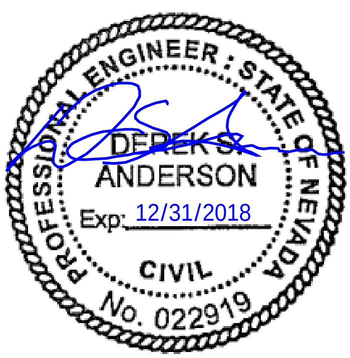
FLOODWAY IMPROVEMENTS STUDY
CITY OF CALIENTE, NEVADA

December 2018

Prepared by:
SUNRISE ENGINEERING, INC.
11 NORTH 300 WEST
WASHINGTON, UTAH 84780
435.789.7364

Project Team Leads:



Derek Anderson, P.E. 12/06/18
Project Manager

TABLE OF CONTENTS

LIST OF FIGURES

APPENDICES

APPENDICES (CONTINUED)

FLOODWAY IMPROVEMENTS STUDY
CITY OF CALIENTE, NEVADA

December 2018

1 INTRODUCTION

The City of Caliente (the City or Caliente) is located in eastern Nevada in rural Lincoln County on Highway 93 (Figure 1). Two major drainage basins, Meadow Valley Wash and Clover Creek, converge within the city limits. Downstream of the confluence, Meadow Valley Wash runs southwest, approximately 70 miles to Glendale, Nevada and flows into the Muddy River.

Repeated flooding in Caliente has been documented since 1906 when the Union Pacific Railroad began constructing tracks along Meadow Valley Wash. The active Federal Emergency Management Agency (FEMA) floodplain covers the majority of the City (FEMA Flood Insurance Rate Map or FIRM, Appendix A). The Meadow Valley Wash and Clover Creek watersheds have caused serious problems such as flooding, property loss, sedimentation, high groundwater, sewer system damage, threat to city and county properties, threat to highway and railroad crossing structures, and threat to environmental and biological conditions within the watersheds. In January 2005, a severe winter storm occurred in this area, which resulted in flooding throughout Lincoln County. The peak flow at Caliente was higher than the largest historical peak discharge ever recorded and was estimated to be a less-than-2% frequency (more than 50-year return period) event by the U.S. Geological Survey (USGS). The flood caused significant damage to private and public properties.

1.1 Project History

After the 2005 severe winter storm, Sunrise Engineering, Inc. (Sunrise) was retained by Caliente in 2007 to evaluate the drainage conditions in Caliente. Sunrise collected and reviewed published and unpublished studies, maps, historical records, and other documents (Sunrise, 2007 A and B), and made recommendations in a detailed study report entitled Meadow Valley Wash Linear Park Improvements – Hydrologic / Hydraulic / Sediment Analysis (Sunrise, 2008). The primary goal of that project was to build a linear city park along Meadow Valley Wash within the city limits for environmental protection and recreation purposes. At the same time, because of the serious flooding problems in Caliente, an important component of the project was to enable drainage through the linear park. Improvement design concepts and options were provided in the report. Limited by available funding, Caliente only constructed a portion of the linear park project (see site photos included in Appendix B).

1.2 Major Problems

The Sunrise 2007 and 2008 reports summarized five major offsite drainage problems based on the reviewed documents, engineer's findings from site inspections, and hydrologic, hydraulic and sediment transport studies. The two most serious problems were described as follows:

1. Repeated flooding in Caliente has been documented since 1906 and has caused serious problems. A deep channel was established during the 1906 flooding. Most of Caliente is within the 100 year floodplain (Appendix A).
2. Large amounts of sediment have been generated in the Clover Creek watershed and moved to and deposited within an approximately 2.3 mile stretch of Clover Creek – Meadow Valley Wash within Caliente. High sediment volumes are a natural part of the Clover Creek – Meadow Valley Wash system, as a result, the channel through Caliente used to be 8 to 14 feet deeper than it is today. During high water flows, most sedimentation problems in Caliente originate from the Clover Creek watershed.

The reports also listed 10 critical drainage elements in Caliente. The top five elements from the report (Sunrise, 2008 Figure 1) are listed as follows:

1. The approximately 2.3-mile-long Clover Creek and Meadow Valley Wash channels that are characterized by sediment and vegetation – Since most of Caliente is located within the Meadow Valley Wash 100-year floodplain, flooding creates a significant risk to human life.
2. The State of Nevada Caliente Youth Center (CYC) where the wash is relatively wide but is seriously impeded by the culvert-fill crossing on the entry road – The sediment wedge upstream of the CYC crossing is as much as 8 feet deep and from 200,000 to 300,000 cubic yards of sediment appear to have been deposited upstream of the crossing since 1984.
3. The location of the two-barrel culvert crossing (access to CYC) – The twelve foot diameter culverts on the CYC access road now have only 1.5 to 2.0 feet of free flow area due to sediment accumulation.
4. The U.S. Highway 93 bridge at the northeast end of Caliente that narrowly spans the wash – Sediment deposited in Meadow Valley Wash downstream of the northeast Highway 93 bridge appears to have been carried in from Clover Creek and deposited as a wedge.
5. The U.S. Highway 93 bridge at the southwest end of Caliente – This bridge with truss supports is only a few feet above the stream bed.

Following the completion of the Sunrise 2008 study, a few drainage improvements were made:

1. A portion of the linear park project was constructed based in part on the Sunrise 2008 study recommendations.
2. The two-barrel culvert crossing near CYC was removed and replaced by a bridge designed by Nevada Department of Transportation (DOT).

3. A pedestrian bridge access to Caliente Elementary School was rebuilt based on the Sunrise 2008 study recommendations.

Although these projects have improved the drainage conditions locally, flooding and sediment problems still exist throughout Caliente.

1.3 Scope of Work

Sunrise has been retained by Caliente to continue to develop solutions to the drainage problems. The current contract includes the following scope of services:

1. Data collection and review
2. Site Survey
3. Study update
4. Potential Project Identification & Analysis
5. Detailed Projects Analysis
6. Summary Report
7. Application for Funding
8. Incidental Project & Administrative Costs

2 DATA COLLECTION AND REVIEW

The collected and reviewed data include FEMA, 1985; Trudy Rhoades, 1992; Meadow Valley / Clover Creek Technical Review Team, 2000; Otis Bay Riverine Consultants, 2001; Bio-West, Inc., 2006; USGS, 2006; Northwest Hydraulic Consultants, 2007; and other collected documents related in the Sunrise report entitled Meadow Valley Wash Linear Park Improvements Hydrologic Data Collection and Engineering Review (Sunrise, 2007 B). FEMA updated and published its new Flood Insurance Study (FIS), Lincoln County, Nevada in 2010 (FEMA, 2010). Natural Channel Design, Inc. performed a geomorphic study entitled Meadow Valley Wash Geomorphic and Riparian Corridor Analysis and Practice Recommendations in 2014 (Natural Channel Design, Inc., 2014). Sunrise completed a stormwater planning study (master plan) for the City in 2016. These studies were also reviewed. Applicable design concepts regarding the floodplain improvements from these studies were adopted, modified, combined with other measures, and recommended in this report.

3 SITE SURVEY

Aero-Graphics, Inc. performed a LiDAR survey for the reaches of Meadow Valley Wash and Clover Creek within the Caliente City limits. A one-foot interval topographic contour map was developed by Sunrise using the survey data. The contour map was used to generate the geometric input data – cross sections for the hydraulic models (See Section 4).

Sunrise also performed a detailed GPS data survey of the crossing structures located within the City limits. The survey data provided control for the LiDAR survey and was used to generate the geometric input data – crossing structures for the hydraulic models (Section 4).

A contour map in PDF format, which was developed from the site survey was prepared for the City and is provided in Appendix C.

4 STUDY UPDATE

Based on the updated survey data and current watershed conditions, the hydrologic, hydraulic and sediment transport analysis and modeling previously conducted by Sunrise (Sunrise 2008) needs to be updated.

4.1 Watershed Hydrology

The purpose of the hydrologic analysis is to calculate and determine the peak storm water discharges and sediment loads generated and released from the two watersheds to the Caliente area (Figure 2). The detailed analysis and modeling in the Sunrise 2008 study was performed only for the Clover Creek watershed because a) most sedimentation problems in Caliente originate from the Clover Creek watershed according to the Meadow Valley / Clover Creek Watershed Management Plan (Phase I) (TRT, 2000, and Natural Channel Design, Inc., 2014) and site observations; b) published flood data (FEMA, 1985, and 2010) for Clover Creek was modeled based on a watershed area of 258 square miles which is smaller than the area delineated by Sunrise and other studies; and c) the available budget is limited. Hydrograph routing ended at the east city limits, approximately 3,400 feet east of the confluence of Meadow Valley Wash and Clover Creek.

The Clover Creek watershed before the confluence with Meadow Valley Wash encompasses an area of 364 square miles, and was delineated and divided into 15 sub-watersheds based on the USGS topographic maps (USGS, varied date) as shown in Figure 3.

Watershed hydrologic conditions were modeled using a hydrologic / hydraulic computer program, SEDCAD 4 for Windows, which was developed by the University of Kentucky (Warner, 2004). The SCS Unit Hydrograph method has been slightly modified to establish a more accurate prediction of disturbed lands and forested areas. Modeled rainfalls included the 2-, 5-, 10-, 25-, 50-, and 100-year return period storm events. Input data were established by analyzing the U.S. Geological Survey (USGS) topographic quadrangle maps (USGS, varied date), NOAA, FEMA and USGS rainfall data, NRCS soil reports, review of previous studies, and observations from site inspections.

4.1.1 Hydrologic Input Data

The input data for the 2008 hydrologic models (Sunrise, 2008) was modified based on updated rainfall and watershed conditions. The model input preparation sheets are included in Appendix D and briefly discussed here.

Storm Type

SEDCAD 4 uses the National Resources Conservation Service (NRCS, formerly Soil Conservation Service, or SCS) storm type distributions that are considered very conservative – i.e. the peak flow prediction based on the type distributions will be higher than almost any actual measured storm. In Nevada, the SCS Type II storm distribution should be applied and was used in this study.

Rainfall Depth

The rainfall data was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 1: Semi-arid Southwest (NOAA, Revised 2011). The point rainfall depths for the 2-, 5-, 10-, 25-, 50- and 100-year 24-hour storm events are respectively 1.66, 2.12, 2.49, 3.00, 3.40, and 3.81 inches (Appendix E).

NRCS Runoff Curve Number

Soil data was obtained from the NRCS and BLM soil surveys (SCS and BLM, 1976, and NRCS, 2000). The soil types in the watershed range from hydrologic group B (silt loam or loam) to D (clay loam, silty clay loam, sandy clay, silty clay, or clay) as presented in Figure 4 and described in Appendix F. The watershed is located in a semiarid mountainous area with sagebrush, under fair hydrologic conditions. The area-weighted NRCS runoff curve numbers (CN) for the soil cover estimated based on NRCS Technical Release 55 (NRCS, 1986) are from 60.0 to 69.8. The calculation procedure is outlined in Appendix D.

Time of Concentration

Both the total area and the hydraulically longest flow path for each sub-watershed were measured and calculated based on the watershed delineations. Time of concentration for a sub-watershed can be calculated within SEDCAD 4 by using the SCS runoff curve method and a Routing Calculator included in the program. The time of concentration consists of an initial flow component (combination of sheet flow and shallow concentrated flow) and a channel flow component. The flow lengths and slopes for each component were measured based on USGS maps (Figure 3) and presented in Appendix D.

Channel Routing Parameter

Muskingum routing was used to route the hydrographs down a watercourse. Category 8 (large gullies, diversions and low flowing streams) included in the SEDCAD 4 Routing Calculator was selected for the channel routing. The routing characteristics, obtained based on the drainage system networking (Figure 3), are included in Appendix D.

Unit Hydrograph Response Shape

The unit hydrograph methodology with a double triangle dimensionless unit hydrograph shape (DUHS) is used in SEDCAD 4 (Warner, 2004). Three different types of DUHS can be chosen to provide the model user with the opportunity to obtain a refined prediction of the storm hydrographs. The "medium DUHS" and "slow DUHS" types were used based on land cover types and engineer's judgment. The "medium DUHS" was developed for pasture land, land in row crops, small grain and legumes, pastures with less than 50% ground cover, and semi-arid mountain brush mixture and sagebrush with a grass understory and 30% or less ground cover. The "slow DUHS" was developed for heavily forested areas with thick ground residue covering greater than 75% of the surface.

Impact of Disturbed Areas

The total disturbed area, including the linear park and associated cut and fill areas, was estimated to be less than 0.2 square miles (approximately 0.05% of the 364-square mile total watershed area). Apparently, compared with the runoff from the undisturbed areas of the watershed, the additional runoff from the linear park improvements project is minimal. Therefore, the SEDCAD model did not account for the additional runoff from the disturbed areas.

4.1.2 Sedimentology Data

There are no changes to the input data for the 2008 sediment analysis models (Sunrise, 2008). However, the output was alternated from the 2008 models due to the hydrology update (Section 4.1.1). The model input preparation sheets are included in Appendix D and briefly discussed here.

Soil Particle Size Distribution

Based on the NRCS soil surveys (Appendix F, SCS and BLM, 1976, and NRCS, 2000), area-weighted particle size distributions for sub-watersheds were calculated and included in Appendix D. 50 soil samples were also taken from the stream beds of Meadow Valley Wash and Clover Creek. Soil gradation tests were conducted for these samples (CMT Engineering Laboratories, 2007) and the particle size distribution charts from these tests are included in Appendix G. The onsite soil samples were only used in the sediment transport analysis (Section 5.0).

Miscellaneous Sub-Watershed Sedimentology Input

A set of sediment-related factors – soil erodibility (K factor), representative slope length (L factor), representative slope (S factor), type of soil cover (C Factor) and control practices (P factor) – were calculated (area-weighted) or selected for each sub-watershed (Appendix D) based on the NRCS soil surveys (Appendix F, SCS and BLM, 1976, and NRCS, 2000), site conditions, and the gradation test results.

4.1.3 Upstream Control Structure Data

The Mathews Canyon and Pine Canyon dams are flood retarding structures. The runoff generated in sub-watersheds 5 (32.2 square mile Mathews Canyon drainage basin) and 9 (34.2 square mile Pine Canyon drainage basin) is regulated by the outlet structures. These reservoir-dam systems were modeled as detention ponds in SEDCAD. The stage-outflow relationships were developed based on site measurements and USGS topographic map data, and calibrated to match the available historical records.

4.1.4 SEDCAD Output

Hydrologic model results (for Clover Creek watershed) are included in output reports, hydrographs, and sediment graphs, all generated by SEDCAD (Appendix H). Important output data for peak discharge and sediment load are summarized in the following Tables.

Peak Discharge

Output hydrographs at the watershed outlet (C15, Figure 3) for the 24-hour 2-, 5-, 10-, 25-, 50-, and 100-year storm events are included in Appendix H-2. Peak discharges are listed in Table 1. Published FEMA peak discharges (FEMA, 2010) are also included for comparison purposes.

Table 1. SEDCAD Output – Peak Discharges from Clover Creek Watershed

Return Period (years)	SEDCAD Output (cfs)	FEMA Published (cfs)
2	130	N/A [1]
5	622	N/A
10	1,266	1,090
25	2,414	N/A
50	3,496	3,710
100	4,749	4,700

[1] N/A – not available

The discharges modeled using SEDCAD are higher than those published by FEMA (except the 50-year storm). It is the engineer's opinion that the differences were generated due to the different watershed areas and different approaches used in current SEDCAD models versus the FEMA study.

Sediment Load

The total sediment loads (including the bed load and the suspended load) at the watershed outlet (C15, Figure 3) generated by the modeled storm events are listed in Table 2. Sediment graphs modeled by SEDCAD are included in Appendix H-3.

Table 2. SEDCAD Output – Sediment Loads[1] from Clover Creek Watershed

Return Period (year)	Total Sediment Load (tons)	Approximate Volume[2] (yd^3)
2	7,738	5,210
5	43,416	29,240
10	99,347	66,900
25	209,753	141,250
50	319,526	215,170
100	451,594	304,100

[1] Sediment load – the total amount of sediment carried by a storm event through its duration, not necessarily the amount of sediment deposited in the channel in Caliente

[2] Volume – calculated based on 110 pounds per ft^3 (or 0.6734 yd^3 per ton) of sediment

4.2 Open Channel Hydraulics – Existing Conditions

Open channel hydraulic analysis provided the conceptual hydraulic design data for the floodway Improvements project. Hydraulic characteristics for open channels were modeled using the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center River Analysis System Model – HEC-RAS steady flow simulation (USACE, 2016). Two sets of HEC-RAS models were set up for the purposes of conceptual hydraulic design. The first set of models simulated the existing or pre-project conditions for the 10-, 25-, 50-, and 100-year storm events. The second set of models analyzed the conceptual design conditions. Input data were obtained from the up-to-date aerial survey contours and point survey for the crossing structures, hydrologic analysis results, soil sample tests, review of previous studies, and observations from site inspections.

The open channel hydraulic modeling was conducted on an 11,000 foot long reach of Meadow Valley Wash and a 6,600 foot long reach of Clover Creek. The upstream boundary of the modeled Meadow Valley Wash section is located approximately 3,400 feet northeast of the confluence of Meadow Valley Wash – Antelope Canyon, approximately 150 feet south of the north city limit. The upstream boundary of the modeled Clover Creek section is located about 3,200 feet east of the east city limit. The downstream boundary of the study area is located downstream of the confluence of Meadow Valley Wash – Newman Canyon, approximately 100 feet north of the south city limit. The total modeled river reach is approximately 17,600 linear feet (3.33 miles), 14,200 feet (2.69 miles) of which is located within the city limits. Existing crossing structures in the study area include the new Nevada DOT bridge crossing on Clover Creek near the CYC, an abandoned Union Pacific Railroad (UPRR) bridge 67 feet upstream of the confluence of Meadow Valley Wash – Clover Creek, a U.S. Highway 93 bridge 131 feet downstream of the confluence of Meadow Valley Wash – Clover Creek, three pedestrian bridges, and a U.S. Highway 93 truss bridge about 800 feet north of the confluence of Meadow Valley Wash – Newman Canyon.

4.2.1 Hydraulic Design Standard Selection

The final hydrologic and hydraulic design standard, generally either a 50-year or a 100-year storm event, will be discussed with the City (and, if needed, other government agencies), and will be selected by the City. In this study, 2-, 5-, 10-, 25-, 50- and 100-year events were modeled for the existing conditions.

4.2.2 HEC-RAS Hydraulic Model Input Data

Geometric Data

Cross-sections used to model the channel flows and crossings under the existing conditions were generated along Meadow Valley Wash and Clover Creek by using the survey data (Aero-Graphics, Inc., 2017, and Sunrise, 2017) and numbered using the river stations as shown in Figure 5. Each of the cross-sections were set wide enough to carry the 100-year peak discharge (see Steady Flow Data). River stations for the study boundaries, stream confluence and crossing structures are shown in Table 3 and Figure 5.

Table 3. River Stations

Channel	Element	Reach	River Station (ft)
Clover Creek (CC)	Confluence with Meadow Valley Wash	CC	10 + 00
	Abandoned UPRR Bridge	CC	10 + 78
	New Nevada DOT Bridge	CC	13 + 06
	Upstream Study Boundary	CC	76 + 24
Meadow Valley Wash (MVW)	Downstream Study Boundary	MVW	11 + 23
	Southwest U.S. Highway 93 Bridge	MVW	22 + 32
	New Pedestrian Bridge 1	MVW	41 + 79
	New Pedestrian Bridge 2	MVW	54 + 85
	Elementary School Pedestrian Bridge	MVW	77 + 28
	Northeast U.S. Highway 93 Bridge	MVW	84 + 74
	Confluence with Clover Creek	MVW	86 + 23
	Upstream Study Boundary	MVW	120 + 95

Manning's n values from 0.045 to 0.065 were utilized according to commonly used n values (USACE, 2003) that apply to the site conditions, and according to engineer's judgment.

Steady Flow Data

The discharges used to perform the steady state flow analyses are summarized in Table 4.

Table 4. Steady Flow Peak Discharges (cfs)

Return Period (year)	Clover Creek	Meadow Valley Wash	
		Upstream of Confluence	Downstream of Confluence
2	130	260	312
5	622	1,010	1,210
10	1,090	2,020	2,430
25	2,414	4,200	5,050
50	3,710	6,690	8,050
100	4,700	10,100	12,200

Clover Creek: Peak discharge values for the 2-, 5-, and 25-year storm events were obtained from the SEDCAD model results (Table 1). For the 10-, 50-, and 100-year events, FEMA FIS discharges were used (Table 1, or FEMA, 2010).

Meadow Valley Wash: For the 2-, 5-, and 25-year events, a Log Pearson III analysis (HEC FFA Model) was performed to generate the peak discharges downstream of Caliente. Historical flood data was obtained from the USGS gaging station (No. 09418500) located 4.5 miles southwest of Caliente. The Area Corrected Method (USGS, 1997) was then used to calculate the peak discharges upstream of the confluence with Clover Creek (Appendix I). For the 10-, 50-, and 100-year events, FEMA FIS discharges were used (Table 1, or FEMA, 2010).

Steady Flow Boundary Conditions

1. Clover Creek at Confluence – downstream control and junction with Meadow Valley Wash were used.
2. Meadow Valley Wash at Confluence – downstream control and junction with Clover Creek were used.
3. Meadow Valley Wash – downstream control and normal depth condition with local channel bottom slope 0.008 were used.

4.2.3 HEC-RAS Hydraulic Model Output

HEC-RAS steady flow hydraulic analysis was performed. The model output tables generated by HEC-RAS are included in Appendix J. Selected model results are listed in Tables 5 and 6.

Discussion

1. As related in Section 1.2, the two-barrel culvert located along Clover Creek (access to CYC) was the cause of acute hydraulic disruption and sediment accumulation. Based on Sunrise, 2008, "Peak flow from a 10-year storm event could overtop the north bank (elevation 4406.01) upstream of the culvert and inundate the CYC access road and the area in the vicinity with 1 foot of water. The inundation area extends further upstream when a higher event occurs. If this

crossing is not removed or replaced by a properly designed bridge, even a moderately frequent storm event can cause the crossing to fail and inundate the area in the vicinity of this structure". The updated HEC-RAS model results show that the new Nevada DOT bridge, which is the replacement structure for the two-barrel culvert crossing, was constructed completely above the 100-year floodplain. Therefore, the flooding problems previously caused by the two-barrel culvert should be mitigated.

2. The updated HEC-RAS model output indicates that, under the existing conditions, the peak flood of a 25-year storm passes through Caliente safely until it reaches the southwest U.S. Highway 93 bridge. Sediment has accumulated around the bridge, which results in only a few feet of clearance between the low member of the truss structure and the elevated (by sediment) stream bed. The bridge is submerged and the left bank upstream of the bridge could be overtopped if the truss openings are blocked by debris.
3. A 50-year storm event could cause inundation along Meadow Valley Wash starting at 1) the north Caliente city limits; 2) approximately 800 feet upstream of the new pedestrian bridge 2; and 3) approximately 1,200 feet upstream of the southwest U.S. Highway 93 bridge. If a 100-year event occurred in the Meadow Valley Wash watershed, the inundation area would extend further upstream of the study limit as shown in the FEMA FIRM (Appendix A). The existing conditions 100-year floodplain is shown in Figures 6. For comparison purposes, the effective FEMA FIRM was shown in the same figure.
4. Flow velocities in the modeled channel sections are generally low (Appendix J) because of the low gradient (average slope < 0.5%) of Meadow Valley Wash through Caliente. As a result, also because of the limited floodplain terrace width, it appears that an ideal self-cleaning channel design may not be feasible. The channel improvements may be accomplished through proper geomorphologic cross-section design and sediment control measures.

Table 5. HEC-RAS Model Results for Clover Creek – Existing Conditions

Return Period (year)	River Station (Location)	WSE [1] (ft)	Top Width (ft)	Avg. Velocity [2] (fps)	Note
25	10 + 78 (Abandoned UPRR Bridge)	4401.93	93.3	3.9	-
50		4404.96	108.4	4.0	4' Freeboard
100		4408.61	133.8	3.4	0.3' Freeboard
25	13 + 06 (New Nevada DOT Bridge)	4402.29	102.0	4.3	-
50		4405.30	136.9	4.1	5' Freeboard
100		4408.88	187.6	3.1	1.3' Freeboard

[1] WSE – water surface elevation

[2] Avg. Velocity – average velocity in channel

Table 6. HEC-RAS Model Results for Meadow Valley Wash – Existing Conditions

Return Period (year)	River Station (Location)	WSE[1] (ft)	Top Width (ft)	Avg. Velocity[2] (fps)	Note
25	22 + 32 (SW U.S. Hwy 93 Truss Bridge)	4370.58	150.2	3.9	Submerged
50		4378.69	1260.5	1.3	Overtopped
100		4380.20	1382.6	1.6	Overtopped
25	38 + 61 (Between Avery Rd and Tailor Ln)	4375.40	152.1	5.4	In channel
50		4378.89	2604.2	1.5	Inundation
100		4380.42	3321.6	1.3	Inundation
25	41 + 79 (New Pedestrian Bridge 1)	4377.40	118.8	7.1	In channel
50		4378.61	129.8	9.4	In channel
100		4380.77	1342.0	6.1	Inundation
25	54 + 85 (New Pedestrian Bridge 2)	4386.56	117.9	5.7	In channel
50		4389.55	2429.7	1.9	Inundation
100		4390.77	2451.5	2.0	Inundation
25	75 + 39 (Near Market St)	4396.30	96.6	7.6	In channel
50		4396.48	97.2	11.8	In channel
100		4400.91	1566.5	6.1	Inundation
25	77 + 28 (Elementary School Pedestrian Bridge)	4397.45	83.31	8.0	In channel
50		4399.17	88.47	10.3	In channel
100		4400.79	297.52	13.0	In channel
25	84 + 74 (NE U.S. Hwy 93 Bridge)	4401.34	86.9	7.0	In channel
50		4404.10	96.2	8.3	In channel
100		4408.14	1041.6	7.0	Inundation

[1] and [2] – same as Table 5.

4.3 Sediment Transport Analysis – Existing Conditions

The sediment transport analysis component of HEC-RAS is capable of simulating channel dynamic procedures to predict the movement of sediment in a river/stream setting based on one-dimensional quasi-unsteady open channel flow modeling. Sediment transport modeling uncertainty is in the range of 100% due to the fact that a one-dimensional model is trying to solve a difficult three-dimensional problem. Therefore, the purpose of the sediment transport analysis for the Caliente Floodway Improvements Project is to pinpoint problem areas, not to predict exact sediment loads. A sediment model requires a geometry data file, a quasi-unsteady flow data file, a sediment data file, and a sediment analysis plan file.

4.3.1 Sediment Design Standard Selection

Based on findings from collected data, observations from site inspections, and previous study (Sunrise, 2008), either the 2-, 5-, or 10-year storm event should be selected as the sediment design standard (for both the existing and the conceptual design conditions).

The Sediment transport analysis model needs two sets of input: quasi-unsteady flow data, and sediment data. The input data preparation sheets are included in Appendix K.

4.3.2 Quasi-Unsteady Flow Input Data

Clover Creek Upstream Inflow Hydrograph

Clover Creek hydrographs for the 2-, 5-, and 10-year events (10-year event modified to match FEMA FIS, 2010) were obtained from the SEDCAD model output (Appendix H-2) and tabulated as shown in Appendix K-1.

Meadow Valley Wash Upstream Inflow Hydrograph

Meadow Valley Wash inflow hydrographs upstream of the confluence with Clover Creek were first generated by assuming a similar shape as the Clover Creek hydrographs upstream of the confluence and matching the peak discharges shown in column 3 of Table 4. The hydrographs were then adjusted/shifted in order to generate the downstream hydrographs.

Meadow Valley Wash Downstream Hydrograph

Meadow Valley Wash hydrographs downstream of Caliente (combination of the upstream Meadow Valley Wash and Clover Creek hydrographs) were generated in HEC-RAS by adjusting/shifting the upstream hydrographs (postponing the time of concentration and peak time) until the combined hydrographs matched the peak discharges shown in column 4 of Table 4. The incremental change in discharge for each hydrograph was calculated at 0.2 hours for most time periods, and 0.0167 hours (1 minute) around the peak. Inflow hydrographs are shown in Appendix K-1.

Water Temperature

The water temperature for all calculations was set at 48 degrees Fahrenheit (48°F), which was obtained by averaging the available USGS gaging station (No. 09418500) records between the months of November and February from 1977 to 1984 (Appendix K-2). Winter months were used for the water temperature average since most floods along Clover Creek and Meadow Valley Wash have occurred during winter.

Boundary Conditions

Upstream boundary conditions for both Meadow Valley Wash and Clover Creek were set up using the flow series method by inputting the inflow hydrographs as described above. The normal depth method, similar to the steady flow model boundary conditions, was used for the downstream boundary condition of Meadow Valley Wash.

4.3.3 Sediment Input Data

Sediment Transport Equations

There are seven transport functions available in HEC-RAS. Yang's Equation for sand (Appendix K-3) was selected for current models since this equation is supported by data obtained in both flume experiments and field data under a wide range of conditions found in alluvial channels, e.g. sediment size, sediment concentration, channel widths, depths, water temperature, and average channel velocity (USACE, 2002).

Sorting Method

Active layer thickness and vertical bed layer tracking assumptions can be computed by selecting a sorting method (two methods available in HEC-RAS). HEC-RAS default Exner 5 method was selected in current models.

Fall Velocity Method

Rubey's equation was used to compute the particle fall velocities. Among the four fall velocity methods, Rubey's equation (Appendix K-3) has been shown to be adequate for silt, sand, and gravel grains (USACE, 2002).

Maximum Depth

The maximum depth of sediment that may be active for a given cross-section was arbitrarily set at 5 feet for most cross-sections. This number may be modified based on model results or observed conditions such as bedrock.

Mobile Cross-Section Limits

Lateral erosion limits were set at the channel banks since the channels were proposed to have sufficient protection to resist erosion damage.

Bed gradation Templates

Stream bed soil samples were taken approximately every 1,000 feet along Meadow Valley Wash throughout the study area. Soil samples of stream bed, sand bar, and banks were taken about every 1,000 feet along Clover Creek from the confluence with Meadow Valley Wash to just upstream of the confluence with Ash Canyon Wash. Soil particle size distributions (gradations) were generated through laboratory analysis of the field samples (Appendix G) and input to the HEC-RAS sediment transport model by assigning a representative bed gradation to each cross-section.

Sediment Transport Boundary Conditions

Clover Creek Upstream – a flow-sediment load rating curve, defined as the total sediment load (tons/day) delivered to the boundary for a given discharge (cfs), was used as the sediment boundary condition at the upstream Clover Creek boundary. The sediment loads and related discharges for the 2-, 5-, and 10-year events, called flow-load points, were obtained from the SEDCAD model output (Tables 1 and 2). For the rating curve, the gradational character of the sediment load must be specified for each flow-load point. With the absence of field data, the gradational character of the sediment loads for each flow-load point was determined by calculating transport rates for the various size fractions taken directly from the sediment transport equation – Yang's Equation (Appendix K-4). Variables in Yang's Equation that were dependent upon channel geometry were calculated using a typical cross-section shape and channel slope near the upstream Clover Creek boundary.

Meadow Valley Wash Upstream – the equilibrium load boundary condition, assuming the sediment inflow equals the sediment capacity, was used since Meadow Valley Wash upstream of the confluence with Clover Creek does not appear to have serious sedimentation problems.

Meadow Valley Wash Downstream – a downstream pass through boundary condition, meaning that sediment material transported out of the downstream control volume is precisely equal to the inflow material, was used in current models.

Sediment Properties

HEC-RAS default sediment properties were used: specific gravity = 2.65, unit weight of sand and gravel = 100 lb/ft^3, unit weight of silt = 80 lb/ft^3, unit weight of clay = 70 lb/ft^3.

4.3.4 HEC-RAS Sediment Transport Model Output

HEC-RAS sediment transport analysis models were performed for the existing conditions. The model output tables and profiles showing the streambed changes during the modeled storm events, both generated by HEC-RAS, are included in Appendix L. Based on the model results, channel aggradations generally occur in the following sediment areas in Caliente (Figure 7):

Clover Creek

Sediment Area 1:	River Station 10+00 to 26+00, a 1,600 foot section at and upstream of the confluence of Meadow Valley Wash – Clover Creek.

Meadow Valley Wash

Sediment Area 2:	River Station 77+00 to 92+00, a 1,500 foot section around the confluence of Meadow Valley Wash – Clover Creek, both upstream and downstream of the northeast U.S. Highway 93 bridge; and
Sediment Area 3:	River Station 21+00 to 23+00, around the southwest U.S. Highway 93 bridge, adjacent to the downstream boundary of the study area.

In addition, the model output also shows that sediment could accumulate between River Stations 45+00 and 68+00 in Meadow Valley Wash during a high frequency event (2-year storm) and be washed away downstream during a larger event (5- or 10-year storm).

Discussion

The Sunrise 2008 report stated that the two-barrel culvert crossing (access to CYC) over Clover Creek caused acute stream bed aggradation and hydraulic problems. Also, sediment generated from a 5-year 24-hour storm in the Clover Creek watershed created channel bed aggradation as high as 3 feet at the upstream end of the two-barrel culvert.

The updated HEC-RAS model results show that the new Nevada DOT bridge will allow sediment to pass through at this location (Appendix L). Therefore, the six sediment areas identified in the 2008 study results (Sunrise, 2008) are now reduced to three: upstream of the confluence of Meadow Valley Wash – Clover Creek, in the vicinity of the confluence of Meadow Valley Wash – Clover Creek, and from the southwest U.S. Highway 93 bridge to the southwest Caliente city limits. The model output also shows that degradation will occur upstream and between the sediment areas. During the site inspection, serious bank erosion problems were observed within a broad area along the Meadow Valley Wash channel (Appendix B).

5 DESIGN RECOMMENDATIONS

After discussing with the City, collecting and analyzing the available studies, publications and other data (Sunrise, 2007B; Sunrise, 2008; FEMA, 2010; Natural Channel Design, Inc., 2014; and Sunrise 2017) and performing the hydrologic and hydraulic model runs (Section 4), eight potential floodway improvements projects were preliminarily proposed.

5.1 Description of Potential Projects

Potential Project 1 – Clover Creek

This potential project is located along a reach of Clover Creek between the confluence of Meadow Valley Wash – Clover Creek and the east Caliente city limits. Two proposed improvements make up Potential Project 1.

First, a riprap sediment control structure or a three-foot-high, 4% slope riprap drop structure is proposed in the Clover Creek channel near the CYC, at CC River Station 37+00, about 2,700 feet upstream of the confluence with Meadow Valley Wash (Figure 8). The purpose of the structure is to trap sediment at this location to minimize the future possible accumulation of sediment in the downstream channel bed. The channel would be flattened from the east city limit to the structure to help trap sediment. The structure would be designed for high and moderate frequency flooding events (small storms) and would have little significant impact on the passage of major events.

Second, the channel section near the CYC, from approximately CC River Station 13+80 (60 feet upstream of the new Nevada DOT bridge) to 17+80, would be slightly modified at the right bank (looking downstream) to facilitate adequate channel capacity to contain the 100-year peak flood. Proposed modifications would include cleaning up the streambed between CC River Station 7+00 and the proposed sediment/grade control structure, for passing base flows and moderately frequent storm flows (up to 25-year events, see Potential Project 3 – Meadow Valley Wash (North) for details). Modifications would also include the removal of existing manmade berms upstream of the proposed sediment/grade control structure.

If this project is completed, as shown in Figure 8 (approximated floodplain), the flooding problems near the CYC due to a 100-year flood event could be resolved. Also, the majority of the sediment generated in the Clover Creek watershed would be deposited upstream of the grade control structure.

Potential Project 2 – Antelope Canyon

This potential project is located on 1) Meadow Valley Wash between the northeast U.S. Highway 93 bridge and a location 1,200 feet upstream of Antelope Canyon Wash, from approximately MVW River Station 84+90 to 111+50; and 2) a short reach of Antelope Canyon Wash upstream of the confluence of Meadow Valley Wash – Antelope Canyon Wash. The proposed improvements would largely consist of replacing an existing culvert structure crossing under U.S. Highway 93, approximately 400 feet north of the confluence, as well as channel improvements.

The existing culvert, owned by Nevada DOT, was sized significantly smaller than necessary. The 2010 FEMA FIS illustrates that a 100-year flood overtops the culvert by two plus feet (FEMA, 2010, also see the FIRM sections included in Appendix A). This crossing was preliminarily resized using the Federal Highway Administration (FHWA) computer program HY8 that is coded in the Integrated Drainage Design Software HYDRAIN for Windows (FHWA, 1999). Based on the model results (Appendix M), a two-barrel 20' × 12' concrete box culvert (or a properly designed bridge) could safely pass the 100-year peak discharge of 4,018 cfs (4,492 cfs according to Sunrise, 2016).

The channel section around the confluence of Meadow Valley Wash – Clover Creek, from approximately MVW River Station 84+90 to 91+90, would be slightly modified at the left bank (looking downstream) to facilitate adequate channel capacity to contain the 100-year peak flood. Additionally, cleaning up the streambed between the confluence of Meadow Valley Wash – Clover Creek and the confluence of Meadow Valley Wash – Antelope Canyon Wash is proposed to more efficiently pass base flows and moderately frequent storm flows (up to 25-year events, see Potential Project 3 – Meadow Valley Wash (North) for details).

If this project is completed, as shown in Figure 8 (approximated floodplain), the flooding problems due to a 100-year flood event in this area could be resolved.

Potential Project 3 – Meadow Valley Wash (North)

This potential project consists of channel modifications to improve floodway conditions. Proposed improvements would include channel restoration by widening, terracing and extracting sediment from an approximately 3,240 linear foot reach of Meadow Valley Wash, from approximately MVW River Station 52+50 to 85+10. The proposed channel geometry improvements would be as follows (and shown in Figure 9):

1. A conceptual bank-full channel designed to pass base flows and frequent storm flows (2-year events). The primary function of this channel would be to successfully transport sediment. This channel should remain free of vegetation. The width/depth ratio should be larger than 25 – typical for sand bed channels. The side slope of the channel should be 3 : 1 (horizontal : vertical).
2. A conceptual geomorphic floodplain designed to carry moderately frequent storm flows (up to 25-year events). However, this channel feature could be flooded annually or every couple of years and should not contain any structures. The side slope of this area should be maximum 2 : 1. Riprap or vegetation is proposed at all sections to stabilize the channel banks and protect the channel from possible erosion and scour damage.
3. A conceptual floodplain terrace designed to carry high and extreme floods (100-year events). This channel tier could be used for trails that can withstand periodic flooding. However, appropriate roughness should be maintained. The side slope for this area may vary from 2 : 1 to 3 : 1.

This potential project also includes installation of bank protection measures (riprap or gabions) at a section of the left bank slope, downstream of the elementary school pedestrian bridge, at which the bank material has been washed away and the slope is unstable.

Furthermore, the sediment and debris that has accumulated under and around the existing northeast U.S. Highway 93 bridge would be completely removed. The HEC-RAS model results (Appendix J, and Table 6) show that without removing sediment and reconfiguring the bridge structure (to have no or minimal influence on the channel hydraulics and sediment transport), it is impossible to safely pass a 100-year flood without overtopping the left bank.

When this project is completed, as shown in Figure 8 (approximated floodplain), the majority of the flooding problems due to a 100-year flood event in this area could be resolved (if the highway bridge is properly replaced).

Potential Project 4 – Meadow Valley Wash (South)

This potential project consists of channel modifications to improve floodway conditions. Proposed improvements would include channel restoration by widening, terracing and extracting sediment from an approximately 3,550 linear foot reach of Meadow Valley Wash, from approximately MVW River Station 17+00 to 52+50. The proposed channel geometry improvements would be as described in Potential Project 3 – Meadow Valley Wash (North).

The existing southwest U.S. Highway 93 bridge significantly lowers the flow and sediment transport capacity of Meadow Valley Wash at this location (see photos in Appendix B). The HEC-RAS model results (Appendix J, and Table 6) show that without removing and reconfiguring the bridge structure (to have little to no influence on the channel hydraulics and sediment transport), it is impossible to safely pass either a 50- or 100-year flood event without overtopping both banks.

When this project is completed, as shown in Figure 8 (approximated floodplain), the majority of the flooding problems due to a 100-year flood event in this area could be resolved (if the highway bridge is removed and replaced).

Additionally, there are several sections of existing levees built along the east and west banks of Meadow Valley Wash within the reaches for Potential Projects 3 and 4. These levees do not meet design standards for FEMA certification. Therefore, it is assumed that these levees would be removed with the construction of the floodway improvements project. Also, new levees (or similar flood control structure) are proposed at several sections on both sides of Meadow Valley Wash to provide a minimum of one-foot freeboard when a 100-year peak flow passes through Caliente. A gravel road between the residential homes and the southeast bank of Meadow Valley Wash would be maintained as a maintenance alley.

<u>Potential Project 5 – Meader Canyon</u>

According to Caliente, large amounts of rocks and cobbles discharge from Meader Canyon to Meadow Valley Wash during storm events (Appendix B). While it is ideal to keep the sediment within Meader Canyon by building a sediment/debris basin upstream of the confluence with Meadow Valley Wash (Figure 8), the availability of adequate land for such a structure is an issue. Therefore, grade control structures along the reach of Meader Canyon wash could provide some relief to sediment deposition issues, however, frequent maintenance and cleaning of grade control structures would be required. Note: there are no flooding problems at this site.

<u>Potential Project 6 – Newman Canyon</u>

Large amounts of sediment generated in Newman Canyon deposit in Meadow Valley Wash with the storm runoff from this canyon (Appendix B). Newman Canyon hydrology was not analyzed in the 2010 FEMA FIS. Therefore, based on the results from a preliminary hydrologic model (HEC-1), the 2-, 5-, 10-, 25-, 50- and 100-year 24-hour peak discharges from this canyon are respectively 324, 712, 1,064, 1,632, 2,096, and 2,615 cfs, and the related total runoff volumes 155, 307, 438, 645, 813, and 1,000 acre-feet, respectively (see Appendix N). Sediment loads generated in the watershed during these events are estimated to be very high. Therefore, it would be ideal to keep the sediment within Newman Wash by building a sediment/debris basin upstream of the confluence with Meadow Valley Wash (Figure 8). This proposed project would be similar to a debris basin constructed in Spring Heights, though a Newman Canyon sediment/debris basin would be much larger. Generally speaking, a debris basin at this site could not be constructed large enough to be used as a detention basin for low frequency events due to the high flows and large total runoff volumes.

This project would also include lowering the City's sewer main line which crosses Meadow Valley Wash approximately 1,000 feet downstream of the southwest US Highway 93 bridge.

Potential Project 7 – Diversion Channel

This potential project consists of an earthen diversion channel between Clover Creek (or upper Meadow Valley Wash) and a location downstream of the southwest U.S. Highway 93 bridge, as shown in Figure 10. Limited by the available space, the maximum top width of a diversion channel would be approximately 50 feet. Assuming the channel is designed with 2 : 1 (horizontal : vertical) side slopes, 8 foot depth, and 1 foot freeboard, the conveyance capacity of the channel would be approximately 3,200 cfs. This potential project would provide adequate flood protection to Caliente during a 25- or 50-year event. However, to achieve adequate flood protection during a 100-year event, this potential project would need to be combined with portions of Potential Projects 3 and 4. Additionally, where the diversion channel meets back up with Meadow Valley Wash, the flow coming from the diversion channel would likely deposit large amounts of sediment within Meadow Valley Wash.

5.2 Preliminary Evaluation of Potential Projects

To assist in evaluating and comparing the potential projects, an evaluating and ranking matrix consisting of five criteria with a range of point values was developed. The matrix was built to attempt to conceptually evaluate the recommended projects over a range of criteria. The focus was to select a limited number of approximately independent criteria that should cover a reasonable range of factors that impact design alternative selection.

5.2.1 Evaluation Criteria

The five evaluated criteria include level of flood control, level of sediment control, project cost, jurisdictional impact, and maintenance. These evaluation criteria cover a wide range of factors that are considered to be the most significant factors when comparing alternatives. Not all criteria are weighted equally. More significant criteria are weighted more by having higher maximum point values. The criteria given the most weighting are the level of flood control, and project cost. The evaluation criteria with corresponding ranges in point values are present in Table 7.

Table 7. Design Alternative Evaluation Criteria

Evaluation Criteria	Range of Point Values
Level of Flood Control	1 to 15
Level of Sediment Control	1 to 12
Project Cost	1 to 15
Jurisdictional Impact	1 to 10
Maintenance	1 to 8

Level of Flood Control

This criterion allows the ranking of alternatives based on the degree of flood control measures provided within the project. Because of the serious flooding problems existing in Caliente, this criterion is one of the most important factors of the project and given the most weighting – with point values ranging from 1 to 15. In the evaluating and ranking matrix, an alternative which provides flood control at a 100-year level would be assigned a higher point value than an alternative that provides flood control to lower levels.

Level of Sediment Control

This criterion allows the ranking of alternatives based on the degree of the sediment control measures provided within the project. Because of the serious sedimentation problems existing within Caliente, this criterion is another very important factor of the project and is given a high weighting – with point values ranging from 1 to 12. In the evaluating and ranking matrix, an alternative which provides good sediment control would be assigned a higher point value than an alternative that provides little to no sediment control.

Project Cost

Project cost is a key or critical factor that has great impact on a potential project. Total project costs would include factors such as study, survey, legal process, land purchase, right of way and easement acquisition, geotechnical investigation, design and planning, construction, construction management, environmental mitigation, contingency, and all other costs directly related to a project. Maintenance costs are evaluated as another criterion (see below). Instead of a detailed capital analysis of the current conceptual design phase of a project, cost evaluation is performed by assigning a point value to each alternative through a cost comparison at a conceptual level. The point values for this criterion range from 1 to 15. In the evaluating and ranking matrix, higher cost alternatives would be assigned lower point values, while lower cost alternatives would be assigned higher values.

Jurisdictional Impact

Land and facilities within the study area are owned by the City, Lincoln County, State of Nevada, and private land owners. The jurisdictional impact criterion reflects the degree of impact from the rules, regulations, and other restrictions by federal and local government agencies other than the City, as well as dealing with potential issues related to private landowners. This criterion is an important factor to the project, but not as critical as the level of flood and sediment control and project cost. Therefore, the point values for this criterion range from 1 to 10. In the evaluating and ranking matrix, an alternative with significant impacts from agencies and private landowners would be assigned a lower point value than an alternative that has insignificant impacts.

Maintenance

This criterion reflects the degree of post-project maintenance work that the City will conduct to maintain proposed flood control improvements in a functioning and satisfactory manner. Maintenance is a long-term effort and an important factor to a project, but not as critical as the other criteria discussed previously. Therefore, the point values for this criterion range from 1 to 8. In the evaluating and ranking matrix, an alternative that has significant maintenance requirements would be assigned a lower point value than an alternative that requires a lower level of maintenance.

5.2.2 Evaluating and Ranking Matrix

The alternatives were evaluated by assigning a point value for each individual evaluation criterion based on the relative merit of a specific alternative compared to other alternatives, as discussed in Section 5.2.1. The point values for the entire evaluation criteria for a particular alternative were then totaled and a point value assigned to the alternative. The evaluating and ranking matrix created for the potential projects is presented in Table 8.

Table 8. Preliminary Evaluating and Ranking Matrix

Evaluation Criteria	Potential Project						
	1	2	3	4	5	6	7
Level of Flood Control	2	7	14	15	2	4	8
Level of Sed. Control	12	6	7	7	9	12	2
Project Cost	5	4 [1]	2 [2]	2 [3]	8	5	1
Jurisdictional Impact	4	2 [4]	2 [4]	2 [4]	1 [4]	2 [4]	4
Maintenance	1	4	2	2	1	1	4
Total Points	24	23	27	28	21	24	19
Ranking	4	5	2	1	6	3	7

[1] Replacement of Antelope Canyon culvert and midlevel channel modifications

[2] Replacement of northeast U.S. Highway 93 bridge and significant channel modifications

[3] Replacement of southwest U.S. Highway 93 bridge and significant channel modifications

[4] Coordination with Nevada DOT, Lincoln County, and/or private land owners

Based on the preliminary evaluation, the evaluation matrix ranked Potential Project 4 the highest with a total of 28 points based on the high level of flood control. The second highest ranked project is Potential Project 3, which received a total of 27 points, also based on the high level of flood control. Potential Project 7 received the lowest ranking based on its high cost and low level of sediment control, high probability for jurisdictional impact and high maintenance over the life of the project.

6 CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

The analyses completed in this study placed an emphasis on Clover Creek watershed hydrology, and open channel hydraulics and sediment transport along Meadow Valley Wash within Caliente. Based on the study, the following conclusions and preliminary recommendations are made.

6.1 Conclusions

1. The main flooding problems associated with Meadow Valley Wash within Caliente are the result of a low gradient streambed, significantly unregulated channel sections, and insufficient flow capacities of crossing structures.
2. Sediment deposited within Caliente is generated from the Clover Creek watershed, as well as Meader and Newman Canyons.
3. An ideal self-cleaning channel design is not feasible due to the low channel gradient and the limited floodplain terrace width available along Meadow Valley Wash through Caliente.
4. Channel widening, terracing and extracting sediment without removing or reconfiguring crossing structures cannot effectively improve the hydraulic and sediment conditions for the drainage system.
5. Floodway improvements were proposed as individual projects located along various river sections. These potential projects were evaluated based on selected criteria.

6.2 Preliminary Recommendations

1. <u>Projects 4 and 3 – Meadow Valley Wash</u> – channel modifications, bridge reconfiguration or removal and replacement, and levee installations are recommended when funding is available. These projects are costly and involve working with Nevada DOT and private landowners. However, if implemented, these projects would have a significant positive benefit on flood control in the area. The majority of the mapped FEMA inundation areas within Caliente could be removed from the floodplain with the completion of these projects.
2. <u>Project 6 – Newman Canyon</u> – construction of a debris basin along Newman Canyon wash is the next recommended project. While heavy maintenance would be required to operate this project, the sedimentation problems caused by deposition from Newman Canyon are significant and would be greatly improved by the installation of a debris basin. Another benefit would be flood control for frequent storm events.
3. <u>Project 1 – Clover Creek</u> – construction of a riprap sediment control structure and completion of minor channel modifications to Clover Creek between the east city limits and the confluence with Meadow Valley Wash is the next recommended project. The cost of this project is relatively low, and the expected sediment control level is high.
4. <u>Project 2 – Antelope Canyon</u> – replacement of an existing culvert structure crossing U.S. Highway 93, some channel modifications and cleanup is recommended next. The cost of the project and the jurisdictional impact (working with Nevada DOT) on the project are moderate. However, effective flood control benefits are high. A large inundation area mapped by FEMA could potentially be removed from the 100-year floodplain with the completion of this project.
5. <u>Project 5 – Meader Canyon</u> – construction of grade control structures in Meader Canyon is the next recommended project. The cost would be quite low when compared to the other potential projects. However, the jurisdictional impact on this project would be high due to private landowners. Heavy maintenance would also be required.

6. Project 7 – Diversion Channel – is not recommended for development. This project is very costly, and while it could divert flood flow from Meadow Valley Wash or Clover Creek, the potential for significant sediment deposition in Meadow Valley Wash where the diversion channel returns is a significant deterrent for development. Also, this project would need to be combined with a portion of Projects 3 and 4 in order to provide protection from the 100-year event.

7 SELECTION OF ALTERNATIVES FOR DETAILED ANALYSIS

The top three projects from the Preliminary Evaluating and Ranking Matrix (Table 8) were selected for further detailed analysis and recommendations. The top three projects are as follows:

1. Project 4 (Prioritized Project 1) – Meadow Valley Wash (South)
2. Project 3 (Prioritized Project 2) – Meadow Valley Wash (North)
3. Project 6 (Prioritized Project 3) – Newman Canyon

8 DETAILED ANALYSIS AND RECOMMENDATIONS

A detailed analysis was performed for each prioritized project selected by Caliente.

8.1 Prioritized Project 1 – Meadow Valley Wash (South)

The existing conditions HEC-RAS model (see Section 4.2) was modified between MVW River Stations 17+00 and 52+50. These modifications included 1) construction of a new southwest U.S. Highway 93 bridge to have minimal influence on the channel hydraulics and sediment transport, and to pass a 100-year peak flood; 2) cleaning up the streambed by removing the accumulated sediment; 3) improving channel geometry as described in Section 5.1; and 4) if needed, adding levees (or similar flood control structure) at the river banks.

Model outputs show that following construction of a new southwest U.S. Highway 93 bridge, the Meadow Valley Wash channel conveys the 50-year peak flood (8,050 cfs) safely up to MVW River Station 39+00 (Avery Road) where the right bank (looking downstream) is overtopped from this location upstream. To maintain the 100-year peak flow (12,200 cfs) within the Meadow Valley Wash channel, levees (or similar flood control structure) are required on both river banks. The resulting overtopping water depths vary from 0.5 to 4.0 feet.

8.2 Prioritized Project 2 – Meadow Valley Wash (North)

The existing conditions HEC-RAS model (see Section 4.2) was modified between MVW River Stations 52+50 and 86+00. These modifications, similar to prioritized project 1, included 1) replacing the northeast U.S. Highway 93 bridge to have minimal influence on the channel hydraulics and sediment transport, and to pass a 100-year peak flood; 2) cleaning up the streambed by removing the accumulated sediment; 3) improving channel geometry as described in Section 5.1; and 4) if needed, adding levees at the river banks (or similar flood control structure). Removal of the abandoned UPRR bridge on Clover Creek would have no impact on the Meadow Valley Wash hydraulics.

Model output shows that after reconfiguration of the existing northeast U.S. Highway 93 bridge, the Meadow Valley Wash channel conveys the 50-year peak flood (8,050 cfs) safely between approximately MVW River Stations 75+00 (200 feet southwest of Locust Street) and 86+00 (immediately downstream of the confluence of Meadow Valley Wash – Clover Creek), and either the right or left bank (looking downstream) or both are overtopped along the rest of the project reach. To maintain the 100-year peak flow (12,200 cfs) in the Meadow Valley Wash channel, levees (or similar flood control structure) are required on both banks. The resulting overtopping water depths vary from 0.5 to 5.5 feet.

8.3 Prioritized Project 3 – Newman Canyon

See Section 8.4.2.

8.4 Cost Estimate

Based on the hydraulic analysis results, construction costs for each prioritized project was estimated.

8.4.1 Cost of Prioritized Projects 1 and 2

Any improvements to both the southwest and northeast U.S. Highway 93 bridges cannot be conducted by Caliente since Nevada DOT owns the bridges and the City is not permitted to proceed with any work within the highway right of way under the structures. Therefore, the costs developed for the prioritized projects 1 and 2 include channel modifications and levee construction.

The proposed channel geometry improvements are described in Section 5.1 and shown in Figure 9. It was estimated that approximately 63,000 and 60,000 cubic yards of sediment material would be required to be removed from the prioritized projects 1 and 2, respectively. In addition, 25,500 and 24,000 cubic yards of riprap material would need to be installed for bank protection, respectively.

According to the updated FEMA design criteria, for a levee or levee system to be recognized as providing a 1-percent-annual-chance (100-year) level of flood protection on the FEMA digital FIRMs (accrediting levee systems on NFIP flood maps), the system must meet strict requirements. Three of the requirements are 1) minimum crest width of 10 to 12 feet; 2) floodwater side slope of 2.5: 1 (h: v) and land side slope of 3: 1 (h: v); and 3) minimum freeboard of 3 feet above the Base Flood Elevation (BFE, 100-year flood elevation). To meet these requirements, the minimum base width of the levees proposed for the projects was estimated to be 29.25 feet for a 0.5-foot deep overtopping flood depth, and 56.75 feet for a 5.5-foot deep overtopping flood depth. If sand material is used, a 5: 1 (h: v) land side slope is required, which results in 36.25 to 73.75 feet of levee base width, respectively. Limited by the site conditions, construction of a FEMA accredited levee system along Meadow Valley Wash within Caliente would not be possible.

A suitable alternative to levee construction would be the installation of reinforced concrete counterfort flood walls along both banks of Meadow Valley Wash within the study reaches. The height of the walls would range from 1.5 to 6.5 feet above grade to meet the FEMA 1-foot freeboard requirement for flood walls. The width of the walls was estimated to be 10 or 12 inches. The lengths of the walls are 6,650 and 5,500 feet for the prioritized projects 1 and 2, respectively. FEMA floodwall requirements are included in Appendix O.

Based on the quantities, the construction costs were estimated and are summarized in Table 9. Detailed cost estimates are included in Appendix P.

Table 9. Cost Estimate (US Dollars)

Pay Item	Prioritized Potential Project	
	1	2
PROJECT CONSTRUCTION COSTS		
Mobilization	$50,000	$50,000
Site Preparation, Cleaning and Grubbing, Selective Tree Removal	$50,000	$50,000
Sediment Removal	$820,000	$781,000
Earth Work on Stream Banks	$100,000	$100,000
Riprap Installation	$352,000	$344,000
Foundation Trench	$246,000	$204,000
Buttress Flood Wall Installation	$1,347,000	$1,124,000
PROFESSIONAL & INCIDENTAL COSTS		
Funding Administration	$15,000	$15,000
Environmental Assessment	$50,000	$0
Utility & Topographic Mapping	$10,000	$10,000
Parcel Tract Map & Easement Documents	$20,000	$20,000
Geotechnical Investigation	$15,000	$15,000
Engineering Design	$300,000	$250,000
Bidding & Negotiating	$12,000	$12,000
Engineering Construction Services	$325,000	$300,000
FEMA CLOMR & LOMR including review fees	$0	$46,500
Attorney Fees	$20,000	$20,000
Miscellaneous Incidental Administration	$50,000	$50,000
20% Contingency	$756,000	$678,000
Inflation Rate	3%	3%
Total	$5,416,000	$4,857,000

[1] Based on RSMeans Heavy Construction Data

[2] Replacement of northeast and southwest U.S. Highway 93 bridges not included

Construction cost estimates also take into account inflation, assuming the projects would not be constructed until at least two years from now.

8.4.2 Cost of Prioritized Project 3

Construction of a debris basin along Newman Canyon wash would be similar to, but much larger than the debris basin project constructed in Spring Heights. The 100-year peak discharge from Newman Canyon, 2,615 cfs, is more than 10 times higher than Spring Heights, 254 cfs. Based on the hydrologic model, the 2-, 5-, 10-, 25-, 50- and 100-year 24-hour peak discharges from Newman Canyon are respectively 324, 712, 1,064, 1,632, 2,096, and 2,615 cfs, and the related total runoff volumes are 155, 307, 438, 645, 813, and 1,000 acre-feet, respectively. Therefore, it is not feasible to construct a debris basin at the Newman Canyon site that could be used as a detention basin for the high flows and large total runoff volumes, while still retaining sediment on site and safely passing the 100-year flood. Construction of a smaller debris basin to control higher frequency events while still being able to safely pass a 100-year flood would be the most viable option. Therefore, it is assumed that construction of a debris basin in Newman Canyon that is three times larger than the Spring Heights project would be possible. Based on the development costs of the Spring Heights debris basin (approximately $730,000), lowering of the City's sewer main line located approximately 1,000 feet downstream of the southwest US Highway 93 bridge, and a 3% inflation rate, the cost for implementing prioritized project 3 was estimated to be approximately $3,000,000.

9 REFERENCES

Aero-Graphics, Inc., 2007. Aerial Photogrammetric Survey for the City of Caliente, Two-foot Interval Contour Map and Electronic Files (Surface Model).

Bio-West, Inc., 2006. Meadow Valley Wash – Final Baseline Ecological Assessment and Imagery.

Clover Creek Technical Review Team, 2000. Meadow Valley/Clover Creek Watershed Management Plan (Phase I).

Federal Highway Administration (FHWA), 1999. HYDRAIN for Windows – Integrated Drainage Design Computer System, Office of Technology Application, Washington, DC.

FEMA, 1985. Flood Insurance Study, City of Caliente, Lincoln County, Nevada.

FEMA, 2010. Flood Insurance Study, City of Caliente, Lincoln County, Nevada.

NOAA, 2006. NOAA Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 1, Version 4.0: Semiarid Southwest.

Northwest Hydraulic Consultants, 2007. 1583 DR – Nevada Awareness Mapping, Caliente, Lincoln County. Prepared for FEMA Region IX.

NRCS, 1986. Technical Release No. 55 (TR-55), Urban Hydrology for Small Watersheds. Room 326W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410.

NRCS, 2000. Soil Survey of Lincoln County, Nevada, South Part.

Otis Bay Riverine Consultants, 2001. Meadow Valley Wash Site Assessment for Flood Risk Improvement.

PBS&J, 2007. Geomorphic Assessment – Condor Canyon, Prepared for BLM, Ely Field Office.

Resource Concepts, Inc., 2006. Meadow Valley Wash Post-Flood Damage Assessment and Recommendations. Prepared for the BLM, Ely Field Office.

RSMeans Construction Publishers & Consultants, 2025. Heavy Construction Cost Data. 700 Longwater Drive, Norwell, MA 02061.

Rhoades, T., 1992. Erosion Sites Baseline Data Monitoring Summary Report. Caliente Resource Area NV-055.

SCS and BLM, 1976. Soil Survey of Meadow Valley Area, Nevada – Utah, Parts of Lincoln County, Nevada, and Iron County, Utah.

Sunrise Engineering, Inc., 2007 A. Detailed Survey for Eight Crossing Structures on Meadow Valley Wash / Clover Creek within the City of Caliente limits.

Sunrise Engineering, Inc., 2007 B. Meadow Valley Wash Linear Park Improvements Hydrologic Data Collection and Engineering Review.

Sunrise Engineering, Inc., 2008. Meadow Valley Wash Linear Park Improvements – Hydrologic / Hydraulic / Sediment Analysis.

Sunrise Engineering, Inc., 2016.

Sunrise Engineering, Inc., 2017. Detailed Survey for Eight Crossing Structures on Meadow Valley Wash / Clover Creek within the City of Caliente limits.

USACE, 2002. HEC-RAS, River Analysis System Hydraulic Reference Manual, Version 3.1. USACE Institute of Water Resources Hydrologic Engineering Center, 609 Second Street, Davis, CA 95616.

USACE, 2006. HEC-RAS, River Analysis System User's Manual, Version 4.0 Beta. USACE Institute of Water Resources Hydrologic Engineering Center, 609 Second Street, Davis, CA 95616.

USACE, Los Angeles District, 2006 A. Mathews Canyon Dam.

USACE, Los Angeles District, 2006 B. Pine Canyon Dam.

USGS, Date Varied. 7.5-Minute Series Topographic Quadrangle Maps.

USGS, 1997. Methods for Estimating Magnitude and Frequency of Flood in the Southwestern United States.

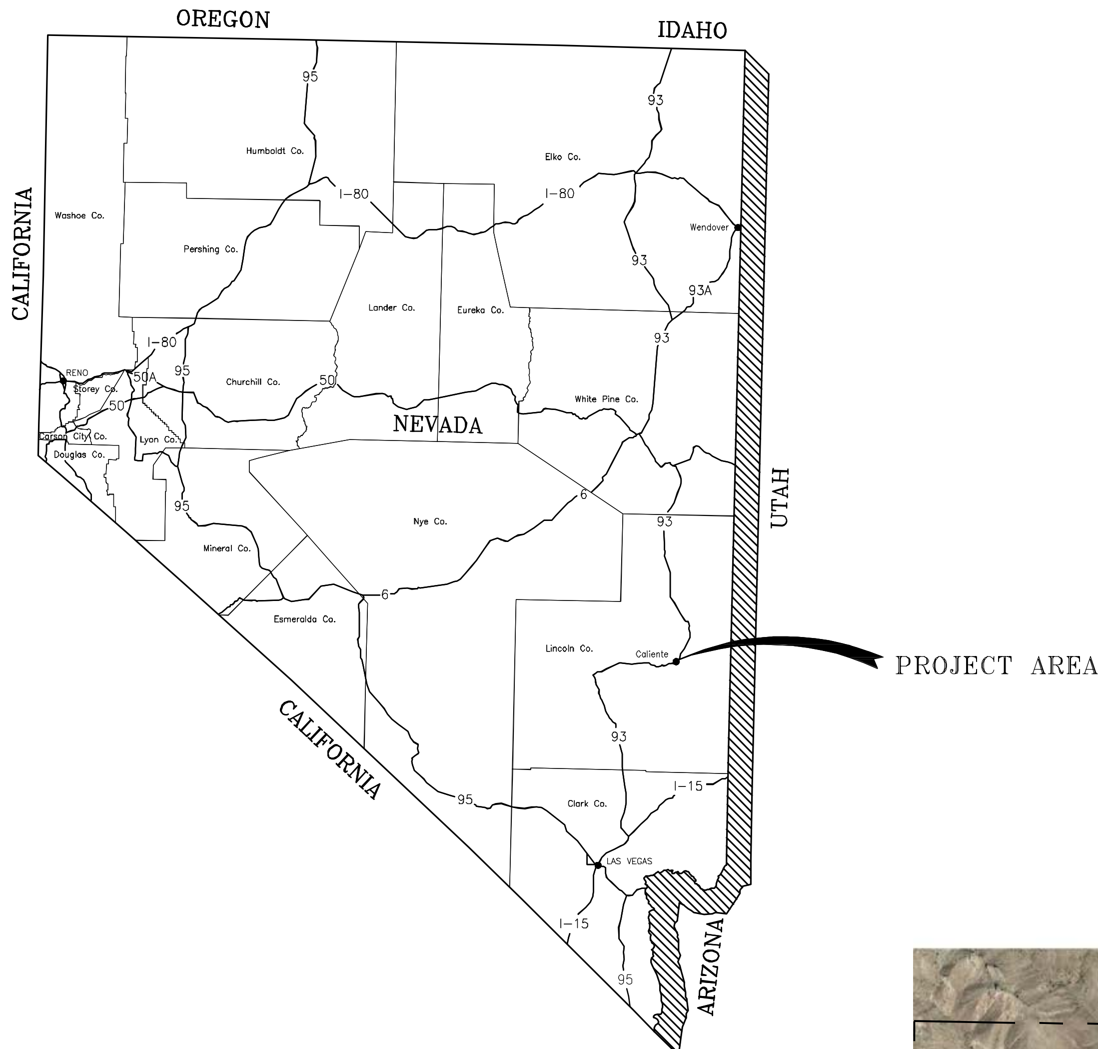
USGS, 2005. Flooding Sets Records in Places in Southern Nevada, Southern Utah, and Northwestern Arizona.

USGS, 2006. Flooding in Clark and Lincoln Counties, Nevada, December 2004 and January 2005.

Warner, R.C., 2004. SEDCAD 4 for Windows 95/98/NT/2000/Me/XP, Design Manual and User's Guide. University of Kentucky, Biosystems and Agricultural Engineering Department, Cooperative Extension Service.

FIGURES

AREA MAP
NOT TO SCALE



LOCATION MAP
NOT TO SCALE

REV NO.	COMMENT	DATE

FOR REVIEW ONLY NOT FOR CONSTRUCTION

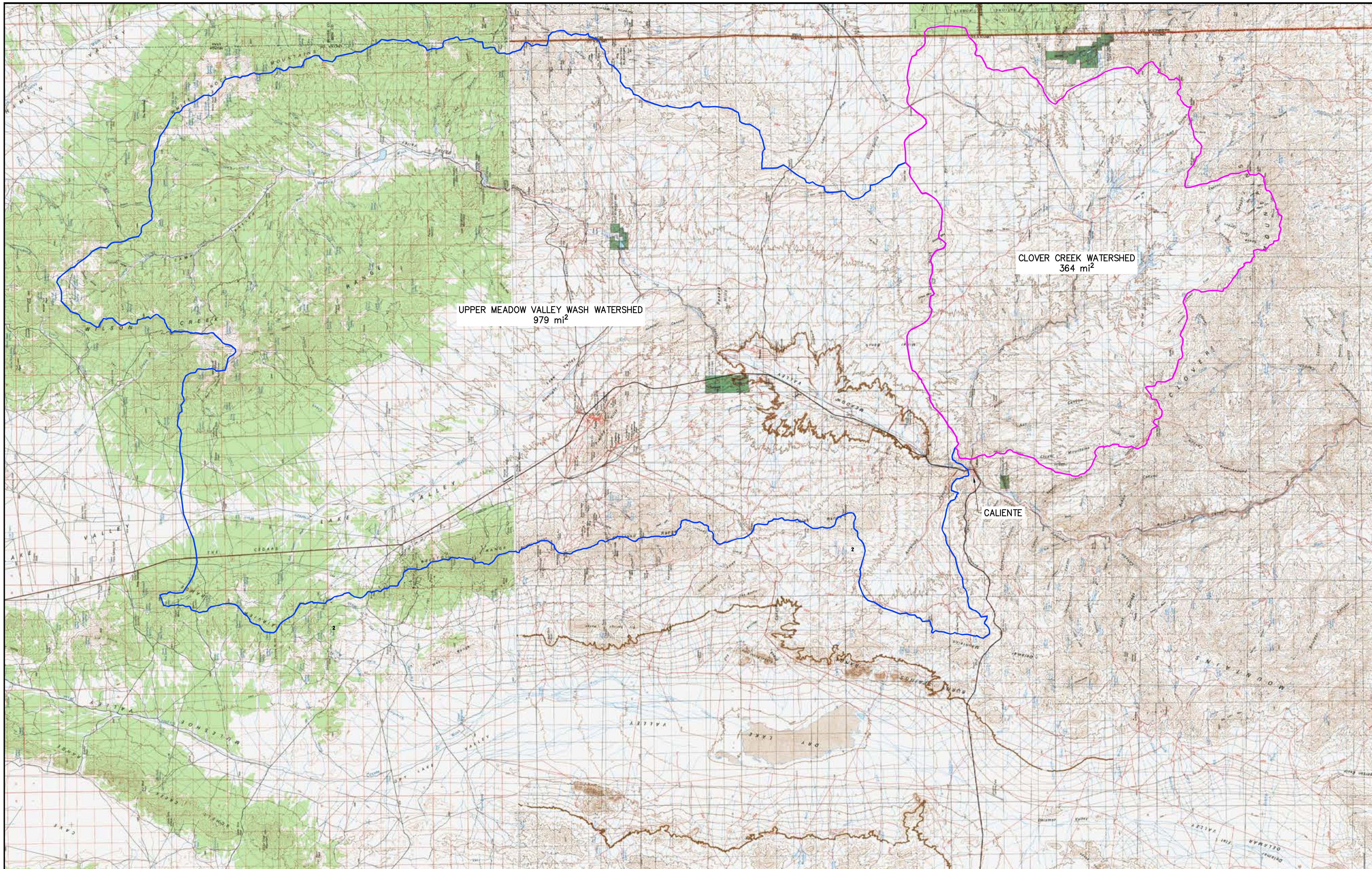
SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY

PROJECT LOCATION MAP

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 1



NORTH

SCALE
0 15000' 30000'

LEGEND

- CLOVER CREEK WATERSHED BOUNDARY (magenta line)
- MEADOW VALLEY WASH WATERSHED BOUNDARY (blue line)

REV NO.	COMMENT	DATE

FOR REVIEW ONLY NOT FOR CONSTRUCTION

SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY
MEADOW VALLEY & CLOVER CREEK WATERSHEDS

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 2

NORTH

SCALE
0 6000' 12000'

LEGEND

(red line)	SUB-WATERSHED BOUNDARY
S1	SUB-WATERSHED IDENTIFIER
C1•	CONCENTRATION POINT INDENTIFIER
①	SEDCAD STRUCTURE IDENTIFIER
(black line)	BASIN ROUTING DIRECTION
(blue line)	CHANNEL ROUTING DIRECTION

REV NO.	COMMENT	DATE

FOR REVIEW ONLY NOT FOR CONSTRUCTION

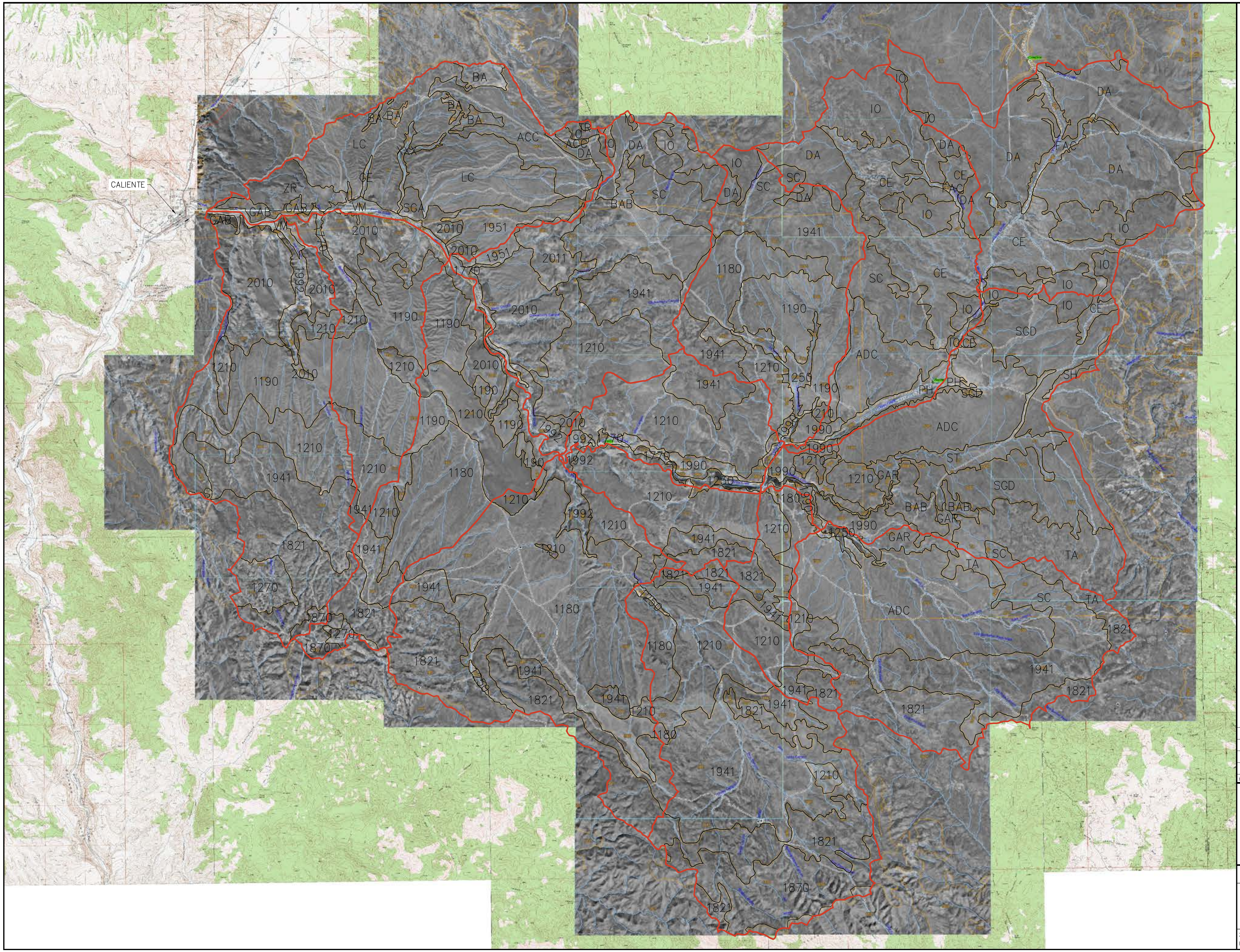
SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY
CLOVER CREEK SUB-WATERSHEDS
AND HYDROLOGIC ROUTING SCHEME

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 3

P:\Caliente\06061 Caliente Floodway Improvements Study\Civil 3D\CALFLDIMP-Fig3.dwg Mar 25, 2018 6:05pm lqi



NORTH

SCALE
0 6000' 12000'

LEGEND

SUB-WATERSHED BOUNDARY

DA SOIL TYPE (SEE APPENDIX E)

REV NO.	COMMENT	DATE

FOR REVIEW ONLY NOT FOR CONSTRUCTION

SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY

SOILS MAP

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 4

P:\Caliente\06061 Caliente Floodway Improvements Study\Civil 3D\CALF\DMP-Fig4.dwg Mar 25, 2018 6:07pm lqi

NORTH

SCALE
0 500' 1000'

LEGEND

(A) 10+46.40 CROSS SECTION ID AND STATION

CITY LIMITS

NOTE:

1 SOME BOUNDING CROSS SECTIONS FOR CROSSING STRUCTURES ARE NOT SHOWN.
2 INTERPOLATED CROSS SECTIONS ARE NOT SHOWN.

REV NO.	COMMENT	DATE

FOR REVIEW ONLY NOT FOR CONSTRUCTION

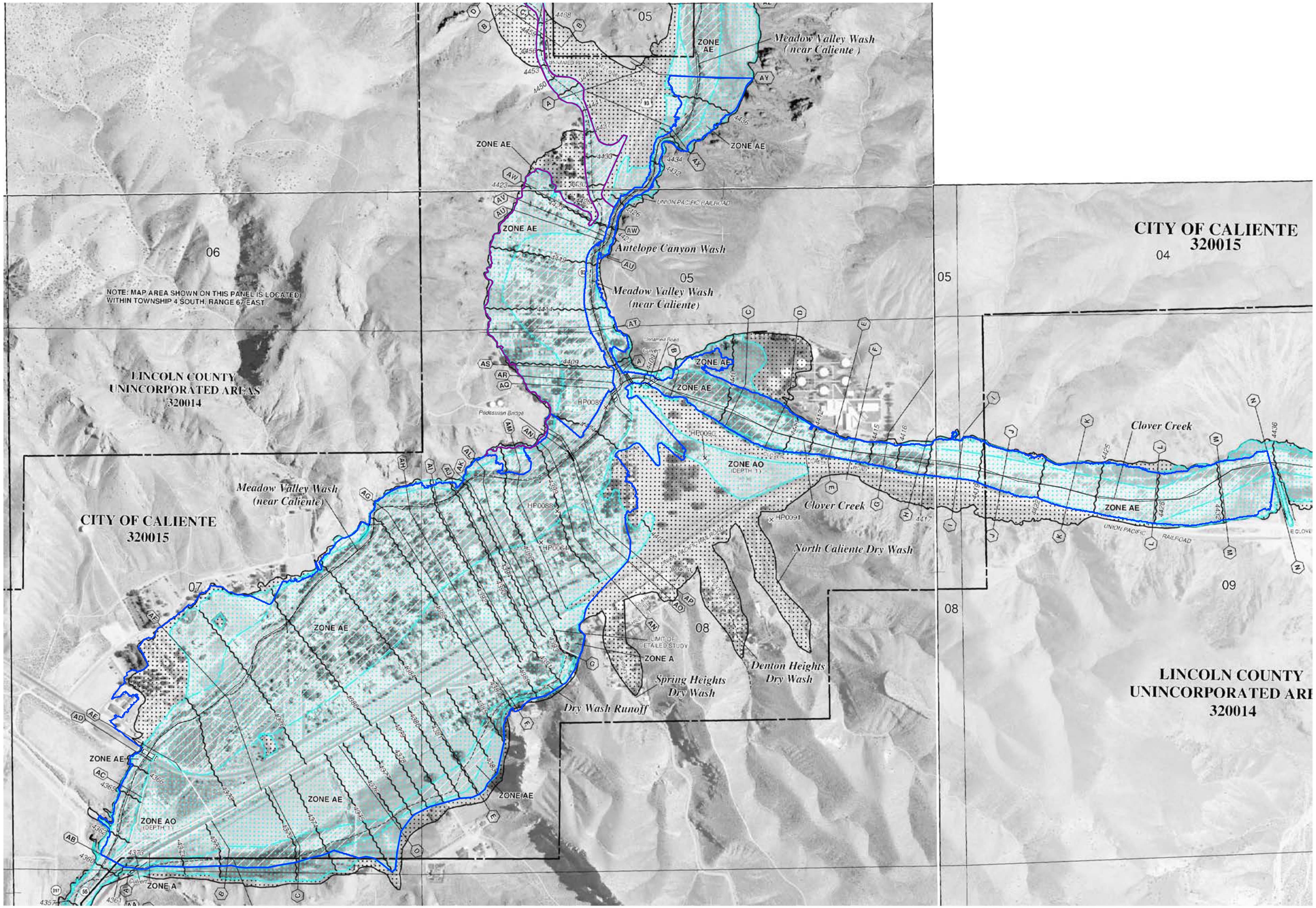
SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY
HEC-RAS HYDRAULIC MODEL
CROSS SECTIONS

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 5

P:\Caliente\06061 Caliente Floodway Improvements Study\Civil 3D\CALFLDIMP-Fig5&7.dwg Mar 28, 2018 9:46pm lqi



NORTH

SCALE

0 500' 1000'

LEGEND

MODELED 100–YEAR STORM FLOODPLAIN BOUNDARY – BASED ON EXISTING CONDITIONS MODEL

100–YEAR STORM FLOODPLAIN BOUNDARY – ANTELOPE CANYON (FROM FIRM)

ACTIVE FEMA FLOODPLAIN BOUNDARY (FROM FIRM)

REV NO.	COMMENT	DATE

FOR REVIEW ONLY
NOT
FOR CONSTRUCTION

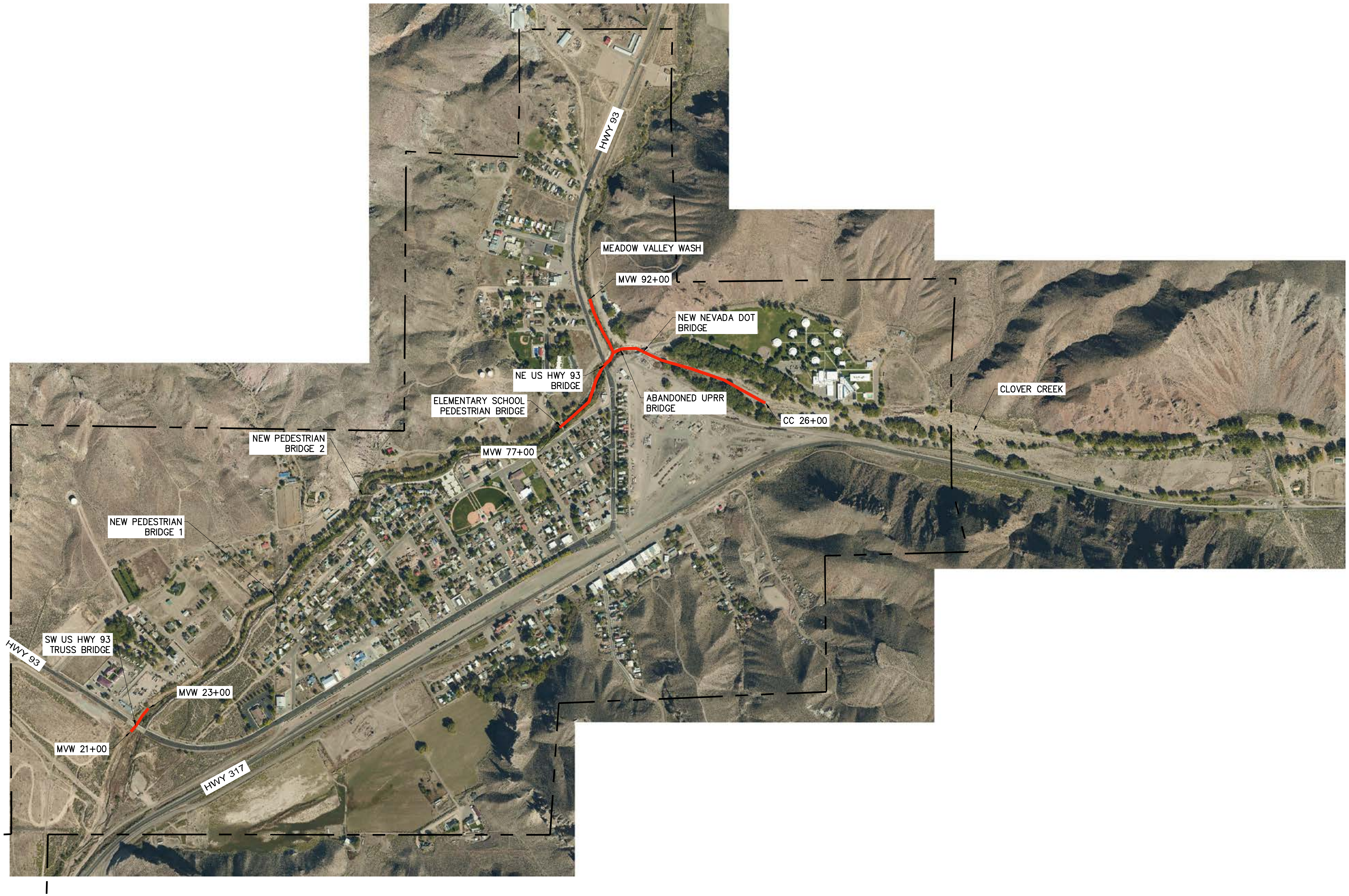
SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY
EXISTING CONDITIONS
100–YEAR STORM FLOODPLAIN

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 6

P:\Caliente\06061 Caliente Floodway Improvements Study\Civil 3D\CALFLDIMP-Fig6.dwg Apr 19, 2018 6:06pm lqi



NORTH

SCALE
0 500' 1000'

LEGEND

REACH OF SEDIMENT AREA

CITY LIMITS

REV NO.	COMMENT	DATE

FOR REVIEW ONLY
NOT
FOR CONSTRUCTION

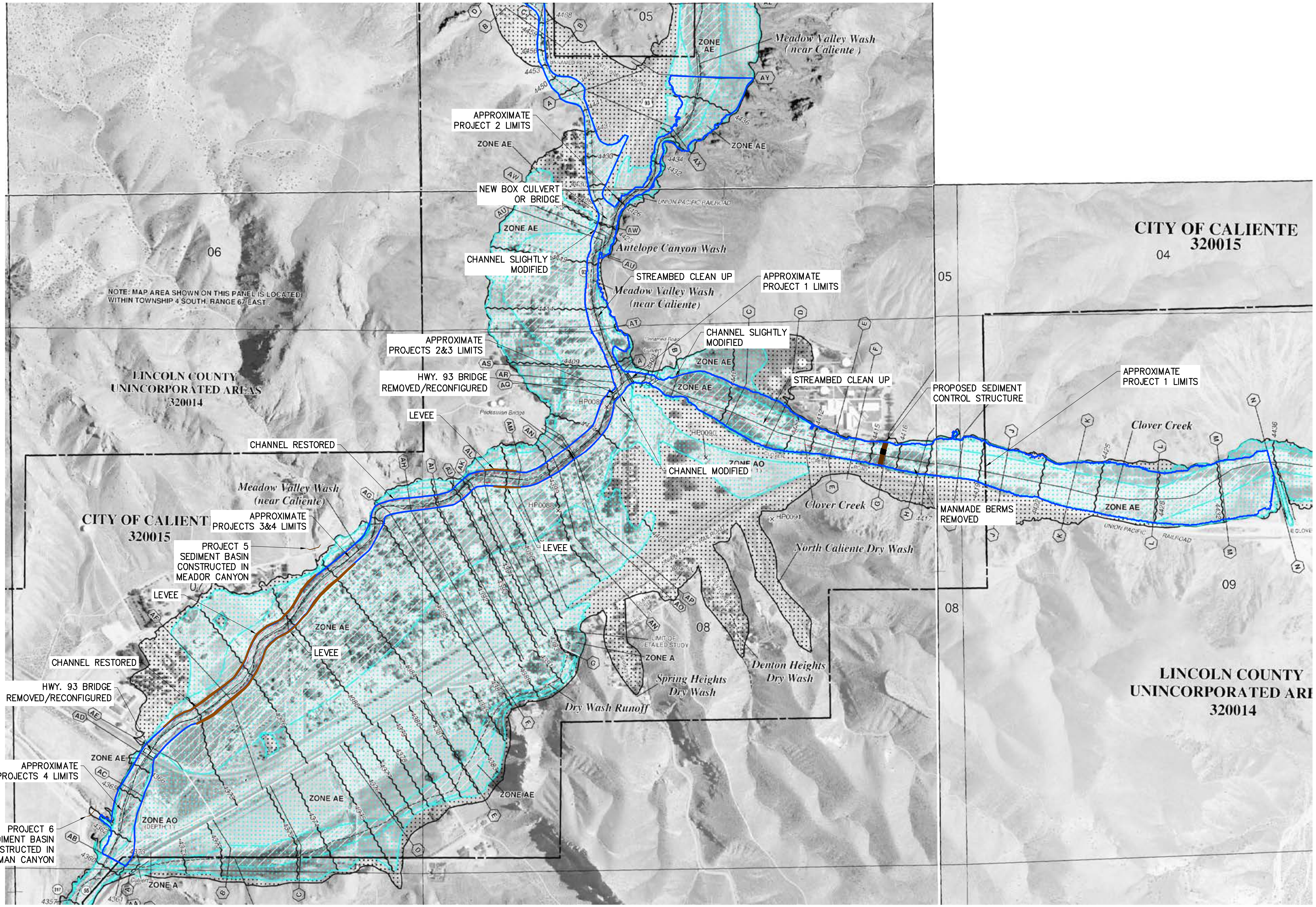
SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY
EXISTING CONDITIONS
SEDIMENT AREAS

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 7

P:\Caliente\06061 Caliente Floodway Improvements Study\Civil 3D\CALFLDIMP-Fig5&7.dwg Apr 23, 2018 6:01pm lqi



NORTH

SCALE 0 500' 1000'

LEGEND

- APPROXIMATE 100-YEAR STORM FLOODPLAIN BOUNDARY - BASED ON EXISTING CONDITIONS MODEL
- ACTIVE FEMA FLOODPLAIN BOUNDARY
- GEOMORPHIC FLOODPLAIN CHANNEL (UP TO 25-YEAR FLOOD)
- LEVEE OR SEDIMENT CONTROL STRUCTURE

REV NO.	COMMENT	DATE

FOR REVIEW ONLY NOT FOR CONSTRUCTION

SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

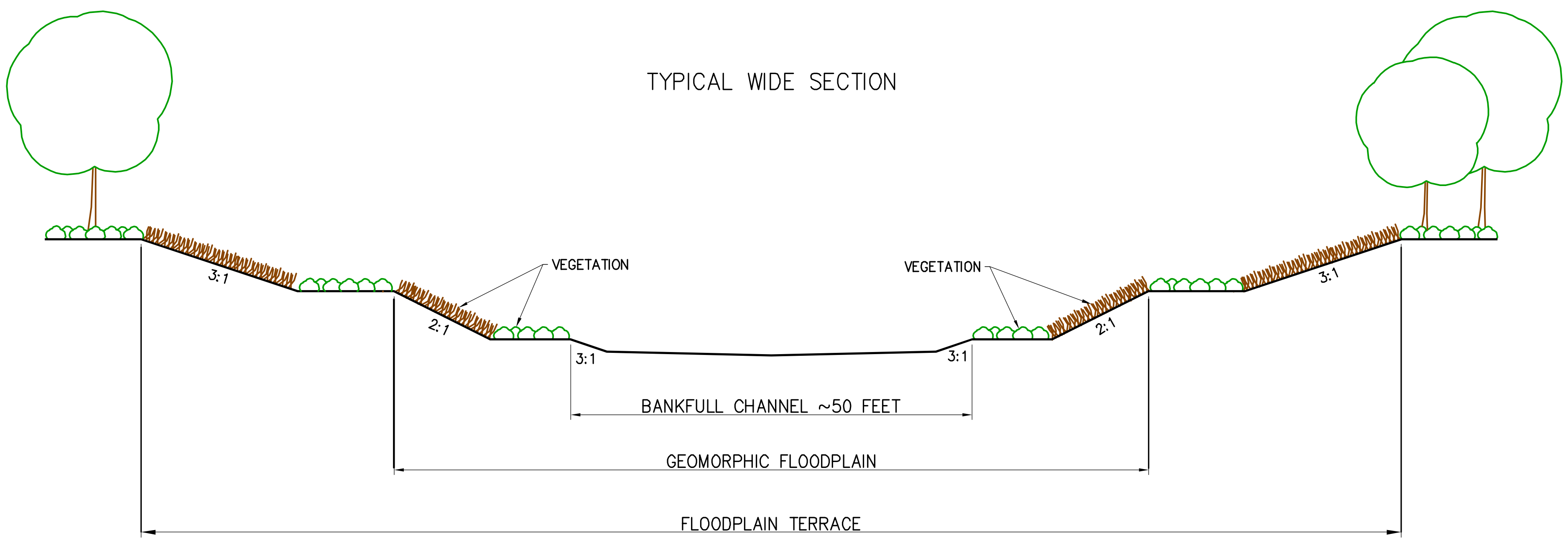
CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY
POTENTIAL PROPECTS 1 TO 6
WITH PRELIMINARY FLOODPLAIN

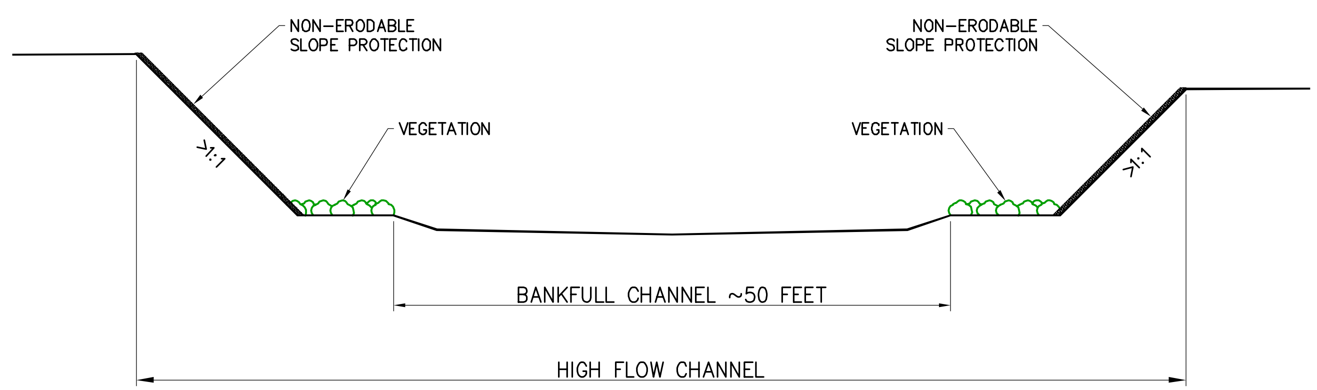
SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 8

P:\Caliente\06061 Caliente Floodway Improvements Study\Civil 3D\CALFLDIMP-Fig8-9-10.dwg Aug 16, 2018 8:52am lqi

TYPICAL WIDE SECTION



TYPICAL DEEP SECTION



NORTH

SCALE
0 500' 1000'

LEGEND

REV NO.	COMMENT	DATE

FOR REVIEW ONLY NOT FOR CONSTRUCTION

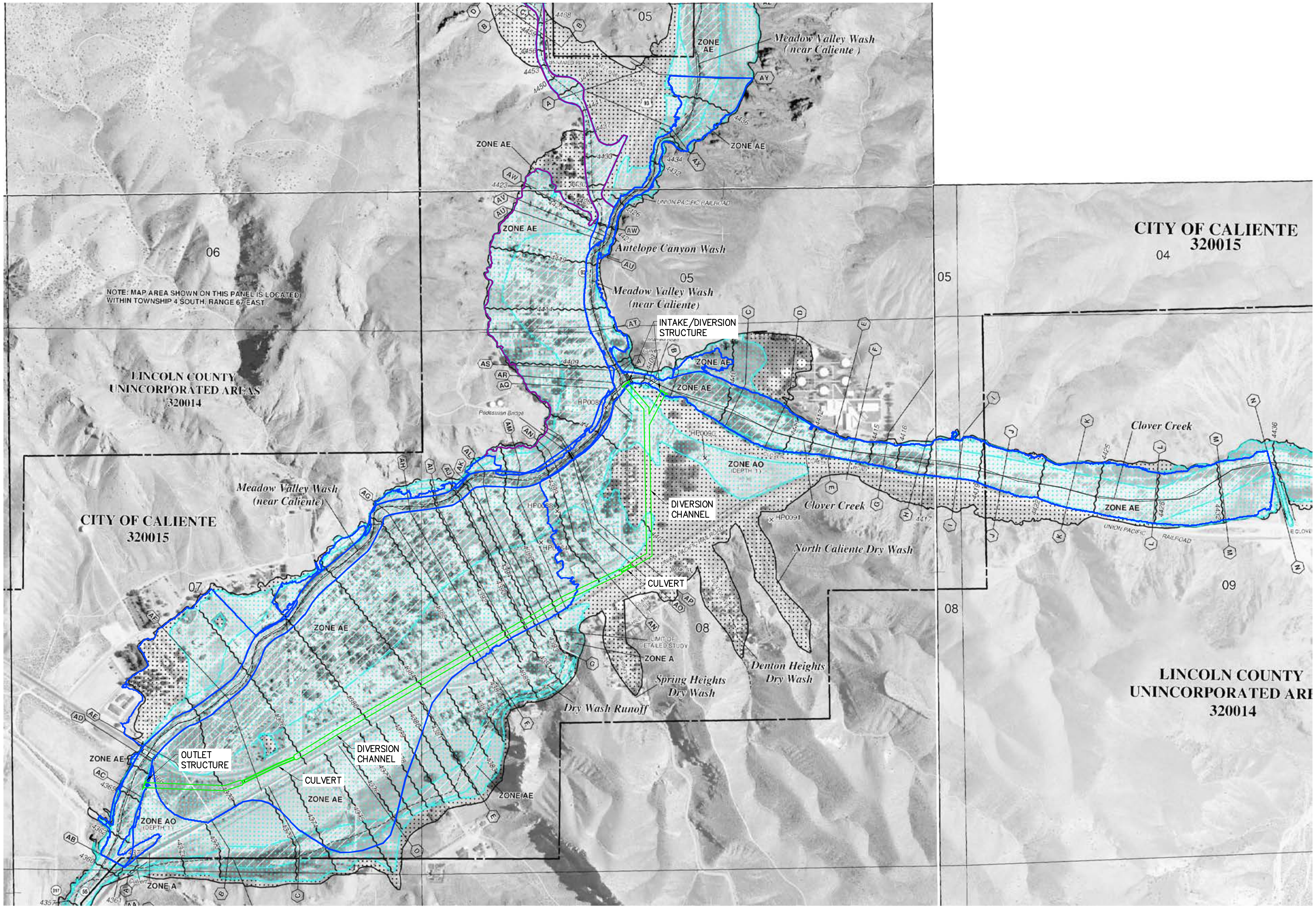
SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY
POTENTIAL PROJECTS
CONCEPTUAL TYPICAL CROSS SECTIONS

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 9

P:\Caliente\06061 Caliente Floodway Improvements Study\Civil 3D\CALFLDIMP-Fig8-9-10.dwg Mar 30, 2018 7:42am lqi



LEGEND

APPROXIMATE 100-YEAR STORM FLOODPLAIN BOUNDARY – BASED ON EXISTING CONDITIONS MODEL

ACTIVE FEMA FLOODPLAIN BOUNDARY

REV NO.	COMMENT	DATE

FOR REVIEW ONLY NOT FOR CONSTRUCTION

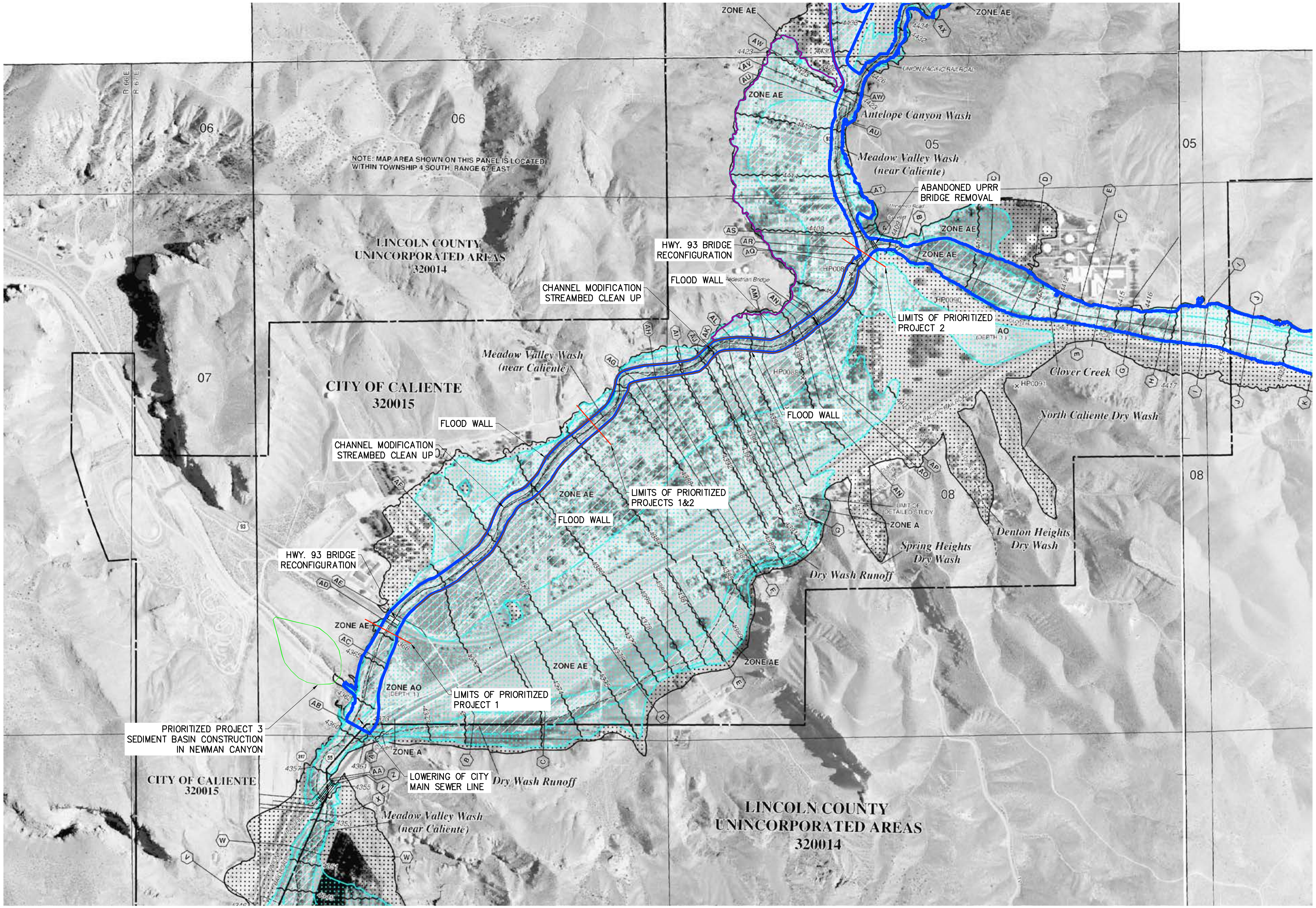
SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY
POTENTIAL PROJECT 7
WITH PRELIMINARY FLOODPLAIN

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 10

P:\Caliente\06061 Caliente Floodway Improvements Study\Civil 3D\CALFLDIMP-Fig8-10-11.dwg Mar 29, 2018 9:51pm lqi



NORTH

SCALE 0 500' 1000'

LEGEND

- APPROXIMATE 100-YEAR STORM FLOODPLAIN BOUNDARY – BASED ON PROPOSED PROJECT CONDITIONS MODEL
- ACTIVE FEMA FLOODPLAIN BOUNDARY
- ACTIVE FEMA FLOODPLAIN BOUNDARY – INUNDATED BY ANTELOPE CANYON OVERTOP
- FLOOD WALL
- SEDIMENT BASIN

REV NO.	COMMENT	DATE

FOR REVIEW ONLY NOT FOR CONSTRUCTION

SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UTAH 84047
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

CALIENTE CITY

FLOODWAY IMPROVEMENTS STUDY
PRIORITIZED PROPECTS
SELECTED BY CALIENTE

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
06061	LQ	BP	DA	01 of 000	FIG. 11

P:\Caliente\06061 Caliente Floodway Improvements Study\Civil 3D\CALFLDIMP-Fig11.dwg Sep 20, 2018 3:04pm lqi

APPENDICES

Appendix A
FEMA Flood Insurance Rate Map

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2006.

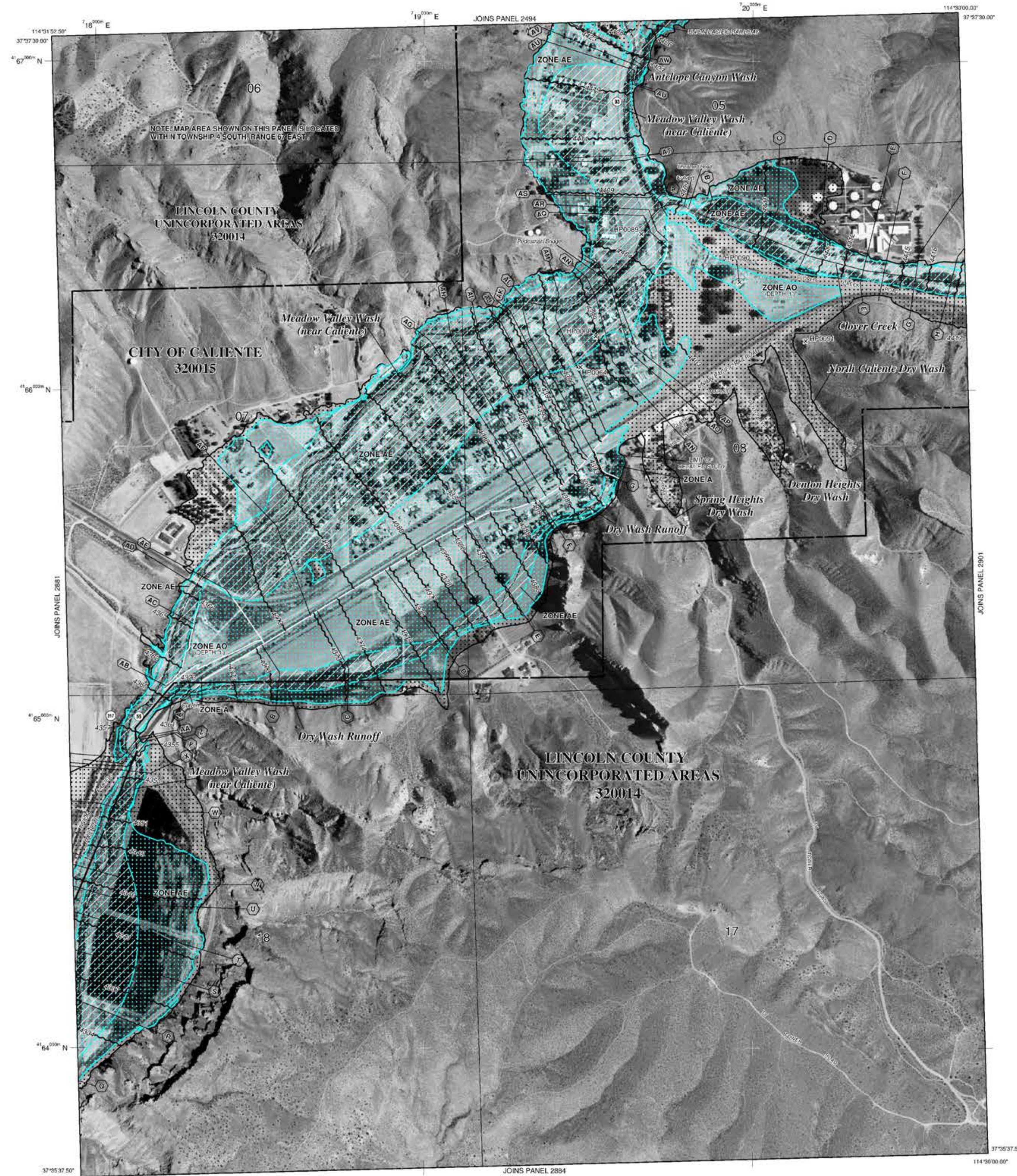
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, *a Flood Insurance Study report*, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A)—(A)	Cross section line
(23)- - -(23)	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 11
6000000 M	5000-foot grid ticks: Nevada State Plane coordinate system, east zone (FIPSZONE 2701), Transverse Mercator
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 5, 2010
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2882D

FIRM
FLOOD INSURANCE RATE MAP
LINCOLN COUNTY, NEVADA
AND INCORPORATED AREAS

PANEL 2882 OF 5400
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LINCOLN COUNTY	320014	2882	D
CALIENTE, CITY OF	320015	2882	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
32017C2882D

EFFECTIVE DATE
AUGUST 5, 2010

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242,** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2006.

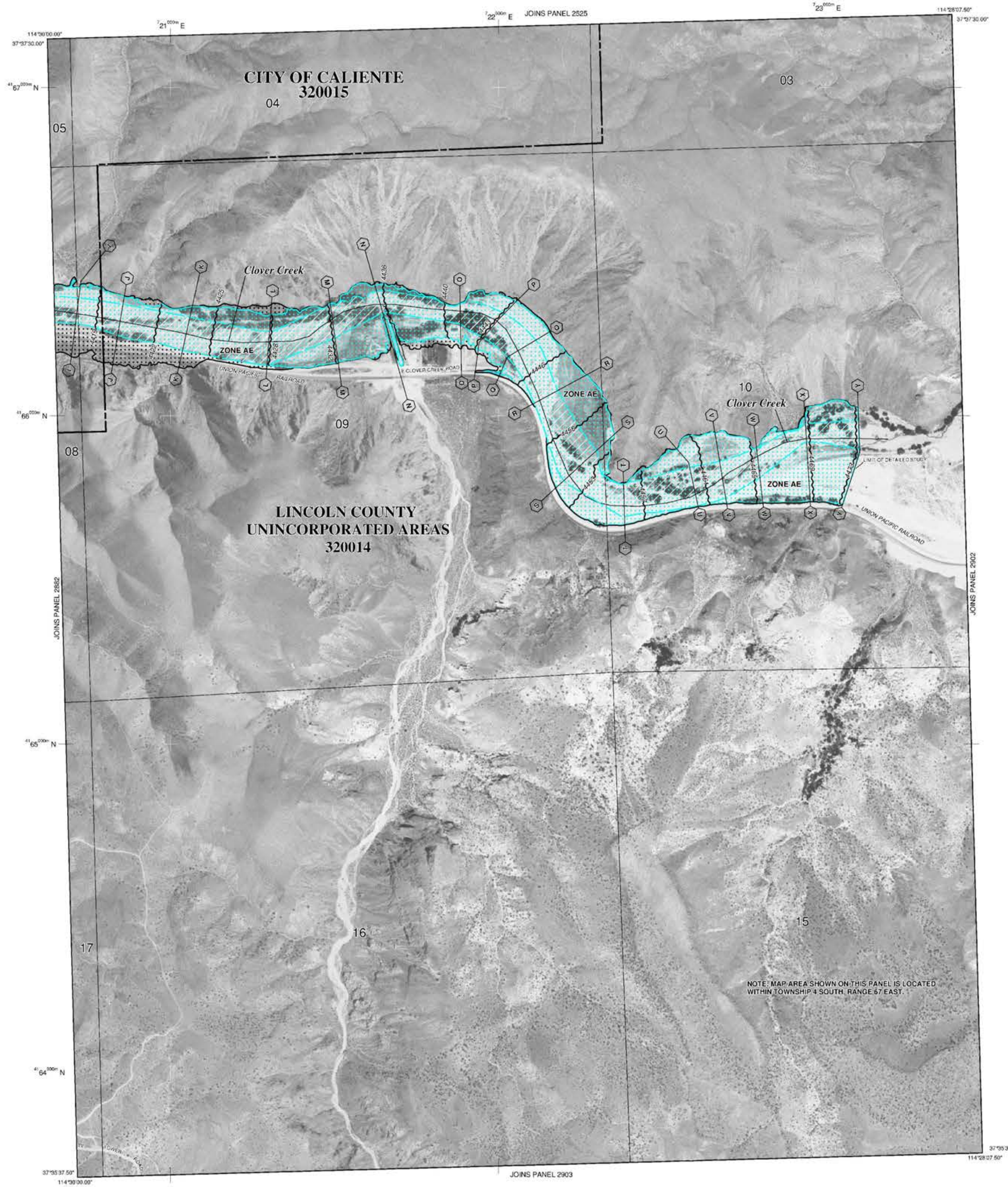
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, *a Flood Insurance Study report,* and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

~~ 513 ~~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A)——(A)	Cross section line
(23)- - - -(23)	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000m N	1000-meter Universal Transverse Mercator grid ticks, zone 11
6000000 M	5000-foot grid ticks: Nevada State Plane coordinate system, east zone (FIPSZONE 2701), Transverse Mercator
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 5, 2010
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 2901D

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
LINCOLN COUNTY, NEVADA
AND INCORPORATED AREAS

PANEL 2901 OF 5400
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LINCOLN COUNTY	320014	2901	D
CALIENTE, CITY OF	320015	2901	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 32017C2901D

EFFECTIVE DATE AUGUST 5, 2010

Federal Emergency Management Agency

Appendix B
Site Photos

Photo 1. Clover Creek – Near Caliente

Photo 2. Clover Creek – Near Confluence with Meadow Valley Wash

Photo 3. Clover Creek Crossing Structure – New Nevada DOT Bridge

Photo 4. Clover Creek Crossing Structure – Abandoned Railroad Bridge

Photo 5. Confluence – Clover Creek Confluence with Meadow Valley Wash

Photo 6. Meadow Valley Wash Crossing Structure –
Northeast U.S. Highway 93 Bridge


Photo 7. Meadow Valley Wash Crossing Structure –
Elementary School Pedestrian Bridge


Photo 8. Meadow Valley Wash Channel – Near Elementary School

Photo 9. Meadow Valley Wash Crossing Structure –
New Pedestrian Bridge 1

Photo 10. Meador Canyon – Near Confluence with Meadow Valley Wash

Photo 11. Meadow Valley Wash Crossing Structure –
New Pedestrian Bridge 2

Photo 12. Meadow Valley Wash Linear Park – Trail

Photo 13. Meadow Valley Wash Linear Park – Gabion Wall

Photo 14. Meadow Valley Wash Crossing Structure –
New Pedestrian Bridge 3

Photo 15. Meadow Valley Wash – Southwestern Caliente

Photo 16. Meadow Valley Wash Crossing Structure –
Southwest U.S. Highway 93 Bridge

Photo 17. Meadow Valley Wash – Sediment Area

Photo 18. Meadow Valley Wash – Bank Erosion
Downstream Southwest U.S. Highway 93 Bridge


Photo 19. Meadow Valley Wash – Sediment from Newman Canyon


Photo 20. Meadow Valley Wash Crossing Structure –
Union Pacific Railroad Bridge Southeast Caliente

Photo 21. Meadow Valley Wash – Boy Scout Rock

Appendix C
Caliente Survey Map

Appendix D
SEDCAD Input Data Preparation Sheets

Caliente Floodway Improvements
Clover Creek Subwatersheds

Sub-Watershed	Area (ft^2)	Area (acres)	Area (mi^2)
S1	806,548,150	18516	28.93
S2	757,281,259	17385	27.16
S3	592,324,404	13598	21.25
S4	952,628,798	21869	34.17
S5	897,773,946	20610	32.20
S6	214,738,148	4930	7.70
S7	214,100,709	4915	7.68
S8	324,636,396	7453	11.64
S9	952,789,997	21873	34.18
S10	1,007,308,886	23125	36.13
S11	585,747,186	13447	21.01
S12	805,115,523	18483	28.88
S13	431,109,385	9897	15.46
S14	717,349,980	16468	25.73
S15	888,777,822	20404	31.88
Total	10,148,230,589	232,971	364.02

Caliente Floodway Improvements
NRCS Curve Numbers (CN)

Soil Type	Land Description	NRCS	CN	S1 Area (acres)	S2 Area (acres)	S3 Area (acres)	S4 Area (acres)	S5 Area (acres)	S6 Area (acres)	S7 Area (acres)	S8 Area (acres)	S9 Area (acres)	S10 Area (acres)	S11 Area (acres)	S12 Area (acres)	S13 Area (acres)	S14 Area (acres)	S15 Area (acres)
ACC	Sagebrush, Fair to Good	D	64.5	666.7													2678.8	
BA	Same	D	64.5														852.3	
CE	Same	D	64.5	2674.9	4998.2		376.5											
CR	Same	D	64.5	125.9														
DA	Same	C	57.5	11693.9	1744.9	438.5									1559.2		385.0	
FAC	Same	B	45.5	798.5	344.4		21.0											
GE	Same	B	45.5														339.8	
IO	Same	D	64.5	3182.8	4031.7	519.0	619.9								730.5		187.8	
LC	Same	B	45.5														7747.6	
SGD	Same	C	57.5	37.1			6854.0											
ST	Same	C	57.5				1246.2											
TR	Same	D	64.5												92.3		35.2	
ZR	Same	D	64.5														1136.3	
1180,ADC	Same	C	57.5		2681.7	2391.2	4475.2	8360.0	662.1			1275.5	11715.2	3691.8				
1190	Same	C	57.5		225.0	3542.0							54.9	2815.8		5001.5		3442.1
1210,BAB	Same	D	64.5		25.2	1182.6	2086.7	260.4	2030.9	3623.0	4589.3	3577.9	1541.8	2681.9	7090.5	1878.6	49.3	4175.9
1230	Same	C	57.5			80.1	45.6				447.6							
1250,PH	Same	B	45.5		704.5	731.6	321.2	242.9		44.5		91.5	87.3					
1270	Same	B	45.5											172.8				1058.4
1770,VM	Same	B	45.5								190.5				408.6	91.4	434.1	255.6
1821,TA	Same	D	64.5				3322.5	4879.7	919.3	524.8		4732.9	5625.1	1044.2				3288.6
1870	Same	B	45.5									3851.3		433.2				207.9
1941,SC	Same	D	64.5		2391.0	4303.8	217.2	6233.9	1204.3	627.7	1263.9	8344.0	3443.2	891.9	3554.7	149.1		3452.0
1951,UR	Same	D	64.5												283.2		1468.8	
1990,GAR	Same	D	64.5		259.7	311.6	2201.5	559.5	75.8		738.2							
1992,GAB	Same	D	64.5							84.7	167.1		690.8	532.3	635.6		372.5	754.7
2010,SGA	Same	D	64.5					34.6	16.4		45.1			1118.7	2935.5	2752.9	729.4	3618.6
2011	Same	D	64.5												1154.1			
			Total Area	19179.8	17406.4	13500.3	21787.7	20571.0	4908.9	4904.9	7441.7	21873.0	23158.4	13382.7	18444.3	9873.5	16416.9	20253.6
			Area Weighted Avg. CN	59.43	61.48	60.13	60.15	61.43	63.56	64.33	63.59	60.67	60.87	60.24	63.49	60.78	54.47	61.88

Caliente Floodway Improvements
Time of Concentration (T_c)

Sub-Watershed	Initial Flow				Channel Flow			
	US Elev. (ft)	DS Elev. (ft)	Vertical D (ft)	Horizontal D (ft)	US Elev. (ft)	DS Elev. (ft)	Vertical D (ft)	Horizontal D (ft)
S1	6365	6057	308	4928	6057	5675	382	44208
S2	6460	6320	140	1782	6320	5395	925	82214
S3	7320	6680	640	2432	6680	5395	1285	45904
S4	6625	6400	225	1159	6400	5330	1070	77825
S5	6758	6280	478	1767	6280	5420	860	54814
S6	6170	6000	170	2081	6000	5330	670	34028
S7	6080	5760	320	1015	5760	5076	684	43683
S8	6040	5880	160	1087	5880	5076	804	56155
S9	7180	6720	460	2651	6720	5596	1124	56889
S10	6640	6080	560	7056	6080	5076	1004	55040
S11	7300	7000	300	1413	7000	4680	2320	77249
S12	6951	6460	491	2692	6460	4680	1780	51481
S13	6090	5985	105	1726	5985	4500	1485	62431
S14	6704	6180	524	1476	6180	4405	1775	72424
S15	7479	7120	359	980	7120	4405	2715	76062

Caliente Floodway Improvements
NRCS Soil Erodibility Factor (K)

Soil Type	K Factor	S1 Area (acres)	S2 Area (acres)	S3 Area (acres)	S4 Area (acres)	S5 Area (acres)	S6 Area (acres)	S7 Area (acres)	S8 Area (acres)	S9 Area (acres)	S10 Area (acres)	S11 Area (acres)	S12 Area (acres)	S13 Area (acres)	S14 Area (acres)	S15 Area (acres)
ACC	0.17														2678.8	
BA	0.37														852.3	
CE	0.2	2674.9	4998.2		376.5											
CR	0.24	125.9														
DA	0.17	11693.9	1744.9	438.5									1559.2		385.0	
FAC	0.2	798.5	344.4		21.0											
GE	0.37														339.8	
IO	0.1	3182.8	4031.7	519.0	619.9								730.5		187.8	
LC	0.24														7747.6	
SGD	0.17	37.1			6854.0											
ST	0.43				1246.2											
TR	0.24												92.3		35.2	
ZR	0.24														1136.3	
1180,ADC	0.28		2681.7	2391.2	4475.2	8360.0	662.1			1275.5	11715.2	3691.8				
1190	0.24		225.0	3542.0							54.9	2815.8		5001.5		3442.1
1210,BAB	0.15		25.2	1182.6	2086.7	260.4	2030.9	3623.0	4589.3	3577.9	1541.8	2681.9	7090.5	1878.6	49.3	4175.9
1230	0.32			80.1	45.6				447.6							
1250,PH	0.43		704.5	731.6	321.2	242.9		44.5		91.5	87.3					
1270	0.15											172.8				1058.4
1770,VM	0.1								190.5				408.6	91.4	434.1	255.6
1821,TA	0.15				3322.5	4879.7	919.3	524.8		4732.9	5625.1	1044.2				3288.6
1870	0.17									3851.3		433.2				207.9
1941,SC	0.15		2391.0	4303.8	217.2	6233.9	1204.3	627.7	1263.9	8344.0	3443.2	891.9	3554.7	149.1		3452.0
1951,UR	0.24												283.2		1468.8	
1990,GAR	0.15		259.7	311.6	2201.5	559.5	75.8		738.2							
1992,GAB	0.15							84.7	167.1		690.8	532.3	635.6		372.5	754.7
2010,SGA	0.15					34.6	16.4		45.1			1118.7	2935.5	2752.9	729.4	3618.6
2011	0.15												1154.1			
	Total Area	18513.2	17406.4	13500.3	21787.7	20571.0	4908.9	4904.9	7441.7	21873.0	23158.4	13382.7	18444.3	9873.5	16416.9	20253.6
	Area Weighted K Factor	0.16	0.19	0.21	0.20	0.21	0.17	0.15	0.16	0.16	0.22	0.21	0.15	0.20	0.22	0.16

Caliente Floodway Improvements
Channel Routing

Routing (CP[1] to CP)	US Elev. (ft)	DS Elev. (ft)	Vertical D (ft)	Horizontal D (ft)
C1 to C3	5675	5395	280	39968
C3 to C6	5395	5330	65	6975
C5 to C6	5420	5330	90	13083
C6 to C10	5330	5076	254	36504
C9 to C10	5596	5076	520	27885
C10 to C12	5076	4680	396	40494
C12 to C13	4680	4500	180	25730
C13 to C15	4500	4405	95	11245

[1] Concentration Point

Caliente Floodway Improvements
Sedimentology Data

			Representative Slope Length		
Sub-Watershed	US Elev. (ft)	DS Elev. (ft)	Vertical Distance (ft)	Horizontal Distance (ft)	Slope (%)
S1	6365	6220	145	897	16.16
S2	6460	6400	60	505	11.88
S3	7320	7000	320	869	36.82
S4	6625	6520	105	441	23.81
S5	6758	6600	158	563	28.06
S6	6170	6120	50	616	8.12
S7	6080	5840	240	643	37.33
S8	6040	5960	80	395	20.25
S9	7180	6960	220	410	53.66
S10	6640	6520	120	457	26.26
S11	7300	7120	180	756	23.81
S12	6951	6700	251	665	37.74
S13	6090	6040	50	339	14.75
S14	6704	6600	104	357	29.13
S15	7479	7280	199	457	43.54

Caliente Floodway Improvements
NRCS Soil Gradation

Soil Type	Total Area (acres)
ACC	3345.4
BA	852.3
CE	8049.6
CR	125.9
DA	15821.5
FAC	1164.0
GE	339.8
IO	9271.7
LC	7747.6
SGD	6891.2
ST	1246.2
TR	127.5
ZR	1136.3
1180,ADC	35252.8
1190	15081.3
1210,BAB	34794.1
1230	573.3
1250,PH	2223.7
1270	1231.2
1770,VM	1380.2
1821,TA	24337.1
1870	4492.4
1941,SC	36076.9
1951,UR	1752.0
1990,GAR	4146.2
1992,GAB	3237.7
2010,SGA	11251.3
2011	1154.1
Total	233103.1

Soil Type Particle Size (mm)	ACC (% finer)	BA (% finer)	CE (% finer)	CR (% finer)	DA (% finer)	FAC (% finer)	GE (% finer)	IO (% finer)	LC (% finer)
4.75	82.5		85		90	95	100	80	80
2	60		80		80	70	95	75	65
0.425	40		70		75	50	72.5	65	50
0.075	20		55		55	30	42.5	55	30

SGD (% finer)	ST (% finer)	TR (% finer)	ZR (% finer)	1180 (% finer)	1190 (% finer)	1210 (% finer)	1230 (% finer)	1250 (% finer)	1270 (% finer)
80	80	70	70	81.7	73.3	70.8	100	100	82.5
70	65	60	60	70.8	64.2	60	100	91.3	72.5
55	55	50	55	44.2	50.8	47.5	97.5	77.5	57.5
30	40	40	35	33.3	35.8	36.7	85	53.8	40

1770 (% finer)	1821 (% finer)	1870 (% finer)	1941 (% finer)	1951 (% finer)	1990 (% finer)	1992 (% finer)	2010 (% finer)	2011 (% finer)
83.8	61.3	81.3	63.8	50	67.5	63.8	56.3	51.3
70	36.2	71.3	50	40	62.5	58.8	50	40
57.5	28.8	51.3	35	35	50	47.5	38.8	27.5
43.8	18.8	28.8	21.3	27.5	42.5	38.8	28.8	13.8

Partical Size (mm)	Area Weighted Gradation (% finer)
4.75	72.9
2	60.9
0.425	46.8
0.075	33.4

Note: Gradations for soil types BA and CR were unavailable.

Appendix E
NOAA Atlas 14 Rainfall Data

NOAA Atlas 14, Volume 1, Version 5
Location name: Caliente, Nevada, USA*
Latitude: 37.5122°, Longitude: -114.3013°
Elevation: 5714.91 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.154 (0.130-0.184)	0.201 (0.169-0.241)	0.278 (0.233-0.332)	0.343 (0.285-0.411)	0.442 (0.360-0.527)	0.526 (0.423-0.627)	0.621 (0.489-0.745)	0.730 (0.559-0.881)	0.898 (0.664-1.10)	1.05 (0.751-1.30)
10-min	0.235 (0.198-0.280)	0.305 (0.257-0.367)	0.423 (0.355-0.506)	0.522 (0.433-0.625)	0.672 (0.548-0.802)	0.800 (0.643-0.955)	0.945 (0.744-1.13)	1.11 (0.851-1.34)	1.37 (1.01-1.67)	1.60 (1.14-1.98)
15-min	0.291 (0.246-0.348)	0.378 (0.319-0.454)	0.524 (0.440-0.627)	0.648 (0.537-0.775)	0.834 (0.679-0.995)	0.991 (0.798-1.18)	1.17 (0.922-1.41)	1.38 (1.06-1.66)	1.70 (1.25-2.08)	1.98 (1.42-2.46)
30-min	0.391 (0.332-0.468)	0.510 (0.429-0.612)	0.705 (0.592-0.844)	0.872 (0.723-1.04)	1.12 (0.915-1.34)	1.34 (1.07-1.59)	1.58 (1.24-1.89)	1.85 (1.42-2.24)	2.28 (1.69-2.80)	2.66 (1.91-3.31)
60-min	0.485 (0.410-0.579)	0.631 (0.532-0.757)	0.873 (0.733-1.05)	1.08 (0.895-1.29)	1.39 (1.13-1.66)	1.65 (1.33-1.97)	1.95 (1.54-2.34)	2.29 (1.76-2.77)	2.82 (2.09-3.46)	3.30 (2.36-4.09)
2-hr	0.572 (0.491-0.670)	0.732 (0.629-0.858)	0.978 (0.835-1.15)	1.19 (1.01-1.40)	1.51 (1.26-1.77)	1.78 (1.47-2.09)	2.10 (1.69-2.46)	2.44 (1.92-2.90)	2.97 (2.27-3.57)	3.43 (2.54-4.17)
3-hr	0.646 (0.569-0.744)	0.821 (0.719-0.949)	1.08 (0.940-1.24)	1.29 (1.12-1.49)	1.60 (1.37-1.85)	1.87 (1.58-2.16)	2.17 (1.80-2.53)	2.51 (2.03-2.94)	3.03 (2.39-3.59)	3.49 (2.68-4.17)
6-hr	0.803 (0.706-0.920)	1.02 (0.896-1.16)	1.31 (1.15-1.50)	1.56 (1.36-1.78)	1.90 (1.65-2.17)	2.19 (1.87-2.50)	2.49 (2.11-2.86)	2.83 (2.35-3.26)	3.35 (2.73-3.92)	3.81 (3.03-4.50)
12-hr	1.00 (0.889-1.14)	1.27 (1.13-1.45)	1.64 (1.44-1.87)	1.93 (1.69-2.20)	2.32 (2.02-2.64)	2.63 (2.27-2.99)	2.94 (2.52-3.37)	3.28 (2.78-3.77)	3.77 (3.13-4.36)	4.20 (3.44-4.91)
24-hr	1.31 (1.18-1.46)	1.66 (1.50-1.85)	2.12 (1.91-2.37)	2.49 (2.24-2.78)	3.00 (2.68-3.34)	3.40 (3.01-3.79)	3.81 (3.35-4.25)	4.23 (3.69-4.73)	4.81 (4.15-5.40)	5.26 (4.50-5.93)
2-day	1.47 (1.32-1.64)	1.87 (1.68-2.08)	2.42 (2.17-2.70)	2.86 (2.56-3.19)	3.47 (3.08-3.87)	3.95 (3.49-4.42)	4.46 (3.90-4.99)	4.99 (4.33-5.61)	5.72 (4.90-6.46)	6.31 (5.35-7.18)
3-day	1.63 (1.48-1.81)	2.07 (1.87-2.29)	2.66 (2.40-2.95)	3.14 (2.82-3.48)	3.81 (3.40-4.23)	4.33 (3.85-4.82)	4.89 (4.31-5.45)	5.47 (4.78-6.12)	6.28 (5.42-7.05)	6.93 (5.91-7.82)
4-day	1.79 (1.63-1.98)	2.27 (2.06-2.50)	2.91 (2.63-3.21)	3.42 (3.09-3.78)	4.14 (3.72-4.58)	4.72 (4.21-5.22)	5.33 (4.72-5.91)	5.96 (5.23-6.63)	6.84 (5.93-7.64)	7.54 (6.47-8.47)
7-day	2.13 (1.93-2.36)	2.70 (2.44-2.99)	3.46 (3.12-3.85)	4.08 (3.66-4.53)	4.93 (4.40-5.48)	5.60 (4.97-6.23)	6.31 (5.56-7.03)	7.04 (6.16-7.87)	8.06 (6.96-9.06)	8.87 (7.58-10.0)
10-day	2.40 (2.16-2.66)	3.04 (2.74-3.37)	3.89 (3.50-4.32)	4.57 (4.10-5.07)	5.49 (4.91-6.10)	6.22 (5.52-6.92)	6.97 (6.15-7.78)	7.75 (6.78-8.66)	8.81 (7.63-9.90)	9.66 (8.28-10.9)
20-day	3.02 (2.73-3.33)	3.83 (3.46-4.23)	4.85 (4.37-5.36)	5.62 (5.05-6.22)	6.63 (5.94-7.35)	7.40 (6.60-8.21)	8.18 (7.25-9.09)	8.96 (7.90-9.99)	9.99 (8.73-11.2)	10.8 (9.35-12.1)
30-day	3.67 (3.32-4.05)	4.65 (4.21-5.12)	5.89 (5.32-6.50)	6.83 (6.16-7.54)	8.08 (7.25-8.93)	9.02 (8.06-9.99)	9.97 (8.86-11.1)	10.9 (9.65-12.1)	12.2 (10.7-13.6)	13.1 (11.4-14.7)
45-day	4.39 (3.96-4.87)	5.57 (5.02-6.17)	7.04 (6.32-7.81)	8.15 (7.30-9.06)	9.63 (8.58-10.7)	10.7 (9.53-12.0)	11.9 (10.5-13.2)	13.0 (11.4-14.6)	14.6 (12.7-16.4)	15.8 (13.6-17.9)
60-day	5.07 (4.55-5.63)	6.44 (5.78-7.15)	8.14 (7.28-9.04)	9.41 (8.39-10.5)	11.1 (9.81-12.3)	12.3 (10.9-13.7)	13.6 (11.9-15.1)	14.8 (12.9-16.6)	16.5 (14.3-18.5)	17.8 (15.2-20.1)

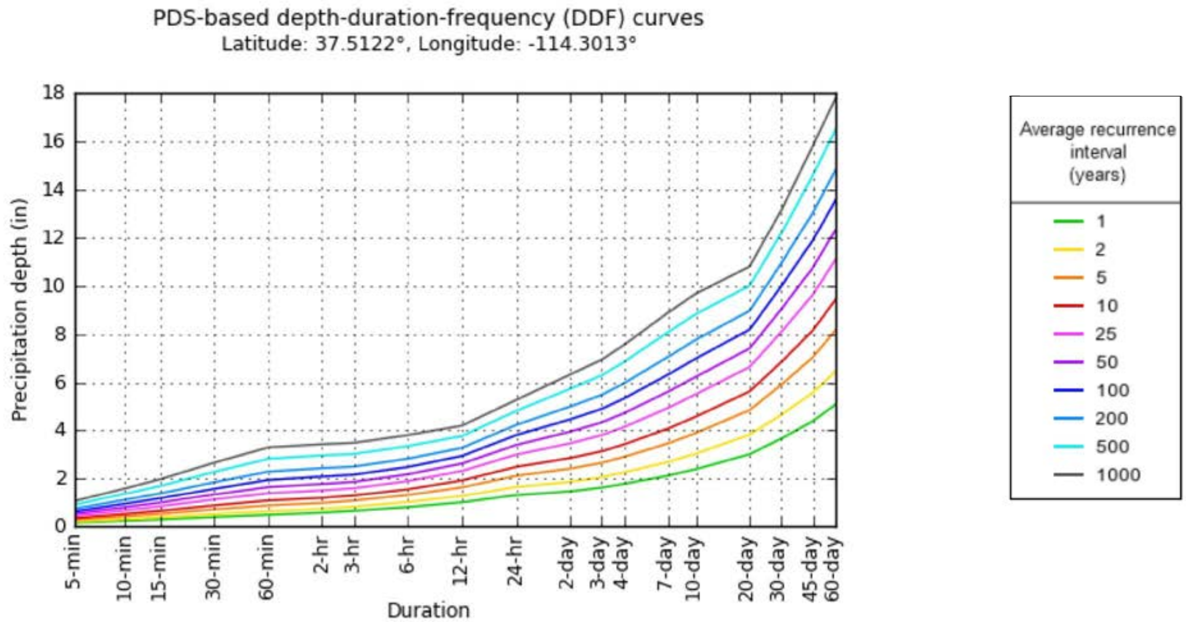
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

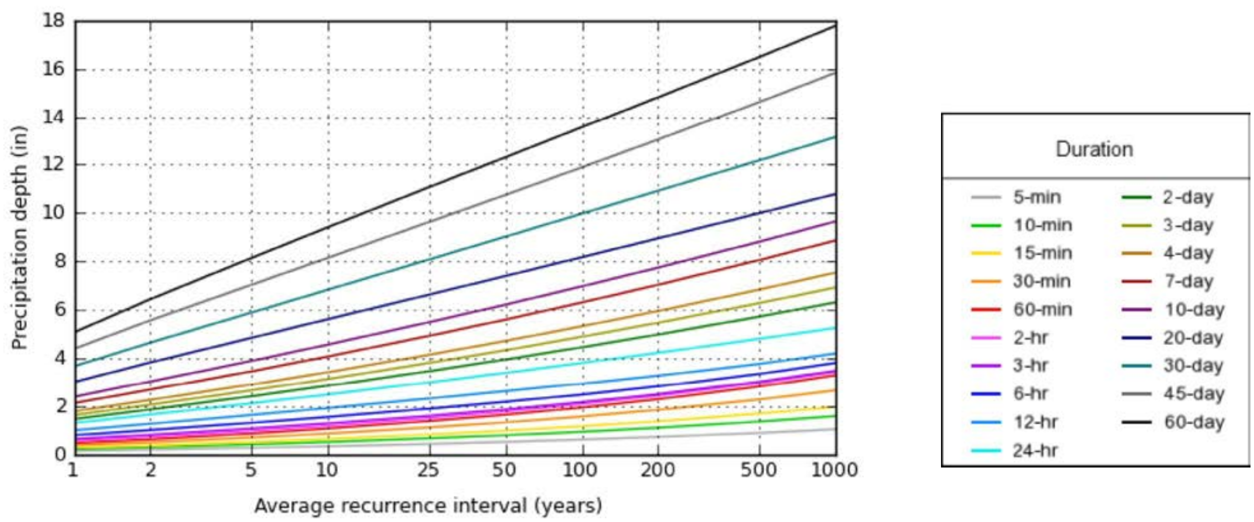
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



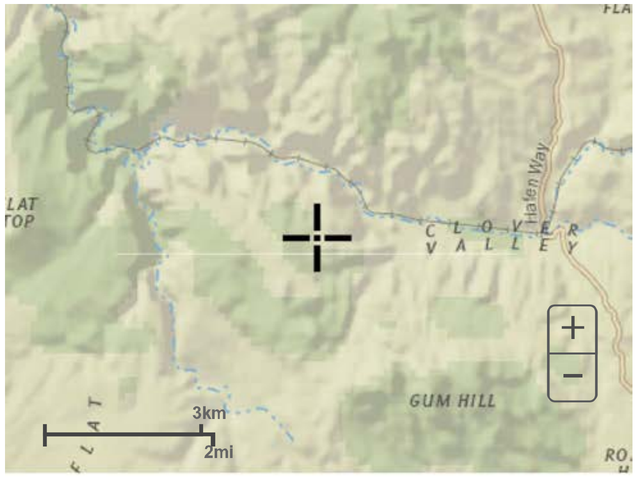


NOAA Atlas 14, Volume 1, Version 5 Created (GMT): Mon Feb 26 23:45:51 2018

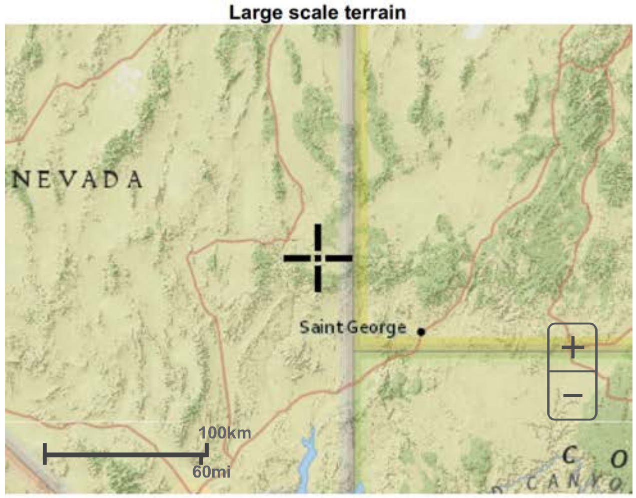
Back to Top

Maps & aerials

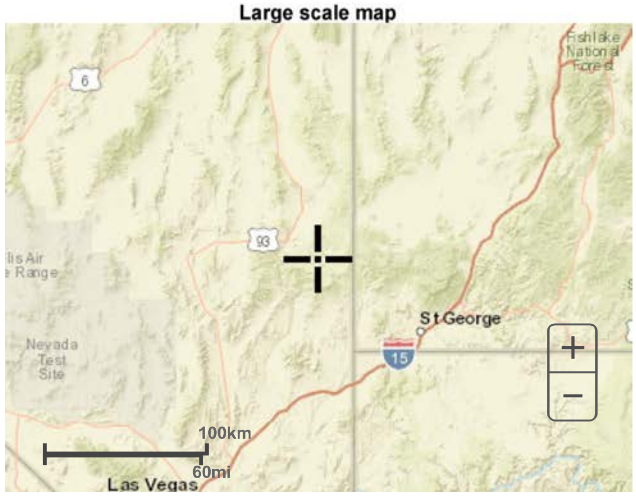
Small scale terrain



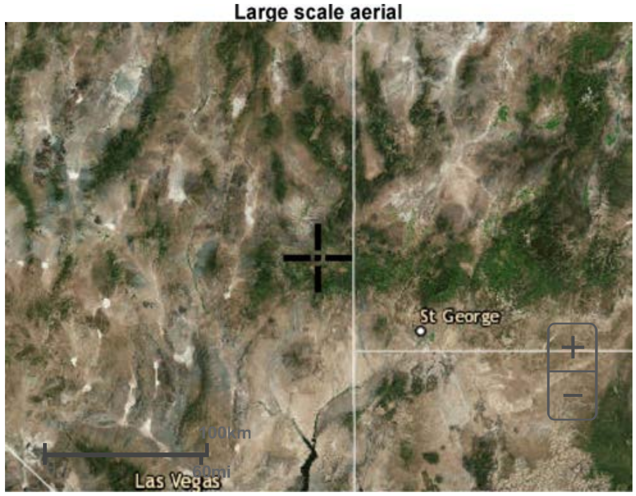
Large scale terrain



Large scale map



Large scale aerial

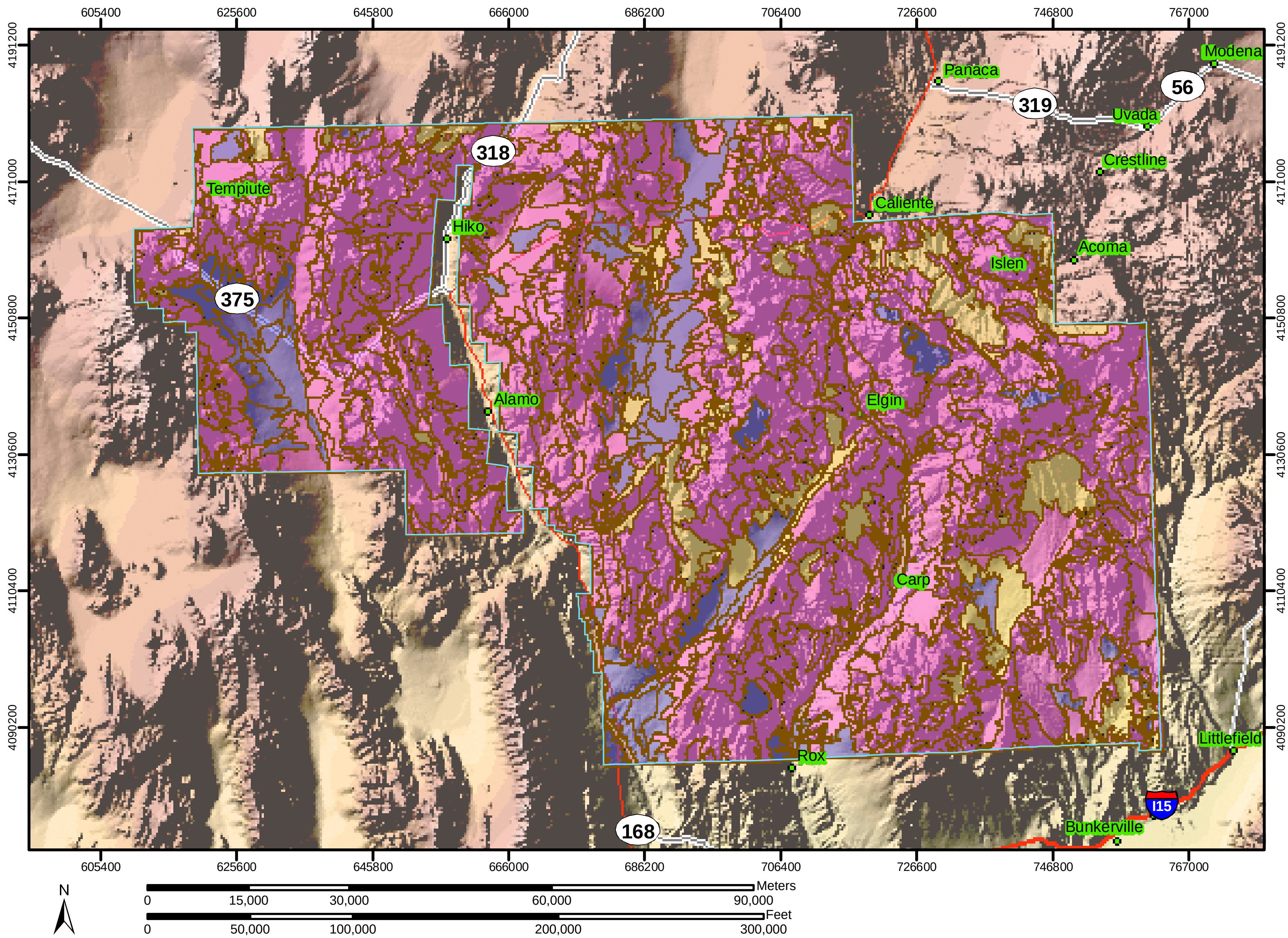


Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Appendix F
NRCS and BLM Soil Survey Maps


605400
625600
645800
666000
686200
706400
726600
746800
767000
4191200
4171000
4150800
4130600
4110400
4090200
Modena
Panaca
56
319
Uvada
Crestline
318
Tempiute
Caliente
Hiko
Acoma
Islen
375
Alamo
Elgin
Carp
Littlefield
Rox
I15
Bunkerville
168
N
0
15,000
30,000
60,000
90,000
Meters
0
50,000
100,000
200,000
300,000
Feet

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Municipalities

Cities

Urban Areas

Water Features

Oceans

Transportation

Roads

Interstate Highways

US Routes

State Highways

Local Roads

Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lincoln County, Nevada, South Part
Survey Area Data: Version 5, Jul 11, 2007

Date(s) aerial images were photographed: 5/2/1990; 5/4/1990; 2/24/1992; 8/28/1992; 9/21/1992; 9/27/1992; 6/24/1993; 7/4/1993; 7/5/1993; 4/16/1994; 5/21/1994; 5/22/1994; 5/29/1994; 6/3/1994; 6/9/1994; 6/10/1994; 6/25/1994; 9/11/1994; 8/18/1995; 7/13/1997; 1998; 6/26/1999; 9/6/1999; 9/7/1999; 9/21/1999; 9/24/1999; 9/25/1999; 9/26/1999; 10/9/1999; 10/10/1999; 9/10/2000

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1000	Weiser-Tencee-Arizo association	B	5,150.3	0.2%
1001	Weiser-Tencee association	B	31,500.5	1.3%
1010	Tencee-Weiser association	D	9,875.6	0.4%
1016	Tencee association	D	23,808.0	0.9%
1017	Tencee-Bard-Arizo association	D	12,807.6	0.5%
1020	Kurstan-Tencee association	B	15,370.8	0.6%
1021	Kurstan-Knob Hill association	B	5,903.6	0.2%
1030	Arizo-Bluepoint association	A	8,609.2	0.3%
1031	Arizo association	A	3,707.2	0.1%
1040	Akela-Rock outcrop association	D	19,340.6	0.8%
1041	Akela-Rochpah-Rock outcrop association	D	9,787.7	0.4%
1052	Knob Hill-Arizo association	B	5,142.4	0.2%
1060	St. Thomas-Chinkle-Rock outcrop association	D	5,376.9	0.2%
1061	St. Thomas-Zeheme-Rock outcrop association	D	95,013.8	3.8%
1062	Zeheme-Chinkle-Shankba association	D	13,596.3	0.5%
1063	Zeheme-Kanesprings-Rock outcrop association	D	4,036.3	0.2%
1064	Zeheme-Kanackey-Rock outcrop association	D	3,376.4	0.1%
1065	Zeheme-Rock outcrop association	D	20,440.9	0.8%
1066	Zeheme-Boxspring-Rock outcrop association	D	12,539.4	0.5%
1070	Bellehelen-Brier association	D	43,782.4	1.7%

Hydrologic Soil Group— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1080	Kaspal-Canutio association	C	27,192.0	1.1%
1090	Logring-Rock outcrop association	D	35,034.6	1.4%
1091	Logring-Eaglepass-Rock outcrop complex	D	5,990.0	0.2%
1100	Geta-Arizo association	B	11,927.2	0.5%
1101	Geta gravelly sandy loam, 2 to 4 percent slopes	B	8,580.8	0.3%
1102	Geta-Bluepoint-Arizo association	A	3,793.6	0.2%
1110	Kanesprings-Kanackey-Rock outcrop association	D	30,513.2	1.2%
1111	Nuhelen-Farepeak association	D	962.9	0.0%
1113	Kanesprings-Gabbvally association	D	12,109.8	0.5%
1133	Lojet-Qwynn-Littleailie association	B	1,909.9	0.1%
1160	Silent-Koyen association	D	7,379.3	0.3%
1170	Alko-Arizo association	D	26,435.2	1.1%
1172	Alko-Geta assocation	D	7,123.0	0.3%
1180	Acoma-Decan-Cath association	C	26,074.0	1.0%
1190	Minu-Shroe-Acoma association	C	25,795.6	1.0%
1210	Brier-Acoma-Bellehelen association	D	33,083.6	1.3%
1211	Brier-Rock outcrop association	D	15,510.1	0.6%
1220	Lien-Devildog association	D	9,373.5	0.4%
1230	Pahranagat association	C	687.8	0.0%
1250	Patter-Heist association	B	1,427.7	0.1%
1260	Hollace-Gabbvally association	D	10,539.3	0.4%
1261	Hollace-Rochpah-Wyva association	D	3,378.8	0.1%
1262	Hollace-Winklo-Wyva association	D	5,876.8	0.2%
1270	Laross-Rock outcrop association	B	9,803.8	0.4%
1300	Mormount-Arizo association	D	13,781.7	0.5%

Hydrologic Soil Group— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1302	Mormount very gravelly sandy loam, 2 to 8 percent slopes	D	10,238.4	0.4%
1303	Mormount-Canutio association	D	17,369.6	0.7%
1340	Aymate-Canutio association	C	14,803.7	0.6%
1341	Aymate sandy loam, 0 to 2 percent slopes	C	3,601.8	0.1%
1342	Aymate-Mormount-Arizo association	C	3,673.8	0.1%
1350	Bard gravelly fine sandy loam, 2 to 8 percent slopes	D	1,688.0	0.1%
1360	Canutio-Arizo association	B	3,204.2	0.1%
1370	Mormon Mesa association	D	17,955.4	0.7%
1371	Mormon Mesa-Naye-Dalian association	D	21,506.4	0.9%
1372	Mormon Mesa-Tonopah-Arada association	D	19,984.1	0.8%
1380	Bracken gravelly fine sandy loam, 2 to 8 percent slopes	B	2,415.2	0.1%
1390	Shankba-Chinkle-Kanackey association	D	5,453.5	0.2%
1400	Cave-Canutio association	D	11,677.7	0.5%
1401	Cave-Arizo association	D	59,541.9	2.4%
1403	Cave-Tencee association	D	32,545.4	1.3%
1404	Cave-Mormount-Canutio association	D	10,459.7	0.4%
1405	Cave-Zeheme association	D	5,593.9	0.2%
1406	Cave very gravelly sandy loam, 4 to 30 percent slopes	D	41,893.3	1.7%
1420	Kanackey-Rock outcrop association	D	4,696.5	0.2%
1430	Typic Torriorthents-Badland association	C	15,132.0	0.6%
1460	Pintwater-Rochpah association	D	65,046.0	2.6%
1470	Tybo-Keefa-Koyen association	B	4,531.9	0.2%
1471	Tybo-Koyen association	D	30,356.5	1.2%

Hydrologic Soil Group— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1472	Tybo-Geer association	D	6,237.7	0.2%
1473	Tybo-Leo association	D	13,773.9	0.5%
1474	Tybo-Delamar association	D	16,108.2	0.6%
1475	Treadwell-Veet association	D	3.5	0.0%
1490	Keefa-Penoyer association	B	2,953.7	0.1%
1491	Keefa, warm-Penoyer association	B	2,244.0	0.1%
1510	Koyen gravelly sandy loam, 2 to 4 percent slopes	B	31,851.7	1.3%
1512	Koyen-Penoyer association	B	12,502.9	0.5%
1520	Geer-Penoyer association	B	35,200.1	1.4%
1530	Delamar-Leo association	B	14,142.0	0.6%
1531	Delamar-Veet association	B	3,154.1	0.1%
1533	Delamar-Tybo-Koyen association	B	12,643.8	0.5%
1534	Delamar-Koyen association	B	31,608.7	1.3%
1535	Delamar gravelly sandy loam, 2 to 8 percent slopes	B	28,382.9	1.1%
1540	Oleman-Leo association	D	18,312.2	0.7%
1541	Oleman-Cave association	D	6,697.2	0.3%
1542	Oleman gravelly sandy loam, 4 to 15 percent slopes	D	14,703.9	0.6%
1550	Pahroc-Leo association	D	34,648.1	1.4%
1551	Pahroc very gravelly very fine sandy loam, 4 to 15 percent slopes	D	24,840.9	1.0%
1570	Kyler-Eaglepass-Rock outcrop association	D	17,785.5	0.7%
1571	Kyler-Logring-Rock outcrop association	D	22,307.3	0.9%
1590	Winklo-Wyva assocation	C	24,404.3	1.0%
1591	Winklo-Rochpah-Rock outcrop association	C	7,028.9	0.3%
1650	Handpah-Veet association	D	51,222.8	2.0%
1660	Dewrust-Veet association	C	9,762.3	0.4%

Hydrologic Soil Group— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1680	Rochpah-Hollace-Gabbvally association	D	6,014.2	0.2%
1681	Rochpah-Veet association	D	22,429.1	0.9%
1683	Rochpah-Rock outcrop-Leo association	D	10,218.7	0.4%
1690	Jolan-Geer association	C	5,709.1	0.2%
1700	Sierocliff-Veet association	C	2,943.5	0.1%
1710	Cliffdown gravelly sandy loam, 4 to 8 percent slopes	B	899.4	0.0%
1730	Cath-Veet association	C	6,856.0	0.3%
1734	Qwynn-Devildog association	B	4,236.5	0.2%
1741	Slaw silt loam, 0 to 2 percent slopes	C	3,077.6	0.1%
1750	Chanybuck-Brier-Rock outcrop	D	3,389.1	0.1%
1761	Wyva-Rock outcrop association	D	4,047.4	0.2%
1762	Wyva-Slidymtn association	D	17,136.1	0.7%
1770	Veet-Mosida association	B	3,494.1	0.1%
1810	Boxspring-Rock outcrop association	D	100,477.1	4.0%
1811	Boxspring-Theriot-Rock outcrop association	D	26,963.6	1.1%
1821	Turba-Acti association	D	139,778.7	5.6%
1830	Zaqua-Winklo association	D	44,759.1	1.8%
1831	Zaqua-Boxspring association	D	10,467.6	0.4%
1832	Zaqua-Winklo-Kanesprings association	D	53,183.5	2.1%
1833	Zaqua-Rock outcrop association	D	9,362.5	0.4%
1850	Rapado-Oleman association	C	20,483.6	0.8%
1851	Rapado-Veet association	C	4,309.8	0.2%
1870	Faleria-Laross association	B	12,128.1	0.5%
1880	Tejabe-Pintwater-Rock outcrop association	D	19,632.6	0.8%

Hydrologic Soil Group— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1881	Richinde-Pintwater-Rock outcrop association	C	542.2	0.0%
1885	Richinde-Chubard-Richinde, very stony association	C	427.9	0.0%
1890	Welring-Rock outcrop association	D	6,866.7	0.3%
1900	Glendale-Bluepoint association	B	1,250.7	0.0%
1910	Land silt loam, 0 to 2 percent slopes	C	171.0	0.0%
1920	Motoqua-Rock outcrop association	D	15,972.3	0.6%
1921	Motoqua-Thunderbird association	D	45,242.5	1.8%
1940	Chubard, stony-Rock outcrop association	C	548.8	0.0%
1941	Slidymtn-Capsus association	D	66,231.2	2.6%
1942	Richinde-Chubard association	C	497.4	0.0%
1950	Ursine-Lomoine association	D	14,591.9	0.6%
1951	Ursine association	D	36,139.8	1.4%
1952	Ursine-Geer association	D	137.1	0.0%
1955	Treadwell-Chuckridge-Handpah association	D	4,163.9	0.2%
1960	Crystal Springs gravelly sandy loam, 2 to 8 percent slopes	D	7,512.9	0.3%
1980	Longjim-Arizo association	D	22,704.7	0.9%
1990	Gabbvally-Rock outcrop association	D	48,328.1	1.9%
1991	Gabbvally-Hollace association	D	12,518.2	0.5%
1992	Gabbvally-Brier-Rock outcrop association	D	29,212.9	1.2%
1993	Richinde-Rock outcrop association	C	1,488.4	0.1%
2000	Playas	D	4,401.2	0.2%
2010	Stewval-Gabbvally association	D	74,128.8	3.0%
2011	Stewval-Lomoine-Rock outcrop association	D	35,792.3	1.4%
2123	Littleailie-Lojet association	C	1,027.2	0.0%

Hydrologic Soil Group— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
2290	Richinde-Chubard-Rock outcrop association	C	4,161.3	0.2%
2292	Chubard-Richinde association	C	6,377.5	0.3%
2297	Chubard-Richinde-Rock outcrop association, steep	C	169.9	0.0%
2298	Chubard-Richinde association, steep	C	2,617.7	0.1%
2320	Blackcan association	D	1,151.6	0.0%
3192	Saltydog-Ambush-Panacker association	B	266.0	0.0%
3193	Ewelac-Playas association	D	2,968.2	0.1%
3194	Ambush-Panacker-Playas association	B	655.1	0.0%
3673	Kyler, very stony-Rock outcrop-Kyler association	D	393.4	0.0%
Totals for Area of Interest (AOI)			2,509,995.4	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

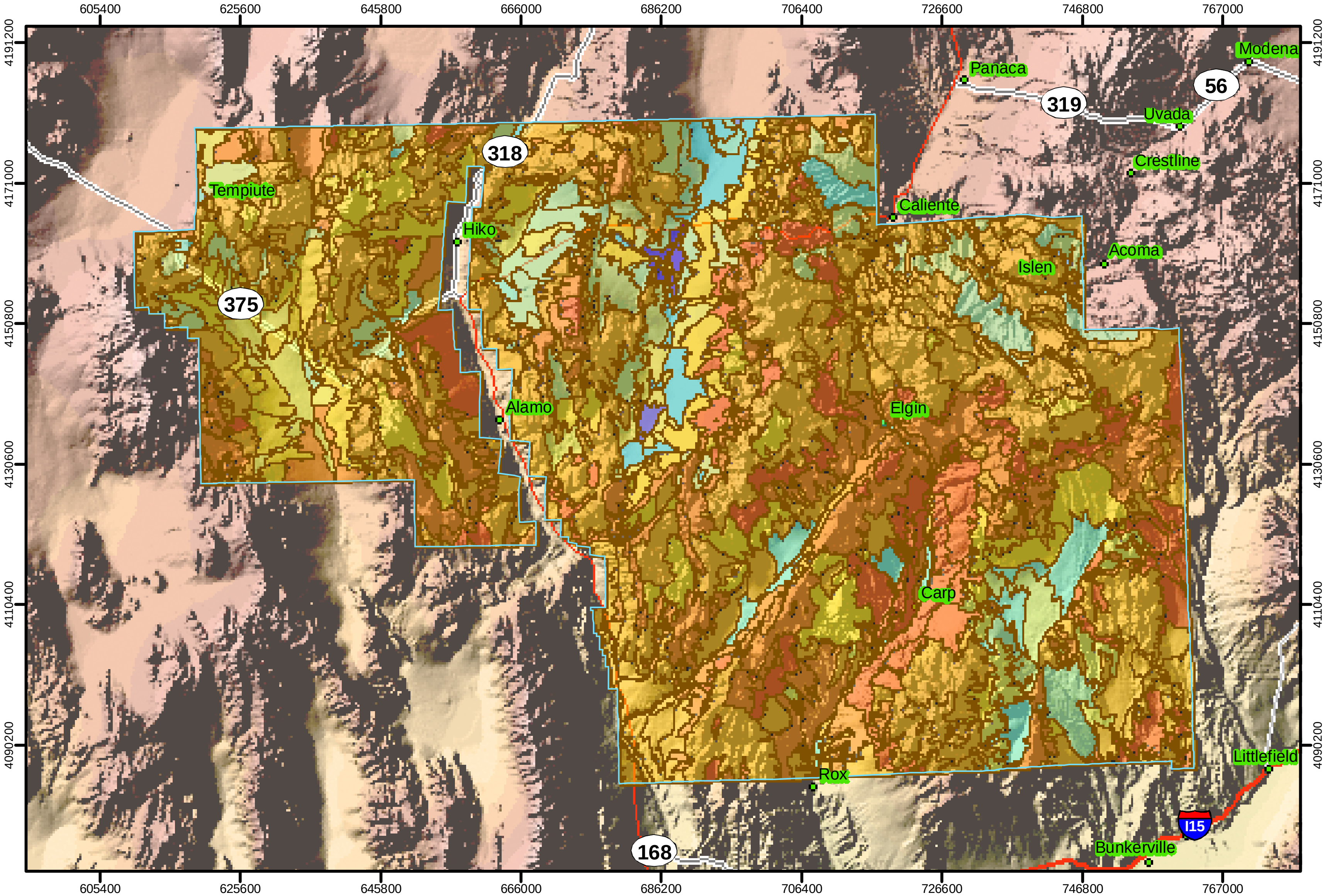
Rating Options

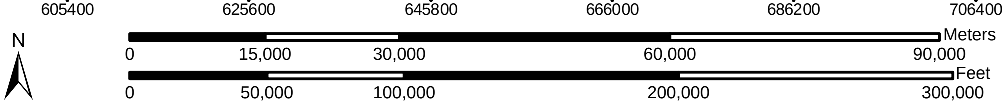
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

K Factor, Whole Soil–Lincoln County, Nevada, South Part





MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

.02

.05

.10

.15

.17

.20

.24

.28

.32

.37

.43

.49

.55

.64

Not rated or not available

Political Features

Municipalities

Cities

Urban Areas

Water Features

Oceans

Transportation

Roads

Interstate Highways

US Routes

State Highways

Local Roads

Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lincoln County, Nevada, South Part
Survey Area Data: Version 5, Jul 11, 2007

Date(s) aerial images were photographed: 5/2/1990; 5/4/1990; 2/24/1992; 8/28/1992; 9/21/1992; 9/27/1992; 6/24/1993; 7/4/1993; 7/5/1993; 4/16/1994; 5/21/1994; 5/22/1994; 5/29/1994; 6/3/1994; 6/9/1994; 6/10/1994; 6/25/1994; 9/11/1994; 8/18/1995; 7/13/1997; 1998; 6/26/1999; 9/6/1999; 9/7/1999; 9/21/1999; 9/24/1999; 9/25/1999; 9/26/1999; 10/9/1999; 10/10/1999; 9/10/2000

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1000	Weiser-Tencee-Arizo association	.15	5,150.3	0.2%
1001	Weiser-Tencee association	.15	31,500.5	1.3%
1010	Tencee-Weiser association	.10	9,875.6	0.4%
1016	Tencee association	.10	23,808.0	0.9%
1017	Tencee-Bard-Arizo association	.10	12,807.6	0.5%
1020	Kurstan-Tencee association	.15	15,370.8	0.6%
1021	Kurstan-Knob Hill association	.15	5,903.6	0.2%
1030	Arizo-Bluepoint association	.15	8,609.2	0.3%
1031	Arizo association	.15	3,707.2	0.1%
1040	Akela-Rock outcrop association	.10	19,340.6	0.8%
1041	Akela-Rochpah-Rock outcrop association	.10	9,787.7	0.4%
1052	Knob Hill-Arizo association	.15	5,142.4	0.2%
1060	St. Thomas-Chinkle-Rock outcrop association	.10	5,376.9	0.2%
1061	St. Thomas-Zeheme-Rock outcrop association	.15	95,013.8	3.8%
1062	Zeheme-Chinkle-Shankba association	.20	13,596.3	0.5%
1063	Zeheme-Kanesprings-Rock outcrop association	.20	4,036.3	0.2%
1064	Zeheme-Kanackey-Rock outcrop association	.10	3,376.4	0.1%
1065	Zeheme-Rock outcrop association	.10	20,440.9	0.8%
1066	Zeheme-Boxspring-Rock outcrop association	.20	12,539.4	0.5%
1070	Bellehelen-Brier association	.15	43,782.4	1.7%

K Factor, Whole Soil— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1080	Kaspal-Canutio association	.15	27,192.0	1.1%
1090	Logring-Rock outcrop association	.17	35,034.6	1.4%
1091	Logring-Eaglepass-Rock outcrop complex	.17	5,990.0	0.2%
1100	Geta-Arizo association	.32	11,927.2	0.5%
1101	Geta gravelly sandy loam, 2 to 4 percent slopes	.32	8,580.8	0.3%
1102	Geta-Bluepoint-Arizo association	.32	3,793.6	0.2%
1110	Kanesprings-Kanackey-Rock outcrop association	.17	30,513.2	1.2%
1111	Nuhelen-Farepeak association	.10	962.9	0.0%
1113	Kanesprings-Gabbvally association	.17	12,109.8	0.5%
1133	Lojet-Qwynn-Littleailie association	.17	1,909.9	0.1%
1160	Silent-Koyen association	.20	7,379.3	0.3%
1170	Alko-Arizo association	.15	26,435.2	1.1%
1172	Alko-Geta assocation	.20	7,123.0	0.3%
1180	Acoma-Decan-Cath association	.28	26,074.0	1.0%
1190	Minu-Shroe-Acoma association	.24	25,795.6	1.0%
1210	Brier-Acoma-Bellehelen association	.15	33,083.6	1.3%
1211	Brier-Rock outcrop association	.10	15,510.1	0.6%
1220	Lien-Devildog association	.10	9,373.5	0.4%
1230	Pahranagat association	.32	687.8	0.0%
1250	Patter-Heist association	.43	1,427.7	0.1%
1260	Hollace-Gabbvally association	.17	10,539.3	0.4%
1261	Hollace-Rochpah-Wyva association	.17	3,378.8	0.1%
1262	Hollace-Winklo-Wyva association	.17	5,876.8	0.2%
1270	Laross-Rock outcrop association	.15	9,803.8	0.4%
1300	Mormount-Arizo association	.32	13,781.7	0.5%

K Factor, Whole Soil— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1302	Mormount very gravelly sandy loam, 2 to 8 percent slopes	.17	10,238.4	0.4%
1303	Mormount-Canutio association	.32	17,369.6	0.7%
1340	Aymate-Canutio association	.24	14,803.7	0.6%
1341	Aymate sandy loam, 0 to 2 percent slopes	.28	3,601.8	0.1%
1342	Aymate-Mormount-Arizo association	.24	3,673.8	0.1%
1350	Bard gravelly fine sandy loam, 2 to 8 percent slopes	.20	1,688.0	0.1%
1360	Canutio-Arizo association	.10	3,204.2	0.1%
1370	Mormon Mesa association	.28	17,955.4	0.7%
1371	Mormon Mesa-Naye-Dalian association	.15	21,506.4	0.9%
1372	Mormon Mesa-Tonopah-Arada association	.15	19,984.1	0.8%
1380	Bracken gravelly fine sandy loam, 2 to 8 percent slopes	.20	2,415.2	0.1%
1390	Shankba-Chinkle-Kanackey association	.10	5,453.5	0.2%
1400	Cave-Canutio association	.05	11,677.7	0.5%
1401	Cave-Arizo association	.05	59,541.9	2.4%
1403	Cave-Tencee association	.05	32,545.4	1.3%
1404	Cave-Mormount-Canutio association	.05	10,459.7	0.4%
1405	Cave-Zeheme association	.05	5,593.9	0.2%
1406	Cave very gravelly sandy loam, 4 to 30 percent slopes	.05	41,893.3	1.7%
1420	Kanackey-Rock outcrop association	.10	4,696.5	0.2%
1430	Typic Torriorthents-Badland association	.05	15,132.0	0.6%
1460	Pintwater-Rochpah association	.15	65,046.0	2.6%
1470	Tybo-Keefa-Koyen association	.20	4,531.9	0.2%
1471	Tybo-Koyen association	.28	30,356.5	1.2%

K Factor, Whole Soil— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1472	Tybo-Geer association	.28	6,237.7	0.2%
1473	Tybo-Leo association	.17	13,773.9	0.5%
1474	Tybo-Delamar association	.28	16,108.2	0.6%
1475	Treadwell-Veet association	.15	3.5	0.0%
1490	Keefa-Penoyer association	.20	2,953.7	0.1%
1491	Keefa, warm-Penoyer association	.20	2,244.0	0.1%
1510	Koyen gravelly sandy loam, 2 to 4 percent slopes	.20	31,851.7	1.3%
1512	Koyen-Penoyer association	.20	12,502.9	0.5%
1520	Geer-Penoyer association	.37	35,200.1	1.4%
1530	Delamar-Leo association	.17	14,142.0	0.6%
1531	Delamar-Veet association	.17	3,154.1	0.1%
1533	Delamar-Tybo-Koyen association	.24	12,643.8	0.5%
1534	Delamar-Koyen association	.17	31,608.7	1.3%
1535	Delamar gravelly sandy loam, 2 to 8 percent slopes	.17	28,382.9	1.1%
1540	Oleman-Leo association	.05	18,312.2	0.7%
1541	Oleman-Cave association	.15	6,697.2	0.3%
1542	Oleman gravelly sandy loam, 4 to 15 percent slopes	.15	14,703.9	0.6%
1550	Pahroc-Leo association	.17	34,648.1	1.4%
1551	Pahroc very gravelly very fine sandy loam, 4 to 15 percent slopes	.17	24,840.9	1.0%
1570	Kyler-Eaglepass-Rock outcrop association	.15	17,785.5	0.7%
1571	Kyler-Logring-Rock outcrop association	.15	22,307.3	0.9%
1590	Winklo-Wyva assocation	.10	24,404.3	1.0%
1591	Winklo-Rochpah-Rock outcrop association	.15	7,028.9	0.3%
1650	Handpah-Veet association	.24	51,222.8	2.0%
1660	Dewrust-Veet association	.10	9,762.3	0.4%

K Factor, Whole Soil— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1680	Rochpah-Hollace-Gabbvally association	.10	6,014.2	0.2%
1681	Rochpah-Veet association	.10	22,429.1	0.9%
1683	Rochpah-Rock outcrop-Leo association	.10	10,218.7	0.4%
1690	Jolan-Geer association	.64	5,709.1	0.2%
1700	Sierocliff-Veet association	.10	2,943.5	0.1%
1710	Cliffdown gravelly sandy loam, 4 to 8 percent slopes	.24	899.4	0.0%
1730	Cath-Veet association	.24	6,856.0	0.3%
1734	Qwynn-Devildog association	.10	4,236.5	0.2%
1741	Slaw silt loam, 0 to 2 percent slopes	.55	3,077.6	0.1%
1750	Chanybuck-Brier-Rock outcrop	.05	3,389.1	0.1%
1761	Wyva-Rock outcrop association	.05	4,047.4	0.2%
1762	Wyva-Slidymtn association	.05	17,136.1	0.7%
1770	Veet-Mosida association	.10	3,494.1	0.1%
1810	Boxspring-Rock outcrop association	.15	100,477.1	4.0%
1811	Boxspring-Theriot-Rock outcrop association	.15	26,963.6	1.1%
1821	Turba-Acti association	.15	139,778.7	5.6%
1830	Zaqua-Winklo association	.10	44,759.1	1.8%
1831	Zaqua-Boxspring association	.10	10,467.6	0.4%
1832	Zaqua-Winklo-Kanesprings association	.10	53,183.5	2.1%
1833	Zaqua-Rock outcrop association	.10	9,362.5	0.4%
1850	Rapado-Oleman association	.17	20,483.6	0.8%
1851	Rapado-Veet association	.17	4,309.8	0.2%
1870	Faleria-Laross association	.17	12,128.1	0.5%
1880	Tejabe-Pintwater-Rock outcrop association	.10	19,632.6	0.8%

K Factor, Whole Soil— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1881	Richinde-Pintwater-Rock outcrop association	.10	542.2	0.0%
1885	Richinde-Chubard-Richinde, very stony association	.10	427.9	0.0%
1890	Welring-Rock outcrop association	.15	6,866.7	0.3%
1900	Glendale-Bluepoint association	.32	1,250.7	0.0%
1910	Land silt loam, 0 to 2 percent slopes	.43	171.0	0.0%
1920	Motoqua-Rock outcrop association	.05	15,972.3	0.6%
1921	Motoqua-Thunderbird association	.05	45,242.5	1.8%
1940	Chubard, stony-Rock outcrop association	.05	548.8	0.0%
1941	Slidymtn-Capsus association	.15	66,231.2	2.6%
1942	Richinde-Chubard association	.05	497.4	0.0%
1950	Ursine-Lomoine association	.32	14,591.9	0.6%
1951	Ursine association	.24	36,139.8	1.4%
1952	Ursine-Geer association	.24	137.1	0.0%
1955	Treadwell-Chuckridge-Handpah association	.15	4,163.9	0.2%
1960	Crystal Springs gravelly sandy loam, 2 to 8 percent slopes	.20	7,512.9	0.3%
1980	Longjim-Arizo association	.10	22,704.7	0.9%
1990	Gabbvally-Rock outcrop association	.15	48,328.1	1.9%
1991	Gabbvally-Hollace association	.15	12,518.2	0.5%
1992	Gabbvally-Brier-Rock outcrop association	.15	29,212.9	1.2%
1993	Richinde-Rock outcrop association	.10	1,488.4	0.1%
2000	Playas	.37	4,401.2	0.2%
2010	Stewval-Gabbvally association	.15	74,128.8	3.0%
2011	Stewval-Lomoine-Rock outcrop association	.15	35,792.3	1.4%
2123	Littleailie-Lojet association	.20	1,027.2	0.0%

K Factor, Whole Soil— Summary by Map Unit — Lincoln County, Nevada, South Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
2290	Richinde-Chubard-Rock outcrop association	.10	4,161.3	0.2%
2292	Chubard-Richinde association	.10	6,377.5	0.3%
2297	Chubard-Richinde-Rock outcrop association, steep	.05	169.9	0.0%
2298	Chubard-Richinde association, steep	.05	2,617.7	0.1%
2320	Blackcan association	.15	1,151.6	0.0%
3192	Saltydog-Ambush-Panacker association	.49	266.0	0.0%
3193	Ewelac-Playas association	.32	2,968.2	0.1%
3194	Ambush-Panacker-Playas association	.32	655.1	0.0%
3673	Kyler, very stony-Rock outcrop-Kyler association	.15	393.4	0.0%
Totals for Area of Interest (AOI)			2,509,995.4	100.0%

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

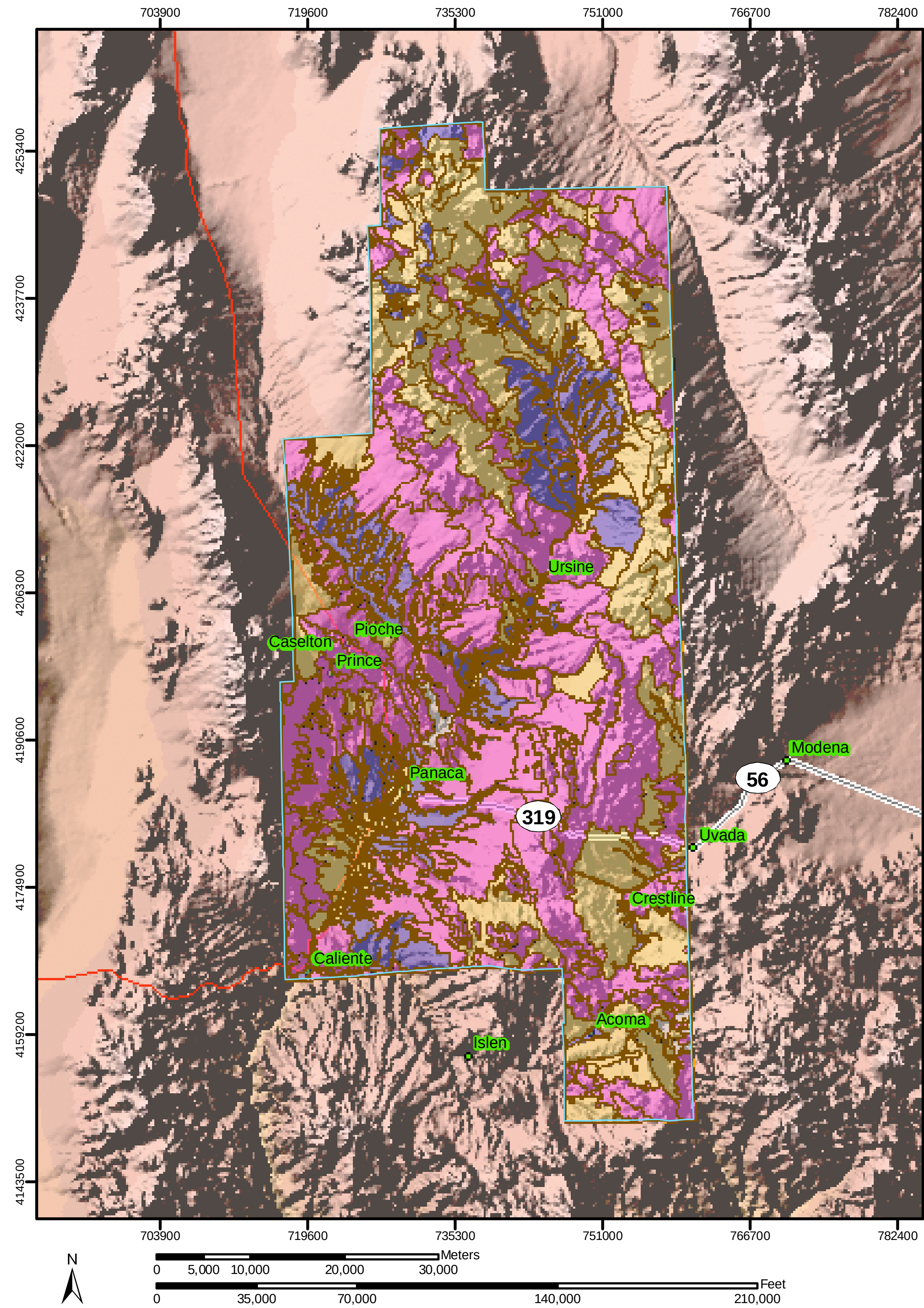
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Layer Options: Surface Layer


703900
719600
735300
751000
766700
782400
4253400
4237700
4222000
4206300
4190600
4174900
4159200
4143500
Ursine
Pioche
Caselton
Prince
Modena
56
Panaca
319
Uvada
Crestline
Caliente
Acoma
Islen
N
Meters
0
5,000
10,000
20,000
30,000
Feet
0
35,000
70,000
140,000
210,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities

- Cities
- Urban Areas

Water Features

- Oceans

Transportation

Roads

- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Meadow Valley Area, Nevada and Utah
Survey Area Data: Version 4, Dec 11, 2006

Date(s) aerial images were photographed: 5/4/1990; 6/23/1993; 6/24/1993; 7/4/1993; 7/5/1993; 4/16/1994; 5/21/1994; 5/22/1994; 6/24/1994; 8/4/1994; 9/11/1994; 8/18/1995; 5/10/1997; 7/13/1997; 7/20/1997; 10/26/1997; 10/10/1998; 10/11/1998; 6/26/1999; 6/27/1999; 7/21/1999; 7/22/1999; 9/3/1999; 9/4/1999; 9/6/1999; 9/7/1999; 9/21/1999; 9/24/1999; 9/25/1999; 9/26/1999; 10/9/1999; 10/10/1999; 9/10/2000

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ACC	Acana gravelly sandy loam, 2 to 8 percent slopes	D	39,097.9	4.5%
ADC	Acoma-Decan-Cath association	C	9,335.5	1.1%
AE	Acana-Ursine association	D	5,096.0	0.6%
ANC	Aned sandy loam, 2 to 8 percent slopes	D	1,609.0	0.2%
BA	Badland	D	19,036.5	2.2%
BAB	Brier-Acoma-Bellehelen association	D	1,853.9	0.2%
BB	Badland-Bit association	D	5,870.1	0.7%
BD2	Badland-Buster, eroded-Holsine association	B	9,362.5	1.1%
BEB	Bellehelen-Brier association	D	2,462.9	0.3%
BKF	Basket gravelly fine sandy loam, 30 to 50 percent slopes	B	6,587.1	0.8%
BL	Basket-Lize-Satt association	B	3,925.2	0.4%
Bm	Bicondoa sandy loam	C	241.4	0.0%
Bn	Bicondoa silty clay loam, drained	C	519.4	0.1%
Bo	Bicondoa complex	D	569.3	0.1%
BR	Buster-Rough broken land association	B	3,836.4	0.4%
CAC	Cath gravelly loam, 2 to 8 percent slopes	C	8,478.9	1.0%
CC	Chuska-Checkett gravelly loams, 8 to 25 percent slopes	D	6,804.5	0.8%
CD	Cedaran-Decan association	D	982.4	0.1%
CE	Cedaran-Rock outcrop complex	D	10,094.0	1.2%
CG	Cliffdown-Geer association	B	6,763.6	0.8%
CR	Checkett-Rock outcrop complex, 8 to 25 percent slopes	D	3,590.8	0.4%
DA	Decan-Uana association	C	51,442.3	5.9%

Hydrologic Soil Group— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
DC	Deerlodge-Checkett gravelly loams, 2 to 8 percent slopes	C	951.9	0.1%
DCC	Decathon gravelly loam, 2 to 8 percent slopes	C	2,222.6	0.3%
DED	Decathon-Basket association, moderately steep	C	2,935.2	0.3%
DEE	Decathon-Basket association, steep	B	9,874.0	1.1%
DH	Deerlodge-Ursine association	C	7,075.3	0.8%
DMD	Denmark gravelly loam, 2 to 15 percent slopes	D	3,584.9	0.4%
DN	Denmark-Linco association	D	4,744.3	0.5%
FAC	Fanu gravelly fine sandy loam, 0 to 8 percent slopes	B	2,623.6	0.3%
GAB	Gabbvally-Brier-Rock outcrop association	D	493.5	0.1%
GAR	Gabbvally-Rock outcrop association	D	1,448.6	0.2%
GE	Geer fine sandy loam, gravel substratum	B	3,478.2	0.4%
Gf	Geer silt loam	B	1,397.9	0.2%
Gg	Geer silt loam, slightly saline	C	4,087.6	0.5%
Gh	Geer silt loam, strongly saline	C	1,652.7	0.2%
Gk	Geer silt loam, wet	C	769.9	0.1%
GM	Geer-Heist association	B	7,285.3	0.8%
GOV	Gomine-Vennob-Rock outcrop complex, 15 to 40 percent slopes	D	5,674.8	0.6%
HA	Hamtah-Tica-Rock outcrop association	C	8,585.8	1.0%
HC	Hamtah-Udel-Rock outcrop association	C	20,639.5	2.4%
HDC	Heist gravelly sandy loam, 0 to 8 percent slopes	B	4,361.5	0.5%
HEC	Heist gravelly sandy loam, sand substratum, 0 to 8 percent slopes	B	981.5	0.1%
HN	Holsine-Usine-Buster association	B	3,665.2	0.4%

Hydrologic Soil Group— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
HOC	Holtle loam, 0 to 8 percent slopes	B	4,644.2	0.5%
HR	Holtle-Four Star association	B	575.2	0.1%
HSC	Homestake gravelly sandy loam, 4 to 8 percent slopes	C	11,390.0	1.3%
HTC	Homestake very stony sandy loam, 2 to 8 percent slopes	C	2,813.8	0.3%
IND	Itca stony clay loam, 2 to 15 percent slopes	D	10,418.7	1.2%
IO	Itca-Cedaran-Rock outcrop association	D	60,467.4	6.9%
IR	Itca-Rock outcrop association	D	44,221.5	5.1%
JCD	Jarab cobbly loam, 2 to 15 percent slopes	D	6,168.1	0.7%
KER	Kyler-Eaglepass-Rock outcrop association	D	819.1	0.1%
KO	Kyler-Rock outcrop complex	D	3,196.6	0.4%
KR	Kyler-Rock outcrop-Kyler variant association	D	3,191.7	0.4%
LAB	Lien gravelly fine sandy loam, 2 to 4 percent slopes	D	3,011.4	0.3%
LC	Linco-Acana association	B	15,073.2	1.7%
LD	Linco-Badland association	B	16,822.3	1.9%
LE	Lize association	B	4,385.6	0.5%
LT	Lize-Tica association	B	4,623.4	0.5%
MO	Monroe loam, 0 to 2 percent slopes	B	379.9	0.0%
MR	Motoqua-Rock outcrop association	D	3,203.9	0.4%
MU	Met-Ursine association	B	5,752.4	0.7%
MVC	Minu gravelly sandy loam, 2 to 8 percent slopes	D	6,148.8	0.7%
MW	Monroe-Wales silt loams, 0 to 2 percent slopes	B	1,518.9	0.2%
MWC	Minu stony sandy loam, 0 to 8 percent slopes	D	25,749.6	2.9%
NR	Nevtah-Rock outcrop association	C	10,966.7	1.3%

Hydrologic Soil Group— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
NSD	Nevu gravelly sandy loam, 4 to 15 percent slopes	C	4,967.9	0.6%
OTR	Onaqui-Tolman-Rock outcrop complex, 15 to 50 percent slopes	D	1,264.4	0.1%
Pa	Pahranagat silt loam, drained, strongly saline	C	1,132.0	0.1%
Pd	Pahranagat silt loam, strongly saline	C	479.3	0.1%
Pe	Pahranagat silty clay loam	C	395.3	0.0%
Pg	Pahranagat silty clay loam, drained	C	647.4	0.1%
PH	Patter-Heist association	B	783.4	0.1%
PMC	Pamsdel gravelly loam, 2 to 8 percent slopes	C	2,924.2	0.3%
PN	Patter-Geer association	B	8,378.5	1.0%
PO	Patter-Heist-Geer association	B	1,898.9	0.2%
PS	Pioche-Rock outcrop complex	D	3,129.9	0.4%
PTB	Poorma very fine sandy loam, 0 to 4 percent slopes	B	3,099.6	0.4%
PV	Poorma variant silt loam	D	1,526.4	0.2%
RB	Radec-Bodacious complex, 15 to 60 percent slopes	D	1,987.6	0.2%
RO	Rock land		5,680.6	0.6%
RR	Radec-Rock outcrop complex, 8 to 25 percent slopes	D	649.1	0.1%
RRD	Roval gravelly loam, 2 to 15 percent slopes	D	25,086.1	2.9%
RV	Roval-Acana association	D	5,447.8	0.6%
SAD2	Satt stony sandy loam, 4 to 15 percent slopes, eroded	C	2,209.0	0.3%
SC	Slidymtn-Capsus association	D	5,693.9	0.7%
SCC2	Satt stony fine sandy loam, 2 to 8 percent slopes, eroded	C	1,990.8	0.2%
SD	Satt association	C	9,257.8	1.1%
SEF	Seval extremely gravelly sandy loam, 30 to 50 percent slopes	C	2,709.9	0.3%

Hydrologic Soil Group— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
SGA	Stewval-Gabbvally association	D	1,737.4	0.2%
SGD	Shroe gravelly loam, 2 to 15 percent slopes	C	8,701.7	1.0%
SH	Shroe-Badland association	C	3,933.4	0.4%
SKC	Sierocliff gravelly sandy loam, 2 to 8 percent slopes	C	6,587.5	0.8%
SL	Slickens	B	145.3	0.0%
SLR	Stewval-Lomoine-Rock outcrop association	D	9.4	0.0%
ST	Stampede gravelly loam	C	1,208.9	0.1%
SUD	Studhorse gravelly loam, 2 to 15 percent slopes	C	2,327.0	0.3%
SWC	Swisbob very stony loam, 4 to 8 percent slopes	D	6,289.8	0.7%
TA	Turba-Acti association	D	5,627.1	0.6%
TN	Tica-Nevtah-Rock outcrop association	C	12,793.8	1.5%
TR	Tica-Rock outcrop association	D	40,791.3	4.7%
TTB	Timpahute gravelly loam, 0 to 4 percent slopes	D	9,684.8	1.1%
UG	Ursine-Geer association	D	1,469.6	0.2%
UK	Udel-Rock outcrop association	D	12,668.8	1.4%
UL	Ursine-Lomoine association	D	177.3	0.0%
UMB	Umil gravelly loam, 2 to 4 percent slopes	D	7,701.2	0.9%
UR	Ursine association	D	9,335.5	1.1%
URD	Ursine gravelly loam, 2 to 15 percent slopes	D	10,013.4	1.1%
URE	Ursine gravelly loam, 15 to 30 percent slopes	D	2,439.8	0.3%
US	Ursine-Badland association	D	9,975.4	1.1%
UT	Urtah-Rock outcrop association	C	3,173.9	0.4%
UWD	Urwil stony fine sandy loam, 2 to 15 percent slopes	C	4,057.6	0.5%
VBR	Vennob-Bodacious-Rock outcrop association, 15 to 50 percent slopes	D	1,388.2	0.2%

Hydrologic Soil Group— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
VCC	Vicu stony sandy loam, 2 to 8 percent slopes	C	2,588.0	0.3%
VGC	Vil gravelly loam, 2 to 8 percent slopes	D	5,324.2	0.6%
VM	Veet-Mosida association	B	864.9	0.1%
W	Water		123.1	0.0%
WMF	Wilpar very stony sandy loam, 30 to 50 percent slopes	C	4,075.8	0.5%
WNG	Winu extremely stony loam, 50 to 75 percent slopes	C	11,877.7	1.4%
WR	Winu-Rock outcrop association	C	29,657.0	3.4%
WS	Winz association	B	5,094.0	0.6%
ZOF	Zoate cobbly loam, 15 to 50 percent slopes	D	8,636.3	1.0%
ZR	Zoate-Rock outcrop association	D	11,560.6	1.3%
Totals for Area of Interest (AOI)			875,015.2	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

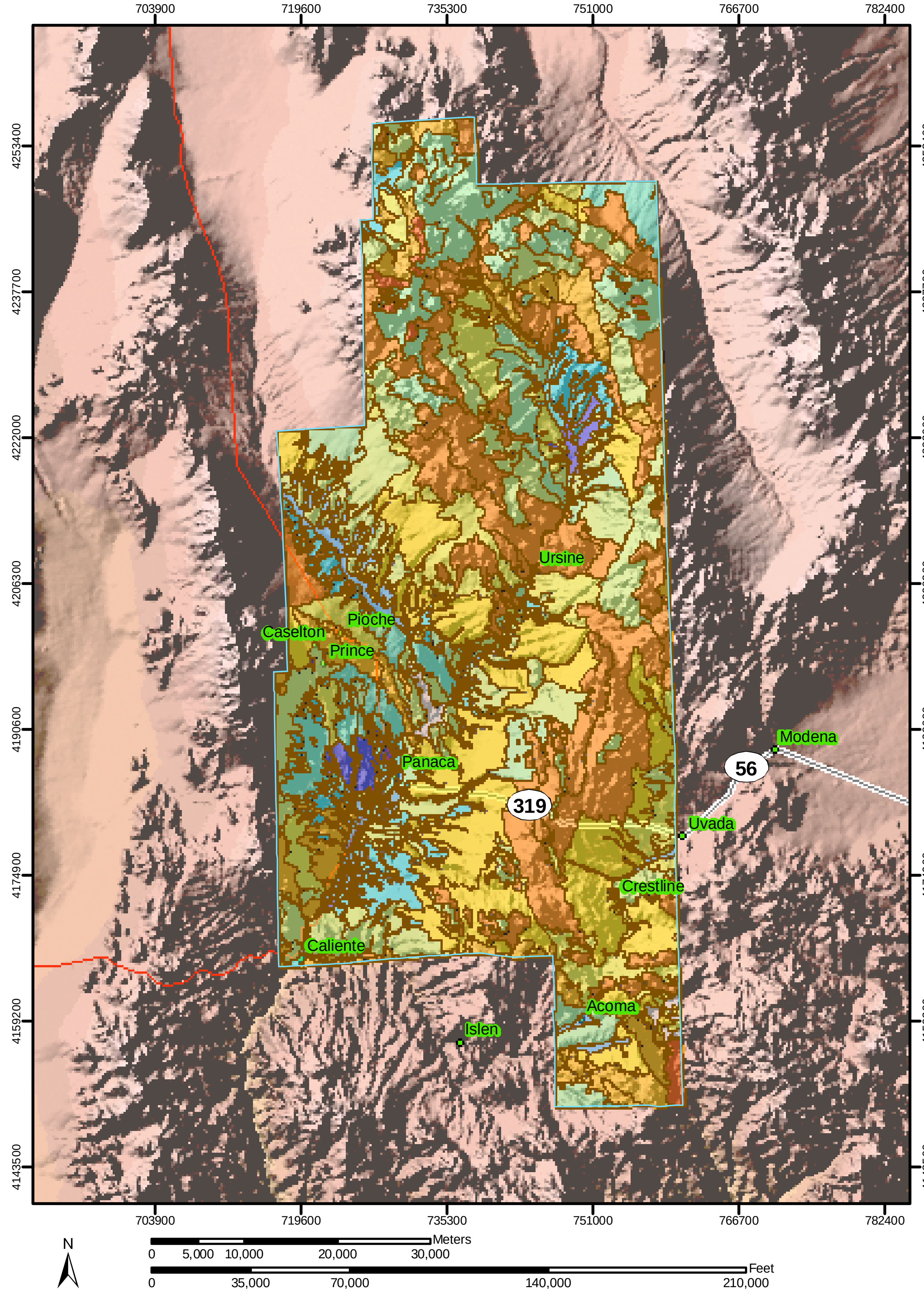
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower


703900
719600
735300
751000
766700
782400
4253400
4237700
4222000
4206300
4190600
4174900
4159200
4143500
Ursine
Pioche
Caselton
Prince
Modena
56
Panaca
319
Uvada
Crestline
Caliente
Acoma
Islen
N
Meters
0 5,000 10,000 20,000 30,000
Feet
0 35,000 70,000 140,000 210,000

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

.02

.05

.10

.15

.17

.20

.24

.28

.32

.37

.43

.49

.55

.64

Not rated or not available

Political Features

Municipalities

Cities

Urban Areas

Water Features

Oceans

Transportation

Roads

Interstate Highways

US Routes

State Highways

Local Roads

Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Meadow Valley Area, Nevada and Utah
Survey Area Data: Version 4, Dec 11, 2006

Date(s) aerial images were photographed: 5/4/1990; 6/23/1993; 6/24/1993; 7/4/1993; 7/5/1993; 4/16/1994; 5/21/1994; 5/22/1994; 6/24/1994; 8/4/1994; 9/11/1994; 8/18/1995; 5/10/1997; 7/13/1997; 7/20/1997; 10/26/1997; 10/10/1998; 10/11/1998; 6/26/1999; 6/27/1999; 7/21/1999; 7/22/1999; 9/3/1999; 9/4/1999; 9/6/1999; 9/7/1999; 9/21/1999; 9/24/1999; 9/25/1999; 9/26/1999; 10/9/1999; 10/10/1999; 9/10/2000

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ACC	Acana gravelly sandy loam, 2 to 8 percent slopes	.17	39,097.9	4.5%
ADC	Acoma-Decan-Cath association	.28	9,335.5	1.1%
AE	Acana-Ursine association	.17	5,096.0	0.6%
ANC	Aned sandy loam, 2 to 8 percent slopes	.24	1,609.0	0.2%
BA	Badland	.37	19,036.5	2.2%
BAB	Brier-Acoma-Bellehelen association	.15	1,853.9	0.2%
BB	Badland-Bit association	.37	5,870.1	0.7%
BD2	Badland-Buster, eroded-Holsine association	.37	9,362.5	1.1%
BEB	Bellehelen-Brier association	.15	2,462.9	0.3%
BKF	Basket gravelly fine sandy loam, 30 to 50 percent slopes	.24	6,587.1	0.8%
BL	Basket-Lize-Satt association	.24	3,925.2	0.4%
Bm	Bicondoa sandy loam	.20	241.4	0.0%
Bn	Bicondoa silty clay loam, drained	.28	519.4	0.1%
Bo	Bicondoa complex	.28	569.3	0.1%
BR	Buster-Rough broken land association	.20	3,836.4	0.4%
CAC	Cath gravelly loam, 2 to 8 percent slopes	.28	8,478.9	1.0%
CC	Chuska-Checkett gravelly loams, 8 to 25 percent slopes	.20	6,804.5	0.8%
CD	Cedaran-Decan association	.20	982.4	0.1%
CE	Cedaran-Rock outcrop complex	.20	10,094.0	1.2%
CG	Cliffdown-Geer association	.24	6,763.6	0.8%
CR	Checkett-Rock outcrop complex, 8 to 25 percent slopes	.24	3,590.8	0.4%
DA	Decan-Uana association	.17	51,442.3	5.9%

K Factor, Whole Soil— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
DC	Deerlodge-Checkett gravelly loams, 2 to 8 percent slopes	.20	951.9	0.1%
DCC	Decathon gravelly loam, 2 to 8 percent slopes	.28	2,222.6	0.3%
DED	Decathon-Basket association, moderately steep	.28	2,935.2	0.3%
DEE	Decathon-Basket association, steep	.28	9,874.0	1.1%
DH	Deerlodge-Ursine association	.15	7,075.3	0.8%
DMD	Denmark gravelly loam, 2 to 15 percent slopes	.20	3,584.9	0.4%
DN	Denmark-Linco association	.20	4,744.3	0.5%
FAC	Fanu gravelly fine sandy loam, 0 to 8 percent slopes	.20	2,623.6	0.3%
GAB	Gabbvally-Brier-Rock outcrop association	.15	493.5	0.1%
GAR	Gabbvally-Rock outcrop association	.15	1,448.6	0.2%
GE	Geer fine sandy loam, gravel substratum	.37	3,478.2	0.4%
Gf	Geer silt loam	.43	1,397.9	0.2%
Gg	Geer silt loam, slightly saline	.43	4,087.6	0.5%
Gh	Geer silt loam, strongly saline	.43	1,652.7	0.2%
Gk	Geer silt loam, wet	.55	769.9	0.1%
GM	Geer-Heist association	.37	7,285.3	0.8%
GOV	Gomine-Vennob-Rock outcrop complex, 15 to 40 percent slopes	.10	5,674.8	0.6%
HA	Hamtah-Tica-Rock outcrop association	.10	8,585.8	1.0%
HC	Hamtah-Udel-Rock outcrop association	.10	20,639.5	2.4%
HDC	Heist gravelly sandy loam, 0 to 8 percent slopes	.28	4,361.5	0.5%
HEC	Heist gravelly sandy loam, sand substratum, 0 to 8 percent slopes	.28	981.5	0.1%
HN	Holsine-Usine-Buster association	.24	3,665.2	0.4%

K Factor, Whole Soil— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HOC	Holtle loam, 0 to 8 percent slopes	.37	4,644.2	0.5%
HR	Holtle-Four Star association	.37	575.2	0.1%
HSC	Homestake gravelly sandy loam, 4 to 8 percent slopes	.20	11,390.0	1.3%
HTC	Homestake very stony sandy loam, 2 to 8 percent slopes	.20	2,813.8	0.3%
IND	Itca stony clay loam, 2 to 15 percent slopes	.10	10,418.7	1.2%
IO	Itca-Cedaran-Rock outcrop association	.10	60,467.4	6.9%
IR	Itca-Rock outcrop association	.10	44,221.5	5.1%
JCD	Jarab cobbly loam, 2 to 15 percent slopes	.20	6,168.1	0.7%
KER	Kyler-Eaglepass-Rock outcrop association	.15	819.1	0.1%
KO	Kyler-Rock outcrop complex	.15	3,196.6	0.4%
KR	Kyler-Rock outcrop-Kyler variant association	.15	3,191.7	0.4%
LAB	Lien gravelly fine sandy loam, 2 to 4 percent slopes	.37	3,011.4	0.3%
LC	Linco-Acana association	.24	15,073.2	1.7%
LD	Linco-Badland association	.24	16,822.3	1.9%
LE	Lize association	.15	4,385.6	0.5%
LT	Lize-Tica association	.15	4,623.4	0.5%
MO	Monroe loam, 0 to 2 percent slopes	.37	379.9	0.0%
MR	Motoqua-Rock outcrop association	.05	3,203.9	0.4%
MU	Met-Ursine association	.55	5,752.4	0.7%
MVC	Minu gravelly sandy loam, 2 to 8 percent slopes	.24	6,148.8	0.7%
MW	Monroe-Wales silt loams, 0 to 2 percent slopes	.43	1,518.9	0.2%
MWC	Minu stony sandy loam, 0 to 8 percent slopes	.20	25,749.6	2.9%
NR	Nevtah-Rock outcrop association	.28	10,966.7	1.3%

K Factor, Whole Soil— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
NSD	Nevu gravelly sandy loam, 4 to 15 percent slopes	.17	4,967.9	0.6%
OTR	Onaqui-Tolman-Rock outcrop complex, 15 to 50 percent slopes	.15	1,264.4	0.1%
Pa	Pahranagat silt loam, drained, strongly saline	.32	1,132.0	0.1%
Pd	Pahranagat silt loam, strongly saline	.37	479.3	0.1%
Pe	Pahranagat silty clay loam	.37	395.3	0.0%
Pg	Pahranagat silty clay loam, drained	.32	647.4	0.1%
PH	Patter-Heist association	.43	783.4	0.1%
PMC	Pamsdel gravelly loam, 2 to 8 percent slopes	.17	2,924.2	0.3%
PN	Patter-Geer association	.43	8,378.5	1.0%
PO	Patter-Heist-Geer association	.43	1,898.9	0.2%
PS	Pioche-Rock outcrop complex	.15	3,129.9	0.4%
PTB	Poorma very fine sandy loam, 0 to 4 percent slopes	.55	3,099.6	0.4%
PV	Poorma variant silt loam	.55	1,526.4	0.2%
RB	Radec-Bodacious complex, 15 to 60 percent slopes	.10	1,987.6	0.2%
RO	Rock land		5,680.6	0.6%
RR	Radec-Rock outcrop complex, 8 to 25 percent slopes	.10	649.1	0.1%
RRD	Roval gravelly loam, 2 to 15 percent slopes	.17	25,086.1	2.9%
RV	Roval-Acana association	.17	5,447.8	0.6%
SAD2	Satt stony sandy loam, 4 to 15 percent slopes, eroded	.10	2,209.0	0.3%
SC	Slidymtn-Capsus association	.15	5,693.9	0.7%
SCC2	Satt stony fine sandy loam, 2 to 8 percent slopes, eroded	.10	1,990.8	0.2%
SD	Satt association	.10	9,257.8	1.1%
SEF	Seval extremely gravelly sandy loam, 30 to 50 percent slopes	.10	2,709.9	0.3%

K Factor, Whole Soil— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
SGA	Stewval-Gabbvally association	.15	1,737.4	0.2%
SGD	Shroe gravelly loam, 2 to 15 percent slopes	.17	8,701.7	1.0%
SH	Shroe-Badland association	.15	3,933.4	0.4%
SKC	Sierocliff gravelly sandy loam, 2 to 8 percent slopes	.10	6,587.5	0.8%
SL	Slickens	.64	145.3	0.0%
SLR	Stewval-Lomoine-Rock outcrop association	.15	9.4	0.0%
ST	Stampede gravelly loam	.43	1,208.9	0.1%
SUD	Studhorse gravelly loam, 2 to 15 percent slopes	.20	2,327.0	0.3%
SWC	Swisbob very stony loam, 4 to 8 percent slopes	.15	6,289.8	0.7%
TA	Turba-Acti association	.15	5,627.1	0.6%
TN	Tica-Nevtah-Rock outcrop association	.24	12,793.8	1.5%
TR	Tica-Rock outcrop association	.24	40,791.3	4.7%
TTB	Timpahute gravelly loam, 0 to 4 percent slopes	.24	9,684.8	1.1%
UG	Ursine-Geer association	.24	1,469.6	0.2%
UK	Udel-Rock outcrop association	.10	12,668.8	1.4%
UL	Ursine-Lomoine association	.32	177.3	0.0%
UMB	Umil gravelly loam, 2 to 4 percent slopes	.32	7,701.2	0.9%
UR	Ursine association	.24	9,335.5	1.1%
URD	Ursine gravelly loam, 2 to 15 percent slopes	.32	10,013.4	1.1%
URE	Ursine gravelly loam, 15 to 30 percent slopes	.32	2,439.8	0.3%
US	Ursine-Badland association	.32	9,975.4	1.1%
UT	Urtah-Rock outcrop association	.10	3,173.9	0.4%
UWD	Urwil stony fine sandy loam, 2 to 15 percent slopes	.15	4,057.6	0.5%
VBR	Vennob-Bodacious-Rock outcrop association, 15 to 50 percent slopes	.10	1,388.2	0.2%

K Factor, Whole Soil— Summary by Map Unit — Meadow Valley Area, Nevada and Utah				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
VCC	Vicu stony sandy loam, 2 to 8 percent slopes	.17	2,588.0	0.3%
VGC	Vil gravelly loam, 2 to 8 percent slopes	.28	5,324.2	0.6%
VM	Veet-Mosida association	.10	864.9	0.1%
W	Water		123.1	0.0%
WMF	Wilpar very stony sandy loam, 30 to 50 percent slopes	.15	4,075.8	0.5%
WNG	Winu extremely stony loam, 50 to 75 percent slopes	.28	11,877.7	1.4%
WR	Winu-Rock outcrop association	.28	29,657.0	3.4%
WS	Winz association	.05	5,094.0	0.6%
ZOF	Zoate cobbly loam, 15 to 50 percent slopes	.24	8,636.3	1.0%
ZR	Zoate-Rock outcrop association	.24	11,560.6	1.3%
Totals for Area of Interest (AOI)			875,015.2	100.0%

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Layer Options: Surface Layer

Appendix G
Soil Sample Gradation Test Results

Particle-Size Analysis of Soils

(ASTM D422)

© IGES 2004

Project: Sunrise Engineering (02390/002/0003)
No: M00256-016
Location: MVW Linear Park Improvements, Caliente, NV
Date: 10/9/2007
By: NB

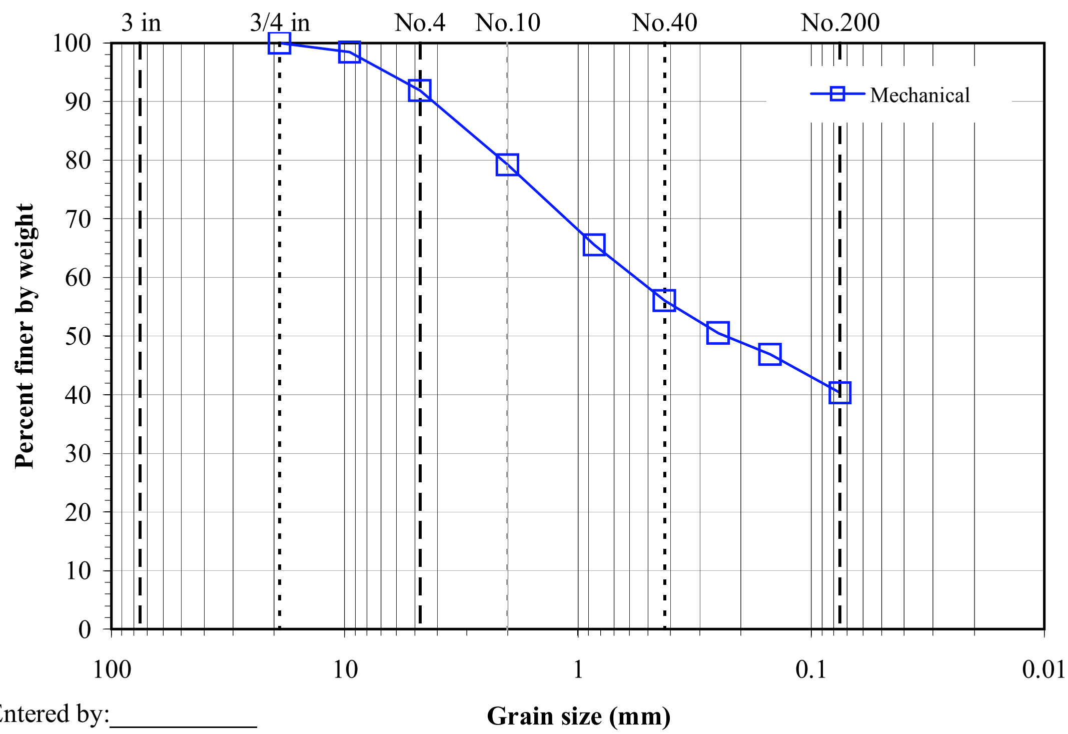
Boring No.:
Sample: 1
Depth:
Description:

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	912.05	878.9
Split fraction:	1.000	

Moisture data

Moist soil + tare (g):	-	1200.50
Dry soil + tare (g):	-	1167.38
Tare (g):	-	288.45
Moisture content (%):	0.0	3.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
12"	-	300	-
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	100.0
3/8"	13.70	9.5	98.4
No.4	71.70	4.75	91.8
No.10	183.10	2	79.2
No.20	302.70	0.85	65.6
No.40	386.50	0.425	56.0
No.60	434.70	0.25	50.5
No.100	467.10	0.15	46.9
No.200	524.60	0.075	40.3



Entered by:___________
Reviewed:___________

Z:\PROJECTS\M00256_Sunrise_Engineering\016\[GSDv1.xls]1

Particle-Size Analysis of Soils

(ASTM D422)

© IGES 2004

Project: **Sunrise Engineering (02390/002/0003)**
No: **M00256-016**
Location: MVW Linear Park Improvements, Caliente, NV
Date: 10/9/2007
By: NB

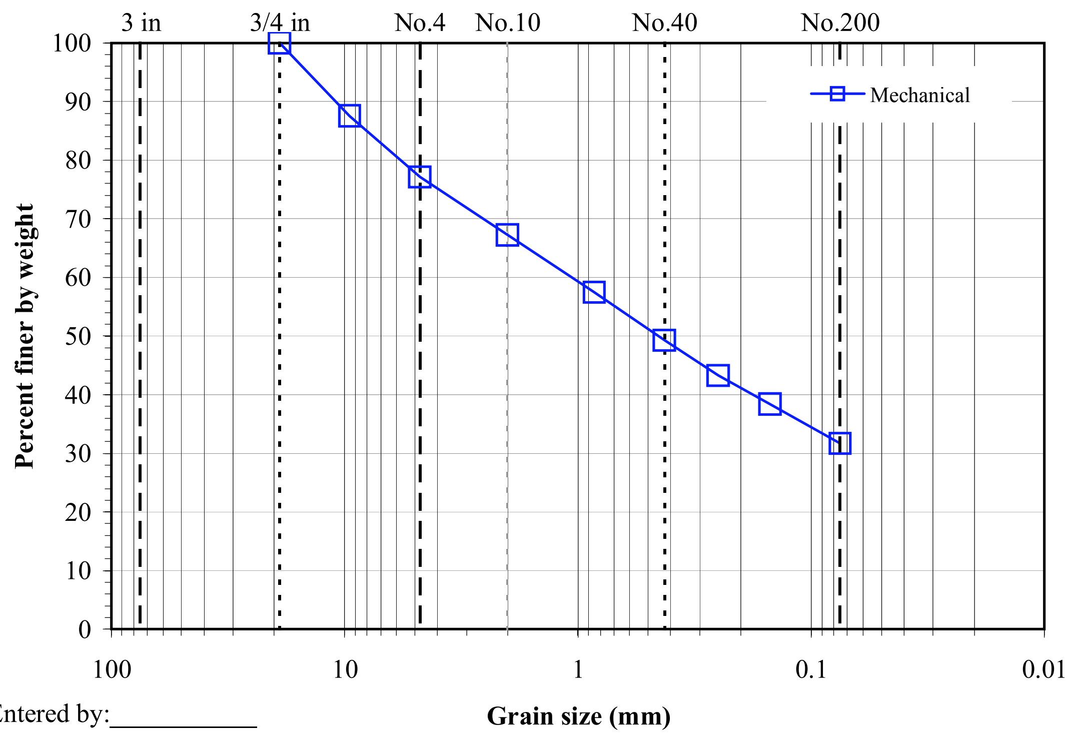
Boring No.:
Sample: **2**
Depth:
Description:

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	964.27	888.7
Split fraction:	1.000	

Moisture data

Moist soil + tare (g):	-	1237.55
Dry soil + tare (g):	-	1162.02
Tare (g):	-	273.28
Moisture content (%):	0.0	8.5

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
12"	-	300	-
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	100.0
3/8"	110.60	9.5	87.6
No.4	203.30	4.75	77.1
No.10	291.00	2	67.3
No.20	378.00	0.85	57.5
No.40	450.70	0.425	49.3
No.60	504.30	0.25	43.3
No.100	547.40	0.15	38.4
No.200	607.20	0.075	31.7



Entered by:___________
Reviewed:___________

Particle-Size Analysis of Soils

(ASTM D422)

© IGES 2004

Project: Sunrise Engineering (02390/002/0003)
No: M00256-016
Location: MVW Linear Park Improvements, Caliente, NV
Date: 10/9/2007
By: NB

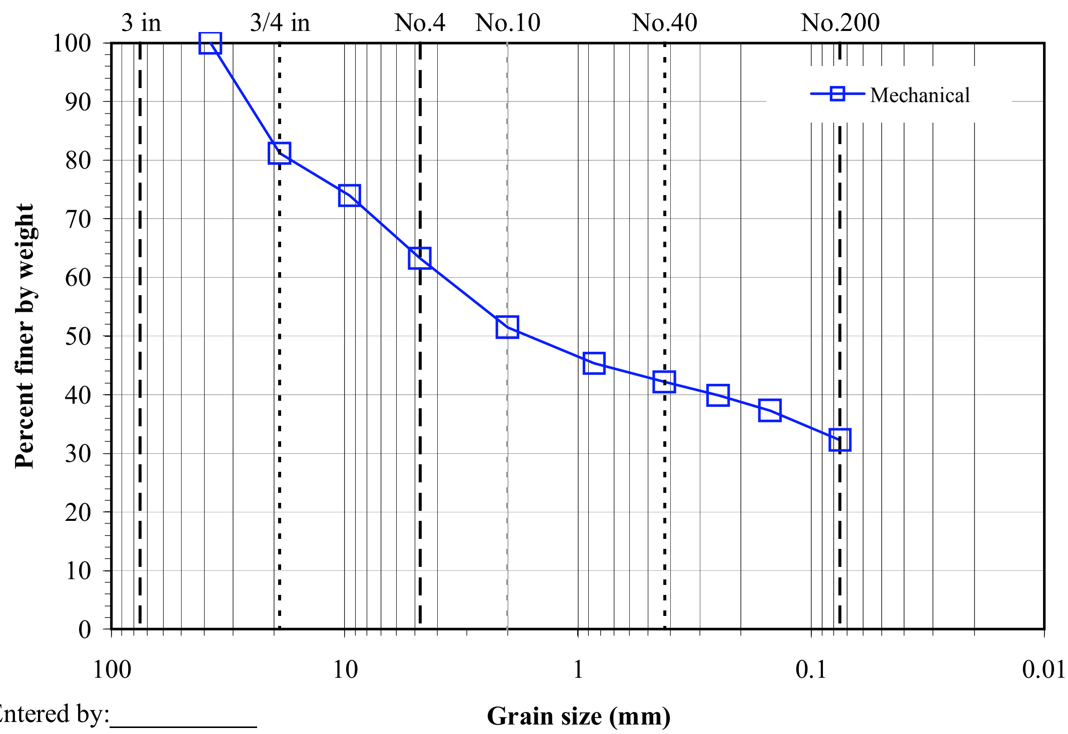
Boring No.:
Sample: 3
Depth:
Description:

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	1441.94	1352.6
Split fraction:	1.000	

Moisture data

Moist soil + tare (g):	-	1736.49
Dry soil + tare (g):	-	1647.15
Tare (g):	-	294.55
Moisture content (%):	0.0	6.6

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
12"	-	300	-
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	255.00	19	81.1
3/8"	352.30	9.5	74.0
No.4	497.20	4.75	63.2
No.10	655.80	2	51.5
No.20	739.20	0.85	45.3
No.40	782.30	0.425	42.2
No.60	813.10	0.25	39.9
No.100	848.20	0.15	37.3
No.200	916.10	0.075	32.3



Entered by:___________
Reviewed:___________

Z:\PROJECTS\M00256_Sunrise_Engineering\016\[GSDv1.xls]3

Particle-Size Analysis of Soils

(ASTM D422)

© IGES 2004

Project: Sunrise Engineering (02390/002/0003) **Boring No.:**

No: M00256-016 **Sample:** 4

Location: MVW Linear Park Improvements, Caliente, NV **Depth:**

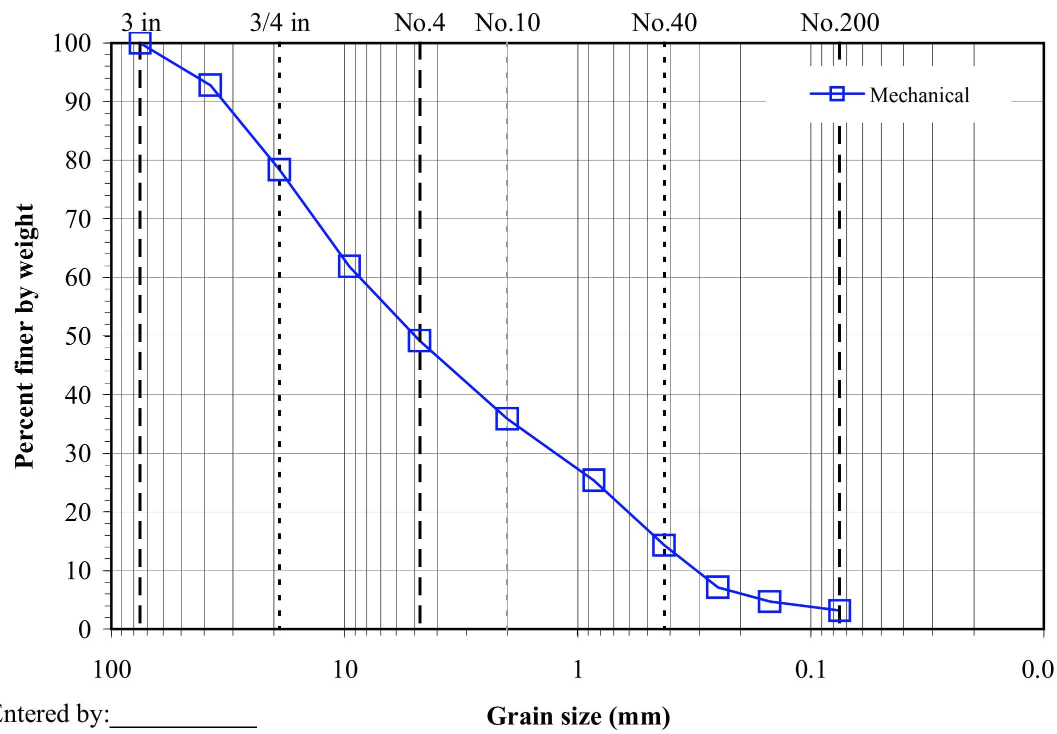
Date: 10/9/2007 Description:

By: NB

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	2247.99	2157.6
Split fraction:	1.000	

Moisture data		
Moist soil + tare (g):	-	2711.10
Dry soil + tare (g):	-	2620.70
Tare (g):	-	463.11
Moisture content (%):	0.0	4.2

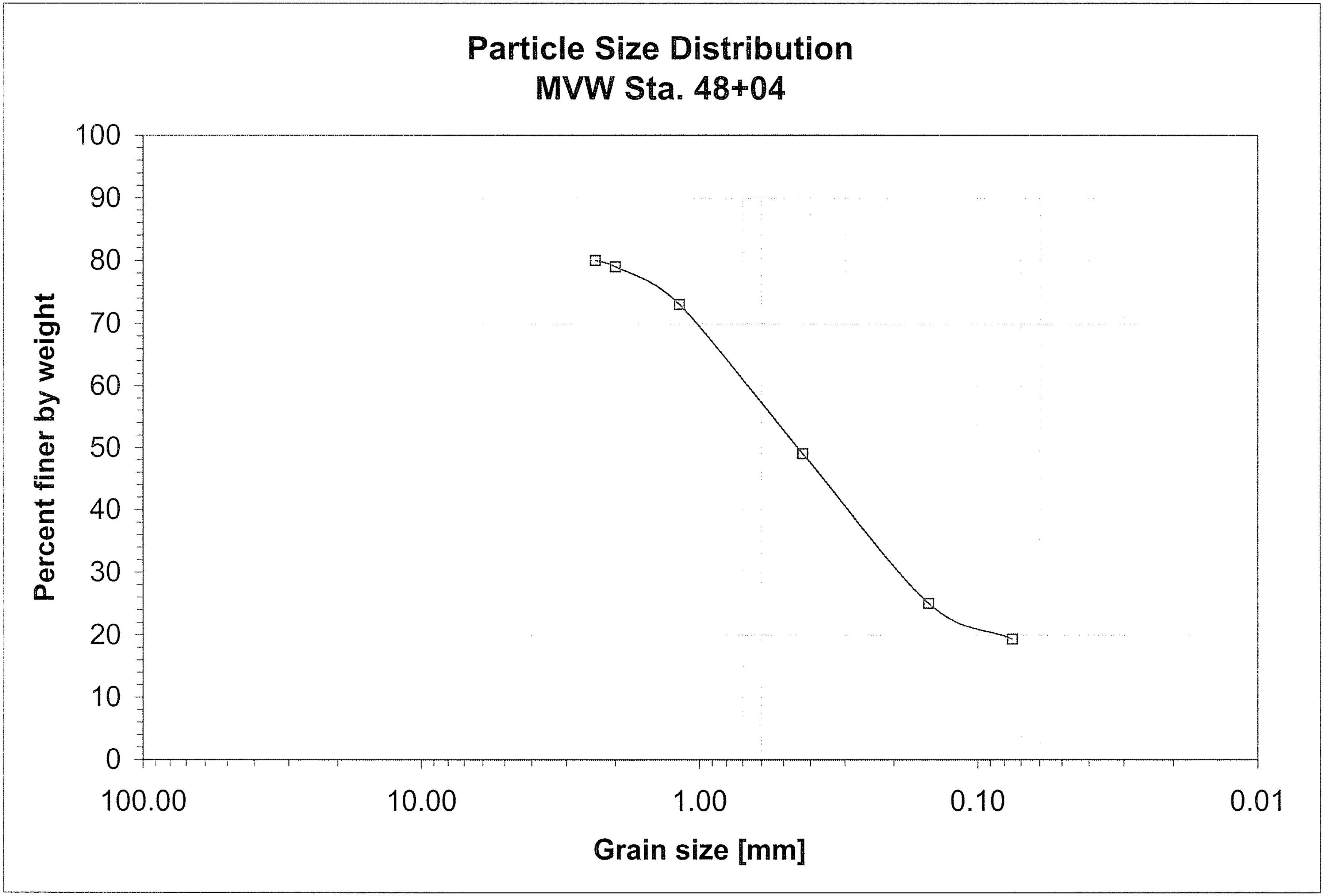
Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
12"	-	300	-
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	100.0
1.5"	155.00	37.5	92.8
3/4"	466.90	19	78.4
3/8"	823.00	9.5	61.9
No.4	1095.40	4.75	49.2
No.10	1383.50	2	35.9
No.20	1610.00	0.85	25.4
No.40	1849.30	0.425	14.3
No.60	2003.00	0.25	7.2
No.100	2056.40	0.15	4.7
No.200	2088.90	0.075	3.2



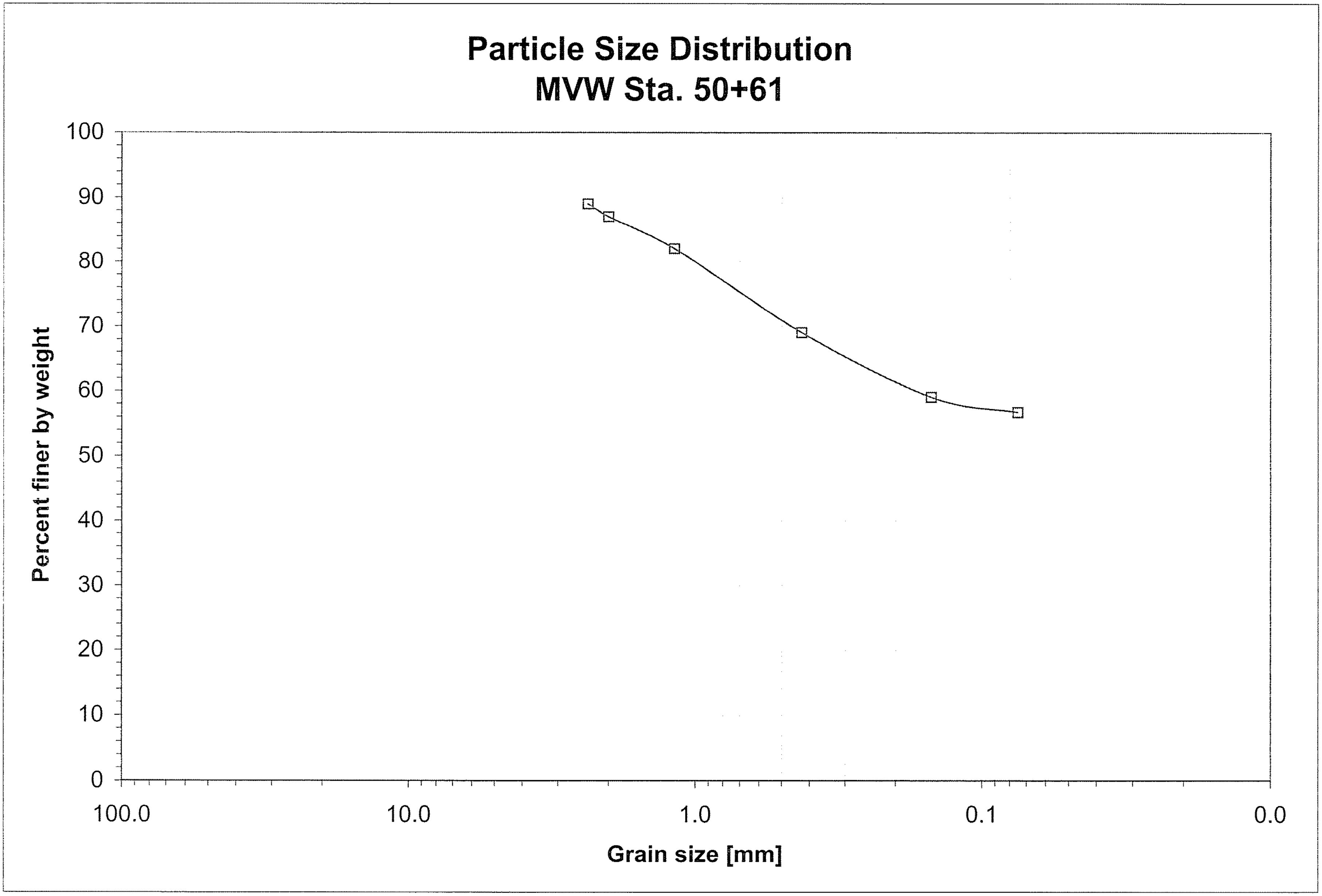
Entered by:___________

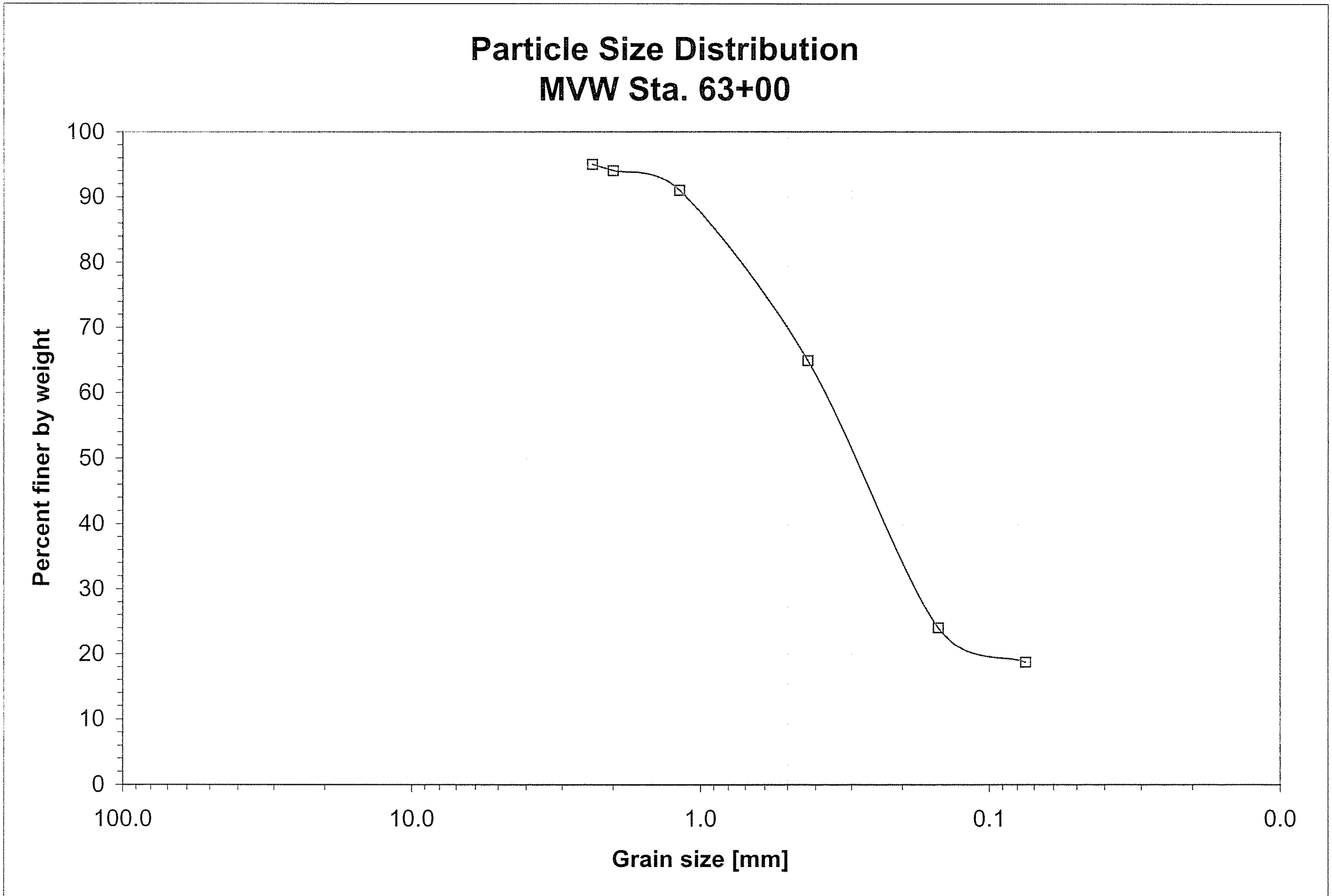
Reviewed:___________

Z:\PROJECTS\M00256_Sunrise_Engineering\016\[GSDv1.xls]4

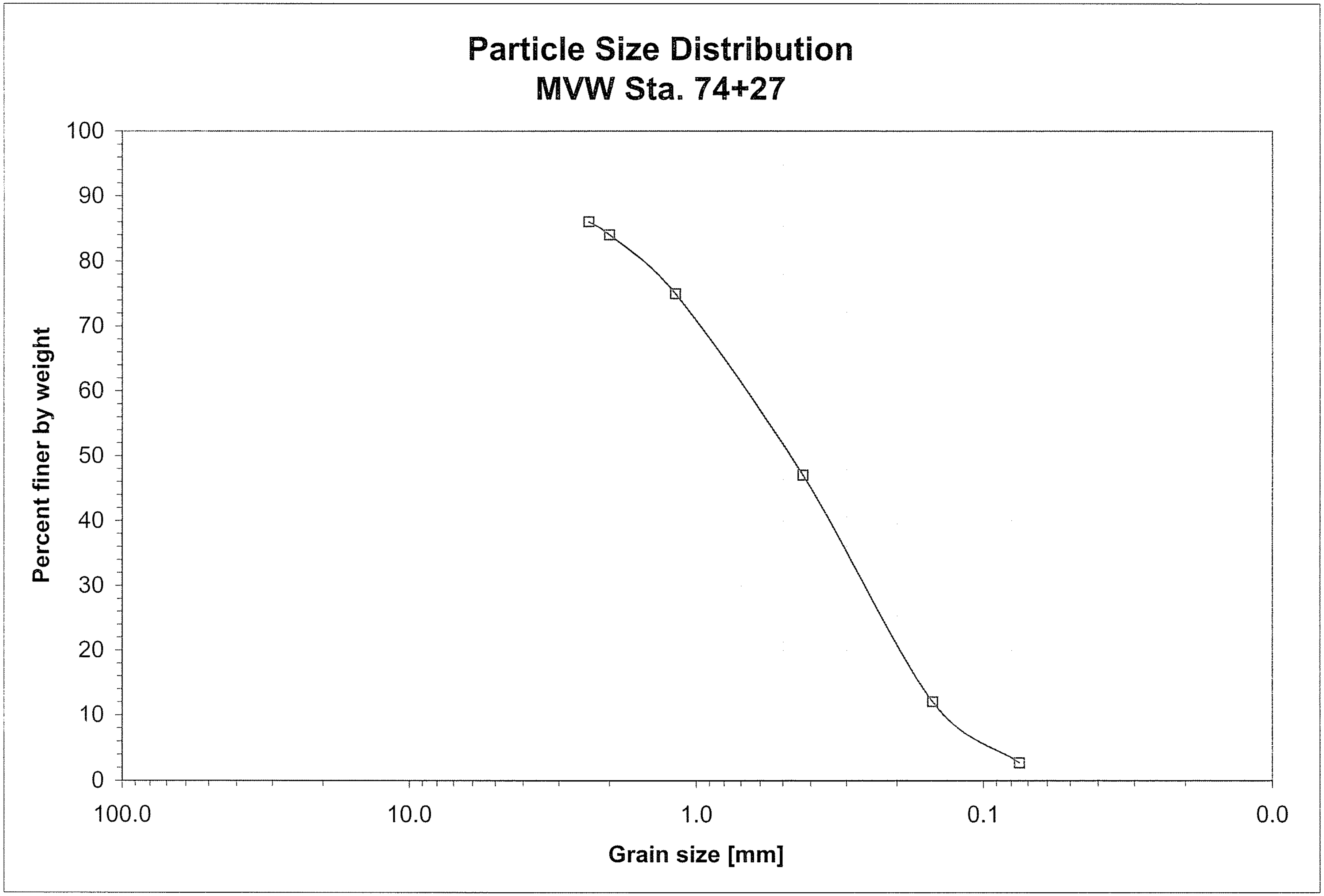


Particle Size Distribution
MVW Sta. 48+04
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.00
10.00
1.00
0.10
0.01
Grain size [mm]

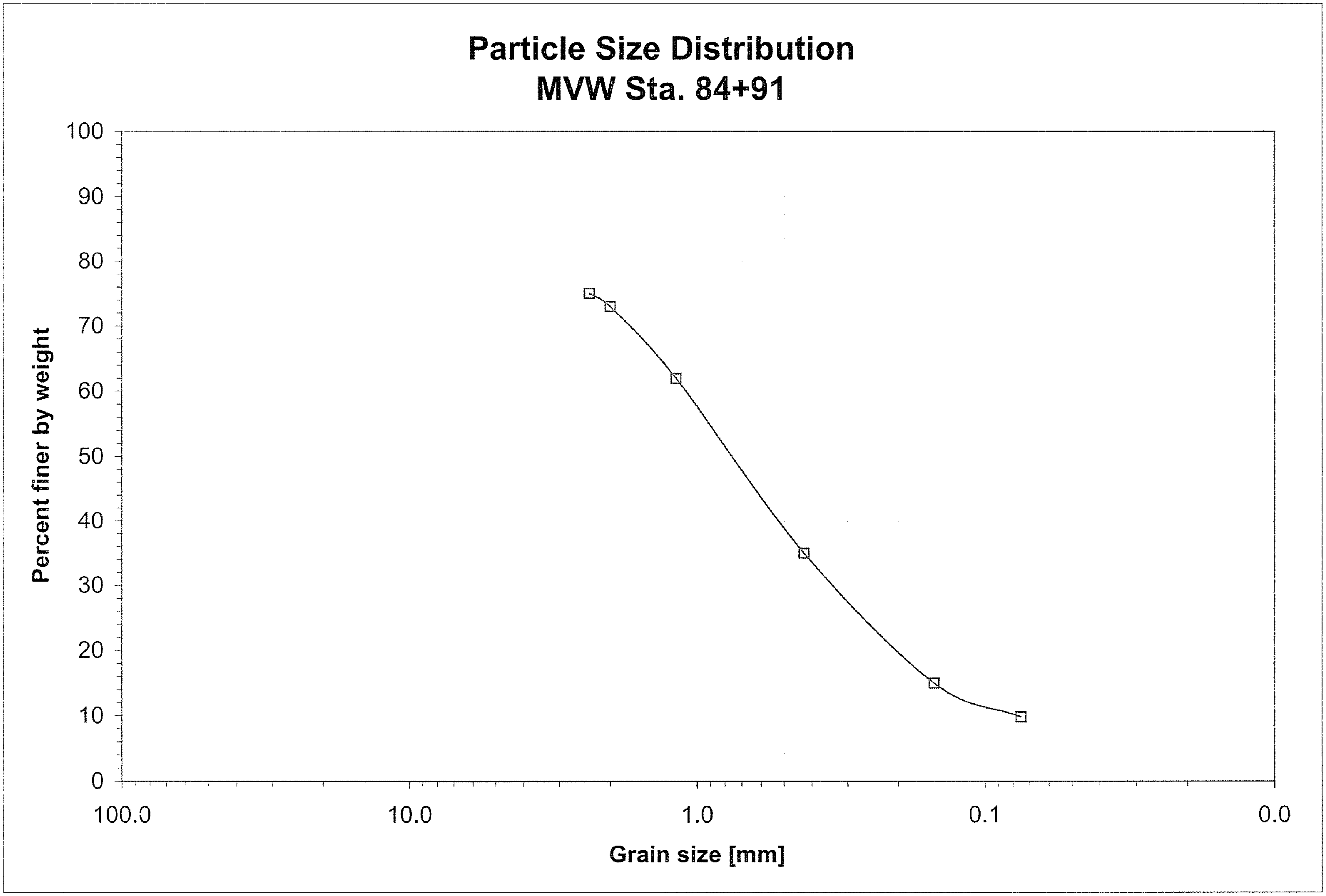

Particle Size Distribution
MVW Sta. 50+61
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

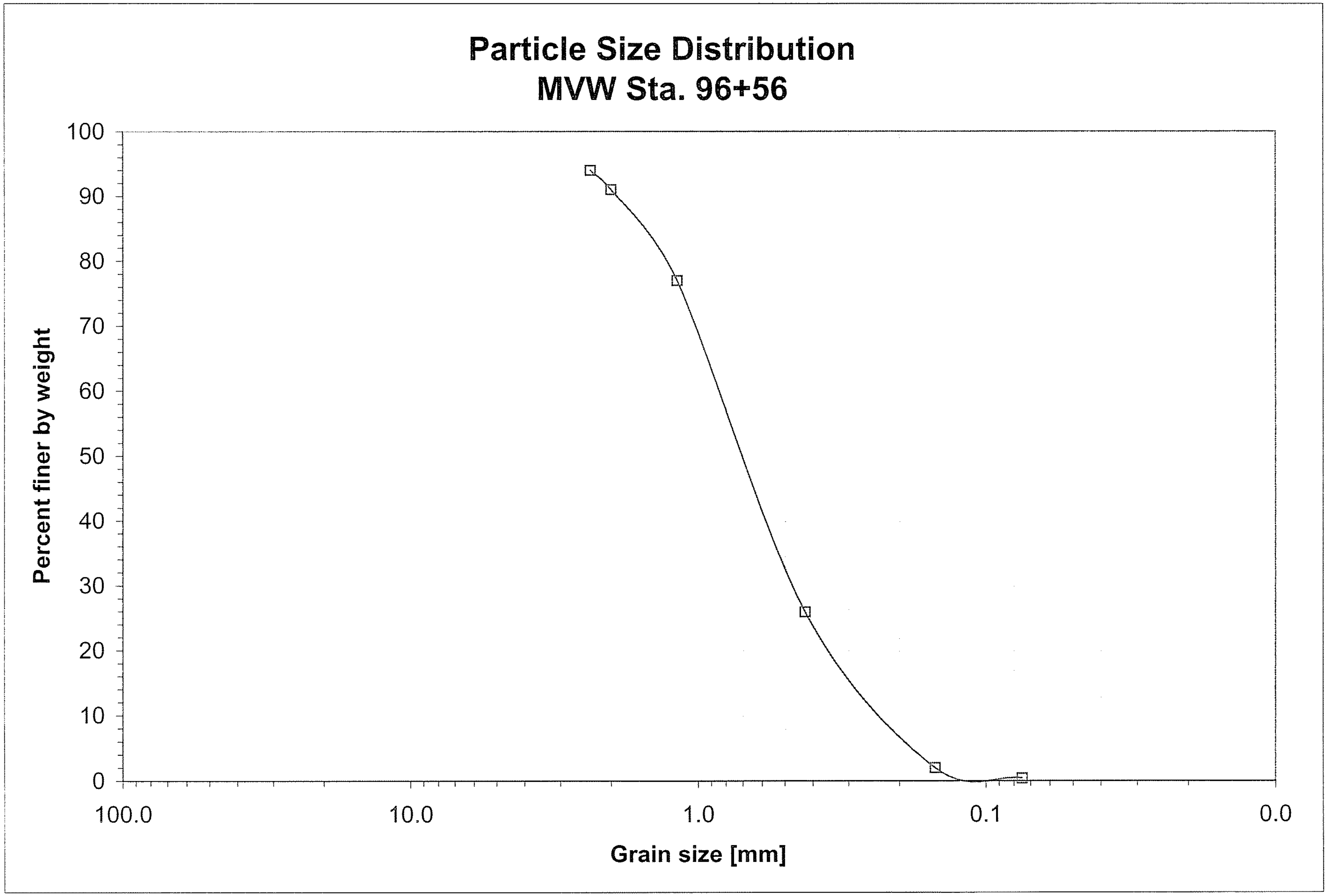


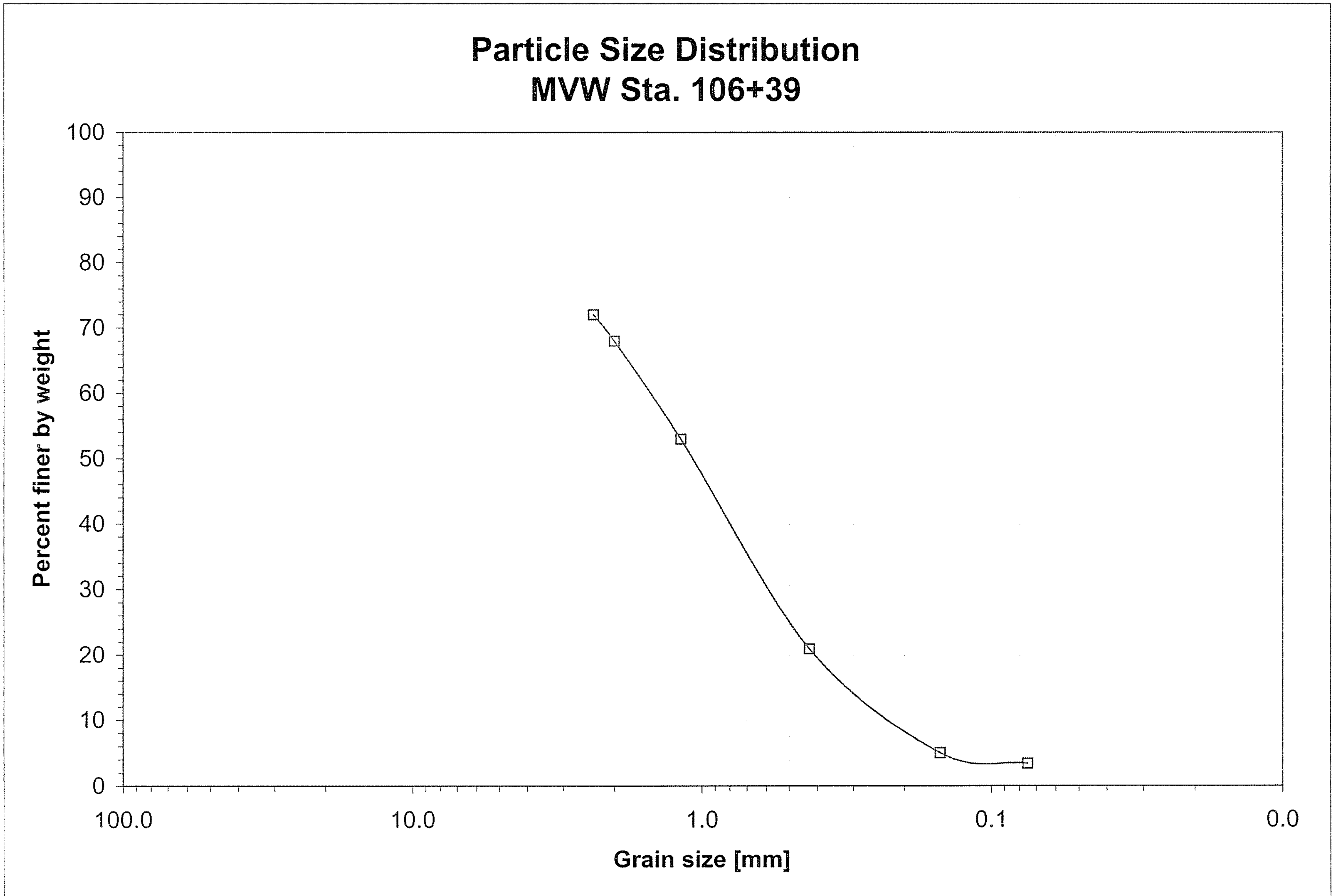
Particle Size Distribution
MVW Sta. 63+00
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

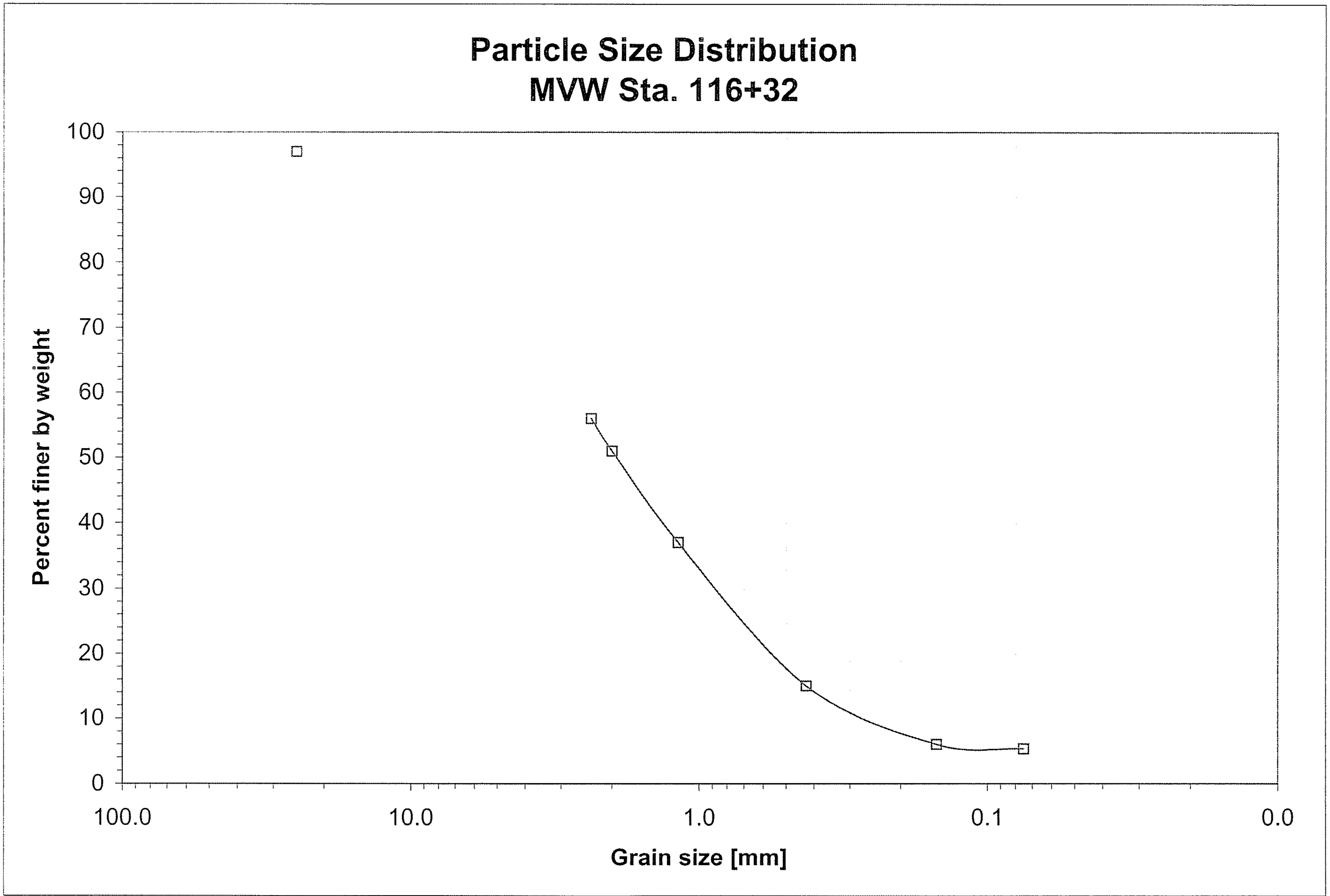


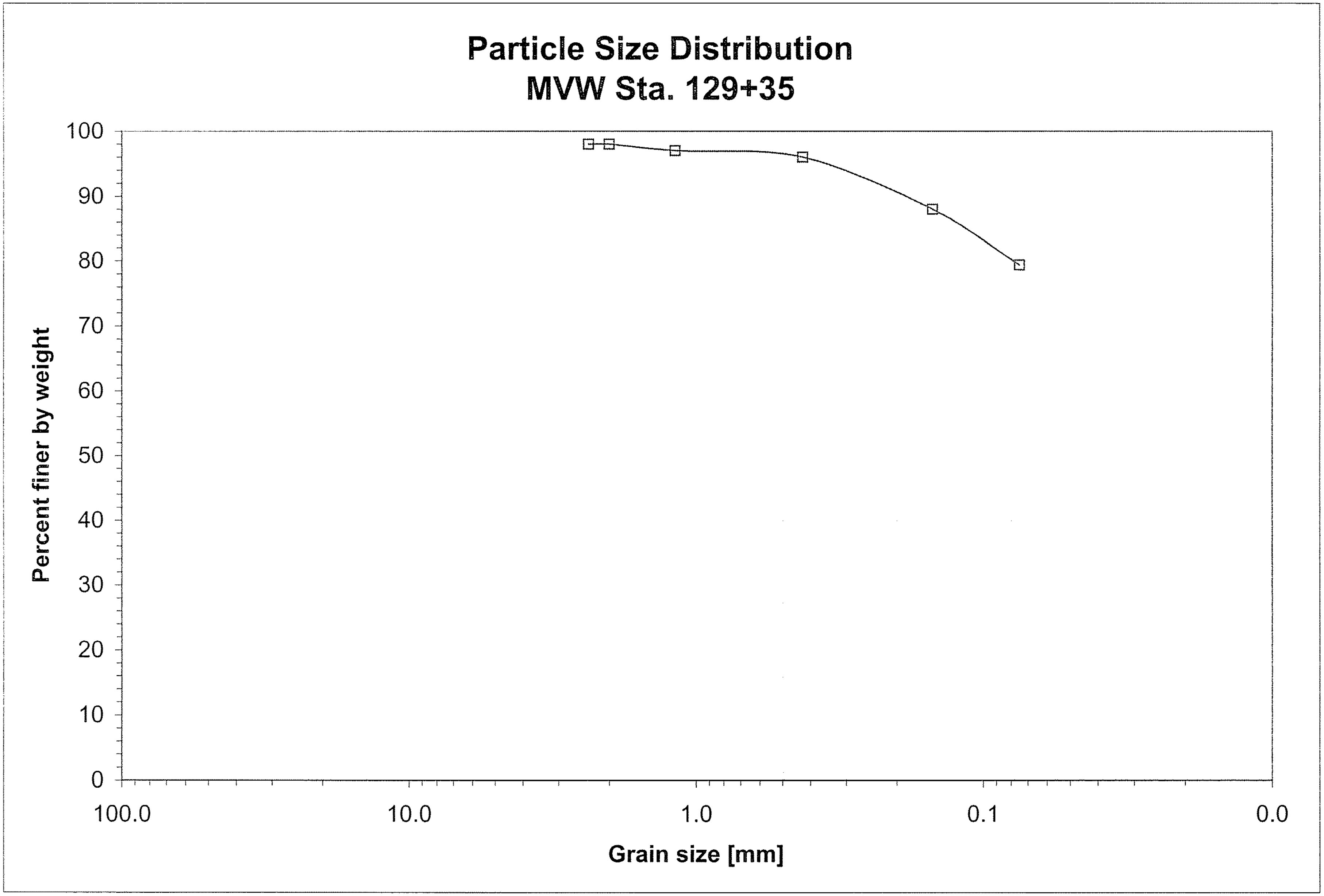
Particle Size Distribution
MVW Sta. 74+27
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]


Particle Size Distribution
MVW Sta. 84+91
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

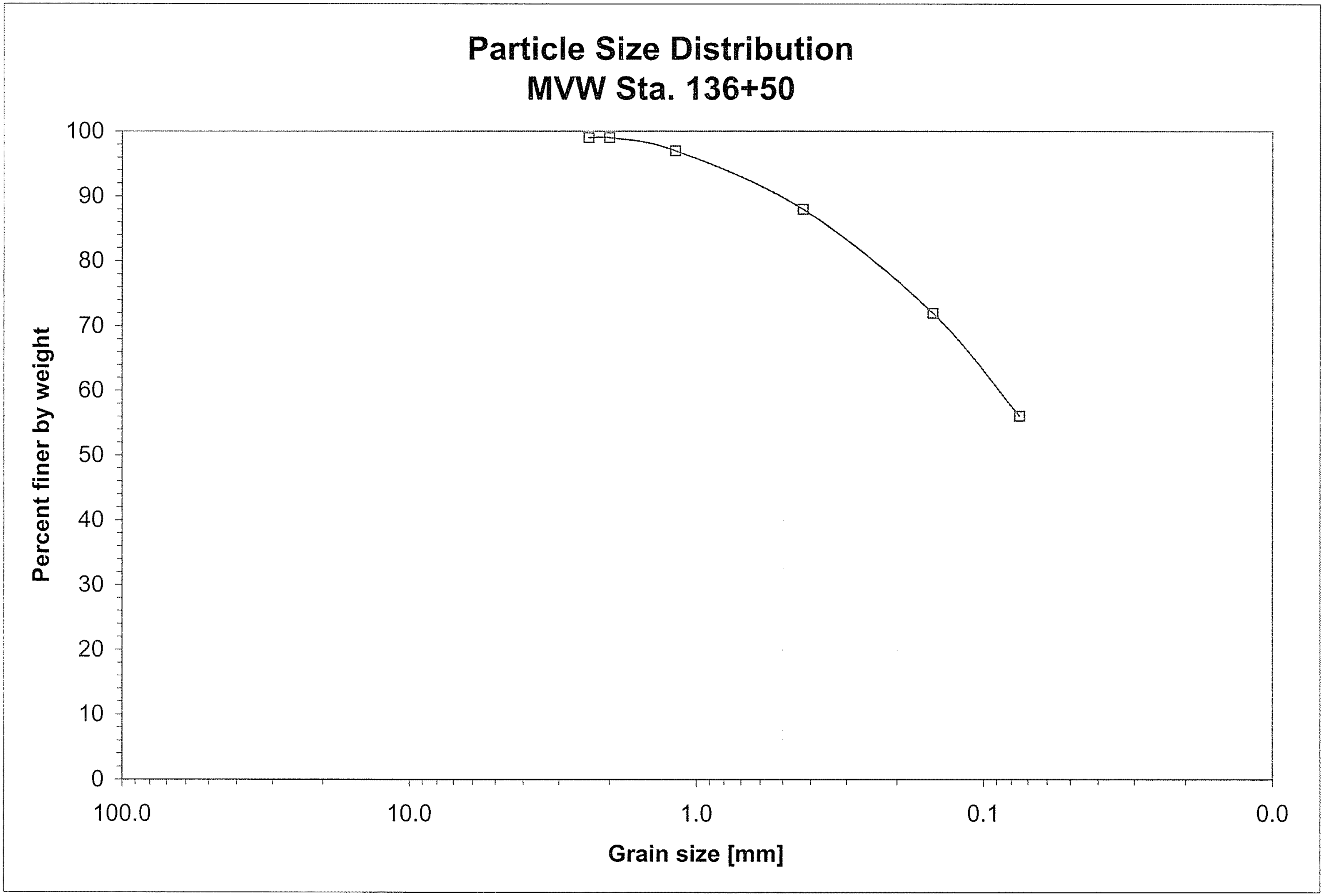

Particle Size Distribution
MVW Sta. 96+56
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]


Particle Size Distribution
MVW Sta. 106+39
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

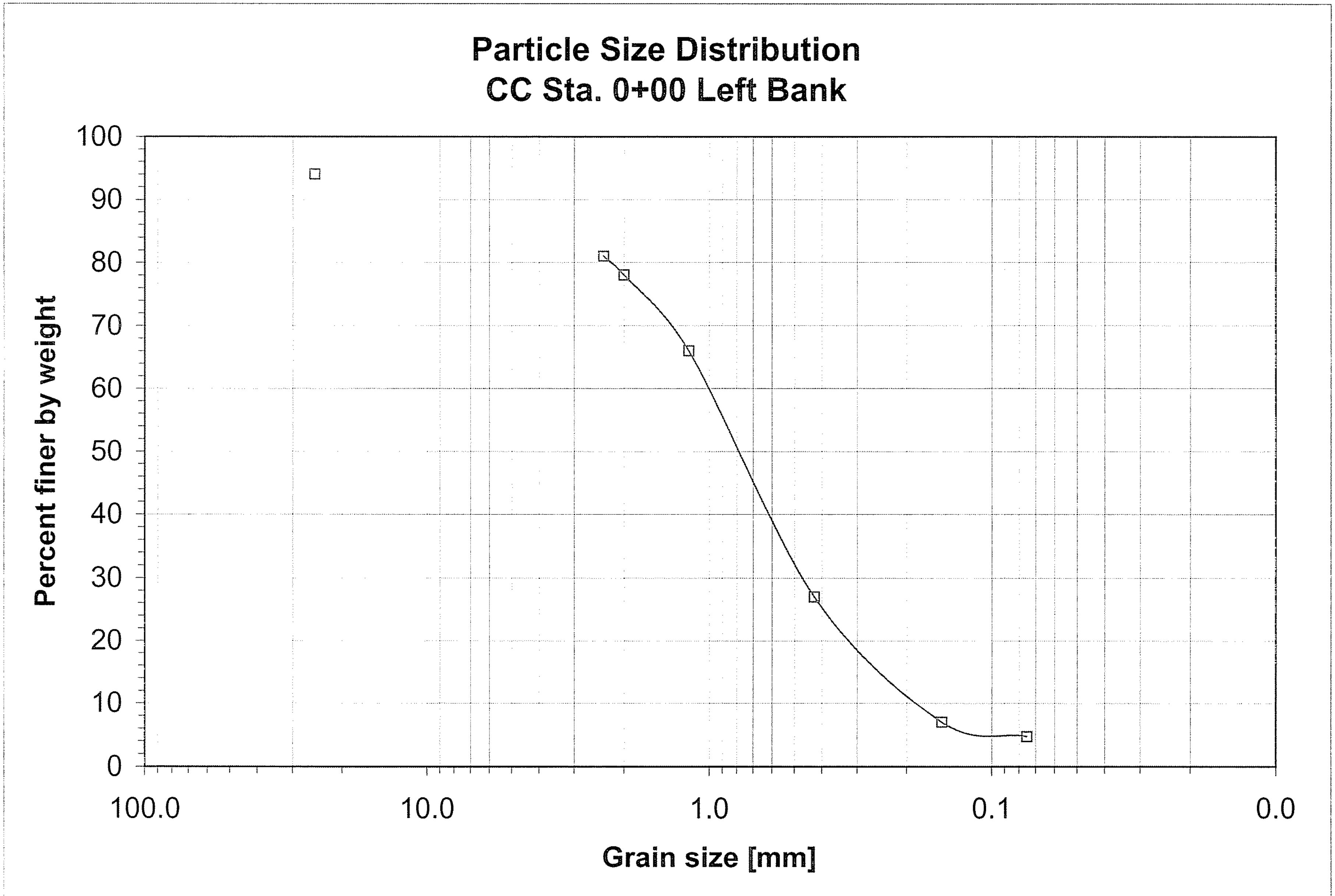

Particle Size Distribution
MVW Sta. 116+32
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]



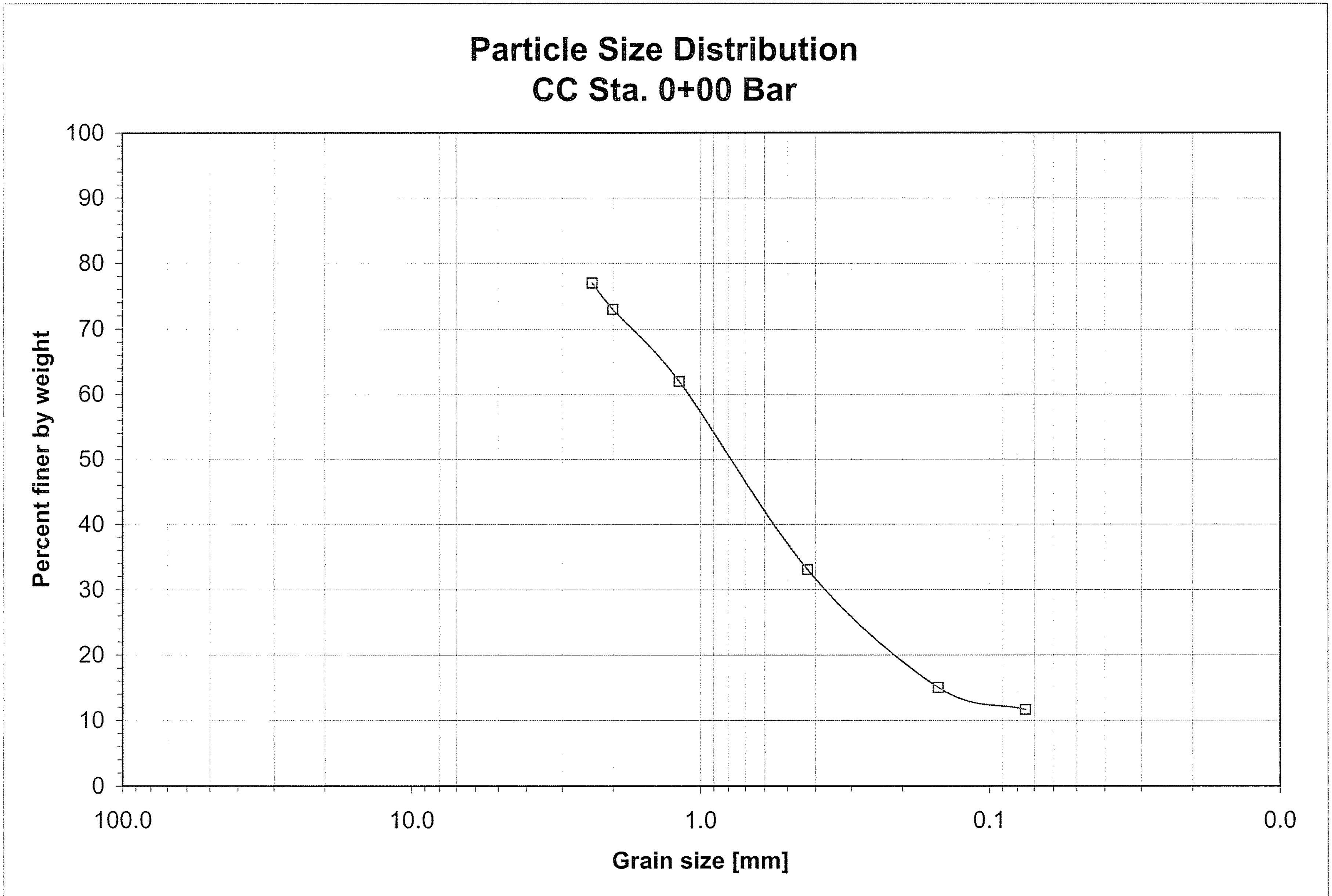
Particle Size Distribution
MVW Sta. 129+35
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

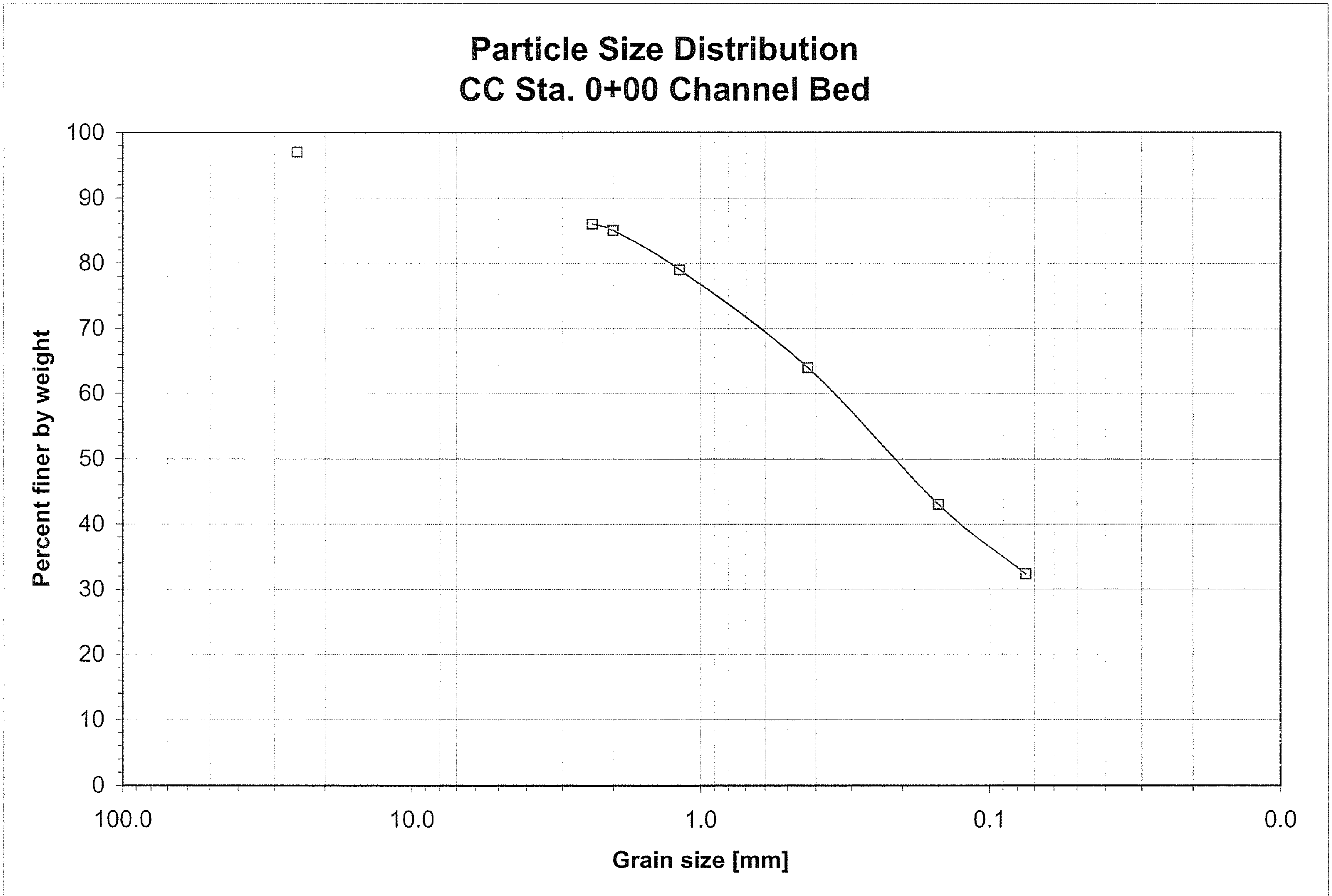


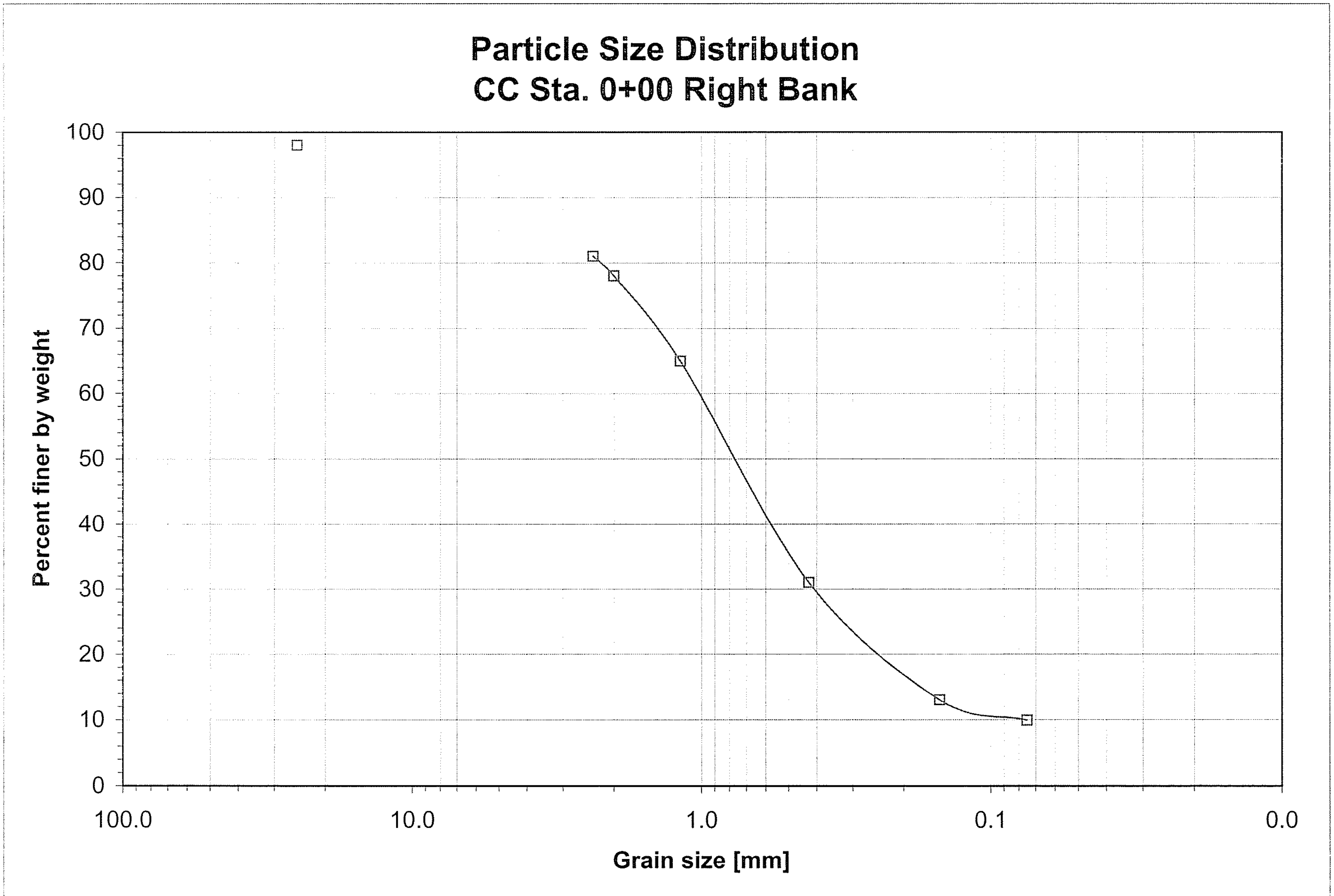
Particle Size Distribution
MVW Sta. 136+50
Percent finer by weight
Grain size [mm]
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0



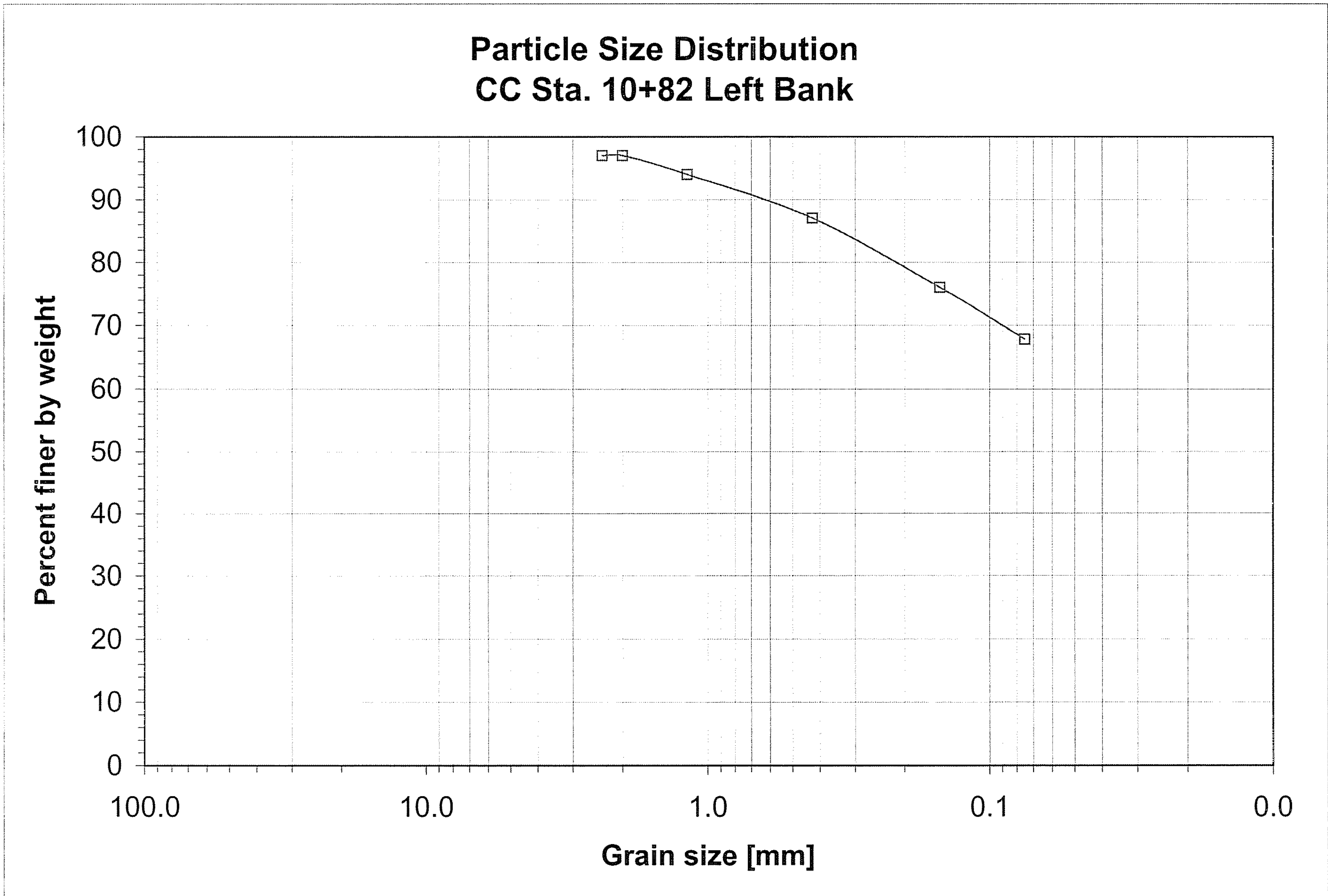
Particle Size Distribution
CC Sta. 0+00 Left Bank
100
90
80
70
60
50
40
30
20
10
0
Percent finer by weight
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

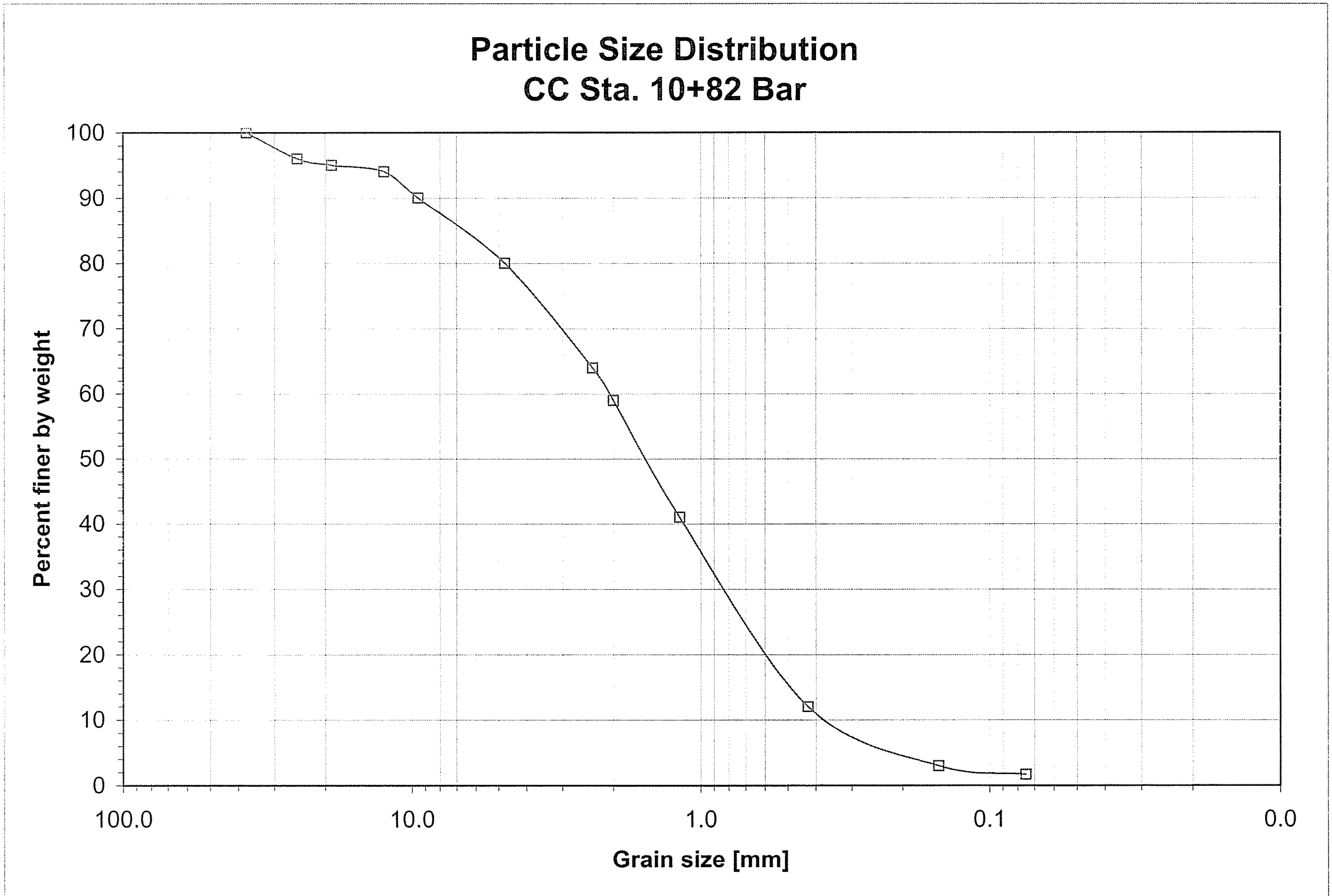

Particle Size Distribution
CC Sta. 0+00 Bar
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]


Particle Size Distribution
CC Sta. 0+00 Channel Bed
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

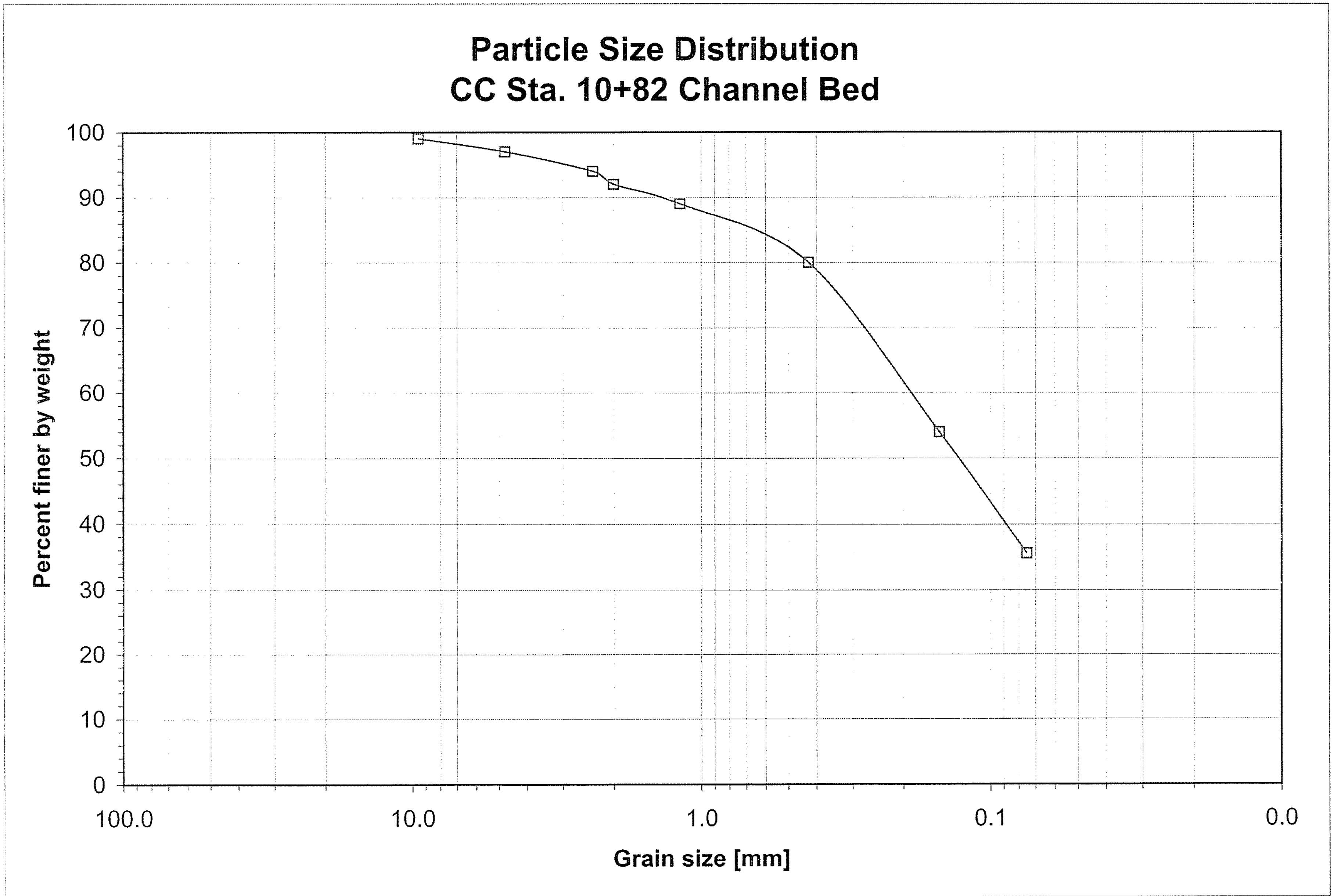


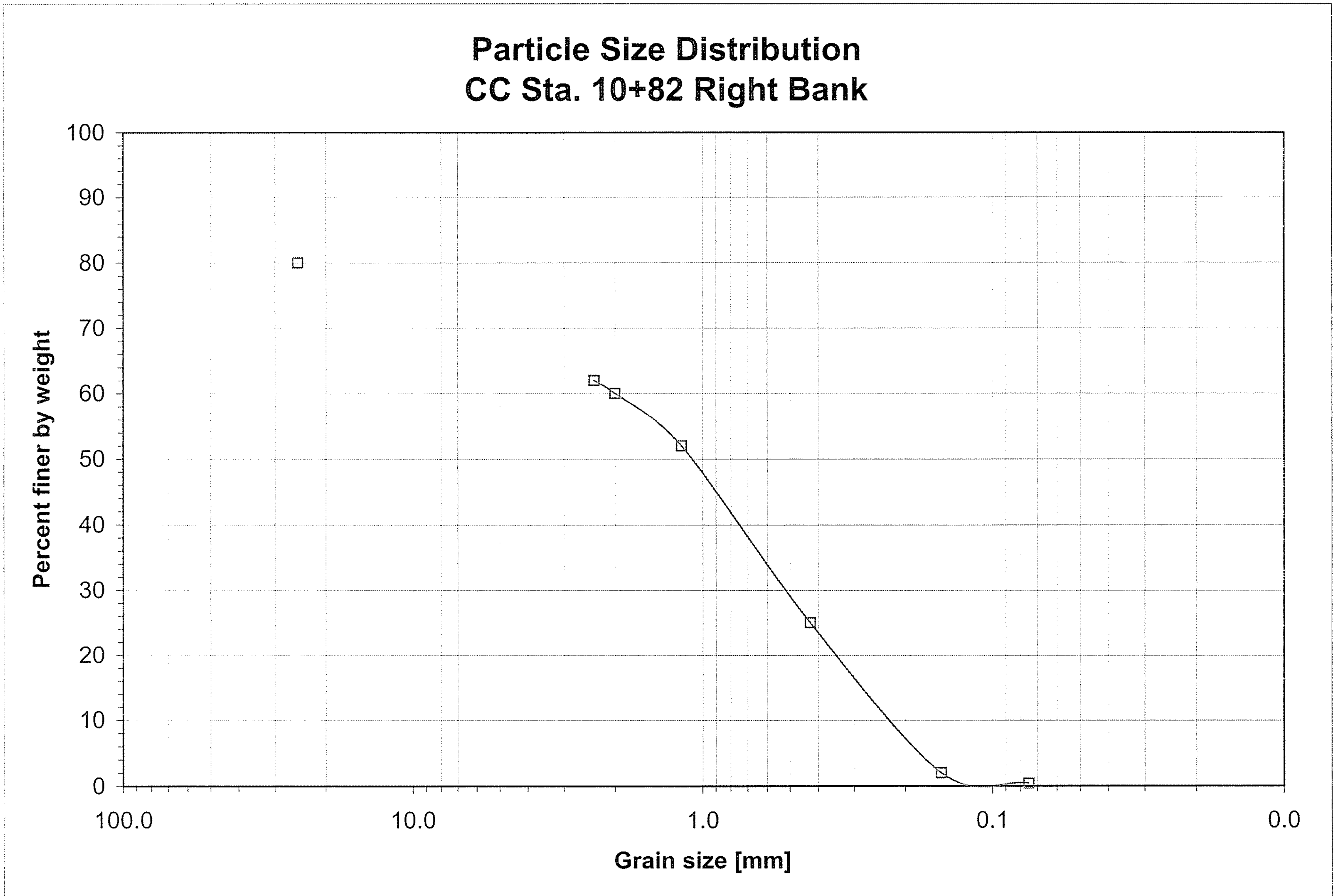
Particle Size Distribution
CC Sta. 0+00 Right Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

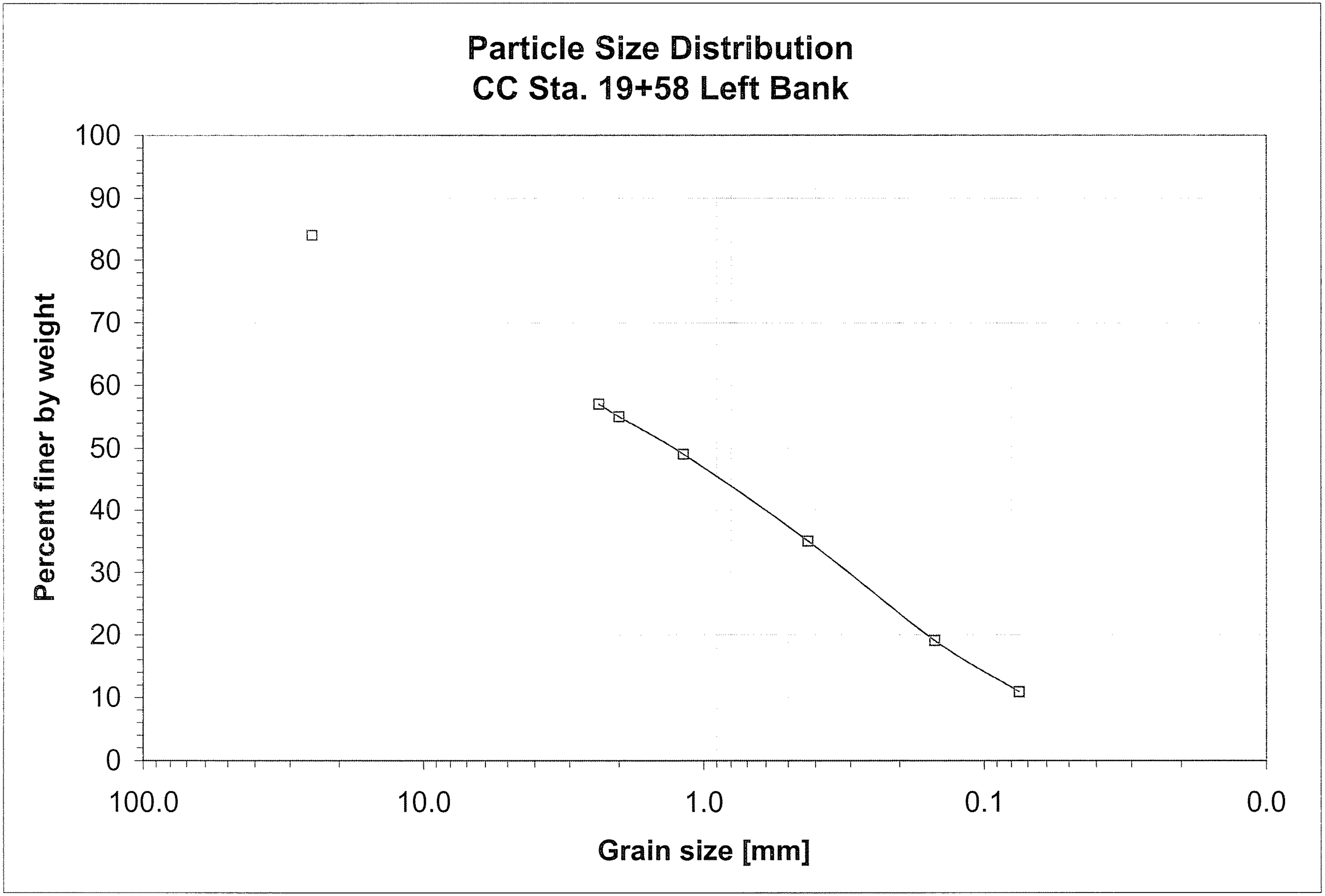

Particle Size Distribution
CC Sta. 10+82 Left Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

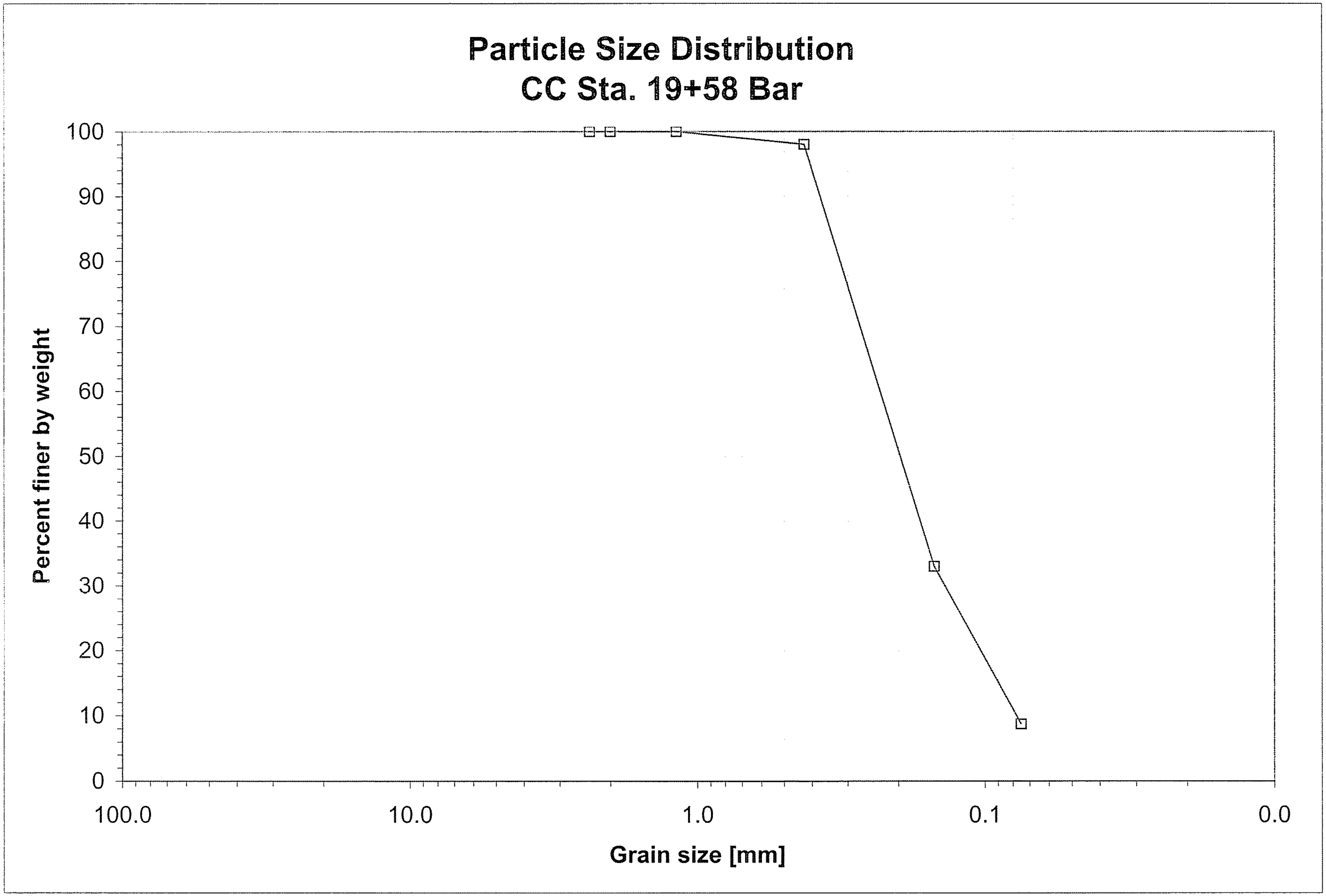


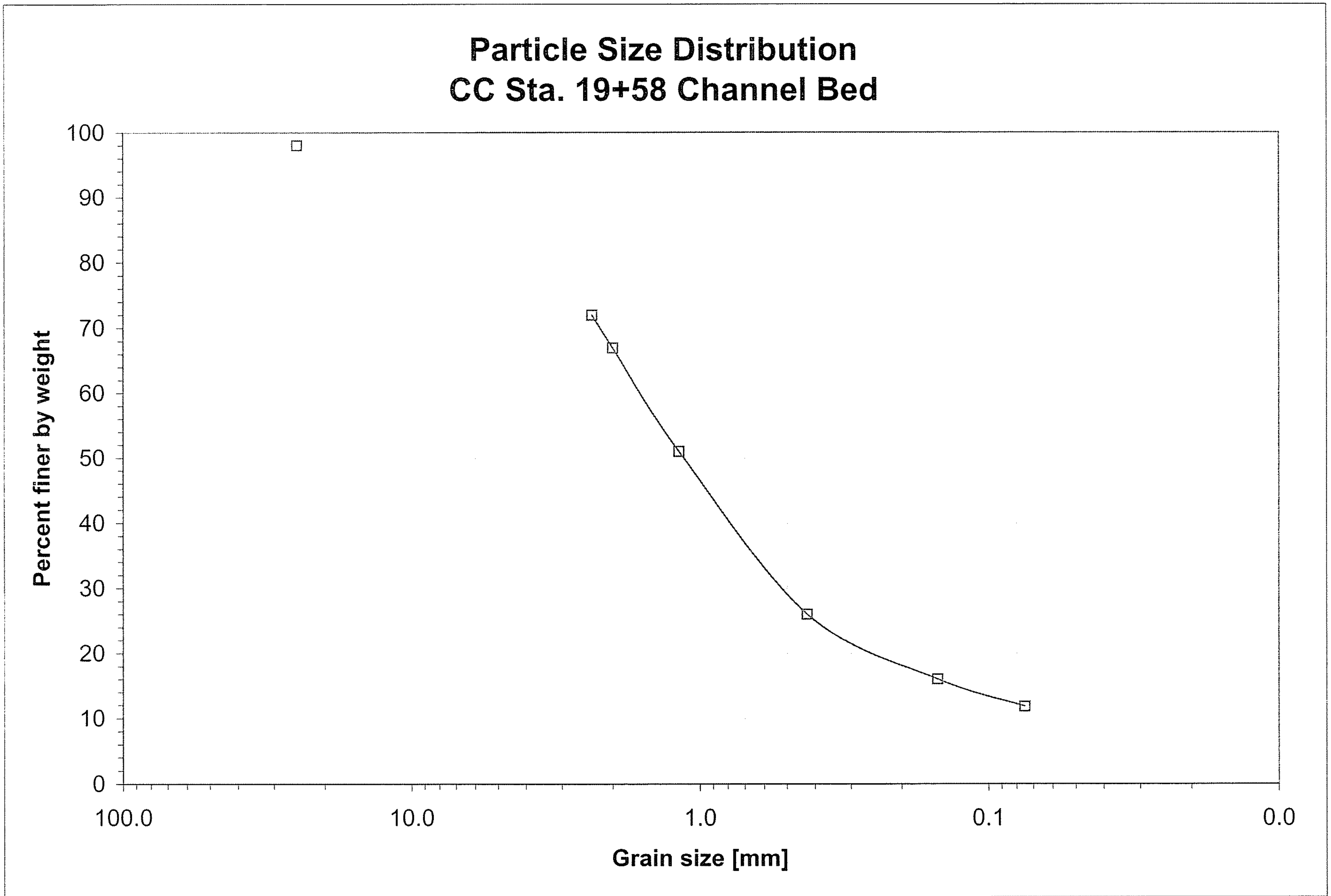
Particle Size Distribution
CC Sta. 10+82 Bar
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

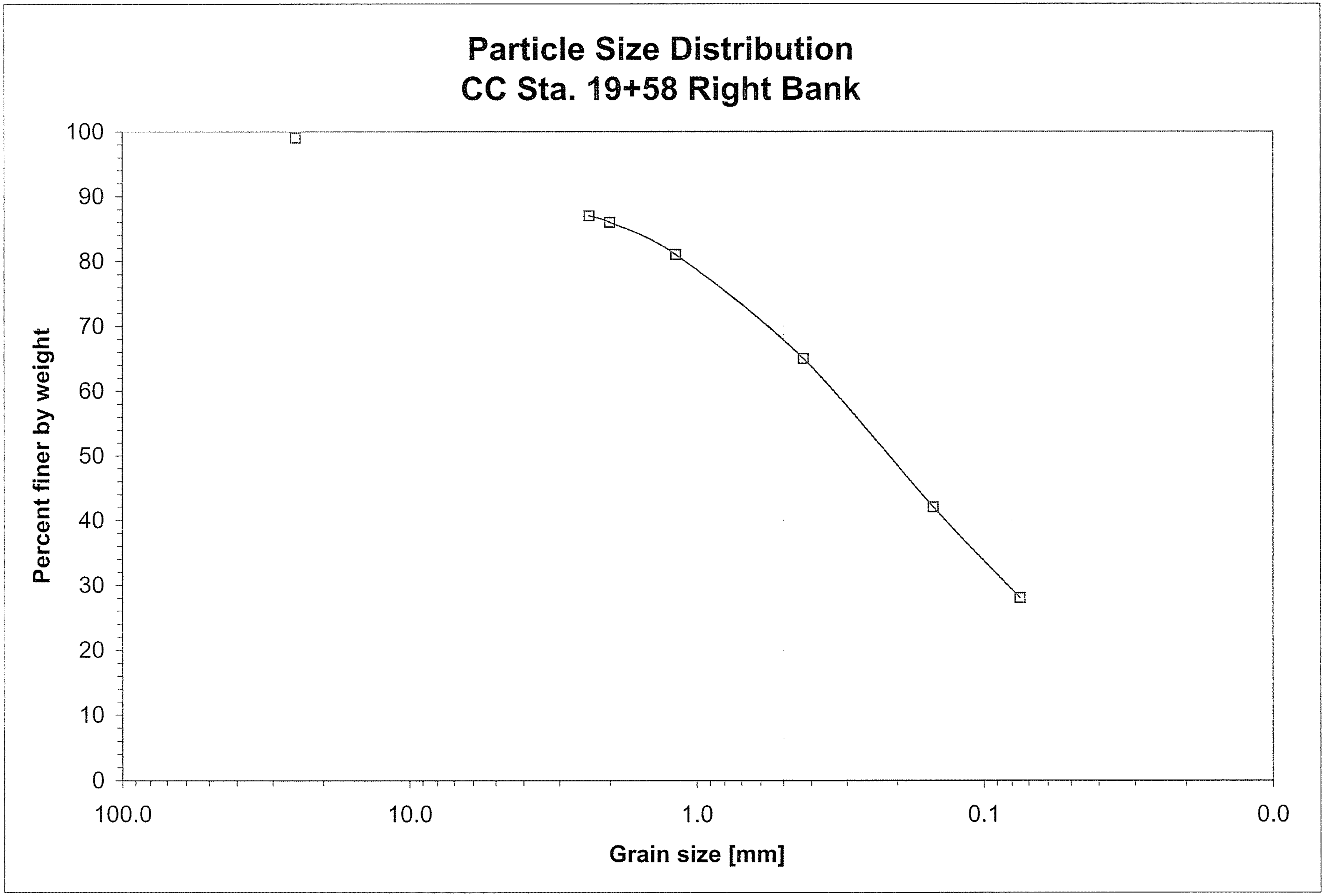

Particle Size Distribution
CC Sta. 10+82 Channel Bed
100
90
80
70
60
50
40
30
20
10
0
Percent finer by weight
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

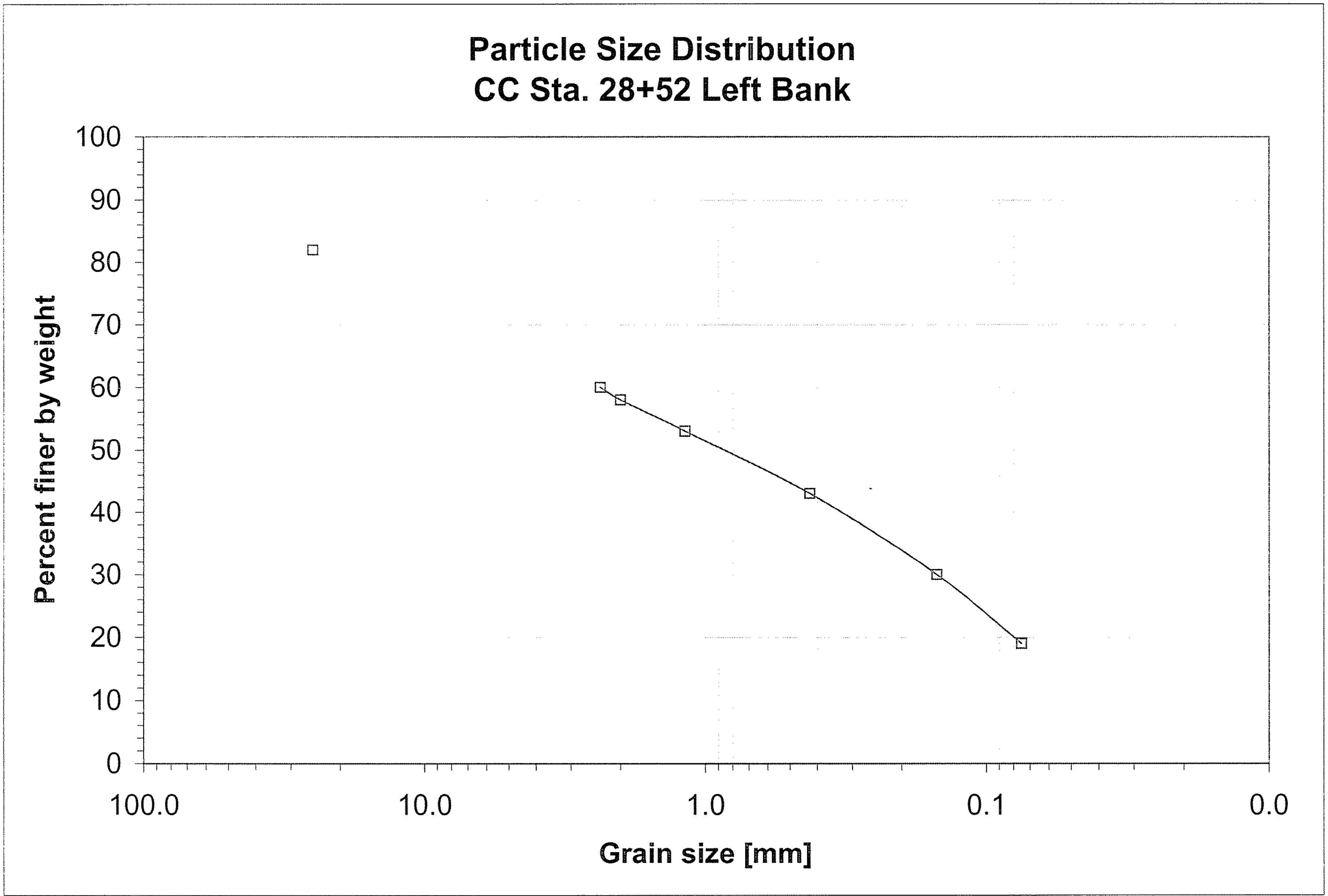

Particle Size Distribution
CC Sta. 10+82 Right Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]


Particle Size Distribution
CC Sta. 19+58 Left Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

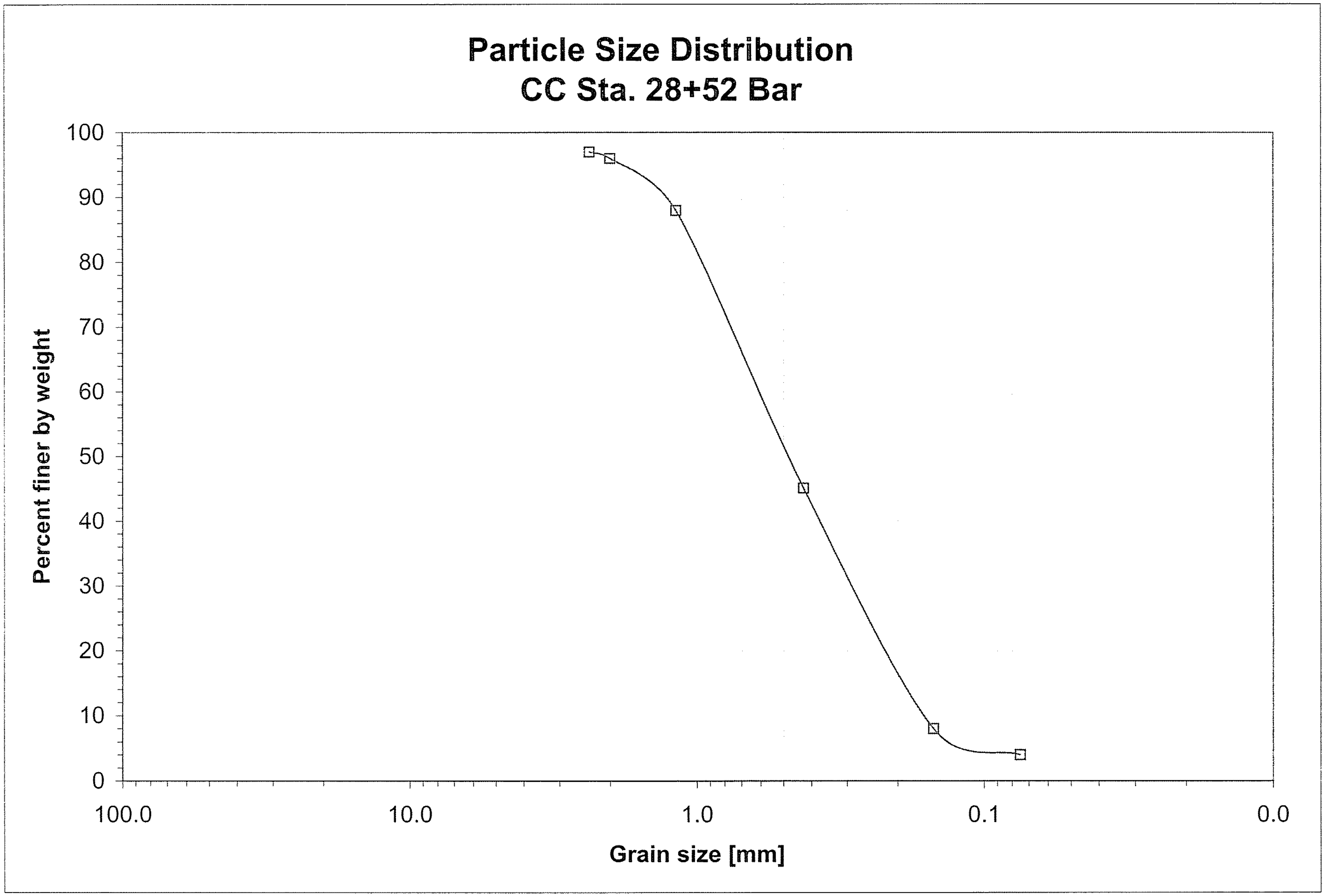

Particle Size Distribution
CC Sta. 19+58 Bar
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

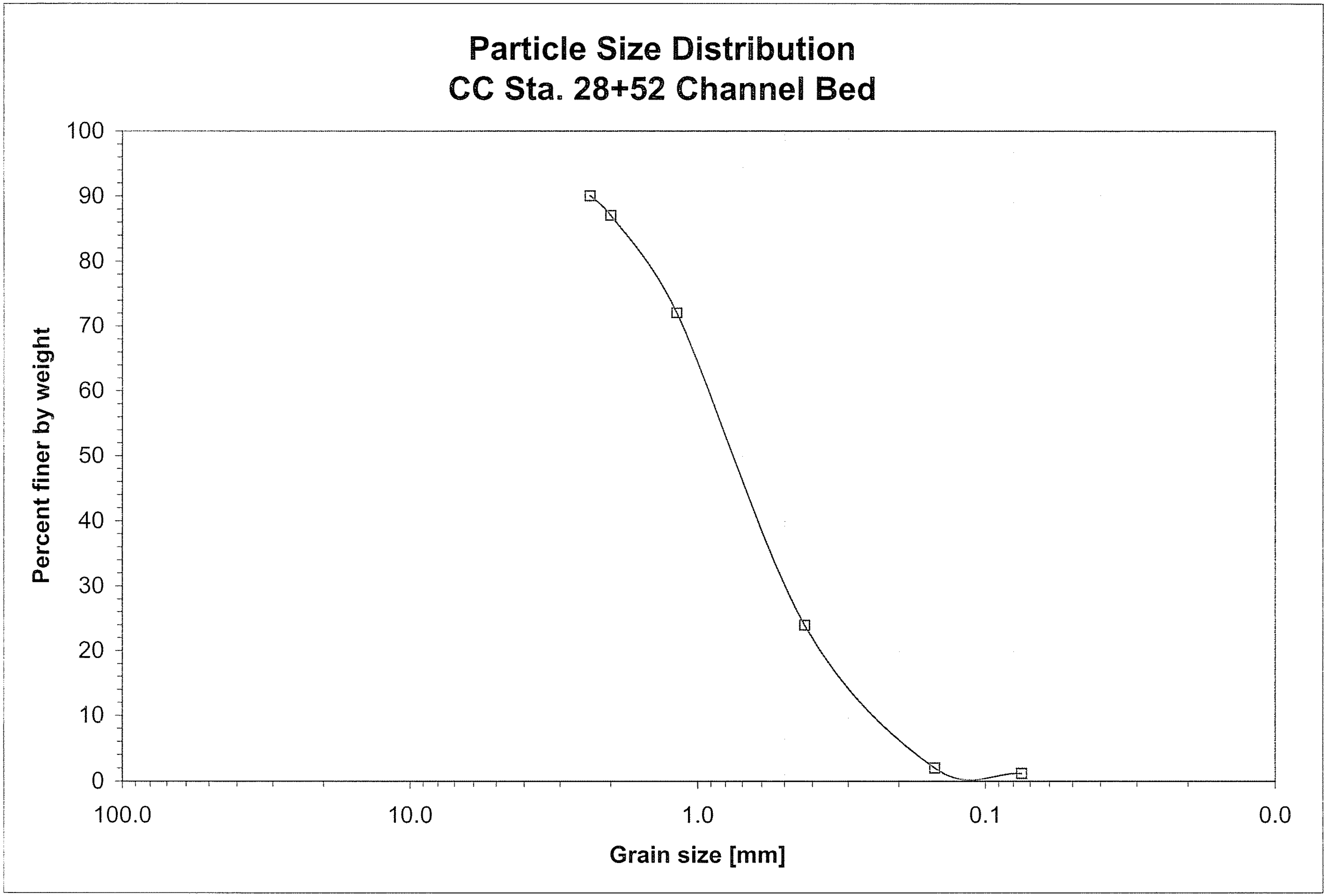

Particle Size Distribution
CC Sta. 19+58 Channel Bed
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]


Particle Size Distribution
CC Sta. 19+58 Right Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

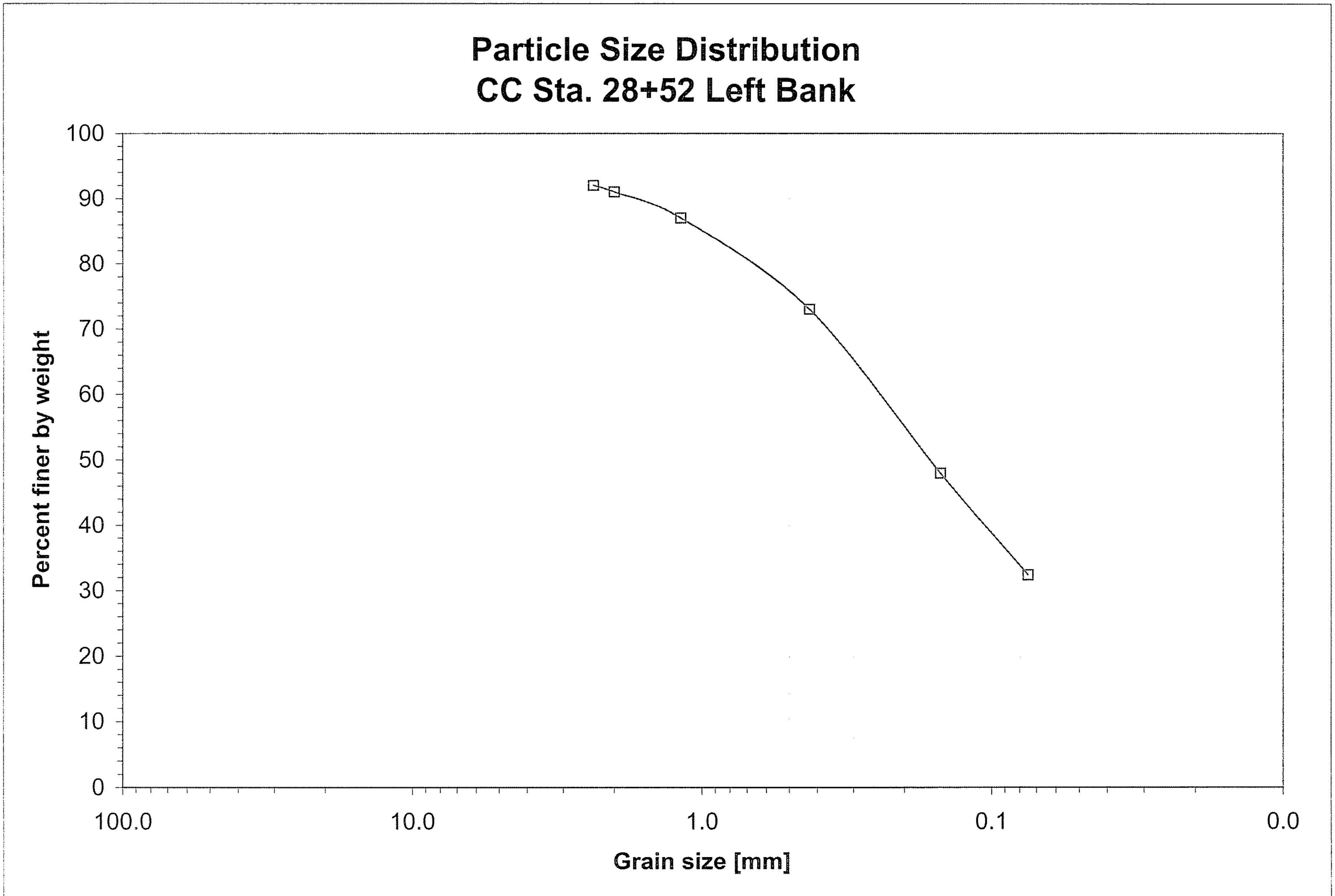


Particle Size Distribution
CC Sta. 28+52 Left Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

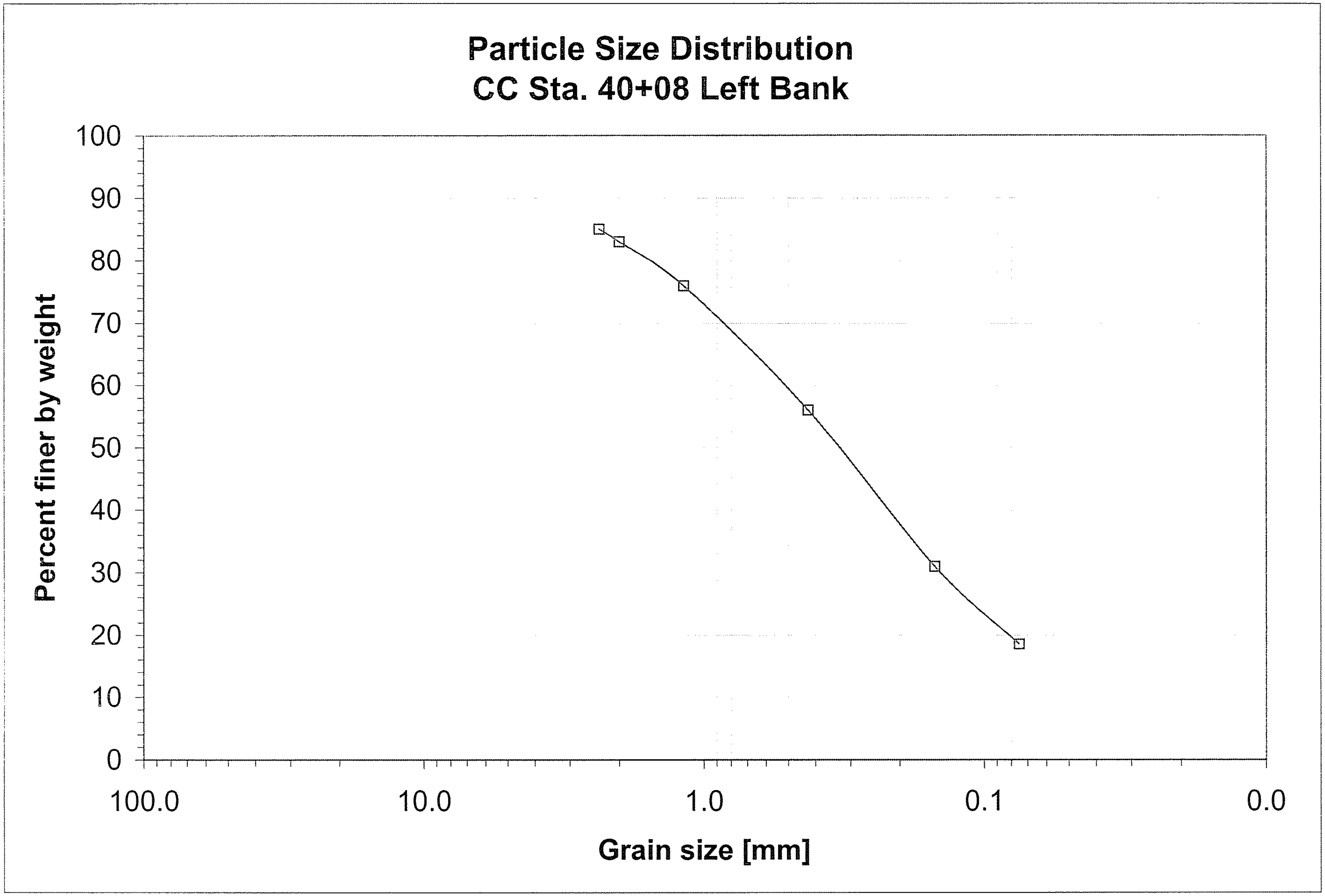

Particle Size Distribution
CC Sta. 28+52 Bar
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

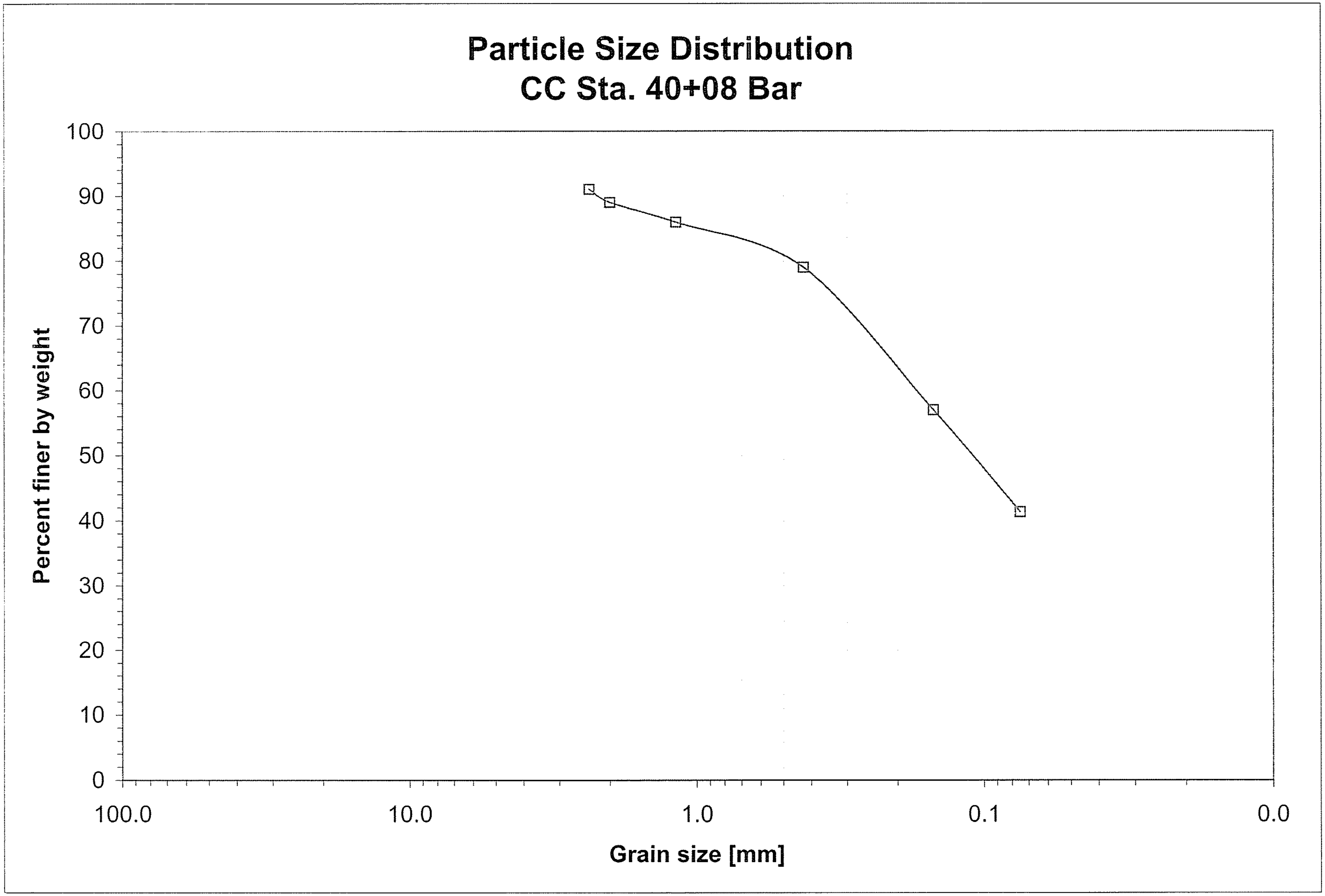


Particle Size Distribution
CC Sta. 28+52 Channel Bed
100
90
80
70
60
50
40
30
20
10
0
Percent finer by weight
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

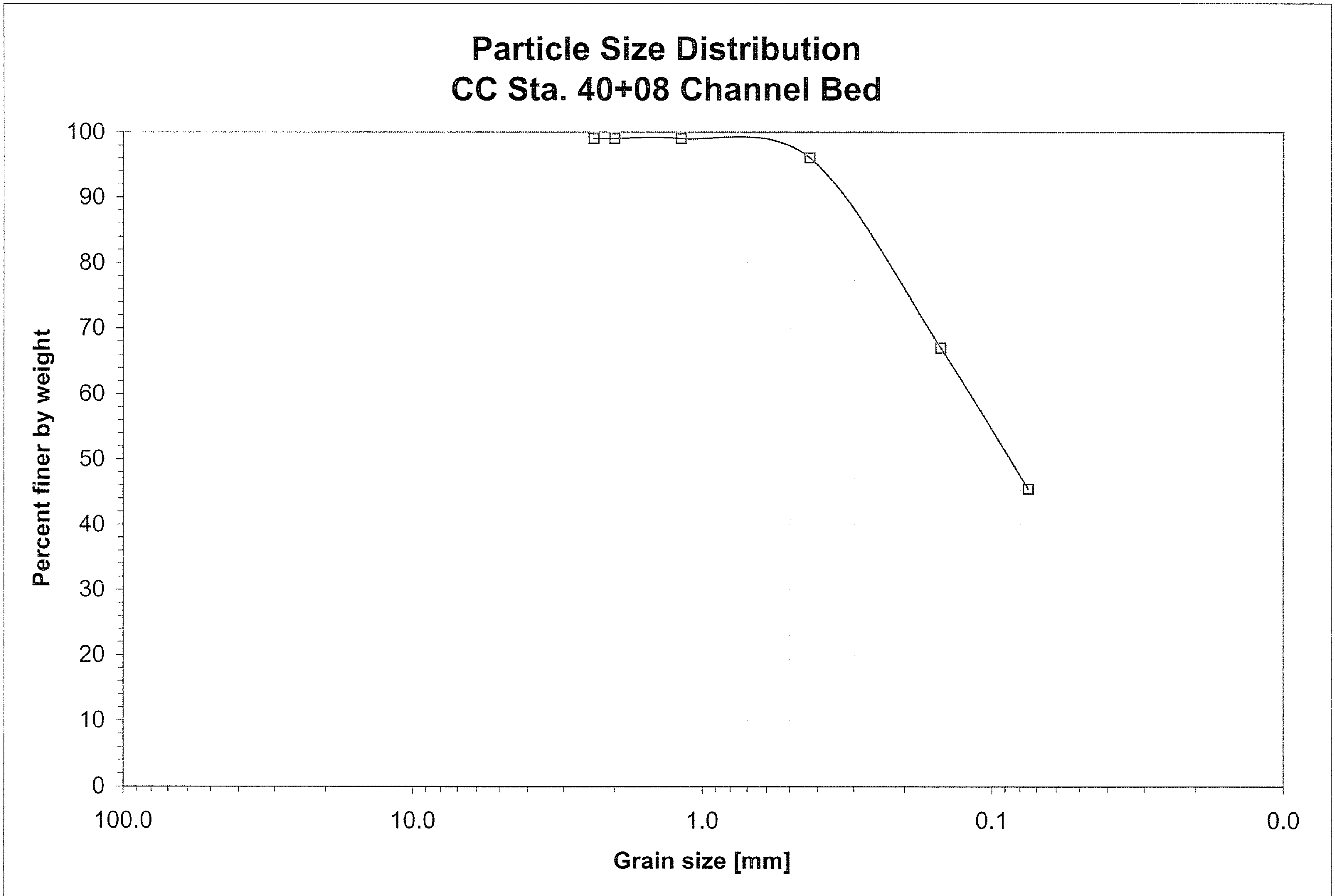


Particle Size Distribution
CC Sta. 28+52 Left Bank
Percent finer by weight
0
10
20
30
40
50
60
70
80
90
100
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

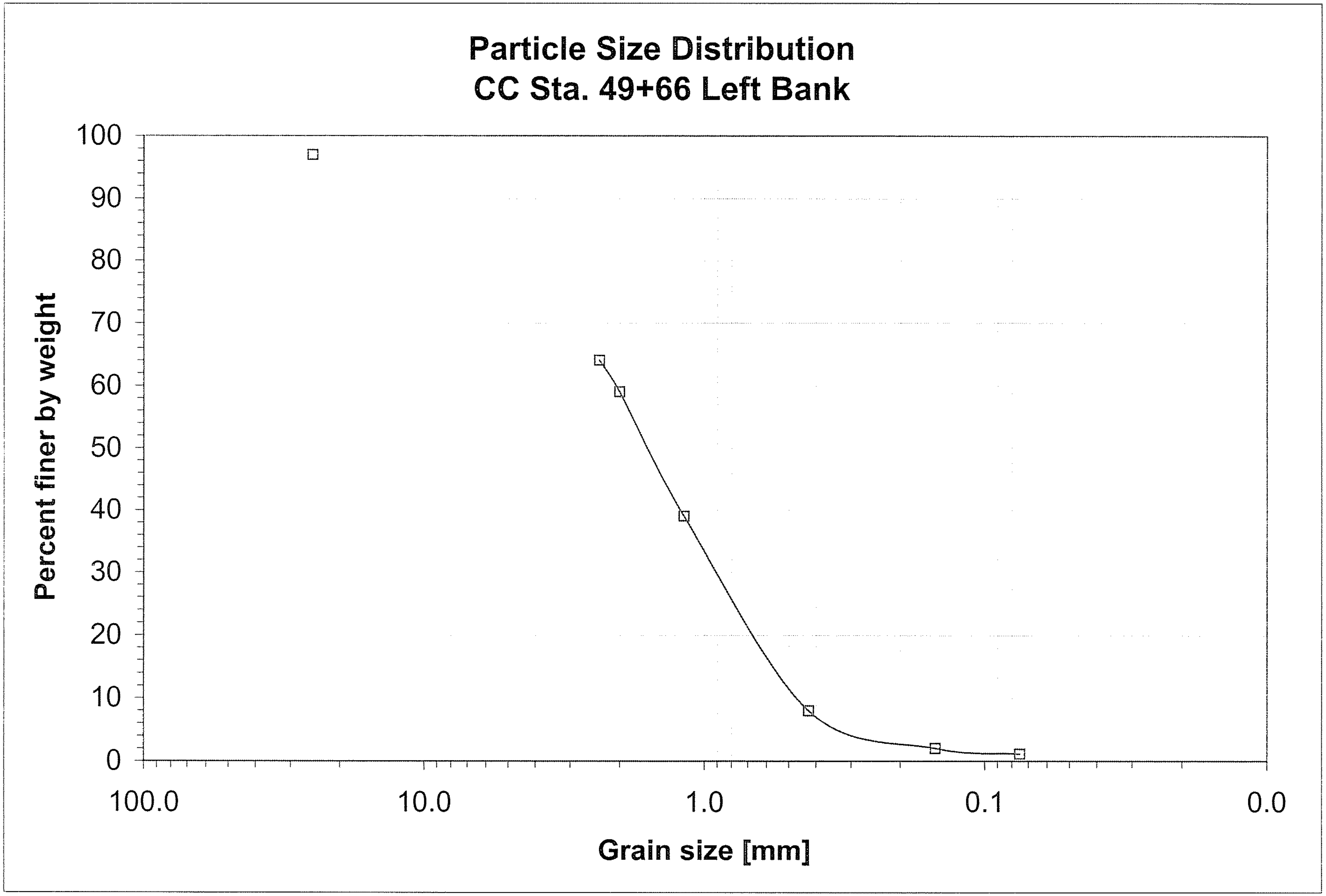

Particle Size Distribution
CC Sta. 40+08 Left Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

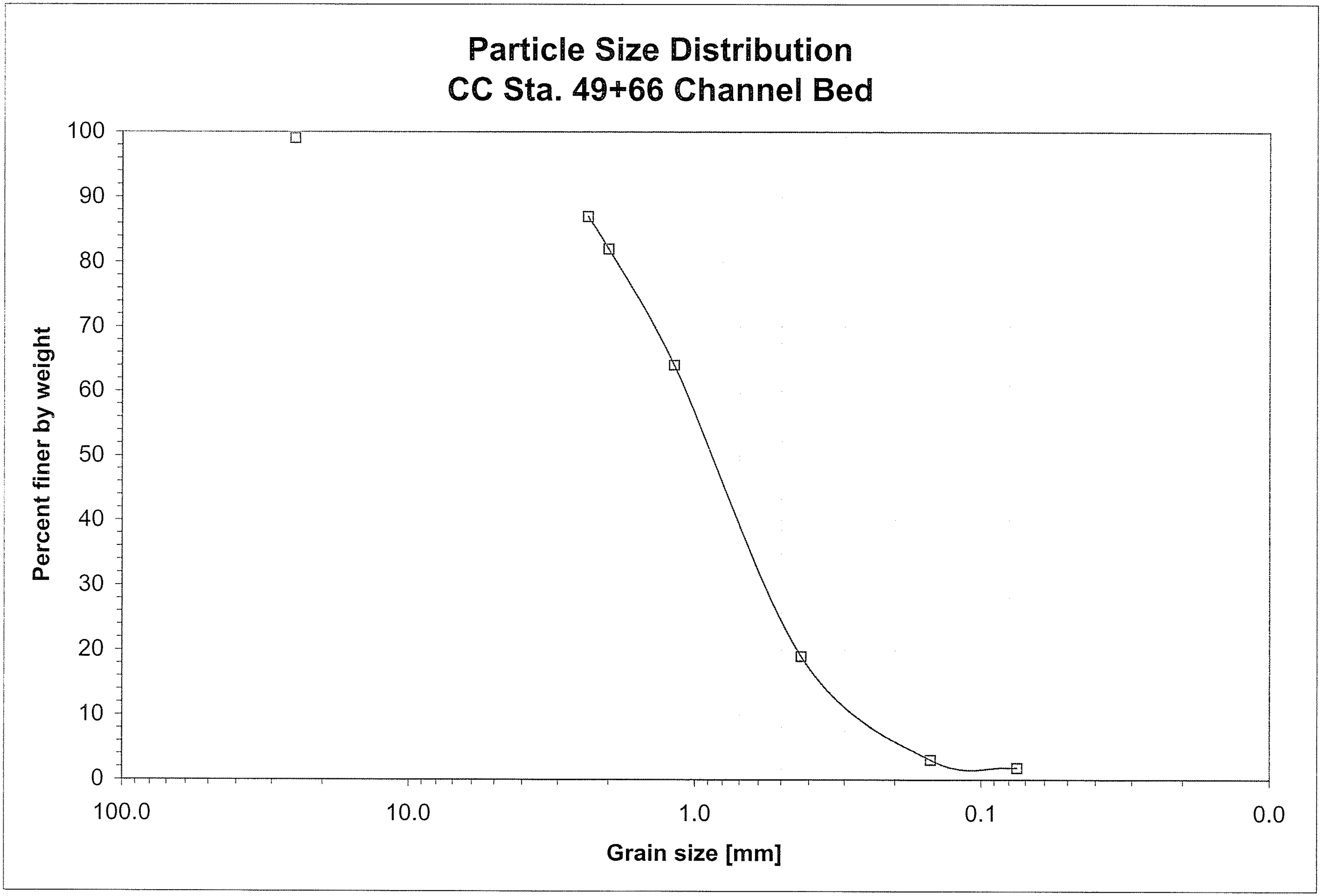


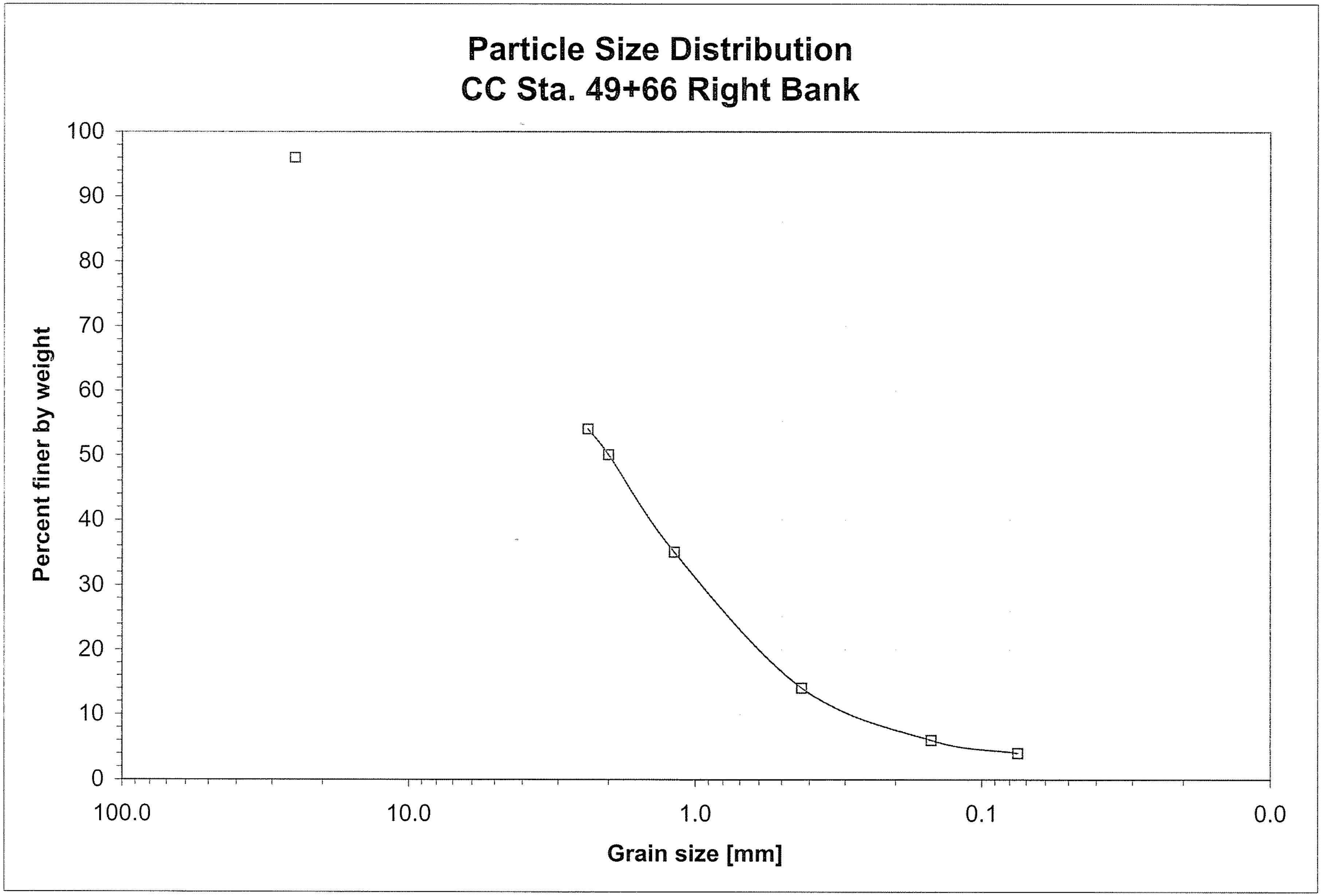
Particle Size Distribution
CC Sta. 40+08 Bar
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

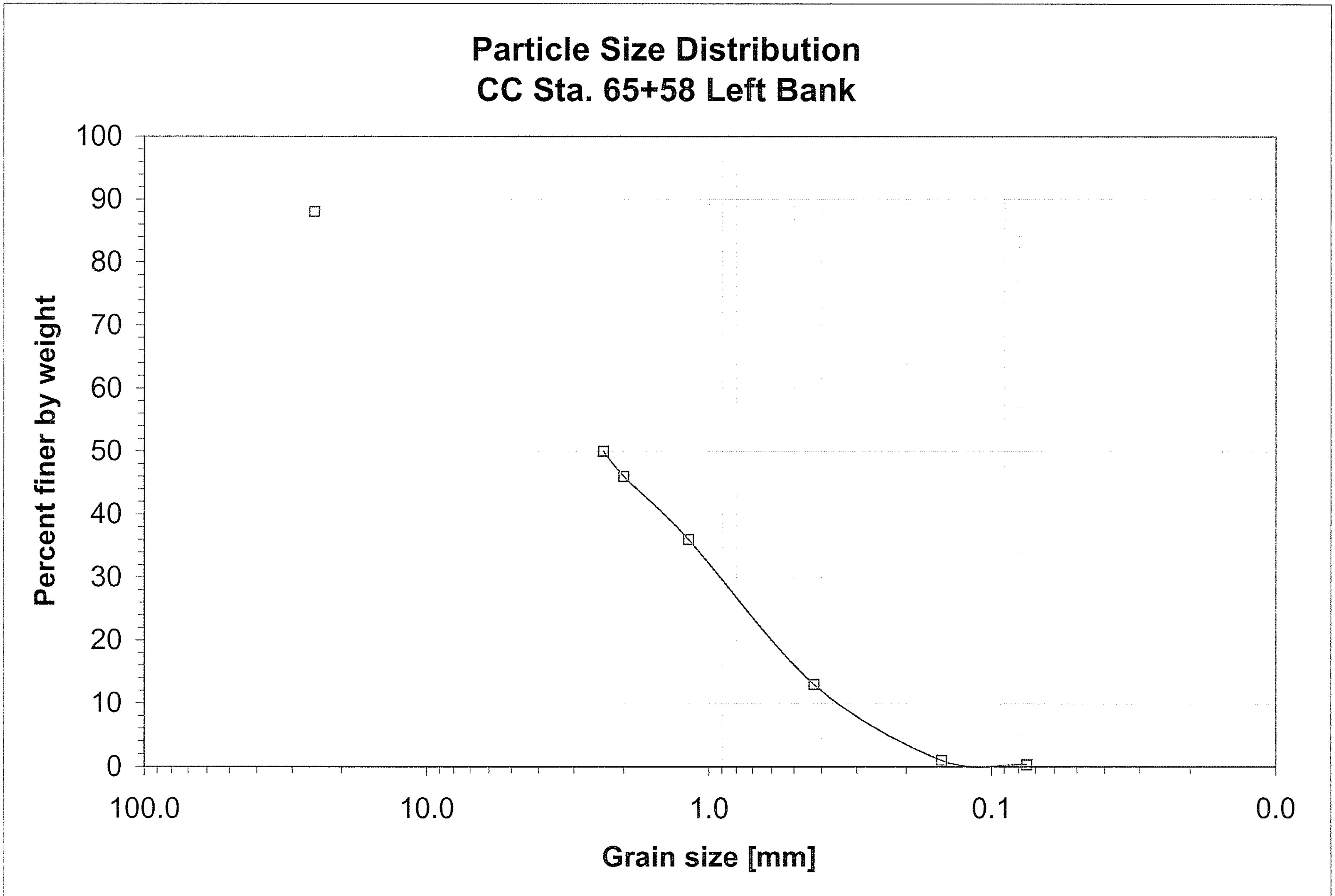


Particle Size Distribution
CC Sta. 40+08 Channel Bed
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

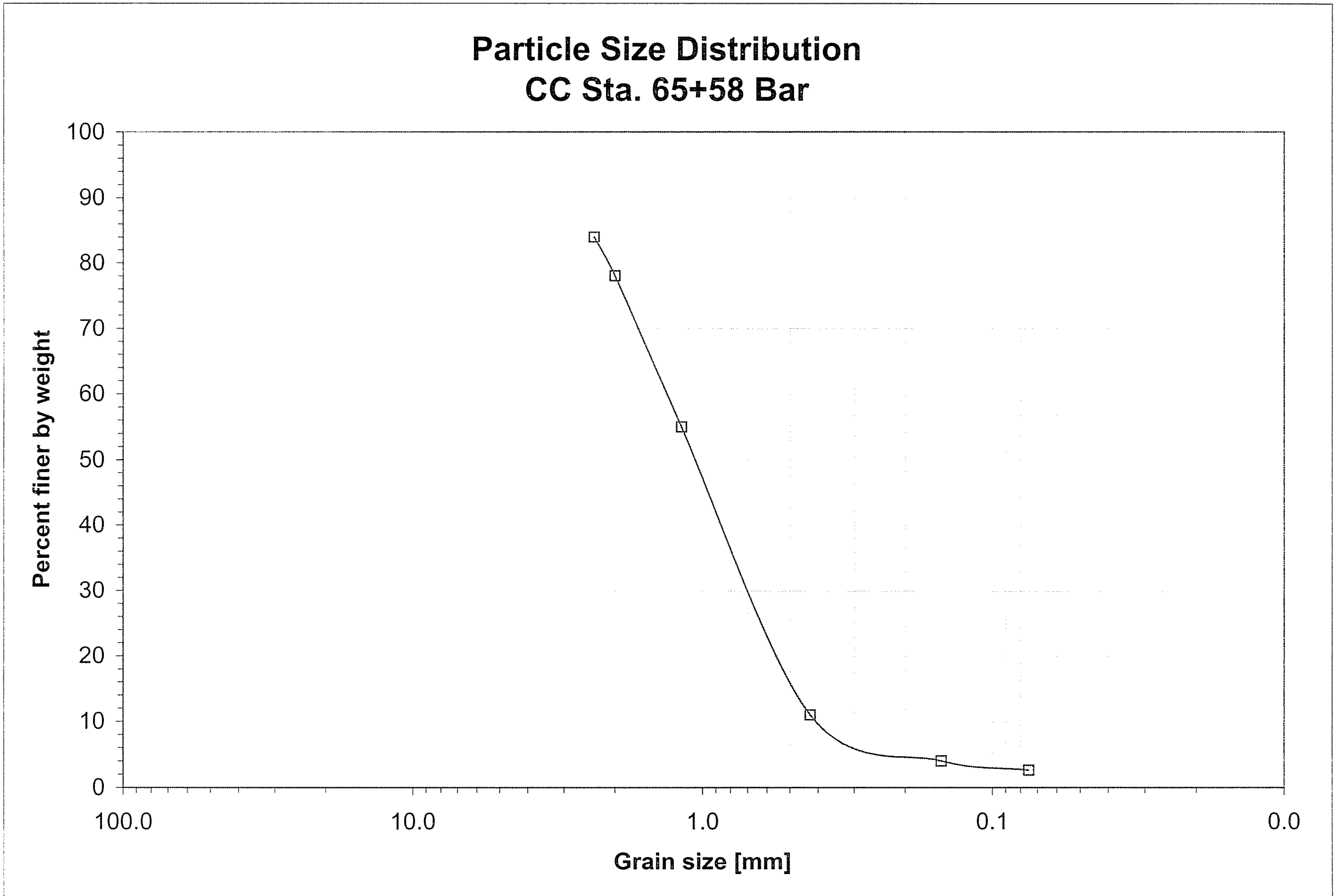

Particle Size Distribution
CC Sta. 49+66 Left Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]


Particle Size Distribution
CC Sta. 49+66 Channel Bed
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

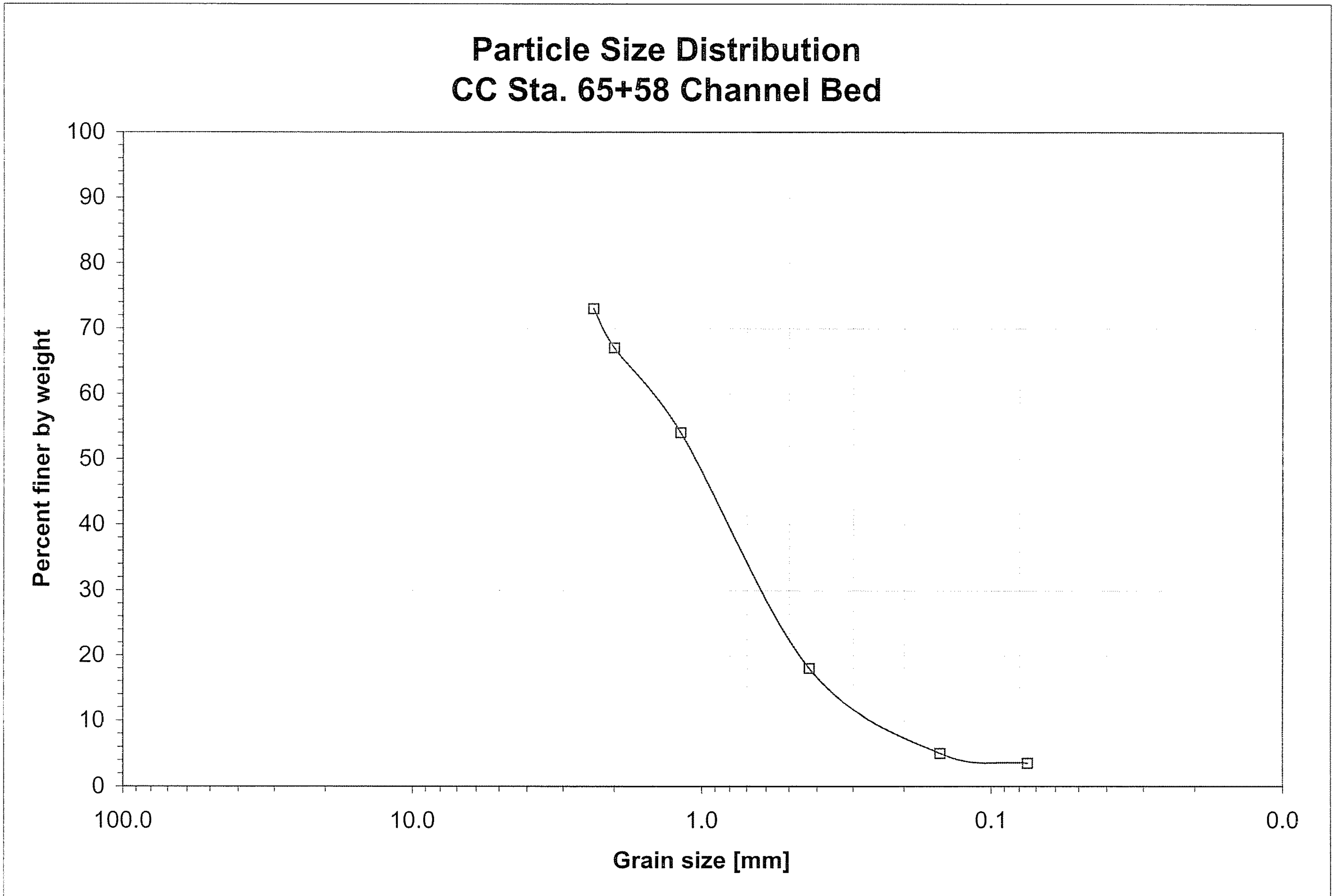

Particle Size Distribution
CC Sta. 49+66 Right Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

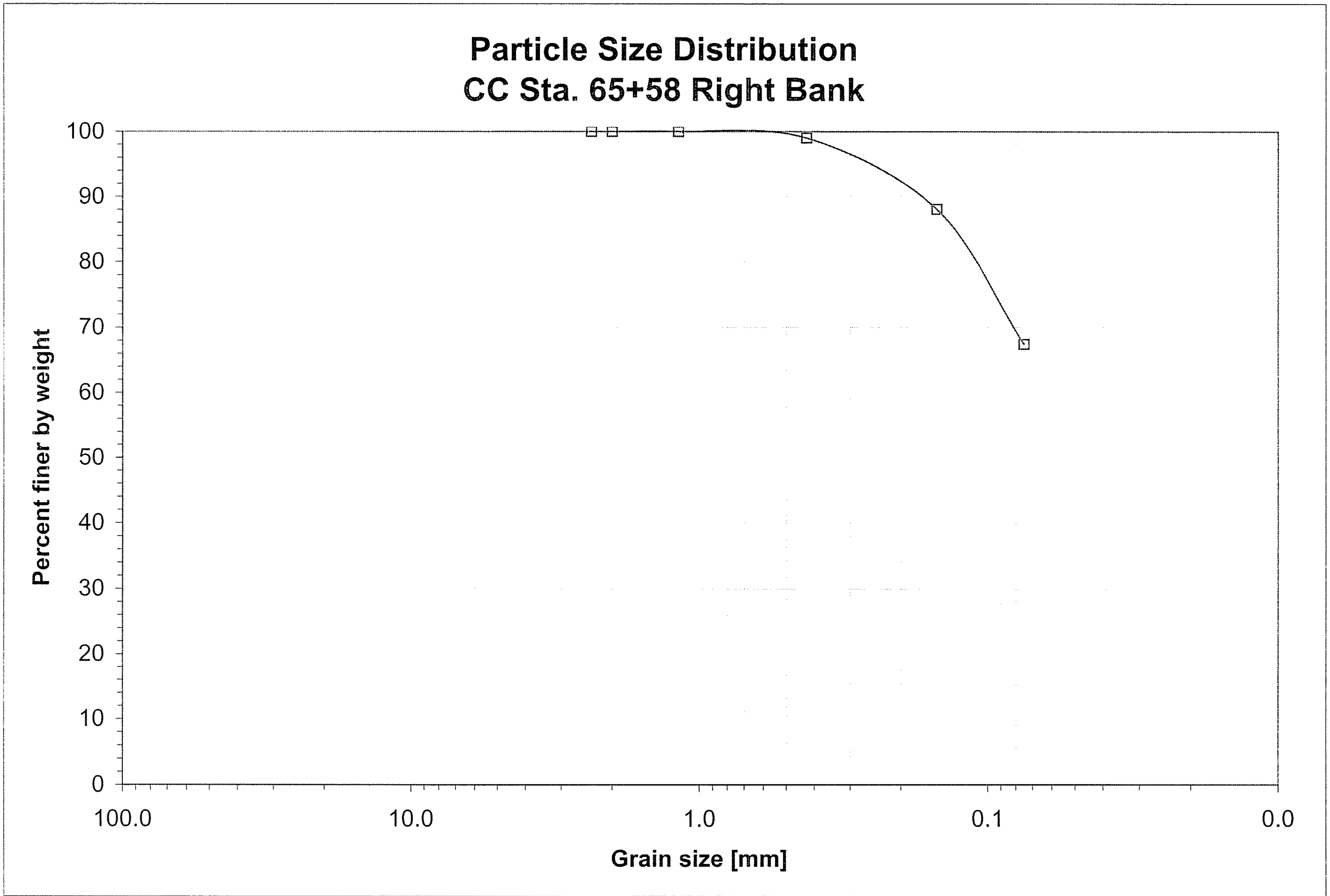


Particle Size Distribution
CC Sta. 65+58 Left Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]



Particle Size Distribution
CC Sta. 65+58 Bar
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]


Particle Size Distribution
CC Sta. 65+58 Channel Bed
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]



Particle Size Distribution
CC Sta. 65+58 Right Bank
Percent finer by weight
100
90
80
70
60
50
40
30
20
10
0
100.0
10.0
1.0
0.1
0.0
Grain size [mm]

Appendix H
SEDCAD Model Output

H-1
SEDCAD Reports

Li Qi

Sunrise Engineering, Inc.

General Information

Storm Information:

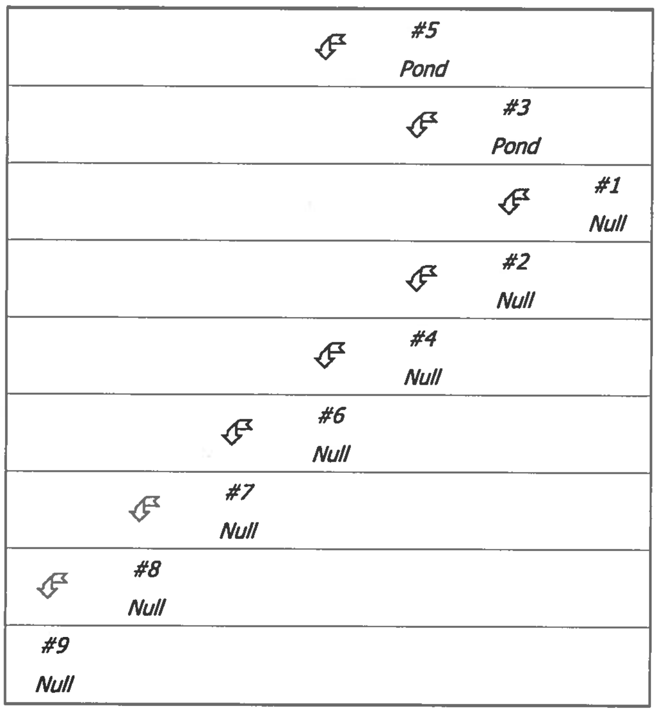
Storm Type:	NRCS Type II
Design Storm:	2 yr - 24 hr
Rainfall Depth:	1.660 inches

Particle Size Distribution:

Size (mm)	Gradation 1
4.7500	72.860%
2.0000	60.830%
0.4250	46.760%
0.0750	33.370%
0.0040	15.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	4.423	0.298	C1_S1
Null	#2	==>	#4	0.670	0.315	C3_S2,S3
Pond	#3	==>	#4	1.465	0.297	C5_S5_Mathews
Null	#4	==>	#6	4.056	0.298	C6_S4,S6
Pond	#5	==>	#6	1.893	0.353	C9_S9_Pine
Null	#6	==>	#7	3.800	0.318	C10_S7,S8,S10
Null	#7	==>	#8	2.859	0.298	C12_S11,S12
Null	#8	==>	#9	1.135	0.309	C13_S13
Null	#9	==>	End	0.000	0.000	C15_S14,S15



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.70	280.00	39,968.00	2.51	4.423
#1	**Muskingum K:**					**4.423**
#2	8. Large gullies, diversions, and low flowing streams	0.93	65.00	6,975.74	2.89	0.670

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	**Muskingum K:**					**0.670**
#3	8. Large gullies, diversions, and low flowing streams	0.69	90.00	13,083.29	2.48	1.465
#3	**Muskingum K:**					**1.465**
#4	8. Large gullies, diversions, and low flowing streams	0.70	254.00	36,504.74	2.50	4.056
#4	**Muskingum K:**					**4.056**
#5	8. Large gullies, diversions, and low flowing streams	1.86	520.00	27,885.02	4.09	1.893
#5	**Muskingum K:**					**1.893**
#6	8. Large gullies, diversions, and low flowing streams	0.98	396.00	40,494.93	2.96	3.800
#6	**Muskingum K:**					**3.800**
#7	8. Large gullies, diversions, and low flowing streams	0.70	180.00	25,732.66	2.50	2.859
#7	**Muskingum K:**					**2.859**
#8	8. Large gullies, diversions, and low flowing streams	0.84	95.00	11,245.26	2.75	1.135
#8	**Muskingum K:**					**1.135**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#5	In	21,873.000	21,873.000	23.07	35.18	451.6	18,409	9.96	8.32
	Out			10.83	26.20	44.3	2,142	0.00	0.00
#3	In	20,610.000	20,610.000	33.65	42.00	1,460.5	36,674	20.91	18.52
	Out			12.44	27.15	99.3	3,664	0.00	0.00
#1		18,516.000	18,516.000	11.17	18.82	271.0	21,785	10.94	9.17
#2		30,983.000	49,499.000	35.65	72.91	1,473.9	37,965	20.16	13.78
#4		26,799.000	96,908.000	75.81	161.62	2,323.5	25,725	13.33	9.95
#6		35,493.000	154,274.000	112.68	283.27	4,196.4	25,769	12.91	10.73
#7		31,930.000	186,204.000	123.96	365.89	6,527.5	38,927	19.19	13.12
#8		9,897.000	196,101.000	126.14	382.39	6,602.6	34,428	16.89	13.01
#9		36,872.000	232,973.000	129.68	429.66	7,738.7	36,129	17.55	13.46

Li Qi

Sunrise Engineering, Inc.

General Information

Storm Information:

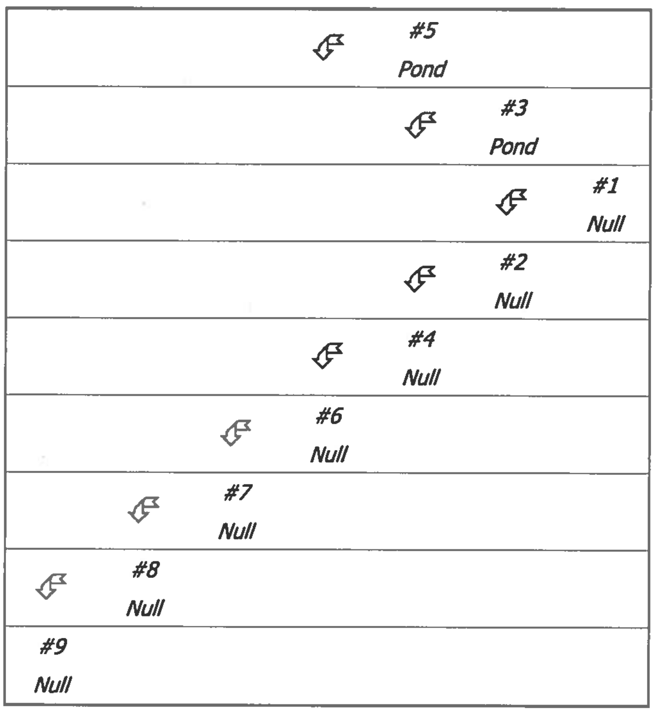
Storm Type:	NRCS Type II
Design Storm:	5 yr - 24 hr
Rainfall Depth:	2.120 inches

Particle Size Distribution:

Size (mm)	Gradation 1
4.7500	72.860%
2.0000	60.830%
0.4250	46.760%
0.0750	33.370%
0.0040	15.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	4.423	0.298	C1_S1
Null	#2	==>	#4	0.670	0.315	C3_S2,S3
Pond	#3	==>	#4	1.465	0.297	C5_S5_Mathews
Null	#4	==>	#6	4.056	0.298	C6_S4,S6
Pond	#5	==>	#6	1.893	0.353	C9_S9_Pine
Null	#6	==>	#7	3.800	0.318	C10_S7,S8,S10
Null	#7	==>	#8	2.859	0.298	C12_S11,S12
Null	#8	==>	#9	1.135	0.309	C13_S13
Null	#9	==>	End	0.000	0.000	C15_S14,S15



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.70	280.00	39,968.00	2.51	4.423
#1	**Muskingum K:**					**4.423**
#2	8. Large gullies, diversions, and low flowing streams	0.93	65.00	6,975.74	2.89	0.670

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	**Muskingum K:**					**0.670**
#3	8. Large gullies, diversions, and low flowing streams	0.69	90.00	13,083.29	2.48	1.465
#3	**Muskingum K:**					**1.465**
#4	8. Large gullies, diversions, and low flowing streams	0.70	254.00	36,504.74	2.50	4.056
#4	**Muskingum K:**					**4.056**
#5	8. Large gullies, diversions, and low flowing streams	1.86	520.00	27,885.02	4.09	1.893
#5	**Muskingum K:**					**1.893**
#6	8. Large gullies, diversions, and low flowing streams	0.98	396.00	40,494.93	2.96	3.800
#6	**Muskingum K:**					**3.800**
#7	8. Large gullies, diversions, and low flowing streams	0.70	180.00	25,732.66	2.50	2.859
#7	**Muskingum K:**					**2.859**
#8	8. Large gullies, diversions, and low flowing streams	0.84	95.00	11,245.26	2.75	1.135
#8	**Muskingum K:**					**1.135**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#5	In	21,873.000	21,873.000	97.51	169.18	2,439.3	20,074	5.81	4.93
	Out			63.60	149.35	976.8	8,342	0.00	0.00
#3	In	20,610.000	20,610.000	153.88	179.60	7,719.9	47,707	13.99	11.65
	Out			66.94	145.95	2,554.8	17,911	0.00	0.00
#1		18,516.000	18,516.000	57.34	115.92	1,875.4	23,317	8.80	7.59
#2		30,983.000	49,499.000	162.38	364.77	8,880.8	52,506	19.54	11.33
#4		26,799.000	96,908.000	331.30	757.63	15,848.8	34,423	11.16	8.05
#6		35,493.000	154,274.000	517.39	1,263.45	25,137.9	31,826	8.56	6.85
#7		31,930.000	186,204.000	580.54	1,575.95	36,135.0	50,570	12.17	7.40
#8		9,897.000	196,101.000	594.11	1,653.87	36,831.2	43,492	10.42	7.39
#9		36,872.000	232,973.000	622.12	1,875.38	43,416.4	43,680	9.82	7.23

Li Qi

Sunrise Engineering, Inc.

General Information

Storm Information:

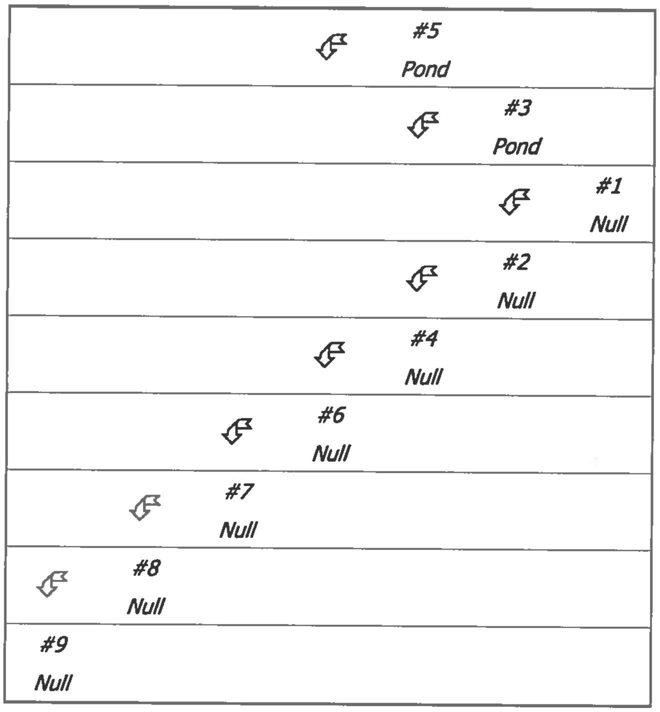
Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	2.490 inches

Particle Size Distribution:

Size (mm)	Gradation 1
4.7500	72.860%
2.0000	60.830%
0.4250	46.760%
0.0750	33.370%
0.0040	15.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	4.423	0.298	C1_S1
Null	#2	==>	#4	0.670	0.315	C3_S2,S3
Pond	#3	==>	#4	1.465	0.297	C5_S5_Mathews
Null	#4	==>	#6	4.056	0.298	C6_S4,S6
Pond	#5	==>	#6	1.893	0.353	C9_S9_Pine
Null	#6	==>	#7	3.800	0.318	C10_S7,S8,S10
Null	#7	==>	#8	2.859	0.298	C12_S11,S12
Null	#8	==>	#9	1.135	0.309	C13_S13
Null	#9	==>	End	0.000	0.000	C15_S14,S15



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.70	280.00	39,968.00	2.51	4.423
#1	**Muskingum K:**					**4.423**
#2	8. Large gullies, diversions, and low flowing streams	0.93	65.00	6,975.74	2.89	0.670

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	**Muskingum K:**					**0.670**
#3	8. Large gullies, diversions, and low flowing streams	0.69	90.00	13,083.29	2.48	1.465
#3	**Muskingum K:**					**1.465**
#4	8. Large gullies, diversions, and low flowing streams	0.70	254.00	36,504.74	2.50	4.056
#4	**Muskingum K:**					**4.056**
#5	8. Large gullies, diversions, and low flowing streams	1.86	520.00	27,885.02	4.09	1.893
#5	**Muskingum K:**					**1.893**
#6	8. Large gullies, diversions, and low flowing streams	0.98	396.00	40,494.93	2.96	3.800
#6	**Muskingum K:**					**3.800**
#7	8. Large gullies, diversions, and low flowing streams	0.70	180.00	25,732.66	2.50	2.859
#7	**Muskingum K:**					**2.859**
#8	8. Large gullies, diversions, and low flowing streams	0.84	95.00	11,245.26	2.75	1.135
#8	**Muskingum K:**					**1.135**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#5	In	21,873.000	21,873.000	200.92	338.23	5,389.9	22,350	2.69	2.26
	Out			111.67	307.86	3,934.4	16,270	0.00	0.00
#3	In	20,610.000	20,610.000	333.06	348.26	17,236.9	56,935	11.95	9.55
	Out			110.34	289.97	8,746.5	31,631	0.00	0.00
#1		18,516.000	18,516.000	118.76	245.47	4,291.8	24,904	2.57	2.24
#2		30,983.000	49,499.000	318.55	737.85	20,212.0	65,312	8.79	4.57
#4		26,799.000	96,908.000	642.06	1,508.37	39,044.3	42,816	4.95	3.46
#6		35,493.000	154,274.000	1,018.71	2,484.45	60,391.5	38,422	3.78	2.97
#7		31,930.000	186,204.000	1,175.34	3,071.84	82,978.6	58,360	5.62	3.37
#8		9,897.000	196,101.000	1,203.03	3,226.90	84,485.0	50,106	4.77	3.32
#9		36,872.000	232,973.000	1,265.71	3,689.73	99,346.7	48,661	4.76	3.50

Li Qi

Sunrise Engineering, Inc.

General Information

Storm Information:

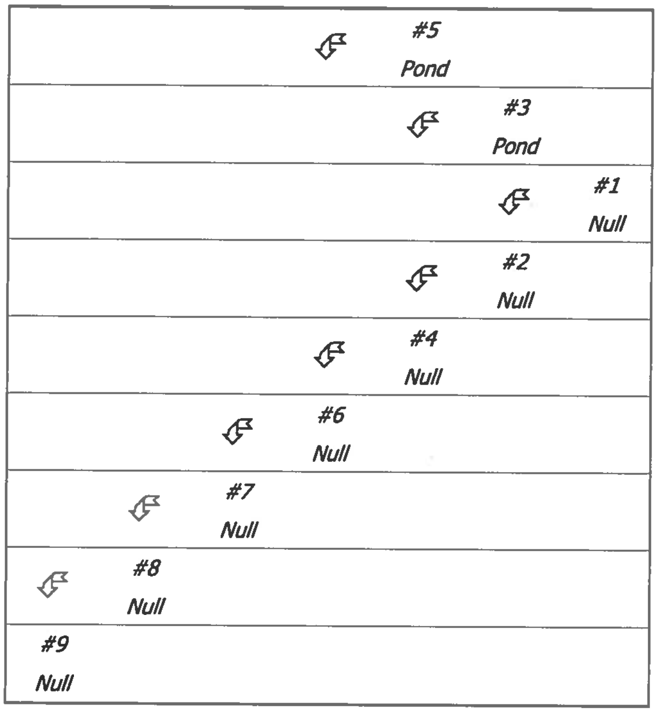
Storm Type:	NRCS Type II
Design Storm:	25 yr - 24 hr
Rainfall Depth:	3.000 inches

Particle Size Distribution:

Size (mm)	Gradation 1
4.7500	72.860%
2.0000	60.830%
0.4250	46.760%
0.0750	33.370%
0.0040	15.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	4.423	0.298	C1_S1
Null	#2	==>	#4	0.670	0.315	C3_S2,S3
Pond	#3	==>	#4	1.465	0.297	C5_S5_Mathews
Null	#4	==>	#6	4.056	0.298	C6_S4,S6
Pond	#5	==>	#6	1.893	0.353	C9_S9_Pine
Null	#6	==>	#7	3.800	0.318	C10_S7,S8,S10
Null	#7	==>	#8	2.859	0.298	C12_S11,S12
Null	#8	==>	#9	1.135	0.309	C13_S13
Null	#9	==>	End	0.000	0.000	C15_S14,S15



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.70	280.00	39,968.00	2.51	4.423
#1	**Muskingum K:**					**4.423**
#2	8. Large gullies, diversions, and low flowing streams	0.93	65.00	6,975.74	2.89	0.670

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	**Muskingum K:**					**0.670**
#3	8. Large gullies, diversions, and low flowing streams	0.69	90.00	13,083.29	2.48	1.465
#3	**Muskingum K:**					**1.465**
#4	8. Large gullies, diversions, and low flowing streams	0.70	254.00	36,504.74	2.50	4.056
#4	**Muskingum K:**					**4.056**
#5	8. Large gullies, diversions, and low flowing streams	1.86	520.00	27,885.02	4.09	1.893
#5	**Muskingum K:**					**1.893**
#6	8. Large gullies, diversions, and low flowing streams	0.98	396.00	40,494.93	2.96	3.800
#6	**Muskingum K:**					**3.800**
#7	8. Large gullies, diversions, and low flowing streams	0.70	180.00	25,732.66	2.50	2.859
#7	**Muskingum K:**					**2.859**
#8	8. Large gullies, diversions, and low flowing streams	0.84	95.00	11,245.26	2.75	1.135
#8	**Muskingum K:**					**1.135**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#5	In	21,873.000	21,873.000	403.37	646.14	11,441.8	25,080	2.14	1.77
	Out			170.22	579.38	9,083.5	20,275	0.00	0.00
#3	In	20,610.000	20,610.000	695.55	651.31	36,966.0	67,185	13.53	10.47
	Out			158.49	491.26	18,551.4	41,834	0.00	0.00
#1		18,516.000	18,516.000	239.85	487.31	9,340.3	27,306	0.92	0.79
#2		30,983.000	49,499.000	607.37	1,421.42	43,998.4	79,721	7.60	3.63
#4		26,799.000	96,908.000	1,252.09	2,874.75	84,515.9	51,307	4.54	3.04
#6		35,493.000	154,274.000	1,924.53	4,695.25	128,867.8	45,437	3.32	2.51
#7		31,930.000	186,204.000	2,224.74	5,770.69	174,568.7	66,503	4.88	2.88
#8		9,897.000	196,101.000	2,278.49	6,065.97	177,574.1	57,059	4.09	2.80
#9		36,872.000	232,973.000	2,413.69	6,986.24	209,752.7	54,117	3.58	2.63

Li Qi

Sunrise Engineering, Inc.

General Information

Storm Information:

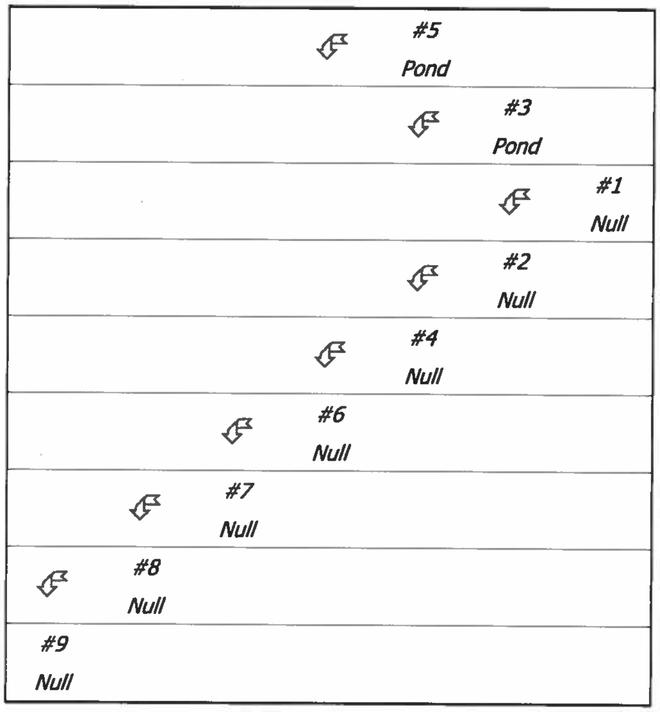
Storm Type:	NRCS Type II
Design Storm:	50 yr - 24 hr
Rainfall Depth:	3.400 inches

Particle Size Distribution:

Size (mm)	Gradation 1
4.7500	72.860%
2.0000	60.830%
0.4250	46.760%
0.0750	33.370%
0.0040	15.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	4.423	0.298	C1_S1
Null	#2	==>	#4	0.670	0.315	C3_S2,S3
Pond	#3	==>	#4	1.465	0.297	C5_S5_Mathews
Null	#4	==>	#6	4.056	0.298	C6_S4,S6
Pond	#5	==>	#6	1.893	0.353	C9_S9_Pine
Null	#6	==>	#7	3.800	0.318	C10_S7,S8,S10
Null	#7	==>	#8	2.859	0.298	C12_S11,S12
Null	#8	==>	#9	1.135	0.309	C13_S13
Null	#9	==>	End	0.000	0.000	C15_S14,S15



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.70	280.00	39,968.00	2.51	4.423
#1	**Muskingum K:**					**4.423**
#2	8. Large gullies, diversions, and low flowing streams	0.93	65.00	6,975.74	2.89	0.670

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	**Muskingum K:**					**0.670**
#3	8. Large gullies, diversions, and low flowing streams	0.69	90.00	13,083.29	2.48	1.465
#3	**Muskingum K:**					**1.465**
#4	8. Large gullies, diversions, and low flowing streams	0.70	254.00	36,504.74	2.50	4.056
#4	**Muskingum K:**					**4.056**
#5	8. Large gullies, diversions, and low flowing streams	1.86	520.00	27,885.02	4.09	1.893
#5	**Muskingum K:**					**1.893**
#6	8. Large gullies, diversions, and low flowing streams	0.98	396.00	40,494.93	2.96	3.800
#6	**Muskingum K:**					**3.800**
#7	8. Large gullies, diversions, and low flowing streams	0.70	180.00	25,732.66	2.50	2.859
#7	**Muskingum K:**					**2.859**
#8	8. Large gullies, diversions, and low flowing streams	0.84	95.00	11,245.26	2.75	1.135
#8	**Muskingum K:**					**1.135**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#5	In	21,873.000	21,873.000	605.96	939.31	17,719.8	26,880	2.25	1.85
	Out			208.95	781.49	13,400.8	22,097	0.00	0.00
#3	In	20,610.000	20,610.000	1,062.49	937.54	57,469.0	73,494	15.22	11.61
	Out			188.61	618.54	25,817.4	47,331	0.00	0.00
#1		18,516.000	18,516.000	360.58	720.89	14,613.4	28,923	0.65	0.56
#2		30,983.000	49,499.000	891.60	2,074.58	68,326.3	88,663	8.03	3.65
#4		26,799.000	96,908.000	1,845.37	4,175.21	128,586.0	56,271	4.97	3.24
#6		35,493.000	154,274.000	2,786.86	6,792.97	195,358.7	49,649	3.60	2.67
#7		31,930.000	186,204.000	3,208.23	8,326.02	264,693.3	71,491	5.28	3.10
#8		9,897.000	196,101.000	3,287.00	8,754.63	269,149.0	61,326	4.40	2.99
#9		36,872.000	232,973.000	3,495.55	10,120.56	319,525.5	57,523	3.70	2.72

Li Qi

Sunrise Engineering, Inc.

General Information

Storm Information:

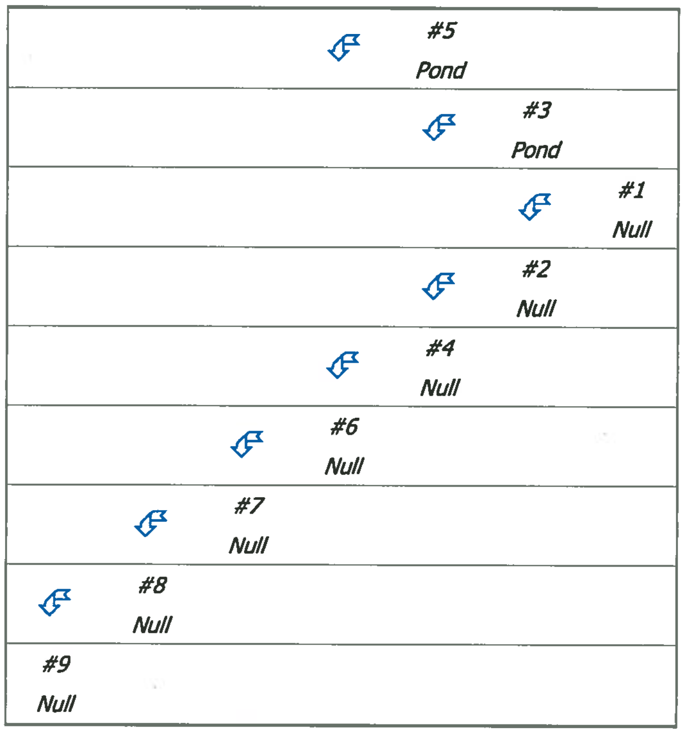
Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	3.810 inches

Particle Size Distribution:

Size (mm)	Gradation 1
4.7500	72.860%
2.0000	60.830%
0.4250	46.760%
0.0750	33.370%
0.0040	15.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	4.423	0.298	C1_S1
Null	#2	==>	#4	0.670	0.315	C3_S2,S3
Pond	#3	==>	#4	1.465	0.297	C5_S5_Mathews
Null	#4	==>	#6	4.056	0.298	C6_S4,S6
Pond	#5	==>	#6	1.893	0.353	C9_S9_Pine
Null	#6	==>	#7	3.800	0.318	C10_S7,S8,S10
Null	#7	==>	#8	2.859	0.298	C12_S11,S12
Null	#8	==>	#9	1.135	0.309	C13_S13
Null	#9	==>	End	0.000	0.000	C15_S14,S15



Structure Routing Details:

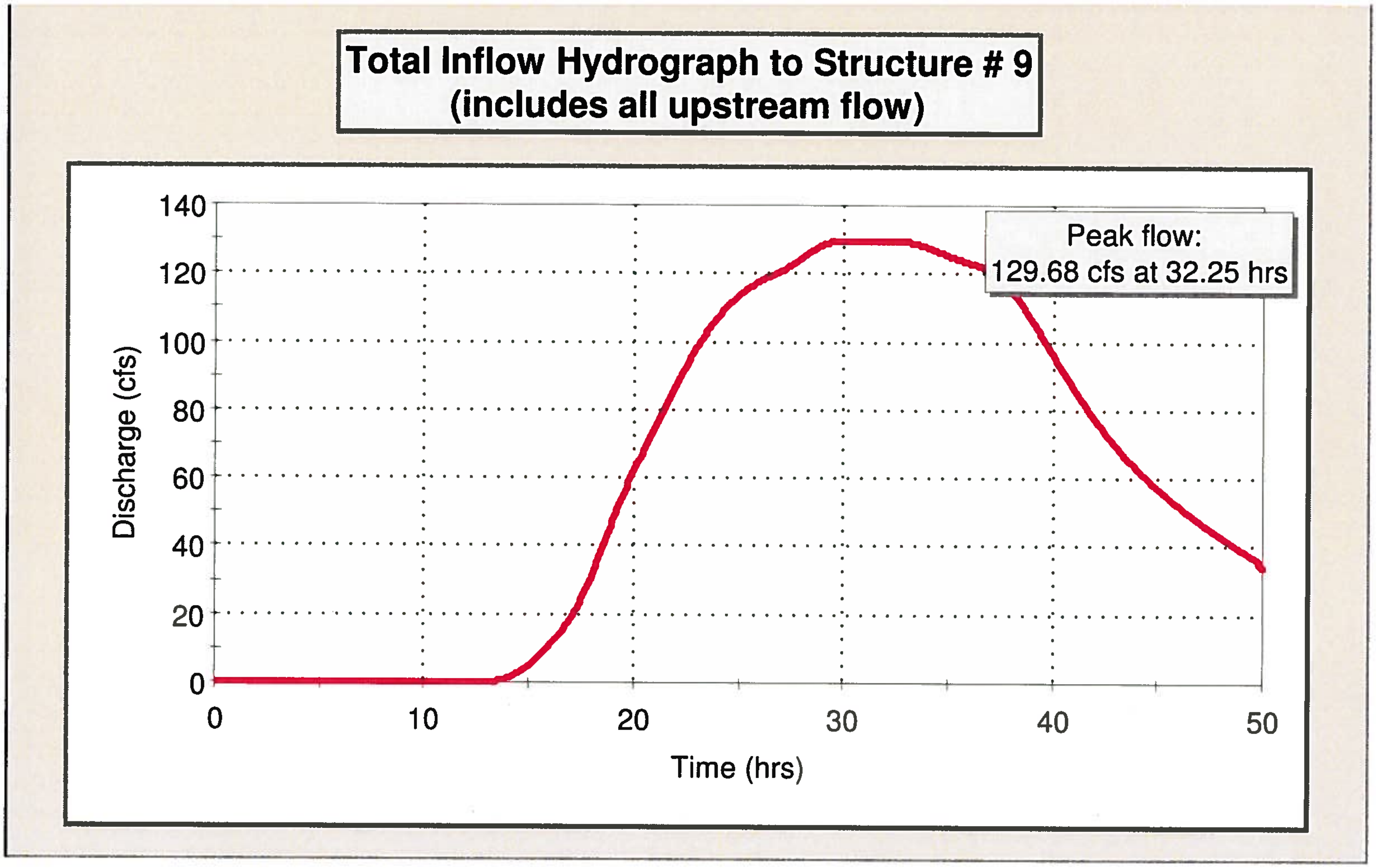
Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.70	280.00	39,968.00	2.51	4.423
#1	**Muskingum K:**					**4.423**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	0.93	65.00	6,975.74	2.89	0.670
#2	**Muskingum K:**					**0.670**
#3	8. Large gullies, diversions, and low flowing streams	0.69	90.00	13,083.29	2.48	1.465
#3	**Muskingum K:**					**1.465**
#4	8. Large gullies, diversions, and low flowing streams	0.70	254.00	36,504.74	2.50	4.056
#4	**Muskingum K:**					**4.056**
#5	8. Large gullies, diversions, and low flowing streams	1.86	520.00	27,885.02	4.09	1.893
#5	**Muskingum K:**					**1.893**
#6	8. Large gullies, diversions, and low flowing streams	0.98	396.00	40,494.93	2.96	3.800
#6	**Muskingum K:**					**3.800**
#7	8. Large gullies, diversions, and low flowing streams	0.70	180.00	25,732.66	2.50	2.859
#7	**Muskingum K:**					**2.859**
#8	8. Large gullies, diversions, and low flowing streams	0.84	95.00	11,245.26	2.75	1.135
#8	**Muskingum K:**					**1.135**

Structure Summary:

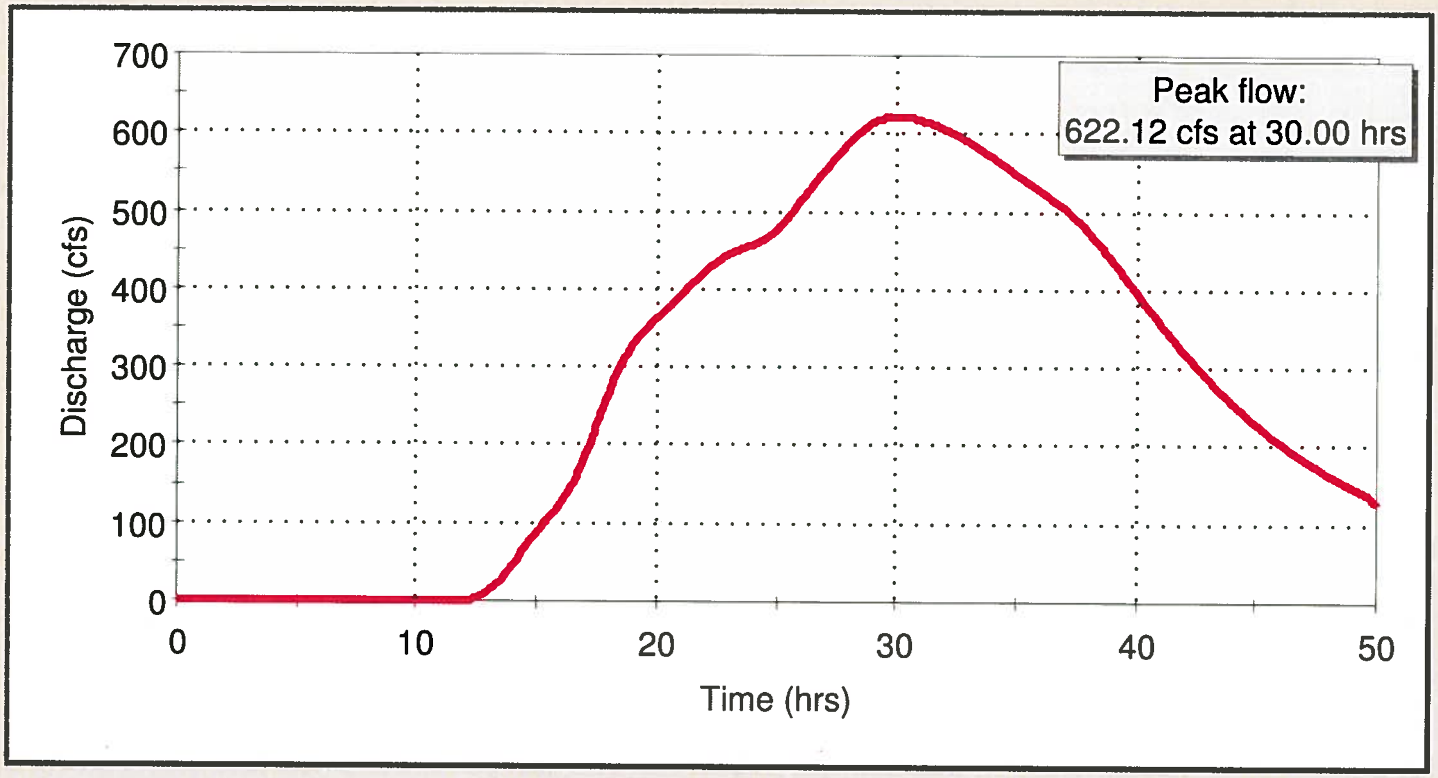
		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#5	In	21,873.000	21,873.000	849.16	1,280.04	25,456.4	28,480	2.50	2.04
	Out			242.82	957.64	17,579.1	23,491	0.00	0.00
#3	In	20,610.000	20,610.000	1,505.92	1,268.59	82,757.5	78,917	16.94	12.78
	Out			214.39	725.87	32,639.0	51,761	0.00	0.00
#1		18,516.000	18,516.000	505.49	994.67	21,144.6	30,394	0.65	0.56
#2		30,983.000	49,499.000	1,226.62	2,835.30	98,995.3	96,154	9.10	4.03
#4		26,799.000	96,908.000	2,547.44	5,686.27	181,546.4	60,500	5.70	3.65
#6		35,493.000	154,274.000	3,792.65	9,225.95	274,499.1	53,284	4.13	3.02
#7		31,930.000	186,204.000	4,348.23	11,285.92	372,663.5	75,758	6.00	3.51
#8		9,897.000	196,101.000	4,455.31	11,869.41	378,784.5	64,967	4.99	3.37
#9		36,872.000	232,973.000	4,748.65	13,760.32	451,593.5	60,434	4.12	3.03

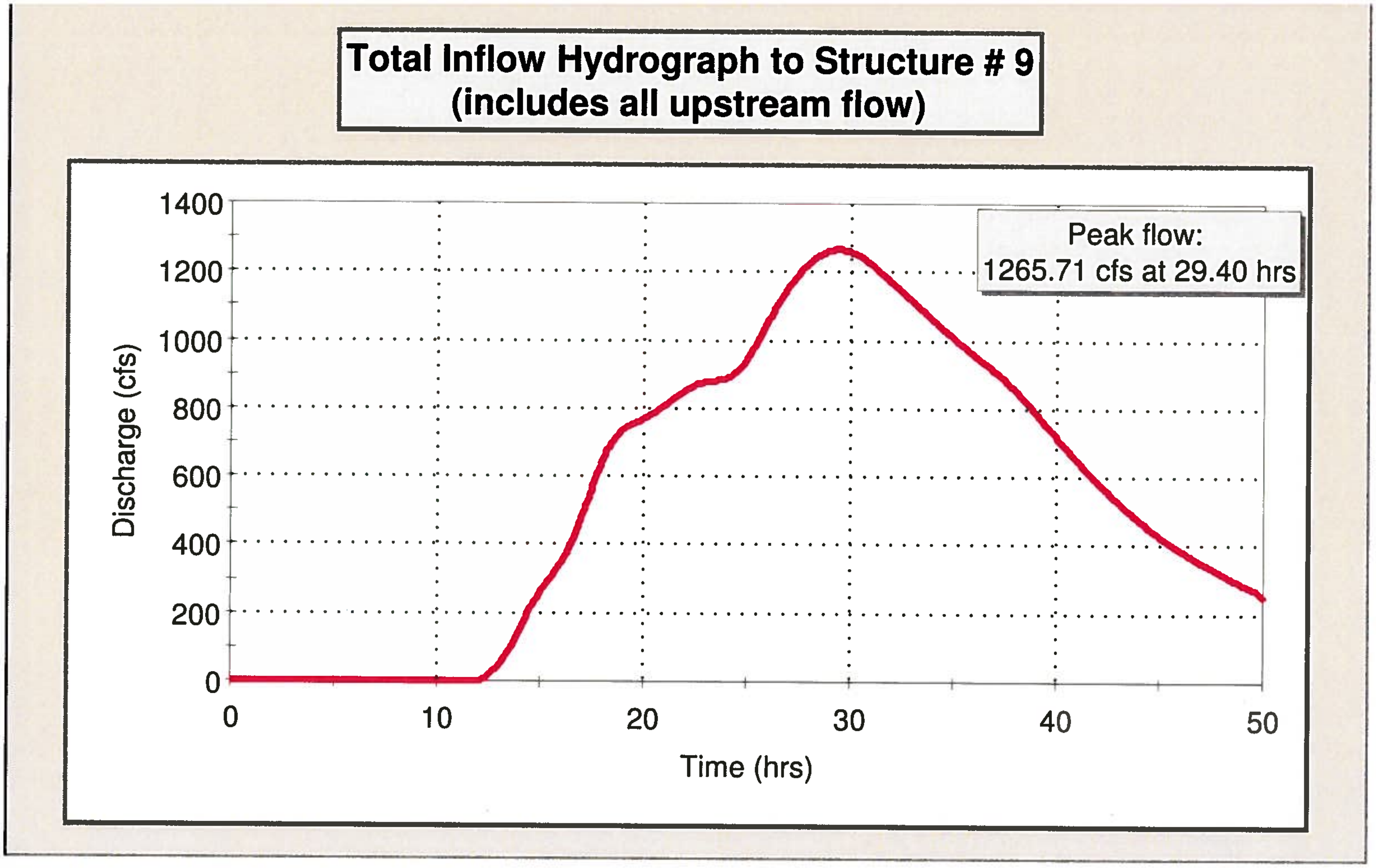
H-2
Hydrographs



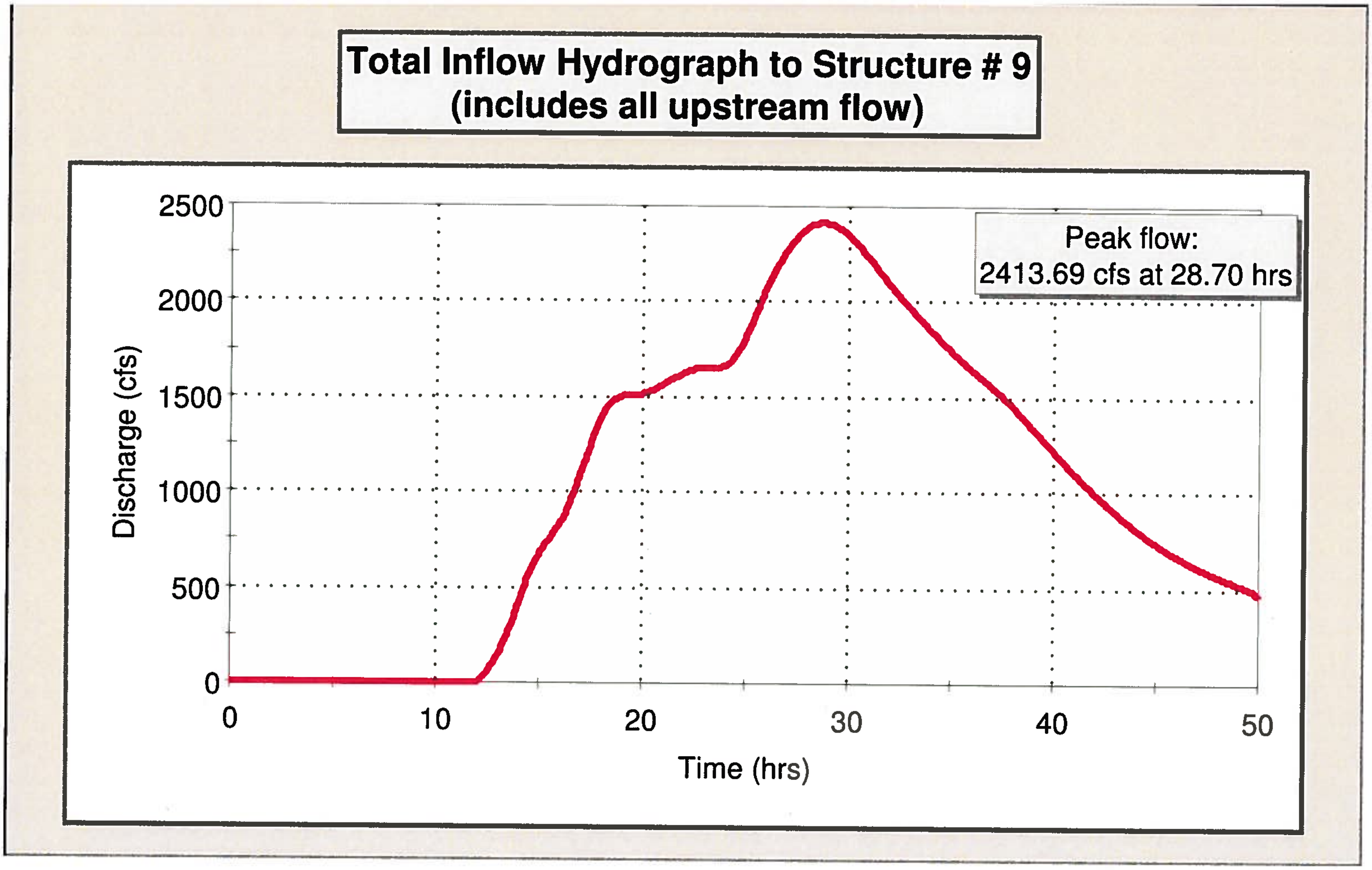
Total Inflow Hydrograph to Structure # 9
(includes all upstream flow)
Peak flow:
129.68 cfs at 32.25 hrs
Discharge (cfs)
Time (hrs)
0
20
40
60
80
100
120
140
0
10
20
30
40
50

Total Inflow Hydrograph to Structure # 9
(includes all upstream flow)



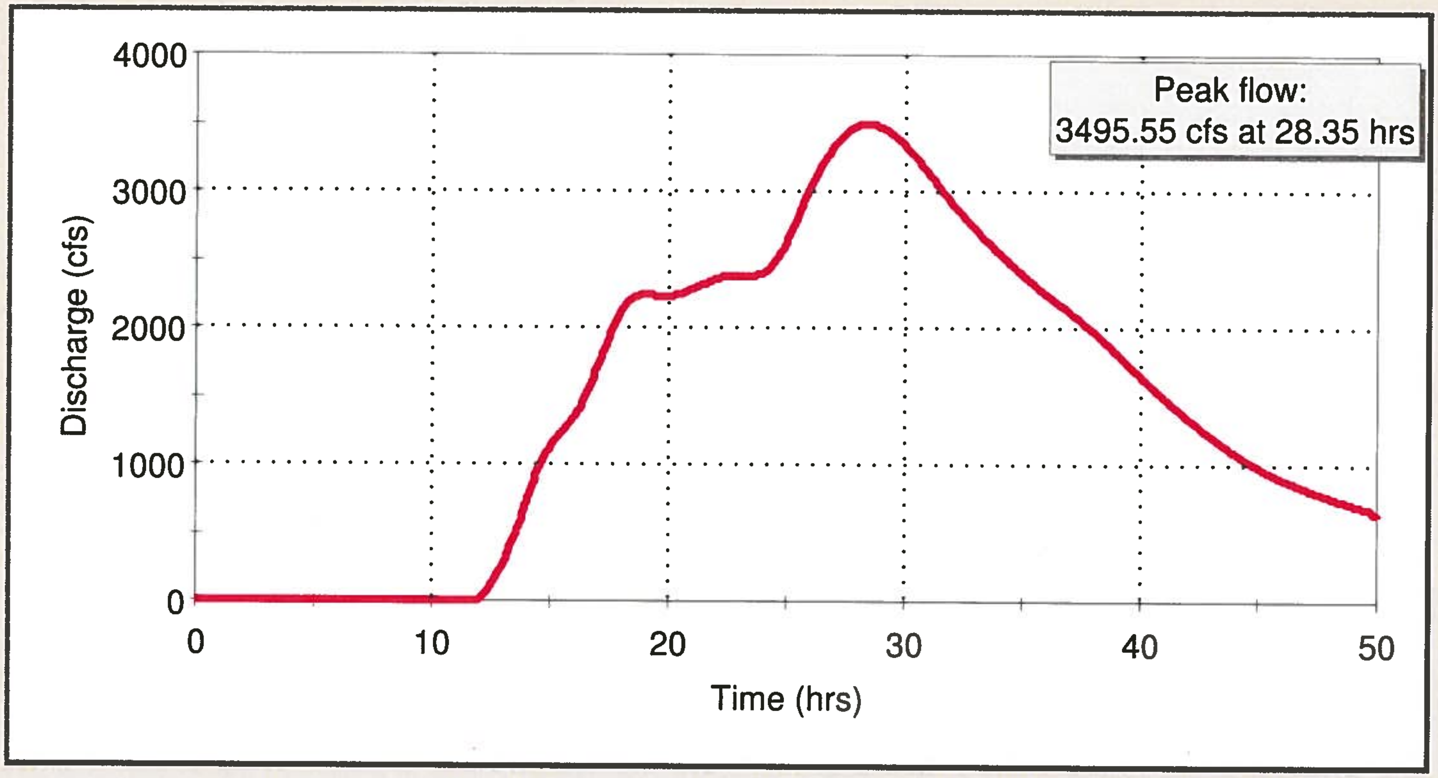


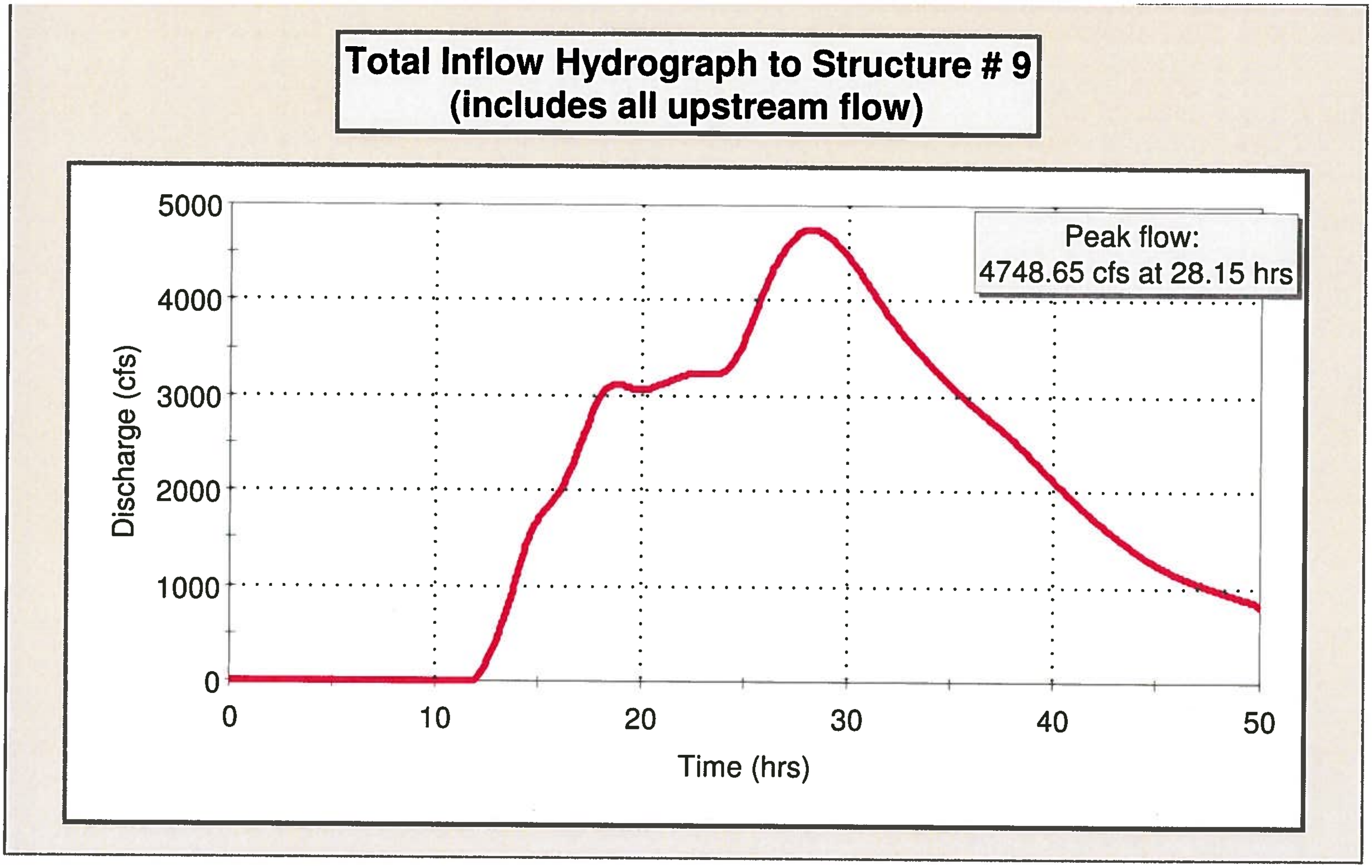
Total Inflow Hydrograph to Structure # 9
(includes all upstream flow)
Peak flow:
1265.71 cfs at 29.40 hrs
Discharge (cfs)
1400
1200
1000
800
600
400
200
0
0
10
20
30
40
50
Time (hrs)



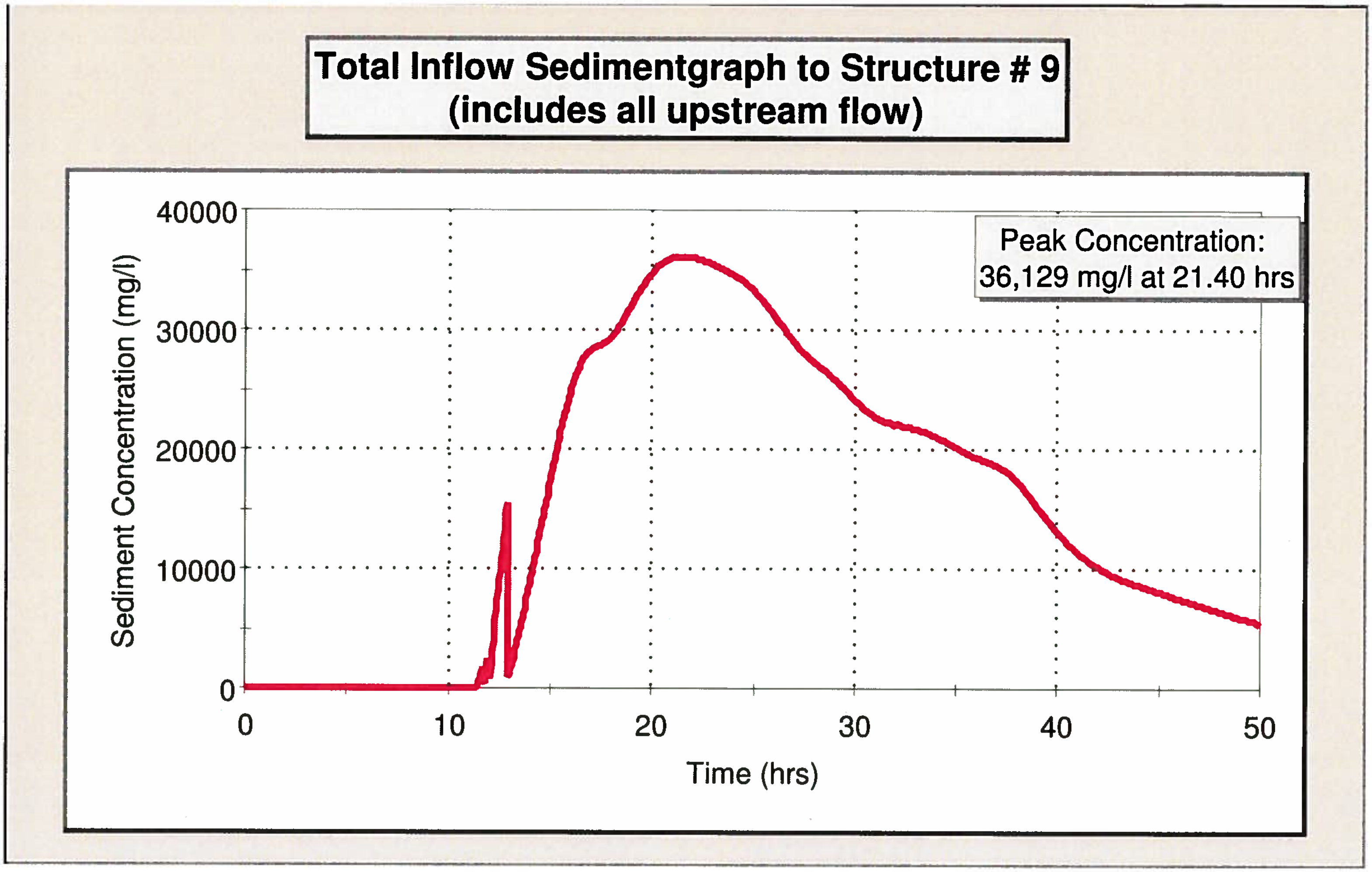
Total Inflow Hydrograph to Structure # 9
(includes all upstream flow)
Peak flow:
2413.69 cfs at 28.70 hrs
Discharge (cfs)
2500
2000
1500
1000
500
0
0
10
20
30
40
50
Time (hrs)

Total Inflow Hydrograph to Structure # 9
(includes all upstream flow)

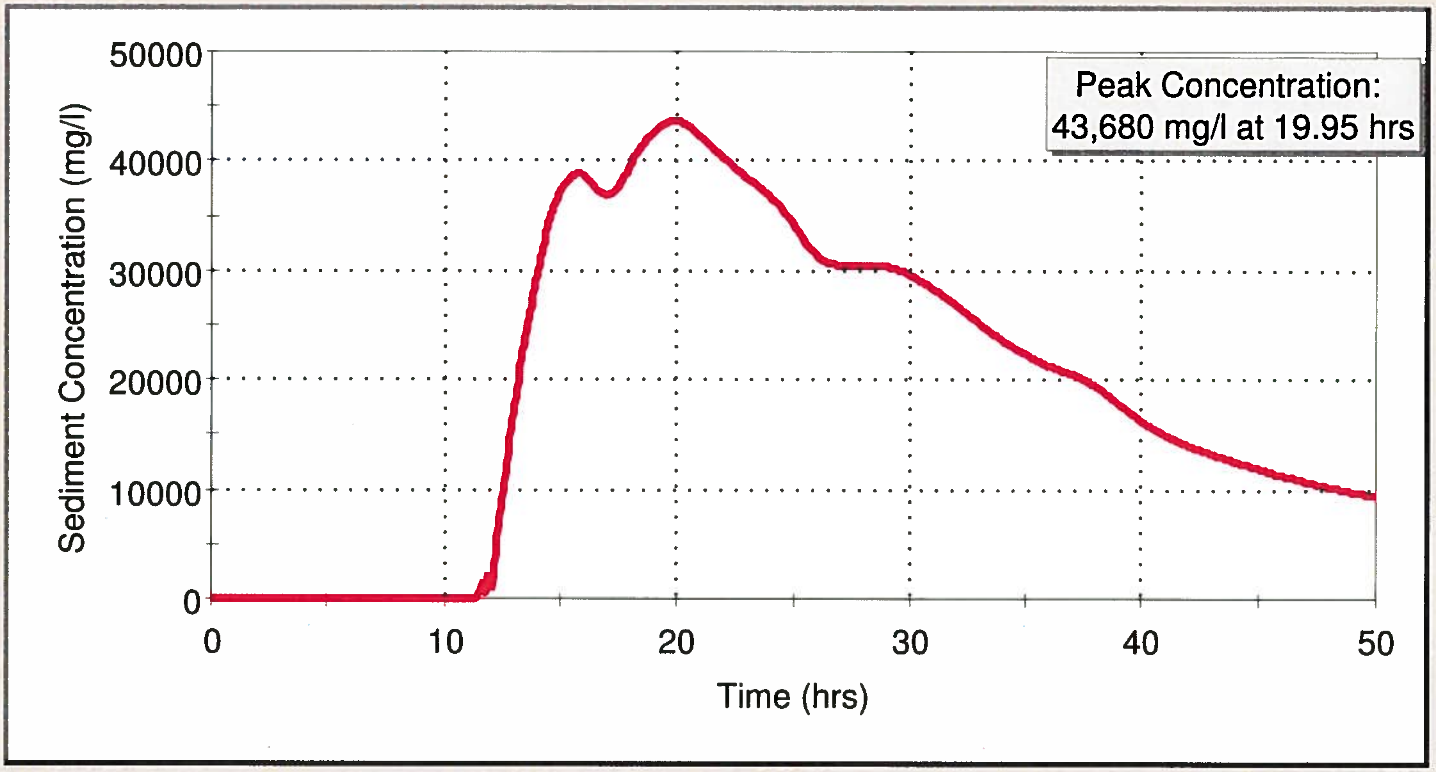



Total Inflow Hydrograph to Structure # 9
(includes all upstream flow)
Peak flow:
4748.65 cfs at 28.15 hrs
Discharge (cfs)
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
Time (hrs)

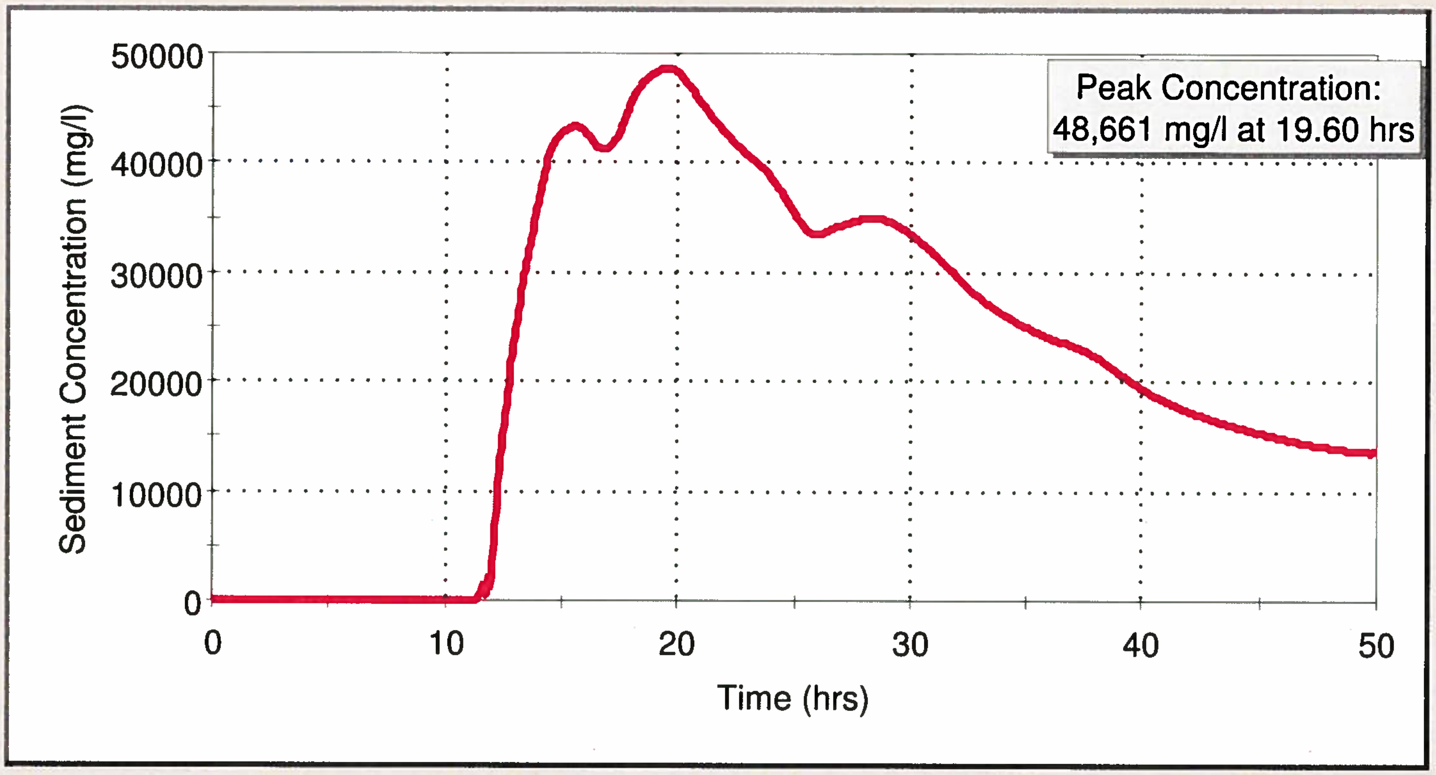
H-3
Sediment Graphs


Total Inflow Sedimentgraph to Structure # 9
(includes all upstream flow)
Peak Concentration:
36,129 mg/l at 21.40 hrs
Sediment Concentration (mg/l)
40000
30000
20000
10000
0
0
10
20
30
40
50
Time (hrs)

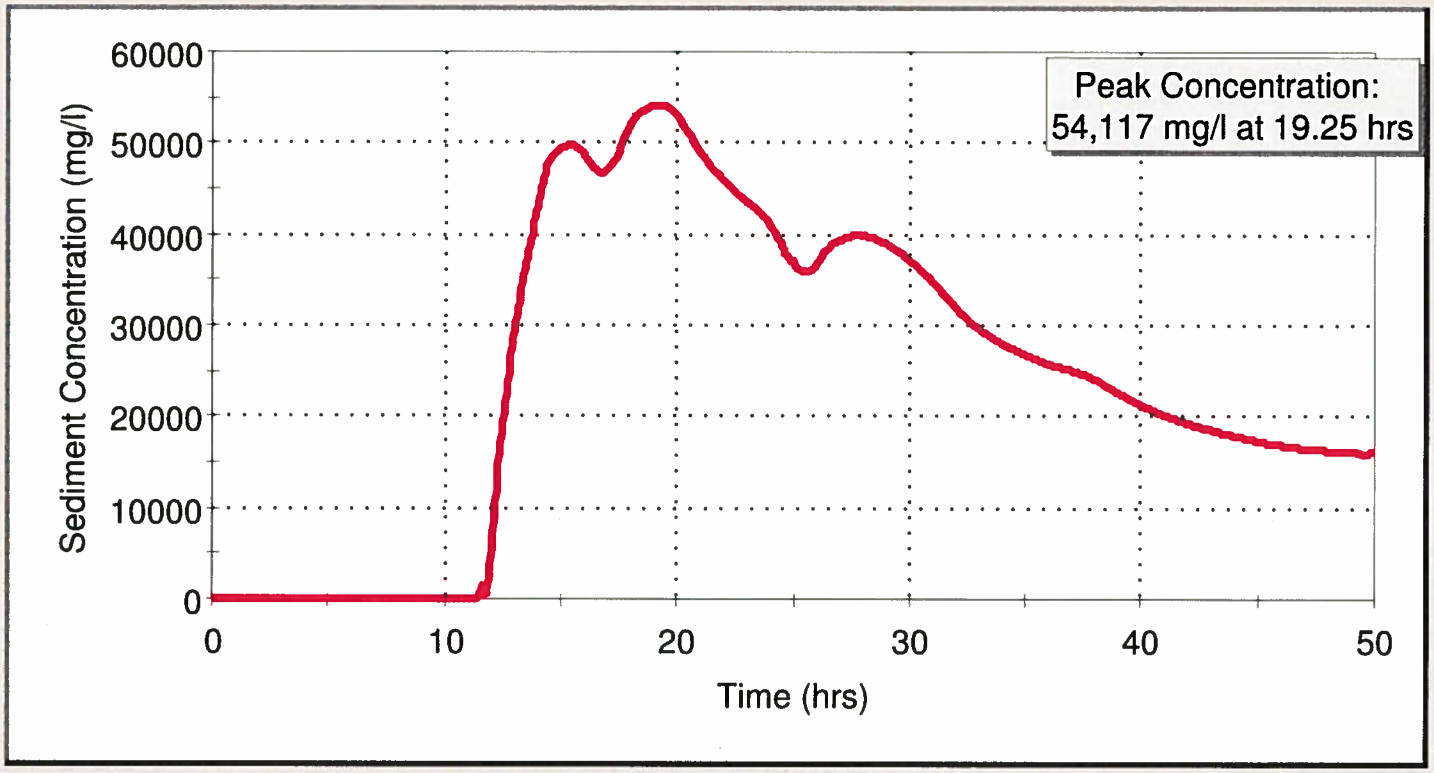
Total Inflow Sedimentgraph to Structure # 9
(includes all upstream flow)

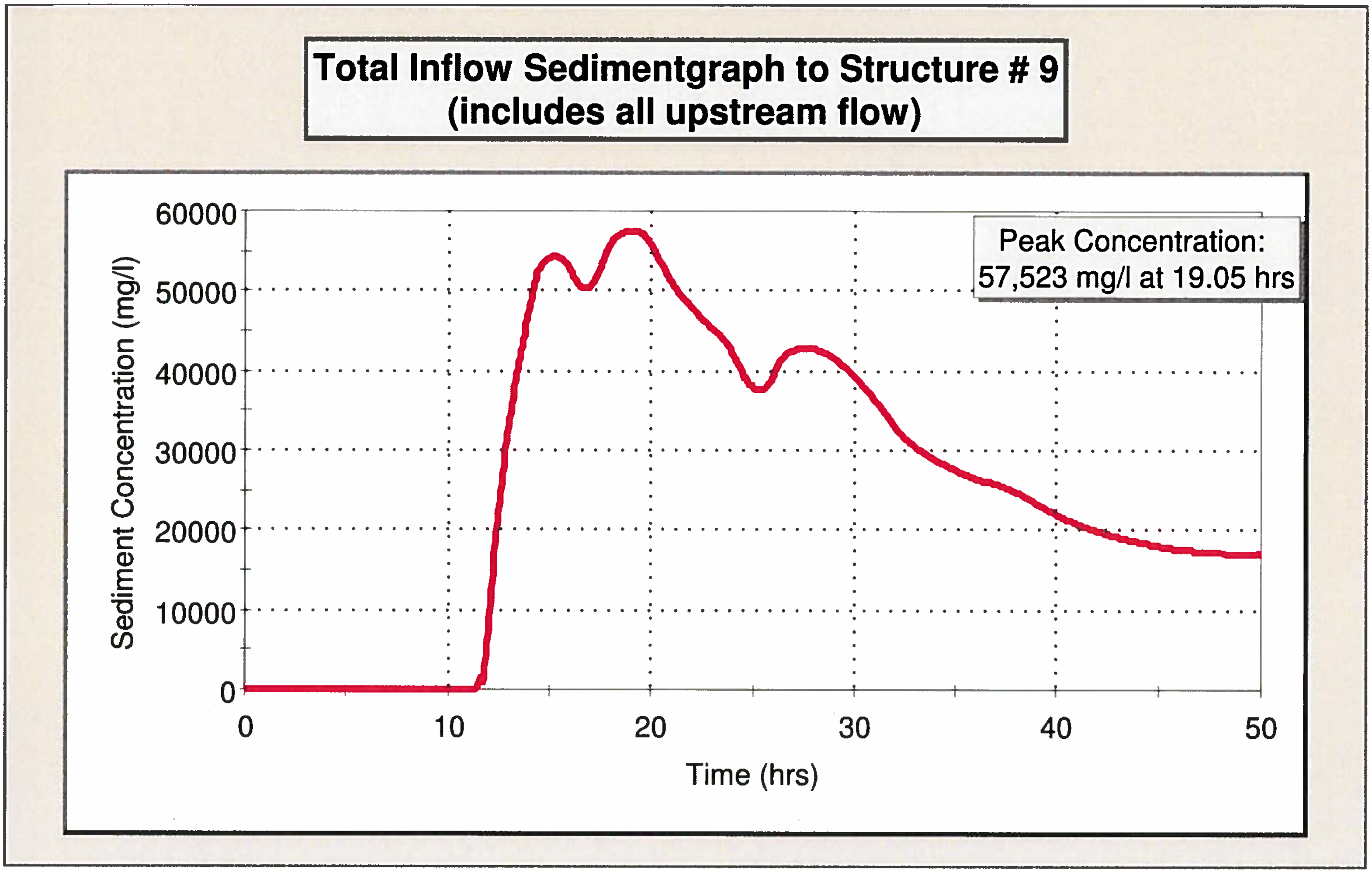


Total Inflow Sedimentgraph to Structure # 9
(includes all upstream flow)

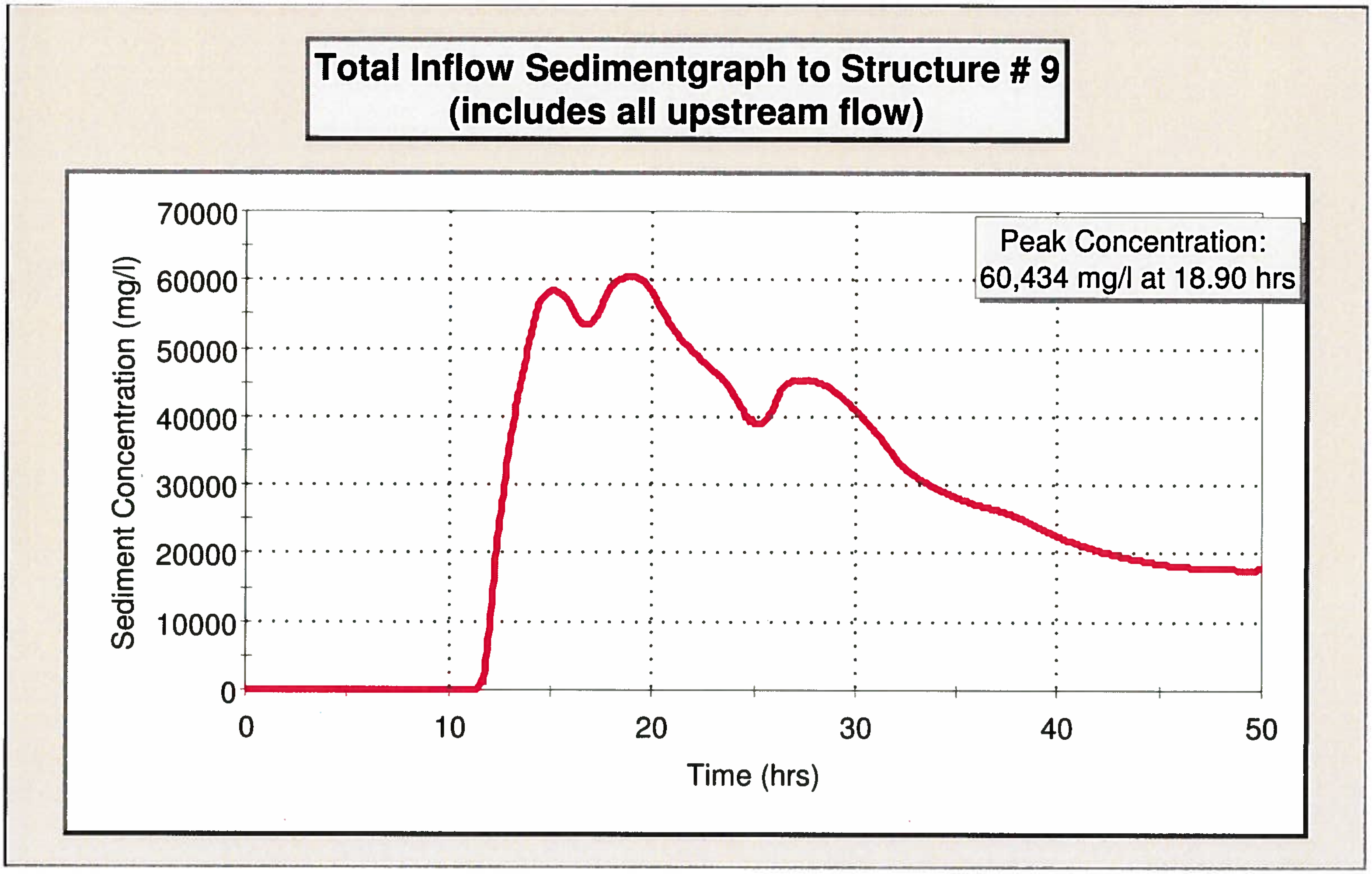


Total Inflow Sedimentgraph to Structure # 9
(includes all upstream flow)





Total Inflow Sedimentgraph to Structure # 9
(includes all upstream flow)
Peak Concentration:
57,523 mg/l at 19.05 hrs
Sediment Concentration (mg/l)
60000
50000
40000
30000
20000
10000
0
0
10
20
30
40
50
Time (hrs)


Total Inflow Sedimentgraph to Structure # 9
(includes all upstream flow)
Peak Concentration:
60,434 mg/l at 18.90 hrs
Sediment Concentration (mg/l)
70000
60000
50000
40000
30000
20000
10000
0
0
10
20
30
40
50
Time (hrs)

Appendix I
HEC FFA Model (Log Pearson III Analysis) Results

```
***********************************     ***********************************
*               FFA               *     *                                 *
*     FLOOD FREQUENCY ANALYSIS    *     *   U.S. ARMY CORPS OF ENGINEERS  *
*     PROGRAM DATE:  FEB 1995     *     * THE HYDROLOGIC ENGINEERING CENTER *
*          VERSION:  3.1          *     *        609 SECOND STREET        *
*     RUN  DATE   AND   TIME:     *     *     DAVIS, CALIFORNIA 95616     *
*        10 JAN 08    13:46:23    *     *         (916) 756-1104          *
*                                 *     *                                 *
***********************************     ***********************************



 INPUT FILE NAME: C:\HECEXE\MVWLPI\MVWLPI.IN
OUTPUT FILE NAME: C:\HECEXE\MVWLPI\MVWLPI.OUT



**TITLE RECORD(S)**
TT   STAGE FREQUENCY ANALYSIS
TT   FITTING THE LOG-PEARSON TYPE III DISTRIBUTION WITH REGIONAL SKEW = 0.15
TT   USGS RECORD OF ANNUAL PEAKS AT 09418500
TT       1       2       3       4       5       6       7       8       9

**JOB RECORD(S)**
     IPPC   ISKFX  IPROUT    IFMT    IWYR   IUNIT   ISMRY   IPNCH    IREG
J1     1       0       3       9       0       1       3       1       0

       A       B  CLIMIT  NDSSCV    IEXT
J2   .40     .40     .00       1       0

**FREQUENCY ARRAY**
FR     6   1.000   2.000   4.000  10.000  20.000  50.000

**SPECIAL FORMAT**
FT   (4x,I2,2x,I2,2x,I4,2X,F8.2)

**SPECIFIED VARIABLE AND UNITS**
FU       Q    CFS

**STATION IDENTIFICATION**
ID   MVW nr Caliente Hist Record

**GENERALIZED SKEW**
     ISTN   GGMSE    SKEW
GS  HIST     .302     .15

**SPECIAL STATION INFORMATION**
    IYRA    IYRL  HITHRS  LOTHRS    LOGT    NDEC    NSIG
SI     0       0      0.      0.       2       4       0

**HP PLOT **
     HP PLOT FILE                  IHPCV  KLIMIT    IPER    BAREA
HP SCN7.pcl                            2       0       1 1670   SQ MI

     SELECTED CURVES ON HPPLOT
          COMPUTED PROBABILITY CURVE
          CONFIDENCE LIMITS

HP Systematic Record w/ reduced
HP USGS 09418500
HP Meadow Valley Wash nr Calient
HP Water Years in Record: 1910-2

**HISTORIC EVENTS**
QH   1   7  1910    10364.
QH   2  27  1938    14010.

**SYSTEMATIC EVENTS**
     51 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
```

ED ++
+++

FINAL RESULTS

-PLOTTING POSITIONS- MVW nr Caliente Hist Record

EVENTS ANALYZED				ORDERED EVENTS			
MON	DAY	YEAR	Q CFS	RANK	WATER YEAR	Q CFS	WEIBULL PLOT POS
7	1	1910	10364.0000	1	1938	14010.0000	1.02
27	2	1938	14010.0000	2	1910	10364.0000	2.04
5	2	1951	47.0000	3	2006	8100.0000	3.50
27	3	1952	935.0000	4	1978	2400.0000	5.40
2	8	1953	103.0000	5	1980	2370.0000	7.30
4	9	1954	771.0000	6	1981	2360.0000	9.20
3	8	1955	734.0000	7	1995	1930.0000	11.10
30	6	1956	1402.0000	8	1983	1610.0000	13.01
11	2	1957	109.0000	9	1957	1402.0000	14.91
22	3	1958	249.0000	10	1983	1320.0000	16.81
19	2	1959	75.0000	11	1973	1230.0000	18.71
10	2	1960	98.0000	12	1971	1200.0000	20.61
14	9	1963	270.0000	13	1968	1150.0000	22.51
17	7	1965	168.0000	14	1973	1000.0000	24.41
29	7	1966	547.0000	15	1953	935.0000	26.31
7	12	1966	680.0000	16	1992	905.0000	28.21
9	8	1968	1150.0000	17	1970	865.0000	30.11
31	3	1969	865.0000	18	1954	771.0000	32.01
15	8	1970	1200.0000	19	1976	756.0000	33.91
26	8	1971	496.0000	20	1974	734.0000	35.81
27	8	1972	1230.0000	21	1955	734.0000	37.72
10	10	1972	1000.0000	22	1966	680.0000	39.62
4	8	1974	734.0000	23	1994	651.0000	41.52
30	7	1975	756.0000	24	1967	547.0000	43.42
31	7	1976	324.0000	25	2004	540.0000	45.32
2	10	1976	263.0000	26	1972	496.0000	47.22
5	3	1978	2400.0000	27	1999	465.0000	49.12
14	2	1979	2370.0000	28	1977	324.0000	51.02
15	2	1980	2360.0000	29	1964	270.0000	52.92
6	3	1981	34.0000	30	1976	263.0000	54.82
12	8	1982	1320.0000	31	1959	249.0000	56.72
3	3	1983	1610.0000	32	1987	234.0000	58.62
29	7	1985	99.0000	33	1990	176.0000	60.52
16	2	1986	234.0000	34	1966	168.0000	62.42
15	2	1987	45.0000	35	1987	115.0000	64.33
7	11	1987	115.0000	36	2004	114.0000	66.23
11	8	1989	176.0000	37	1958	109.0000	68.13
16	8	1990	102.0000	38	1953	103.0000	70.03
1	3	1991	25.0000	39	1991	102.0000	71.93
4	3	1992	905.0000	40	1986	99.0000	73.83
27	3	1993	651.0000	41	1961	98.0000	75.73
15	1	1994	28.0000	42	1960	75.0000	77.63
6	3	1995	1930.0000	43	2001	68.0000	79.53
15	7	1996	33.0000	44	1951	47.0000	81.43
7	9	1997	38.0000	45	1988	45.0000	83.33
23	2	1998	465.0000	46	2000	39.0000	85.23
31	8	1999	39.0000	47	1997	38.0000	87.13
22	2	2000	33.0000	48	1981	34.0000	89.04
31	10	2000	68.0000	49	1997	33.0000	90.94
5	12	2001	4.1000	50	2001	33.0000	92.84
15	8	2003	540.0000	51	1995	28.0000	94.74
9	9	2004	114.0000	52	1991	25.0000	96.64
11	1	2005	8100.0000	53	2001	4.1000	98.54

NOTE- PLOTTING POSITIONS BASED ON-HISTORIC PERIOD (H) = 97
NUMBER OF HISTORIC EVENTS PLUS HIGH OUTLIERS(Z) = 2
WEIGHTING FACTOR FOR SYSTEMATIC EVENTS (W) = 1.8627

-OUTLIER TESTS -

LOW OUTLIER TEST

BASED ON 51 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.775

0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF 3.6

HIGH OUTLIER TEST

BASED ON 51 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.775

0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF 22046.

STATISTICS AND FREQUENCY CURVE ADJUSTED FOR 0 HIGH OUTLIER(S)
AND 2 HISTORIC EVENT(S)

-SKEW WEIGHTING -

BASED ON 97 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW = .063
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW = .302

FINAL RESULTS

-FREQUENCY CURVE- MVW nr Caliente Hist Record

COMPUTED CURVE Q IN CFS	EXPECTED PROBABILITY Q IN CFS	PERCENT CHANCE EXCEEDANCE	CONFIDENCE LIMITS .05 Q IN CFS	CONFIDENCE LIMITS .95 Q IN CFS
12200.0000	14200.0000	1.00	28100.0000	6490.0000
8050.0000	9030.0000	2.00	17300.0000	4500.0000
5050.0000	5490.0000	4.00	10100.0000	2970.0000
2430.0000	2550.0000	10.00	4340.0000	1530.0000
1210.0000	1240.0000	20.00	1980.0000	806.0000
312.0000	312.0000	50.00	457.0000	213.0000

ADJUSTED STATISTICS

LOG TRANSFORM: Q, CFS		NUMBER OF EVENTS	
MEAN	2.4819	HISTORIC EVENTS	2
STANDARD DEV	.7120	HIGH OUTLIERS	0
COMPUTED SKEW	-.1611	LOW OUTLIERS	0
REGIONAL SKEW	.1500	ZERO OR MISSING	0
ADOPTED SKEW	-.1000	SYSTEMATIC EVENTS	51
		HISTORIC PERIOD	97

HP PLOT WRITTEN TO THE FILE: SCN7.pcl

Appendix J
Existing Conditions HEC-RAS Hydraulic Model Output – Standard Table and Selected Cross Sections

HEC-RAS Plan: Cliente Exis

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Meadow Valley Wa	MVW-Up	12095.00	2-Year	260.00	4419.67	4423.34		4423.42	0.002268	2.24	116.05	49.64	0.26
Meadow Valley Wa	MVW-Up	12095.00	5-Year	1010.00	4419.67	4425.81		4426.05	0.003420	4.00	252.42	60.42	0.35
Meadow Valley Wa	MVW-Up	12095.00	10-Year	2020.00	4419.67	4427.68		4428.14	0.004352	5.44	371.55	66.39	0.41
Meadow Valley Wa	MVW-Up	12095.00	25-Year	4200.00	4419.67	4430.54		4431.38	0.005325	7.32	574.04	75.17	0.47
Meadow Valley Wa	MVW-Up	12095.00	50-Year	6690.00	4419.67	4432.89		4433.72	0.004597	7.72	1181.77	401.75	0.45
Meadow Valley Wa	MVW-Up	12095.00	100-year	10100.00	4419.67	4435.59		4436.00	0.002162	6.28	2638.19	631.88	0.32
Meadow Valley Wa	MVW-Up	11475.85	2-Year	260.00	4417.44	4420.46	4419.98	4420.65	0.012282	3.58	72.72	54.80	0.55
Meadow Valley Wa	MVW-Up	11475.85	5-Year	1010.00	4417.44	4422.61	4421.38	4422.95	0.007991	4.69	215.24	77.88	0.50
Meadow Valley Wa	MVW-Up	11475.85	10-Year	2020.00	4417.44	4424.41	4422.61	4424.89	0.006411	5.57	362.66	85.13	0.48
Meadow Valley Wa	MVW-Up	11475.85	25-Year	4200.00	4417.44	4427.27	4424.40	4427.98	0.005517	6.77	620.80	95.65	0.47
Meadow Valley Wa	MVW-Up	11475.85	50-Year	6690.00	4417.44	4429.78	4425.77	4430.70	0.005142	7.68	871.32	104.00	0.47
Meadow Valley Wa	MVW-Up	11475.85	100-year	10100.00	4417.44	4433.11	4427.89	4434.06	0.004653	7.89	1405.88	269.52	0.45
Meadow Valley Wa	MVW-Up	10284.37	2-Year	260.00	4409.09	4411.60	4410.63	4411.74	0.005015	2.91	89.50	46.62	0.37
Meadow Valley Wa	MVW-Up	10284.37	5-Year	1010.00	4409.09	4413.73	4412.14	4414.15	0.006831	5.20	194.41	52.09	0.47
Meadow Valley Wa	MVW-Up	10284.37	10-Year	2020.00	4409.09	4415.54	4413.61	4416.28	0.008147	6.88	293.57	58.02	0.54
Meadow Valley Wa	MVW-Up	10284.37	25-Year	4200.00	4409.09	4418.29	4415.88	4419.57	0.009232	9.08	462.61	64.65	0.60
Meadow Valley Wa	MVW-Up	10284.37	50-Year	6690.00	4409.09	4420.93	4418.08	4422.62	0.009145	10.43	641.68	71.19	0.61
Meadow Valley Wa	MVW-Up	10284.37	100-year	10100.00	4409.09	4422.76	4420.44	4425.38	0.012311	13.00	777.04	76.99	0.72
Meadow Valley Wa	MVW-Up	10062.85	2-Year	260.00	4408.00	4410.64	4409.69	4410.73	0.004066	2.34	110.96	69.36	0.33
Meadow Valley Wa	MVW-Up	10062.85	5-Year	1010.00	4408.00	4412.77	4410.95	4412.98	0.003797	3.71	272.48	80.49	0.36
Meadow Valley Wa	MVW-Up	10062.85	10-Year	2020.00	4408.00	4414.61	4412.03	4414.94	0.003963	4.66	433.84	93.39	0.38
Meadow Valley Wa	MVW-Up	10062.85	25-Year	4200.00	4408.00	4417.57	4413.89	4418.08	0.003828	5.74	732.03	111.13	0.39
Meadow Valley Wa	MVW-Up	10062.85	50-Year	6690.00	4408.00	4420.54	4415.44	4421.08	0.003553	5.91	1161.22	208.18	0.39
Meadow Valley Wa	MVW-Up	10062.85	100-year	10100.00	4408.00	4423.02	4417.34	4423.62	0.002874	6.36	1712.62	230.45	0.36
Meadow Valley Wa	MVW-Up	10028.82	2-Year	260.00	4408.27	4410.26	4409.76	4410.49	0.012211	3.83	67.80	46.10	0.56
Meadow Valley Wa	MVW-Up	10028.82	5-Year	1010.00	4408.27	4412.19	4411.31	4412.73	0.013072	5.89	171.48	63.94	0.63
Meadow Valley Wa	MVW-Up	10028.82	10-Year	2020.00	4408.27	4413.96	4412.69	4414.69	0.010720	6.87	294.12	74.61	0.61
Meadow Valley Wa	MVW-Up	10028.82	25-Year	4200.00	4408.27	4416.91	4414.72	4417.86	0.007936	7.82	536.86	88.26	0.56
Meadow Valley Wa	MVW-Up	10028.82	50-Year	6690.00	4408.27	4419.84	4416.45	4420.87	0.006658	8.12	824.22	111.43	0.53
Meadow Valley Wa	MVW-Up	10028.82	100-year	10100.00	4408.27	4422.04	4418.42	4423.40	0.006875	9.36	1079.48	119.42	0.55
Meadow Valley Wa	MVW-Up	9184.98	2-Year	260.00	4396.27	4398.93	4398.31	4399.31	0.014385	4.96	52.44	26.35	0.62
Meadow Valley Wa	MVW-Up	9184.98	5-Year	1010.00	4396.27	4402.00	4400.55	4402.73	0.010750	6.84	147.68	34.87	0.59
Meadow Valley Wa	MVW-Up	9184.98	10-Year	2020.00	4396.27	4404.42	4402.51	4405.54	0.010881	8.47	238.44	39.69	0.61
Meadow Valley Wa	MVW-Up	9184.98	25-Year	4200.00	4396.27	4408.09	4405.58	4409.81	0.011420	10.52	399.28	48.56	0.65
Meadow Valley Wa	MVW-Up	9184.98	50-Year	6690.00	4396.27	4411.34	4408.32	4413.48	0.011607	11.75	569.35	58.89	0.67
Meadow Valley Wa	MVW-Up	9184.98	100-year	10100.00	4396.27	4414.15	4411.42	4416.30	0.010262	12.28	1038.01	257.45	0.65
Meadow Valley Wa	MVW-Up	8771.51	2-Year	260.00	4391.84	4395.24		4395.44	0.006423	3.60	72.21	32.47	0.43
Meadow Valley Wa	MVW-Up	8771.51	5-Year	1010.00	4391.84	4397.34		4398.05	0.011892	6.75	149.62	40.89	0.62
Meadow Valley Wa	MVW-Up	8771.51	10-Year	2020.00	4391.84	4399.05		4400.31	0.014784	9.00	224.49	46.24	0.72
Meadow Valley Wa	MVW-Up	8771.51	25-Year	4200.00	4391.84	4401.48		4403.81	0.018649	12.23	343.31	51.63	0.84
Meadow Valley Wa	MVW-Up	8771.51	50-Year	6690.00	4391.84	4403.43		4406.89	0.022129	14.93	448.05	55.78	0.93
Meadow Valley Wa	MVW-Up	8771.51	100-year	10100.00	4391.84	4406.62		4410.53	0.018686	15.85	637.06	62.10	0.87
Meadow Valley Wa	MVW-Down	8511.49	2-Year	312.00	4390.39	4393.18	4392.31	4393.31	0.005666	2.93	106.53	60.72	0.39
Meadow Valley Wa	MVW-Down	8511.49	5-Year	1210.00	4390.39	4395.69	4393.76	4395.99	0.004718	4.44	272.65	71.54	0.40
Meadow Valley Wa	MVW-Down	8511.49	10-Year	2430.00	4390.39	4397.97	4395.13	4398.43	0.004308	5.46	445.21	78.82	0.40
Meadow Valley Wa	MVW-Down	8511.49	25-Year	5050.00	4390.39	4401.34	4397.35	4402.09	0.004313	6.97	724.25	86.88	0.43
Meadow Valley Wa	MVW-Down	8511.49	50-Year	8050.00	4390.39	4404.10	4399.29	4405.16	0.004715	8.25	975.49	96.21	0.46
Meadow Valley Wa	MVW-Down	8511.49	100-year	12200.00	4390.39	4408.14	4401.43	4408.76	0.002537	7.02	2896.14	1041.60	0.35
Meadow Valley Wa	MVW-Down	8474.41		Bridge									
Meadow Valley Wa	MVW-Down	8440.11	2-Year	312.00	4390.01	4392.81	4391.66	4392.90	0.003756	2.46	127.01	68.76	0.32
Meadow Valley Wa	MVW-Down	8440.11	5-Year	1210.00	4390.01	4395.37	4393.09	4395.60	0.003275	3.85	314.27	76.96	0.34
Meadow Valley Wa	MVW-Down	8440.11	10-Year	2430.00	4390.01	4397.64	4394.37	4398.01	0.003320	4.88	497.71	85.38	0.36
Meadow Valley Wa	MVW-Down	8440.11	25-Year	5050.00	4390.01	4400.98	4396.50	4401.59	0.003521	6.27	805.02	98.03	0.39
Meadow Valley Wa	MVW-Down	8440.11	50-Year	8050.00	4390.01	4403.71	4398.42	4404.56	0.003859	7.40	1088.29	110.44	0.42
Meadow Valley Wa	MVW-Down	8440.11	100-year	12200.00	4390.01	4406.29	4400.59	4407.49	0.004546	8.79	1387.44	122.55	0.46
Meadow Valley Wa	MVW-Down	8340.40*	2-Year	312.00	4389.55	4392.43	4391.29	4392.53	0.003687	2.48	125.62	66.10	0.32
Meadow Valley Wa	MVW-Down	8340.40*	5-Year	1210.00	4389.55	4395.04	4392.74	4395.27	0.003317	3.91	309.73	75.12	0.34
Meadow Valley Wa	MVW-Down	8340.40*	10-Year	2430.00	4389.55	4397.29	4394.07	4397.67	0.003440	4.97	488.52	83.98	0.36
Meadow Valley Wa	MVW-Down	8340.40*	25-Year	5050.00	4389.55	4400.60	4396.21	4401.23	0.003692	6.40	788.91	96.93	0.40
Meadow Valley Wa	MVW-Down	8340.40*	50-Year	8050.00	4389.55	4403.27	4398.16	4404.16	0.004049	7.57	1064.05	108.53	0.43
Meadow Valley Wa	MVW-Down	8340.40*	100-year	12200.00	4389.55	4405.72	4400.36	4407.01	0.004963	9.08	1343.71	121.25	0.48
Meadow Valley Wa	MVW-Down	8240.70*	2-Year	312.00	4389.09	4392.07	4390.96	4392.16	0.003616	2.51	124.26	63.52	0.32
Meadow Valley Wa	MVW-Down	8240.70*	5-Year	1210.00	4389.09	4394.69	4392.38	4394.94	0.003410	3.97	304.40	73.66	0.34
Meadow Valley Wa	MVW-Down	8240.70*	10-Year	2430.00	4389.09	4396.91	4393.74	4397.32	0.003622	5.08	477.98	82.98	0.37
Meadow Valley Wa	MVW-Down	8240.70*	25-Year	5050.00	4389.09	4400.19	4395.94	4400.85	0.003908	6.54	771.86	96.15	0.41
Meadow Valley Wa	MVW-Down	8240.70*	50-Year	8050.00	4389.09	4402.80	4397.84	4403.74	0.004284	7.76	1036.77	106.31	0.44
Meadow Valley Wa	MVW-Down	8240.70*	100-year	12200.00	4389.09	4405.09	4400.13	4406.47	0.005519	9.45	1291.58	119.24	0.51
Meadow Valley Wa	MVW-Down	8140.99*	2-Year	312.00	4388.63	4391.71	4390.54	4391.81	0.003531	2.53	123.12	61.07	0.31
Meadow Valley Wa	MVW-Down	8140.99*	5-Year	1210.00	4388.63	4394.34	4392.02	4394.59	0.003536	4.05	298.43	72.24	0.35
Meadow Valley Wa	MVW-Down	8140.99*	10-Year	2430.00	4388.63	4396.52	4393.40	4396.94	0.003859	5.21	466.68	82.26	0.39
Meadow Valley Wa	MVW-Down	8140.99*	25-Year	5050.00	4388.63	4399.75	4395.63	4400.45	0.004129	6.71	753.04	94.36	0.42
Meadow Valley Wa	MVW-Down	8140.99*	50-Year	8050.00	4388.63	4402.30	4397.66	4403.29	0.004587	8.01	1005.41	103.72	0.45
Meadow Valley Wa	MVW-Down	8140.99*	100-year	12200.00	4388.63	4404.34	4399.84	4405.87	0.006281	9.94	1227.60	118.43	0.54
Meadow Valley Wa	MVW-Down	8041.29*	2-Year	312.00	4388.18	4391.36	4390.14	4391.46	0.003450	2.56	122.07	58.80	0.31

HEC-RAS Plan: Cliente Exis (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Meadow Valley Wa	MVW-Down	8041.29*	5-Year	1210.00	4388.18	4393.96	4391.68	4394.23	0.003727	4.15	291.36	70.93	0.36
Meadow Valley Wa	MVW-Down	8041.29*	10-Year	2430.00	4388.18	4396.09	4393.11	4396.54	0.004178	5.35	454.41	81.98	0.40
Meadow Valley Wa	MVW-Down	8041.29*	25-Year	5050.00	4388.18	4399.28	4395.40	4400.02	0.004403	6.90	731.63	92.15	0.43
Meadow Valley Wa	MVW-Down	8041.29*	50-Year	8050.00	4388.18	4401.73	4397.36	4402.81	0.005005	8.31	968.68	100.85	0.47
Meadow Valley Wa	MVW-Down	8041.29*	100-year	12200.00	4388.18	4404.64	4399.56	4405.17	0.002830	6.80	3467.19	1712.16	0.36
Meadow Valley Wa	MVW-Down	7742.17	2-Year	312.00	4386.80	4390.28	4388.87	4390.39	0.003706	2.69	115.98	54.60	0.33
Meadow Valley Wa	MVW-Down	7742.17	5-Year	1210.00	4386.80	4392.56	4390.69	4392.90	0.005349	4.67	259.19	69.64	0.43
Meadow Valley Wa	MVW-Down	7742.17	10-Year	2430.00	4386.80	4394.49	4392.20	4395.07	0.005781	6.08	399.70	75.57	0.47
Meadow Valley Wa	MVW-Down	7742.17	25-Year	5050.00	4386.80	4397.45	4394.41	4398.43	0.006278	7.97	633.88	83.31	0.51
Meadow Valley Wa	MVW-Down	7742.17	50-Year	8050.00	4386.80	4399.17	4396.37	4400.81	0.008692	10.30	781.50	88.47	0.61
Meadow Valley Wa	MVW-Down	7742.17	100-year	12200.00	4386.80	4400.79	4398.71	4403.40	0.012474	13.00	991.53	297.52	0.74
Meadow Valley Wa	MVW-Down	7728.26		Bridge									
Meadow Valley Wa	MVW-Down	7714.35	2-Year	312.00	4386.70	4390.16	4388.88	4390.27	0.004833	2.75	113.41	63.30	0.36
Meadow Valley Wa	MVW-Down	7714.35	5-Year	1210.00	4386.70	4392.42	4390.67	4392.72	0.005013	4.39	275.66	77.84	0.41
Meadow Valley Wa	MVW-Down	7714.35	10-Year	2430.00	4386.70	4394.38	4391.98	4394.86	0.005027	5.57	436.16	85.46	0.43
Meadow Valley Wa	MVW-Down	7714.35	25-Year	5050.00	4386.70	4397.39	4394.03	4398.18	0.005078	7.14	707.30	94.72	0.46
Meadow Valley Wa	MVW-Down	7714.35	50-Year	8050.00	4386.70	4399.11	4395.90	4400.43	0.006981	9.19	875.98	101.51	0.55
Meadow Valley Wa	MVW-Down	7714.35	100-year	12200.00	4386.70	4400.33	4398.04	4402.63	0.011162	12.16	1002.91	108.40	0.71
Meadow Valley Wa	MVW-Down	7539.37	2-Year	312.00	4386.33	4389.35	4388.18	4389.46	0.004433	2.73	114.38	60.56	0.35
Meadow Valley Wa	MVW-Down	7539.37	5-Year	1210.00	4386.33	4391.39	4389.80	4391.75	0.006119	4.82	251.14	71.42	0.45
Meadow Valley Wa	MVW-Down	7539.37	10-Year	2430.00	4386.33	4393.24	4391.16	4393.84	0.006681	6.22	390.82	80.26	0.50
Meadow Valley Wa	MVW-Down	7539.37	25-Year	5050.00	4386.33	4396.30	4393.38	4397.19	0.006280	7.56	667.56	96.57	0.51
Meadow Valley Wa	MVW-Down	7539.37	50-Year	8050.00	4386.33	4396.48	4395.33	4398.63	0.014757	11.75	685.30	97.17	0.78
Meadow Valley Wa	MVW-Down	7539.37	100-year	12200.00	4386.33	4400.91	4397.34	4401.26	0.002371	6.08	4076.62	1566.52	0.33
Meadow Valley Wa	MVW-Down	7131.16	2-Year	312.00	4383.85	4386.55	4385.95	4386.73	0.011246	3.41	91.39	69.54	0.53
Meadow Valley Wa	MVW-Down	7131.16	5-Year	1210.00	4383.85	4388.64	4387.38	4389.02	0.007321	4.92	245.74	77.20	0.49
Meadow Valley Wa	MVW-Down	7131.16	10-Year	2430.00	4383.85	4390.75	4388.62	4391.29	0.005791	5.86	414.71	82.91	0.46
Meadow Valley Wa	MVW-Down	7131.16	25-Year	5050.00	4383.85	4394.08	4390.65	4394.87	0.005022	7.15	706.10	92.39	0.46
Meadow Valley Wa	MVW-Down	7131.16	50-Year	8050.00	4383.85	4396.70	4392.49	4396.83	0.001207	3.94	4174.82	1813.37	0.23
Meadow Valley Wa	MVW-Down	7131.16	100-year	12200.00	4383.85	4394.67	4394.67	4398.66	0.023534	16.03	761.07	94.31	0.99
Meadow Valley Wa	MVW-Down	6799.08	2-Year	312.00	4380.18	4384.09	4382.93	4384.22	0.005356	2.98	104.63	55.02	0.38
Meadow Valley Wa	MVW-Down	6799.08	5-Year	1210.00	4380.18	4386.92	4384.67	4387.21	0.004099	4.30	281.11	68.95	0.38
Meadow Valley Wa	MVW-Down	6799.08	10-Year	2430.00	4380.18	4389.19	4386.17	4389.65	0.004144	5.43	447.40	77.23	0.40
Meadow Valley Wa	MVW-Down	6799.08	25-Year	5050.00	4380.18	4392.56	4388.47	4393.32	0.004331	6.97	725.01	87.68	0.43
Meadow Valley Wa	MVW-Down	6799.08	50-Year	8050.00	4380.18	4395.02	4390.46	4395.99	0.005743	8.05	1121.24	252.76	0.49
Meadow Valley Wa	MVW-Down	6799.08	100-year	12200.00	4380.18	4396.10	4392.81	4396.15	0.000702	2.88	7868.96	2215.76	0.17
Meadow Valley Wa	MVW-Down	6620.54	2-Year	312.00	4379.24	4383.09	4381.87	4383.26	0.005356	3.30	94.55	42.26	0.39
Meadow Valley Wa	MVW-Down	6620.54	5-Year	1210.00	4379.24	4386.08	4383.88	4386.41	0.004886	4.62	261.94	65.42	0.41
Meadow Valley Wa	MVW-Down	6620.54	10-Year	2430.00	4379.24	4388.30	4385.57	4388.84	0.004912	5.88	413.43	70.89	0.43
Meadow Valley Wa	MVW-Down	6620.54	25-Year	5050.00	4379.24	4391.50	4387.86	4392.43	0.005498	7.73	653.29	79.18	0.47
Meadow Valley Wa	MVW-Down	6620.54	50-Year	8050.00	4379.24	4393.00	4389.95	4394.67	0.008694	10.38	775.51	84.82	0.61
Meadow Valley Wa	MVW-Down	6620.54	100-year	12200.00	4379.24	4396.01	4392.41	4396.05	0.000444	2.62	9003.88	2164.70	0.14
Meadow Valley Wa	MVW-Down	6485.08	2-Year	312.00	4378.89	4382.56	4380.90	4382.68	0.003387	2.80	111.52	45.86	0.32
Meadow Valley Wa	MVW-Down	6485.08	5-Year	1210.00	4378.89	4385.52	4382.97	4385.81	0.003893	4.33	279.73	65.62	0.37
Meadow Valley Wa	MVW-Down	6485.08	10-Year	2430.00	4378.89	4387.71	4384.70	4388.20	0.004312	5.64	430.69	71.93	0.41
Meadow Valley Wa	MVW-Down	6485.08	25-Year	5050.00	4378.89	4390.83	4387.06	4391.70	0.005004	7.53	692.41	130.53	0.46
Meadow Valley Wa	MVW-Down	6485.08	50-Year	8050.00	4378.89	4391.84	4389.15	4393.49	0.008678	10.45	843.52	157.87	0.61
Meadow Valley Wa	MVW-Down	6485.08	100-year	12200.00	4378.89	4392.47	4392.47	4395.56	0.015936	14.46	944.06	162.70	0.83
Meadow Valley Wa	MVW-Down	6252.93	2-Year	312.00	4377.91	4381.59	4380.16	4381.75	0.004727	3.22	97.03	41.67	0.37
Meadow Valley Wa	MVW-Down	6252.93	5-Year	1210.00	4377.91	4384.31	4382.35	4384.70	0.005922	4.95	244.29	64.66	0.45
Meadow Valley Wa	MVW-Down	6252.93	10-Year	2430.00	4377.91	4386.41	4384.06	4387.02	0.005973	6.27	387.80	71.45	0.47
Meadow Valley Wa	MVW-Down	6252.93	25-Year	5050.00	4377.91	4389.48	4386.37	4390.43	0.005947	7.93	749.38	424.60	0.50
Meadow Valley Wa	MVW-Down	6252.93	50-Year	8050.00	4377.91	4390.46	4388.60	4391.51	0.006979	9.18	1655.68	1242.04	0.55
Meadow Valley Wa	MVW-Down	6252.93	100-year	12200.00	4377.91	4391.44	4391.44	4392.15	0.005662	8.78	3158.56	1659.40	0.50
Meadow Valley Wa	MVW-Down	5972.18	2-Year	312.00	4377.09	4380.33	4378.99	4380.46	0.004439	2.91	107.09	51.06	0.35
Meadow Valley Wa	MVW-Down	5972.18	5-Year	1210.00	4377.09	4382.33	4380.82	4382.80	0.007736	5.49	220.43	60.94	0.51
Meadow Valley Wa	MVW-Down	5972.18	10-Year	2430.00	4377.09	4384.28	4382.36	4385.03	0.008404	6.96	348.90	71.30	0.56
Meadow Valley Wa	MVW-Down	5972.18	25-Year	5050.00	4377.09	4387.41	4384.87	4388.52	0.007766	8.45	611.86	153.79	0.56
Meadow Valley Wa	MVW-Down	5972.18	50-Year	8050.00	4377.09	4389.75	4386.90	4390.05	0.003005	5.69	2999.20	1759.96	0.36
Meadow Valley Wa	MVW-Down	5972.18	100-year	12200.00	4377.09	4390.89	4389.68	4391.07	0.001956	5.02	5071.52	1849.92	0.29
Meadow Valley Wa	MVW-Down	5687.36	2-Year	312.00	4375.70	4379.15	4377.72	4379.22	0.004126	2.10	148.77	111.05	0.32
Meadow Valley Wa	MVW-Down	5687.36	5-Year	1210.00	4375.70	4381.50	4379.37	4381.63	0.002188	2.89	419.10	119.06	0.27
Meadow Valley Wa	MVW-Down	5687.36	10-Year	2430.00	4375.70	4383.69	4380.27	4383.88	0.001859	3.53	688.78	127.16	0.27
Meadow Valley Wa	MVW-Down	5687.36	25-Year	5050.00	4375.70	4387.11	4381.85	4387.39	0.001645	4.30	1351.94	649.09	0.27
Meadow Valley Wa	MVW-Down	5687.36	50-Year	8050.00	4375.70	4389.56	4383.27	4389.65	0.000630	3.00	5167.06	1862.93	0.17
Meadow Valley Wa	MVW-Down	5687.36	100-year	12200.00	4375.70	4390.80	4384.93	4390.84	0.000321	2.32	10163.47	2479.70	0.12
Meadow Valley Wa	MVW-Down	5551.77*	2-Year	312.00	4375.38	4378.58	4377.38	4378.68	0.003843	2.52	123.96	66.78	0.33
Meadow Valley Wa	MVW-Down	5551.77*	5-Year	1210.00	4375.38	4381.00	4378.93	4381.24	0.003805	3.90	309.92	85.09	0.36
Meadow Valley Wa	MVW-Down	5551.77*	10-Year	2430.00	4375.38	4383.17	4380.25	4383.52	0.003729	4.76	510.98	102.32	0.38
Meadow Valley Wa	MVW-Down	5551.77*	25-Year	5050.00	4375.38	4386.56	4382.25	4387.07	0.003144	5.70	886.38	117.86	0.37
Meadow Valley Wa	MVW-Down	5551.77*	50-Year	8050.00	4375.38	4389.55	4384.03	4389.57	0.000282	1.94	8136.78	2429.70	0.11
Meadow Valley Wa	MVW-Down	5551.77*	100-year	12200.00	4375.38	4390.77	4385.93	4390.80	0.000260	2.02	11120.84	2451.47	0.11
Meadow Valley Wa	MVW-Down	5484.68		Bridge									

HEC-RAS Plan: Cliente Exis (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Meadow Valley Wa	MVW-Down	5416.17	2-Year	312.00	4375.06	4377.91	4376.76	4378.03	0.004792	2.81	111.12	59.69	0.36
Meadow Valley Wa	MVW-Down	5416.17	5-Year	1210.00	4375.06	4380.33	4378.42	4380.65	0.004721	4.49	269.43	69.67	0.40
Meadow Valley Wa	MVW-Down	5416.17	10-Year	2430.00	4375.06	4382.41	4379.80	4382.93	0.004934	5.76	421.77	76.63	0.43
Meadow Valley Wa	MVW-Down	5416.17	25-Year	5050.00	4375.06	4385.64	4382.03	4386.49	0.005130	7.38	684.68	87.00	0.46
Meadow Valley Wa	MVW-Down	5416.17	50-Year	8050.00	4375.06	4387.71	4384.04	4389.02	0.006699	9.19	875.48	97.41	0.54
Meadow Valley Wa	MVW-Down	5416.17	100-year	12200.00	4375.06	4390.74	4386.38	4390.76	0.000202	1.74	12172.57	2423.79	0.10
Meadow Valley Wa	MVW-Down	5326.25	2-Year	312.00	4374.99	4377.54	4376.39	4377.64	0.003732	2.61	119.50	59.15	0.32
Meadow Valley Wa	MVW-Down	5326.25	5-Year	1210.00	4374.99	4379.92	4377.91	4380.23	0.004527	4.47	270.90	67.71	0.39
Meadow Valley Wa	MVW-Down	5326.25	10-Year	2430.00	4374.99	4381.93	4379.32	4382.48	0.005043	5.91	411.15	71.56	0.43
Meadow Valley Wa	MVW-Down	5326.25	25-Year	5050.00	4374.99	4385.03	4381.55	4385.99	0.005758	7.87	641.99	78.18	0.48
Meadow Valley Wa	MVW-Down	5326.25	50-Year	8050.00	4374.99	4387.08	4383.61	4388.41	0.006820	9.47	961.09	181.16	0.54
Meadow Valley Wa	MVW-Down	5326.25	100-year	12200.00	4374.99	4388.67	4386.09	4390.52	0.008417	11.47	1253.55	185.92	0.61
Meadow Valley Wa	MVW-Down	5243.44	2-Year	312.00	4374.76	4377.24	4376.06	4377.34	0.003488	2.56	121.95	59.23	0.31
Meadow Valley Wa	MVW-Down	5243.44	5-Year	1210.00	4374.76	4379.53	4377.56	4379.85	0.004675	4.50	268.74	68.71	0.40
Meadow Valley Wa	MVW-Down	5243.44	10-Year	2430.00	4374.76	4381.50	4378.99	4382.04	0.005351	5.91	411.28	76.66	0.45
Meadow Valley Wa	MVW-Down	5243.44	25-Year	5050.00	4374.76	4384.58	4381.27	4385.40	0.007669	7.22	699.46	128.34	0.54
Meadow Valley Wa	MVW-Down	5243.44	50-Year	8050.00	4374.76	4386.91	4383.64	4387.75	0.005784	7.48	1156.58	204.76	0.49
Meadow Valley Wa	MVW-Down	5243.44	100-year	12200.00	4374.76	4388.57	4386.12	4389.71	0.006305	8.85	1500.46	210.15	0.53
Meadow Valley Wa	MVW-Down	4905.68	2-Year	312.00	4373.30	4375.65	4374.84	4375.78	0.006427	2.92	107.00	68.02	0.41
Meadow Valley Wa	MVW-Down	4905.68	5-Year	1210.00	4373.30	4377.98	4376.27	4378.23	0.004778	4.05	298.40	92.00	0.40
Meadow Valley Wa	MVW-Down	4905.68	10-Year	2430.00	4373.30	4380.08	4377.50	4380.44	0.003974	4.79	507.33	105.45	0.38
Meadow Valley Wa	MVW-Down	4905.68	25-Year	5050.00	4373.30	4382.93	4379.38	4383.52	0.003961	6.15	821.31	115.83	0.41
Meadow Valley Wa	MVW-Down	4905.68	50-Year	8050.00	4373.30	4385.29	4380.99	4386.03	0.004359	6.91	1235.96	253.99	0.44
Meadow Valley Wa	MVW-Down	4905.68	100-year	12200.00	4373.30	4385.10	4382.89	4386.89	0.010904	10.79	1187.98	248.68	0.69
Meadow Valley Wa	MVW-Down	4516.37	2-Year	312.00	4369.36	4373.20	4372.23	4373.36	0.006027	3.20	97.64	50.27	0.40
Meadow Valley Wa	MVW-Down	4516.37	5-Year	1210.00	4369.36	4375.67	4373.93	4376.08	0.006372	5.14	235.29	61.00	0.46
Meadow Valley Wa	MVW-Down	4516.37	10-Year	2430.00	4369.36	4377.46	4375.49	4378.15	0.009226	6.66	364.79	85.15	0.57
Meadow Valley Wa	MVW-Down	4516.37	25-Year	5050.00	4369.36	4379.90	4378.01	4381.04	0.011119	8.57	589.28	108.39	0.65
Meadow Valley Wa	MVW-Down	4516.37	50-Year	8050.00	4369.36	4382.33	4380.13	4383.15	0.015038	7.44	1165.64	422.30	0.71
Meadow Valley Wa	MVW-Down	4516.37	100-year	12200.00	4369.36	4382.83	4382.39	4383.13	0.006843	5.48	3354.19	1616.67	0.49
Meadow Valley Wa	MVW-Down	4193.80*	2-Year	312.00	4367.99	4371.45	4370.29	4371.57	0.005035	2.86	108.95	59.02	0.37
Meadow Valley Wa	MVW-Down	4193.80*	5-Year	1210.00	4367.99	4373.62	4371.97	4373.90	0.006925	4.30	281.41	105.24	0.46
Meadow Valley Wa	MVW-Down	4193.80*	10-Year	2430.00	4367.99	4375.11	4373.50	4375.58	0.006647	5.48	443.58	111.14	0.48
Meadow Valley Wa	MVW-Down	4193.80*	25-Year	5050.00	4367.99	4377.40	4375.15	4378.20	0.006708	7.14	707.32	118.78	0.52
Meadow Valley Wa	MVW-Down	4193.80*	50-Year	8050.00	4367.99	4378.61	4376.65	4379.99	0.010282	9.43	853.76	129.83	0.65
Meadow Valley Wa	MVW-Down	4193.80*	100-year	12200.00	4367.99	4380.77	4380.27	4381.17	0.005388	6.08	3157.12	1342.02	0.46
Meadow Valley Wa	MVW-Down	4179.4		Bridge									
Meadow Valley Wa	MVW-Down	4164.47	2-Year	312.00	4367.87	4371.26	4370.11	4371.39	0.007488	2.88	108.33	61.05	0.38
Meadow Valley Wa	MVW-Down	4164.47	5-Year	1210.00	4367.87	4373.37	4371.91	4373.65	0.009563	4.25	284.44	107.12	0.46
Meadow Valley Wa	MVW-Down	4164.47	10-Year	2430.00	4367.87	4374.88	4373.23	4375.33	0.008956	5.39	450.69	112.45	0.47
Meadow Valley Wa	MVW-Down	4164.47	25-Year	5050.00	4367.87	4377.17	4374.86	4377.94	0.009070	7.05	716.76	119.67	0.51
Meadow Valley Wa	MVW-Down	4164.47	50-Year	8050.00	4367.87	4378.12	4376.35	4379.57	0.014623	9.68	831.72	122.99	0.66
Meadow Valley Wa	MVW-Down	4164.47	100-year	12200.00	4367.87	4380.19	4378.13	4380.74	0.009715	6.99	2631.80	1302.12	0.52
Meadow Valley Wa	MVW-Down	3860.88	2-Year	312.00	4365.65	4369.72	4368.23	4369.77	0.003883	1.81	172.73	119.09	0.26
Meadow Valley Wa	MVW-Down	3860.88	5-Year	1210.00	4365.65	4371.14	4369.75	4371.33	0.006092	3.45	351.08	128.30	0.37
Meadow Valley Wa	MVW-Down	3860.88	10-Year	2430.00	4365.65	4373.50	4370.56	4373.71	0.003290	3.66	663.33	138.43	0.30
Meadow Valley Wa	MVW-Down	3860.88	25-Year	5050.00	4365.65	4375.40	4372.06	4375.84	0.004991	5.35	944.11	152.11	0.38
Meadow Valley Wa	MVW-Down	3860.88	50-Year	8050.00	4365.65	4378.89	4373.45	4378.91	0.000242	1.45	8916.53	2604.19	0.09
Meadow Valley Wa	MVW-Down	3860.88	100-year	12200.00	4365.65	4380.42	4375.07	4380.43	0.000150	1.28	15175.32	3321.55	0.07
Meadow Valley Wa	MVW-Down	3200.70	2-Year	312.00	4361.79	4364.95	4364.41	4365.11	0.016508	3.21	97.13	83.86	0.53
Meadow Valley Wa	MVW-Down	3200.70	5-Year	1210.00	4361.79	4367.54	4365.70	4367.72	0.004940	3.39	357.03	114.54	0.34
Meadow Valley Wa	MVW-Down	3200.70	10-Year	2430.00	4361.79	4372.59	4366.82	4372.69	0.000850	2.46	988.23	135.13	0.16
Meadow Valley Wa	MVW-Down	3200.70	25-Year	5050.00	4361.79	4372.68	4368.40	4373.08	0.003542	5.05	1000.12	135.45	0.33
Meadow Valley Wa	MVW-Down	3200.70	50-Year	8050.00	4361.79	4378.79	4369.86	4378.80	0.000120	1.27	9881.77	1921.96	0.07
Meadow Valley Wa	MVW-Down	3200.70	100-year	12200.00	4361.79	4380.32	4371.56	4380.34	0.000125	1.40	12836.47	1924.97	0.07
Meadow Valley Wa	MVW-Down	2294.13	2-Year	312.00	4359.71	4362.75	4360.74	4362.78	0.000978	1.32	236.93	93.94	0.15
Meadow Valley Wa	MVW-Down	2294.13	5-Year	1210.00	4359.71	4366.12	4361.90	4366.18	0.000821	1.86	650.63	133.53	0.15
Meadow Valley Wa	MVW-Down	2294.13	10-Year	2430.00	4359.71	4372.26	4363.04	4372.30	0.000239	1.58	1539.09	157.52	0.09
Meadow Valley Wa	MVW-Down	2294.13	25-Year	5050.00	4359.71	4370.58	4364.75	4370.82	0.001777	3.94	1281.31	150.15	0.24
Meadow Valley Wa	MVW-Down	2294.13	50-Year	8050.00	4359.71	4378.69	4366.10	4378.70	0.000091	1.31	8817.84	1260.54	0.06
Meadow Valley Wa	MVW-Down	2294.13	100-year	12200.00	4359.71	4380.20	4367.71	4380.23	0.000120	1.60	10807.58	1382.58	0.07
Meadow Valley Wa	MVW-Down	2232.4		Bridge									
Meadow Valley Wa	MVW-Down	2185.97	2-Year	312.00	4359.73	4362.57	4361.06	4362.60	0.001472	1.32	237.04	128.10	0.17
Meadow Valley Wa	MVW-Down	2185.97	5-Year	1210.00	4359.73	4364.32	4362.12	4364.42	0.002515	2.57	471.18	138.98	0.25
Meadow Valley Wa	MVW-Down	2185.97	10-Year	2430.00	4359.73	4365.75	4362.99	4365.95	0.003294	3.60	675.44	146.59	0.30
Meadow Valley Wa	MVW-Down	2185.97	25-Year	5050.00	4359.73	4368.09	4364.41	4368.46	0.003851	4.89	1032.85	158.28	0.34
Meadow Valley Wa	MVW-Down	2185.97	50-Year	8050.00	4359.73	4369.34	4365.71	4370.00	0.005716	6.52	1234.69	164.86	0.42
Meadow Valley Wa	MVW-Down	2185.97	100-year	12200.00	4359.73	4371.17	4367.24	4372.14	0.006660	7.91	1542.34	172.11	0.47
Meadow Valley Wa	MVW-Down	1821.41	2-Year	312.00	4358.63	4361.82	4360.86	4361.85	0.003060	1.42	220.40	184.72	0.23
Meadow Valley Wa	MVW-Down	1821.41	5-Year	1210.00	4358.63	4363.35	4361.73	4363.43	0.002943	2.26	534.30	214.78	0.25
Meadow Valley Wa	MVW-Down	1821.41	10-Year	2430.00	4358.63	4364.65	4362.41	4364.79	0.002964	2.96	820.63	221.21	0.27
Meadow Valley Wa	MVW-Down	1821.41	25-Year	5050.00	4358.63	4367.09	4363.47	4367.30	0.002494	3.69	1369.58	232.25	0.27
Meadow Valley Wa	MVW-Down	1821.41	50-Year	8050.00	4358.63	4367.51	4364.41	4367.98	0.005085	5.48	1469.43	234.60	0.39
Meadow Valley Wa	MVW-Down	1821.41	100-year	12200.00	4358.63	4369.19	4365.54	4369.85	0.005494	6.54	1866.25	240.70	0.41

HEC-RAS Plan: Cliente Exis (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Meadow Valley Wa	MVW-Down	1123.12	2-Year	312.00	4355.57	4358.50	4357.62	4358.59	0.007996	2.38	130.96	102.73	0.37
Meadow Valley Wa	MVW-Down	1123.12	5-Year	1210.00	4355.57	4360.03	4358.95	4360.22	0.008016	3.53	342.44	149.04	0.41
Meadow Valley Wa	MVW-Down	1123.12	10-Year	2430.00	4355.57	4361.24	4359.75	4361.58	0.008003	4.63	525.40	151.55	0.44
Meadow Valley Wa	MVW-Down	1123.12	25-Year	5050.00	4355.57	4361.05	4361.05	4362.66	0.041697	10.18	495.91	151.15	0.99
Meadow Valley Wa	MVW-Down	1123.12	50-Year	8050.00	4355.57	4363.05	4362.26	4363.58	0.007991	5.93	1375.70	271.43	0.46
Meadow Valley Wa	MVW-Down	1123.12	100-year	12200.00	4355.57	4364.54	4362.58	4365.26	0.008002	6.91	1785.72	278.24	0.48
Clover Creek	Clover Creek	7623.96	2-Year	130.00	4430.95	4431.78		4431.83	0.008774	1.88	69.26	146.31	0.48
Clover Creek	Clover Creek	7623.96	5-Year	622.00	4430.95	4432.30	4432.14	4432.52	0.017285	3.75	165.88	206.27	0.74
Clover Creek	Clover Creek	7623.96	10-Year	1090.00	4430.95	4432.74	4432.44	4433.00	0.016043	4.13	264.19	269.16	0.73
Clover Creek	Clover Creek	7623.96	25-Year	2414.00	4430.95	4433.52		4433.90	0.014413	4.95	487.57	348.46	0.74
Clover Creek	Clover Creek	7623.96	50-Year	3710.00	4430.95	4434.14		4434.48	0.013050	4.70	789.41	566.39	0.70
Clover Creek	Clover Creek	7623.96	100-year	4700.00	4430.95	4434.41		4434.80	0.011652	4.97	944.84	571.79	0.68
Clover Creek	Clover Creek	7111.13	2-Year	130.00	4426.91	4428.50		4428.53	0.004932	1.51	85.87	162.11	0.37
Clover Creek	Clover Creek	7111.13	5-Year	622.00	4426.91	4429.50		4429.55	0.002810	1.74	357.42	359.22	0.31
Clover Creek	Clover Creek	7111.13	10-Year	1090.00	4426.91	4429.97		4430.03	0.002875	2.03	538.09	438.06	0.32
Clover Creek	Clover Creek	7111.13	25-Year	2414.00	4426.91	4430.72		4430.83	0.003130	2.71	889.25	497.02	0.36
Clover Creek	Clover Creek	7111.13	50-Year	3710.00	4426.91	4431.21		4431.37	0.003390	3.26	1136.82	511.62	0.39
Clover Creek	Clover Creek	7111.13	100-year	4700.00	4426.91	4431.54		4431.74	0.003505	3.59	1310.56	524.71	0.40
Clover Creek	Clover Creek	6409.01	2-Year	130.00	4424.24	4425.28	4424.89	4425.33	0.004253	1.70	76.54	108.85	0.36
Clover Creek	Clover Creek	6409.01	5-Year	622.00	4424.24	4426.20		4426.32	0.008707	2.78	223.75	260.22	0.53
Clover Creek	Clover Creek	6409.01	10-Year	1090.00	4424.24	4426.60		4426.74	0.008891	3.02	360.39	375.26	0.54
Clover Creek	Clover Creek	6409.01	25-Year	2414.00	4424.24	4427.32		4427.54	0.007686	3.77	640.90	430.12	0.54
Clover Creek	Clover Creek	6409.01	50-Year	3710.00	4424.24	4427.87		4428.14	0.006579	4.21	881.68	445.54	0.53
Clover Creek	Clover Creek	6409.01	100-year	4700.00	4424.24	4428.22		4428.54	0.006127	4.51	1041.54	449.04	0.52
Clover Creek	Clover Creek	5577.60	2-Year	130.00	4420.11	4421.53	4421.20	4421.55	0.004822	1.27	102.02	245.93	0.35
Clover Creek	Clover Creek	5577.60	5-Year	622.00	4420.11	4422.30	4421.71	4422.35	0.002995	1.79	347.37	351.53	0.32
Clover Creek	Clover Creek	5577.60	10-Year	1090.00	4420.11	4422.73	4421.95	4422.80	0.002925	2.14	509.27	387.36	0.33
Clover Creek	Clover Creek	5577.60	25-Year	2414.00	4420.11	4423.51	4422.46	4423.64	0.003124	2.96	816.38	401.34	0.37
Clover Creek	Clover Creek	5577.60	50-Year	3710.00	4420.11	4424.05	4422.84	4424.25	0.003469	3.57	1038.93	416.04	0.40
Clover Creek	Clover Creek	5577.60	100-year	4700.00	4420.11	4424.40	4423.09	4424.65	0.003668	3.96	1185.97	423.45	0.42
Clover Creek	Clover Creek	4897.08	2-Year	130.00	4415.62	4417.36	4416.83	4417.49	0.007541	2.91	44.65	43.39	0.51
Clover Creek	Clover Creek	4897.08	5-Year	622.00	4415.62	4418.57	4418.21	4418.75	0.011532	3.37	184.65	198.86	0.62
Clover Creek	Clover Creek	4897.08	10-Year	1090.00	4415.62	4419.00	4418.65	4419.23	0.011768	3.86	282.02	250.87	0.64
Clover Creek	Clover Creek	4897.08	25-Year	2414.00	4415.62	4419.80	4419.42	4420.08	0.010362	4.29	562.96	389.65	0.63
Clover Creek	Clover Creek	4897.08	50-Year	3710.00	4415.62	4420.33	4419.77	4420.69	0.008741	4.80	772.70	400.52	0.61
Clover Creek	Clover Creek	4897.08	100-year	4700.00	4415.62	4420.70	4420.02	4421.10	0.007874	5.11	921.23	404.23	0.59
Clover Creek	Clover Creek	4446.53	2-Year	130.00	4413.37	4415.73	4414.92	4415.75	0.002279	1.16	112.34	177.90	0.26
Clover Creek	Clover Creek	4446.53	5-Year	622.00	4413.37	4416.71	4415.83	4416.75	0.002261	1.60	389.69	379.12	0.28
Clover Creek	Clover Creek	4446.53	10-Year	1090.00	4413.37	4417.13	4416.20	4417.19	0.002296	1.98	551.57	393.83	0.29
Clover Creek	Clover Creek	4446.53	25-Year	2414.00	4413.37	4417.99	4416.77	4418.10	0.002331	2.70	892.91	402.86	0.32
Clover Creek	Clover Creek	4446.53	50-Year	3710.00	4413.37	4418.66	4417.13	4418.81	0.002320	3.18	1165.72	410.13	0.33
Clover Creek	Clover Creek	4446.53	100-year	4700.00	4413.37	4419.11	4417.37	4419.30	0.002296	3.47	1352.61	413.81	0.34
Clover Creek	Clover Creek	4084.21	2-Year	130.00	4411.96	4414.16	4413.37	4414.26	0.009608	2.47	52.69	78.21	0.53
Clover Creek	Clover Creek	4084.21	5-Year	622.00	4411.96	4415.31	4414.78	4415.41	0.006869	2.62	237.57	252.19	0.48
Clover Creek	Clover Creek	4084.21	10-Year	1090.00	4411.96	4415.79	4415.17	4415.92	0.005839	2.94	370.53	292.38	0.46
Clover Creek	Clover Creek	4084.21	25-Year	2414.00	4411.96	4416.58	4415.81	4416.83	0.005726	4.00	603.47	295.42	0.49
Clover Creek	Clover Creek	4084.21	50-Year	3710.00	4411.96	4417.22	4416.25	4417.56	0.005457	4.67	794.78	297.36	0.50
Clover Creek	Clover Creek	4084.21	100-year	4700.00	4411.96	4417.68	4416.50	4418.08	0.005221	5.05	930.28	298.77	0.50
Clover Creek	Clover Creek	3719.14	2-Year	130.00	4409.83	4411.67	4411.24	4411.73	0.005209	1.95	66.80	90.20	0.40
Clover Creek	Clover Creek	3719.14	5-Year	622.00	4409.83	4412.79	4412.11	4412.94	0.006676	3.04	204.86	170.83	0.49
Clover Creek	Clover Creek	3719.14	10-Year	1090.00	4409.83	4413.30	4412.63	4413.50	0.007518	3.60	303.16	214.41	0.53
Clover Creek	Clover Creek	3719.14	25-Year	2414.00	4409.83	4414.32	4413.49	4414.64	0.006230	4.54	531.34	229.57	0.53
Clover Creek	Clover Creek	3719.14	50-Year	3710.00	4409.83	4415.09	4414.02	4415.51	0.005768	5.22	711.14	235.52	0.53
Clover Creek	Clover Creek	3719.14	100-year	4700.00	4409.83	4415.60	4414.36	4416.09	0.005595	5.66	831.07	238.19	0.53
Clover Creek	Clover Creek	3404.10	2-Year	130.00	4408.55	4410.10		4410.14	0.004896	1.64	79.38	132.80	0.37
Clover Creek	Clover Creek	3404.10	5-Year	622.00	4408.55	4411.04		4411.15	0.004854	2.65	235.16	190.17	0.42
Clover Creek	Clover Creek	3404.10	10-Year	1090.00	4408.55	4411.65		4411.80	0.004014	3.08	353.60	196.94	0.41
Clover Creek	Clover Creek	3404.10	25-Year	2414.00	4408.55	4412.68		4412.97	0.004479	4.29	562.34	206.68	0.46
Clover Creek	Clover Creek	3404.10	50-Year	3710.00	4408.55	4413.46		4413.87	0.004732	5.10	727.32	214.84	0.49
Clover Creek	Clover Creek	3404.10	100-year	4700.00	4408.55	4413.94		4414.44	0.004965	5.67	829.54	216.80	0.51
Clover Creek	Clover Creek	3189.97	2-Year	130.00	4406.79	4408.18	4408.02	4408.34	0.017145	3.19	40.74	64.03	0.71
Clover Creek	Clover Creek	3189.97	5-Year	622.00	4406.79	4409.55		4409.79	0.008518	3.88	160.29	111.19	0.57
Clover Creek	Clover Creek	3189.97	10-Year	1090.00	4406.79	4410.44		4410.65	0.007416	3.68	296.05	200.32	0.53
Clover Creek	Clover Creek	3189.97	25-Year	2414.00	4406.79	4411.52		4411.85	0.006151	4.61	523.40	219.37	0.53
Clover Creek	Clover Creek	3189.97	50-Year	3710.00	4406.79	4412.33		4412.76	0.005604	5.26	705.51	226.22	0.52
Clover Creek	Clover Creek	3189.97	100-year	4700.00	4406.79	4412.49		4413.12	0.007671	6.34	741.38	227.21	0.62
Clover Creek	Clover Creek	2589.51	2-Year	130.00	4402.05	4404.48	4403.43	4404.56	0.003220	2.17	59.82	47.41	0.34
Clover Creek	Clover Creek	2589.51	5-Year	622.00	4402.05	4406.42	4404.99	4406.56	0.003660	2.97	209.27	114.35	0.39
Clover Creek	Clover Creek	2589.51	10-Year	1090.00	4402.05	4407.31	4405.91	4407.48	0.003920	3.24	338.32	185.92	0.41
Clover Creek	Clover Creek	2589.51	25-Year	2414.00	4402.05	4408.56	4407.14	4408.76	0.004284	3.62	703.60	373.51	0.43
Clover Creek	Clover Creek	2589.51	50-Year	3710.00	4402.05	4408.92		4409.25	0.006013	4.70	837.92	381.81	0.52
Clover Creek	Clover Creek	2589.51	100-year	4700.00	4402.05	4409.81		4410.07	0.003381	4.21	1189.43	401.05	0.41
Clover Creek	Clover Creek	2147.64	2-Year	130.00	4399.56	4400.79	4400.79	4401.25	0.031182	5.43	23.95	26.40	1.00
Clover Creek	Clover Creek	2147.64	5-Year	622.00	4399.56	4402.36	4402.36	4403.02	0.027907	6.48	95.95	74.62	1.01

HEC-RAS Plan: Cliente Exis (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Clover Creek	Clover Creek	2147.64	10-Year	1090.00	4399.56	4402.97	4402.97	4403.84	0.025034	7.51	146.02	88.88	1.00
Clover Creek	Clover Creek	2147.64	25-Year	2414.00	4399.56	4404.32	4404.32	4405.36	0.016292	8.47	324.19	169.22	0.88
Clover Creek	Clover Creek	2147.64	50-Year	3710.00	4399.56	4406.60		4406.85	0.004858	4.23	927.47	370.59	0.47
Clover Creek	Clover Creek	2147.64	100-year	4700.00	4399.56	4409.36		4409.45	0.000680	2.51	2044.43	423.61	0.20
Clover Creek	Clover Creek	1533.57	2-Year	130.00	4395.27	4396.76	4396.12	4396.80	0.002479	1.73	75.20	69.43	0.29
Clover Creek	Clover Creek	1533.57	5-Year	622.00	4395.27	4398.62	4397.06	4398.74	0.002153	2.86	217.44	84.33	0.31
Clover Creek	Clover Creek	1533.57	10-Year	1090.00	4395.27	4399.98	4397.67	4400.14	0.001824	3.16	345.12	101.81	0.30
Clover Creek	Clover Creek	1533.57	25-Year	2414.00	4395.27	4402.76	4399.05	4402.97	0.001382	3.61	669.29	131.15	0.28
Clover Creek	Clover Creek	1533.57	50-Year	3710.00	4395.27	4405.61	4400.06	4405.79	0.000854	3.42	1084.27	160.10	0.23
Clover Creek	Clover Creek	1533.57	100-year	4700.00	4395.27	4409.04	4400.69	4409.15	0.000370	2.67	1947.95	350.24	0.16
Clover Creek	Clover Creek	1479.44*	2-Year	130.00	4394.95	4396.53	4396.01	4396.61	0.005097	2.35	55.29	55.26	0.41
Clover Creek	Clover Creek	1479.44*	5-Year	622.00	4394.95	4398.41	4397.15	4398.59	0.003611	3.37	184.47	82.67	0.40
Clover Creek	Clover Creek	1479.44*	10-Year	1090.00	4394.95	4399.83	4397.85	4400.02	0.002351	3.48	312.93	96.59	0.34
Clover Creek	Clover Creek	1479.44*	25-Year	2414.00	4394.95	4402.65	4399.25	4402.88	0.001615	3.85	627.60	125.67	0.30
Clover Creek	Clover Creek	1479.44*	50-Year	3710.00	4394.95	4405.54	4400.21	4405.74	0.000959	3.58	1035.97	155.99	0.24
Clover Creek	Clover Creek	1479.44*	100-year	4700.00	4394.95	4408.99	4400.92	4409.12	0.000443	2.87	1639.77	193.15	0.17
Clover Creek	Clover Creek	1425.31*	2-Year	130.00	4394.62	4396.22	4395.70	4396.33	0.005435	2.56	50.77	46.80	0.43
Clover Creek	Clover Creek	1425.31*	5-Year	622.00	4394.62	4398.16	4396.96	4398.37	0.004369	3.71	167.50	74.88	0.44
Clover Creek	Clover Creek	1425.31*	10-Year	1090.00	4394.62	4399.66	4397.76	4399.88	0.002695	3.75	290.83	89.02	0.37
Clover Creek	Clover Creek	1425.31*	25-Year	2414.00	4394.62	4402.53	4399.18	4402.79	0.001847	4.08	591.47	119.75	0.32
Clover Creek	Clover Creek	1425.31*	50-Year	3710.00	4394.62	4405.46	4400.26	4405.68	0.001075	3.75	990.25	151.81	0.26
Clover Creek	Clover Creek	1425.31*	100-year	4700.00	4394.62	4408.96	4400.98	4409.10	0.000486	2.96	1590.48	191.85	0.18
Clover Creek	Clover Creek	1371.18*	2-Year	130.00	4394.30	4395.94	4395.38	4396.04	0.005151	2.56	50.77	44.96	0.42
Clover Creek	Clover Creek	1371.18*	5-Year	622.00	4394.30	4397.93	4396.70	4398.15	0.003958	3.70	167.92	69.83	0.42
Clover Creek	Clover Creek	1371.18*	10-Year	1090.00	4394.30	4399.52	4397.46	4399.74	0.002532	3.79	287.80	82.51	0.36
Clover Creek	Clover Creek	1371.18*	25-Year	2414.00	4394.30	4402.40	4398.95	4402.68	0.001949	4.26	566.95	111.85	0.33
Clover Creek	Clover Creek	1371.18*	50-Year	3710.00	4394.30	4405.38	4400.06	4405.62	0.001183	3.91	948.38	146.06	0.27
Clover Creek	Clover Creek	1371.18*	100-year	4700.00	4394.30	4408.92	4400.83	4409.07	0.000534	3.05	1542.06	190.33	0.19
Clover Creek	Clover Creek	1327.05*	2-Year	130.00	4393.97	4395.69	4395.07	4395.78	0.004374	2.41	53.91	46.21	0.39
Clover Creek	Clover Creek	1327.05*	5-Year	622.00	4393.97	4397.76	4396.38	4397.95	0.003115	3.50	177.80	67.12	0.38
Clover Creek	Clover Creek	1327.05*	10-Year	1090.00	4393.97	4399.40	4397.07	4399.61	0.002159	3.67	297.32	79.13	0.33
Clover Creek	Clover Creek	1327.05*	25-Year	2414.00	4393.97	4402.29	4398.62	4402.58	0.001798	4.30	561.06	102.01	0.32
Clover Creek	Clover Creek	1327.05*	50-Year	3710.00	4393.97	4405.30	4399.80	4405.55	0.001231	4.06	914.57	136.89	0.28
Clover Creek	Clover Creek	1327.05*	100-year	4700.00	4393.97	4408.88	4400.58	4409.04	0.000583	3.14	1494.72	187.58	0.20
Clover Creek	Clover Creek	1306.38		Bridge									
Clover Creek	Clover Creek	1282.92*	2-Year	130.00	4393.65	4395.49	4394.73	4395.56	0.003324	2.09	62.30	54.04	0.34
Clover Creek	Clover Creek	1282.92*	5-Year	622.00	4393.65	4397.62	4395.94	4397.78	0.002358	3.23	192.78	66.47	0.33
Clover Creek	Clover Creek	1282.92*	10-Year	1090.00	4393.65	4399.29	4396.65	4399.48	0.001803	3.49	312.14	77.75	0.31
Clover Creek	Clover Creek	1282.92*	25-Year	2414.00	4393.65	4402.15	4398.21	4402.43	0.001673	4.27	564.75	97.79	0.31
Clover Creek	Clover Creek	1282.92*	50-Year	3710.00	4393.65	4405.13	4399.46	4405.41	0.001170	4.18	886.92	121.12	0.27
Clover Creek	Clover Creek	1282.92*	100-year	4700.00	4393.65	4408.74	4400.26	4408.90	0.000648	3.28	1430.97	181.41	0.21
Clover Creek	Clover Creek	1208.79*	2-Year	130.00	4393.32	4395.33	4394.40	4395.37	0.001791	1.70	76.45	56.57	0.26
Clover Creek	Clover Creek	1208.79*	5-Year	622.00	4393.32	4397.48	4395.55	4397.62	0.001789	2.97	209.69	66.43	0.29
Clover Creek	Clover Creek	1208.79*	10-Year	1090.00	4393.32	4399.19	4396.29	4399.36	0.001484	3.30	329.81	76.76	0.28
Clover Creek	Clover Creek	1208.79*	25-Year	2414.00	4393.32	4402.04	4397.81	4402.31	0.001504	4.18	578.01	95.12	0.30
Clover Creek	Clover Creek	1208.79*	50-Year	3710.00	4393.32	4405.05	4399.06	4405.32	0.001069	4.17	890.68	113.53	0.26
Clover Creek	Clover Creek	1208.79*	100-year	4700.00	4393.32	4408.68	4399.90	4408.85	0.000683	3.39	1387.00	173.54	0.21
Clover Creek	Clover Creek	1154.66*	2-Year	130.00	4393.00	4395.28	4394.04	4395.30	0.000814	1.33	98.01	58.07	0.18
Clover Creek	Clover Creek	1154.66*	5-Year	622.00	4393.00	4397.42	4395.11	4397.53	0.001289	2.68	232.30	66.76	0.25
Clover Creek	Clover Creek	1154.66*	10-Year	1090.00	4393.00	4399.13	4395.82	4399.28	0.001178	3.08	353.81	76.50	0.25
Clover Creek	Clover Creek	1154.66*	25-Year	2414.00	4393.00	4401.98	4397.35	4402.23	0.001319	4.03	599.49	93.95	0.28
Clover Creek	Clover Creek	1154.66*	50-Year	3710.00	4393.00	4405.00	4398.64	4405.26	0.000983	4.09	906.62	110.67	0.25
Clover Creek	Clover Creek	1154.66*	100-year	4700.00	4393.00	4408.63	4399.46	4408.82	0.000567	3.47	1357.37	147.07	0.20
Clover Creek	Clover Creek	1100.53*	2-Year	130.00	4392.67	4395.25	4393.62	4395.27	0.000407	1.06	122.14	59.54	0.13
Clover Creek	Clover Creek	1100.53*	5-Year	622.00	4392.67	4397.37	4394.69	4397.46	0.000937	2.42	256.92	67.24	0.22
Clover Creek	Clover Creek	1100.53*	10-Year	1090.00	4392.67	4399.09	4395.42	4399.21	0.000949	2.87	380.29	77.58	0.23
Clover Creek	Clover Creek	1100.53*	25-Year	2414.00	4392.67	4401.93	4396.98	4402.16	0.001150	3.87	624.25	93.29	0.26
Clover Creek	Clover Creek	1100.53*	50-Year	3710.00	4392.67	4404.96	4398.22	4405.21	0.000892	4.00	928.02	108.43	0.24
Clover Creek	Clover Creek	1100.53*	100-year	4700.00	4392.67	4408.61	4399.04	4408.79	0.000524	3.44	1364.93	133.80	0.19
Clover Creek	Clover Creek	1077.85		Bridge									
Clover Creek	Clover Creek	1046.40	2-Year	130.00	4392.35	4395.24		4395.25	0.000222	0.88	148.02	60.90	0.10
Clover Creek	Clover Creek	1046.40	5-Year	622.00	4392.35	4397.34		4397.42	0.000692	2.19	283.37	68.09	0.19
Clover Creek	Clover Creek	1046.40	10-Year	1090.00	4392.35	4399.05		4399.16	0.000763	2.67	408.79	78.47	0.21
Clover Creek	Clover Creek	1046.40	25-Year	2414.00	4392.35	4401.88	4396.53	4402.09	0.000997	3.70	651.71	92.79	0.25
Clover Creek	Clover Creek	1046.40	50-Year	3710.00	4392.35	4404.92	4397.76	4405.16	0.000807	3.89	953.54	106.92	0.23
Clover Creek	Clover Creek	1046.40	100-year	4700.00	4392.35	4408.58	4398.61	4408.76	0.000490	3.40	1382.79	130.34	0.18

Appendix K
HEC-RAS Sediment Transport Analysis Model
Input Data Preparation Sheets

K-1

Inflow Hydrographs

Caliente Floodway Improvements
Input Hydrographs

2-Year

Clover Creek			Meadow Valley Wash			Combined
Duration (hr)	Increment (hr)	Flow (cfs)	Duration (hr)	Increment (hr)	Flow (cfs)	Flow (hr)
96	12	2	96	12	10	12
26	1	2	26	1	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	3	1	0.2	10	13
1	0.2	5	1	0.2	10	15
1	0.2	10	1	0.2	10	20
1	0.2	18	1	0.2	10	28
1	0.2	30	1	0.2	10	40
1	0.2	45	1	0.2	10	55
1	0.2	62	1	0.2	10	72
1	0.2	76	1	0.2	10	86
1	0.2	88	1	0.2	10	98
1	0.2	3	1	0.2	10	13
1	0.2	5	1	0.2	10	15
1	0.2	10	1	0.2	10	20
1	0.2	18	1	0.2	10	28
1	0.2	30	1	0.2	10	40
1	0.2	45	1	0.2	10	55
1	0.2	62	1	0.2	10	72
1	0.2	76	1	0.2	10	86
1	0.2	88	1	0.2	10	98
1	0.2	99	1	0.2	10	109
1	0.2	108	1	0.2	10	118
1	0.2	113	1	0.2	10	123
1	0.2	117	1	0.2	10	127
1	0.2	120	1	0.2	10	130
1	0.2	125	1	0.2	10	135
1	0.0167	128	1	0.2	11	139
1	0.0167	130	1	0.2	12	142
1	0.0167	130	1	0.2	13	143
1	0.0167	130	1	0.2	14	144
1	0.0167	130	1	0.2	16	146
1	0.0167	128	1	0.2	24	152
1	0.2	125	1	0.2	68	193
1	0.2	123	1	0.2	104	227
1	0.2	120	1	0.2	129	249
1	0.2	116	1	0.2	148	264
1	0.2	107	1	0.2	171	278
1	0.2	95	1	0.2	187	282

5-Year

Clover Creek			Meadow Valley Wash			Combined
Duration (hr)	Increment (hr)	Flow (cfs)	Duration (hr)	Increment (hr)	Flow (cfs)	Flow (hr)
96	12	2	96	12	10	12
26	1	2	26	1	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	3	1	0.2	10	13
1	0.2	4	1	0.2	10	14
1	0.2	6	1	0.2	10	16
1	0.2	8	1	0.2	10	18
1	0.2	10	1	0.2	10	20
1	0.2	12	1	0.2	10	22
1	0.2	15	1	0.2	10	25
1	0.2	40	1	0.2	10	50
1	0.2	90	1	0.2	10	100
1	0.2	125	1	0.2	10	135
1	0.2	175	1	0.2	10	185
1	0.2	260	1	0.2	10	270
1	0.2	325	1	0.2	10	335
1	0.2	365	1	0.2	10	375
1	0.2	400	1	0.2	10	410
1	0.2	430	1	0.2	10	440
1	0.2	450	1	0.2	10	460
1	0.2	460	1	0.2	10	470
1	0.2	480	1	0.2	11	491
1	0.2	520	1	0.2	12	532
1	0.2	550	1	0.2	13	563
1	0.0167	590	1	0.2	15	605
1	0.0167	615	1	0.2	17	632
1	0.0167	622	1	0.2	21	643
1	0.0167	615	1	0.2	31	646
1	0.0167	600	1	0.2	134	734
1	0.2	585	1	0.2	221	806
1	0.2	570	1	0.2	288	858
1	0.2	545	1	0.2	414	959
1	0.2	525	1	0.2	561	1086
1	0.2	510	1	0.2	641	1151
1	0.2	480	1	0.2	675	1155
1	0.2	440	1	0.2	708	1148
1	0.2	390	1	0.2	748	1138
1	0.2	350	1	0.2	775	1125
1	0.2	315	1	0.2	775	1090
1	0.2	280	1	0.2	821	1101

10-Year

Clover Creek			Meadow Valley Wash			Combined
Duration (hr)	Increment (hr)	Flow (cfs)	Duration (hr)	Increment (hr)	Flow (cfs)	Flow (hr)
96	12	2	96	12	10	12
26	1	2	26	1	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	4	1	0.2	10	14
1	0.2	6	1	0.2	10	16
1	0.2	10	1	0.2	10	20
1	0.2	16	1	0.2	10	26
1	0.2	25	1	0.2	10	35
1	0.2	50	1	0.2	10	60
1	0.2	150	1	0.2	10	160
1	0.2	270	1	0.2	10	280
1	0.2	350	1	0.2	10	360
1	0.2	490	1	0.2	10	500
1	0.2	650	1	0.2	10	660
1	0.2	730	1	0.2	10	740
1	0.2	765	1	0.2	10	775
1	0.2	800	1	0.2	11	811
1	0.2	855	1	0.2	13	868
1	0.2	880	1	0.2	15	895
1	0.2	890	1	0.2	17	907
1	0.2	960	1	0.2	20	980
1	0.2	1070	1	0.2	30	1100
1	0.0167	1165	1	0.2	40	1205
1	0.0167	1235	1	0.2	50	1285
1	0.0167	1266	1	0.2	100	1366
1	0.0167	1260	1	0.2	198	1458
1	0.0167	1205	1	0.2	398	1603
1	0.2	1160	1	0.2	615	1775
1	0.2	1100	1	0.2	754	1854
1	0.2	1050	1	0.2	987	2037
1	0.2	1000	1	0.2	1209	2209
1	0.2	950	1	0.2	1287	2237
1	0.2	905	1	0.2	1298	2203
1	0.2	855	1	0.2	1342	2197
1	0.2	785	1	0.2	1393	2178
1	0.2	715	1	0.2	1415	2130
1	0.2	650	1	0.2	1421	2071
1	0.2	585	1	0.2	1587	2172
1	0.2	525	1	0.2	1765	2290

1	0.2	85	1	0.2	198	283
1	0.2	76	1	0.2	209	285
1	0.2	70	1	0.2	223	293
1	0.2	62	1	0.0167	237	299
1	0.2	57	1	0.0167	251	308
1	0.2	52	1	0.0167	260	312
1	0.2	48	1	0.0167	260	308
1	0.2	44	1	0.0167	252	296
1	0.2	39	1	0.0167	245	284
1	0.2	35	1	0.2	240	275
1	0.2	30	1	0.2	220	250
1	0.2	25	1	0.2	204	229
1	0.2	20	1	0.2	188	208
1	0.2	15	1	0.2	173	188
1	0.2	10	1	0.2	159	169
1	0.2	6	1	0.2	148	154
1	0.2	4	1	0.2	137	141
1	0.2	3	1	0.2	128	131
1	0.2	2	1	0.2	119	121
1	0.2	2	1	0.2	111	113
1	0.2	2	1	0.2	103	105
1	0.2	2	1	0.2	96	98
1	0.2	2	1	0.2	89	91
1	0.2	2	1	0.2	83	85
1	0.2	2	1	0.2	77	79
1	0.2	2	1	0.2	72	74
1	0.2	2	1	0.2	67	69
1	0.2	2	1	0.2	62	64
1	0.2	2	1	0.2	57	59
1	0.2	2	1	0.2	52	54
1	0.2	2	1	0.2	48	50
1	0.2	2	1	0.2	44	46
1	0.2	2	1	0.2	40	42
1	0.2	2	1	0.2	36	38
1	0.2	2	1	0.2	32	34
1	0.2	2	1	0.2	29	31
1	0.2	2	1	0.2	26	28
1	0.2	2	1	0.2	23	25
1	0.2	2	1	0.2	20	22
1	0.2	2	1	0.2	18	20
1	0.2	2	1	0.2	16	18
1	0.2	2	1	0.2	14	16
1	0.2	2	1	0.2	12	14
1	0.2	2	1	0.2	11	13
1	0.2	2	1	0.2	10	12

1	0.2	255	1	0.2	895	1150
1	0.2	225	1	0.0167	961	1186
1	0.2	200	1	0.0167	1001	1201
1	0.2	185	1	0.0167	1010	1195
1	0.2	165	1	0.0167	1001	1166
1	0.2	150	1	0.0167	974	1124
1	0.2	125	1	0.2	941	1066
1	0.2	100	1	0.2	915	1015
1	0.2	75	1	0.2	888	963
1	0.2	50	1	0.2	851	901
1	0.2	30	1	0.2	814	844
1	0.2	15	1	0.2	768	783
1	0.2	10	1	0.2	721	731
1	0.2	5	1	0.2	661	666
1	0.2	4	1	0.2	601	605
1	0.2	3	1	0.2	541	544
1	0.2	2	1	0.2	494	496
1	0.2	2	1	0.2	445	447
1	0.2	2	1	0.2	395	397
1	0.2	2	1	0.2	348	350
1	0.2	2	1	0.2	315	317
1	0.2	2	1	0.2	281	283
1	0.2	2	1	0.2	248	250
1	0.2	2	1	0.2	221	223
1	0.2	2	1	0.2	188	190
1	0.2	2	1	0.2	158	160
1	0.2	2	1	0.2	128	130
1	0.2	2	1	0.2	103	105
1	0.2	2	1	0.2	78	80
1	0.2	2	1	0.2	58	60
1	0.2	2	1	0.2	40	42
1	0.2	2	1	0.2	26	28
1	0.2	2	1	0.2	20	22
1	0.2	2	1	0.2	19	21
1	0.2	2	1	0.2	18	20
1	0.2	2	1	0.2	17	19
1	0.2	2	1	0.2	16	18
1	0.2	2	1	0.2	15	17
1	0.2	2	1	0.2	14	16
1	0.2	2	1	0.2	13	15
1	0.2	2	1	0.2	12	14
1	0.2	2	1	0.2	11	13
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12

1	0.2	480	1	0.0167	1920	2400
1	0.2	420	1	0.0167	2015	2435
1	0.2	390	1	0.0167	2020	2410
1	0.2	350	1	0.0167	1976	2326
1	0.2	320	1	0.0167	1876	2196
1	0.2	290	1	0.2	1765	2055
1	0.2	255	1	0.2	1676	1931
1	0.2	220	1	0.2	1576	1796
1	0.2	185	1	0.2	1482	1667
1	0.2	150	1	0.2	1409	1559
1	0.2	115	1	0.2	1343	1458
1	0.2	80	1	0.2	1253	1333
1	0.2	45	1	0.2	1165	1210
1	0.2	20	1	0.2	1065	1085
1	0.2	10	1	0.2	970	980
1	0.2	6	1	0.2	887	893
1	0.2	4	1	0.2	804	808
1	0.2	3	1	0.2	726	729
1	0.2	2	1	0.2	665	667
1	0.2	2	1	0.2	604	606
1	0.2	2	1	0.2	545	547
1	0.2	2	1	0.2	488	490
1	0.2	2	1	0.2	433	435
1	0.2	2	1	0.2	380	382
1	0.2	2	1	0.2	329	331
1	0.2	2	1	0.2	280	282
1	0.2	2	1	0.2	233	235
1	0.2	2	1	0.2	188	190
1	0.2	2	1	0.2	148	150
1	0.2	2	1	0.2	113	115
1	0.2	2	1	0.2	83	85
1	0.2	2	1	0.2	58	60
1	0.2	2	1	0.2	38	40
1	0.2	2	1	0.2	23	25
1	0.2	2	1	0.2	18	20
1	0.2	2	1	0.2	15	17
1	0.2	2	1	0.2	13	15
1	0.2	2	1	0.2	12	14
1	0.2	2	1	0.2	11	13
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12
1	0.2	2	1	0.2	10	12

K-2
Water Temperature Data

Water Temperature: Meadow Valley Wash		
USGS Gaging Station 09418500		
Date	Temp (^oC)	Temp (^oF)
Dec-77	7.5	45.5
Jan-78	7.0	44.6
Feb-78	16.0	60.8
Nov-78	11.0	51.8
Dec-78	8.0	46.4
Dec-79	3.0	37.4
Jan-80	10.0	50.0
Jan-81	7.5	45.5
Feb-81	15.5	59.9
Feb-82	7.0	44.6
Nov-82	4.0	39.2
Dec-82	7.0	44.6
Jan-83	9.0	48.2
Feb-83	12.5	54.5
Nov-83	6.0	42.8
Jan-84	8.0	46.4
Averages	**8.7**	**47.6**

K-3
Yang’s and Rubey’s Equations

Yang's Equation (1996)

$$Log(C_t) = 5.435 - 0.286 Log\left(\frac{\omega D_{50}}{\nu}\right) - 0.457 Log\frac{V_*}{\omega} + \left(1.799 - 0.409 Log\frac{\omega D_{50}}{\nu} - 0.314 Log\frac{V_*}{\omega}\right) Log\left(\frac{VS}{\omega} - \frac{V_{cr}S}{\omega}\right)$$

- C_t = Sediment concentration in parts per million by weight
- ω = Fall velocity of the sediment, ft/s
- ν = Kinematic viscosity, ft^2/s
- V_* = Shear velocity $(gRS)^{0.5}$, ft/s
- V = Velocity, ft/s
- V_{cr} = Critical velocity, ft/s
- R = Hydraulic radius
- S = Energy slope

Rubey Equation (1931)

$$\omega = \frac{\left[1636(\rho_s - \rho)d^3 + 9\mu^2\right]^{0.5} - 3\mu}{500d}$$

- ω = Terminal fall velocity of the sediment, m/s
- ρ_s = Density of sediment, kg/m^3
- ρ = Density of water, kg/m^3
- μ = Dynamic viscosity, $N*s/m^2$
- d = particle diameter, m

K-4
Calculation of Input Sediment Rating Curves

Yang's Equation 2-YR

$$Log(C_t) = 5.435 - 0.286 Log\left(\frac{\omega D_{50}}{\nu}\right) - 0.457 Log\frac{V_*}{\omega} + \left(1.799 - 0.409 Log\frac{\omega D_{50}}{\nu} - 0.314 Log\frac{V_*}{\omega}\right) Log\left(\frac{VS}{\omega} - \frac{V_{cr}S}{\omega}\right)$$

	D = 0.0447 mm		D = 0.0884 mm		D = 0.177 mm		D = 0.354 mm	
Q =	130	cfs	130	cfs	130	cfs	130	cfs
y =	0.47	ft	0.47	ft	0.47	ft	0.47	ft
V =	1.88	fps	1.88	fps	1.88	fps	1.88	fps
D =	0.0447	mm	0.0884	mm	0.177	mm	0.354	mm
D =	0.00015	ft	0.00029	ft	0.00058	ft	0.00116	ft
S =	0.008774	ft/ft	0.008774	ft/ft	0.008774	ft/ft	0.008774	ft/ft
ν =	1.41E-05	ft^2/s	1.41E-05	ft^2/s	1.41E-05	ft^2/s	1.41E-05	ft^2/s
ω =	0.0070	fps	0.0210	fps	0.0700	fps	0.2000	fps
γ =	62.4	lb/ft^3	62.4	lb/ft^3	62.4	lb/ft^3	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$	1.94	$slugs/ft^3$	1.94	$slugs/ft^3$	1.94	$slugs/ft^3$
τ_o =	0.257	lb/ft^2	0.257	lb/ft^2	0.257	lb/ft^2	0.257	lb/ft^2
V_* =	0.364	fps	0.364	fps	0.364	fps	0.364	fps
V_*D_{50}/ν =	3.79		7.49		15.00		30.00	
V_{cr}/ω =	5.482		3.729		2.900		2.424	
$V_{cr}S/\omega$ =	0.048		0.033		0.025		0.021	
VS/ω =	2.356		0.785		0.236		0.082	
V_*/ω =	52.03		17.34		5.20		1.82	
$\omega D_{50}/\nu$ =	0.07		0.43		2.88		16.47	
Log C_t =	5.603		4.781		4.037		3.488	
C_t =	400831	ppm by weight	60352	ppm by weight	10897	ppm by weight	3079	ppm by weight
Q_s =	140467	tons/day	21150	tons/day	3819	tons/day	1079	tons/day

D = 0.707 mm		
Q =	130	cfs
y =	0.47	ft
V =	1.88	fps
D =	0.707	mm
D =	0.00232	ft
S =	0.008774	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.3500	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.257	lb/ft^2
V_* =	0.364	fps
V_*D_{50}/ν =	59.91	
V_{cr}/ω =	2.116	
$V_{cr}S/\omega$ =	0.019	
VS/ω =	0.047	
V_*/ω =	1.04	
$\omega D_{50}/\nu$ =	57.58	
Log C_t =	3.266	
C_t =	1844	ppm by weight
Q_s =	646	tons/day

D = 1.41 mm		
Q =	130	cfs
y =	0.47	ft
V =	1.88	fps
D =	1.41	mm
D =	0.00463	ft
S =	0.008774	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.7200	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.257	lb/ft^2
V_* =	0.364	fps
V_*D_{50}/ν =	119.49	
V_{cr}/ω =	1.899	
$V_{cr}S/\omega$ =	0.017	
VS/ω =	0.023	
V_*/ω =	0.51	
$\omega D_{50}/\nu$ =	236.22	
Log C_t =	2.861	
C_t =	726	ppm by weight
Q_s =	254	tons/day

D =2.83 mm		
Q =	130	cfs
y =	0.47	ft
V =	1.88	fps
D =	2.83	mm
D =	0.00928	ft
S =	0.008774	ft/ft
ν =	1.41E-05	ft^2/s
ω =	1.1000	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.257	lb/ft^2
V_* =	0.364	fps
V_*D_{50}/ν =	239.82	
V_{cr}/ω =	1.738	
$V_{cr}S/\omega$ =	0.015	
VS/ω =	0.015	
V_*/ω =	0.33	
$\omega D_{50}/\nu$ =	724.34	
Log C_t =	Not used	
C_t =	Not used	ppm by weight
Q_s =	Not used	tons/day

From Fig. 3.1 HDS-6		
Grain Cl.	D (mm)	ω (fps)
CM	0.0447	0.007
VFS	0.0884	0.021
FS	0.177	0.070
MS	0.354	0.200
CS	0.707	0.350
VCS	1.41	0.720
VFG	2.83	1.100

Transport Rates		
Grain Cl.	tons/day	fraction
CM	140467	**0.8390**
VFS	21150	**0.1263**
FS	3819	**0.0228**
MS	1079	**0.0064**
CS	646	**0.0039**
VCS	254	**0.0015**
VFG	Not used	**Not used**

HEC-RAS Steady Flow Output:

y - Hydraulic radius

V - Cross section velocity

S - Energy slope

Yang's Equation 5-YR

$$Log(C_t) = 5.435 - 0.286 Log\left(\frac{\omega D_{50}}{\nu}\right) - 0.457 Log\frac{V_*}{\omega} + \left(1.799 - 0.409 Log\frac{\omega D_{50}}{\nu} - 0.314 Log\frac{V_*}{\omega}\right) Log\left(\frac{VS}{\omega} - \frac{V_{cr}S}{\omega}\right)$$

	D = 0.0447 mm			D = 0.0884 mm			D = 0.177 mm			D = 0.354 mm	
Q =	622	cfs	Q =	622	cfs	Q =	622	cfs	Q =	622	cfs
y =	0.8	ft	y =	0.8	ft	y =	0.8	ft	y =	0.8	ft
V =	3.75	fps	V =	3.75	fps	V =	3.75	fps	V =	3.75	fps
D =	0.0447	mm	D =	0.0884	mm	D =	0.177	mm	D =	0.354	mm
D =	0.00015	ft	D =	0.00029	ft	D =	0.00058	ft	D =	0.00116	ft
S =	0.017285	ft/ft	S =	0.017285	ft/ft	S =	0.017285	ft/ft	S =	0.017285	ft/ft
ν =	1.41E-05	ft^2/s	ν =	1.41E-05	ft^2/s	ν =	1.41E-05	ft^2/s	ν =	1.41E-05	ft^2/s
ω =	0.0070	fps	ω =	0.0210	fps	ω =	0.0700	fps	ω =	0.2000	fps
γ =	62.4	lb/ft^3	γ =	62.4	lb/ft^3	γ =	62.4	lb/ft^3	γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$	ρ =	1.94	$slugs/ft^3$	ρ =	1.94	$slugs/ft^3$	ρ =	1.94	$slugs/ft^3$
τ_o =	0.863	lb/ft^2	τ_o =	0.863	lb/ft^2	τ_o =	0.863	lb/ft^2	τ_o =	0.863	lb/ft^2
V_* =	0.667	fps	V_* =	0.667	fps	V_* =	0.667	fps	V_* =	0.667	fps
V_*D_{50}/v =	6.94		V_*D_{50}/v =	13.72		V_*D_{50}/v =	27.47		V_*D_{50}/v =	54.93	
V_{cr}/ω =	3.860		V_{cr}/ω =	2.981		V_{cr}/ω =	2.473		V_{cr}/ω =	2.148	
$V_{cr}S/\omega$ =	0.067		$V_{cr}S/\omega$ =	0.052		$V_{cr}S/\omega$ =	0.043		$V_{cr}S/\omega$ =	0.037	
VS/ω =	9.260		VS/ω =	3.087		VS/ω =	0.926		VS/ω =	0.324	
V_*/ω =	95.27		V_*/ω =	31.76		V_*/ω =	9.53		V_*/ω =	3.33	
$\omega D_{50}/v$ =	0.07		$\omega D_{50}/v$ =	0.43		$\omega D_{50}/v$ =	2.88		$\omega D_{50}/v$ =	16.47	
Log C_t =	6.439		Log C_t =	5.565		Log C_t =	4.786		Log C_t =	4.231	
C_t =	2747711	ppm by weight	C_t =	367161	ppm by weight	C_t =	61067	ppm by weight	C_t =	17040	ppm by weight
Q_s =	4607123	tons/day	Q_s =	615623	tons/day	Q_s =	102391	tons/day	Q_s =	28571	tons/day

D = 0.707 mm		
Q =	622	cfs
y =	0.8	ft
V =	3.75	fps
D =	0.707	mm
D =	0.00232	ft
S =	0.017285	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.3500	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.863	lb/ft^2
V_* =	0.667	fps
V_*D_{50}/ν =	109.71	
V_{cr}/ω =	1.922	
$V_{cr}S/\omega$ =	0.033	
VS/ω =	0.185	
V_*/ω =	1.91	
$\omega D_{50}/\nu$ =	57.58	
Log C_t =	3.993	
C_t =	9831	ppm by weight
Q_s =	16484	tons/day

D = 1.41 mm		
Q =	622	cfs
y =	0.8	ft
V =	3.75	fps
D =	1.41	mm
D =	0.00463	ft
S =	0.017285	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.7200	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.863	lb/ft^2
V_* =	0.667	fps
V_*D_{50}/ν =	218.80	
V_{cr}/ω =	1.756	
$V_{cr}S/\omega$ =	0.030	
VS/ω =	0.090	
V_*/ω =	0.93	
$\omega D_{50}/\nu$ =	236.22	
Log C_t =	3.745	
C_t =	5553	ppm by weight
Q_s =	9312	tons/day

D =2.83 mm		
Q =	622	cfs
y =	0.8	ft
V =	3.75	fps
D =	2.83	mm
D =	0.00928	ft
S =	0.017285	ft/ft
ν =	1.41E-05	ft^2/s
ω =	1.1000	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.863	lb/ft^2
V_* =	0.667	fps
V_*D_{50}/ν =	439.16	
V_{cr}/ω =	1.628	
$V_{cr}S/\omega$ =	0.028	
VS/ω =	0.059	
V_*/ω =	0.61	
$\omega D_{50}/\nu$ =	724.34	
Log C_t =	3.662	
C_t =	4592	ppm by weight
Q_s =	7699	tons/day

From Fig. 3.1 HDS-6		
Grain Cl.	D (mm)	ω (fps)
CM	0.0447	0.007
VFS	0.0884	0.021
FS	0.177	0.070
MS	0.354	0.200
CS	0.707	0.350
VCS	1.41	0.720
VFG	2.83	1.100

Transport Rates		
Grain Cl.	tons/day	fraction
FM	4607123	**0.8552**
MM	615623	**0.1143**
CM	102391	**0.0190**
VFS	28571	**0.0053**
FS	16484	**0.0031**
MS	9312	**0.0017**
CS	7699	**0.0014**

HEC-RAS Steady Flow Output:

y - Hydraulic radius

V - Cross section velocity

S - Energy slope

Yang's Equation 10-YR

$$Log(C_t) = 5.435 - 0.286 Log\left(\frac{\omega D_{50}}{\nu}\right) - 0.457 Log\frac{V_*}{\omega} + \left(1.799 - 0.409 Log\frac{\omega D_{50}}{\nu} - 0.314 Log\frac{V_*}{\omega}\right) Log\left(\frac{VS}{\omega} - \frac{V_{cr}S}{\omega}\right)$$

D = 0.0447 mm

Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	0.0447	mm
D =	0.00015	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.0070	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/v =	7.40	
V_{cr}/ω =	3.750	
$V_{cr}S/\omega$ =	0.060	
VS/ω =	9.465	
V_*/ω =	101.59	
$\omega D_{50}/v$ =	0.07	
Log C_t =	6.434	
C_t =	2716364	ppm by weight
Q_s =	7981469	tons/day

D = 0.0884 mm

Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	0.0884	mm
D =	0.00029	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.0210	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/v =	14.63	
V_{cr}/ω =	2.922	
$V_{cr}S/\omega$ =	0.047	
VS/ω =	3.155	
V_*/ω =	33.86	
$\omega D_{50}/v$ =	0.43	
Log C_t =	5.563	
C_t =	365661	ppm by weight
Q_s =	1074419	tons/day

D = 0.177 mm

Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	0.177	mm
D =	0.00058	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.0700	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/v =	29.29	
V_{cr}/ω =	2.437	
$V_{cr}S/\omega$ =	0.039	
VS/ω =	0.947	
V_*/ω =	10.16	
$\omega D_{50}/v$ =	2.88	
Log C_t =	4.789	
C_t =	61481	ppm by weight
Q_s =	180648	tons/day

D = 0.354 mm

Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	0.354	mm
D =	0.00116	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.2000	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/v =	58.58	
V_{cr}/ω =	2.124	
$V_{cr}S/\omega$ =	0.034	
VS/ω =	0.331	
V_*/ω =	3.56	
$\omega D_{50}/v$ =	16.47	
Log C_t =	4.241	
C_t =	17405	ppm by weight
Q_s =	51140	tons/day

D = 0.707 mm		
Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	0.707	mm
D =	0.00232	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.3500	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/ν =	116.99	
V_{cr}/ω =	1.905	
$V_{cr}S/\omega$ =	0.031	
VS/ω =	0.189	
V_*/ω =	2.03	
$\omega D_{50}/\nu$ =	57.58	
Log C_t =	4.006	
C_t =	10131	ppm by weight
Q_s =	29768	tons/day

D = 1.41 mm		
Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	1.41	mm
D =	0.00463	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.7200	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/ν =	233.31	
V_{cr}/ω =	1.743	
$V_{cr}S/\omega$ =	0.028	
VS/ω =	0.092	
V_*/ω =	0.99	
$\omega D_{50}/\nu$ =	236.22	
Log C_t =	3.768	
C_t =	5863	ppm by weight
Q_s =	17228	tons/day

D =2.83 mm		
Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	2.83	mm
D =	0.00928	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	1.1000	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/ν =	468.27	
V_{cr}/ω =	1.618	
$V_{cr}S/\omega$ =	0.026	
VS/ω =	0.060	
V_*/ω =	0.65	
$\omega D_{50}/\nu$ =	724.34	
Log C_t =	3.695	
C_t =	4950	ppm by weight
Q_s =	14545	tons/day

From Fig. 3.1 HDS-6		
Grain Cl.	D (mm)	ω (fps)
CM	0.0447	0.007
VFS	0.0884	0.021
FS	0.177	0.070
MS	0.354	0.200
CS	0.707	0.350
VCS	1.41	0.720
VFG	2.83	1.100

Transport Rates		
Grain Cl.	tons/day	fraction
FM	7981469	**0.8537**
MM	1074419	**0.1149**
CM	180648	**0.0193**
VFS	51140	**0.0055**
FS	29768	**0.0032**
MS	17228	**0.0018**
CS	14545	**0.0016**

HEC-RAS Steady Flow Output:

y - Hydraulic radius

V - Cross section velocity

S - Energy slope

Yang's Equation 2-YR

$$Log(C_t) = 5.435 - 0.286 Log\left(\frac{\omega D_{50}}{\nu}\right) - 0.457 Log\frac{V_*}{\omega} + \left(1.799 - 0.409 Log\frac{\omega D_{50}}{\nu} - 0.314 Log\frac{V_*}{\omega}\right) Log\left(\frac{VS}{\omega} - \frac{V_{cr}S}{\omega}\right)$$

	D = 0.0447 mm			D = 0.0884 mm			D = 0.177 mm			D = 0.354 mm	
Q =	130	cfs	Q =	130	cfs	Q =	130	cfs	Q =	130	cfs
y =	0.47	ft	y =	0.47	ft	y =	0.47	ft	y =	0.47	ft
V =	1.88	fps	V =	1.88	fps	V =	1.88	fps	V =	1.88	fps
D =	0.0447	mm	D =	0.0884	mm	D =	0.177	mm	D =	0.354	mm
D =	0.00015	ft	D =	0.00029	ft	D =	0.00058	ft	D =	0.00116	ft
S =	0.008774	ft/ft	S =	0.008774	ft/ft	S =	0.008774	ft/ft	S =	0.008774	ft/ft
ν =	1.41E-05	ft^2/s	ν =	1.41E-05	ft^2/s	ν =	1.41E-05	ft^2/s	ν =	1.41E-05	ft^2/s
ω =	0.0070	fps	ω =	0.0210	fps	ω =	0.0700	fps	ω =	0.2000	fps
γ =	62.4	lb/ft^3	γ =	62.4	lb/ft^3	γ =	62.4	lb/ft^3	γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$	ρ =	1.94	$slugs/ft^3$	ρ =	1.94	$slugs/ft^3$	ρ =	1.94	$slugs/ft^3$
τ_o =	0.257	lb/ft^2	τ_o =	0.257	lb/ft^2	τ_o =	0.257	lb/ft^2	τ_o =	0.257	lb/ft^2
V_* =	0.364	fps	V_* =	0.364	fps	V_* =	0.364	fps	V_* =	0.364	fps
V_*D_{50}/v =	3.79		V_*D_{50}/v =	7.49		V_*D_{50}/v =	15.00		V_*D_{50}/v =	30.00	
V_{cr}/ω =	5.482		V_{cr}/ω =	3.729		V_{cr}/ω =	2.900		V_{cr}/ω =	2.424	
$V_{cr}S/\omega$ =	0.048		$V_{cr}S/\omega$ =	0.033		$V_{cr}S/\omega$ =	0.025		$V_{cr}S/\omega$ =	0.021	
VS/ω =	2.356		VS/ω =	0.785		VS/ω =	0.236		VS/ω =	0.082	
V_*/ω =	52.03		V_*/ω =	17.34		V_*/ω =	5.20		V_*/ω =	1.82	
$\omega D_{50}/v$ =	0.07		$\omega D_{50}/v$ =	0.43		$\omega D_{50}/v$ =	2.88		$\omega D_{50}/v$ =	16.47	
Log C_t =	5.603		Log C_t =	4.781		Log C_t =	4.037		Log C_t =	3.488	
C_t =	400831	ppm by weight	C_t =	60352	ppm by weight	C_t =	10897	ppm by weight	C_t =	3079	ppm by weight
Q_s =	140467	tons/day	Q_s =	21150	tons/day	Q_s =	3819	tons/day	Q_s =	1079	tons/day

D = 0.707 mm		
Q =	130	cfs
y =	0.47	ft
V =	1.88	fps
D =	0.707	mm
D =	0.00232	ft
S =	0.008774	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.3500	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.257	lb/ft^2
V_* =	0.364	fps
$V_* D_{50}/\nu$ =	59.91	
V_{cr}/ω =	2.116	
$V_{cr}S/\omega$ =	0.019	
VS/ω =	0.047	
V_*/ω =	1.04	
$\omega D_{50}/\nu$ =	57.58	
Log C_t =	3.266	
C_t =	1844	ppm by weight
Q_s =	646	tons/day

D = 1.41 mm		
Q =	130	cfs
y =	0.47	ft
V =	1.88	fps
D =	1.41	mm
D =	0.00463	ft
S =	0.008774	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.7200	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.257	lb/ft^2
V_* =	0.364	fps
$V_* D_{50}/\nu$ =	119.49	
V_{cr}/ω =	1.899	
$V_{cr}S/\omega$ =	0.017	
VS/ω =	0.023	
V_*/ω =	0.51	
$\omega D_{50}/\nu$ =	236.22	
Log C_t =	2.861	
C_t =	726	ppm by weight
Q_s =	254	tons/day

D =2.83 mm		
Q =	130	cfs
y =	0.47	ft
V =	1.88	fps
D =	2.83	mm
D =	0.00928	ft
S =	0.008774	ft/ft
ν =	1.41E-05	ft^2/s
ω =	1.1000	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.257	lb/ft^2
V_* =	0.364	fps
$V_* D_{50}/\nu$ =	239.82	
V_{cr}/ω =	1.738	
$V_{cr}S/\omega$ =	0.015	
VS/ω =	0.015	
V_*/ω =	0.33	
$\omega D_{50}/\nu$ =	724.34	
Log C_t =	Not used	
C_t =	Not used	ppm by weight
Q_s =	Not used	tons/day

From Fig. 3.1 HDS-6		
Grain Cl.	D (mm)	ω (fps)
CM	0.0447	0.007
VFS	0.0884	0.021
FS	0.177	0.070
MS	0.354	0.200
CS	0.707	0.350
VCS	1.41	0.720
VFG	2.83	1.100

Transport Rating Curve for B.C.		
Grain Cl.	tons/day	fraction
CM	140467	**0.8390**
VFS	21150	**0.1263**
FS	3819	**0.0228**
MS	1079	**0.0064**
CS	646	**0.0039**
VCS	254	**0.0015**
VFG	Not used	**Not used**

HEC-RAS Steady Flow Output:

y - Hydraulic radius

V - Cross section velocity

S - Energy slope

Yang's Equation 5-YR

$$Log(C_t) = 5.435 - 0.286 Log\left(\frac{\omega D_{50}}{\nu}\right) - 0.457 Log\frac{V_*}{\omega} + \left(1.799 - 0.409 Log\frac{\omega D_{50}}{\nu} - 0.314 Log\frac{V_*}{\omega}\right) Log\left(\frac{VS}{\omega} - \frac{V_{cr}S}{\omega}\right)$$

	D = 0.0447 mm		D = 0.0884 mm		D = 0.177 mm		D = 0.354 mm	
Q =	622	cfs	622	cfs	622	cfs	622	cfs
y =	0.8	ft	0.8	ft	0.8	ft	0.8	ft
V =	3.75	fps	3.75	fps	3.75	fps	3.75	fps
D =	0.0447	mm	0.0884	mm	0.177	mm	0.354	mm
D =	0.00015	ft	0.00029	ft	0.00058	ft	0.00116	ft
S =	0.017285	ft/ft	0.017285	ft/ft	0.017285	ft/ft	0.017285	ft/ft
ν =	1.41E-05	ft^2/s	1.41E-05	ft^2/s	1.41E-05	ft^2/s	1.41E-05	ft^2/s
ω =	0.0070	fps	0.0210	fps	0.0700	fps	0.2000	fps
γ =	62.4	lb/ft^3	62.4	lb/ft^3	62.4	lb/ft^3	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$	1.94	$slugs/ft^3$	1.94	$slugs/ft^3$	1.94	$slugs/ft^3$
τ_o =	0.863	lb/ft^2	0.863	lb/ft^2	0.863	lb/ft^2	0.863	lb/ft^2
V_* =	0.667	fps	0.667	fps	0.667	fps	0.667	fps
V_*D_{50}/v =	6.94		13.72		27.47		54.93	
V_{cr}/ω =	3.860		2.981		2.473		2.148	
$V_{cr}S/\omega$ =	0.067		0.052		0.043		0.037	
VS/ω =	9.260		3.087		0.926		0.324	
V_*/ω =	95.27		31.76		9.53		3.33	
$\omega D_{50}/v$ =	0.07		0.43		2.88		16.47	
Log C_t =	6.439		5.565		4.786		4.231	
C_t =	2747711	ppm by weight	367161	ppm by weight	61067	ppm by weight	17040	ppm by weight
Q_s =	4607123	tons/day	615623	tons/day	102391	tons/day	28571	tons/day

D = 0.707 mm		
$Q =$	622	cfs
$y =$	0.8	ft
$V =$	3.75	fps
$D =$	0.707	mm
$D =$	0.00232	ft
$S =$	0.017285	ft/ft
$\nu =$	1.41E-05	ft^2/s
$\omega =$	0.3500	fps
$\gamma =$	62.4	lb/ft^3
$\rho =$	1.94	$slugs/ft^3$
$\tau_o =$	0.863	lb/ft^2
$V_* =$	0.667	fps
$V_*D_{50}/\nu =$	109.71	
$V_{cr}/\omega =$	1.922	
$V_{cr}S/\omega =$	0.033	
$VS/\omega =$	0.185	
$V_*/\omega =$	1.91	
$\omega D_{50}/\nu =$	57.58	
$\text{Log } C_t =$	3.993	
$C_t =$	9831	ppm by weight
$Q_s =$	16484	tons/day

D = 1.41 mm		
$Q =$	622	cfs
$y =$	0.8	ft
$V =$	3.75	fps
$D =$	1.41	mm
$D =$	0.00463	ft
$S =$	0.017285	ft/ft
$\nu =$	1.41E-05	ft^2/s
$\omega =$	0.7200	fps
$\gamma =$	62.4	lb/ft^3
$\rho =$	1.94	$slugs/ft^3$
$\tau_o =$	0.863	lb/ft^2
$V_* =$	0.667	fps
$V_*D_{50}/\nu =$	218.80	
$V_{cr}/\omega =$	1.756	
$V_{cr}S/\omega =$	0.030	
$VS/\omega =$	0.090	
$V_*/\omega =$	0.93	
$\omega D_{50}/\nu =$	236.22	
$\text{Log } C_t =$	3.745	
$C_t =$	5553	ppm by weight
$Q_s =$	9312	tons/day

D =2.83 mm		
$Q =$	622	cfs
$y =$	0.8	ft
$V =$	3.75	fps
$D =$	2.83	mm
$D =$	0.00928	ft
$S =$	0.017285	ft/ft
$\nu =$	1.41E-05	ft^2/s
$\omega =$	1.1000	fps
$\gamma =$	62.4	lb/ft^3
$\rho =$	1.94	$slugs/ft^3$
$\tau_o =$	0.863	lb/ft^2
$V_* =$	0.667	fps
$V_*D_{50}/\nu =$	439.16	
$V_{cr}/\omega =$	1.628	
$V_{cr}S/\omega =$	0.028	
$VS/\omega =$	0.059	
$V_*/\omega =$	0.61	
$\omega D_{50}/\nu =$	724.34	
$\text{Log } C_t =$	3.662	
$C_t =$	4592	ppm by weight
$Q_s =$	7699	tons/day

From Fig. 3.1 HDS-6		
Grain Cl.	D (mm)	ω (fps)
CM	0.0447	0.007
VFS	0.0884	0.021
FS	0.177	0.070
MS	0.354	0.200
CS	0.707	0.350
VCS	1.41	0.720
VFG	2.83	1.100

Transport Rating Curve for B.C.		
Grain Cl.	tons/day	fraction
FM	4607123	**0.8552**
MM	615623	**0.1143**
CM	102391	**0.0190**
VFS	28571	**0.0053**
FS	16484	**0.0031**
MS	9312	**0.0017**
CS	7699	**0.0014**

HEC-RAS Steady Flow Output:

y - Hydraulic radius

V - Cross section velocity

S - Energy slope

Yang's Equation 10-YR

$$Log(C_t) = 5.435 - 0.286 Log\left(\frac{\omega D_{50}}{\nu}\right) - 0.457 Log\frac{V_*}{\omega} + \left(1.799 - 0.409 Log\frac{\omega D_{50}}{\nu} - 0.314 Log\frac{V_*}{\omega}\right) Log\left(\frac{VS}{\omega} - \frac{V_{cr}S}{\omega}\right)$$

	D = 0.0447 mm		D = 0.0884 mm		D = 0.177 mm		D = 0.354 mm	
Q =	1090	cfs	1090	cfs	1090	cfs	1090	cfs
y =	0.98	ft	0.98	ft	0.98	ft	0.98	ft
V =	4.13	fps	4.13	fps	4.13	fps	4.13	fps
D =	0.0447	mm	0.0884	mm	0.177	mm	0.354	mm
D =	0.00015	ft	0.00029	ft	0.00058	ft	0.00116	ft
S =	0.016043	ft/ft	0.016043	ft/ft	0.016043	ft/ft	0.016043	ft/ft
ν =	1.41E-05	ft^2/s	1.41E-05	ft^2/s	1.41E-05	ft^2/s	1.41E-05	ft^2/s
ω =	0.0070	fps	0.0210	fps	0.0700	fps	0.2000	fps
γ =	62.4	lb/ft^3	62.4	lb/ft^3	62.4	lb/ft^3	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$	1.94	$slugs/ft^3$	1.94	$slugs/ft^3$	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2	0.981	lb/ft^2	0.981	lb/ft^2	0.981	lb/ft^2
V_* =	0.711	fps	0.711	fps	0.711	fps	0.711	fps
V_*D_{50}/v =	7.40		14.63		29.29		58.58	
V_{cr}/ω =	3.750		2.922		2.437		2.124	
$V_{cr}S/\omega$ =	0.060		0.047		0.039		0.034	
VS/ω =	9.465		3.155		0.947		0.331	
V_*/ω =	101.59		33.86		10.16		3.56	
$\omega D_{50}/v$ =	0.07		0.43		2.88		16.47	
Log C_t =	6.434		5.563		4.789		4.241	
C_t =	2716364	ppm by weight	365661	ppm by weight	61481	ppm by weight	17405	ppm by weight
Q_s =	7981469	tons/day	1074419	tons/day	180648	tons/day	51140	tons/day

D = 0.707 mm		
Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	0.707	mm
D =	0.00232	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.3500	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/ν =	116.99	
V_{cr}/ω =	1.905	
$V_{cr}S/\omega$ =	0.031	
VS/ω =	0.189	
V_*/ω =	2.03	
$\omega D_{50}/\nu$ =	57.58	
Log C_t =	4.006	
C_t =	10131	ppm by weight
Q_s =	29768	tons/day

D = 1.41 mm		
Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	1.41	mm
D =	0.00463	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	0.7200	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/ν =	233.31	
V_{cr}/ω =	1.743	
$V_{cr}S/\omega$ =	0.028	
VS/ω =	0.092	
V_*/ω =	0.99	
$\omega D_{50}/\nu$ =	236.22	
Log C_t =	3.768	
C_t =	5863	ppm by weight
Q_s =	17228	tons/day

D =2.83 mm		
Q =	1090	cfs
y =	0.98	ft
V =	4.13	fps
D =	2.83	mm
D =	0.00928	ft
S =	0.016043	ft/ft
ν =	1.41E-05	ft^2/s
ω =	1.1000	fps
γ =	62.4	lb/ft^3
ρ =	1.94	$slugs/ft^3$
τ_o =	0.981	lb/ft^2
V_* =	0.711	fps
V_*D_{50}/ν =	468.27	
V_{cr}/ω =	1.618	
$V_{cr}S/\omega$ =	0.026	
VS/ω =	0.060	
V_*/ω =	0.65	
$\omega D_{50}/\nu$ =	724.34	
Log C_t =	3.695	
C_t =	4950	ppm by weight
Q_s =	14545	tons/day

From Fig. 3.1 HDS-6		
Grain Cl.	D (mm)	ω (fps)
CM	0.0447	0.007
VFS	0.0884	0.021
FS	0.177	0.070
MS	0.354	0.200
CS	0.707	0.350
VCS	1.41	0.720
VFG	2.83	1.100

Transport Rating Curve for B.C.		
Grain Cl.	tons/day	fraction
FM	7981469	**0.8537**
MM	1074419	**0.1149**
CM	180648	**0.0193**
VFS	51140	**0.0055**
FS	29768	**0.0032**
MS	17228	**0.0018**
CS	14545	**0.0016**

HEC-RAS Steady Flow Output:

y - Hydraulic radius

V - Cross section velocity

S - Energy slope

Appendix L
Existing Conditions HEC-RAS Sediment Transport Analysis Model Output – Tables and Profiles Showing Streambed Changes

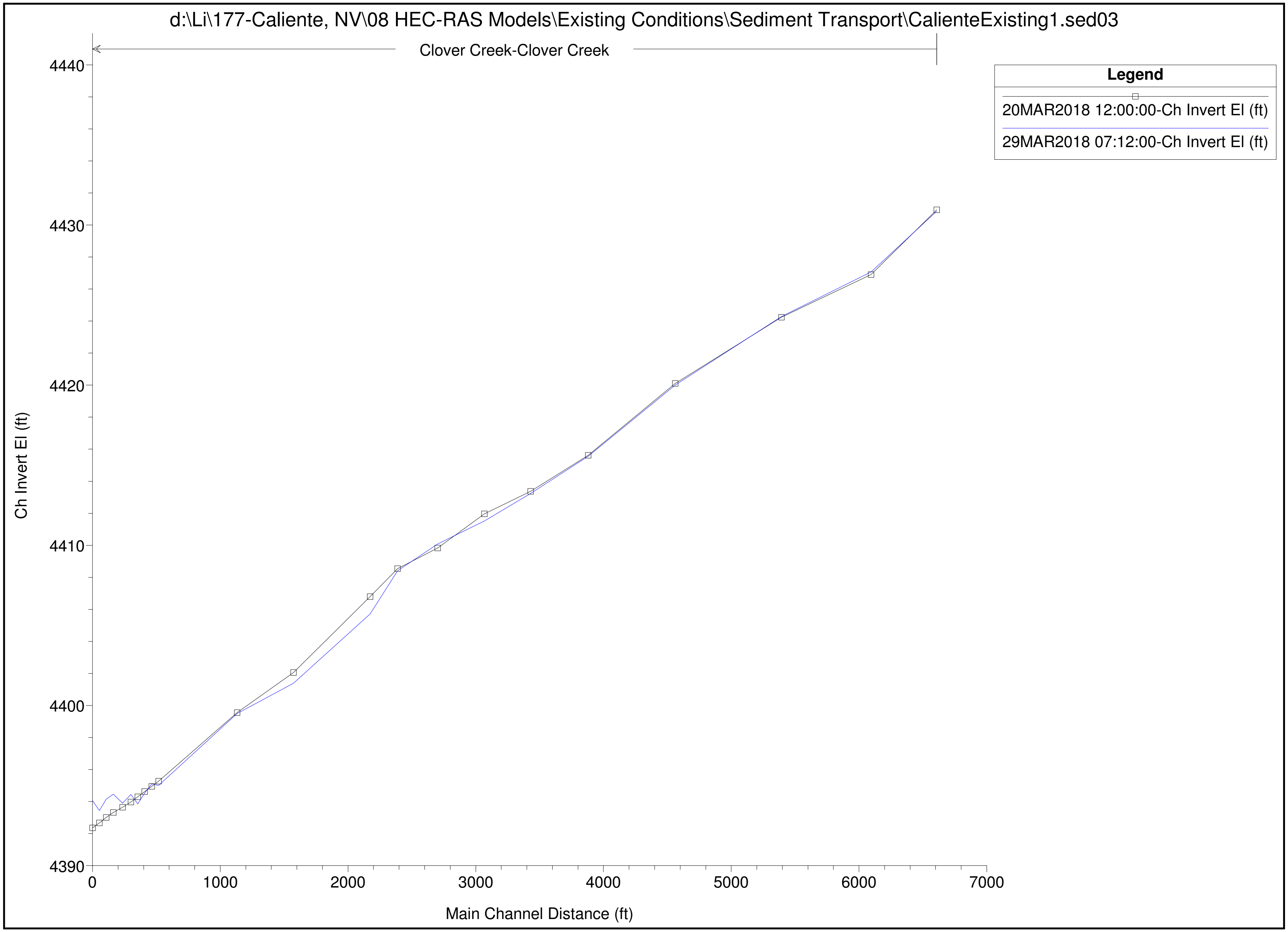
Caliente Floodway Improvements
Sediment Transport Analysis Results

2-Year Storm

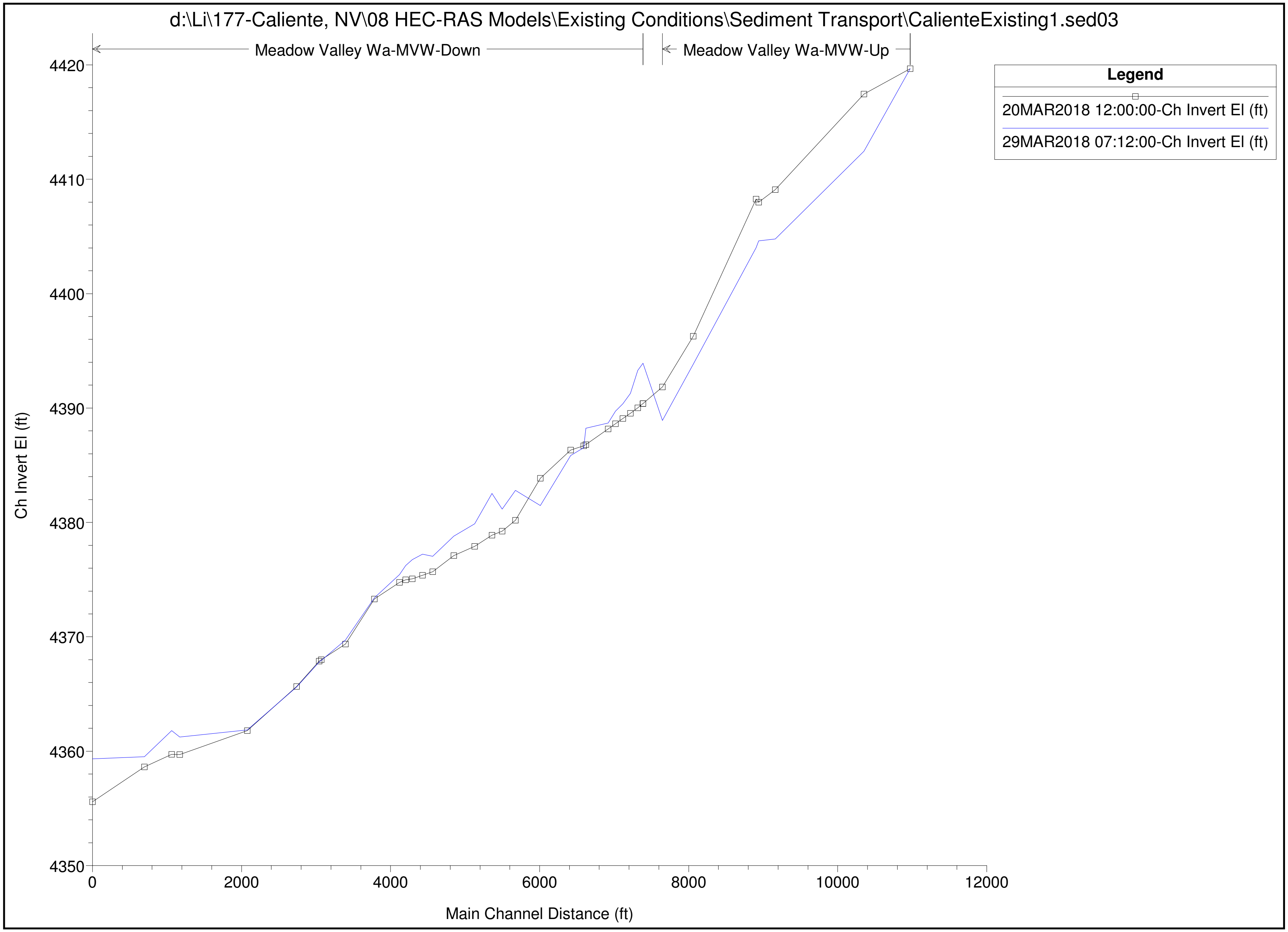
	River	Reach	R. Station	Elev. Begin (ft)	Elev. End (ft)	Δ (ft)
1	Clover Creek	CC	7623.96	4430.95	4430.86	-0.09
2	Clover Creek	CC	7111.13	4426.91	4427.07	0.15
3	Clover Creek	CC	6409.01	4424.24	4424.29	0.05
4	Clover Creek	CC	5577.60	4420.11	4420.01	-0.10
5	Clover Creek	CC	4897.08	4415.62	4415.57	-0.06
6	Clover Creek	CC	4446.53	4413.37	4413.23	-0.14
7	Clover Creek	CC	4084.21	4411.96	4411.52	-0.44
8	Clover Creek	CC	3719.14	4409.83	4410.08	0.25
9	Clover Creek	CC	3404.10	4408.55	4408.41	-0.14
10	Clover Creek	CC	3189.97	4406.79	4405.72	-1.07
11	Clover Creek	CC	2589.51	4402.05	4401.39	-0.66
12	Clover Creek	CC	2147.64	4399.56	4399.49	-0.07
13	Clover Creek	CC	1533.57	4395.27	4395.01	-0.26
14	Clover Creek	CC	1479.44*	4394.95	4395.10	0.15
15	Clover Creek	CC	1425.31*	4394.62	4394.53	-0.10
16	Clover Creek	CC	1371.18*	4394.30	4393.85	-0.45
17	Clover Creek	CC	1327.05*	4393.97	4394.45	0.48
18	Clover Creek	CC	1282.92*	4393.65	4393.90	0.25
19	Clover Creek	CC	1208.79*	4393.32	4394.46	1.14
20	Clover Creek	CC	1154.66*	4393.00	4394.14	1.14
21	Clover Creek	CC	1100.53*	4392.67	4393.44	0.77
22	Clover Creek	CC	1046.40	4392.35	4394.06	1.71
23	CC - MVW	MVW - CC		Confluence		
24	M. V. Wash	MVW-Up	12095.00	4419.67	4419.67	0.00
25	M. V. Wash	MVW-Up	11475.85	4417.44	4412.45	-4.99
26	M. V. Wash	MVW-Up	10284.37	4409.09	4404.79	-4.30
27	M. V. Wash	MVW-Up	10062.85	4408.00	4404.61	-3.39
28	M. V. Wash	MVW-Up	10028.82	4408.27	4404.01	-4.26
29	M. V. Wash	MVW-Up	9184.98	4396.27	4393.83	-2.44
30	M. V. Wash	MVW-Up	8771.51	4391.84	4388.92	-2.93
31	M. V. Wash	MVW - CC		Confluence		
32	M. V. Wash	MVW-Down	8511.49	4390.39	4393.91	3.52
33	M. V. Wash	MVW-Down	8440.11	4390.01	4393.30	3.29
34	M. V. Wash	MVW-Down	8340.40*	4389.55	4391.28	1.73
35	M. V. Wash	MVW-Down	8240.70*	4389.09	4390.38	1.29
36	M. V. Wash	MVW-Down	8140.99*	4388.63	4389.73	1.10
37	M. V. Wash	MVW-Down	8041.29*	4388.18	4388.68	0.50
38	M. V. Wash	MVW-Down	7742.17	4386.80	4388.23	1.43

39	M. V. Wash	MVW-Down	7714.35	4386.70	4386.54	-0.16
40	M. V. Wash	MVW-Down	7539.37	4386.33	4385.86	-0.47
41	M. V. Wash	MVW-Down	7131.16	4383.85	4381.48	-2.37
42	M. V. Wash	MVW-Down	6799.08	4380.18	4382.79	2.61
43	M. V. Wash	MVW-Down	6620.54	4379.24	4381.17	1.93
44	M. V. Wash	MVW-Down	6485.08	4378.89	4382.54	3.65
45	M. V. Wash	MVW-Down	6252.93	4377.91	4379.89	1.98
46	M. V. Wash	MVW-Down	5972.18	4377.09	4378.79	1.70
47	M. V. Wash	MVW-Down	5687.36	4375.70	4377.05	1.35
48	M. V. Wash	MVW-Down	5551.77*	4375.38	4377.22	1.84
49	M. V. Wash	MVW-Down	5416.17	4375.06	4376.74	1.68
50	M. V. Wash	MVW-Down	5326.25	4374.99	4376.23	1.24
51	M. V. Wash	MVW-Down	5243.44	4374.76	4375.45	0.69
52	M. V. Wash	MVW-Down	4905.68	4373.30	4373.40	0.10
53	M. V. Wash	MVW-Down	4516.37	4369.36	4369.72	0.36
54	M. V. Wash	MVW-Down	4193.80*	4367.99	4367.93	-0.06
55	M. V. Wash	MVW-Down	4164.47	4367.87	4367.78	-0.09
56	M. V. Wash	MVW-Down	3860.88	4365.65	4365.62	-0.03
57	M. V. Wash	MVW-Down	3200.70	4361.79	4361.87	0.07
58	M. V. Wash	MVW-Down	2294.13	4359.71	4361.23	1.52
59	M. V. Wash	MVW-Down	2185.97	4359.73	4361.80	2.07
60	M. V. Wash	MVW-Down	1821.41	4358.63	4359.52	0.89
61	M. V. Wash	MVW-Down	1123.12	4355.57	4359.33	3.76

* Interpolated Cross Section



d:\Li\177-Caliente, NV\08 HEC-RAS Models\Existing Conditions\Sediment Transport\CalienteExisting1.sed03
Clover Creek-Clover Creek
Legend
20MAR2018 12:00:00-Ch Invert El (ft)
29MAR2018 07:12:00-Ch Invert El (ft)
Ch Invert El (ft)
4440
4430
4420
4410
4400
4390
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)

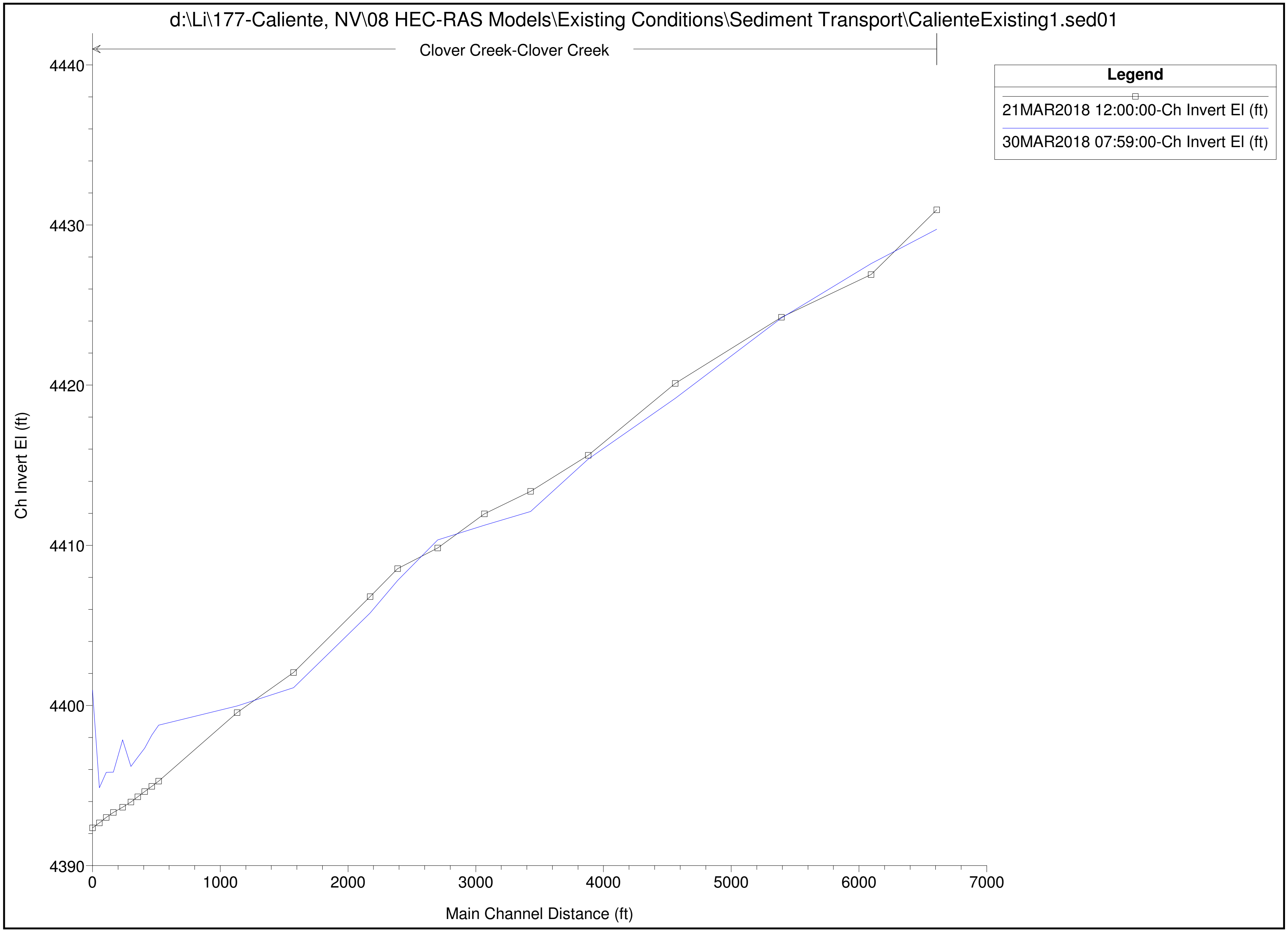

d:\Li\177-Caliente, NV\08 HEC-RAS Models\Existing Conditions\Sediment Transport\CalienteExisting1.sed03
Meadow Valley Wa-MVW-Down
Meadow Valley Wa-MVW-Up
Legend
20MAR2018 12:00:00-Ch Invert El (ft)
29MAR2018 07:12:00-Ch Invert El (ft)
Ch Invert El (ft)
Main Channel Distance (ft)
4350
4360
4370
4380
4390
4400
4410
4420
0
2000
4000
6000
8000
10000
12000

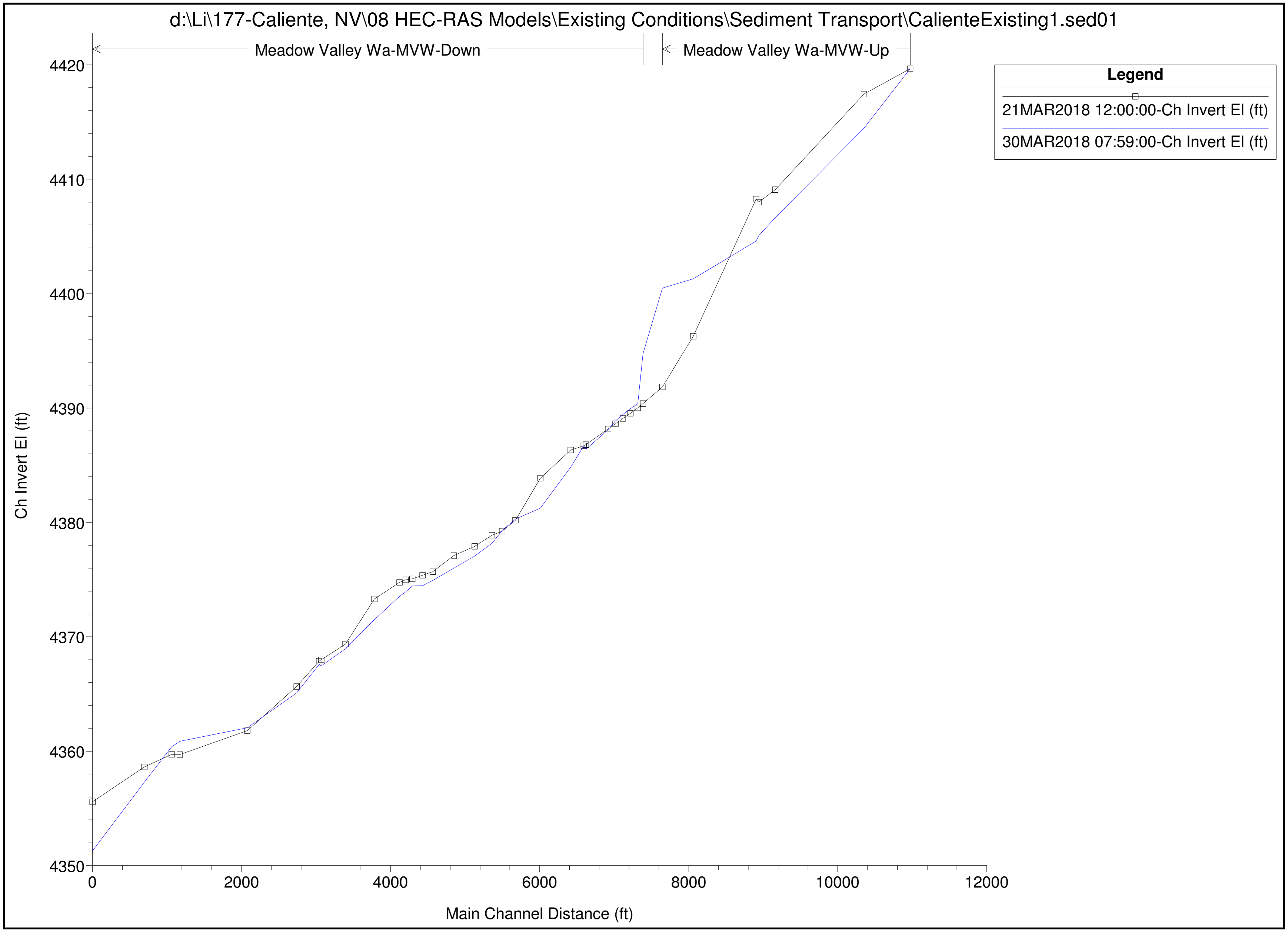
5-Year Storm

	River	Reach	R. Station	Elev. Begin (ft)	Elev. End (ft)	Δ (ft)
1	Clover Creek	CC	7623.96	4430.95	4429.73	-1.22
2	Clover Creek	CC	7111.13	4426.91	4427.59	0.68
3	Clover Creek	CC	6409.01	4424.24	4424.20	-0.04
4	Clover Creek	CC	5577.60	4420.11	4419.17	-0.94
5	Clover Creek	CC	4897.08	4415.62	4415.39	-0.23
6	Clover Creek	CC	4446.53	4413.37	4412.11	-1.26
7	Clover Creek	CC	4084.21	4411.96	4411.25	-0.71
8	Clover Creek	CC	3719.14	4409.83	4410.34	0.51
9	Clover Creek	CC	3404.10	4408.55	4407.81	-0.74
10	Clover Creek	CC	3189.97	4406.79	4405.77	-1.02
11	Clover Creek	CC	2589.51	4402.05	4401.11	-0.94
12	Clover Creek	CC	2147.64	4399.56	4399.97	0.41
13	Clover Creek	CC	1533.57	4395.27	4398.78	3.50
14	Clover Creek	CC	1479.44*	4394.95	4398.15	3.20
15	Clover Creek	CC	1425.31*	4394.62	4397.34	2.72
16	Clover Creek	CC	1371.18*	4394.30	4396.77	2.47
17	Clover Creek	CC	1327.05*	4393.97	4396.19	2.22
18	Clover Creek	CC	1282.92*	4393.65	4397.84	4.19
19	Clover Creek	CC	1208.79*	4393.32	4395.84	2.52
20	Clover Creek	CC	1154.66*	4393.00	4395.82	2.82
21	Clover Creek	CC	1100.53*	4392.67	4394.87	2.19
22	Clover Creek	CC	1046.40	4392.35	4400.96	8.61
23	CC - MVW	MVW - CC		Confluence		
24	M. V. Wash	MVW-Up	12095.00	4419.67	4419.67	0.00
25	M. V. Wash	MVW-Up	11475.85	4417.44	4414.47	-2.97
26	M. V. Wash	MVW-Up	10284.37	4409.09	4406.64	-2.45
27	M. V. Wash	MVW-Up	10062.85	4408.00	4405.07	-2.93
28	M. V. Wash	MVW-Up	10028.82	4408.27	4404.60	-3.67
29	M. V. Wash	MVW-Up	9184.98	4396.27	4401.30	5.03
30	M. V. Wash	MVW-Up	8771.51	4391.84	4400.49	8.65
31	M. V. Wash	MVW - CC		Confluence		
32	M. V. Wash	MVW-Down	8511.49	4390.39	4394.75	4.36
33	M. V. Wash	MVW-Down	8440.11	4390.01	4390.37	0.36
34	M. V. Wash	MVW-Down	8340.40*	4389.55	4389.96	0.41
35	M. V. Wash	MVW-Down	8240.70*	4389.09	4389.43	0.34
36	M. V. Wash	MVW-Down	8140.99*	4388.63	4388.89	0.26
37	M. V. Wash	MVW-Down	8041.29*	4388.18	4388.12	-0.06
38	M. V. Wash	MVW-Down	7742.17	4386.80	4386.38	-0.42
39	M. V. Wash	MVW-Down	7714.35	4386.70	4386.70	0.00
40	M. V. Wash	MVW-Down	7539.37	4386.33	4384.84	-1.49
41	M. V. Wash	MVW-Down	7131.16	4383.85	4381.24	-2.61

42	M. V. Wash	MVW-Down	6799.08	4380.18	4380.29	0.11
43	M. V. Wash	MVW-Down	6620.54	4379.24	4379.30	0.06
44	M. V. Wash	MVW-Down	6485.08	4378.89	4378.18	-0.71
45	M. V. Wash	MVW-Down	6252.93	4377.91	4377.06	-0.85
46	M. V. Wash	MVW-Down	5972.18	4377.09	4375.99	-1.10
47	M. V. Wash	MVW-Down	5687.36	4375.70	4374.93	-0.77
48	M. V. Wash	MVW-Down	5551.77*	4375.38	4374.48	-0.90
49	M. V. Wash	MVW-Down	5416.17	4375.06	4374.44	-0.62
50	M. V. Wash	MVW-Down	5326.25	4374.99	4373.93	-1.06
51	M. V. Wash	MVW-Down	5243.44	4374.76	4373.53	-1.24
52	M. V. Wash	MVW-Down	4905.68	4373.30	4371.51	-1.79
53	M. V. Wash	MVW-Down	4516.37	4369.36	4368.95	-0.41
54	M. V. Wash	MVW-Down	4193.80*	4367.99	4367.46	-0.53
55	M. V. Wash	MVW-Down	4164.47	4367.87	4367.58	-0.29
56	M. V. Wash	MVW-Down	3860.88	4365.65	4365.10	-0.55
57	M. V. Wash	MVW-Down	3200.70	4361.79	4362.05	0.26
58	M. V. Wash	MVW-Down	2294.13	4359.71	4360.86	1.15
59	M. V. Wash	MVW-Down	2185.97	4359.73	4360.38	0.65
60	M. V. Wash	MVW-Down	1821.41	4358.63	4357.30	-1.33
61	M. V. Wash	MVW-Down	1123.12	4355.57	4351.29	-4.28

* Interpolated Cross Section


d:\Li\177-Caliente, NV\08 HEC-RAS Models\Existing Conditions\Sediment Transport\CalienteExisting1.sed01
Clover Creek-Clover Creek
Legend
21MAR2018 12:00:00-Ch Invert El (ft)
30MAR2018 07:59:00-Ch Invert El (ft)
Ch Invert El (ft)
4390
4400
4410
4420
4430
4440
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)

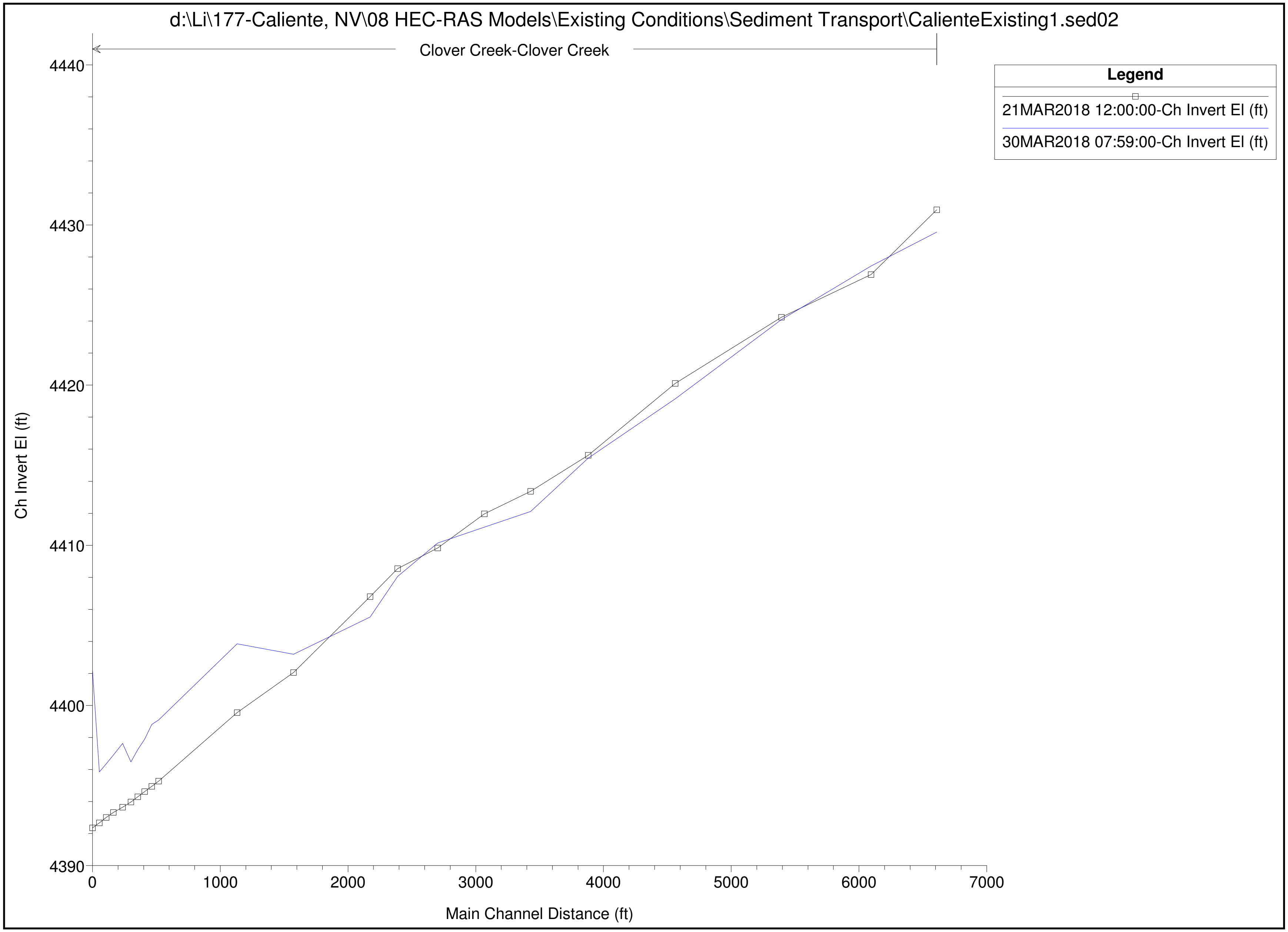

d:\Li\177-Caliente, NV\08 HEC-RAS Models\Existing Conditions\Sediment Transport\CalienteExisting1.sed01
Meadow Valley Wa-MVW-Down
Meadow Valley Wa-MVW-Up
Legend
21MAR2018 12:00:00-Ch Invert El (ft)
30MAR2018 07:59:00-Ch Invert El (ft)
Ch Invert El (ft)
4420
4410
4400
4390
4380
4370
4360
4350
0
2000
4000
6000
8000
10000
12000
Main Channel Distance (ft)

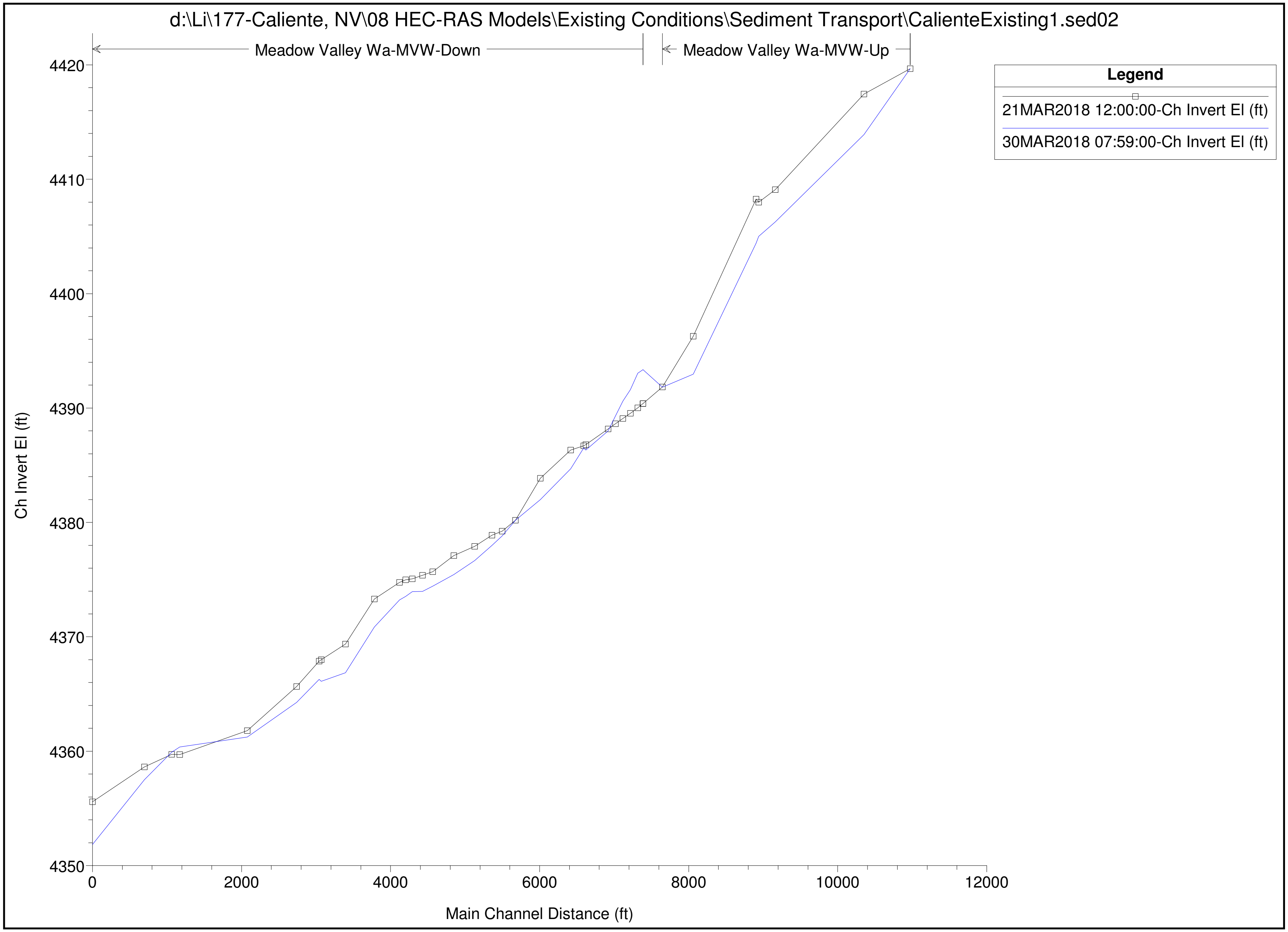
10-Year Storm

	River	Reach	R. Station	Elev. Begin (ft)	Elev. End (ft)	Δ (ft)
1	Clover Creek	CC	7623.96	4430.95	4429.56	-1.39
2	Clover Creek	CC	7111.13	4426.91	4427.45	0.54
3	Clover Creek	CC	6409.01	4424.24	4424.10	-0.14
4	Clover Creek	CC	5577.60	4420.11	4419.14	-0.97
5	Clover Creek	CC	4897.08	4415.62	4415.45	-0.17
6	Clover Creek	CC	4446.53	4413.37	4412.11	-1.26
7	Clover Creek	CC	4084.21	4411.96	4411.14	-0.82
8	Clover Creek	CC	3719.14	4409.83	4410.14	0.31
9	Clover Creek	CC	3404.10	4408.55	4408.05	-0.50
10	Clover Creek	CC	3189.97	4406.79	4405.52	-1.27
11	Clover Creek	CC	2589.51	4402.05	4403.19	1.14
12	Clover Creek	CC	2147.64	4399.56	4403.85	4.29
13	Clover Creek	CC	1533.57	4395.27	4399.09	3.82
14	Clover Creek	CC	1479.44*	4394.95	4398.81	3.86
15	Clover Creek	CC	1425.31*	4394.62	4397.89	3.27
16	Clover Creek	CC	1371.18*	4394.30	4397.24	2.94
17	Clover Creek	CC	1327.05*	4393.97	4396.47	2.49
18	Clover Creek	CC	1282.92*	4393.65	4397.63	3.98
19	Clover Creek	CC	1208.79*	4393.32	4396.90	3.58
20	Clover Creek	CC	1154.66*	4393.00	4396.35	3.35
21	Clover Creek	CC	1100.53*	4392.67	4395.85	3.18
22	Clover Creek	CC	1046.40	4392.35	4402.15	9.80
23	CC - MVW	MVW - CC		Confluence		
24	M. V. Wash	MVW-Up	12095.00	4419.67	4419.67	0.00
25	M. V. Wash	MVW-Up	11475.85	4417.44	4413.91	-3.53
26	M. V. Wash	MVW-Up	10284.37	4409.09	4406.28	-2.81
27	M. V. Wash	MVW-Up	10062.85	4408.00	4405.00	-3.00
28	M. V. Wash	MVW-Up	10028.82	4408.27	4404.41	-3.86
29	M. V. Wash	MVW-Up	9184.98	4396.27	4392.96	-3.31
30	M. V. Wash	MVW-Up	8771.51	4391.84	4391.83	-0.01
31	M. V. Wash	MVW - CC		Confluence		
32	M. V. Wash	MVW-Down	8511.49	4390.39	4393.36	2.96
33	M. V. Wash	MVW-Down	8440.11	4390.01	4393.04	3.03
34	M. V. Wash	MVW-Down	8340.40*	4389.55	4391.61	2.06
35	M. V. Wash	MVW-Down	8240.70*	4389.09	4390.60	1.51
36	M. V. Wash	MVW-Down	8140.99*	4388.63	4389.31	0.68
37	M. V. Wash	MVW-Down	8041.29*	4388.18	4388.00	-0.18
38	M. V. Wash	MVW-Down	7742.17	4386.80	4386.33	-0.47
39	M. V. Wash	MVW-Down	7714.35	4386.70	4386.50	-0.20
40	M. V. Wash	MVW-Down	7539.37	4386.33	4384.68	-1.65
41	M. V. Wash	MVW-Down	7131.16	4383.85	4382.00	-1.85

42	M. V. Wash	MVW-Down	6799.08	4380.18	4380.18	0.00
43	M. V. Wash	MVW-Down	6620.54	4379.24	4378.81	-0.43
44	M. V. Wash	MVW-Down	6485.08	4378.89	4377.98	-0.91
45	M. V. Wash	MVW-Down	6252.93	4377.91	4376.67	-1.24
46	M. V. Wash	MVW-Down	5972.18	4377.09	4375.45	-1.65
47	M. V. Wash	MVW-Down	5687.36	4375.70	4374.43	-1.27
48	M. V. Wash	MVW-Down	5551.77*	4375.38	4373.98	-1.40
49	M. V. Wash	MVW-Down	5416.17	4375.06	4373.96	-1.10
50	M. V. Wash	MVW-Down	5326.25	4374.99	4373.53	-1.46
51	M. V. Wash	MVW-Down	5243.44	4374.76	4373.22	-1.54
52	M. V. Wash	MVW-Down	4905.68	4373.30	4370.86	-2.44
53	M. V. Wash	MVW-Down	4516.37	4369.36	4366.86	-2.50
54	M. V. Wash	MVW-Down	4193.80*	4367.99	4366.12	-1.87
55	M. V. Wash	MVW-Down	4164.47	4367.87	4366.28	-1.59
56	M. V. Wash	MVW-Down	3860.88	4365.65	4364.27	-1.38
57	M. V. Wash	MVW-Down	3200.70	4361.79	4361.25	-0.54
58	M. V. Wash	MVW-Down	2294.13	4359.71	4360.36	0.65
59	M. V. Wash	MVW-Down	2185.97	4359.73	4359.92	0.19
60	M. V. Wash	MVW-Down	1821.41	4358.63	4357.52	-1.11
61	M. V. Wash	MVW-Down	1123.12	4355.57	4351.85	-3.72

* Interpolated Cross Section


d:\Li\177-Caliente, NV\08 HEC-RAS Models\Existing Conditions\Sediment Transport\CalienteExisting1.sed02
Clover Creek-Clover Creek
Legend
21MAR2018 12:00:00-Ch Invert El (ft)
30MAR2018 07:59:00-Ch Invert El (ft)
Ch Invert El (ft)
4390
4400
4410
4420
4430
4440
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)


d:\Li\177-Caliente, NV\08 HEC-RAS Models\Existing Conditions\Sediment Transport\CalienteExisting1.sed02
Meadow Valley Wa-MVW-Down
Meadow Valley Wa-MVW-Up
Legend
21MAR2018 12:00:00-Ch Invert El (ft)
30MAR2018 07:59:00-Ch Invert El (ft)
Ch Invert El (ft)
4350
4360
4370
4380
4390
4400
4410
4420
Main Channel Distance (ft)
0
2000
4000
6000
8000
10000
12000

Appendix M
Antelope Canyon Culvert HY8 Model Output

CURRENT DATE: 04-26-2018 FILE DATE: 04-26-2018
CURRENT TIME: 12:28:51 FILE NAME: ANTELOP1

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	4416.00	4412.00	140.06	2 RCB	20.00	12.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: ANTELOP1 DATE: 04-26-2018

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4418.53	499.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4420.02	998.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4421.26	1497.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4422.40	1996.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4423.47	2496.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4424.46	2995.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4425.40	3494.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4426.31	3993.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4426.35	4018.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
4428.12	4992.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: ANTELOP1 DATE: 04-26-2018

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
0.00	0.000	0.00	0.00	0.00
4418.53	0.000	499.20	0.00	0.00
4420.02	0.000	998.40	0.00	0.00
4421.26	0.000	1497.60	0.00	0.00
4422.40	0.000	1996.80	0.00	0.00
4423.47	0.000	2496.00	0.00	0.00
4424.46	0.000	2995.20	0.00	0.00
4425.40	0.000	3494.40	0.00	0.00
4426.31	0.000	3993.60	0.00	0.00
4426.35	0.000	4018.00	0.00	0.00
4428.12	0.000	4992.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 04-26-2018 FILE DATE: 04-26-2018
CURRENT TIME: 12:28:51 FILE NAME: ANTELOP1

PERFORMANCE CURVE FOR CULVERT 1 - 2(20.00 (ft) BY 12.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	4416.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
499.20	4418.53	2.53	2.53	1-S2n	0.57	1.69	0.81	1.56	15.32	7.15
998.40	4420.02	4.02	4.02	1-S2n	1.14	2.69	1.37	2.34	18.21	9.09
1497.60	4421.26	5.26	5.26	1-S2n	1.46	3.53	1.90	2.95	19.75	10.41
1996.80	4422.40	6.40	6.40	1-S2n	1.75	4.27	2.37	3.47	21.06	11.43
2496.00	4423.47	7.47	7.47	1-S2n	2.03	4.96	2.85	3.93	21.93	12.26
2995.20	4424.46	8.46	8.46	1-S2n	2.32	5.60	3.30	4.35	22.72	12.98
3494.40	4425.40	9.40	9.40	1-S2n	2.57	6.20	3.70	4.73	23.60	13.61
3993.60	4426.31	10.31	10.31	1-S2n	2.79	6.78	4.08	5.10	24.48	14.18
4018.00	4426.35	10.35	10.35	1-S2n	2.80	6.81	4.11	5.11	24.46	14.20
4992.00	4428.12	12.12	12.12	5-S2n	3.24	7.87	4.87	5.75	25.64	15.16

El. inlet face invert 4416.00 ft El. outlet invert 4412.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **************

INLET STATION	0.00 ft
INLET ELEVATION	4416.00 ft
OUTLET STATION	140.00 ft
OUTLET ELEVATION	4412.00 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0286
CULVERT LENGTH ALONG SLOPE	140.06 ft

***** CULVERT DATA SUMMARY ************************

BARREL SHAPE	BOX
BARREL SPAN	20.00 ft
BARREL RISE	12.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (30-75 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 04-26-2018 FILE DATE: 04-26-2018
CURRENT TIME: 12:28:51 FILE NAME: ANTELOP1

TAILWATER

******* REGULAR CHANNEL CROSS SECTION ****************

BOTTOM WIDTH	40.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.030
MANNING'S n (.01-0.1)	0.045
CHANNEL INVERT ELEVATION	4412.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	4412.00 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	4412.00	0.000	0.00	0.00	0.00
499.20	4413.56	1.009	1.56	7.15	2.92
998.40	4414.34	1.048	2.34	9.09	4.37
1497.60	4414.95	1.069	2.95	10.41	5.51
1996.80	4415.47	1.081	3.47	11.43	6.49
2496.00	4415.93	1.090	3.93	12.26	7.36
2995.20	4416.35	1.097	4.35	12.98	8.14
3494.40	4416.73	1.102	4.73	13.61	8.86
3993.60	4417.10	1.107	5.10	14.18	9.54
4018.00	4417.11	1.107	5.11	14.20	9.57
4992.00	4417.75	1.114	5.75	15.16	10.77

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	100.00 ft
CREST LENGTH	200.00 ft
OVERTOPPING CREST ELEVATION	4426.30 ft

Appendix N
Newman Canyon Watershed HY8 Model Output

```
1***************************************                                                                               ***************************************
 *                                     *                                                                               *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                                             *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998             *                                                                               *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1               *                                                                               *          609 SECOND STREET          *
 *                                     *                                                                               *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   30APR18  TIME  18:14:15   *                                                                             *           (916) 756-1104            *
 *                                     *                                                                               *                                     *
 ***************************************                                                                               ***************************************


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


                         THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

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

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

 *** FREE ***
                        *DIAGRAM
            1           ID   NEWMAN CANYON WATERSHED
            2           ID   CALIENTE, NEVADA
            3           ID
            4           ID   MODELED BY SUNRISE ENGINEERING, INC.
            5           ID   INPUT FILE - NEWMAN24.DAT
            6           ID
            7           JP       5
            8           IT       3       0       0     541
            9           IO       5       0       0
           10           IN      15
                        *

           11           KK     SW1
           12           KM   NEWMAN WATERSHED
           13           BA   13.42
                        *
                        * NOAA ATLAS 14 VOLUME 1 VERSION 5
                        * 5-, 10-, 25-, 50- AND 100-YEAR 24-HOUR RAINFALL DEPTHS
           14           PG       5    1.89
           15           PG      10    2.20
           16           PG      25    2.62
           17           PG      50    2.96
           18           PG     100    3.31
                        *
                        * SCS TYPE II 24-HOUR RAINFALL DISTRIBUTION
           19           PG      24
           20           PC     0.0     0.2     0.5     0.8     1.1     1.4     1.7     2.0     2.3     2.6
           21           PC     2.9     3.2     3.5     3.8     4.1     4.4     4.8     5.2     5.6     6.0
           22           PC     6.4     6.8     7.2     7.6     8.0     8.5     9.0     9.5    10.0    10.5
           23           PC    11.0    11.5    12.0    12.6    13.3    14.0    14.7    15.5    16.3    17.2
           24           PC    18.1    19.1    20.3    21.8    23.6    25.7    28.3    38.7    66.3    70.7
           25           PC    73.5    75.8    77.6    79.1    80.4    81.5    82.5    83.4    84.2    84.9
           26           PC    85.6    86.3    86.9    87.5    88.1    88.7    89.3    89.8    90.3    90.8
           27           PC    91.3    91.8    92.2    92.6    93.0    93.4    93.8    94.2    94.6    95.0
           28           PC    95.3    95.6    95.9    96.2    96.5    96.8    97.1    97.4    97.7    98.0
           29           PC    98.3    98.6    98.9    99.2    99.5    99.8   100.0
                        *
           30           KM   5-YEAR STORM
           31           PR      24
           32           PT       5
                        *
                        * SCS CURVE NUMBER LOSS RATE
                        * HYDROLOGIC SOIL GROUP D, FAIR LANDCOVER CONDITION
           33           LS       0    80.0
                        *
                        * SCS UNIT HYDROGRAPH APPROACH
                        * USACE LAG TIME TLAG
           34           UD   2.102
                        *
           35           KO       1
                        *
           36           KP       2
           37           KM   10-YEAR STORM
```

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

  38          PR      24
  39          PT      10
  40          LS       0    80.0
              *
  41          KO       1
              *
  42          KP       3
  43          KM   25-YEAR STORM
  44          PR      24
  45          PT      25
  46          LS       0    80.0
              *
  47          KO       1
              *
  48          KP       4
  49          KM   50-YEAR STORM
  50          PR      24
  51          PT      50
  52          LS       0    80.0
              *
  53          KO       1
              *
  54          KP       5
  55          KM   100-YEAR STORM
  56          PR      24
  57          PT     100
  58          LS       0    80.0
              *
  59          KO       1
              *
  60          ZZ
```

```
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

    11         SW1

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

```
1***************************************                                                         ***************************************
 *                                     *                                                         *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                       *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998             *                                                         *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1               *                                                         *          609 SECOND STREET          *
 *                                     *                                                         *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   30APR18  TIME  18:14:15   *                                                       *            (916) 756-1104           *
 *                                     *                                                         *                                     *
 ***************************************                                                         ***************************************


                           NEWMAN CANYON WATERSHED
                           CALIENTE, NEVADA

                           MODELED BY SUNRISE ENGINEERING, INC.
                           INPUT FILE - NEWMAN24.DAT

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

      IT          HYDROGRAPH TIME DATA
                         NMIN           3  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1    0  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ         541  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE      2    0  ENDING DATE
                       NDTIME        0300  ENDING TIME
                        ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL     .05 HOURS
                         TOTAL TIME BASE   27.00 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT

      JP          MULTI-PLAN OPTION
                        NPLAN           5  NUMBER OF PLANS

      JR          MULTI-RATIO OPTION
                      RATIOS OF RUNOFF
                     1.00
```

****

HYDROGRAPH AT STATION SW1
PLAN 1, RATIO = 1.00

****

DA MON	HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW
1	0000	1	0.	*	1	0648	137	0.	*	1	1336	273	680.	*	1	2024	409	177.
1	0003	2	0.	*	1	0651	138	0.	*	1	1339	274	700.	*	1	2027	410	176.
1	0006	3	0.	*	1	0654	139	0.	*	1	1342	275	718.	*	1	2030	411	175.
1	0009	4	0.	*	1	0657	140	0.	*	1	1345	276	735.	*	1	2033	412	174.
1	0012	5	0.	*	1	0700	141	0.	*	1	1348	277	750.	*	1	2036	413	173.
1	0015	6	0.	*	1	0703	142	0.	*	1	1351	278	764.	*	1	2039	414	171.
1	0018	7	0.	*	1	0706	143	0.	*	1	1354	279	776.	*	1	2042	415	170.
1	0021	8	0.	*	1	0709	144	0.	*	1	1357	280	787.	*	1	2045	416	169.
1	0024	9	0.	*	1	0712	145	0.	*	1	1400	281	798.	*	1	2048	417	168.
1	0027	10	0.	*	1	0715	146	0.	*	1	1403	282	807.	*	1	2051	418	167.
1	0030	11	0.	*	1	0718	147	0.	*	1	1406	283	815.	*	1	2054	419	166.
1	0033	12	0.	*	1	0721	148	0.	*	1	1409	284	821.	*	1	2057	420	164.
1	0036	13	0.	*	1	0724	149	0.	*	1	1412	285	826.	*	1	2100	421	163.
1	0039	14	0.	*	1	0727	150	0.	*	1	1415	286	829.	*	1	2103	422	162.
1	0042	15	0.	*	1	0730	151	0.	*	1	1418	287	831.	*	1	2106	423	161.
1	0045	16	0.	*	1	0733	152	0.	*	1	1421	288	831.	*	1	2109	424	160.
1	0048	17	0.	*	1	0736	153	0.	*	1	1424	289	831.	*	1	2112	425	159.
1	0051	18	0.	*	1	0739	154	0.	*	1	1427	290	829.	*	1	2115	426	157.
1	0054	19	0.	*	1	0742	155	0.	*	1	1430	291	827.	*	1	2118	427	156.
1	0057	20	0.	*	1	0745	156	0.	*	1	1433	292	824.	*	1	2121	428	155.
1	0100	21	0.	*	1	0748	157	0.	*	1	1436	293	820.	*	1	2124	429	154.
1	0103	22	0.	*	1	0751	158	0.	*	1	1439	294	815.	*	1	2127	430	153.
1	0106	23	0.	*	1	0754	159	0.	*	1	1442	295	810.	*	1	2130	431	152.
1	0109	24	0.	*	1	0757	160	0.	*	1	1445	296	804.	*	1	2133	432	151.
1	0112	25	0.	*	1	0800	161	0.	*	1	1448	297	796.	*	1	2136	433	149.
1	0115	26	0.	*	1	0803	162	0.	*	1	1451	298	788.	*	1	2139	434	148.
1	0118	27	0.	*	1	0806	163	0.	*	1	1454	299	779.	*	1	2142	435	147.
1	0121	28	0.	*	1	0809	164	0.	*	1	1457	300	769.	*	1	2145	436	146.
1	0124	29	0.	*	1	0812	165	0.	*	1	1500	301	758.	*	1	2148	437	145.
1	0127	30	0.	*	1	0815	166	0.	*	1	1503	302	746.	*	1	2151	438	144.
1	0130	31	0.	*	1	0818	167	0.	*	1	1506	303	733.	*	1	2154	439	143.
1	0133	32	0.	*	1	0821	168	0.	*	1	1509	304	720.	*	1	2157	440	142.
1	0136	33	0.	*	1	0824	169	0.	*	1	1512	305	706.	*	1	2200	441	141.
1	0139	34	0.	*	1	0827	170	0.	*	1	1515	306	691.	*	1	2203	442	140.
1	0142	35	0.	*	1	0830	171	0.	*	1	1518	307	677.	*	1	2206	443	139.
1	0145	36	0.	*	1	0833	172	0.	*	1	1521	308	663.	*	1	2209	444	138.
1	0148	37	0.	*	1	0836	173	0.	*	1	1524	309	650.	*	1	2212	445	137.
1	0151	38	0.	*	1	0839	174	0.	*	1	1527	310	637.	*	1	2215	446	136.
1	0154	39	0.	*	1	0842	175	0.	*	1	1530	311	624.	*	1	2218	447	135.
1	0157	40	0.	*	1	0845	176	0.	*	1	1533	312	612.	*	1	2221	448	134.
1	0200	41	0.	*	1	0848	177	0.	*	1	1536	313	600.	*	1	2224	449	133.
1	0203	42	0.	*	1	0851	178	0.	*	1	1539	314	589.	*	1	2227	450	132.
1	0206	43	0.	*	1	0854	179	0.	*	1	1542	315	578.	*	1	2230	451	132.
1	0209	44	0.	*	1	0857	180	0.	*	1	1545	316	567.	*	1	2233	452	131.
1	0212	45	0.	*	1	0900	181	0.	*	1	1548	317	557.	*	1	2236	453	130.
1	0215	46	0.	*	1	0903	182	0.	*	1	1551	318	546.	*	1	2239	454	129.
1	0218	47	0.	*	1	0906	183	0.	*	1	1554	319	536.	*	1	2242	455	129.
1	0221	48	0.	*	1	0909	184	0.	*	1	1557	320	526.	*	1	2245	456	128.
1	0224	49	0.	*	1	0912	185	0.	*	1	1600	321	516.	*	1	2248	457	127.
1	0227	50	0.	*	1	0915	186	0.	*	1	1603	322	507.	*	1	2251	458	127.

1	0230	51	0.	*	1	0918	187	0.	*	1	1606	323	498.	*	1	2254	459	126.
1	0233	52	0.	*	1	0921	188	0.	*	1	1609	324	489.	*	1	2257	460	126.
1	0236	53	0.	*	1	0924	189	0.	*	1	1612	325	481.	*	1	2300	461	125.
1	0239	54	0.	*	1	0927	190	0.	*	1	1615	326	473.	*	1	2303	462	125.
1	0242	55	0.	*	1	0930	191	0.	*	1	1618	327	465.	*	1	2306	463	124.
1	0245	56	0.	*	1	0933	192	0.	*	1	1621	328	457.	*	1	2309	464	124.
1	0248	57	0.	*	1	0936	193	0.	*	1	1624	329	449.	*	1	2312	465	123.
1	0251	58	0.	*	1	0939	194	0.	*	1	1627	330	442.	*	1	2315	466	123.
1	0254	59	0.	*	1	0942	195	0.	*	1	1630	331	434.	*	1	2318	467	123.
1	0257	60	0.	*	1	0945	196	0.	*	1	1633	332	427.	*	1	2321	468	122.
1	0300	61	0.	*	1	0948	197	0.	*	1	1636	333	420.	*	1	2324	469	122.
1	0303	62	0.	*	1	0951	198	0.	*	1	1639	334	413.	*	1	2327	470	122.
1	0306	63	0.	*	1	0954	199	0.	*	1	1642	335	406.	*	1	2330	471	121.
1	0309	64	0.	*	1	0957	200	0.	*	1	1645	336	399.	*	1	2333	472	121.
1	0312	65	0.	*	1	1000	201	0.	*	1	1648	337	393.	*	1	2336	473	121.
1	0315	66	0.	*	1	1003	202	0.	*	1	1651	338	386.	*	1	2339	474	120.
1	0318	67	0.	*	1	1006	203	0.	*	1	1654	339	380.	*	1	2342	475	120.
1	0321	68	0.	*	1	1009	204	0.	*	1	1657	340	373.	*	1	2345	476	120.
1	0324	69	0.	*	1	1012	205	0.	*	1	1700	341	368.	*	1	2348	477	120.
1	0327	70	0.	*	1	1015	206	0.	*	1	1703	342	362.	*	1	2351	478	119.
1	0330	71	0.	*	1	1018	207	0.	*	1	1706	343	357.	*	1	2354	479	119.
1	0333	72	0.	*	1	1021	208	0.	*	1	1709	344	351.	*	1	2357	480	119.
1	0336	73	0.	*	1	1024	209	0.	*	1	1712	345	346.	*	2	0000	481	119.
1	0339	74	0.	*	1	1027	210	0.	*	1	1715	346	341.	*	2	0003	482	118.
1	0342	75	0.	*	1	1030	211	0.	*	1	1718	347	336.	*	2	0006	483	118.
1	0345	76	0.	*	1	1033	212	0.	*	1	1721	348	332.	*	2	0009	484	118.
1	0348	77	0.	*	1	1036	213	0.	*	1	1724	349	327.	*	2	0012	485	118.
1	0351	78	0.	*	1	1039	214	0.	*	1	1727	350	322.	*	2	0015	486	117.
1	0354	79	0.	*	1	1042	215	0.	*	1	1730	351	318.	*	2	0018	487	117.
1	0357	80	0.	*	1	1045	216	0.	*	1	1733	352	314.	*	2	0021	488	117.
1	0400	81	0.	*	1	1048	217	0.	*	1	1736	353	310.	*	2	0024	489	116.
1	0403	82	0.	*	1	1051	218	0.	*	1	1739	354	306.	*	2	0027	490	116.
1	0406	83	0.	*	1	1054	219	0.	*	1	1742	355	302.	*	2	0030	491	115.
1	0409	84	0.	*	1	1057	220	0.	*	1	1745	356	298.	*	2	0033	492	115.
1	0412	85	0.	*	1	1100	221	0.	*	1	1748	357	294.	*	2	0036	493	114.
1	0415	86	0.	*	1	1103	222	0.	*	1	1751	358	290.	*	2	0039	494	114.
1	0418	87	0.	*	1	1106	223	0.	*	1	1754	359	287.	*	2	0042	495	113.
1	0421	88	0.	*	1	1109	224	0.	*	1	1757	360	283.	*	2	0045	496	112.
1	0424	89	0.	*	1	1112	225	0.	*	1	1800	361	280.	*	2	0048	497	112.
1	0427	90	0.	*	1	1115	226	0.	*	1	1803	362	276.	*	2	0051	498	111.
1	0430	91	0.	*	1	1118	227	0.	*	1	1806	363	273.	*	2	0054	499	110.
1	0433	92	0.	*	1	1121	228	0.	*	1	1809	364	270.	*	2	0057	500	109.
1	0436	93	0.	*	1	1124	229	0.	*	1	1812	365	267.	*	2	0100	501	108.
1	0439	94	0.	*	1	1127	230	0.	*	1	1815	366	264.	*	2	0103	502	107.
1	0442	95	0.	*	1	1130	231	0.	*	1	1818	367	261.	*	2	0106	503	105.
1	0445	96	0.	*	1	1133	232	0.	*	1	1821	368	258.	*	2	0109	504	104.
1	0448	97	0.	*	1	1136	233	0.	*	1	1824	369	255.	*	2	0112	505	103.
1	0451	98	0.	*	1	1139	234	0.	*	1	1827	370	252.	*	2	0115	506	101.
1	0454	99	0.	*	1	1142	235	1.	*	1	1830	371	250.	*	2	0118	507	100.
1	0457	100	0.	*	1	1145	236	1.	*	1	1833	372	247.	*	2	0121	508	98.
1	0500	101	0.	*	1	1148	237	2.	*	1	1836	373	245.	*	2	0124	509	96.
1	0503	102	0.	*	1	1151	238	4.	*	1	1839	374	242.	*	2	0127	510	95.
1	0506	103	0.	*	1	1154	239	6.	*	1	1842	375	240.	*	2	0130	511	93.
1	0509	104	0.	*	1	1157	240	10.	*	1	1845	376	237.	*	2	0133	512	91.
1	0512	105	0.	*	1	1200	241	14.	*	1	1848	377	235.	*	2	0136	513	89.
1	0515	106	0.	*	1	1203	242	20.	*	1	1851	378	232.	*	2	0139	514	87.
1	0518	107	0.	*	1	1206	243	27.	*	1	1854	379	230.	*	2	0142	515	85.
1	0521	108	0.	*	1	1209	244	35.	*	1	1857	380	228.	*	2	0145	516	83.
1	0524	109	0.	*	1	1212	245	44.	*	1	1900	381	226.	*	2	0148	517	81.

1	0527	110	0.	*	1	1215	246	55.	*	1	1903	382	223.	*	2	0151	518	79.
1	0530	111	0.	*	1	1218	247	66.	*	1	1906	383	221.	*	2	0154	519	77.
1	0533	112	0.	*	1	1221	248	79.	*	1	1909	384	219.	*	2	0157	520	75.
1	0536	113	0.	*	1	1224	249	92.	*	1	1912	385	217.	*	2	0200	521	73.
1	0539	114	0.	*	1	1227	250	106.	*	1	1915	386	215.	*	2	0203	522	71.
1	0542	115	0.	*	1	1230	251	122.	*	1	1918	387	213.	*	2	0206	523	69.
1	0545	116	0.	*	1	1233	252	139.	*	1	1921	388	211.	*	2	0209	524	67.
1	0548	117	0.	*	1	1236	253	157.	*	1	1924	389	209.	*	2	0212	525	65.
1	0551	118	0.	*	1	1239	254	177.	*	1	1927	390	207.	*	2	0215	526	63.
1	0554	119	0.	*	1	1242	255	198.	*	1	1930	391	205.	*	2	0218	527	61.
1	0557	120	0.	*	1	1245	256	220.	*	1	1933	392	203.	*	2	0221	528	59.
1	0600	121	0.	*	1	1248	257	244.	*	1	1936	393	201.	*	2	0224	529	57.
1	0603	122	0.	*	1	1251	258	270.	*	1	1939	394	200.	*	2	0227	530	55.
1	0606	123	0.	*	1	1254	259	297.	*	1	1942	395	198.	*	2	0230	531	53.
1	0609	124	0.	*	1	1257	260	325.	*	1	1945	396	196.	*	2	0233	532	52.
1	0612	125	0.	*	1	1300	261	354.	*	1	1948	397	195.	*	2	0236	533	50.
1	0615	126	0.	*	1	1303	262	384.	*	1	1951	398	193.	*	2	0239	534	48.
1	0618	127	0.	*	1	1306	263	415.	*	1	1954	399	191.	*	2	0242	535	46.
1	0621	128	0.	*	1	1309	264	445.	*	1	1957	400	190.	*	2	0245	536	45.
1	0624	129	0.	*	1	1312	265	475.	*	1	2000	401	188.	*	2	0248	537	43.
1	0627	130	0.	*	1	1315	266	504.	*	1	2003	402	187.	*	2	0251	538	41.
1	0630	131	0.	*	1	1318	267	532.	*	1	2006	403	185.	*	2	0254	539	40.
1	0633	132	0.	*	1	1321	268	560.	*	1	2009	404	184.	*	2	0257	540	38.
1	0636	133	0.	*	1	1324	269	587.	*	1	2012	405	183.	*	2	0300	541	37.
1	0639	134	0.	*	1	1327	270	612.	*	1	2015	406	181.	*				
1	0642	135	0.	*	1	1330	271	636.	*	1	2018	407	180.	*				
1	0645	136	0.	*	1	1333	272	658.	*	1	2021	408	179.	*				
				*					*					*				

****

```
  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     27.00-HR
+   (CFS)       (HR)
                           (CFS)
+     831.     14.35                513.        177.        158.         158.
                        (INCHES)    .355        .491        .491         .491
                         (AC-FT)    254.        352.        352.         352.

                         CUMULATIVE AREA =   13.42 SQ MI
```

HYDROGRAPH AT STATION SW1
PLAN 2, RATIO = 1.00

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0648	137	0.	1		1336	273	1006.	1		2024	409	231.
1		0003	2	0.	1		0651	138	0.	1		1339	274	1034.	1		2027	410	229.
1		0006	3	0.	1		0654	139	0.	1		1342	275	1058.	1		2030	411	228.
1		0009	4	0.	1		0657	140	0.	1		1345	276	1081.	1		2033	412	226.
1		0012	5	0.	1		0700	141	0.	1		1348	277	1101.	1		2036	413	225.
1		0015	6	0.	1		0703	142	0.	1		1351	278	1120.	1		2039	414	223.
1		0018	7	0.	1		0706	143	0.	1		1354	279	1136.	1		2042	415	221.
1		0021	8	0.	1		0709	144	0.	1		1357	280	1150.	1		2045	416	220.
1		0024	9	0.	1		0712	145	0.	1		1400	281	1163.	1		2048	417	218.
1		0027	10	0.	1		0715	146	0.	1		1403	282	1174.	1		2051	418	217.
1		0030	11	0.	1		0718	147	0.	1		1406	283	1183.	1		2054	419	215.
1		0033	12	0.	1		0721	148	0.	1		1409	284	1191.	1		2057	420	214.
1		0036	13	0.	1		0724	149	0.	1		1412	285	1196.	1		2100	421	212.
1		0039	14	0.	1		0727	150	0.	1		1415	286	1199.	1		2103	422	210.
1		0042	15	0.	1		0730	151	0.	1		1418	287	1200.	1		2106	423	209.
1		0045	16	0.	1		0733	152	0.	1		1421	288	1198.	1		2109	424	207.
1		0048	17	0.	1		0736	153	0.	1		1424	289	1195.	1		2112	425	206.
1		0051	18	0.	1		0739	154	0.	1		1427	290	1191.	1		2115	426	204.
1		0054	19	0.	1		0742	155	0.	1		1430	291	1186.	1		2118	427	203.
1		0057	20	0.	1		0745	156	0.	1		1433	292	1180.	1		2121	428	201.
1		0100	21	0.	1		0748	157	0.	1		1436	293	1173.	1		2124	429	200.
1		0103	22	0.	1		0751	158	0.	1		1439	294	1164.	1		2127	430	198.
1		0106	23	0.	1		0754	159	0.	1		1442	295	1155.	1		2130	431	197.
1		0109	24	0.	1		0757	160	0.	1		1445	296	1144.	1		2133	432	195.
1		0112	25	0.	1		0800	161	0.	1		1448	297	1132.	1		2136	433	194.
1		0115	26	0.	1		0803	162	0.	1		1451	298	1118.	1		2139	434	192.
1		0118	27	0.	1		0806	163	0.	1		1454	299	1104.	1		2142	435	191.
1		0121	28	0.	1		0809	164	0.	1		1457	300	1088.	1		2145	436	189.
1		0124	29	0.	1		0812	165	0.	1		1500	301	1070.	1		2148	437	188.
1		0127	30	0.	1		0815	166	0.	1		1503	302	1052.	1		2151	438	186.
1		0130	31	0.	1		0818	167	0.	1		1506	303	1032.	1		2154	439	185.
1		0133	32	0.	1		0821	168	0.	1		1509	304	1011.	1		2157	440	183.
1		0136	33	0.	1		0824	169	0.	1		1512	305	990.	1		2200	441	182.
1		0139	34	0.	1		0827	170	0.	1		1515	306	969.	1		2203	442	181.
1		0142	35	0.	1		0830	171	0.	1		1518	307	948.	1		2206	443	179.
1		0145	36	0.	1		0833	172	0.	1		1521	308	927.	1		2209	444	178.
1		0148	37	0.	1		0836	173	0.	1		1524	309	907.	1		2212	445	177.
1		0151	38	0.	1		0839	174	0.	1		1527	310	888.	1		2215	446	176.
1		0154	39	0.	1		0842	175	0.	1		1530	311	869.	1		2218	447	174.
1		0157	40	0.	1		0845	176	0.	1		1533	312	851.	1		2221	448	173.
1		0200	41	0.	1		0848	177	0.	1		1536	313	834.	1		2224	449	172.
1		0203	42	0.	1		0851	178	0.	1		1539	314	818.	1		2227	450	171.
1		0206	43	0.	1		0854	179	0.	1		1542	315	801.	1		2230	451	170.
1		0209	44	0.	1		0857	180	0.	1		1545	316	785.	1		2233	452	169.
1		0212	45	0.	1		0900	181	0.	1		1548	317	770.	1		2236	453	168.
1		0215	46	0.	1		0903	182	0.	1		1551	318	755.	1		2239	454	167.
1		0218	47	0.	1		0906	183	0.	1		1554	319	740.	1		2242	455	166.
1		0221	48	0.	1		0909	184	0.	1		1557	320	725.	1		2245	456	165.
1		0224	49	0.	1		0912	185	0.	1		1600	321	711.	1		2248	457	164.
1		0227	50	0.	1		0915	186	0.	1		1603	322	698.	1		2251	458	163.

1	0230	51	0.	*	1	0918	187	0.	*	1	1606	323	685.	*	1	2254	459	163.
1	0233	52	0.	*	1	0921	188	0.	*	1	1609	324	672.	*	1	2257	460	162.
1	0236	53	0.	*	1	0924	189	0.	*	1	1612	325	660.	*	1	2300	461	161.
1	0239	54	0.	*	1	0927	190	0.	*	1	1615	326	648.	*	1	2303	462	161.
1	0242	55	0.	*	1	0930	191	0.	*	1	1618	327	637.	*	1	2306	463	160.
1	0245	56	0.	*	1	0933	192	0.	*	1	1621	328	626.	*	1	2309	464	159.
1	0248	57	0.	*	1	0936	193	0.	*	1	1624	329	615.	*	1	2312	465	159.
1	0251	58	0.	*	1	0939	194	0.	*	1	1627	330	604.	*	1	2315	466	158.
1	0254	59	0.	*	1	0942	195	0.	*	1	1630	331	593.	*	1	2318	467	158.
1	0257	60	0.	*	1	0945	196	0.	*	1	1633	332	582.	*	1	2321	468	157.
1	0300	61	0.	*	1	0948	197	0.	*	1	1636	333	572.	*	1	2324	469	157.
1	0303	62	0.	*	1	0951	198	0.	*	1	1639	334	562.	*	1	2327	470	156.
1	0306	63	0.	*	1	0954	199	0.	*	1	1642	335	552.	*	1	2330	471	156.
1	0309	64	0.	*	1	0957	200	0.	*	1	1645	336	542.	*	1	2333	472	156.
1	0312	65	0.	*	1	1000	201	0.	*	1	1648	337	533.	*	1	2336	473	155.
1	0315	66	0.	*	1	1003	202	0.	*	1	1651	338	524.	*	1	2339	474	155.
1	0318	67	0.	*	1	1006	203	0.	*	1	1654	339	514.	*	1	2342	475	154.
1	0321	68	0.	*	1	1009	204	0.	*	1	1657	340	506.	*	1	2345	476	154.
1	0324	69	0.	*	1	1012	205	0.	*	1	1700	341	497.	*	1	2348	477	154.
1	0327	70	0.	*	1	1015	206	0.	*	1	1703	342	489.	*	1	2351	478	153.
1	0330	71	0.	*	1	1018	207	0.	*	1	1706	343	482.	*	1	2354	479	153.
1	0333	72	0.	*	1	1021	208	0.	*	1	1709	344	474.	*	1	2357	480	153.
1	0336	73	0.	*	1	1024	209	0.	*	1	1712	345	467.	*	2	0000	481	153.
1	0339	74	0.	*	1	1027	210	0.	*	1	1715	346	460.	*	2	0003	482	152.
1	0342	75	0.	*	1	1030	211	0.	*	1	1718	347	453.	*	2	0006	483	152.
1	0345	76	0.	*	1	1033	212	0.	*	1	1721	348	446.	*	2	0009	484	152.
1	0348	77	0.	*	1	1036	213	0.	*	1	1724	349	439.	*	2	0012	485	151.
1	0351	78	0.	*	1	1039	214	0.	*	1	1727	350	433.	*	2	0015	486	151.
1	0354	79	0.	*	1	1042	215	0.	*	1	1730	351	427.	*	2	0018	487	150.
1	0357	80	0.	*	1	1045	216	0.	*	1	1733	352	421.	*	2	0021	488	150.
1	0400	81	0.	*	1	1048	217	0.	*	1	1736	353	415.	*	2	0024	489	149.
1	0403	82	0.	*	1	1051	218	0.	*	1	1739	354	409.	*	2	0027	490	149.
1	0406	83	0.	*	1	1054	219	0.	*	1	1742	355	403.	*	2	0030	491	148.
1	0409	84	0.	*	1	1057	220	0.	*	1	1745	356	398.	*	2	0033	492	148.
1	0412	85	0.	*	1	1100	221	0.	*	1	1748	357	393.	*	2	0036	493	147.
1	0415	86	0.	*	1	1103	222	0.	*	1	1751	358	387.	*	2	0039	494	146.
1	0418	87	0.	*	1	1106	223	0.	*	1	1754	359	382.	*	2	0042	495	145.
1	0421	88	0.	*	1	1109	224	0.	*	1	1757	360	377.	*	2	0045	496	144.
1	0424	89	0.	*	1	1112	225	0.	*	1	1800	361	373.	*	2	0048	497	143.
1	0427	90	0.	*	1	1115	226	0.	*	1	1803	362	368.	*	2	0051	498	142.
1	0430	91	0.	*	1	1118	227	0.	*	1	1806	363	363.	*	2	0054	499	141.
1	0433	92	0.	*	1	1121	228	0.	*	1	1809	364	359.	*	2	0057	500	140.
1	0436	93	0.	*	1	1124	229	0.	*	1	1812	365	354.	*	2	0100	501	138.
1	0439	94	0.	*	1	1127	230	1.	*	1	1815	366	350.	*	2	0103	502	137.
1	0442	95	0.	*	1	1130	231	1.	*	1	1818	367	346.	*	2	0106	503	135.
1	0445	96	0.	*	1	1133	232	1.	*	1	1821	368	342.	*	2	0109	504	134.
1	0448	97	0.	*	1	1136	233	2.	*	1	1824	369	338.	*	2	0112	505	132.
1	0451	98	0.	*	1	1139	234	2.	*	1	1827	370	334.	*	2	0115	506	130.
1	0454	99	0.	*	1	1142	235	3.	*	1	1830	371	331.	*	2	0118	507	128.
1	0457	100	0.	*	1	1145	236	4.	*	1	1833	372	327.	*	2	0121	508	126.
1	0500	101	0.	*	1	1148	237	6.	*	1	1836	373	323.	*	2	0124	509	124.
1	0503	102	0.	*	1	1151	238	10.	*	1	1839	374	320.	*	2	0127	510	122.
1	0506	103	0.	*	1	1154	239	14.	*	1	1842	375	316.	*	2	0130	511	119.
1	0509	104	0.	*	1	1157	240	20.	*	1	1845	376	313.	*	2	0133	512	117.
1	0512	105	0.	*	1	1200	241	28.	*	1	1848	377	310.	*	2	0136	513	114.
1	0515	106	0.	*	1	1203	242	37.	*	1	1851	378	306.	*	2	0139	514	112.
1	0518	107	0.	*	1	1206	243	48.	*	1	1854	379	303.	*	2	0142	515	109.
1	0521	108	0.	*	1	1209	244	61.	*	1	1857	380	300.	*	2	0145	516	107.
1	0524	109	0.	*	1	1212	245	76.	*	1	1900	381	297.	*	2	0148	517	104.

1	0527	110	0.	*	1	1215	246	92.	*	1	1903	382	294.	*	2	0151	518	102.
1	0530	111	0.	*	1	1218	247	110.	*	1	1906	383	291.	*	2	0154	519	99.
1	0533	112	0.	*	1	1221	248	129.	*	1	1909	384	288.	*	2	0157	520	97.
1	0536	113	0.	*	1	1224	249	149.	*	1	1912	385	285.	*	2	0200	521	94.
1	0539	114	0.	*	1	1227	250	172.	*	1	1915	386	282.	*	2	0203	522	91.
1	0542	115	0.	*	1	1230	251	196.	*	1	1918	387	280.	*	2	0206	523	89.
1	0545	116	0.	*	1	1233	252	222.	*	1	1921	388	277.	*	2	0209	524	86.
1	0548	117	0.	*	1	1236	253	249.	*	1	1924	389	274.	*	2	0212	525	84.
1	0551	118	0.	*	1	1239	254	279.	*	1	1927	390	271.	*	2	0215	526	81.
1	0554	119	0.	*	1	1242	255	311.	*	1	1930	391	269.	*	2	0218	527	78.
1	0557	120	0.	*	1	1245	256	345.	*	1	1933	392	266.	*	2	0221	528	76.
1	0600	121	0.	*	1	1248	257	381.	*	1	1936	393	264.	*	2	0224	529	73.
1	0603	122	0.	*	1	1251	258	419.	*	1	1939	394	261.	*	2	0227	530	71.
1	0606	123	0.	*	1	1254	259	459.	*	1	1942	395	259.	*	2	0230	531	69.
1	0609	124	0.	*	1	1257	260	500.	*	1	1945	396	257.	*	2	0233	532	66.
1	0612	125	0.	*	1	1300	261	543.	*	1	1948	397	254.	*	2	0236	533	64.
1	0615	126	0.	*	1	1303	262	587.	*	1	1951	398	252.	*	2	0239	534	62.
1	0618	127	0.	*	1	1306	263	631.	*	1	1954	399	250.	*	2	0242	535	59.
1	0621	128	0.	*	1	1309	264	675.	*	1	1957	400	248.	*	2	0245	536	57.
1	0624	129	0.	*	1	1312	265	718.	*	1	2000	401	246.	*	2	0248	537	55.
1	0627	130	0.	*	1	1315	266	759.	*	1	2003	402	244.	*	2	0251	538	53.
1	0630	131	0.	*	1	1318	267	800.	*	1	2006	403	242.	*	2	0254	539	51.
1	0633	132	0.	*	1	1321	268	839.	*	1	2009	404	240.	*	2	0257	540	49.
1	0636	133	0.	*	1	1324	269	877.	*	1	2012	405	238.	*	2	0300	541	47.
1	0639	134	0.	*	1	1327	270	912.	*	1	2015	406	236.	*				
1	0642	135	0.	*	1	1330	271	945.	*	1	2018	407	235.	*				
1	0645	136	0.	*	1	1333	272	977.	*	1	2021	408	233.	*				
				*					*					*				

****

	PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
				6-HR	24-HR	72-HR	27.00-HR
+	(CFS)	(HR)					
			(CFS)				
+	1200.	14.30		725.	246.	218.	218.
			(INCHES)	.502	.681	.681	.681
			(AC-FT)	359.	488.	488.	488.

CUMULATIVE AREA = 13.42 SQ MI

****

HYDROGRAPH AT STATION SW1
PLAN 3, RATIO = 1.00

****

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0648	137	0.	*	1		1336	273	1509.	*	1		2024	409	307.
1		0003	2	0.	*	1		0651	138	0.	*	1		1339	274	1547.	*	1		2027	410	304.
1		0006	3	0.	*	1		0654	139	0.	*	1		1342	275	1580.	*	1		2030	411	302.
1		0009	4	0.	*	1		0657	140	0.	*	1		1345	276	1611.	*	1		2033	412	300.
1		0012	5	0.	*	1		0700	141	0.	*	1		1348	277	1638.	*	1		2036	413	298.
1		0015	6	0.	*	1		0703	142	0.	*	1		1351	278	1663.	*	1		2039	414	296.
1		0018	7	0.	*	1		0706	143	0.	*	1		1354	279	1683.	*	1		2042	415	293.
1		0021	8	0.	*	1		0709	144	0.	*	1		1357	280	1701.	*	1		2045	416	291.
1		0024	9	0.	*	1		0712	145	0.	*	1		1400	281	1717.	*	1		2048	417	289.
1		0027	10	0.	*	1		0715	146	0.	*	1		1403	282	1731.	*	1		2051	418	287.
1		0030	11	0.	*	1		0718	147	0.	*	1		1406	283	1742.	*	1		2054	419	285.
1		0033	12	0.	*	1		0721	148	0.	*	1		1409	284	1750.	*	1		2057	420	283.
1		0036	13	0.	*	1		0724	149	0.	*	1		1412	285	1754.	*	1		2100	421	280.
1		0039	14	0.	*	1		0727	150	0.	*	1		1415	286	1756.	*	1		2103	422	278.
1		0042	15	0.	*	1		0730	151	0.	*	1		1418	287	1754.	*	1		2106	423	276.
1		0045	16	0.	*	1		0733	152	0.	*	1		1421	288	1749.	*	1		2109	424	274.
1		0048	17	0.	*	1		0736	153	0.	*	1		1424	289	1743.	*	1		2112	425	272.
1		0051	18	0.	*	1		0739	154	0.	*	1		1427	290	1734.	*	1		2115	426	270.
1		0054	19	0.	*	1		0742	155	0.	*	1		1430	291	1725.	*	1		2118	427	268.
1		0057	20	0.	*	1		0745	156	0.	*	1		1433	292	1713.	*	1		2121	428	265.
1		0100	21	0.	*	1		0748	157	0.	*	1		1436	293	1700.	*	1		2124	429	263.
1		0103	22	0.	*	1		0751	158	0.	*	1		1439	294	1685.	*	1		2127	430	261.
1		0106	23	0.	*	1		0754	159	0.	*	1		1442	295	1669.	*	1		2130	431	259.
1		0109	24	0.	*	1		0757	160	0.	*	1		1445	296	1651.	*	1		2133	432	257.
1		0112	25	0.	*	1		0800	161	0.	*	1		1448	297	1631.	*	1		2136	433	255.
1		0115	26	0.	*	1		0803	162	0.	*	1		1451	298	1609.	*	1		2139	434	253.
1		0118	27	0.	*	1		0806	163	0.	*	1		1454	299	1586.	*	1		2142	435	251.
1		0121	28	0.	*	1		0809	164	0.	*	1		1457	300	1560.	*	1		2145	436	249.
1		0124	29	0.	*	1		0812	165	0.	*	1		1500	301	1533.	*	1		2148	437	247.
1		0127	30	0.	*	1		0815	166	0.	*	1		1503	302	1504.	*	1		2151	438	245.
1		0130	31	0.	*	1		0818	167	0.	*	1		1506	303	1474.	*	1		2154	439	243.
1		0133	32	0.	*	1		0821	168	0.	*	1		1509	304	1443.	*	1		2157	440	241.
1		0136	33	0.	*	1		0824	169	0.	*	1		1512	305	1410.	*	1		2200	441	240.
1		0139	34	0.	*	1		0827	170	0.	*	1		1515	306	1378.	*	1		2203	442	238.
1		0142	35	0.	*	1		0830	171	0.	*	1		1518	307	1347.	*	1		2206	443	236.
1		0145	36	0.	*	1		0833	172	0.	*	1		1521	308	1316.	*	1		2209	444	234.
1		0148	37	0.	*	1		0836	173	0.	*	1		1524	309	1286.	*	1		2212	445	232.
1		0151	38	0.	*	1		0839	174	0.	*	1		1527	310	1257.	*	1		2215	446	231.
1		0154	39	0.	*	1		0842	175	0.	*	1		1530	311	1230.	*	1		2218	447	229.
1		0157	40	0.	*	1		0845	176	0.	*	1		1533	312	1203.	*	1		2221	448	227.
1		0200	41	0.	*	1		0848	177	0.	*	1		1536	313	1178.	*	1		2224	449	226.
1		0203	42	0.	*	1		0851	178	0.	*	1		1539	314	1153.	*	1		2227	450	224.
1		0206	43	0.	*	1		0854	179	0.	*	1		1542	315	1129.	*	1		2230	451	223.
1		0209	44	0.	*	1		0857	180	0.	*	1		1545	316	1105.	*	1		2233	452	221.
1		0212	45	0.	*	1		0900	181	0.	*	1		1548	317	1082.	*	1		2236	453	220.
1		0215	46	0.	*	1		0903	182	0.	*	1		1551	318	1060.	*	1		2239	454	219.
1		0218	47	0.	*	1		0906	183	0.	*	1		1554	319	1039.	*	1		2242	455	218.
1		0221	48	0.	*	1		0909	184	0.	*	1		1557	320	1017.	*	1		2245	456	217.
1		0224	49	0.	*	1		0912	185	0.	*	1		1600	321	997.	*	1		2248	457	215.
1		0227	50	0.	*	1		0915	186	0.	*	1		1603	322	977.	*	1		2251	458	214.

1	0230	51	0.	*	1	0918	187	0.	*	1	1606	323	958.	*	1	2254	459	213.
1	0233	52	0.	*	1	0921	188	0.	*	1	1609	324	939.	*	1	2257	460	212.
1	0236	53	0.	*	1	0924	189	0.	*	1	1612	325	922.	*	1	2300	461	212.
1	0239	54	0.	*	1	0927	190	0.	*	1	1615	326	905.	*	1	2303	462	211.
1	0242	55	0.	*	1	0930	191	0.	*	1	1618	327	888.	*	1	2306	463	210.
1	0245	56	0.	*	1	0933	192	0.	*	1	1621	328	871.	*	1	2309	464	209.
1	0248	57	0.	*	1	0936	193	0.	*	1	1624	329	855.	*	1	2312	465	208.
1	0251	58	0.	*	1	0939	194	0.	*	1	1627	330	839.	*	1	2315	466	208.
1	0254	59	0.	*	1	0942	195	0.	*	1	1630	331	823.	*	1	2318	467	207.
1	0257	60	0.	*	1	0945	196	0.	*	1	1633	332	808.	*	1	2321	468	206.
1	0300	61	0.	*	1	0948	197	0.	*	1	1636	333	793.	*	1	2324	469	206.
1	0303	62	0.	*	1	0951	198	0.	*	1	1639	334	778.	*	1	2327	470	205.
1	0306	63	0.	*	1	0954	199	0.	*	1	1642	335	764.	*	1	2330	471	204.
1	0309	64	0.	*	1	0957	200	0.	*	1	1645	336	750.	*	1	2333	472	204.
1	0312	65	0.	*	1	1000	201	0.	*	1	1648	337	736.	*	1	2336	473	203.
1	0315	66	0.	*	1	1003	202	0.	*	1	1651	338	723.	*	1	2339	474	203.
1	0318	67	0.	*	1	1006	203	0.	*	1	1654	339	709.	*	1	2342	475	202.
1	0321	68	0.	*	1	1009	204	0.	*	1	1657	340	697.	*	1	2345	476	202.
1	0324	69	0.	*	1	1012	205	0.	*	1	1700	341	685.	*	1	2348	477	201.
1	0327	70	0.	*	1	1015	206	0.	*	1	1703	342	673.	*	1	2351	478	201.
1	0330	71	0.	*	1	1018	207	0.	*	1	1706	343	662.	*	1	2354	479	201.
1	0333	72	0.	*	1	1021	208	0.	*	1	1709	344	651.	*	1	2357	480	200.
1	0336	73	0.	*	1	1024	209	0.	*	1	1712	345	641.	*	2	0000	481	200.
1	0339	74	0.	*	1	1027	210	0.	*	1	1715	346	631.	*	2	0003	482	199.
1	0342	75	0.	*	1	1030	211	0.	*	1	1718	347	620.	*	2	0006	483	199.
1	0345	76	0.	*	1	1033	212	0.	*	1	1721	348	611.	*	2	0009	484	198.
1	0348	77	0.	*	1	1036	213	0.	*	1	1724	349	601.	*	2	0012	485	198.
1	0351	78	0.	*	1	1039	214	0.	*	1	1727	350	592.	*	2	0015	486	197.
1	0354	79	0.	*	1	1042	215	0.	*	1	1730	351	583.	*	2	0018	487	197.
1	0357	80	0.	*	1	1045	216	0.	*	1	1733	352	574.	*	2	0021	488	196.
1	0400	81	0.	*	1	1048	217	0.	*	1	1736	353	566.	*	2	0024	489	196.
1	0403	82	0.	*	1	1051	218	0.	*	1	1739	354	558.	*	2	0027	490	195.
1	0406	83	0.	*	1	1054	219	1.	*	1	1742	355	550.	*	2	0030	491	194.
1	0409	84	0.	*	1	1057	220	1.	*	1	1745	356	542.	*	2	0033	492	193.
1	0412	85	0.	*	1	1100	221	1.	*	1	1748	357	534.	*	2	0036	493	192.
1	0415	86	0.	*	1	1103	222	1.	*	1	1751	358	526.	*	2	0039	494	191.
1	0418	87	0.	*	1	1106	223	1.	*	1	1754	359	519.	*	2	0042	495	190.
1	0421	88	0.	*	1	1109	224	2.	*	1	1757	360	512.	*	2	0045	496	189.
1	0424	89	0.	*	1	1112	225	2.	*	1	1800	361	505.	*	2	0048	497	187.
1	0427	90	0.	*	1	1115	226	3.	*	1	1803	362	499.	*	2	0051	498	186.
1	0430	91	0.	*	1	1118	227	3.	*	1	1806	363	492.	*	2	0054	499	184.
1	0433	92	0.	*	1	1121	228	4.	*	1	1809	364	486.	*	2	0057	500	183.
1	0436	93	0.	*	1	1124	229	5.	*	1	1812	365	479.	*	2	0100	501	181.
1	0439	94	0.	*	1	1127	230	6.	*	1	1815	366	473.	*	2	0103	502	179.
1	0442	95	0.	*	1	1130	231	7.	*	1	1818	367	467.	*	2	0106	503	177.
1	0445	96	0.	*	1	1133	232	8.	*	1	1821	368	462.	*	2	0109	504	175.
1	0448	97	0.	*	1	1136	233	10.	*	1	1824	369	456.	*	2	0112	505	172.
1	0451	98	0.	*	1	1139	234	12.	*	1	1827	370	451.	*	2	0115	506	170.
1	0454	99	0.	*	1	1142	235	14.	*	1	1830	371	446.	*	2	0118	507	167.
1	0457	100	0.	*	1	1145	236	17.	*	1	1833	372	440.	*	2	0121	508	165.
1	0500	101	0.	*	1	1148	237	22.	*	1	1836	373	435.	*	2	0124	509	162.
1	0503	102	0.	*	1	1151	238	29.	*	1	1839	374	430.	*	2	0127	510	159.
1	0506	103	0.	*	1	1154	239	37.	*	1	1842	375	425.	*	2	0130	511	156.
1	0509	104	0.	*	1	1157	240	47.	*	1	1845	376	421.	*	2	0133	512	153.
1	0512	105	0.	*	1	1200	241	61.	*	1	1848	377	416.	*	2	0136	513	150.
1	0515	106	0.	*	1	1203	242	76.	*	1	1851	378	412.	*	2	0139	514	146.
1	0518	107	0.	*	1	1206	243	94.	*	1	1854	379	407.	*	2	0142	515	143.
1	0521	108	0.	*	1	1209	244	115.	*	1	1857	380	403.	*	2	0145	516	140.
1	0524	109	0.	*	1	1212	245	139.	*	1	1900	381	398.	*	2	0148	517	136.

1	0527	110	0.	*	1	1215	246	165.	*	1	1903	382	394.	*	2	0151	518	133.	
1	0530	111	0.	*	1	1218	247	193.	*	1	1906	383	390.	*	2	0154	519	130.	
1	0533	112	0.	*	1	1221	248	223.	*	1	1909	384	386.	*	2	0157	520	126.	
1	0536	113	0.	*	1	1224	249	255.	*	1	1912	385	382.	*	2	0200	521	123.	
1	0539	114	0.	*	1	1227	250	290.	*	1	1915	386	378.	*	2	0203	522	119.	
1	0542	115	0.	*	1	1230	251	327.	*	1	1918	387	374.	*	2	0206	523	116.	
1	0545	116	0.	*	1	1233	252	366.	*	1	1921	388	370.	*	2	0209	524	113.	
1	0548	117	0.	*	1	1236	253	408.	*	1	1924	389	366.	*	2	0212	525	109.	
1	0551	118	0.	*	1	1239	254	454.	*	1	1927	390	363.	*	2	0215	526	106.	
1	0554	119	0.	*	1	1242	255	502.	*	1	1930	391	359.	*	2	0218	527	102.	
1	0557	120	0.	*	1	1245	256	553.	*	1	1933	392	355.	*	2	0221	528	99.	
1	0600	121	0.	*	1	1248	257	607.	*	1	1936	393	352.	*	2	0224	529	96.	
1	0603	122	0.	*	1	1251	258	664.	*	1	1939	394	349.	*	2	0227	530	93.	
1	0606	123	0.	*	1	1254	259	723.	*	1	1942	395	345.	*	2	0230	531	90.	
1	0609	124	0.	*	1	1257	260	784.	*	1	1945	396	342.	*	2	0233	532	87.	
1	0612	125	0.	*	1	1300	261	847.	*	1	1948	397	339.	*	2	0236	533	83.	
1	0615	126	0.	*	1	1303	262	912.	*	1	1951	398	336.	*	2	0239	534	81.	
1	0618	127	0.	*	1	1306	263	976.	*	1	1954	399	333.	*	2	0242	535	78.	
1	0621	128	0.	*	1	1309	264	1039.	*	1	1957	400	330.	*	2	0245	536	75.	
1	0624	129	0.	*	1	1312	265	1101.	*	1	2000	401	327.	*	2	0248	537	72.	
1	0627	130	0.	*	1	1315	266	1161.	*	1	2003	402	324.	*	2	0251	538	69.	
1	0630	131	0.	*	1	1318	267	1219.	*	1	2006	403	322.	*	2	0254	539	67.	
1	0633	132	0.	*	1	1321	268	1275.	*	1	2009	404	319.	*	2	0257	540	64.	
1	0636	133	0.	*	1	1324	269	1328.	*	1	2012	405	316.	*	2	0300	541	62.	
1	0639	134	0.	*	1	1327	270	1378.	*	1	2015	406	314.	*					
1	0642	135	0.	*	1	1330	271	1425.	*	1	2018	407	311.	*					
1	0645	136	0.	*	1	1333	272	1468.	*	1	2021	408	309.	*					
				*					*					*					

****

	PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
				6-HR	24-HR	72-HR	27.00-HR
+	(CFS)	(HR)					
			(CFS)				
+	1756.	14.25		1042.	348.	309.	309.
			(INCHES)	.722	.964	.964	.964
			(AC-FT)	517.	690.	690.	690.

CUMULATIVE AREA = 13.42 SQ MI

****

HYDROGRAPH AT STATION SW1
PLAN 4, RATIO = 1.00

****

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0648	137	0.	*	1		1336	273	1955.	*	1		2024	409	369.
1		0003	2	0.	*	1		0651	138	0.	*	1		1339	274	2001.	*	1		2027	410	366.
1		0006	3	0.	*	1		0654	139	0.	*	1		1342	275	2041.	*	1		2030	411	364.
1		0009	4	0.	*	1		0657	140	0.	*	1		1345	276	2078.	*	1		2033	412	361.
1		0012	5	0.	*	1		0700	141	0.	*	1		1348	277	2111.	*	1		2036	413	358.
1		0015	6	0.	*	1		0703	142	0.	*	1		1351	278	2140.	*	1		2039	414	356.
1		0018	7	0.	*	1		0706	143	0.	*	1		1354	279	2164.	*	1		2042	415	353.
1		0021	8	0.	*	1		0709	144	0.	*	1		1357	280	2185.	*	1		2045	416	350.
1		0024	9	0.	*	1		0712	145	0.	*	1		1400	281	2203.	*	1		2048	417	348.
1		0027	10	0.	*	1		0715	146	0.	*	1		1403	282	2218.	*	1		2051	418	345.
1		0030	11	0.	*	1		0718	147	0.	*	1		1406	283	2230.	*	1		2054	419	342.
1		0033	12	0.	*	1		0721	148	0.	*	1		1409	284	2238.	*	1		2057	420	340.
1		0036	13	0.	*	1		0724	149	0.	*	1		1412	285	2242.	*	1		2100	421	337.
1		0039	14	0.	*	1		0727	150	0.	*	1		1415	286	2241.	*	1		2103	422	334.
1		0042	15	0.	*	1		0730	151	0.	*	1		1418	287	2237.	*	1		2106	423	332.
1		0045	16	0.	*	1		0733	152	0.	*	1		1421	288	2229.	*	1		2109	424	329.
1		0048	17	0.	*	1		0736	153	0.	*	1		1424	289	2218.	*	1		2112	425	327.
1		0051	18	0.	*	1		0739	154	0.	*	1		1427	290	2206.	*	1		2115	426	324.
1		0054	19	0.	*	1		0742	155	0.	*	1		1430	291	2192.	*	1		2118	427	321.
1		0057	20	0.	*	1		0745	156	0.	*	1		1433	292	2175.	*	1		2121	428	319.
1		0100	21	0.	*	1		0748	157	0.	*	1		1436	293	2157.	*	1		2124	429	316.
1		0103	22	0.	*	1		0751	158	0.	*	1		1439	294	2136.	*	1		2127	430	314.
1		0106	23	0.	*	1		0754	159	0.	*	1		1442	295	2114.	*	1		2130	431	311.
1		0109	24	0.	*	1		0757	160	0.	*	1		1445	296	2089.	*	1		2133	432	309.
1		0112	25	0.	*	1		0800	161	0.	*	1		1448	297	2063.	*	1		2136	433	306.
1		0115	26	0.	*	1		0803	162	0.	*	1		1451	298	2033.	*	1		2139	434	304.
1		0118	27	0.	*	1		0806	163	0.	*	1		1454	299	2002.	*	1		2142	435	301.
1		0121	28	0.	*	1		0809	164	0.	*	1		1457	300	1968.	*	1		2145	436	299.
1		0124	29	0.	*	1		0812	165	0.	*	1		1500	301	1932.	*	1		2148	437	296.
1		0127	30	0.	*	1		0815	166	0.	*	1		1503	302	1895.	*	1		2151	438	294.
1		0130	31	0.	*	1		0818	167	0.	*	1		1506	303	1855.	*	1		2154	439	292.
1		0133	32	0.	*	1		0821	168	0.	*	1		1509	304	1814.	*	1		2157	440	289.
1		0136	33	0.	*	1		0824	169	0.	*	1		1512	305	1772.	*	1		2200	441	287.
1		0139	34	0.	*	1		0827	170	0.	*	1		1515	306	1731.	*	1		2203	442	285.
1		0142	35	0.	*	1		0830	171	0.	*	1		1518	307	1690.	*	1		2206	443	283.
1		0145	36	0.	*	1		0833	172	0.	*	1		1521	308	1650.	*	1		2209	444	280.
1		0148	37	0.	*	1		0836	173	0.	*	1		1524	309	1612.	*	1		2212	445	278.
1		0151	38	0.	*	1		0839	174	0.	*	1		1527	310	1575.	*	1		2215	446	276.
1		0154	39	0.	*	1		0842	175	0.	*	1		1530	311	1539.	*	1		2218	447	274.
1		0157	40	0.	*	1		0845	176	0.	*	1		1533	312	1504.	*	1		2221	448	272.
1		0200	41	0.	*	1		0848	177	0.	*	1		1536	313	1472.	*	1		2224	449	270.
1		0203	42	0.	*	1		0851	178	0.	*	1		1539	314	1441.	*	1		2227	450	268.
1		0206	43	0.	*	1		0854	179	0.	*	1		1542	315	1410.	*	1		2230	451	267.
1		0209	44	0.	*	1		0857	180	0.	*	1		1545	316	1379.	*	1		2233	452	265.
1		0212	45	0.	*	1		0900	181	0.	*	1		1548	317	1350.	*	1		2236	453	263.
1		0215	46	0.	*	1		0903	182	0.	*	1		1551	318	1322.	*	1		2239	454	262.
1		0218	47	0.	*	1		0906	183	0.	*	1		1554	319	1294.	*	1		2242	455	260.
1		0221	48	0.	*	1		0909	184	0.	*	1		1557	320	1267.	*	1		2245	456	259.
1		0224	49	0.	*	1		0912	185	0.	*	1		1600	321	1240.	*	1		2248	457	258.
1		0227	50	0.	*	1		0915	186	0.	*	1		1603	322	1215.	*	1		2251	458	256.

1	0230	51	0.	*	1	0918	187	0.	*	1	1606	323	1191.	*	1	2254	459	255.
1	0233	52	0.	*	1	0921	188	0.	*	1	1609	324	1167.	*	1	2257	460	254.
1	0236	53	0.	*	1	0924	189	0.	*	1	1612	325	1144.	*	1	2300	461	253.
1	0239	54	0.	*	1	0927	190	0.	*	1	1615	326	1123.	*	1	2303	462	252.
1	0242	55	0.	*	1	0930	191	0.	*	1	1618	327	1102.	*	1	2306	463	251.
1	0245	56	0.	*	1	0933	192	0.	*	1	1621	328	1080.	*	1	2309	464	250.
1	0248	57	0.	*	1	0936	193	0.	*	1	1624	329	1060.	*	1	2312	465	249.
1	0251	58	0.	*	1	0939	194	0.	*	1	1627	330	1039.	*	1	2315	466	248.
1	0254	59	0.	*	1	0942	195	0.	*	1	1630	331	1019.	*	1	2318	467	247.
1	0257	60	0.	*	1	0945	196	0.	*	1	1633	332	1000.	*	1	2321	468	246.
1	0300	61	0.	*	1	0948	197	0.	*	1	1636	333	980.	*	1	2324	469	246.
1	0303	62	0.	*	1	0951	198	0.	*	1	1639	334	962.	*	1	2327	470	245.
1	0306	63	0.	*	1	0954	199	0.	*	1	1642	335	944.	*	1	2330	471	244.
1	0309	64	0.	*	1	0957	200	0.	*	1	1645	336	926.	*	1	2333	472	244.
1	0312	65	0.	*	1	1000	201	0.	*	1	1648	337	909.	*	1	2336	473	243.
1	0315	66	0.	*	1	1003	202	0.	*	1	1651	338	891.	*	1	2339	474	242.
1	0318	67	0.	*	1	1006	203	0.	*	1	1654	339	875.	*	1	2342	475	242.
1	0321	68	0.	*	1	1009	204	0.	*	1	1657	340	859.	*	1	2345	476	241.
1	0324	69	0.	*	1	1012	205	0.	*	1	1700	341	843.	*	1	2348	477	241.
1	0327	70	0.	*	1	1015	206	0.	*	1	1703	342	829.	*	1	2351	478	240.
1	0330	71	0.	*	1	1018	207	0.	*	1	1706	343	815.	*	1	2354	479	240.
1	0333	72	0.	*	1	1021	208	0.	*	1	1709	344	801.	*	1	2357	480	239.
1	0336	73	0.	*	1	1024	209	0.	*	1	1712	345	788.	*	2	0000	481	239.
1	0339	74	0.	*	1	1027	210	1.	*	1	1715	346	775.	*	2	0003	482	238.
1	0342	75	0.	*	1	1030	211	1.	*	1	1718	347	762.	*	2	0006	483	238.
1	0345	76	0.	*	1	1033	212	1.	*	1	1721	348	750.	*	2	0009	484	237.
1	0348	77	0.	*	1	1036	213	1.	*	1	1724	349	738.	*	2	0012	485	236.
1	0351	78	0.	*	1	1039	214	1.	*	1	1727	350	726.	*	2	0015	486	236.
1	0354	79	0.	*	1	1042	215	2.	*	1	1730	351	715.	*	2	0018	487	235.
1	0357	80	0.	*	1	1045	216	2.	*	1	1733	352	704.	*	2	0021	488	234.
1	0400	81	0.	*	1	1048	217	3.	*	1	1736	353	693.	*	2	0024	489	233.
1	0403	82	0.	*	1	1051	218	3.	*	1	1739	354	683.	*	2	0027	490	233.
1	0406	83	0.	*	1	1054	219	4.	*	1	1742	355	673.	*	2	0030	491	232.
1	0409	84	0.	*	1	1057	220	4.	*	1	1745	356	662.	*	2	0033	492	231.
1	0412	85	0.	*	1	1100	221	5.	*	1	1748	357	653.	*	2	0036	493	229.
1	0415	86	0.	*	1	1103	222	6.	*	1	1751	358	643.	*	2	0039	494	228.
1	0418	87	0.	*	1	1106	223	7.	*	1	1754	359	634.	*	2	0042	495	227.
1	0421	88	0.	*	1	1109	224	8.	*	1	1757	360	626.	*	2	0045	496	225.
1	0424	89	0.	*	1	1112	225	9.	*	1	1800	361	617.	*	2	0048	497	224.
1	0427	90	0.	*	1	1115	226	10.	*	1	1803	362	609.	*	2	0051	498	222.
1	0430	91	0.	*	1	1118	227	12.	*	1	1806	363	600.	*	2	0054	499	220.
1	0433	92	0.	*	1	1121	228	14.	*	1	1809	364	592.	*	2	0057	500	218.
1	0436	93	0.	*	1	1124	229	15.	*	1	1812	365	584.	*	2	0100	501	216.
1	0439	94	0.	*	1	1127	230	18.	*	1	1815	366	577.	*	2	0103	502	214.
1	0442	95	0.	*	1	1130	231	20.	*	1	1818	367	569.	*	2	0106	503	211.
1	0445	96	0.	*	1	1133	232	23.	*	1	1821	368	562.	*	2	0109	504	209.
1	0448	97	0.	*	1	1136	233	26.	*	1	1824	369	555.	*	2	0112	505	206.
1	0451	98	0.	*	1	1139	234	30.	*	1	1827	370	549.	*	2	0115	506	203.
1	0454	99	0.	*	1	1142	235	34.	*	1	1830	371	542.	*	2	0118	507	200.
1	0457	100	0.	*	1	1145	236	40.	*	1	1833	372	535.	*	2	0121	508	196.
1	0500	101	0.	*	1	1148	237	47.	*	1	1836	373	529.	*	2	0124	509	193.
1	0503	102	0.	*	1	1151	238	57.	*	1	1839	374	523.	*	2	0127	510	190.
1	0506	103	0.	*	1	1154	239	69.	*	1	1842	375	517.	*	2	0130	511	186.
1	0509	104	0.	*	1	1157	240	84.	*	1	1845	376	511.	*	2	0133	512	182.
1	0512	105	0.	*	1	1200	241	103.	*	1	1848	377	505.	*	2	0136	513	179.
1	0515	106	0.	*	1	1203	242	124.	*	1	1851	378	499.	*	2	0139	514	175.
1	0518	107	0.	*	1	1206	243	149.	*	1	1854	379	494.	*	2	0142	515	171.
1	0521	108	0.	*	1	1209	244	177.	*	1	1857	380	488.	*	2	0145	516	167.
1	0524	109	0.	*	1	1212	245	209.	*	1	1900	381	483.	*	2	0148	517	163.

1	0527	110	0.	*	1	1215	246	243.	*	1	1903	382	477.	*	2	0151	518	159.
1	0530	111	0.	*	1	1218	247	280.	*	1	1906	383	472.	*	2	0154	519	155.
1	0533	112	0.	*	1	1221	248	319.	*	1	1909	384	467.	*	2	0157	520	151.
1	0536	113	0.	*	1	1224	249	362.	*	1	1912	385	462.	*	2	0200	521	147.
1	0539	114	0.	*	1	1227	250	407.	*	1	1915	386	457.	*	2	0203	522	142.
1	0542	115	0.	*	1	1230	251	456.	*	1	1918	387	452.	*	2	0206	523	138.
1	0545	116	0.	*	1	1233	252	507.	*	1	1921	388	448.	*	2	0209	524	134.
1	0548	117	0.	*	1	1236	253	562.	*	1	1924	389	443.	*	2	0212	525	130.
1	0551	118	0.	*	1	1239	254	621.	*	1	1927	390	438.	*	2	0215	526	126.
1	0554	119	0.	*	1	1242	255	684.	*	1	1930	391	434.	*	2	0218	527	122.
1	0557	120	0.	*	1	1245	256	750.	*	1	1933	392	429.	*	2	0221	528	118.
1	0600	121	0.	*	1	1248	257	819.	*	1	1936	393	425.	*	2	0224	529	114.
1	0603	122	0.	*	1	1251	258	892.	*	1	1939	394	421.	*	2	0227	530	111.
1	0606	123	0.	*	1	1254	259	968.	*	1	1942	395	417.	*	2	0230	531	107.
1	0609	124	0.	*	1	1257	260	1046.	*	1	1945	396	413.	*	2	0233	532	103.
1	0612	125	0.	*	1	1300	261	1126.	*	1	1948	397	409.	*	2	0236	533	100.
1	0615	126	0.	*	1	1303	262	1208.	*	1	1951	398	405.	*	2	0239	534	96.
1	0618	127	0.	*	1	1306	263	1289.	*	1	1954	399	402.	*	2	0242	535	93.
1	0621	128	0.	*	1	1309	264	1369.	*	1	1957	400	398.	*	2	0245	536	89.
1	0624	129	0.	*	1	1312	265	1447.	*	1	2000	401	394.	*	2	0248	537	86.
1	0627	130	0.	*	1	1315	266	1523.	*	1	2003	402	391.	*	2	0251	538	83.
1	0630	131	0.	*	1	1318	267	1595.	*	1	2006	403	388.	*	2	0254	539	79.
1	0633	132	0.	*	1	1321	268	1665.	*	1	2009	404	385.	*	2	0257	540	76.
1	0636	133	0.	*	1	1324	269	1731.	*	1	2012	405	381.	*	2	0300	541	73.
1	0639	134	0.	*	1	1327	270	1793.	*	1	2015	406	378.	*				
1	0642	135	0.	*	1	1330	271	1851.	*	1	2018	407	375.	*				
1	0645	136	0.	*	1	1333	272	1904.	*	1	2021	408	372.	*				
				*					*					*				

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	27.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 2242.	14.20		1319.	436.	388.	388.
		(INCHES)	.914	1.209	1.209	1.209
		(AC-FT)	654.	866.	866.	866.

CUMULATIVE AREA = 13.42 SQ MI

****

HYDROGRAPH AT STATION SW1
PLAN 5, RATIO = 1.00

****

DA MON	HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW
1	0000	1	0.	*	1	0648	137	0.	*	1	1336	273	2440.	*	1	2024	409	435.
1	0003	2	0.	*	1	0651	138	0.	*	1	1339	274	2494.	*	1	2027	410	431.
1	0006	3	0.	*	1	0654	139	0.	*	1	1342	275	2542.	*	1	2030	411	428.
1	0009	4	0.	*	1	0657	140	0.	*	1	1345	276	2585.	*	1	2033	412	425.
1	0012	5	0.	*	1	0700	141	0.	*	1	1348	277	2624.	*	1	2036	413	421.
1	0015	6	0.	*	1	0703	142	0.	*	1	1351	278	2658.	*	1	2039	414	418.
1	0018	7	0.	*	1	0706	143	0.	*	1	1354	279	2685.	*	1	2042	415	415.
1	0021	8	0.	*	1	0709	144	0.	*	1	1357	280	2709.	*	1	2045	416	412.
1	0024	9	0.	*	1	0712	145	0.	*	1	1400	281	2728.	*	1	2048	417	409.
1	0027	10	0.	*	1	0715	146	0.	*	1	1403	282	2745.	*	1	2051	418	406.
1	0030	11	0.	*	1	0718	147	0.	*	1	1406	283	2758.	*	1	2054	419	402.
1	0033	12	0.	*	1	0721	148	0.	*	1	1409	284	2765.	*	1	2057	420	399.
1	0036	13	0.	*	1	0724	149	0.	*	1	1412	285	2768.	*	1	2100	421	396.
1	0039	14	0.	*	1	0727	150	0.	*	1	1415	286	2765.	*	1	2103	422	393.
1	0042	15	0.	*	1	0730	151	0.	*	1	1418	287	2758.	*	1	2106	423	390.
1	0045	16	0.	*	1	0733	152	0.	*	1	1421	288	2746.	*	1	2109	424	387.
1	0048	17	0.	*	1	0736	153	0.	*	1	1424	289	2731.	*	1	2112	425	383.
1	0051	18	0.	*	1	0739	154	0.	*	1	1427	290	2714.	*	1	2115	426	380.
1	0054	19	0.	*	1	0742	155	0.	*	1	1430	291	2695.	*	1	2118	427	377.
1	0057	20	0.	*	1	0745	156	0.	*	1	1433	292	2673.	*	1	2121	428	374.
1	0100	21	0.	*	1	0748	157	0.	*	1	1436	293	2648.	*	1	2124	429	371.
1	0103	22	0.	*	1	0751	158	0.	*	1	1439	294	2621.	*	1	2127	430	368.
1	0106	23	0.	*	1	0754	159	0.	*	1	1442	295	2592.	*	1	2130	431	365.
1	0109	24	0.	*	1	0757	160	0.	*	1	1445	296	2561.	*	1	2133	432	362.
1	0112	25	0.	*	1	0800	161	0.	*	1	1448	297	2526.	*	1	2136	433	359.
1	0115	26	0.	*	1	0803	162	0.	*	1	1451	298	2489.	*	1	2139	434	356.
1	0118	27	0.	*	1	0806	163	0.	*	1	1454	299	2449.	*	1	2142	435	353.
1	0121	28	0.	*	1	0809	164	0.	*	1	1457	300	2406.	*	1	2145	436	350.
1	0124	29	0.	*	1	0812	165	0.	*	1	1500	301	2360.	*	1	2148	437	348.
1	0127	30	0.	*	1	0815	166	0.	*	1	1503	302	2313.	*	1	2151	438	345.
1	0130	31	0.	*	1	0818	167	0.	*	1	1506	303	2263.	*	1	2154	439	342.
1	0133	32	0.	*	1	0821	168	0.	*	1	1509	304	2212.	*	1	2157	440	339.
1	0136	33	0.	*	1	0824	169	0.	*	1	1512	305	2159.	*	1	2200	441	336.
1	0139	34	0.	*	1	0827	170	0.	*	1	1515	306	2108.	*	1	2203	442	334.
1	0142	35	0.	*	1	0830	171	0.	*	1	1518	307	2057.	*	1	2206	443	331.
1	0145	36	0.	*	1	0833	172	0.	*	1	1521	308	2007.	*	1	2209	444	328.
1	0148	37	0.	*	1	0836	173	0.	*	1	1524	309	1960.	*	1	2212	445	326.
1	0151	38	0.	*	1	0839	174	0.	*	1	1527	310	1913.	*	1	2215	446	323.
1	0154	39	0.	*	1	0842	175	0.	*	1	1530	311	1869.	*	1	2218	447	321.
1	0157	40	0.	*	1	0845	176	0.	*	1	1533	312	1826.	*	1	2221	448	319.
1	0200	41	0.	*	1	0848	177	0.	*	1	1536	313	1786.	*	1	2224	449	316.
1	0203	42	0.	*	1	0851	178	0.	*	1	1539	314	1747.	*	1	2227	450	314.
1	0206	43	0.	*	1	0854	179	0.	*	1	1542	315	1709.	*	1	2230	451	312.
1	0209	44	0.	*	1	0857	180	0.	*	1	1545	316	1671.	*	1	2233	452	310.
1	0212	45	0.	*	1	0900	181	0.	*	1	1548	317	1635.	*	1	2236	453	308.
1	0215	46	0.	*	1	0903	182	0.	*	1	1551	318	1600.	*	1	2239	454	307.
1	0218	47	0.	*	1	0906	183	0.	*	1	1554	319	1566.	*	1	2242	455	305.
1	0221	48	0.	*	1	0909	184	0.	*	1	1557	320	1532.	*	1	2245	456	303.
1	0224	49	0.	*	1	0912	185	0.	*	1	1600	321	1500.	*	1	2248	457	302.
1	0227	50	0.	*	1	0915	186	0.	*	1	1603	322	1469.	*	1	2251	458	300.

1	0230	51	0.	*	1	0918	187	0.	*	1	1606	323	1439.	*	1	2254	459	299.
1	0233	52	0.	*	1	0921	188	0.	*	1	1609	324	1409.	*	1	2257	460	297.
1	0236	53	0.	*	1	0924	189	0.	*	1	1612	325	1382.	*	1	2300	461	296.
1	0239	54	0.	*	1	0927	190	0.	*	1	1615	326	1355.	*	1	2303	462	295.
1	0242	55	0.	*	1	0930	191	0.	*	1	1618	327	1329.	*	1	2306	463	294.
1	0245	56	0.	*	1	0933	192	0.	*	1	1621	328	1303.	*	1	2309	464	292.
1	0248	57	0.	*	1	0936	193	0.	*	1	1624	329	1277.	*	1	2312	465	291.
1	0251	58	0.	*	1	0939	194	0.	*	1	1627	330	1252.	*	1	2315	466	290.
1	0254	59	0.	*	1	0942	195	0.	*	1	1630	331	1227.	*	1	2318	467	289.
1	0257	60	0.	*	1	0945	196	0.	*	1	1633	332	1203.	*	1	2321	468	288.
1	0300	61	0.	*	1	0948	197	0.	*	1	1636	333	1180.	*	1	2324	469	287.
1	0303	62	0.	*	1	0951	198	0.	*	1	1639	334	1157.	*	1	2327	470	287.
1	0306	63	0.	*	1	0954	199	1.	*	1	1642	335	1135.	*	1	2330	471	286.
1	0309	64	0.	*	1	0957	200	1.	*	1	1645	336	1113.	*	1	2333	472	285.
1	0312	65	0.	*	1	1000	201	1.	*	1	1648	337	1091.	*	1	2336	473	284.
1	0315	66	0.	*	1	1003	202	1.	*	1	1651	338	1070.	*	1	2339	474	283.
1	0318	67	0.	*	1	1006	203	1.	*	1	1654	339	1050.	*	1	2342	475	283.
1	0321	68	0.	*	1	1009	204	2.	*	1	1657	340	1030.	*	1	2345	476	282.
1	0324	69	0.	*	1	1012	205	2.	*	1	1700	341	1011.	*	1	2348	477	281.
1	0327	70	0.	*	1	1015	206	2.	*	1	1703	342	993.	*	1	2351	478	281.
1	0330	71	0.	*	1	1018	207	2.	*	1	1706	343	976.	*	1	2354	479	280.
1	0333	72	0.	*	1	1021	208	3.	*	1	1709	344	960.	*	1	2357	480	280.
1	0336	73	0.	*	1	1024	209	3.	*	1	1712	345	943.	*	2	0000	481	279.
1	0339	74	0.	*	1	1027	210	4.	*	1	1715	346	927.	*	2	0003	482	278.
1	0342	75	0.	*	1	1030	211	5.	*	1	1718	347	912.	*	2	0006	483	278.
1	0345	76	0.	*	1	1033	212	5.	*	1	1721	348	896.	*	2	0009	484	277.
1	0348	77	0.	*	1	1036	213	6.	*	1	1724	349	882.	*	2	0012	485	276.
1	0351	78	0.	*	1	1039	214	7.	*	1	1727	350	867.	*	2	0015	486	276.
1	0354	79	0.	*	1	1042	215	8.	*	1	1730	351	854.	*	2	0018	487	275.
1	0357	80	0.	*	1	1045	216	9.	*	1	1733	352	841.	*	2	0021	488	274.
1	0400	81	0.	*	1	1048	217	10.	*	1	1736	353	828.	*	2	0024	489	273.
1	0403	82	0.	*	1	1051	218	11.	*	1	1739	354	815.	*	2	0027	490	272.
1	0406	83	0.	*	1	1054	219	13.	*	1	1742	355	802.	*	2	0030	491	271.
1	0409	84	0.	*	1	1057	220	14.	*	1	1745	356	790.	*	2	0033	492	269.
1	0412	85	0.	*	1	1100	221	16.	*	1	1748	357	778.	*	2	0036	493	268.
1	0415	86	0.	*	1	1103	222	18.	*	1	1751	358	767.	*	2	0039	494	267.
1	0418	87	0.	*	1	1106	223	20.	*	1	1754	359	755.	*	2	0042	495	265.
1	0421	88	0.	*	1	1109	224	22.	*	1	1757	360	745.	*	2	0045	496	263.
1	0424	89	0.	*	1	1112	225	25.	*	1	1800	361	734.	*	2	0048	497	261.
1	0427	90	0.	*	1	1115	226	27.	*	1	1803	362	724.	*	2	0051	498	259.
1	0430	91	0.	*	1	1118	227	30.	*	1	1806	363	714.	*	2	0054	499	257.
1	0433	92	0.	*	1	1121	228	33.	*	1	1809	364	704.	*	2	0057	500	255.
1	0436	93	0.	*	1	1124	229	36.	*	1	1812	365	694.	*	2	0100	501	252.
1	0439	94	0.	*	1	1127	230	40.	*	1	1815	366	685.	*	2	0103	502	250.
1	0442	95	0.	*	1	1130	231	44.	*	1	1818	367	676.	*	2	0106	503	247.
1	0445	96	0.	*	1	1133	232	48.	*	1	1821	368	668.	*	2	0109	504	244.
1	0448	97	0.	*	1	1136	233	54.	*	1	1824	369	659.	*	2	0112	505	240.
1	0451	98	0.	*	1	1139	234	60.	*	1	1827	370	651.	*	2	0115	506	237.
1	0454	99	0.	*	1	1142	235	67.	*	1	1830	371	643.	*	2	0118	507	233.
1	0457	100	0.	*	1	1145	236	75.	*	1	1833	372	635.	*	2	0121	508	229.
1	0500	101	0.	*	1	1148	237	85.	*	1	1836	373	627.	*	2	0124	509	226.
1	0503	102	0.	*	1	1151	238	98.	*	1	1839	374	620.	*	2	0127	510	221.
1	0506	103	0.	*	1	1154	239	115.	*	1	1842	375	612.	*	2	0130	511	217.
1	0509	104	0.	*	1	1157	240	135.	*	1	1845	376	605.	*	2	0133	512	213.
1	0512	105	0.	*	1	1200	241	159.	*	1	1848	377	598.	*	2	0136	513	209.
1	0515	106	0.	*	1	1203	242	187.	*	1	1851	378	591.	*	2	0139	514	204.
1	0518	107	0.	*	1	1206	243	219.	*	1	1854	379	585.	*	2	0142	515	199.
1	0521	108	0.	*	1	1209	244	255.	*	1	1857	380	578.	*	2	0145	516	195.
1	0524	109	0.	*	1	1212	245	295.	*	1	1900	381	571.	*	2	0148	517	190.

1	0527	110	0.	*	1	1215	246	339.	*	1	1903	382	565.	*	2	0151	518	185.
1	0530	111	0.	*	1	1218	247	386.	*	1	1906	383	559.	*	2	0154	519	181.
1	0533	112	0.	*	1	1221	248	435.	*	1	1909	384	552.	*	2	0157	520	176.
1	0536	113	0.	*	1	1224	249	489.	*	1	1912	385	546.	*	2	0200	521	171.
1	0539	114	0.	*	1	1227	250	546.	*	1	1915	386	540.	*	2	0203	522	166.
1	0542	115	0.	*	1	1230	251	607.	*	1	1918	387	535.	*	2	0206	523	162.
1	0545	116	0.	*	1	1233	252	671.	*	1	1921	388	529.	*	2	0209	524	157.
1	0548	117	0.	*	1	1236	253	739.	*	1	1924	389	523.	*	2	0212	525	152.
1	0551	118	0.	*	1	1239	254	813.	*	1	1927	390	518.	*	2	0215	526	147.
1	0554	119	0.	*	1	1242	255	890.	*	1	1930	391	512.	*	2	0218	527	143.
1	0557	120	0.	*	1	1245	256	972.	*	1	1933	392	507.	*	2	0221	528	138.
1	0600	121	0.	*	1	1248	257	1058.	*	1	1936	393	502.	*	2	0224	529	134.
1	0603	122	0.	*	1	1251	258	1149.	*	1	1939	394	497.	*	2	0227	530	129.
1	0606	123	0.	*	1	1254	259	1242.	*	1	1942	395	492.	*	2	0230	531	125.
1	0609	124	0.	*	1	1257	260	1338.	*	1	1945	396	487.	*	2	0233	532	121.
1	0612	125	0.	*	1	1300	261	1436.	*	1	1948	397	482.	*	2	0236	533	116.
1	0615	126	0.	*	1	1303	262	1536.	*	1	1951	398	478.	*	2	0239	534	112.
1	0618	127	0.	*	1	1306	263	1635.	*	1	1954	399	473.	*	2	0242	535	108.
1	0621	128	0.	*	1	1309	264	1733.	*	1	1957	400	469.	*	2	0245	536	104.
1	0624	129	0.	*	1	1312	265	1828.	*	1	2000	401	465.	*	2	0248	537	100.
1	0627	130	0.	*	1	1315	266	1920.	*	1	2003	402	461.	*	2	0251	538	97.
1	0630	131	0.	*	1	1318	267	2008.	*	1	2006	403	457.	*	2	0254	539	93.
1	0633	132	0.	*	1	1321	268	2092.	*	1	2009	404	453.	*	2	0257	540	89.
1	0636	133	0.	*	1	1324	269	2172.	*	1	2012	405	449.	*	2	0300	541	86.
1	0639	134	0.	*	1	1327	270	2247.	*	1	2015	406	445.	*				
1	0642	135	0.	*	1	1330	271	2316.	*	1	2018	407	442.	*				
1	0645	136	0.	*	1	1333	272	2380.	*	1	2021	408	438.	*				
				*					*					*				

```
*******************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR     27.00-HR
+   (CFS)        (HR)
                              (CFS)
+    2768.     14.20                 1618.         532.         473.         473.
                           (INCHES)  1.121        1.474        1.474        1.474
                            (AC-FT)   802.        1055.        1055.        1055.

                            CUMULATIVE AREA =   13.42 SQ MI
```

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO FLOWS RATIO 1 1.00
HYDROGRAPH AT					
+	SW1	13.42	1	FLOW	831.
				TIME	14.35
			2	FLOW	1200.
				TIME	14.30
			3	FLOW	1756.
				TIME	14.25
			4	FLOW	2242.
				TIME	14.20
			5	FLOW	2768.
				TIME	14.20

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

Appendix O
FEMA Floodwall Requirements

4 Other Flood Protection Measures

Chapters 1, 2, and 3 focus on dry floodproofing, but other flood protection measures are also available to protect existing non-residential buildings from flooding. This chapter describes several other flood protection measures and the factors that should be considered when selecting one of these measures or a combination of measures.

- The flood protection measures that are discussed in this chapter are:
- Permanent floodwalls and levees, which create a barrier between the building and floodwaters
- Wet floodproofing, which allows floodwaters to enter the building while using various techniques to minimize flood damage and protect critical systems and contents
- Floodproofing measures for electrical and mechanical utility systems that are difficult to dry floodproof
- Emergency measures for temporary protection (sandbags, temporary flood barriers, and flood wrapping systems)

As with the dry floodproofing measures discussed in the previous chapters, the flood protection measures in this chapter should be evaluated by a registered design professional to determine the design flood forces and which measures would be most effective.

4.1 Floodwalls and Levees

Permanent floodwalls and levees are constructed barriers that provide flood protection to one or more buildings. Unlike the dry floodproofing measures described in Chapter 3, which provide structural protection for shallow flood depths, floodwalls and levees can provide effective flood protection to buildings that experience flood levels of 4 feet or greater. However, if a floodwall or levee is breached or overtopped, then the barriers provide no flood protection.

4.1.1 Floodwalls

A floodwall is a freestanding, permanent, engineered structure designed to prevent encroachment of floodwaters. Floodwalls, which are typically constructed of reinforced concrete or masonry, provide a barrier against

> **Warning**
>
> Floodwalls and levees are not permitted to address Substantial Improvement/Damage and do not bring new buildings into compliance with NFIP regulations unless they are accredited per 44 CFR § 65.10. Furthermore, the floodwalls and levees described in this chapter do not affect NFIP flood insurance rates or mandatory purchase requirements.
>
> Additionally, NFIP regulations do not permit encroachments such as floodwalls and levees in a regulatory floodway unless hydrologic and hydraulic analyses demonstrate that the proposed floodwall or levee would not result in any increase in flood levels in the community during the base flood (44 CFR § 60.3(d)(3)).

inundation, protect structures from hydrostatic and hydrodynamic loads, and may deflect flood-borne debris and ice away from the building. When located in an area where ASCE 7 is referenced by adopted codes, floodwalls must be designed to resist ASCE 7 load combinations. Figure 4-1 shows a masonry floodwall.

Figure 4-1. Typical masonry floodwall with engineered closures, which protected the Oak Grove Lutheran School in Fargo, ND, from flooding in 2001 (source: Flood Control America, LLC)

Floodwalls are normally placed some distance from the building to avoid having to make structural modifications to the building. Depending on the site topography, floodwalls may protect only the low side of the site (and must tie into high ground), or they may surround the site. Floodwalls that surround a site have openings that provide access to the site. The openings must be closed before the onset of a flood, which is done by installing engineered closure structures (see Figure 4-1). Site access is affected while the closure structures are in place.

When a building is protected by a floodwall, underground utilities that serve the building and run under the floodwall must be considered so the utilities do not become conduits that allow floodwaters to pass through or under the floodwall and into the building. See Section 4.1.1.2.

The following sections contain information on the most common types of floodwalls, the building and site characteristics to be considered when designing a floodwall, and the floodwall design process.

4.1.1.1 Types of Floodwalls

The most common types of floodwalls are gravity, cantilever, buttress, and counterfort (see Figure 4-2).

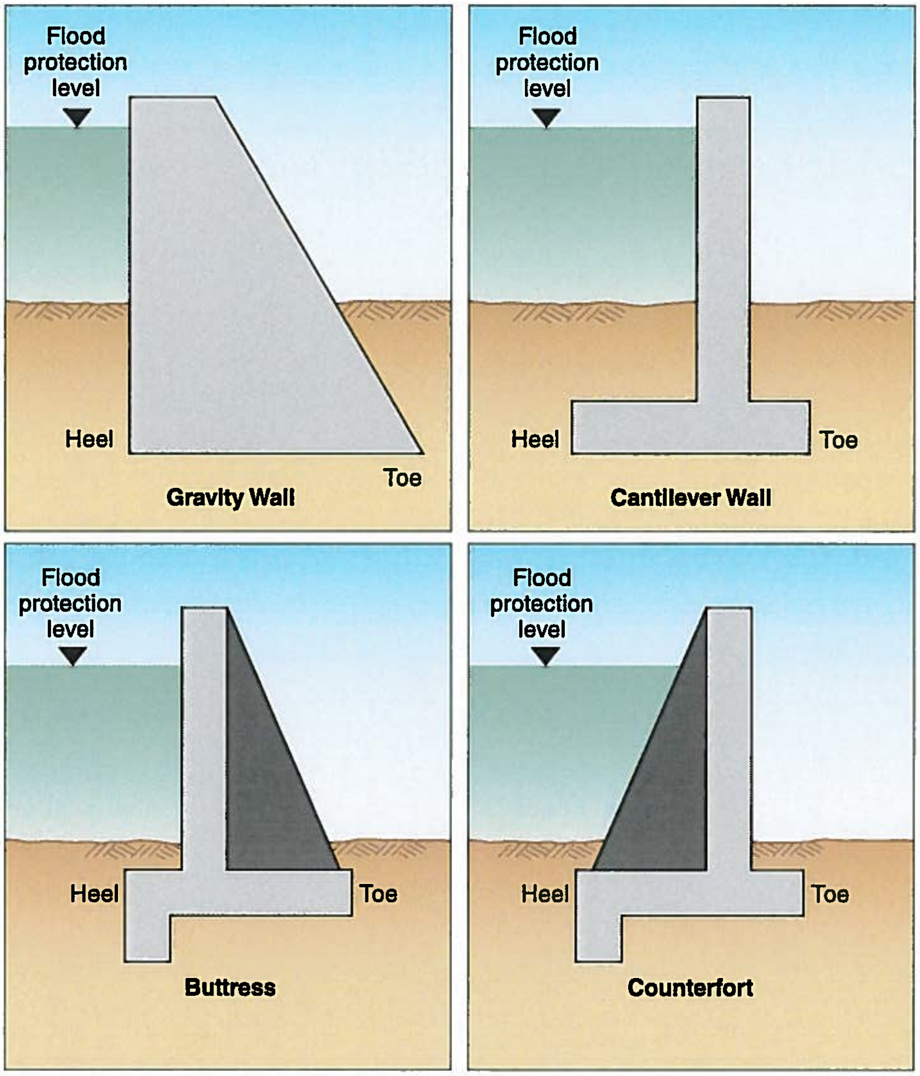


Figure 4-2. Gravity, cantilever, buttress, and counterfort floodwalls

4.1.1.1.1 Gravity Floodwalls

As the name implies, a gravity floodwall depends on its weight for structural stability. Structural stability is attained by effective positioning of the mass of the wall at its base, rather than by the weight of the retained materials (water or soil) on top of the wall foundations. A gravity floodwall resists overturning primarily because of the dead weight of the construction material (concrete or masonry); it is simply too heavy to be overturned by a lateral flood load.

Compared to the other types of floodwalls that are discussed, gravity floodwalls are relatively easy and straight-forward to construct. However, the primary disadvantage of gravity floodwalls is that they require massive amounts of material compared to the other floodwall types. As the height of a gravity floodwall increases and the amount of required material increases, the more cost-effective the other types of floodwalls become. Gravity walls are therefore most appropriate for low walls or lightly loaded walls. In addition, the sheer weight of the floodwalls required to resist flood forces can overload the bearing capacity of the supporting soils, which can make gravity floodwalls inappropriate when walls need to be relatively tall and the bearing soils are relatively weak.

4.1.1.1.2 Cantilever Floodwalls

Cantilever floodwalls are the most common type of floodwall because they are economical to design and construct. They use cantilever action to retain the mass behind the wall. Cantilever floodwalls are usually constructed of reinforced concrete or concrete block with steel reinforcing bars embedded in the concrete core of the wall (see Figure 4-3).

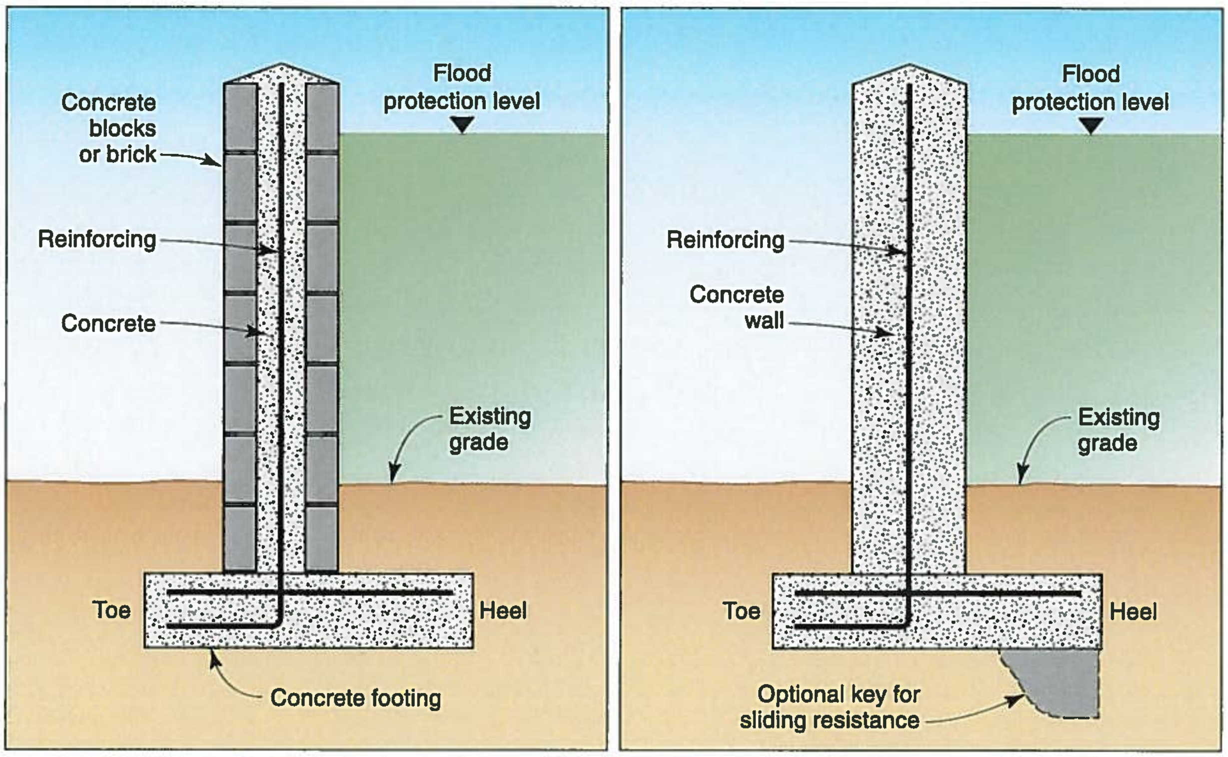


Figure 4-3. Concrete cantilever floodwall reinforcement

Stability is achieved partially from the weight of the soil on the heel portion of the base and from the weight of the wall itself balanced by the lateral forces and overturning moments (see Figure 4-4). The footing is often constructed with a "key" to increase sliding resistance (see Figure 4-3).

Because a cantilever floodwall often also serves as a cantilever retaining wall, the floodwall must be designed to resist the load combinations in ASCE 7 or the loads in other accepted engineering standards. The design should take into account buoyancy effects that reduce the submerged weight of the floodwall and the reduced bearing capacity of the soils that support the wall. Backfill may be placed along the side of the wall exposed to flooding to keep water away from the wall during flooding conditions.

Similar to the gravity floodwall, as the flood elevation increases and the required materials and cost of the cantilevered floodwall increase, the more cost-effective the alternative types of floodwalls may become.

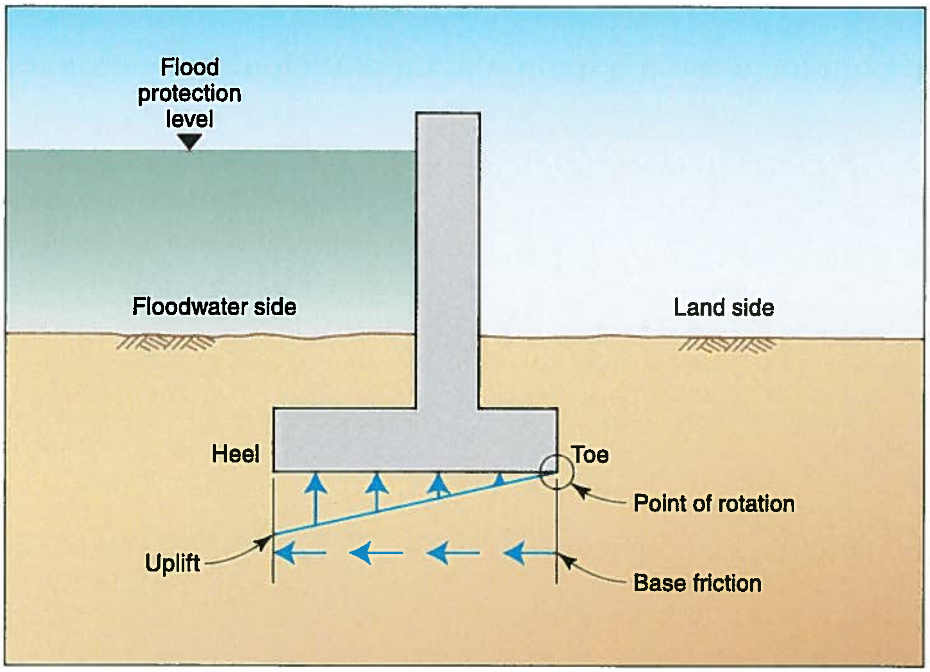


Figure 4-4. Stability of a cantilever floodwall

4.1.1.1.3 Buttress and Counterfort Floodwalls

The only difference between a buttress and counterfort floodwall is that the transverse support wall is on opposite sides (see Figure 4-2). In a buttressed floodwall, the transverse support wall is on the heel side, opposite the retained materials, and in a counterfort wall, the transverse support wall is on the toe side. Counterfort floodwalls are more widely used than buttressed floodwalls because their transverse support walls are hidden under the retained material (water or soil), whereas buttress floodwalls occupy what could otherwise be usable space in front of the wall.

A counterfort floodwall is similar to a cantilever floodwall except that a counterfort can be used when the cantilever would be long or when very high pressures would be exerted behind the wall. Counterfort walls include intermediate transverse support bracing designed and built at intervals along the wall to allow for a more economical wall design. Counterfort walls are generally cost-effective for walls higher than 20 feet.

4.1.1.2 Building and Site Considerations in Floodwall Design

Designing a floodwall requires detailed information about the existing building and site. Key information includes:

- Surveyed lowest point of entry
- Topographic and utilities survey
- Identified flood hazards
- Soil type
- Local building requirements
- Owner preferences

After this information has been collected, the designer must assess the existing building and site conditions, as follows:

- **Existing building foundation conditions.** Existing building foundation conditions may affect the floodwall design directly. For example, evidence of seepage or cracking in foundation walls may indicate the need to relieve hydrostatic pressure on the foundation as part of the floodwall design.
- **Soil type.** The type of soil surrounding the existing building is a key consideration in floodwall design. In general, the more cohesive soils (e.g., silty sands, clays) have lower permeability and reduced seepage potential, and can simplify floodwall drainage design. Less cohesive soils, such as clean sands or gravels, tend to have higher permeability and increased seepage potential, which must be accounted for in the drainage design. More cohesive soils tend to have lower bearing capacity and frictional resistance that may require larger floodwall footings than those on less cohesive soils.
- **Potential for seepage under the floodwall.** A floodwall may not reduce the hydrostatic pressures against a below-grade foundation. Seepage under the floodwall and the natural capillary action of the soil layer may result in a water level inside the floodwall that is equal to or above grade. The water level inside the floodwall increases as the depth of flooding outside the floodwall increases and may compromise floodwall effectiveness for long-duration events if not addressed.
- The potential for seepage under the floodwall can be relieved by installing a foundation drainage system (drainage tile and sump pump) at the footing level and/or by extending the distance from the foundation to the floodwall. Seepage pressures can also be decreased by placing backfill against the floodwall to extend the point where floodwaters submerge the soil or by installing a sheet pile or cement curtain cutoff wall below the floodwall foundation surrounding the existing structure. Computing the proper spacing between the structure and floodwall foundation, backfill soils, or cutoff walls required to address seepage pressure is complex and should be done by an experienced geotechnical engineer.

> **Warning**
>
> Flood duration is a critical consideration in the design of floodwall seepage control measures. The longer the duration (i.e., the longer floodwaters are in contact with the floodwall), the greater the potential for seepage and the greater the need for seepage control measures such as backfill or cutoff walls.

- **Number and size of floodwall openings.** The number and size of floodwall openings have a direct impact not only on the floodwall design but also on the operation of the existing building. Floodwalls with fewer and smaller openings are simpler to design and require less warning time to protect with floodwall closures, but the reduced number of openings can limit site access, hampering the ability of the existing building to function efficiently. Designers can consider passive floodwall opening systems that minimize the need for human intervention. Designers must therefore discuss the floodwall openings and access/egress issues with owners to understand the needs and level of disruption to be expected to facility operations.
- **Utility penetrations through or under the floodwall.** Utilities that penetrate the floodwall or run under the floodwall may become conduits that allow floodwaters to enter the area protected by the floodwall. Utilities should be sealed, and because sealing is rarely 100 percent effective, provisions to collect and dispose of seepage that flows through underground utilities should be installed.

Best Practice – Floodwall System with Passive Floodgates Protects Two Hospitals

Lourdes Hospital in Binghamton, NY, is in the 100-year floodplain of the Susquehanna River. Flooding in 2006 forced the hospital to close for 2 weeks and caused $20 million in damage (FEMA 2011a). Relocating the hospital was not feasible, but it was determined that a floodwall system would provide the necessary protection. The system was constructed for an estimated $7 million using funds from FEMA and New York State. The floodwall, which protects the hospital to a 500-year flood elevation, consists of a concrete T-wall and passive floodgates at each of the 11 entry points. The gates automatically deploy during a flood, triggered by the hydrostatic pressure of the rising floodwaters. When the floodwaters recede, the gates lower to their original open position. The floodwall was completed in 2010.

In 2011, Tropical Storm Lee swept through Binghamton depositing 7.5 inches of rain in a single day. The Susquehanna River crested at 25.7 feet before receding (NOAA 2011). Despite the record rainfall, the hospital remained fully operational and experienced no flooding (see Figures 4-5 and 4-6).

Figure 4-5. Floodwall successfully safeguards Lourdes Hospital from Tropical Storm Lee flooding (source: FloodBreak)

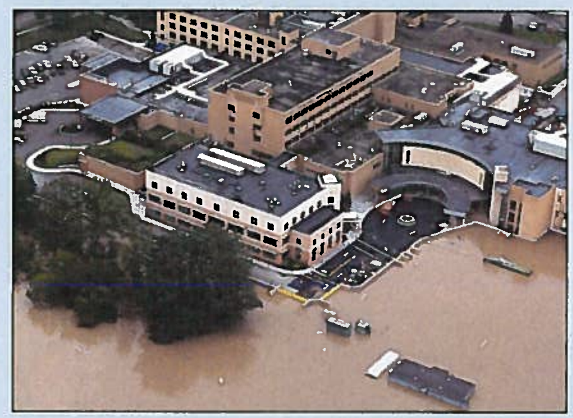


Figure 4-6 Aerial view showing effective protection of Lourdes Hospital from flooding as a result of Tropical Storm Lee

Columbus Regional Hospital in Columbus, IN, was closed for 6 months in 2008 because of flooding. The flooding forced the evacuation of 157 patients, knocked out primary and emergency electrical systems, and caused $180 million in damage (Columbus Regional Hospital 2012). Relocating the hospital was not feasible because of cost. FEMA and the hospital staff determined that a floodwall would be the best way to provide flood protection. Construction began in June 2011 and was completed in April 2012. The floodwall was funded by the FEMA Public Assistance Program, 406 Mitigation Program. The encircling 2,400-foot floodwall is 2 feet higher than the 100-year flood elevation and incorporates 15 passive floodgates (FEMA 2012c). The hospital has also strengthened its Flood Emergency Response Plan. Hospital officials are more involved with community management now and remain aware of weather conditions (see Figures 4-7 and 4-8).

Figure 4-7. Floodwaters surround Columbus Regional Hospital in 2008

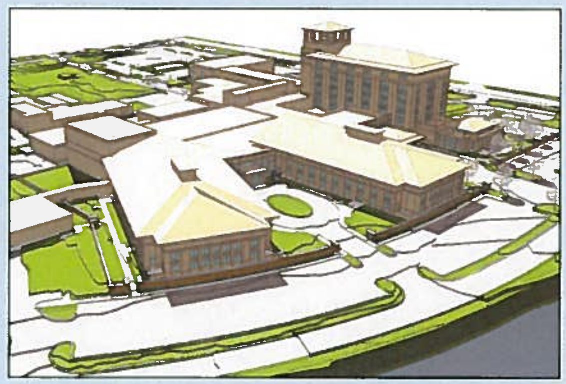


Figure 4-8 Columbus Regional Hospital schematic of floodwall plan

4.1.1.3 Floodwall Design Process

Floodwall design depends primarily on the type of flooding expected at the building site. High water levels and velocities can exert significant hydrostatic and hydrodynamic forces that must be accounted for in the floodwall design.

The design of any type of floodwall must address the following three concerns:

- Ability of the wall to resist external loads and hold back floodwater
- Sufficiency of floodwall closure strength and stiffness to resist the calculated stresses
- Ability of surrounding soils to resist scour and erosion

Most non-residential floodwalls are engineered to flood depths of 6 or 7 feet above existing grade. A minimum of 1 foot of freeboard above the flood protection level is recommended. Tall floodwalls (taller than 10 feet) can be expensive to construct and maintain and may require additional land for grading and drainage.

Designers should follow the eight-step process shown in Figure 4-9 and develop specifications for appurtenances such as drainage systems, waterproof materials to stop seepage and leakage, and miscellaneous details to meet site and owner preferences.

Important issues to be considered in the eight-step floodwall design process are as follows:

- When determining the wall height and footing depth based on site and design flood conditions (Step 1 in Figure 4-9), remember to include freeboard where appropriate and when required by local codes or regulations.
- Use load combinations specified by ASCE 7 to calculate lateral and vertical forces acting on the wall (Step 3 in Figure 4-9).
- If the calculated factors of safety against sliding, overturning, or bearing capacity failure of the wall are insufficient (Steps 4, 5, and 7 in Figure 4-9), revise wall dimensions and repeat analyses based on the corrected dimensions.

The floodwall design process is iterative—the initial design is based on experience and successful designs, checked against design loads and conditions, and revised as necessary until all requirements are satisfied by the design.

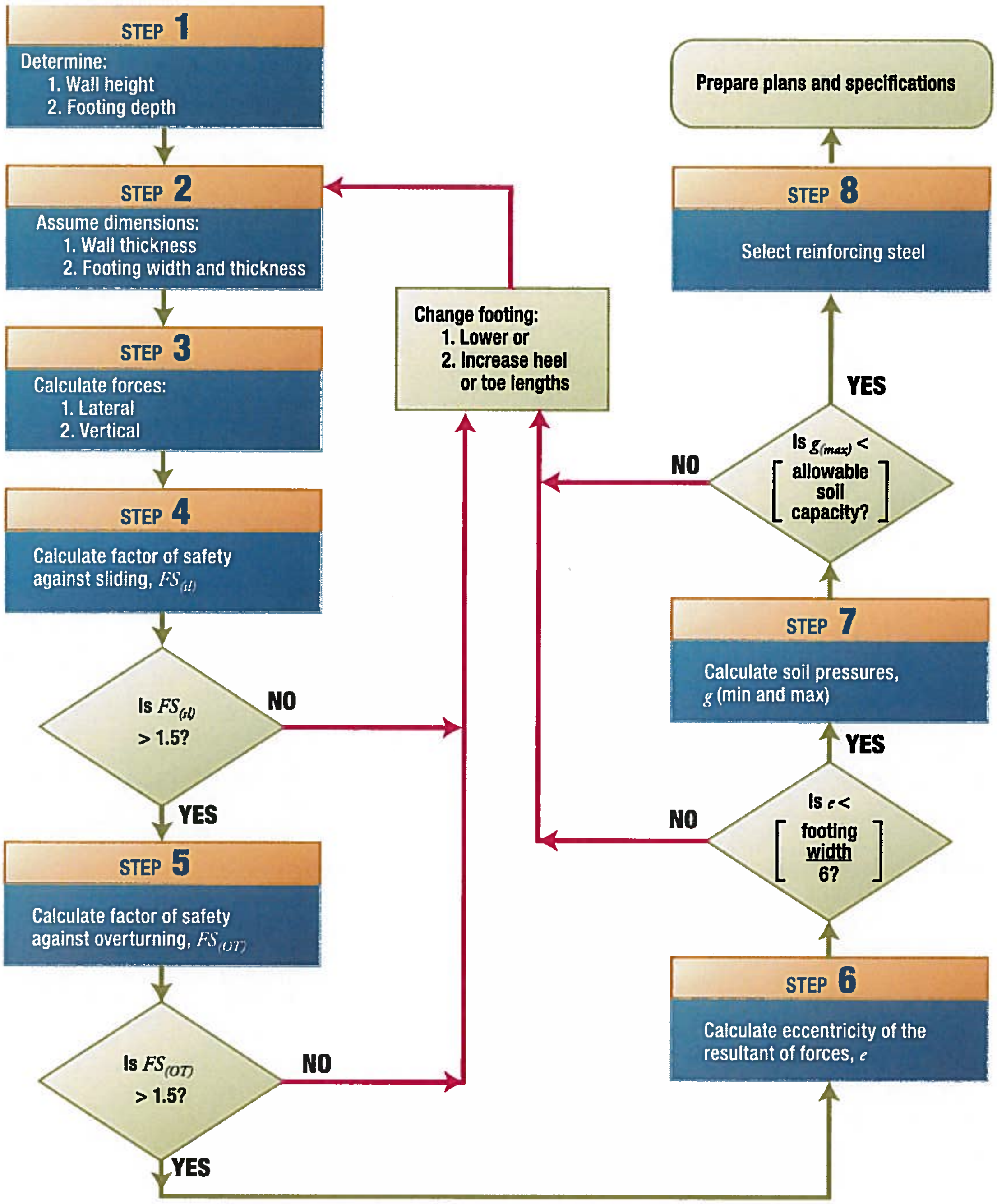


Figure 4-9. Floodwall design process

Appendix P
Detailed Cost Estimate

CONSTRUCTION COST ESTIMATE

OWNER: City of Caliente	PROJECT: Floodway Improvements Study Prioritized Project 1
LOCATION: PO Box 1006 100 Depot Avenue, Caliente, Nevada 89008	ESTIMATE LEVEL: Detailed Preliminary DATE: 12/5/2018 FILE:

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	PROJECT CONSTRUCTION COSTS				
1	Mobilization			$50,000.00	$50,000.00
2	Site Preparation, Cleaning and Grubbing, Selective Tree Removal			$50,000.00	$50,000.00
3	Sediment Removal				$819,358.16
	Load/Haul/Stockpile, Assume 10% Bulking	69,300	CY	$12.95	$819,358.16
4	Earth Work on Banks - Excavation and Grading	1	LS	$100,000.00	$100,000.00
5	Riprap Installation				$351,406.37
	Machine Placed for Slope Protection ((3550' x 2) x 3' x3')	2,367	CY	$63.00	$140,088.29
	18" Minimum Thickness, Not Grouted (1500' x 20' Estimated)	2,222	SY	$103.00	$211,318.08
6	Foundation Trench (4' Wall: 5000' Long, 6' Bottom, 4' Deep, 1:1 Side Slope)				$245,303.93
	(6.5' Wall: 1650' Long, 7' Bottom, 4' Deep, 1:1 Side Slope)				
	Excavation - Common, 4' to 6' Deep, 1/2 C.Y. Excavator	10,096	CY	$7.55	$69,595.28
	Bedding	1,539	CY	$39.00	$56,812.24
	Bedding - 3/4-Inch Maximum Size				
	Gradation Limits:				
	Passing No. 200 Seive - 5% or Less				
	Passing No. 50 Seive - 25% or Less				
	Backfill - Compacted	7,019	CY	$9.15	$58,632.35
	Compacted to Relative Density not Less				
	Than 70%				
	Gradation Limits:				
	Passing No. 200 Seive - 5% or Less				
	Passing No. 50 Seive - 25% or Less				
	Load/Haul/Stockpile, Assume 20% Bulking	5,097	CY	$12.95	$60,264.05
7	Buttress Flood Wall				$1,346,290.76
	Spread Footing (5000' x 4' x 12" + 1650 x 5' x 12" + 6650' x 1' x 12")	1,293	CY	$400.00	$568,485.28
	Concrete Wall (5000' x 5' x 12" + 1650' x 7.5' x 12") (4' and 6.5' Height, 1' Buried)	1,384	CY	$500.00	$742,076.60
	Buttress (250 x 0.5 x 4' x 2' x 12" + 82 x 0.5 x 6.5' x 3' x 12")	67	CY	$500.00	$35,728.88
	PROFESSIONAL & INCIDENTAL COSTS				$817,000.00
8	Professional & Incidental Costs				
	Funding Administration	1	LS	$15,000.00	$15,000.00
	Environmental Assessment	1	LS	$50,000.00	$50,000.00
	Utility & Topographic Mapping	1	LS	$10,000.00	$10,000.00
	Parcel Tract Map & Easement Documents	1	LS	$20,000.00	$20,000.00
	Geotechnical Investigation	1	LS	$15,000.00	$15,000.00
	Engineering Design	1	LS	$300,000.00	$300,000.00
	Bidding & Negotiating	1	LS	$12,000.00	$12,000.00
	Engineering Construction Services	1	LS	$325,000.00	$325,000.00
	FEMA CLOMR and LOMR including review fee ($7,250 + $9,250)	1	LS	$0.00	$0.00
	Attorney Fees	1	LS	$20,000.00	$20,000.00
	Miscellaneous Incedental Administration	1	LS	$50,000.00	$50,000.00
	SUBTOTAL				$3,779,359.22
9	20% Contingency				$755,871.84
	Inflation Rate			3%	
	TOTAL				$5,415,303.06

PREPARED BY: Li Qi, Project Engineer

CHECK BY: Derek Anderson, Project Manager

CONSTRUCTION COST ESTIMATE					
OWNER: City of Caliente		PROJECT: Floodway Improvements Study Prioritized Project 2			
LOCATION: PO Box 1006 100 Depot Avenue, Caliente, Nevada 89008		ESTIMATE LEVEL: Detailed Preliminary DATE: 12/5/2018 FILE:			
PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	PROJECT CONSTRUCTION COSTS				
1	Mobilization			$50,000.00	$50,000.00
2	Site Preparation, Cleaning and Grubbing, Selective Tree Removal			$50,000.00	$50,000.00
3	Sediment Removal				$780,341.10
	Load/Haul/Stockpile, Assume 10% Bulking	66,000	CY	$12.95	$780,341.10
4	Earth Work on Banks - Excavation and Grading	1	LS	$100,000.00	$100,000.00
5	Riprap Installation				$343,514.08
	Machine Placed for Slope Protection ((3350' x 2) x 3' x3')	2,233	CY	$63.00	$132,195.99
	18" Minimum Thickness, Not Grouted (1500' x 20' Estimated)	2,222	SY	$103.00	$211,318.08
6	Foundation Trench (4' Wall: 4000' Long, 6' Bottom, 4' Deep, 1:1 Side Slope)				$203,603.67
	(6.5' Wall: 1500' Long, 7' Bottom, 4' Deep, 1:1 Side Slope)				
	Excavation - Common, 4' to 6' Deep, 1/2 C.Y. Excavator	8,370	CY	$7.55	$57,698.22
	Bedding	1,278	CY	$39.00	$47,172.62
	Bedding - 3/4-Inch Maximum Size				
	Gradation Limits:				
	Passing No. 200 Seive - 5% or Less				
	Passing No. 50 Seive - 25% or Less				
	Backfill - Compacted	5,772	CY	$9.15	$48,220.86
	Compacted to Relative Density not Less				
	Than 70%				
	Gradation Limits:				
	Passing No. 200 Seive - 5% or Less				
	Passing No. 50 Seive - 25% or Less				
	Load/Haul/Stockpile, Assume 20% Bulking	4,272	CY	$12.95	$50,511.98
7	Buttress Flood Wall				$1,123,442.09
	Spread Footing (4000' x 4' x 12" + 1500' x 5' x 12" + 5500' x 1' x 12")	1,074	CY	$400.00	$472,380.32
	Concrete Wall (4000' x 5' x 12" + 1500' x 7.5' x 12") (4' and 6.5' Height, 1' Buried)	1,157	CY	$500.00	$620,465.38
	Buttress (200 x 0.5 x 4' x 2' x 12" + 76 x 0.5 x 6.5' x 3' x 12")	57	CY	$500.00	$30,596.39
	PROFESSIONAL & INCIDENTAL COSTS				$738,500.00
8	Professional & Incidental Costs				
	Funding Administration	1	LS	$15,000.00	$15,000.00
	Environmental Assessment	1	LS	$0.00	$0.00
	Utility & Topographic Mapping	1	LS	$10,000.00	$10,000.00
	Parcel Tract Map & Easement Documents	1	LS	$20,000.00	$20,000.00
	Geotechnical Investigation	1	LS	$15,000.00	$15,000.00
	Engineering Design	1	LS	$250,000.00	$250,000.00
	Bidding & Negotiating	1	LS	$12,000.00	$12,000.00
	Engineering Construction Services	1	LS	$300,000.00	$300,000.00
	FEMA CLOMR and LOMR including review fee ($7,250 + $9,250)	1	LS	$46,500.00	$46,500.00
	Attorney Fees	1	LS	$20,000.00	$20,000.00
	Miscellaneous Incedental Administration	1	LS	$50,000.00	$50,000.00
	SUBTOTAL				$3,389,400.94
9	20% Contingency				$677,880.19
	Inflation Rate			3%	
	TOTAL				$4,856,546.37

PREPARED BY: Li Qi, Project Engineer

CHECK BY: Derek Anderson, Project Manager