13	1576.52		1577.09	0.005568	6.05	660.67	314.62	0.74
Main	653.0061	PF 7	5000.00	1574.13	1576.84		1577.51	0.005564	6.56	762.17	321.56	0.75
Main	653.0061	PF 8	6000.00	1574.13	1577.13		1577.89	0.005560	6.99	858.03	328.62	0.76
Main	653.0061	PF 9	7000.00	1574.13	1577.40		1578.25	0.005535	7.41	944.06	329.72	0.77
Main	653.0061	PF 10	8000.00	1574.13	1577.64		1578.59	0.005521	7.80	1025.21	330.75	0.78
Main	653.0061	PF 11	9000.00	1574.13	1577.87		1578.91	0.005517	8.17	1101.77	331.37	0.79
Main	653.0061	PF 12	10000.00	1574.13	1578.09		1579.22	0.005502	8.51	1175.23	331.37	0.80
Main	653.0061	PF 13	15000.00	1574.13	1579.09		1580.63	0.005467	9.96	1505.43	331.37	0.82
Main	653.0061	PF 14	20000.00	1574.13	1579.96		1581.89	0.005458	11.15	1793.64	331.37	0.84
Main	653.0061	PF 15	25000.00	1574.13	1580.75		1583.05	0.005458	12.17	2054.42	331.37	0.86
Main	653.0061	PF 16	30000.00	1574.13	1581.47		1584.13	0.005461	13.07	2295.39	331.37	0.88
Main	400.8275	PF 1	250.00	1572.61	1573.43		1573.49	0.004617	1.97	127.21	285.10	0.52
Main	400.8275	PF 2	500.00	1572.61	1573.67		1573.77	0.004494	2.51	198.83	301.63	0.55
Main	400.8275	PF 3	1000.00	1572.61	1574.01		1574.18	0.004522	3.31	302.35	305.43	0.59
Main	400.8275	PF 4	2000.00	1572.61	1574.53		1574.82	0.004560	4.34	460.60	311.16	0.63
Main	400.8275	PF 5	3000.00	1572.61	1574.94		1575.34	0.004595	5.09	589.59	315.76	0.66
Main	400.8275	PF 6	4000.00	1572.61	1575.30		1575.80	0.004599	5.68	704.10	319.78	0.67
Main	400.8275	PF 7	5000.00	1572.61	1575.61		1576.21	0.004621	6.20	807.54	329.78	0.69
Main	400.8275	PF 8	6000.00	1572.61	1575.90		1576.59	0.004664	6.68	901.64	331.66	0.71
Main	400.8275	PF 9	7000.00	1572.61	1576.16		1576.94	0.004695	7.11	989.18	336.27	0.72
Main	400.8275	PF 10	8000.00	1572.61	1576.41		1577.28	0.004715	7.51	1072.14	336.27	0.73
Main	400.8275	PF 11	9000.00	1572.61	1576.64		1577.60	0.004731	7.87	1150.99	336.27	0.74
Main	400.8275	PF 12	10000.00	1572.61	1576.86		1577.91	0.004745	8.22	1226.27	336.27	0.75
Main	400.8275	PF 13	15000.00	1572.61	1577.87		1579.31	0.004797	9.68	1563.98	336.27	0.78
Main	400.8275	PF 14	20000.00	1572.61	1578.74		1580.56	0.004834	10.88	1858.01	336.27	0.81
Main	400.8275	PF 15	25000.00	1572.61	1579.53		1581.71	0.004858	11.91	2123.92	336.27	0.83
Main	400.8275	PF 16	30000.00	1572.61	1580.26		1582.79	0.004874	12.81	2369.64	336.27	0.85
Main	167.5157	PF 1	250.00	1571.51	1572.31	1572.12	1572.38	0.005002	2.10	118.97	256.06	0.54
Main	167.5157	PF 2	500.00	1571.51	1572.56	1572.34	1572.66	0.005008	2.60	192.44	301.50	0.57
Main	167.5157	PF 3	1000.00	1571.51	1572.89	1572.62	1573.07	0.005001	3.41	293.41	305.57	0.61
Main	167.5157	PF 4	2000.00	1571.51	1573.39	1573.03	1573.70	0.005002	4.46	448.43	311.98	0.66
Main	167.5157	PF 5	3000.00	1571.51	1573.80	1573.37	1574.22	0.005003	5.21	576.12	317.68	0.68
Main	167.5157	PF 6	4000.00	1571.51	1574.15	1573.68	1574.68	0.005002	5.80	689.94	332.59	0.70
Main	167.5157	PF 7	5000.00	1571.51	1574.47	1573.96	1575.09	0.005000	6.30	795.87	337.39	0.71
Main	167.5157	PF 8	6000.00	1571.51	1574.75	1574.22	1575.46	0.005004	6.77	890.25	338.11	0.73
Main	167.5157	PF 9	7000.00	1571.51	1575.01	1574.47	1575.81	0.005002	7.19	978.04	338.11	0.74
Main	167.5157	PF 10	8000.00	1571.51	1575.25	1574.71	1576.14	0.005002	7.58	1060.87	338.11	0.75
Main	167.5157	PF 11	9000.00	1571.51	1575.49	1574.93	1576.46	0.005001	7.94	1139.66	338.11	0.76
Main	167.5157	PF 12	10000.00	1571.51	1575.71	1575.14	1576.77	0.005001	8.28	1215.03	338.11	0.76
Main	167.5157	PF 13	15000.00	1571.51	1576.71	1576.06	1578.17	0.005008	9.72	1553.63	338.11	0.79
Main	167.5157	PF 14	20000.00	1571.51	1577.59	1576.90	1579.42	0.005005	10.88	1850.63	338.11	0.82
Main	167.5157	PF 15	25000.00	1571.51	1578.39	1577.65	1580.56	0.005003	11.88	2119.61	338.11	0.83
Main	167.5157	PF 16	30000.00	1571.51	1579.12	1578.38	1581.63	0.005002	12.77	2368.24	338.11	0.85

Profile Output Table - Standard Table 2

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width

			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Main	1263.004	PF 1	1576.17	1576.16	0.01	0.01	0.00		250.00		293.74
Main	1263.004	PF 2	1576.52	1576.49	0.02	0.02	0.00		500.00		297.89
Main	1263.004	PF 3	1577.02	1576.98	0.05	0.04	0.00		1000.00		303.83
Main	1263.004	PF 4	1577.77	1577.67	0.10	0.06	0.00		2000.00		307.97
Main	1263.004	PF 5	1578.37	1578.21	0.15	0.07	0.00		3000.00		311.22
Main	1263.004	PF 6	1578.88	1578.68	0.21	0.08	0.00		4000.00		314.08
Main	1263.004	PF 7	1579.35	1579.09	0.26	0.09	0.01		4999.66	0.34	319.16
Main	1263.004	PF 8	1579.77	1579.46	0.31	0.09	0.01		5998.17	1.83	321.39
Main	1263.004	PF 9	1580.16	1579.80	0.36	0.10	0.01		6996.16	3.84	323.42
Main	1263.004	PF 10	1580.53	1580.12	0.41	0.11	0.01		7993.84	6.16	326.97
Main	1263.004	PF 11	1580.88	1580.42	0.46	0.11	0.01		8991.41	8.59	326.97
Main	1263.004	PF 12	1581.21	1580.70	0.51	0.11	0.01		9988.89	11.11	326.97
Main	1263.004	PF 13	1582.71	1581.96	0.75	0.13	0.01		14975.74	24.26	326.97
Main	1263.004	PF 14	1584.03	1583.05	0.98	0.14	0.01		19962.63	37.38	326.97
Main	1263.004	PF 15	1585.24	1584.03	1.21	0.15	0.01		24949.89	50.11	326.97
Main	1263.004	PF 16	1586.36	1584.93	1.43	0.15	0.01		29937.61	62.39	326.97
Main	1181.086	PF 1	1576.16	1576.15	0.01	0.01	0.00		250.00		302.90
Main	1181.086	PF 2	1576.49	1576.47	0.02	0.02	0.00		500.00		305.48
Main	1181.086	PF 3	1576.98	1576.94	0.04	0.03	0.00		1000.00		308.14
Main	1181.086	PF 4	1577.71	1577.62	0.09	0.04	0.00		2000.00		312.00
Main	1181.086	PF 5	1578.29	1578.15	0.14	0.06	0.00		3000.00		315.11
Main	1181.086	PF 6	1578.80	1578.61	0.19	0.06	0.00		4000.00		317.77
Main	1181.086	PF 7	1579.26	1579.02	0.24	0.07	0.00		5000.00		320.16
Main	1181.086	PF 8	1579.67	1579.38	0.29	0.08	0.00		6000.00		322.66
Main	1181.086	PF 9	1580.06	1579.72	0.34	0.08	0.00		7000.00		326.39
Main	1181.086	PF 10	1580.42	1580.03	0.39	0.09	0.00		8000.00		329.70
Main	1181.086	PF 11	1580.76	1580.32	0.44	0.09	0.00		9000.00		329.70
Main	1181.086	PF 12	1581.09	1580.60	0.48	0.10	0.00		10000.00		329.70
Main	1181.086	PF 13	1582.57	1581.85	0.72	0.11	0.00		15000.00		329.70
Main	1181.086	PF 14	1583.88	1582.93	0.95	0.12	0.00		20000.00		329.70
Main	1181.086	PF 15	1585.08	1583.91	1.17	0.13	0.00		25000.00		329.70
Main	1181.086	PF 16	1586.20	1584.81	1.38	0.13	0.00		30000.00		329.70
Main	1110.847	PF 1	1576.15	1576.14	0.01	0.03	0.00		250.00		303.27
Main	1110.847	PF 2	1576.47	1576.46	0.02	0.05	0.00		500.00		306.27
Main	1110.847	PF 3	1576.95	1576.92	0.04	0.07	0.01		1000.00		309.57
Main	1110.847	PF 4	1577.67	1577.58	0.09	0.10	0.01		2000.00		313.60
Main	1110.847	PF 5	1578.24	1578.10	0.14	0.12	0.01		3000.00		316.87
Main	1110.847	PF 6	1578.73	1578.54	0.19	0.13	0.02		4000.00		319.68
Main	1110.847	PF 7	1579.18	1578.94	0.24	0.15	0.02		5000.00		324.06
Main	1110.847	PF 8	1579.59	1579.30	0.29	0.16	0.02		6000.00		328.60
Main	1110.847	PF 9	1579.97	1579.63	0.34	0.16	0.02		7000.00		329.69
Main	1110.847	PF 10	1580.33	1579.94	0.39	0.17	0.03		8000.00		331.22
Main	1110.847	PF 11	1580.67	1580.23	0.44	0.17	0.03		9000.00		331.22
Main	1110.847	PF 12	1580.99	1580.50	0.49	0.18	0.03		10000.00		331.22
Main	1110.847	PF 13	1582.46	1581.73	0.73	0.20	0.04		15000.00		331.22
Main	1110.847	PF 14	1583.76	1582.80	0.96	0.21	0.04		20000.00		331.22
Main	1110.847	PF 15	1584.95	1583.77	1.18	0.22	0.05		25000.00		331.22
Main	1110.847	PF 16	1586.06	1584.66	1.40	0.22	0.05		30000.00		331.22
Main	1019.093	PF 1	1576.12	1576.08	0.03	0.49	0.00		250.00		299.62
Main	1019.093	PF 2	1576.42	1576.36	0.06	0.51	0.00		500.00		301.84
Main	1019.093	PF 3	1576.88	1576.77	0.11	0.55	0.00		1000.00		305.04
Main	1019.093	PF 4	1577.55	1577.36	0.20	0.59	0.01		2000.00		309.75
Main	1019.093	PF 5	1578.10	1577.82	0.28	0.62	0.01		3000.00		313.67
Main	1019.093	PF 6	1578.58	1578.22	0.36	0.63	0.01		4000.00		318.39
Main	1019.093	PF 7	1579.02	1578.59	0.43	0.65	0.01		5000.00		323.22
Main	1019.093	PF 8	1579.42	1578.91	0.51	0.66	0.01		6000.00		327.56
Main	1019.093	PF 9	1579.79	1579.21	0.57	0.67	0.02		7000.00		331.00
Main	1019.093	PF 10	1580.13	1579.49	0.64	0.67	0.02		8000.00		331.99
Main	1019.093	PF 11	1580.47	1579.76	0.71	0.68	0.02		9000.00		332.32
Main	1019.093	PF 12	1580.78	1580.01	0.77	0.68	0.02		10000.00		332.32
Main	1019.093	PF 13	1582.23	1581.14	1.09	0.70	0.03		15000.00		332.32
Main	1019.093	PF 14	1583.51	1582.13	1.38	0.71	0.03		20000.00		332.32
Main	1019.093	PF 15	1584.69	1583.03	1.66	0.72	0.04		25000.00		332.32
Main	1019.093	PF 16	1585.78	1583.86	1.92	0.72	0.04		30000.00		332.32

Main	826.9817	PF 1	1575.63	1575.57	0.05	0.80	0.00		250.00		284.00
Main	826.9817	PF 2	1575.91	1575.82	0.09	0.82	0.00		500.00		304.28
Main	826.9817	PF 3	1576.32	1576.17	0.15	0.83	0.00		1000.00		308.46
Main	826.9817	PF 4	1576.96	1576.68	0.27	0.84	0.01		2000.00		312.29
Main	826.9817	PF 5	1577.48	1577.10	0.38	0.84	0.01		3000.00		315.51
Main	826.9817	PF 6	1577.94	1577.46	0.48	0.84	0.01		4000.00		319.76
Main	826.9817	PF 7	1578.36	1577.80	0.56	0.84	0.01		5000.00		326.51
Main	826.9817	PF 8	1578.75	1578.10	0.65	0.84	0.01		6000.00		327.73
Main	826.9817	PF 9	1579.10	1578.37	0.73	0.84	0.01		7000.00		328.89
Main	826.9817	PF 10	1579.44	1578.63	0.82	0.84	0.01		7999.93	0.07	330.25
Main	826.9817	PF 11	1579.77	1578.87	0.90	0.85	0.01		8999.62	0.38	330.25
Main	826.9817	PF 12	1580.08	1579.10	0.98	0.85	0.01		9999.23	0.77	330.25
Main	826.9817	PF 13	1581.50	1580.14	1.36	0.85	0.02		14997.11	2.89	330.25
Main	826.9817	PF 14	1582.77	1581.05	1.72	0.85	0.02		19995.09	4.91	330.25
Main	826.9817	PF 15	1583.93	1581.88	2.05	0.85	0.02		24993.21	6.79	330.25
Main	826.9817	PF 16	1585.01	1582.64	2.37	0.86	0.03		29991.46	8.54	330.25
Main	653.0061	PF 1	1574.83	1574.76	0.07	1.33	0.00		250.00		291.66
Main	653.0061	PF 2	1575.08	1574.97	0.12	1.32	0.01		500.00		302.51
Main	653.0061	PF 3	1575.49	1575.29	0.20	1.30	0.01		1000.00		304.84
Main	653.0061	PF 4	1576.11	1575.78	0.34	1.28	0.01		2000.00		308.82
Main	653.0061	PF 5	1576.63	1576.17	0.46	1.28	0.02		3000.00		311.92
Main	653.0061	PF 6	1577.09	1576.52	0.57	1.27	0.02		4000.00		314.62
Main	653.0061	PF 7	1577.51	1576.84	0.67	1.28	0.02		5000.00		321.56
Main	653.0061	PF 8	1577.89	1577.13	0.76	1.28	0.02		6000.00		328.62
Main	653.0061	PF 9	1578.25	1577.40	0.85	1.28	0.02		7000.00		329.72
Main	653.0061	PF 10	1578.59	1577.64	0.95	1.28	0.02		8000.00		330.75
Main	653.0061	PF 11	1578.91	1577.87	1.04	1.29	0.02		9000.00		331.37
Main	653.0061	PF 12	1579.22	1578.09	1.12	1.29	0.02		10000.00		331.37
Main	653.0061	PF 13	1580.63	1579.09	1.54	1.29	0.03		15000.00		331.37
Main	653.0061	PF 14	1581.89	1579.96	1.93	1.29	0.03		20000.00		331.37
Main	653.0061	PF 15	1583.05	1580.75	2.30	1.30	0.04		25000.00		331.37
Main	653.0061	PF 16	1584.13	1581.47	2.65	1.30	0.04		30000.00		331.37
Main	400.8275	PF 1	1573.49	1573.43	0.06	1.12	0.00		250.00		285.10
Main	400.8275	PF 2	1573.77	1573.67	0.10	1.11	0.00		500.00		301.63
Main	400.8275	PF 3	1574.18	1574.01	0.17	1.11	0.00		1000.00		305.43
Main	400.8275	PF 4	1574.82	1574.53	0.29	1.11	0.00		2000.00		311.16
Main	400.8275	PF 5	1575.34	1574.94	0.40	1.12	0.00		3000.00		315.76
Main	400.8275	PF 6	1575.80	1575.30	0.50	1.12	0.00		4000.00		319.78
Main	400.8275	PF 7	1576.21	1575.61	0.60	1.12	0.00	2.96	4997.04		329.78
Main	400.8275	PF 8	1576.59	1575.90	0.69	1.13	0.00	9.82	5990.18	0.00	331.66
Main	400.8275	PF 9	1576.94	1576.16	0.78	1.13	0.00	18.46	6980.10	1.44	336.27
Main	400.8275	PF 10	1577.28	1576.41	0.87	1.13	0.00	28.29	7967.02	4.69	336.27
Main	400.8275	PF 11	1577.60	1576.64	0.96	1.13	0.00	38.92	8952.21	8.87	336.27
Main	400.8275	PF 12	1577.91	1576.86	1.04	1.14	0.00	50.09	9936.27	13.63	336.27
Main	400.8275	PF 13	1579.31	1577.87	1.44	1.14	0.00	110.05	14848.42	41.53	336.27
Main	400.8275	PF 14	1580.56	1578.74	1.82	1.15	0.00	172.22	19756.26	71.52	336.27
Main	400.8275	PF 15	1581.71	1579.53	2.18	1.15	0.00	234.22	24664.28	101.50	336.27
Main	400.8275	PF 16	1582.79	1580.26	2.52	1.15	0.00	295.24	29573.85	130.90	336.27
Main	167.5157	PF 1	1572.38	1572.31	0.07				250.00		256.06
Main	167.5157	PF 2	1572.66	1572.56	0.10				500.00		301.50
Main	167.5157	PF 3	1573.07	1572.89	0.18				1000.00		305.57
Main	167.5157	PF 4	1573.70	1573.39	0.31				2000.00		311.98
Main	167.5157	PF 5	1574.22	1573.80	0.42				3000.00		317.68
Main	167.5157	PF 6	1574.68	1574.15	0.52			0.11	3999.89		332.59
Main	167.5157	PF 7	1575.09	1574.47	0.62			5.44	4994.56		337.39
Main	167.5157	PF 8	1575.46	1574.75	0.71			14.19	5985.81		338.11
Main	167.5157	PF 9	1575.81	1575.01	0.80			24.81	6975.19		338.11
Main	167.5157	PF 10	1576.14	1575.25	0.89			36.64	7963.37		338.11
Main	167.5157	PF 11	1576.46	1575.49	0.98			49.29	8950.71		338.11
Main	167.5157	PF 12	1576.77	1575.71	1.06			62.52	9937.48		338.11
Main	167.5157	PF 13	1578.17	1576.71	1.46			133.11	14866.89		338.11
Main	167.5157	PF 14	1579.42	1577.59	1.83			206.29	19793.71		338.11
Main	167.5157	PF 15	1580.56	1578.39	2.18			279.34	24720.66		338.11
Main	167.5157	PF 16	1581.63	1579.12	2.51			351.38	29648.62		338.11

Appendix F

Rittenhouse FRS Emergency Spillway HEC-RAS Model

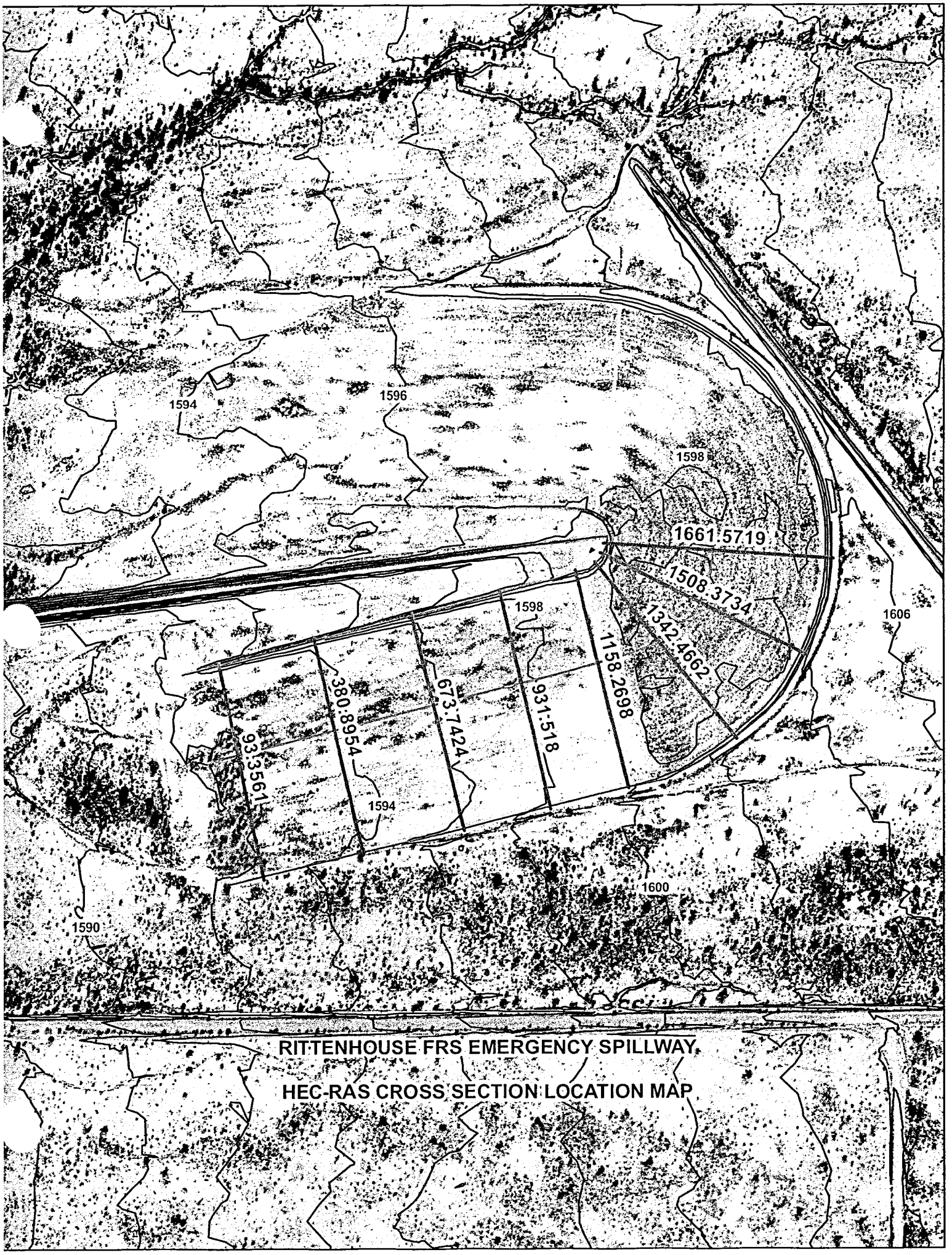
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 South Kyrene Road, Suite 201, Tempe, Arizona 85284
Phone: 480-752-2124 Fax: 480-839-2193

HEC-RAS Plan: R_ES_030 River: Rittenhouse_ES Reach: Main

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 # C
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main	1661.571	PF 1	250	1597.8	1599.06		1599.06	0.000108	0.47	530.91	606.19	0.09
Main	1661.571	PF 2	500	1597.8	1599.29		1599.3	0.000197	0.74	672.79	608.37	0.12
Main	1661.571	PF 3	1000	1597.8	1599.64		1599.66	0.000318	1.13	884.92	611.43	0.17
Main	1661.571	PF 4	2000	1597.8	1600.16		1600.2	0.000465	1.67	1200.43	615.57	0.21
Main	1661.571	PF 5	3000	1597.8	1600.55		1600.62	0.000568	2.08	1444.68	618.76	0.24
Main	1661.571	PF 6	4000	1597.8	1600.89		1600.98	0.000647	2.42	1654.06	621.43	0.26
Main	1661.571	PF 7	5000	1597.8	1601.19		1601.3	0.000713	2.72	1839.5	623.78	0.28
Main	1661.571	PF 8	6000	1597.8	1601.46		1601.6	0.000768	2.98	2010.13	625.94	0.29
Main	1661.571	PF 9	7000	1597.8	1601.71		1601.87	0.000816	3.23	2168.09	627.92	0.31
Main	1661.571	PF 10	8000	1597.8	1601.95		1602.13	0.000858	3.45	2316.4	629.8	0.32
Main	1661.571	PF 11	9000	1597.8	1602.17		1602.38	0.000896	3.66	2456.44	631.58	0.33
Main	1661.571	PF 12	10000	1597.8	1602.38		1602.61	0.000931	3.86	2589.92	633.26	0.34
Main	1661.571	PF 13	15000	1597.8	1603.32		1603.66	0.00108	4.71	3187.7	647.25	0.37
Main	1661.571	PF 14	20000	1597.8	1604.12		1604.57	0.00117	5.4	3706.38	650.16	0.4
Main	1661.571	PF 15	25000	1597.8	1604.82		1605.38	0.001248	6	4165.46	652.72	0.42
Main	1661.571	PF 16	30000	1597.8	1605.47		1606.13	0.001319	6.54	4588.08	658.43	0.44
Main	1661.571	PF 17	35000	1597.8	1606.07		1606.83	0.001366	7.02	4983.76	658.43	0.45
Main	1661.571	PF 18	40000	1597.8	1606.63		1607.5	0.001406	7.47	5356.78	658.43	0.46
Main	1661.571	PF 19	45000	1597.8	1607.17		1608.14	0.00144	7.88	5711.39	658.43	0.47
Main	1661.571	PF 20	50000	1597.8	1607.69		1608.75	0.00147	8.26	6050.73	658.43	0.48

WSEL	Q Total	Depth	Q * 0.25
1598.6	0	0	0
1599.06	250	0.46	62.5
1599.29	500	0.69	125
1599.64	1000	1.04	250
1600.16	2000	1.56	500
1600.55	3000	1.95	750
1600.89	4000	2.29	1000
1601.19	5000	2.59	1250
1601.46	6000	2.86	1500
1601.71	7000	3.11	1750
1601.95	8000	3.35	2000
1602.17	9000	3.57	2250
1602.38	10000	3.78	2500
1603.32	15000	4.72	3750
1604.12	20000	5.52	5000
1604.82	25000	6.22	6250
1605.47	30000	6.87	7500
1606.07	35000	7.47	8750
1606.63	40000	8.03	10000
1607.17	45000	8.57	11250
1607.69	50000	9.09	12500

Set Grid Nos. 24493 - 24496 to this elevation, which is the 2007 surveyed elevation



RITTENHOUSE FRS EMERGENCY SPILLWAY

HEC-RAS CROSS SECTION LOCATION MAP

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                    HEC-RAS Version 3.1.3 May 2005
                     U.S. Army Corp of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California

          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Rittenhouse ES Rating Curve
Project File : Rittenhouse_ES.prj
Run Date and Time: 6/22/2007 4:24:51 PM

Project in English units

PLAN DATA

Plan Title: Rittenhouse ES Rating with n=0.030
Plan File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Rittenhouse_ES.p01

Geometry Title: Rittenhouse ES with n=0.030
Geometry File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Rittenhouse_ES.g01

Flow Title : Rittenhouse ES Rating Curve Flows
Flow File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Rittenhouse_ES.f01

Plan Summary Information:

Number of:	Cross Sections =	8	Multiple Openings =	0
	Culverts =	0	Inline Structures =	0
	Bridges =	0	Lateral Structures =	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Rittenhouse ES Rating Curve Flows
Flow File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Rittenhouse_ES.f01

Flow Data (cfs)

River	Reach	RS	PF 1	PF 2	PF 3	PF 4	PF 5	PF 6	PF 7	PF 8
Rittenhouse_ES	Main	1661.571	250	500	1000	2000	3000	4000	5000	6000

River	Reach	RS	PF 9	PF 10	PF 11	PF 12	PF 13	PF 14	PF 15	PF 16
Rittenhouse_ES	Main	1661.571	7000	8000	9000	10000	15000	20000	25000	30000

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Rittenhouse_ES	Main	PF 1		Normal S = 0.005
Rittenhouse_ES	Main	PF 2		Normal S = 0.005
Rittenhouse_ES	Main	PF 3		Normal S = 0.005
Rittenhouse_ES	Main	PF 4		Normal S = 0.005
Rittenhouse_ES	Main	PF 5		Normal S = 0.005
Rittenhouse_ES	Main	PF 6		Normal S = 0.005
Rittenhouse_ES	Main	PF 7		Normal S = 0.005
Rittenhouse_ES	Main	PF 8		Normal S = 0.005
Rittenhouse_ES	Main	PF 9		Normal S = 0.005
Rittenhouse_ES	Main	PF 10		Normal S = 0.005
Rittenhouse_ES	Main	PF 11		Normal S = 0.005
Rittenhouse_ES	Main	PF 12		Normal S = 0.005
Rittenhouse_ES	Main	PF 13		Normal S = 0.005
Rittenhouse_ES	Main	PF 14		Normal S = 0.005
Rittenhouse_ES	Main	PF 15		Normal S = 0.005
Rittenhouse_ES	Main	PF 16		Normal S = 0.005
Rittenhouse_ES	Main	PF 17		Normal S = 0.005
Rittenhouse_ES	Main	PF 18		Normal S = 0.005
Rittenhouse_ES	Main	PF 19		Normal S = 0.005
Rittenhouse_ES	Main	PF 20		Normal S = 0.005

GEOMETRY DATA

Geometry Title: Rittenhouse ES with n=0.030
Geometry File : x:\projects\Agency\ASLD\Desert_Drive\hec-ras\FLO2D\Rittenhouse_ES.g01

CROSS SECTION

RIVER: Rittenhouse_ES
REACH: Main RS: 1661.571

INPUT
Description:
Station Elevation Data num= 52

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1605.33	4.08	1605.27	5.27	1604.94	15.35	1602.17	27.59	1598.94
29.53	1598.81	33.12	1598.77	61.07	1598.16	93.55	1597.85	102.78	1597.8
103.58	1597.8	124.1	1598.15	126.75	1598.15	141.17	1598.16	159.42	1598.13
170.5	1598.13	187.57	1598.1	199	1598.17	232.96	1598.23	245.42	1598.21
275.98	1598.43	278.25	1598.44	278.87	1598.44	322.35	1598.09	339.82	1598.05
389.49	1598.07	393.94	1598.08	424.36	1597.95	438.03	1597.98	454.75	1598.06
475.97	1598.16	516.61	1598.28	519.85	1598.29	522.33	1598.28	534.56	1598.36
555.16	1598.45	562.51	1598.44	582.91	1598.33	595.58	1598.28	604.99	1598.23
619.16	1598.09	626.19	1598.01	627.93	1598.01	631.44	1598.72	635.72	1599.49
640.46	1600.6	645.54	1601.84	647.23	1602.24	649.46	1602.75	653.05	1602.94
657.37	1603.25	658.43	1603.28						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	658.43	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	658.43	287.08	153.2	32.12	.1	.3

CROSS SECTION

RIVER: Rittenhouse_ES
REACH: Main RS: 1508.373

INPUT
Description:
Station Elevation Data num= 49

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1603.82	.85	1603.79	2.49	1603.42	8.83	1601.99	22.92	1598.72
29.77	1598.56	39.75	1598.41	55.71	1597.94	60.32	1597.88	78.26	1597.9
102.25	1597.82	115.88	1597.82	143.5	1597.81	154.45	1597.89	156.47	1597.89
164.13	1597.91	183.04	1597.94	210.38	1597.93	222.81	1597.9	254.18	1597.86
262.77	1597.83	309.85	1597.89	330.94	1597.85	342.28	1597.81	357.43	1597.79
394.44	1597.84	424.89	1597.83	425.85	1597.82	427.52	1597.81	457.98	1597.79
483.15	1597.74	495.04	1597.76	512.22	1597.74	534.48	1597.81	546.77	1597.83
554.15	1597.87	567.98	1597.99	578.83	1597.98	584.63	1597.89	586.65	1597.88
623.6	1597.99	624.09	1597.99	629.67	1599.96	630.24	1600.13	632.22	1600.58
643.89	1603.19	645.49	1603.3	653.5	1603.83	654.13	1603.86		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	654.13	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	654.13	312.94	165.91	34.07	.1	.3

CROSS SECTION

RIVER: Rittenhouse_ES
REACH: Main RS: 1342.466

INPUT
Description:
Station Elevation Data num= 45

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1602.19	6.12	1602.08	6.38	1602.08	16.44	1600.09	23.17	1598.91
36.64	1598.44	43.44	1598.19	51.42	1598.21	67.53	1598.28	80.33	1598.15
94.22	1598.08	121.73	1597.85	138.47	1597.77	176.46	1597.89	188.18	1597.91
196.06	1597.93	227.07	1597.96	231.86	1597.97	261.34	1597.84	284.8	1597.74
293.33	1597.77	339.4	1597.77	340.05	1597.77	384.55	1598.13	401.16	1598.13
435.45	1598.04	436.98	1598.03	438.85	1598.02	473.18	1597.59	498.38	1597.38
503.41	1597.36	536.32	1597.49	559.06	1597.79	591.42	1598.23	598.49	1598.35
608.22	1598.48	618.29	1598.53	622.6	1598.69	628.43	1600.2	630.25	1600.63
636.32	1601.75	642.87	1602.85	646.72	1603.08	648.64	1603.19	650.82	1603.32

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	0	.03	650.82	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	650.82	343.2	184.2	64.76	.1	.3

CROSS SECTION

RIVER: Rittenhouse_ES
REACH: Main RS: 1158.269

INPUT
Description: Approximate Weir Location
Station Elevation Data num= 39

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1599.8	1.6	1599.77	5.2	1599.71	12.88	1599.04	15.92	1598.87
32.32	1598.8	68.85	1598.67	102.23	1598.64	118.74	1598.67	136.06	1598.59
169.2	1598.53	187.19	1598.52	219.13	1598.55	249.93	1598.58	269.23	1598.6
299.34	1598.59	319.29	1598.61	339.99	1598.63	369.28	1598.7	390.73	1598.65
418.98	1598.62	441.63	1598.61	469.5	1598.59	493.33	1598.72	519.43	1598.81
544.85	1598.98	569.17	1598.99	585.62	1598.95	587.59	1598.94	590.48	1599.01
611.05	1599.82	616.89	1600.68	618.23	1600.9	626.42	1601.78	626.55	1601.8
627.99	1601.93	634.16	1602.5	639.55	1603	640.5	1603.09		

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Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03       0     .03   640.5     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
              0   640.5           231.41  226.75  223.38             .1       .3

CROSS SECTION


RIVER: Rittenhouse_ES
REACH: Main               RS: 931.5180

INPUT
Description:
Station Elevation Data    num=      39
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1598.64    8.21 1598.49   10.05 1598.46    11.2 1598.44   11.67 1598.43
   12.01 1598.41    17.4 1598.39   59.91 1598.02   95.56 1597.65  103.34 1597.67
  117.27 1597.68  170.57 1597.73  198.61 1597.61  224.97 1597.57  276.69 1597.59
  298.45 1597.56  305.58 1597.58  320.62 1597.64  346.42 1597.67  356.11 1597.76
  386.23 1597.88  420.59 1597.74  424.43 1597.73  426.82 1597.71  469.97 1597.48
  502.71 1597.16  504.55 1597.15  505.68 1597.18  529.89 1597.72  539.35  1597.6
  547.88 1597.44  568.64 1597.42  589.26 1597.29  595.54 1597.45  612.33  1597.8
  619.82 1598.54  620.57 1598.61  621.31 1598.78  630.75 1601.09

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03       0     .03  630.75     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
              0  630.75           254.87  257.78  259.95             .1       .3

CROSS SECTION


RIVER: Rittenhouse_ES
REACH: Main               RS: 673.7423

INPUT
Description:
Station Elevation Data    num=      34
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1597.03     .44 1597.03    6.23 1596.98    9.16 1596.96   12.51 1596.66
   16.63 1596.44   53.28 1595.91   68.09 1595.74   88.59 1595.63  104.68 1595.64
  173.25 1595.94  186.59 1595.94   234.4 1595.67  241.02 1595.66  260.17 1595.71
   295.3 1595.82   330.6 1595.84  353.17  1595.9  377.38 1595.64  392.69 1595.42
  403.48  1595.5  431.86 1595.69  441.47 1595.73  483.38  1595.9  500.15 1595.98
  520.29 1596.03  553.66 1595.94  576.31 1595.88  594.21 1595.87  610.54  1595.9
  616.45 1596.61  619.22 1596.95  623.57 1598.39  628.42 1600.07

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03       0     .03  628.42     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
              0  628.42           295.39  292.85  290.94             .1       .3

CROSS SECTION


RIVER: Rittenhouse_ES
REACH: Main               RS: 380.8954

INPUT
Description:
Station Elevation Data    num=      36
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    7.73 1594.92    9.32 1594.79   13.77 1594.42   16.45 1594.29   17.85 1594.24
```

51.04	1594.11	73.69	1593.92	113.59	1593.49	119.68	1593.42	124.39	1593.42
162.2	1593.37	182	1593.5	203.44	1593.73	228.41	1593.68	263.13	1593.48
303.89	1593.57	308.57	1593.6	343.51	1593.48	348.75	1593.47	349.15	1593.47
350.76	1593.47	394.04	1593.55	424.39	1593.75	436.08	1593.83	473.96	1593.83
487.99	1593.82	489.79	1593.83	529.47	1593.71	564.07	1593.81	568.33	1593.84
593.92	1594.07	608.69	1594.15	613.78	1594.84	615.17	1595.06	623.55	1597.1
626.24	1597.79								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
7.73	.03	7.73	.03	626.24	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
7.73	626.24	293.26	287.54	283.29	.1	.3

CROSS SECTION

RIVER: Rittenhouse_ES
REACH: Main RS: 93.35609

INPUT
Description:
Station Elevation Data num= 35

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
8.43	1593.08	10.5	1592.97	19.17	1592.53	19.74	1592.49	29.2	1592.27
57.15	1592.04	76.27	1591.99	110.21	1592.14	128.4	1592.22	168.48	1591.8
177	1591.74	197.75	1591.6	225.14	1591.55	253.77	1591.54	287.76	1591.68
324.67	1591.86	354.73	1592.05	374.2	1591.87	397.25	1591.73	420.04	1591.93
441.11	1592.16	462.83	1592.31	484.08	1592.47	492.01	1592.31	516.97	1592.03
536.86	1592.03	550.53	1592.12	569.14	1592.21	586.99	1592.44	608.16	1592.77
612.51	1593.53	616.28	1594.2	620.01	1595.05	623.93	1595.97	628.46	1596.01

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
8.43	.03	8.43	.03	628.46	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
8.43	628.46	111.33	93.36	108.32	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Rittenhouse_ES

Reach	River Sta.	n1	n2	n3
Main	1661.571	.03	.03	.03
Main	1508.373	.03	.03	.03
Main	1342.466	.03	.03	.03
Main	1158.269	.03	.03	.03
Main	931.5180	.03	.03	.03
Main	673.7423	.03	.03	.03
Main	380.8954	.03	.03	.03
Main	93.35609	.03	.03	.03

SUMMARY OF REACH LENGTHS

River: Rittenhouse_ES

Reach	River Sta.	Left	Channel	Right
Main	1661.571	287.08	153.2	32.12
Main	1508.373	312.94	165.91	34.07
Main	1342.466	343.2	184.2	64.76
Main	1158.269	231.41	226.75	223.38

Main	931.5180	254.87	257.78	259.95
Main	673.7423	295.39	292.85	290.94
Main	380.8954	293.26	287.54	283.29
Main	93.35609	111.33	93.36	108.32

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Rittenhouse_ES

Reach	River Sta.	Contr.	Expan.
Main	1661.571	.1	.3
Main	1508.373	.1	.3
Main	1342.466	.1	.3
Main	1158.269	.1	.3
Main	931.5180	.1	.3
Main	673.7423	.1	.3
Main	380.8954	.1	.3
Main	93.35609	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Main	1661.571	PF 1	250.00	1597.80	1599.06		1599.06	0.000108	0.47	530.91	606.19	0.09
Main	1661.571	PF 2	500.00	1597.80	1599.29		1599.30	0.000197	0.74	672.79	608.37	0.12
Main	1661.571	PF 3	1000.00	1597.80	1599.64		1599.66	0.000318	1.13	884.92	611.43	0.17
Main	1661.571	PF 4	2000.00	1597.80	1600.16		1600.20	0.000465	1.67	1200.43	615.57	0.21
Main	1661.571	PF 5	3000.00	1597.80	1600.55		1600.62	0.000568	2.08	1444.68	618.76	0.24
Main	1661.571	PF 6	4000.00	1597.80	1600.89		1600.98	0.000647	2.42	1654.06	621.43	0.26
Main	1661.571	PF 7	5000.00	1597.80	1601.19		1601.30	0.000713	2.72	1839.50	623.78	0.28
Main	1661.571	PF 8	6000.00	1597.80	1601.46		1601.60	0.000768	2.98	2010.13	625.94	0.29
Main	1661.571	PF 9	7000.00	1597.80	1601.71		1601.87	0.000816	3.23	2168.09	627.92	0.31
Main	1661.571	PF 10	8000.00	1597.80	1601.95		1602.13	0.000858	3.45	2316.40	629.80	0.32
Main	1661.571	PF 11	9000.00	1597.80	1602.17		1602.38	0.000896	3.66	2456.44	631.58	0.33
Main	1661.571	PF 12	10000.00	1597.80	1602.38		1602.61	0.000931	3.86	2589.92	633.26	0.34
Main	1661.571	PF 13	15000.00	1597.80	1603.32		1603.66	0.001080	4.71	3187.70	647.25	0.37
Main	1661.571	PF 14	20000.00	1597.80	1604.12		1604.57	0.001170	5.40	3706.38	650.16	0.40
Main	1661.571	PF 15	25000.00	1597.80	1604.82		1605.38	0.001248	6.00	4165.46	652.72	0.42
Main	1661.571	PF 16	30000.00	1597.80	1605.47		1606.13	0.001319	6.54	4588.08	658.43	0.44
Main	1661.571	PF 17	35000.00	1597.80	1606.07		1606.83	0.001366	7.02	4983.76	658.43	0.45
Main	1661.571	PF 18	40000.00	1597.80	1606.63		1607.50	0.001406	7.47	5356.78	658.43	0.46
Main	1661.571	PF 19	45000.00	1597.80	1607.17		1608.14	0.001440	7.88	5711.39	658.43	0.47
Main	1661.571	PF 20	50000.00	1597.80	1607.69		1608.75	0.001470	8.26	6050.73	658.43	0.48
Main	1508.373	PF 1	250.00	1597.74	1599.05		1599.05	0.000042	0.35	705.04	605.60	0.06
Main	1508.373	PF 2	500.00	1597.74	1599.28		1599.28	0.000093	0.59	841.09	607.20	0.09
Main	1508.373	PF 3	1000.00	1597.74	1599.61		1599.62	0.000183	0.96	1043.99	609.58	0.13
Main	1508.373	PF 4	2000.00	1597.74	1600.10		1600.14	0.000315	1.49	1346.46	613.19	0.18
Main	1508.373	PF 5	3000.00	1597.74	1600.48		1600.54	0.000419	1.90	1580.70	616.48	0.21
Main	1508.373	PF 6	4000.00	1597.74	1600.81		1600.89	0.000502	2.24	1782.16	619.34	0.23
Main	1508.373	PF 7	5000.00	1597.74	1601.10		1601.20	0.000574	2.55	1960.80	621.86	0.25
Main	1508.373	PF 8	6000.00	1597.74	1601.36		1601.49	0.000635	2.82	2125.68	624.19	0.27
Main	1508.373	PF 9	7000.00	1597.74	1601.61		1601.75	0.000689	3.07	2278.56	626.33	0.28
Main	1508.373	PF 10	8000.00	1597.74	1601.84		1602.01	0.000737	3.30	2422.38	628.35	0.30
Main	1508.373	PF 11	9000.00	1597.74	1602.05		1602.25	0.000781	3.52	2558.27	630.25	0.31
Main	1508.373	PF 12	10000.00	1597.74	1602.26		1602.47	0.000821	3.72	2687.94	632.08	0.32
Main	1508.373	PF 13	15000.00	1597.74	1603.17		1603.50	0.000980	4.59	3267.78	640.20	0.36
Main	1508.373	PF 14	20000.00	1597.74	1603.95		1604.39	0.001110	5.30	3774.18	654.13	0.39
Main	1508.373	PF 15	25000.00	1597.74	1604.64		1605.19	0.001192	5.91	4227.17	654.13	0.41
Main	1508.373	PF 16	30000.00	1597.74	1605.28		1605.93	0.001259	6.46	4641.83	654.13	0.43
Main	1508.373	PF 17	35000.00	1597.74	1605.87		1606.62	0.001315	6.96	5029.02	654.13	0.44
Main	1508.373	PF 18	40000.00	1597.74	1606.43		1607.28	0.001363	7.42	5394.34	654.13	0.46
Main	1508.373	PF 19	45000.00	1597.74	1606.96		1607.91	0.001404	7.84	5742.08	654.13	0.47
Main	1508.373	PF 20	50000.00	1597.74	1607.47		1608.52	0.001439	8.23	6075.06	654.13	0.48

Main	1342.466	PF 1	250.00	1597.36	1599.04		1599.05	0.000049	0.37	671.99	601.55	0.06
Main	1342.466	PF 2	500.00	1597.36	1599.26		1599.26	0.000109	0.62	801.38	603.60	0.10
Main	1342.466	PF 3	1000.00	1597.36	1599.57		1599.59	0.000214	1.01	992.84	606.63	0.14
Main	1342.466	PF 4	2000.00	1597.36	1600.04		1600.08	0.000374	1.57	1277.88	611.11	0.19
Main	1342.466	PF 5	3000.00	1597.36	1600.40		1600.46	0.000499	2.00	1498.09	614.42	0.23
Main	1342.466	PF 6	4000.00	1597.36	1600.71		1600.80	0.000600	2.37	1687.69	617.37	0.25
Main	1342.466	PF 7	5000.00	1597.36	1600.98		1601.09	0.000687	2.69	1855.83	620.22	0.27
Main	1342.466	PF 8	6000.00	1597.36	1601.23		1601.37	0.000760	2.98	2011.59	622.84	0.29
Main	1342.466	PF 9	7000.00	1597.36	1601.46		1601.63	0.000826	3.25	2156.26	625.27	0.31
Main	1342.466	PF 10	8000.00	1597.36	1601.68		1601.87	0.000883	3.49	2292.60	627.55	0.32
Main	1342.466	PF 11	9000.00	1597.36	1601.89		1602.10	0.000936	3.72	2421.52	629.77	0.33
Main	1342.466	PF 12	10000.00	1597.36	1602.08		1602.32	0.000985	3.93	2544.81	632.27	0.35
Main	1342.466	PF 13	15000.00	1597.36	1602.95		1603.32	0.001176	4.83	3102.42	644.58	0.39
Main	1342.466	PF 14	20000.00	1597.36	1603.70		1604.18	0.001307	5.57	3588.59	650.82	0.42
Main	1342.466	PF 15	25000.00	1597.36	1604.37		1604.97	0.001400	6.22	4022.37	650.82	0.44
Main	1342.466	PF 16	30000.00	1597.36	1604.98		1605.69	0.001476	6.79	4420.07	650.82	0.46
Main	1342.466	PF 17	35000.00	1597.36	1605.55		1606.38	0.001538	7.30	4792.12	650.82	0.47
Main	1342.466	PF 18	40000.00	1597.36	1606.09		1607.03	0.001590	7.78	5143.82	650.82	0.49
Main	1342.466	PF 19	45000.00	1597.36	1606.61		1607.65	0.001633	8.21	5479.09	650.82	0.50
Main	1342.466	PF 20	50000.00	1597.36	1607.10		1608.25	0.001671	8.62	5800.60	650.82	0.51
Main	1158.269	PF 1	250.00	1598.52	1598.98	1598.83	1599.01	0.003623	1.40	178.41	553.58	0.44
Main	1158.269	PF 2	500.00	1598.52	1599.15	1598.95	1599.20	0.003653	1.82	275.26	582.40	0.47
Main	1158.269	PF 3	1000.00	1598.52	1599.39	1599.13	1599.48	0.003759	2.40	416.16	591.25	0.50
Main	1158.269	PF 4	2000.00	1598.52	1599.75		1599.91	0.003847	3.16	632.91	606.66	0.55
Main	1158.269	PF 5	3000.00	1598.52	1600.03		1600.25	0.003964	3.73	803.24	612.48	0.57
Main	1158.269	PF 6	4000.00	1598.52	1600.27		1600.55	0.004015	4.20	952.07	614.13	0.59
Main	1158.269	PF 7	5000.00	1598.52	1600.49		1600.82	0.004109	4.62	1082.14	615.57	0.61
Main	1158.269	PF 8	6000.00	1598.52	1600.69		1601.07	0.004135	4.97	1206.11	616.93	0.63
Main	1158.269	PF 9	7000.00	1598.52	1600.87		1601.31	0.004164	5.30	1321.37	618.06	0.64
Main	1158.269	PF 10	8000.00	1598.52	1601.05		1601.54	0.004191	5.59	1430.44	619.62	0.65
Main	1158.269	PF 11	9000.00	1598.52	1601.21		1601.75	0.004227	5.87	1532.91	621.16	0.66
Main	1158.269	PF 12	10000.00	1598.52	1601.37		1601.96	0.004253	6.13	1631.67	622.63	0.67
Main	1158.269	PF 13	15000.00	1598.52	1602.09		1602.90	0.004341	7.22	2078.65	629.69	0.70
Main	1158.269	PF 14	20000.00	1598.52	1602.71		1603.73	0.004380	8.08	2475.25	636.46	0.72
Main	1158.269	PF 15	25000.00	1598.52	1603.28		1604.49	0.004385	8.81	2837.36	640.50	0.74
Main	1158.269	PF 16	30000.00	1598.52	1603.80		1605.19	0.004363	9.46	3172.31	640.50	0.75
Main	1158.269	PF 17	35000.00	1598.52	1604.30		1605.86	0.004335	10.03	3488.57	640.50	0.76
Main	1158.269	PF 18	40000.00	1598.52	1604.77		1606.50	0.004303	10.55	3790.13	640.50	0.76
Main	1158.269	PF 19	45000.00	1598.52	1605.22		1607.11	0.004267	11.03	4080.05	640.50	0.77
Main	1158.269	PF 20	50000.00	1598.52	1605.66		1607.70	0.004229	11.47	4360.58	640.50	0.77
Main	931.5180	PF 1	250.00	1597.15	1597.88	1597.77	1597.93	0.006604	1.69	147.51	539.84	0.57
Main	931.5180	PF 2	500.00	1597.15	1598.02	1597.91	1598.10	0.006630	2.21	225.83	555.15	0.61
Main	931.5180	PF 3	1000.00	1597.15	1598.24		1598.37	0.006744	2.88	346.99	581.80	0.66
Main	931.5180	PF 4	2000.00	1597.15	1598.56		1598.77	0.006715	3.71	538.60	615.40	0.70
Main	931.5180	PF 5	3000.00	1597.15	1598.80		1599.09	0.006723	4.35	689.45	621.39	0.73
Main	931.5180	PF 6	4000.00	1597.15	1599.01		1599.38	0.006747	4.88	819.02	622.24	0.75
Main	931.5180	PF 7	5000.00	1597.15	1599.20		1599.64	0.006701	5.33	938.88	623.03	0.76
Main	931.5180	PF 8	6000.00	1597.15	1599.38		1599.89	0.006692	5.72	1048.46	623.75	0.78
Main	931.5180	PF 9	7000.00	1597.15	1599.54		1600.11	0.006705	6.09	1150.01	624.41	0.79
Main	931.5180	PF 10	8000.00	1597.15	1599.69		1600.33	0.006695	6.41	1247.16	625.05	0.80
Main	931.5180	PF 11	9000.00	1597.15	1599.84		1600.54	0.006691	6.72	1339.38	625.65	0.81
Main	931.5180	PF 12	10000.00	1597.15	1599.98		1600.75	0.006687	7.00	1427.70	626.23	0.82
Main	931.5180	PF 13	15000.00	1597.15	1600.62	1600.30	1601.67	0.006675	8.22	1825.73	628.82	0.85
Main	931.5180	PF 14	20000.00	1597.15	1601.17	1600.86	1602.48	0.006690	9.21	2171.83	630.75	0.87
Main	931.5180	PF 15	25000.00	1597.15	1601.66	1601.36	1603.23	0.006698	10.07	2483.66	630.75	0.89
Main	931.5180	PF 16	30000.00	1597.15	1602.12	1601.85	1603.94	0.006702	10.82	2771.86	630.75	0.91
Main	931.5180	PF 17	35000.00	1597.15	1602.54	1602.28	1604.60	0.006716	11.51	3040.19	630.75	0.92
Main	931.5180	PF 18	40000.00	1597.15	1602.94	1602.72	1605.24	0.006730	12.15	3293.27	630.75	0.94
Main	931.5180	PF 19	45000.00	1597.15	1603.33	1603.11	1605.84	0.006746	12.73	3533.73	630.75	0.95
Main	931.5180	PF 20	50000.00	1597.15	1603.69	1603.50	1606.43	0.006761	13.29	3763.41	630.75	0.96
Main	673.7423	PF 1	250.00	1595.42	1596.05	1595.98	1596.10	0.007625	1.73	144.24	568.53	0.61
Main	673.7423	PF 2	500.00	1595.42	1596.19	1596.09	1596.27	0.007591	2.27	220.50	578.83	0.65
Main	673.7423	PF 3	1000.00	1595.42	1596.39		1596.52	0.007605	2.96	337.57	594.30	0.69
Main	673.7423	PF 4	2000.00	1595.42	1596.68		1596.91	0.007755	3.90	512.22	604.69	0.75
Main	673.7423	PF 5	3000.00	1595.42	1596.92		1597.24	0.007711	4.57	656.41	609.28	0.78
Main	673.7423	PF 6	4000.00	1595.42	1597.13		1597.53	0.007705	5.09	785.65	619.75	0.80

Main	673.7423	PF 7	5000.00	1595.42	1597.30		1597.79	0.007759	5.58	896.75	620.29	0.82
Main	673.7423	PF 8	6000.00	1595.42	1597.47		1598.03	0.007760	5.99	1000.83	620.80	0.83
Main	673.7423	PF 9	7000.00	1595.42	1597.63		1598.26	0.007716	6.36	1100.15	621.28	0.84
Main	673.7423	PF 10	8000.00	1595.42	1597.78	1597.58	1598.48	0.007721	6.71	1192.17	621.73	0.85
Main	673.7423	PF 11	9000.00	1595.42	1597.92	1597.72	1598.69	0.007714	7.03	1280.32	622.16	0.86
Main	673.7423	PF 12	10000.00	1595.42	1598.06	1597.86	1598.89	0.007706	7.33	1364.80	622.57	0.87
Main	673.7423	PF 13	15000.00	1595.42	1598.67	1598.48	1599.82	0.007636	8.58	1748.31	624.39	0.90
Main	673.7423	PF 14	20000.00	1595.42	1599.21	1599.03	1600.64	0.007562	9.58	2086.69	625.95	0.93
Main	673.7423	PF 15	25000.00	1595.42	1599.71	1599.54	1601.40	0.007498	10.44	2394.74	627.37	0.94
Main	673.7423	PF 16	30000.00	1595.42	1600.16	1600.02	1602.11	0.007436	11.19	2680.99	628.42	0.95
Main	673.7423	PF 17	35000.00	1595.42	1600.59	1600.46	1602.78	0.007375	11.87	2949.71	628.42	0.97
Main	673.7423	PF 18	40000.00	1595.42	1601.00	1600.91	1603.41	0.007318	12.48	3204.85	628.42	0.97
Main	673.7423	PF 19	45000.00	1595.42	1601.38	1601.31	1604.03	0.007266	13.05	3448.56	628.42	0.98
Main	673.7423	PF 20	50000.00	1595.42	1601.76	1601.69	1604.62	0.007219	13.58	3682.53	628.42	0.99
Main	380.8954	PF 1	250.00	1593.37	1593.91	1593.81	1593.96	0.007022	1.78	140.61	501.46	0.59
Main	380.8954	PF 2	500.00	1593.37	1594.06	1593.95	1594.14	0.006876	2.27	220.36	536.61	0.62
Main	380.8954	PF 3	1000.00	1593.37	1594.29	1594.13	1594.42	0.006816	2.87	348.57	593.20	0.66
Main	380.8954	PF 4	2000.00	1593.37	1594.60	1594.40	1594.82	0.006652	3.74	534.81	600.40	0.70
Main	380.8954	PF 5	3000.00	1593.37	1594.85		1595.15	0.006599	4.37	685.97	605.27	0.72
Main	380.8954	PF 6	4000.00	1593.37	1595.07		1595.44	0.006503	4.88	820.08	607.49	0.74
Main	380.8954	PF 7	5000.00	1593.37	1595.27		1595.71	0.006435	5.31	941.19	608.31	0.75
Main	380.8954	PF 8	6000.00	1593.37	1595.46		1595.96	0.006378	5.70	1053.46	609.06	0.76
Main	380.8954	PF 9	7000.00	1593.37	1595.62		1596.19	0.006384	6.06	1155.90	609.75	0.78
Main	380.8954	PF 10	8000.00	1593.37	1595.79		1596.42	0.006325	6.37	1256.51	610.43	0.78
Main	380.8954	PF 11	9000.00	1593.37	1595.95		1596.63	0.006280	6.66	1352.16	611.08	0.79
Main	380.8954	PF 12	10000.00	1593.37	1596.10		1596.84	0.006242	6.93	1443.74	611.69	0.79
Main	380.8954	PF 13	15000.00	1593.37	1596.77		1597.78	0.006113	8.08	1857.22	614.46	0.82
Main	380.8954	PF 14	20000.00	1593.37	1597.36		1598.62	0.006031	9.01	2220.36	616.83	0.84
Main	380.8954	PF 15	25000.00	1593.37	1597.89		1599.39	0.005966	9.80	2550.62	618.51	0.85
Main	380.8954	PF 16	30000.00	1593.37	1598.38		1600.10	0.005929	10.52	2852.63	618.51	0.86
Main	380.8954	PF 17	35000.00	1593.37	1598.84		1600.77	0.005898	11.16	3135.76	618.51	0.87
Main	380.8954	PF 18	40000.00	1593.37	1599.27		1601.42	0.005873	11.75	3403.64	618.51	0.88
Main	380.8954	PF 19	45000.00	1593.37	1599.69	1599.24	1602.03	0.005851	12.30	3658.99	618.51	0.89
Main	380.8954	PF 20	50000.00	1593.37	1600.08	1599.63	1602.63	0.005832	12.81	3903.54	618.51	0.90
Main	93.35609	PF 1	250.00	1591.54	1592.22	1592.06	1592.26	0.005009	1.63	153.38	483.74	0.51
Main	93.35609	PF 2	500.00	1591.54	1592.39	1592.22	1592.46	0.005002	2.05	244.09	545.82	0.54
Main	93.35609	PF 3	1000.00	1591.54	1592.63	1592.42	1592.74	0.005000	2.63	379.68	582.18	0.57
Main	93.35609	PF 4	2000.00	1591.54	1592.97	1592.69	1593.16	0.005000	3.44	582.05	598.90	0.61
Main	93.35609	PF 5	3000.00	1591.54	1593.24	1592.92	1593.50	0.005002	4.03	744.12	602.44	0.64
Main	93.35609	PF 6	4000.00	1591.54	1593.48	1593.11	1593.79	0.005002	4.52	885.25	603.78	0.66
Main	93.35609	PF 7	5000.00	1591.54	1593.69	1593.29	1594.07	0.005001	4.94	1013.10	604.97	0.67
Main	93.35609	PF 8	6000.00	1591.54	1593.88	1593.46	1594.32	0.005006	5.31	1130.85	606.07	0.68
Main	93.35609	PF 9	7000.00	1591.54	1594.07	1593.61	1594.56	0.005002	5.64	1241.70	607.10	0.69
Main	93.35609	PF 10	8000.00	1591.54	1594.24	1593.76	1594.79	0.005001	5.94	1346.35	608.02	0.70
Main	93.35609	PF 11	9000.00	1591.54	1594.40	1593.91	1595.00	0.005001	6.22	1445.79	608.74	0.71
Main	93.35609	PF 12	10000.00	1591.54	1594.56	1594.05	1595.21	0.005001	6.49	1541.03	609.42	0.72
Main	93.35609	PF 13	15000.00	1591.54	1595.26	1594.68	1596.16	0.005000	7.61	1970.46	612.48	0.75
Main	93.35609	PF 14	20000.00	1591.54	1595.87	1595.24	1597.00	0.005001	8.52	2346.66	615.09	0.77
Main	93.35609	PF 15	25000.00	1591.54	1596.43	1595.76	1597.77	0.005001	9.28	2693.07	620.03	0.78
Main	93.35609	PF 16	30000.00	1591.54	1596.94	1596.25	1598.48	0.005008	9.98	3005.13	620.03	0.80
Main	93.35609	PF 17	35000.00	1591.54	1597.41	1596.70	1599.16	0.005006	10.61	3298.72	620.03	0.81
Main	93.35609	PF 18	40000.00	1591.54	1597.86	1597.15	1599.80	0.005004	11.19	3576.19	620.03	0.82
Main	93.35609	PF 19	45000.00	1591.54	1598.28	1597.54	1600.42	0.005004	11.72	3840.33	620.03	0.83
Main	93.35609	PF 20	50000.00	1591.54	1598.69	1597.94	1601.01	0.005003	12.22	4093.28	620.03	0.84

Profile Output Table - Standard Table 2

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
Main	1661.571	PF 1	1599.06	1599.06	0.00	0.01	0.00		250.00		606.19
Main	1661.571	PF 2	1599.30	1599.29	0.01	0.02	0.00		500.00		608.37
Main	1661.571	PF 3	1599.66	1599.64	0.02	0.04	0.00		1000.00		611.43
Main	1661.571	PF 4	1600.20	1600.16	0.04	0.06	0.00		2000.00		615.57
Main	1661.571	PF 5	1600.62	1600.55	0.07	0.07	0.00		3000.00		618.76
Main	1661.571	PF 6	1600.98	1600.89	0.09	0.09	0.00		4000.00		621.43
Main	1661.571	PF 7	1601.30	1601.19	0.11	0.10	0.00		5000.00		623.78

Main	1661.571	PF 8	1601.60	1601.46	0.14	0.11	0.00	6000.00	625.94
Main	1661.571	PF 9	1601.87	1601.71	0.16	0.11	0.00	7000.00	627.92
Main	1661.571	PF 10	1602.13	1601.95	0.19	0.12	0.00	8000.00	629.80
Main	1661.571	PF 11	1602.38	1602.17	0.21	0.13	0.00	9000.00	631.58
Main	1661.571	PF 12	1602.61	1602.38	0.23	0.13	0.00	10000.00	633.26
Main	1661.571	PF 13	1603.66	1603.32	0.34	0.16	0.00	15000.00	647.25
Main	1661.571	PF 14	1604.57	1604.12	0.45	0.17	0.00	20000.00	650.16
Main	1661.571	PF 15	1605.38	1604.82	0.56	0.19	0.00	25000.00	652.72
Main	1661.571	PF 16	1606.13	1605.47	0.66	0.20	0.00	30000.00	658.43
Main	1661.571	PF 17	1606.83	1606.07	0.77	0.21	0.00	35000.00	658.43
Main	1661.571	PF 18	1607.50	1606.63	0.87	0.21	0.00	40000.00	658.43
Main	1661.571	PF 19	1608.14	1607.17	0.96	0.22	0.00	45000.00	658.43
Main	1661.571	PF 20	1608.75	1607.69	1.06	0.22	0.00	50000.00	658.43
Main	1508.373	PF 1	1599.05	1599.05	0.00	0.01	0.00	250.00	605.60
Main	1508.373	PF 2	1599.28	1599.28	0.01	0.02	0.00	500.00	607.20
Main	1508.373	PF 3	1599.62	1599.61	0.01	0.03	0.00	1000.00	609.58
Main	1508.373	PF 4	1600.14	1600.10	0.03	0.06	0.00	2000.00	613.19
Main	1508.373	PF 5	1600.54	1600.48	0.06	0.08	0.00	3000.00	616.48
Main	1508.373	PF 6	1600.89	1600.81	0.08	0.09	0.00	4000.00	619.34
Main	1508.373	PF 7	1601.20	1601.10	0.10	0.10	0.00	5000.00	621.86
Main	1508.373	PF 8	1601.49	1601.36	0.12	0.12	0.00	6000.00	624.19
Main	1508.373	PF 9	1601.75	1601.61	0.15	0.12	0.00	7000.00	626.33
Main	1508.373	PF 10	1602.01	1601.84	0.17	0.13	0.00	8000.00	628.35
Main	1508.373	PF 11	1602.25	1602.05	0.19	0.14	0.00	9000.00	630.25
Main	1508.373	PF 12	1602.47	1602.26	0.21	0.15	0.00	10000.00	632.08
Main	1508.373	PF 13	1603.50	1603.17	0.33	0.18	0.00	15000.00	640.20
Main	1508.373	PF 14	1604.39	1603.95	0.44	0.20	0.00	20000.00	654.13
Main	1508.373	PF 15	1605.19	1604.64	0.54	0.21	0.01	25000.00	654.13
Main	1508.373	PF 16	1605.93	1605.28	0.65	0.23	0.01	30000.00	654.13
Main	1508.373	PF 17	1606.62	1605.87	0.75	0.24	0.01	35000.00	654.13
Main	1508.373	PF 18	1607.28	1606.43	0.85	0.24	0.01	40000.00	654.13
Main	1508.373	PF 19	1607.91	1606.96	0.95	0.25	0.01	45000.00	654.13
Main	1508.373	PF 20	1608.52	1607.47	1.05	0.26	0.01	50000.00	654.13
Main	1342.466	PF 1	1599.05	1599.04	0.00	0.03	0.00	250.00	601.55
Main	1342.466	PF 2	1599.26	1599.26	0.01	0.06	0.00	500.00	603.60
Main	1342.466	PF 3	1599.59	1599.57	0.02	0.10	0.01	1000.00	606.63
Main	1342.466	PF 4	1600.08	1600.04	0.04	0.16	0.01	2000.00	611.11
Main	1342.466	PF 5	1600.46	1600.40	0.06	0.20	0.02	3000.00	614.42
Main	1342.466	PF 6	1600.80	1600.71	0.09	0.23	0.02	4000.00	617.37
Main	1342.466	PF 7	1601.09	1600.98	0.11	0.25	0.02	5000.00	620.22
Main	1342.466	PF 8	1601.37	1601.23	0.14	0.27	0.02	6000.00	622.84
Main	1342.466	PF 9	1601.63	1601.46	0.16	0.29	0.03	7000.00	625.27
Main	1342.466	PF 10	1601.87	1601.68	0.19	0.31	0.03	8000.00	627.55
Main	1342.466	PF 11	1602.10	1601.89	0.21	0.32	0.03	9000.00	629.77
Main	1342.466	PF 12	1602.32	1602.08	0.24	0.33	0.03	10000.00	632.27
Main	1342.466	PF 13	1603.32	1602.95	0.36	0.37	0.04	15000.00	644.58
Main	1342.466	PF 14	1604.18	1603.70	0.48	0.40	0.05	20000.00	650.82
Main	1342.466	PF 15	1604.97	1604.37	0.60	0.42	0.06	25000.00	650.82
Main	1342.466	PF 16	1605.69	1604.98	0.72	0.43	0.07	30000.00	650.82
Main	1342.466	PF 17	1606.38	1605.55	0.83	0.45	0.07	35000.00	650.82
Main	1342.466	PF 18	1607.03	1606.09	0.94	0.45	0.08	40000.00	650.82
Main	1342.466	PF 19	1607.65	1606.61	1.05	0.46	0.08	45000.00	650.82
Main	1342.466	PF 20	1608.25	1607.10	1.15	0.46	0.09	50000.00	650.82
Main	1158.269	PF 1	1599.01	1598.98	0.03	1.08	0.00	250.00	553.58
Main	1158.269	PF 2	1599.20	1599.15	0.05	1.09	0.00	500.00	582.40
Main	1158.269	PF 3	1599.48	1599.39	0.09	1.12	0.00	1000.00	591.25
Main	1158.269	PF 4	1599.91	1599.75	0.16	1.13	0.01	2000.00	606.66
Main	1158.269	PF 5	1600.25	1600.03	0.22	1.15	0.01	3000.00	612.48
Main	1158.269	PF 6	1600.55	1600.27	0.27	1.16	0.01	4000.00	614.13
Main	1158.269	PF 7	1600.82	1600.49	0.33	1.17	0.01	5000.00	615.57
Main	1158.269	PF 8	1601.07	1600.69	0.38	1.18	0.01	6000.00	616.93
Main	1158.269	PF 9	1601.31	1600.87	0.44	1.18	0.01	7000.00	618.06
Main	1158.269	PF 10	1601.54	1601.05	0.49	1.18	0.02	8000.00	619.62
Main	1158.269	PF 11	1601.75	1601.21	0.54	1.19	0.02	9000.00	621.16
Main	1158.269	PF 12	1601.96	1601.37	0.58	1.19	0.02	10000.00	622.63
Main	1158.269	PF 13	1602.90	1602.09	0.81	1.21	0.02	15000.00	629.69
Main	1158.269	PF 14	1603.73	1602.71	1.01	1.21	0.03	20000.00	636.46

Main	1158.269	PF 15	1604.49	1603.28	1.21	1.22	0.04	25000.00	640.50
Main	1158.269	PF 16	1605.19	1603.80	1.39	1.21	0.04	30000.00	640.50
Main	1158.269	PF 17	1605.86	1604.30	1.56	1.21	0.05	35000.00	640.50
Main	1158.269	PF 18	1606.50	1604.77	1.73	1.21	0.06	40000.00	640.50
Main	1158.269	PF 19	1607.11	1605.22	1.89	1.20	0.06	45000.00	640.50
Main	1158.269	PF 20	1607.70	1605.66	2.04	1.20	0.07	50000.00	640.50
Main	931.5180	PF 1	1597.93	1597.88	0.04	1.83	0.00	250.00	539.84
Main	931.5180	PF 2	1598.10	1598.02	0.08	1.83	0.00	500.00	555.15
Main	931.5180	PF 3	1598.37	1598.24	0.13	1.84	0.00	1000.00	581.80
Main	931.5180	PF 4	1598.77	1598.56	0.21	1.86	0.00	2000.00	615.40
Main	931.5180	PF 5	1599.09	1598.80	0.29	1.85	0.00	3000.00	621.39
Main	931.5180	PF 6	1599.38	1599.01	0.37	1.86	0.00	4000.00	622.24
Main	931.5180	PF 7	1599.64	1599.20	0.44	1.86	0.00	5000.00	623.03
Main	931.5180	PF 8	1599.89	1599.38	0.51	1.86	0.00	6000.00	623.75
Main	931.5180	PF 9	1600.11	1599.54	0.58	1.85	0.01	7000.00	624.41
Main	931.5180	PF 10	1600.33	1599.69	0.64	1.85	0.01	8000.00	625.05
Main	931.5180	PF 11	1600.54	1599.84	0.70	1.85	0.01	9000.00	625.65
Main	931.5180	PF 12	1600.75	1599.98	0.76	1.85	0.01	10000.00	626.23
Main	931.5180	PF 13	1601.67	1600.62	1.05	1.84	0.01	15000.00	628.82
Main	931.5180	PF 14	1602.48	1601.17	1.32	1.83	0.01	20000.00	630.75
Main	931.5180	PF 15	1603.23	1601.66	1.57	1.83	0.01	25000.00	630.75
Main	931.5180	PF 16	1603.94	1602.12	1.82	1.82	0.01	30000.00	630.75
Main	931.5180	PF 17	1604.60	1602.54	2.06	1.81	0.01	35000.00	630.75
Main	931.5180	PF 18	1605.24	1602.94	2.29	1.81	0.01	40000.00	630.75
Main	931.5180	PF 19	1605.84	1603.33	2.52	1.80	0.01	45000.00	630.75
Main	931.5180	PF 20	1606.43	1603.69	2.74	1.80	0.01	50000.00	630.75
Main	673.7423	PF 1	1596.10	1596.05	0.05	2.14	0.00	250.00	568.53
Main	673.7423	PF 2	1596.27	1596.19	0.08	2.11	0.00	500.00	578.83
Main	673.7423	PF 3	1596.52	1596.39	0.14	2.11	0.00	1000.00	594.30
Main	673.7423	PF 4	1596.91	1596.68	0.24	2.10	0.01	2000.00	604.69
Main	673.7423	PF 5	1597.24	1596.92	0.32	2.09	0.01	3000.00	609.28
Main	673.7423	PF 6	1597.53	1597.13	0.40	2.07	0.01	4000.00	619.75
Main	673.7423	PF 7	1597.79	1597.30	0.48	2.06	0.01	5000.00	620.29
Main	673.7423	PF 8	1598.03	1597.47	0.56	2.06	0.02	6000.00	620.80
Main	673.7423	PF 9	1598.26	1597.63	0.63	2.05	0.02	7000.00	621.28
Main	673.7423	PF 10	1598.48	1597.78	0.70	2.04	0.02	8000.00	621.73
Main	673.7423	PF 11	1598.69	1597.92	0.77	2.03	0.02	9000.00	622.16
Main	673.7423	PF 12	1598.89	1598.06	0.83	2.03	0.03	10000.00	622.57
Main	673.7423	PF 13	1599.82	1598.67	1.14	1.99	0.04	15000.00	624.39
Main	673.7423	PF 14	1600.64	1599.21	1.43	1.97	0.05	20000.00	625.95
Main	673.7423	PF 15	1601.40	1599.71	1.69	1.95	0.06	25000.00	627.37
Main	673.7423	PF 16	1602.11	1600.16	1.94	1.94	0.07	30000.00	628.42
Main	673.7423	PF 17	1602.78	1600.59	2.19	1.93	0.08	35000.00	628.42
Main	673.7423	PF 18	1603.41	1601.00	2.42	1.91	0.08	40000.00	628.42
Main	673.7423	PF 19	1604.03	1601.38	2.64	1.90	0.09	45000.00	628.42
Main	673.7423	PF 20	1604.62	1601.76	2.86	1.89	0.09	50000.00	628.42
Main	380.8954	PF 1	1593.96	1593.91	0.05	1.69	0.00	250.00	501.46
Main	380.8954	PF 2	1594.14	1594.06	0.08	1.68	0.00	500.00	536.61
Main	380.8954	PF 3	1594.42	1594.29	0.13	1.67	0.01	1000.00	593.20
Main	380.8954	PF 4	1594.82	1594.60	0.22	1.65	0.01	2000.00	600.40
Main	380.8954	PF 5	1595.15	1594.85	0.30	1.64	0.01	3000.00	605.27
Main	380.8954	PF 6	1595.44	1595.07	0.37	1.63	0.02	4000.00	607.49
Main	380.8954	PF 7	1595.71	1595.27	0.44	1.62	0.02	5000.00	608.31
Main	380.8954	PF 8	1595.96	1595.46	0.50	1.62	0.02	6000.00	609.06
Main	380.8954	PF 9	1596.19	1595.62	0.57	1.62	0.02	7000.00	609.75
Main	380.8954	PF 10	1596.42	1595.79	0.63	1.61	0.02	8000.00	610.43
Main	380.8954	PF 11	1596.63	1595.95	0.69	1.61	0.03	9000.00	611.08
Main	380.8954	PF 12	1596.84	1596.10	0.74	1.60	0.03	10000.00	611.69
Main	380.8954	PF 13	1597.78	1596.77	1.01	1.59	0.03	15000.00	614.46
Main	380.8954	PF 14	1598.62	1597.36	1.26	1.58	0.04	20000.00	616.83
Main	380.8954	PF 15	1599.39	1597.89	1.49	1.57	0.05	25000.00	618.51
Main	380.8954	PF 16	1600.10	1598.38	1.72	1.56	0.05	30000.00	618.51
Main	380.8954	PF 17	1600.77	1598.84	1.93	1.56	0.06	35000.00	618.51
Main	380.8954	PF 18	1601.42	1599.27	2.14	1.56	0.06	40000.00	618.51
Main	380.8954	PF 19	1602.03	1599.69	2.35	1.55	0.06	45000.00	618.51
Main	380.8954	PF 20	1602.63	1600.08	2.55	1.55	0.07	50000.00	618.51

Main	93.35609	PF 1	1592.26	1592.22	0.04	250.00	483.74
Main	93.35609	PF 2	1592.46	1592.39	0.07	500.00	545.82
Main	93.35609	PF 3	1592.74	1592.63	0.11	1000.00	582.18
Main	93.35609	PF 4	1593.16	1592.97	0.18	2000.00	598.90
Main	93.35609	PF 5	1593.50	1593.24	0.25	3000.00	602.44
Main	93.35609	PF 6	1593.79	1593.48	0.32	4000.00	603.78
Main	93.35609	PF 7	1594.07	1593.69	0.38	5000.00	604.97
Main	93.35609	PF 8	1594.32	1593.88	0.44	6000.00	606.07
Main	93.35609	PF 9	1594.56	1594.07	0.49	7000.00	607.10
Main	93.35609	PF 10	1594.79	1594.24	0.55	8000.00	608.02
Main	93.35609	PF 11	1595.00	1594.40	0.60	9000.00	608.74
Main	93.35609	PF 12	1595.21	1594.56	0.65	10000.00	609.42
Main	93.35609	PF 13	1596.16	1595.26	0.90	15000.00	612.48
Main	93.35609	PF 14	1597.00	1595.87	1.13	20000.00	615.09
Main	93.35609	PF 15	1597.77	1596.43	1.34	25000.00	620.03
Main	93.35609	PF 16	1598.48	1596.94	1.55	30000.00	620.03
Main	93.35609	PF 17	1599.16	1597.41	1.75	35000.00	620.03
Main	93.35609	PF 18	1599.80	1597.86	1.94	40000.00	620.03
Main	93.35609	PF 19	1600.42	1598.28	2.13	45000.00	620.03
Main	93.35609	PF 20	1601.01	1598.69	2.32	50000.00	620.03

Appendix G

Sediment Yield Calculation Sheets and Supporting Data

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Subbasin ID P_1

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	5.2	sq. mi.
Area Contributing Sediment =	5.2	sq. mi.
Peak Inflow	3363	cfs
Flow Volume	445	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	45	336	95	0.56	20691
Q-5	0.25	111	841	95	0.56	57738
Q-10	0.35	156	1177	95	0.56	84164
Q-25	0.55	245	1850	95	0.56	139630
Q-50	0.75	334	2522	95	0.56	197625
Q-100	1	445	3363	95	0.56	272755

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
10	0.10	1.7%
s456	0.26	18.9%
s457	0.26	28.9%
580	0.32	0.5%
98	0.17	30.0%
610	0.24	1.0%
45	0.10	0.6%
565	0.24	1.7%
52	0.08	11.2%
3	0.16	2.1%
48	0.08	2.5%
44	0.10	0.6%
290	0.28	0.4%
Weighted K Factor:	0.20	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Low Density Residential	29.5%	0.78	0.63	0.37	0.18	0.05
Open	70.4%	0.95	1	0.44	0.42	0.29
			Composite Weighted C Factor=			0.35

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	631	ft	(Basin Average)
Slope Angles:	20.75		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	11.22		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	20691	0.20	11.22	0.35	1.00	16302	1.31
Q-5	57738	0.20	11.22	0.35	1.00	45491	3.65
Q-10	84164	0.20	11.22	0.35	1.00	66312	5.32
Q-25	139630	0.20	11.22	0.35	1.00	110012	8.83
Q-50	197625	0.20	11.22	0.35	1.00	155705	12.50
Q-100	272755	0.20	11.22	0.35	1.00	214899	17.25
Weighted Average Annual Sediment Yield:						30883	2.48

Total Sediment Yield Volume (ac. ft)	12.9

Subbasin ID P_2

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	4.9	sq. mi.
Area Contributing Sediment =	4.9	sq. mi.
Peak Inflow	4160	cfs
Flow Volume	435	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	44	416	95	0.56	23013
Q-5	0.25	109	1040	95	0.56	64219
Q-10	0.35	152	1456	95	0.56	93611
Q-25	0.55	239	2288	95	0.56	155302
Q-50	0.75	326	3120	95	0.56	219805
Q-100	1	435	4160	95	0.56	303368

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
12	0.24	7.2%
s457	0.26	18.4%
48	0.08	11.0%
61	0.30	3.2%
44	0.10	15.2%
49	0.08	1.6%
52	0.08	5.8%
98	0.17	10.6%
3	0.16	0.4%
63	0.15	0.4%
116	0.47	1.8%
68	0.15	8.2%
s286	0.50	2.7%
s456	0.26	13.7%
Weighted K Factor:	0.19	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Very Low Density Residential	41.0%	0.85	0.76	0.4	0.26	0.11
Open	59.0%	0.95	1	0.44	0.42	0.25
			Composite Weighted C Factor=			0.35

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	564	ft	(Basin Average)
Slope Angles:	18.48		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	8.71		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	23013	0.19	8.71	0.35	1.00	13672	1.16
Q-5	64219	0.19	8.71	0.35	1.00	38152	3.25
Q-10	93611	0.19	8.71	0.35	1.00	55614	4.74
Q-25	155302	0.19	8.71	0.35	1.00	92265	7.86
Q-50	219805	0.19	8.71	0.35	1.00	130586	11.12
Q-100	303368	0.19	8.71	0.35	1.00	180231	15.35
Weighted Average Annual Sediment Yield:						25901	2.21

Total Sediment Yield Volume (ac. ft)	10.8

Subbasin ID P_3

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	12.27	sq. mi.
Area Contributing Sediment =	12.27	sq. mi.
Peak Inflow	9143	cfs
Flow Volume	1050	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	105	914	95	0.56	58587
Q-5	0.25	263	2286	95	0.56	163490
Q-10	0.35	368	3200	95	0.56	238317
Q-25	0.55	578	5029	95	0.56	395372
Q-50	0.75	788	6857	95	0.56	559587
Q-100	1	1050	9143	95	0.56	772324

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
10	0.10	2.6%
12	0.24	9.3%
s456	0.26	19.1%
s457	0.26	24.1%
48	0.08	0.7%
52	0.08	0.8%
115	0.27	1.4%
98	0.17	17.8%
116	0.47	5.1%
s286	0.50	2.4%
44	0.10	16.6%
Weighted K Factor:	0.23	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Very Low Density Residential	27.2%	0.85	0.76	0.4	0.26	0.07
Open	66.4%	0.95	1	0.44	0.42	0.28
Low Density Residential	6.3%	0.78	0.63	0.37	0.18	0.01
			Composite Weighted C Factor=			0.36

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	873	ft	(Basin Average)
Slope Angles:	19.00		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	11.35		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	58587	0.23	11.35	0.36	1.00	53840	1.83
Q-5	163490	0.23	11.35	0.36	1.00	150246	5.11
Q-10	238317	0.23	11.35	0.36	1.00	219011	7.45
Q-25	395372	0.23	11.35	0.36	1.00	363342	12.36
Q-50	559587	0.23	11.35	0.36	1.00	514254	17.49
Q-100	772324	0.23	11.35	0.36	1.00	709756	24.14
Weighted Average Annual Sediment Yield:						102000	3.47

Total Sediment Yield Volume (ac. ft)	42.6

Subbasin ID P_4

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	2.78	sq. mi.
Area Contributing Sediment =	2.78	sq. mi.
Peak Inflow	2518	cfs
Flow Volume	209	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	21	252	95	0.56	11524
Q-5	0.25	52	630	95	0.56	32158
Q-10	0.35	73	881	95	0.56	46876
Q-25	0.55	115	1385	95	0.56	77768
Q-50	0.75	157	1889	95	0.56	110069
Q-100	1	209	2518	95	0.56	151914

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
216	0.21	5.2%
10	0.10	0.6%
12	0.24	3.0%
580	0.32	14.5%
206	0.26	45.9%
610	0.24	0.5%
565	0.24	8.8%
52	0.08	1.7%
115	0.27	3.2%
98	0.17	2.1%
265	0.27	0.5%
44	0.10	10.8%
290	0.28	3.2%
Weighted K Factor:	0.24	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	3.6%	0.82	0.31	0.12	0.03	0.00
Very Low Density Residential	1.8%	0.85	0.76	0.4	0.26	0.00
Open	92.4%	0.95	1	0.44	0.42	0.39
Low Density Residential	2.2%	0.78	0.63	0.37	0.18	0.00
			Composite Weighted C Factor=			0.40

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	703	ft	(Basin Average)
Slope Angles:	2.23		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.62		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	11524	0.24	0.62	0.40	1.00	681	0.10
Q-5	32158	0.24	0.62	0.40	1.00	1900	0.29
Q-10	46876	0.24	0.62	0.40	1.00	2770	0.42
Q-25	77768	0.24	0.62	0.40	1.00	4595	0.69
Q-50	110069	0.24	0.62	0.40	1.00	6503	0.98
Q-100	151914	0.24	0.62	0.40	1.00	8976	1.35
Weighted Average Annual Sediment Yield:						1290	0.19

Total Sediment Yield Volume (ac. ft)	0.5

Subbasin ID P_5

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	7.09	sq. mi.
Area Contributing Sediment =	7.09	sq. mi.
Peak Inflow	4149	cfs
Flow Volume	625	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	63	415	95	0.56	28149
Q-5	0.25	156	1037	95	0.56	78552
Q-10	0.35	219	1452	95	0.56	114504
Q-25	0.55	344	2282	95	0.56	189964
Q-50	0.75	469	3112	95	0.56	268864
Q-100	1	625	4149	95	0.56	371078

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
216	0.21	1.5%
215	0.24	5.3%
113	0.32	6.7%
206	0.26	1.4%
335	0.28	19.5%
44	0.10	17.3%
565	0.24	3.3%
575	0.32	2.0%
115	0.27	2.0%
98	0.17	15.2%
12	0.24	9.9%
116	0.47	7.0%
265	0.27	1.7%
68	0.15	5.9%
290	0.28	1.1%
Weighted K Factor:	0.23	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Multi-Family Residential	5.3%	0.78	0.63	0.2	0.10	0.01
Industrial	0.4%	0.85	0.39	0.17	0.06	0.00
Commercial	6.4%	0.82	0.31	0.12	0.03	0.00
Medium Density Residential	6.7%	0.78	0.63	0.2	0.10	0.01
Very Low Density Residential	22.9%	0.85	0.76	0.4	0.26	0.06
Open	58.3%	0.95	1	0.44	0.42	0.24
			Composite Weighted C Factor=			0.32

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	432	ft	(Basin Average)
Slope Angles:	1.74		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.40		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	28149	0.23	0.40	0.32	1.00	821	0.05
Q-5	78552	0.23	0.40	0.32	1.00	2291	0.13
Q-10	114504	0.23	0.40	0.32	1.00	3340	0.20
Q-25	189964	0.23	0.40	0.32	1.00	5541	0.33
Q-50	268864	0.23	0.40	0.32	1.00	7843	0.46
Q-100	371078	0.23	0.40	0.32	1.00	10824	0.64
Weighted Average Annual Sediment Yield:						1556	0.09

Total Sediment Yield Volume (ac. ft)	0.6

Subbasin ID P_9

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	0.36	sq. mi.
Area Contributing Sediment =	0.36	sq. mi.
Peak Inflow	846	cfs
Flow Volume	49	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	5	85	95	0.56	2777
Q-5	0.25	12	212	95	0.56	7749
Q-10	0.35	17	296	95	0.56	11296
Q-25	0.55	27	465	95	0.56	18740
Q-50	0.75	37	635	95	0.56	26523
Q-100	1	49	846	95	0.56	36607

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
335	0.28	5.1%
77	0.32	39.2%
113	0.32	23.7%
575	0.32	11.9%
78	0.32	20.1%
Weighted K Factor:	0.32	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	3.8%	0.82	0.31	0.12	0.03	0.00
Industrial	53.5%	0.85	0.39	0.17	0.06	0.03
Open	42.0%	0.95	1	0.44	0.42	0.18
Medium Density Residential	0.7%	0.78	0.63	0.2	0.10	0.00
			Composite Weighted C Factor=			0.21

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	453	ft	(Basin Average)
Slope Angles:	1.22		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.33		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	2777	0.32	0.33	0.21	1.00	60	0.07
Q-5	7749	0.32	0.33	0.21	1.00	166	0.19
Q-10	11296	0.32	0.33	0.21	1.00	243	0.28
Q-25	18740	0.32	0.33	0.21	1.00	402	0.47
Q-50	26523	0.32	0.33	0.21	1.00	570	0.66
Q-100	36607	0.32	0.33	0.21	1.00	786	0.91
Weighted Average Annual Sediment Yield:						113	0.13

Total Sediment Yield Volume (ac. ft)	0.0

Subbasin ID P_11

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.44	sq. mi.
Area Contributing Sediment =	1.44	sq. mi.
Peak Inflow	1710	cfs
Flow Volume	124	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	12	171	95	0.56	6927
Q-5	0.25	31	428	95	0.56	19329
Q-10	0.35	43	599	95	0.56	28176
Q-25	0.55	68	941	95	0.56	46744
Q-50	0.75	93	1283	95	0.56	66159
Q-100	1	124	1710	95	0.56	91310

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
215	0.24	50.1%
335	0.28	7.8%
575	0.32	9.9%
77	0.32	6.1%
75	0.32	6.3%
113	0.32	11.5%
s283	0.33	1.0%
78	0.32	7.2%
Weighted K Factor:	0.28	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.8%	0.82	0.31	0.12	0.03	0.00
Open	99.2%	0.95	1	0.44	0.42	0.41
			Composite Weighted C Factor=			0.41

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	1053	ft	(Basin Average)
Slope Angles:	1.13		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.47		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	6927	0.28	0.47	0.41	1.00	377	0.11
Q-5	19329	0.28	0.47	0.41	1.00	1052	0.30
Q-10	28176	0.28	0.47	0.41	1.00	1533	0.44
Q-25	46744	0.28	0.47	0.41	1.00	2544	0.74
Q-50	66159	0.28	0.47	0.41	1.00	3601	1.04
Q-100	91310	0.28	0.47	0.41	1.00	4970	1.44
Weighted Average Annual Sediment Yield:						714	0.21

Total Sediment Yield Volume (ac. ft)	0.3

Subbasin ID R_1

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	9.73	sq. mi.
Area Contributing Sediment =	9.73	sq. mi.
Peak Inflow	4177	cfs
Flow Volume	763	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	76	418	95	0.56	31595
Q-5	0.25	191	1044	95	0.56	88169
Q-10	0.35	267	1462	95	0.56	128522
Q-25	0.55	420	2297	95	0.56	213220
Q-50	0.75	572	3133	95	0.56	301780
Q-100	1	763	4177	95	0.56	416506

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
250	0.24	41.1%
s456	0.26	19.4%
430	0.27	8.5%
290	0.28	3.6%
s457	0.26	27.4%
Weighted K Factor:	0.25	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	272	ft	(Basin Average)
Slope Angles:	9.55		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	2.11		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	31595	0.25	2.11	0.42	1.00	7070	0.30
Q-5	88169	0.25	2.11	0.42	1.00	19728	0.85
Q-10	128522	0.25	2.11	0.42	1.00	28757	1.23
Q-25	213220	0.25	2.11	0.42	1.00	47709	2.05
Q-50	301780	0.25	2.11	0.42	1.00	67524	2.90
Q-100	416506	0.25	2.11	0.42	1.00	93195	4.00
Weighted Average Annual Sediment Yield:						13393	0.57

Total Sediment Yield Volume (ac. ft)	5.6

Subbasin ID R_2

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.67	sq. mi.
Area Contributing Sediment =	1.67	sq. mi.
Peak Inflow	2067	cfs
Flow Volume	145	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	15	207	95	0.56	8408
Q-5	0.25	36	517	95	0.56	23462
Q-10	0.35	51	723	95	0.56	34201
Q-25	0.55	80	1137	95	0.56	56740
Q-50	0.75	109	1550	95	0.56	80306
Q-100	1	145	2067	95	0.56	110836

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	67.3%
250	0.24	7.4%
260	0.24	8.7%
290	0.28	11.2%
430	0.27	5.4%
Weighted K Factor:	0.30	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.7%	0.82	0.31	0.12	0.03	0.00
Multi-Family Residential	1.3%	0.78	0.63	0.2	0.10	0.00
Very Low Density Residential	3.2%	0.85	0.76	0.4	0.26	0.01
Open	94.8%	0.95	1	0.44	0.42	0.40
			Composite Weighted C Factor=			0.41

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	224	ft	(Basin Average)
Slope Angles:	1.60		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.27		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	8408	0.30	0.27	0.41	1.00	277	0.07
Q-5	23462	0.30	0.27	0.41	1.00	773	0.19
Q-10	34201	0.30	0.27	0.41	1.00	1127	0.28
Q-25	56740	0.30	0.27	0.41	1.00	1870	0.47
Q-50	80306	0.30	0.27	0.41	1.00	2647	0.66
Q-100	110836	0.30	0.27	0.41	1.00	3654	0.91
Weighted Average Annual Sediment Yield:						525	0.13

Total Sediment Yield Volume (ac. ft)	0.2

Subbasin ID R_3

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	0.67	sq. mi.
Area Contributing Sediment =	0.67	sq. mi.
Peak Inflow	1133	cfs
Flow Volume	75	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	8	113	95	0.56	4151
Q-5	0.25	19	283	95	0.56	11583
Q-10	0.35	26	397	95	0.56	16884
Q-25	0.55	41	623	95	0.56	28011
Q-50	0.75	56	850	95	0.56	39646
Q-100	1	75	1133	95	0.56	54718

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	97.7%
260	0.24	2.3%
Weighted K Factor:	0.32	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.4%	0.82	0.31	0.12	0.03	0.00
Very Low Density Residential	42.7%	0.85	0.76	0.4	0.26	0.11
Open	56.9%	0.95	1	0.44	0.42	0.24
			Composite Weighted C Factor=			0.35

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	265	ft	(Basin Average)
Slope Angles:	0.98		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.22		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	4151	0.32	0.22	0.35	1.00	101	0.06
Q-5	11583	0.32	0.22	0.35	1.00	283	0.18
Q-10	16884	0.32	0.22	0.35	1.00	413	0.26
Q-25	28011	0.32	0.22	0.35	1.00	685	0.43
Q-50	39646	0.32	0.22	0.35	1.00	969	0.60
Q-100	54718	0.32	0.22	0.35	1.00	1337	0.83
Weighted Average Annual Sediment Yield:						192	0.12

Total Sediment Yield Volume (ac. ft)	0.1

Subbasin ID R_4

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	10.52	sq. mi.
Area Contributing Sediment =	10.52	sq. mi.
Peak Inflow	7456	cfs
Flow Volume	910	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	91	746	95	0.56	48238
Q-5	0.25	228	1864	95	0.56	134612
Q-10	0.35	319	2610	95	0.56	196221
Q-25	0.55	501	4101	95	0.56	325534
Q-50	0.75	683	5592	95	0.56	460743
Q-100	1	910	7456	95	0.56	635902

K, Soil Erodibility Factor; Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	56.8%
260	0.24	1.1%
250	0.24	39.2%
430	0.27	2.8%
Weighted K Factor:	0.29	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.3%	0.82	0.31	0.12	0.03	0.00
Very Low Density Residential	11.4%	0.85	0.76	0.4	0.26	0.03
Open	88.3%	0.95	1	0.44	0.42	0.37
			Composite Weighted C Factor=			0.40

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	272	ft	(Basin Average)
Slope Angles:	4.44		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.76		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	48238	0.29	0.76	0.40	1.00	4207	0.17
Q-5	134612	0.29	0.76	0.40	1.00	11739	0.47
Q-10	196221	0.29	0.76	0.40	1.00	17111	0.68
Q-25	325534	0.29	0.76	0.40	1.00	28388	1.13
Q-50	460743	0.29	0.76	0.40	1.00	40179	1.59
Q-100	635902	0.29	0.76	0.40	1.00	55454	2.20
Weighted Average Annual Sediment Yield:						7969	0.32

Total Sediment Yield Volume (ac. ft)	3.3

Subbasin ID R_5

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	0.53	sq. mi.
Area Contributing Sediment =	0.53	sq. mi.
Peak Inflow	1105	cfs
Flow Volume	56	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	6	111	95	0.56	3475
Q-5	0.25	14	276	95	0.56	9698
Q-10	0.35	20	387	95	0.56	14137
Q-25	0.55	31	608	95	0.56	23453
Q-50	0.75	42	829	95	0.56	33194
Q-100	1	56	1105	95	0.56	45813

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	59.5%
570	0.32	40.5%
Weighted K Factor:	0.32	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	1.4%	0.82	0.31	0.12	0.03	0.00
Open	98.6%	0.95	1	0.44	0.42	0.41
			Composite Weighted C Factor=			0.41

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	321	ft	(Basin Average)
Slope Angles:	0.38		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.18		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	3475	0.32	0.18	0.41	1.00	80	0.06
Q-5	9698	0.32	0.18	0.41	1.00	224	0.18
Q-10	14137	0.32	0.18	0.41	1.00	327	0.26
Q-25	23453	0.32	0.18	0.41	1.00	543	0.43
Q-50	33194	0.32	0.18	0.41	1.00	768	0.61
Q-100	45813	0.32	0.18	0.41	1.00	1060	0.84
Weighted Average Annual Sediment Yield:						152	0.12

Total Sediment Yield Volume (ac. ft)	0.1

Subbasin ID R_6

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.55	sq. mi.
Area Contributing Sediment =	1.55	sq. mi.
Peak Inflow	2467	cfs
Flow Volume	154	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	15	247	95	0.56	9602
Q-5	0.25	39	617	95	0.56	26794
Q-10	0.35	54	863	95	0.56	39058
Q-25	0.55	85	1357	95	0.56	64797
Q-50	0.75	116	1850	95	0.56	91710
Q-100	1	154	2467	95	0.56	126576

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	61.8%
570	0.32	29.4%
290	0.28	8.8%
Weighted K Factor:	0.32	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	3.4%	0.82	0.31	0.12	0.03	0.00
Industrial	0.3%	0.85	0.39	0.17	0.06	0.00
Open	96.3%	0.95	1	0.44	0.42	0.40
			Composite Weighted C Factor=			0.40

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	263	ft	(Basin Average)
Slope Angles:	1.16		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.24		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	9602	0.32	0.24	0.40	1.00	295	0.08
Q-5	26794	0.32	0.24	0.40	1.00	824	0.22
Q-10	39058	0.32	0.24	0.40	1.00	1201	0.32
Q-25	64797	0.32	0.24	0.40	1.00	1992	0.54
Q-50	91710	0.32	0.24	0.40	1.00	2820	0.76
Q-100	126576	0.32	0.24	0.40	1.00	3892	1.05
Weighted Average Annual Sediment Yield:						559	0.15

Total Sediment Yield Volume (ac. ft)	0.2

Subbasin ID R_7

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	0.89	sq. mi.
Area Contributing Sediment =	0.89	sq. mi.
Peak Inflow	1226	cfs
Flow Volume	93	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	9	123	95	0.56	4894
Q-5	0.25	23	307	95	0.56	13656
Q-10	0.35	33	429	95	0.56	19906
Q-25	0.55	51	674	95	0.56	33024
Q-50	0.75	70	920	95	0.56	46741
Q-100	1	93	1226	95	0.56	64510

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	97.1%
250	0.24	2.9%
Weighted K Factor:	0.32	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.5%	0.82	0.31	0.12	0.03	0.00
Open	99.5%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	206	ft	(Basin Average)
Slope Angles:	1.75		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.28		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	4894	0.32	0.28	0.42	1.00	179	0.08
Q-5	13656	0.32	0.28	0.42	1.00	499	0.23
Q-10	19906	0.32	0.28	0.42	1.00	728	0.34
Q-25	33024	0.32	0.28	0.42	1.00	1207	0.57
Q-50	46741	0.32	0.28	0.42	1.00	1708	0.80
Q-100	64510	0.32	0.28	0.42	1.00	2358	1.11
Weighted Average Annual Sediment Yield:						339	0.16

Total Sediment Yield Volume (ac. ft)	0.1

Subbasin ID R_8

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	2.9	sq. mi.
Area Contributing Sediment =	2.9	sq. mi.
Peak Inflow	3306	cfs
Flow Volume	301	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	30	331	95	0.56	16464
Q-5	0.25	75	827	95	0.56	45943
Q-10	0.35	105	1157	95	0.56	66971
Q-25	0.55	166	1818	95	0.56	111106
Q-50	0.75	226	2480	95	0.56	157253
Q-100	1	301	3306	95	0.56	217035

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	90.2%
215	0.24	7.6%
205	0.24	0.9%
290	0.28	1.4%
Weighted K Factor:	0.31	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	1.2%	0.82	0.31	0.12	0.03	0.00
Multi-Family Residential	1.2%	0.78	0.63	0.2	0.10	0.00
Industrial	0.5%	0.85	0.39	0.17	0.06	0.00
Open	97.1%	0.95	1	0.44	0.42	0.41
			Composite Weighted C Factor=			0.41

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	299	ft	(Basin Average)
Slope Angles:	1.47		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.30		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	16464	0.31	0.30	0.41	1.00	620	0.09
Q-5	45943	0.31	0.30	0.41	1.00	1731	0.25
Q-10	66971	0.31	0.30	0.41	1.00	2523	0.36
Q-25	111106	0.31	0.30	0.41	1.00	4185	0.60
Q-50	157253	0.31	0.30	0.41	1.00	5923	0.85
Q-100	217035	0.31	0.30	0.41	1.00	8175	1.18
Weighted Average Annual Sediment Yield:						1175	0.17

Total Sediment Yield Volume (ac. ft)	0.5

Subbasin ID R_9

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	3	sq. mi.
Area Contributing Sediment =	3	sq. mi.
Peak Inflow	2900	cfs
Flow Volume	232	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	23	290	95	0.56	13223
Q-5	0.25	58	725	95	0.56	36901
Q-10	0.35	81	1015	95	0.56	53789
Q-25	0.55	128	1595	95	0.56	89237
Q-50	0.75	174	2175	95	0.56	126301
Q-100	1	232	2900	95	0.56	174317

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	29.8%
215	0.24	8.2%
205	0.24	10.9%
570	0.32	29.6%
575	0.32	5.6%
290	0.28	15.9%
Weighted K Factor:	0.30	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	531	ft	(Basin Average)
Slope Angles:	1.06		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.33		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	13223	0.30	0.33	0.42	1.00	536	0.07
Q-5	36901	0.30	0.33	0.42	1.00	1496	0.21
Q-10	53789	0.30	0.33	0.42	1.00	2181	0.30
Q-25	89237	0.30	0.33	0.42	1.00	3618	0.50
Q-50	126301	0.30	0.33	0.42	1.00	5121	0.71
Q-100	174317	0.30	0.33	0.42	1.00	7068	0.98
Weighted Average Annual Sediment Yield:						1016	0.14

Total Sediment Yield Volume (ac. ft)	0.4

Subbasin ID R_10

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	4.35	sq. mi.
Area Contributing Sediment =	4.35	sq. mi.
Peak Inflow	2796	cfs
Flow Volume	302	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	30	280	95	0.56	15017
Q-5	0.25	76	699	95	0.56	41906
Q-10	0.35	106	979	95	0.56	61086
Q-25	0.55	166	1538	95	0.56	101343
Q-50	0.75	227	2097	95	0.56	143436
Q-100	1	302	2796	95	0.56	197965

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
215	0.24	32.4%
595	0.24	28.2%
570	0.32	2.3%
575	0.32	18.3%
345	0.32	5.8%
205	0.24	12.6%
Weighted K Factor:	0.26	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	534	ft	(Basin Average)
Slope Angles:	1.29		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.36		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	15017	0.26	0.36	0.42	1.00	595	0.06
Q-5	41906	0.26	0.36	0.42	1.00	1661	0.16
Q-10	61086	0.26	0.36	0.42	1.00	2421	0.23
Q-25	101343	0.26	0.36	0.42	1.00	4016	0.39
Q-50	143436	0.26	0.36	0.42	1.00	5684	0.55
Q-100	197965	0.26	0.36	0.42	1.00	7844	0.75
Weighted Average Annual Sediment Yield:						1127	0.11

Total Sediment Yield Volume (ac. ft)	0.5

Subbasin ID **R_11**

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.28	sq. mi.
Area Contributing Sediment =	1.28	sq. mi.
Peak Inflow	1204	cfs
Flow Volume	73	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	7	120	95	0.56	4230
Q-5	0.25	18	301	95	0.56	11804
Q-10	0.35	26	421	95	0.56	17206
Q-25	0.55	40	662	95	0.56	28546
Q-50	0.75	55	903	95	0.56	40402
Q-100	1	73	1204	95	0.56	55762

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
s283	0.33	7.3%
345	0.32	5.8%
215	0.24	4.2%
595	0.24	82.1%
575	0.32	0.6%
Weighted K Factor:	0.25	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	1000	ft	(Basin Average)
Slope Angles:	1.28		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.50		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	4230	0.25	0.50	0.42	1.00	221	0.07
Q-5	11804	0.25	0.50	0.42	1.00	618	0.20
Q-10	17206	0.25	0.50	0.42	1.00	900	0.29
Q-25	28546	0.25	0.50	0.42	1.00	1493	0.49
Q-50	40402	0.25	0.50	0.42	1.00	2114	0.69
Q-100	55762	0.25	0.50	0.42	1.00	2917	0.95
Weighted Average Annual Sediment Yield:						419	0.14

Total Sediment Yield Volume (ac. ft)	0.2

Subbasin ID R_12

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.13	sq. mi.
Area Contributing Sediment =	1.13	sq. mi.
Peak Inflow	1521	cfs
Flow Volume	116	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	12	152	95	0.56	6249
Q-5	0.25	29	380	95	0.56	17438
Q-10	0.35	41	532	95	0.56	25420
Q-25	0.55	64	837	95	0.56	42171
Q-50	0.75	87	1141	95	0.56	59687
Q-100	1	116	1521	95	0.56	82378

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	97.7%
205	0.24	2.1%
290	0.28	0.3%
Weighted K Factor:	0.32	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	168	ft	(Basin Average)
Slope Angles:	2.27		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.31		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	6249	0.32	0.31	0.42	1.00	255	0.09
Q-5	17438	0.32	0.31	0.42	1.00	710	0.26
Q-10	25420	0.32	0.31	0.42	1.00	1035	0.38
Q-25	42171	0.32	0.31	0.42	1.00	1718	0.63
Q-50	59687	0.32	0.31	0.42	1.00	2431	0.90
Q-100	82378	0.32	0.31	0.42	1.00	3356	1.24
Weighted Average Annual Sediment Yield:						482	0.18

Total Sediment Yield Volume (ac. ft)	0.2

Subbasin ID R_13

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	7.08	sq. mi.
Area Contributing Sediment =	7.08	sq. mi.
Peak Inflow	5216	cfs
Flow Volume	508	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	51	522	95	0.56	28492
Q-5	0.25	127	1304	95	0.56	79508
Q-10	0.35	178	1826	95	0.56	115897
Q-25	0.55	279	2869	95	0.56	192275
Q-50	0.75	381	3912	95	0.56	272135
Q-100	1	508	5216	95	0.56	375592

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	33.2%
215	0.24	11.0%
205	0.24	8.4%
575	0.32	5.9%
595	0.24	41.5%
Weighted K Factor:	0.27	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.8%	0.82	0.31	0.12	0.03	0.00
Open	98.9%	0.95	1	0.44	0.42	0.41
Medium Density Residential	0.2%	0.78	0.63	0.2	0.10	0.00
			Composite Weighted C Factor=			0.41

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	315	ft	(Basin Average)
Slope Angles:	2.37		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.43		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	28492	0.27	0.43	0.41	1.00	1391	0.08
Q-5	79508	0.27	0.43	0.41	1.00	3882	0.23
Q-10	115897	0.27	0.43	0.41	1.00	5659	0.33
Q-25	192275	0.27	0.43	0.41	1.00	9389	0.55
Q-50	272135	0.27	0.43	0.41	1.00	13288	0.78
Q-100	375592	0.27	0.43	0.41	1.00	18340	1.08
Weighted Average Annual Sediment Yield:						2636	0.16

Total Sediment Yield Volume (ac. ft)	1.1

Subbasin ID R_14

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.3	sq. mi.
Area Contributing Sediment =	1.3	sq. mi.
Peak Inflow	1558	cfs
Flow Volume	76	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	8	156	95	0.56	4998
Q-5	0.25	19	390	95	0.56	13948
Q-10	0.35	27	545	95	0.56	20332
Q-25	0.55	42	857	95	0.56	33731
Q-50	0.75	57	1169	95	0.56	47740
Q-100	1	76	1558	95	0.56	65890

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
595	0.24	91.3%
575	0.32	8.7%
Weighted K Factor:	0.25	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	312	ft	(Basin Average)
Slope Angles:	2.02		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.38		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	4998	0.25	0.38	0.42	1.00	196	0.06
Q-5	13948	0.25	0.38	0.42	1.00	547	0.18
Q-10	20332	0.25	0.38	0.42	1.00	797	0.26
Q-25	33731	0.25	0.38	0.42	1.00	1323	0.42
Q-50	47740	0.25	0.38	0.42	1.00	1872	0.60
Q-100	65890	0.25	0.38	0.42	1.00	2584	0.83
Weighted Average Annual Sediment Yield:						371	0.12

Total Sediment Yield Volume (ac. ft)	0.2

Subbasin ID R_15

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	0.67	sq. mi.
Area Contributing Sediment =	0.67	sq. mi.
Peak Inflow	742	cfs
Flow Volume	38	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	4	74	95	0.56	2238
Q-5	0.25	10	186	95	0.56	6245
Q-10	0.35	13	260	95	0.56	9103
Q-25	0.55	21	408	95	0.56	15102
Q-50	0.75	29	557	95	0.56	21375
Q-100	1	38	742	95	0.56	29500

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
595	0.24	100.0%
Weighted K Factor:	0.24	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	343	ft	(Basin Average)
Slope Angles:	2.13		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.42		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	2238	0.24	0.42	0.42	1.00	93	0.06
Q-5	6245	0.24	0.42	0.42	1.00	260	0.16
Q-10	9103	0.24	0.42	0.42	1.00	379	0.24
Q-25	15102	0.24	0.42	0.42	1.00	629	0.39
Q-50	21375	0.24	0.42	0.42	1.00	890	0.55
Q-100	29500	0.24	0.42	0.42	1.00	1228	0.77
Weighted Average Annual Sediment Yield:						177	0.11

Total Sediment Yield Volume (ac. ft)	0.1

Subbasin ID **V_1**

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	11.84	sq. mi.
Area Contributing Sediment =	11.84	sq. mi.
Peak Inflow	5320	cfs
Flow Volume	770	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	77	532	95	0.56	36364
Q-5	0.25	193	1330	95	0.56	101476
Q-10	0.35	270	1862	95	0.56	147919
Q-25	0.55	424	2926	95	0.56	245400
Q-50	0.75	578	3990	95	0.56	347326
Q-100	1	770	5320	95	0.56	479368

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	15.0%
s457	0.26	17.8%
625	0.24	11.4%
290	0.28	3.7%
240	0.22	5.1%
s456	0.26	1.1%
250	0.24	15.5%
430	0.27	30.2%
Weighted K Factor:	0.26	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	99.9%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	276	ft	(Basin Average)
Slope Angles:	5.53		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	1.00		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	36364	0.26	1.00	0.42	1.00	4043	0.14
Q-5	101476	0.26	1.00	0.42	1.00	11282	0.40
Q-10	147919	0.26	1.00	0.42	1.00	16446	0.58
Q-25	245400	0.26	1.00	0.42	1.00	27284	0.96
Q-50	347326	0.26	1.00	0.42	1.00	38617	1.36
Q-100	479368	0.26	1.00	0.42	1.00	53298	1.88
Weighted Average Annual Sediment Yield:						7659	0.27

Total Sediment Yield Volume (ac. ft)	3.2

Subbasin ID V_2

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.05	sq. mi.
Area Contributing Sediment =	1.05	sq. mi.
Peak Inflow	1672	cfs
Flow Volume	106	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	11	167	95	0.56	6265
Q-5	0.25	27	418	95	0.56	17482
Q-10	0.35	37	585	95	0.56	25484
Q-25	0.55	58	920	95	0.56	42278
Q-50	0.75	80	1254	95	0.56	59838
Q-100	1	106	1672	95	0.56	82586

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	99.0%
290	0.28	1.0%
Weighted K Factor:	0.32	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.7%	0.82	0.31	0.12	0.03	0.00
Open	99.3%	0.95	1	0.44	0.42	0.41
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	200	ft	(Basin Average)
Slope Angles:	2.26		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.33		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	6265	0.32	0.33	0.42	1.00	277	0.11
Q-5	17482	0.32	0.33	0.42	1.00	772	0.31
Q-10	25484	0.32	0.33	0.42	1.00	1125	0.45
Q-25	42278	0.32	0.33	0.42	1.00	1867	0.74
Q-50	59838	0.32	0.33	0.42	1.00	2643	1.05
Q-100	82586	0.32	0.33	0.42	1.00	3647	1.45
Weighted Average Annual Sediment Yield:						524	0.21

Total Sediment Yield Volume (ac. ft)	0.2

Subbasin ID **V_3**

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.1	sq. mi.
Area Contributing Sediment =	1.1	sq. mi.
Peak Inflow	1699	cfs
Flow Volume	115	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	12	170	95	0.56	6616
Q-5	0.25	29	425	95	0.56	18464
Q-10	0.35	40	595	95	0.56	26914
Q-25	0.55	63	934	95	0.56	44651
Q-50	0.75	86	1274	95	0.56	63196
Q-100	1	115	1699	95	0.56	87221

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	77.3%
13	0.22	0.6%
45	0.10	9.8%
22	0.28	1.8%
580	0.32	10.6%
Weighted K Factor:	0.30	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.3%	0.82	0.31	0.12	0.03	0.00
Very Low Density Residential	0.2%	0.85	0.76	0.4	0.26	0.00
Open	86.8%	0.95	1	0.44	0.42	0.36
Medium Density Residential	12.6%	0.78	0.63	0.2	0.10	0.01
			Composite Weighted C Factor=			0.38

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	165	ft	(Basin Average)
Slope Angles:	2.84		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.37		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	6616	0.30	0.37	0.38	1.00	274	0.10
Q-5	18464	0.30	0.37	0.38	1.00	766	0.29
Q-10	26914	0.30	0.37	0.38	1.00	1116	0.42
Q-25	44651	0.30	0.37	0.38	1.00	1852	0.70
Q-50	63196	0.30	0.37	0.38	1.00	2621	0.99
Q-100	87221	0.30	0.37	0.38	1.00	3618	1.37
Weighted Average Annual Sediment Yield:						520	0.20

Total Sediment Yield Volume (ac. ft)	0.2

Subbasin ID V_4

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.77	sq. mi.
Area Contributing Sediment =	1.77	sq. mi.
Peak Inflow	2548	cfs
Flow Volume	180	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	18	255	95	0.56	10670
Q-5	0.25	45	637	95	0.56	29774
Q-10	0.35	63	892	95	0.56	43401
Q-25	0.55	99	1401	95	0.56	72004
Q-50	0.75	135	1911	95	0.56	101910
Q-100	1	180	2548	95	0.56	140653

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	65.1%
13	0.22	2.3%
215	0.24	14.3%
205	0.24	2.2%
580	0.32	3.4%
45	0.10	5.2%
575	0.32	2.6%
595	0.24	0.7%
290	0.28	4.2%
Weighted K Factor:	0.29	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	3.8%	0.82	0.31	0.12	0.03	0.00
Open	81.9%	0.95	1	0.44	0.42	0.34
Medium Density Residential	14.3%	0.78	0.63	0.2	0.10	0.01
			Composite Weighted C Factor=			0.36

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	149	ft	(Basin Average)
Slope Angles:	4.63		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.59		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	10670	0.29	0.59	0.36	1.00	659	0.16
Q-5	29774	0.29	0.59	0.36	1.00	1838	0.43
Q-10	43401	0.29	0.59	0.36	1.00	2680	0.63
Q-25	72004	0.29	0.59	0.36	1.00	4446	1.05
Q-50	101910	0.29	0.59	0.36	1.00	6292	1.48
Q-100	140653	0.29	0.59	0.36	1.00	8684	2.05
Weighted Average Annual Sediment Yield:						1248	0.29

Total Sediment Yield Volume (ac. ft)	0.5

Subbasin ID V_5

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	4.45	sq. mi.
Area Contributing Sediment =	4.45	sq. mi.
Peak Inflow	2866	cfs
Flow Volume	247	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	25	287	95	0.56	13605
Q-5	0.25	62	717	95	0.56	37967
Q-10	0.35	86	1003	95	0.56	55343
Q-25	0.55	136	1576	95	0.56	91815
Q-50	0.75	185	2150	95	0.56	129950
Q-100	1	247	2866	95	0.56	179353

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
205	0.24	13.8%
575	0.32	11.5%
595	0.24	74.6%
Weighted K Factor:	0.25	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	327	ft	(Basin Average)
Slope Angles:	2.42		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.45		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	13605	0.25	0.45	0.42	1.00	640	0.06
Q-5	37967	0.25	0.45	0.42	1.00	1787	0.17
Q-10	55343	0.25	0.45	0.42	1.00	2604	0.24
Q-25	91815	0.25	0.45	0.42	1.00	4320	0.41
Q-50	129950	0.25	0.45	0.42	1.00	6115	0.57
Q-100	179353	0.25	0.45	0.42	1.00	8440	0.79
Weighted Average Annual Sediment Yield:						1213	0.11

Total Sediment Yield Volume (ac. ft)	0.5

Subbasin ID **V_6**

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.97	sq. mi.
Area Contributing Sediment =	1.97	sq. mi.
Peak Inflow	1771	cfs
Flow Volume	138	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	14	177	95	0.56	7500
Q-5	0.25	35	443	95	0.56	20929
Q-10	0.35	48	620	95	0.56	30508
Q-25	0.55	76	974	95	0.56	50613
Q-50	0.75	104	1328	95	0.56	71635
Q-100	1	138	1771	95	0.56	98869

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	25.9%
13	0.22	2.5%
22	0.28	1.2%
625	0.24	33.4%
45	0.10	11.7%
580	0.32	0.9%
430	0.27	24.4%
Weighted K Factor:	0.25	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.3%	0.82	0.31	0.12	0.03	0.00
Very Low Density Residential	2.7%	0.85	0.76	0.4	0.26	0.01
Open	89.6%	0.95	1	0.44	0.42	0.37
Medium Density Residential	7.4%	0.78	0.63	0.2	0.10	0.01
			Composite Weighted C Factor=			0.39

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	206	ft	(Basin Average)
Slope Angles:	5.01		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.77		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	7500	0.25	0.77	0.39	1.00	565	0.12
Q-5	20929	0.25	0.77	0.39	1.00	1576	0.33
Q-10	30508	0.25	0.77	0.39	1.00	2297	0.49
Q-25	50613	0.25	0.77	0.39	1.00	3811	0.81
Q-50	71635	0.25	0.77	0.39	1.00	5394	1.14
Q-100	98869	0.25	0.77	0.39	1.00	7445	1.58
Weighted Average Annual Sediment Yield:						1070	0.23

Total Sediment Yield Volume (ac. ft)	0.4

Subbasin ID V_7

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.71	sq. mi.
Area Contributing Sediment =	1.71	sq. mi.
Peak Inflow	2352	cfs
Flow Volume	170	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	17	235	95	0.56	9881
Q-5	0.25	43	588	95	0.56	27572
Q-10	0.35	60	823	95	0.56	40192
Q-25	0.55	94	1294	95	0.56	66679
Q-50	0.75	128	1764	95	0.56	94373
Q-100	1	170	2352	95	0.56	130251

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	70.8%
13	0.22	5.7%
205	0.24	5.0%
22	0.28	0.4%
580	0.32	3.5%
45	0.10	7.7%
575	0.32	0.6%
595	0.24	6.2%
Weighted K Factor:	0.29	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	1.4%	0.82	0.31	0.12	0.03	0.00
Open	84.8%	0.95	1	0.44	0.42	0.35
Medium Density Residential	13.8%	0.78	0.63	0.2	0.10	0.01
			Composite Weighted C Factor=			0.37

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	178	ft	(Basin Average)
Slope Angles:	4.01		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.55		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	9881	0.29	0.55	0.37	1.00	577	0.14
Q-5	27572	0.29	0.55	0.37	1.00	1611	0.39
Q-10	40192	0.29	0.55	0.37	1.00	2349	0.57
Q-25	66679	0.29	0.55	0.37	1.00	3897	0.95
Q-50	94373	0.29	0.55	0.37	1.00	5515	1.35
Q-100	130251	0.29	0.55	0.37	1.00	7612	1.86
Weighted Average Annual Sediment Yield:						1094	0.27

Total Sediment Yield Volume (ac. ft)	0.5

Subbasin ID V_8

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	4.08	sq. mi.
Area Contributing Sediment =	4.08	sq. mi.
Peak Inflow	2597	cfs
Flow Volume	254	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	25	260	95	0.56	13078
Q-5	0.25	64	649	95	0.56	36495
Q-10	0.35	89	909	95	0.56	53197
Q-25	0.55	140	1428	95	0.56	88255
Q-50	0.75	191	1948	95	0.56	124912
Q-100	1	254	2597	95	0.56	172399

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	16.1%
13	0.22	1.3%
215	0.24	10.9%
595	0.24	42.1%
22	0.28	0.9%
580	0.32	0.6%
45	0.10	4.4%
565	0.24	2.8%
575	0.32	3.3%
205	0.24	17.5%
Weighted K Factor:	0.25	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.5%	0.82	0.31	0.12	0.03	0.00
Open	99.5%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	338	ft	(Basin Average)
Slope Angles:	2.33		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.45		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	13078	0.25	0.45	0.42	1.00	605	0.06
Q-5	36495	0.25	0.45	0.42	1.00	1689	0.17
Q-10	53197	0.25	0.45	0.42	1.00	2462	0.25
Q-25	88255	0.25	0.45	0.42	1.00	4084	0.42
Q-50	124912	0.25	0.45	0.42	1.00	5780	0.59
Q-100	172399	0.25	0.45	0.42	1.00	7977	0.82
Weighted Average Annual Sediment Yield:						1146	0.12

Total Sediment Yield Volume (ac. ft)	0.5

Subbasin ID V_9

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	4.11	sq. mi.
Area Contributing Sediment =	4.11	sq. mi.
Peak Inflow	3337	cfs
Flow Volume	260	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	26	334	95	0.56	15247
Q-5	0.25	65	834	95	0.56	42548
Q-10	0.35	91	1168	95	0.56	62022
Q-25	0.55	143	1835	95	0.56	102895
Q-50	0.75	195	2503	95	0.56	145632
Q-100	1	260	3337	95	0.56	200996

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	17.8%
215	0.24	23.4%
595	0.24	48.4%
575	0.32	2.8%
205	0.24	7.6%
Weighted K Factor:	0.26	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	293	ft	(Basin Average)
Slope Angles:	2.69		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.47		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	15247	0.26	0.47	0.42	1.00	768	0.08
Q-5	42548	0.26	0.47	0.42	1.00	2144	0.22
Q-10	62022	0.26	0.47	0.42	1.00	3125	0.32
Q-25	102895	0.26	0.47	0.42	1.00	5184	0.53
Q-50	145632	0.26	0.47	0.42	1.00	7337	0.75
Q-100	200996	0.26	0.47	0.42	1.00	10126	1.03
Weighted Average Annual Sediment Yield:						1455	0.15

Total Sediment Yield Volume (ac. ft)	0.6

Subbasin ID V_10

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	2.91	sq. mi.
Area Contributing Sediment =	2.91	sq. mi.
Peak Inflow	2992	cfs
Flow Volume	220	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	22	299	95	0.56	13062
Q-5	0.25	55	748	95	0.56	36451
Q-10	0.35	77	1047	95	0.56	53134
Q-25	0.55	121	1646	95	0.56	88151
Q-50	0.75	165	2244	95	0.56	124763
Q-100	1	220	2992	95	0.56	172194

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	12.1%
13	0.22	2.5%
625	0.24	35.5%
580	0.32	4.8%
98	0.17	1.4%
63	0.15	1.3%
610	0.24	3.7%
22	0.28	6.4%
565	0.24	1.1%
260	0.24	3.3%
430	0.27	0.9%
48	0.08	24.9%
290	0.28	1.5%
110	0.20	0.5%
Weighted K Factor:	0.21	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.2%	0.82	0.31	0.12	0.03	0.00
Low Density Residential	13.6%	0.78	0.63	0.37	0.18	0.02
Open	86.1%	0.95	1	0.44	0.42	0.36
			Composite Weighted C Factor=			0.38

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	220	ft	(Basin Average)
Slope Angles:	7.38		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	1.31		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	13062	0.21	1.31	0.38	1.00	1413	0.20
Q-5	36451	0.21	1.31	0.38	1.00	3943	0.57
Q-10	53134	0.21	1.31	0.38	1.00	5747	0.82
Q-25	88151	0.21	1.31	0.38	1.00	9534	1.37
Q-50	124763	0.21	1.31	0.38	1.00	13494	1.94
Q-100	172194	0.21	1.31	0.38	1.00	18624	2.67
Weighted Average Annual Sediment Yield:						2677	0.38

Total Sediment Yield Volume (ac. ft)	1.1

Subbasin ID V_11

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	5.24	sq. mi.
Area Contributing Sediment =	5.24	sq. mi.
Peak Inflow	4740	cfs
Flow Volume	442	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	44	474	95	0.56	24980
Q-5	0.25	111	1185	95	0.56	69709
Q-10	0.35	155	1659	95	0.56	101614
Q-25	0.55	243	2607	95	0.56	168578
Q-50	0.75	332	3555	95	0.56	238597
Q-100	1	442	4740	95	0.56	329303

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	37.6%
13	0.22	8.9%
215	0.24	1.0%
595	0.24	25.7%
48	0.08	1.0%
580	0.32	3.2%
610	0.24	0.7%
570	0.32	4.2%
22	0.28	5.3%
565	0.24	6.8%
52	0.08	0.5%
45	0.10	1.5%
205	0.24	0.7%
290	0.28	2.6%
Weighted K Factor:	0.27	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	1.1%	0.82	0.31	0.12	0.03	0.00
Low Density Residential	9.3%	0.78	0.63	0.37	0.18	0.02
Open	83.0%	0.95	1	0.44	0.42	0.35
Medium Density Residential	6.6%	0.78	0.63	0.2	0.10	0.01
			Composite Weighted C Factor=			0.37

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	294	ft	(Basin Average)
Slope Angles:	3.10		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.54		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	24980	0.27	0.54	0.37	1.00	1363	0.11
Q-5	69709	0.27	0.54	0.37	1.00	3804	0.30
Q-10	101614	0.27	0.54	0.37	1.00	5545	0.44
Q-25	168578	0.27	0.54	0.37	1.00	9199	0.73
Q-50	238597	0.27	0.54	0.37	1.00	13020	1.04
Q-100	329303	0.27	0.54	0.37	1.00	17970	1.43
Weighted Average Annual Sediment Yield:						2582	0.21

Total Sediment Yield Volume (ac. ft)	1.1

Subbasin ID V_12

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	7.77	sq. mi.
Area Contributing Sediment =	7.77	sq. mi.
Peak Inflow	5010	cfs
Flow Volume	594	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	59	501	95	0.56	30406
Q-5	0.25	149	1253	95	0.56	84849
Q-10	0.35	208	1754	95	0.56	123683
Q-25	0.55	327	2756	95	0.56	205191
Q-50	0.75	446	3758	95	0.56	290417
Q-100	1	594	5010	95	0.56	400823

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
13	0.22	0.6%
s456	0.26	4.1%
s457	0.26	26.1%
625	0.24	4.0%
63	0.15	1.7%
610	0.24	1.1%
45	0.10	2.4%
112	0.32	0.2%
565	0.24	0.4%
52	0.08	4.2%
110	0.20	1.3%
98	0.17	2.4%
3	0.16	2.9%
260	0.24	7.3%
430	0.27	19.8%
48	0.08	1.7%
250	0.24	10.8%
44	0.10	5.6%
290	0.28	1.5%
240	0.22	2.0%
Weighted K Factor:	0.23	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Low Density Residential	9.9%	0.78	0.63	0.37	0.18	0.02
Open	90.1%	0.95	1	0.44	0.42	0.38
			Composite Weighted C Factor=			0.39

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	404	ft	(Basin Average)
Slope Angles:	19.10		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	7.79		

P, Erosion Control Factor

No Practice, Natural or Regulated	1
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	30406	0.23	7.79	0.39	1.00	21116	1.13
Q-5	84849	0.23	7.79	0.39	1.00	58926	3.17
Q-10	123683	0.23	7.79	0.39	1.00	85895	4.61
Q-25	205191	0.23	7.79	0.39	1.00	142501	7.66
Q-50	290417	0.23	7.79	0.39	1.00	201688	10.83
Q-100	400823	0.23	7.79	0.39	1.00	278364	14.95
Weighted Average Annual Sediment Yield:						40004	2.15

Total Sediment Yield Volume (ac. ft)	16.7

Subbasin ID **V_13**

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	1.5	sq. mi.
Area Contributing Sediment =	1.5	sq. mi.
Peak Inflow	2879	cfs
Flow Volume	163	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	16	288	95	0.56	10807
Q-5	0.25	41	720	95	0.56	30159
Q-10	0.35	57	1008	95	0.56	43962
Q-25	0.55	90	1583	95	0.56	72934
Q-50	0.75	122	2159	95	0.56	103227
Q-100	1	163	2879	95	0.56	142470

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
13	0.22	0.3%
48	0.08	1.3%
44	0.10	13.2%
45	0.10	18.9%
52	0.08	47.1%
3	0.16	19.0%
Weighted K Factor:	0.10	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	2.6%	0.82	0.31	0.12	0.03	0.00
Low Density Residential	97.4%	0.78	0.63	0.37	0.18	0.18
			Composite Weighted C Factor=			0.18

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	322	ft	(Basin Average)
Slope Angles:	9.48		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	2.27		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	10807	0.10	2.27	0.18	1.00	455	0.13
Q-5	30159	0.10	2.27	0.18	1.00	1268	0.35
Q-10	43962	0.10	2.27	0.18	1.00	1849	0.51
Q-25	72934	0.10	2.27	0.18	1.00	3068	0.85
Q-50	103227	0.10	2.27	0.18	1.00	4342	1.21
Q-100	142470	0.10	2.27	0.18	1.00	5992	1.67
Weighted Average Annual Sediment Yield:						861	0.24

Total Sediment Yield Volume (ac. ft)	0.4

Subbasin ID V_14

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	3.15	sq. mi.
Area Contributing Sediment =	3.15	sq. mi.
Peak Inflow	2586	cfs
Flow Volume	204	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	20	259	95	0.56	11540
Q-5	0.25	51	647	95	0.56	32202
Q-10	0.35	71	905	95	0.56	46940
Q-25	0.55	112	1422	95	0.56	77874
Q-50	0.75	153	1940	95	0.56	110219
Q-100	1	204	2586	95	0.56	152121

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
605	0.32	1.6%
13	0.22	0.9%
215	0.24	28.8%
595	0.24	3.3%
48	0.08	2.1%
206	0.26	30.8%
570	0.32	0.5%
22	0.28	0.5%
565	0.24	11.4%
575	0.32	6.4%
3	0.16	6.3%
265	0.27	0.3%
290	0.28	7.0%
Weighted K Factor:	0.25	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Commercial	0.8%	0.82	0.31	0.12	0.03	0.00
Low Density Residential	5.7%	0.78	0.63	0.37	0.18	0.01
Open	91.0%	0.95	1	0.44	0.42	0.38
Medium Density Residential	2.5%	0.78	0.63	0.2	0.10	0.00
			Composite Weighted C Factor=			0.39

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	814	ft	(Basin Average)
Slope Angles:	1.26		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.44		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	11540	0.25	0.44	0.39	1.00	498	0.07
Q-5	32202	0.25	0.44	0.39	1.00	1391	0.18
Q-10	46940	0.25	0.44	0.39	1.00	2027	0.27
Q-25	77874	0.25	0.44	0.39	1.00	3363	0.45
Q-50	110219	0.25	0.44	0.39	1.00	4760	0.63
Q-100	152121	0.25	0.44	0.39	1.00	6569	0.87
Weighted Average Annual Sediment Yield:						944	0.13

Total Sediment Yield Volume (ac. ft)	0.4

Subbasin ID **V_17**

Design Sediment Yield (MUSLE) Ys = Rw * K * LS * C * P

Rw, Storm Energy Runoff Factor; Rw = a(V*q)^b

Drainage Area =	0.46	sq. mi.
Area Contributing Sediment =	0.46	sq. mi.
Peak Inflow	665	cfs
Flow Volume	21	ac. ft.

Recurrence Interval	Ratios	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	0.1	2	67	95	0.56	1510
Q-5	0.25	5	166	95	0.56	4213
Q-10	0.35	7	233	95	0.56	6142
Q-25	0.55	12	366	95	0.56	10189
Q-50	0.75	16	499	95	0.56	14422
Q-100	1	21	665	95	0.56	19904

K, Soil Erodibility Factor: Table 14, Camp, 1986

Soil Map Unit	K	% of Basin
s283	0.33	96.8%
595	0.24	3.0%
Weighted K Factor:	0.33	

C, Cover and Management Factor; Figures 5-7, SCS Ag. Handbook #537

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Open	100.0%	0.95	1	0.44	0.42	0.42
			Composite Weighted C Factor=			0.42

LS, Topographic Factor; LS = ((L/72.6)^n)*(0.065+0.0454*S+0.0065*S^2)

Slope Lengths:	231	ft	(Basin Average)
Slope Angles:	2.76		(Basin Average)
n =	0.5		
Eq'n B.4 ADWR Manual, Appendix B			
LS =	0.43		

P, Erosion Control Factor

No Practice, Natural or Regulated	
Weighted P for Contributing Watershed	1

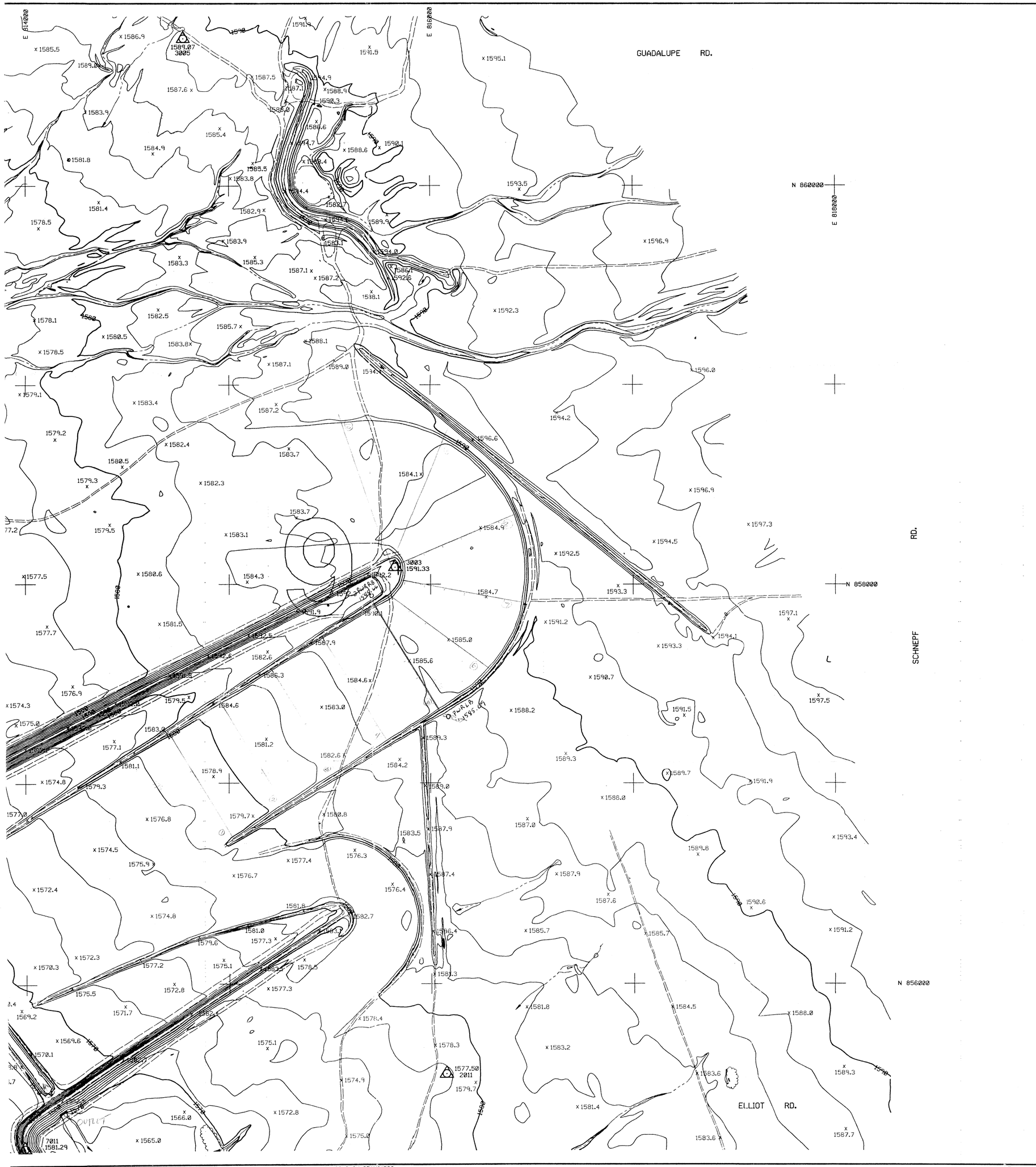
Soil Bulk Density

Soil Bulk Density	110 lb/ft^3

Weighted Average Annual Sediment Yield:

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)
Q-2	1510	0.33	0.43	0.42	1.00	88	0.08
Q-5	4213	0.33	0.43	0.42	1.00	246	0.22
Q-10	6142	0.33	0.43	0.42	1.00	359	0.33
Q-25	10189	0.33	0.43	0.42	1.00	596	0.54
Q-50	14422	0.33	0.43	0.42	1.00	843	0.77
Q-100	19904	0.33	0.43	0.42	1.00	1164	1.06
Weighted Average Annual Sediment Yield:						167	0.15

Total Sediment Yield Volume (ac. ft)	0.1



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

POWERLINE FRS

F.C.D. CONTRACT NO. FCD 93-51

LEGEND

100-YR FLOODPLAIN BOUNDARY	
FLOODWAY BOUNDARY	
HYDRAULIC BASE LINE WITH RIVER MILE	M12.0 M13.0
CROSS SECTION	A FP=100 Yr WSE / FW=Floodway WSE A
ELEVATION REFERENCE MARK	ERM3 X
BASE FLOOD ELEVATIONS	1221
ZONE DESIGNATIONS	ZONE AE
CORPORATE LIMITS	Corporate Limits
COUNTY, PARISH, STATE OR INTERNATIONAL BOUNDARY	County Boundary

PRIMARY CONTROL POINTS

NOTE: ALL ELEVATIONS ARE BASED ON NAVD 88 (NORTH AMERICAN VERTICAL DATUM 1988)

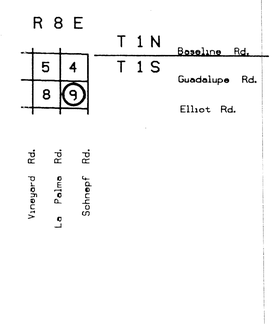
I.D. NO.	ELEV. (FT)	DESCRIPTION/LOCATION
2011	1577.50	Set ½" rebar (flush) +/-500' South-southwest of the end of the levee at the Northeast end of the Vineyard structure.
3002	1591.59	Set 60d nail (flush) on South edge of trail atop Powerline structure at the Southwest corner of the structure.
3003	1591.33	Set ½" rebar (flush) on level ground at the Southeast end of the Powerline structure.
3005	1589.07	Set 60d nail (flush) +/-50' South of trail running Northwest to Southeast through Sections 5 and 4 and approximately 900' Northwest of large stock tank near the South ¼ Corner of Section 4, T1S, R8E.
7011	1581.29	Set 60d nail (flush) 7.0' East and 1.1' above BC in Concrete marked "A-27" atop Vineyard structure at Station 350+00. Point is at Northwest corner of the Vineyard structure.

NOTES

REGISTERED LAND SURVEYOR CERTIFICATE NO. 26401 LEE HARBERS ARIZONA U.S.A.

INDEX MAP

Map Sheet 4 represents Section 9, T1S, R8E



200 0' 200 400

SCALE: 1" = 200'

CONTOUR INTERVAL = 2 FEET

McLAIN HARBERS CO., INC

	BY	DATE
DESIGN	-	-
DESIGN CHK.	-	-
PLANS	-	-
PLANS CHK.	-	-

SUBMITTED BY: DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

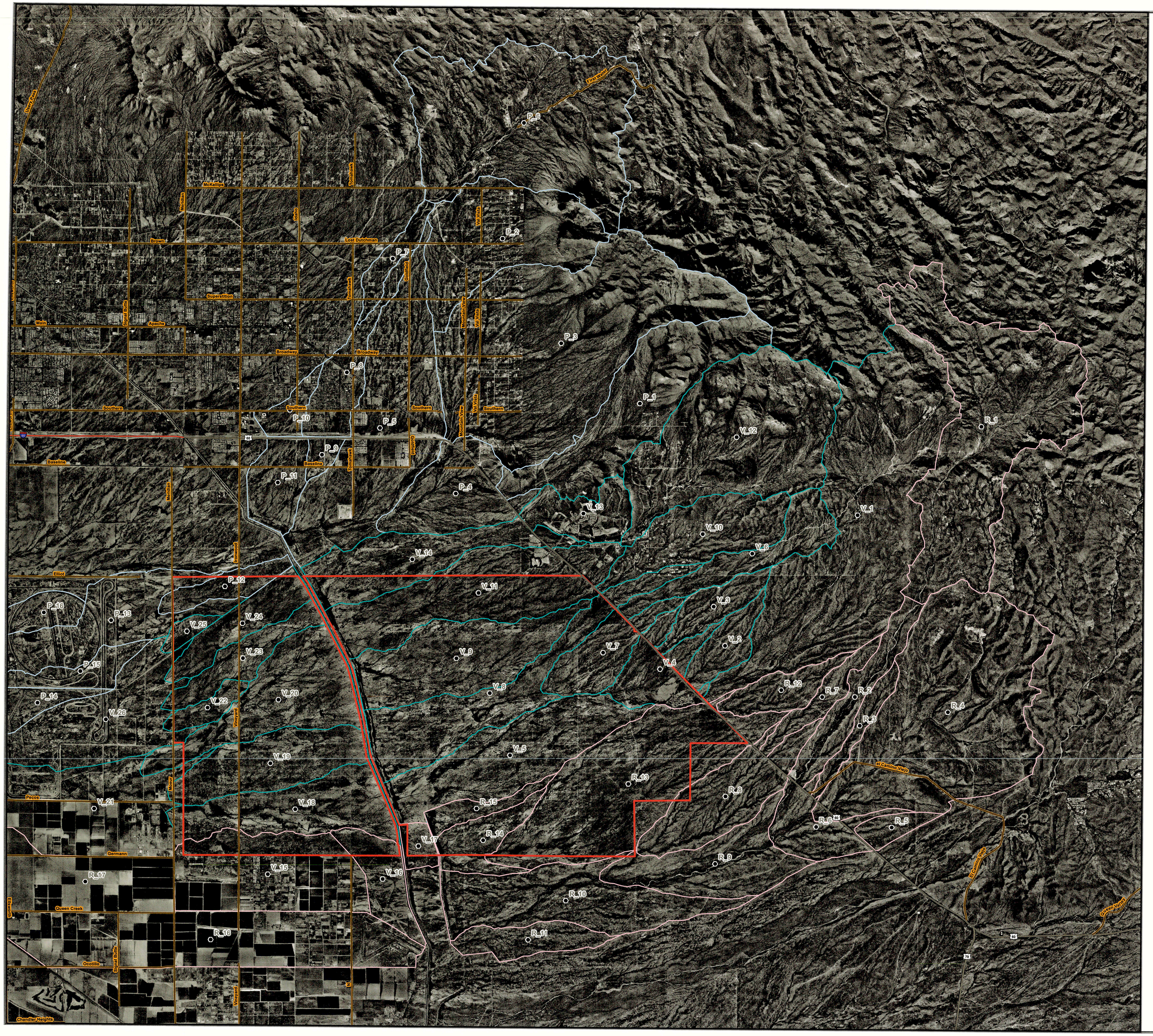
CHIEF ENGINEER AND GENERAL MANAGER

SHEET 4 OF 4

ADM,MRB REV. DEC. 10, 1991

THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS 1"=200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS AND BASED ON GROUND CONTROL SURVEY DATA PROVID BY COLLINS-PINA.

SECTION 9
T 1 S, R 8 E


Arizona State Land Department
Desert Drive Area Study
Volume I -
Existing Conditions HEC-1
Plate 1A
Watershed Drainage Areas
Legend
Sub-basin Centroid
Roads
Interstate
US, State, County Hwys
Major Arterials
Project Area
Drainage Basins
Powerline FRS Watershed
Rittenhouse FRS Watershed
Vineyard FRS Watershed
N
0 0.5 1 2 Miles
Aerial Image: Digital Orthophoto, April 13, 2006, .5 foot pixel resolution within project area.
Aerial Image: Digital Orthophoto, Prior to year 2000, 1 meter pixel resolution outside project area.
Coordinate System: NAD 1983 StatePlane Arizona Central FIPS 0202 Feet Intl.
ALRIS, 2003
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.