

**Fourmile Creek and Mudd Gulch
Hydrologic/Hydraulic Analysis
Technical Support Data Notebook
City of Cañon City
Fremont County, Colorado**

Prepared for

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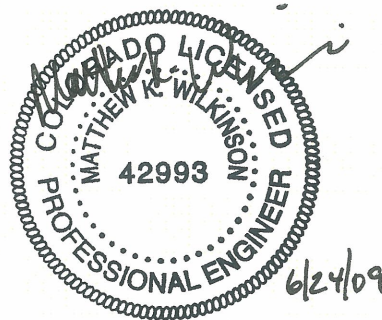
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Section 1

General Documentation

1.1. Engineer Certification

PBS&J performed the hydrologic/hydraulic study for Fourmile Creek and Mudd Gulch, located in the City of Cañon City (the City), Colorado. The work was authorized by a contract between the City and PBS&J. The work consisted of performing hydrologic/hydraulic analyses and preparing revised floodplain delineation work maps. I am a registered professional engineer in the State of Colorado and have affixed my professional seal to this study below.



1.2. Project Background and Purpose

This Technical Support Data Notebook (TSDN) details the methods and results used to develop the Fourmile Creek and Mudd Gulch floodplains within the City. Located in south-central Colorado's Fremont County, the Fourmile Creek and Mudd Gulch drainage basins are adjacent tributary drainageways flowing into the upper Arkansas River near the City. Fourmile Creek has a total contributing drainage area of 437 square miles and conveys flow from north to south through mountainous terrain within the upper limits of the basin out into the high mountain valley landscape marking the southern watershed area. Located directly to the east of the lower Fourmile Creek basin, the 5-square-mile Mudd Gulch watershed conveys flow in a south-southwesterly direction towards its confluence point with the Arkansas River. Storm runoff generated in the upper reaches of Mudd Gulch is regulated by the 272 acre-foot Mudd Gulch Detention Dam before reaching the corporate limits for the City. The Mudd Gulch Detention Dam was constructed for flood control purposes. Fourmile Creek and Mudd Gulch parallel each other directly upstream of U.S. Highway 50. From this point flow from these two tributaries passes under Highway 50 and continues in a southern direction through the gently sloped urban and agricultural lands located along the eastern edge of the City.

Flooding observed along these two drainageways typically has resulted from frontal and convective rainstorms in the spring, summer, and fall, but it has also occurred from heavy

snowmelt in the late spring months. Floods stemming from long-duration heavy frontal rainstorms and snowmelt typically results in moderate peak flows and runoff volumes over a longer duration, while flooding resulting from the convective storms typically produces higher peak flows with a lower runoff volume over shorter periods of time. A number of factors including the large drainage area for Fourmile Creek, sparse vegetative cover and high runoff potential over the lower elevations of the basins, as well as drastic changes in the slope of the terrain combine to create a unique potential for flooding along these drainageways.

In recent years this region of Fremont County, specifically areas in and around the City, has observed an increase in urban and agricultural development along the flood zone for these two drainageways. Continued growth within this area, coupled with the increased risk to human life and property has resulted in the need to re-evaluate and update the flood hazard zones along lower Fourmile Creek and Mudd Gulch.

1.3. FEMA Flood Zone Information

Prior to the completion of this study, a detailed floodplain analysis for Fourmile Creek and Mudd Gulch had not been completed and approved by FEMA. The effective FEMA flood zone along Fourmile Creek was established through an approximate Zone A floodplain delineation. This study will replace the effective Zone A floodplain along Fourmile Creek from the confluence with the Arkansas River to a point approximately 3.0 miles upstream near the corporate limit for the City with a detailed Zone AE (with floodway) floodplain delineation. Please refer to **Figure 1-1** for an overview of the effective FEMA flood zones in this area.

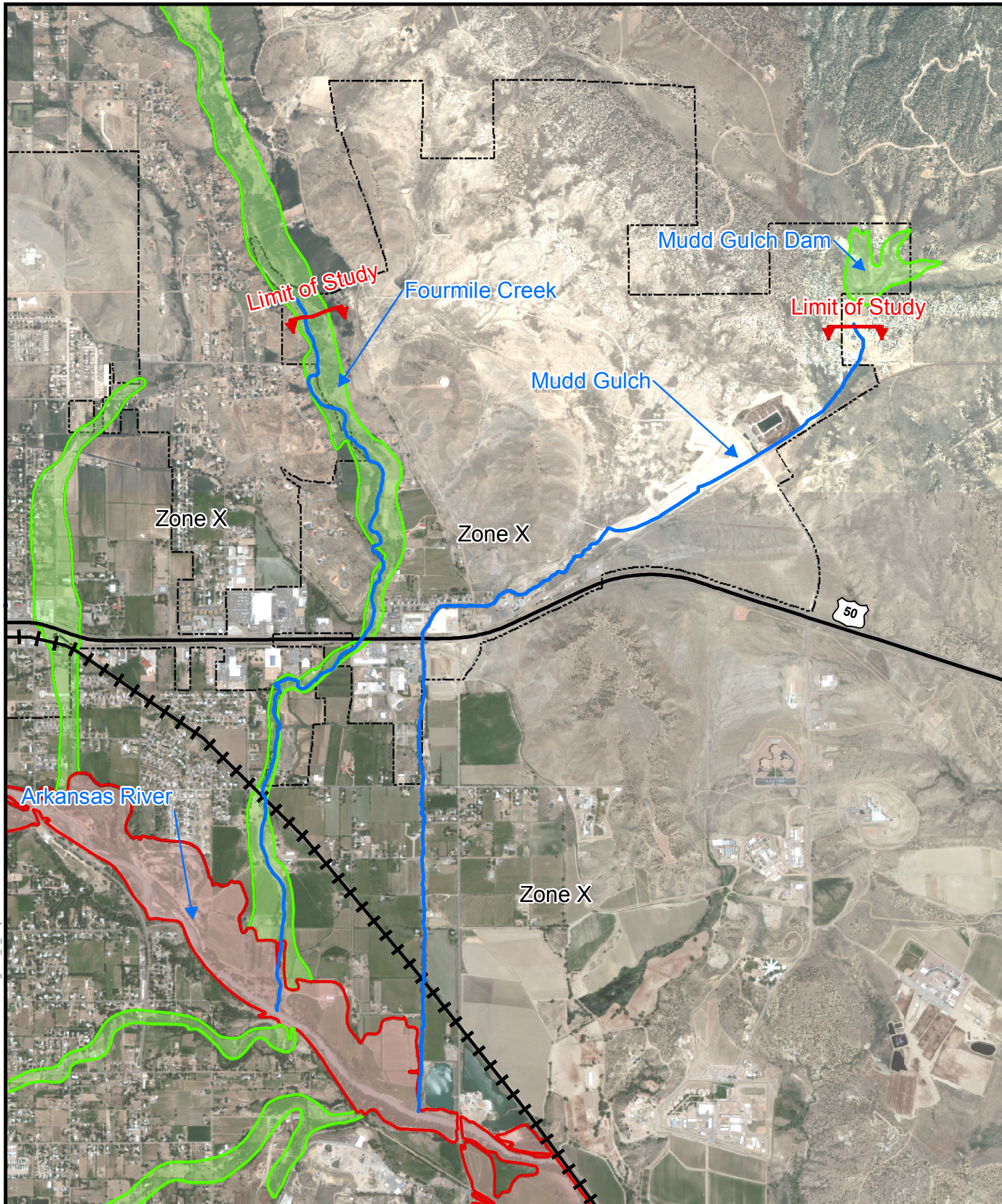
No previous studies have been completed along Mudd Gulch and there are no effective FEMA flood zones in this area. Note that a small area upstream of the limit of detailed study for this analysis is currently mapped as approximate Zone A. This approximate Zone A is located on the upstream side of the Mudd Gulch Detention Dam. At the request of Fremont County, PBS&J has refined this effective Zone A delineation based on 2001 2-foot topography obtained from the County. The Mudd Gulch drainageway located downstream of the dam will be mapped as a detailed Zone AE (with floodway) floodplain on the new FIRM panels. This new Zone AE mapping extends from the confluence with the Arkansas River upstream for a distance of approximately 3.75 miles to the upstream limit of detailed study located at the downstream side of the Mudd Gulch Detention Dam.

The purpose of this new study is to revise the existing floodplain delineation shown on the current effective Flood Insurance Rate Maps (FIRM) for the City of Cañon City (Community Number 080068), and for Fremont County Unincorporated Areas (Community Number 080067). The affected panel numbers are as follows: 0629E, 0635E, 0637E, and 0641E. As part of this project, PBS&J will complete a Physical Map Revision (PMR) to incorporate the new floodplain boundaries onto the panels.

1.4. Deliverables Checklist

Deliverables Checklist is attached at the end of this section.

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Legend

- Fourmile Creek and Mudd Gulch
- Highway
- Railroad
- City of Cañon City Corporate Limit

Effective Flood Hazard Area

- A
- AE
- X



0 1,250 2,500
Feet
1 inch equals 2,500 feet

**FIGURE 1-1:
Project Overview**

Fourmile Creek and Mudd Gulch H&H Analysis and PMR

Prepared for:
City of Cañon City

PBSJ 4604 DTC Blvd, Suite 700
Denver, Colorado 80237
Phone: 303-221-7275

Aerial Source:
Fremont County Spring 2005

DELIVERABLES CHECKLIST

**DELIVERABLES CHECKLIST – FOURMILE CREEK AND MUDD GULCH TSDN
CITY OF CAÑON CITY, FREMONT COUNTY, COLORADO**

TSDN CATEGORY	DATA TYPE	DATA SUBMITTED
General Documentation	Special Problem Reports Index	N/A
	Special Problem Reports	N/A
	Contact Reports Index	N/A
	Contact Reports	N/A
	Meeting Minutes/Reports Index	N/A
	Meeting Minutes/Reports	N/A
	Correspondence with/from FEMA	N/A
	Correspondence with/from Contractor	N/A
	Other General Correspondence	N/A
Engineering Analysis	Hydrologic Analysis Index	✓
	Summary Report of Hydrologic Analysis	✓
	Computer Models, Calculations and Execution	✓
	Summary Report for Independent QA/QC	✓
	Hydraulic Analysis Index	✓
	Cross Section Information	✓
	Floodway Analysis	✓
	Key to Cross-Section Labeling	✓
	Computer Models, Calculations and Execution	✓
	Cross-Section Plots	✓
	Summary Report for Independent QA/QC	✓
	Key to Transect Labeling	N/A
	Transect and Surge Data	N/A
	Wave Height Information	N/A

**DELIVERABLES CHECKLIST – FOURMILE CREEK AND MUDD GULCH TSDN
CITY OF CAÑON CITY, FREMONT COUNTY, COLORADO**

TSDN CATEGORY	DATA TYPE	DATA SUBMITTED
Engineering Analysis (Cont'd)	Computer Models, Calculations and Execution	N/A
	Summary Repot for Independent QA/QC	✓
	Shallow Flooding Models, Calculations and Execution	N/A
	Summary Report for Independent QA/QC	N/A
	Ice-Jam Flooding Models, Calculations and Execution	N/A
	Summary Report for Independent QA/QC	N/A
	Alluvial Fan Flooding Models, Calculations, Execution	N/A
	Summary Report for Independent QA/QC	N/A
Draft FIS Report	FIS Report Narrative (Complete)	N/A
	FIS Report Narrative (Revisions Summary)	N/A
	Summary of Discharges Table	✓
	Floodway Data Table	✓
	Summary of Stillwater Elevations Table	N/A
	Transect Locations Table	N/A
	Surge Elevations Table	N/A
	Flood Profiles	✓
	Certification of Compliance for Work	—
	Other Relevant Data	—
Mapping Information	Mapping Information Index	—
	Topographic Mapping (Hardcopy Version)	✓
	Topographic Mapping (Digital Version)	✓
	Summary Report for Independent QA/QC	✓
	Work Maps (Hardcopy Version)	✓
	Work Maps (Digital Version)	✓

**DELIVERABLES CHECKLIST – FOURMILE CREEK AND MUDD GULCH TSDN
CITY OF CAÑON CITY, FREMONT COUNTY, COLORADO**

TSDN CATEGORY	DATA TYPE	DATA SUBMITTED
Mapping Information (Cont'd)	Preliminary DFIRM (Hardcopy Version)	N/A
	CD-ROM with DFIRM Data	✓
	USGS Digital Orthophoto Quadrangle(s)	—
	Soil and Vegetation Maps	✓
	USGS Topographic Quadrangle Maps	—
	Flood Hazard Boundary Map	—
	Community Maps	—
	All Other Maps	—
	DFIRM Database Data (Basic)	—
	DFIRM Database Data (Enhanced)	—
	Digital Data Submission Checklist	—
	Narrative	—
	Photogrammetric Survey Documentation	—
	GPS Survey Documentation	—
	Field Survey Notes/Notebook	✓
Miscellaneous Reference Materials	SCS/NRCS Flood Hazard Analyses Report(s)	N/A
	USGS Floodplain Information Report(s)	N/A
	USACE Feasibility Study Reports	N/A
	Watershed Studies	N/A
	Site Visit Photographs	✓
	Community Population and Demographic	—
	Tax Base Reports	—
	Legal References	—

Section 2

Hydrologic Analysis

2.1. Background

This section of the TSDN details the methodology used in the hydrologic analysis to develop the 10%, 2%, 1%, and 0.2% annual chance flood discharges for Fourmile Creek and Mudd Gulch. Based on established FEMA methodology, these flood discharges may be estimated using regional regression equations, gaging station data, or rainfall-runoff models. Fourmile Creek is a gaged stream with a large tributary area, so the flood discharges were determined directly from the gaging station data. Mudd Gulch, on the other hand, has a relatively small tributary area with flow from the upstream portions of the watershed regulated and stored in the Mudd Gulch Detention Dam. Regional regression equations may not be valid for Mudd Gulch because of the relatively small drainage area and because of the regulated flow discharging from the detention basin. Thus, the flood discharge for Mudd Gulch was estimated by developing a rainfall-runoff model using the HEC-HMS computer program. A summary of the hydrologic analysis for Fourmile Creek and Mudd Gulch is discussed in more detail below. Supporting documentation for the hydrologic analysis is also included at the end of this section (**Section 2.5**).

2.2. Fourmile Creek

There is a U.S. Geological Survey (USGS) stream gage located on Fourmile Creek in the study area, 3,100 feet upstream of the Arkansas River (USGS 07096500 Fourmile Creek near Cañon City, Colorado). This gage has a drainage area of 434 square miles and 32 years of annual peak flow data, from 1949 to 1953 and from 1971 to 1997. In order to estimate the 100-year flow for Fourmile Creek, the peak flow records were analyzed in accordance with the standards presented in Bulletin 17B (IACWD 1982) using the *PEAKFQ* program (USGS 2006). The results were then compared to published discharge-frequency relations in a report prepared by the USGS for gaged sites on unregulated streams in Colorado.

Bulletin 17B Annual Peak Flow Frequency Analysis

The peak flow data for the Fourmile Creek stream gage was obtained from the National Water Information System (<http://nwis.waterdata.usgs.gov/usa/nwis/peak>). The data was downloaded in the WATSTORE file format and directly imported into the *PeakFQ* computer program. For this analysis, the gap between the systematic-record periods (from 1954 to 1970) was ignored based on the assumption that the lack of record in the interim was unrelated to hydrologic conditions.

The peak flow rates for various return periods based on the Bulletin 17B frequency analysis are shown in **Table 2-1**. The frequency analysis from the *PeakFQ* computer program is included in the supporting documentation at the end of this section (**Section 2.5**).

USGS Regional Report

The USGS conducted a regional flood study and published a report titled *Analysis of the Magnitude and frequency of Floods in Colorado* (USGS 2000). The report includes flood-frequency curves that depict the relation of annual peak discharge to annual exceedance probability as determined by the Log-Pearson probability distribution. These curves were developed using records of annual peak discharges at 328 gaging stations on unregulated streams having a minimum of 10 years of record. One of the stations included in the report was the Fourmile Creek gage in the study area. A copy of the report is provided in the supporting documentation at the end of this section (**Section 2.5**).

The peak flow rates on Fourmile Creek for various return periods based on the USGS report are shown in **Table 2-1**.

Table 2-1 Fourmile Creek Peak Discharge Comparison

Annual Exceedance Probability	Peak Discharges (cfs)	
	Bulletin 17B Analysis	USGS Report
10%	2010	2110
2%	4643	5110
1%	6269	7020
0.2%	11600	13500

The peak discharges resulting from the Bulletin 17B frequency analysis are relatively similar to the discharges published in the USGS report. The peak flows published in the USGS report were slightly higher and were therefore used in the hydraulic model.

It should be noted that the 100-year peak flow estimated using the USGS Regression equation for Fourmile Creek is 4,656 cfs, which is lower than the peak discharge estimate derived directly from the gaging station data as described above. The results from the regression equations were not used to estimate peak discharges for this study since Fourmile Creek is a gaged stream.

2.3. Mudd Gulch

The 10%, 2%, 1%, and 0.2% annual chance flood peak discharges for Mudd Gulch were estimated through the development of a HEC-HMS hydrologic model. No stream gages were identified along Mudd Gulch for use in this analysis. The resulting peak flows generated with the HEC-HMS model were utilized in the hydraulic model for Mudd Gulch. The HEC-HMS model can be found on the Digital Data DVD that accompanies this report.

This section discusses the criteria, methodology, and assumptions applied to the Mudd Gulch hydrologic analysis.

2.3.1. Mudd Gulch Dam

The Mudd Gulch Detention Dam is located in the foothills in the northeastern portion of the City, 3.9 miles upstream of the Arkansas River along Mudd Gulch. The Mudd Gulch Detention Dam has a tributary area of 2.23 square miles and is used for flood control purposes. Thus, design plans for the Mudd Gulch Detention Dam (refer to **Section 6** for a copy of the plans) from 1971 were reviewed and a stage-storage-discharge relationship was incorporated into the hydrologic model for the 10%, 2%, 1%, and 0.2% annual chance storm events in order to account for the attenuation and to determine the outflow from the Mudd Gulch Dam. The stage-storage-discharge relationship used in the HEC-HMS model is shown in **Table 2-2**.

Table 2-2 Mudd Gulch Dam Stage-Storage-Discharge Relationship

Stage (ft)	Discharge ¹ (cfs)	Storage (ac-ft)
5522	0	0.00
5526	0	0.08
5530	0	0.46
5533.3	0	1.96
5540.9	8	21.31
5542	10	27.74
5544.2	15	42.98
5546	19	57.83
5550	24	99.72
5554	28	155.49
5558	30	227.42
5560.1	30	272.38
5562	131	318.32
5566	135	432.00
5570	3790	565.20
5574	13145	727.50
5575	16146	773.55

Notes:

1- Discharge values referenced from Mudd Gulch Dam design plans

2.3.2. Subbasin Delineation

The Mudd Gulch watershed was delineated and subdivided into hydrologic subbasins using ArcHydro, an extension to ESRI's ArcGIS platform. The initial subbasin boundaries were delineated in GIS using a 10-meter digital elevation model obtained from the USGS Seamless Map (<http://seamless.usgs.gov/>). Upon completion of the initial basin delineation, a 2-foot topographic coverage obtained from the City of Cañon City, aerial imagery, and site visits to the project location were utilized to modify the boundaries as necessary. Final watershed and subbasin boundaries were determined to be representative of the existing drainage patterns

present within the Mudd Gulch basin. The delineation resulted in a total of 7 subbasins within the 5.3 square-mile watershed. The subbasins range in size from 0.2 to 1.4 square miles and are shown on **Figure 2-3** at the end of this section.

2.3.3. Computer Modeling

HEC-HMS version 3.2 was used to model hydrologic processes within Mudd Gulch. The HEC-HMS modeling program is a graphical user interface designed to simulate the precipitation-runoff response in dendritic urban and natural watersheds. The model incorporates user-specified meteorological models, precipitation losses, transform methods, and reach routing for a given watershed.

2.3.4. Rainfall and Storm Distribution

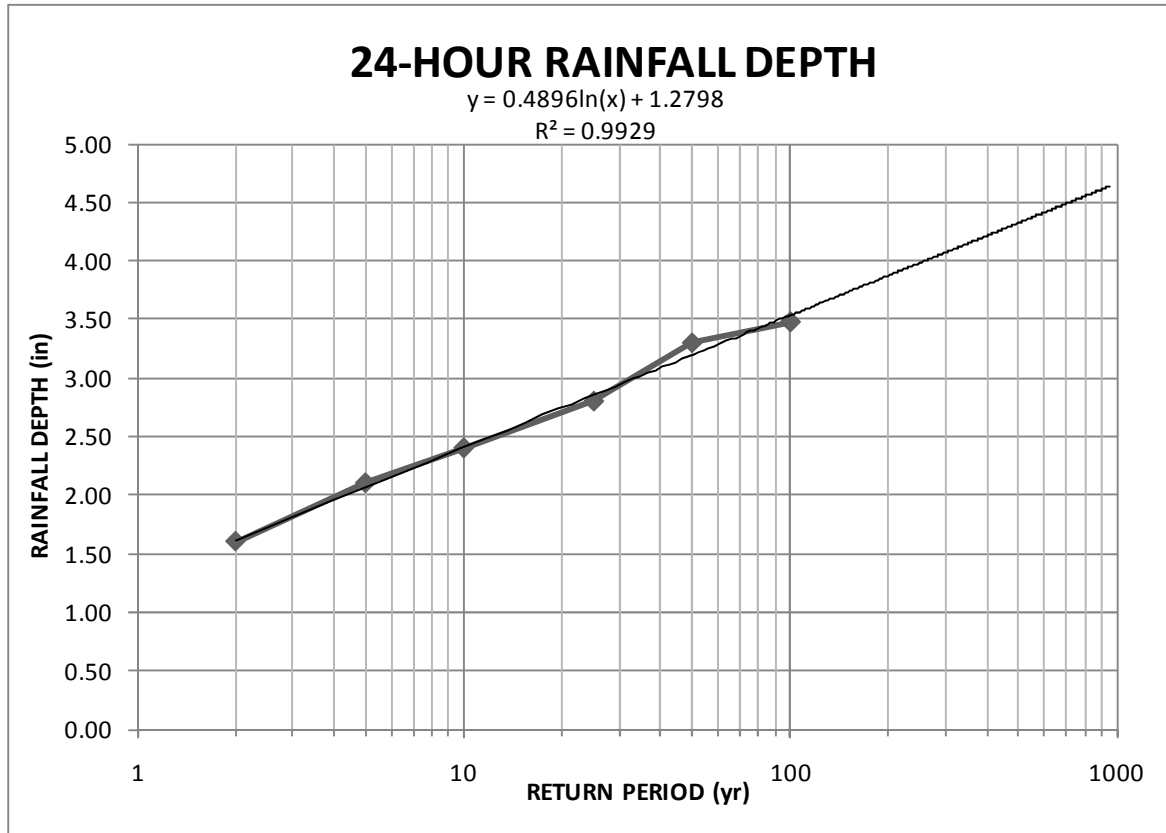
The meteorological model for Mudd Gulch utilized a 24-hour SCS Type II storm distribution to simulate rainfall over the watershed. This specific distribution was chosen based on recommendations presented in Figure B-2 of the Natural Resources Conservation Service Technical Reference-55 (TR-55) manual. Point precipitation depths for the 10% and 2% annual chance 24-hour storm events were taken from the National Oceanic and Atmospheric Administration (NOAA) Precipitation Frequency Atlas of the Western United States, Volume III – Colorado isopluvial maps. For the 1% annual chance storm event, the NOAA Atlas rainfall grids were obtained in ESRI Grid format. The Mudd Gulch subbasins were overlaid on top of the rainfall grid in GIS and an area-weighted average rainfall depth was calculated for each subbasin. The average 1% rainfall depth for the entire Mudd Gulch Watershed is 3.48 inches.

By plotting the rainfall depths for 2, 5, 10, 25, 50, and 100-year storm events within excel, a logarithmic trendline can be developed. The associated equation can then be used to calculate rainfall depth for the 500-year storm event. Based on this method, the rainfall depth for the 500-year storm event is 4.32 inches. The input values and associated logarithmic trendline are shown below in **Table 2-3**.

Table 2-3 24-Hour Rainfall Depths used to Calculate the 500-Year Rainfall Depth

RETURN FREQUENCY (yr)	24-HR RAINFALL DEPTH (in)
2	1.60
5	2.10
10	2.40
25	2.80
50	3.30
100	3.48
500	4.32

Note: The 24-hour rainfall depth for the 2 – 50 year storm events were taken from NOAA 2, Atlas 3, Volume III – Colorado Isopluvial Maps. For the 100-year event an average depth of 3.48 inches was determined by calculating the area-weighted average rainfall depths of each subbasin in the HEC-HMS model (these depths range from 3.4 – 3.65 inches).

Chart 2-1 Logarithmic Trendline used to Calculate the 500-Year Rainfall Depth

In accordance with NOAA guidelines, an aerial adjustment factor (AAF) was not applied to the point precipitation depths due to the small size of the Mudd Gulch drainage basin. The total rainfall depths corresponding to each design storm are shown in **Table 2-4**.

Table 2-4 NOAA 24-Hour Total Rainfall Depths Used in the Hydrologic Models

DESIGN STORM TOTAL RAINFALL DEPTHS				
DESCRIPTION	10% RAINFALL EVENT (in)	2% RAINFALL EVENT (in)	1% RAINFALL EVENT (in)	0.2% RAINFALL EVENT (in)
Mudd Gulch	2.4	3.3	3.48*	4.32

*Note: 3.48 inches is the average 100-year rainfall depth for the entire Mudd Gulch Watershed. For the 100-year event, area-weighted average rainfall depths were used for each subbasin in the HEC-HMS model ranging from 3.4 – 3.65 inches.

2.3.5. Soils

Soils data for the watershed was obtained in GIS format from the NRCS Geospatial Data Gateway. The GIS layer shows the limits of each soil type and

the corresponding hydrologic soil group and soil map unit number. The soils data is shown on **Figure 2-1** at the end of this section.

NRCS methodology divides soils into four hydrologic soil groups as defined below:

- A High infiltration rate, low runoff potential
- B Moderate infiltration rate, moderately low runoff potential
- C Low infiltration rate, moderately high runoff potential
- D Very low infiltration rate, high runoff potential

2.3.6. Land Use

Land use data for the Mudd Gulch basin was obtained from the USGS National Land Cover Data (NLCD) 2001 dataset and was then verified/revised based on the examination of aerial imagery in the project area. The NRCS TR-55 Urban Hydrology for Small Watersheds manual and the NLCD Land Use descriptions were used to assign a set of corresponding base curve numbers to the land use categories for each hydrologic soil type. Aerial imagery and a detailed site investigation were utilized to validate the land use and land cover distribution throughout the watershed. The land use data used in the analysis is shown on **Figure 2-2** at the end of this section. See **Table 2-5** for a summary of the selected land cover types and corresponding base curve number values used in this analysis.

2.3.7. Curve Numbers

Rainfall losses due to soil infiltration, depression storage, and other factors were calculated using the National Resource Conservation Service curve number method, which is a function of soil type, land cover, and antecedent moisture condition. The average antecedent moisture condition (AMC II) was used for computing losses.

The curve number information was compiled using GIS polygon processing of subbasin delineations, soil map unit delineations, and land use layers. To calculate a curve number for a given subbasin, each subbasin was subdivided into polygons of unique land use and soil type combinations, and a weighted curve number was calculated based on the curve numbers from **Table 2-5** and the hydrologic soil group of each soil map unit. A weighted curve number was then calculated for the entire subbasin based on the areas of the subdivided polygons and their associated curve numbers. The drainage area and calculated curve numbers for each subbasin are shown in **Table 2-6**.

Table 2-5 Land Use Categories and Base Curve Numbers

BASE RUNOFF CURVE NUMBERS FOR MUDD GULCH					
NLCD 2001 LAND COVER CLASS ID	CORRESPONDING TR-55 COVER DESCRIPTION	HYDROLOGIC SOIL GROUP			
		A	B	C	D
11	Open Water – Generally less than 25% cover or vegetation or soil	30	30	30	30
21	Residential districts by average lot size of 1 acre (Average impervious area= 20%).	51	68	79	84
22	Residential districts by average lot size of 1/3 acre (Average impervious area= 30%).	57	72	81	86
23	Residential districts by average lot size of 1/8 acre (Average impervious area= 65%).	77	85	90	92
24	Urban districts: Commercial and Business (Average impervious area= 85%).	89	92	94	95
31	Open space (lawns, parks, golf courses, cemeteries, etc.). Poor condition (grass cover < 50%).	68	79	86	89
42	Woods-grass combination (orchard or tree farm - Poor condition)	57	73	82	86
52	Brush-brush-weed-grass mixture with brush the major element (Poor condition).	48	67	77	83
71	Pasture, grassland, or range - continuous forage for grazing. Poor condition (<50% ground cover or heavily grazed with no mulch).	68	79	86	89
82	Row crops with straight row (SR) and crop residue cover (CR). Good condition.	64	75	82	85

Table 2-6 Curve Number Summary

FINAL COMPOSITE CURVE NUMBER SUMMARY			
SUBBASIN ID	TOTAL DRAINAGE AREA (ACRES)	TOTAL DRAINAGE AREA (SQ MI)	COMPOSITE SCS CURVE NUMBER
MG01	730.2	1.1	83.1
MG02	694.2	1.1	82.2
MG03	157.9	0.2	84.1
MG04	902.3	1.4	81.8
MG05	351.4	0.5	84.0
MG06	426.3	0.7	83.5
MG07	129.3	0.2	81.5

2.3.8. Lag Times

After accounting for any losses due to infiltration, the remaining volume of rainfall received over a watershed is considered excess precipitation. This excess rainfall is then transformed into direct runoff. The transform roughly defines the amount of time it takes rainfall to “transform” into peak runoff flows. The SCS Unit Hydrograph method was utilized to transform excess precipitation resulting from each storm event. This method requires the calculation of a lag time (T_L) for each individual subbasin. The lag time is defined as the time difference between the center of mass of rainfall excess and the peak of the unit hydrograph, and can be approximated from the time of concentration (T_c). For this analysis, the TR-55 procedure for calculating travel time (T_T) and time of concentration was followed, which defines the movement of runoff through a watershed in three phases: sheet flow, shallow concentrated flow, and open channel flow.

Sheet Flow

The TR-55 equation for sheet flow is displayed below.

$$T_T = (0.007 * (nL)^{0.8}) / ((P_2)^{0.5} * s^{0.4})$$

Where:

T_T – Travel time (hr)
 n – Manning’s roughness coefficient
 L – Flow length (less than 300 feet)
 P_2 – 2-yr 24-hr rainfall (in)
 s – Slope of hydraulic grade line (land slope, ft/ft)

P_2 , the 2-year 24-hour rainfall total of 1.6 inches was taken from the NOAA Precipitation Frequency Atlas of the Western United States Volume III - Colorado isopluvial maps. Slope was determined from 2-foot contours obtained from the City.

Shallow Concentrated Flow

Shallow concentrated flow was assumed to occur after the end of sheet flow until reaching a point where well-defined channels were visible on the aerial imagery, or where blue lines indicating streams were observed on the USGS topographic maps. The TR-55 equation for shallow concentrated flow is shown below.

$$T_T = (L / 3600 * V)$$

Where:

T_T – Travel time (hr)
 L – Flow length (ft)
 V – Average velocity (ft/s)
 3600 – Conversion factor from seconds to hours

The average velocity used in this equation was calculated from Equation 3-1 (unpaved channel) in the TR-55 manual and is displayed below.

$$V = 16.1345 * s^{0.5}$$

Where:

V – Average velocity (ft/s)

s – Slope of hydraulic grade line (channel slope (ft/ft))

Open Channel Flow

The remaining flow length through each subbasin from the point of termination of shallow concentrated flow to the subbasin outlet point was assumed to be open channel flow. The TR-55 equation for open channel flow is identical to the equation used to calculate travel time for shallow concentrated flow. However, the average velocity for open channel flow was calculated using Equation 3-4 in the TR-55 manual that is displayed below. Manning's roughness coefficients for open channel flow were taken from Chow (1959), and based on a visual evaluation of each individual reach location.

$$V = 1.49/n * r^{(2/3)} * s^{(1/2)}$$

Where:

V – Average velocity (ft/s)

n – Manning's roughness coefficient for open channel flow

r – Hydraulic radius (ft)

s – Slope of hydraulic grade line (channel slope (ft/ft))

Upon completing the calculation of travel times for sheet flow, shallow concentrated flow, and open channel flow, these values were summed to yield the time of concentration for each subbasin. The final lag time was then approximated by applying the equation below:

$$T_L (hr) = 0.6 * T_C$$

Where:

T_L – lag time (hr)

T_C – time of concentration (hr)

The lag times computed for each subbasin are shown in **Table 2-7**.

Table 2-7 Lag Time Summary

MUDD GULCH SUB-WATERSHED LAG TIME SUMMARY						
SUBBASIN	TOTAL FLOWPATH LENGTH (ft)	SHEET FLOW TT ₁ (min)	SHALLOW CONCENTRATED FLOW TT ₂ (min)	OPEN CHANNEL FLOW TT ₃ (min)	TIME OF CONCENTRATION T _c (min)	SCS LAG TIME T _L (min)
MG01	11911	22	8	13	43	26
MG02	11385	30	8	16	54	33
MG03	4800	15	11	5	31	19
MG04	11873	20	12	16	48	29
MG05	7962	15	31	5	51	31
MG06	7275	15	31	4	50	30
MG07	5396	30	15	9	54	33

2.3.9. Channel Routing

Muskingum-Cunge routing parameters were utilized to approximate the effects of channel routing along the main stem reaches of Mudd Gulch. Muskingum-Cunge routing requires the following physical input parameters: roughness coefficient, base width, side slope, slope, and reach length. The routing parameters used in the Mudd Gulch hydrologic analysis are shown in **Table 2-8**.

Table 2-8 Muskingum-Cunge Routing Parameter Summary

MUSKINGUM-CUNGE CHANNEL ROUTING							
REACH ID	REACH NAME	REACH LENGTH (ft)	SLOPE (ft/ft)	MANNING'S n	ASSUMED CHANNEL SHAPE	ASSUMED CHANNEL BOTTOM WIDTH (ft)	ASSUMED CHANNEL SIDE SLOPE (xH:1V)
1	R_MG_Dam	3528	0.018	0.045	TRAPEZOIDAL	20	2
2	R_4MilePkwy	7463	0.019	0.045	TRAPEZOIDAL	40	1
3	R_US50	2670	0.010	0.045	TRAPEZOIDAL	10	3
4	R_Grand	3731	0.008	0.045	TRAPEZOIDAL	10	3
5	R_RailRd	2448	0.006	0.045	TRAPEZOIDAL	10	3

2.4. HEC-HMS Model Results

The HEC-HMS model for Mudd Gulch was run for the 10%, 2%, 1%, and 0.2% annual chance storm events. A summary of flows at key locations from the HEC-HMS model is shown in **Table 2-9** and **Figure 2-3**.

Table 2-9 HEC-HMS Results

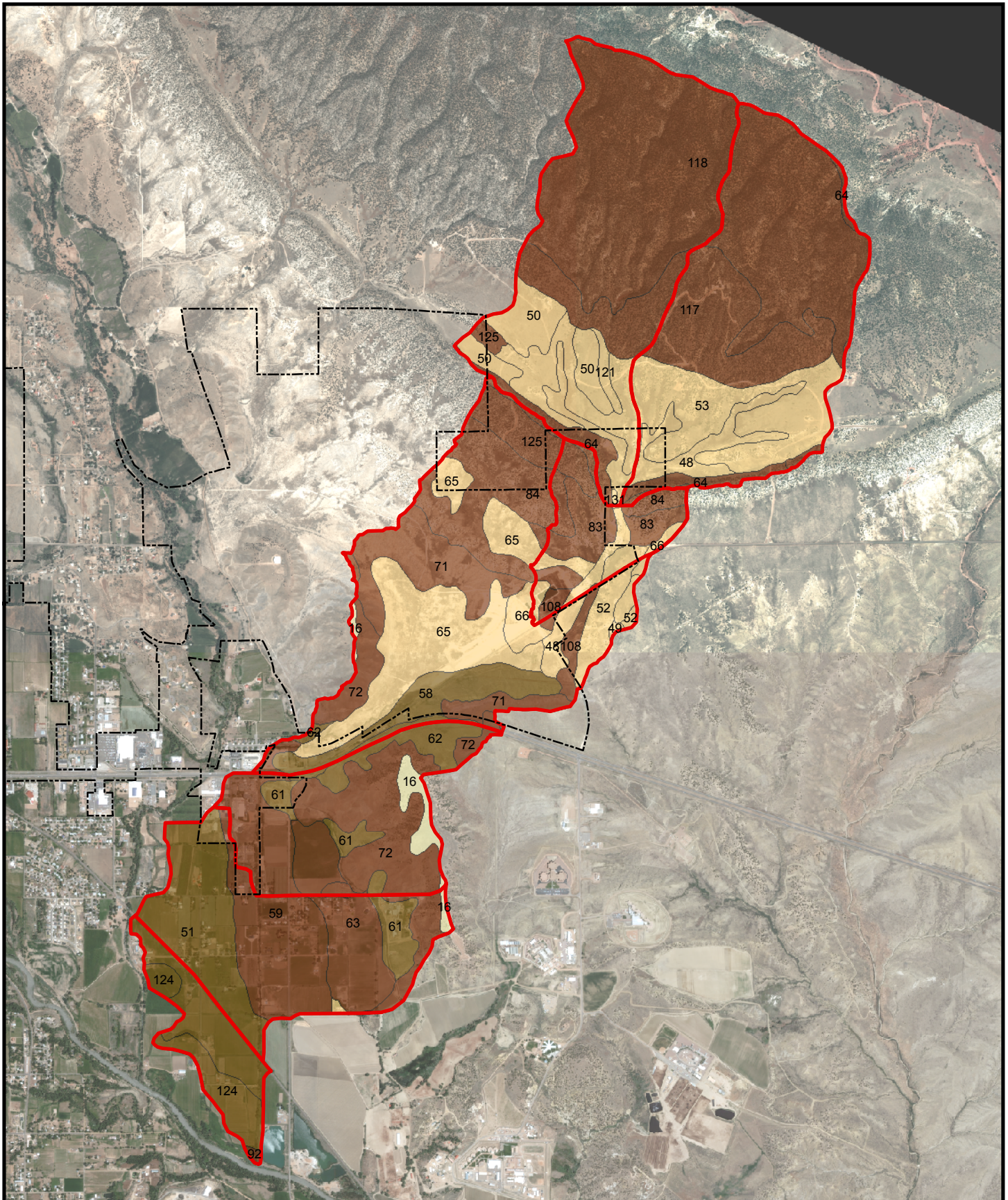
MUDD GULCH HEC-HMS SUMMARY					
HEC-HMS NODE	DRAINAGE AREA (sq mi)	PEAK FLOW RATES (cfs)			
		10% ANNUAL CHANCE FLOOD	2% ANNUAL CHANCE FLOOD	1% ANNUAL CHANCE FLOOD	0.2% ANNUAL CHANCE FLOOD
CMG_Inflow	2.22	860.1	1535.9	1605.3	2358.6
MG_Dam	2.22	23	28.4	28.6	30
C4MilePkwY	2.47	145	254	270	385
CUS50	3.88	646	1192	1297	1857
CGrandView	4.43	853	1571	1724	2437
CRailRoad	5.1	1054	1970	2191	3078
CArkansasRiv	5.3	1099	2061	2302	3226

2.5. Supporting Documentation

At the end of this section there is a collection of support documentation for the hydrologic analysis. The documentation includes:

- Hydrologic Analysis Index
- Bulletin 17B Flood Frequency Analysis for Fourmile Creek
- Analysis of the Magnitude and Frequency of Floods in Colorado (USGS)
- NOAA Atlas 2, Volume III, Isopluvial Precipitation Maps
- Curve Number Calculations – Mudd Gulch
- Lag Time Calculations – Mudd Gulch
- HEC-HMS Schematic – Mudd Gulch
- HEC-HMS Results – Mudd Gulch

GA01122009.X\Projects\100001092_Four Mile - Mud Gulch\Henderson\GIS\MXD\FIGURES\SoilsOverview.mxd



Legend

 Subbasin Boundary

 City of Cañon City Corporate Limit

Hydrologic Soil Group

 A - Low Runoff Potential

 B - Moderately Low Runoff Potential

 C - Moderately High Runoff Potential

 D - High Runoff Potential

 124 Soil Map Unit Symbol



0 1,500 3,000
Feet
1 inch equals 3,000 feet

**FIGURE 2-1:
Mudd Gulch Basin Soils Overview**

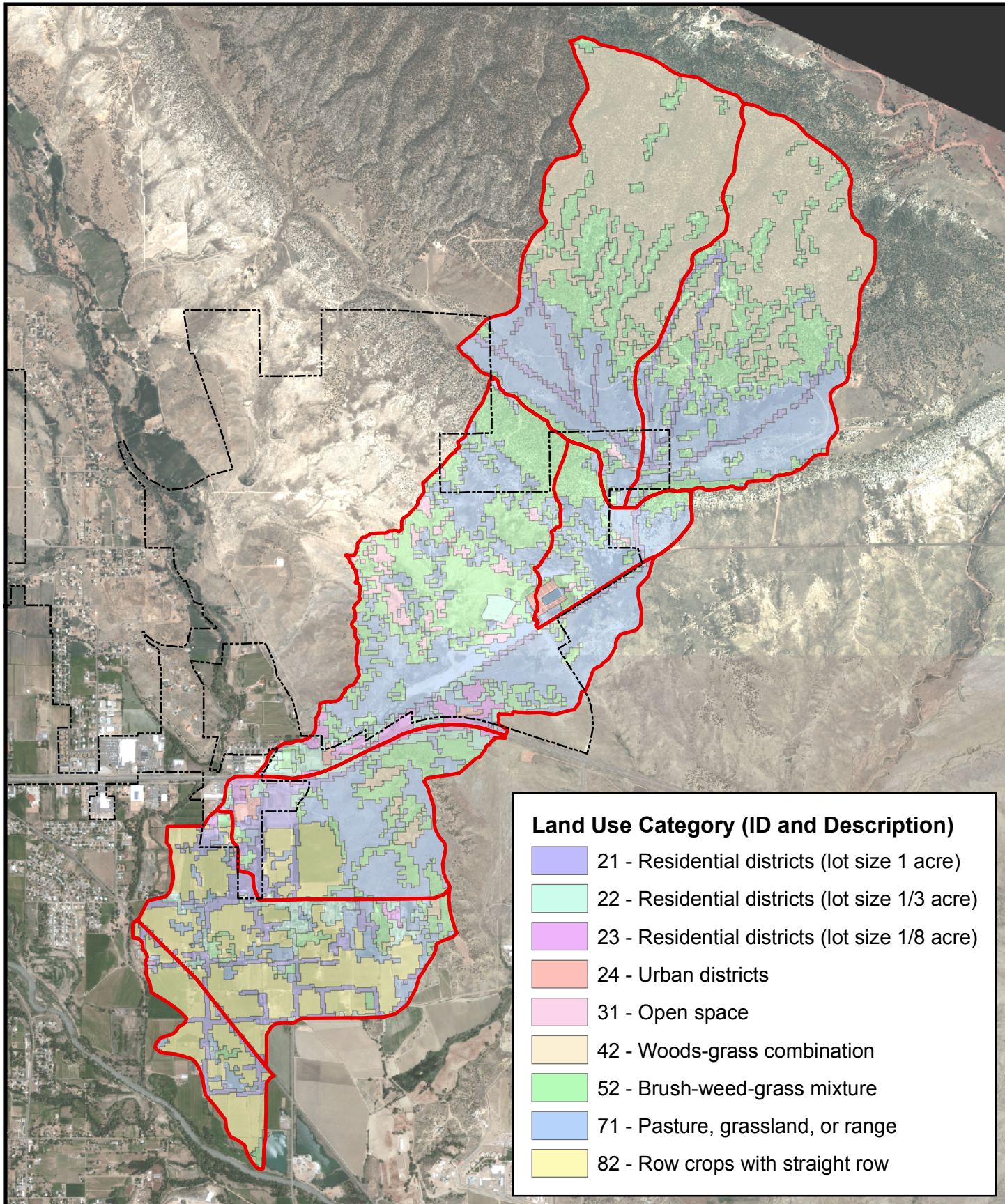
Fourmile Creek and Mudd Gulch H&H Analysis and PMR

Prepared for:
City of Cañon City

PBSJ 4604 DTC Blvd, Suite 700
Denver, Colorado 80237
Phone: 303-221-7275

Aerial Source:
Fremont County Spring 2005

CA01122009.X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\GIS\MXD\FIGURES\LandUseOverview.mxd



Legend

-  Subbasin Boundary
-  City of Cañon City Corporate Limit

Aerial Source: Fremont County Spring 2005



0 1,500 3,000
Feet
1 inch equals 3,000 feet

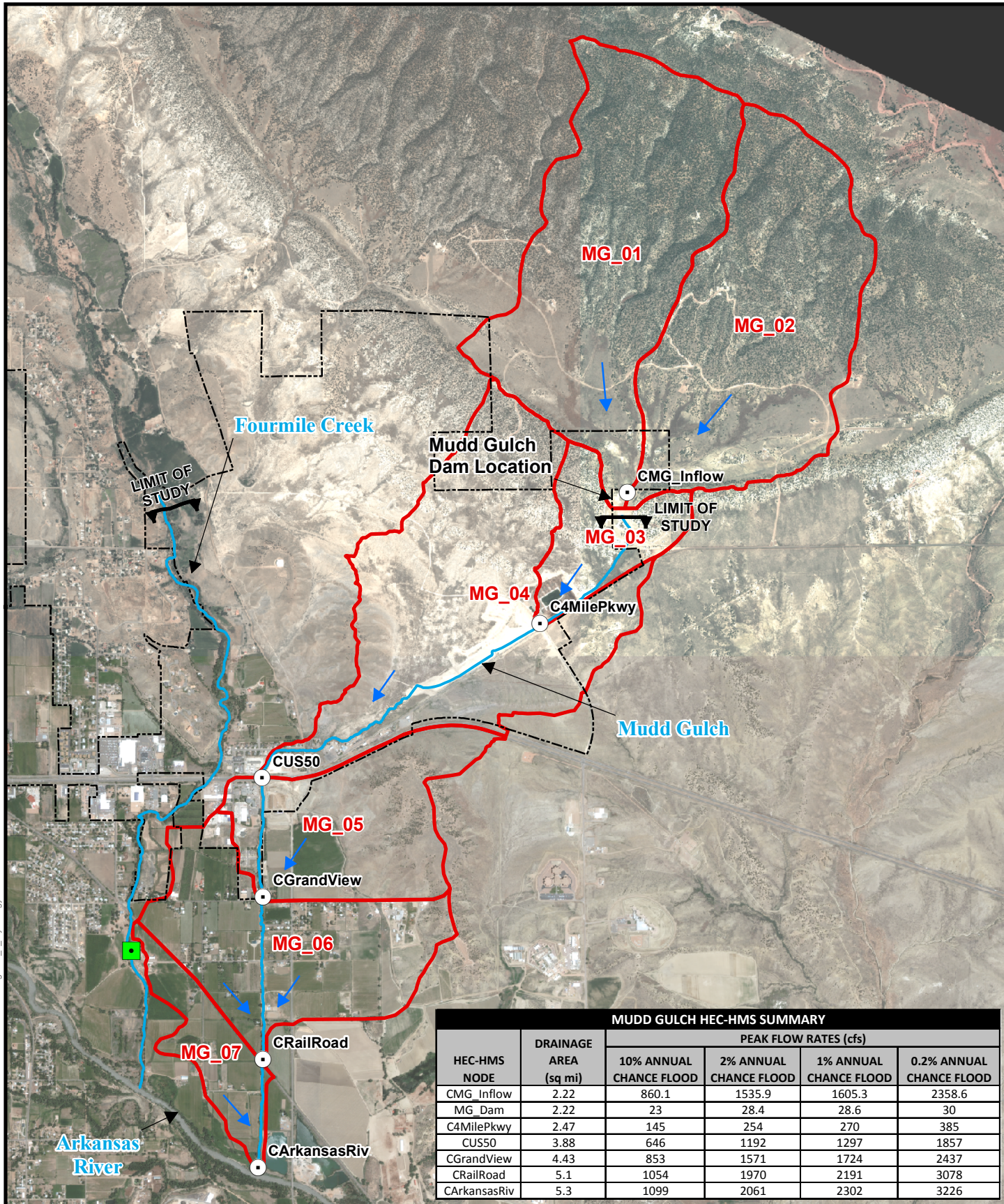
**FIGURE 2-2:
Mudd Gulch Basin Land Use Overview**

**Fourmile Creek and Mudd Gulch
H&H Analysis and PMR**

Prepared for:
City of Cañon City

PBSJ 4604 DTC Blvd, Suite 700
Denver, Colorado 80237
Phone: 303-221-7275

BR 06/03/2009 X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\GIS\MXD\TSDN FIGURES\Figure2_3_Hydrology.mxd



Legend

- Subbasin Boundary
- City of Cañon City Corporate Limit
- USGS Stream Gage (Fourmile Creek)
- HEC-HMS Combination Point
- Mudd Gulch and Fourmile Creek
- Flow Direction

Aerial Source: Fremont County Spring 2005



0 1,500 3,000
Feet
1 inch equals 3,000 feet

FIGURE 2-3:
Mudd Gulch Basin Hydrology Overview

Fourmile Creek and Mudd Gulch H&H Analysis and PMR

Prepared for:
City of Cañon City

PBSJ 4604 DTC Blvd, Suite 700
Denver, Colorado 80237
Phone: 303-221-7275

HYDROLOGIC ANALYSIS SUPPORTING DOCUMENTATION

- Hydrologic Analysis Index
- Bulletin 17B Flood Frequency Analysis Output Report for Fourmile Creek
- Analysis of the Magnitude and Frequency of Floods in Colorado (USGS)
- NOAA Atlas 2, Volume III, Isopluvial Precipitation Maps
- Curve Number Calculations – Mudd Gulch
- Lag Time Calculations – Mudd Gulch
- HEC-HMS Schematic – Mudd Gulch
- HEC-HMS Results – Mudd Gulch

HYDROLOGIC ANALYSIS INDEX

HYDROLOGIC ANALYSES INDEX

MAP REVISION	
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[illegible]

**BULLETIN 17B FLOOD FREQUENCY ANALYSIS FOR
FOURMILE CREEK**

4MILE_BULLETIN17B.PRT

1
 Program PeakFq U. S. GEOLOGICAL SURVEY Seq.000.000
 Ver. 5.2 Annual peak flow frequency analysis Run Date / Time
 11/01/2007 following Bulletin 17-B Guidelines 11/12/2008 11:04

--- PROCESSING OPTIONS ---

Plot option = None
 Basin char output = None
 Print option = Yes
 Debug print = No
 Input peaks listing = Long
 Input peaks format = WATSTORE peak file

Input files used:
 peaks (ascii) - X:\PROJECTS\100001092_FOUR MILE - MUD
 GULCH\HENDERSON\HYDROLOGY\FOURMILE\FOURMIL
 specifications - PKFQWPSF.TMP

Output file(s):
 main - X:\PROJECTS\100001092_FOUR MILE - MUD
 GULCH\HENDERSON\HYDROLOGY\FOURMILE\FOURMIL

1

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.001
 Ver. 5.2 Annual peak flow frequency analysis Run Date / Time
 11/01/2007 following Bulletin 17-B Guidelines 11/12/2008 11:04

Station - 07096500 FOURMILE CREEK NEAR CANON CITY, CO.

I N P U T D A T A S U M M A R Y

Number of peaks in record	=	32
Peaks not used in analysis	=	0
Systematic peaks in analysis	=	32
Historic peaks in analysis	=	0
Years of historic record	=	0
Generalized skew	=	-0.118
Standard error	=	0.550
Mean Square error	=	0.303
Skew option	=	WEIGHTED
Gage base discharge	=	0.0
User supplied high outlier threshold	=	--
User supplied low outlier criterion	=	--
Plotting position parameter	=	0.00

***** NOTICE -- Preliminary machine computations. *****
 ***** User responsible for assessment and interpretation. *****

WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE.	0.0
WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION.	36.6
WCF163I-NO HIGH OUTLIERS OR HISTORIC PEAKS EXCEEDED HHBASE.	7685.6

1

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.002
 Ver. 5.2 Annual peak flow frequency analysis Run Date / Time
 11/01/2007 following Bulletin 17-B Guidelines 11/12/2008 11:04

4MILE_BULLETIN17B.PRT

Station - 07096500 FOURMILE CREEK NEAR CANON CITY, CO.

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	2.7247	0.4481	0.212
BULL.17B ESTIMATE	0.0	1.0000	2.7247	0.4481	0.092

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES	
				LOWER	UPPER
0.9950	40.6	45.7	33.3	19.1	68.5
0.9900	51.6	56.6	44.1	25.6	84.0
0.9500	99.9	103.7	92.6	57.5	149.1
0.9000	142.9	145.1	136.2	88.4	204.8
0.8000	221.7	220.6	216.2	148.4	305.7
0.6667	335.8	330.5	332.3	238.2	454.1
0.5000	522.2	511.5	522.2	383.9	709.2
0.4292	628.0	615.3	630.5	464.6	862.0
0.2000	1258.0	1249.0	1291.0	912.7	1876.0
0.1000	2010.0	2033.0	2117.0	1399.0	3260.0
0.0400	3335.0	3474.0	3670.0	2188.0	6013.0
0.0200	4643.0	4955.0	5320.0	2915.0	9017.0
0.0100	6269.0	6861.0	7527.0	3772.0	13050.0
0.0050	8269.0	9287.0	10470.0	4777.0	18390.0
0.0020	11600.0	13490.0	15900.0	6366.0	27990.0

1

Program PeakFq
Ver. 5.2
11/01/2007

U. S. GEOLOGICAL SURVEY
Annual peak flow frequency analysis
following Bulletin 17-B Guidelines

Seq.001.003
Run Date / Time
11/12/2008 11:04

Station - 07096500 FOURMILE CREEK NEAR CANON CITY, CO.

I N P U T D A T A L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1949	310.0		1982	1290.0	
1950	778.0		1983	1140.0	
1951	4260.0		1984	2290.0	
1952	140.0		1985	3530.0	
1953	732.0		1986	738.0	
1971	116.0		1987	400.0	
1972	188.0		1988	725.0	
1973	631.0		1989	104.0	
1974	354.0		1990	287.0	
1975	275.0		1991	3580.0	
1976	185.0		1992	1740.0	

		4MILE_BULLETIN17B.PRT	
1977	325.0	1993	70.0
1978	339.0	1994	809.0
1979	230.0	1995	445.0
1980	580.0	1996	852.0
1981	658.0	1997	603.0

Explanation of peak discharge qualification codes

PeakFQ CODE	NWIS CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

- Minus-flagged discharge -- Not used in computation
 -8888.0 -- No discharge value given
 - Minus-flagged water year -- Historic peak used in computation

1

Program PeakFq	U. S. GEOLOGICAL SURVEY	Seq.001.004
Ver. 5.2	Annual peak flow frequency analysis	Run Date / Time
11/01/2007	following Bulletin 17-B Guidelines	11/12/2008 11:04

Station - 07096500 FOURMILE CREEK NEAR CANON CITY, CO.

EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1951	4260.0	0.0303	0.0303
1991	3580.0	0.0606	0.0606
1985	3530.0	0.0909	0.0909
1984	2290.0	0.1212	0.1212
1992	1740.0	0.1515	0.1515
1982	1290.0	0.1818	0.1818
1983	1140.0	0.2121	0.2121
1996	852.0	0.2424	0.2424
1994	809.0	0.2727	0.2727
1950	778.0	0.3030	0.3030
1986	738.0	0.3333	0.3333
1953	732.0	0.3636	0.3636
1988	725.0	0.3939	0.3939
1981	658.0	0.4242	0.4242
1973	631.0	0.4545	0.4545
1997	603.0	0.4848	0.4848
1980	580.0	0.5152	0.5152
1995	445.0	0.5455	0.5455
1987	400.0	0.5758	0.5758
1974	354.0	0.6061	0.6061
1978	339.0	0.6364	0.6364
1977	325.0	0.6667	0.6667
1949	310.0	0.6970	0.6970

4MILE_BULLETIN17B.PRT

1990	287.0	0.7273	0.7273
1975	275.0	0.7576	0.7576
1979	230.0	0.7879	0.7879
1972	188.0	0.8182	0.8182
1976	185.0	0.8485	0.8485
1952	140.0	0.8788	0.8788
1971	116.0	0.9091	0.9091
1989	104.0	0.9394	0.9394
1993	70.0	0.9697	0.9697

1

End PeakFQ analysis.

Stations processed :	1
Number of errors :	0
Stations skipped :	0
Station years :	32

Data records may have been ignored for the stations listed below.
 (Card type must be Y, Z, N, H, I, 2, 3, 4, or *.)
 (2, 4, and * records are ignored.)

For the station below, the following records were ignored:

FINISHED PROCESSING STATION: 07096500 USGS FOURMILE CREEK NEAR CANON CIT

For the station below, the following records were ignored:

FINISHED PROCESSING STATION:

**ANALYSIS OF THE MAGNITUDE AND FREQUENCY OF
FLOODS IN COLORADO (USGS)**

**Prepared in cooperation with the
Colorado Department of Transportation
and the Bureau of Land Management**

Analysis of the Magnitude and Frequency of Floods in Colorado

Water-Resources Investigations Report 99–4190

Analysis of the Magnitude and Frequency of Floods in Colorado

By J.E. Vaill

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 99–4190

Prepared in cooperation with the
COLORADO DEPARTMENT OF TRANSPORTATION
and the BUREAU OF LAND MANAGEMENT

Denver, Colorado
2000

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Charles G. Groat, Director

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CONVERSION FACTORS AND VERTICAL DATUM

	Multiply	By	To obtain
inch		25.4	millimeter
foot (ft)		0.3048	meter
mile		1.609	kilometer
square mile (mi ²)		2.59	square kilometer
cubic foot per second (ft ³ /s)		0.02832	cubic meter per second

Analysis of the Magnitude and Frequency of Floods in Colorado

By J.E. Vaill

Abstract

Regionalized flood-frequency relations need to be updated on a regular basis (about every 10 years). The latest study on regionalized flood-frequency equations for Colorado used data collected through water year 1981. A study was begun in 1994 by the U.S. Geological Survey, in cooperation with the Colorado Department of Transportation and the Bureau of Land Management, to include streamflow data collected since water year 1981 in the regionalized flood-frequency relations for Colorado. Longer periods of streamflow data and improved statistical analysis methods were used to define regression relations for estimating peak discharges having recurrence intervals of 2, 5, 10, 25, 50, 100, 200, and 500 years for unregulated streams in Colorado. The regression relations can be applied to sites of interest on gaged and ungaged streams. Ordinary least-squares regression was used to determine the best explanatory basin or climatic characteristic variables for each peak-discharge characteristic, and generalized least-squares regression was used to determine the best regression relation. Drainage-basin area, mean annual precipitation, and mean basin slope were determined to be statistically significant explanatory variables in the regression relations. Separate regression relations were developed for each of five distinct hydrologic regions in the State. The mean standard errors of estimate and average standard error of prediction associated with the regression relations generally ranged from 40 to 80 percent, except for one hydrologic region where the errors ranged from about 200 to 300 percent. Methods are presented for determining the magnitude of peak discharges for sites located at gaging stations, for sites located

near gaging stations on the same stream when the ratio of drainage-basin areas is between about 0.5 and 1.5, and for sites where the drainage basin crosses a flood-region boundary or a State boundary. Methods are presented for determining the magnitude of peak discharges for sites located at gaging stations, for sites located near gaging stations on the same stream when the ratio of drainage-basin areas is between about 0.5 and 1.5, and for sites where the drainage basin crosses a flood-region boundary or a State boundary.

INTRODUCTION

In Colorado, various Federal, State, and local governments use hydrologic data collected and published by the U.S. Geological Survey (USGS) in making decisions about the cost-effective planning and design of highway bridges and culverts, flood-plain management, reservoir management, and other water issues. The data are collected from a network of streamflow-gaging stations operated by the USGS, and part of that data is used to develop regression equations for determining the magnitude and frequency of floods on Colorado streams.

Because of recent improvements in statistical analysis, longer periods of record at more streamflow-gaging stations, and the need to update regression equations regularly (about every 10 years) as recommended by the Federal Highway Administration (FHWA) (L.A. Arneson, Federal Highway Administration, oral commun., 1994), in 1994, the USGS, in cooperation with the Colorado Department of Transportation (CDOT) and the Bureau of Land Management (BLM), developed new regression equations for determining flood magnitude and frequency on unregulated streams.

Purpose and Scope

This report presents the regression equations and the methods for determining the magnitude and frequency of floods on unregulated streams in Colorado. In addition to data used in previous studies (see the “Previous Studies” section), about 2,700 additional years of record (12–22 years for each gaging station) and 64 additional gaging stations were available for the new analysis of flood magnitude and frequency. Data through water year 1993 were used, and additional periods of record included water years 1983–85 when high runoff resulted in peaks of record at numerous gaging stations west of the Continental Divide.

The regression equations were developed for recurrence intervals ranging from 2 to 500 years. The methods for determining peak discharges depended on whether the site was gaged, was on a stream near a gaged site, or was ungaged and whether the drainage area upstream from a site crossed a hydrologic region boundary.

Previous Studies

Hydrologic data collected from the gaging-station network in Colorado have been used in previous studies to develop regionalized flood-frequency equations. A series of reports in the 1960’s defined flood-frequency relations for the Arkansas (Patterson, 1964), Rio Grande (Patterson, 1965), Colorado (Patterson and Somers, 1966), and South Platte (Matthai, 1968) River Basins. Livingston (1970) developed equations for a range of flow characteristics for the mountains of Colorado. Hedman and others (1972) improved the accuracy of some of Livingston’s (1970) equations by relating measurements of channel geometry to mean annual and peak flows. McCain and Jarrett (1976) used improved methods for estimating flood frequency and used additional streamflow records to estimate flood characteristics for unregulated streams in Colorado. Kircher and others (1985) developed equations for flow characteristics in Colorado, excluding the plains region, using additional streamflow records and improved statistical methods for equation selection. Livingston and Minges (1987) developed equations for estimating flood characteristics for small (less than 20 mi²) rural drainage basins in the plains region of eastern

Colorado. Jarrett and Costa (1988) developed regression equations for a relatively homogeneous hydrologic foothill region in the South Platte River Basin (excluding drainage areas upstream from the South Platte River at South Platte, Colo.). Each of these previous flood-frequency studies identified geographical areas of the State where additional data would improve the accuracy of the regression equations.

Approach

This study differs from most of the previous flood-frequency studies in areal coverage, number of gaging stations used, and lengths of streamflow records used. Results in this study were based on as much as 12 additional years of streamflow record at gaging stations used in previous studies and include 64 gaging stations not used previously. Only one gaging station per stream was used unless the drainage area of a downstream gaging station was greater than about 2.5 times the drainage area of the upstream gaging station. Drainage areas for the gaging stations used in the analysis ranged from about 5 mi² to about 1,000 mi² (table 3 in the “Supplemental Data” section at the back of the report). The regression equations are based on at least 10 or more years of streamflow records for 328 gaging stations in Colorado and adjacent States (fig. 1). A gaging station was not in the regression analysis for a region if basin characteristics were not available.

Flood-Frequency Analysis at Streamflow-Gaging Stations

Records of annual peak discharges at gaging stations and drainage-basin characteristics are the data bases used in this study. The data bases are compiled and maintained by the USGS. Records throughout the study area were selected and examined for accuracy and for the assumptions needed for a valid flood-frequency analysis. The following assumptions are used to validate flood-frequency analyses: (1) the data represent independent, random events, (2) the process generating the events is stationary with respect to time, (3) the data are from the same population and are identically distributed, and (4) the sample is representative of the entire population. Data through water year 1993 were used in the analyses.

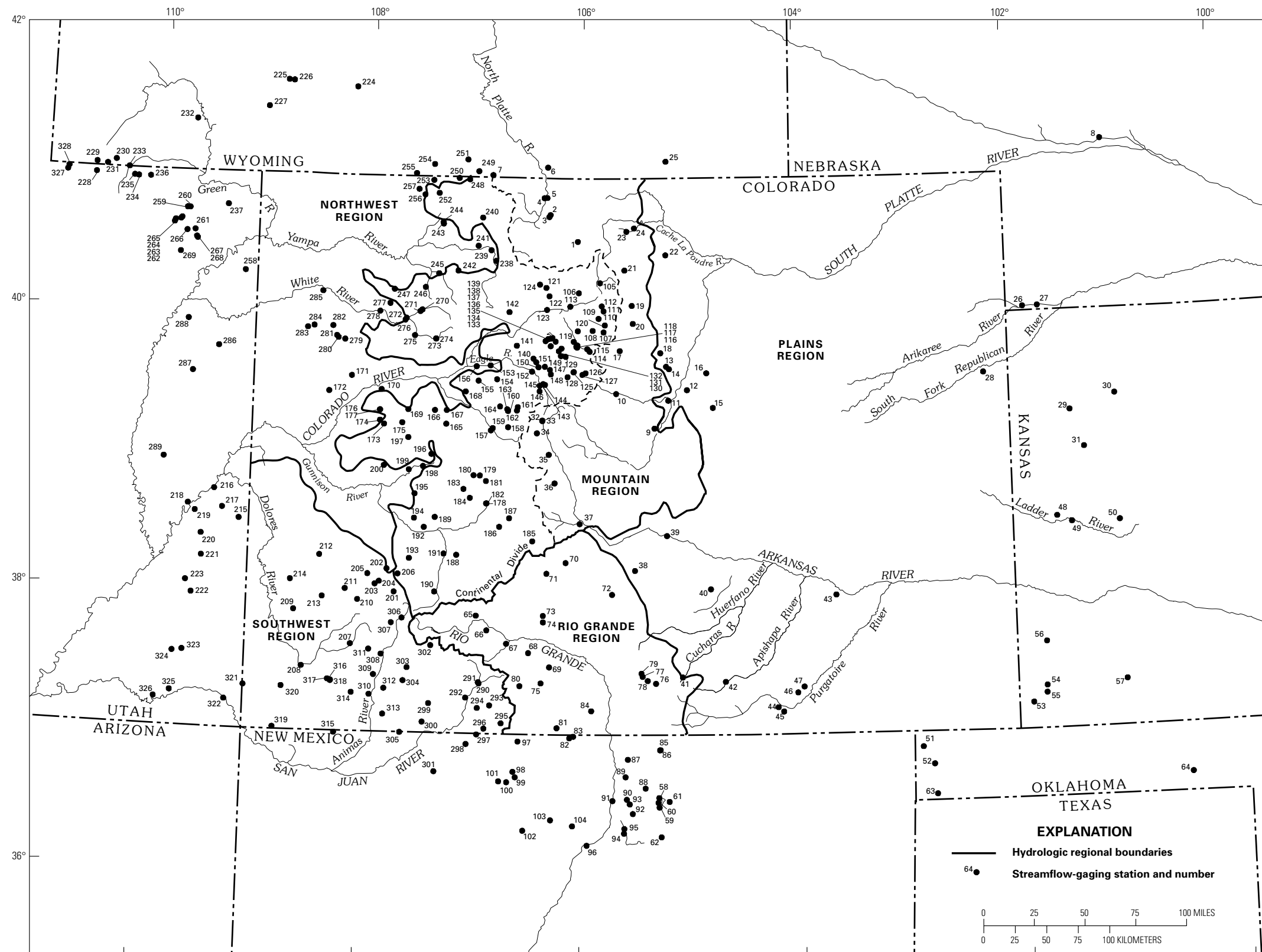


Figure 1. Boundaries of hydrologic regions and location of streamflow-gaging stations in Colorado and adjacent States.

Peak discharges for selected recurrence intervals were determined for each gaging station from a flood-frequency curve based on a Log-Pearson Type III probability distribution as recommended by the Interagency Advisory Committee on Water Data (IACWD) (1982). These peak discharges are listed in table 3 (in the “Supplemental Data” section at the back of the report). Three parameters required for fitting a Log-Pearson Type III probability distribution to a series of annual peak discharges are the mean, standard deviation, and skew coefficient of the logarithms of the peak discharges. The skew of a frequency distribution has a large effect on the resulting shape of the distribution. The skew coefficient of the station record is sensitive to extreme events, making it difficult to obtain an estimate of an accurate skew coefficient from a small sample. The accuracy of the estimated skew coefficient can be improved by weighting the gaging-station skew with a generalized skew coefficient estimated by pooling information from nearby sites. Generalized skew coefficients of logarithms of annual maximum streamflow from a generalized skew map developed by the IACWD (1982) (fig. 2) were weighted with gaging-station skew to determine a weighted skew coefficient. Using the assumption that the generalized skew coefficient is unbiased and independent of the gaging-station skew, the mean square error of the weighted estimate is minimized by weighting the gaging-station and the generalized skew coefficients in inverse proportion to their individual mean square errors (Tasker, 1978).

Historical adjustments to the recorded gaging-station data were used where applicable, and low outliers were deleted using the low-outlier test recommended by the IACWD (1982). Low outliers are small peak discharges (less than a given base) that depart from the low end of a fitted flood-frequency curve. Low outliers can have an adverse effect on computed flood-frequency curves for gaged sites by causing a large negative skew coefficient that can distort the upper end of the flood-frequency curve. Flood-frequency curves for gaging stations within about 50 miles of the Colorado State line that were developed by other investigators in neighboring States may differ from the flood-frequency curves developed for this analysis because of the use of a different skew-coefficient map or the deletion of different low outliers.

A flood-frequency curve (fig. 3) graphically depicts the relation of annual peak discharge to annual exceedance probability as determined from the Log-Pearson probability distribution. Annual exceedance probability is the probability, in percent, that a given flood magnitude would be exceeded in any 1 year. A recurrence interval is the reciprocal of the annual exceedance probability multiplied by 100 and is the average time interval, in years, between exceedances of a given flood. For example, a flood having a 1-percent exceedance probability has a recurrence interval of 100 years. Because recurrence intervals are long-term averages, flood magnitudes greater than those of a specific recurrence interval may have occurred more or less frequently than indicated by the recurrence interval. For example, 10-year floods may occur in successive years at some sites and may not occur for more than 10 years at other sites. In this report, the term “recurrence interval” is used to describe the exceedance probability of a flood magnitude. Flood-frequency curves were developed for 328 gaging stations on unregulated streams having a minimum of 10 years of record. The flood magnitudes that were determined from the flood-frequency curves for each gaging station are listed in table 3 (in the “Supplemental Data” section at the back of the report). Included are data for recurrence intervals of 2, 5, 10, 25, 50, 100, 200, and 500 years.

Regional Flood-Frequency Analysis

The regional regression equations discussed in this report relate flood magnitude, the dependent variable, to easily measured drainage-basin and climatic characteristics, the independent variable. The study area was divided into five distinct hydrologic regions; each region representing an area of similar basin physiographic and climatic characteristics. The hydrologic regional boundaries were defined by McCain and Jarrett (1976) and Kircher and others (1985). These boundaries were determined by plotting the regression residuals (the difference between the discharge predicted from the regression equation and the discharge determined from the station flood-frequency curve) on a map and drawing boundaries around physiographic regions in which the regression residuals were similar. Examination of regression residuals for the current study did not indicate any need to change the previously defined regional boundaries.

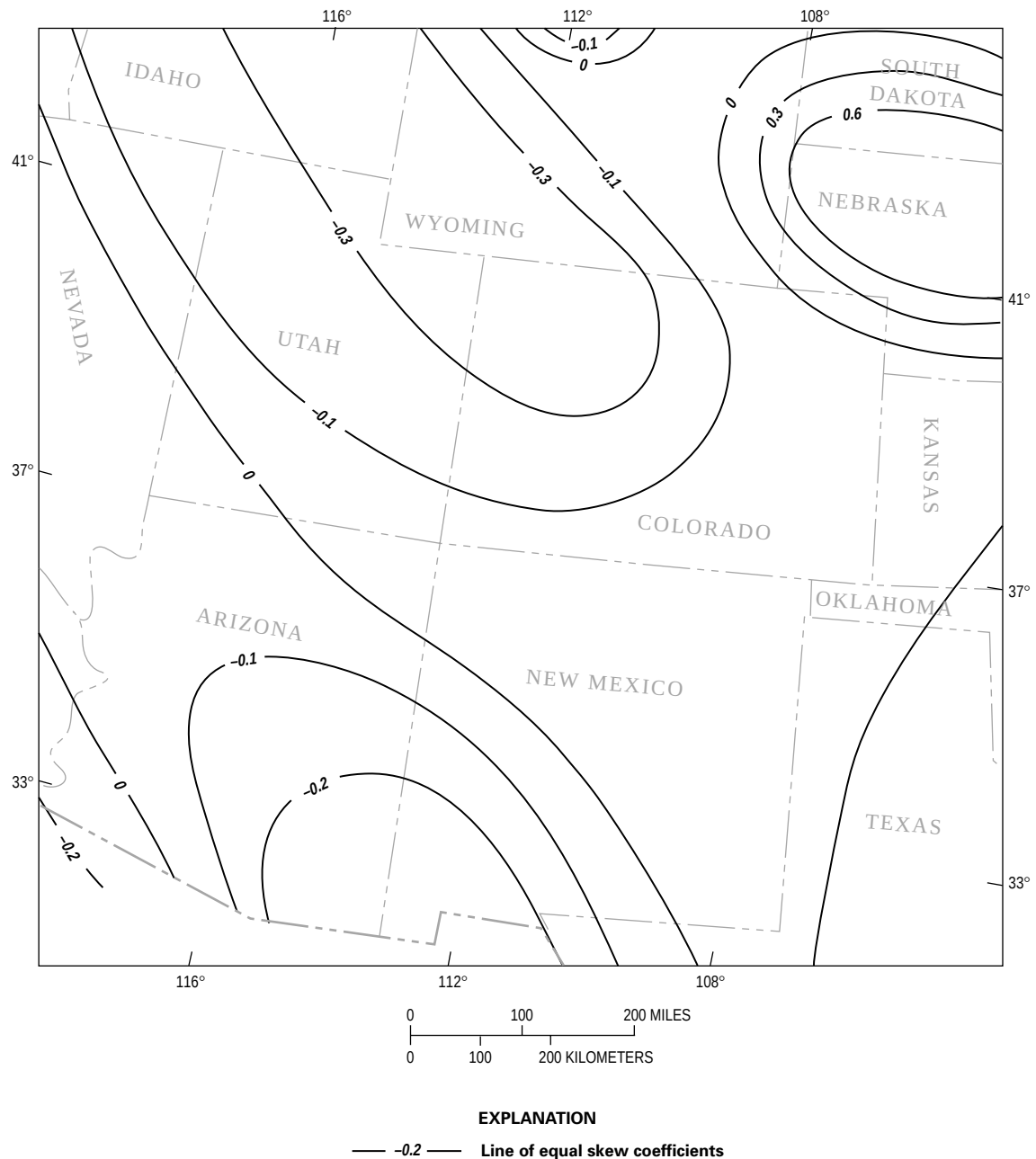


Figure 2. Generalized skew coefficients of the logarithms of annual maximum streamflow for Colorado and adjacent States (from Interagency Advisory Committee on Water Data, 1982).

Separate regression equations for estimating flood magnitude were developed for each of these five regions. The five hydrologic regions used in the study area (fig. 1) are referred to as the mountain region, Rio Grande region, southwest region, northwest region, and the plains region. The mountain region consists of the high topographic relief of the Rocky Mountains north of the Continental Divide and north

of the Rio Grande drainage basin to the Colorado-Wyoming border and is defined by the 7,500-ft elevation contour along the eastern and western slopes of the Rocky Mountains. The Rio Grande region includes all the Rio Grande drainage basin, the San Juan Mountains east of the Continental Divide, the San Luis Valley, and the Sangre de Cristo Mountains, which includes a part of the headwaters

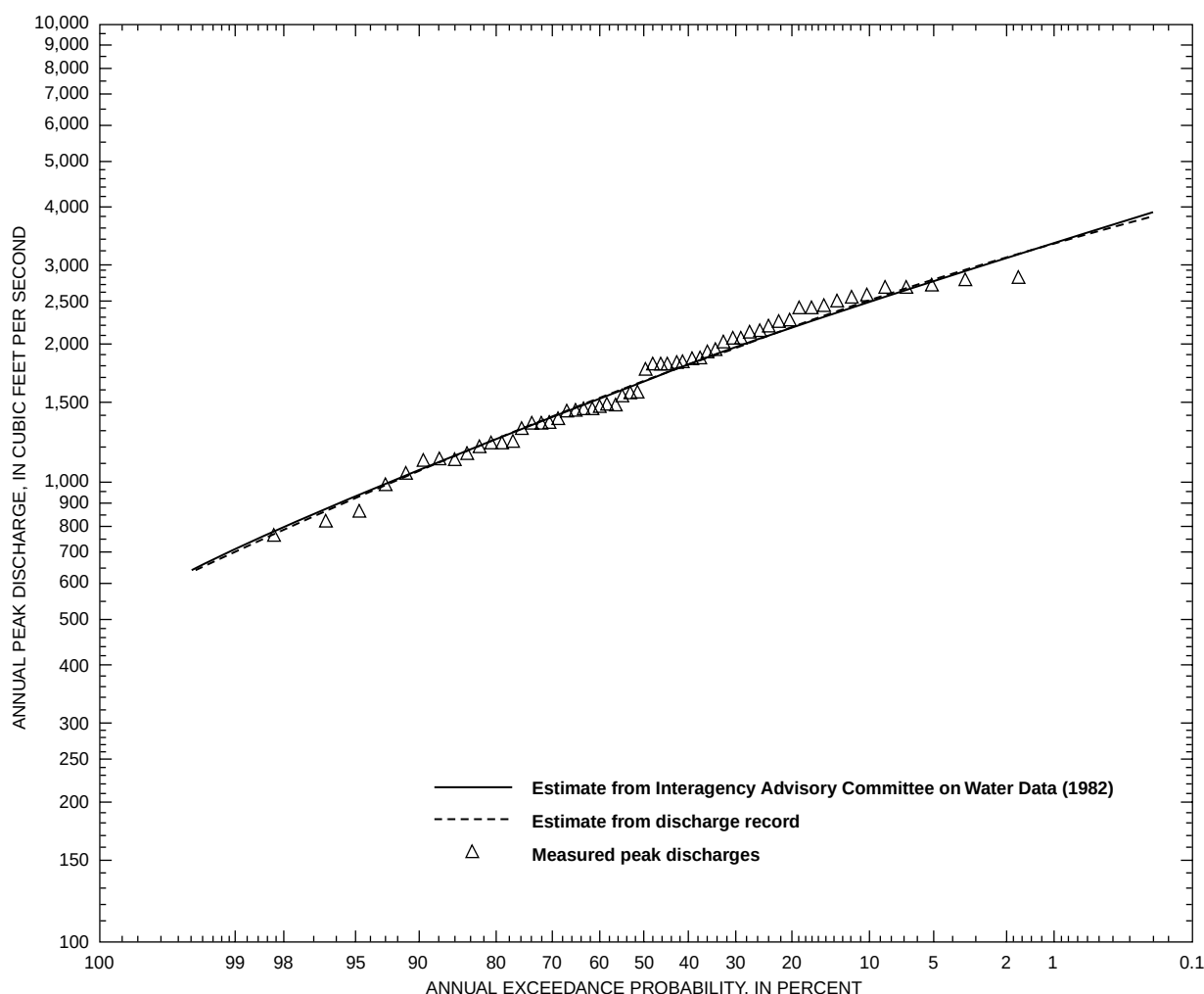


Figure 3. Flood-frequency curve for Lake Fork at Gateview, Colorado.

of the Arkansas drainage basin above 9,000 ft on the eastern slope of the Sangre de Cristo Mountains. Elevations range from about 7,500 to 14,000 ft in the region. The Continental Divide forms a topographic barrier between the mountain and Rio Grande regions and between the Rio Grande and southwest regions. The southwest region includes the San Juan Mountains west of the Continental Divide to the Colorado-Utah State line and south from the 7,500-ft elevation along the north side of the Uncompahgre Plateau. Elevations in the southwest region range from about 5,000 ft near the Colorado-Utah State line to about 14,000 ft near the Continental Divide. The Uncompahgre Plateau forms a major orographic barrier to air masses moving north from the south and southwest. Annual precipitation south of the Uncompahgre Plateau ranges from about 12 to 25 inches and decreases to about 8 inches at lower

elevations north of the Uncompahgre Plateau in the northwest region (U.S. Geological Survey, 1984). The northwest region is located north of the 7,500-ft elevation along the north side of the Uncompahgre Plateau and west of the mountain region to the Colorado-Utah State line and the Colorado-Wyoming State line. Elevations in the northwest region range from about 5,000 to 7,500 ft, with the exception of the 8,000- to 9,000-ft Roan Plateau in the central part of the region. The western boundary of the plains region coincides with a line along an elevation of 7,500 ft in the South Platte River Basin, south to a transition zone near the Chaffee-Fremont County line, to a line along an elevation of about 9,000 ft in the Arkansas River Basin. The region extends east to the State lines of Kansas and Nebraska, south to the State lines of New Mexico and Oklahoma, and north to the Colorado-Wyoming State line.

REGRESSION ANALYSIS

Ordinary least-squares (OLS) and generalized least-squares (GLS) regression analyses were used in this study. OLS analysis was used for preliminary delineation of flood regions and selection of significant explanatory characteristics. GLS regression analysis was used to further define the explanatory variables determined using OLS analysis and to compute the final regression equations. GLS regression is a more appropriate method for developing regional regression equations of streamflow characteristics than OLS regression (Stedinger and Tasker, 1985) because using flood-frequency characteristics at gaged sites as a response variable could violate two assumptions of OLS regression. Those assumptions are that the response variable at each site is independent and has equal variance and that peak discharges for nearby drainage basins may be correlated as a result of similar climatic events.

Multiple Regression and Drainage-Basin Characteristics

Multiple-regression equations, expressing flood magnitudes as a function of drainage-basin characteristics, were developed for each hydrologic region. Base 10 logarithmic transformations were performed on all streamflow and drainage-basin-characteristic data prior to the regression analyses. These data were transformed to normalize the variables and residuals, to obtain a constant variance about the regression line, and to obtain linear relations between dependent and independent variables as required for regression analyses (Stedinger and Tasker, 1985). The regression relations based on logarithmic transformation of the variables were:

$$\log Q_t = \log K + a \log A + b \log B + \dots n \log N \quad (1)$$

or, taking antilogs,

$$Q_t = KA^a B^b \dots N^n \quad (2)$$

where

Q_t (the response variable) is the estimated flood magnitude, in cubic feet per second, having a T-year recurrence interval; K is a regression constant; $A, B, \dots N$

(the explanatory variables) are values of drainage-basin characteristics, and $a, b, \dots n$ are regression coefficients.

Based on the results of previous streamflow regionalization studies (McCain and Jarrett, 1976; Kircher and others, 1985) and on consideration of physical characteristics that affect streamflow, a set of drainage-basin and climatic characteristics were evaluated for inclusion as explanatory variables in the regression equations. These characteristics included drainage area, mean drainage-basin slope, mean channel slope, gaging-station elevation, percentage of drainage area covered by lakes and ponds, mean annual precipitation, and percentage of drainage basin covered by forest. Richter and others (1984) defined these characteristics in greater detail and summarized the characteristics for most of the drainage basins used in this report. Drainage-basin-characteristic data used in this study that have been determined since Richter and others (1984) are unpublished.

Combinations of the explanatory variables were evaluated using OLS multiple-regression methods. Stepwise regression adds explanatory variables, one at a time, to the basic regression equation until all statistically significant variables have been included. The statistical significance of certain variables already in the equation may change as other variables are added. Consequently, variables that may be added at one step could be removed at a later step. The purpose of using stepwise regression is to include all the explanatory variables that have a great effect on the response variable and to exclude the variables that have little effect on the response variable. Drainage area was the most statistically significant variable in all of the regression equations. Other statistically significant variables were mean annual precipitation and mean drainage-basin slope.

Generalized Least-Squares Regression

After acceptable drainage-basin characteristics were determined and the five hydrologic regions were delineated, GLS regression was performed. Stedinger and Tasker (1985) reported that the GLS method provides more accurate estimates of the regression coefficients, better estimates of the accuracy of the regression equation, and almost unbiased estimates of the model-error variance. The GLS analysis was performed using ANNIE/WDM, a set of programs designed for analyzing hydrologic data (Flynn and others, 1995).

Regression coefficients were estimated by considering the time-sampling error in the streamflow characteristics and the cross correlation between sites. The time-sampling error is associated with the length of record for a gaging station. A gaging station with a short period of record may have a large time-sampling error because the record may not be representative of the actual flood history of the site based on a larger number of years. A short period of record has the possibility of falling within a wet or dry climatic cycle (Thomas and Lindskov, 1983).

Use of the GLS method requires estimates of the cross correlation between streamflows at every pair of sites. Sample estimates of cross correlation based on recorded streamflows from short periods of record are often imprecise. To overcome this problem, the sample correlations were smoothed by relating them to distance between gaging stations using a nonlinear-regression model (Tasker and Stedinger, 1989).

The regression equations that were developed using the GLS method related drainage-basin characteristics to peak discharges by using a weighting matrix to account for the different time-sampling errors and cross correlations of concurrent peak-discharge records of the various gaging stations. The final regression equations developed for each region using GLS, the standard errors of estimate, and the average standard error of prediction are listed in table 1.

Limitations and Accuracy of Regression Equations

The regression equations provide a means for determining flood peaks for selected recurrence intervals for ungaged streams in Colorado. The equations were developed from gaging-station data on streams with little or no regulation in the basin and where significant urban development or other major basin changes have not occurred. Thus, the regression equations may not be valid where regulation is a factor or where a drainage basin has been altered by urban development. The regression equations also will not be valid where unique, localized geologic features affect floods. As with any regression analysis, the regression equations are defined only within the range of the independent variables used. For this study, the range of values of the basin characteristics used is listed in table 2. Extrapolation beyond the range of basin characteristics given may provide unreliable results.

The accuracy of a regression equation generally is assessed in terms of the standard error of estimate and the average standard error of prediction. The standard error of estimate is a measure of how well the observed peak streamflows agree with the regression estimate of the peak streamflows. The largest standard errors of estimate were found in the plains region. The standard errors ranged from 204 to 306 percent. These large errors may be attributed to the sparsity of gaging stations within the streamflow-gaging-station network in this region and the variability of the magnitude of annual peak streamflows. The smallest standard errors of estimate were found in the mountain region where the errors ranged from 41 to 58 percent. Standard errors of estimate and the average standard error of prediction for the regression equations in each hydrologic region are listed in table 1.

The average standard error of prediction at an ungaged site is a measure of the expected accuracy with which the regression equation can estimate a flood of a given recurrence interval. The average standard error of prediction includes errors associated with the regression equation and any time sampling error. The largest average standard errors of prediction were found in the plains region where errors ranged from 89 to 100 percent. The smallest average standard errors of prediction were found in the mountain region where errors ranged from 44 to 52 percent.

ESTIMATING MAGNITUDE OF PEAK DISCHARGES

The regression equations developed for this study are for estimation of peak discharges at ungaged sites. Peak-discharge estimates also are often required at or near gaged sites or at an ungaged site on the same stream as a gaged site. The methods for estimating the magnitude of peak discharges in general are explained in this section.

Summary table, pdf page 39.

Gaged Sites

Magnitudes of peak discharges for gaged sites can be estimated using equations defined in this study. Table 3 (in the "Supplemental Data" section at the back of the report) lists the peak discharges from the flood-frequency curve for each gaging station for various recurrence intervals. Once the recurrence

Table 1. Regional flood-frequency equations, Colorado

[Q, discharge, in cubic feet per second; A, drainage area, in square miles; P, mean annual precipitation, in inches; S, mean drainage-basin slope, in foot per foot]

Recurrence interval, in years	Regression equation	Standard error of the model, in percent	Average standard error of prediction, in percent
Mountain region			
2	$Q = 11.0 (A)^{0.663} (S + 1.0)^{3.465}$	58.5	59.6
5	$Q = 17.9 (A)^{0.677} (S + 1.0)^{2.739}$	47.7	48.6
10	$Q = 23.0 (A)^{0.685} (S + 1.0)^{2.364}$	43.7	44.6
25	$Q = 29.4 (A)^{0.695} (S + 1.0)^{2.004}$	41.4	42.3
50	$Q = 34.5 (A)^{0.700} (S + 1.0)^{1.768}$	41.4	42.3
100	$Q = 39.5 (A)^{0.706} (S + 1.0)^{1.577}$	42.4	43.4
200	$Q = 44.6 (A)^{0.710} (S + 1.0)^{1.408}$	44.2	45.2
500	$Q = 51.5 (A)^{0.715} (S + 1.0)^{1.209}$	47.5	48.6
Rio Grande region			
2	$Q = 0.03 (A)^{0.979} (P)^{1.615}$	77.7	82.6
5	$Q = 0.12 (A)^{0.940} (P)^{1.384}$	64.0	67.9
10	$Q = 0.25 (A)^{0.914} (P)^{1.277}$	58.2	61.9
25	$Q = 0.52 (A)^{0.884} (P)^{1.117}$	53.4	56.8
50	$Q = 0.81 (A)^{0.864} (P)^{1.121}$	51.2	54.5
100	$Q = 1.19 (A)^{0.846} (P)^{1.074}$	49.9	53.3
200	$Q = 1.67 (A)^{0.828} (P)^{1.036}$	49.5	52.9
500	$Q = 2.48 (A)^{0.808} (P)^{0.995}$	50.0	53.6
Southwest region			
2	$Q = 28.7 (A)^{0.699}$	85.0	87.3
5	$Q = 50.5 (A)^{0.693}$	74.1	76.1
10	$Q = 66.0 (A)^{0.697}$	71.4	73.4
25	$Q = 86.3 (A)^{0.704}$	71.2	73.4
50	$Q = 102.0 (A)^{0.709}$	72.8	75.0
100	$Q = 118.4 (A)^{0.715}$	75.6	78.0
200	$Q = 135.5 (A)^{0.720}$	79.1	81.7
500	$Q = 159.4 (A)^{0.728}$	85.0	87.9
Northwest region			
2	$Q = 0.39 (A)^{0.684} (P)^{1.304}$	82.6	85.6
5	$Q = 2.84 (A)^{0.674} (P)^{0.833}$	71.5	74.0
10	$Q = 7.56 (A)^{0.671} (P)^{0.601}$	68.5	70.9
25	$Q = 20.6 (A)^{0.669} (P)^{0.362}$	67.1	69.7
50	$Q = 38.8 (A)^{0.667} (P)^{0.210}$	67.2	69.8
100	$Q = 104.7 (A)^{0.624}$	75.0	76.7
200	$Q = 118.5 (A)^{0.624}$	77.8	79.6
500	$Q = 137.6 (A)^{0.623}$	83.1	85.1
Plains region			
2	$Q = 39.0 (A)^{0.486}$	234	258
5	$Q = 195.8 (A)^{0.399}$	204	224
10	$Q = 364.6 (A)^{0.400}$	212	234
25	$Q = 725.3 (A)^{0.395}$	232	256
50	$Q = 1116 (A)^{0.392}$	250	278
100	$Q = 1640 (A)^{0.388}$	267	300
200	$Q = 2324 (A)^{0.385}$	284	321
500	$Q = 3534 (A)^{0.380}$	306	348

interval of interest is selected, a weighted estimate of the peak discharge can be computed for a site using the regression equation for the appropriate region and the peak-discharge value from the flood-frequency curve.

Weighted estimates are used for unregulated streams to reduce the time-sampling error that may occur in a station flood-frequency estimate. This time-sampling error is associated with the length of record for a gaging station. A station with a short period of record may have a large time-sampling error because its record may not be representative of the actual flood history of the site based on a large number of years. The observed period of record has the possibility of falling within a wet or dry climatic cycle. The weighted estimate of flood frequency should be a better indicator of the true value because the regression estimate is an average of the flood histories of many gaging stations over a long period of time (Thomas and Lindskov, 1983).

Table 2. Basin characteristics and the range of values used in the analysis

Basin characteristics	Range of values
Drainage-basin area, in square miles	5.5 to 988.0
Mean annual precipitation, in inches	7.0 to 49.0
Mean drainage-basin elevation, in feet	2,805 to 12,200
Mean drainage-basin slope, in foot per foot	0.081 to 0.562

Sites near Gaging Stations on the Same Stream

Peak discharges for sites near gaging stations on the same stream can be estimated by using a ratio of drainage area for the sites near the ungaged sites and the gaged sites. This method is considered to be reliable when the drainage-area ratio is between about 0.5 and 1.5 and when the two sites have similar drainage-basin and climatic characteristics. If the sites of interest have similar basin and climatic characteristics and meet the drainage-area-ratio requirement, peak discharges can be computed by the following equation:

$$Q_{T(u)} = Q_{T(g)}(A_u/A_g)^x, \quad (3)$$

where

- $Q_{T(u)}$ is the peak discharge, in cubic feet per second, at the ungaged site for T-year recurrence interval;
- $Q_{T(g)}$ is the weighted peak discharge, in cubic feet per second, at the gaged site for T-year recurrence interval;
- A_u is the drainage area, in square miles, at the ungaged site;
- A_g is the drainage area, in square miles, at the gaged site; and
- x is the average exponent for drainage area for each flood region as follows:

Flood region	Exponent
Mountains	0.69
Rio Grande	0.88
Southwest	0.71
Northwest	0.64
Plains	0.40

The following is an example calculation to determine the 100-year peak discharge for an ungaged site near a gaged site on the same stream in the mountain region. The drainage area at the ungaged site is given as 350 mi² and at the gaged site is 450 mi². The weighted discharge for the 100-year peak at the gaged site is given as 11,500 ft³/s.

1. Check that the drainage area ratio A_u/A_g is between 0.5 and 1.5. That ratio is as follows:

$$A_u/A_g = 350/450 = 0.78$$

which meets the ratio requirement.

2. Compute the discharge at the ungaged site using the specified values in equation 3:

$$Q_{100(u)} = 11,500(350/450)^{0.69} = 9,670 \text{ ft}^3/\text{s}.$$

Ungaged Sites

Peak discharges at ungaged sites can be computed using the appropriate regional equation shown in table 1. For sites on streams that cross regional boundaries, results from more than one of the regional equations need to be weighted as described below.

For streams that cross regional boundaries, peak-discharge estimates for a given recurrence interval can be quite different depending on the regional equation used. The following equation for weighting estimates from two regional equations can be used:

$$Q_{T(w)} = Q_{T(a)} \text{Area}_{(a)} + Q_{T(b)} \text{Area}_{(b)} / \text{Area}_{(t)} \quad (4)$$

where

- $Q_{T(w)}$ is the weighted discharge, in cubic feet per second, for T-year recurrence interval;
- $Q_{T(a)}$ is the discharge for region (a), in cubic feet per second, for T-year recurrence interval;
- $\text{Area}_{(a)}$ is the drainage area in region (a), in square miles;
- $Q_{T(b)}$ is the discharge for region (b), in cubic feet per second, for T-year recurrence interval;
- $\text{Area}_{(b)}$ is the drainage area in region (b), in square miles; and
- $\text{Area}_{(t)}$ is the total drainage area in both regions, in square miles.

An example calculation to determine the 50-year peak discharge for an ungaged site with a drainage area in the northwest region and in the southwest region follows. The total drainage area is composed of 280 mi² in the northwest region and 55 mi² in the southwest region. Mean annual precipitation is given as 25 inches for the site.

Calculate the 50-year peak discharge using the appropriate equation for each region from table 1 and the drainage area in each region:

- Southwest region drainage area

$$Q_{50} = 102.0 (A)^{0.709}$$

where

A is the drainage area, in mi²

$$Q_{50} = 102.0 (55)^{0.709} = 1,750 \text{ ft}^3/\text{s}.$$

- Northwest region drainage area

$$Q_{50} = 38.8(A)^{0.667}(P)^{0.210}$$

where

- A is the drainage area, in square miles; and
- P is the mean annual precipitation, in inches.

$$Q_{50} = 38.8(280)^{0.667}(25)^{0.210} = 3,270 \text{ ft}^3/\text{s}.$$

- Total drainage area using equation (4)

$$Q_{T(w)} = Q_{T(a)} \text{Area}_{(a)} + Q_{T(b)} \text{Area}_{(b)} / \text{Area}_{(t)}$$

$$Q_{50(w)} = 1,750(55) + 3,270(280) / (280 + 55) = 3,020 \text{ ft}^3/\text{s}.$$

When a site is on a stream that crosses a State boundary, peak discharge can be calculated by averaging estimates from relations for both States. For example, to determine the 10-year recurrence-interval peak discharge at a site near the Colorado-Wyoming State line, the 10-year peak discharge needs to be calculated as the average of the estimates obtained using both the equation for Colorado and the equation for Wyoming (Lowham, 1988). Regional regression equations for Utah, Arizona, and parts of Wyoming and New Mexico are presented by Thomas and others (1994). Regression equations are presented for Kansas by Clement (1987) and for Oklahoma by Tortorelli and Bergman (1985). Regional equations are presented for Texas by Asquith and Slade (1997) and for Nebraska by Soenksen and others (1999).

SUMMARY

Various Federal, State, and local governments in Colorado use hydrologic data collected and published by the USGS in making decisions about the cost-effective planning and design of highway bridges and culverts, flood-plain management, reservoir management, and other water issues. Part of that data is used to develop regression equations for determining the magnitude and frequency of floods in Colorado. Regression equations and the methods for determining the magnitude and frequency of floods on unregulated streams were developed for recurrence intervals ranging from 2 to 500 years. The methods for determining peak discharges depended on whether the site was gaged, was on a stream near a gaged site, or was

ungaged and on whether the drainage area upstream from a site crossed a hydrologic region boundary. This study differs from most of the previous flood-frequency studies in areal coverage, number of gaging stations used, and lengths of streamflow records used. Data used in the study were from previous flood-frequency studies, about 2,700 additional years of gaging-station record through water year 1993, and 64 additional gaging stations. Only one gaging station per stream was used unless the drainage area of a downstream gaging station was greater than about 2.5 times the drainage area of the upstream gaging station.

Flood-frequency curves were determined for 328 gaging stations on unregulated streams having at least 10 years of record based on a Log-Pearson Type III probability distribution. Historical adjustments to the recorded gaging-station data were used where applicable, and low outliers were deleted using the low-outlier test recommended by the IACWD (1982). The regional regression equations discussed in this report relate flood magnitude to easily measured drainage-basin and climatic characteristics. The study area was divided into five distinct hydrologic regions because basin physiography and climate differ greatly throughout the area: the mountain, Rio Grande, southwest, northwest, and the plains regions. Separate regression equations for estimating peak discharges were developed for each of these five regions for recurrence intervals of 2, 5, 10, 25, 50, 100, 200, and 500 years.

An OLS regression was used for preliminary delineation of flood regions and selection of statistically significant explanatory drainage-basin and climatic characteristics. GLS regression analysis was used to compute the final regression equations. Drainage area was the most statistically significant variable in all of the regression equations. Other statistically significant variables were mean annual precipitation and mean drainage-basin slope. Application of the regression equations to sites having drainage-basin characteristics outside the range of those used in the study may provide unreliable results.

Methods are presented for determining the magnitude of peak discharges for sites located at gaging stations, for sites located near gaging stations on the same stream when the ratio of drainage-basin areas is between about 0.5 and 1.5, and for sites where the drainage basin crosses a flood-region boundary or a State boundary.

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SUPPLEMENTAL DATA

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years
P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
1	06616000	North Fork Michigan River near Gould, Colo.	40.5494	106.0206	20.5	25	9,800	26.0
2	06617100	Michigan River at Walden, Colo.	40.7411	106.2789	182.0	25	9,500	20.0
3	06618500	Illinois Creek at Walden, Colo.	40.7264	106.2900	259.0	25	9,000	19.0
4	06619000	Michigan River near Cowdrey, Colo.	40.8617	106.3367	478.0	11	9,100	21.0
5	06619500	Canadian River at Cowdrey, Colo.	40.8631	106.3108	181.0	12	8,800	20.0
6	06621000	Douglas Creek near Foxpark, Wyo.	41.0811	106.3069	120.0	26	9,190	30.0
7	06623800	Encampment River above Hog Park Creek near Encampment, Wyo.	41.0236	106.8242	72.7	20	9,700	26.0
8	06692000	Birdwood Creek near Hershey, Nebr.	41.2222	101.0700	940.0	60	3,470	18.5
9	06700500	Goose Creek above Cheesman Lake, Colo.	39.2089	105.3031	86.6	51	10,100	19.0
10	06706000	North Fork South Platte River below Geneva Creek, at Grant, Colo.	39.4572	105.6581	127.0	31	10,800	27.0
11	06707000	North Fork South Platte River at South Platte, Colo.	39.4089	105.1753	479.0	60	9,400	21.0
12	06709500	Plum Creek near Louviers, Colo.	39.4844	105.0019	302.0	28	6,900	16.0
13	06710500	Bear Creek at Morrison, Colo.	39.6531	105.1953	164.0	66	8,800	23.0
14	06711000	Turkey Creek near Morrison, Colo.	39.6356	105.1681	50.1	12	7,700	18.0
15	06712000	Cherry Creek near Franktown, Colo.	39.3558	104.7628	169.0	36	7,100	16.0
16	06712500	Cherry Creek near Melvin, Colo.	39.6050	104.8219	360.0	29	6,600	16.0
17	06716500	Clear Creek near Lawson, Colo.	39.7658	105.6256	147.0	26	10,800	26.0
18	06719500	Clear Creek near Golden, Colo.	39.7506	105.2483	399.0	62	9,600	22.0
19	06722500	South St. Vrain Creek near Ward, Colo.	40.0908	105.5139	14.4	24	10,500	23.0
20	06725500	Middle Boulder Creek at Nederland, Colo.	39.9617	105.5039	36.2	32	10,400	27.0
21	06732000	Glacier Creek near Estes Park, Colo.	40.3447	105.5833	20.8	18	10,700	30.0
22	06739500	Buckhorn Creek near Masonville, Colo.	40.4539	105.1983	134.0	11	7,400	16.0
23	06748530	Little Beaver Creek near Rustic, Colo.	40.6231	105.5644	12.3	13	9,700	23.0
24	06748600	South Fork Cache La Poudre River near Rustic, Colo.	40.6469	105.4930	92.4	19	9,900	22.0
25	06755000	South Crow Creek near Hecla, Wyo.	41.1264	105.1939	13.9	35	7,810	16.0
26	06823500	Buffalo Creek near Haigler, Nebr.	40.0394	101.8658	260.0	54	3,700	17.8
27	06824000	Rock Creek at Parks, Nebr.	40.0417	101.7278	20.0	54	3,350	18.0
28	06825500	Landsman Creek near Hale, Colo.	39.5756	102.2517	268.0	23	4,200	16.0
29	06844700	South Fork Sappa Creek near Brewster, Kans.	39.2853	101.4656	74.0	22	3,595	19.0
30	06847600	Prairie Dog Creek tributary at Colby, Kans.	39.3911	101.0453	7.5	21	3,204	20.0
31	06858500	North Fork Smoky Hill River near McAllaster, Kans.	39.0169	101.3475	670.0	24	3,990	17.5
32	07079500	East Fork Arkansas River near Leadville, Colo.	39.2597	106.3400	50.0	11	11,400	27.0
33	07081000	Tennessee Creek near Leadville, Colo.	39.2642	106.3403	48.0	15	10,800	25.0
34	07083000	Halfmoon Creek near Malta, Colo.	39.1722	106.3886	23.6	29	11,800	21.0
35	07086500	Clear Creek above Clear Creek Reservoir, Colo.	39.0181	106.2772	67.1	29	11,800	23.0

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
06616000	0.229	179	237	270	307	331	353	374	398
06617100	0.134	494	710	847	1,010	1,130	1,250	1,360	1,500
06618500	0.133	401	798	1,130	1,640	2,080	2,570	3,110	3,910
06619000	0.126	493	827	1,060	1,370	1,590	1,820	2,050	2,350
06619500	0.155	293	477	617	812	971	1,140	1,320	1,580
06621000	--	956	1,280	1,470	1,690	1,830	1,970	2,100	2,260
06623800	--	990	1,270	1,430	1,610	1,740	1,850	1,960	2,090
06692000	--	362	532	677	904	1,110	1,350	1,630	2,090
06700500	0.305	173	278	356	465	553	645	744	885
06706000	0.343	491	675	780	897	974	1,040	1,110	1,180
06707000	0.301	836	1,290	1,600	1,980	2,250	2,530	2,800	3,150
06709500	0.174	641	2,330	4,700	10,200	17,000	27,300	42,300	72,600
06710500	0.296	391	985	1,700	3,210	4,970	7,500	11,100	18,300
06711000	0.224	114	294	475	785	1,080	1,440	1,860	2,520
06712000	--	660	1,960	3,410	6,090	8,820	12,300	16,500	23,600
06712500	--	2,430	6,290	10,200	16,700	22,800	30,100	38,600	51,800
06716500	0.446	1,030	1,360	1,560	1,770	1,920	2,050	2,170	2,330
06719500	0.390	1,570	2,490	3,190	4,180	5,000	5,880	6,840	8,230
06722500	0.277	241	305	346	397	435	472	508	557
06725500	0.319	445	561	629	706	759	807	853	911
06732000	0.421	243	302	337	377	404	430	454	485
06739500	--	822	3,960	8,910	21,000	36,200	59,200	92,400	158,000
06748530	0.227	79	118	145	179	204	230	255	289
06748600	0.270	487	713	869	1,070	1,230	1,390	1,550	1,780
06755000	--	17	38	57	91	125	165	215	298
06823500	--	26	45	62	88	112	141	174	228
06824000	--	44	81	117	177	235	308	398	550
06825500	--	1,380	3,510	5,670	9,410	13,000	17,400	22,600	31,000
06844700	--	54	383	961	2,370	4,080	6,480	9,670	15,300
06847600	--	213	568	901	1,420	1,860	2,340	2,860	3,600
06858500	--	334	1,940	4,500	10,500	17,500	27,300	40,400	63,500
07079500	0.305	405	584	698	837	937	1,030	1,130	1,250
07081000	0.225	326	433	493	560	605	645	681	726
07083000	0.517	258	349	407	479	531	583	634	701
07086500	0.460	583	809	951	1,120	1,250	1,360	1,480	1,630

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations—Continued

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
36	07089000	Cottonwood Creek below Hot Springs, near Buena Vista, Colo.	38.8128	106.2217	65.0	37	11,300	25.0
37	07093500	South Arkansas River near Salida, Colo.	38.5214	105.9892	208.0	14	9,500	25.0
38	07095000	Grape Creek near Westcliffe, Colo.	38.1861	105.4831	320.0	48	9,300	21.0
39	07096500	Fourmile Creek near Canon City, Colo.	38.4364	105.1908	434.0	10	8,100	15.0
40	07107500	St. Charles River at Burnt Mill, Colo.	38.0517	104.7931	172.0	18	8,000	21.0
41	07114000	Cucharas River at Boyd Ranch, near La Veta, Colo.	37.4200	105.0522	56.0	40	9,900	25.0
42	07118000	Apishapa River near Aguilar, Colo.	37.3864	104.6653	126.0	10	8,100	25.0
43	07121500	Timpas Creek at mouth near Swink, Colo.	38.0028	103.6550	496.0	12	4,900	12.0
44	07125100	Frijole Creek near Alfalfa, Colo.	37.2000	104.1936	80.0	12	6,400	15.0
45	07125500	San Francisco Creek near Alfalfa, Colo.	37.1683	104.1444	160.0	14	6,600	17.0
46	07126100	Luning Arroyo near Model, Colo.	37.3044	104.0150	86.0	10	5,600	14.0
47	07126200	Van Bremer Arroyo near Model, Colo.	37.3458	103.9575	168.0	11	5,500	12.0
48	07138600	White Woman Creek tributary near Selkirk, Kans.	38.5250	101.6211	38.0	19	3,580	18.0
49	07138650	White Woman Creek near Leoti, Kans.	38.4811	101.4878	750.0	20	--	17.0
50	07138800	Lion Creek tributary near Modoc, Kans.	38.4800	101.0500	7.0	21	3,124	19.0
51	07154650	Tesesquite Creek near Kenton, Okla.	36.8978	102.9011	25.4	19	4,557	15.5
52	07155100	Cold Springs Creek near Wheelless, Okla.	36.7722	102.8045	11.0	17	4,600	15.8
53	07155900	North Fork Cimarron River tributary near Elkhart, Kans.	37.1908	101.8983	75.0	19	3,553	18.0
54	07156000	North Fork Cimarron River tributary near Richfield, Kans.	37.3100	101.7717	103.0	19	3,513	18.0
55	07156010	North Fork Cimarron River at Richfield, Kans.	37.2583	101.7750	463.0	15	3,840	17.6
56	07156220	Bear Creek near Johnson, Kans.	37.6264	101.7611	835.0	28	3,920	17.5
57	07156600	Cimarron River tributary near Moscow, Kans.	37.3353	101.0500	13.0	19	2,937	18.5
58	07204000	Moreno Creek at Eagle Nest, N. Mex.	36.5539	105.2675	73.8	48	10,200	20.0
59	07204500	Cieneguilla Creek near Eagle Nest, N. Mex.	36.4853	105.2650	56.0	44	9,400	19.0
60	07205000	Sixmile Creek near Eagle Nest, N. Mex.	36.5186	105.2747	10.5	51	9,500	20.0
61	07206400	Clear Creek near Ute Park, N. Mex.	36.5264	105.1750	7.4	22	9,770	17.0
62	07217000	Coyote Creek below Black Lake, N. Mex.	36.2722	105.2472	48.0	12	9,300	19.0
63	07232650	Aqua Frio Creek near Felt, Okla.	36.5564	102.7861	31.0	12	4,572	15.6
64	07234100	Clear Creek near Elmwood, Okla.	36.6450	100.5019	170.0	27	2,805	19.8
65	08216500	Willow Creek at Creede, Colo.	37.8561	106.9269	35.3	25	11,500	24.0
66	08218500	Goose Creek at Wagonwheel Gap, Colo.	37.7519	106.8294	90.0	21	10,700	26.0
67	08219500	South Fork Rio Grande at South Fork, Colo.	37.6569	106.6486	216.0	52	10,400	30.0
68	08220500	Pinos Creek near Del Norte, Colo.	37.5917	106.4494	53.0	40	10,500	30.0
69	08223500	Rock Creek near Monte Vista, Colo.	37.4903	106.2589	32.9	25	10,400	15.0

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
07089000	0.416	330	462	550	661	744	827	910	1,020
07093500	0.347	310	536	713	964	1,170	1,400	1,640	1,990
07095000	0.203	391	876	1,330	2,090	2,780	3,610	4,570	6,090
07096500	0.252	513	1,290	2,110	3,610	5,110	7,020	9,410	13,500
07107500	--	1,720	5,420	10,000	19,700	30,500	45,600	66,000	104,000
07114000	0.359	124	244	340	477	588	707	833	1,010
07118000	0.253	2,130	3,910	5,200	6,870	8,110	9,350	10,600	12,200
07121500	--	1,280	3,420	5,710	9,840	14,000	19,100	25,500	36,100
07125100	--	2,090	5,140	8,390	14,300	20,500	28,300	38,300	55,600
07125500	--	2,990	6,980	10,800	17,200	23,100	30,100	38,200	51,100
07126100	--	421	2,300	5,110	11,200	17,900	26,700	37,800	56,300
07126200	--	642	2,320	4,270	7,790	11,200	15,300	20,100	27,500
07138600	--	53	168	302	561	831	1,180	1,620	2,370
07138650	--	122	1,940	6,950	24,000	49,900	92,700	158,000	289,000
07138800	--	91	182	251	342	411	480	550	640
07154650	--	1,510	4,190	6,790	11,000	14,600	18,800	23,300	29,900
07155100	--	88	408	913	2,160	3,780	6,260	9,940	17,400
07155900	--	57	734	2,480	8,310	17,400	32,700	56,900	108,000
07156000	--	738	2,390	4,340	8,080	12,000	17,000	23,400	34,200
07156010	--	763	3,530	8,030	19,500	35,000	59,500	97,000	177,000
07156220	--	761	3,280	6,580	13,200	20,200	29,100	40,000	58,000
07156600	--	461	1,400	2,340	3,870	5,220	6,730	8,370	10,700
07204000	--	62	124	171	232	279	325	371	432
07204500	--	111	240	347	503	631	769	914	1,120
07205000	--	27	53	77	113	146	184	227	293
07206400	--	23	52	80	127	172	227	293	399
07217000	--	42	176	384	906	1,600	2,710	4,410	8,060
07232650	--	140	700	1,560	3,570	6,010	9,500	14,300	23,300
07234100	--	996	5,680	12,800	28,600	46,200	69,500	99,100	149,000
08216500	--	191	301	376	472	543	613	683	776
08218500	--	371	555	684	851	980	1,110	1,250	1,430
08219500	0.295	1,500	2,320	2,920	3,760	4,430	5,150	5,920	7,020
08220500	0.308	180	315	419	562	678	800	928	1,110
08223500	0.315	86	148	192	247	288	328	368	420

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations—Continued

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years
P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
70	08224500	Kerber Creek at Ashley Ranch, near Villa Grove, Colo.	38.2411	106.1158	38.0	43	10,500	19.0
71	08227000	Saguache Creek near Saguache, Colo.	38.1633	106.2900	595.0	64	10,200	16.0
72	08227500	North Crestone Creek near Crestone, Colo.	38.0136	105.6922	10.7	40	11,300	20.0
73	08230500	Carnero Creek near La Garita, Colo.	37.8597	106.3189	117.0	52	10,100	20.0
74	08231000	La Garita Creek near La Garita, Colo.	37.8133	106.3178	61.0	55	10,100	18.0
75	08236000	Alamosa River above Terrace Reservoir, Colo.	37.3747	106.3342	107.0	47	11,000	29.0
76	08240500	Trinchera Creek above Turners Ranch, near Fort Garland, Colo.	37.3747	105.2944	45.0	53	10,400	22.0
77	08241000	Trinchera Creek above Mountain Home Reservoir, near Fort Garland, Colo.	37.3947	105.3686	61.0	32	10,000	18.0
78	08241500	Sangre De Cristo Creek near Fort Garland, Colo.	37.4250	105.4144	190.0	52	9,200	15.0
79	08242500	Ute Creek near Fort Garland, Colo.	37.4472	105.4250	32.0	53	10,000	16.0
80	08245500	Conejos River at Platoro, Colo.	37.3539	106.5244	44.4	17	11,200	35.0
81	08246500	Conejos River near Mogote, Colo.	37.0539	106.1869	282.0	43	10,300	26.0
82	08247500	San Antonio River at Ortiz, Colo.	36.9931	106.0381	110.0	60	9,500	11.0
83	08248000	Los Pinos River near Ortiz, Colo.	36.9822	106.0731	167.0	66	9,900	24.0
84	08248500	San Antonio River at Mouth, near Manassa, Colo.	37.1769	105.8775	348.0	52	9,100	12.0
85	08252500	Costilla Creek above Costilla Dam, N. Mex.	36.8978	105.2544	25.1	44	11,430	25.0
86	08253000	Casias Creek near Costilla, N. Mex.	36.8967	105.2597	16.6	46	11,100	25.0
87	08263000	Latir Creek near Cerro, N. Mex.	36.8292	105.5472	10.5	32	11,500	24.0
88	08264000	Red River near Red River, N. Mex.	36.6222	105.3889	19.1	24	10,790	25.0
89	08265000	Red River near Questa, N. Mex.	36.7033	105.5678	113.0	53	9,930	21.0
90	08267500	Rio Hondo near Valdez, N. Mex.	36.5417	105.5558	36.2	48	10,100	23.0
91	08268500	Arroyo Hondo at Arroyo Hondo, N. Mex.	36.5322	105.6850	65.6	48	9,730	20.0
92	08269000	Rio Pueblo De Taos near Taos, N. Mex.	36.4394	105.5031	66.6	48	9,500	25.0
93	08271000	Rio Lucero near Arroyo Seco, N. Mex.	36.5083	105.5303	16.6	54	10,790	24.0
94	08275500	Rio Grande Del Rancho near Talpa, N. Mex.	36.2978	105.5819	83.0	30	9,400	22.0
95	08275600	Rio Chiquito near Talpa, N. Mex.	36.3319	105.5783	37.0	24	9,350	22.0
96	08279000	Embudo Creek at Dixon, N. Mex.	36.2108	105.9131	305.0	46	8,980	21.0
97	08281200	Wolf Creek near Chama, N. Mex.	36.9556	106.5361	27.7	13	9,600	27.4
98	08283500	Rio Chama at Park View, N. Mex.	36.7375	106.5778	405.0	33	9,270	22.0
99	08284000	Rito De Tierra Amarilla at Tierra Amarilla, N. Mex.	36.6986	106.5569	49.7	23	8,850	20.5
100	08284100	Rio Chama near La Puente, N. Mex.	36.6625	106.6325	480.0	27	9,000	24.0
101	08284500	Willow Creek near Park View, N. Mex.	36.6681	106.7042	193.0	34	8,000	18.0
102	08286650	Canjilon Creek above Abiquiu Reservoir, N. Mex.	36.3153	106.4847	144.0	14	6,300	--
103	08288000	El Rito near El Rito, N. Mex.	36.3917	106.2389	50.5	33	8,700	22.0

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
08224500	0.358	95	162	215	292	356	427	504	618
08227000	0.233	310	513	662	862	1,020	1,180	1,350	1,580
08227500	0.573	84	150	209	306	396	505	635	848
08230500	0.259	140	323	500	796	1,080	1,410	1,810	2,440
08231000	0.292	158	291	394	537	651	771	897	1,070
08236000	0.306	944	1,400	1,730	2,190	2,550	2,940	3,360	3,950
08240500	0.368	114	219	309	447	567	704	859	1,090
08241000	0.309	114	229	321	452	559	672	791	957
08241500	0.239	148	336	523	848	1,170	1,560	2,040	2,840
08242500	0.318	135	211	264	334	388	444	500	578
08245500	0.346	1,030	1,220	1,330	1,450	1,540	1,620	1,700	1,800
08246500	0.255	2,650	3,660	4,400	5,400	6,200	7,050	7,950	9,230
08247500	0.155	471	816	1,080	1,430	1,710	2,000	2,310	2,740
08248000	0.156	1,300	1,890	2,270	2,710	3,020	3,310	3,590	3,940
08248500	0.140	819	1,440	1,860	2,360	2,710	3,040	3,360	3,740
08252500	0.251	63	145	235	408	596	851	1,190	1,830
08253000	--	61	100	128	166	194	223	253	294
08263000	--	47	77	100	132	158	185	215	258
08264000	--	107	166	207	261	302	343	385	443
08265000	--	254	434	570	757	907	1,060	1,230	1,460
08267500	--	165	272	351	458	543	632	725	854
08268500	--	155	319	470	713	937	1,200	1,510	1,990
08269000	--	180	380	549	803	1,020	1,250	1,510	1,880
08271000	--	121	189	235	294	337	379	421	477
08275500	--	147	303	427	600	738	881	1,030	1,230
08275600	--	71	156	232	351	458	581	720	931
08279000	--	1,060	1,820	2,310	2,900	3,300	3,670	4,020	4,440
08281200	--	561	922	1,210	1,630	1,990	2,390	2,840	3,500
08283500	--	4,020	5,770	6,970	8,520	9,700	10,900	12,100	13,800
08284000	--	285	541	742	1,020	1,250	1,480	1,730	2,070
08284100	--	3,990	6,670	8,650	11,300	13,500	15,700	18,000	21,100
08284500	--	1,160	1,870	2,420	3,220	3,880	4,600	5,390	6,550
08286650	--	681	1,190	1,590	2,190	2,690	3,250	3,860	4,770
08288000	--	220	406	570	831	1,070	1,350	1,670	2,190

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations—Continued

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
104	08289000	Rio Ojo Caliente at La Madera, N. Mex.	36.3497	106.0436	419.0	51	8,640	16.0
105	09012500	North Inlet at Grand Lake, Colo.	40.2533	105.8108	45.9	11	10,700	29.0
106	09020000	Willow Creek near Granby, Colo.	40.1806	106.0086	109.0	19	9,600	25.0
107	09024000	Fraser River at Winter Park, Colo.	39.9000	105.7761	27.6	22	10,700	35.0
108	09026500	St. Louis Creek near Fraser, Colo.	39.9100	105.8778	32.9	33	10,700	30.0
109	09032000	Ranch Creek near Fraser, Colo.	39.9500	105.7650	19.9	14	10,300	29.0
110	09032500	Ranch Creek near Tabernash, Colo.	39.9975	105.8231	51.3	17	9,900	23.0
111	09033000	Meadow Creek near Tabernash, Colo.	40.0508	105.7769	8.0	21	10,500	30.0
112	09033500	Strawberry Creek near Granby, Colo.	40.0867	105.7942	11.6	10	9,500	26.0
113	09034500	Colorado River at Hot Sulphur Springs, Colo.	40.0833	106.0875	825.0	28	9,900	26.0
114	09034900	Bobtail Creek near Jones Pass, Colo.	39.7603	105.9058	5.5	10	11,800	38.0
115	09035500	Williams Fork below Steelman Creek, Colo.	39.7789	105.9278	16.3	15	11,600	36.0
116	09035700	Williams Fork above Darling Creek, near Leal, Colo.	39.7894	106.0217	34.7	10	11,300	32.0
117	09035800	Darling Creek near Leal, Colo.	39.8047	106.0197	8.2	10	10,800	24.0
118	09035900	South Fork of Williams Fork near Leal, Colo.	39.7956	106.0303	27.2	10	10,900	32.0
119	09036000	Williams Fork near Leal, Colo.	39.8314	106.0542	89.3	35	10,900	24.0
120	09036500	Keyser Creek near Leal, Colo.	39.9075	106.0167	13.8	10	10,500	21.0
121	09039000	Troublesome Creek near Pearmont, Colo.	40.2175	106.3125	44.6	22	9,900	27.0
122	09040000	East Fork Troublesome Creek near Troublesome, Colo.	40.1575	106.2828	76.0	29	9,300	24.0
123	09040500	Troublesome Creek near Troublesome, Colo.	40.0592	106.3050	168.0	23	9,100	25.0
124	09041100	Antelope Creek near Kremmling, Colo.	40.2406	106.3731	11.5	13	8,900	25.0
125	09047000	Blue River at Dillon, Colo.	39.6139	106.0514	128.0	44	10,800	28.0
126	09047500	Snake River near Montezuma, Colo.	39.6056	105.9425	57.7	28	11,400	27.0
127	09047700	Keystone Gulch near Dillon, Colo.	39.5944	105.9719	9.1	18	11,000	25.0
128	09050100	Tenmile Creek below North Tenmile Creek, at Frisco, Colo.	39.5769	106.1092	93.3	18	11,200	25.0
129	09050500	Tenmile Creek at Dillon, Colo.	39.6125	106.0542	111.0	40	11,000	29.0
130	09052000	Rock Creek near Dillon, Colo.	39.7231	106.1281	15.8	23	10,800	28.0
131	09052400	Boulder Creek at Upper Station, near Dillon, Colo.	39.7281	106.1728	8.6	10	11,300	35.0
132	09052800	Slate Creek at Upper Station, near Dillon, Colo.	39.7631	106.1919	14.2	10	10,900	38.0
133	09053000	Slate Creek near Dillon, Colo.	39.7817	106.1672	16.6	12	10,700	34.0
134	09053500	Blue River above Green Mountain Reservoir, Colo.	39.8319	106.2222	511.0	19	10,700	27.0
135	09054000	Black Creek below Black Lake, near Dillon, Colo.	39.7992	106.2678	15.0	16	11,300	41.0
136	09054500	Black Creek above Green Mountain Reservoir, Colo.	39.8558	106.2519	18.5	10	10,700	30.0

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
08289000	--	1,060	1,730	2,190	2,790	3,230	3,670	4,100	4,680
09012500	0.156	751	901	990	1,090	1,170	1,240	1,300	1,390
09020000	0.249	558	713	802	901	967	1,030	1,080	1,150
09024000	0.366	317	441	525	633	715	798	882	997
09026500	0.340	218	350	430	521	580	634	682	738
09032000	0.317	190	237	264	295	316	336	354	377
09032500	0.280	357	455	517	592	646	699	751	819
09033000	0.220	187	234	262	294	317	338	359	386
09033500	--	71	97	115	136	152	169	185	207
09034500	0.281	5,220	7,060	8,210	9,590	10,600	11,500	12,400	13,600
09034900	0.407	137	177	201	230	250	270	289	313
09035500	0.411	279	344	379	417	441	463	482	506
09035700	0.376	395	492	551	621	671	720	767	828
09035800	0.342	100	151	186	231	266	301	337	386
09035900	0.384	293	372	416	464	496	524	549	580
09036000	0.366	1,000	1,260	1,400	1,550	1,640	1,720	1,790	1,880
09036500	0.372	148	170	183	198	209	218	228	239
09039000	0.336	207	336	428	551	646	743	844	981
09040000	0.276	305	520	678	893	1,060	1,240	1,420	1,670
09040500	0.254	452	674	826	1,020	1,170	1,320	1,480	1,680
09041100	0.173	22	42	61	91	119	152	191	254
09047000	0.283	725	926	1,050	1,180	1,280	1,370	1,450	1,560
09047500	0.379	535	720	831	961	1,050	1,140	1,220	1,320
09047700	0.315	39	61	76	97	113	130	148	172
09050100	0.336	940	1,280	1,500	1,750	1,920	2,090	2,250	2,450
09050500	0.324	1,080	1,380	1,550	1,740	1,870	1,990	2,110	2,260
09052000	0.353	93	239	265	294	314	332	350	370
09052400	0.484	151	200	231	270	300	329	358	397
09052800	0.495	214	273	313	364	402	442	482	537
09053000	0.449	183	230	258	291	313	334	354	379
09053500	0.314	2,970	4,010	4,610	5,270	5,710	6,110	6,480	6,920
09054000	0.554	274	324	351	381	401	419	436	457
09054500	--	261	330	374	428	467	505	542	592

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations—Continued

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
137	09055000	Otter Creek above Green Mountain Reservoir, Colo.	39.8528	106.2672	8.4	10	9,800	20.0
138	09055300	Cataract Creek near Kremmling, Colo.	39.8353	106.3158	12.0	10	10,800	35.0
139	09055500	Cataract Creek above Green Mountain Reservoir, Colo.	39.8500	106.2908	13.6	10	10,500	31.0
140	09058500	Piney River below Piney Lake, near Minturn, Colo.	39.7081	106.4272	13.0	19	10,900	36.0
141	09059500	Piney River near State Bridge, Colo.	39.8000	106.5833	86.2	31	9,800	29.0
142	09060500	Rock Creek near Toponas, Colo.	40.0411	106.6553	47.6	23	9,400	23.0
143	09063200	Wearyman Creek near Red Cliff, Colo.	39.5206	106.3183	8.8	11	10,900	36.0
144	09063400	Turkey Creek near Red Cliff, Colo.	39.5256	106.3356	23.8	12	10,800	34.0
145	09063500	Turkey Creek at Red Cliff, Colo.	39.5139	106.3667	29.4	20	10,500	33.0
146	09064500	Homestake Creek near Red Cliff, Colo.	39.4733	106.3672	58.2	30	11,100	27.0
147	09065500	Gore Creek at Upper Station, near Minturn, Colo.	39.6278	106.2733	14.4	21	11,100	36.0
148	09066000	Black Gore Creek near Minturn, Colo.	39.5964	106.2644	12.6	21	10,800	40.0
149	09066200	Booth Creek near Minturn, Colo.	39.6506	106.3211	6.0	11	10,900	36.0
150	09066300	Middle Creek near Minturn, Colo.	39.6472	106.3800	5.9	11	10,400	35.0
151	09066400	Red Sandstone Creek near Minturn, Colo.	39.6828	106.4008	7.3	12	10,700	33.0
152	09066500	Gore Creek near Minturn, Colo.	39.6147	106.4394	101.0	12	10,400	32.0
153	09067500	Eagle River at Eagle, Colo.	39.6567	106.8247	629.0	14	9,800	27.0
154	09068000	Brush Creek near Eagle, Colo.	39.5572	106.7625	71.4	22	9,800	28.0
155	09069500	Gypsum Creek near Gypsum, Colo.	39.5456	106.9342	62.7	11	9,600	28.0
156	09070000	Eagle River below Gypsum, Colo.	39.6494	106.9530	945.0	29	9,500	27.0
157	09073500	Roaring Fork River at Aspen, Colo.	39.1894	106.8139	109.0	13	11,000	30.0
158	09073700	Hunter Creek above Midway Creek, near Aspen, Colo.	39.2139	106.6553	6.2	11	12,200	39.0
159	09074000	Hunter Creek near Aspen, Colo.	39.2058	106.7969	41.1	13	10,700	32.0
160	09078000	Fryingpan River at Norrie, Colo.	39.3308	106.6575	90.6	31	10,500	29.0
161	09078100	North Fork Fryingpan River above Cunningham Creek, near Norrie, Colo.	39.3589	106.5678	12.0	12	11,400	38.0
162	09078200	Cunningham Creek near Norrie, Colo.	39.3342	106.5747	7.1	12	10,700	29.0
163	09078500	North Fork Fryingpan River near Norrie, Colo.	39.3428	106.6653	42.0	33	10,600	30.0
164	09080100	Fryingpan River at Meredith, Colo.	39.3625	106.7319	191.0	13	10,600	30.0
165	09081600	Crystal River above Avalanche Creek, near Redstone, Colo.	39.2322	107.2267	167.0	20	10,200	33.0
166	09082800	North Thompson Creek near Carbondale, Colo.	39.3297	107.3328	26.8	12	9,500	34.0
167	09083000	Thompson Creek near Carbondale, Colo.	39.3306	107.2239	75.7	14	9,100	31.0
168	09084000	Cattle Creek near Carbondale, Colo.	39.4667	107.0517	31.1	15	9,500	24.0
169	09089500	West Divide Creek near Raven, Colo.	39.3311	107.5794	64.6	20	8,400	27.0
170	09092500	Beaver Creek near Rifle, Colo.	39.4719	107.8319	7.9	23	9,400	26.0
171	09093000	Parachute Creek near Parachute, Colo.	39.5669	108.1103	141.0	13	8,100	18.0

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
09055000	--	56	77	90	106	117	127	138	151
09055300	0.368	213	249	269	290	304	317	329	343
09055500	--	274	331	365	405	433	460	486	519
09058500	0.499	275	350	396	452	493	532	571	621
09059500	0.329	608	801	913	1,040	1,130	1,210	1,280	1,370
09060500	0.196	331	429	481	533	566	593	617	645
09063200	0.280	73	107	129	157	177	196	216	241
09063400	0.303	206	330	420	541	636	734	836	977
09063500	0.316	308	423	488	559	605	646	683	727
09064500	0.359	781	994	1,110	1,230	1,310	1,380	1,440	1,520
09065500	0.440	352	479	555	643	703	759	812	878
09066000	0.309	205	270	307	348	376	401	424	452
09066200	0.518	150	213	256	309	349	389	430	484
09066300	0.386	67	91	105	121	132	143	152	164
09066400	0.259	107	151	180	214	239	263	286	316
09066500	0.396	1,190	1,510	1,690	1,880	2,000	2,110	2,210	2,330
09067500	0.330	4,750	5,940	6,630	7,410	7,940	8,430	8,900	9,470
09068000	0.362	297	442	545	681	788	898	1,010	1,170
09069500	0.338	164	249	307	382	439	496	554	632
09070000	0.320	3,770	5,030	5,800	6,700	7,340	7,940	8,520	9,260
09073500	0.369	1,620	2,230	2,620	3,080	3,420	3,740	4,050	4,460
09073700	0.485	288	400	475	570	641	713	785	882
09074000	0.302	643	828	928	1,030	1,100	1,160	1,220	1,280
09078000	0.403	978	1,310	1,490	1,710	1,850	1,980	2,100	2,250
09078100	0.445	223	296	342	395	433	469	504	549
09078200	0.355	138	198	238	291	331	371	412	467
09078500	0.367	533	737	869	1,030	1,150	1,270	1,380	1,530
09080100	0.368	1,680	1,980	2,150	2,340	2,460	2,570	2,680	2,810
09081600	0.426	2,260	2,860	3,220	3,650	3,960	4,250	4,540	4,910
09082800	0.202	232	318	368	424	461	495	526	564
09083000	0.257	430	665	823	1,020	1,170	1,310	1,460	1,640
09084000	0.292	141	229	287	356	406	452	497	552
09089500	0.260	382	605	764	971	1,130	1,290	1,460	1,680
09092500	0.244	46	65	78	93	105	116	127	142
09093000	0.369	298	703	1,070	1,640	2,140	2,700	3,310	4,220

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations—Continued

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
172	09095000	Roan Creek near De Beque, Colo.	39.4533	108.3164	321.0	17	7,500	18.0
173	09096000	Plateau Creek at upper station, near Collbran, Colo.	39.2236	107.8014	24.1	13	9,400	29.0
174	09096500	Plateau Creek near Collbran, Colo.	39.2506	107.8400	80.4	36	9,700	31.0
175	09096800	Buzzard Creek below Owens Creek, near Heiberger, Colo.	39.2361	107.6333	49.7	15	9,400	35.0
176	09097500	Buzzard Creek near Collbran, Colo.	39.3250	107.8414	143.0	54	8,400	23.0
177	09097600	Brush Creek near Collbran, Colo.	39.3250	107.8417	9.6	12	9,600	30.0
178	09110000	Taylor River at Almont, Colo.	38.6644	106.8447	477.0	18	10,900	27.0
179	09110500	East River near Crested Butte, Colo.	38.8644	106.9092	90.3	12	10,900	39.0
180	09111500	Slate River near Crested Butte, Colo.	38.8656	106.9672	70.1	12	10,400	33.0
181	09112000	Cement Creek near Crested Butte, Colo.	38.8244	106.8522	26.1	12	10,900	32.0
182	09112500	East River at Almont, Colo.	38.6644	106.8475	289.0	47	10,200	31.0
183	09113300	Ohio Creek at Bladwin, Colo.	38.7656	107.0578	47.2	12	10,200	32.0
184	09113500	Ohio Creek near Baldwin, Colo.	38.7022	106.9978	121.0	24	10,000	22.0
185	09115500	Tomichi Creek at Sargents, Colo.	38.3950	106.4219	149.0	41	10,100	23.0
186	09117000	Tomichi Creek at Parlin, Colo.	38.4972	106.7256	427.0	14	9,600	19.0
187	09118000	Quartz Creek near Ohio City, Colo.	38.5597	106.6358	106.0	24	10,700	25.0
188	09122000	Cebolla Creek at Powderhorn, Colo.	38.2914	107.1139	340.0	18	10,500	19.0
189	09122500	Soap Creek near Sapinero, Colo.	38.5608	107.3161	57.4	11	9,900	29.0
190	09123500	Lake Fork at Lake City, Colo.	38.0250	107.3078	115.0	14.	11,500	28.0
191	09124500	Lake Fork at Gateview, Colo.	38.2989	107.2294	334.0	59	10,900	24.0
192	09125000	Curecanti Creek near Sapinero, Colo.	38.4878	107.4144	35.0	27	9,700	22.0
193	09126000	Cimarron River near Cimarron, Colo.	38.2625	107.5442	66.6	16	10,900	31.0
194	09127500	Crystal Creek near Maher, Colo.	38.5519	107.5056	42.2	21	9,600	25.0
195	09128500	Smith Fork near Crawford, Colo.	38.7278	107.5061	42.8	40	9,200	23.0
196	09130500	East Muddy Creek near Bardine, Colo.	39.0133	107.3578	133.0	19	8,700	26.0
197	09130600	West Muddy Creek near Ragged Mountain, Colo.	39.1308	107.5747	7.4	10	9,400	38.0
198	09132500	North Fork Gunnison River near Somerset, Colo.	38.9258	107.4336	526.0	27	8,900	25.0
199	09133000	North Fork Gunnison River near Paonia, Colo.	38.8992	107.5631	653.0	10	8,800	27.0
200	09134500	Leroux Creek near Cedaredge, Colo.	38.9264	107.7931	34.5	29	9,700	33.0
201	09145000	Uncompahgre River at Ouray, Colo.	38.0192	107.6756	42.0	14	11,400	30.0
202	09146200	Uncompahgre River near Ridgway, Colo.	38.1839	107.7453	149.0	17	9,500	27.0
203	09146400	West Fork Dallas Creek near Ridgway, Colo.	38.0736	107.8506	14.1	15	10,200	35.0
204	09146500	East Fork Dallas Creek near Ridgway, Colo.	38.0933	107.8131	16.8	16	10,800	32.0
205	09146600	Pleasant Valley Creek near Noel, Colo.	38.1456	107.9192	8.2	12	9,100	20.0
206	09147100	Cow Creek near Ridgway, Colo.	38.1494	107.6442	45.4	18	10,700	29.0
207	09165000	Dolores River below Rico, Colo.	37.6389	108.0597	105.0	24	10,600	31.0

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
09095000	0.456	578	1,110	1,500	2,030	2,440	2,840	3,250	3,790
09096000	0.194	201	310	386	487	564	643	724	835
09096500	0.169	1,230	1,580	1,800	2,080	2,290	2,510	2,720	3,010
09096800	0.158	362	522	624	749	838	924	1,010	1,120
09097500	0.200	558	906	1,140	1,440	1,650	1,860	2,070	2,330
09097600	0.345	88	156	211	291	358	432	513	631
09110000	0.247	2,080	2,840	3,300	3,810	4,150	4,470	4,770	5,130
09110500	0.422	1,000	1,120	1,180	1,250	1,300	1,350	1,400	1,450
09111500	0.375	1,050	1,150	1,200	1,260	1,290	1,320	1,350	1,380
09112000	0.272	210	272	310	355	387	417	447	485
09112500	0.333	2,200	3,050	3,660	4,470	5,110	5,780	6,500	7,500
09113300	0.315	368	525	626	750	839	926	1,010	1,120
09113500	0.256	670	965	1,140	1,340	1,480	1,600	1,720	1,860
09115500	0.293	356	551	677	832	942	1,050	1,150	1,280
09117000	0.239	421	588	686	797	872	940	1,000	1,080
09118000	0.344	363	504	588	687	756	820	881	957
09122000	0.242	664	1,160	1,540	2,080	2,520	2,990	3,490	4,210
09122500	0.385	455	615	725	866	975	1,090	1,200	1,360
09123500	0.396	861	1,110	1,270	1,460	1,600	1,730	1,860	2,030
09124500	0.390	1,660	2,160	2,460	2,810	3,050	3,280	3,490	3,770
09125000	0.283	254	350	408	477	524	568	611	664
09126000	0.366	832	1,180	1,430	1,750	2,000	2,270	2,540	2,920
09127500	0.259	285	407	482	570	631	688	743	812
09128500	0.408	365	593	761	991	1,170	1,360	1,560	1,840
09130500	0.271	923	1,310	1,580	1,930	2,200	2,480	2,760	3,150
09130600	0.166	87	159	214	293	357	425	497	598
09132500	0.291	3,450	5,010	6,070	7,430	8,440	9,460	10,500	11,900
09133000	0.288	4,570	6,450	7,670	9,160	10,200	11,300	12,400	13,700
09134500	0.161	701	922	1,060	1,230	1,360	1,480	1,590	1,750
09145000	0.480	971	1,370	1,650	2,020	2,320	2,630	2,950	3,410
09146200	0.399	1,140	1,510	1,720	1,970	2,130	2,280	2,420	2,590
09146400	0.358	81	126	159	203	238	275	314	368
09146500	0.400	173	231	265	304	331	357	381	411
09146600	0.139	151	282	385	529	646	769	899	1,080
09147100	0.238	643	895	1,070	1,290	1,460	1,630	1,810	2,050
09165000	0.374	1,190	1,600	1,860	2,190	2,420	2,650	2,880	3,180

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations—Continued

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
208	09166500	Dolores River at Dolores, Colo.	37.4725	108.4969	504.0	60	9,800	30.0
209	09168100	Disappointment Creek near Dove Creek, Colo.	37.8767	108.5825	147.0	18	8,000	22.0
210	09172000	Fall Creek near Fall Creek, Colo.	37.9583	108.0053	33.4	18	10,000	32.0
211	09172500	San Miguel River near Placerville, Colo.	38.0347	108.1208	308.0	40	10,200	25.0
212	09174500	Cottonwood Creek near Nucla, Colo.	38.2736	108.3622	38.8	10	7,700	17.0
213	09175000	West Naturita Creek near Norwood, Colo.	37.9758	108.3272	53.0	13	8,500	31.0
214	09175900	Dry Creek near Naturita, Colo.	38.0922	108.6214	78.6	10	7,400	18.0
215	09177500	Taylor Creek near Gateway, Colo.	38.5189	109.1092	15.4	23	9,000	17.0
216	09181000	Onion Creek near Moab, Utah	38.7250	109.3444	18.8	13	5,702	12.3
217	09182000	Castle Creek above Diversions, near Moab, Utah	38.5928	109.2650	7.6	24	9,480	24.7
218	09183000	Courthouse Wash near Moab, Utah	38.6128	109.5792	162.0	23	4,810	7.5
219	09184000	Mill Creek near Moab, Utah	38.5622	109.5133	74.9	34	7,170	16.7
220	09185200	Kane Springs Canyon near Moab, Utah	38.4000	109.4500	17.8	15	6,620	15.9
221	09185500	Hatch Wash near La Sal, Utah	38.2433	109.4394	378.0	22	6,550	13.1
222	09186500	Indian Creek above Cottonwood Creek, near Monticello, Utah	37.9750	109.5181	31.2	22	8,590	21.2
223	09187000	Cottonwood Creek near Monticello, Utah	38.0625	109.5736	115.0	16	7,210	17.9
224	09216537	Delaney Draw near Red Desert, Wyo.	41.6394	108.1286	32.8	24	7,040	7.0
225	09216550	Deadman Wash near Point Of Rocks, Wyo.	41.6750	108.7361	152.0	20	7,000	8.0
226	09216560	Bitter Creek near Point of Rocks, Wyo.	41.6778	108.7861	765.0	15	7,010	7.5
227	09216700	Salt Wells Creek near Rock Springs, Wyo.	41.4833	108.9667	515.0	18	7,340	9.5
228	09217900	Blacks Fork near Robertson, Wyo.	40.9592	110.5794	130.0	16	10,640	20.0
229	09218500	Blacks Fork near Millburne, Wyo.	41.0317	110.5786	152.0	31	10,270	19.0
230	09220000	East Fork of Smith Fork near Robertson, Wyo.	41.0542	110.3978	53.0	41	10,250	20.0
231	09220500	West Fork Of Smith Fork near Robertson, Wyo.	41.0222	110.4786	37.2	41	9,790	20.0
232	09224980	Summers Dry Creek near Green River, Wyo.	41.3736	109.6444	423.0	16	6,880	12.0
233	09226000	Henrys Fork near Lonetree, Wyo.	41.0064	110.2703	56.0	30	10,270	23.0
234	09226500	Middle Fork Beaver Creek near Lonetree, Wyo.	40.9444	110.1786	28.0	22	10,480	30.5
235	09227500	West Fork Beaver Creek near Lonetree, Wyo.	40.9472	110.2167	23.0	14	10,490	32.0
236	09228500	Burnt Fork near Burntfork, Wyo.	40.9464	110.0656	52.8	40	10,300	29.3
237	09235600	Pot Creek above Diversions, near Vernal, Utah	40.7681	109.3183	25.0	22	8,167	19.6
238	09238500	Walton Creek near Steamboat Springs, Colo.	40.4081	106.7864	42.4	10	9,300	49.0
239	09239500	Yampa River at Steamboat Springs, Colo.	40.4836	106.8317	604.0	69	8,800	25.0
240	09241000	Elk River at Clark, Colo.	40.7175	106.9153	216.0	48	9,000	37.0

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
09166500	0.312	3,310	4,950	6,090	7,600	8,760	9,950	11,200	12,800
09168100	0.240	1,190	2,580	3,880	6,030	8,030	10,400	13,200	17,700
09172000	0.264	200	394	572	865	1,140	1,470	1,860	2,490
09172500	0.370	1,350	1,920	2,310	2,820	3,200	3,590	3,980	4,520
09174500	--	125	237	324	443	538	637	739	878
09175000	0.152	387	597	746	942	1,090	1,250	1,410	1,630
09175900	0.145	615	1,400	2,220	3,710	5,230	7,190	9,690	14,100
09177500	0.118	113	265	402	616	803	1,010	1,240	1,590
09181000	--	754	1,400	1,860	2,470	2,930	3,380	3,830	4,410
09182000	--	9	19	27	37	45	54	62	74
09183000	--	2,140	4,640	7,010	11,000	14,700	19,200	24,500	33,100
09184000	--	659	1,720	2,840	4,840	6,820	9,270	12,300	17,200
09185200	--	535	844	1,060	1,340	1,550	1,770	1,990	2,290
09185500	--	501	1,220	1,960	3,240	4,500	6,060	7,960	11,100
09186500	--	136	383	679	1,280	1,950	2,880	4,150	6,500
09187000	--	395	1,270	2,310	4,300	6,370	9,050	12,400	18,100
09216537	0.100	90	247	420	737	1,060	1,470	1,990	2,850
09216550	0.096	403	731	984	1,340	1,620	1,930	2,240	2,690
09216560	--	478	952	1,340	1,910	2,390	2,910	3,460	4,260
09216700	--	1,150	2,180	2,950	3,970	4,750	5,540	6,340	7,390
09217900	--	1,630	2,100	2,370	2,670	2,880	3,060	3,240	3,450
09218500	--	1,470	1,840	2,070	2,350	2,560	2,760	2,960	3,220
09220000	--	505	746	926	1,180	1,380	1,600	1,840	2,180
09220500	--	443	706	905	1,190	1,420	1,660	1,930	2,310
09224980	0.081	721	2,300	4,180	7,880	11,800	17,000	23,700	35,300
09226000	--	583	900	1,150	1,500	1,790	2,110	2,460	2,980
09226500	--	316	490	610	764	880	996	1,110	1,270
09227500	--	168	254	315	397	460	525	593	686
09228500	--	283	509	711	1,040	1,340	1,700	2,130	2,820
09235600	--	63	126	182	269	346	434	535	688
09238500	--	1,350	1,810	2,100	2,430	2,670	2,900	3,110	3,390
09239500	0.205	3,570	4,540	5,100	5,730	6,160	6,560	6,940	7,410
09241000	0.247	2,630	3,360	3,760	4,210	4,500	4,750	4,990	5,270

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations—Continued

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years
P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
241	09242500	Elk River near Milner, Colo.	40.5147	106.9533	415.0	12	8,400	30.0
242	09244100	Fish Creek near Milner, Colo.	40.3342	107.1386	34.5	18	8,200	23.0
243	09245000	Elkhead Creek near Elkhead, Colo.	40.6697	107.2844	64.2	23	8,400	26.0
244	09245500	North Fork Elkhead Creek near Elkhead, Colo.	40.6806	107.2867	21.0	15	8,600	41.0
245	09249000	East Fork of Williams Fork near Pagoda, Colo.	40.3125	107.3194	150.0	18	9,200	26.0
246	09249200	South Fork of Williams Fork near Pagoda, Colo.	40.2122	107.4422	46.7	10	9,200	32.0
247	09250000	Milk Creek near Thornburgh, Colo.	40.1936	107.7317	65.0	23	7,800	18.0
248	09251500	Middle Fork Little Snake River near Battle Creek, Colo.	40.9906	107.0436	120.0	10	8,700	33.0
249	09251800	North Fork Little Snake River near Encampment, Wyo.	41.0500	106.9583	9.6	10	9,470	30.0
250	09253000	Little Snake River near Slater, Colo.	40.9994	107.1428	285.0	35	8,600	31.0
251	09253400	Battle Creek near Encampment, Wyo.	41.1333	107.0639	13.0	8	9,590	40.0
252	09254500	Slater Fork at Baxter Ranch, near Slater, Colo.	40.8894	107.3300	80.0	10	8,700	24.0
253	09255000	Slater Fork near Slater, Colo.	40.9817	107.3828	161.0	50	8,400	22.0
254	09256000	Savery Creek near Savery, Wyo.	41.0961	107.3789	330.0	30	7,870	19.0
255	09257000	Little Snake River near Dixon, Wyo.	41.0283	107.5486	988.0	47	8,030	18.0
256	09257500	Willow Creek near Baggs, Wyo.	40.8767	107.4639	5.0	10	9,000	20.0
257	09258000	Willow Creek near Dixon, Wyo.	40.9156	107.5211	24.0	27	8,200	19.0
258	09263700	Cliff Creek near Jensen, Utah	40.3000	109.1333	64.0	15	6,570	14.0
259	09264000	Ashley Creek below Trout Creek near Vernal, Utah	40.7333	109.6778	27.0	11	9,930	28.0
260	09264500	South Fork Ashley Creek near Vernal, Utah	40.7333	109.7028	20.0	12	10,480	30.3
261	09266500	Ashley Creek near Vernal, Utah	40.5775	109.6214	101.0	67	9,440	23.0
262	09268000	Dry Fork above Sinks, near Dry Fork, Utah	40.6264	109.8194	44.4	36	10,240	29.7
263	09268500	North Fork of Dry Fork near Dry Fork, Utah	40.6428	109.8103	8.6	35	10,122	29.6
264	09268900	Brownie Canyon above Sinks, near Dry Fork, Utah	40.6594	109.7503	8.2	19	10,107	28.0
265	09269000	East Fork of Dry Fork near Dry Fork, Utah	40.6500	109.7611	12.0	18	9,360	28.6
266	09270000	Dry Fork below springs near Dry Fork, Utah	40.5694	109.6969	97.4	21	9,360	27.5
267	09270500	Dry Fork at mouth near Dry Fork, Utah	40.5264	109.6050	115.0	26	9,190	23.0
268	09271000	Ashley Creek, Sign of the Maine, near Vernal, Utah	40.5172	109.5958	241.0	30	9,100	23.0
269	09271800	Halfway Hollow tributary near Lapoint, Utah	40.4167	109.7500	5.6	15	6,547	10.8
270	09302450	Lost Creek near Buford, Colo.	40.0503	107.4683	21.5	11	8,960	27.5

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
09242500	0.240	3,830	4,560	4,980	5,460	5,790	6,090	6,380	6,740
09244100	0.216	161	246	299	361	404	443	481	527
09245000	0.189	943	1,420	1,730	2,090	2,350	2,600	2,830	3,130
09245500	0.210	408	654	829	1,060	1,240	1,420	1,610	1,860
09249000	0.222	917	1,220	1,420	1,660	1,830	2,000	2,170	2,400
09249200	0.235	632	766	844	934	996	1,050	1,110	1,180
09250000	0.171	359	624	833	1,140	1,390	1,660	1,960	2,390
09251500	0.190	1,750	2,750	3,470	4,430	5,180	5,950	6,750	7,850
09251800	--	371	468	527	598	647	695	741	801
09253000	0.227	2,110	2,920	3,420	4,030	4,450	4,860	5,260	5,760
09253400	--	326	441	519	619	695	772	851	959
09254500	0.185	611	791	907	1,050	1,160	1,260	1,360	1,500
09255000	0.181	830	1,170	1,400	1,710	1,940	2,180	2,420	2,750
09256000	--	1,090	1,630	1,950	2,320	2,560	2,790	2,990	3,240
09257000	--	4,490	6,000	6,940	8,060	8,860	9,620	10,400	11,300
09257500	--	90	102	109	116	120	124	128	132
09258000	0.168	161	248	306	378	431	483	534	600
09263700	--	166	745	1,510	3,040	4,630	6,640	9,080	13,000
09264000	--	436	562	633	712	764	812	856	910
09264500	--	316	414	471	535	578	618	655	700
09266500	--	1,080	1,600	1,940	2,360	2,650	2,940	3,220	3,570
09268000	--	526	745	886	1,060	1,190	1,310	1,430	1,590
09268500	--	76	116	143	178	204	231	257	293
09268900	--	188	281	341	415	469	520	571	636
09269000	--	131	191	226	264	290	312	332	356
09270000	--	527	761	912	1,100	1,230	1,360	1,480	1,650
09270500	--	496	962	1,280	1,680	1,950	2,200	2,440	2,720
09271000	--	1,390	2,030	2,460	2,990	3,390	3,780	4,180	4,700
09271800	--	91	301	532	937	1,320	1,780	2,300	3,110
09302450	0.197	503	766	924	1,100	1,220	1,330	1,430	1,550

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations—Continued

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years
P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
271	09302500	Marvine Creek near Buford, Colo.	40.0383	107.4875	59.7	12	9,780	32.2
272	09303000	North Fork White River at Buford, Colo.	39.9875	107.6139	259.0	24	9,529	30.9
273	09303300	South Fork White River at Budes Resort, Colo.	39.8433	107.3342	52.3	19	10,569	40.0
274	09303320	Wagonwheel Creek at Budes Resort, Colo.	39.8428	107.3361	7.4	14	10,640	40.0
275	09303400	South Fork White River near Budes Resort, Colo.	39.8642	107.5333	128.0	19	10,250	40.0
276	09304000	South Fork White River at Buford, Colo.	39.9744	107.6247	177.0	25	9,800	36.3
277	09304300	Coal Creek near Meeker, Colo.	40.0914	107.7694	25.1	11	7,956	28.5
278	09304500	White River near Meeker, Colo.	40.0336	107.8617	755.0	66	8,940	29.6
279	09306007	Piceance Creek below Rio Blanco, Colo.	39.8261	108.1825	177.0	21	7,628	24.5
280	09306058	Willow Creek near Rio Blanco, Colo.	39.8372	108.2436	48.4	12	7,500	21.8
281	09306061	Piceance Creek above Hunter Creek, near Rio Blanco, Colo.	39.8506	108.2583	309.0	14	7,552	21.2
282	09306200	Piceance Creek below Ryan Gulch, near Rio Blanco, Colo.	39.9211	108.2969	506.0	11	7,415	20.8
283	09306235	Corral Gulch below Water Gulch, near Rangely, Colo.	39.9061	108.5322	8.6	14	7,740	20.0
284	09306242	Corral Gulch near Rangely, Colo.	39.9203	108.4722	31.6	21	7,490	20.0
285	09306255	Yellow Creek near White River, Colo.	40.1686	108.4006	262.0	17	6,877	17.3
286	09306800	Bitter Creek near Bonanza, Utah	39.7533	109.3542	324.0	10	7,146	16.1
287	09307500	Willow Creek above diversions near Ouray, Utah	39.5664	109.5867	297.0	24	7,650	16.8
288	09308000	Willow Creek near Ouray, Utah	39.9389	109.6478	897.0	23	7,080	13.7
289	09328900	Crescent Wash near Crescent Junction, Utah	38.9422	109.8206	23.3	10	6,180	12.7
290	09340000	East Fork San Juan River near Pagosa Springs, Colo.	37.3694	106.8917	86.9	41	10,200	39.0
291	09341500	West Fork San Juan River near Pagosa Springs, Colo.	37.3786	106.8989	87.9	26	10,000	42.0
292	09342500	San Juan River at Pagosa Springs, Colo.	37.2661	107.0103	298.0	46	9,700	36.0
293	09343000	Rio Blanco near Pagosa Springs, Colo.	37.2128	106.7939	58.0	37	10,000	39.0
294	09343500	Rito Blanco near Pagosa Springs, Colo.	37.1936	106.9047	23.3	18	9,400	34.0
295	09344000	Navajo River at Banded Peak Ranch, near Chromo, Colo.	37.0853	106.6889	69.8	41	10,500	37.0
296	09345500	Little Navajo River at Chromo, Colo.	37.0456	106.8425	21.9	17	8,900	26.0
297	09346000	Navajo River at Edith, Colo.	37.0028	106.9069	172.0	36	9,200	33.0
298	09346200	Rio Amargo at Dulce, N. Mex.	36.9333	107.0000	168.0	26	7,930	17.7
299	09349500	Piedra River near Piedra, Colo.	37.2222	107.3422	371.0	34	9,400	33.0
300	09349800	Piedra River near Arboles, Colo.	37.0883	107.3972	629.0	20	8,300	27.0
301	09350800	Vaqueros Canyon near Gobernador, N. Mex.	36.7333	107.2833	60.5	31	7,500	15.0
302	09352500	Los Pinos River below Snowslide Canyon, near Weminuche Pass, Colo.	37.6389	107.3333	25.3	13	11,200	45.0

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
09302500	0.245	318	400	447	498	532	563	591	626
09303000	0.237	1,380	1,890	2,230	2,640	2,940	3,240	3,540	3,930
09303300	0.198	924	1,380	1,700	2,120	2,440	2,760	3,090	3,540
09303320	0.159	188	260	307	365	406	447	488	540
09303400	0.256	1,700	2,480	3,030	3,770	4,350	4,940	5,570	6,440
09304000	0.259	1,800	2,310	2,600	2,920	3,140	3,340	3,530	3,760
09304300	0.285	50	80	100	126	144	162	180	203
09304500	0.222	3,170	4,210	4,840	5,600	6,140	6,650	7,150	7,780
09306007	0.283	148	294	411	576	710	851	1,000	1,210
09306058	0.272	14	36	58	99	140	191	254	360
09306061	0.263	193	381	534	758	943	1,140	1,360	1,660
09306200	0.243	145	255	345	479	594	723	867	1,080
09306235	0.253	14	69	158	382	673	1,120	1,780	3,110
09306242	0.236	39	175	383	883	1,510	2,450	3,810	6,490
09306255	0.197	154	508	982	2,040	3,310	5,170	7,850	13,200
09306800	0.287	115	451	894	1,820	2,840	4,210	6,000	9,150
09307500	--	241	476	692	1,050	1,380	1,780	2,260	3,030
09308000	--	636	1,860	3,170	5,510	7,810	10,600	14,000	19,300
09328900	--	439	1,140	1,890	3,260	4,670	6,460	8,720	12,600
09340000	0.387	924	1,350	1,640	2,020	2,300	2,600	2,900	3,310
09341500	0.400	1,320	1,830	2,170	2,590	2,910	3,230	3,550	3,970
09342500	0.342	2,610	4,160	5,480	7,570	9,460	11,700	14,300	18,400
09343000	0.428	853	1,200	1,450	1,780	2,030	2,290	2,570	2,950
09343500	0.239	190	313	401	519	610	704	800	932
09344000	0.368	650	897	1,070	1,280	1,450	1,620	1,790	2,020
09345500	0.225	146	253	334	447	538	633	733	874
09346000	0.277	852	1,310	1,660	2,160	2,570	3,020	3,510	4,230
09346200	--	1,030	1,490	1,830	2,280	2,650	3,040	3,440	4,030
09349500	0.344	2,090	3,480	4,640	6,400	7,950	9,710	11,700	14,800
09349800	0.290	2,420	3,960	5,130	6,790	8,150	9,610	11,200	13,500
09350800	--	196	490	822	1,470	2,180	3,130	4,410	6,760
09352500	--	324	518	656	839	981	1,130	1,280	1,480

Table 3. Drainage-basin characteristics and flood-frequency data at streamflow-gaging stations—Continued

[LATDEG, latitude in decimal degrees; LNGDEG, longitude in decimal degree; DAREA, drainage area in square miles; YRSPK, years P2, P5, P10, P25, P100, P200, and P500 are the indicated recurrence intervals for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year,

Map number (fig. 1)	Station number	Station name	LATDEG	LNGDEG	DAREA	YRSPK	ELEV	PRECIP
303	09352900	Vallecito Creek near Bayfield, Colo.	37.4775	107.5431	72.1	13	11,400	46.0
304	09353500	Los Pinos River near Bayfield, Colo.	37.3828	107.5769	270.0	12	10,400	37.0
305	09355000	Spring Creek at La Boca, Colo.	37.0111	107.5964	58.0	32	7,300	12.0
306	09357500	Animas River at Howardsville, Colo.	37.8331	107.5989	55.9	40	11,900	31.0
307	09359000	Mineral Creek near Silverton, Colo.	37.7975	107.6947	43.9	14	11,700	38.0
308	09359500	Animas River above Tacoma, Colo.	37.5703	107.7800	348.0	11	11,200	34.0
309	09361000	Hermosa Creek near Hermosa, Colo.	37.4219	107.8444	172.0	45	9,600	34.0
310	09361500	Animas River at Durango, Colo.	37.2792	107.8797	692.0	55	10,200	30.0
311	09362000	Lightner Creek near Durango, Colo.	37.6039	107.8931	66.0	22	8,400	22.0
312	09363000	Florida River near Durango, Colo.	37.3253	107.7483	97.4	46	9,900	38.0
313	09363100	Salt Creek near Oxford, Colo.	37.1397	107.7528	17.7	22	6,800	18.0
314	09365500	La Plata River at Hesperus, Colo.	37.2897	108.0400	37.0	61	10,200	35.0
315	09366500	La Plata River at Colorado-New Mexico State line	36.9997	108.1881	331.0	63	7,712	35.0
316	09368500	West Mancos River near Mancos, Colo.	37.3817	108.2575	39.4	16	9,300	30.0
317	09369000	East Mancos River near Mancos, Colo.	37.3703	108.2308	11.9	15	9,700	30.0
318	09369500	Middle Mancos River near Mancos, Colo.	37.3739	108.2300	12.1	15	9,300	28.0
319	09371000	Mancos River near Towaoc, Colo.	37.0275	108.7408	526.0	41	7,200	16.0
320	09371500	McElmo Creek near Cortez, Colo.	37.3228	108.6725	230.0	10	6,500	15.0
321	09372000	McElmo Creek near Colorado-Utah State line	37.3242	109.0150	346.0	30	6,300	10.5
322	09372200	McElmo Creek near Bluff, Utah	37.2167	109.1833	720.0	11	6,200	10.3
323	09378700	Cottonwood Wash near Blanding, Utah	37.5606	109.5781	205.0	22	6,820	16.4
324	09378950	Comb Wash near Blanding, Utah	37.5500	109.6667	10.3	10	5,760	12.0
325	09379000	Comb Wash near Bluff, Utah	37.2661	109.6750	280.0	10	6,060	11.5
326	09379300	Lime Creek near Mexican Hat, Utah	37.2167	109.8167	32.0	15	5,360	8.8
327	10011500	Bear River near Utah-Wyoming State line	40.9653	110.8528	172.0	38	9,770	31.7
328	10012000	Mill Creek at Utah-Wyoming State line	40.9917	110.8417	59.0	19	9,320	24.0

of record; ELEV, mean basin elevation in feet; PRECIP, mean annual precipitation in inches; BSLOPE, mean basin slope in foot per foot; 200-year, and 500-year peak discharge; --, not available]

Station number	BSLOPE	P2	P5	P10	P25	P50	P100	P200	P500
09352900	0.537	1,140	1,650	2,050	2,610	3,090	3,620	4,200	5,070
09353500	0.424	2,320	3,250	3,850	4,580	5,110	5,620	6,130	6,790
09355000	0.165	374	658	902	1,290	1,630	2,030	2,500	3,230
09357500	0.516	980	1,270	1,460	1,680	1,850	2,010	2,170	2,370
09359000	0.569	830	1,110	1,300	1,550	1,740	1,940	2,150	2,430
09359500	0.501	5,390	7,310	8,510	9,970	11,000	12,000	13,000	14,300
09361000	0.562	989	1,690	2,230	2,980	3,580	4,220	4,910	5,880
09361500	0.488	4,850	7,060	8,690	10,900	12,700	14,700	16,700	19,700
09362000	0.290	488	974	1,400	2,080	2,680	3,370	4,160	5,380
09363000	0.336	988	1,480	1,840	2,350	2,750	3,190	3,660	4,330
09363100	0.056	215	393	533	735	901	1,080	1,270	1,550
09365500	0.485	436	737	959	1,260	1,500	1,740	2,000	2,350
09366500	0.168	720	1,480	2,170	3,280	4,300	5,510	6,920	9,140
09368500	0.281	318	585	805	1,130	1,410	1,710	2,050	2,550
09369000	0.426	105	181	247	350	444	553	681	882
09369500	0.207	104	195	269	374	461	554	654	798
09371000	0.265	1,180	2,110	2,860	3,960	4,890	5,920	7,050	8,720
09371500	0.090	810	1,620	2,390	3,720	5,020	6,630	8,620	12,000
09372000	0.1280	961	1,540	1,980	2,600	3,110	3,650	4,230	5,070
09372200	--	659	1,810	3,190	6,030	9,280	13,800	20,100	32,100
09378700	--	1,080	2,740	4,600	8,170	12,000	17,100	23,700	35,700
09378950	--	751	1,450	2,080	3,110	4,070	5,210	6,560	8,720
09379000	--	1,830	3,170	4,320	6,110	7,710	9,570	11,700	15,100
09379300	--	1,690	4,160	6,530	10,400	14,000	18,100	22,800	30,100
10011500	--	1,850	2,390	2,710	3,090	3,350	3,600	3,830	4,130
10012000	--	391	544	642	760	845	927	1,010	1,110

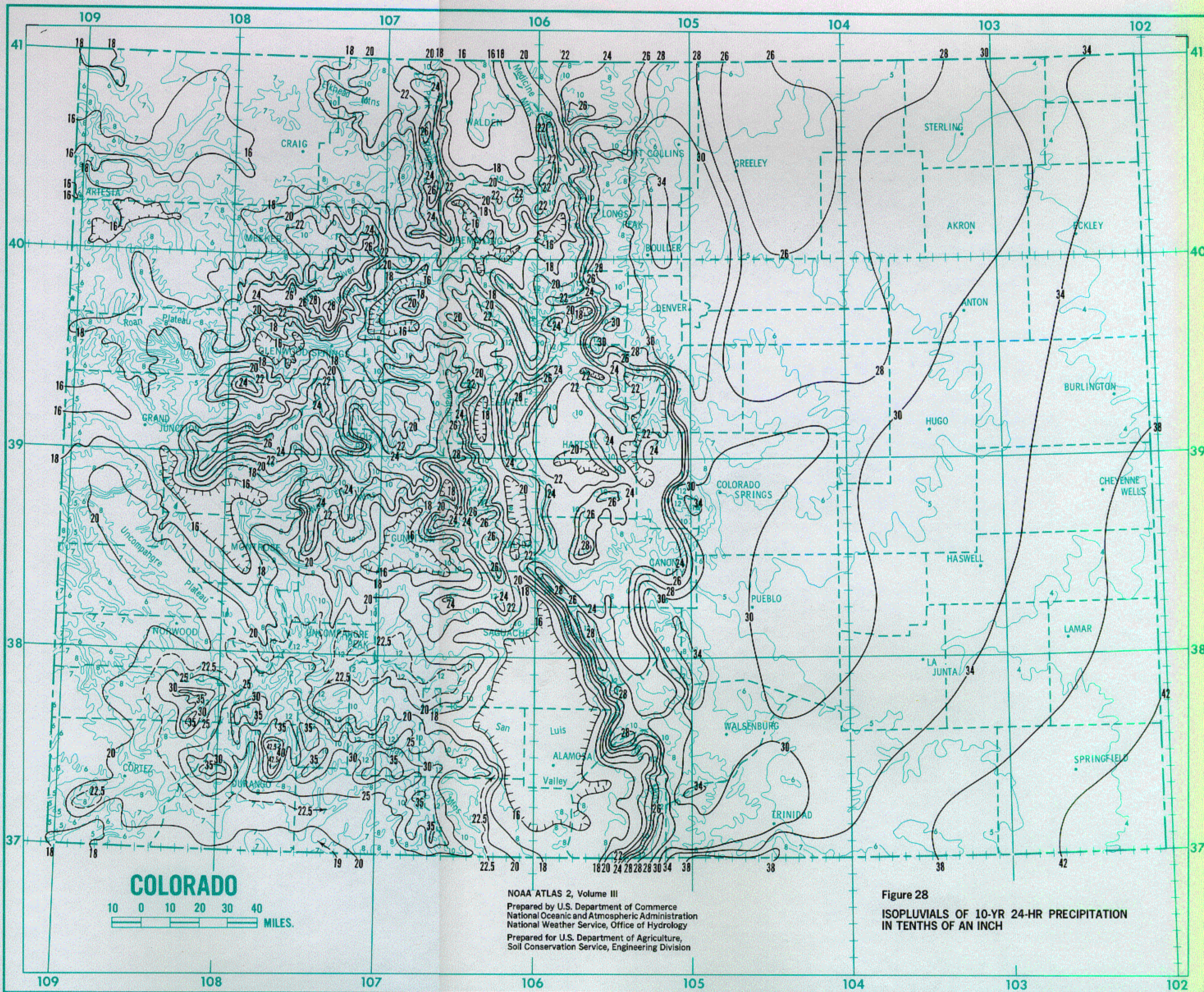
Summary Table Of Selected Basin Characteristics

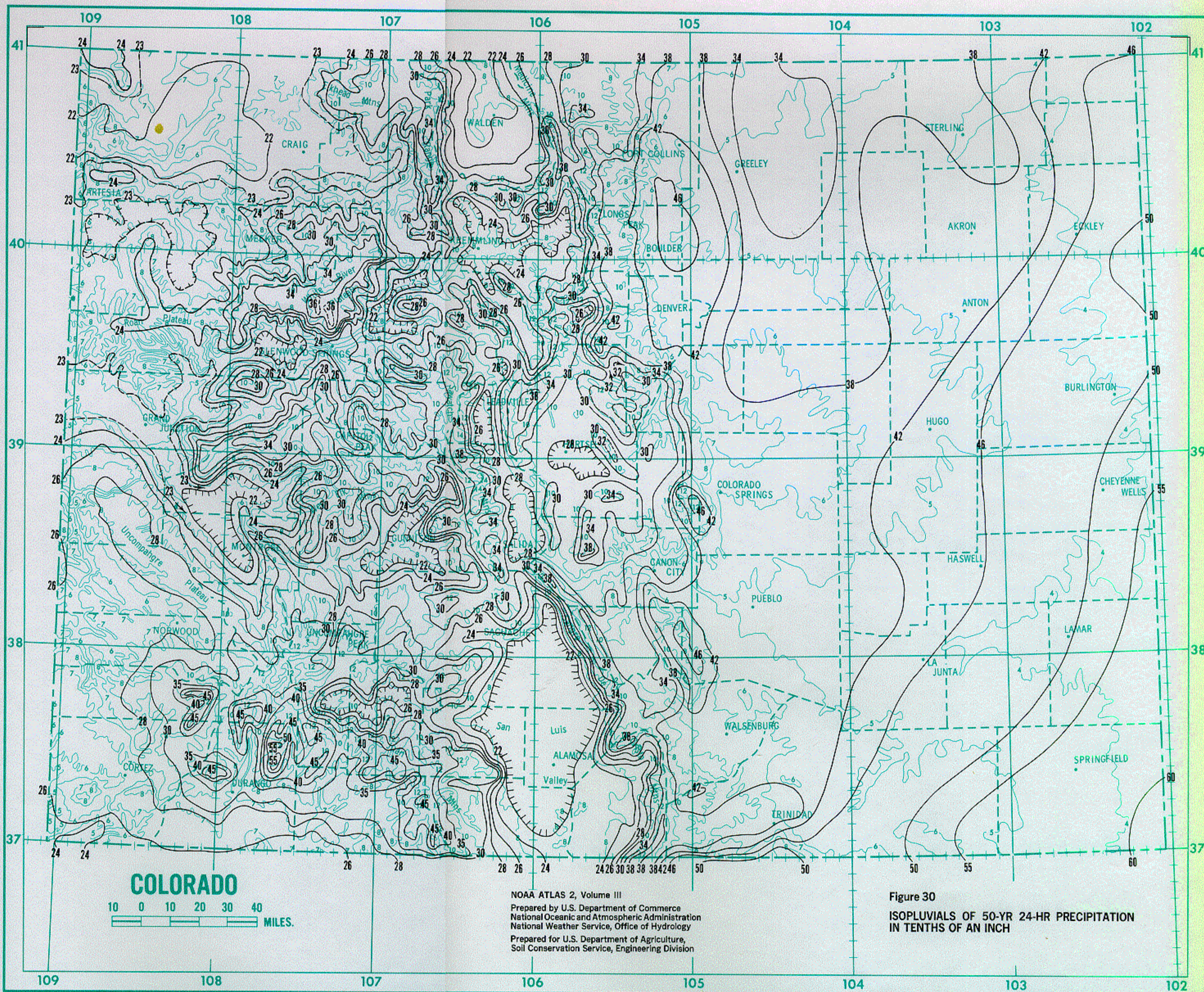
In this version of the report, a summary table of selected basin characteristics has been provided. This table includes drainage area and basin slope (maximum and minimum) for Mountain region, Plains region, Rio Grande region, Northwest region, and Southwest region.

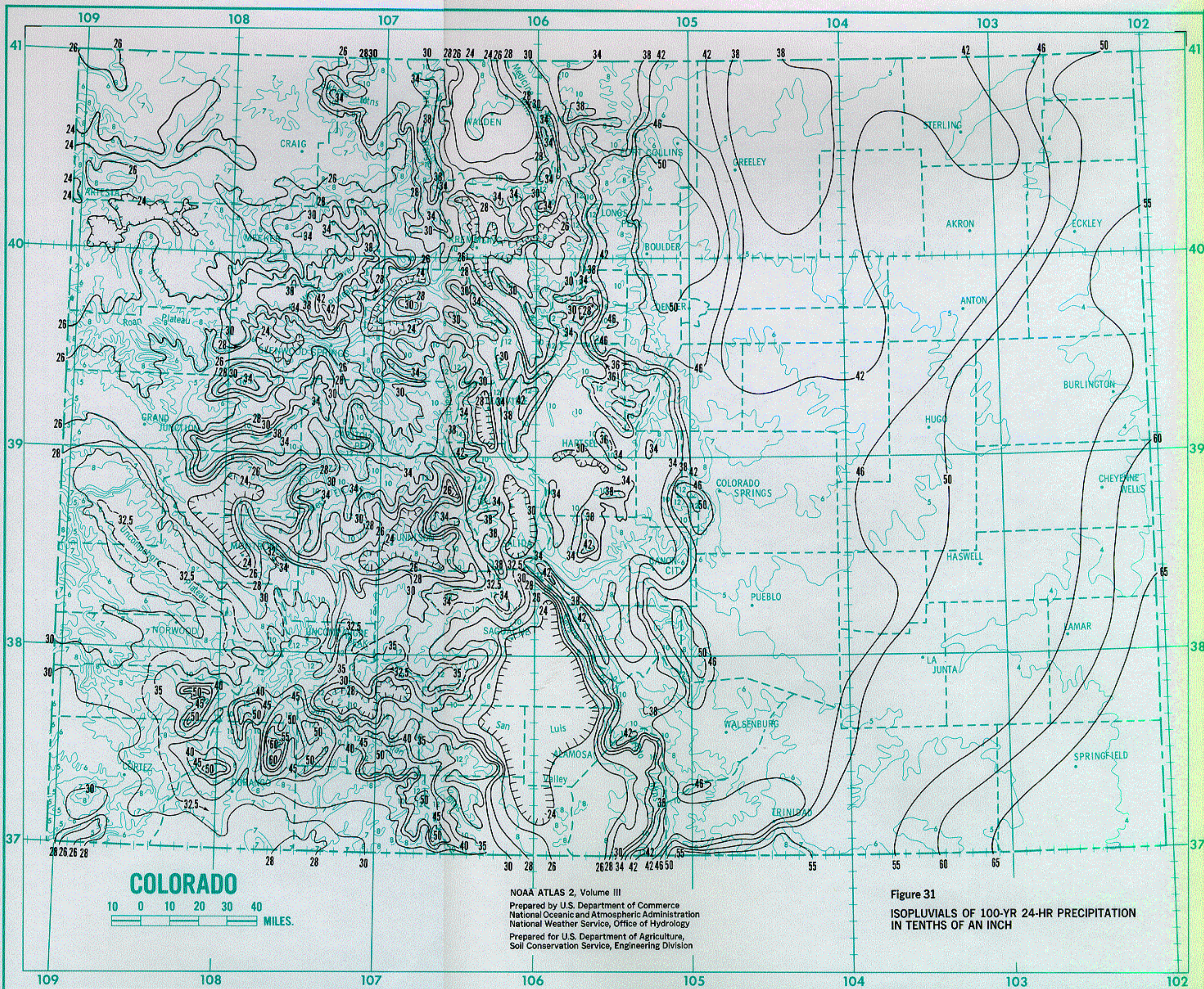
Summary of selected basin characteristics

Region	Minimum	Maximum
Mountain region		
Drainage area	5.5	945
Basin slope	0.126	0.554
Plains region		
Drainage area	7	940
Rio Grande region		
Drainage area	10.5	595
Precipitation	11	35
Northwest region		
Drainage area	5	988
Precipitation	7	49
Southwest region		
Drainage area	8.2	720

**NOAA ATLAS 2, VOLUME III, ISOPLUVIAL
PRECIPITATION MAPS**







CURVE NUMBER CALCULATIONS – MUDD GULCH

MUDD GULCH HYDROLOGIC ANALYSIS - CURVE NUMBER CALCULATION BREAKDOWN											
BASIN	NLCD 2001 Land Cover Class	SOIL MAP UNIT #	Hydrologic Soil Group	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
MG_01	21	117	D	84	107988	31809429	0.34%	0.34%	0.3	0.3	
MG_01	21	125	D	84	82509	31809429	0.26%	0.60%	0.2	0.5	
MG_01	21	48	B	68	155959	31809429	0.49%	1.09%	0.3	0.8	
MG_01	21	50	B	68	356290	31809429	1.12%	2.21%	0.8	1.6	
MG_01	21	53	B	68	393502	31809429	1.24%	3.45%	0.8	2.4	
MG_01	31	48	B	79	28339	31809429	0.09%	3.54%	0.1	2.5	
MG_01	31	53	B	79	21435	31809429	0.07%	3.60%	0.1	2.6	
MG_01	31	64	D	89	68123	31809429	0.21%	3.82%	0.2	2.8	
MG_01	42	117	D	86	1901654	31809429	5.98%	9.80%	5.1	7.9	
MG_01	42	118	D	86	14806244	31809429	46.55%	56.34%	40.0	47.9	
MG_01	42	50	B	73	2358	31809429	0.01%	56.35%	0.0	47.9	
MG_01	42	53	B	73	974	31809429	0.00%	56.35%	0.0	47.9	
MG_01	42	64	D	86	19908	31809429	0.06%	56.41%	0.1	48.0	
MG_01	52	117	D	83	1500499	31809429	4.72%	61.13%	3.9	51.9	
MG_01	52	118	D	83	3774607	31809429	11.87%	73.00%	9.8	61.8	
MG_01	52	121	B	67	54014	31809429	0.17%	73.17%	0.1	61.9	
MG_01	52	125	D	83	77437	31809429	0.24%	73.41%	0.2	62.1	
MG_01	52	131	0	83	10181	31809429	0.03%	73.44%	0.0	62.1	
MG_01	52	48	B	67	52196	31809429	0.16%	73.61%	0.1	62.2	
MG_01	52	50	B	67	203839	31809429	0.64%	74.25%	0.4	62.6	
MG_01	52	53	B	67	340832	31809429	1.07%	75.32%	0.7	63.4	
MG_01	52	64	D	83	769301	31809429	2.42%	77.74%	2.0	65.4	
MG_01	71	117	D	89	27323	31809429	0.09%	77.82%	0.1	65.4	
MG_01	71	121	B	79	346974	31809429	1.09%	78.92%	0.9	66.3	
MG_01	71	125	D	89	165986	31809429	0.52%	79.44%	0.5	66.8	
MG_01	71	131	0	89	40679	31809429	0.13%	79.56%	0.1	66.9	
MG_01	71	48	B	79	793002	31809429	2.49%	82.06%	2.0	68.8	
MG_01	71	50	B	79	2684634	31809429	8.44%	90.50%	6.7	75.5	
MG_01	71	53	B	79	2657499	31809429	8.35%	98.85%	6.6	82.1	
MG_01	71	64	D	89	363137	31809429	1.14%	99.99%	1.0	83.1	
MG_01	71	83	D	89	2005	31809429	0.01%	100.00%	0.0	83.1	83.1
MG_02	21	117	D	84	630765	30237992	2.09%	2.09%	1.8	1.8	
MG_02	21	48	B	68	316187	30237992	1.05%	3.13%	0.7	2.5	
MG_02	21	53	B	68	529112	30237992	1.75%	4.88%	1.2	3.7	
MG_02	21	64	D	84	21791	30237992	0.07%	4.95%	0.1	3.7	
MG_02	21	84	D	84	26703	30237992	0.09%	5.04%	0.1	3.8	
MG_02	31	48	B	79	13487	30237992	0.04%	5.09%	0.0	3.8	
MG_02	31	53	B	79	15	30237992	0.00%	5.09%	0.0	3.8	
MG_02	42	117	D	86	2706798	30237992	8.95%	14.04%	7.7	11.5	
MG_02	42	118	D	86	10307339	30237992	34.09%	48.13%	29.3	40.8	

BASIN	NLCD 2001 Land Cover Class	SOIL MAP UNIT #	Hydrologic Soil Group	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
MG_02	42	53	B	73	11883	30237992	0.04%	48.16%	0.0	40.9	
MG_02	42	64	D	86	130296	30237992	0.43%	48.60%	0.4	41.2	
MG_02	52	117	D	83	3503848	30237992	11.59%	60.18%	9.6	50.9	
MG_02	52	118	D	83	2045036	30237992	6.76%	66.95%	5.6	56.5	
MG_02	52	48	B	67	147212	30237992	0.49%	67.43%	0.3	56.8	
MG_02	52	53	B	67	1518471	30237992	5.02%	72.46%	3.4	60.2	
MG_02	52	64	D	83	664809	30237992	2.20%	74.65%	1.8	62.0	
MG_02	52	84	D	83	71780	30237992	0.24%	74.89%	0.2	62.2	
MG_02	71	117	D	89	72389	30237992	0.24%	75.13%	0.2	62.4	
MG_02	71	118	D	89	176962	30237992	0.59%	75.72%	0.5	62.9	
MG_02	71	131	0	89	679	30237992	0.00%	75.72%	0.0	62.9	
MG_02	71	48	B	79	1657557	30237992	5.48%	81.20%	4.3	67.2	
MG_02	71	53	B	79	5410615	30237992	17.89%	99.09%	14.1	81.4	
MG_02	71	64	D	89	255337	30237992	0.84%	99.94%	0.8	82.1	
MG_02	71	84	D	89	18919	30237992	0.06%	100.00%	0.1	82.2	82.2
MG_03	21	108	D	84	1689	6878538	0.02%	0.02%	0.0	0.0	
MG_03	21	48	B	68	10422	6878538	0.15%	0.18%	0.1	0.1	
MG_03	21	52	B	68	31146	6878538	0.45%	0.63%	0.3	0.4	
MG_03	21	66	B	68	6449	6878538	0.09%	0.72%	0.1	0.5	
MG_03	21	83	D	84	70433	6878538	1.02%	1.75%	0.9	1.4	
MG_03	21	84	D	84	45747	6878538	0.67%	2.41%	0.6	1.9	
MG_03	22	108	D	86	5361	6878538	0.08%	2.49%	0.1	2.0	
MG_03	22	52	B	72	3922	6878538	0.06%	2.55%	0.0	2.0	
MG_03	22	66	B	72	2858	6878538	0.04%	2.59%	0.0	2.1	
MG_03	24	108	D	95	71505	6878538	1.04%	3.63%	1.0	3.0	
MG_03	24	66	B	92	136666	6878538	1.99%	5.61%	1.8	4.9	
MG_03	24	84	D	95	20349	6878538	0.30%	5.91%	0.3	5.1	
MG_03	31	108	D	89	472	6878538	0.01%	5.92%	0.0	5.2	
MG_03	31	48	B	79	37402	6878538	0.54%	6.46%	0.4	5.6	
MG_03	31	83	D	89	18658	6878538	0.27%	6.73%	0.2	5.8	
MG_03	31	84	D	89	43367	6878538	0.63%	7.36%	0.6	6.4	
MG_03	52	108	D	83	75317	6878538	1.09%	8.46%	0.9	7.3	
MG_03	52	125	D	83	570097	6878538	8.29%	16.75%	6.9	14.2	
MG_03	52	48	B	67	117886	6878538	1.71%	18.46%	1.1	15.3	
MG_03	52	52	B	67	56700	6878538	0.82%	19.28%	0.6	15.9	
MG_03	52	64	D	83	96231	6878538	1.40%	20.68%	1.2	17.0	
MG_03	52	65	B	67	67676	6878538	0.98%	21.67%	0.7	17.7	
MG_03	52	66	B	67	8745	6878538	0.13%	21.79%	0.1	17.8	
MG_03	52	83	D	83	663505	6878538	9.65%	31.44%	8.0	25.8	
MG_03	52	84	D	83	853700	6878538	12.41%	43.85%	10.3	36.1	
MG_03	71	108	D	89	184181	6878538	2.68%	46.53%	2.4	38.5	

BASIN	NLCD 2001 Land Cover Class	SOIL MAP UNIT #	Hydrologic Soil Group	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
MG_03	71	125	D	89	28144	6878538	0.41%	46.94%	0.4	38.8	
MG_03	71	131	O	89	9144	6878538	0.13%	47.07%	0.1	39.0	
MG_03	71	48	B	79	460366	6878538	6.69%	53.76%	5.3	44.2	
MG_03	71	52	B	79	352064	6878538	5.12%	58.88%	4.0	48.3	
MG_03	71	64	D	89	85638	6878538	1.24%	60.13%	1.1	49.4	
MG_03	71	65	B	79	292226	6878538	4.25%	64.38%	3.4	52.7	
MG_03	71	66	B	79	278429	6878538	4.05%	68.42%	3.2	55.9	
MG_03	71	83	D	89	1685878	6878538	24.51%	92.93%	21.8	77.8	
MG_03	71	84	D	89	486164	6878538	7.07%	100.00%	6.3	84.1	84.1
MG_04	21	108	D	84	31387	39305879	0.08%	0.08%	0.1	0.1	
MG_04	21	48	B	68	57032	39305879	0.15%	0.22%	0.1	0.2	
MG_04	21	52	B	68	38319	39305879	0.10%	0.32%	0.1	0.2	
MG_04	21	58	C	79	67500	39305879	0.17%	0.49%	0.1	0.4	
MG_04	21	59	D	84	17280	39305879	0.04%	0.54%	0.0	0.4	
MG_04	21	65	B	68	68413	39305879	0.17%	0.71%	0.1	0.5	
MG_04	21	66	B	68	74460	39305879	0.19%	0.90%	0.1	0.7	
MG_04	21	71	D	84	28691	39305879	0.07%	0.97%	0.1	0.7	
MG_04	21	72	D	84	50110	39305879	0.13%	1.10%	0.1	0.8	
MG_04	22	108	D	86	31295	39305879	0.08%	1.18%	0.1	0.9	
MG_04	22	48	B	72	45	39305879	0.00%	1.18%	0.0	0.9	
MG_04	22	52	B	72	41492	39305879	0.11%	1.29%	0.1	1.0	
MG_04	22	58	C	81	836175	39305879	2.13%	3.41%	1.7	2.7	
MG_04	22	59	D	86	174097	39305879	0.44%	3.86%	0.4	3.1	
MG_04	22	62	C	81	159710	39305879	0.41%	4.26%	0.3	3.4	
MG_04	22	65	B	72	521771	39305879	1.33%	5.59%	1.0	4.4	
MG_04	22	66	B	72	46382	39305879	0.12%	5.71%	0.1	4.4	
MG_04	22	71	D	86	303483	39305879	0.77%	6.48%	0.7	5.1	
MG_04	22	72	D	86	31984	39305879	0.08%	6.56%	0.1	5.2	
MG_04	23	58	C	90	671287	39305879	1.71%	8.27%	1.5	6.7	
MG_04	23	59	D	92	45360	39305879	0.12%	8.39%	0.1	6.8	
MG_04	23	62	C	90	407813	39305879	1.04%	9.42%	0.9	7.7	
MG_04	23	65	B	85	121724	39305879	0.31%	9.73%	0.3	8.0	
MG_04	23	71	D	92	312168	39305879	0.79%	10.53%	0.7	8.7	
MG_04	23	72	D	92	110424	39305879	0.28%	10.81%	0.3	9.0	
MG_04	24	58	C	94	41559	39305879	0.11%	10.91%	0.1	9.1	
MG_04	24	65	B	92	55641	39305879	0.14%	11.06%	0.1	9.2	
MG_04	24	66	B	92	71004	39305879	0.18%	11.24%	0.2	9.4	
MG_04	24	71	D	95	87300	39305879	0.22%	11.46%	0.2	9.6	
MG_04	31	65	B	79	791959	39305879	2.01%	13.47%	1.6	11.2	
MG_04	31	66	B	79	65667	39305879	0.17%	13.64%	0.1	11.3	
MG_04	31	71	D	89	508143	39305879	1.29%	14.93%	1.2	12.5	

BASIN	NLCD 2001 Land Cover Class	SOIL MAP UNIT #	Hydrologic Soil Group	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
MG_04	31	72	D	89	20520	39305879	0.05%	14.99%	0.0	12.5	
MG_04	31	84	D	89	390728	39305879	0.99%	15.98%	0.9	13.4	
MG_04	52	108	D	83	95992	39305879	0.24%	16.22%	0.2	13.6	
MG_04	52	125	D	83	1748104	39305879	4.45%	20.67%	3.7	17.3	
MG_04	52	16	A	48	58963	39305879	0.15%	20.82%	0.1	17.4	
MG_04	52	48	B	67	104038	39305879	0.26%	21.09%	0.2	17.6	
MG_04	52	52	B	67	2	39305879	0.00%	21.09%	0.0	17.6	
MG_04	52	58	C	77	422662	39305879	1.08%	22.16%	0.8	18.4	
MG_04	52	59	D	83	88475	39305879	0.23%	22.39%	0.2	18.6	
MG_04	52	62	C	77	6894	39305879	0.02%	22.40%	0.0	18.6	
MG_04	52	64	D	83	133399	39305879	0.34%	22.74%	0.3	18.9	
MG_04	52	65	B	67	3342666	39305879	8.50%	31.25%	5.7	24.6	
MG_04	52	66	B	67	219461	39305879	0.56%	31.81%	0.4	24.9	
MG_04	52	71	D	83	3095085	39305879	7.87%	39.68%	6.5	31.5	
MG_04	52	72	D	83	647236	39305879	1.65%	41.33%	1.4	32.8	
MG_04	52	83	D	83	119884	39305879	0.31%	41.63%	0.3	33.1	
MG_04	52	84	D	83	2337620	39305879	5.95%	47.58%	4.9	38.0	
MG_04	71	108	D	89	663114	39305879	1.69%	49.27%	1.5	39.5	
MG_04	71	125	D	89	38912	39305879	0.10%	49.37%	0.1	39.6	
MG_04	71	16	A	68	73727	39305879	0.19%	49.55%	0.1	39.7	
MG_04	71	48	B	79	591817	39305879	1.51%	51.06%	1.2	40.9	
MG_04	71	49	B	79	81478	39305879	0.21%	51.27%	0.2	41.1	
MG_04	71	52	B	79	1417537	39305879	3.61%	54.87%	2.8	44.0	
MG_04	71	58	C	86	1416176	39305879	3.60%	58.48%	3.1	47.0	
MG_04	71	62	C	86	4032	39305879	0.01%	58.49%	0.0	47.1	
MG_04	71	64	D	89	52573	39305879	0.13%	58.62%	0.1	47.2	
MG_04	71	65	B	79	4638252	39305879	11.80%	70.42%	9.3	56.5	
MG_04	71	66	B	79	543679	39305879	1.38%	71.80%	1.1	57.6	
MG_04	71	71	D	89	946617	39305879	2.41%	74.21%	2.1	59.7	
MG_04	71	72	D	89	847332	39305879	2.16%	76.37%	1.9	61.7	
MG_04	71	83	D	89	20045	39305879	0.05%	76.42%	0.0	61.7	
MG_04	71	84	D	89	2390643	39305879	6.08%	82.50%	5.4	67.1	
MG_04	21	108	D	84	1689	39305879	0.00%	82.50%	0.0	67.1	
MG_04	21	48	B	68	10422	39305879	0.03%	82.53%	0.0	67.1	
MG_04	21	52	B	68	31146	39305879	0.08%	82.61%	0.1	67.2	
MG_04	21	66	B	68	6449	39305879	0.02%	82.63%	0.0	67.2	
MG_04	21	83	D	84	70433	39305879	0.18%	82.81%	0.2	67.4	
MG_04	21	84	D	84	45747	39305879	0.12%	82.92%	0.1	67.4	
MG_04	22	108	D	86	5361	39305879	0.01%	82.94%	0.0	67.5	
MG_04	22	52	B	72	3922	39305879	0.01%	82.95%	0.0	67.5	
MG_04	22	66	B	72	2858	39305879	0.01%	82.95%	0.0	67.5	

BASIN	NLCD 2001 Land Cover Class	SOIL MAP UNIT #	Hydrologic Soil Group	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
MG_04	24	108	D	95	71505	39305879	0.18%	83.13%	0.2	67.6	
MG_04	24	66	B	92	136666	39305879	0.35%	83.48%	0.3	68.0	
MG_04	24	84	D	95	20349	39305879	0.05%	83.53%	0.0	68.0	
MG_04	31	108	D	89	472	39305879	0.00%	83.54%	0.0	68.0	
MG_04	31	48	B	79	37402	39305879	0.10%	83.63%	0.1	68.1	
MG_04	31	83	D	89	18658	39305879	0.05%	83.68%	0.0	68.1	
MG_04	31	84	D	89	43367	39305879	0.11%	83.79%	0.1	68.2	
MG_04	52	108	D	83	75317	39305879	0.19%	83.98%	0.2	68.4	
MG_04	52	125	D	83	570097	39305879	1.45%	85.43%	1.2	69.6	
MG_04	52	48	B	67	117886	39305879	0.30%	85.73%	0.2	69.8	
MG_04	52	52	B	67	56700	39305879	0.14%	85.87%	0.1	69.9	
MG_04	52	64	D	83	96231	39305879	0.24%	86.12%	0.2	70.1	
MG_04	52	65	B	67	67676	39305879	0.17%	86.29%	0.1	70.2	
MG_04	52	66	B	67	8745	39305879	0.02%	86.31%	0.0	70.2	
MG_04	52	83	D	83	663505	39305879	1.69%	88.00%	1.4	71.6	
MG_04	52	84	D	83	853700	39305879	2.17%	90.17%	1.8	73.4	
MG_04	71	108	D	89	184181	39305879	0.47%	90.64%	0.4	73.8	
MG_04	71	125	D	89	28144	39305879	0.07%	90.71%	0.1	73.9	
MG_04	71	131	O	89	9144	39305879	0.02%	90.74%	0.0	73.9	
MG_04	71	48	B	79	460366	39305879	1.17%	91.91%	0.9	74.9	
MG_04	71	52	B	79	352064	39305879	0.90%	92.80%	0.7	75.6	
MG_04	71	64	D	89	85638	39305879	0.22%	93.02%	0.2	75.8	
MG_04	71	65	B	79	292226	39305879	0.74%	93.77%	0.6	76.3	
MG_04	71	66	B	79	278429	39305879	0.71%	94.47%	0.6	76.9	
MG_04	71	83	D	89	1685878	39305879	4.29%	98.76%	3.8	80.7	
MG_04	71	84	D	89	486164	39305879	1.24%	100.00%	1.1	81.8	81.8
MG_05	21	58	C	79	24462	15308335	0.16%	0.16%	0.1	0.1	
MG_05	21	59	D	84	1212807	15308335	7.92%	8.08%	6.7	6.8	
MG_05	21	61	C	79	424483	15308335	2.77%	10.86%	2.2	9.0	
MG_05	21	62	C	79	98799	15308335	0.65%	11.50%	0.5	9.5	
MG_05	21	63	D	84	81400	15308335	0.53%	12.03%	0.4	9.9	
MG_05	21	72	D	84	106987	15308335	0.70%	12.73%	0.6	10.5	
MG_05	22	51	C	81	557	15308335	0.00%	12.73%	0.0	10.5	
MG_05	22	58	C	81	33735	15308335	0.22%	12.96%	0.2	10.7	
MG_05	22	59	D	86	232926	15308335	1.52%	14.48%	1.3	12.0	
MG_05	22	61	C	81	29444	15308335	0.19%	14.67%	0.2	12.2	
MG_05	22	62	C	81	483182	15308335	3.16%	17.83%	2.6	14.7	
MG_05	22	63	D	86	7400	15308335	0.05%	17.87%	0.0	14.8	
MG_05	22	71	D	86	13880	15308335	0.09%	17.96%	0.1	14.8	
MG_05	22	72	D	86	173775	15308335	1.14%	19.10%	1.0	15.8	
MG_05	23	51	C	90	6207	15308335	0.04%	19.14%	0.0	15.9	

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MG_05	23	58	C	90	46048	15308335	0.30%	19.44%	0.3	16.1	
MG_05	23	59	D	92	343274	15308335	2.24%	21.68%	2.1	18.2	
MG_05	23	61	C	90	5248	15308335	0.03%	21.72%	0.0	18.2	
MG_05	23	62	C	90	208572	15308335	1.36%	23.08%	1.2	19.4	
MG_05	23	72	D	92	47439	15308335	0.31%	23.39%	0.3	19.7	
MG_05	24	59	D	95	252000	15308335	1.65%	25.04%	1.6	21.3	
MG_05	42	16	A	57	16097	15308335	0.11%	25.14%	0.1	21.3	
MG_05	42	62	C	82	240	15308335	0.00%	25.14%	0.0	21.4	
MG_05	42	72	D	86	567324	15308335	3.71%	28.85%	3.2	24.5	
MG_05	52	16	A	48	202993	15308335	1.33%	30.17%	0.6	25.2	
MG_05	52	59	D	83	224292	15308335	1.47%	31.64%	1.2	26.4	
MG_05	52	61	C	77	120012	15308335	0.78%	32.42%	0.6	27.0	
MG_05	52	62	C	77	492156	15308335	3.21%	35.64%	2.5	29.5	
MG_05	52	63	D	83	32171	15308335	0.21%	35.85%	0.2	29.6	
MG_05	52	71	D	83	69445	15308335	0.45%	36.30%	0.4	30.0	
MG_05	52	72	D	83	2437747	15308335	15.92%	52.23%	13.2	43.2	
MG_05	71	16	A	68	709913	15308335	4.64%	56.86%	3.2	46.4	
MG_05	71	59	D	89	170274	15308335	1.11%	57.98%	1.0	47.4	
MG_05	71	61	C	86	561597	15308335	3.67%	61.65%	3.2	50.5	
MG_05	71	62	C	86	418355	15308335	2.73%	64.38%	2.4	52.9	
MG_05	71	63	D	89	28775	15308335	0.19%	64.57%	0.2	53.1	
MG_05	71	71	D	89	105652	15308335	0.69%	65.26%	0.6	53.7	
MG_05	71	72	D	89	3058320	15308335	19.98%	85.23%	17.8	71.4	
MG_05	82	59	D	85	809003	15308335	5.28%	90.52%	4.5	75.9	
MG_05	82	61	C	82	31793	15308335	0.21%	90.73%	0.2	76.1	
MG_05	82	63	D	85	1350465	15308335	8.82%	99.55%	7.5	83.6	
MG_05	82	71	D	85	3836	15308335	0.03%	99.57%	0.0	83.6	
MG_05	82	72	D	85	65253	15308335	0.43%	100.00%	0.4	84.0	84.0
MG_06	21	48	B	68	7314	18570965	0.04%	0.04%	0.0	0.0	
MG_06	21	51	C	79	1142461	18570965	6.15%	6.19%	4.9	4.9	
MG_06	21	59	D	84	1388768	18570965	7.48%	13.67%	6.3	11.2	
MG_06	21	61	C	79	10634	18570965	0.06%	13.73%	0.0	11.2	
MG_06	21	63	D	84	476980	18570965	2.57%	16.30%	2.2	13.4	
MG_06	21	72	D	84	140622	18570965	0.76%	17.05%	0.6	14.0	
MG_06	22	48	B	72	24840	18570965	0.13%	17.19%	0.1	14.1	
MG_06	22	51	C	81	254503	18570965	1.37%	18.56%	1.1	15.2	
MG_06	22	59	D	86	605431	18570965	3.26%	21.82%	2.8	18.0	
MG_06	22	61	C	81	245287	18570965	1.32%	23.14%	1.1	19.1	
MG_06	22	63	D	86	324482	18570965	1.75%	24.88%	1.5	20.6	
MG_06	22	71	D	86	8433	18570965	0.05%	24.93%	0.0	20.6	
MG_06	22	72	D	86	106181	18570965	0.57%	25.50%	0.5	21.1	

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MG_06	23	51	C	90	67108	18570965	0.36%	25.86%	0.3	21.4	
MG_06	23	59	D	92	11421	18570965	0.06%	25.92%	0.1	21.5	
MG_06	23	61	C	90	116623	18570965	0.63%	26.55%	0.6	22.1	
MG_06	23	72	D	92	377	18570965	0.00%	26.55%	0.0	22.1	
MG_06	42	16	A	57	430	18570965	0.00%	26.56%	0.0	22.1	
MG_06	42	72	D	86	114309	18570965	0.62%	27.17%	0.5	22.6	
MG_06	52	16	A	48	140521	18570965	0.76%	27.93%	0.4	23.0	
MG_06	52	51	C	77	241062	18570965	1.30%	29.23%	1.0	24.0	
MG_06	52	59	D	83	323516	18570965	1.74%	30.97%	1.4	25.4	
MG_06	52	61	C	77	145968	18570965	0.79%	31.76%	0.6	26.0	
MG_06	52	63	D	83	252341	18570965	1.36%	33.11%	1.1	27.1	
MG_06	52	72	D	83	283946	18570965	1.53%	34.64%	1.3	28.4	
MG_06	71	16	A	68	26224	18570965	0.14%	34.78%	0.1	28.5	
MG_06	71	51	C	86	602589	18570965	3.24%	38.03%	2.8	31.3	
MG_06	71	59	D	89	439921	18570965	2.37%	40.40%	2.1	33.4	
MG_06	71	61	C	86	199134	18570965	1.07%	41.47%	0.9	34.3	
MG_06	71	63	D	89	574683	18570965	3.09%	44.56%	2.8	37.1	
MG_06	71	71	D	89	6795	18570965	0.04%	44.60%	0.0	37.1	
MG_06	71	72	D	89	528550	18570965	2.85%	47.45%	2.5	39.6	
MG_06	82	48	B	75	47399	18570965	0.26%	47.70%	0.2	39.8	
MG_06	82	51	C	82	4338782	18570965	23.36%	71.07%	19.2	59.0	
MG_06	82	59	D	85	3080083	18570965	16.59%	87.65%	14.1	73.1	
MG_06	82	61	C	82	523086	18570965	2.82%	90.47%	2.3	75.4	
MG_06	82	63	D	85	1649200	18570965	8.88%	99.35%	7.5	83.0	
MG_06	82	72	D	85	120960	18570965	0.65%	100.00%	0.6	83.5	83.5
MG_07	11	124	C	30	28207	5631877	0.50%	0.50%	0.2	0.2	
MG_07	11	92	D	30	7707	5631877	0.14%	0.64%	0.0	0.2	
MG_07	21	124	C	79	202889	5631877	3.60%	4.24%	2.8	3.0	
MG_07	21	51	C	79	650883	5631877	11.56%	15.80%	9.1	12.2	
MG_07	22	51	C	81	22496	5631877	0.40%	16.20%	0.3	12.5	
MG_07	23	51	C	90	22494	5631877	0.40%	16.60%	0.4	12.9	
MG_07	52	124	C	77	45069	5631877	0.80%	17.40%	0.6	13.5	
MG_07	52	51	C	77	101700	5631877	1.81%	19.20%	1.4	14.9	
MG_07	52	92	D	83	47431	5631877	0.84%	20.04%	0.7	15.6	
MG_07	71	124	C	86	195041	5631877	3.46%	23.51%	3.0	18.5	
MG_07	71	51	C	86	326554	5631877	5.80%	29.31%	5.0	23.5	
MG_07	82	124	C	82	1994267	5631877	35.41%	64.72%	29.0	52.6	
MG_07	82	51	C	82	1945688	5631877	34.55%	99.26%	28.3	80.9	
MG_07	82	92	D	85	41451	5631877	0.74%	100.00%	0.6	81.5	81.5

LAG TIME CALCULATIONS – MUDD GULCH

MUDD GULCH HYDROLOGIC ANALYSIS - SCS HYDROLOGIC PARAMETER SUMMARY

BASIN LAG TIME CALCULATIONS

	Sheet Flow				Shallow Concentrated Flow					Channel Flow						Time of Concentration Tc= T1+T2+ T3 (hr)	SCS Time Lag= 0.6*Tc (min)
BASIN	Flow Length (ft)	Slope (ft/ft)	Mannings' n	Travel Time, T1 (hr)	Flow Length (ft)	Slope (ft/ft)	Paved or Unpaved	Average Velocity (ft/s)	Travel Time, T2 (hr)	Flow Length (ft)	Slope (ft/ft)	Mannings' n	Average Channel Width (ft)	Average Velocity* (ft/s)	Travel Time, T3 (hr)		
MG-01	292	0.376	0.40	0.37	2163	0.079	unpaved	4.52	0.13	9455	0.061	0.045	40	11.90	0.22	26	
MG-02	272	0.147	0.40	0.51	2535	0.099	unpaved	5.07	0.14	8579	0.043	0.045	40	9.21	0.26	33	
MG_03	200	0.175	0.24	0.25	2600	0.057	unpaved	3.84	0.19	2000	0.021	0.045	20	6.72	0.08	19	
MG-04	283	0.159	0.24	0.34	2735	0.057	unpaved	3.87	0.20	8855	0.024	0.045	40	9.34	0.26	29	
MG_05	285	0.315	0.24	0.26	5388	0.033	unpaved	2.93	0.51	2289	0.012	0.045	10	8.04	0.08	31	
MG-06	285	0.326	0.24	0.25	5388	0.032	unpaved	2.87	0.52	1602	0.009	0.045	10	7.04	0.06	30	
MG-07	200	0.030	0.24	0.50	1396	0.009	unpaved	1.56	0.25	3800	0.008	0.045	10	6.67	0.16	33	

*Channel flow velocities are calculated based on a representative trapezoidal channel with bank-full condition.
Reference: NRCS Technical Release 55- Urban Hydrology for Small Watersheds, June 1986

Channel Flow - Average Velocity Calculations

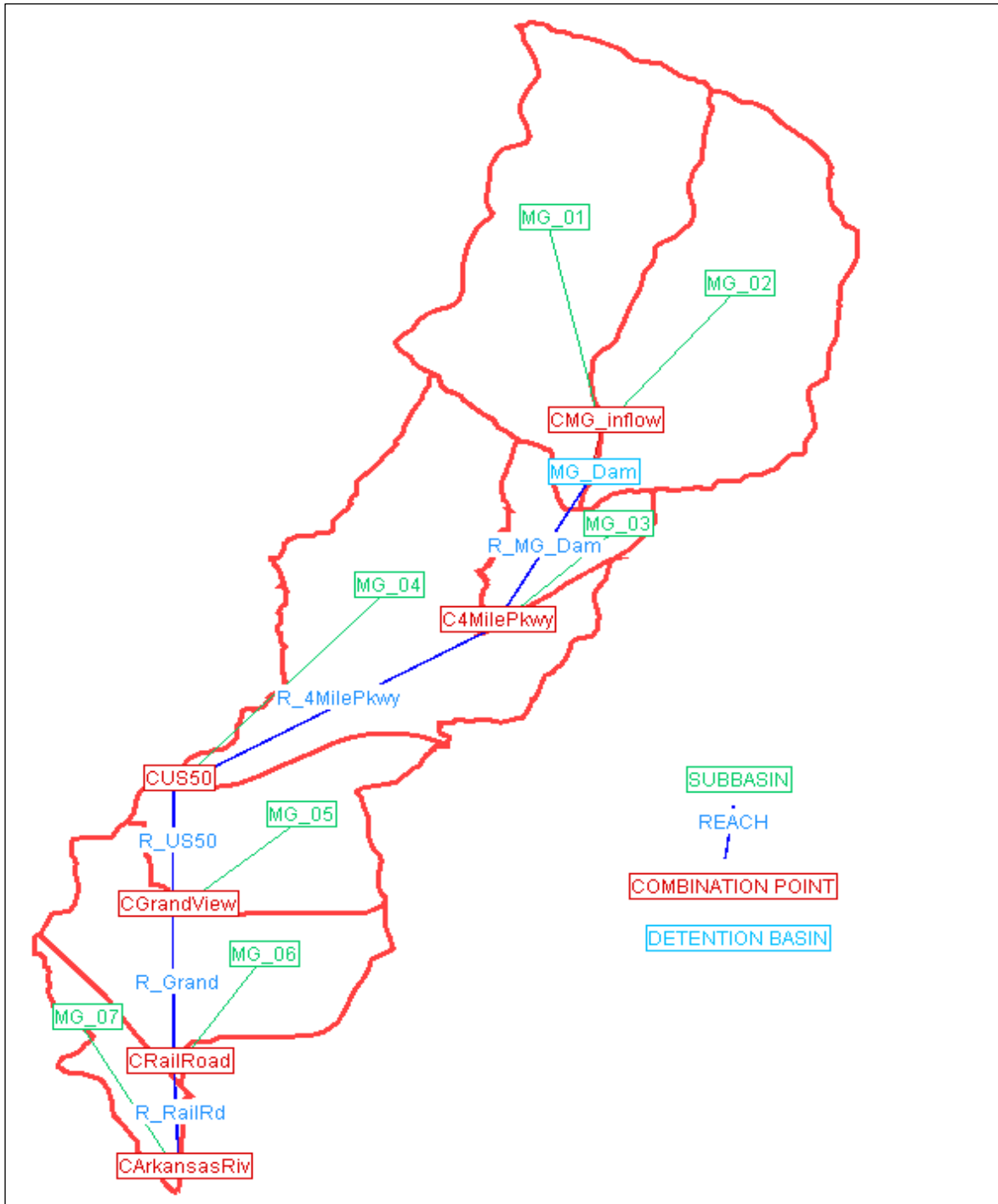
Velocity Calculation	SUBBASIN:						
	MG_01	MG_02	MG_03	MG_04	MG_05	MG_06	MG_07
Bank-Full Depth	2	1.75	2	2.75	5.5	5.5	5.5
Bottom Width	40	40	20	40	10	10	10
Left Bank Slope	3	3	2	1	3	3	3
Right Bank Slope	3	3	2	1	3	3	3
n	0.045	0.045	0.045	0.045	0.045	0.045	0.045
S	6.1%	4.3%	2.1%	2.4%	1.2%	0.9%	0.8%
Top Width	52	50.5	28	45.5	43	43	43
Area	92	79.1875	48	117.563	145.75	145.75	145.75
P	52.65	51.07	28.94	47.78	44.79	44.79	44.79
R	1.75	1.55	1.66	2.46	3.25	3.25	3.25
V	11.90	9.21	6.72	9.34	8.04	7.04	6.67
Q	1094.56	729.51	322.68	1097.75	1172.16	1025.53	972.56

HEC-HMS SCHEMATIC – MUDD GULCH



HEC-HMS

PROJECT: MUDD GULCH HYDROLOGIC ANALYSIS
BASIN MODEL SCHEMATIC: MuddGulch_w_Dam
June 3, 2009



HEC-HMS RESULTS – MUDD GULCH

MUDD GULCH HEC-HMS RESULTS						
Hydrologic Element	Drainage Area (sq mi)	Peak Discharge (cfs)				500-yr
		10-yr	50-yr	100-yr	500-yr	
CMG_inflow	2.22	860	1536	1605	2359	2359
MG_Dam	2.22	23	28	29	30	30
C4MilePkwy	2.47	145	254	270	385	385
CUS50	3.88	646	1192	1297	1857	1857
CGrandView	4.43	853	1571	1724	2437	2437
CRailRoad	5.1	1054	1970	2191	3078	3078
CArkansasRiv	5.3	1099	2061	2302	3226	3226
MG_01	1.14	502	887	922	1354	1354
MG_02	1.08	377	681	716	1052	1052
MG_03	0.25	145	251	266	377	377
MG_04	1.41	526	956	1043	1483	1483
MG_05	0.55	227	395	442	596	596
MG_06	0.67	274	481	552	731	731
MG_07	0.2	67	122	144	190	190

Section 3

Hydraulic Analysis

3.1. Overview

Fourmile Creek and Mudd Gulch water surface elevations used in the floodplain mapping were determined using HEC-RAS, Version 4.0.0 (United States Army Corps of Engineers (USACE), 2008). In addition, FlowMaster (Bentley Systems, Inc., 2005) was used to analyze a breakout area south of Highway 50 to verify that the 100-year flood depth was less than 1 foot. The models can be found in **Section 3** of the Data DVD provided with this document.

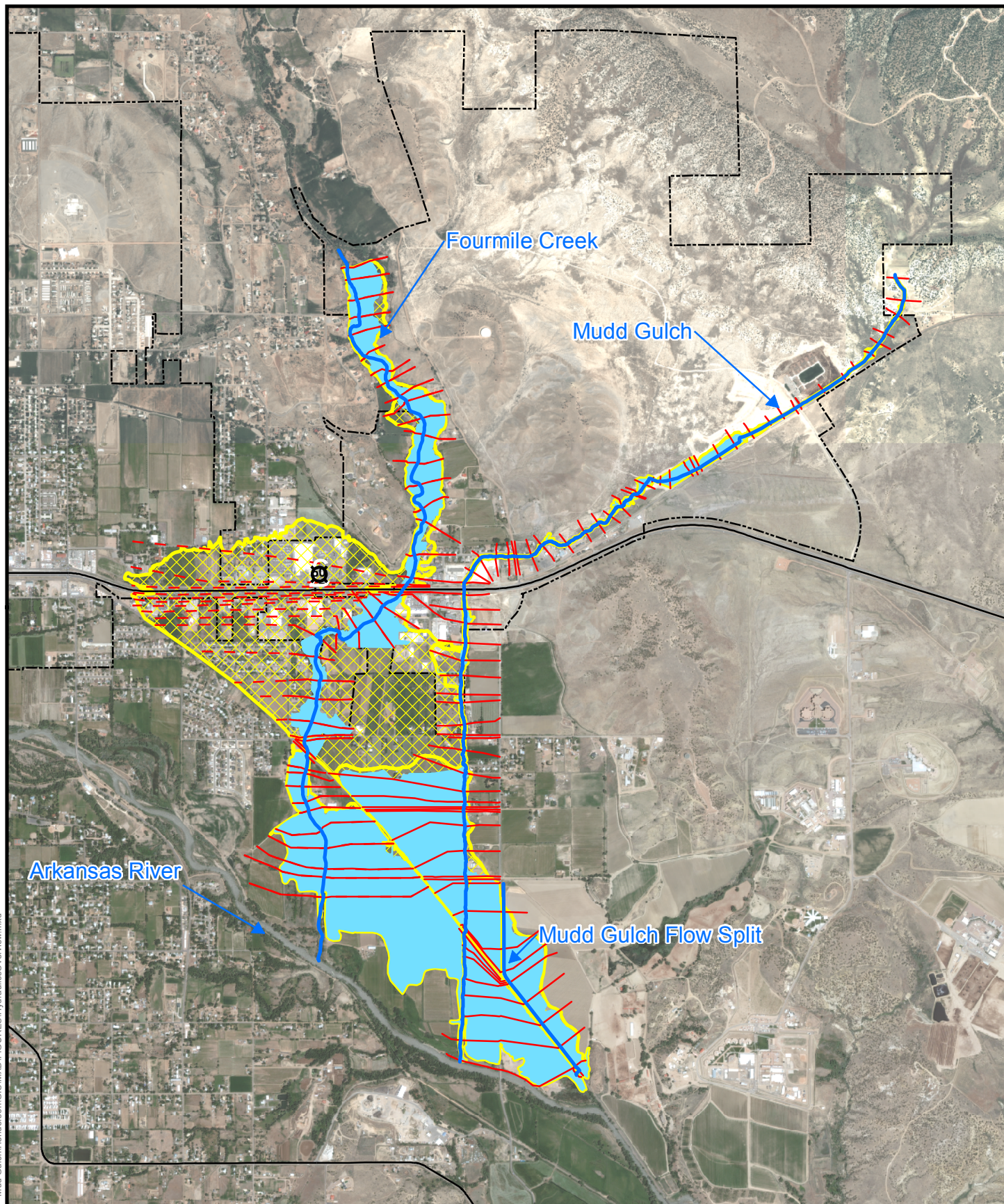
In the HEC-RAS model, there is a reach for both Fourmile Creek and Mudd Gulch. In addition, approximately 2,500 feet upstream from the Arkansas River on the north side of the railroad, the 100-year flow is not contained in the Mudd Gulch reach and breaks out to the east between cross-sections 3389 and 2499. Since this was a significant breakout, the amount of flow splitting east over Mackenzie Avenue was quantified using lateral weirs in HEC-RAS, and the detailed hydraulic model was extended east by adding another reach that will be referred to as the “Mudd Gulch Flow Split.” The Mudd Gulch Flow Split and the other reaches modeled in HEC-RAS are shown in **Figure 3-1**, which provides an overview of the study area and the resulting floodplain mapping. Detailed hydraulic workmaps are located in **Section 5** of this document.

3.2. Terrain Data

Terrain data in this model was based on a composite of breaklines and mass points that were provided by Fremont County. The terrain data is from the year 2001 and is based on 2-foot contour resolution. To supplement this topographic information provided by Fremont County, Cornerstone Land Consultants, Inc. was contracted to provide field survey data for channels, overbanks, and structures (bridges & culverts) in 2008. In general, available survey data was then used to populate station-elevation information for cross-sections in the hydraulic model. To automate this process, survey points that were used for the definition of cross-section geometry were converted into breaklines and incorporated into the terrain data used in this study. The survey data along with the associated breaklines are supplied on the DVD that accompanies this report. The topography data and all elevation data associated with the hydraulic model and floodplains are referenced to the North American Vertical Datum (NAVD) of 1988.

It should be noted that there are two locations in the study area where topographic information from Fremont County was not used. The first location is downstream of Fourmile Parkway in the vicinity of a detention pond designed by Monument Valley Engineers, Inc (MVE) in 2007. Two-foot contours in this area were obtained by converting an electronic CAD file from the MVE project to a GIS shapefile and incorporating it into the terrain. The As-built plans for the detention pond are included in the reference material in Section 6, and the GIS shapefile of the 2-ft contours in this area is included on the Data DVD. The second location where the Fremont County

C:\04\06\2009\X\Projects\100001092_Four Mile - Mud Gulch\Henderson\GIS\MXD\FIGURES\Hydraulics\Overview.mxd



Legend

- Fourmile Creek, Mudd Gulch, MG Flow Split
- Cross Sections
- Fourmile 500-year cross section extensions
- 1% Annual Chance Boundary
- 0.2% Annual Chance Boundary
- City of Cañon City Corporate Limit

Aerial Source:
Fremont County Spring 2005



0 1,250 2,500
Feet
1 inch equals 2,500 feet

FIGURE 3-1:
Fourmile Creek and Mudd Gulch
Hydraulics Overview

Fourmile Creek and Mudd Gulch H&H Analysis and PMR

Prepared for:
City of Cañon City

PBSJ 4604 DTC Blvd, Suite 700
Denver, Colorado 80237
Phone: 303-221-7275

topographic information was not used is south of Rehabilitation Facility at the intersection of Fourmile Parkway and County Road 123. For this location, floodplain mapping is based on survey data only. These two locations are shown on Sheet 2 of the Hydraulic Work Maps provided in **Section 5**. The composite terrain in TIN (Triangulated Irregular Network) format can be found on the Data DVD provided with this document.

3.3. Manning Roughness

Manning's *n* values for the HEC-RAS model were determined by field reconnaissance (see Data DVD provided with this document for field investigation photos) and from information available on aerial photographs of the site. The range of values used in this study is shown in **Table 3-1**.

Table 3-1 Roughness N-Values ¹

ROUGHNESS COEFFICIENT SUMMARY			
LOCATION	LEFT OVERBANK	RIGHT OVERBANK	CHANNEL
FOURMILE CREEK MUDD GULCH	0.035 - 0.08	0.035 - 0.08	0.015 - 0.08

3.4. Hydraulic Structures

Field surveys were conducted by Cornerstone Land Surveying in 2008-2009 to obtain the information necessary to accurately model the structures on Fourmile Creek and Mudd Gulch. The survey data and field notes are located on the Data DVD provided with this document. All structures were appropriately modeled using HEC-RAS. It should be noted that no storage attenuation was incorporated into the hydrologic analysis at the MVE detention pond downstream of Fourmile Parkway. In the hydraulic model, the peak flow through the detention pond was taken from the combination point at Highway 50 downstream. Thus, the flow used in the hydraulic model at this location is considered to be conservative for floodplain mapping purposes.

There were eleven structures modeled in the study reach – three on Fourmile Creek, seven on Mudd Gulch, and one on Mudd Gulch Flow Split. From downstream to upstream the structures on Fourmile Creek were Railroad bridge (Station 4073.00), Grandview St. bridge (Station 4379.56), and Highway 50 bridge (Station 8632.47). Likewise, on Mudd Gulch the structures cross the Railroad (Station 2473.27), Adams Avenue (Station 3493.08), Highland Avenue (Station 4820.16), Grandview St. (Station 6253.73), Highway 50 (Station 9048.02), Fourmile Lane (Station 10391.79), and Fourmile Parkway (Station 16809.73). There is only one structure on Mudd Gulch Flow Split which crosses the Railroad (Station 68.78). Survey data were available for each bridge opening/culvert size and deckway (refer to the Data DVD). This data was incorporated into the geometry information during HEC-RAS hydraulic model setup.

¹ Manning's roughness coefficients based on *Open-Channel Hydraulics* by Ven Te Chow, 1959, McGraw-Hill, New York, NY.

3.5. Boundary Conditions

The HEC-RAS model was executed under the assumption of subcritical flow. The normal depth slope that was used to set the downstream starting water surface elevation on Fourmile Creek, Mudd Gulch, and Mudd Gulch Flow Split is 0.003, 0.01, and 0.01 ft/ft, respectively. However, the flood profiles presented in **Section 4** correctly show the back water effect from Arkansas River. The water surface elevation of Arkansas River at Fourmile Creek and Mudd Gulch confluences is 5,254 and 5,238 feet, respectively.

3.6. Flow Change Description

There are four locations along Mudd Gulch where the flow changes in the hydraulic model. For Fourmile Creek, the flow did not change in the hydraulic model because the flow was based on the Fourmile Creek USGS gage data. Selection of the flow change locations for Mudd Gulch was based on the results presented in the hydrologic analysis. For example, the flow utilized in the hydraulic model at the upstream end of Mudd Gulch (Sta 20181.26) represents the peak flow from the combination point located at Fourmile Parkway. Similarly, for the cross-sections located along the reach between Fourmile Parkway and Highway 50 (Sta 16216.12 to 8669.89), the peak flow value from the combination point located at Highway 50 was used, and so forth. Assigning peak flows to the cross sections using downstream combination points assures adequate flow values for floodplain mapping. The flow change locations and peak flow rates used in this analysis are shown in **Table 3-2**.

Table 3-2 Fourmile Creek and Mudd Gulch Flow Change Summary

FLOW CHANGE SUMMARY					
RIVER (HEC-HMS NODE)	RIVER STATION	PEAK FLOW RATES (cfs)			
		10% ANNUAL CHANCE FLOOD	2% ANNUAL CHANCE FLOOD	1% ANNUAL CHANCE FLOOD	0.2% ANNUAL CHANCE FLOOD
FOURMILE CREEK	16382.73	2110	5110	7020	13500
MUDD GULCH (C4MilePkwy)	20181.26	145	254	270	385
MUDD GULCH (CUS50)	16216.12	646	1192	1297	1857
MUDD GULCH (CGrandView)	8411.16	853	1571	1724	2437
MUDD GULCH (CRailRoad)	5974.50	1054	1970	2191	3078
MUDD GULCH (CArkansasRiv)	2189.83	1099	2061	2302	3226

3.7. HEC-RAS Model

After incorporating the latest topographic information into one surface (terrain data is available in TIN format on the Data DVD), the cross-sections were cut using HEC-GeoRAS. HEC-GeoRAS is a GIS extension that provides the user with a set of procedures, tools, and utilities for the preparation of GIS data for import into HEC-RAS and generation of GIS data from RAS output. Following the import of cross-section geometry information, structure data, flow data, and boundary conditions, the HEC-RAS project is grouped into three plans to model the required number of flood events.

The first plan named “Fourmile/ Mudd Gulch (100/50/10-year)” is to model 10, 2, and 1% annual chance flood events. The geometry in the hydraulic model included reaches for Fourmile Creek, Mudd Gulch, and the Mudd Gulch Flow Split. The Mudd Gulch Flow Split reach models the uncontained flow from Mudd Gulch that weirs over Mackenzie Avenue between the Railroad and Adams Avenue (please refer to Sheet 5 of Hydraulic Work Maps). The second plan named “Fourmile/ Mudd Gulch (500-year)” is to model 0.2% annual chance flood event. The purpose of creating a separate plan for the 500-year flow event was to incorporate the extended cross-sections needed to appropriately map the 500-year floodplain on Fourmile Creek (please refer to Sheet 3 of the Hydraulic Work Maps). The last plan named “Fourmile/ Mudd Gulch (100-Encroachment)” has been created for the floodway analysis. Although this plan shares the same geometry as the first plan, the floodway analysis uses different set of flow values. This is explained further in the following section.

3.8. Floodway Modeling

The floodway analysis was based on equal conveyance reduction on each side of the floodplain. HEC-RAS encroachment method 4 was used to estimate the floodway and method 1 was used to refine the floodway. The results of the floodway computations are tabulated at selected cross sections in the Floodway Data Tables (see **Section 4**).

The floodway analysis required the creation of a new plan named “Fourmile/ Mudd Gulch (100-Encroachment)”. This plan shares the same geometry with plan named “Fourmile/ Mudd Gulch (100/50/10-year)”. The only difference was the flow data and some of the plan options used during encroachment analysis.

Floodway analysis started with examining the breakout areas on Fourmile Creek and Mudd Gulch for the 100-year flow event, which is the base event for floodway analysis. This was done because any lateral weir used for calculating the amount of breakout at one cross section should be removed if an encroachment was defined at that location. The criteria of removing or not removing a lateral weir during the encroachment analysis depend on its effect on the increase of base flood elevation. If removing a lateral weir causes surcharges over 1.0 foot, then no encroachment is defined at those cross-sections.

In the case of Fourmile Creek, the only breakout occurred over lateral weirs 7819 and 7454. These lateral weirs connect cross-sections 7820, 7454, and 6921 (please refer to Sheet 4 of the Hydraulic Work Maps). The 1% annual chance flow rate of this breakout

was 163 cfs. Removing these laterals during the encroachment analysis was achieved by unchecking the optimization option under flow optimization options in HEC-RAS. Removing the laterals resulted in an increase in flow on Fourmile Creek since the breakout flow stayed in the main channel instead of leaving the system. However, the surcharges remained under 1.0 foot. For this reason, encroachment stations were defined at this location. It should be noted that the surcharges are calculated by reducing the flow values in the base flow profile “1%” while the full flow values are used in the encroachment profile “Floodway” in HEC-RAS flow file for this plan (please see the hydraulic model on the Data DVD).

The breakout area for Mudd Gulch is located between cross-sections 3389 and 2499. The total amount of flow splitting east over Mackenzie Avenue (from cross section 3389 to 2519) is approximately 1,270 cfs. Since this is a significant break out, removing the laterals and letting the full flow to stay in the main channel caused surcharges higher than 1.0 foot. For this reason, no encroachment station has been defined for these cross-sections and the flow was allowed to weir over Mackenzie Avenue in the floodway analysis. As a result, the 1% annual chance floodplain should be considered as a floodway at this location. A detailed hydraulic model was performed by modeling the Mudd Gulch Flow Split reach for this breakout area.

Generally, floodway surcharges reside between 0.00 feet and 1.00 foot. Maximum negative surcharges of -0.02 feet occurred at Fourmile Creek station 13545.88 and Mudd Gulch station 16216.12. The negative surcharges are negligible and it should be noted that the 100-year flood is contained within the channel at and downstream of these cross sections and therefore encroachment stations were not specified inside bank stations at these locations. Many floodway surcharges are close to 0.00 ft since the base flow is contained in the channel and additional encroachment tended to cause negative surcharge at these locations.

Using HEC-GeoRAS, the hydraulic model results were exported to GIS and the resulting floodplains were created and mapped on the 2-foot contour data. Floodplain widths were modified for several cross-sections to ensure that the appropriate widths were represented at each composite cross section (refer to **Section 5.2** for more detail). The detailed Hydraulic Work Maps showing flood zones, floodways, stream centerlines, cross-sections, and base flood elevations are located in **Section 5** of this document.

3.9. Supporting Documentation

This section is a collection of support documentation for the hydraulic modeling. Please refer to **Section 6** for PBS&J’s quality assurance and quality control documentation. The following documents can be found at the end of this section:

- Hydraulic Analysis Index
- Key to Cross-Sectional Labeling
- HEC-RAS Report
- Annotated CHECK-RAS Report
- Cross-Section Plots

HYDRAULIC ANALYSIS SUPPORTING DOCUMENTATION

- Hydraulic Analysis Index
- Key to Cross-Sectional Labeling
- HEC-RAS Report
- Annotated CHECK-RAS Report
- Cross-Section Plots

HYDRAULIC ANALYSIS INDEX

HYDRAULIC ANALYSES INDEX

MAP REVISION

[illegible]

KEY TO CROSS-SECTIONAL LABELING

KEY TO CROSS-SECTIONAL LABELING

MAP REVISION

Community Name:	City of Cañon City	State:	Colorado
Community ID No.:	080068	County:	Fremont
Compiled By:	PBS&J		
Date TSDN Submitted:	June 2009		
Prepared by:	PBS&J		
Flooding Source:	Fourmile Creek		
Run Date:	April 10, 2009		
Field Survey Section No.	Cross Section Letter in Draft FIS Report	Computer Stationing	
	AC	16018.02	
	AB	15788.95	
	AA	15380.94	
		15048.74	
	Z	14576.82	
	Y	14082.25	
	X	13545.88	
	W	13318.55	
		12947.26	
	V	12788.01	
		12322.54	
	U	11997.88	
	T	11451.47	
	S	10930.27	
	R	10292.38	
		10048.25	
	Q	9338.16	
		8895.63	
		8742.65	
	P	8684.30	
	O	8569.65	
		8490.80	
	N	8139.05	
		7819.74	
	M	7454.19	
	L	6921.01	
		6349.33	
	K	5984.11	
		5506.21	
	J	5147.36	
	I	4711.74	
	H	4394.51	

		4329.78
	G	4111.69
	F	4050.69
	E	3756.25
		3680.22
	D	3432.09
	C	3121.18
	B	2953.71
	A	2512.02
		2154.04
		1765.52
		1606.54
		1222.98
		666.22
		68.69

KEY TO CROSS-SECTIONAL LABELING

MAP REVISION

Community Name:	City of Cañon City	State:	Colorado
Community ID No.:	080068	County:	Fremont
Compiled By:	PBS&J		
Date TSDN Submitted:	June 2009		
Prepared by:	PBS&J		
Flooding Source:	Mudd Gulch		
Run Date:	April 10, 2009		
Field Survey Section No.	Cross Section Letter in Draft FIS Report	Computer Stationing	
	AK	20181.26	
		19700.71	
	AJ	19402.88	
		18990.06	
	AI	18760.00	
		18518.88	
	AH	18116.98	
		17844.24	
	AG	17384.73	
	AF	16869.32	
		16749.55	
		16485.74	
	AE	16216.12	
		15806.06	
	AD	15397.66	
		15035.70	
	AC	14623.73	
		14522.74	
	AB	14414.32	
	AA	14002.14	
		13823.62	
		13676.00	
	Z	13478.31	
		13246.54	
	Y	13164.55	
		12837.83	
	X	12530.28	
		12220.19	
	W	11900.70	
	V	11496.49	
	U	10979.19	
		10698.07	

	T	10419.12
		10364.86
		10261.61
		10030.00
	S	9710.46
		9424.36
	R	9164.50
		8955.76
	Q	8669.89
		8411.16
		8031.07
	P	7701.39
		7414.21
	O	7054.93
	N	6896.94
		6479.48
	M	6282.00
		6217.24
	L	5974.50
	K	5477.27
		5134.21
		4937.94
	J	4835.77
		4798.82
		4752.50
	I	4479.82
	H	4005.63
	G	3515.21
		3469.15
	F	3389.17
	E	2868.02
		2519.13
	D	2498.67
		2418.14
	C	2189.83
	B	1989.08
		1574.31
	A	1261.28
		863.78
		411.13
		30.00

KEY TO CROSS-SECTIONAL LABELING

MAP REVISION

Community Name:	City of Cañon City	State:	Colorado
Community ID No.:	080068	County:	Fremont
Compiled By:	PBS&J		
Date TSDN Submitted:	June 2009		
Prepared by:	PBS&J		
Flooding Source:	Mudd Gulch Flow Split		
Run Date:	April 10, 2009		
Field Survey Section No.	Cross Section Letter in Draft FIS Report	Computer Stationing	
		3569.53	
	G	3568.53	
	F	2878.94	
		2455.99	
	E	2211.55	
	D	1729.42	
	C	1234.55	
	B	685.37	
	A	224.65	
		104.89	
		14.14	

HEC-RAS REPORT

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
MuddGulch	Reach1	20181.26	0.2%	500-year	385.00	5511.21	5514.85	5513.48	5515.11	0.003384	4.14	93.09	33.35	0.44
MuddGulch	Reach1	20181.26	1%	100-50-10yr	270.00	5511.21	5514.18	5513.08	5514.40	0.003618	3.78	71.49	31.10	0.44
MuddGulch	Reach1	20181.26	2%	100-50-10yr	254.00	5511.21	5514.07	5513.02	5514.29	0.003671	3.72	68.28	30.75	0.44
MuddGulch	Reach1	20181.26	10%	100-50-10yr	145.00	5511.21	5513.29	5512.55	5513.45	0.004109	3.20	45.31	28.13	0.44
MuddGulch	Reach1	19700.71	0.2%	500-year	385.00	5505.98	5510.74	5510.64	5511.84	0.018411	8.44	45.63	18.67	0.95
MuddGulch	Reach1	19700.71	1%	100-50-10yr	270.00	5505.98	5510.17	5510.00	5511.06	0.017333	7.55	35.74	16.49	0.90
MuddGulch	Reach1	19700.71	2%	100-50-10yr	254.00	5505.98	5510.09	5509.89	5510.94	0.016999	7.39	34.39	16.17	0.89
MuddGulch	Reach1	19700.71	10%	100-50-10yr	145.00	5505.98	5509.32	5509.06	5509.94	0.015922	6.28	23.10	13.20	0.84
MuddGulch	Reach1	19402.88	0.2%	500-year	385.00	5502.41	5505.60	5505.48	5506.51	0.017064	7.65	50.30	24.10	0.93
MuddGulch	Reach1	19402.88	1%	100-50-10yr	270.00	5502.41	5505.08	5504.96	5505.85	0.017440	7.01	38.52	21.49	0.92
MuddGulch	Reach1	19402.88	2%	100-50-10yr	254.00	5502.41	5505.00	5504.89	5505.74	0.017686	6.93	36.66	21.04	0.92
MuddGulch	Reach1	19402.88	10%	100-50-10yr	145.00	5502.41	5504.37	5504.25	5504.92	0.017714	5.93	24.46	17.87	0.89
MuddGulch	Reach1	18990.06	0.2%	500-year	385.00	5496.33	5499.65	5499.34	5500.32	0.013013	6.57	58.60	29.27	0.82
MuddGulch	Reach1	18990.06	1%	100-50-10yr	270.00	5496.33	5499.19	5498.85	5499.73	0.012502	5.91	45.67	25.96	0.79
MuddGulch	Reach1	18990.06	2%	100-50-10yr	254.00	5496.33	5499.12	5498.78	5499.64	0.012315	5.79	43.89	25.47	0.78
MuddGulch	Reach1	18990.06	10%	100-50-10yr	145.00	5496.33	5498.48	5498.17	5498.87	0.012166	4.99	29.08	20.96	0.75
MuddGulch	Reach1	18760.00	0.2%	500-year	385.00	5492.34	5495.73	5495.73	5496.59	0.020598	7.46	51.61	30.43	1.01
MuddGulch	Reach1	18760.00	1%	100-50-10yr	270.00	5492.34	5495.29	5495.29	5496.03	0.021217	6.90	39.11	26.49	1.00
MuddGulch	Reach1	18760.00	2%	100-50-10yr	254.00	5492.34	5495.21	5495.21	5495.94	0.021684	6.85	37.06	25.79	1.01
MuddGulch	Reach1	18760.00	10%	100-50-10yr	145.00	5492.34	5494.67	5494.64	5495.22	0.021403	5.93	24.46	20.96	0.97
MuddGulch	Reach1	18518.88	0.2%	500-year	385.00	5490.26	5492.91	5492.59	5493.14	0.005997	4.22	120.36	176.22	0.56
MuddGulch	Reach1	18518.88	1%	100-50-10yr	270.00	5490.26	5492.60	5492.25	5492.81	0.006528	3.89	88.47	150.30	0.56
MuddGulch	Reach1	18518.88	2%	100-50-10yr	254.00	5490.26	5492.56	5492.21	5492.76	0.006607	3.83	83.65	141.16	0.56
MuddGulch	Reach1	18518.88	10%	100-50-10yr	145.00	5490.26	5492.17	5491.79	5492.33	0.007113	3.23	48.84	66.06	0.56
MuddGulch	Reach1	18116.98	0.2%	500-year	385.00	5484.64	5488.15	5488.15	5489.03	0.020545	7.53	51.16	29.53	1.01
MuddGulch	Reach1	18116.98	1%	100-50-10yr	270.00	5484.64	5487.62	5487.62	5488.43	0.021281	7.23	37.37	23.48	1.01
MuddGulch	Reach1	18116.98	2%	100-50-10yr	254.00	5484.64	5487.54	5487.54	5488.33	0.021480	7.14	35.59	22.94	1.01
MuddGulch	Reach1	18116.98	10%	100-50-10yr	145.00	5484.64	5486.93	5486.93	5487.55	0.023304	6.36	22.80	18.61	1.01
MuddGulch	Reach1	17844.24	0.2%	500-year	385.00	5478.80	5481.36	5481.36	5482.20	0.020478	7.33	52.54	31.88	1.01
MuddGulch	Reach1	17844.24	1%	100-50-10yr	270.00	5478.80	5480.95	5480.95	5481.66	0.021522	6.75	39.98	28.50	1.00
MuddGulch	Reach1	17844.24	2%	100-50-10yr	254.00	5478.80	5480.88	5480.88	5481.57	0.021849	6.67	38.06	27.95	1.01
MuddGulch	Reach1	17844.24	10%	100-50-10yr	145.00	5478.80	5480.38	5480.37	5480.90	0.022753	5.75	25.22	23.93	0.99
MuddGulch	Reach1	17384.73	0.2%	500-year	385.00	5468.19	5470.84	5470.84	5471.76	0.019869	7.69	50.07	27.31	1.00
MuddGulch	Reach1	17384.73	1%	100-50-10yr	270.00	5468.19	5470.37	5470.37	5471.16	0.021111	7.12	37.92	24.35	1.01
MuddGulch	Reach1	17384.73	2%	100-50-10yr	254.00	5468.19	5470.30	5470.30	5471.06	0.021246	7.01	36.21	23.91	1.00
MuddGulch	Reach1	17384.73	10%	100-50-10yr	145.00	5468.19	5469.72	5469.72	5470.31	0.023308	6.16	23.53	20.30	1.01
MuddGulch	Reach1	16869.32	0.2%	500-year	385.00	5451.46	5455.23	5455.23	5456.18	0.025431	7.82	49.23	26.13	1.00
MuddGulch	Reach1	16869.32	1%	100-50-10yr	270.00	5451.46	5454.72	5454.72	5455.55	0.026936	7.31	36.92	22.63	1.01
MuddGulch	Reach1	16869.32	2%	100-50-10yr	254.00	5451.46	5454.66	5454.66	5455.46	0.026666	7.18	35.40	22.16	1.00
MuddGulch	Reach1	16869.32	10%	100-50-10yr	145.00	5451.46	5454.00	5454.00	5454.65	0.029343	6.46	22.43	17.64	1.01
MuddGulch	Reach1	16809.73		Culvert										
MuddGulch	Reach1	16749.55	0.2%	500-year	385.00	5449.69	5451.85	5451.85	5452.71	0.025969	7.46	51.61	30.27	1.01
MuddGulch	Reach1	16749.55	1%	100-50-10yr	270.00	5449.69	5451.46	5451.45	5452.16	0.026832	6.69	40.33	28.64	0.99
MuddGulch	Reach1	16749.55	2%	100-50-10yr	254.00	5449.69	5451.42	5451.40	5452.08	0.026137	6.50	39.08	28.46	0.98
MuddGulch	Reach1	16749.55	10%	100-50-10yr	145.00	5449.69	5451.02	5450.93	5451.44	0.023388	5.16	28.11	26.09	0.89
MuddGulch	Reach1	16485.74	0.2%	500-year	385.00	5444.00	5445.90	5445.90	5446.41	0.018088	5.73	67.16	66.47	1.01
MuddGulch	Reach1	16485.74	1%	100-50-10yr	270.00	5444.00	5445.63	5445.63	5446.08	0.019310	5.37	50.25	57.59	1.01
MuddGulch	Reach1	16485.74	2%	100-50-10yr	254.00	5444.00	5445.59	5445.59	5446.03	0.019647	5.32	47.70	56.12	1.02
MuddGulch	Reach1	16485.74	10%	100-50-10yr	145.00	5444.00	5445.25	5445.25	5445.60	0.020771	4.72	30.73	45.20	1.01
MuddGulch	Reach1	16216.12	0.2%	500-year	1857.00	5433.07	5439.26	5439.26	5440.97	0.012709	10.50	176.91	51.78	1.00
MuddGulch	Reach1	16216.12	1%	100-50-10yr	1297.00	5433.07	5438.36	5438.36	5439.83	0.013310	9.72	133.41	45.53	1.00
MuddGulch	Reach1	16216.12	2%	100-50-10yr	1192.00	5433.07	5438.17	5438.17	5439.59	0.013475	9.55	124.80	44.19	1.00
MuddGulch	Reach1	16216.12	10%	100-50-10yr	646.00	5433.07	5436.98	5436.98	5438.07	0.014821	8.39	76.97	35.83	1.01
MuddGulch	Reach1	15806.06	0.2%	500-year	1857.00	5425.98	5430.99	5430.99	5432.02	0.010163	8.31	242.47	135.50	0.89
MuddGulch	Reach1	15806.06	1%	100-50-10yr	1297.00	5425.98	5430.20	5430.20	5431.27	0.013353	8.31	157.15	81.94	0.98
MuddGulch	Reach1	15806.06	2%	100-50-10yr	1192.00	5425.98	5430.02	5430.02	5431.10	0.014469	8.33	143.19	69.34	1.01
MuddGulch	Reach1	15806.06	10%	100-50-10yr	646.00	5425.98	5429.13	5429.13	5429.96	0.015790	7.31	88.39	54.71	1.01
MuddGulch	Reach1	15397.66	0.2%	500-year	1857.00	5419.45	5423.92	5423.92	5424.73	0.009490	9.22	308.34	213.11	0.89
MuddGulch	Reach1	15397.66	1%	100-50-10yr	1297.00	5419.45	5423.61	5423.61	5424.24	0.007997	7.92	245.15	186.40	0.80
MuddGulch	Reach1	15397.66	2%	100-50-10yr	1192.00	5419.45	5423.50	5423.50	5424.13	0.008134	7.81	226.66	178.13	0.80
MuddGulch	Reach1	15397.66	10%	100-50-10yr	646.00	5419.45	5422.91	5422.91	5423.44	0.007964	6.66	135.10	132.81	0.76
MuddGulch	Reach1	15035.70	0.2%	500-year	1857.00	5412.80	5417.64	5417.64	5418.43	0.008399	8.98	305.31	186.51	0.84
MuddGulch	Reach1	15035.70	1%	100-50-10yr	1297.00	5412.80	5417.20	5417.20	5417.90	0.008330	8.19	228.73	160.16	0.82
MuddGulch	Reach1	15035.70	2%	100-50-10yr	1192.00	5412.80	5417.10	5417.10	5417.79	0.008271	8.00	214.06	154.77	0.81
MuddGulch	Reach1	15035.70	10%	100-50-10yr	646.00	5412.80	5416.49	5416.49	5417.04	0.007899	6.73	130.36	119.39	0.76
MuddGulch	Reach1	14623.73	0.2%	500-year	1857.00	5404.62	5410.33	5410.33	5411.82	0.012866	9.79	189.82	131.11	1.00
MuddGulch	Reach1	14623.73	1%	100-50-10yr	1297.00	5404.62	5409.60	5409.60	5410.85	0.013526	8.97	144.58	58.03	1.00
MuddGulch	Reach1	14623.73	2%	100-50-10yr	1192.00	5404.62	5409.43	5409.43	5410.64	0.013710	8.83	135.03	56.08	1.00
MuddGulch	Reach1	14623.73	10%	100-50-10yr	646.00	5404.62	5408.38	5408.38	5409.34	0.015076	7.85	82.31	43.79	1.01
MuddGulch	Reach1	14522.74	0.2%	500-year	1857.00	5402.00	5405.27	5405.27	5406.76	0.012729	9.79	189.71	242.61	1.01
MuddGulch	Reach1	14522.74	1%	100-50-10yr	1297.00	5402.00	5404.60	5404.60	5405.81	0.013717	8.82	146.97	237.19	1.01
MuddGulch	Reach1	14522.74	2%	100-50-10yr	1192.00	5402.00	5404.47	5404.47	5405.61	0.013847	8.59	138.82	236.13	1.01
MuddGulch	Reach1	14522.74	10%	100-50-10yr	646.00	5402.00	5403.81	5403.66	5404.46	0.011705	6.51	99.28	230.75	0.88
MuddGulch	Reach1	14414.32	0.2%	500-year	1857.00	5401.50	5405.44	5403.94	5405.85	0.002709	5.17	358.99	23	

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
MuddGulch	Reach1	14414.32	1%	100-50-10yr	1297.00	5401.50	5404.32	5403.43	5404.74	0.004098	5.18	250.50	222.19	0.56
MuddGulch	Reach1	14414.32	2%	100-50-10yr	1192.00	5401.50	5404.08	5403.33	5404.51	0.004672	5.23	227.91	220.19	0.59
MuddGulch	Reach1	14414.32	10%	100-50-10yr	646.00	5401.50	5403.18	5402.72	5403.49	0.005831	4.45	145.11	212.69	0.62
MuddGulch	Reach1	14002.14	0.2%	500-year	1857.00	5401.00	5405.48	5402.23	5405.52	0.000219	1.62	1147.75	276.34	0.14
MuddGulch	Reach1	14002.14	1%	100-50-10yr	1297.00	5401.00	5404.27	5401.97	5404.31	0.000311	1.58	819.79	265.98	0.16
MuddGulch	Reach1	14002.14	2%	100-50-10yr	1192.00	5401.00	5403.99	5401.93	5404.03	0.000355	1.60	746.09	263.56	0.17
MuddGulch	Reach1	14002.14	10%	100-50-10yr	646.00	5401.00	5402.89	5401.62	5402.92	0.000494	1.40	460.51	253.53	0.18
MuddGulch	Reach1	13823.62	0.2%	500-year	1857.00	5400.50	5405.00	5403.31	5405.39	0.002679	5.02	370.22	106.27	0.47
MuddGulch	Reach1	13823.62	1%	100-50-10yr	1297.00	5400.50	5403.68	5402.73	5404.13	0.004286	5.39	240.70	88.36	0.58
MuddGulch	Reach1	13823.62	2%	100-50-10yr	1192.00	5400.50	5403.32	5402.61	5403.82	0.005473	5.68	209.69	85.40	0.64
MuddGulch	Reach1	13823.62	10%	100-50-10yr	646.00	5400.50	5401.93	5401.93	5402.60	0.016462	6.55	98.60	74.37	1.00
MuddGulch	Reach1	13676.00	0.2%	500-year	1857.00	5394.30	5401.81	5401.81	5404.70	0.003304	13.66	135.96	66.89	1.01
MuddGulch	Reach1	13676.00	1%	100-50-10yr	1297.00	5394.30	5401.13	5401.13	5403.38	0.003502	12.04	107.73	42.82	1.00
MuddGulch	Reach1	13676.00	2%	100-50-10yr	1192.00	5394.30	5400.87	5400.87	5403.01	0.003608	11.74	101.50	33.57	1.01
MuddGulch	Reach1	13676.00	10%	100-50-10yr	646.00	5394.30	5399.46	5399.46	5400.88	0.003769	9.56	67.59	24.00	1.00
MuddGulch	Reach1	13478.31	0.2%	500-year	1857.00	5396.64	5399.17	5399.17	5400.14	0.014525	7.91	234.89	266.70	1.01
MuddGulch	Reach1	13478.31	1%	100-50-10yr	1297.00	5396.64	5398.75	5398.75	5399.53	0.016032	7.05	183.85	207.90	1.01
MuddGulch	Reach1	13478.31	2%	100-50-10yr	1192.00	5396.64	5398.67	5398.67	5399.40	0.016213	6.84	174.18	197.48	1.01
MuddGulch	Reach1	13478.31	10%	100-50-10yr	646.00	5396.64	5398.19	5398.19	5398.68	0.018887	5.61	115.21	142.93	1.02
MuddGulch	Reach1	13246.54	0.2%	500-year	1857.00	5382.05	5385.83	5385.83	5387.41	0.012921	10.09	184.08	58.43	1.00
MuddGulch	Reach1	13246.54	1%	100-50-10yr	1297.00	5382.05	5385.13	5385.13	5386.40	0.013872	9.02	143.79	57.74	1.01
MuddGulch	Reach1	13246.54	2%	100-50-10yr	1192.00	5382.05	5384.99	5384.99	5386.19	0.014105	8.78	135.71	57.58	1.01
MuddGulch	Reach1	13246.54	10%	100-50-10yr	646.00	5382.05	5384.19	5384.19	5384.99	0.015711	7.19	89.83	56.67	1.01
MuddGulch	Reach1	13164.55	0.2%	500-year	1857.00	5369.86	5373.85	5373.85	5375.16	0.013424	9.19	201.98	77.89	1.01
MuddGulch	Reach1	13164.55	1%	100-50-10yr	1297.00	5369.86	5373.20	5373.20	5374.31	0.014209	8.44	153.58	70.50	1.01
MuddGulch	Reach1	13164.55	2%	100-50-10yr	1192.00	5369.86	5373.07	5373.07	5374.13	0.014171	8.23	144.89	69.09	1.00
MuddGulch	Reach1	13164.55	10%	100-50-10yr	646.00	5369.86	5372.23	5372.23	5373.01	0.015544	7.13	90.67	57.73	1.00
MuddGulch	Reach1	12837.83	0.2%	500-year	1857.00	5364.14	5370.68	5368.46	5371.12	0.002891	5.34	347.96	84.23	0.44
MuddGulch	Reach1	12837.83	1%	100-50-10yr	1297.00	5364.14	5369.38	5367.77	5369.79	0.003595	5.15	251.76	70.43	0.48
MuddGulch	Reach1	12837.83	2%	100-50-10yr	1192.00	5364.14	5369.12	5367.61	5369.52	0.003782	5.10	233.54	68.47	0.49
MuddGulch	Reach1	12837.83	10%	100-50-10yr	646.00	5364.14	5367.66	5367.77	5367.99	0.005050	4.60	140.30	59.94	0.53
MuddGulch	Reach1	12530.28	0.2%	500-year	1857.00	5360.45	5366.64	5366.64	5369.13	0.017391	12.65	146.75	29.86	1.01
MuddGulch	Reach1	12530.28	1%	100-50-10yr	1297.00	5360.45	5365.47	5365.47	5367.52	0.018003	11.49	112.86	27.84	1.01
MuddGulch	Reach1	12530.28	2%	100-50-10yr	1192.00	5360.45	5365.22	5365.22	5367.18	0.018129	11.22	106.21	27.42	1.01
MuddGulch	Reach1	12530.28	10%	100-50-10yr	646.00	5360.45	5363.78	5363.78	5365.17	0.019417	9.44	68.42	24.94	1.00
MuddGulch	Reach1	12220.19	0.2%	500-year	1857.00	5356.30	5361.48	5360.64	5362.63	0.008874	8.61	215.64	50.29	0.73
MuddGulch	Reach1	12220.19	1%	100-50-10yr	1297.00	5356.30	5360.45	5359.87	5361.42	0.010085	7.89	164.35	49.09	0.76
MuddGulch	Reach1	12220.19	2%	100-50-10yr	1192.00	5356.30	5360.25	5359.70	5361.17	0.010358	7.72	154.42	48.86	0.77
MuddGulch	Reach1	12220.19	10%	100-50-10yr	646.00	5356.30	5359.08	5358.79	5359.75	0.012740	6.57	98.36	47.51	0.80
MuddGulch	Reach1	11900.70	0.2%	500-year	1857.00	5351.90	5358.67	5357.52	5359.92	0.008112	8.96	207.18	41.99	0.71
MuddGulch	Reach1	11900.70	1%	100-50-10yr	1297.00	5351.90	5357.58	5356.56	5358.56	0.007992	7.97	162.74	39.42	0.69
MuddGulch	Reach1	11900.70	2%	100-50-10yr	1192.00	5351.90	5357.34	5356.37	5358.28	0.007990	7.76	153.66	38.88	0.69
MuddGulch	Reach1	11900.70	10%	100-50-10yr	646.00	5351.90	5355.97	5355.20	5356.59	0.007889	6.31	102.31	35.65	0.66
MuddGulch	Reach1	11496.49	0.2%	500-year	1857.00	5347.52	5353.20	5353.20	5355.33	0.016208	11.72	158.44	37.43	1.00
MuddGulch	Reach1	11496.49	1%	100-50-10yr	1297.00	5347.52	5352.14	5352.14	5353.93	0.017070	10.75	120.66	34.03	1.01
MuddGulch	Reach1	11496.49	2%	100-50-10yr	1192.00	5347.52	5351.92	5351.92	5353.64	0.017225	10.52	113.36	33.34	1.00
MuddGulch	Reach1	11496.49	10%	100-50-10yr	646.00	5347.52	5350.60	5350.60	5351.85	0.018634	8.95	72.21	29.12	1.00
MuddGulch	Reach1	10979.19	0.2%	500-year	1857.00	5337.45	5344.58	5343.95	5346.22	0.011061	10.27	180.78	38.84	0.84
MuddGulch	Reach1	10979.19	1%	100-50-10yr	1297.00	5337.45	5343.40	5342.83	5344.79	0.011367	9.43	137.47	34.43	0.83
MuddGulch	Reach1	10979.19	2%	100-50-10yr	1192.00	5337.45	5343.16	5342.61	5344.48	0.011336	9.21	129.36	33.53	0.83
MuddGulch	Reach1	10979.19	10%	100-50-10yr	646.00	5337.45	5341.60	5341.15	5342.58	0.011865	7.92	81.53	27.71	0.81
MuddGulch	Reach1	10698.07	0.2%	500-year	1857.00	5330.52	5339.96	5339.96	5342.33	0.017099	12.36	150.27	31.84	1.00
MuddGulch	Reach1	10698.07	1%	100-50-10yr	1297.00	5330.52	5338.69	5338.69	5340.75	0.018047	11.53	112.51	27.55	1.01
MuddGulch	Reach1	10698.07	2%	100-50-10yr	1192.00	5330.52	5338.40	5338.40	5340.41	0.018412	11.37	104.81	26.59	1.01
MuddGulch	Reach1	10698.07	10%	100-50-10yr	646.00	5330.52	5336.69	5336.69	5338.26	0.020045	10.07	64.13	20.80	1.01
MuddGulch	Reach1	10419.12	0.2%	500-year	1857.00	5328.00	5333.31	5332.39	5334.32	0.007119	8.07	230.21	70.20	0.69
MuddGulch	Reach1	10419.12	1%	100-50-10yr	1297.00	5328.00	5332.51	5331.66	5333.26	0.007018	6.96	186.41	63.08	0.67
MuddGulch	Reach1	10419.12	2%	100-50-10yr	1192.00	5328.00	5332.33	5331.50	5333.04	0.007118	6.76	176.45	61.46	0.66
MuddGulch	Reach1	10419.12	10%	100-50-10yr	646.00	5328.00	5331.23	5330.52	5331.70	0.007251	5.49	117.73	51.62	0.64
MuddGulch	Reach1	10391.79		Bridge										
MuddGulch	Reach1	10364.86	0.2%	500-year	1857.00	5325.73	5331.19	5331.19	5333.10	0.016075	11.11	167.14	43.98	1.00
MuddGulch	Reach1	10364.86	1%	100-50-10yr	1297.00	5325.73	5330.21	5330.21	5331.84	0.016966	10.26	126.46	39.21	1.01
MuddGulch	Reach1	10364.86	2%	100-50-10yr	1192.00	5325.73	5330.01	5330.01	5331.58	0.017104	10.04	118.67	38.23	1.00
MuddGulch	Reach1	10364.86	10%	100-50-10yr	646.00	5325.73	5328.75	5328.75	5329.92	0.018763	8.69	74.30	32.08	1.01
MuddGulch	Reach1	10261.61	0.2%	500-year	1857.00	5323.80	5328.56	5328.28	5330.09	0.012969	9.93	187.09	50.02	0.90
MuddGulch	Reach1	10261.61	1%	100-50-10yr	1297.00	5323.80	5327.72	5327.41	5328.94	0.012785	8.85	146.60	46.28	0.88
MuddGulch	Reach1	10261.61	2%	100-50-10yr	1192.00	5323.80	5327.54	5327.23	5328.70	0.012845	8.63	138.11	45.46	0.87
MuddGulch	Reach1	10261.61	10%	100-50-10yr	646.00	5323.80	5326.45	5326.16	5327.23	0.012882	7.09	91.06	40.60	0.83
MuddGulch	Reach1	10030.00	0.2%	500-year	1857.00	5319.19	5324.78	5324.78	5326.65	0.016149	10.98	169.14	45.71	1.01
MuddGulch	Reach1	10030.00	1%	100-50-10yr	1297.00	5319.19	5323.83	5323.83	5325.42	0.017048	10.13	128.00	40.76	1.01
MuddGulch	Reach1	10030.00	2%	100-50-10yr	1192.00	5319.19	5323.63	5323.63	5325.16	0.017151	9.92	120.21	39.76	1.00
MuddGulch	Reach1	10030.00	10%	100-50-10yr	646.00	5319.19	5322.41	5322.41	5323.55	0.018805	8.58	75.32	33.38	1.01
MuddGulch	Reach1	9710.46	0.2%	500-year	1857.00	5316.24	5321.34	5319.99	5322.19	0.005846	7.38	251.55	55.55	0.61
MuddGulch	Reach1	9710.46	1%	100-50-10yr	1297.00	5316.24	5320.38	5319.26						

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
MuddGulch	Reach1	9710.46	2%	100-50-10yr	1192.00	5316.24	5320.16	5319.11	5320.79	0.006017	6.37	187.20	53.65	0.60
MuddGulch	Reach1	9710.46	10%	100-50-10yr	646.00	5316.24	5318.97	5318.23	5319.39	0.006445	5.20	124.18	51.72	0.59
MuddGulch	Reach1	9424.36	0.2%	500-year	1857.00	5311.83	5317.63	5317.63	5319.49	0.015993	10.96	169.50	45.60	1.00
MuddGulch	Reach1	9424.36	1%	100-50-10yr	1297.00	5311.83	5316.66	5316.66	5318.26	0.017006	10.15	127.81	40.52	1.01
MuddGulch	Reach1	9424.36	2%	100-50-10yr	1192.00	5311.83	5316.47	5316.47	5318.00	0.016983	9.91	120.32	39.53	1.00
MuddGulch	Reach1	9424.36	10%	100-50-10yr	646.00	5311.83	5315.22	5315.22	5316.38	0.018773	8.61	75.02	32.98	1.01
MuddGulch	Reach1	9164.50	0.2%	500-year	1857.00	5306.12	5313.82	5311.76	5315.00	0.004426	8.74	212.38	74.62	0.59
MuddGulch	Reach1	9164.50	1%	100-50-10yr	1297.00	5306.12	5311.75	5310.74	5312.94	0.007125	8.74	148.44	61.58	0.70
MuddGulch	Reach1	9164.50	2%	100-50-10yr	1192.00	5306.12	5311.30	5310.54	5312.52	0.008361	8.86	134.50	58.74	0.75
MuddGulch	Reach1	9164.50	10%	100-50-10yr	646.00	5306.12	5309.34	5309.34	5310.54	0.018395	8.79	73.51	45.43	1.01
MuddGulch	Reach1	9048.02			Culvert									
MuddGulch	Reach1	8955.76	0.2%	500-year	1857.00	5300.01	5309.93	5306.75	5310.77	0.002611	7.37	252.10	65.54	0.46
MuddGulch	Reach1	8955.76	1%	100-50-10yr	1297.00	5300.01	5308.80	5305.74	5309.36	0.002128	6.00	216.11	59.97	0.41
MuddGulch	Reach1	8955.76	2%	100-50-10yr	1192.00	5300.01	5308.54	5305.55	5309.05	0.002053	5.74	207.66	58.66	0.40
MuddGulch	Reach1	8955.76	10%	100-50-10yr	646.00	5300.01	5307.03	5304.25	5307.29	0.001454	4.05	159.46	51.19	0.32
MuddGulch	Reach1	8669.89	0.2%	500-year	1857.00	5302.11	5309.70	5306.00	5309.98	0.001298	4.23	438.96	86.02	0.31
MuddGulch	Reach1	8669.89	1%	100-50-10yr	1297.00	5302.11	5308.53	5305.31	5308.74	0.001191	3.66	354.16	77.49	0.29
MuddGulch	Reach1	8669.89	2%	100-50-10yr	1192.00	5302.11	5308.26	5305.17	5308.46	0.001188	3.56	334.89	75.59	0.29
MuddGulch	Reach1	8669.89	10%	100-50-10yr	646.00	5302.11	5306.76	5304.34	5306.88	0.001019	2.76	234.31	64.26	0.25
MuddGulch	Reach1	8411.16	0.2%	500-year	2437.00	5302.69	5307.45	5306.90	5308.81	0.010439	9.37	260.10	64.04	0.82
MuddGulch	Reach1	8411.16	1%	100-50-10yr	1724.00	5302.69	5306.62	5306.10	5307.69	0.010454	8.31	207.58	61.75	0.80
MuddGulch	Reach1	8411.16	2%	100-50-10yr	1571.00	5302.69	5306.43	5305.93	5307.42	0.010383	8.02	195.93	61.23	0.79
MuddGulch	Reach1	8411.16	10%	100-50-10yr	853.00	5302.69	5305.38	5304.94	5306.01	0.010284	6.41	133.08	58.35	0.75
MuddGulch	Reach1	8031.07	0.2%	500-year	2437.00	5298.42	5303.75	5303.10	5304.96	0.009615	8.86	275.06	70.96	0.79
MuddGulch	Reach1	8031.07	1%	100-50-10yr	1724.00	5298.42	5302.93	5302.31	5303.89	0.009392	7.88	218.90	66.38	0.76
MuddGulch	Reach1	8031.07	2%	100-50-10yr	1571.00	5298.42	5302.71	5302.12	5303.63	0.009497	7.67	204.76	65.18	0.76
MuddGulch	Reach1	8031.07	10%	100-50-10yr	853.00	5298.42	5301.59	5301.12	5302.21	0.009711	6.31	135.15	58.90	0.73
MuddGulch	Reach1	7701.39	0.2%	500-year	2437.00	5295.67	5300.98	5300.02	5301.89	0.008514	7.69	316.94	703.88	0.69
MuddGulch	Reach1	7701.39	1%	100-50-10yr	1724.00	5295.67	5300.08	5299.26	5300.84	0.008785	7.03	245.12	263.34	0.70
MuddGulch	Reach1	7701.39	2%	100-50-10yr	1571.00	5295.67	5299.84	5299.07	5300.58	0.008736	6.92	227.08	150.97	0.70
MuddGulch	Reach1	7701.39	10%	100-50-10yr	853.00	5295.67	5298.67	5298.10	5299.20	0.008465	5.86	145.64	64.16	0.69
MuddGulch	Reach1	7414.21	0.2%	500-year	2437.00	5292.29	5296.76	5296.72	5298.43	0.017399	10.39	235.10	163.90	0.99
MuddGulch	Reach1	7414.21	1%	100-50-10yr	1724.00	5292.29	5295.89	5295.89	5297.35	0.017065	9.67	178.32	93.84	1.01
MuddGulch	Reach1	7414.21	2%	100-50-10yr	1571.00	5292.29	5295.70	5295.70	5297.09	0.017293	9.43	166.60	61.09	1.01
MuddGulch	Reach1	7414.21	10%	100-50-10yr	853.00	5292.29	5294.67	5294.67	5295.66	0.018953	7.97	107.05	54.34	1.00
MuddGulch	Reach1	7054.93	0.2%	500-year	2437.00	5284.18	5290.32	5290.32	5292.48	0.015564	11.79	206.64	48.36	1.01
MuddGulch	Reach1	7054.93	1%	100-50-10yr	1724.00	5284.18	5289.30	5289.30	5291.11	0.016175	10.81	159.54	44.04	1.00
MuddGulch	Reach1	7054.93	2%	100-50-10yr	1571.00	5284.18	5289.05	5289.05	5290.78	0.016409	10.56	148.71	42.98	1.00
MuddGulch	Reach1	7054.93	10%	100-50-10yr	853.00	5284.18	5287.68	5287.68	5288.96	0.018217	9.08	93.93	37.17	1.01
MuddGulch	Reach1	6896.94	0.2%	500-year	2437.00	5278.64	5286.03	5286.03	5288.36	0.015923	12.25	198.90	43.28	1.01
MuddGulch	Reach1	6896.94	1%	100-50-10yr	1724.00	5278.64	5284.91	5284.91	5286.89	0.016485	11.29	152.70	38.72	1.00
MuddGulch	Reach1	6896.94	2%	100-50-10yr	1571.00	5278.64	5284.58	5284.58	5286.52	0.016736	11.19	140.39	36.42	1.00
MuddGulch	Reach1	6896.94	10%	100-50-10yr	853.00	5278.64	5283.07	5282.83	5284.40	0.014495	9.24	92.36	28.75	0.91
MuddGulch	Reach1	6479.48	0.2%	500-year	2437.00	5274.11	5284.28	5281.59	5285.00	0.003575	6.82	357.11	62.80	0.50
MuddGulch	Reach1	6479.48	1%	100-50-10yr	1724.00	5274.11	5282.62	5280.55	5283.30	0.004226	6.63	259.99	54.26	0.53
MuddGulch	Reach1	6479.48	2%	100-50-10yr	1571.00	5274.11	5282.23	5280.28	5282.90	0.004378	6.55	239.68	52.30	0.54
MuddGulch	Reach1	6479.48	10%	100-50-10yr	853.00	5274.11	5280.18	5278.84	5280.73	0.005291	5.96	143.13	41.72	0.57
MuddGulch	Reach1	6282.00	0.2%	500-year	2437.00	5271.78	5283.39	5280.59	5284.27	0.003287	7.53	323.68	56.37	0.49
MuddGulch	Reach1	6282.00	1%	100-50-10yr	1724.00	5271.78	5281.72	5279.44	5282.47	0.003972	6.94	248.45	48.65	0.52
MuddGulch	Reach1	6282.00	2%	100-50-10yr	1571.00	5271.78	5281.30	5279.15	5282.03	0.004305	6.85	229.29	46.68	0.53
MuddGulch	Reach1	6282.00	10%	100-50-10yr	853.00	5271.78	5279.12	5277.51	5279.70	0.005086	6.13	139.25	36.62	0.55
MuddGulch	Reach1	6253.73			Bridge									
MuddGulch	Reach1	6217.24	0.2%	500-year	2437.00	5271.14	5283.35	5279.16	5283.99	0.001846	6.38	381.72	307.57	0.39
MuddGulch	Reach1	6217.24	1%	100-50-10yr	1724.00	5271.14	5281.66	5278.07	5282.15	0.001942	5.64	305.46	119.07	0.38
MuddGulch	Reach1	6217.24	2%	100-50-10yr	1571.00	5271.14	5281.22	5277.81	5281.69	0.002011	5.50	285.88	70.64	0.38
MuddGulch	Reach1	6217.24	10%	100-50-10yr	853.00	5271.14	5279.03	5276.41	5279.34	0.001986	4.46	191.10	51.72	0.36
MuddGulch	Reach1	5974.50	0.2%	500-year	3078.00	5270.12	5279.73	5279.73	5282.30	0.015365	12.86	239.39	47.03	1.00
MuddGulch	Reach1	5974.50	1%	100-50-10yr	2191.00	5270.12	5279.27	5278.47	5280.83	0.009996	10.04	218.18	45.01	0.80
MuddGulch	Reach1	5974.50	2%	100-50-10yr	1970.00	5270.12	5279.01	5278.10	5280.42	0.009330	9.52	206.85	43.89	0.77
MuddGulch	Reach1	5974.50	10%	100-50-10yr	1054.00	5270.12	5277.50	5276.28	5278.32	0.006902	7.24	145.59	37.28	0.65
MuddGulch	Reach1	5477.27	0.2%	500-year	3078.00	5268.76	5279.52	5276.66	5279.77	0.001113	4.75	1032.41	951.83	0.30
MuddGulch	Reach1	5477.27	1%	100-50-10yr	2191.00	5268.76	5278.38	5275.69	5278.69	0.001491	4.94	575.30	326.73	0.34
MuddGulch	Reach1	5477.27	2%	100-50-10yr	1970.00	5268.76	5278.04	5275.42	5278.35	0.001533	4.84	495.25	149.55	0.34
MuddGulch	Reach1	5477.27	10%	100-50-10yr	1054.00	5268.76	5276.20	5273.98	5276.46	0.001846	4.20	277.60	97.09	0.35
MuddGulch	Reach1	5134.21	0.2%	500-year	3078.00	5267.94	5276.57	5276.57	5278.66	0.013799	11.67	273.40	2473.73	0.95
MuddGulch	Reach1	5134.21	1%	100-50-10yr	2191.00	5267.94	5275.54	5275.54	5277.34	0.016466	10.79	203.84	2329.89	1.00
MuddGulch	Reach1	5134.21	2%	100-50-10yr	1970.00	5267.94	5275.27	5275.27	5276.98	0.017172	10.47	188.25	2151.28	1.01
MuddGulch	Reach1	5134.21	10%	100-50-10yr	1054.00	5267.94	5273.09	5273.09	5274.86	0.017809	10.69	98.64	28.38	1.01
MuddGulch	Reach1	4937.94	0.2%	500-year	3078.00	5266.65	5273.36	5271.36	5273.39	0.000669	2.58	2991.70	2109.59	0.21
MuddGulch	Reach1	4937.94	1%	100-50-10yr	2191.00	5266.65	5273.12	5270.88	5273.14	0.000521	2.22	2528.17	2102.68	0.19
MuddGulch	Reach1	4937.94	2%	100-50-10yr	1970.00	5266.65	5273.05	5270.73	5273.07	0.000477	2.11	2402.94	2101.56	0.18
MuddGulch	Reach1	4937.94	10%	100-50-10yr	1054.00	5266.65	5272.61	5270.08	5272.62	0.000292	1.58	1640.77	1772.77	0.14
MuddGulch	Reach1	4835.77	0.2%	500-year	3078.00	5265.15	5272.88	5272.81	5273.17	0.003357	6.91	1675.53	1693.83	0.50

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
MuddGulch	Reach1	4835.77	1%	100-50-10yr	2191.00	5265.15	5272.60	5272.60	5272.93	0.003319	6.65	1259.29	1560.26	0.49
MuddGulch	Reach1	4835.77	2%	100-50-10yr	1970.00	5265.15	5272.52	5272.52	5272.86	0.003286	6.55	1146.23	1522.77	0.49
MuddGulch	Reach1	4835.77	10%	100-50-10yr	1054.00	5265.15	5272.32	5270.50	5272.51	0.001556	4.41	875.18	1425.47	0.33
MuddGulch	Reach1	4820.16		Bridge										
MuddGulch	Reach1	4798.82	0.2%	500-year	3078.00	5264.74	5272.57	5272.57	5272.92	0.003657	7.31	1294.65	1718.60	0.52
MuddGulch	Reach1	4798.82	1%	100-50-10yr	2191.00	5264.74	5272.41	5272.41	5272.71	0.002795	6.28	1080.82	1655.28	0.45
MuddGulch	Reach1	4798.82	2%	100-50-10yr	1970.00	5264.74	5272.33	5272.33	5272.64	0.002805	6.23	976.68	1608.03	0.45
MuddGulch	Reach1	4798.82	10%	100-50-10yr	1054.00	5264.74	5270.09	5270.09	5271.92	0.016273	10.86	97.04	85.92	1.01
MuddGulch	Reach1	4752.50	0.2%	500-year	3078.00	5262.17	5269.90	5269.74	5271.53	0.012566	10.26	299.92	97.61	0.97
MuddGulch	Reach1	4752.50	1%	100-50-10yr	2191.00	5262.17	5269.70	5268.95	5270.63	0.007529	7.74	282.96	94.27	0.74
MuddGulch	Reach1	4752.50	2%	100-50-10yr	1970.00	5262.17	5269.53	5268.74	5270.36	0.007061	7.33	268.82	91.42	0.71
MuddGulch	Reach1	4752.50	10%	100-50-10yr	1054.00	5262.17	5268.57	5267.51	5269.02	0.005288	5.42	194.47	75.39	0.59
MuddGulch	Reach1	4479.82	0.2%	500-year	3078.00	5260.11	5268.49	5268.49	5269.07	0.004723	7.12	811.35	1587.77	0.55
MuddGulch	Reach1	4479.82	1%	100-50-10yr	2191.00	5260.11	5267.64	5266.87	5268.58	0.007519	7.99	339.77	894.63	0.67
MuddGulch	Reach1	4479.82	2%	100-50-10yr	1970.00	5260.11	5267.40	5266.44	5268.32	0.007764	7.81	281.73	715.91	0.68
MuddGulch	Reach1	4479.82	10%	100-50-10yr	1054.00	5260.11	5264.99	5264.99	5266.30	0.019043	9.16	115.02	45.01	1.01
MuddGulch	Reach1	4005.63	0.2%	500-year	3078.00	5255.04	5262.96	5262.96	5263.60	0.005734	7.54	735.40	1101.18	0.63
MuddGulch	Reach1	4005.63	1%	100-50-10yr	2191.00	5255.04	5261.69	5261.69	5263.42	0.016398	10.55	207.65	654.91	1.01
MuddGulch	Reach1	4005.63	2%	100-50-10yr	1970.00	5255.04	5261.42	5261.42	5263.07	0.016475	10.29	191.45	305.08	1.01
MuddGulch	Reach1	4005.63	10%	100-50-10yr	1054.00	5255.04	5261.46	5259.99	5261.92	0.004553	5.43	193.99	330.51	0.53
MuddGulch	Reach1	3515.21	0.2%	500-year	3078.00	5251.87	5259.76	5259.65	5260.15	0.004420	6.54	949.33	984.44	0.55
MuddGulch	Reach1	3515.21	1%	100-50-10yr	2191.00	5251.87	5259.66	5259.24	5259.90	0.002700	5.03	877.59	967.85	0.43
MuddGulch	Reach1	3515.21	2%	100-50-10yr	1970.00	5251.87	5259.64	5259.11	5259.84	0.002251	4.58	866.03	965.19	0.39
MuddGulch	Reach1	3515.21	10%	100-50-10yr	1054.00	5251.87	5258.05	5257.38	5258.77	0.009263	6.79	160.84	170.55	0.74
MuddGulch	Reach1	3493.08		Bridge										
MuddGulch	Reach1	3469.15	0.2%	500-year	3078.00	5251.50	5258.10	5257.94	5258.54	0.008507	8.43	845.86	1049.25	0.71
MuddGulch	Reach1	3469.15	1%	100-50-10yr	2191.00	5251.50	5257.63	5257.37	5258.18	0.010329	8.61	537.84	743.35	0.77
MuddGulch	Reach1	3469.15	2%	100-50-10yr	1970.00	5251.50	5257.50	5257.34	5258.04	0.009987	8.28	462.46	607.77	0.75
MuddGulch	Reach1	3469.15	10%	100-50-10yr	1054.00	5251.50	5256.93	5256.37	5257.27	0.006634	6.05	280.35	217.97	0.60
MuddGulch	Reach1	3389.17	0.2%	500-year	3078.00	5251.29	5257.66	5256.57	5257.74	0.001899	3.17	1389.12	674.41	0.33
MuddGulch	Reach1	3389.17	1%	100-50-10yr	2191.00	5251.29	5257.25	5256.30	5257.32	0.001861	2.86	1125.68	650.60	0.32
MuddGulch	Reach1	3389.17	2%	100-50-10yr	1970.00	5251.29	5257.09	5256.26	5257.16	0.002028	2.87	1024.34	642.71	0.33
MuddGulch	Reach1	3389.17	10%	100-50-10yr	1054.00	5251.29	5256.47	5255.92	5256.53	0.002456	3.03	631.22	613.44	0.36
MuddGulch	Reach1	3389.00		Lat Struct										
MuddGulch	Reach1	2868.02	0.2%	500-year	2950.86	5249.44	5254.62	5254.62	5255.43	0.012899	9.78	493.30	890.54	0.88
MuddGulch	Reach1	2868.02	1%	100-50-10yr	2173.93	5249.44	5254.12	5254.12	5254.94	0.014223	9.49	369.06	807.49	0.91
MuddGulch	Reach1	2868.02	2%	100-50-10yr	1957.69	5249.44	5254.09	5254.09	5254.78	0.012101	8.72	362.21	804.45	0.84
MuddGulch	Reach1	2868.02	10%	100-50-10yr	1054.00	5249.44	5253.48	5253.48	5254.03	0.009878	7.31	236.91	736.85	0.75
MuddGulch	Reach1	2868.00		Lat Struct										
MuddGulch	Reach1	2519.13	0.2%	500-year	1033.00	5244.48	5250.09	5248.33	5250.27	0.002343	3.39	315.21	918.12	0.37
MuddGulch	Reach1	2519.13	1%	100-50-10yr	950.57	5244.48	5249.93	5248.21	5250.10	0.002384	3.35	289.07	907.70	0.37
MuddGulch	Reach1	2519.13	2%	100-50-10yr	878.68	5244.48	5249.79	5248.08	5249.95	0.002367	3.28	269.74	884.13	0.37
MuddGulch	Reach1	2519.13	10%	100-50-10yr	742.64	5244.48	5249.29	5247.85	5249.47	0.002957	3.43	216.56	814.51	0.40
MuddGulch	Reach1	2519.00		Lat Struct										
MuddGulch	Reach1	2498.67	0.2%	500-year	970.22	5243.77	5249.23	5248.06	5250.01	0.005870	7.08	137.13	985.54	0.61
MuddGulch	Reach1	2498.67	1%	100-50-10yr	921.10	5243.77	5249.11	5247.96	5249.85	0.005855	6.92	133.02	965.01	0.61
MuddGulch	Reach1	2498.67	2%	100-50-10yr	878.68	5243.77	5249.00	5247.87	5249.72	0.005842	6.79	129.40	943.05	0.60
MuddGulch	Reach1	2498.67	10%	100-50-10yr	742.64	5243.77	5248.63	5247.58	5249.25	0.005805	6.34	117.20	842.22	0.59
MuddGulch	Reach1	2473.27		Bridge										
MuddGulch	Reach1	2418.14	0.2%	500-year	970.22	5243.10	5247.73	5246.66	5248.55	0.006194	7.27	133.42	1045.15	0.64
MuddGulch	Reach1	2418.14	1%	100-50-10yr	921.10	5243.10	5247.67	5246.56	5248.43	0.005837	7.00	131.65	1044.19	0.62
MuddGulch	Reach1	2418.14	2%	100-50-10yr	878.68	5243.10	5247.63	5246.47	5248.34	0.005498	6.74	130.29	1043.46	0.60
MuddGulch	Reach1	2418.14	10%	100-50-10yr	742.64	5243.10	5247.49	5246.18	5248.04	0.004422	5.91	125.73	1023.73	0.53
MuddGulch	Reach1	2189.83	0.2%	500-year	1118.22	5242.25	5246.42	5246.22	5246.99	0.006987	6.43	209.37	988.29	0.65
MuddGulch	Reach1	2189.83	1%	100-50-10yr	1032.10	5242.25	5246.23	5246.10	5246.86	0.008040	6.61	184.41	985.51	0.69
MuddGulch	Reach1	2189.83	2%	100-50-10yr	969.68	5242.25	5246.09	5246.01	5246.76	0.008968	6.75	165.74	983.43	0.72
MuddGulch	Reach1	2189.83	10%	100-50-10yr	787.64	5242.25	5245.62	5245.30	5246.38	0.012056	7.02	114.12	875.90	0.82
MuddGulch	Reach1	1989.08	0.2%	500-year	1118.22	5237.86	5245.45	5243.58	5245.97	0.004079	5.78	193.36	883.30	0.51
MuddGulch	Reach1	1989.08	1%	100-50-10yr	1032.10	5237.86	5245.22	5243.40	5245.72	0.004055	5.65	182.60	856.68	0.51
MuddGulch	Reach1	1989.08	2%	100-50-10yr	969.68	5237.86	5245.04	5243.25	5245.52	0.004051	5.56	174.42	836.88	0.50
MuddGulch	Reach1	1989.08	10%	100-50-10yr	787.64	5237.86	5244.48	5242.81	5244.91	0.004053	5.27	149.50	785.76	0.50
MuddGulch	Reach1	1574.31	0.2%	500-year	1118.22	5234.65	5241.49	5241.26	5242.96	0.014822	9.72	115.08	615.02	0.92
MuddGulch	Reach1	1574.31	1%	100-50-10yr	1032.10	5234.65	5241.25	5241.05	5242.69	0.015293	9.63	107.14	581.02	0.93
MuddGulch	Reach1	1574.31	2%	100-50-10yr	969.68	5234.65	5241.08	5240.89	5242.49	0.015510	9.53	101.74	556.56	0.93
MuddGulch	Reach1	1574.31	10%	100-50-10yr	787.64	5234.65	5240.56	5240.38	5241.86	0.015904	9.12	86.34	509.91	0.93
MuddGulch	Reach1	1261.28	0.2%	500-year	1118.22	5232.98	5238.75	5237.45	5239.71	0.007098	7.83	142.74	826.97	0.65
MuddGulch	Reach1	1261.28	1%	100-50-10yr	1032.10	5232.98	5238.55	5237.24	5239.44	0.006886	7.57	136.38	802.68	0.64
MuddGulch	Reach1	1261.28	2%	100-50-10yr	969.68	5232.98	5238.36	5237.09	5239.22	0.006870	7.42	130.65	783.28	0.63
MuddGulch	Reach1	1261.28	10%	100-50-10yr	787.64	5232.98	5237.74	5236.62	5238.51	0.007089	7.05	111.80	678.46	0.64
MuddGulch	Reach1	863.78	0.2%	500-year	1118.22	5229.99	5238.01	5234.55	5238.32	0.001642	4.46	254.56	1403.66	0.33
MuddGulch	Reach1	863.78	1%	100-50-10yr	1032.10	5229.99	5237.86	5234.38	5238.14	0.001523	4.24	244.26	1396.45	0.31

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
MuddGulch	Reach1	863.78	2%	100-50-10yr	969.68	5229.99	5237.69	5234.23	5237.95	0.001463	4.10	236.22	1364.02	0.31
MuddGulch	Reach1	863.78	10%	100-50-10yr	787.64	5229.99	5237.10	5233.79	5237.31	0.001325	3.73	211.37	1297.91	0.29
MuddGulch	Reach1	411.13	0.2%	500-year	1118.22	5230.38	5236.15	5235.26	5236.89	0.007680	7.04	197.52	1882.20	0.68
MuddGulch	Reach1	411.13	1%	100-50-10yr	1032.10	5230.38	5235.97	5235.07	5236.74	0.008115	7.09	158.90	1803.66	0.69
MuddGulch	Reach1	411.13	2%	100-50-10yr	969.68	5230.38	5235.83	5234.93	5236.59	0.008185	7.02	140.40	1703.85	0.69
MuddGulch	Reach1	411.13	10%	100-50-10yr	787.64	5230.38	5235.39	5234.48	5236.06	0.007896	6.59	119.48	1632.34	0.67
MuddGulch	Reach1	30.00	0.2%	500-year	1118.22	5228.25	5233.04	5232.17	5233.49	0.010007	5.43	205.95	2247.08	0.72
MuddGulch	Reach1	30.00	1%	100-50-10yr	1032.10	5228.25	5232.68	5231.99	5233.25	0.010009	6.07	170.05	2180.29	0.74
MuddGulch	Reach1	30.00	2%	100-50-10yr	969.68	5228.25	5232.51	5231.88	5233.10	0.009994	6.17	157.18	2156.95	0.74
MuddGulch	Reach1	30.00	10%	100-50-10yr	787.64	5228.25	5232.08	5231.57	5232.66	0.009989	6.14	128.24	2094.64	0.74
MG Flow Split	Reach1	3569.53	0.2%	500-year	0.10	5248.54	5250.80	5248.71	5250.80	0.000000	0.00	59.70	139.43	0.00
MG Flow Split	Reach1	3569.53	1%	100-50-10yr	0.10	5248.54	5250.27	5248.71	5250.27	0.000001	0.01	11.21	49.29	0.00
MG Flow Split	Reach1	3569.53	2%	100-50-10yr	0.10	5248.54	5250.04	5248.71	5250.04	0.000001	0.02	4.69	6.39	0.00
MG Flow Split	Reach1	3569.53	10%	100-50-10yr	0.10	5248.54	5248.77	5248.71	5248.79	0.015084	0.90	0.11	0.95	0.46
MG Flow Split	Reach1	3568.53	0.2%	500-year	127.24	5248.54	5250.59	5250.59	5250.78	0.045351	3.50	36.32	102.33	1.04
MG Flow Split	Reach1	3568.53	1%	100-50-10yr	17.17	5248.54	5250.15	5250.15	5250.25	0.059903	2.60	6.61	35.52	1.06
MG Flow Split	Reach1	3568.53	2%	100-50-10yr	12.41	5248.54	5249.71	5249.71	5250.00	0.041625	4.34	2.86	4.99	1.01
MG Flow Split	Reach1	3568.53	10%	100-50-10yr	0.10	5248.54	5248.71	5248.71	5248.75	0.075370	1.64	0.06	0.71	0.99
MG Flow Split	Reach1	2878.94	0.2%	500-year	2045.10	5240.66	5244.36	5242.89	5244.43	0.001996	2.08	983.12	587.08	0.28
MG Flow Split	Reach1	2878.94	1%	100-50-10yr	1240.53	5240.66	5243.89	5242.37	5243.94	0.001951	1.73	715.86	552.56	0.27
MG Flow Split	Reach1	2878.94	2%	100-50-10yr	1091.42	5240.66	5243.76	5242.27	5243.81	0.001813	1.69	647.68	493.55	0.26
MG Flow Split	Reach1	2878.94	10%	100-50-10yr	311.46	5240.66	5242.88	5241.51	5242.89	0.000658	0.96	324.06	268.01	0.15
MG Flow Split	Reach1	2455.99	0.2%	500-year	2107.88	5241.14	5243.90	5242.43	5243.93	0.000765	1.31	1615.23	945.44	0.18
MG Flow Split	Reach1	2455.99	1%	100-50-10yr	1270.00	5241.14	5243.50	5242.15	5243.52	0.000598	1.02	1245.17	876.64	0.15
MG Flow Split	Reach1	2455.99	2%	100-50-10yr	1091.42	5241.14	5243.40	5242.08	5243.41	0.000551	0.94	1157.81	863.36	0.14
MG Flow Split	Reach1	2455.99	10%	100-50-10yr	311.46	5241.14	5242.72	5241.71	5242.73	0.000255	0.50	624.41	678.11	0.09
MG Flow Split	Reach1	2211.55	0.2%	500-year	2107.88	5241.50	5243.50	5242.84	5243.57	0.003675	2.18	967.83	852.48	0.36
MG Flow Split	Reach1	2211.55	1%	100-50-10yr	1270.00	5241.50	5243.15	5242.60	5243.21	0.004085	1.87	679.83	816.04	0.36
MG Flow Split	Reach1	2211.55	2%	100-50-10yr	1091.42	5241.50	5243.07	5242.54	5243.12	0.004141	1.78	614.06	802.36	0.36
MG Flow Split	Reach1	2211.55	10%	100-50-10yr	311.46	5241.50	5242.56	5242.18	5242.58	0.002944	1.12	277.35	558.79	0.28
MG Flow Split	Reach1	1729.42	0.2%	500-year	2107.88	5238.35	5241.38	5240.49	5241.54	0.004819	3.18	662.15	404.21	0.44
MG Flow Split	Reach1	1729.42	1%	100-50-10yr	1270.00	5238.35	5240.76	5240.16	5240.89	0.005628	2.93	432.81	335.43	0.46
MG Flow Split	Reach1	1729.42	2%	100-50-10yr	1091.42	5238.35	5240.59	5240.07	5240.72	0.006040	2.88	378.96	318.49	0.47
MG Flow Split	Reach1	1729.42	10%	100-50-10yr	311.46	5238.35	5239.71	5239.53	5239.81	0.015514	2.58	120.50	241.70	0.65
MG Flow Split	Reach1	1234.55	0.2%	500-year	2107.88	5236.27	5239.99	5238.52	5240.07	0.001951	2.34	902.43	444.86	0.29
MG Flow Split	Reach1	1234.55	1%	100-50-10yr	1270.00	5236.27	5239.43	5238.14	5239.48	0.001675	1.91	666.04	397.12	0.26
MG Flow Split	Reach1	1234.55	2%	100-50-10yr	1091.42	5236.27	5239.29	5238.06	5239.34	0.001580	1.79	611.41	385.25	0.25
MG Flow Split	Reach1	1234.55	10%	100-50-10yr	311.46	5236.27	5238.28	5237.46	5238.30	0.001238	1.14	273.19	280.86	0.20
MG Flow Split	Reach1	685.37	0.2%	500-year	2107.88	5234.72	5238.26	5237.56	5238.41	0.005265	3.14	671.85	447.94	0.45
MG Flow Split	Reach1	685.37	1%	100-50-10yr	1270.00	5234.72	5237.74	5237.26	5237.86	0.006421	2.82	450.06	408.27	0.47
MG Flow Split	Reach1	685.37	2%	100-50-10yr	1091.42	5234.72	5237.60	5237.18	5237.72	0.007155	2.77	393.60	397.54	0.49
MG Flow Split	Reach1	685.37	10%	100-50-10yr	311.46	5234.72	5237.10	5236.67	5237.14	0.004436	1.51	205.64	359.50	0.35
MG Flow Split	Reach1	685.00			Lat Struct									
MG Flow Split	Reach1	224.65	0.2%	500-year	2018.91	5229.81	5235.93	5234.82	5236.17	0.004483	3.93	513.79	215.24	0.45
MG Flow Split	Reach1	224.65	1%	100-50-10yr	1268.89	5229.81	5235.38	5234.08	5235.54	0.004023	3.20	396.56	208.99	0.41
MG Flow Split	Reach1	224.65	2%	100-50-10yr	1091.42	5229.81	5235.22	5233.85	5235.36	0.003822	3.00	363.30	202.48	0.40
MG Flow Split	Reach1	224.65	10%	100-50-10yr	311.46	5229.81	5232.24	5232.24	5232.86	0.028704	6.34	49.10	40.10	1.01
MG Flow Split	Reach1	224.00			Lat Struct									
MG Flow Split	Reach1	104.89	0.2%	500-year	2014.45	5222.54	5236.01	5227.69	5236.03	0.000082	1.12	1792.01	239.25	0.07
MG Flow Split	Reach1	104.89	1%	100-50-10yr	1268.72	5222.54	5235.44	5227.12	5235.45	0.000042	0.77	1654.98	239.25	0.05
MG Flow Split	Reach1	104.89	2%	100-50-10yr	1091.42	5222.54	5235.27	5226.97	5235.28	0.000033	0.68	1615.25	237.10	0.05
MG Flow Split	Reach1	104.89	10%	100-50-10yr	311.46	5222.54	5231.07	5226.12	5231.08	0.000021	0.41	753.28	162.46	0.03
MG Flow Split	Reach1	68.78			Culvert									
MG Flow Split	Reach1	14.14	0.2%	500-year	2014.45	5221.69	5228.29	5227.66	5228.81	0.010012	5.77	349.01	149.94	0.67
MG Flow Split	Reach1	14.14	1%	100-50-10yr	1268.72	5221.69	5227.66	5226.90	5228.04	0.010004	4.93	257.37	140.03	0.64
MG Flow Split	Reach1	14.14	2%	100-50-10yr	1091.42	5221.69	5227.31	5226.71	5227.72	0.009997	5.12	213.20	109.35	0.65
MG Flow Split	Reach1	14.14	10%	100-50-10yr	311.46	5221.69	5225.15	5224.54	5225.54	0.010004	5.01	62.20	32.49	0.64
Fournile	Reach1	16382.73	0.2%	500-year	13500.00	5356.28	5367.26	5367.26	5369.85	0.008908	14.23	1298.34	263.46	0.87
Fournile	Reach1	16382.73	1%	100-50-10yr	7020.00	5356.28	5365.13	5365.13	5367.01	0.008571	11.45	765.78	238.10	0.81
Fournile	Reach1	16382.73	2%	100-50-10yr	5110.00	5356.28	5364.08	5363.79	5365.86	0.009791	10.80	520.94	226.85	0.84
Fournile	Reach1	16382.73	10%	100-50-10yr	2110.00	5356.28	5361.68	5361.04	5362.71	0.009644	8.16	258.71	76.36	0.78
Fournile	Reach1	16018.02	0.2%	500-year	13500.00	5354.00	5363.39	5363.39	5365.00	0.007136	12.44	1915.17	544.82	0.78
Fournile	Reach1	16018.02	1%	100-50-10yr	7020.00	5354.00	5361.64	5361.64	5363.15	0.007432	10.77	1013.08	441.18	0.76
Fournile	Reach1	16018.02	2%	100-50-10yr	5110.00	5354.00	5360.48	5360.48	5362.18	0.009971	10.86	597.00	264.90	0.85
Fournile	Reach1	16018.02	10%	100-50-10yr	2110.00	5354.00	5358.85	5358.08	5359.62	0.007148	7.09	310.84	126.04	0.68
Fournile	Reach1	15788.95	0.2%	500-year	13500.00	5351.82	5361.02	5359.96	5361.68	0.004809	9.16	2633.36	678.93	0.62
Fournile	Reach1	15788.95	1%	100-50-10yr	7020.00	5351.82	5359.46	5358.96	5360.02	0.005116	7.95	1606.81	629.63	0.61
Fournile	Reach1	15788.95	2%	100-50-10yr	5110.00	5351.82	5358.76	5358.57	5359.39	0.006109	7.90	1174.99	607.15	0.65
Fournile	Reach1	15788.95	10%	100-50-10yr	2110.00	5351.82	5357.69	5357.12	5358.17	0.004959	6.00	549.49	532.06	0.56
Fournile	Reach1	15380.94	0.2%	500-year	13500.00	5347.59	5358.06	5358.06	5359.33	0.007473	12.39	2208.79	682.47	0.78
Fournile	Reach1	15380.94	1%	100-50-10yr	7020.00	5347.59	5356.43	5356.43	5357.57	0.007478	10.63	1260.95	546.93	0.75
Fournile	Reach1	15380.94	2%	100-50-10yr	5110.00	5347.59	5355.84	5355.84	5356.82	0.006730	9.44	962.83	459.71	0.70
Fournile	Reach1	15380.94	10%	100-50-10yr	2110.00	5347.59	5353.50	5353.30	5354.94	0.013706	9.65	218.65	63.43	0.92

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Fourmile	Reach1	15048.74	0.2%	500-year	13500.00	5345.98	5356.64	5355.11	5357.37	0.003058	9.11	2596.08	624.99	0.51
Fourmile	Reach1	15048.74	1%	100-50-10yr	7020.00	5345.98	5353.95	5353.00	5354.90	0.005055	9.43	1100.42	405.50	0.63
Fourmile	Reach1	15048.74	2%	100-50-10yr	5110.00	5345.98	5353.00	5352.22	5353.91	0.005560	8.98	755.17	283.36	0.64
Fourmile	Reach1	15048.74	10%	100-50-10yr	2110.00	5345.98	5350.79	5350.28	5351.51	0.007178	7.63	329.62	125.02	0.68
Fourmile	Reach1	14576.82	0.2%	500-year	13500.00	5342.00	5353.25	5352.76	5355.47	0.007272	13.30	1357.35	729.51	0.79
Fourmile	Reach1	14576.82	1%	100-50-10yr	7020.00	5342.00	5351.37	5350.65	5352.67	0.005459	9.83	928.18	604.20	0.65
Fourmile	Reach1	14576.82	2%	100-50-10yr	5110.00	5342.00	5350.45	5349.65	5351.56	0.005298	8.81	720.49	485.70	0.63
Fourmile	Reach1	14576.82	10%	100-50-10yr	2110.00	5342.00	5348.01	5346.76	5348.69	0.005537	6.59	320.51	100.98	0.60
Fourmile	Reach1	14082.25	0.2%	500-year	13500.00	5340.07	5348.90	5348.90	5351.24	0.010728	12.58	1231.92	320.04	0.91
Fourmile	Reach1	14082.25	1%	100-50-10yr	7020.00	5340.07	5346.75	5346.75	5348.55	0.014386	10.79	662.80	207.91	0.98
Fourmile	Reach1	14082.25	2%	100-50-10yr	5110.00	5340.07	5346.09	5345.95	5347.50	0.014412	9.54	536.43	177.26	0.95
Fourmile	Reach1	14082.25	10%	100-50-10yr	2110.00	5340.07	5344.80	5344.06	5345.40	0.008006	6.23	338.46	130.96	0.68
Fourmile	Reach1	13545.88	0.2%	500-year	13500.00	5338.00	5347.46	5343.88	5347.99	0.001680	5.92	2421.46	410.04	0.38
Fourmile	Reach1	13545.88	1%	100-50-10yr	7020.00	5338.00	5344.24	5342.22	5344.70	0.002955	5.46	1291.01	305.84	0.46
Fourmile	Reach1	13545.88	2%	100-50-10yr	5110.00	5338.00	5343.12	5341.56	5343.56	0.003950	5.31	963.15	281.59	0.51
Fourmile	Reach1	13545.88	10%	100-50-10yr	2110.00	5338.00	5340.85	5340.20	5341.25	0.007285	5.11	413.19	201.94	0.63
Fourmile	Reach1	13318.55	0.2%	500-year	13500.00	5332.99	5343.77	5343.77	5346.97	0.009561	14.87	1067.14	189.50	0.90
Fourmile	Reach1	13318.55	1%	100-50-10yr	7020.00	5332.99	5340.83	5340.83	5343.29	0.012339	12.67	584.57	138.17	0.96
Fourmile	Reach1	13318.55	2%	100-50-10yr	5110.00	5332.99	5339.75	5339.75	5341.86	0.014025	11.66	444.22	121.37	0.98
Fourmile	Reach1	13318.55	10%	100-50-10yr	2110.00	5332.99	5337.26	5337.26	5338.75	0.016549	9.80	215.40	72.32	1.00
Fourmile	Reach1	12947.26	0.2%	500-year	13500.00	5330.28	5339.93	5338.86	5342.20	0.007298	12.15	1139.01	381.53	0.78
Fourmile	Reach1	12947.26	1%	100-50-10yr	7020.00	5330.28	5338.14	5336.47	5339.22	0.004920	8.34	849.57	315.31	0.61
Fourmile	Reach1	12947.26	2%	100-50-10yr	5110.00	5330.28	5337.34	5335.59	5338.11	0.004316	7.07	725.66	178.59	0.56
Fourmile	Reach1	12947.26	10%	100-50-10yr	2110.00	5330.28	5335.10	5333.75	5335.51	0.004026	5.12	411.96	127.94	0.50
Fourmile	Reach1	12788.01	0.2%	500-year	13500.00	5328.88	5340.04	5338.58	5340.97	0.003313	9.31	2231.39	888.41	0.54
Fourmile	Reach1	12788.01	1%	100-50-10yr	7020.00	5328.88	5337.42	5336.47	5338.41	0.004539	8.71	1105.59	685.27	0.60
Fourmile	Reach1	12788.01	2%	100-50-10yr	5110.00	5328.88	5336.24	5335.44	5337.28	0.005676	8.55	737.41	539.93	0.65
Fourmile	Reach1	12788.01	10%	100-50-10yr	2110.00	5328.88	5333.89	5332.98	5334.62	0.007481	6.85	307.97	97.53	0.68
Fourmile	Reach1	12322.54	0.2%	500-year	13500.00	5324.53	5336.37	5336.37	5338.43	0.012362	11.96	1396.17	833.52	0.69
Fourmile	Reach1	12322.54	1%	100-50-10yr	7020.00	5324.53	5332.64	5331.75	5334.58	0.019778	11.19	627.47	479.51	0.81
Fourmile	Reach1	12322.54	2%	100-50-10yr	5110.00	5324.53	5331.92	5330.65	5333.25	0.015310	9.25	552.43	266.13	0.70
Fourmile	Reach1	12322.54	10%	100-50-10yr	2110.00	5324.53	5329.75	5328.48	5330.34	0.011306	6.19	340.97	92.62	0.57
Fourmile	Reach1	11997.88	0.2%	500-year	13500.00	5322.39	5330.91	5330.63	5333.11	0.008852	12.57	1207.18	436.51	0.85
Fourmile	Reach1	11997.88	1%	100-50-10yr	7020.00	5322.39	5328.92	5328.49	5330.39	0.008852	10.00	760.24	399.03	0.80
Fourmile	Reach1	11997.88	2%	100-50-10yr	5110.00	5322.39	5328.01	5327.67	5329.30	0.010019	9.26	582.02	290.38	0.82
Fourmile	Reach1	11997.88	10%	100-50-10yr	2110.00	5322.39	5326.55	5326.01	5327.16	0.008572	6.29	338.63	149.05	0.70
Fourmile	Reach1	11451.47	0.2%	500-year	13500.00	5318.74	5326.70	5326.09	5328.48	0.007647	11.81	1367.82	658.89	0.79
Fourmile	Reach1	11451.47	1%	100-50-10yr	7020.00	5318.74	5324.89	5324.39	5326.01	0.006967	9.23	896.85	608.78	0.72
Fourmile	Reach1	11451.47	2%	100-50-10yr	5110.00	5318.74	5324.45	5323.64	5325.23	0.005389	7.64	787.04	597.61	0.62
Fourmile	Reach1	11451.47	10%	100-50-10yr	2110.00	5318.74	5322.66	5321.96	5323.18	0.006185	5.95	385.96	389.28	0.61
Fourmile	Reach1	10930.27	0.2%	500-year	13500.00	5315.07	5322.04	5322.04	5324.02	0.010057	12.36	1288.16	663.79	0.88
Fourmile	Reach1	10930.27	1%	100-50-10yr	7020.00	5315.07	5320.48	5320.48	5321.84	0.009581	9.91	828.75	641.84	0.82
Fourmile	Reach1	10930.27	2%	100-50-10yr	5110.00	5315.07	5319.60	5319.60	5321.08	0.012773	9.92	549.11	518.46	0.91
Fourmile	Reach1	10930.27	10%	100-50-10yr	2110.00	5315.07	5318.25	5317.90	5318.96	0.011024	6.77	311.74	275.61	0.79
Fourmile	Reach1	10292.38	0.2%	500-year	13500.00	5310.48	5319.08	5317.01	5320.14	0.004711	10.29	1835.06	583.34	0.63
Fourmile	Reach1	10292.38	1%	100-50-10yr	7020.00	5310.48	5317.13	5315.31	5317.73	0.003774	7.68	1227.38	438.52	0.54
Fourmile	Reach1	10292.38	2%	100-50-10yr	5110.00	5310.48	5316.24	5314.71	5316.72	0.003709	6.87	997.68	408.52	0.52
Fourmile	Reach1	10292.38	10%	100-50-10yr	2110.00	5310.48	5314.08	5312.96	5314.46	0.005678	6.02	486.42	263.59	0.59
Fourmile	Reach1	10048.25	0.2%	500-year	13500.00	5306.26	5316.68	5316.08	5317.92	0.005606	12.01	2067.44	550.12	0.70
Fourmile	Reach1	10048.25	1%	100-50-10yr	7020.00	5306.26	5314.69	5314.23	5315.80	0.005847	10.38	1136.53	383.08	0.69
Fourmile	Reach1	10048.25	2%	100-50-10yr	5110.00	5306.26	5313.88	5313.29	5314.89	0.005735	9.48	854.62	315.45	0.67
Fourmile	Reach1	10048.25	10%	100-50-10yr	2110.00	5306.26	5312.01	5311.16	5312.62	0.004733	6.79	409.83	172.53	0.57
Fourmile	Reach1	9338.16	0.2%	500-year	13500.00	5302.08	5312.34	5311.86	5314.09	0.006262	12.22	1741.43	517.61	0.74
Fourmile	Reach1	9338.16	1%	100-50-10yr	7020.00	5302.08	5309.74	5309.25	5311.31	0.007810	10.75	817.53	223.00	0.78
Fourmile	Reach1	9338.16	2%	100-50-10yr	5110.00	5302.08	5308.67	5308.36	5310.11	0.008880	10.08	601.68	185.03	0.81
Fourmile	Reach1	9338.16	10%	100-50-10yr	2110.00	5302.08	5306.53	5306.28	5307.59	0.012234	8.24	257.65	106.80	0.87
Fourmile	Reach1	8895.63	0.2%	500-year	13500.00	5300.06	5310.20	5307.95	5311.47	0.004808	9.04	1497.92	3995.59	0.62
Fourmile	Reach1	8895.63	1%	100-50-10yr	7020.00	5300.06	5308.28	5305.64	5308.93	0.003136	6.47	1084.75	196.17	0.48
Fourmile	Reach1	8895.63	2%	100-50-10yr	5110.00	5300.06	5307.26	5304.80	5307.77	0.002824	5.72	894.11	180.15	0.45
Fourmile	Reach1	8895.63	10%	100-50-10yr	2110.00	5300.06	5304.65	5303.05	5304.96	0.003053	4.48	470.59	144.92	0.44
Fourmile	Reach1	8742.65	0.2%	500-year	13500.00	5298.69	5309.94	5306.52	5310.83	0.002602	7.58	1779.91	5171.29	0.47
Fourmile	Reach1	8742.65	1%	100-50-10yr	7020.00	5298.69	5308.12	5304.46	5308.52	0.001565	5.07	1384.03	324.60	0.35
Fourmile	Reach1	8742.65	2%	100-50-10yr	5110.00	5298.69	5307.12	5303.67	5307.41	0.001395	4.37	1169.94	226.12	0.33
Fourmile	Reach1	8742.65	10%	100-50-10yr	2110.00	5298.69	5304.45	5302.06	5304.61	0.001401	3.26	647.97	180.19	0.30
Fourmile	Reach1	8684.30	0.2%	500-year	13500.00	5298.18	5309.26	5306.56	5310.54	0.003732	9.07	1489.23	4527.53	0.56
Fourmile	Reach1	8684.30	1%	100-50-10yr	7020.00	5298.18	5307.90	5304.60	5308.40	0.001820	5.64	1244.00	182.48	0.38
Fourmile	Reach1	8684.30	2%	100-50-10yr	5110.00	5298.18	5306.96	5303.90	5307.31	0.001563	4.76	1074.09	181.80	0.34
Fourmile	Reach1	8684.30	10%	100-50-10yr	2110.00	5298.18	5304.32	5302.48	5304.51	0.001817	3.52	600.26	179.87	0.34
Fourmile	Reach1	8632.47		Bridge										
Fourmile	Reach1	8569.65	0.2%	500-year	13500.00	5298.25	5308.62	5305.63	5309.81	0.003148	8.75	1542.92	4446.29	0.53
Fourmile	Reach1	8569.65	1%	100-50-10yr	7020.00	5298.25	5306.53	5303.60	5307.09	0.002165	6.01	1167.44	247.82	0.42
Fourmile	Reach1	8569.65	2%	100-50-10yr	5110.00	5298.25	5305.67	5302.86	5306.07	0.001840	5.04	1013.19	228.81	0.37
Fourmile	Reach1	8569.65	10%	100-50-10yr	2110.00	5298.25	5302.97	5301.28	5303.21	0.002463	3.95	533.72	174.18	0.39

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Fourmile	Reach1	8490.80	0.2%	500-year	13500.00	5297.69	5307.98	5306.09	5309.42	0.005163	9.64	1400.14	5049.17	0.65
Fourmile	Reach1	8490.80	1%	100-50-10yr	7020.00	5297.69	5306.10	5303.90	5306.82	0.003626	6.84	1026.47	271.54	0.52
Fourmile	Reach1	8490.80	2%	100-50-10yr	5110.00	5297.69	5305.32	5303.07	5305.84	0.003055	5.81	880.19	205.69	0.47
Fourmile	Reach1	8490.80	10%	100-50-10yr	2110.00	5297.69	5302.50	5301.28	5302.90	0.004601	5.10	413.80	143.33	0.53
Fourmile	Reach1	8139.05	0.2%	500-year	13500.00	5294.01	5305.32	5305.32	5307.15	0.007220	13.19	1589.73	5139.56	0.78
Fourmile	Reach1	8139.05	1%	100-50-10yr	7020.00	5294.01	5303.78	5303.78	5305.15	0.005876	10.49	1009.57	578.30	0.68
Fourmile	Reach1	8139.05	2%	100-50-10yr	5110.00	5294.01	5303.01	5303.01	5304.31	0.005829	9.71	726.69	472.46	0.66
Fourmile	Reach1	8139.05	10%	100-50-10yr	2110.00	5294.01	5299.98	5298.67	5300.95	0.006427	7.92	266.53	59.07	0.66
Fourmile	Reach1	7819.74	0.2%	500-year	13500.00	5292.09	5302.53	5301.99	5303.42	0.004545	10.25	2279.75	4950.41	0.61
Fourmile	Reach1	7819.74	1%	100-50-10yr	7020.00	5292.09	5301.11	5300.81	5301.85	0.004031	8.58	1431.26	1084.15	0.56
Fourmile	Reach1	7819.74	2%	100-50-10yr	5110.00	5292.09	5300.39	5299.95	5301.25	0.004597	8.56	884.77	963.12	0.58
Fourmile	Reach1	7819.74	10%	100-50-10yr	2110.00	5292.09	5298.02	5296.68	5298.92	0.006163	7.63	276.60	140.47	0.64
Fourmile	Reach1	7819.00			Lat Struct									
Fourmile	Reach1	7454.19	0.2%	500-year	11439.14	5290.00	5299.96	5299.78	5301.18	0.005999	10.69	1669.97	3706.66	0.71
Fourmile	Reach1	7454.19	1%	100-50-10yr	6891.50	5290.00	5298.85	5298.80	5299.93	0.005650	9.34	1123.41	580.46	0.67
Fourmile	Reach1	7454.19	2%	100-50-10yr	5109.90	5290.00	5298.20	5298.20	5299.30	0.005871	8.87	802.89	551.79	0.68
Fourmile	Reach1	7454.19	10%	100-50-10yr	2110.00	5290.00	5295.56	5294.73	5296.47	0.007303	7.66	275.34	79.57	0.73
Fourmile	Reach1	7454.00			Lat Struct									
Fourmile	Reach1	6921.01	0.2%	500-year	11025.39	5284.84	5295.74	5295.74	5297.72	0.007597	11.66	1151.10	1442.72	0.78
Fourmile	Reach1	6921.01	1%	100-50-10yr	6857.05	5284.84	5292.97	5292.97	5295.42	0.014161	12.56	545.73	111.73	1.00
Fourmile	Reach1	6921.01	2%	100-50-10yr	5109.48	5284.84	5291.77	5291.77	5294.03	0.014686	12.08	422.87	94.28	1.01
Fourmile	Reach1	6921.01	10%	100-50-10yr	2110.00	5284.84	5289.26	5289.26	5290.74	0.016868	9.78	215.70	73.62	1.01
Fourmile	Reach1	6349.33	0.2%	500-year	11025.39	5280.45	5290.07	5287.19	5290.86	0.002952	7.15	1542.24	258.68	0.52
Fourmile	Reach1	6349.33	1%	100-50-10yr	6857.05	5280.45	5288.51	5288.51	5289.05	0.002453	5.86	1170.43	220.23	0.45
Fourmile	Reach1	6349.33	2%	100-50-10yr	5109.48	5280.45	5287.71	5284.95	5288.12	0.002147	5.10	1001.76	200.27	0.40
Fourmile	Reach1	6349.33	10%	100-50-10yr	2110.00	5280.45	5285.47	5283.36	5285.66	0.001720	3.56	592.22	167.77	0.33
Fourmile	Reach1	5984.11	0.2%	500-year	11025.39	5278.10	5287.81	5287.04	5289.16	0.007641	9.34	1180.53	265.16	0.77
Fourmile	Reach1	5984.11	1%	100-50-10yr	6857.05	5278.10	5286.06	5285.78	5287.37	0.009921	9.17	747.52	230.94	0.90
Fourmile	Reach1	5984.11	2%	100-50-10yr	5109.48	5278.10	5285.21	5285.17	5286.51	0.011168	9.15	558.49	214.31	1.00
Fourmile	Reach1	5984.11	10%	100-50-10yr	2110.00	5278.10	5283.27	5282.70	5284.32	0.010087	8.22	256.65	77.35	0.80
Fourmile	Reach1	5506.21	0.2%	500-year	11439.14	5275.94	5286.64	5283.80	5287.23	0.002096	6.13	1887.62	387.67	0.45
Fourmile	Reach1	5506.21	1%	100-50-10yr	6891.50	5275.94	5284.56	5282.08	5285.06	0.002410	5.69	1210.74	280.88	0.48
Fourmile	Reach1	5506.21	2%	100-50-10yr	5109.90	5275.94	5283.36	5281.26	5283.85	0.002872	5.65	903.79	229.60	0.50
Fourmile	Reach1	5506.21	10%	100-50-10yr	2110.00	5275.94	5280.78	5279.45	5281.15	0.004199	4.91	429.88	146.60	0.51
Fourmile	Reach1	5147.36	0.2%	500-year	11439.14	5272.32	5285.51	5283.00	5286.32	0.002903	7.26	1613.00	299.69	0.51
Fourmile	Reach1	5147.36	1%	100-50-10yr	6891.50	5272.32	5283.36	5281.22	5284.04	0.003322	6.62	1041.28	231.55	0.55
Fourmile	Reach1	5147.36	2%	100-50-10yr	5109.90	5272.32	5281.78	5280.24	5282.57	0.004342	7.15	714.95	181.51	0.63
Fourmile	Reach1	5147.36	10%	100-50-10yr	2110.00	5272.32	5278.86	5277.19	5279.54	0.004659	6.59	320.42	89.20	0.61
Fourmile	Reach1	5146.00			Lat Struct									
Fourmile	Reach1	4711.74	0.2%	500-year	10666.26	5270.29	5285.67	5280.39	5285.79	0.000315	3.38	4763.59	1456.45	0.18
Fourmile	Reach1	4711.74	1%	100-50-10yr	6891.50	5270.29	5283.33	5279.38	5283.46	0.000435	3.45	2619.54	1160.44	0.20
Fourmile	Reach1	4711.74	2%	100-50-10yr	5109.90	5270.29	5281.64	5278.76	5281.79	0.000642	3.71	1811.47	487.01	0.24
Fourmile	Reach1	4711.74	10%	100-50-10yr	2110.00	5270.29	5277.37	5275.06	5277.88	0.003006	5.73	368.56	93.34	0.51
Fourmile	Reach1	4710.00			Lat Struct									
Fourmile	Reach1	4394.51	0.2%	500-year	10343.75	5268.43	5284.31	5279.45	5285.32	0.002242	8.29	1692.88	1072.71	0.45
Fourmile	Reach1	4394.51	1%	100-50-10yr	6891.50	5268.43	5282.23	5277.69	5283.02	0.001836	7.13	966.58	499.05	0.40
Fourmile	Reach1	4394.51	2%	100-50-10yr	5109.90	5268.43	5280.74	5276.55	5281.34	0.001759	6.24	818.27	114.06	0.38
Fourmile	Reach1	4394.51	10%	100-50-10yr	2110.00	5268.43	5276.56	5273.87	5276.97	0.002437	5.09	414.66	89.23	0.41
Fourmile	Reach1	4379.56			Bridge									
Fourmile	Reach1	4329.78	0.2%	500-year	10343.75	5268.74	5281.10	5281.10	5284.74	0.008892	16.12	740.14	690.50	0.90
Fourmile	Reach1	4329.78	1%	100-50-10yr	6891.50	5268.74	5279.20	5279.20	5282.12	0.009017	14.14	550.37	404.69	0.87
Fourmile	Reach1	4329.78	2%	100-50-10yr	5109.90	5268.74	5277.94	5277.94	5280.50	0.009490	13.00	424.77	320.72	0.87
Fourmile	Reach1	4329.78	10%	100-50-10yr	2110.00	5268.74	5274.01	5274.01	5276.08	0.015046	11.53	182.96	57.75	1.00
Fourmile	Reach1	4111.69	0.2%	500-year	10343.75	5268.00	5280.26	5275.19	5281.11	0.001676	7.38	1402.18	317.92	0.40
Fourmile	Reach1	4111.69	1%	100-50-10yr	6891.50	5268.00	5277.46	5273.68	5278.14	0.002034	6.65	1036.99	145.97	0.41
Fourmile	Reach1	4111.69	2%	100-50-10yr	5109.90	5268.00	5276.10	5272.79	5276.64	0.002063	5.94	859.97	133.63	0.41
Fourmile	Reach1	4111.69	10%	100-50-10yr	2110.00	5268.00	5273.25	5270.95	5273.52	0.001801	4.15	508.22	121.38	0.35
Fourmile	Reach1	4073.00			Bridge									
Fourmile	Reach1	4050.69	0.2%	500-year	10343.75	5266.21	5276.45	5276.45	5279.62	0.010625	14.54	774.39	195.20	0.94
Fourmile	Reach1	4050.69	1%	100-50-10yr	6891.50	5266.21	5274.91	5274.75	5277.33	0.010717	12.53	574.44	187.72	0.91
Fourmile	Reach1	4050.69	2%	100-50-10yr	5109.90	5266.21	5274.32	5273.38	5275.99	0.008474	10.40	496.70	181.03	0.79
Fourmile	Reach1	4050.69	10%	100-50-10yr	2110.00	5266.21	5272.69	5270.93	5273.25	0.003727	6.00	351.88	121.05	0.51
Fourmile	Reach1	3756.25	0.2%	500-year	10343.75	5264.29	5273.76	5273.34	5275.00	0.007040	10.19	1358.76	370.21	0.74
Fourmile	Reach1	3756.25	1%	100-50-10yr	6891.50	5264.29	5272.52	5272.52	5273.80	0.009065	9.89	910.14	352.66	0.80
Fourmile	Reach1	3756.25	2%	100-50-10yr	5109.90	5264.29	5271.91	5271.91	5273.08	0.009397	9.17	697.17	338.36	0.80
Fourmile	Reach1	3756.25	10%	100-50-10yr	2110.00	5264.29	5269.87	5269.87	5270.98	0.018884	8.46	249.37	116.13	1.02
Fourmile	Reach1	3680.22	0.2%	500-year	10343.75	5263.24	5273.29	5272.44	5274.53	0.004476	10.23	1386.72	352.28	0.62
Fourmile	Reach1	3680.22	1%	100-50-10yr	6891.50	5263.24	5271.71	5271.08	5272.98	0.005381	9.78	896.98	268.45	0.66
Fourmile	Reach1	3680.22	2%	100-50-10yr	5109.90	5263.24	5271.10	5270.07	5272.08	0.004516	8.42	742.55	235.96	0.59
Fourmile	Reach1	3680.22	10%	100-50-10yr	2110.00	5263.24	5268.87	5267.34	5269.47	0.004364	6.20	348.85	116.94	0.54
Fourmile	Reach1	3432.09	0.2%	500-year	10343.75	5261.12	5273.17	5270.88	5273.63	0.001767	6.22	2080.30	459.46	0.39

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Fourmile	Reach1	3432.09	1%	100-50-10yr	6891.50	5261.12	5271.33	5270.04	5271.83	0.002658	6.42	1360.13	421.37	0.45
Fourmile	Reach1	3432.09	2%	100-50-10yr	5109.90	5261.12	5270.65	5269.46	5271.08	0.002571	5.84	1106.12	402.92	0.44
Fourmile	Reach1	3432.09	10%	100-50-10yr	2110.00	5261.12	5267.75	5266.25	5268.34	0.004724	6.18	341.27	101.26	0.56
Fourmile	Reach1	3121.18	0.2%	500-year	10343.75	5259.34	5272.32	5270.04	5272.98	0.002110	7.49	1726.36	542.85	0.43
Fourmile	Reach1	3121.18	1%	100-50-10yr	6891.50	5259.34	5269.94	5269.01	5270.80	0.003745	8.21	1053.18	365.99	0.55
Fourmile	Reach1	3121.18	2%	100-50-10yr	5109.90	5259.34	5268.06	5268.06	5269.64	0.008043	10.29	562.83	276.11	0.77
Fourmile	Reach1	3121.18	10%	100-50-10yr	2110.00	5259.34	5264.82	5264.37	5266.11	0.011238	9.11	231.69	64.57	0.85
Fourmile	Reach1	2953.71	0.2%	500-year	10343.75	5257.91	5270.19	5268.56	5272.28	0.005848	11.74	912.35	749.64	0.70
Fourmile	Reach1	2953.71	1%	100-50-10yr	6891.50	5257.91	5268.47	5266.53	5269.98	0.005315	9.92	709.35	300.95	0.65
Fourmile	Reach1	2953.71	2%	100-50-10yr	5109.90	5257.91	5265.75	5265.31	5267.84	0.011107	11.61	440.27	83.99	0.89
Fourmile	Reach1	2953.71	10%	100-50-10yr	2110.00	5257.91	5263.46	5262.57	5264.45	0.007938	7.97	264.80	69.35	0.72
Fourmile	Reach1	2512.02	0.2%	500-year	10343.75	5256.28	5265.96	5264.50	5267.47	0.005385	9.89	1062.01	1935.35	0.68
Fourmile	Reach1	2512.02	1%	100-50-10yr	6891.50	5256.28	5265.01	5263.09	5265.94	0.003946	7.73	901.45	1929.76	0.57
Fourmile	Reach1	2512.02	2%	100-50-10yr	5109.90	5256.28	5264.33	5262.26	5264.99	0.003262	6.53	785.73	1906.87	0.51
Fourmile	Reach1	2512.02	10%	100-50-10yr	2110.00	5256.28	5262.12	5260.08	5262.45	0.002476	4.59	459.76	936.23	0.43
Fourmile	Reach1	2512.00			Lat Struct									
Fourmile	Reach1	2154.04	0.2%	500-year	10216.59	5254.34	5263.38	5263.38	5264.90	0.009534	10.84	1186.94	2261.69	0.89
Fourmile	Reach1	2154.04	1%	100-50-10yr	6891.50	5254.34	5262.60	5262.60	5263.84	0.008815	9.56	902.54	2154.12	0.86
Fourmile	Reach1	2154.04	2%	100-50-10yr	5109.90	5254.34	5262.09	5262.09	5263.17	0.008174	8.70	717.38	2113.44	0.83
Fourmile	Reach1	2154.04	10%	100-50-10yr	2110.00	5254.34	5260.28	5259.02	5261.00	0.007213	6.82	309.53	824.63	0.67
Fourmile	Reach1	1765.52	0.2%	500-year	10216.59	5252.00	5261.34	5260.42	5261.73	0.002858	6.66	2527.77	2903.92	0.47
Fourmile	Reach1	1765.52	1%	100-50-10yr	6891.50	5252.00	5260.72	5259.78	5261.02	0.002434	5.73	2033.63	2521.85	0.43
Fourmile	Reach1	1765.52	2%	100-50-10yr	5109.90	5252.00	5260.29	5259.27	5260.55	0.002185	5.15	1699.70	2163.00	0.40
Fourmile	Reach1	1765.52	10%	100-50-10yr	2110.00	5252.00	5257.82	5256.54	5258.51	0.005704	6.67	316.40	668.92	0.61
Fourmile	Reach1	1606.54	0.2%	500-year	10216.59	5249.47	5260.14	5260.14	5261.02	0.005940	9.78	2010.76	2641.98	0.72
Fourmile	Reach1	1606.54	1%	100-50-10yr	6891.50	5249.47	5259.67	5259.67	5260.42	0.004838	8.48	1566.86	2418.84	0.65
Fourmile	Reach1	1606.54	2%	100-50-10yr	5109.90	5249.47	5259.35	5259.35	5260.03	0.004169	7.66	1252.78	2129.19	0.58
Fourmile	Reach1	1606.54	10%	100-50-10yr	2110.00	5249.47	5257.00	5254.93	5257.72	0.004316	6.82	309.26	357.39	0.54
Fourmile	Reach1	1222.98	0.2%	500-year	10216.59	5248.00	5257.44	5256.63	5257.92	0.004640	6.91	2138.01	3339.53	0.63
Fourmile	Reach1	1222.98	1%	100-50-10yr	6891.50	5248.00	5256.54	5256.20	5257.02	0.005640	6.94	1481.61	3160.56	0.73
Fourmile	Reach1	1222.98	2%	100-50-10yr	5109.90	5248.00	5256.02	5255.88	5256.56	0.006473	7.16	1117.47	2613.74	0.83
Fourmile	Reach1	1222.98	10%	100-50-10yr	2110.00	5248.00	5254.68	5253.65	5255.48	0.008378	7.47	374.97	960.40	0.72
Fourmile	Reach1	666.22	0.2%	500-year	10216.59	5246.00	5254.46	5253.15	5255.32	0.004492	7.73	1456.37	3511.44	0.58
Fourmile	Reach1	666.22	1%	100-50-10yr	6891.50	5246.00	5253.23	5252.24	5253.96	0.005255	7.05	1062.53	3166.64	0.60
Fourmile	Reach1	666.22	2%	100-50-10yr	5109.90	5246.00	5252.49	5251.55	5253.14	0.005816	6.54	828.14	2491.90	0.61
Fourmile	Reach1	666.22	10%	100-50-10yr	2110.00	5246.00	5250.84	5250.02	5251.24	0.006537	5.07	416.30	1584.36	0.60
Fourmile	Reach1	68.69	0.2%	500-year	10216.59	5244.00	5252.42	5250.21	5253.19	0.003001	7.48	1527.65	4308.91	0.50
Fourmile	Reach1	68.69	1%	100-50-10yr	6891.50	5244.00	5251.06	5249.29	5251.65	0.003001	6.49	1189.18	3889.20	0.48
Fourmile	Reach1	68.69	2%	100-50-10yr	5109.90	5244.00	5250.22	5248.65	5250.70	0.003001	5.83	978.47	3674.51	0.47
Fourmile	Reach1	68.69	10%	100-50-10yr	2110.00	5244.00	5248.38	5247.06	5248.66	0.003006	4.26	520.76	3263.22	0.43

HEC-RAS

River	Reach	River Sta	Profile	Plan	Q US (cfs)	Q Leaving Total (cfs)	Q DS (cfs)	Q Weir (cfs)	Q Gates (cfs)	Wr Top Width (ft)	Weir Max Depth (ft)	Weir Avg Depth (ft)	Min El Weir Flow (ft)	E.G. US. (ft)	W.S. US. (ft)	E.G. DS (ft)	W.S. DS (ft)
Mudd Gulch	Reach1	3389.00	0.2%	500-year	3078.00	127.21	2950.86	127.21		188.68	0.84	0.43	5253.78	5257.74	5257.66	5255.43	5254.62
Mudd Gulch	Reach1	3389.00	1%	100-50-10yr	2191.00	17.26	2173.93	17.26		100.14	0.34	0.19	5253.78	5257.32	5257.25	5254.94	5254.12
Mudd Gulch	Reach1	3389.00	2%	100-50-10yr	1970.00	12.41	1957.69	12.41		94.38	0.31	0.15	5253.78	5257.16	5257.09	5254.78	5254.09
Mudd Gulch	Reach1	3389.00	10%	100-50-10yr	1054.00	0.00	1054.00	0.00					5253.78	5256.53	5256.47	5254.03	5253.48
Mudd Gulch	Reach1	2868.00	0.2%	500-year	2950.86	1919.80	1033.00	1919.80		699.40	1.85	1.21	5249.48	5255.43	5254.62	5250.27	5250.09
Mudd Gulch	Reach1	2868.00	1%	100-50-10yr	2173.93	1226.33	950.57	1226.33		699.40	1.50	0.88	5249.48	5254.94	5254.12	5250.10	5249.93
Mudd Gulch	Reach1	2868.00	2%	100-50-10yr	1957.69	1062.05	878.68	1062.05		699.40	1.42	0.80	5249.48	5254.78	5254.09	5249.95	5249.79
Mudd Gulch	Reach1	2868.00	10%	100-50-10yr	1054.00	311.44	742.64	311.44		463.54	0.86	0.46	5249.48	5254.03	5253.48	5249.47	5249.29
Mudd Gulch	Reach1	2519.00	0.2%	500-year	1033.00	63.05	970.22	63.05		165.27	0.61	0.31	5249.48	5250.27	5250.09	5250.01	5249.23
Mudd Gulch	Reach1	2519.00	1%	100-50-10yr	950.57	29.48	921.10	29.48		123.80	0.45	0.22	5249.48	5250.10	5249.93	5249.85	5249.11
Mudd Gulch	Reach1	2519.00	2%	100-50-10yr	878.68	0.00	878.68	0.00					5249.48	5249.95	5249.79	5249.72	5249.00
Mudd Gulch	Reach1	2519.00	10%	100-50-10yr	742.64	0.00	742.64	0.00					5249.48	5249.47	5249.29	5249.25	5248.63
MG Flow Split	Reach1	685.00	0.2%	500-year	2107.88	87.69	2018.91	87.69		107.77	0.60	0.54	5235.38	5238.41	5238.26	5236.17	5235.93
MG Flow Split	Reach1	685.00	1%	100-50-10yr	1270.00	1.11	1268.89	1.11		97.02	0.05	0.03	5235.38	5237.86	5237.74	5235.54	5235.38
MG Flow Split	Reach1	685.00	2%	100-50-10yr	1091.42	0.00	1091.42	0.00					5235.38	5237.72	5237.60	5235.36	5235.22
MG Flow Split	Reach1	685.00	10%	100-50-10yr	311.46	0.00	311.46	0.00					5235.38	5237.14	5237.10	5232.86	5232.24
MG Flow Split	Reach1	224.00	0.2%	500-year	2018.91	4.38	2014.45	4.38		4.37	0.70	0.63	5235.31	5236.17	5235.93	5236.03	5236.01
MG Flow Split	Reach1	224.00	1%	100-50-10yr	1268.89	0.17	1268.72	0.17		4.37	0.13	0.07	5235.31	5235.54	5235.38	5235.45	5235.44
MG Flow Split	Reach1	224.00	2%	100-50-10yr	1091.42	0.00	1091.42	0.00					5235.31	5235.36	5235.22	5235.28	5235.27
MG Flow Split	Reach1	224.00	10%	100-50-10yr	311.46	0.00	311.46	0.00					5235.31	5232.86	5232.24	5231.08	5231.07
Fourmile	Reach1	7819.00	0.2%	500-year	13500.00	2071.25	11439.14	2071.25		649.40	2.17	1.34	5299.17	5303.42	5302.53	5301.18	5299.96
Fourmile	Reach1	7819.00	1%	100-50-10yr	7020.00	128.62	6891.50	128.62		354.65	0.78	0.29	5299.17	5301.85	5301.11	5299.93	5298.85
Fourmile	Reach1	7819.00	2%	100-50-10yr	5110.00	0.10	5109.90	0.10		9.57	0.06	0.03	5299.17	5301.25	5300.39	5299.30	5298.20
Fourmile	Reach1	7819.00	10%	100-50-10yr	2110.00	0.00	2110.00	0.00					5299.17	5298.92	5298.02	5296.47	5295.56
Fourmile	Reach1	7454.00	0.2%	500-year	11439.14	412.95	11025.39	412.95		185.77	1.99	0.99	5296.77	5301.18	5299.96	5297.72	5295.74
Fourmile	Reach1	7454.00	1%	100-50-10yr	6891.50	34.39	6857.05	34.39		57.27	0.83	0.42	5296.77	5299.93	5298.85	5295.42	5292.97
Fourmile	Reach1	7454.00	2%	100-50-10yr	5109.90	0.42	5109.48	0.42		7.69	0.16	0.09	5296.77	5299.30	5298.20	5294.03	5291.77
Fourmile	Reach1	7454.00	10%	100-50-10yr	2110.00	0.00	2110.00	0.00					5296.77	5296.47	5295.56	5290.74	5289.26
Fourmile	Reach1	5146.00	0.2%	500-year	11439.14	772.93	10666.26	772.93		326.33	1.41	1.08	5284.22	5286.32	5285.51	5285.79	5285.67
Fourmile	Reach1	4710.00	0.2%	500-year	10666.26	322.73	10343.75	322.73		115.39	1.38	1.25	5283.20	5285.79	5285.67	5285.32	5284.31
Fourmile	Reach1	2512.00	0.2%	500-year	10343.75	127.63	10216.59	127.63		178.82	0.63	0.50	5263.01	5267.47	5265.96	5264.90	5263.38

HEC-RAS Plan: Encroach

River	Reach	River Sta	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Width Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
MuddGulch	Reach1	20181.26	5514.18		5514.40	31.10		270.00			197.98	273.35	
MuddGulch	Reach1	20181.26	5514.18	0.00	5514.40	31.10		270.00		197.98	197.98	273.35	273.35
MuddGulch	Reach1	19700.71	5510.17		5511.06	16.49		270.00			304.03	351.48	
MuddGulch	Reach1	19700.71	5510.17	0.00	5511.06	16.49		270.00		304.03	304.03	351.48	351.48
MuddGulch	Reach1	19402.88	5505.08		5505.85	21.49		270.00			255.86	299.06	
MuddGulch	Reach1	19402.88	5505.08	0.00	5505.85	21.49		270.00		255.86	255.86	299.06	299.06
MuddGulch	Reach1	18990.06	5499.19		5499.73	25.96		270.00			147.92	189.39	
MuddGulch	Reach1	18990.06	5499.19	0.00	5499.73	25.96		270.00		147.92	147.92	189.39	189.39
MuddGulch	Reach1	18760.00	5495.29		5496.03	26.49		270.00			215.46	254.82	
MuddGulch	Reach1	18760.00	5495.29	0.00	5496.03	26.49		270.00		215.46	215.46	254.82	254.82
MuddGulch	Reach1	18518.88	5492.60		5492.81	105.00	4.58	239.49	25.93		57.61	99.17	
MuddGulch	Reach1	18518.88	5492.71	0.11	5492.97	41.56		270.00		57.61	57.61	99.17	99.17
MuddGulch	Reach1	18116.98	5487.62		5488.43	23.48		270.00			12.21	59.21	
MuddGulch	Reach1	18116.98	5487.61	0.00	5488.43	23.45		270.00		12.21	12.21	59.21	59.21
MuddGulch	Reach1	17844.24	5480.95		5481.66	28.50		270.00			29.16	80.03	
MuddGulch	Reach1	17844.24	5480.95	0.00	5481.66	28.49		270.00		29.16	29.16	80.03	80.03
MuddGulch	Reach1	17384.73	5470.37		5471.16	24.35		270.00			25.13	66.98	
MuddGulch	Reach1	17384.73	5470.37	0.00	5471.16	24.33		270.00		25.13	25.13	66.98	66.98
MuddGulch	Reach1	16869.32	5454.72		5455.55	22.63		270.00			61.54	112.63	
MuddGulch	Reach1	16869.32	5454.72	0.00	5455.55	22.60		270.00		61.54	61.54	112.63	112.63
MuddGulch	Reach1	16809.73	Culvert										
MuddGulch	Reach1	16749.55	5451.46		5452.16	28.64		270.00			85.53	140.57	
MuddGulch	Reach1	16749.55	5451.46	0.00	5452.16	28.64		270.00		85.53	85.53	140.57	140.57
MuddGulch	Reach1	16485.74	5445.63		5446.08	57.59		270.00			0.00	69.61	
MuddGulch	Reach1	16485.74	5445.63	0.00	5446.08	57.59		270.00		0.00	0.00	69.61	69.61
MuddGulch	Reach1	16216.12	5438.36		5439.83	45.53		1297.00			0.00	59.06	
MuddGulch	Reach1	16216.12	5438.35	-0.02	5439.83	45.40		1297.00		0.00	0.00	59.06	59.06
MuddGulch	Reach1	15806.06	5430.20		5431.27	81.94		1295.72	1.28		30.57	119.20	
MuddGulch	Reach1	15806.06	5430.48	0.27	5431.33	73.14		1297.00		30.57	30.57	119.20	119.20
MuddGulch	Reach1	15397.66	5423.61		5424.24	186.40	56.72	711.30	528.97		61.79	91.22	
MuddGulch	Reach1	15397.66	5424.47	0.86	5426.44	29.43		1297.00		61.79	61.79	91.22	91.22
MuddGulch	Reach1	15035.70	5417.20		5417.90	160.16	32.93	745.73	518.34		61.44	90.62	
MuddGulch	Reach1	15035.70	5418.04	0.85	5419.99	29.18		1297.00		61.44	61.44	90.62	90.62
MuddGulch	Reach1	14623.73	5409.60		5410.85	58.03		1297.00			53.53	117.88	
MuddGulch	Reach1	14623.73	5409.60	0.00	5410.85	58.03		1297.00		53.53	53.53	117.88	117.88
MuddGulch	Reach1	14522.74	5404.60		5405.81	61.84		1297.00			61.03	351.76	
MuddGulch	Reach1	14522.74	5404.60	0.00	5405.81	61.84		1297.00		61.03	61.03	351.76	351.76
MuddGulch	Reach1	14414.32	5404.32		5404.74	94.95		1297.00			43.39	319.95	
MuddGulch	Reach1	14414.32	5404.32	0.00	5404.74	94.95		1297.00		43.39	43.39	319.95	319.95
MuddGulch	Reach1	14002.14	5404.27		5404.31	265.98		1297.00			11.56	327.22	
MuddGulch	Reach1	14002.14	5404.27	0.00	5404.31	265.98		1297.00		11.56	11.56	327.22	327.22
MuddGulch	Reach1	13823.62	5403.68		5404.13	88.36		1297.00			13.77	158.45	
MuddGulch	Reach1	13823.62	5403.68	0.00	5404.13	88.36		1297.00		13.77	13.77	158.45	158.45
MuddGulch	Reach1	13676.00	5401.13		5403.38	24.00		1297.00			24.91	48.91	
MuddGulch	Reach1	13676.00	5401.13	0.00	5403.38	24.00		1297.00			24.91	48.91	
MuddGulch	Reach1	13478.31	5398.75		5399.53	122.24		1297.00			182.21	304.45	
MuddGulch	Reach1	13478.31	5398.75	0.00	5399.53	122.24		1297.00		182.21	182.21	304.45	304.45
MuddGulch	Reach1	13246.54	5385.13		5386.40	57.74		1297.00			146.03	237.91	
MuddGulch	Reach1	13246.54	5385.13	0.00	5386.40	57.74		1297.00		146.03	146.03	237.91	237.91
MuddGulch	Reach1	13164.55	5373.20		5374.31	70.50		1297.00			137.74	259.78	
MuddGulch	Reach1	13164.55	5373.20	0.00	5374.31	70.50		1297.00		137.74	137.74	259.78	259.78
MuddGulch	Reach1	12837.83	5369.38		5369.79	70.01		1297.00			204.79	301.04	
MuddGulch	Reach1	12837.83	5369.38	0.00	5369.79	70.01		1297.00		204.79	204.79	301.04	301.04
MuddGulch	Reach1	12530.28	5365.47		5367.52	27.84		1297.00			188.79	247.92	
MuddGulch	Reach1	12530.28	5365.47	0.00	5367.52	27.84		1297.00		188.79	188.79	247.92	247.92
MuddGulch	Reach1	12220.19	5360.45		5361.42	49.09		1297.00			176.93	249.87	
MuddGulch	Reach1	12220.19	5360.45	0.00	5361.42	49.09		1297.00		176.93	176.93	249.87	249.87
MuddGulch	Reach1	11900.70	5357.58		5358.56	39.42		1297.00			152.34	235.13	

HEC-RAS Plan: Encroach (Continued)

River	Reach	River Sta	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Width Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
MuddGulch	Reach1	11900.70	5357.58	0.00	5358.56	39.42		1297.00		152.34	152.34	235.13	235.13
MuddGulch	Reach1	11496.49	5352.14		5353.93	34.03		1297.00			155.09	233.17	
MuddGulch	Reach1	11496.49	5352.14	0.00	5353.93	34.03		1297.00		155.09	155.09	233.17	233.17
MuddGulch	Reach1	10979.19	5343.40		5344.79	34.43		1297.00			332.13	414.21	
MuddGulch	Reach1	10979.19	5343.40	0.00	5344.78	34.42		1297.00		332.13	332.13	414.21	414.21
MuddGulch	Reach1	10698.07	5338.69		5340.75	27.55		1297.00			269.32	343.84	
MuddGulch	Reach1	10698.07	5338.69	0.00	5340.75	27.56		1297.00		269.32	269.32	343.84	343.84
MuddGulch	Reach1	10419.12	5332.51		5333.26	55.00		1297.00			291.64	423.20	
MuddGulch	Reach1	10419.12	5332.51	0.00	5333.26	55.00		1297.00		291.64	291.64	423.20	423.20
MuddGulch	Reach1	10391.79BR U	5331.68		5332.99	53.14		1297.00			314.49	392.08	
MuddGulch	Reach1	10391.79BR U	5331.68	0.00	5332.99	53.14		1297.00		291.64	314.49	392.08	423.20
MuddGulch	Reach1	10391.79BR D	5331.38		5332.23	44.75		1297.00			305.15	382.74	
MuddGulch	Reach1	10391.79BR D	5331.38	0.00	5332.23	44.75		1297.00		281.52	305.15	382.74	397.66
MuddGulch	Reach1	10364.86	5330.21		5331.84	39.21		1297.00			281.52	397.66	
MuddGulch	Reach1	10364.86	5330.21	0.00	5331.84	39.21		1297.00		281.52	281.52	397.66	397.66
MuddGulch	Reach1	10261.61	5327.72		5328.94	46.28		1297.00			296.18	395.49	
MuddGulch	Reach1	10261.61	5327.72	0.00	5328.94	46.28		1297.00		296.18	296.18	395.49	395.49
MuddGulch	Reach1	10030.00	5323.83		5325.42	40.76		1297.00			315.36	412.85	
MuddGulch	Reach1	10030.00	5323.83	0.00	5325.42	40.76		1297.00		315.36	315.36	412.85	412.85
MuddGulch	Reach1	9710.46	5320.38		5321.04	53.99		1297.00			446.13	525.03	
MuddGulch	Reach1	9710.46	5320.38	0.00	5321.04	53.99		1297.00		446.13	446.13	525.03	525.03
MuddGulch	Reach1	9424.36	5316.66		5318.26	40.52		1297.00			375.08	448.97	
MuddGulch	Reach1	9424.36	5316.66	0.00	5318.26	40.52		1297.00		375.08	375.08	448.97	448.97
MuddGulch	Reach1	9164.50	5311.75		5312.94	31.00		1297.00			392.59	504.28	
MuddGulch	Reach1	9164.50	5311.75	0.00	5312.94	31.00		1297.00		392.59	392.59	504.28	504.28
MuddGulch	Reach1	9048.02	Culvert										
MuddGulch	Reach1	8955.76	5308.80		5309.36	32.00		1297.00			410.49	525.30	
MuddGulch	Reach1	8955.76	5308.80	0.00	5309.36	32.00		1297.00		410.49	410.49	525.30	525.30
MuddGulch	Reach1	8669.89	5308.53		5308.74	70.61		1297.00			600.43	691.74	
MuddGulch	Reach1	8669.89	5308.53	0.00	5308.74	70.61		1297.00		600.43	600.43	691.74	691.74
MuddGulch	Reach1	8411.16	5306.62		5307.69	61.75		1724.00			626.40	705.89	
MuddGulch	Reach1	8411.16	5306.61	0.00	5307.69	61.75		1724.00		626.40	626.40	705.89	705.89
MuddGulch	Reach1	8031.07	5302.93		5303.89	66.38		1724.00			610.70	687.83	
MuddGulch	Reach1	8031.07	5302.93	0.00	5303.89	66.39		1724.00		610.70	610.70	687.83	687.83
MuddGulch	Reach1	7701.39	5300.08		5300.84	77.12		1724.00			668.78	750.88	
MuddGulch	Reach1	7701.39	5300.07	-0.01	5300.84	77.08		1724.00		668.78	668.78	750.88	750.88
MuddGulch	Reach1	7414.21	5295.89		5297.35	62.33		1724.00			709.61	783.09	
MuddGulch	Reach1	7414.21	5295.90	0.00	5297.35	62.35		1724.00		709.61	709.61	783.09	783.09
MuddGulch	Reach1	7054.93	5289.30		5291.11	44.04		1724.00			714.14	780.59	
MuddGulch	Reach1	7054.93	5289.30	0.00	5291.11	44.03		1724.00		714.14	714.14	780.59	780.59
MuddGulch	Reach1	6896.94	5284.91		5286.89	38.72		1724.00			696.59	767.23	
MuddGulch	Reach1	6896.94	5284.91	0.00	5286.89	38.71		1724.00		696.59	696.59	767.23	767.23
MuddGulch	Reach1	6479.48	5282.62		5283.30	54.26		1724.00			634.71	719.68	
MuddGulch	Reach1	6479.48	5282.69	0.07	5283.35	54.62		1724.00		634.71	634.71	719.68	719.68
MuddGulch	Reach1	6282.00	5281.72		5282.47	45.00		1724.00			630.08	702.33	
MuddGulch	Reach1	6282.00	5281.86	0.14	5282.57	45.00		1724.00		630.08	630.08	702.33	702.33
MuddGulch	Reach1	6253.73 BR U	5281.66		5282.43	45.00		1724.00			644.54	689.54	
MuddGulch	Reach1	6253.73 BR U	5281.81	0.15	5282.53	45.00		1724.00		630.08	644.54	689.54	702.33
MuddGulch	Reach1	6253.73 BR D	5281.72		5282.20	45.00		1724.00			654.54	699.54	
MuddGulch	Reach1	6253.73 BR D	5281.86	0.14	5282.33	45.00		1724.00		643.14	654.54	699.54	719.61
MuddGulch	Reach1	6217.24	5281.66		5282.15	45.00		1724.00			643.14	719.61	
MuddGulch	Reach1	6217.24	5281.81	0.15	5282.28	45.00		1724.00		643.14	643.14	719.61	719.61
MuddGulch	Reach1	5974.50	5279.27		5280.83	45.01		2191.00			648.18	716.66	
MuddGulch	Reach1	5974.50	5280.26	0.99	5281.32	49.36		2191.00		648.18	648.18	716.66	716.66
MuddGulch	Reach1	5477.27	5278.38		5278.69	326.73	399.29	1734.57	57.14		622.28	675.56	
MuddGulch	Reach1	5477.27	5278.70	0.32	5279.25	53.28		2191.00		622.28	622.28	675.56	675.56
MuddGulch	Reach1	5134.21	5275.54		5277.34	60.38	0.91	2189.73	0.36		638.51	694.60	
MuddGulch	Reach1	5134.21	5275.56	0.02	5277.35	56.09		2191.00		638.51	638.51	694.60	694.60

HEC-RAS Plan: Encroach (Continued)

River	Reach	River Sta	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Width Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
Mudd Gulch	Reach1	4937.94	5273.12		5273.14	1872.68		443.86	1747.14		636.32	686.19	
Mudd Gulch	Reach1	4937.94	5273.74	0.63	5273.91	141.01		852.38	1338.62	636.32	636.32	686.19	778.50
Mudd Gulch	Reach1	4835.77	5272.60		5272.93	1426.09		1022.28	1168.72		644.68	687.78	
Mudd Gulch	Reach1	4835.77	5273.13	0.53	5273.60	550.00		1222.43	968.57	644.68	644.68	687.78	1587.00
Mudd Gulch	Reach1	4820.16 BR U	5272.67		5272.80	27.00		438.58			652.71	679.71	
Mudd Gulch	Reach1	4820.16 BR U	5273.36	0.68	5273.36	27.00		0.00		644.68	652.71	679.71	1587.00
Mudd Gulch	Reach1	4820.16 BR D	5272.67		5272.78	27.00		438.58			660.56	687.56	
Mudd Gulch	Reach1	4820.16 BR D	5273.36	0.69	5273.36	27.00		0.00		648.74	660.56	687.56	1587.00
Mudd Gulch	Reach1	4798.82	5272.41		5272.71	1324.45		1002.42	1188.58		648.74	702.68	
Mudd Gulch	Reach1	4798.82	5272.62	0.21	5273.18	524.00		1273.41	917.59	648.74	648.74	702.68	1587.00
Mudd Gulch	Reach1	4752.50	5269.70		5270.63	83.78		2191.00			624.08	746.19	
Mudd Gulch	Reach1	4752.50	5270.00	0.30	5270.78	86.63		2191.00		624.08	624.08	746.19	1500.00
Mudd Gulch	Reach1	4479.82	5267.64		5268.58	313.77	107.60	2064.37	19.03		631.16	690.20	
Mudd Gulch	Reach1	4479.82	5267.75	0.10	5268.81	59.04		2191.00		631.16	631.16	690.20	690.20
Mudd Gulch	Reach1	4005.63	5261.69		5263.42	61.33		2191.00			646.53	710.59	
Mudd Gulch	Reach1	4005.63	5261.71	0.02	5263.42	61.46		2191.00		646.53	646.53	710.59	710.59
Mudd Gulch	Reach1	3515.21	5259.66		5259.90	718.22		1249.90	941.10		613.55	720.58	
Mudd Gulch	Reach1	3515.21	5259.72	0.06	5259.96	612.80		1258.58	932.42	613.55	613.55	720.58	1275.00
Mudd Gulch	Reach1	3493.08 BR U	5259.50		5259.83	685.01		974.19	1216.81		644.55	671.55	
Mudd Gulch	Reach1	3493.08 BR U	5259.51	0.01	5259.88	585.80		1009.02	1181.99	613.55	644.55	671.55	1275.00
Mudd Gulch	Reach1	3493.08 BR D	5258.40		5258.78	656.06		911.45	1279.55		629.17	656.17	
Mudd Gulch	Reach1	3493.08 BR D	5258.38	-0.02	5258.78	606.79		919.60	1271.41	617.90	629.17	656.17	1300.00
Mudd Gulch	Reach1	3469.15	5257.63		5258.18	602.61		903.35	1287.65		617.90	667.97	
Mudd Gulch	Reach1	3469.15	5257.62	-0.01	5258.21	503.33		915.72	1275.28	617.90	617.90	667.97	1300.00
Mudd Gulch	Reach1	3389.17	5257.25		5257.32	642.85		418.04	1772.96		574.63	654.63	
Mudd Gulch	Reach1	3389.17	5257.25	0.00	5257.32	642.85		418.04	1772.96	574.63	574.63	654.63	1265.02
Mudd Gulch	Reach1	3389.00	Lat Struct										
Mudd Gulch	Reach1	2868.02	5254.12		5254.94	219.64		1021.50	1152.43		633.87	666.43	
Mudd Gulch	Reach1	2868.02	5254.12	0.00	5254.94	219.64		1021.50	1152.43		633.87	666.43	
Mudd Gulch	Reach1	2868.00	Lat Struct										
Mudd Gulch	Reach1	2519.13	5249.93		5250.10	151.86	2.31	948.24	0.02		793.09	925.11	
Mudd Gulch	Reach1	2519.13	5249.93	0.00	5250.10	151.86	2.31	948.24	0.02		793.09	925.11	
Mudd Gulch	Reach1	2519.00	Lat Struct										
Mudd Gulch	Reach1	2498.67	5249.11		5249.85	33.00		921.10			983.78	1035.10	
Mudd Gulch	Reach1	2498.67	5249.11	0.00	5249.85	33.00		921.10			983.78	1035.10	
Mudd Gulch	Reach1	2473.27 BR U	5247.99		5249.42	33.00		921.10			990.72	1023.72	
Mudd Gulch	Reach1	2473.27 BR U	5247.99	0.00	5249.42	33.00		921.10			990.72	1023.72	
Mudd Gulch	Reach1	2473.27 BR D	5247.96		5248.62	33.00		921.10			1059.66	1092.66	
Mudd Gulch	Reach1	2473.27 BR D	5247.96	0.00	5248.62	33.00		921.10			1059.66	1092.66	
Mudd Gulch	Reach1	2418.14	5247.67		5248.43	33.00		921.10			1043.07	1102.59	
Mudd Gulch	Reach1	2418.14	5247.67	0.00	5248.43	33.00		921.10			1043.07	1102.59	
Mudd Gulch	Reach1	2189.83	5246.23		5246.86	132.10	89.72	942.27	0.11		1003.41	1053.65	
Mudd Gulch	Reach1	2189.83	5246.23	0.00	5246.86	132.10	89.93	942.06	0.11	78.00	1003.41	1053.65	1067.00
Mudd Gulch	Reach1	1989.08	5245.22		5245.72	46.94		1032.10			954.42	1005.48	
Mudd Gulch	Reach1	1989.08	5245.22	0.00	5245.72	46.95		1032.10		200.00	954.42	1005.48	1005.48
Mudd Gulch	Reach1	1574.31	5241.25		5242.69	31.93		1032.10			819.01	852.88	
Mudd Gulch	Reach1	1574.31	5241.25	-0.01	5242.69	31.90		1032.10		450.00	819.01	852.88	852.88
Mudd Gulch	Reach1	1261.28	5238.55		5239.44	31.13		1032.10			1134.31	1175.08	
Mudd Gulch	Reach1	1261.28	5238.56	0.01	5239.45	31.16		1032.10		1134.31	1134.31	1175.08	1175.08
Mudd Gulch	Reach1	863.78	5237.86		5238.14	64.41	0.14	1031.95			1445.12	1489.34	
Mudd Gulch	Reach1	863.78	5237.88	0.02	5238.16	42.97		1032.10		1445.12	1445.12	1489.34	1489.34
Mudd Gulch	Reach1	411.13	5235.97		5236.74	171.08		1022.21	9.89		1817.78	1867.25	
Mudd Gulch	Reach1	411.13	5235.98	0.01	5236.77	44.39		1032.10		1817.78	1817.78	1867.25	1867.25
Mudd Gulch	Reach1	30.00	5232.68		5233.25	80.85		1032.10			2283.48	2415.23	
Mudd Gulch	Reach1	30.00	5232.68	0.00	5233.25	80.90		1032.10		2283.48	2283.48	2415.23	2415.23
MG Flow Split	Reach1	3569.53	5250.27		5250.27	49.29		0.10			0.00	504.07	
MG Flow Split	Reach1	3569.53	5250.27	0.00	5250.27	49.29		0.10			0.00	504.07	

HEC-RAS Plan: Encroach (Continued)

River	Reach	River Sta	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Width Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
MG Flow Split	Reach1	3568.53	5250.15		5250.25	35.52		17.17			0.00	504.07	
MG Flow Split	Reach1	3568.53	5250.15	0.00	5250.25	35.52		17.17			0.00	504.07	
MG Flow Split	Reach1	2878.94	5243.89		5243.94	552.56		1240.53			0.00	849.69	
MG Flow Split	Reach1	2878.94	5243.89	0.00	5243.94	552.56		1240.53			0.00	849.69	
MG Flow Split	Reach1	2455.99	5243.50		5243.52	876.64		1270.00			0.00	1101.47	
MG Flow Split	Reach1	2455.99	5243.50	0.00	5243.52	876.64		1270.00			0.00	1101.47	
MG Flow Split	Reach1	2211.55	5243.15		5243.21	816.04		1270.00			0.00	1103.99	
MG Flow Split	Reach1	2211.55	5243.15	0.00	5243.21	816.04		1270.00			0.00	1103.99	
MG Flow Split	Reach1	1729.42	5240.76		5240.89	335.43		1270.00			0.00	949.70	
MG Flow Split	Reach1	1729.42	5240.76	0.00	5240.89	335.43		1270.00			0.00	949.70	
MG Flow Split	Reach1	1234.55	5239.43		5239.48	397.12		1270.00			0.00	732.72	
MG Flow Split	Reach1	1234.55	5239.43	0.00	5239.48	397.12		1270.00			0.00	732.72	
MG Flow Split	Reach1	685.37	5237.74		5237.86	408.27		1270.00			0.00	622.76	
MG Flow Split	Reach1	685.37	5237.74	0.00	5237.86	408.27		1270.00			0.00	622.76	
MG Flow Split	Reach1	685.00	Lat Struct										
MG Flow Split	Reach1	224.65	5235.38		5235.54	208.99		1268.89			0.00	258.97	
MG Flow Split	Reach1	224.65	5235.38	0.00	5235.54	208.99		1268.89			0.00	258.97	
MG Flow Split	Reach1	224.00	Lat Struct										
MG Flow Split	Reach1	104.89	5235.44		5235.45	239.25		1268.72			0.00	239.25	
MG Flow Split	Reach1	104.89	5235.44	0.00	5235.45	239.25		1268.72			0.00	239.25	
MG Flow Split	Reach1	68.78	Culvert										
MG Flow Split	Reach1	14.14	5227.66		5228.04	140.03		1268.72			0.00	261.47	
MG Flow Split	Reach1	14.14	5227.66	0.00	5228.04	140.03		1268.72			0.00	261.47	
Fourmile	Reach1	16382.73	5365.13		5367.01	238.10	555.86	6441.84	22.30		608.83	700.20	
Fourmile	Reach1	16382.73	5365.18	0.05	5367.01	238.10	577.03	6419.64	23.33	469.98	608.83	700.20	708.08
Fourmile	Reach1	16018.02	5361.64		5363.15	441.18	1155.94	5778.65	85.41		755.07	841.42	
Fourmile	Reach1	16018.02	5361.68	0.04	5363.09	354.95	1271.09	5663.48	85.43	500.00	755.07	841.42	854.95
Fourmile	Reach1	15788.95	5359.46		5360.02	629.63	3379.81	3605.66	34.53		696.88	782.70	
Fourmile	Reach1	15788.95	5360.36	0.90	5360.88	382.70	3153.02	3866.98		400.00	696.88	782.70	782.70
Fourmile	Reach1	15380.94	5356.43		5357.57	546.93	2236.32	4349.35	434.32		674.57	739.74	
Fourmile	Reach1	15380.94	5356.96	0.53	5358.68	232.65	1176.73	5286.89	556.38	567.35	674.57	739.74	800.00
Fourmile	Reach1	15048.74	5353.95		5354.90	405.50	491.44	3042.53	3486.03		572.76	618.55	
Fourmile	Reach1	15048.74	5353.96	0.01	5355.06	198.34	147.46	3199.93	3672.61	550.00	572.76	618.55	748.34
Fourmile	Reach1	14576.82	5351.37		5352.67	226.53	983.82	6016.68	19.49		685.27	772.72	
Fourmile	Reach1	14576.82	5351.42	0.05	5352.69	222.72	1026.63	5993.37		550.00	685.27	772.72	772.72
Fourmile	Reach1	14082.25	5346.75		5348.55	207.91	21.57	6996.76	1.67		294.44	465.52	
Fourmile	Reach1	14082.25	5346.79	0.04	5348.55	207.92	24.33	6993.51	2.16	265.26	294.44	465.52	473.18
Fourmile	Reach1	13545.88	5344.24		5344.70	305.84	0.23	7009.00	10.77		428.67	716.65	
Fourmile	Reach1	13545.88	5344.22	-0.02	5344.68	305.25	0.19	7009.50	10.31	424.63	428.67	716.65	729.90
Fourmile	Reach1	13318.55	5340.83		5343.29	138.17	70.93	6909.92	39.15		540.27	640.07	
Fourmile	Reach1	13318.55	5340.91	0.08	5343.29	138.17	77.51	6899.26	43.22	517.03	540.27	640.07	655.20
Fourmile	Reach1	12947.26	5338.14		5339.22	156.42	14.64	7004.04	1.32		635.78	781.49	
Fourmile	Reach1	12947.26	5339.10	0.96	5339.89	153.32	30.49	6989.51		628.17	635.78	781.49	781.49
Fourmile	Reach1	12788.01	5337.42		5338.41	357.20	149.69	5762.66	1107.65		691.54	791.94	
Fourmile	Reach1	12788.01	5337.69	0.27	5339.17	122.56	202.07	6817.93		669.38	691.54	791.94	791.94
Fourmile	Reach1	12322.54	5332.64		5334.58	105.67		7020.00			499.45	610.56	
Fourmile	Reach1	12322.54	5332.64	0.00	5334.58	105.68		7020.00		499.45	499.45	610.56	610.56
Fourmile	Reach1	11997.88	5328.92		5330.39	205.89	10.65	6542.71	466.64		560.35	695.02	
Fourmile	Reach1	11997.88	5329.87	0.95	5331.12	134.67		7020.00		560.35	560.35	695.02	695.02
Fourmile	Reach1	11451.47	5324.89		5326.01	247.97	319.78	5464.43	1235.80		478.77	593.56	
Fourmile	Reach1	11451.47	5325.52	0.63	5327.25	114.79		7020.00		478.77	478.77	593.56	593.56
Fourmile	Reach1	10930.27	5320.48		5321.84	289.24	276.28	6079.29	664.43		562.60	697.95	
Fourmile	Reach1	10930.27	5320.97	0.49	5322.62	135.35		7020.00		562.60	562.60	697.95	697.95
Fourmile	Reach1	10292.38	5317.13		5317.73	267.51	4139.14	2819.57	61.30		507.65	566.57	
Fourmile	Reach1	10292.38	5317.78	0.65	5318.72	136.95	3492.62	3527.38		429.62	507.65	566.57	566.57
Fourmile	Reach1	10048.25	5314.69		5315.80	383.08	2210.94	4312.91	496.14		782.98	842.12	
Fourmile	Reach1	10048.25	5314.72	0.03	5316.31	142.12	2261.85	4758.15		700.00	782.98	842.12	842.12

HEC-RAS Plan: Encroach (Continued)

River	Reach	River Sta	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Width Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
Fourmile	Reach1	9338.16	5309.74		5311.31	223.00	775.05	5987.28	257.67		703.07	797.15	
Fourmile	Reach1	9338.16	5309.88	0.14	5311.34	190.00	783.51	5928.21	308.28	650.00	703.07	797.15	840.00
Fourmile	Reach1	8895.63	5308.28		5308.93	196.17		7020.00			235.45	460.38	
Fourmile	Reach1	8895.63	5308.77	0.49	5309.31	203.89		7020.00		235.45	235.45	460.38	460.38
Fourmile	Reach1	8742.65	5308.12		5308.52	214.90		7020.00			312.22	564.61	
Fourmile	Reach1	8742.65	5308.65	0.53	5308.99	216.71		7020.00		312.22	312.22	564.61	564.61
Fourmile	Reach1	8684.30	5307.90		5308.40	180.20		7020.00			385.17	572.12	
Fourmile	Reach1	8684.30	5308.47	0.57	5308.89	180.31		7020.00		385.17	385.17	572.12	572.12
Fourmile	Reach1	8632.47 BR U	5307.85		5308.38	176.01		7019.99	0.01		390.88	570.38	
Fourmile	Reach1	8632.47 BR U	5308.43	0.58	5308.88	176.00		7019.99	0.01	385.17	390.88	570.38	572.12
Fourmile	Reach1	8632.47 BR D	5306.51		5307.10	175.99		7020.00			465.15	644.65	
Fourmile	Reach1	8632.47 BR D	5307.20	0.69	5307.68	175.99		7020.00		304.91	465.15	644.65	714.78
Fourmile	Reach1	8569.65	5306.53		5307.09	179.50		7020.00			304.91	714.78	
Fourmile	Reach1	8569.65	5307.21	0.68	5307.67	179.50		7020.00		304.91	304.91	714.78	714.78
Fourmile	Reach1	8490.80	5306.10		5306.82	191.24		7020.00			542.08	779.28	
Fourmile	Reach1	8490.80	5306.97	0.87	5307.50	198.85		7020.00		542.08	542.08	779.28	779.28
Fourmile	Reach1	8139.05	5303.78		5305.15	373.03	1273.37	5457.09	289.54		758.85	828.92	
Fourmile	Reach1	8139.05	5303.94	0.16	5306.02	190.05	212.55	6405.74	401.71	735.59	758.85	828.92	925.64
Fourmile	Reach1	7819.74	5301.11		5301.85	599.83	683.57	4073.43	2263.00		631.34	695.75	
Fourmile	Reach1	7819.74	5301.69	0.58	5302.59	233.59	66.68	4551.31	2402.01	616.41	631.34	695.75	850.00
Fourmile	Reach1	7819.00	Lat Struct										
Fourmile	Reach1	7454.19	5298.85		5299.93	494.12	998.12	5362.32	531.05		294.88	390.68	
Fourmile	Reach1	7454.19	5299.08	0.22	5300.65	201.12		6295.88	724.12	294.88	294.88	390.68	496.00
Fourmile	Reach1	7454.00	Lat Struct										
Fourmile	Reach1	6921.01	5292.97		5295.42	111.73		6857.05			238.29	366.16	
Fourmile	Reach1	6921.01	5293.07	0.10	5295.53	113.73		7020.00		238.29	238.29	366.16	366.16
Fourmile	Reach1	6349.33	5288.51		5289.05	220.23		6857.05			315.21	581.41	
Fourmile	Reach1	6349.33	5288.59	0.07	5289.13	222.03		7020.00		315.21	315.21	581.41	581.41
Fourmile	Reach1	5984.11	5286.06		5287.37	230.94		6857.05			270.01	533.30	
Fourmile	Reach1	5984.11	5286.12	0.06	5287.44	232.13		7020.00		270.01	270.01	533.30	533.30
Fourmile	Reach1	5506.21	5284.56		5285.06	280.88		6891.50			474.77	800.82	
Fourmile	Reach1	5506.21	5284.69	0.13	5285.18	286.31		7020.00		474.77	474.77	800.82	800.82
Fourmile	Reach1	5147.36	5283.36		5284.04	231.55		6891.50			593.10	837.36	
Fourmile	Reach1	5147.36	5283.57	0.21	5284.21	238.13		7020.00		593.10	593.10	837.36	837.36
Fourmile	Reach1	4711.74	5283.33		5283.46	562.37	110.69	3526.48	3254.33		766.96	877.51	
Fourmile	Reach1	4711.74	5283.44	0.10	5283.60	333.04		3851.94	3168.06	766.96	766.96	877.51	1100.00
Fourmile	Reach1	4394.51	5282.23		5283.02	99.55		6891.50			804.34	931.81	
Fourmile	Reach1	4394.51	5282.32	0.09	5283.13	99.55		7020.00		804.34	804.34	931.81	931.81
Fourmile	Reach1	4379.56 BR U	5282.21		5283.01	98.88		6891.50			817.49	917.04	
Fourmile	Reach1	4379.56 BR U	5282.30	0.09	5283.11	98.88		7020.00		804.34	817.49	917.04	931.81
Fourmile	Reach1	4379.56 BR D	5281.65		5282.83	98.88		6891.50			818.60	918.15	
Fourmile	Reach1	4379.56 BR D	5281.73	0.09	5282.93	98.88		7020.00		818.00	818.60	918.15	955.52
Fourmile	Reach1	4329.78	5279.20		5282.12	99.55	449.96	6441.54			862.00	955.52	
Fourmile	Reach1	4329.78	5279.29	0.09	5282.23	99.55	480.96	6539.04		818.00	862.00	955.52	955.52
Fourmile	Reach1	4111.69	5277.46		5278.14	130.16		6891.50			141.75	293.70	
Fourmile	Reach1	4111.69	5277.54	0.08	5278.23	130.16		7020.00		141.75	141.75	293.70	293.70
Fourmile	Reach1	4073.00 BR U	5277.45		5278.14	130.16		6891.50			157.79	287.95	
Fourmile	Reach1	4073.00 BR U	5277.53	0.08	5278.23	130.16		7020.00		141.75	157.79	287.95	293.70
Fourmile	Reach1	4073.00 BR D	5276.88		5277.95	130.16		6891.50			185.73	315.94	
Fourmile	Reach1	4073.00 BR D	5276.96	0.08	5278.04	130.16		7020.00		185.00	185.73	315.94	316.00
Fourmile	Reach1	4050.69	5274.91		5277.33	130.16		6833.97	57.53		140.59	277.47	
Fourmile	Reach1	4050.69	5275.01	0.10	5277.43	130.16		6950.38	69.62	185.00	140.59	277.47	316.00
Fourmile	Reach1	3756.25	5272.52		5273.80	352.66	69.40	5647.29	1174.81		346.43	467.88	
Fourmile	Reach1	3756.25	5272.56	0.04	5273.87	333.57		5759.19	1260.81	346.43	346.43	467.88	680.00
Fourmile	Reach1	3680.22	5271.71		5272.98	268.45	53.38	5650.60	1187.52		503.43	587.62	
Fourmile	Reach1	3680.22	5271.85	0.13	5273.07	256.08		5682.04	1337.96	503.43	503.43	587.62	759.51
Fourmile	Reach1	3432.09	5271.33		5271.83	378.55	11.69	4746.19	2133.62		622.65	741.61	

HEC-RAS Plan: Encroach (Continued)

River	Reach	River Sta	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Width Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
Fourmile	Reach1	3432.09	5271.41	0.08	5271.93	327.35		4856.38	2163.62	622.65	622.65	741.61	950.00
Fourmile	Reach1	3121.18	5269.94		5270.80	273.20	0.05	5295.91	1595.54		791.80	883.42	
Fourmile	Reach1	3121.18	5270.09	0.16	5270.92	258.20		5309.18	1710.82	791.80	791.80	883.42	1050.00
Fourmile	Reach1	2953.71	5268.47		5269.98	111.64		6819.95	71.55		935.06	1033.51	
Fourmile	Reach1	2953.71	5268.47	0.00	5270.09	95.11		7020.00		935.06	935.06	1033.51	1033.51
Fourmile	Reach1	2512.02	5265.01		5265.94	168.80		6866.63	24.87		962.72	1118.60	
Fourmile	Reach1	2512.02	5265.23	0.22	5266.12	168.80		6988.88	31.12	962.72	962.72	1118.60	1131.52
Fourmile	Reach1	2154.04	5262.60		5263.84	364.02	1000.84	5890.66			1198.38	1358.57	
Fourmile	Reach1	2154.04	5263.45	0.85	5264.47	258.57	653.78	6366.22		1100.00	1198.38	1358.57	1358.57
Fourmile	Reach1	1765.52	5260.72		5261.02	790.62	3429.41	3462.09			1602.18	1709.97	
Fourmile	Reach1	1765.52	5261.59	0.87	5262.50	309.97	1226.86	5793.14		1400.00	1602.18	1709.97	1709.97
Fourmile	Reach1	1606.54	5259.67		5260.42	960.12	2453.30	4438.01	0.19		1743.97	1842.58	
Fourmile	Reach1	1606.54	5260.63	0.95	5261.74	292.58	1318.25	5701.75		1550.00	1743.97	1842.58	1842.58
Fourmile	Reach1	1222.98	5256.54		5257.02	705.39	3007.50	3752.90	131.10		1865.11	2055.36	
Fourmile	Reach1	1222.98	5257.17	0.63	5258.96	182.36		6696.47	323.53	1900.00	1865.11	2055.36	2155.36
Fourmile	Reach1	666.22	5253.23		5253.96	318.68	326.63	6521.33	43.54		2250.81	2468.05	
Fourmile	Reach1	666.22	5253.63	0.41	5254.38	217.24		7020.00		2250.81	2250.81	2468.05	2468.05
Fourmile	Reach1	68.69	5251.06		5251.65	249.44		5973.62	917.88		2860.08	3021.05	
Fourmile	Reach1	68.69	5251.52	0.45	5252.19	189.92		6662.06	357.94	2860.08	2860.08	3021.05	3050.00

ANNOTATED CHECK-RAS REPORT

The only changes that were made to the original TSDN HEC-RAS models were to the computation options within the *Bridge Modeling Approach Editor*. Based on Comment 5, the hydraulic models were revised to include the *Momentum* and *Yarnell* methods for any bridge with piers (under low flow conditions). Additionally, per Comment 6, the hydraulic models were revised to include the *Pressure and/or Weir* method for any structure under high flow conditions. Utilizing these other methods, the 100-year water surface elevation changed at/upstream of only two structures (refer to the Response to Comments text for further discussion). Since the revisions to the HEC-RAS models were only related the computation methodology and the resulting change in water surface elevation was isolated to only two structures, the CHECK-RAS was not rerun.

FourmileCreek_MuddGulch.nt
CHECK-RAS Program: NT Check
Manning's n Value and Transition Loss Coefficient Review

Project File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.prj
Plan File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.p01
Geometry File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.g01
Flow File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.f01
Report File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.nt
Selected profiles: 1%
Date: 4/10/2009
Time: 8:48:08 AM

SECNO	STRUCTURE	NLOB	NCHL	NROB	CNTR	EXP
Fourmile, Reach1						
16382.73		0.05	0.04	0.04	0.1	0.3
		0.06	-----	0.06		
16018.02		0.06	0.04	0.06	0.1	0.3
15788.95		0.06	0.04	0.04	0.1	0.3
		-----	0.04	-----		
15380.94		0.06	0.04	0.06	0.1	0.3
15048.74		0.06	0.04	0.04	0.1	0.3
		0.04	-----	0.06		
14576.82		0.06	0.04	0.06	0.1	0.3
		0.04	-----	-----		
14082.25		0.06	0.04	0.06	0.1	0.3
13545.88		0.06	0.04	0.04	0.1	0.3
		-----	0.04	-----		
13318.55		0.06	0.04	0.06	0.1	0.3
		-----	-----	0.05		
12947.26		0.06	0.04	0.05	0.1	0.3
12788.01		0.06	0.04	0.05	0.1	0.3
12322.54		0.06	0.06	-----	0.1	0.3
11997.88		0.06	0.04	0.04	0.1	0.3
		-----	0.04	-----		
		-----	0.04	-----		
11451.47		0.05	0.04	0.04	0.1	0.3
		-----	0.04	-----		
10930.27		0.05	0.04	0.04	0.1	0.3
		-----	0.04	0.06		
10292.38		0.05	0.04	0.06	0.1	0.3
10048.25		0.05	0.04	0.06	0.1	0.3
9338.16		0.08	0.04	0.06	0.1	0.3
		0.05	0.04	-----		
8895.63		0.08	0.04	0.05	0.1	0.3
		0.05	-----	-----		
8742.65		0.08	0.04	0.04	0.3	0.5
		0.05	0.04	-----		
8684.3		0.08	0.04	0.04	0.3	0.5
		0.05	0.04	-----		
8632.47 Bridge-Up		0.08	0.04	-----	0.3	0.5
		0.05	0.05	-----		
8632.47 Bridge-Dn		0.08	0.08	0.04	0.3	0.5
		-----	0.04	0.05		
8569.65		0.08	0.04	0.05	0.3	0.5
		0.04	-----	-----		
8490.8		0.08	0.04	0.05	0.1	0.3
		0.05	0.04	-----		
8139.05		0.08	0.04	0.04	0.1	0.3
		0.05	0.04	0.05		
7819.74		0.05	0.04	0.05	0.1	0.3
		0.04	-----	0.08		
7819 Lateral weirs						
7454.19		0.05	0.04	0.04	0.1	0.3
		-----	0.04	0.05		
		-----	-----	0.08		
7454 Lateral weirs						
6921.01		0.05	0.04	0.08	0.1	0.3
6349.33		0.05	0.04	0.04	0.1	0.3
		-----	0.04	-----		
5984.11		0.05	0.04	0.04	0.1	0.3
		-----	0.04	-----		
5506.21		0.05	0.04	0.04	0.1	0.3
		-----	0.04	-----		
		-----	0.04	-----		
5147.36		0.05	0.04	0.04	0.1	0.3
		0.04	0.04	-----		
4711.74		0.05	0.04	0.04	0.3	0.5
		0.04	0.04	-----		
4394.51		0.05	0.04	0.08	0.3	0.5
4379.56 Bridge-Up		0.05	0.04	0.04	0.3	0.5
		-----	-----	0.08		
4379.56 Bridge-Dn		0.05	0.05	0.04	0.3	0.5
		-----	0.04	0.08		
		-----	-----	0.08		

FourmileCreek_MuddGulch.nt					
4329.78	0.05	0.04	0.08	0.3	0.5
	-----	0.04	0.08		
4111.69	0.05	0.04	0.04	0.3	0.5
	-----	-----	0.08		
4073 Bridge-Up	0.05	-----	-----	0.3	0.5
	0.04	-----	-----		
4073 Bridge-Dn	0.05	0.05	0.04	0.3	0.5
	-----	0.04	0.08		
4050.69	0.05	0.04	0.04	0.3	0.5
	0.04	-----	0.08		
	-----	-----	0.04		
	-----	-----	0.08		
3756.25	0.05	0.04	0.04	0.1	0.3
	-----	-----	0.05		
3680.22	0.05	0.04	0.04	0.1	0.3
	-----	0.04	-----		
3432.09	0.05	0.04	0.04	0.1	0.3
	0.08	0.04	-----		
3121.18	0.05	0.04	0.04	0.1	0.3
	0.08	0.04	-----		
	0.04	-----	-----		
2953.71	0.05	0.04	0.04	0.1	0.3
	0.08	0.04	-----		
	-----	0.04	-----		
2512.02	0.05	0.04	0.05	0.1	0.3
	-----	0.04	-----		
2154.04	0.05	0.04	0.04	0.1	0.3
	-----	0.04	-----		
	-----	0.04	-----		
1765.52	0.05	0.04	0.05	0.1	0.3
	-----	0.04	-----		
1606.54	0.05	0.04	0.04	0.1	0.3
	-----	0.04	-----		
	-----	0.04	-----		
1222.98	0.05	0.04	0.05	0.1	0.3
	-----	0.04	-----		
666.22	0.05	0.04	0.05	0.1	0.3
MG Flow Split, Reach1					
68.69	0.05	0.04	0.05	0.1	0.3
3569.53	-----	0.045	0.045	0.1	0.3
	-----	0.045	-----		
3568.53	-----	0.045	0.045	0.1	0.3
	-----	0.045	-----		
2878.94	-----	0.045	0.045	0.1	0.3
	-----	0.045	-----		
2455.99	-----	0.045	0.045	0.1	0.3
	-----	0.045	-----		
2211.55	-----	0.045	0.045	0.1	0.3
	-----	0.045	-----		
1729.42	-----	0.045	0.045	0.1	0.3
	-----	0.045	-----		
1234.55	-----	0.045	0.045	0.1	0.3
	-----	0.045	-----		
685.37	-----	0.045	0.045	0.1	0.3
	-----	0.045	-----		
685 Lateral Weirs					
224.65	-----	0.045	0.045	0.3	0.5
	-----	0.045	-----		
224 Lateral Weirs					
104.89	-----	0.045	0.045	0.3	0.5
	-----	0.045	-----		
68.78 Culvert-Up	-----	0.045	0.045	0.3	0.5
	-----	0.045	-----		
68.78 Culvert-Dn	-----	0.045	0.045	0.3	0.5
	-----	0.045	-----		
MuddGulch, Reach1					
14.14	-----	0.045	0.045	0.3	0.5
	-----	0.045	-----		
20181.26	0.05	0.04	0.05	0.1	0.3
19700.71	0.05	0.04	-----	0.1	0.3
	0.04	0.05	-----		
19402.88	0.06	-----	-----	0.1	0.3
	0.04	-----	-----		
18990.06	0.06	0.04	0.06	0.1	0.3
18760	0.06	0.04	-----	0.1	0.3
	0.04	0.06	-----		
18518.88	0.06	0.04	0.06	0.1	0.3
18116.98	0.04	-----	-----	0.1	0.3
17844.24	0.06	0.04	0.04	0.1	0.3
	-----	-----	0.06		
17384.73	0.06	0.06	-----	0.3	0.5
	-----	0.04	-----		
	-----	0.06	-----		
16869.32	0.06	0.045	0.06	0.3	0.5
16809.73Culvert-Up	0.06	0.045	0.06	0.3	0.5
	-----	-----	0.08		
16809.73Culvert-Dn	0.06	-----	-----	0.3	0.5
	0.045	-----	-----		
16749.55	0.06	-----	-----	0.3	0.5
	0.045	-----	-----		
16485.74	-----	0.035	-----	0.3	0.5

16216.12	-----	0.035	FourmileCreek_MuddGulch.nt	0.035	0.1	0.3
15806.06	0.06	0.035	0.035	0.1	0.3	
15397.66	0.06	-----	-----	0.1	0.3	
	0.035	-----	-----			
15035.7	0.06	-----	-----	0.1	0.3	
	0.035	-----	-----			
14623.73	0.06	-----	-----	0.1	0.3	
	0.035	-----	-----			
14522.74	0.06	0.06	-----	0.1	0.3	
	-----	0.035	-----			
	-----	0.06	-----			
14414.32	0.06	0.035	-----	0.1	0.3	
14002.14	0.06	-----	-----	0.1	0.3	
	0.035	-----	-----			
13823.62	0.06	-----	-----	0.1	0.3	
	0.035	-----	-----			
13676	0.06	0.015	0.06	0.1	0.3	
13478.31	0.06	0.035	0.06	0.1	0.3	
13246.54	0.06	0.035	0.06	0.1	0.3	
13164.55	0.06	0.06	0.06	0.1	0.3	
	-----	0.035	-----			
12837.83	0.08	-----	-----	0.1	0.3	
	0.06	-----	-----			
	0.04	-----	-----			
12530.28	0.08	0.06	-----	0.1	0.3	
	0.06	0.04	-----			
	-----	0.06	-----			
12220.19	0.08	0.06	-----	0.1	0.3	
	0.06	0.04	-----			
	-----	0.06	-----			
11900.7	0.08	0.04	0.06	0.1	0.3	
	0.06	-----	-----			
	0.08	-----	-----			
11496.49	0.08	0.04	-----	0.1	0.3	
	-----	0.06	-----			
10979.19	0.08	0.04	0.06	0.1	0.3	
10698.07	0.08	0.08	0.04	0.3	0.5	
	-----	0.04	0.06			
10419.12	0.08	0.04	0.06	0.3	0.5	
10391.79Bridge-Up	0.08	0.04	0.06	0.3	0.5	
10391.79Bridge-Dn	0.08	0.08	0.08	0.3	0.5	
	-----	0.04	0.05			
	-----	0.08	-----			
10364.86	0.08	0.08	0.08	0.3	0.5	
	-----	0.04	0.05			
	-----	0.08	-----			
10261.61	0.08	0.04	0.08	0.3	0.5	
	-----	-----	0.05			
10030	0.08	0.04	0.08	0.1	0.3	
9710.46	0.08	0.08	-----	0.1	0.3	
	-----	0.04	-----			
	-----	0.08	-----			
9424.36	0.08	0.08	0.04	0.3	0.5	
	-----	0.04	0.08			
9164.5	0.08	0.04	0.08	0.3	0.5	
9048.02 Culvert-Up	0.08	0.04	0.08	0.3	0.5	
9048.02 Culvert-Dn	0.035	0.035	0.04	0.3	0.5	
	-----	0.04	0.08			
8955.76	0.035	0.04	0.08	0.3	0.5	
8669.89	0.035	0.04	-----	0.3	0.5	
	0.04	0.08	-----			
8411.16	0.035	-----	-----	0.1	0.3	
	0.04	-----	-----			
8031.07	0.035	0.035	-----	0.1	0.3	
	-----	0.04	-----			
	-----	0.08	-----			
7701.39	0.05	0.05	-----	0.1	0.3	
	-----	0.04	-----			
	-----	0.08	-----			
7414.21	0.05	0.04	-----	0.1	0.3	
	-----	0.08	-----			
7054.93	0.05	0.05	-----	0.1	0.3	
	-----	0.04	-----			
	-----	0.08	-----			
6896.94	0.05	0.04	0.04	0.1	0.3	
	-----	-----	0.08			
6479.48	0.05	0.04	0.08	0.3	0.5	
6282	0.05	0.04	0.08	0.3	0.5	
6253.73 Bridge-Up	0.05	0.04	0.08	0.3	0.5	
6253.73 Bridge-Dn	0.08	0.05	0.04	0.3	0.5	
	0.05	0.04	0.05			
6217.24	0.08	0.04	0.05	0.3	0.5	
	0.05	-----	-----			
5974.5	0.08	0.04	0.05	0.3	0.5	
	0.05	-----	-----			
5477.27	0.05	-----	-----	0.1	0.3	
	0.04	-----	-----			
5134.21	0.05	-----	-----	0.1	0.3	
	0.04	-----	-----			
4937.94	0.05	0.04	0.05	0.3	0.5	
	-----	-----	0.08			

FourmileCreek_MuddGulch.nt					
4835.77	0.05	0.04	0.04	0.3	0.5
	-----	-----	0.05		
			0.08		
4820.16 Bridge-Up	0.05	0.04	0.04	0.3	0.5
	-----	-----	0.05		
			0.08		
4820.16 Bridge-Dn	0.05	0.05	0.04	0.3	0.5
	-----	-----	0.05		
4798.82	0.05	0.05	0.05	0.3	0.5
	-----	-----	0.04		
4752.5	0.05	0.05	0.05	0.3	0.5
	-----	-----	0.04		
4479.82	0.05	0.05	-----	0.1	0.3
	-----	0.04	-----		
		0.05	-----		
4005.63	0.05	0.04	0.05	0.3	0.5
3515.21	0.05	-----	-----	0.3	0.5
	0.04	-----	-----		
3493.08 Bridge-Up	0.05	-----	-----	0.3	0.5
	0.04	-----	-----		
3493.08 Bridge-Dn	0.05	0.04	-----	0.3	0.5
	0.04	0.05	-----		
3469.15	0.05	-----	-----	0.3	0.5
	0.04	-----	-----		
3389.17	0.05	0.05	0.05	0.3	0.5
	-----	0.04	-----		
3389 Lateral Weirs					
2868.02	0.05	-----	-----	0.1	0.3
	0.04	-----	-----		
2868 Lateral Weirs					
2519.13	0.05	0.04	0.04	0.3	0.5
	-----	-----	0.05		
2519 Lateral Weirs					
2498.67	0.05	0.05	0.04	0.3	0.5
	-----	0.04	0.05		
2473.27 Bridge-Up	0.05	0.05	-----	0.3	0.5
	-----	0.04	-----		
2473.27 Bridge-Dn	0.05	-----	-----	0.3	0.5
2418.14	0.05	0.05	0.04	0.3	0.5
	-----	0.04	0.05		
2189.83	0.05	-----	-----	0.3	0.5
	0.04	-----	-----		
1989.08	0.05	-----	-----	0.1	0.3
	0.04	-----	-----		
1574.31	0.05	-----	-----	0.1	0.3
	0.04	-----	-----		
1261.28	0.05	-----	-----	0.1	0.3
	0.04	-----	-----		
863.78	0.05	-----	-----	0.1	0.3
	0.04	-----	-----		
411.13	0.05	-----	-----	0.1	0.3
	0.04	-----	-----		
30	0.05	-----	0	0.1	0.3
	0.04	-----	0.05		

---Summary of Statistics---

	Minimum	Maximum
Left Overbank n Value:	0.035	0.08
Right Overbank n Value:	0	0.08
Channel n Value:	0.015	0.08
Contraction Coefficient:	0.1	0.3
Expansion Coefficient:	0.3	0.5

Maximum channel n value of 0.08 does not affect the hydraulics because those parts of the channel are all higher than flood elevations. Maximum n value of 0.045 is used by the model. No change is necessary.

ROUGHNESS COEFFICIENT CHECK

RS: 13676
 NT RC 03 Channel n value is equal to or less than 0.025
 The n value of the channel is usually larger than 0.025.
 The n value should be reevaluated if it is not representing a concrete lined channel.

Mudd Gulch XS 13676 is located at the detention basin outlet. The channel is concrete-lined.

TRANSITION LOSS COEFFICIENT CHECK

Cross-sections around structures are assigned loss coefficients of 0.3 and 0.5. No change is necessary.

RS: 14.14
 NT TL 02 Contraction and expansion loss coefficients are 0.3 and 0.5 respectively. However, this cross section is not at the structure. They should be equal to 0.1 and 0.3.

RS: 16485.74
 NT TL 02 Contraction and expansion loss coefficients are 0.3 and 0.5 respectively. However, this cross section is not at the structure. They should be equal to 0.1 and 0.3.

RS: 10261.61
NT TL 02 Contraction and expansion loss coefficients are 0.3 and 0.5 respectively. However, this cross section is not at the structure. They should be equal to 0.1 and 0.3.

RS: 8669.89
NT TL 02 Contraction and expansion loss coefficients are 0.3 and 0.5 respectively. However, this cross section is not at the structure. They should be equal to 0.1 and 0.3.

RS: 5974.5
NT TL 02 Contraction and expansion loss coefficients are 0.3 and 0.5 respectively. However, this cross section is not at the structure. They should be equal to 0.1 and 0.3.

RS: 4752.5
NT TL 02 Contraction and expansion loss coefficients are 0.3 and 0.5 respectively. However, this cross section is not at the structure. They should be equal to 0.1 and 0.3.

RS: 3389.17
NT TL 02 Contraction and expansion loss coefficients are 0.3 and 0.5 respectively. However, this cross section is not at the structure. They should be equal to 0.1 and 0.3.

RS: 2189.83
NT TL 02 Contraction and expansion loss coefficients are 0.3 and 0.5 respectively. However, this cross section is not at the structure. They should be equal to 0.1 and 0.3.

ROUGHNESS COEFFICIENT AT STRUCTURES

This has been evaluated. None of the bridges modeled in this study has concrete aprons. The Manning's n represent existing ground condition.

RS: 8632.47
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 8632.47
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 4379.56
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 4379.56
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 4379.56
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 10391.79
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 10391.79
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 6253.73
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 6253.73
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening

section is equal or larger than the channel n value of 0.04 at Section 2
usually, the channel n value of the bridge opening section is
less than the channel n value of Section 2.
The selection of the n value(s) should be reevaluated.

RS: 4820.16

NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening
section is equal or larger than the channel n value of 0.04 at Section 3.
usually, the channel n value of the bridge opening section is
less than the channel n value of Section 3.
The selection of the n value(s) should be reevaluated.

RS: 4820.16

NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening
section is equal or larger than the channel n value of 0.04 at Section 2
usually, the channel n value of the bridge opening section is
less than the channel n value of Section 2.
The selection of the n value(s) should be reevaluated.

RS: 2473.27

NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening
section is equal or larger than the channel n value of 0.04 at Section 3.
usually, the channel n value of the bridge opening section is
less than the channel n value of Section 3.
The selection of the n value(s) should be reevaluated.

---END---

FourmileCreek_MuddGulch.xls
CHECK-RAS Program, XS Check
Cross Section Location and Alignment Review

Project File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.prj
Plan File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.p01
Geometry File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.g01
Flow File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.f01
Report File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.xls
Selected profiles: 1%
Date: 4/10/2009
Time: 8:48:12 AM

SECNO	Len Lob	Len Ch1	Len Rob	TopwdthAct	Q Total	Flow Code
Fourmile, Reach1						
16382.73	495.99	364.71	312.59	238.1	7020	C
16018.02	255.54	229.08	235.52	441.18	7020	C
15788.95	368.03	408	400.02	629.63	7020	
15380.94	348.85	332.2	332.92	546.93	7020	C
15048.74	258.86	471.92	340.25	405.5	7020	
14576.82	395.34	494.58	519.96	226.53	7020	
14082.25	550.33	536.37	338.07	207.91	7020	C
13545.88	152.22	227.33	262.04	305.84	7020	
13318.55	351.35	371.29	333.77	138.17	7020	C
12947.26	170.98	159.24	249.85	156.42	7020	
12788.01	460.57	465.47	256.46	357.2	7020	
12322.54	426.4	324.66	137.77	105.67	7020	D
11997.88	451.93	546.41	567.08	205.89	7020	
11451.47	362.19	521.21	501.82	247.97	7020	
10930.27	352.98	637.88	499.55	289.24	7020	C
10292.38	605.34	244.14	153.98	267.31	7020	
10048.25	479.04	710.09	718.28	385.73	7020	
9338.16	538.57	442.53	468.9	219.93	7020	
8895.63	139.98	152.98	188.04	184.33	7020	
8742.65	49.23	58.35	115.04	210	7020	D
8684.3	124.73	114.65	117.17	180.01	7020	D
8632.47	Bridge #1-Up					
8632.47	Bridge #1-Dn					
8569.65	56.87	78.85	55.89	179.5	7020	
8490.8	407.44	351.76	236.51	191.24	7020	
8139.05	656.01	319.3	294.41	373.03	7020	C
7819.74	649.4	365.55	356.25	599.83	7020	E
7819	Lateral Weirs					
7454.19	435.58	533.18	302.2	494.12	6891.5	
7454	Lateral Weirs					
6921.01	135.06	571.68	640.21	111.73	6857.05	C
6349.33	272.21	365.22	506.74	220.23	6857.05	
5984.11	425.86	477.9	495.22	230.94	6857.05	
5506.21	566.78	358.85	372.01	280.88	6891.5	
5147.36	554.37	435.62	440.98	231.55	6891.5	
4711.74	115.73	317.23	313.42	562.37	6891.5	
4394.51	91	64.73	75	99.55	6891.5	
4379.56	Bridge #1-Up					
4379.56	Bridge #1-Dn					
4329.78	525.47	218.09	57.3	99.55	6891.5	C
4111.69	82.58	61	79.48	130.16	6891.5	
4073	Bridge #1-Up					
4073	Bridge #1-Dn					
4050.69	207.3	294.45	373.51	130.16	6891.5	
3756.25	84.14	76.03	106.35	352.66	6891.5	C
3680.22	215.87	248.13	254.75	268.45	6891.5	
3432.09	240.2	310.91	339.99	378.55	6891.5	
3121.18	193.88	167.46	175.83	273.2	6891.5	
2953.71	350.79	441.69	424.94	111.64	6891.5	
2512.02	453.8	357.98	265.32	168.8	6891.5	
2154.04	418.63	388.52	368.32	364.02	6891.5	C
1765.52	171.99	158.98	158.45	790.62	6891.5	
1606.54	347.9	383.56	373.95	960.12	6891.5	C
1222.98	562.22	556.76	559.69	705.39	6891.5	
666.22	651.1	597.54	364.95	318.68	6891.5	
68.69	69.09	68.69	32.75	249.44	6891.5	
MG Flow Split, Reach1						
3569.53	1.04	1	1	49.29	0.1	D
3568.53	539.17	689.58	699.4	35.52	17.17	D, C
2878.94	295.77	422.96	435.02	552.56	1240.53	D
2455.99	190.45	244.44	263.56	876.64	1270	
2211.55	469.25	482.13	481.26	816.04	1270	
1729.42	513.56	494.87	494.25	335.43	1270	
1234.55	547.4	549.18	550.62	397.12	1270	
685.37	499.74	460.72	460.29	408.27	1270	
685	Lateral Weirs					
224.65	266.65	119.76	4.37	208.99	1268.89	
224	Lateral Weirs					
104.89	43.69	90.75	6.68	239.25	1268.72	E

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68.78	Culvert #1-Up					
68.78	Culvert #1-Dn					
14.14	21.33	14.14	24.19	140.03	1268.72	
MuddGulch, Reach1						
20181.26	458.48	480.55	421.27	31.1	270	
19700.71	375.17	297.83	234.09	16.49	270	
19402.88	397.98	412.83	430.32	21.49	270	
18990.06	226.07	230.05	205.79	25.96	270	
18760	262.15	241.12	251.15	26.49	270	C
18518.88	411.67	401.9	369.19	105	270	
18116.98	283.5	272.74	269.2	23.48	270	C
17844.24	461.94	459.51	465.66	28.5	270	C
17384.73	526.8	515.41	506.53	24.35	270	C
16869.32	104.25	119.76	112.53	22.63	270	C
16809.73	Culvert #1-Up					
16809.73	Culvert #1-Dn					
16749.55	280.82	263.81	276.68	28.64	270	
16485.74	273.61	269.63	274.81	57.59	270	C
16216.12	404.35	410.05	408.38	45.53	1297	C
15806.06	376.88	408.4	362.43	81.94	1297	C
15397.66	362.09	361.96	356.48	186.4	1297	C
15035.7	412.48	411.97	419.7	160.16	1297	C
14623.73	102.36	101	96.46	58.03	1297	C
14522.74	95.94	108.41	133.69	61.84	1297	D, C
14414.32	486.6	412.18	309.92	94.95	1297	D
14002.14	199.17	178.53	199.82	265.98	1297	
13823.62	167.27	147.62	148.49	88.36	1297	
13676	137.41	197.68	304.98	24	1297	C
13478.31	238.15	231.77	208.28	122.24	1297	C
13246.54	26.15	82	77.18	57.74	1297	C
13164.55	387.8	326.72	212.19	70.5	1297	C
12837.83	244.09	307.55	353.6	70.01	1297	D
12530.28	309.77	310.09	235.81	27.84	1297	C
12220.19	294.4	319.49	299.4	49.09	1297	
11900.7	404.62	404.21	415.38	39.42	1297	
11496.49	396.8	517.3	491.35	34.03	1297	C
10979.19	332.27	281.12	215.85	34.43	1297	
10698.07	305.35	278.95	252.25	27.55	1297	C
10419.12	58.51	54.26	49.71	55	1297	
10391.79	Bridge #1-Up					
10391.79	Bridge #1-Dn					
10364.86	114.21	103.25	84.27	39.21	1297	C
10261.61	235.4	231.61	230.86	46.28	1297	
10030	207.29	319.55	391.34	40.76	1297	C
9710.46	183.53	286.1	337.66	53.99	1297	
9424.36	140.46	259.85	305.59	40.52	1297	C
9164.5	235.69	208.74	222.79	31	1297	
9048.02	Culvert #2-Up					
9048.02	Culvert #2-Dn					
9048.02	Culvert #1-Up					
9048.02	Culvert #1-Dn					
9048.02	Culvert #3-Up					
9048.02	Culvert #3-Dn					
8955.76	272	285.87	283.94	32	1297	
8669.89	279.35	258.73	220.3	70.61	1297	D
8411.16	374.38	380.09	411.29	61.75	1724	
8031.07	312.63	329.69	309.14	66.38	1724	
7701.39	301.61	287.18	343.39	77.12	1724	
7414.21	346.04	359.28	346.92	62.33	1724	D, C
7054.93	131.6	157.99	160.08	44.04	1724	C
6896.94	390.56	417.46	441.08	38.72	1724	C
6479.48	243.96	197.48	171.56	54.26	1724	
6282	57.38	64.76	54.32	45	1724	
6253.73	Bridge #1-Up					
6253.73	Bridge #1-Dn					
6217.24	270.07	242.74	199.13	45	1724	
5974.5	427.91	497.24	345.72	45.01	2191	
5477.27	297.77	343.06	422.9	325.7	2191	
5134.21	200.45	196.26	282.85	60.49	2191	C
4937.94	94.22	102.18	117.42	1891.41	2191	D
4835.77	43.66	36.94	44.56	1516.52	2191	D
4820.16	Bridge #1-Up					
4820.16	Bridge #1-Dn					
4798.82	40.26	46.33	26.63	1324.45	2191	D, C
4752.5	254.06	272.68	214.81	83.78	2191	
4479.82	487.39	474.19	569.14	313.77	2191	
4005.63	477.06	490.42	482.57	61.33	2191	D, C
3515.21	146.29	46.06	49.89	718.22	2191	D
3493.08	Bridge #1-Up					
3493.08	Bridge #1-Dn					
3469.15	65	79.98	207.85	602.61	2191	D
3389.17	535.24	521.15	546.1	642.85	2191	D
3389	Lateral Weirs					
2868.02	699.4	348.89	275.54	219.64	2173.93	D, E, C
2868	Lateral Weirs					
2519.13	435.02	20.46	19.1	151.86	950.57	D, E
2519	Lateral Weirs					
2498.67	123.46	80.53	90.94	33	921.1	
2473.27	Bridge #1-Up					
2473.27	Bridge #1-Dn					
2418.14	51.13	228.31	171.02	33	921.1	

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2189.83	48.47	200.76	304.59	132.1	1032.1	
1989.08	29.53	414.77	396.83	46.94	1032.1	D
1574.31	237.65	313.03	326.71	31.93	1032.1	D
1261.28	332.25	397.5	403.47	31.13	1032.1	D
863.78	457.73	452.65	409.2	64.41	1032.1	
411.13	549.53	381.12	326.9	171.08	1032.1	D
30	58.87	30	70.67	80.85	1032.1	D

B=blocked obstruction XS SC 05
 C=critical depth XS SC 03
 D=divided flow XS SC 01
 E=cross section extended XS SC 02
 K=known water-surface XS SC 04

DISTANCE CHECK

RS: 2519.13
 XS DT 03 Left overbank distance is greater than the channel distance by more than five times. Left overbank distance may be in error.

Mudd Gulch XS 2519.13 has a lateral weir on the left overbank. Since the Railroad is skewed, the left overbank distance is correct.

SPACING CHECK

INEFFECTIVE FLOW CHECK

DISCHARGE CHECK

RS: 7454.19
 XS DC 01 Discharge decreases in the downstream direction.

Discharges decrease in the downstream direction due to the presence of lateral weirs.

RS: 6921.01
 XS DC 01 Discharge decreases in the downstream direction.

RS: 2512.02
 XS DC 05 There is no flow on the right overbank at the downstream cross section. There is no flow on the left overbank at this section.

RS: 224.65
 XS DC 01 Discharge decreases in the downstream direction.

RS: 104.89
 XS DC 01 Discharge decreases in the downstream direction.

RS: 2868.02
 XS DC 01 Discharge decreases in the downstream direction.

RS: 2519.13
 XS DC 01 Discharge decreases in the downstream direction.

RS: 2498.67
 XS DC 01 Discharge decreases in the downstream direction.

RS: 863.78
 XS DC 04 There is no flow on the left overbank at the downstream cross section. There is no flow on the right overbank at this section.

The ineffective areas are placed adequately, and distribution of flow is acceptable.

LOCATION CHECK

Cross-sections below are already close to the cross-sections just downstream of them. No additional cross-sections were added to the model.

RS: 11900.7
 XS LC 01 Lench1 Up/TopwdthAct Dn = 11.88
 MaxCh1Dpth Up/MaxCh1Dpth Dn = 1.23
 TopwdthAct Up/TopwdthAct Dn = 1.16
 This cross section is located too far upstream from the critical depth cross section.

RS: 7701.39
 XS LC 01 Lench1 Up/TopwdthAct Dn = 4.61
 MaxCh1Dpth Up/MaxCh1Dpth Dn = 1.23
 TopwdthAct Up/TopwdthAct Dn = 1.24
 This cross section is located too far upstream from the critical depth cross section.

RS: 5477.27
 XS LC 01 Lench1 Up/TopwdthAct Dn = 5.67
 MaxCh1Dpth Up/MaxCh1Dpth Dn = 1.26
 TopwdthAct Up/TopwdthAct Dn = 5.38
 This cross section is located too far upstream from the critical depth cross section.

RS: 4479.82

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XS LC 01 Lench1 Up/TopwdthAct Dn = 7.73
MaxCh1Dpth Up/MaxCh1Dpth Dn = 1.13
TopwdthAct Up/TopwdthAct Dn = 5.12
This cross section is located too far upstream from the
critical depth cross section.

RS: 3389.17

XS LC 01 Lench1 Up/TopwdthAct Dn = 2.37
MaxCh1Dpth Up/MaxCh1Dpth Dn = 1.21
TopwdthAct Up/TopwdthAct Dn = 2.93
This cross section is located too far upstream from the
critical depth cross section.

BOUNDARY CONDITION CHECK

XS BC 02 The name of the stream is Fourmile,Reach1
Normal S = 0.003 is specified as the downstream boundary
for profile 1%

XS BC 02 The name of the stream is MG Flow Split,Reach1
Normal S = 0.01 is specified as the downstream boundary
for profile 1%

XS BC 02 The name of the stream is MuddGulch,Reach1
Normal S = 0.01 is specified as the downstream boundary
for profile 1%

XS BC 03 Maximum number of iterations is 0
It should not be less than 20.

LATERAL WEIRS CHECK

---END---

FourmileCreek_MuddGulch.br
CHECK-RAS Program: Structure Check

Project File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.prj
Plan File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.p01
Geometry File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.g01
Flow File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.f01
Report File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.br
Selected profiles: 1%
Date: 4/10/2009
Time: 8:48:18 AM

RS	MaxLoChord	MnTpRd	EGEL	WSEL	MinChEl	Structure

Fourmile, Reach1						
16382.73			5367.01	5365.13	5356.28	
16018.02			5363.15	5361.64	5354	
15788.95			5360.02	5359.46	5351.82	
15380.94			5357.57	5356.43	5347.59	
15048.74			5354.9	5353.95	5345.98	
14576.82			5352.67	5351.37	5342	
14082.25			5348.55	5346.75	5340.07	
13545.88			5344.7	5344.24	5338	
13318.55			5343.29	5340.83	5332.99	
12947.26			5339.22	5338.14	5330.28	
12788.01			5338.41	5337.42	5328.88	
12322.54			5334.58	5332.64	5324.53	
11997.88			5330.39	5328.92	5322.39	
11451.47			5326.01	5324.89	5318.74	
10930.27			5321.84	5320.48	5315.07	
10292.38			5317.72	5317.12	5310.48	
10048.25			5315.81	5314.72	5306.26	
9338.16			5311.3	5309.69	5302.08	
8895.63			5308.39	5307.53	5300.06	
8742.65			5307.79	5307.26	5298.69	
8684.3			5307.59	5306.92	5298.18	
8632.47						
8632.47	5313.12	5314.26	5307.57	5306.85	5298.18	Bridge #1-Up
8569.65	5312.75	5313.27	5307.11	5306.52	5298.25	Bridge #1-Dn
8490.8			5307.09	5306.53	5298.25	
8139.05			5306.82	5306.1	5297.69	
7819.74			5305.15	5303.78	5294.01	
7454.19			5301.85	5301.11	5292.09	
7819	Lateral Weirs		5299.93	5298.85	5290	
6921.01			5295.42	5292.97	5284.84	
7454	Lateral Weirs					
6349.33			5289.05	5288.51	5280.45	
5984.11			5287.37	5286.06	5278.1	
5506.21			5285.06	5284.56	5275.94	
5147.36			5284.04	5283.36	5272.32	
4711.74			5283.46	5283.33	5270.29	
4394.51			5283.02	5282.23	5268.43	
4379.56						
4379.56	5283.55	5283.53	5283.01	5282.21	5268.43	Bridge #1-Up
4329.78	5283.55	5283.53	5282.83	5281.65	5268.74	Bridge #1-Dn
4111.69			5282.12	5279.2	5268.74	
4073	5278.85	5281.06	5278.14	5277.45	5268	Bridge #1-Up
4073	5278.85	5280.75	5277.95	5276.88	5266.21	Bridge #1-Dn
4050.69			5277.33	5274.91	5266.21	
3756.25			5273.8	5272.52	5264.29	
3680.22			5272.98	5271.71	5263.24	
3432.09			5271.83	5271.33	5261.12	
3121.18			5270.8	5269.94	5259.34	
2953.71			5269.98	5268.47	5257.91	
2512.02			5265.94	5265.01	5256.28	
2154.04			5263.84	5262.6	5254.34	
1765.52			5261.02	5260.72	5252	
1606.54			5260.42	5259.67	5249.47	
1222.98			5257.02	5256.54	5248	
666.22			5253.96	5253.23	5246	
68.69			5251.65	5251.06	5244	
MG Flow Split, Reach1						
3569.53			5250.27	5250.27	5248.54	
3568.53			5250.25	5250.15	5248.54	
2878.94			5243.94	5243.89	5240.66	
2455.99			5243.52	5243.5	5241.14	
2211.55			5243.21	5243.15	5241.5	
1729.42			5240.89	5240.76	5238.35	
1234.55			5239.48	5239.43	5236.27	
685.37			5237.86	5237.74	5234.72	
224.65			5235.54	5235.38	5229.81	
685	Lateral Weirs					

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104.89		5235.45	5235.44	5222.54	
224	Lateral Weirs				
68.78	5230	5233.69	0	5230	5225 Culvert #1-Up
68.78	5227.85	5233.68	0	5225.96	5222.85 Culvert #1-Dn
14.14			5228.04	5227.66	5221.69
MuddGulch, Reach1					
20181.26			5514.4	5514.18	5511.21
19700.71			5511.06	5510.17	5505.98
19402.88			5505.85	5505.08	5502.41
18990.06			5499.73	5499.19	5496.33
18760			5496.03	5495.29	5492.34
18518.88			5492.81	5492.6	5490.26
18116.98			5488.43	5487.62	5484.64
17844.24			5481.66	5480.95	5478.8
17384.73			5471.16	5470.37	5468.19
16869.32			5455.55	5454.72	5451.46
16809.73					
	5455.46	5457.35	0	5452.58	5451.46 Culvert #1-Up
16809.73					
	5454	5456.2	0	5451.98	5450 Culvert #1-Dn
16749.55			5452.16	5451.46	5449.69
16485.74			5446.08	5445.63	5444
16216.12			5439.83	5438.36	5433.07
15806.06			5431.27	5430.2	5425.98
15397.66			5424.24	5423.61	5419.45
15035.7			5417.9	5417.2	5412.8
14623.73			5410.85	5409.6	5404.62
14522.74			5405.81	5404.6	5402
14414.32			5404.74	5404.32	5401.5
14002.14			5404.31	5404.27	5401
13823.62			5404.13	5403.68	5400.5
13676			5403.38	5401.13	5394.3
13478.31			5399.53	5398.75	5396.64
13246.54			5386.4	5385.13	5382.05
13164.55			5374.31	5373.2	5369.86
12837.83			5369.79	5369.38	5364.14
12530.28			5367.52	5365.47	5360.45
12220.19			5361.42	5360.45	5356.3
11900.7			5358.56	5357.58	5351.9
11496.49			5353.93	5352.14	5347.52
10979.19			5344.79	5343.4	5337.45
10698.07			5340.75	5338.69	5330.52
10419.12			5333.26	5332.51	5328
10391.79					
	5342.08	5342.07	5332.99	5331.68	5328 Bridge #1-Up
10391.79					
	5342.07	5342.07	5332.23	5331.38	5325.73 Bridge #1-Dn
10364.86			5331.84	5330.21	5325.73
10261.61			5328.94	5327.72	5323.8
10030			5325.42	5323.83	5319.19
9710.46			5321.04	5320.38	5316.24
9424.36			5318.26	5316.66	5311.83
9164.5			5312.94	5311.75	5306.12
9048.02					
	5311.12	5318.98	0	5309.99	5306.12 Culvert #2-Up
9048.02					
	5305.01	5318.98	0	5305.01	5300.01 Culvert #2-Dn
9048.02					
	5311.12	5318.98	0	5309.99	5306.12 Culvert #1-Up
9048.02					
	5305.01	5318.98	0	5305.01	5300.01 Culvert #1-Dn
9048.02					
	5311.12	5318.98	0	5309.99	5306.12 Culvert #3-Up
9048.02					
	5305.01	5318.98	0	5305.01	5300.01 Culvert #3-Dn
8955.76			5309.36	5308.8	5300.01
8669.89			5308.74	5308.53	5302.11
8411.16			5307.69	5306.62	5302.69
8031.07			5303.89	5302.93	5298.42
7701.39			5300.84	5300.08	5295.67
7414.21			5297.35	5295.89	5292.29
7054.93			5291.11	5289.3	5284.18
6896.94			5286.89	5284.91	5278.64
6479.48			5283.3	5282.62	5274.11
6282			5282.47	5281.72	5271.78
6253.73					
	5286	5285.62	5282.43	5281.66	5271.78 Bridge #1-Up
6253.73					
	5285.9	5286.22	5282.2	5281.72	5271.14 Bridge #1-Dn
6217.24			5282.15	5281.66	5271.14
5974.5			5280.83	5279.27	5270.12
5477.27			5278.69	5278.37	5268.76
5134.21			5277.34	5275.55	5267.94
4937.94			5273.66	5273.65	5266.65
4835.77			5273.61	5273.58	5265.15
4820.16					
	5273.47	5271.63	5273.52	5273.18	5265.15 Bridge #1-Up
4820.16					
	5273.47	5271.63	5273.36	5272.98	5264.74 Bridge #1-Dn
4798.82			5272.71	5272.41	5264.74
4752.5			5270.63	5269.7	5262.17

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4479.82			5268.58	5267.64	5260.11	
4005.63			5263.42	5261.69	5255.04	
3515.21			5259.9	5259.66	5251.87	
3493.08						
3493.08	5259.3	5257.91	5259.83	5259.5	5251.87	Bridge #1-Up
	5259.36	5256.71	5258.78	5258.4	5251.5	Bridge #1-Dn
3469.15			5258.18	5257.63	5251.5	
3389.17			5257.32	5257.25	5251.29	
2868.02			5254.94	5254.12	5249.44	
3389	Lateral Weirs					
2519.13			5250.1	5249.93	5244.48	
2868	Lateral Weirs					
2498.67			5249.85	5249.11	5243.77	
2519	Lateral Weirs					
2473.27						
	5250.4	5249.96	5249.42	5247.99	5243.77	Bridge #1-Up
2473.27						
	5250.58	5249.91	5248.62	5247.96	5243.1	Bridge #1-Dn
2418.14			5248.43	5247.67	5243.1	
2189.83			5246.86	5246.23	5242.25	
1989.08			5245.72	5245.22	5237.86	
1574.31			5242.69	5241.25	5234.65	
1261.28			5239.44	5238.55	5232.98	
863.78			5238.14	5237.86	5229.99	
411.13			5236.74	5235.97	5230.38	
30			5233.25	5232.68	5228.25	

RIVER/REACH: Fourmile, Reach1
RIVER STATION: 8632.47
TYPE OF STRUCTURE: Bridge

Description: HWY-50
Distance from Upstream XS: 2
Deck/Roadway width: 110
Weir Coefficient: 2.6
Maximum allowable submergence for weir flow: 0.98
Elevation at which weir flow begins: 0
Weir crest shape: Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual	
4	8742.65	58.35	5307.26		5307.79	210	
3	8684.3	114.65	5306.92		5307.59	180.01	
	8632.47	110.00	5306.85		5307.57	176.01	Bridge #1-Up
	8632.47	2.65	5306.52		5307.11	175.99	Bridge #1-Dn
2	8569.65	78.85	5306.53		5307.09	179.5	
1	8490.8	351.76	5306.1		5306.82	191.24	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	390.8853	5319.5	0	465.1553	5319.5
				644.65	727.3653	5319.5

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 0
HighFlowMethod: Energy Only
SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
Add Friction component to Momentum
Do not add weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord: 5313.12 MinTopRd: 5314.27 MinElPrs: 5313.12

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Bridge					390.8853	U
					465.1553	644.65 D
	LAButSt	RAButSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd

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Bridge #1	390.85 465.10	570.42 644.67	5315.00 5314.50	5314.26 5313.27	5314.26 5313.27	5313.12 U 5312.75 D
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Name	Q Total	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	7020	7020	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 8632.47 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 5307.59 is equal to or less than MinTopRd of 5314.3.
2. EGEL 3 of 5307.59 is less than MXLocDU of 5313.1.

DISTANCE CHECK
Cross-sections U/S and D/S of bridges are cut along available survey data.
No modification was made to the model.

RS: 8632.47 This is Bridge #1
ST DT 01 'Distance from Upstream XS' of 2.00 is less than the height of the bridge opening of 14.94
Section 3 should be placed at the foot of the road embankment or wing walls.
Distances at Sections 4 & 3, and 'Distance from Upstream XS' should be adjusted.

RS: 8632.47 This is Bridge #1
ST DT 02 The channel distance of 2.650002 at Downstream Internal Section is less than the height of the bridge opening of 14.87
Section 2 should be placed at the foot of the road embankment or wing walls.
Distances at Sections 4, 3 & 2 should be adjusted.

INEFFECTIVE FLOW CHECK

The computed ineffective stations are very similar to the ineffective stations in the model. The ineffective areas defined in the model accurately represents the flow properties. No changes are required.

RS: 8684.3 This is Section 3
ST IF 06 Low flow occurs at Bridge
The velocity head at Section 3 is more than 0.5
The computed left ineffective flow station of 375.91 is less than the selected left ineffective flow station of 390.8853
The left ineffective flow station should be adjusted.

RS: 8569.65 This is Section 2
ST IF 06 Low flow occurs at Bridge
The velocity head at Section 2 is more than 0.5
The computed left ineffective flow station of 450.60 is less than the selected left ineffective flow station of 465.1553
The left ineffective flow station should be adjusted.

RS: 8569.65 This is Section 2.
ST IF 06 Low flow occurs at Bridge
The velocity head at Section 2 is more than 0.5
The computed right ineffective flow station of 659.17 is greater than the selected right ineffective flow station of 644.65
The right ineffective flow station should be adjusted.

RS: 8742.65 This is Section 4
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
This message should be ignored if this section is Section 2 of the upstream structure.

RS: 8490.8 This is section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream structure.

RIVER/REACH: Fourmile, Reach1
RIVER STATION: 4379.56
TYPE OF STRUCTURE: Bridge

Description: GRANDVIEW ST
Distance from Upstream XS: 5

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 Deck/Roadway Width: 25
 Weir Coefficient: 2.6
 Maximum allowable submergence for weir flow: 0.98
 Elevation at which weir flow begins: 0
 Weir crest shape: Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual	
4	4711.74	317.23	5283.33		5283.46	562.37	
3	4394.51	64.73	5282.23		5283.02	99.55	
	4379.56	25.00	5282.21		5283.01	98.88	Bridge #1-Up
	4379.56	34.73	5281.65		5282.83	98.88	Bridge #1-Dn
2	4329.78	218.09	5279.2		5282.12	99.55	
1	4111.69	61.00	5277.46		5278.14	130.16	

Ineffective Flow, Section 3				Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	817.4953	5287.89	0	818.6	5283.53
2	917.04	1131.96	5284.97	918.15	1079.935	5283.53

BRIDGE:
 Bridge Name: Bridge #1
 LowFlowMethod: Highest Energy Answer
 Momentum Cd: 0
 HighFlowMethod: Energy Only
 SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
 Add Friction component to Momentum
 Do not add Weight component to Momentum
 Class B flow critical depth computations use critical depth inside the bridge at the upstream end
 Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord: 5283.55 MinTopRd: 5283.62 MinElPrs: 5283.55

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifSta	RifSta
Bridge					817.4953	917.04 U
					818.6	918.15 D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Bridge #1	817.49	917.04	5283.53	5284.75	5283.53	5283.55 U
	818.60	918.15	5283.53	5284.76	5283.53	5283.55 D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	6891.5	6891.5	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 4379.56 This is Bridge #1
 BR LF 01 Type of flow is low flow because,
 1. EGEL 3 of 5283.02 is equal to or less than MinTopRd of 5283.6.
 2. EGEL 3 of 5283.02 is less than MxLoCdu of 5283.6.

DISTANCE CHECK Cross-sections U/S and D/S of bridges are cut along available survey data.
 No modification was made to the model.

RS: 4379.56 This is Bridge #1
 ST DT 01 'Distance from Upstream XS' of 5.00 is less than the height of the bridge opening of 15.12
 Section 3 should be placed at the foot of the road embankment or wing walls.
 Distances at Sections 4 & 3, and 'Distance from Upstream XS' should be adjusted.

INEFFECTIVE FLOW CHECK

The computed ineffective stations are very similar to the ineffective stations in the model. The ineffective areas defined in the model accurately represents the flow properties. No changes are required.

RS: 4394.51 This is Section 3

ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed left ineffective flow station of 802.37 is less than
 the selected left ineffective flow station of 817.4953
 The left ineffective flow station should be adjusted.

RS: 4394.51 This is Section 3.
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed right ineffective flow station of 932.16 is greater than
 the selected right ineffective flow station of 917.04
 The right ineffective flow station should be adjusted.

RS: 4329.78 This is Section 2
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 2 is more than 0.5
 The computed left ineffective flow station of 803.79 is less than
 the selected left ineffective flow station of 818.6
 The left ineffective flow station should be adjusted.

RS: 4329.78 This is Section 2.
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 2 is more than 0.5
 The computed right ineffective flow station of 932.96 is greater than
 the selected right ineffective flow station of 918.15
 The right ineffective flow station should be adjusted.

RS: 4711.74 This is Section 4
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from
 this section, unless the areas beyond the ineffective flow stations
 are not within the flow path of the stream.
 This message should be ignored if this section is Section 2 of
 the upstream structure.

RS: 4111.69 This is Section 1
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from
 this section, unless the areas beyond the ineffective flow stations
 are not within the flow path of the stream.
 This message should be ignored if this section is Section 3 of the downstream
 structure.

 RIVER/REACH: Fourmile, Reach1
 RIVER STATION: 4073
 TYPE OF STRUCTURE: Bridge

Description:	RAILROAD
Distance from Upstream XS:	2
Deck/Roadway width:	25
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.98
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual	
4	4329.78	218.09	5279.2		5282.12	99.55	
3	4111.69	61.00	5277.46		5278.14	130.16	
	4073	25.00	5277.45		5278.14	130.16	Bridge #1-Up
	4073	34.00	5276.88		5277.95	130.16	Bridge #1-Dn
2	4050.69	294.45	5274.91		5277.33	130.16	
1	3756.25	76.03	5272.52		5273.8	352.66	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	157.79	5282.8	315.92	569.63	5283.45
2	287.95	529.27	5283.45	0	185.76	5282.8

BRIDGE:
 Bridge Name: Bridge #1
 LowFlowMethod: Highest Energy Answer
 Momentum Cd: 0
 HighFlowMethod: Energy Only
 SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
 Add Friction component to Momentum

Do not add weight component to Momentum
 Class B flow critical depth computations use critical depth
 inside the bridge at the upstream end
 Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord: 5278.85 MinTopRd: 5282.81 MinElPrs: 5278.85

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Bridge					157.79 185.76	287.95 U 315.92 D
	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Bridge #1	157.78 185.73	287.96 315.93	5281.06 5280.75	5282.80 5282.80	5281.06 5280.75	5278.85 U 5278.85 D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	6891.5	6891.5	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 4073 This is Bridge #1
 BR LF 01 Type of flow is low flow because,
 1. EGEL 3 of 5278.14 is equal to or less than MinTopRd of 5282.8.
 2. EGEL 3 of 5278.14 is less than MxLoCdu of 5278.9.

DISTANCE CHECK Cross-sections U/S and D/S of bridges are cut along available survey data.
 No modification was made to the model.

RS: 4073 This is Bridge #1
 ST DT 01 'Distance from Upstream XS' of 2.00 is less than the height of the
 bridge opening of 10.85
 Section 3 should be placed at the foot of the road embankment or
 wing walls.
 Distances at Sections 4 & 3, and 'Distance from Upstream XS' should
 be adjusted.

The computed ineffective stations are very similar to the ineffective stations in the
 model. The ineffective areas defined in the model accurately represents the flow
 properties. No changes are required.

INEFFECTIVE FLOW CHECK

RS: 4111.69 This is Section 3
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed left ineffective flow station of 146.93 is less than
 the selected left ineffective flow station of 157.79
 The left ineffective flow station should be adjusted.

RS: 4111.69 This is Section 3.
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed right ineffective flow station of 298.81 is greater than
 the selected right ineffective flow station of 287.95
 The right ineffective flow station should be adjusted.

RS: 4050.69 This is Section 2
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 2 is more than 0.5
 The computed left ineffective flow station of 173.09 is less than
 the selected left ineffective flow station of 185.76
 The left ineffective flow station should be adjusted.

RS: 4050.69 This is Section 2.
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 2 is more than 0.5
 The computed right ineffective flow station of 328.57 is greater than
 the selected right ineffective flow station of 315.92
 The right ineffective flow station should be adjusted.

RS: 4329.78 This is Section 4
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from
 this section, unless the areas beyond the ineffective flow stations
 are not within the flow path of the stream.
 This message should be ignored if this section is Section 2 of
 the upstream structure.

RS: 3756.25 This is Section 1
 ST IF 07 Ineffective flow option was considered at this section.

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However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

RIVER/REACH: MG Flow Split, Reach1
RIVER STATION: 68.78
TYPE OF STRUCTURE: Culvert

Description:
Distance from Upstream XS: 14
Deck/Roadway Width: 54
Weir Coefficient: 2.6
Maximum allowable submergence for weir flow: 0.98
Elevation at which weir flow begins: 0
Weir crest shape: Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual	
4	224.65	119.76	5235.38		5235.54	208.99	
3	104.89	90.75	5235.44		5235.45	239.25	
	68.78	54.00	5230		0	0	Culvert #1-Up
	68.78	22.75	5225.96		0	0	Culvert #1-Dn
2	14.14	14.14	5227.66		5228.04	140.03	

Ineffective Flow, Section 3
Sta L Sta R Elev

Ineffective Flow, Section 2
Sta L Sta R Elev

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Culvert Group						U D

CULVERT:
Culvert Name: Culvert #1
Shape: Circular Rise: 5 Span: 0 Barrels: 2
FHWA Chart #: # 1 - Concrete Pipe Culvert
FHWA Scale #: # 1 - Square edge entrance with headwall
Solution Crit: Highest U.S. EG
UpstrmDist: 14 Length: 54 n-Value: 0.016
EntLossCoef: 0.5 ExtLossCoef: 1 CulvInvEld 5225 CulvInvEld 5222.85
LCntStaU: 112.62 RCntStaU: 118.62 LCntStaD 110.7 RCntStaD 116.7
Culvert Depth Blocked: 0

Culv Area:	39.27	CulvQ:	528.13	MinTopRd:	5233.7	
	LAButSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Culvert #1	110.12	121.12	5233.69	5234.43	5233.69	5230
	108.2	119.2	5233.68	5234.39	5233.68	5227.85

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #1		528.13	740.59	Highest U.S. EG	Pressure and Weir Flow

GEOMETRIC CHECK

RS: 68.78
ST GD 03 The end station of 279.45 from downstream road/weir data
is greater than the end station of 261.47 from downstream internal
section.
The high chord elevation of 5235.15 for the end road/weir station is
greater than the ground elevation of 5234.93 for the end ground station.
The EGEL at section 3 of 5235.45 is greater than the ground elevation.
The road/weir data should be included in the ground data

TYPE OF FLOW CHECK

RS: 68.78 This is Culvert #1
CV PW 01 Type of flow is pressure and weir flow because,

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1. EGEL 3 of 5235.45 is greater than MinTopRd of 5233.70.
2. CulvWSIn of 5230.00 is greater than or equal to MxLocdU of 5230.00.
3. CulvWSout of 5225.96 is less than MxLocdD of 5227.85.
4. Q/ADA0.5 of 6.01 is greater than or equal to 4.0.

DISTANCE CHECK

CULVERT COEFFICIENT CHECK

CULVERT CRITERIA CHECK

INEFFECTIVE FLOW CHECK

RIVER/REACH: MuddGulch, Reach1
RIVER STATION: 16809.73
TYPE OF STRUCTURE: Culvert

Description: FOURMILE PKWY
Distance from Upstream XS: 30
Deck/Roadway width: 85
Weir Coefficient: 2.6
Maximum allowable submergence for weir flow: 0.98
Elevation at which weir flow begins: 0
Weir crest shape: Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual	
4	17384.73	515.41	5470.37		5471.16	24.35	
3	16869.32	119.76	5454.72		5455.55	22.63	
	16809.73	85.00	5452.58		0	0	Culvert #1-Up
	16809.73	4.76	5451.98		0	0	Culvert #1-Dn
2	16749.55	263.81	5451.46		5452.16	28.64	
1	16485.74	269.63	5445.63		5446.08	57.59	

Ineffective Flow, Section 3
Sta L Sta R Elev

Ineffective Flow, Section 2
Sta L Sta R Elev

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Culvert Group						U D

CULVERT:
Culvert Name: Culvert #1
Shape: Box Rise: 4 Span: 20 Barrels: 2
FHWA Chart #: # 8 - flared wingwalls
FHWA Scale #: # 2 - wingwall flared 90 or 15 deg.
Solution Crit: Highest U.S. EG
UpstrmDist: 30 Length: 85 n-Value: 0.015
EntLossCoef: 0.5 ExtLossCoef: 1 CulvInvElU 5451.46 CulvInvElD 5450
LCntStaU: 73.4 RCntStaU: 94.1 LCntStaD 105.37 RCntStaD 126.07
Culvert Depth Blocked: 0

Culv Area:	160	CulvQ:	270	MinTopRd:	5457.35	
	LAButSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Culvert #1	63.4 95.37	104.1 136.07	5457.35 5456.2	5457.35 5457.4	5457.35 5456.2	5455.46 5454

Name	Q Total	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #1	270	0		Highest U.S. EG	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

FourmileCreek_MuddGulch.br

RS: 16809.73 This is Culvert #1
 CV LF 01 Type of flow is low flow because,
 1. EGEL 3 of 5455.55 is less than or equal to MinTopRd of 5457.35.
 2. CulvWSIn of 5452.58 is less than MxLoCdu of 5455.46.
 3. CulvWSout of 5451.98 is less than MxLoCdd of 5454.00.
 4. Q/AD^0.5 of 0.84 is less than 4.0.

DISTANCE CHECK

CULVERT COEFFICIENT CHECK

CULVERT CRITERIA CHECK

INEFFECTIVE FLOW CHECK

RIVER/REACH: MuddGulch, Reach1
 RIVER STATION: 10391.79
 TYPE OF STRUCTURE: Bridge

Description: FOURMILE LN
 Distance from Upstream XS: 10
 Deck/Roadway Width: 30
 Weir Coefficient: 2.6
 Maximum allowable submergence for weir flow: 0.98
 Elevation at which weir flow begins: 0
 Weir crest shape: Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	10698.07	278.95	5338.69		5340.75	27.55	
3	10419.12	54.26	5332.51		5333.26	55	
	10391.79	30.00	5331.68		5332.99	53.14	Bridge #1-Up
	10391.79	14.26	5331.38		5332.23	44.75	Bridge #1-Dn
2	10364.86	103.25	5330.21		5331.84	39.21	
1	10261.61	231.61	5327.72		5328.94	46.28	

Ineffective Flow, Section 3				Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	380.79	636.21	5342.07	371.45	631.2	5342.07
2	0	325.79	5343.2	0	316.45	5342.54

BRIDGE:
 Bridge Name: Bridge #1
 LowFlowMethod: Highest Energy Answer
 Momentum Cd: 0
 HighFlowMethod: Energy only
 SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
 Add Friction component to Momentum
 Do not add Weight component to Momentum
 Class B flow critical depth computations use critical depth
 inside the bridge at the upstream end
 Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord: 5342.08 MinTopRd: 5342.08 MinElPrs: 5342.08

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Bridge					325.79 316.45	380.79 U 371.45 D
	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Bridge #1	325.79 316.45	380.81 371.47	5343.25 5342.54	5342.07 5342.07	5342.07 5342.07	5342.08 U 5342.07 D

Name	Q Total	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	1297	1297	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 10391.79 This is Bridge #1
 BR LF 01 Type of flow is low flow because,
 1. EGEL 3 of 5333.26 is equal to or less than MinTopRd of 5342.1.
 2. EGEL 3 of 5333.26 is less than MxLocDu of 5342.1.

DISTANCE CHECK

Cross-sections U/S and D/S of bridges are cut along available survey data.
 No modification was made to the model.

RS: 10391.79 This is Bridge #1
 ST DT 01 'Distance from Upstream XS' of 10.00 is less than the height of the bridge opening of 14.08
 Section 3 should be placed at the foot of the road embankment or wing walls.
 Distances at Sections 4 & 3, and 'Distance from Upstream XS' should be adjusted.

RS: 10391.79 This is Bridge #1
 ST DT 02 The channel distance of 14.26 at Downstream Internal Section is less than the height of the bridge opening of 16.35
 Section 2 should be placed at the foot of the road embankment or wing walls.
 Distances at Sections 4, 3 & 2 should be adjusted.

INEFFECTIVE FLOW CHECK

The computed ineffective stations are very similar to the ineffective stations in the model. The ineffective areas defined in the model accurately represents the flow properties. No changes are required.

RS: 10419.12 This is Section 3
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed left ineffective flow station of 311.71 is less than the selected left ineffective flow station of 325.79
 The left ineffective flow station should be adjusted.

RS: 10419.12 This is Section 3.
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed right ineffective flow station of 394.89 is greater than the selected right ineffective flow station of 380.79
 The right ineffective flow station should be adjusted.

RS: 10364.86 This is Section 2
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 2 is more than 0.5
 The computed left ineffective flow station of 300.11 is less than the selected left ineffective flow station of 316.45
 The left ineffective flow station should be adjusted.

RS: 10364.86 This is Section 2.
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 2 is more than 0.5
 The computed right ineffective flow station of 387.81 is greater than the selected right ineffective flow station of 371.45
 The right ineffective flow station should be adjusted.

RS: 10698.07 This is Section 4
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
 This message should be ignored if this section is Section 2 of the upstream structure.

RS: 10261.61 This is Section 1
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
 This message should be ignored if this section is Section 3 of the downstream structure.

RIVER/REACH: MuddGulch, Reach1
 RIVER STATION: 9048.02
 TYPE OF STRUCTURE: Culvert

Description: HWY-50
 Distance from Upstream XS: 10
 Deck/Roadway width: 190.74
 Weir Coefficient: 2.6
 Maximum allowable submergence for weir flow: 0.98

Elevation at which weir flow begins: FourmileCreek_MuddGulch.br
 Weir crest shape: 0
 Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual
4	9424.36	259.85	5316.66		5318.26	40.52
3	9164.5	208.74	5311.75		5312.94	31
	9048.02	190.74	5309.99		0	0 Culvert #2-Up
	9048.02	8.00	5305.01		0	0 Culvert #2-Dn
	9048.02	190.74	5309.99		0	0 Culvert #1-Up
	9048.02	8.00	5305.01		0	0 Culvert #1-Dn
	9048.02	190.74	5309.99		0	0 Culvert #3-Up
	9048.02	8.00	5305.01		0	0 Culvert #3-Dn
2	8955.76	285.87	5308.8		5309.36	32
1	8669.89	258.73	5308.53		5308.74	70.61

Ineffective Flow, Section 3			Ineffective Flow, Section 2		
Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	458.38	0	467.81	5326.5
2	489.38	1121.35	499.81	1121.27	5325.89

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Culvert Group					458.38	489.38 U
					467.81	499.81 D

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Culvert Group					458.38	489.38 U
					467.81	499.81 D

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Culvert Group					458.38	489.38 U
					467.81	499.81 D

CULVERT:

Culvert Name: Culvert #2
 Shape: Box Rise: 5 Span: 9 Barrels: 1
 FHWA Chart #: # 8 - flared wingwalls
 FHWA Scale #: # 2 - wingwall flared 90 or 15 deg.
 Solution Crit: Highest U.S. EG

UpstrmDist: 10 Length: 190.74 n-Value: 0.015
 EntLossCoef: 0.5 ExtLossCoef: 1 CulvInveLU 5306.12 CulvInveLD 5300.01
 LCntStaU: 462.88 RCntStaU: 462.88 LCntStaD 473.31 RCntStaD 473.31
 Culvert Depth Blocked: 0

Culv Area: 45 CulvQ: 389.08 MinTopRd: 5326.1

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Culvert #2	458.38	467.38	5326.7	5318.98	5318.98	5311.12 U
	468.81	477.81	5326.36	5318.98	5318.98	5305.01 D

CULVERT:

Culvert Name: Culvert #1
 Shape: Box Rise: 5 Span: 11 Barrels: 1
 FHWA Chart #: # 8 - flared wingwalls
 FHWA Scale #: # 2 - wingwall flared 90 or 15 deg.
 Solution Crit: Highest U.S. EG

UpstrmDist: 10 Length: 190.74 n-Value: 0.015
 EntLossCoef: 0.5 ExtLossCoef: 1 CulvInveLU 5306.12 CulvInveLD 5300.01
 LCntStaU: 473.38 RCntStaU: 473.38 LCntStaD 483.81 RCntStaD 483.81
 Culvert Depth Blocked: 0

Culv Area: 55 CulvQ: 475.9 MinTopRd: 5326.1

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Culvert #1	467.88	478.88	5326.36	5318.98	5318.98	5311.12 U
	478.31	489.31	5326.36	5318.98	5318.98	5305.01 D

FourmileCreek_MuddGulch.br

CULVERT:

Culvert Name: Culvert #3
 Shape: Box Rise: 5 Span: 10 Barrels: 1
 FHWA Chart #: # 8 - flared wingwalls
 FHWA Scale #: # 2 - wingwall flared 90 or 15 deg.
 Solution Crit: Highest U.S. EG

UpstrmDist: 10 Length: 190.74 n-Value: 0.015
 EntLossCoef: 0.5 ExtLossCoef: 1 CulvInveLU 5306.12 CulvInveLD 5300.01
 LCntStaU: 484.38 RCntStaU: 484.38 LCntStaD 494.81 RCntStaD 494.81
 Culvert Depth Blocked: 0

Culv Area: 50 CulvQ: 432.02 MinTopRd: 5326.1

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Culvert #3	479.38	489.38	5326.12	5318.98	5318.98	5311.12 U
	489.81	499.81	5325.92	5318.98	5318.98	5305.01 D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #2	389.08	0		Highest U.S. EG	Low Flow
Culvert #1	475.9	0		Highest U.S. EG	Low Flow
Culvert #3	432.02	0		Highest U.S. EG	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 9048.02 This is Culvert #2
 CV LF 01 Type of flow is low flow because,
 1. EGEL 3 of 5312.94 is less than or equal to MinTopRd of 5326.10.
 2. CulvWSIn of 5309.99 is less than MxLoCdU of 5311.12.
 3. CulvWSout of 5305.01 is greater than or equal to MxLoCdD of 5311.12.
 4. Q/AD^0.5 of 3.87 is less than 4.0.

RS: 9048.02 This is Culvert #1
 CV LF 01 Type of flow is low flow because,
 1. EGEL 3 of 5312.94 is less than or equal to MinTopRd of 5326.10.
 2. CulvWSIn of 5309.99 is less than MxLoCdU of 5311.12.
 3. CulvWSout of 5305.01 is greater than or equal to MxLoCdD of 5311.12.
 4. Q/AD^0.5 of 3.87 is less than 4.0.

RS: 9048.02 This is Culvert #3
 CV LF 01 Type of flow is low flow because,
 1. EGEL 3 of 5312.94 is less than or equal to MinTopRd of 5326.10.
 2. CulvWSIn of 5309.99 is less than MxLoCdU of 5311.12.
 3. CulvWSout of 5305.01 is greater than or equal to MxLoCdD of 5311.12.
 4. Q/AD^0.5 of 3.86 is less than 4.0.

DISTANCE CHECK

CULVERT COEFFICIENT CHECK

CULVERT CRITERIA CHECK

INEFFECTIVE FLOW CHECK

The computed ineffective stations are very similar to the ineffective stations in the model. The ineffective areas defined in the model accurately represents the flow properties. No changes are required.

RS: 9164.5 This is Section 3
 ST IF 06 Low flow occurs at Culvert Group 1
 The velocity head at Section 3 is more than 0.5
 The computed left ineffective flow station of 453.38 is less than
 the selected left ineffective flow station of 458.38
 The left ineffective flow station should be adjusted.

RS: 9164.5 This is Section 3.
 ST IF 06 Low flow occurs at Culvert Group 1
 The velocity head at Section 3 is more than 0.5
 The computed right ineffective flow station of 494.38 is greater than
 the selected right ineffective flow station of 489.38
 The right ineffective flow station should be adjusted.

RS: 8955.76 This is Section 2
 ST IF 06 Low flow occurs at Culvert Group 1
 The velocity head at Section 2 is more than 0.5
 The computed left ineffective flow station of 463.81 is less than
 the selected left ineffective flow station of 467.81
 The left ineffective flow station should be adjusted.

FourmileCreek_MuddGulch.br

RS: 8955.76 This is Section 2.
 ST IF 06 Low flow occurs at Culvert Group 1
 The velocity head at Section 2 is more than 0.5
 The computed right ineffective flow station of 504.81 is greater than
 the selected right ineffective flow station of 499.81
 The right ineffective flow station should be adjusted.

RS: 9424.36 This is Section 4
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from
 this section, unless the areas beyond the ineffective flow stations
 are not within the flow path of the stream.
 This message should be ignored if this section is Section 2 of
 the upstream structure.

RS: 8669.89 This is Section 1
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from
 this section, unless the areas beyond the ineffective flow stations
 are not within the flow path of the stream.
 This message should be ignored if this section is Section 3 of the downstream
 structure.

RIVER/REACH: MuddGulch, Reach1
 RIVER STATION: 6253.73
 TYPE OF STRUCTURE: Bridge

Description: GRANDVIEW ST
 Distance from Upstream XS: 10
 Deck/Roadway Width: 30
 Weir Coefficient: 2.6
 Maximum allowable submergence for weir flow: 0.98
 Elevation at which weir flow begins: 0
 Weir crest shape: Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual
4	6479.48	197.48	5282.62		5283.3	54.26
3	6282	64.76	5281.72		5282.47	45
	6253.73	30.00	5281.66		5282.43	45
	6253.73	24.76	5281.72		5282.2	45
2	6217.24	242.74	5281.66		5282.15	45
1	5974.5	497.24	5279.27		5280.83	45.01

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	644.54	5288.74	0	654.54	5288.59
2	689.54	1178.09	5287.91	699.54	966.02	5287.67

BRIDGE:
 Bridge Name: Bridge #1
 LowFlowMethod: Highest Energy Answer
 Momentum Cd: 0
 HighFlowMethod: Energy Only
 SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
 Add Friction component to Momentum
 Do not add weight component to Momentum
 Class B flow critical depth computations use critical depth
 inside the bridge at the upstream end
 Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord: 5286 MinTopRd: 5287.68 MinElPrs: 5286

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Bridge					644.54 654.54	689.54 U 699.54 D
	LAButSt	RAButSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Bridge #1	644.53 654.54	689.54 699.54	5287.94 5287.85	5285.62 5286.22	5285.62 5286.22	5286.00 U 5285.90 D

Name	Q Total	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	1724	1724	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 6253.73 This is Bridge #1
 BR LF 01 Type of flow is low flow because,
 1. EGEL 3 of 5282.47 is equal to or less than MinTopRd of 5287.7.
 2. EGEL 3 of 5282.47 is less than MxLocD of 5286.0.

DISTANCE CHECK

Cross-sections U/S and D/S of bridges are cut along available survey data.
 No modification was made to the model.

RS: 6253.73 This is Bridge #1
 ST DT 01 'Distance from Upstream XS' of 10.00 is less than the height of the bridge opening of 14.22
 Section 3 should be placed at the foot of the road embankment or wing walls.
 Distances at Sections 4 & 3, and 'Distance from Upstream XS' should be adjusted.

The computed ineffective stations are very similar to the ineffective stations in the model. The ineffective areas defined in the model accurately represents the flow properties. No changes are required.

INEFFECTIVE FLOW CHECK

RS: 6282 This is Section 3
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed left ineffective flow station of 630.31 is less than the selected left ineffective flow station of 644.54
 The left ineffective flow station should be adjusted.

RS: 6282 This is Section 3.
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed right ineffective flow station of 703.76 is greater than the selected right ineffective flow station of 689.54
 The right ineffective flow station should be adjusted.

RS: 6479.48 This is Section 4
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
 This message should be ignored if this section is Section 2 of the upstream structure.

RS: 5974.5 This is Section 1
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
 This message should be ignored if this section is Section 3 of the downstream structure.

RIVER/REACH: MuddGulch, Reach1
 RIVER STATION: 4820.16
 TYPE OF STRUCTURE: Bridge

Description:	HIGHLAND AVE
Distance from Upstream XS:	4
Deck/Roadway width:	25
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.98
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual	
4	4937.94	102.18	5273.65		5273.66	1891.41	
3	4835.77	36.94	5273.58		5273.61	1516.52	
	4820.16	25.00	5273.18		5273.52	1466.29	Bridge #1-Up
	4820.16	7.94	5272.98		5273.36	1416.38	Bridge #1-Dn
2	4798.82	46.33	5272.41		5272.71	1324.45	
1	4752.5	272.68	5269.7		5270.63	83.78	

FourmileCreek_MuddGulch.br

Ineffective Flow, Section 3			Ineffective Flow, Section 2		
Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	652.71	0	660.56	5277
2	679.71	1064	687.56	1090	5277
3	1064	5271.63	1090	5271.63	

BRIDGE:
 Bridge Name: Bridge #1
 LowFlowMethod: Highest Energy Answer
 Momentum Cd: 0
 HighFlowMethod: Energy only
 SluiceGate Cd: 0 Submerged Cd: 0

 Additional Bridge Parameters
 Add Friction component to Momentum
 Do not add Weight component to Momentum
 Class B flow critical depth computations use critical depth
 inside the bridge at the upstream end
 Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord: 5273.47 MinTopRd: 5271.64 MinElPrs: 5273.47

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Bridge					652.71 660.56	679.71 U 687.56 D
	LAButSt	RAButSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Bridge #1	652.71 660.56	679.71 687.56	5274.71 5274.71	5271.63 5271.63	5271.63 5271.63	5273.47 U 5273.47 D

Name	Q Total	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	2191	1101.42	0	Energy only	Sluicgate Pressure and Weir Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 4820.16 This is Bridge #1
 BR PW 01 Type of sluicgate pressure and weir flow because,
 1. EGEL 3 of 5273.61 is greater than MinTopRd of 5271.64.
 2. EGEL 3 of 5273.61 is equal to or greater than MxLoCdU of 5273.47.
 3. WSEL 2 of 5272.41 is less than MxLoCdD of 5273.47.

DISTANCE CHECK

Cross-sections U/S and D/S of bridges are cut along available survey data.
 No modification was made to the model.

RS: 4820.16 This is Bridge #1
 ST DT 01 'Distance from Upstream XS' of 4.00 is less than the height of the
 bridge opening of 8.32
 Section 3 should be placed at the foot of the road embankment or
 wing walls.
 Distances at Sections 4 & 3, and 'Distance from Upstream XS' should
 be adjusted.

RS: 4820.16 This is Bridge #1
 ST DT 02 The channel distance of 7.939999 at Downstream Internal Section is less than
 the height of the bridge opening of 8.73
 Section 2 should be placed at the foot of the road embankment or
 wing walls.
 Distances at Sections 4, 3 & 2 should be adjusted.

INEFFECTIVE FLOW CHECK

RS: 4835.77 This is Section 3
 ST IF 02 Weir flow occurs at Bridge
 However, the ineffective flow elevation of 5277 between stations 679.71
 and 1064 is equal to or greater than the WSEL of 5273.58
 The RMnTpRdu is 5271.63
 The ineffective flow elevation should be equal to or lower than the MnTpRd
 It should also be less than the WSEL.

This is a perched bridge. The weir flow occurs on the right overbank not
 at the main channel. Ineffective areas are set to represent the flow
 conditions. No modification is necessary.

RS: 4798.82 This is Section 2

ST IF 02 Weir flow occurs at Bridge
 However, the ineffective flow elevation of 5277 between stations 687.56 and 1090 is equal to or greater than the WSEL of 5272.41
 The RMnTPRdD is 5271.63 and the MxLoCdD is 5273.47
 The ineffective flow elevation should be between the RMnTPRdD and the MxLoCdD if RMnTPRdD is greater than MxLoCdD. Otherwise, It should be equal to RMnTPRdD.
 It should also be less than the WSEL.

RS: 4937.94 This is Section 4
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
 This message should be ignored if this section is Section 2 of the upstream structure.

RS: 4752.5 This is Section 1
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
 This message should be ignored if this section is Section 3 of the downstream structure.

RIVER/REACH: MuddGulch, Reach1
 RIVER STATION: 3493.08
 TYPE OF STRUCTURE: Bridge

Description: ADAMS AVE (LEFT SIDE ONLY)
 Distance from Upstream XS: 10
 Deck/Roadway Width: 20
 Weir Coefficient: 2.6
 Maximum allowable submergence for weir flow: 0.98
 Elevation at which weir flow begins: 0
 Weir crest shape: Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual
4	4005.63	490.42	5261.69		5263.42	61.33
3	3515.21	46.06	5259.66		5259.9	718.22
	3493.08	20.00	5259.5		5259.83	685.01
	3493.08	16.06	5258.4		5258.78	656.06
2	3469.15	79.98	5257.63		5258.18	602.61
1	3389.17	521.15	5257.25		5257.32	642.85

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	644.55	5262.89	0	629.17	5261.92
2	671.55	689.2	5262.89	656.17	718.56	5261.92

BRIDGE:
 Bridge Name: Bridge #1
 LowFlowMethod: Highest Energy Answer
 Momentum Cd: 0
 HighFlowMethod: Energy Only
 SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
 Add Friction component to Momentum
 Do not add Weight component to Momentum
 Class B flow critical depth computations use critical depth inside the bridge at the upstream end
 Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord: 5259.3 MinTopRd: 5257.9 MinElPrs: 5259.3

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS
Bridge					644.55 629.17	671.55 U 656.17 D
	LAButSt	RAButSt	LMnTPRd	RMnTPRd	MnTPRd	MxLoCd
Bridge #1	644.55 629.17	671.55 656.18	5260.10 5260.54	5257.91 5256.71	5257.91 5256.71	5259.30 U 5259.36 D

FourmileCreek_MuddGulch.br

Name	Q Total	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	2191	974.19	0	Energy only	Sluicgate Pressure and Weir Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 3493.08 This is Bridge #1
 BR PW 01 Type of sluicgate pressure and weir flow because,
 1. EGEL 3 of 5259.90 is greater than MinTopRd of 5257.90.
 2. EGEL 3 of 5259.90 is equal to or greater than MxLoCdu of 5259.30.
 3. WSEL 2 of 5257.63 is less than MxLoCdd of 5259.36.

RS: 3493.08 This is Bridge #1
 BR PW 03 BrSelMthd is Energy Only. Type of flow is sluicgate pressure and weir flow.
 However, EGEL difference between section 3 and 2 is more than 1.0 foot.
 Press/weir should be selected as High Flow Method.

DISTANCE CHECK

INEFFECTIVE FLOW CHECK

The bridge does not continue on the right bank. The weir flow occurs on the right overbank not at the main channel. Ineffective areas are set to represent the flow conditions. No modification is necessary.

RS: 3515.21 This is Section 3
 ST IF 02 Weir flow occurs at Bridge
 However, the ineffective flow elevation of 5262.89 between stations 671.55 and 689.2 is equal to or greater than the WSEL of 5259.66
 The RMnTpRdu is 5257.91
 The ineffective flow elevation should be equal to or lower than the MnTpRd
 It should also be less than the WSEL.

RS: 3469.15 This is Section 2
 ST IF 02 Weir flow occurs at Bridge
 However, the ineffective flow elevation of 5261.92 between stations 656.17 and 718.56 is equal to or greater than the WSEL of 5257.63
 The RMnTpRdd is 5256.705 and the MxLoCdd is 5259.36
 The ineffective flow elevation should be between the RMnTpRdd and the MxLoCdd if RMnTpRdd is greater than MxLoCdd. Otherwise, It should be equal to RMnTpRdd.
 It should also be less than the WSEL.

RS: 4005.63 This is Section 4
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
 This message should be ignored if this section is Section 2 of the upstream structure.

RS: 3389.17 This is Section 1
 ST IF 07 Ineffective flow option was considered at this section.
 However, it should be a fully expanded cross section.
 Ineffective flow stations and elevations should be cleared from this section, unless the areas beyond the ineffective flow stations are not within the flow path of the stream.
 This message should be ignored if this section is Section 3 of the downstream structure.

RIVER/REACH: MuddGulch, Reach1
 RIVER STATION: 2473.27
 TYPE OF STRUCTURE: Bridge

Description:	RAILROAD
Distance from Upstream XS:	25
Deck/Roadway width:	25
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.98
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual
4	2519.13	20.46	5249.93		5250.1	151.86
3	2498.67	80.53	5249.11		5249.85	33
	2473.27	25.00	5247.99		5249.42	33
	2473.27	30.53	5247.96		5248.62	33
2	2418.14	228.31	5247.67		5248.43	33
1	2189.83	200.76	5246.23		5246.86	132.1

FourmileCreek_MuddGulch.br

Ineffective Flow, Section 3			Ineffective Flow, Section 2		
Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	990.72	0	1059.66	5252.38
2	1023.72	1101.552	1092.66	1219.67	5251.57

BRIDGE:
 Bridge Name: Bridge #1
 LowFlowMethod: Highest Energy Answer
 Momentum Cd: 0
 HighFlowMethod: Energy only
 SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
 Add Friction component to Momentum
 Do not add Weight component to Momentum
 Class B flow critical depth computations use critical depth
 inside the bridge at the upstream end
 Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord: 5250.4 MinTopRd: 5252.39 MinElPrs: 5250.4

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RifStaS
Bridge					990.72 1059.66	1023.72U 1092.66D
	LAButSt	RAButSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd
Bridge #1	990.72 1059.66	1023.73 1092.67	5249.96 5249.91	5254.93 5255.11	5249.96 5249.91	5250.40 U 5250.58 D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	921.1	921.1	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 2473.27 This is Bridge #1
 BR LF 01 Type of flow is low flow because,
 1. EGEL 3 of 5249.85 is equal to or less than MinTopRd of 5252.4.
 2. EGEL 3 of 5249.85 is less than MxLoCdU of 5250.4.

DISTANCE CHECK

INEFFECTIVE FLOW CHECK

The computed ineffective stations are very similar to the ineffective stations in the model. The ineffective areas defined in the model accurately represents the flow properties. No changes are required.

RS: 2498.67 This is Section 3
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed left ineffective flow station of 984.09 is less than
 the selected left ineffective flow station of 990.72
 The left ineffective flow station should be adjusted.

RS: 2498.67 This is Section 3.
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 3 is more than 0.5
 The computed right ineffective flow station of 1030.36 is greater than
 the selected right ineffective flow station of 1023.72
 The right ineffective flow station should be adjusted.

RS: 2418.14 This is Section 2
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 2 is more than 0.5
 The computed left ineffective flow station of 1052.18 is less than
 the selected left ineffective flow station of 1059.66
 The left ineffective flow station should be adjusted.

RS: 2418.14 This is Section 2.
 ST IF 06 Low flow occurs at Bridge
 The velocity head at Section 2 is more than 0.5
 The computed right ineffective flow station of 1100.15 is greater than
 the selected right ineffective flow station of 1092.66
 The right ineffective flow station should be adjusted.

RS: 2519.13 This is Section 4
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the areas beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 2 of
the upstream structure.

RS: 2189.83 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the ares beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

---END

FourmileCreek_MuddGulch.mp
CHECK-RAS Program: MULTIPLE PROFILE Check

Project File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.prj
Plan File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.p01
Geometry File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.g01
Flow File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.f01
Report File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.mp
Selected profiles: #10%,#2%,#1%
Date: 4/10/2009
Time: 8:49:23 AM

River Station WSEL	Q Total	Top Wdth Act	Vel Head	Profile Number
Fourmile, Reach1				
16382.73	5361.68	2110	76.36	1.03
16382.73	5364.08	5110	226.85	1.78
16382.73	5365.13	7020	238.1	1.88
16018.02	5358.85	2110	126.04	0.77
16018.02	5360.48	5110	264.9	1.7
16018.02	5361.64	7020	441.18	1.5
15788.95	5357.69	2110	532.06	0.48
15788.95	5358.76	5110	607.15	0.63
15788.95	5359.46	7020	629.63	0.57
15380.94	5353.5	2110	63.43	1.45
15380.94	5355.84	5110	459.71	0.99
15380.94	5356.43	7020	546.93	1.15
15048.74	5350.79	2110	125.02	0.72
15048.74	5353	5110	283.36	0.91
15048.74	5353.95	7020	405.5	0.95
14576.82	5348.01	2110	84.89	0.67
14576.82	5350.45	5110	225.73	1.11
14576.82	5351.37	7020	226.53	1.31
14082.25	5344.8	2110	130.96	0.6
14082.25	5346.09	5110	177.26	1.41
14082.25	5346.75	7020	207.91	1.8
13545.88	5340.85	2110	201.94	0.4
13545.88	5343.12	5110	281.59	0.44
13545.88	5344.24	7020	305.84	0.46
13318.55	5337.26	2110	72.32	1.49
13318.55	5339.75	5110	121.37	2.11
13318.55	5340.83	7020	138.17	2.46
12947.26	5335.1	2110	127.93	0.41
12947.26	5337.34	5110	151.2	0.77
12947.26	5338.14	7020	156.42	1.08
12788.01	5333.89	2110	97.48	0.73
12788.01	5336.24	5110	270.54	1.04
12788.01	5337.42	7020	357.2	0.99
12322.54	5329.76	2110	92.67	0.59
12322.54	5331.92	5110	102.32	1.33
12322.54	5332.64	7020	105.67	1.94
11997.88	5326.54	2110	148.78	0.62
11997.88	5328.01	5110	184.14	1.29
11997.88	5328.92	7020	205.89	1.47
11451.47	5322.68	2110	193.01	0.52
11451.47	5324.45	5110	244.14	0.78
11451.47	5324.89	7020	247.97	1.12
10930.27	5318.22	2110	135.69	0.73
10930.27	5319.6	5110	194.17	1.48
10930.27	5320.48	7020	289.24	1.36
10292.38	5314.11	2110	228.18	0.37
10292.38	5316.24	5110	250.16	0.48
10292.38	5317.12	7020	267.31	0.6
10048.25	5311.88	2110	166.84	0.67
10048.25	5313.87	5110	314.39	1.02
10048.25	5314.72	7020	385.73	1.09
9338.16	5306.76	2110	137.36	0.89
9338.16	5308.69	5110	185.52	1.42
9338.16	5309.69	7020	219.93	1.61
8895.63	5304.16	2110	138.29	0.43
8895.63	5306.53	5110	169.53	0.69
8895.63	5307.53	7020	184.33	0.86
8742.65	5303.77	2110	168.45	0.25
8742.65	5306.26	5110	200.55	0.41
8742.65	5307.26	7020	210	0.53
8684.3	5303.43	2110	174.53	0.36
8684.3	5305.99	5110	179.84	0.5
8684.3	5306.92	7020	180.01	0.67
8632.47 Bridge #1				
8569.65	5302.97	2110	169.63	0.24
8569.65	5305.67	5110	179.5	0.39
8569.65	5306.53	7020	179.5	0.56
8490.8	5302.5	2110	143.33	0.4
8490.8	5305.32	5110	184.41	0.52
8490.8	5306.1	7020	191.24	0.73
8139.05	5299.98	2110	59.07	0.97

FourmileCreek_MuddGulch.mp					
8139.05	5303.01	5110	346.77	1.3	2
8139.05	5303.78	7020	373.03	1.37	1
7819.74	5298.02	2110	62.18	0.9	3
7819.74	5300.39	5110	307.44	0.86	2
7819.74	5301.11	7020	599.83	0.74	1
7819	Lateral weirs				
7454.19	5295.56	2110	79.57	0.91	3
7454.19	5298.2	5109.9	479.62	1.09	2
7454.19	5298.85	6891.5	494.12	1.08	1
7454	Lateral weirs				
6921.01	5289.26	2110	73.62	1.49	3
6921.01	5291.77	5109.48	94.28	2.27	2
6921.01	5292.97	6857.05	111.73	2.45	1
6349.33	5285.47	2110	167.77	0.2	3
6349.33	5287.71	5109.48	200.27	0.4	2
6349.33	5288.51	6857.05	220.23	0.53	1
5984.11	5283.27	2110	77.35	1.05	3
5984.11	5285.21	5109.48	214.31	1.3	2
5984.11	5286.06	6857.05	230.94	1.31	1
5506.21	5280.78	2110	146.6	0.37	3
5506.21	5283.36	5109.9	229.6	0.5	2
5506.21	5284.56	6891.5	280.88	0.5	1
5147.36	5278.86	2110	89.2	0.67	3
5147.36	5281.78	5109.9	181.51	0.79	2
5147.36	5283.36	6891.5	231.55	0.68	1
4711.74	5277.37	2110	93.34	0.51	3
4711.74	5281.64	5109.9	433.18	0.16	2
4711.74	5283.33	6891.5	562.37	0.13	1
4394.51	5276.56	2110	87.61	0.4	3
4394.51	5280.74	5109.9	99.55	0.61	2
4394.51	5282.23	6891.5	99.55	0.79	1
4379.56	Bridge #1				
4329.78	5274.01	2110	44.7	2.07	3
4329.78	5277.94	5109.9	99.55	2.57	2
4329.78	5279.2	6891.5	99.55	2.92	1
4111.69	5273.25	2110	118.23	0.27	3
4111.69	5276.1	5109.9	129.03	0.55	2
4111.69	5277.46	6891.5	130.16	0.69	1
4073	Bridge #1				
4050.69	5272.69	2110	80.9	0.56	3
4050.69	5274.32	5109.9	126.77	1.68	2
4050.69	5274.91	6891.5	130.16	2.42	1
3756.25	5269.87	2110	116.13	1.11	3
3756.25	5271.91	5109.9	338.36	1.18	2
3756.25	5272.52	6891.5	352.66	1.28	1
3680.22	5268.87	2110	116.94	0.59	3
3680.22	5271.1	5109.9	235.96	0.98	2
3680.22	5271.71	6891.5	268.45	1.26	1
3432.09	5267.75	2110	89.22	0.59	3
3432.09	5270.65	5109.9	368.49	0.43	2
3432.09	5271.33	6891.5	378.55	0.5	1
3121.18	5264.82	2110	64.57	1.29	3
3121.18	5268.06	5109.9	235.95	1.58	2
3121.18	5269.94	6891.5	273.2	0.86	1
2953.71	5263.46	2110	69.35	0.99	3
2953.71	5265.75	5109.9	83.99	2.09	2
2953.71	5268.47	6891.5	111.64	1.51	1
2512.02	5262.12	2110	132.81	0.33	3
2512.02	5264.33	5109.9	168.8	0.66	2
2512.02	5265.01	6891.5	168.8	0.92	1
2154.04	5260.28	2110	95.98	0.72	3
2154.04	5262.09	5109.9	362.4	1.08	2
2154.04	5262.6	6891.5	364.02	1.24	1
1765.52	5257.82	2110	85.2	0.69	3
1765.52	5260.29	5109.9	790.62	0.26	2
1765.52	5260.72	6891.5	790.62	0.3	1
1606.54	5257	2110	63.05	0.72	3
1606.54	5259.35	5109.9	952.32	0.68	2
1606.54	5259.67	6891.5	960.12	0.75	1
1222.98	5254.68	2110	375.52	0.8	3
1222.98	5256.02	5109.9	703.06	0.54	2
1222.98	5256.54	6891.5	705.39	0.49	1
666.22	5250.84	2110	189.4	0.4	3
666.22	5252.49	5109.9	313.57	0.65	2
666.22	5253.23	6891.5	318.68	0.74	1
68.69	5248.38	2110	249.44	0.28	3
68.69	5250.22	5109.9	249.44	0.49	2
68.69	5251.06	6891.5	249.44	0.59	1
MG Flow Split, Reach1					
3569.53	5248.77	0.1	0.95	0.01	3
3569.53	5250.04	0.1	6.39	0	2
3569.53	5250.27	0.1	49.29	0	1
3568.53	5248.71	0.1	0.71	0.04	3
3568.53	5249.71	12.41	4.99	0.29	2
3568.53	5250.15	17.17	35.52	0.1	1
2878.94	5242.88	311.46	268.01	0.01	3
2878.94	5243.76	1091.42	493.55	0.04	2
2878.94	5243.89	1240.53	552.56	0.05	1
2455.99	5242.72	311.46	678.11	0	3
2455.99	5243.4	1091.42	863.36	0.01	2
2455.99	5243.5	1270	876.64	0.02	1

FourmileCreek_MuddGulch.mp					
2211.55	5242.56	311.46	558.79	0.02	3
2211.55	5243.07	1091.42	802.36	0.05	2
2211.55	5243.15	1270	816.04	0.05	1
1729.42	5239.71	311.46	241.7	0.1	3
1729.42	5240.59	1091.42	318.49	0.13	2
1729.42	5240.76	1270	335.43	0.13	1
1234.55	5238.28	311.46	280.86	0.02	3
1234.55	5239.29	1091.42	385.25	0.05	2
1234.55	5239.43	1270	397.12	0.06	1
685.37	5237.1	311.46	359.5	0.04	3
685.37	5237.6	1091.42	397.54	0.12	2
685.37	5237.74	1270	408.27	0.12	1
685	Lateral weirs				
224.65	5232.24	311.46	40.1	0.62	3
224.65	5235.22	1091.42	202.48	0.14	2
224.65	5235.38	1268.89	208.99	0.16	1
224	Lateral weirs				
104.89	5231.07	311.46	162.46	0	3
104.89	5235.27	1091.42	237.1	0.01	2
104.89	5235.44	1268.72	239.25	0.01	1
68.78	Culvert #1				
14.14	5225.15	311.46	32.49	0.39	3
14.14	5227.31	1091.42	109.35	0.41	2
14.14	5227.66	1268.72	140.03	0.38	1
MuddGulch, Reach1					
20181.26	5513.29	145	28.13	0.16	3
20181.26	5514.07	254	30.75	0.21	2
20181.26	5514.18	270	31.1	0.22	1
19700.71	5509.32	145	13.2	0.61	3
19700.71	5510.09	254	16.17	0.85	2
19700.71	5510.17	270	16.49	0.89	1
19402.88	5504.37	145	17.87	0.55	3
19402.88	5505	254	21.04	0.75	2
19402.88	5505.08	270	21.49	0.76	1
18990.06	5498.48	145	20.96	0.39	3
18990.06	5499.12	254	25.47	0.52	2
18990.06	5499.19	270	25.96	0.54	1
18760	5494.67	145	20.96	0.55	3
18760	5495.21	254	25.79	0.73	2
18760	5495.29	270	26.49	0.74	1
18518.88	5492.17	145	66.06	0.16	3
18518.88	5492.56	254	105	0.21	2
18518.88	5492.6	270	105	0.21	1
18116.98	5486.93	145	18.61	0.63	3
18116.98	5487.54	254	22.94	0.79	2
18116.98	5487.62	270	23.48	0.81	1
17844.24	5480.38	145	23.93	0.51	3
17844.24	5480.88	254	27.95	0.69	2
17844.24	5480.95	270	28.5	0.71	1
17384.73	5469.72	145	20.3	0.59	3
17384.73	5470.3	254	23.91	0.76	2
17384.73	5470.37	270	24.35	0.79	1
16869.32	5454	145	17.64	0.65	3
16869.32	5454.66	254	22.16	0.8	2
16869.32	5454.72	270	22.63	0.83	1
16809.73	Culvert #1				
16749.55	5451.02	145	26.79	0.41	3
16749.55	5451.42	254	28.46	0.66	2
16749.55	5451.46	270	28.64	0.7	1
16485.74	5445.25	145	45.2	0.35	3
16485.74	5445.59	254	56.12	0.44	2
16485.74	5445.63	270	57.59	0.45	1
16216.12	5436.98	646	35.83	1.09	3
16216.12	5438.17	1192	44.19	1.42	2
16216.12	5438.36	1297	45.53	1.47	1
15806.06	5429.13	646	54.71	0.83	3
15806.06	5430.02	1192	69.34	1.08	2
15806.06	5430.2	1297	81.94	1.07	1
15397.66	5422.91	646	132.81	0.53	3
15397.66	5423.5	1192	178.13	0.63	2
15397.66	5423.61	1297	186.4	0.63	1
15035.7	5416.49	646	119.39	0.55	3
15035.7	5417.1	1192	154.77	0.68	2
15035.7	5417.2	1297	160.16	0.7	1
14623.73	5408.38	646	43.79	0.96	3
14623.73	5409.43	1192	56.08	1.21	2
14623.73	5409.6	1297	58.03	1.25	1
14522.74	5403.81	646	58.66	0.66	3
14522.74	5404.47	1192	61.31	1.14	2
14522.74	5404.6	1297	61.84	1.21	1
14414.32	5403.18	646	90	0.31	3
14414.32	5404.08	1192	93.91	0.42	2
14414.32	5404.32	1297	94.95	0.42	1
14002.14	5402.89	646	253.53	0.03	3
14002.14	5403.99	1192	263.56	0.04	2
14002.14	5404.27	1297	265.98	0.04	1
13823.62	5401.93	646	74.37	0.67	3
13823.62	5403.32	1192	85.4	0.5	2
13823.62	5403.68	1297	88.36	0.45	1
13676	5399.46	646	24	1.42	3

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13676	5400.87	1192	24	2.14	2
13676	5401.13	1297	24	2.25	1
13478.31	5398.19	646	122.24	0.49	3
13478.31	5398.67	1192	122.24	0.73	2
13478.31	5398.75	1297	122.24	0.77	1
13246.54	5384.19	646	56.67	0.8	3
13246.54	5384.99	1192	57.58	1.2	2
13246.54	5385.13	1297	57.74	1.26	1
13164.55	5372.23	646	57.73	0.79	3
13164.55	5373.07	1192	69.09	1.05	2
13164.55	5373.2	1297	70.5	1.11	1
12837.83	5367.66	646	59.94	0.33	3
12837.83	5369.12	1192	68.47	0.4	2
12837.83	5369.38	1297	70.01	0.41	1
12530.28	5363.78	646	24.94	1.38	3
12530.28	5365.22	1192	27.42	1.96	2
12530.28	5365.47	1297	27.84	2.05	1
12220.19	5359.08	646	47.51	0.67	3
12220.19	5360.25	1192	48.86	0.93	2
12220.19	5360.45	1297	49.09	0.97	1
11900.7	5355.97	646	35.65	0.62	3
11900.7	5357.34	1192	38.88	0.93	2
11900.7	5357.58	1297	39.42	0.99	1
11496.49	5350.6	646	29.12	1.24	3
11496.49	5351.92	1192	33.34	1.72	2
11496.49	5352.14	1297	34.03	1.79	1
10979.19	5341.6	646	27.71	0.97	3
10979.19	5343.16	1192	33.53	1.32	2
10979.19	5343.4	1297	34.43	1.38	1
10698.07	5336.69	646	20.8	1.58	3
10698.07	5338.4	1192	26.59	2.01	2
10698.07	5338.69	1297	27.55	2.06	1
10419.12	5331.23	646	50.85	0.47	3
10419.12	5332.33	1192	55	0.71	2
10419.12	5332.51	1297	55	0.75	1
10391.79					
Bridge #1					
10364.86	5328.75	646	32.08	1.17	3
10364.86	5330.01	1192	38.23	1.57	2
10364.86	5330.21	1297	39.21	1.63	1
10261.61	5326.45	646	40.6	0.78	3
10261.61	5327.54	1192	45.46	1.16	2
10261.61	5327.72	1297	46.28	1.22	1
10030	5322.41	646	33.38	1.14	3
10030	5323.63	1192	39.76	1.53	2
10030	5323.83	1297	40.76	1.59	1
9710.46	5318.97	646	51.72	0.42	3
9710.46	5320.16	1192	53.65	0.63	2
9710.46	5320.38	1297	53.99	0.66	1
9424.36	5315.22	646	32.98	1.15	3
9424.36	5316.47	1192	39.53	1.52	2
9424.36	5316.66	1297	40.52	1.6	1
9164.5	5309.34	646	31	1.2	3
9164.5	5311.3	1192	31	1.22	2
9164.5	5311.75	1297	31	1.19	1
culvert #2					
8955.76	5307.03	646	32	0.25	3
8955.76	5308.54	1192	32	0.51	2
8955.76	5308.8	1297	32	0.56	1
8669.89	5306.76	646	64.26	0.12	3
8669.89	5308.26	1192	69.63	0.2	2
8669.89	5308.53	1297	70.61	0.21	1
8411.16	5305.38	853	58.35	0.64	3
8411.16	5306.43	1571	61.23	1	2
8411.16	5306.62	1724	61.75	1.07	1
8031.07	5301.59	853	58.9	0.62	3
8031.07	5302.71	1571	65.18	0.91	2
8031.07	5302.93	1724	66.38	0.96	1
7701.39	5298.67	853	64.16	0.53	3
7701.39	5299.84	1571	75.17	0.74	2
7701.39	5300.08	1724	77.12	0.77	1
7414.21	5294.67	853	54.34	0.99	3
7414.21	5295.7	1571	61.09	1.38	2
7414.21	5295.89	1724	62.33	1.45	1
7054.93	5287.68	853	37.17	1.28	3
7054.93	5289.05	1571	42.98	1.73	2
7054.93	5289.3	1724	44.04	1.81	1
6896.94	5283.07	853	28.75	1.32	3
6896.94	5284.58	1571	36.42	1.94	2
6896.94	5284.91	1724	38.72	1.98	1
6479.48	5280.18	853	41.72	0.55	3
6479.48	5282.23	1571	52.3	0.67	2
6479.48	5282.62	1724	54.26	0.68	1
6282	5279.12	853	36.62	0.58	3
6282	5281.3	1571	44.96	0.73	2
6282	5281.72	1724	45	0.75	1
Bridge #1					
6253.73					
6217.24	5279.03	853	40.85	0.31	3
6217.24	5281.22	1571	45	0.47	2
6217.24	5281.66	1724	45	0.49	1
5974.5	5277.5	1054	37.28	0.81	3

FourmileCreek_MuddGulch.mp					
5974.5	5279.01	1970	43.89	1.41	2
5974.5	5279.27	2191	45.01	1.57	1
5477.27	5276.2	1054	97.17	0.26	3
5477.27	5278.04	1970	149.55	0.31	2
5477.27	5278.37	2191	325.7	0.32	1
5134.21	5273.09	1054	28.39	1.77	3
5134.21	5275.27	1970	57.18	1.7	2
5134.21	5275.55	2191	60.49	1.8	1
4937.94	5272.95	1054	1869.84	0.01	3
4937.94	5273.57	1970	1887.93	0.01	2
4937.94	5273.65	2191	1891.41	0.01	1
4835.77	5271.33	1054	27	1.21	3
4835.77	5273.51	1970	1515.23	0.03	2
4835.77	5273.58	2191	1516.52	0.03	1
4820.16	Bridge #1				
4798.82	5270.09	1054	27	1.83	3
4798.82	5272.33	1970	1289.24	0.31	2
4798.82	5272.41	2191	1324.45	0.29	1
4752.5	5268.31	1054	70.54	0.56	3
4752.5	5269.53	1970	82.16	0.83	2
4752.5	5269.7	2191	83.78	0.93	1
4479.82	5265.63	1054	50.1	0.82	3
4479.82	5267.4	1970	162.11	0.92	2
4479.82	5267.64	2191	313.77	0.94	1
4005.63	5260.47	1054	50.46	0.89	3
4005.63	5261.42	1970	58.92	1.64	2
4005.63	5261.69	2191	61.33	1.73	1
3515.21	5259.14	1054	580.63	0.16	3
3515.21	5259.64	1970	717.6	0.2	2
3515.21	5259.66	2191	718.22	0.24	1
3493.08	Bridge #1				
3469.15	5256.93	1054	212.4	0.34	3
3469.15	5257.5	1970	528.14	0.54	2
3469.15	5257.63	2191	602.61	0.56	1
3389.17	5256.47	1054	613.44	0.06	3
3389.17	5257.09	1970	638.65	0.06	2
3389.17	5257.25	2191	642.85	0.07	1
3389	Lateral weirs				
2868.02	5253.48	1054	194.32	0.55	3
2868.02	5254.09	1957.69	218.45	0.69	2
2868.02	5254.12	2173.93	219.64	0.82	1
2868	Lateral weirs				
2519.13	5249.29	742.64	96.89	0.18	3
2519.13	5249.79	878.68	128.29	0.17	2
2519.13	5249.93	950.57	151.86	0.17	1
2519	Lateral weirs				
2498.67	5248.63	742.64	33	0.62	3
2498.67	5249	878.68	33	0.72	2
2498.67	5249.11	921.1	33	0.74	1
2473.27	Bridge #1				
2418.14	5247.49	742.64	33	0.54	3
2418.14	5247.63	878.68	33	0.71	2
2418.14	5247.67	921.1	33	0.76	1
2189.83	5245.62	787.64	74.76	0.76	3
2189.83	5246.09	969.68	131.56	0.67	2
2189.83	5246.23	1032.1	132.1	0.63	1
1989.08	5244.48	787.64	42.73	0.43	3
1989.08	5245.04	969.68	45.93	0.48	2
1989.08	5245.22	1032.1	46.94	0.5	1
1574.31	5240.56	787.64	28.77	1.29	3
1574.31	5241.08	969.68	31.14	1.41	2
1574.31	5241.25	1032.1	31.93	1.44	1
1261.28	5237.74	787.64	29.4	0.77	3
1261.28	5238.36	969.68	30.74	0.86	2
1261.28	5238.55	1032.1	31.13	0.89	1
863.78	5237.1	787.64	41.4	0.22	3
863.78	5237.69	969.68	42.59	0.26	2
863.78	5237.86	1032.1	64.41	0.28	1
411.13	5235.39	787.64	40.11	0.67	3
411.13	5235.83	969.68	87.98	0.76	2
411.13	5235.97	1032.1	171.08	0.77	1
30	5232.08	787.64	59.7	0.59	3
30	5232.51	969.68	72.8	0.59	2
30	5232.68	1032.1	80.85	0.57	1

Boundary Condition Check

- MP SW 01 The name of the stream is Fourmile,Reach1
(Normal S = 0.003) is specified as the downstream boundary
for profile 1%
- MP SW 01 The name of the stream is Fourmile,Reach1
(Normal S = 0.003) is specified as the downstream boundary
for profile 2%
- MP SW 01 The name of the stream is Fourmile,Reach1
(Normal S = 0.003) is specified as the downstream boundary
for profile 10%

FourmileCreek_MuddGulch.mp

MP SW 01 The name of the stream is MG Flow Split,Reach1
(Normal S = 0.01) is specified as the downstream boundary
for profile 1%

MP SW 01 The name of the stream is MG Flow Split,Reach1
(Normal S = 0.01) is specified as the downstream boundary
for profile 2%

MP SW 01 The name of the stream is MG Flow Split,Reach1
(Normal S = 0.01) is specified as the downstream boundary
for profile 10%

MP SW 01 The name of the stream is MuddGulch,Reach1
(Normal S = 0.01) is specified as the downstream boundary
for profile 1%

MP SW 01 The name of the stream is MuddGulch,Reach1
(Normal S = 0.01) is specified as the downstream boundary
for profile 2%

MP SW 01 The name of the stream is MuddGulch,Reach1
(Normal S = 0.01) is specified as the downstream boundary
for profile 10%

Discharge Check

Water Surface Elevation Check

Topwidth Check

Not Applicable. Ineffective flow areas are placed to represent active flow patterns.

RS: 2512.02
MP TW 01 The topwidth is the same for profile number 2 and 1
Velocity head for profile 2 or 1 is greater than 0.5 foot.

RS: 68.69
MP TW 01 The topwidth is the same for profile number 2 and 1
Velocity head for profile 2 or 1 is greater than 0.5 foot.

RS: 13676
MP TW 01 The topwidth is the same for profile number 3 and 2
Velocity head for profile 3 or 2 is greater than 0.5 foot.

RS: 13676
MP TW 01 The topwidth is the same for profile number 2 and 1
Velocity head for profile 2 or 1 is greater than 0.5 foot.

RS: 13478.31
MP TW 01 The topwidth is the same for profile number 3 and 2
Velocity head for profile 3 or 2 is greater than 0.5 foot.

RS: 13478.31
MP TW 01 The topwidth is the same for profile number 2 and 1
Velocity head for profile 2 or 1 is greater than 0.5 foot.

---END---

FourmileCreek_MuddGulch.fw
CHECK-RAS Program: Floodway Check
Encroachment Method, Starting WSEL, Floodway Width, and Surcharge Review

Project File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.prj
Plan File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.p03
Geometry File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.g01
Flow File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.f03
Report File: X:\Projects\100001092_Four Mile - Mud Gulch\Henderson\Final TSDN\3 Hydraulics\HEC-RAS
Model\FourmileCreek_MuddGulch.fw
Selected profiles: 1%;Floodway
Date: 4/10/2009
Time: 8:42:58 AM

SECNO	Method	Surcharge	EncStaL	EncStaR	LStaEff	RStaEff	Structure
Fourmile, Reach1							
16382.73					469.98	708.08	
16382.73	1	0.05	469.98	708.08	469.98	708.08	
16018.02					413.78	854.95	
16018.02	1	0.04	500	854.95	500	854.95	
15788.95					173.41	803.04	
15788.95	1	0.9	400	782.7	400	782.7	
15380.94					288.44	835.38	
15380.94	1	0.53	567.35	800	567.35	800	
15048.74					342.85	748.34	
15048.74	1	0.01	550	748.34	550	748.34	
14576.82					550	776.53	
14576.82	1	0.05	550	772.72	550	772.72	
14082.25					265.26	473.18	
14082.25	1	0.04	265.26	473.18	265.26	473.18	
13545.88					424.31	730.15	
13545.88	1	-0.02	424.63	729.9	424.64	729.89	
13318.55					517.03	655.2	
13318.55	1	0.08	517.03	655.2	517.03	655.2	
12947.26					628.17	784.6	
12947.26	1	0.96	628.17	781.49	628.17	781.49	
12788.01					669.38	1026.58	
12788.01	1	0.27	669.38	791.94	669.38	791.94	
12322.54					356.27	606.55	
12322.54	1	0	499.45	610.56	500.88	606.55	
11997.88					557.04	762.93	
11997.88	1	0.95	560.35	695.02	560.35	695.02	
11451.47					445.52	693.49	
11451.47	1	0.62	478.77	593.56	478.77	593.56	
10930.27					536.22	825.46	
10930.27	1	0.49	562.6	697.95	562.6	697.95	
10292.38					327.61	594.91	
10292.38	1	0.64	429.62	566.57	429.62	566.57	
10048.25					505.07	890.81	
10048.25	1	0.13	700	842.12	700	842.12	
9338.16					641.21	861.14	
9338.16	1	0.01	650	840	650	840	
8895.63					269.03	453.36	
8895.63	1	0.42	235.45	460.38	263.71	454.67	
8742.65					323.62	552.2	
8742.65	1	0.49	312.22	564.61	319.74	555.83	
8684.3					389.13	570.89	
8684.3	1	0.57	385.17	572.12	388.82	571	
8632.47					390.88	570.41	Bridge #1-Up
8632.47					465.15	644.65	Bridge #1-Dn
8632.47	0	0.59	385.17	572.12	390.88	570.41	Bridge #1-Up
8632.47	0	0.68	304.91	714.78	465.15	644.65	Bridge #1-Dn
8569.65					465.15	644.65	
8569.65	1	0.68	304.91	714.78	465.15	644.65	
8490.8					576.32	767.56	
8490.8	1	0.87	542.08	779.28	560.39	775.17	
8139.05					552.61	925.64	
8139.05	1	0.16	735.59	925.64	735.59	925.64	
7819.74					327.61	927.44	

FourmileCreek_MuddGulch.fw							
7819.74	1	0.58	616.41	850	616.41	850	
7454.19					1.88	496	
7819	Lateral weirs						
7454.19	1	0.22	294.88	496	294.88	496	
6921.01					252.69	364.42	
7454	Lateral weirs						
6921.01	1	0.1	238.29	366.16	251.63	365.36	
6349.33					327.14	547.36	
6349.33	1	0.07	315.21	581.41	326.61	548.64	
5984.11					283.39	514.33	
5984.11	1	0.06	270.01	533.3	283	515.13	
5506.21					503.07	783.95	
5506.21	1	0.13	474.77	800.82	500.72	787.02	
5147.36					599.05	830.59	
5147.36	1	0.21	593.1	837.36	598.03	836.17	
4711.74					601.37	1163.74	
4711.74	1	0.1	766.96	1100	766.96	1100	
4394.51					817.49	917.04	
4394.51	1	0.09	804.34	931.81	817.49	917.04	
4379.56					817.49	917.04	Bridge #1-Up
4379.56					818.6	918.15	Bridge #1-Dn
4379.56	0	0.09	804.34	931.81	817.49	917.04	Bridge #1-Up
4379.56	0	0.09	818	955.52	818.6	918.15	Bridge #1-Dn
4329.78					818.6	918.15	
4329.78	1	0.09	818	955.52	818.6	918.15	
4111.69					157.79	287.95	
4111.69	1	0.08	141.75	293.7	157.79	287.95	
4073					157.79	287.95	Bridge #1-Up
4073					185.76	315.92	Bridge #1-Dn
4073	0	0.08	141.75	293.7	157.79	287.95	Bridge #1-Up
4073	0	0.08	185	316	185.76	315.92	Bridge #1-Dn
4050.69					185.76	315.92	
4050.69	1	0.1	185	316	185.76	315.92	
3756.25					330.53	683.19	
3756.25	1	0.04	346.43	680	346.43	680	
3680.22					491.06	759.51	
3680.22	1	0.13	503.43	759.51	503.43	759.51	
3432.09					607.48	986.03	
3432.09	1	0.08	622.65	950	622.65	950	
3121.18					790.97	1064.18	
3121.18	1	0.16	791.8	1050	791.8	1050	
2953.71					938.4	1050.04	
2953.71	1	0	935.06	1033.51	938.4	1033.51	
2512.02					962.72	1131.52	
2512.02	1	0.22	962.72	1131.52	962.72	1131.52	
2154.04					994.55	1358.57	
2154.04	1	0.85	1100	1358.57	1100	1358.57	
1765.52					919.35	1709.97	
1765.52	1	0.87	1400	1709.97	1400	1709.97	
1606.54					883.82	1843.94	
1606.54	1	0.95	1550	1842.58	1550	1842.58	
1222.98					1376.97	2082.36	
1222.98	1	0.63	1900	2155.36	1900	2082.36	
666.22					2171.13	2489.81	
666.22	12	0.41	2250.81	2468.05	2250.81	2468.05	
68.69					2860.08	3109.52	
68.69	12	0.45	2860.08	3050	2860.08	3050	
MG Flow Split, Reach1							
3569.53					379.35	479.17	
3569.53	0	0	0	0	379.35	479.17	
3568.53					389.21	478.86	
3568.53	0	0	0	0	389.21	478.86	
2878.94					236.1	802.66	
2878.94	0	0	0	0	236.1	802.66	
2455.99					193.62	1070.25	
2455.99	0	0	0	0	193.62	1070.25	
2211.55					265.61	1081.65	
2211.55	0	0	0	0	265.61	1081.65	
1729.42					594.55	929.98	
1729.42	0	0	0	0	594.55	929.98	
1234.55					317.84	714.96	
1234.55	0	0	0	0	317.84	714.96	
685.37					203.83	612.1	
685.37	0	0	0	0	203.83	612.1	
224.65					49.98	258.97	
685	Lateral weirs						
224.65	0	0	0	0	49.98	258.97	
104.89					0	239.25	
224	Lateral weirs						
104.89	0	0	0	0	0	239.25	
68.78					0	0	Culvert #1-Up
68.78					0	0	Culvert #1-Dn
68.78	0	0	0	0	0	0	Culvert #1-Up
68.78	0	0	0	0	0	0	Culvert #1-Dn
14.14					71.68	211.71	
14.14	0	0	0	0	71.68	211.71	
MuddGulch, Reach1							
20181.26					222.2	253.29	
20181.26							
19700.71	1	0	197.98	273.35	222.2	253.29	
					318.14	334.64	

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19700.71	1	0	304.03	351.48	318.14 269.68	334.64 291.17	
19402.88	1	0	255.86	299.06	269.68 157.7	291.17 183.66	
18990.06	1	0	147.92	189.39	157.7 221.54	183.66 248.03	
18760	1	0	215.46	254.82	221.54 45	248.03 150	
18116.98	1	0.11	57.61	99.17	57.61 16.75	99.17 40.23	
17844.24	1	0	12.21	59.21	16.76 36.54	40.21 65.04	
17384.73	1	0	29.16	80.03	36.55 33.04	65.04 57.4	
16869.32	1	0	25.13	66.98	33.05 72.63	57.38 95.26	
16809.73	1	0	61.54	112.63	72.65 0	95.25 0	Culvert #1-Up
16809.73	0	0	0	0	0	0	Culvert #1-Dn
16749.55	0	0	0	0	0	0	Culvert #1-Up
16485.74	1	0	85.53	140.57	98.88 10.6	127.52 68.19	Culvert #1-Dn
16216.12	1	0	0	69.61	10.6 12.29	68.19 57.82	
15806.06	1	-0.02	0	59.06	12.41 48.99	57.81 130.93	
15397.66	1	0.27	30.57	119.2	46.06 46.88	119.2 233.28	
15035.7	1	0.86	61.79	91.22	61.79 52.08	91.22 212.25	
14623.73	1	0.85	61.44	90.62	61.44 55.11	90.62 113.14	
14522.74	1	0	53.53	117.88	55.11 88.16	113.14 325.35	
14414.32	1	0	61.03	351.76	88.16 75.05	325.35 297.24	
14002.14	1	0	43.39	319.95	75.05 34.95	297.24 300.93	
13823.62	1	0	11.56	327.22	34.95 39.68	300.93 128.04	
13676	1	0	13.77	158.45	39.68 24.91	128.04 48.91	
13478.31	0	0	0	0	24.91 182.21	48.91 304.45	
13246.54	1	0	182.21	304.45	182.21 159.54	304.45 217.28	
13164.55	1	0	146.03	237.91	159.54 178.05	217.28 248.55	
12837.83	1	0	137.74	259.78	178.05 211.72	248.55 315.22	
12530.28	1	0	204.79	301.04	211.72 206.32	281.73 234.15	
12220.19	1	0	188.79	247.92	206.32 195.21	234.15 244.3	
11900.7	1	0	176.93	249.87	195.21 185	244.3 224.43	
11496.49	1	0	155.09	233.17	185 174.43	224.43 208.47	
10979.19	1	0	332.13	414.21	174.43 358.87	208.47 393.3	
10979.19	1	0			358.87	393.29	

FourmileCreek_MuddGulch.fw						
				294.83	322.38	
10698.07						
10698.07	1	0	269.32	343.84	294.83	322.39
10419.12					325.79	380.79
10419.12	1	0	291.64	423.2	325.79	380.79
10391.79					325.79	378.93
10391.79					326.7	371.47
10391.79	0	0	291.64	423.2	325.79	378.93
10391.79	0	0	281.52	397.66	326.7	371.47
10364.86					329.71	368.92
10364.86	1	0	281.52	397.66	329.71	368.92
10261.61					326.8	373.08
10261.61	1	0	296.18	395.49	326.8	373.08
10030					347.63	388.4
10030	1	0	315.36	412.85	347.63	388.4
9710.46					460.57	514.56
9710.46	1	0	446.13	525.03	460.57	514.56
9424.36					388.48	429
9424.36	1	0	375.08	448.97	388.48	429
9164.5					458.38	489.38
9164.5	1	0	392.59	504.28	458.38	489.38
9048.02					0	0
9048.02					0	0
9048.02	0	0	0	0	0	0
9048.02	0	0	0	0	0	0
9048.02					0	0
9048.02					0	0
9048.02	0	0	0	0	0	0
9048.02	0	0	0	0	0	0
9048.02					0	0
9048.02					0	0
9048.02	0	0	0	0	0	0
9048.02	0	0	0	0	0	0
9048.02	0	0	0	0	0	0
9048.02	0	0	0	0	0	0
8955.76					467.81	499.81
8955.76	1	0	410.49	525.3	467.81	499.81
8669.89					584.83	680.58
8669.89	1	0	600.43	691.74	609.97	680.58
8411.16					634.95	696.7
8411.16	1	0	626.4	705.89	634.95	696.7
8031.07					616.89	683.28
8031.07	1	0	610.7	687.83	616.89	683.28
7701.39					671.82	748.94
7701.39	1	-0.01	668.78	750.88	671.84	748.91
7414.21					717.1	962.73
7414.21	1	0	709.61	783.09	717.09	779.44
7054.93					728.03	772.06
7054.93	1	0	714.14	780.59	728.03	772.06
6896.94					713.13	751.85
6896.94	1	0	696.59	767.23	713.13	751.84
6479.48					653.53	707.79
6479.48	1	0.07	634.71	719.68	653.35	707.97
6282					644.54	689.54
6282	1	0.14	630.08	702.33	644.54	689.54
6253.73					644.54	689.54
6253.73					654.54	699.54
6253.73	0	0.15	630.08	702.33	644.54	689.54
6253.73	0	0.14	643.14	719.61	654.54	699.54
6217.24					654.54	699.54
6217.24	1	0.15	643.14	719.61	654.54	699.54
5974.5					667.44	712.45
5974.5	1	0.99	648.18	716.66	664.63	713.99
5477.27					538.3	864
5477.27	1	0.32	622.28	675.56	622.28	675.56
5134.21					634.94	695.43
5134.21	1	0.01	638.51	694.6	638.51	694.6
4937.94					637.87	2767.56
4937.94	1	0.71	636.32	780	636.32	780
4835.77					652.71	2553.52
4835.77	1	0.34	644.68	1400	652.71	1400
4820.16					652.71	2503.29
4820.16					660.56	2484.37
4820.16	0	0.39	644.68	1400	652.71	1400
4820.16	0	0.5	648.74	1400	660.56	1400
4798.82					660.56	2440.37
4798.82	1	0.38	648.74	1400	660.56	1400
4752.5					636.22	720
4752.5	1	0.3	624.08	1300	633.37	720
4479.82					546.08	859.85
4479.82	1	0.1	631.16	690.2	631.16	690.2
4005.63					647.57	1012.7
4005.63	1	0.02	646.53	710.59	647.52	708.98
3515.21					644.55	1380.43
3515.21	1	0.06	613.55	1275	644.55	1275
3493.08					644.55	1374.21
3493.08					629.17	1348.86
3493.08	0	0.01	613.55	1275	644.55	1275

Bridge #1-Up
Bridge #1-Dn

Bridge #1-Up

Bridge #1-Dn

Culvert #2-Up
Culvert #2-Dn
Culvert #2-Up
Culvert #2-Dn
Culvert #1-Up
Culvert #1-Dn
Culvert #1-Up
Culvert #1-Dn
Culvert #3-Up
Culvert #3-Dn
Culvert #3-Up
Culvert #3-Dn

Bridge #1-Up
Bridge #1-Dn
Bridge #1-Up
Bridge #1-Dn

Bridge #1-Up
Bridge #1-Dn
Bridge #1-Up
Bridge #1-Dn

3493.08	0	-0.02	617.9	1300	FourmileCreek_MuddGulch.fw	629.17	1300	Bridge #1-Dn
3469.15						629.17	1397.34	
3469.15	1	-0.01	617.9	1300		629.17	1300	
3389.17						593.55	1255.6	
3389.17	1	0	574.63	1265.02		593.55	1255.6	
2868.02						634.44	889.3	
3389	Lateral weirs							
2868.02	0	0	0	0		634.44	889.3	
2519.13						755.84	937.82	
2868	Lateral weirs							
2519.13	0	0	0	0		755.84	937.82	
2498.67						990.72	1023.72	
2519	Lateral weirs							
2498.67	0	0	0	0		990.72	1023.72	
2473.27						990.72	1023.72	Bridge #1-Up
2473.27						1059.66	1092.66	Bridge #1-Dn
2473.27	0	0	0	0		990.72	1023.72	Bridge #1-Up
2473.27	0	0	0	0		1059.66	1092.66	Bridge #1-Dn
2418.14						1059.66	1092.66	
2418.14	0	0	0	0		1059.66	1092.66	
2189.83						922.56	1054.66	
2189.83	1	0	78	1067		922.56	1054.66	
1989.08						125.38	1003.98	
1989.08	1	0	200	1005.48		200	1003.98	
1574.31						172.27	852.5	
1574.31	1	-0.01	450	852.88		450	852.5	
1261.28						470.92	1172.37	
1261.28	11	0.01	1134.31	1175.08		1141.23	1172.39	
863.78						1423.64	1488.05	
863.78	11	0.02	1445.12	1489.34		1445.12	1488.09	
411.13						1822.42	2036.88	
411.13	11	0.01	1817.78	1867.25		1822.4	1866.79	
30						1735.11	2371.51	
30	12	0	2283.48	2415.23		2290.65	2371.55	

ENCROACHMENT METHOD CHECK

RS:	8632.47	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	4379.56	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	4073	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	3569.53	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	3568.53	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	2878.94	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	2455.99	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	2211.55	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	1729.42	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	1234.55	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	685.37	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	224.65	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	104.89	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	68.78	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	14.14	Floodway encroachment method is not selected at this section.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	16809.73	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	13676	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.

No floodway analysis was conducted for Mudd Gulch Flow Split. For this location, floodway is the 100-year floodplain.

RS:	10391.79	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	9048.02	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	9048.02	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	9048.02	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	6253.73	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	4820.16	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	3493.08	HEC-RAS does not allow encroachments to be specified at the structure itself.
FW EM 01	Floodway	encroachment method is not selected at this section.
RS:	2868.02	These cross-sections are in the breakout area. Flow overtops Mackenzie Avenue and flows into Mudd Gulch Flow Split. No encroachment is defined for this location.
FW EM 01	Floodway	
RS:	2519.13	
FW EM 01	Floodway	
RS:	2498.67	
FW EM 01	Floodway	
RS:	2473.27	
FW EM 01	Floodway	
RS:	2418.14	
FW EM 01	Floodway	

FLOODWAY WIDTH CHECK

The channel bank stations are checked. No modification is necessary.

RS:	16018.02	The Left channel bank station may not be at the proper location.
FW FW 03		
RS:	15788.95	The Left channel bank station may not be at the proper location.
FW FW 03		
RS:	14082.25	The Left channel bank station may not be at the proper location.
FW FW 03		
RS:	14082.25	The right channel bank station may not be at the proper location.
FW FW 03		
RS:	13545.88	The right channel bank station may not be at the proper location.
FW FW 03		
RS:	12947.26	The Left channel bank station may not be at the proper location.
FW FW 03		
RS:	10930.27	The right channel bank station may not be at the proper location.
FW FW 03		
RS:	10048.25	The right channel bank station may not be at the proper location.
FW FW 03		
RS:	9338.16	The right channel bank station may not be at the proper location.
FW FW 03		
RS:	8139.05	The Left channel bank station may not be at the proper location.
FW FW 03		
RS:	8139.05	The right channel bank station may not be at the proper location.
FW FW 03		
RS:	7819.74	The right channel bank station may not be at the proper location.
FW FW 03		
RS:	4711.74	The Left channel bank station may not be at the proper location.
FW FW 03		

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RS: 4050.69
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 3756.25
FW FW 03 The right channel bank station may not be at the proper location.

RS: 3432.09
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 3432.09
FW FW 03 The right channel bank station may not be at the proper location.

RS: 3121.18
FW FW 03 The right channel bank station may not be at the proper location.

RS: 2512.02
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2512.02
FW FW 03 The right channel bank station may not be at the proper location.

RS: 1765.52
FW FW 03 The right channel bank station may not be at the proper location.

RS: 1222.98
FW FW 01 Left encroachment station 1900 is more than left channel bank station 1865.11 and less than the right channel bank station 2055.36 Left encroachment station is within the channel. The encroachment station or channel bank station should be adjusted.

RS: 1222.98
FW FW 03 The right channel bank station may not be at the proper location.

RS: 1222.98
FW FW 04 The right station effective of 2082.36 for 1% annual chance floodplain is greater than the right channel bank station (2055.36). The 1% annual chance floodplain is outside the channel. However, the right encroachment station (2155.36) is outside of 1% annual chance floodplain. The right encroachment station should be adjusted.

RS: 68.69
FW FW 03 The right channel bank station may not be at the proper location.

RS: 15397.66
FW FW 03 The right channel bank station may not be at the proper location.

RS: 13676
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 13676
FW FW 03 The right channel bank station may not be at the proper location.

RS: 13478.31
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 6217.24
FW FW 03 The right channel bank station may not be at the proper location.

RS: 5134.21
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 4937.94
FW FW 03 The right channel bank station may not be at the proper location.

RS: 4835.77
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 4835.77
FW FW 03 The right channel bank station may not be at the proper location.

There is an ineffective flow area defined on the right overbank. Right encroachment station is inside of 1% annual chance floodplain. No modification is necessary.

RS: 4798.82
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 4798.82
FW FW 03 The right channel bank station may not be at the proper location.

RS: 4752.5
FW FW 05 The 1% annual chance flood is contained within the channel. Right encroachment station 1300 is outside the channel. Right channel bank station is 746.19 Right encroachment station and/or right channel bank station should be adjusted.

RS: 4752.5
FW FW 06 The right station effective of 720 for the floodway profile is less than the right channel bank station of 746.19 The right side of the floodway boundary is within the channel. The right encroachment station of 1300 is greater than the right channel bank station. The right encroachment station should be the same as the right channel bank station.

Encroachment stations are defined considering the stations for the upstream cross-section (4798.82). No modification is necessary.

RS: 4479.82
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 3389.17
FW FW 04 The right station effective of 1255.6 for 1% annual chance floodplain is greater than the right channel bank station (654.63). The 1% annual chance floodplain is outside the channel. However, the right encroachment station (1265.02) is outside of 1% annual chance floodplain. The right encroachment station should be adjusted.

This cross-section is located just upstream of the breakout area on Mudd Gulch. No encroachment is defined inside of 1% annual chance floodplain.

RS: 2868.02
FW FW 06 The left station effective of 634.44 for the floodway profile is more than the left channel bank station of 633.87 The left side of the floodway boundary is within the channel. The left encroachment station of 0 is less than the left channel bank station. The left encroachment station should be the same as the left channel bank station.

Since this cross-section is in the breakout area no encroachment station is defined.

RS: 2498.67
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2189.83
FW FW 04 The left station effective of 922.56 for 1% annual chance floodplain is less than the left channel bank station 1003.41 The 1% annual chance floodplain is outside the channel. However, the left encroachment station (78) is outside of 1% annual chance floodplain. The left encroachment station should be adjusted.

There is an ineffective flow area defined on the left overbank. Left encroachment station is inside of 1% annual chance floodplain. No modification is necessary. Right encroachment station is the last station of the cross-section. No modification is necessary.

RS: 2189.83
FW FW 04 The right station effective of 1054.66 for 1% annual chance floodplain is greater than the right channel bank station (1053.65). The 1% annual chance floodplain is outside the channel. However, the right encroachment station (1067) is outside of 1% annual chance floodplain. The right encroachment station should be adjusted.

SURCHARGE CHECK

DISCHARGE CHECK

During the floodway analysis for Fourmile Creek, the laterals are removed from the breakout area, so that 163 cfs remained in the mail channel instead of going out of the system. For this reason the full flow of 7020 cfs should be used as the floodway discharge to get an accurate surcharge resulting from removing laterals.

RS: 7454.19
FW FD 01 The floodway discharge of 7020 is not equal to the natural 1% chance discharge of 6891.5 Please justify the use of different discharges for the natural and floodway profiles.

RS: 6921.01
FW FD 01 The floodway discharge of 7020 is not equal to the natural 1% chance discharge of 6857.05 Please justify the use of different discharges for the natural and floodway profiles.

RS: 6349.33
FW FD 01 The floodway discharge of 7020 is not equal to the natural 1% chance discharge of 6857.05 Please justify the use of different discharges for the natural and floodway profiles.

RS: 5984.11
FW FD 01 The floodway discharge of 7020 is not equal to the natural 1% chance discharge of 6857.05 Please justify the use of different discharges for the natural and floodway profiles.

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[illegible]

FourmileCreek_MuddGulch.fw

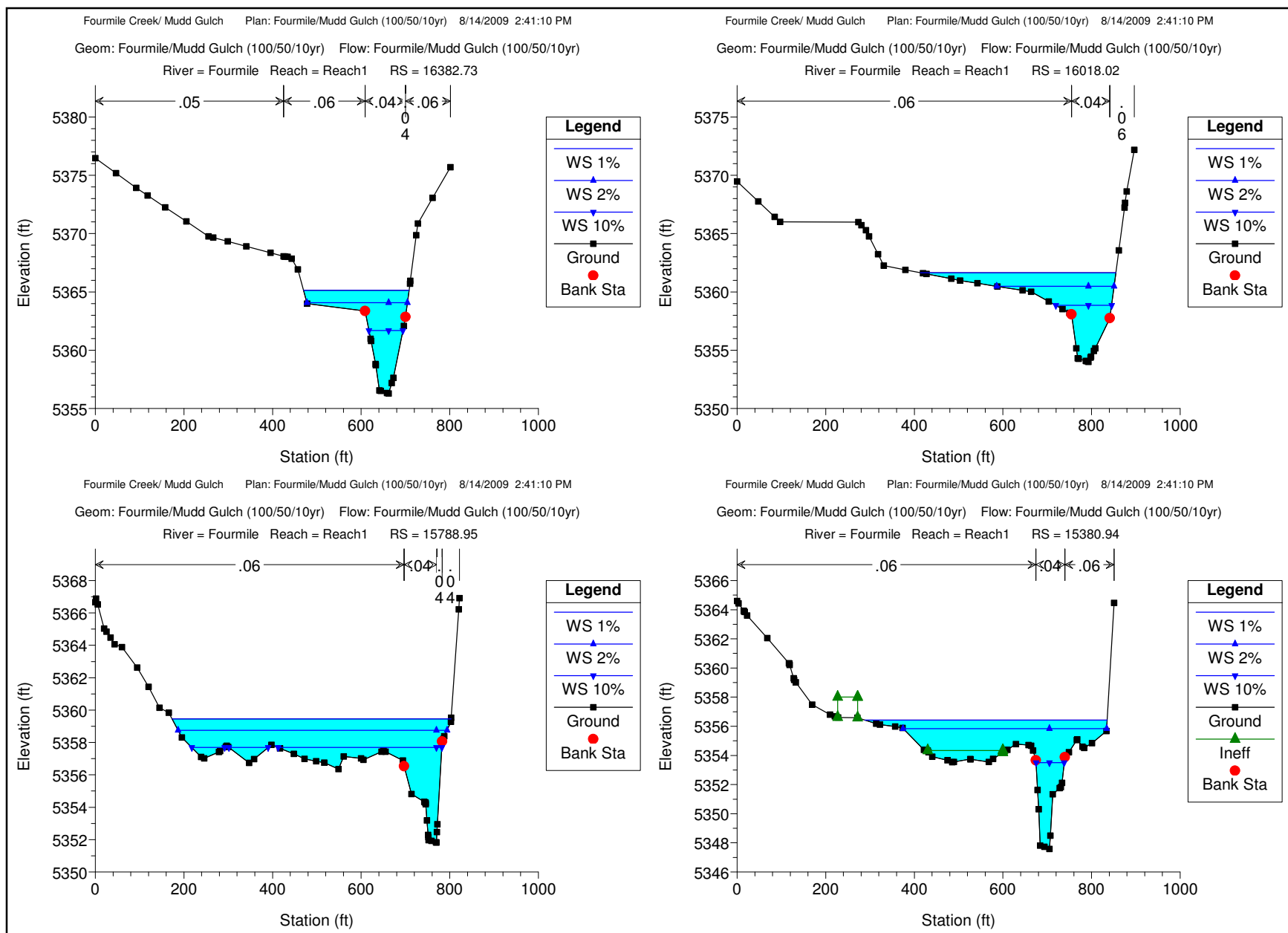
RS: 68.69
FW FD 01 The floodway discharge of 7020 is not equal to the natural 1% chance
discharge of 6891.5
Please justify the use of different discharges for the natural and floodway profiles.

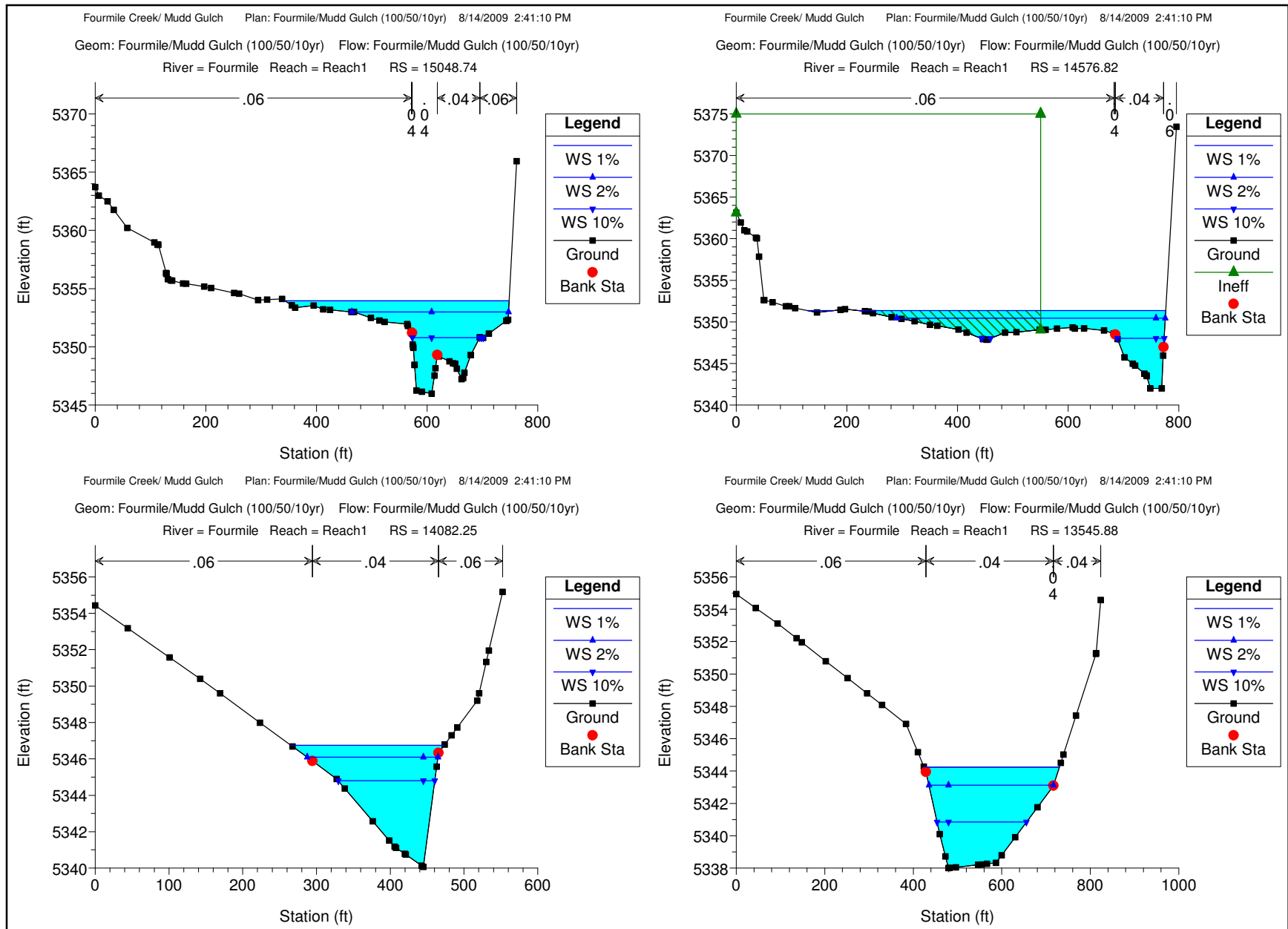
STARTING WATER-SURFACE ELEVATION CHECK

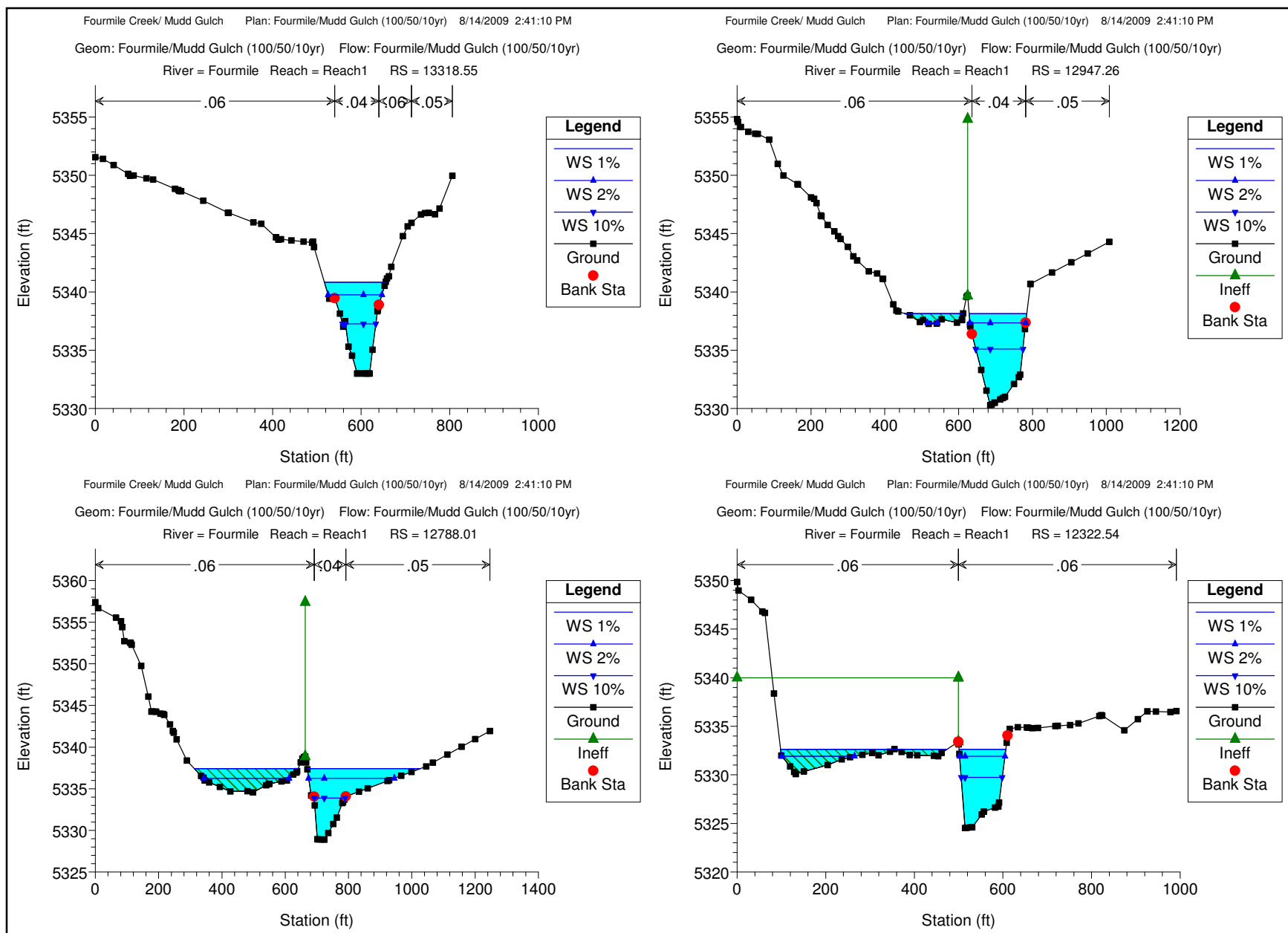
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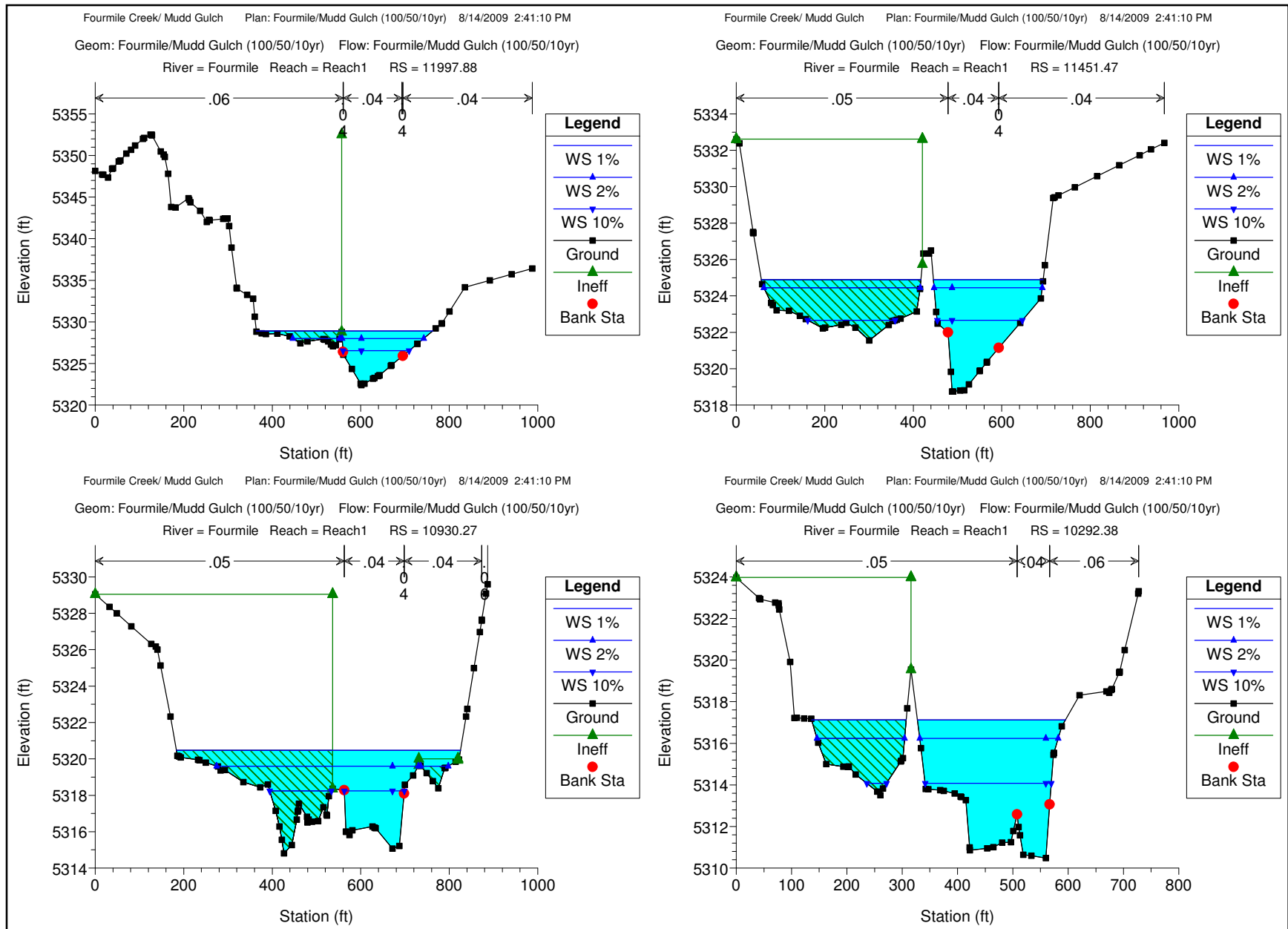
CROSS-SECTION PLOTS

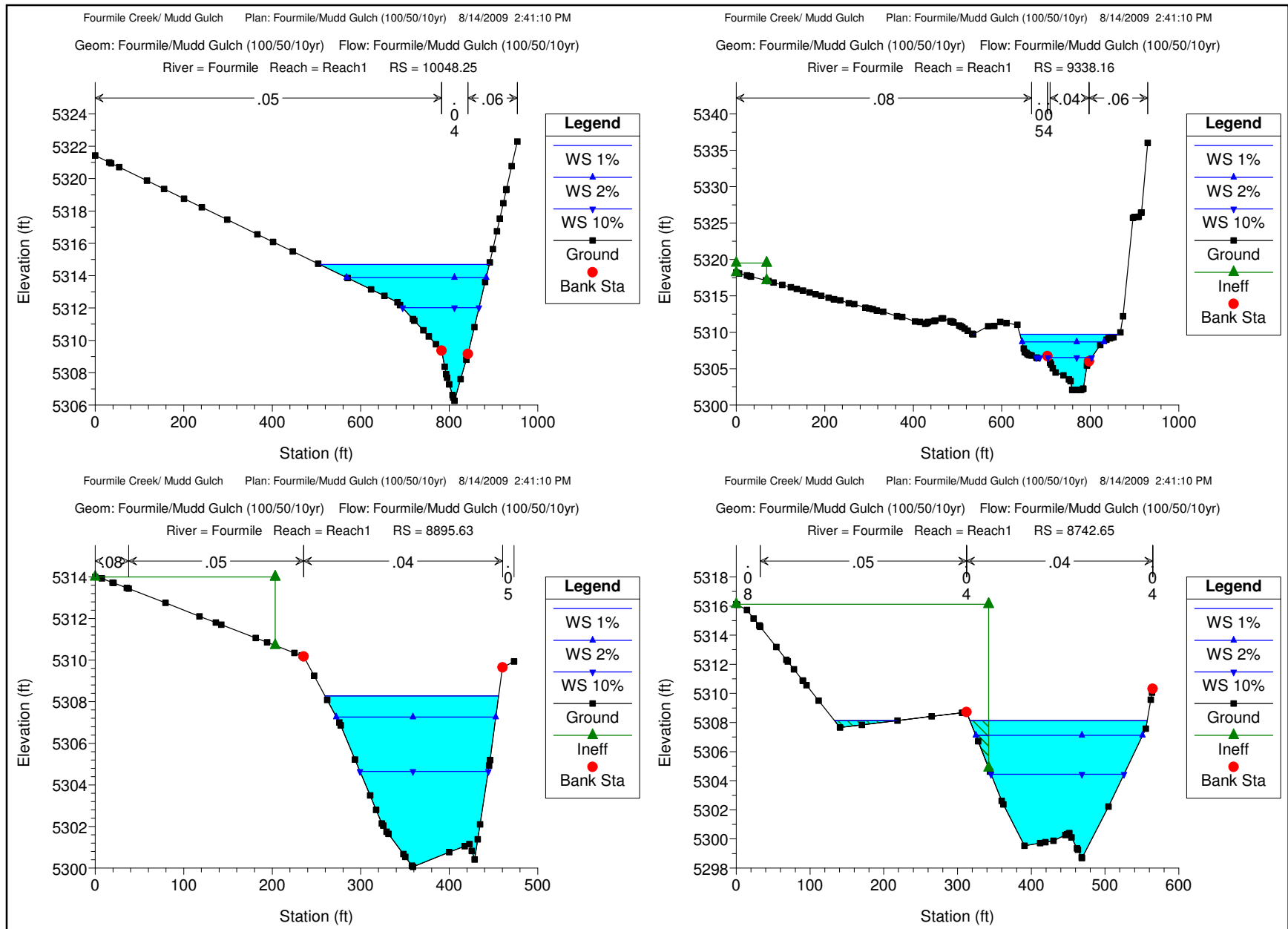
CROSS-SECTION PLOTS
(FOURMILE CREEK, 100-50-10-YEAR)

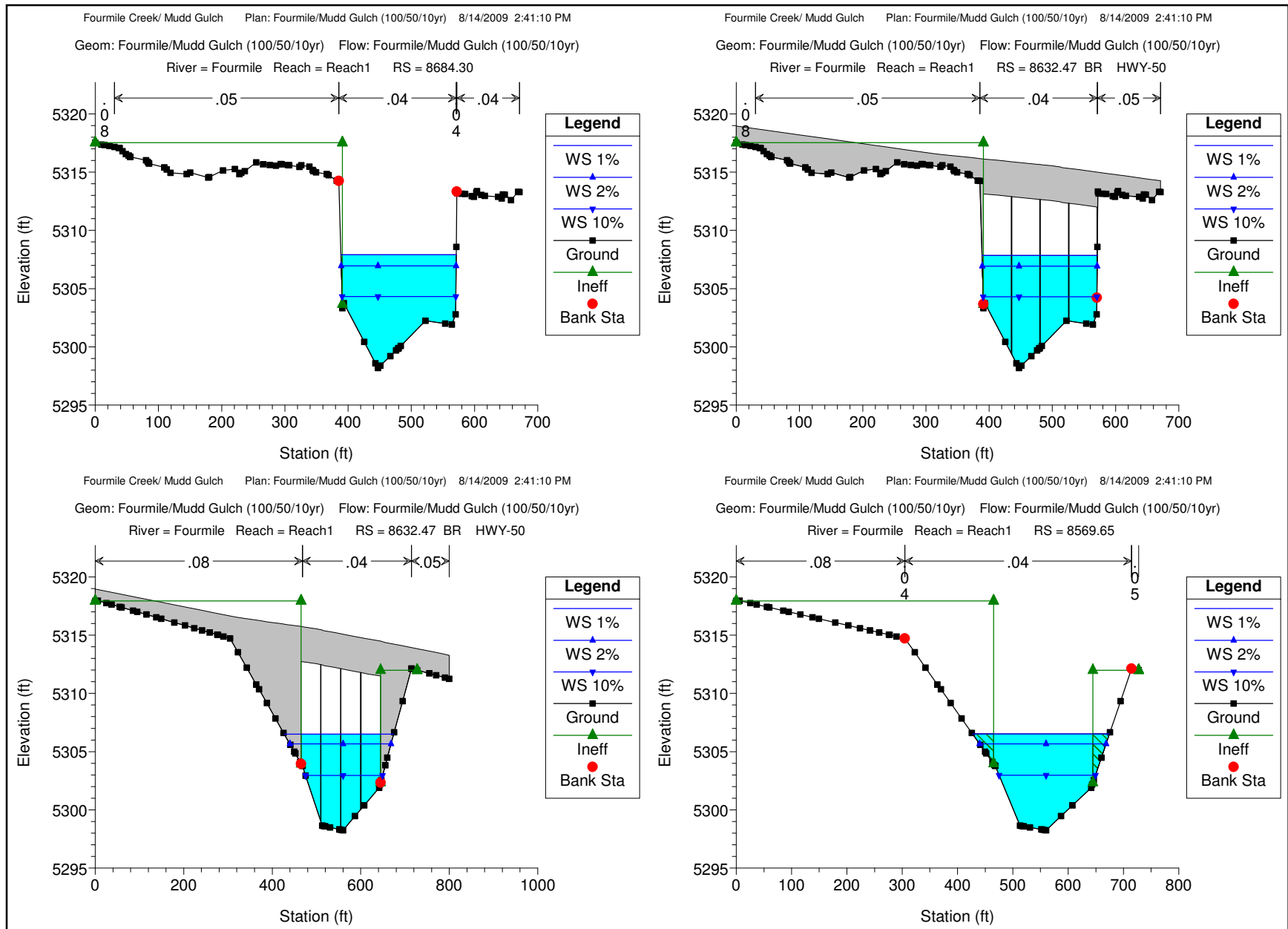


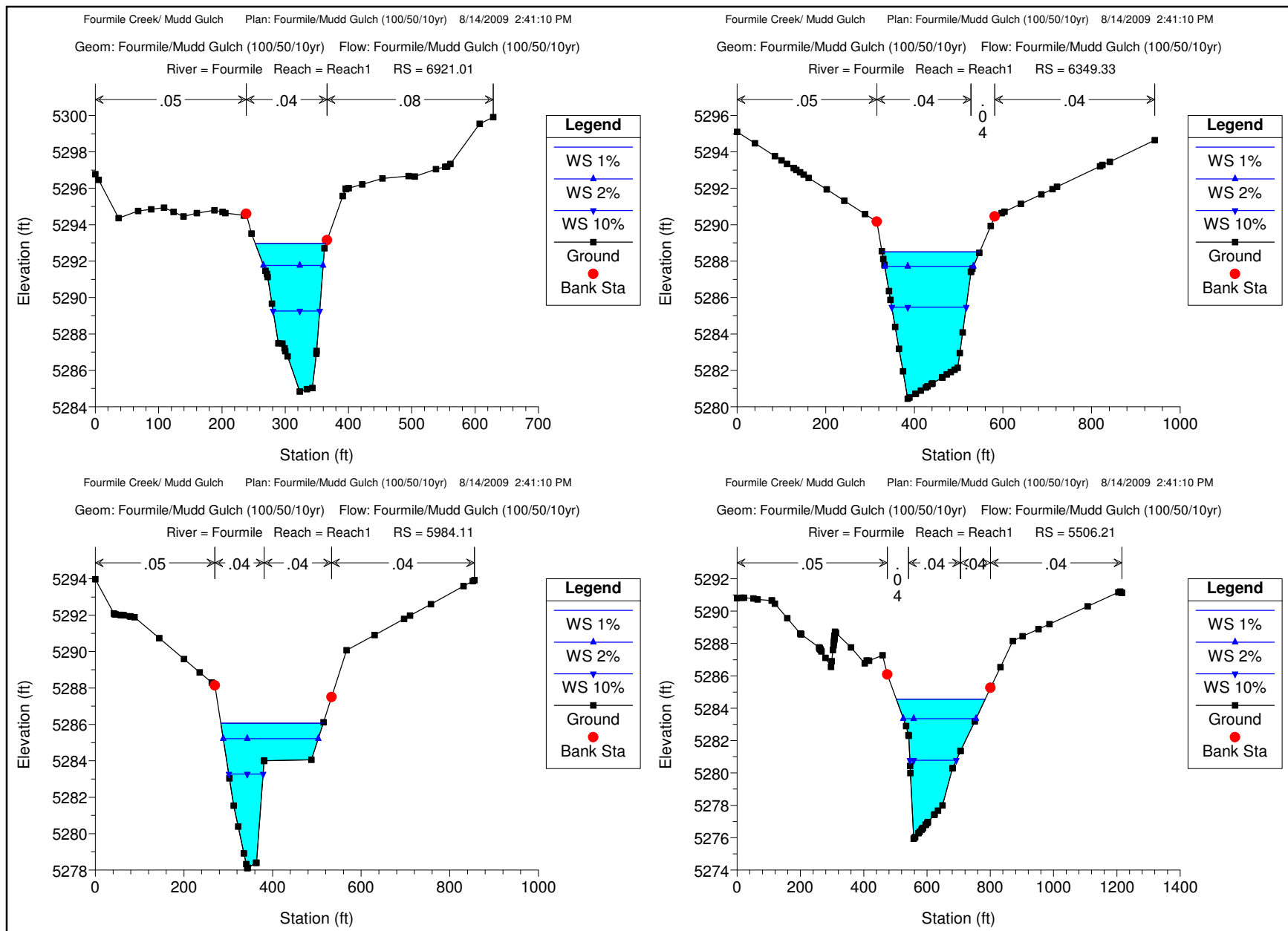


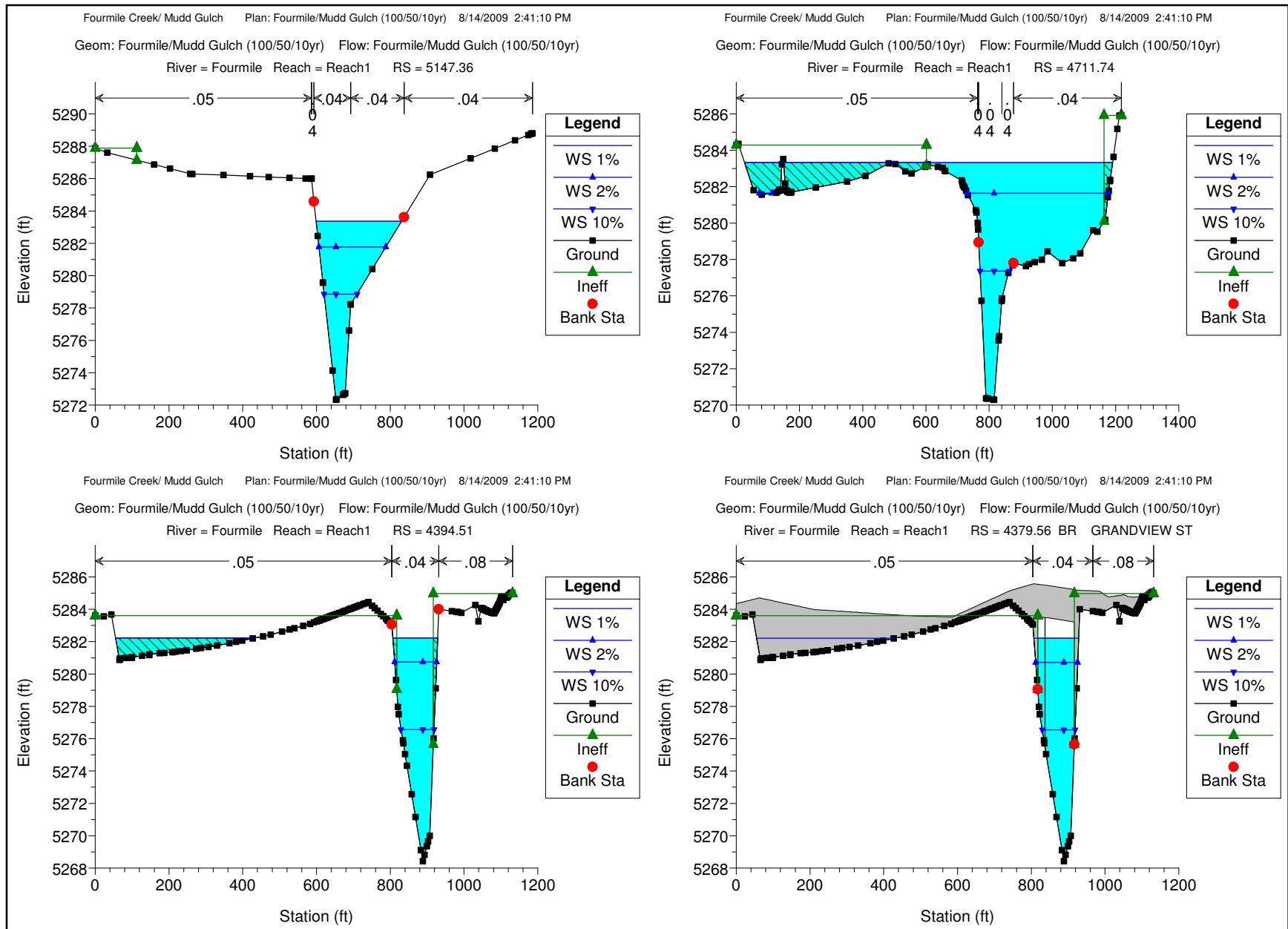


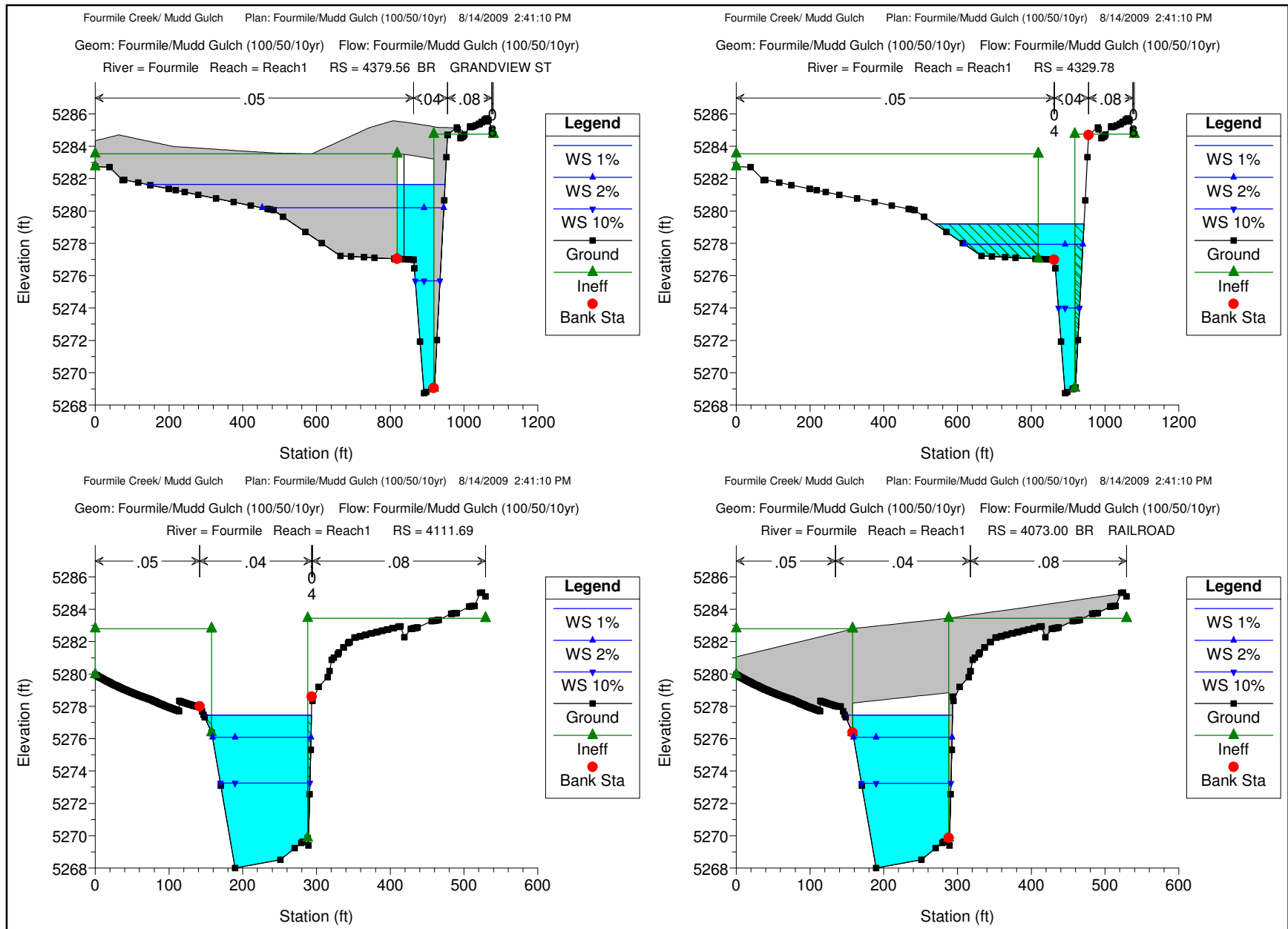


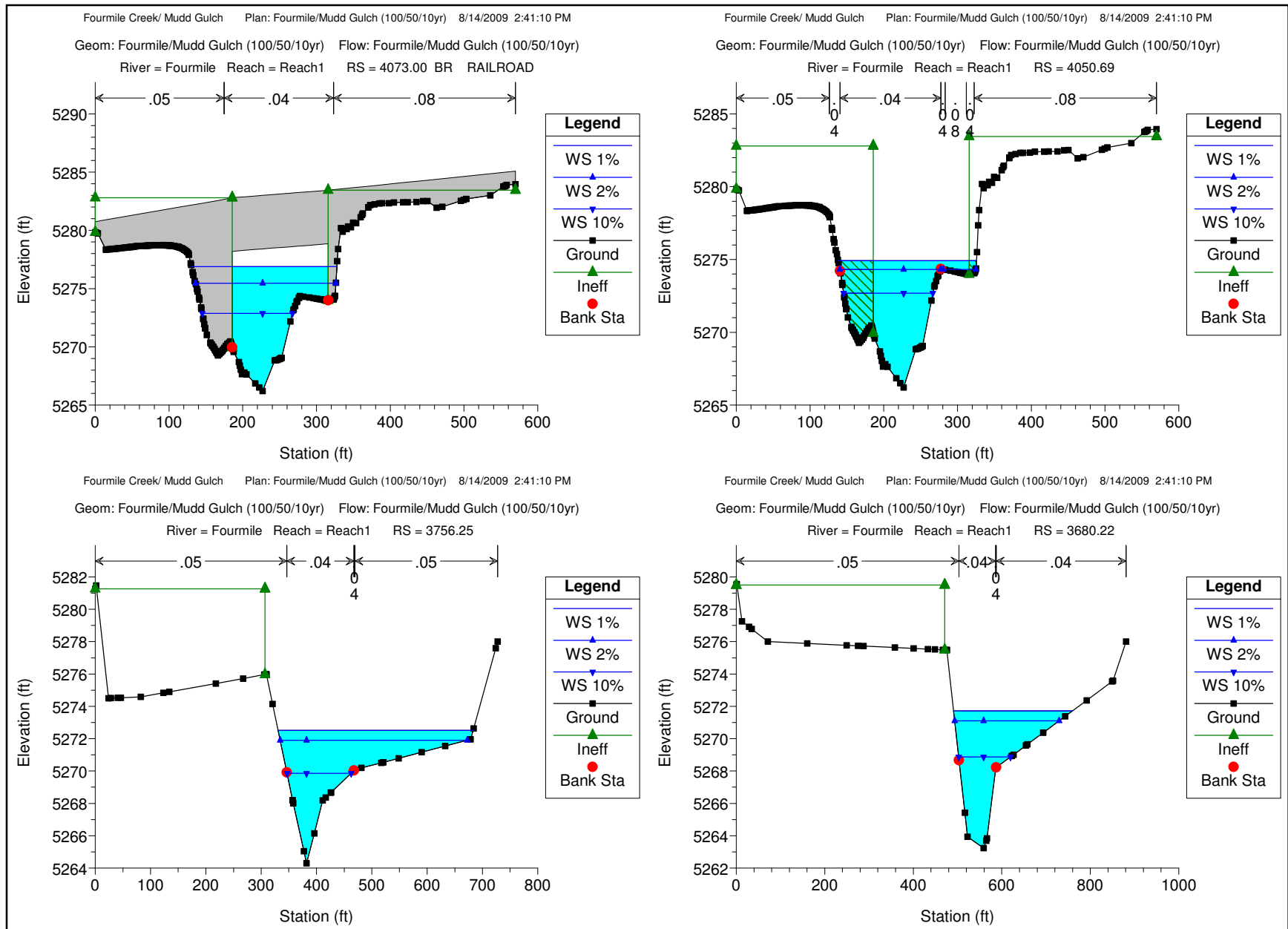


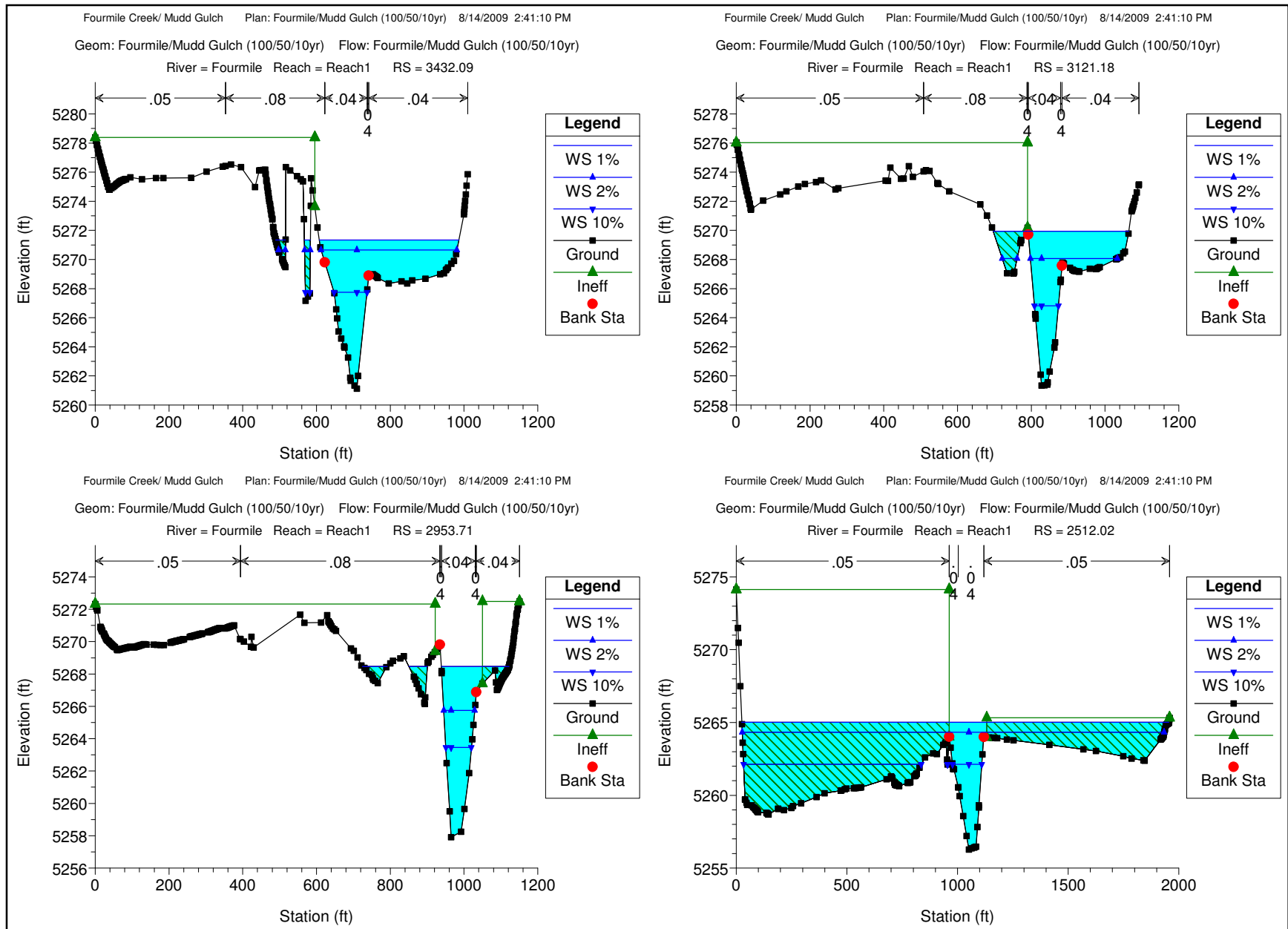


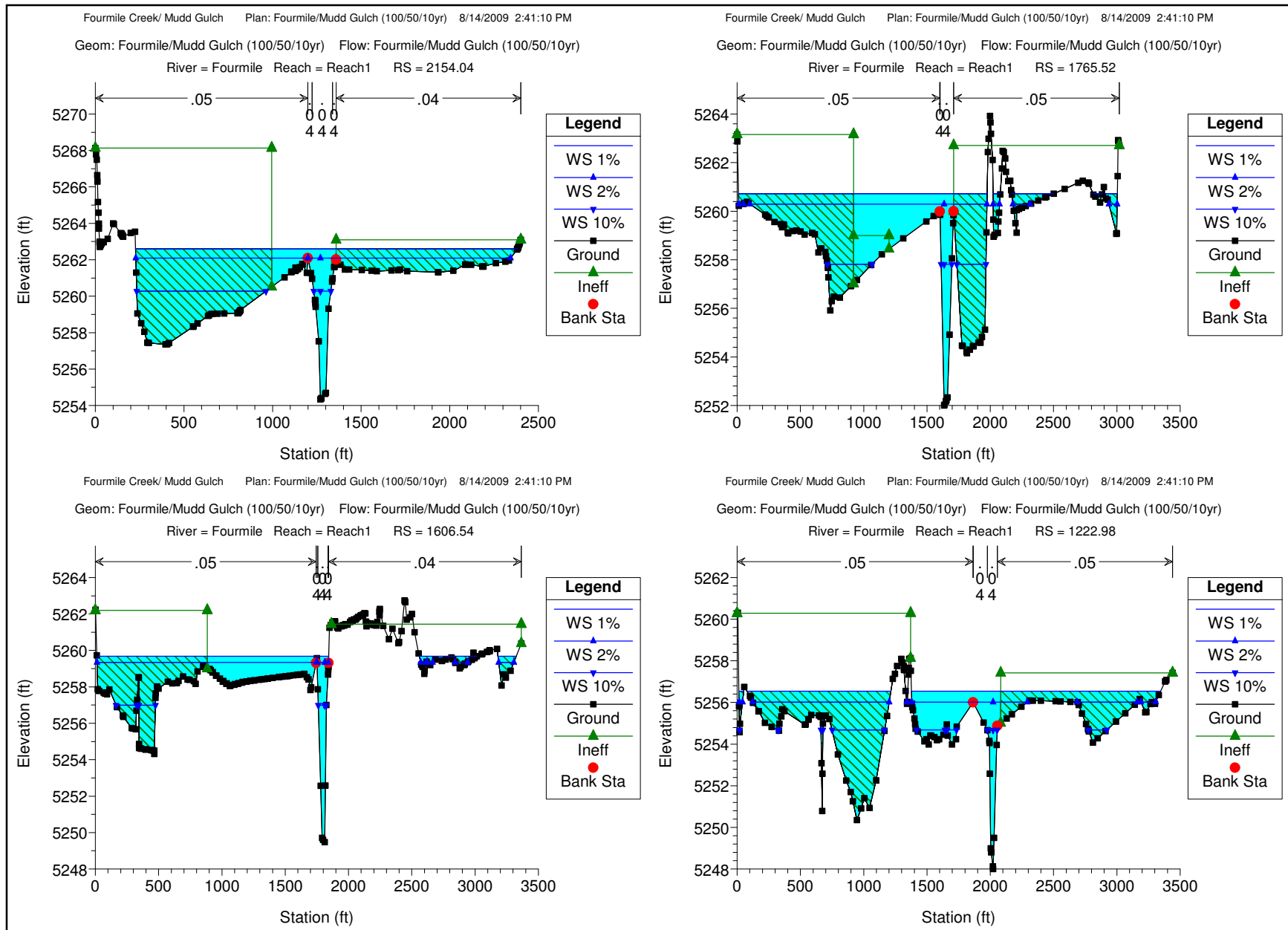






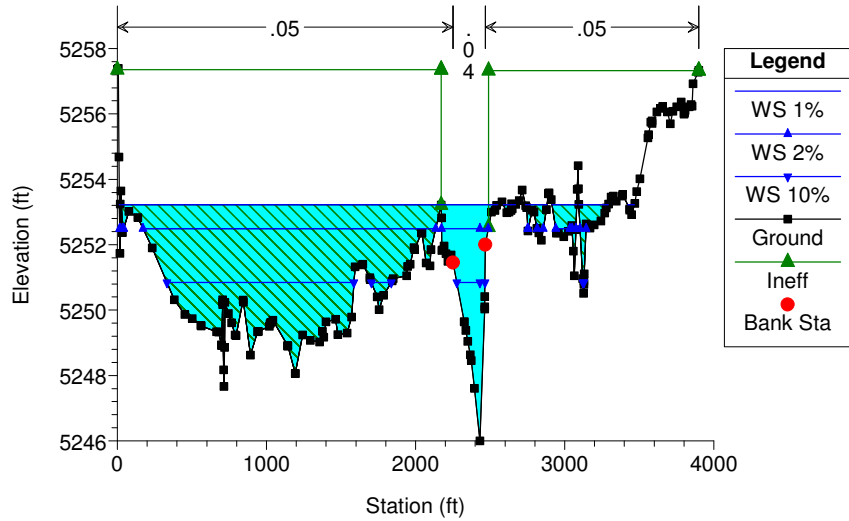






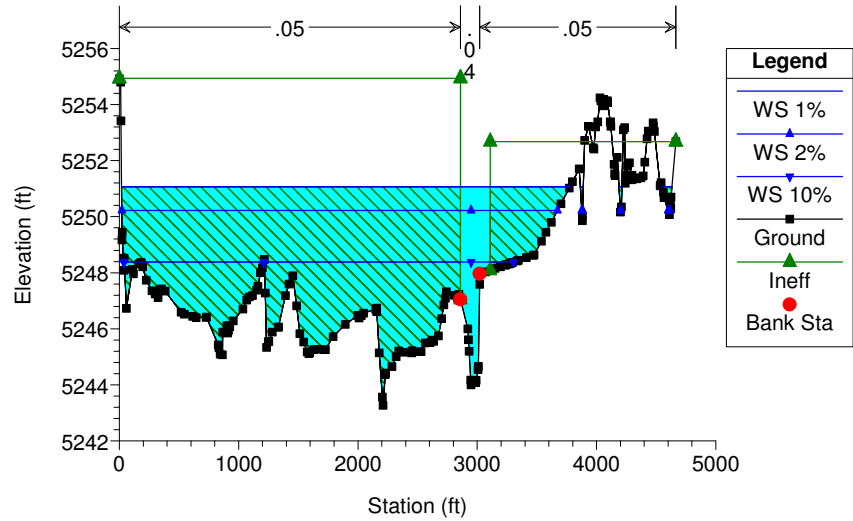
Fourmile Creek/ Mudd Gulch Plan: Fourmile/Mudd Gulch (100/50/10yr) 8/14/2009 2:41:10 PM

Geom: Fourmile/Mudd Gulch (100/50/10yr) Flow: Fourmile/Mudd Gulch (100/50/10yr)
River = Fourmile Reach = Reach1 RS = 666.22

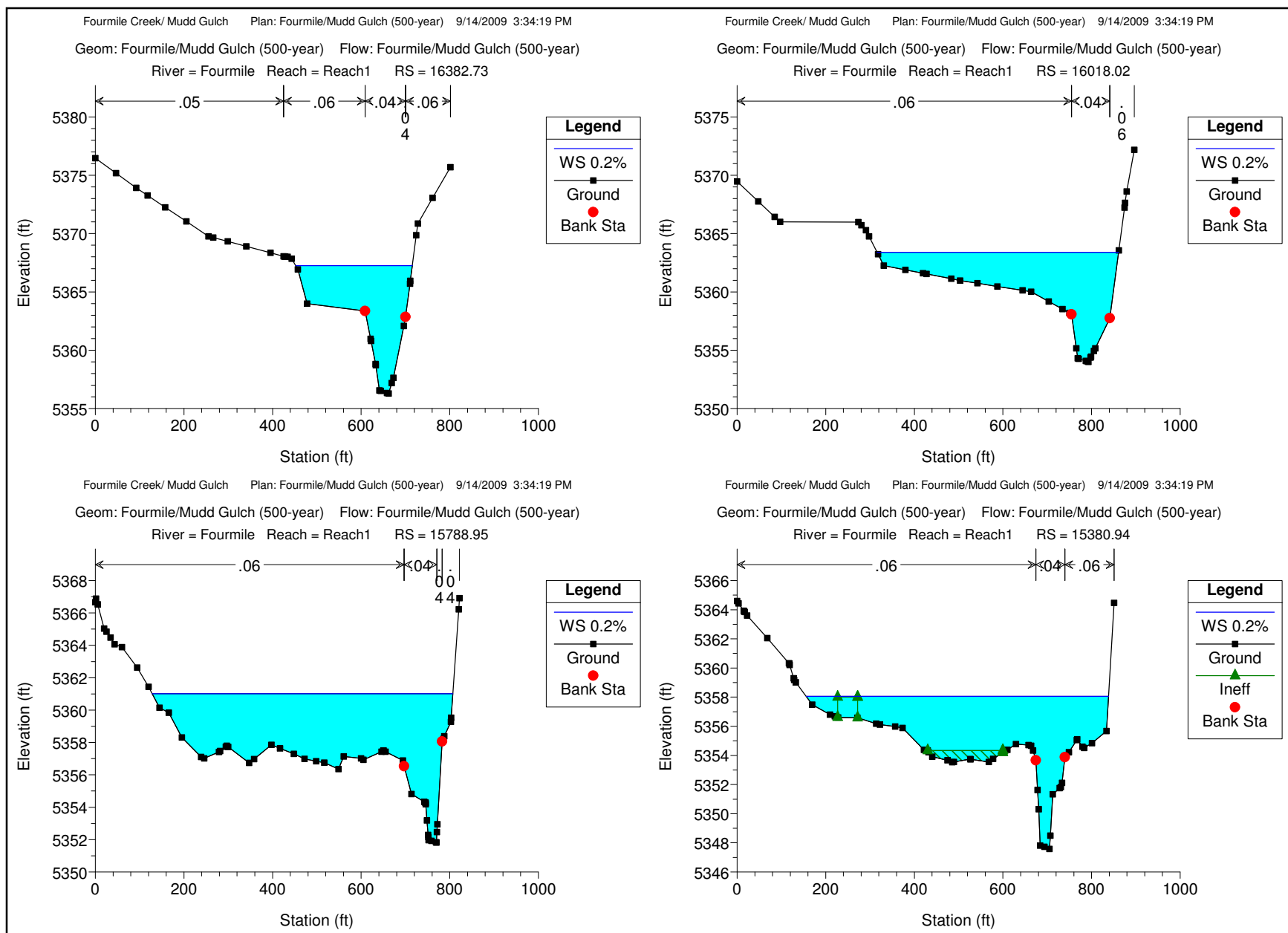


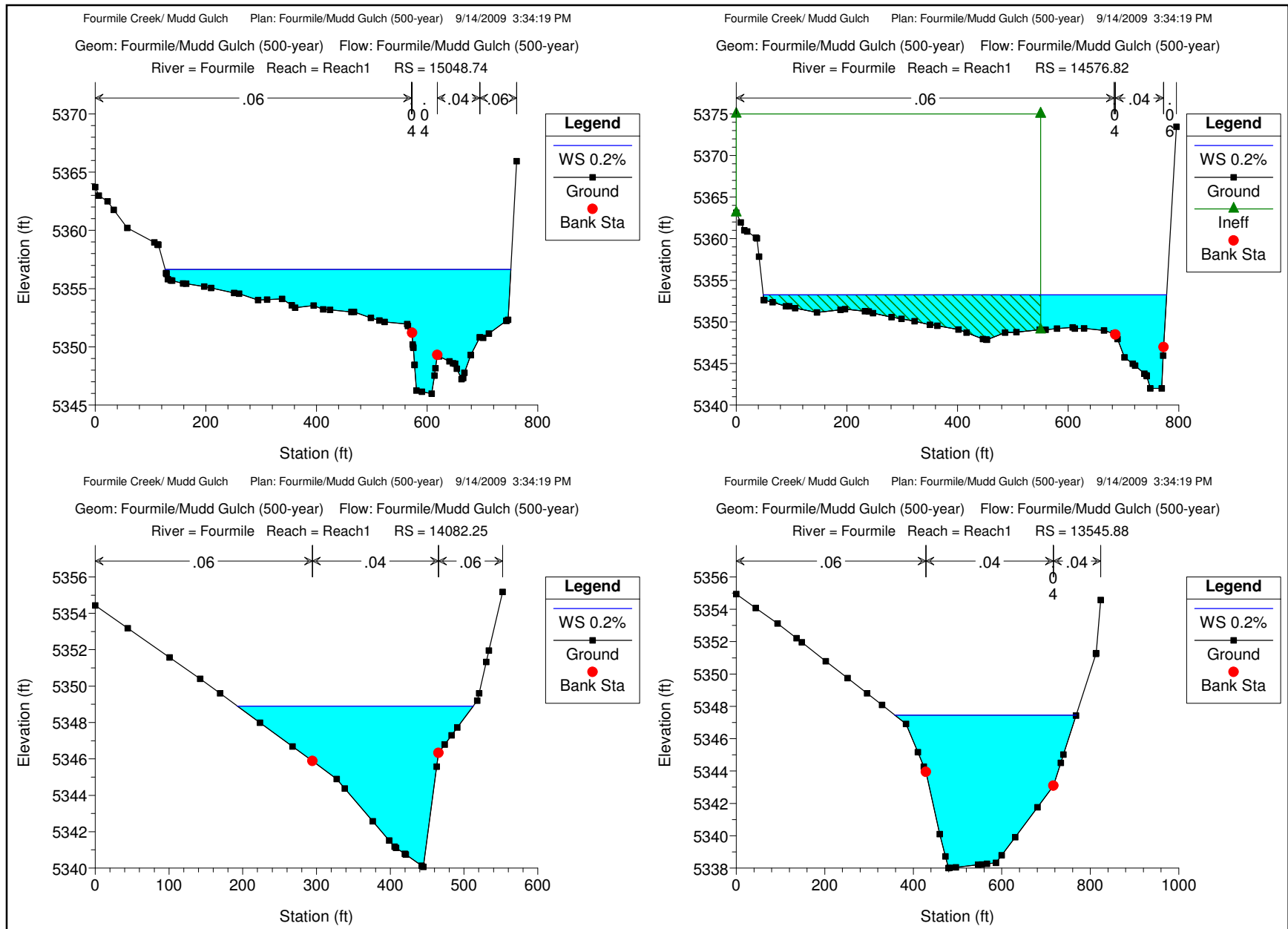
Fourmile Creek/ Mudd Gulch Plan: Fourmile/Mudd Gulch (100/50/10yr) 8/14/2009 2:41:10 PM

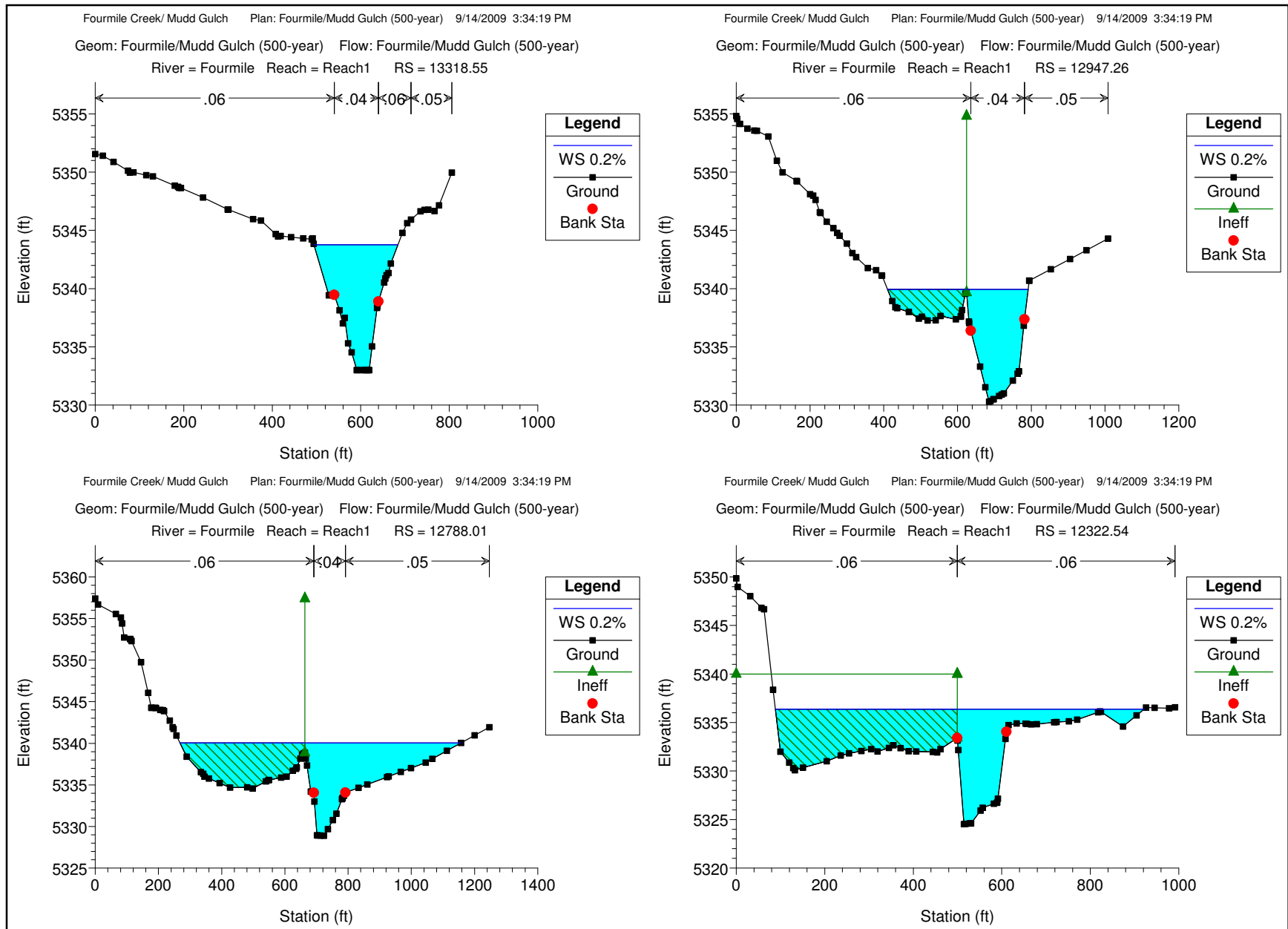
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River = Fourmile Reach = Reach1 RS = 68.69

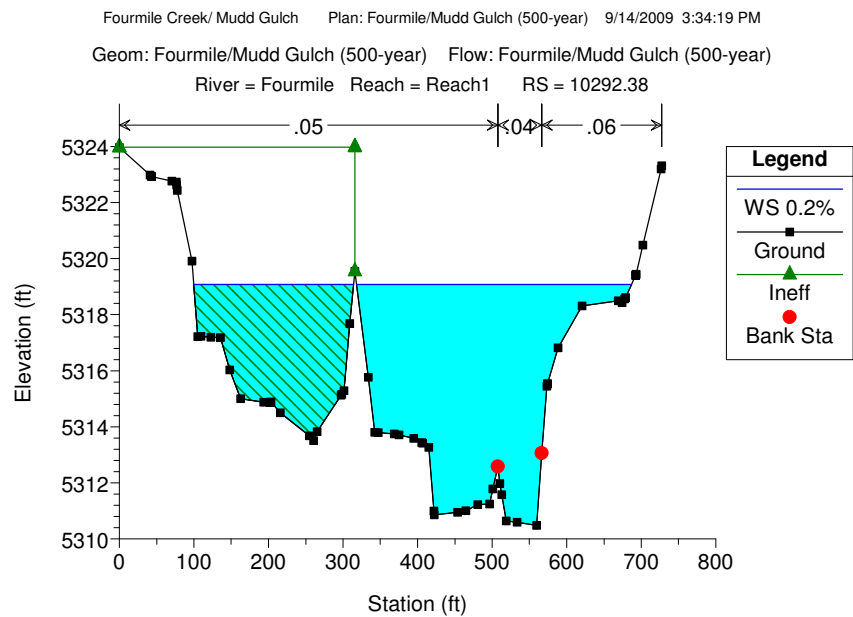
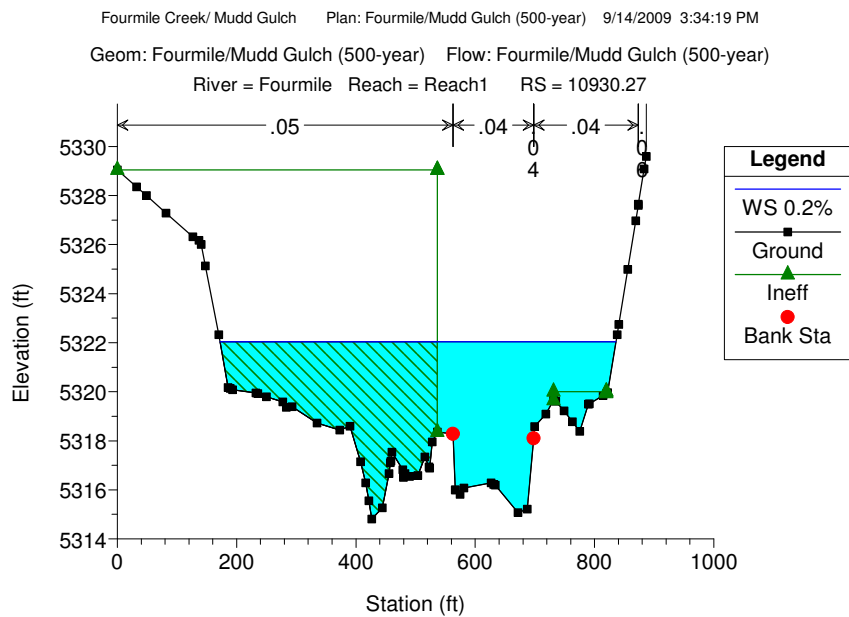


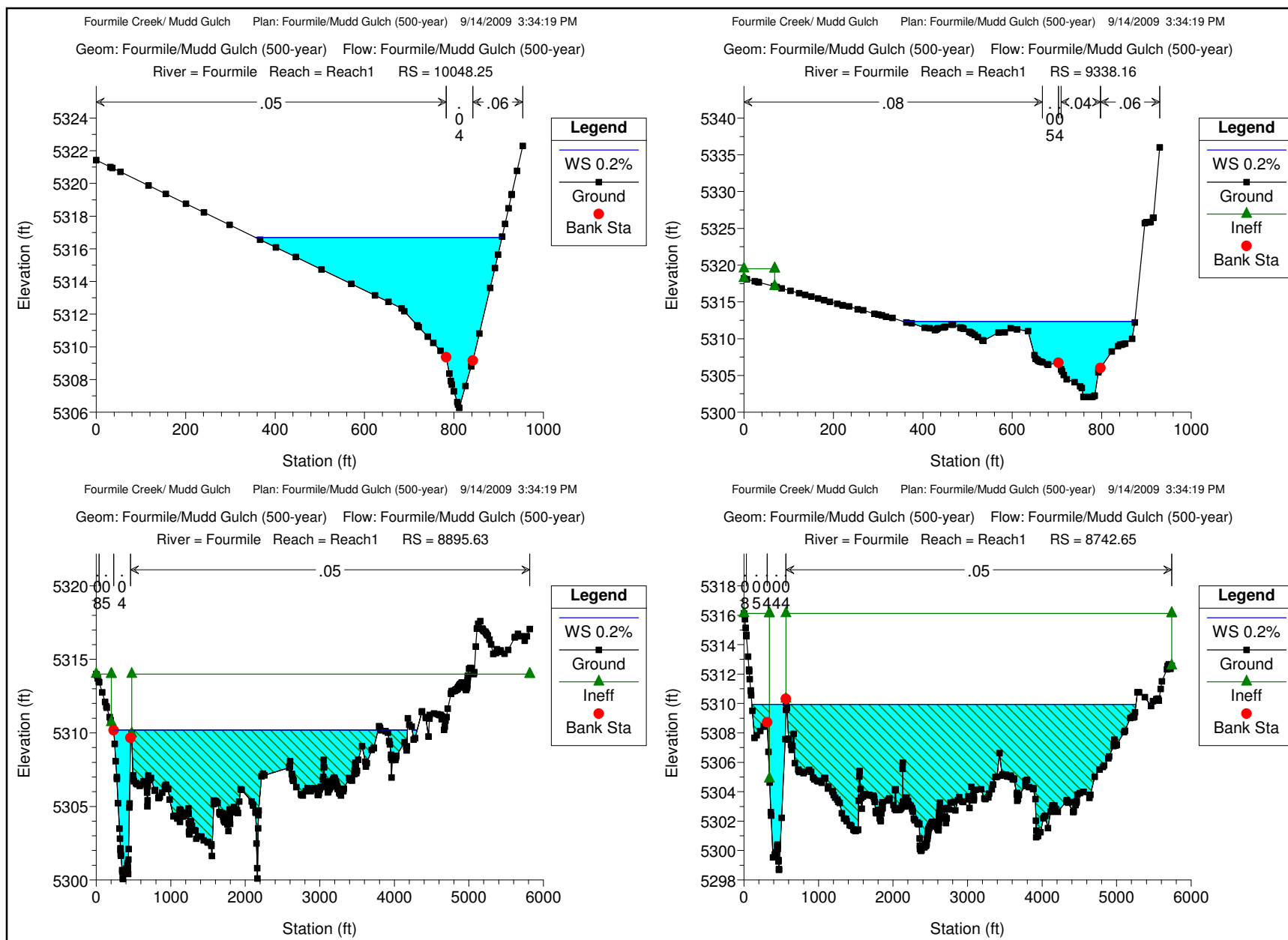
**CROSS-SECTION PLOTS
(FOURMILE CREEK, 500-YEAR)**

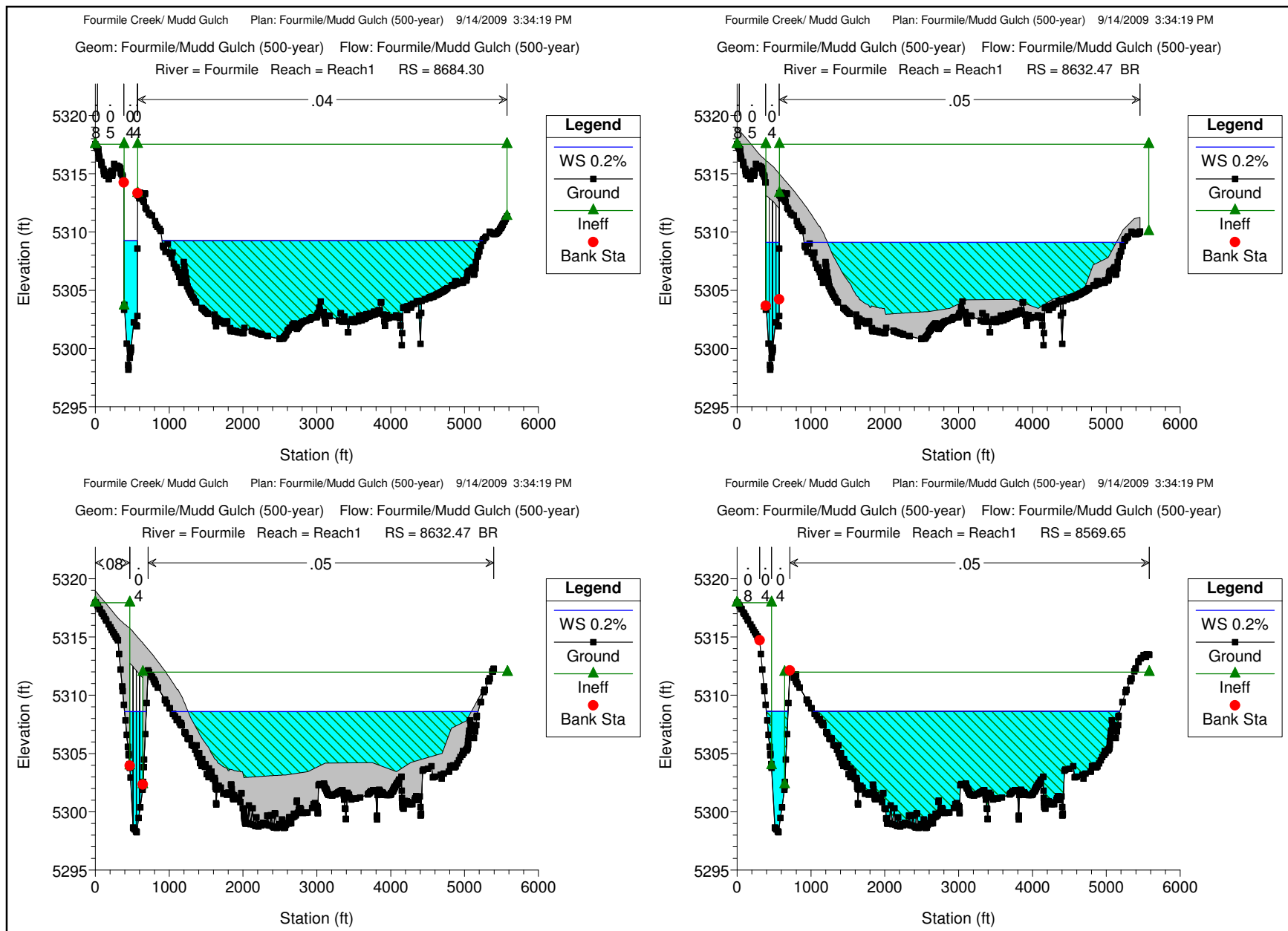


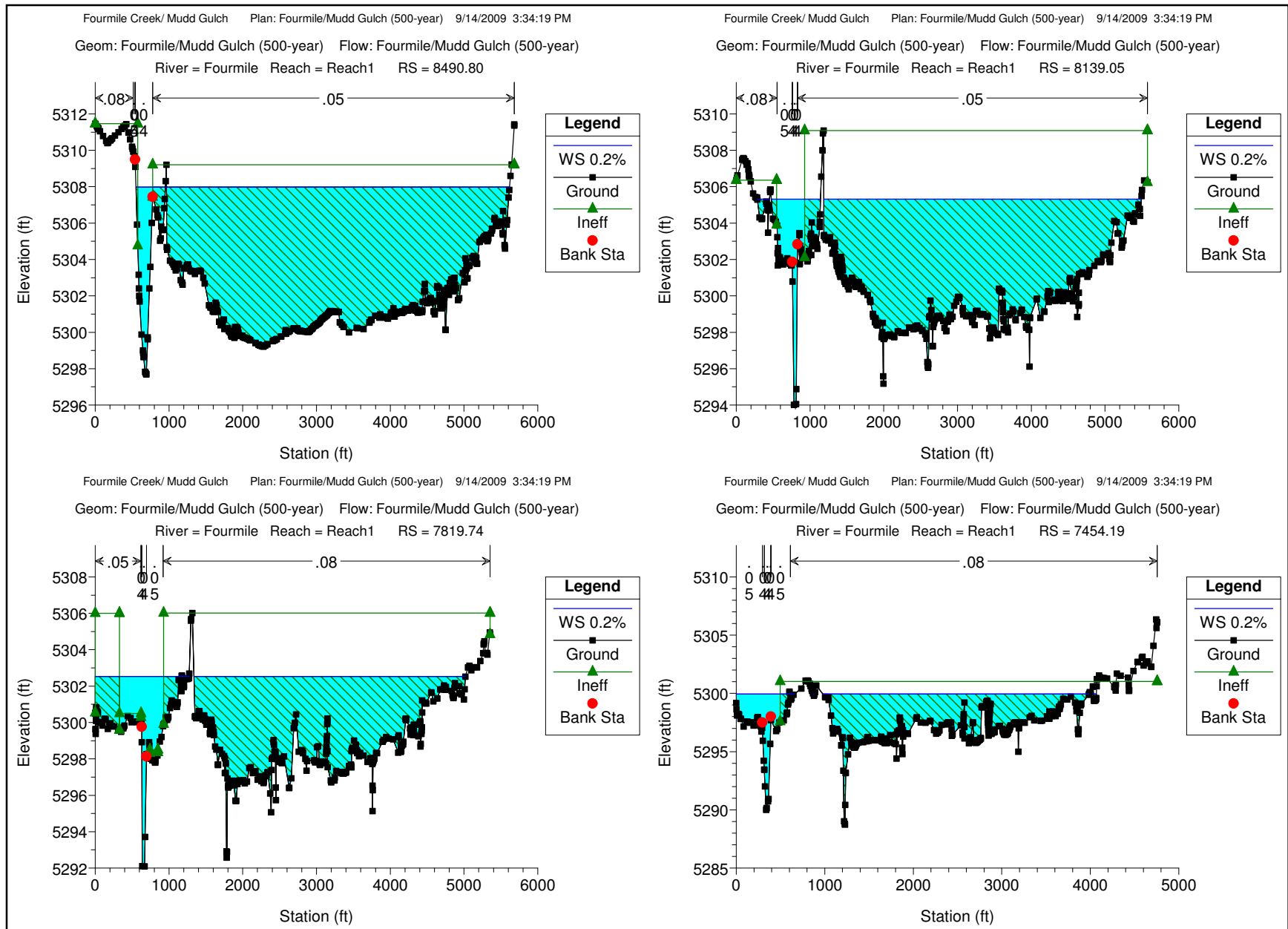


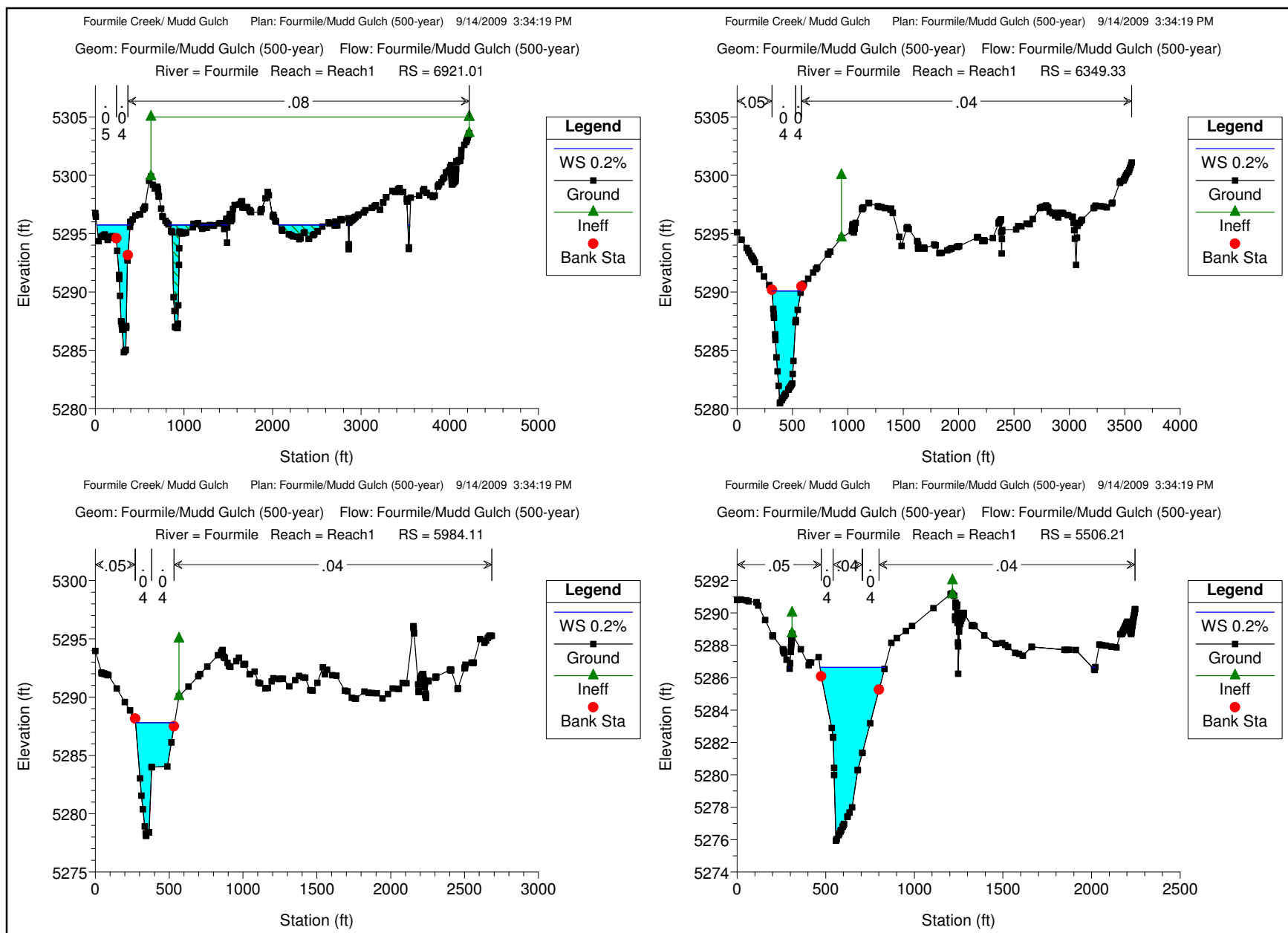


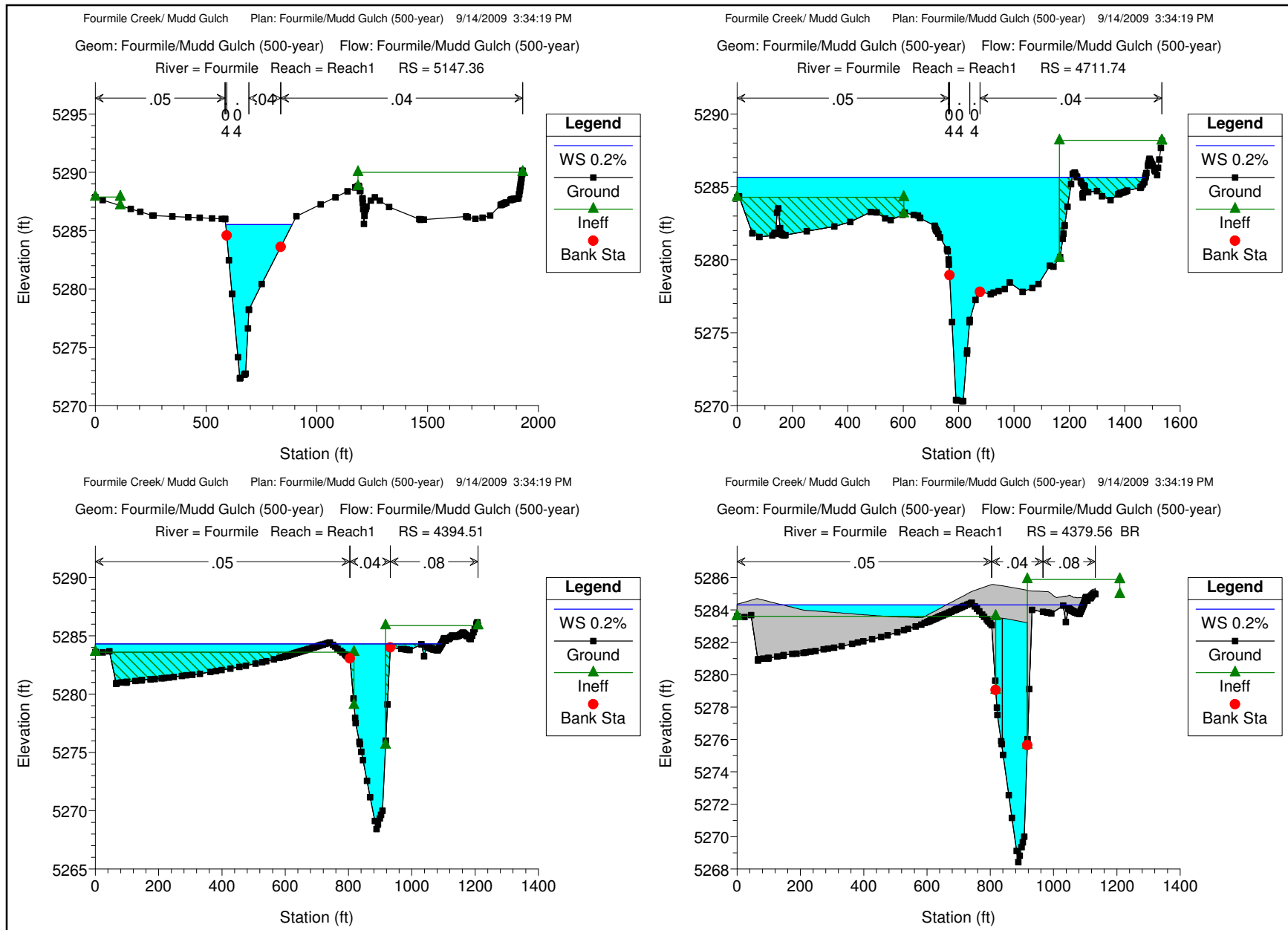


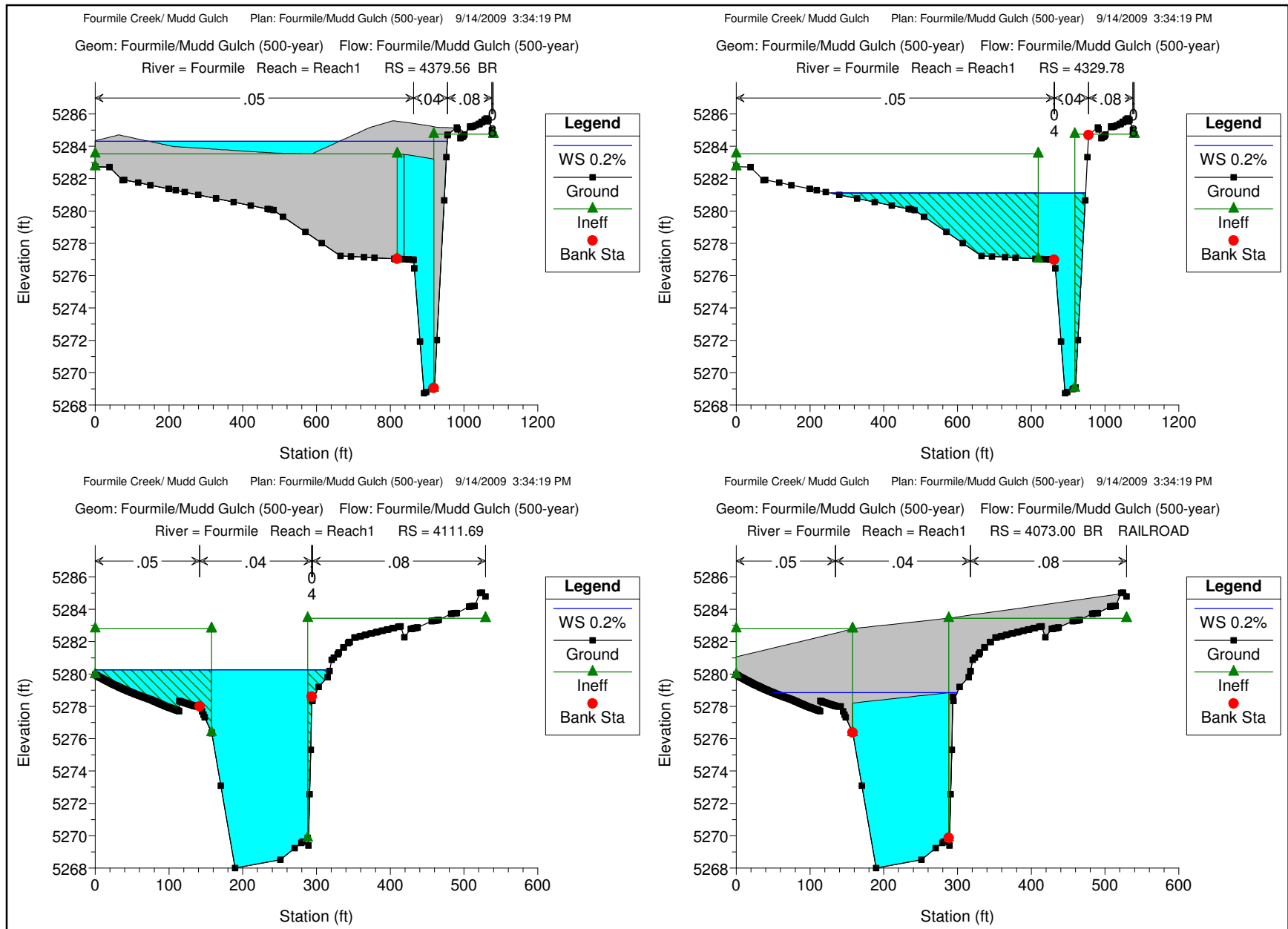


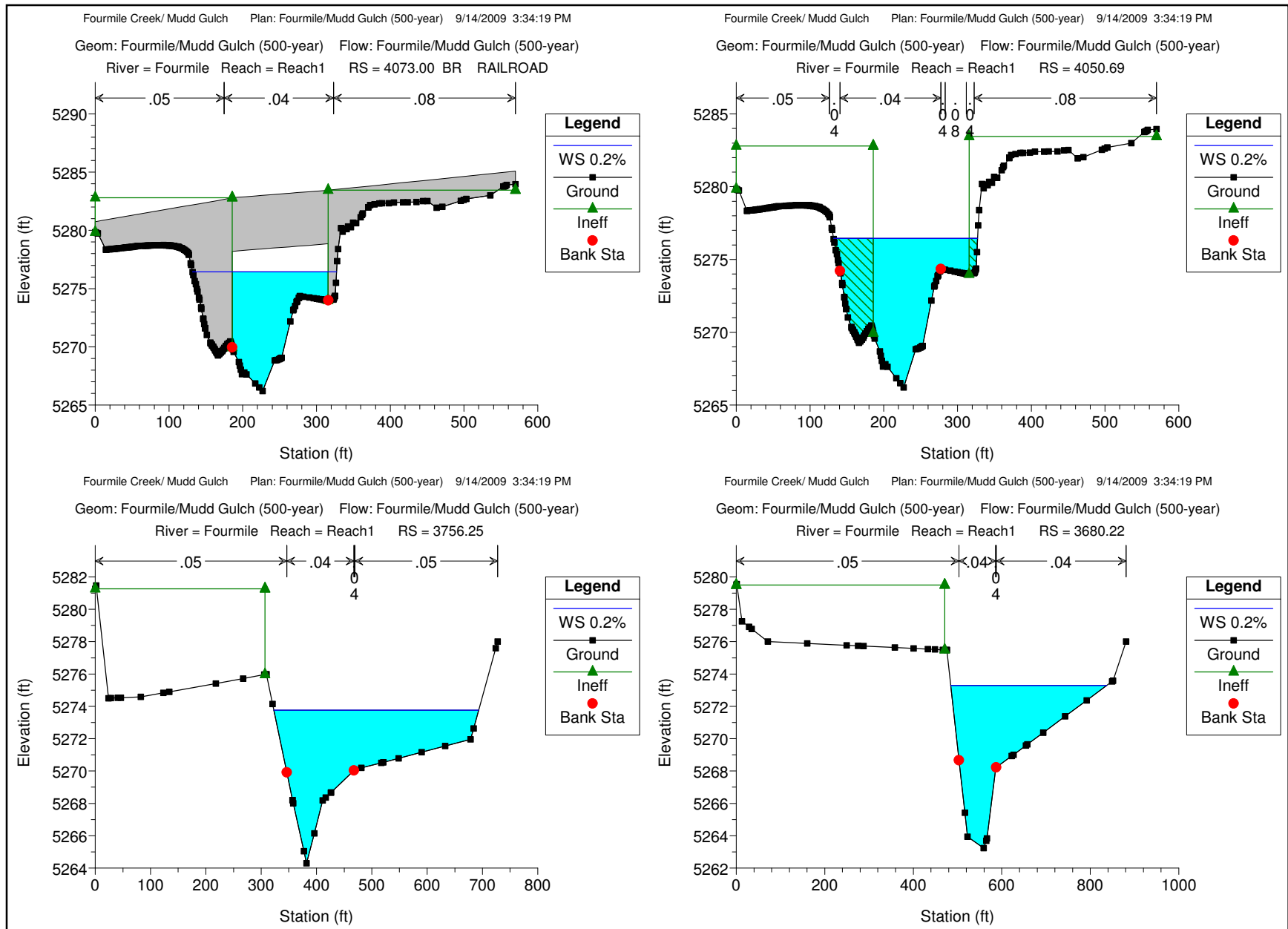


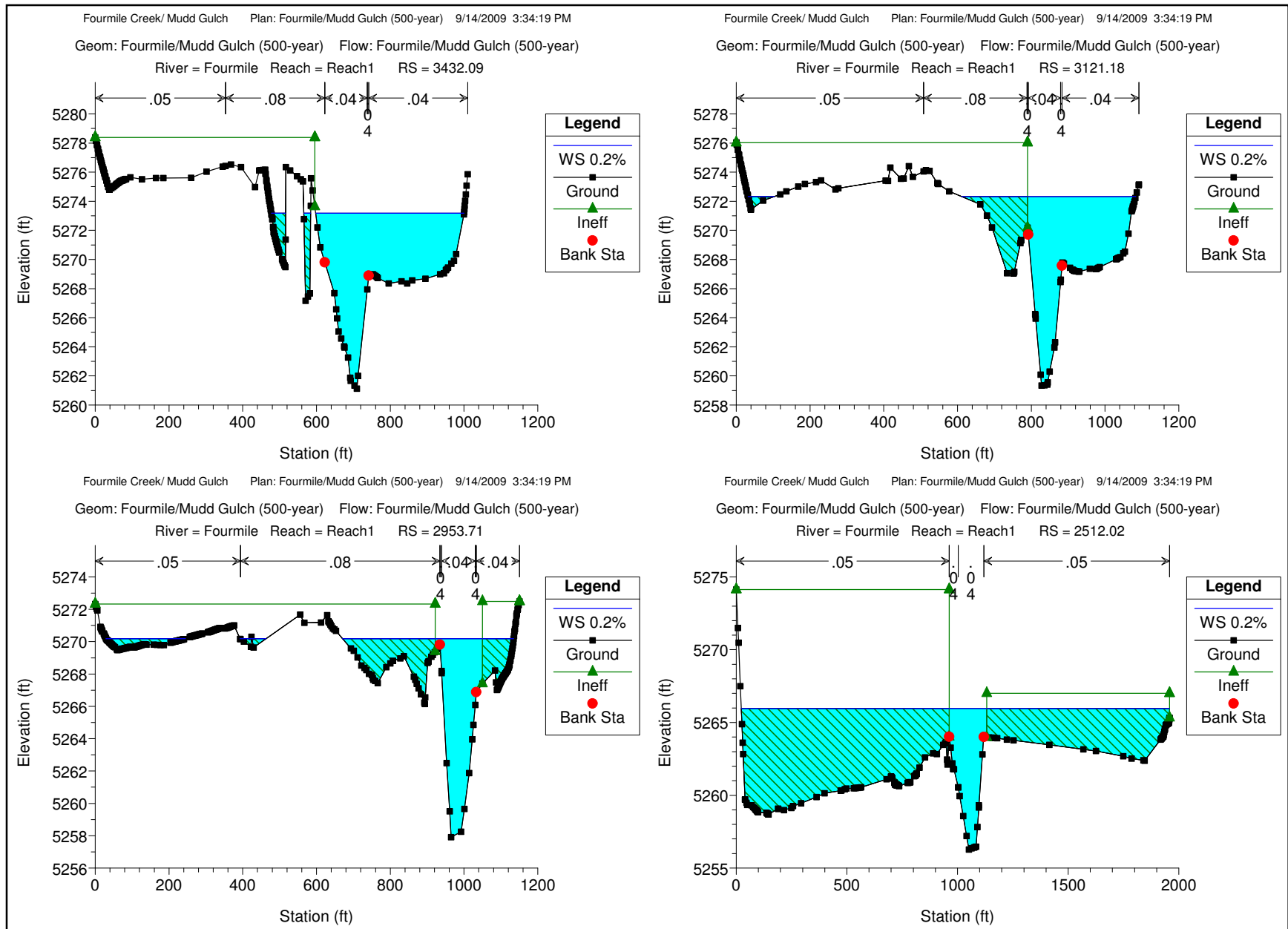


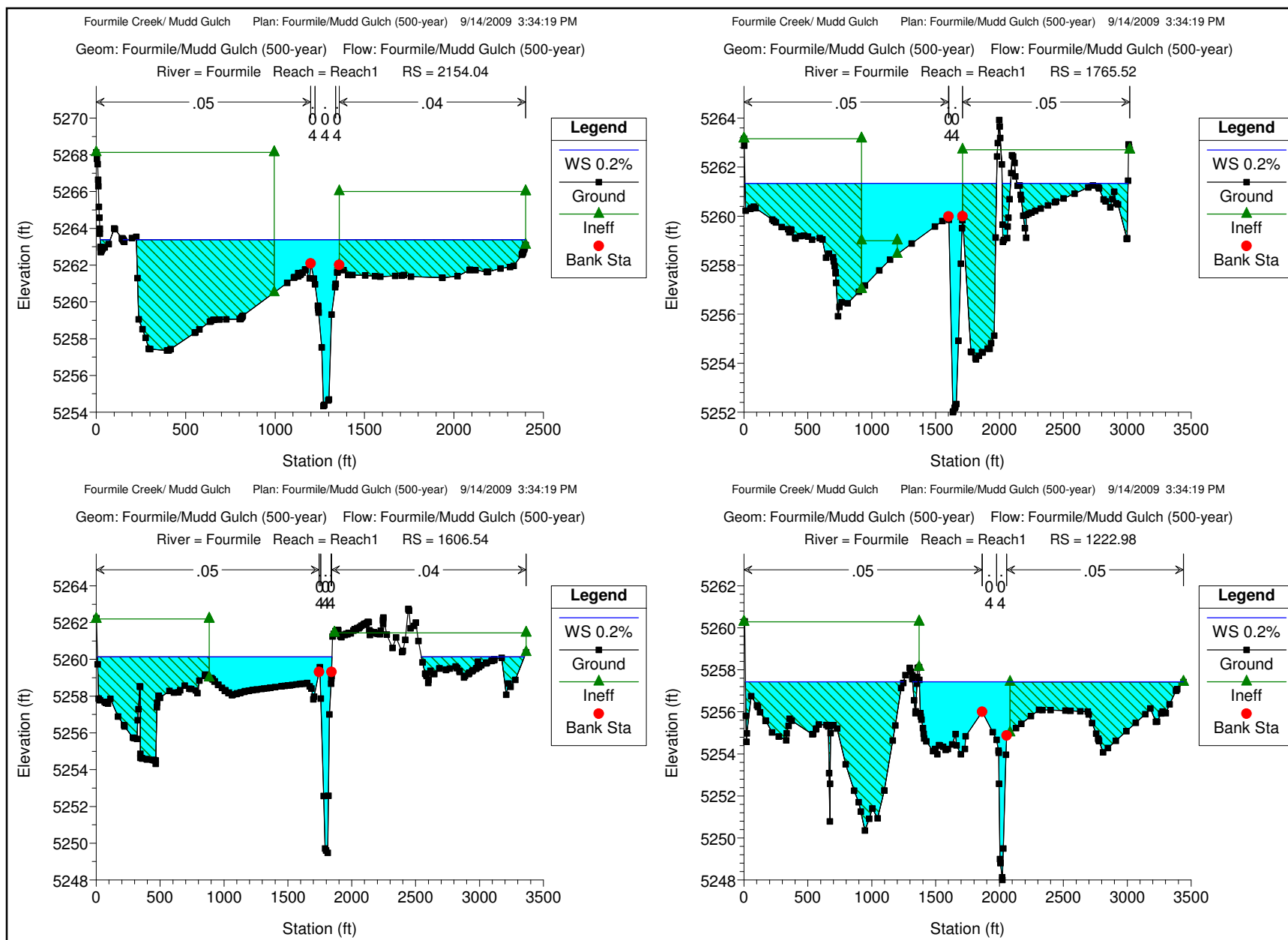








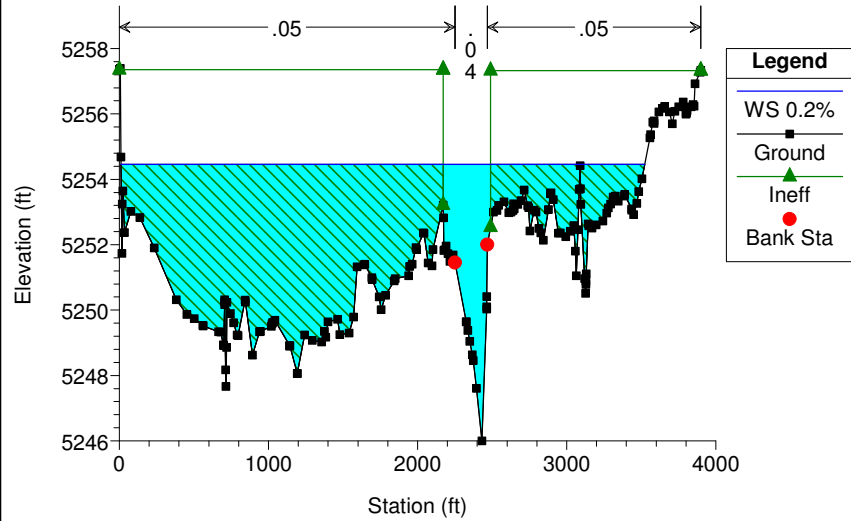




Fourmile Creek/ Mudd Gulch Plan: Fourmile/Mudd Gulch (500-year) 9/14/2009 3:34:19 PM

Geom: Fourmile/Mudd Gulch (500-year) Flow: Fourmile/Mudd Gulch (500-year)

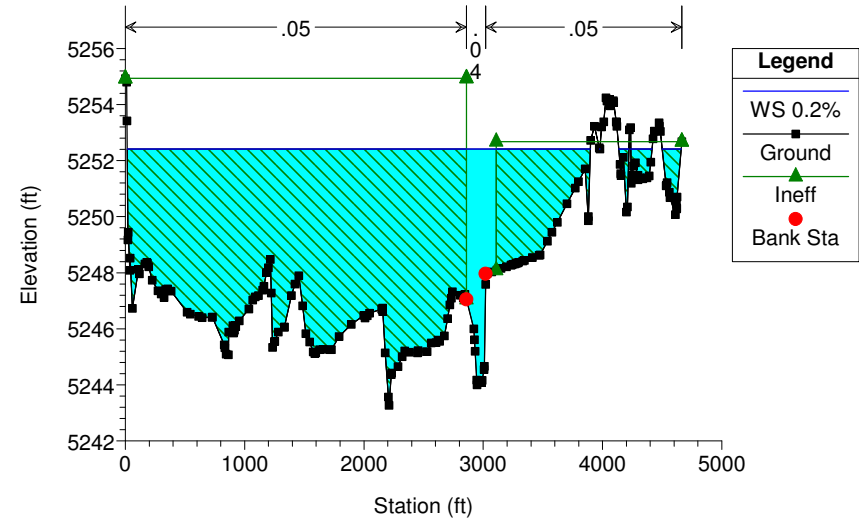
River = Fourmile Reach = Reach1 RS = 666.22



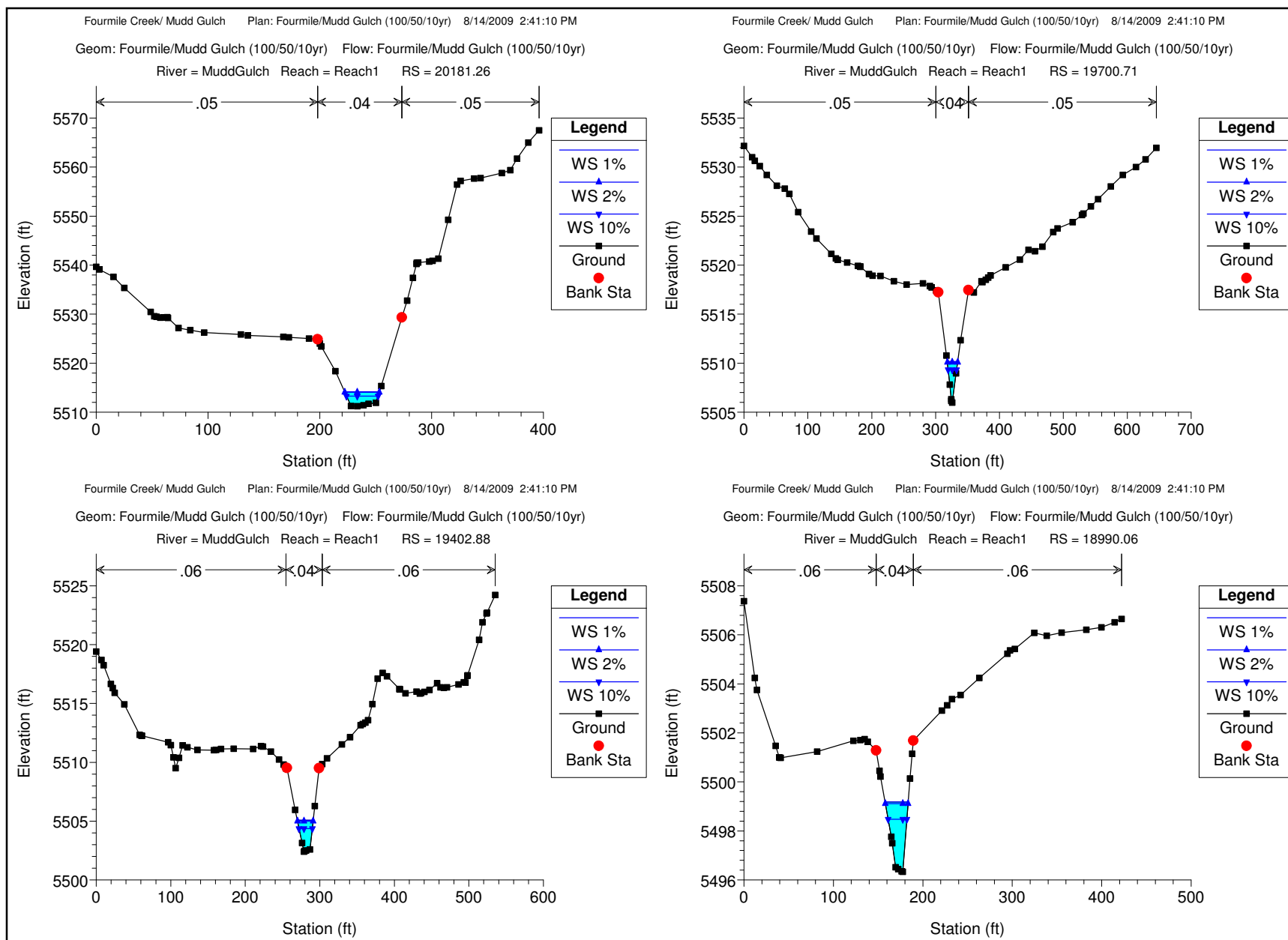
Fourmile Creek/ Mudd Gulch Plan: Fourmile/Mudd Gulch (500-year) 9/14/2009 3:34:19 PM

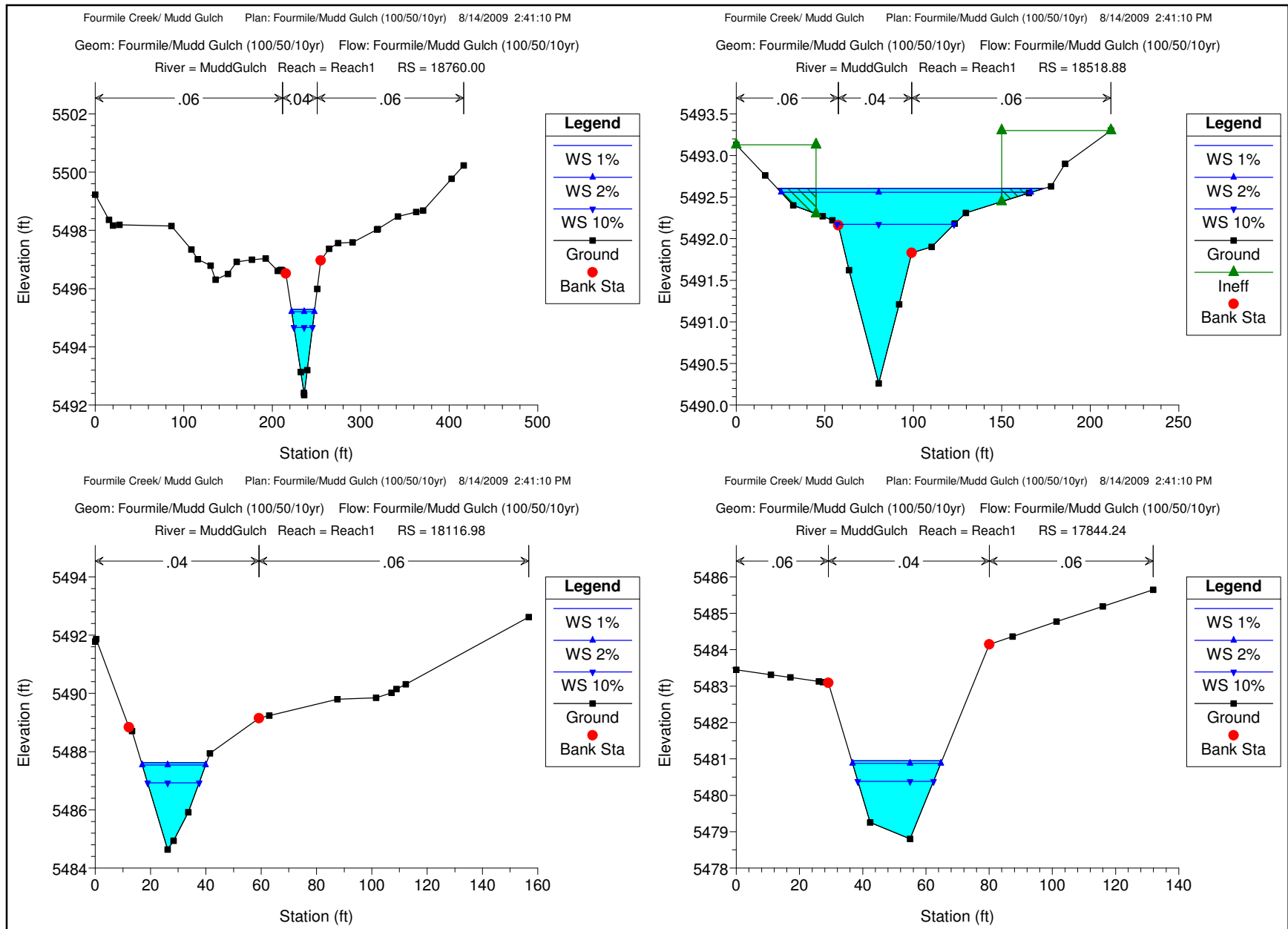
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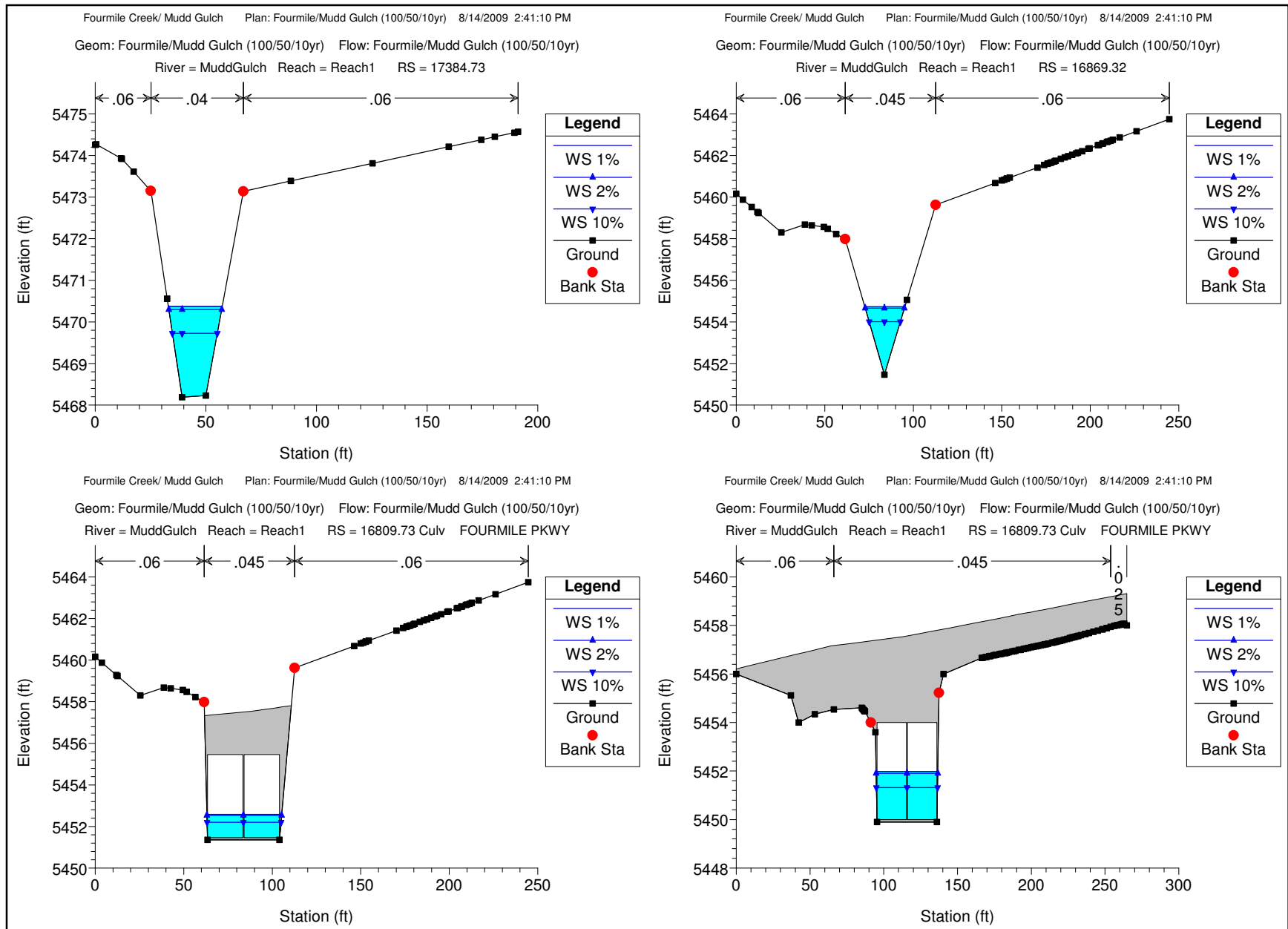
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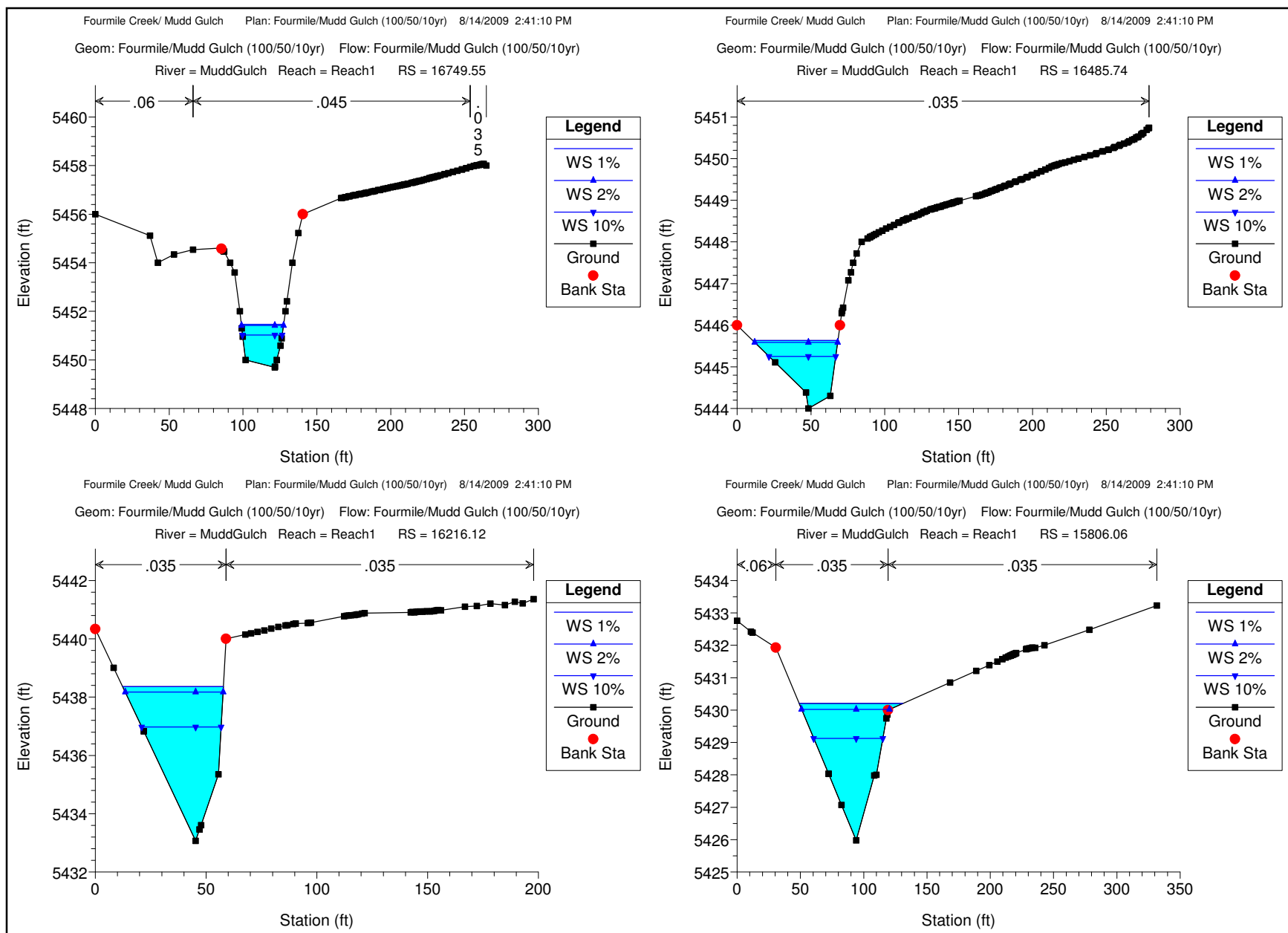


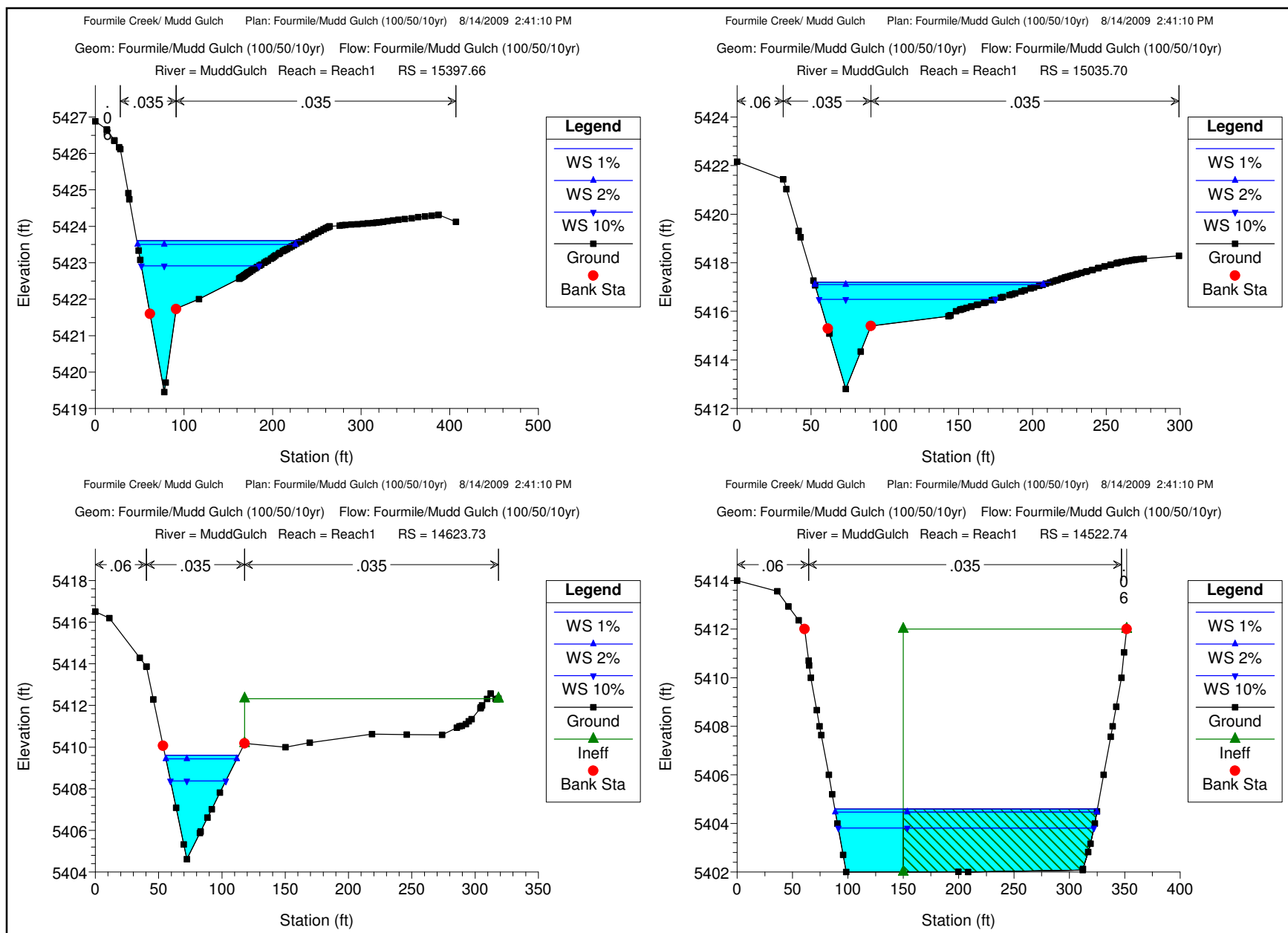
CROSS-SECTION PLOTS
(MUDD GULCH, 100-50-10-YEAR)

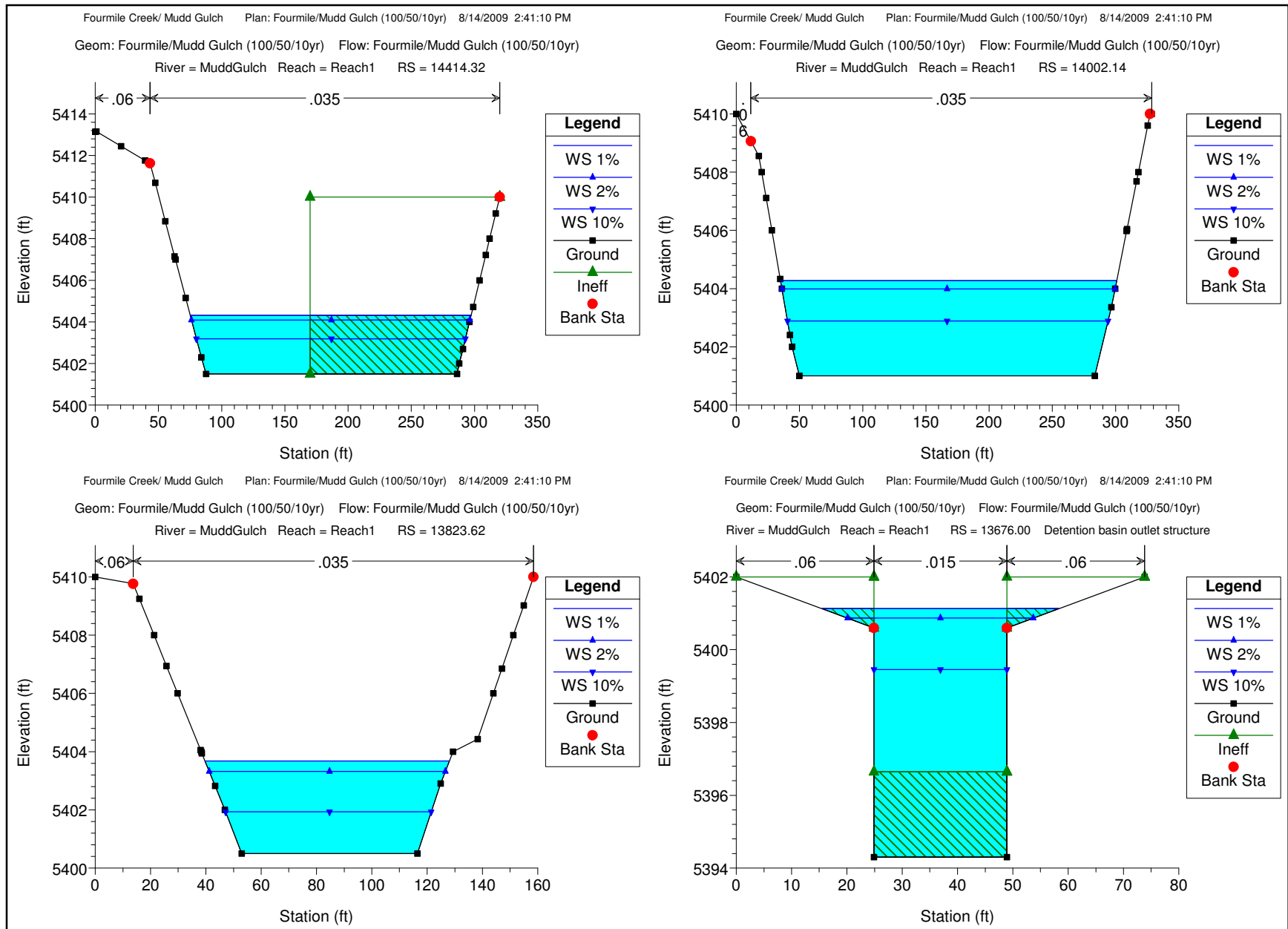


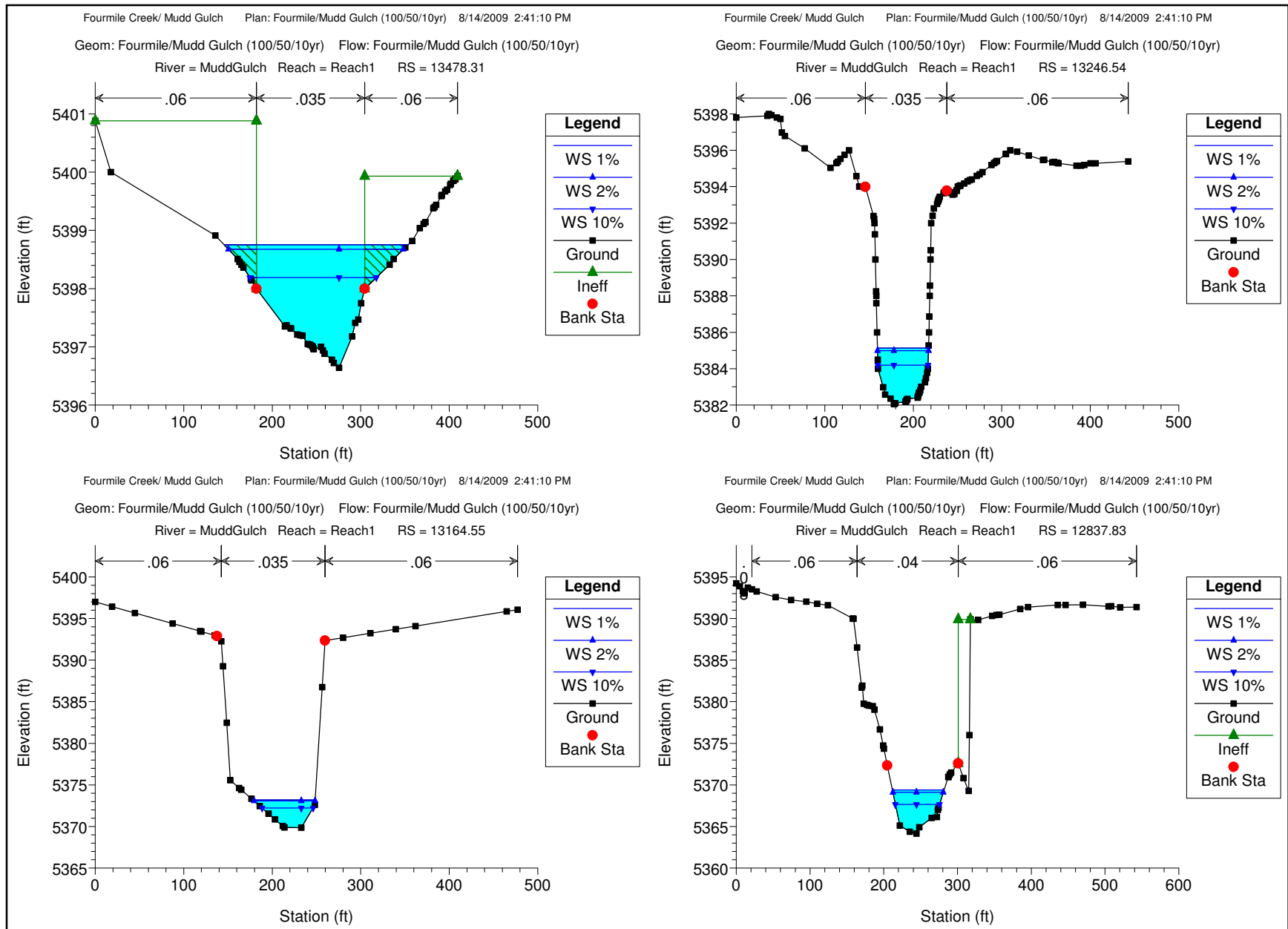


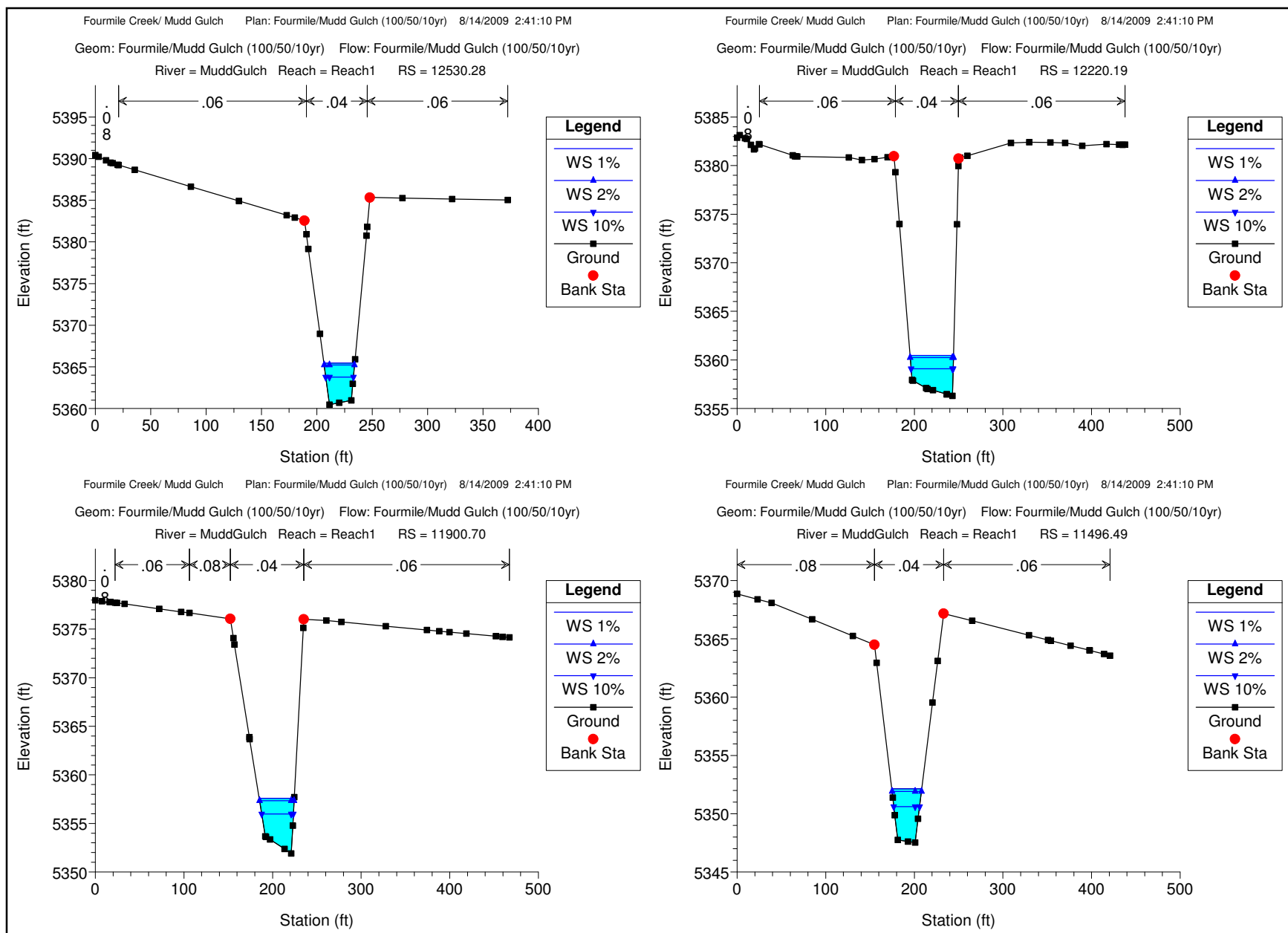


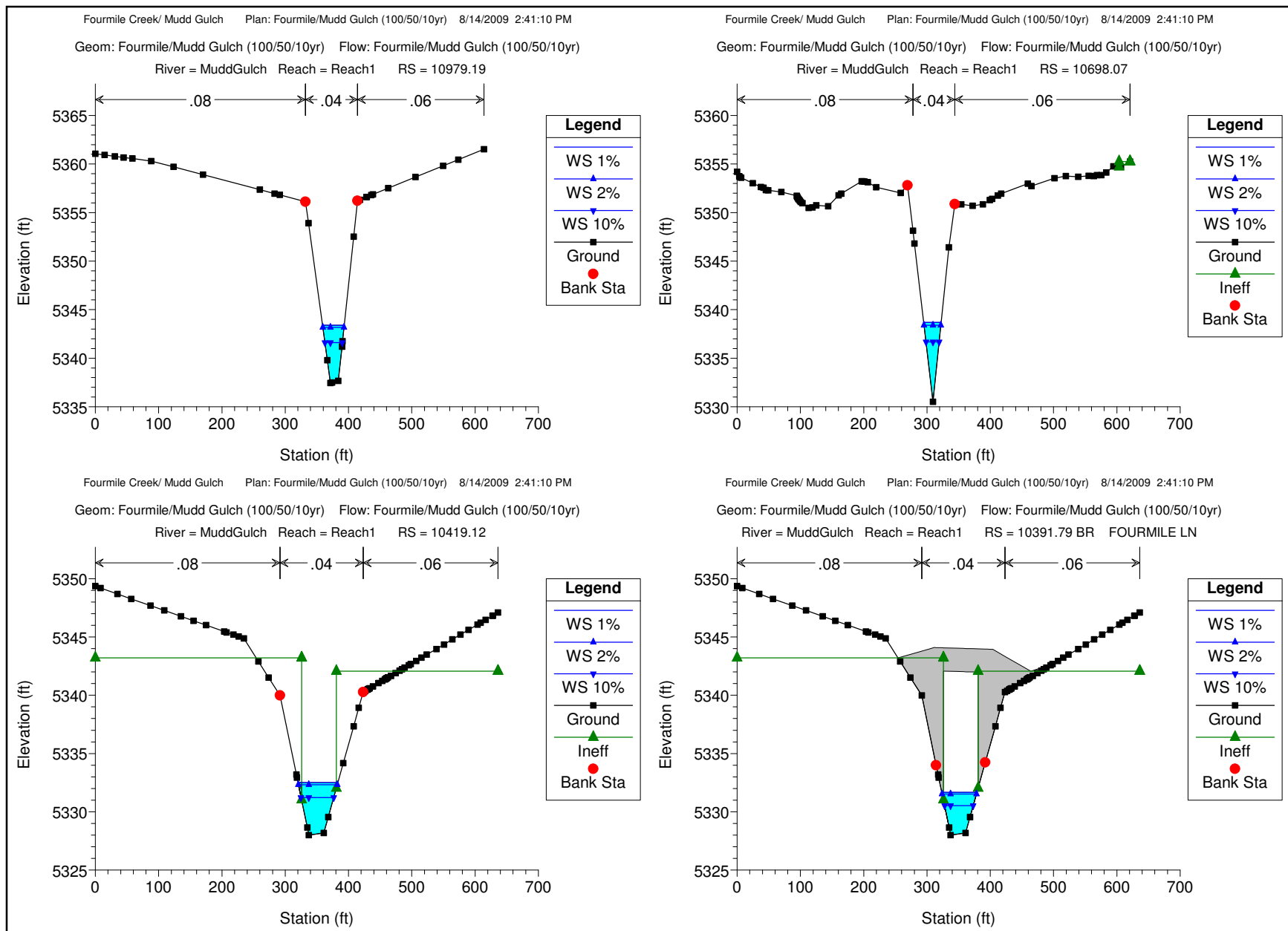


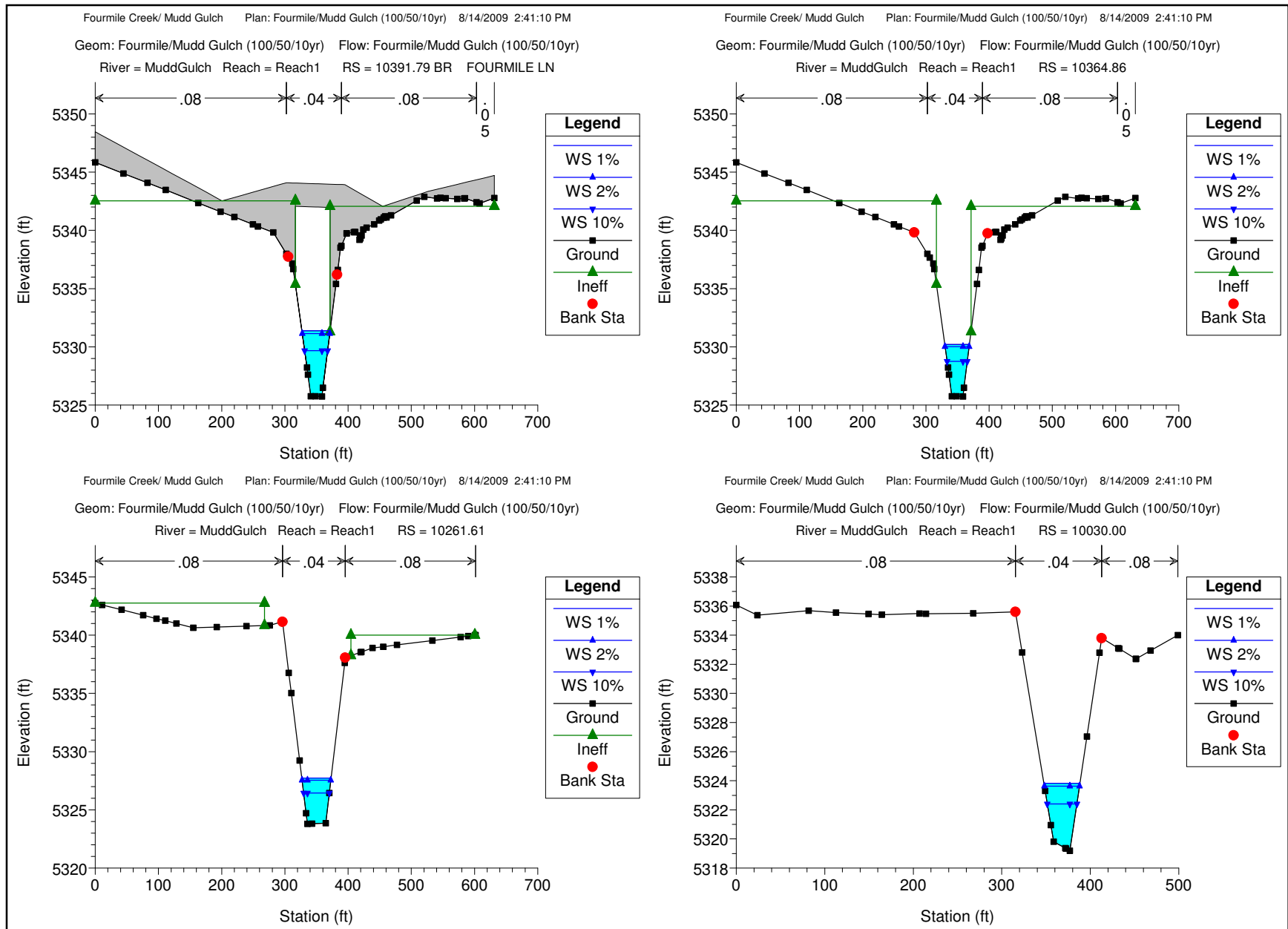


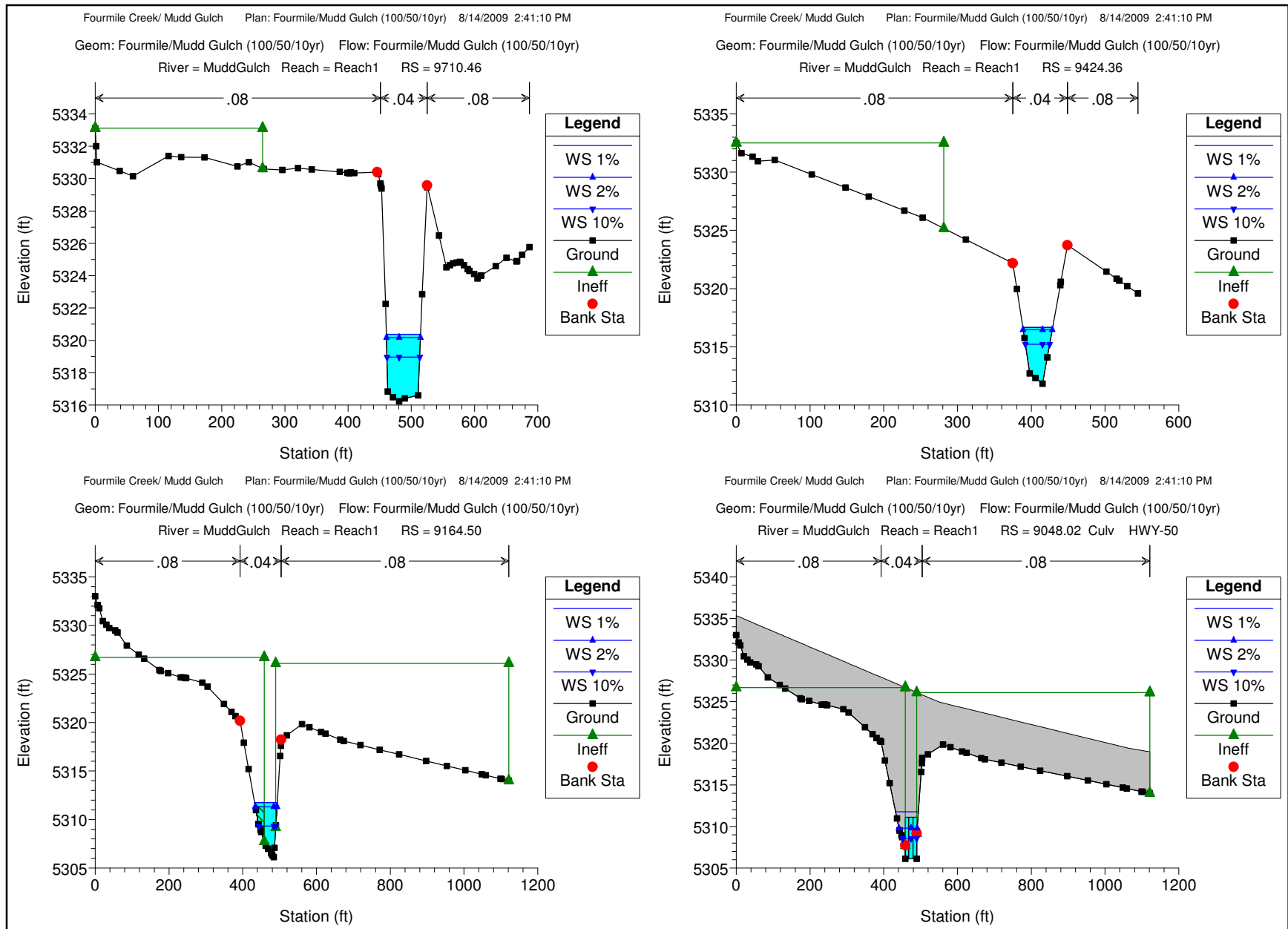


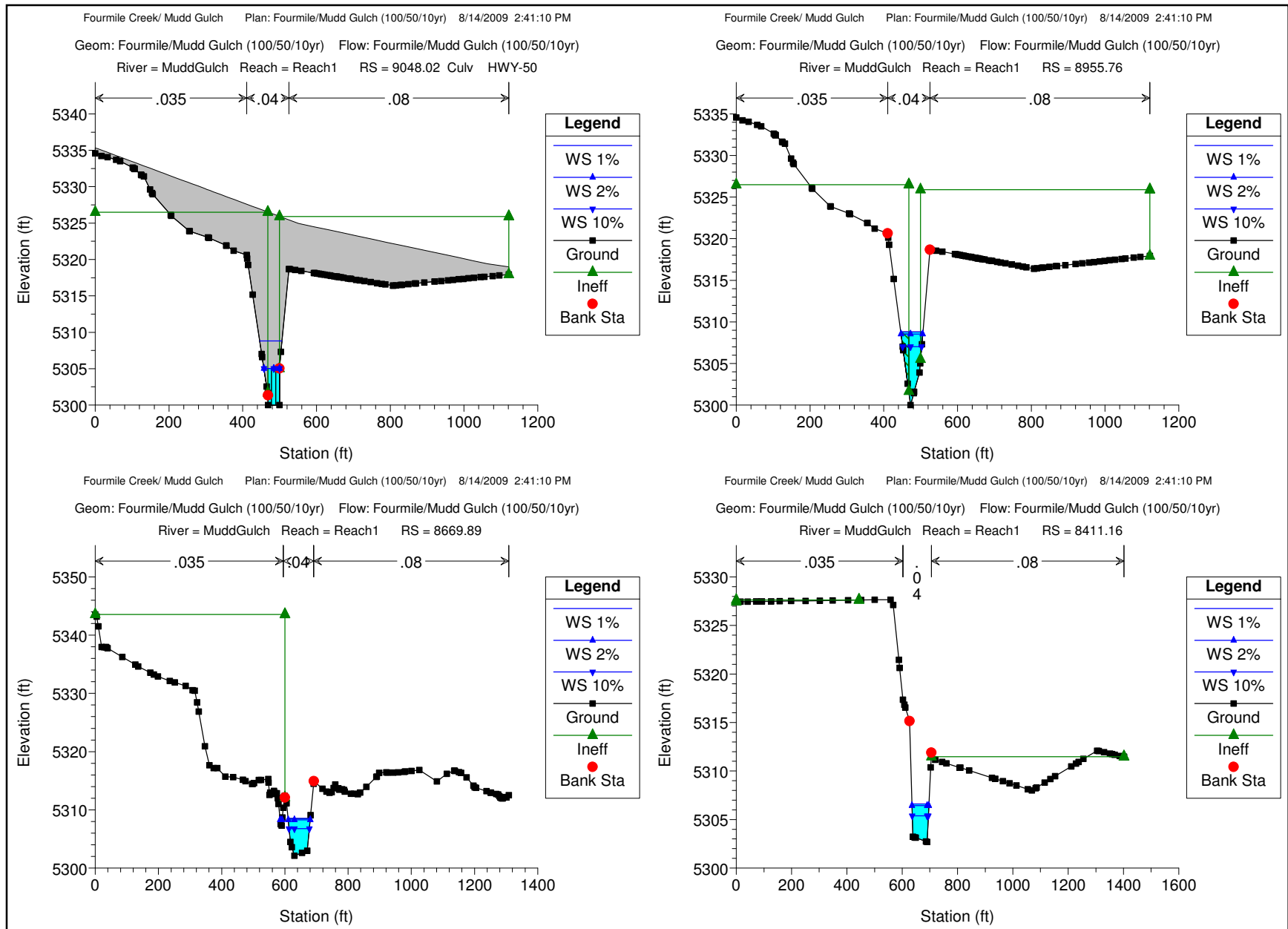


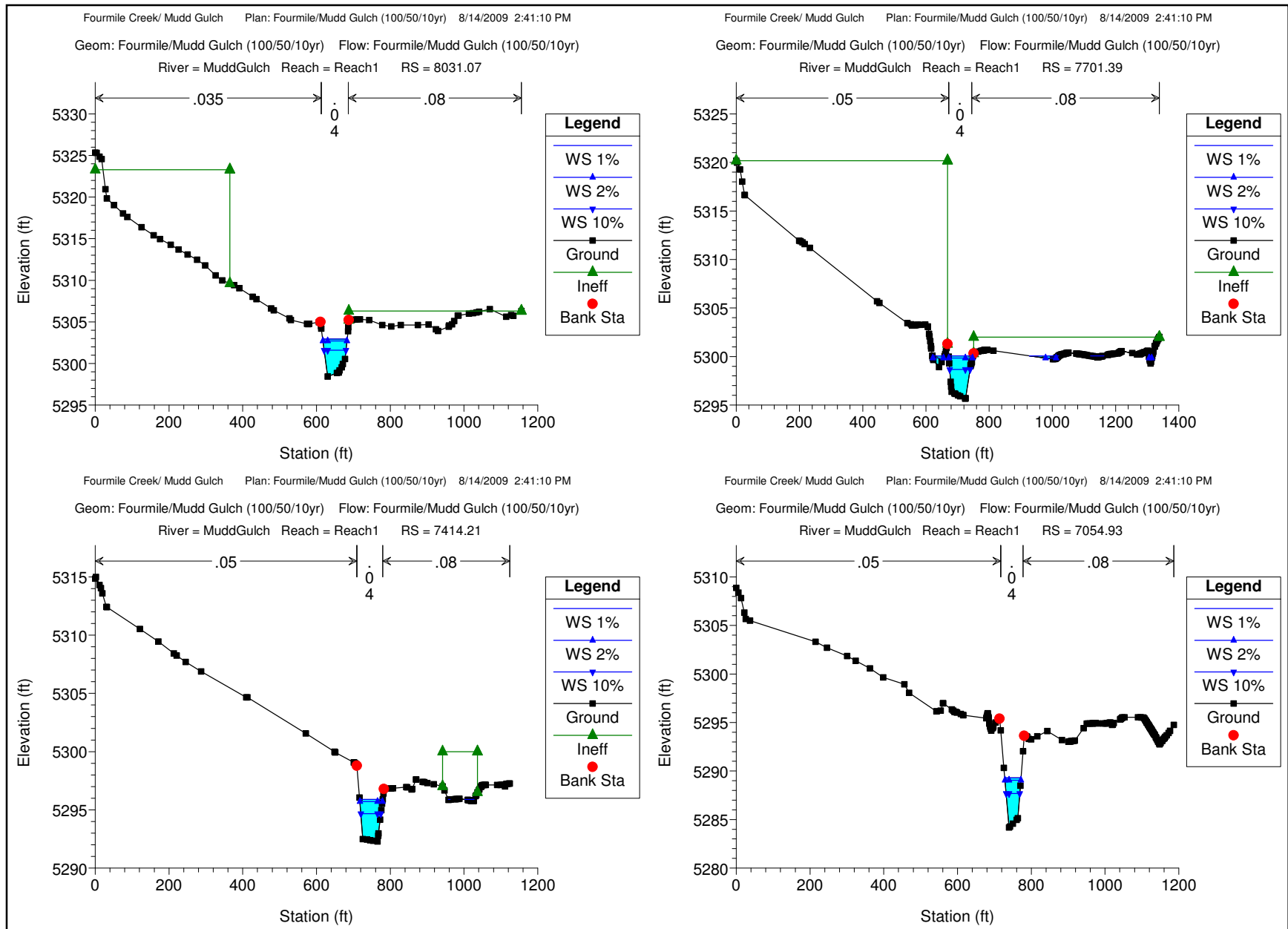


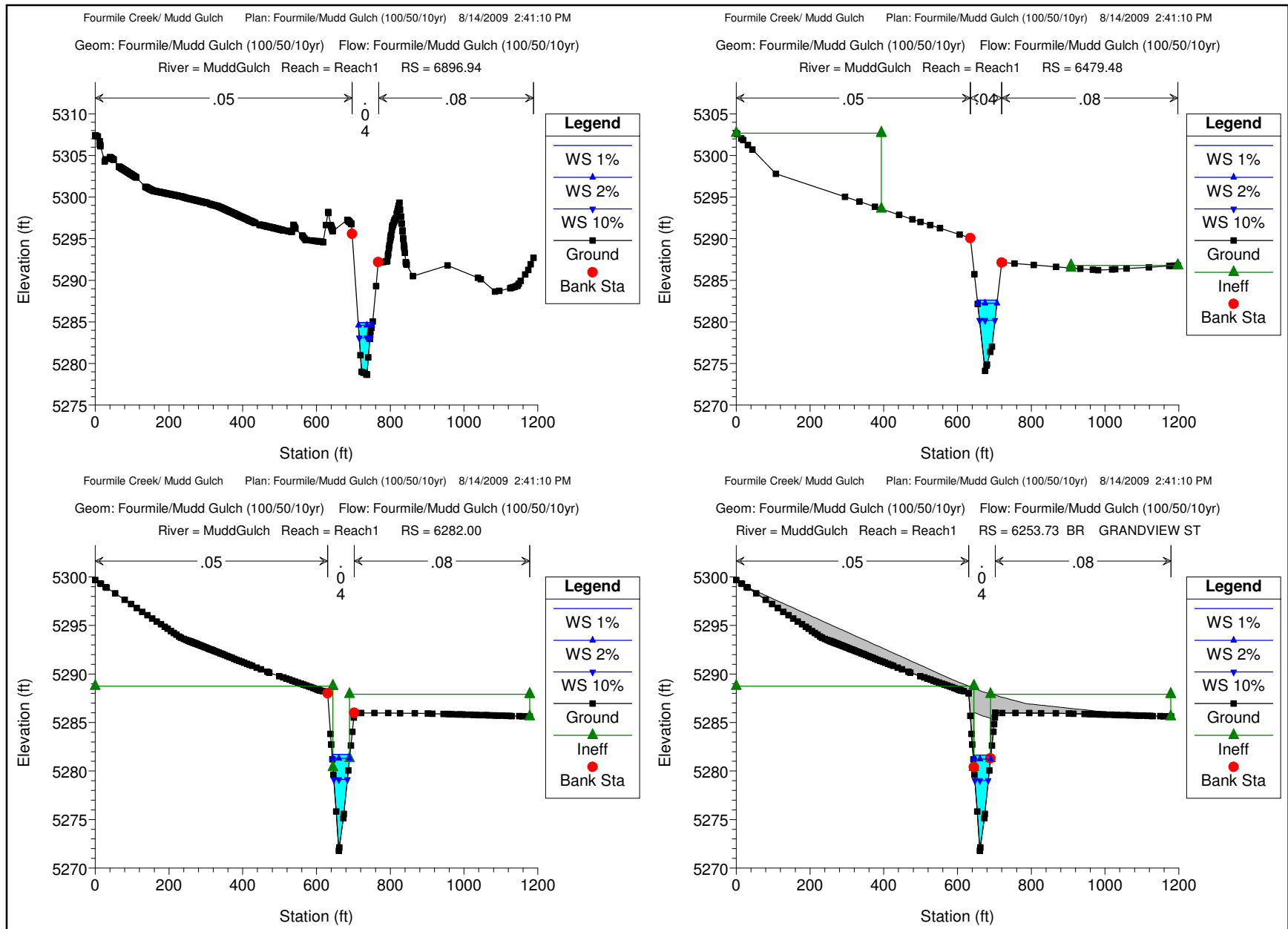


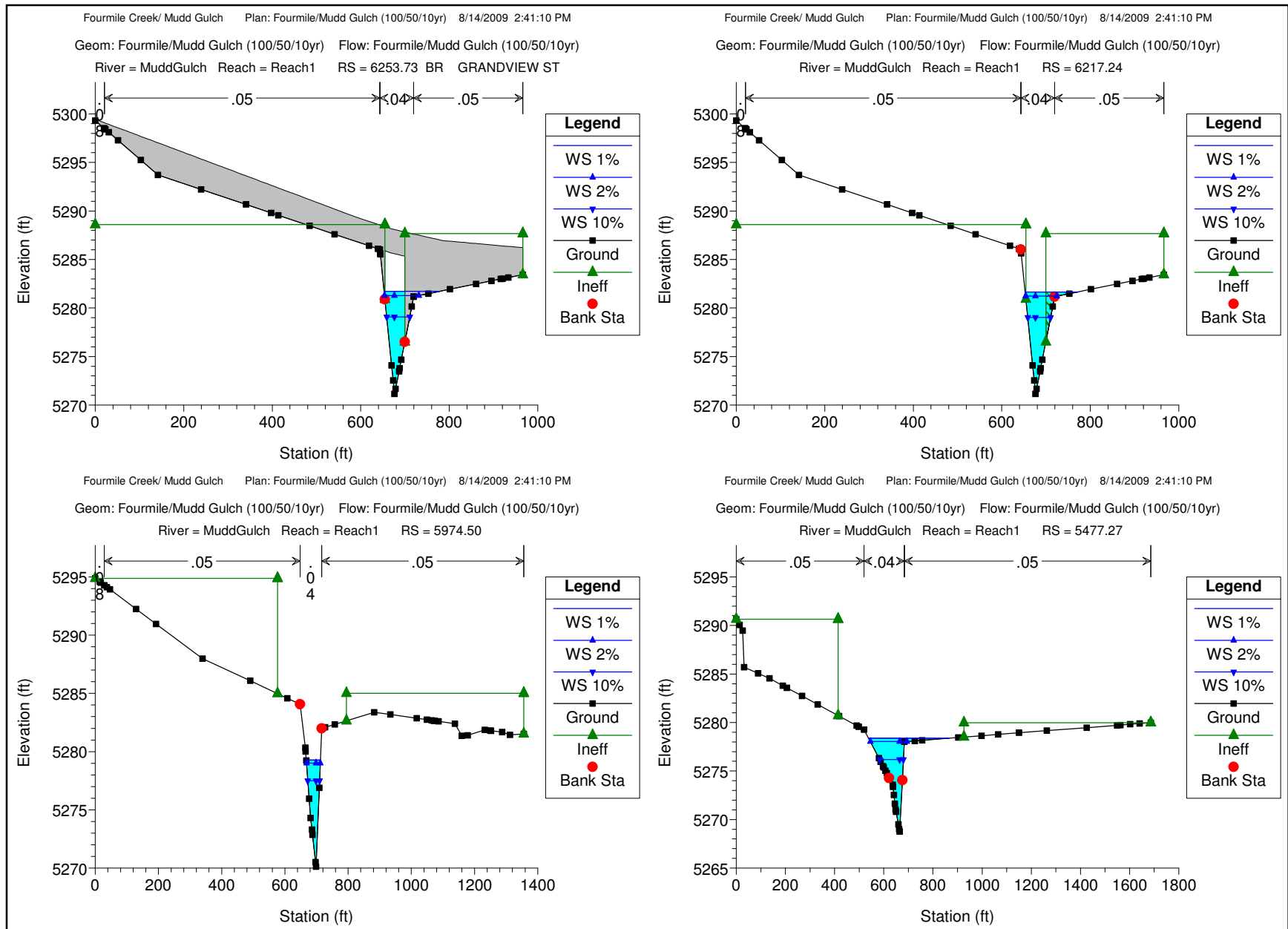


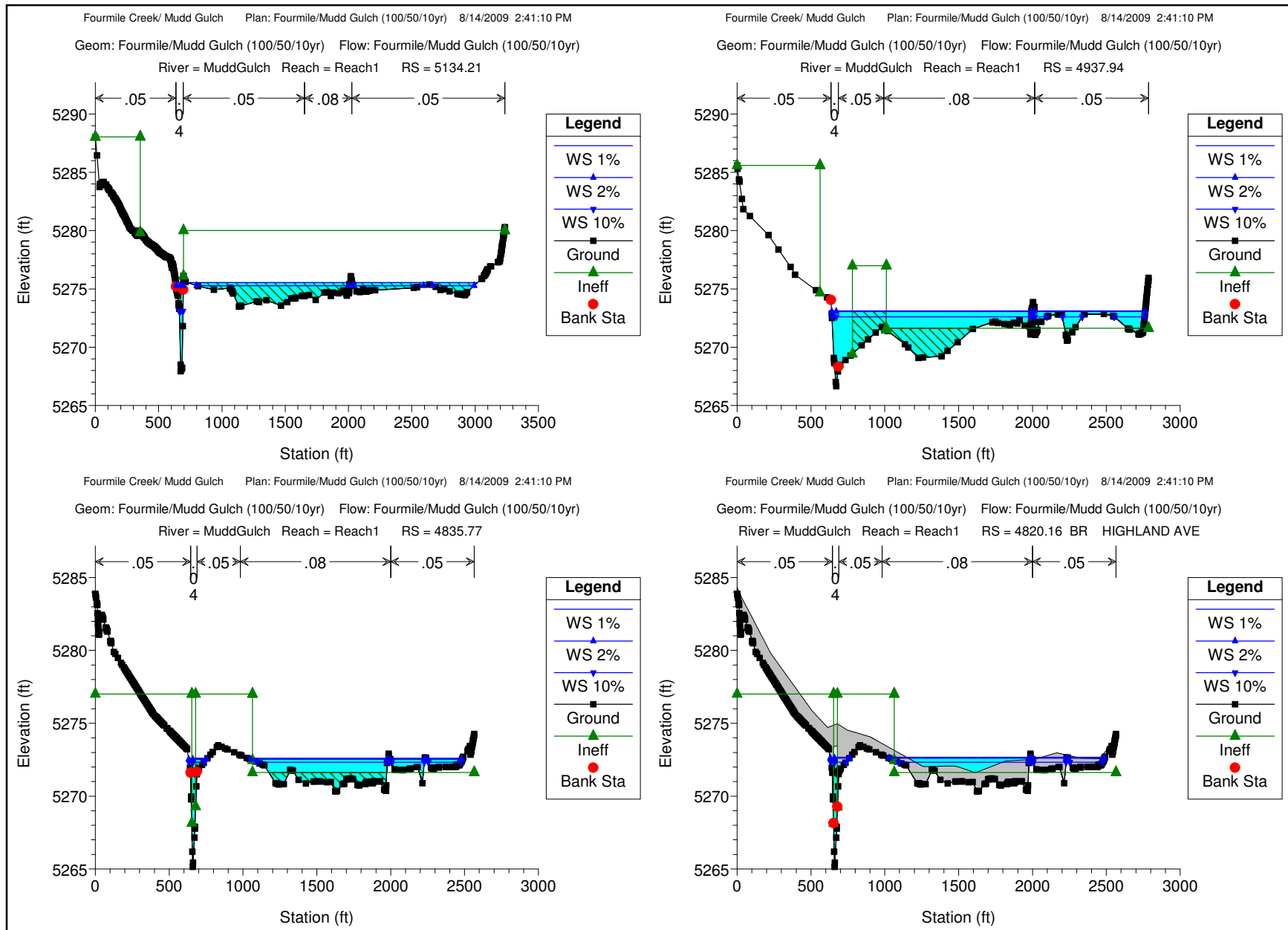


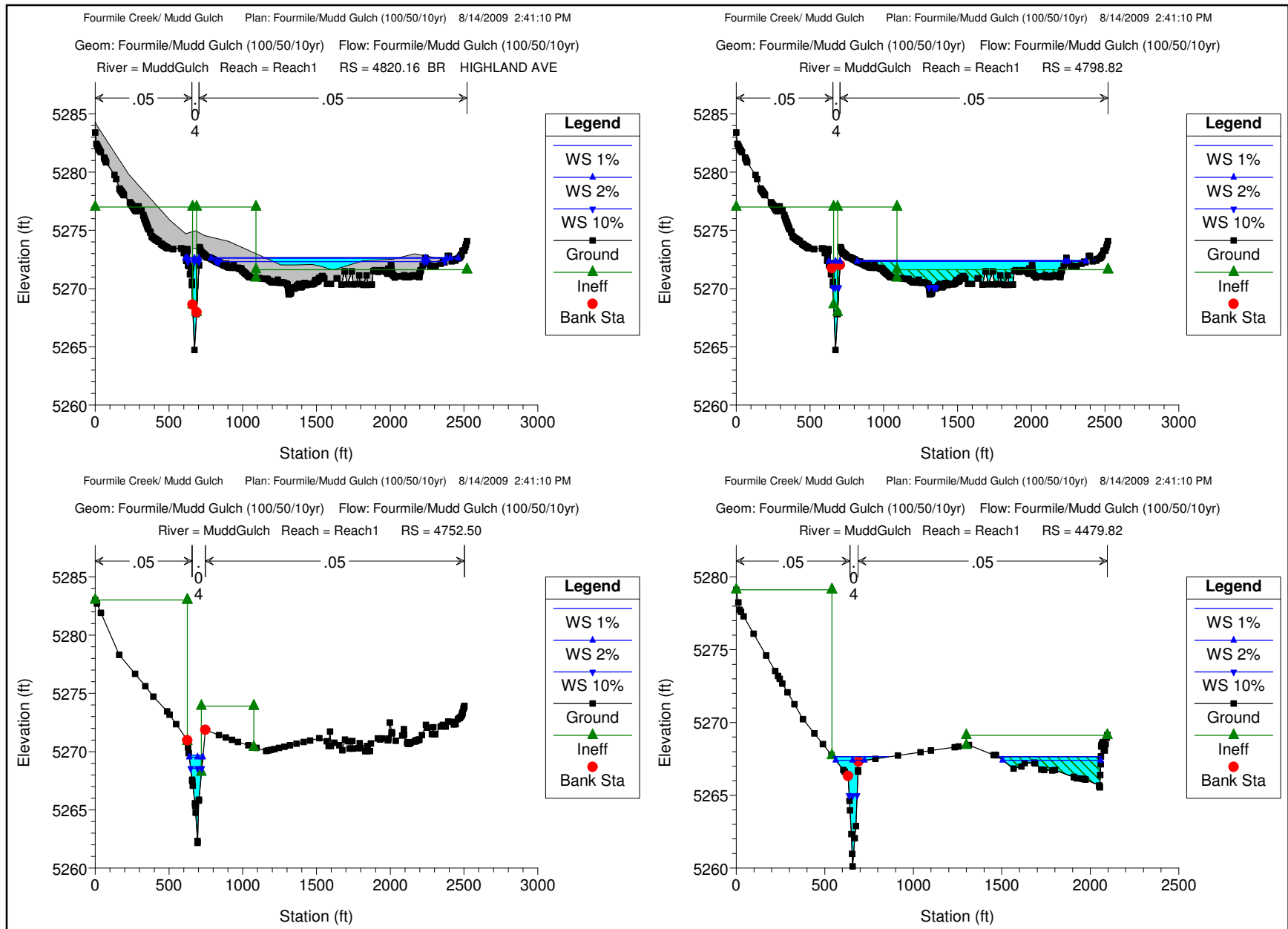


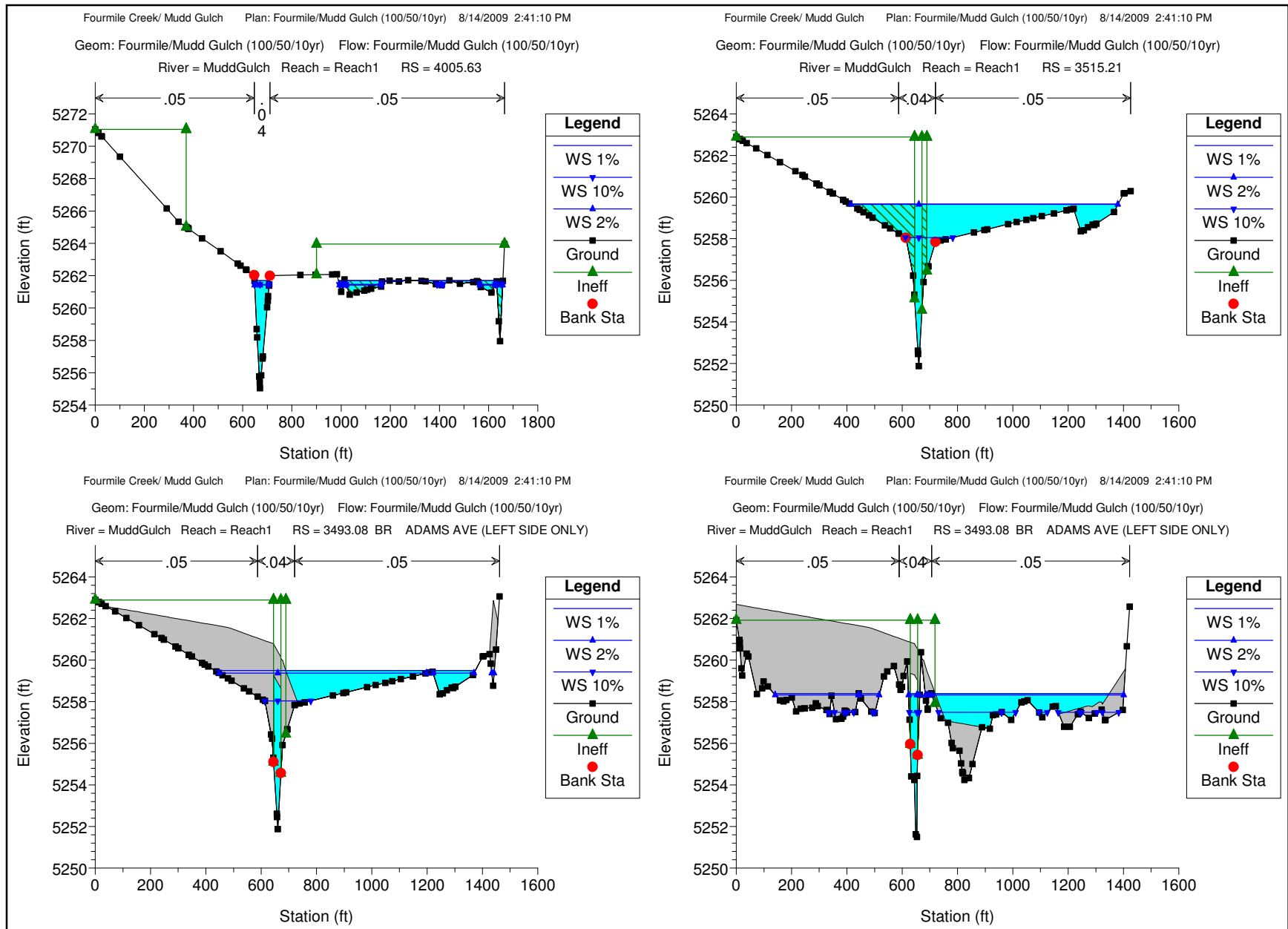


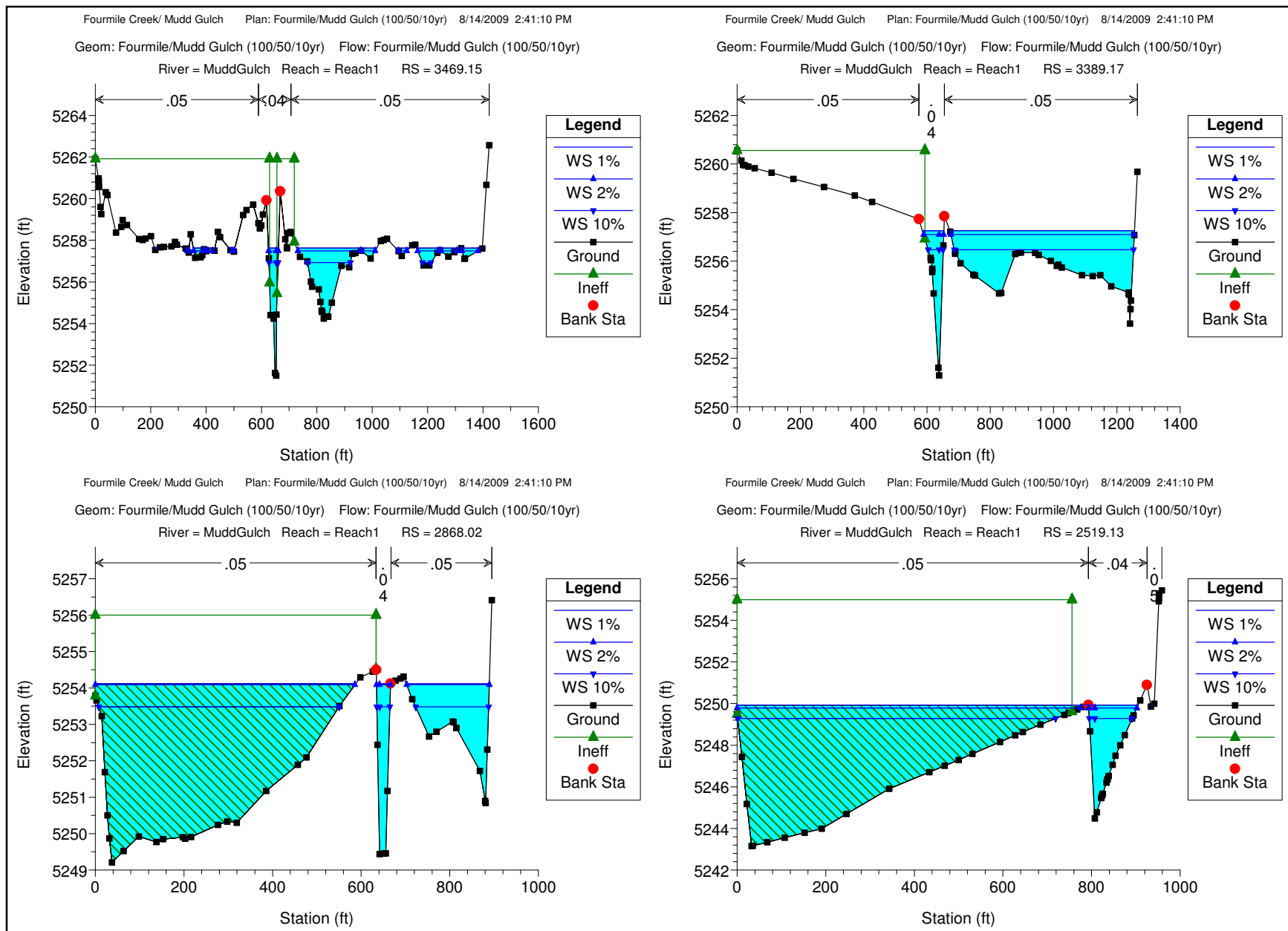


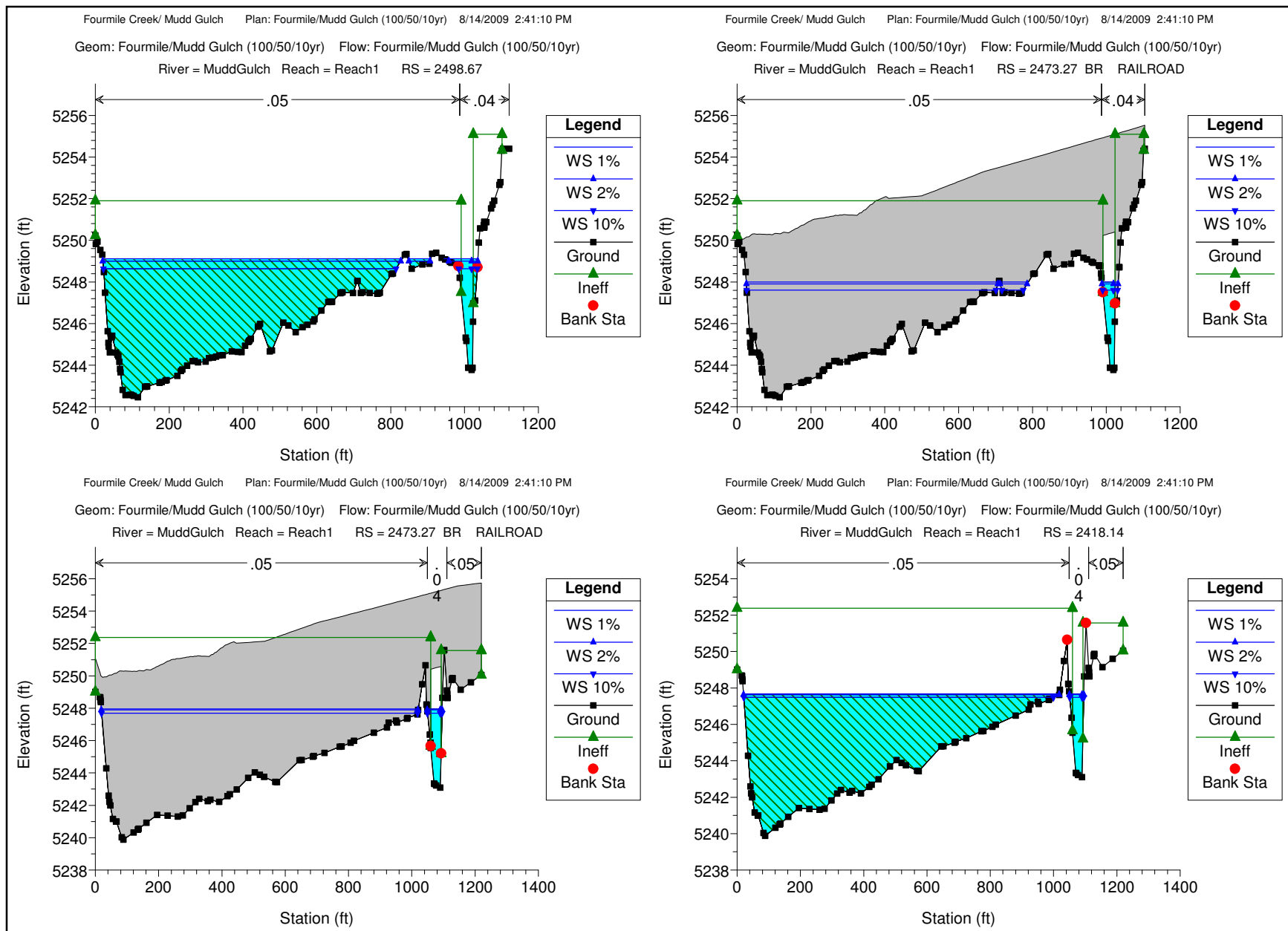


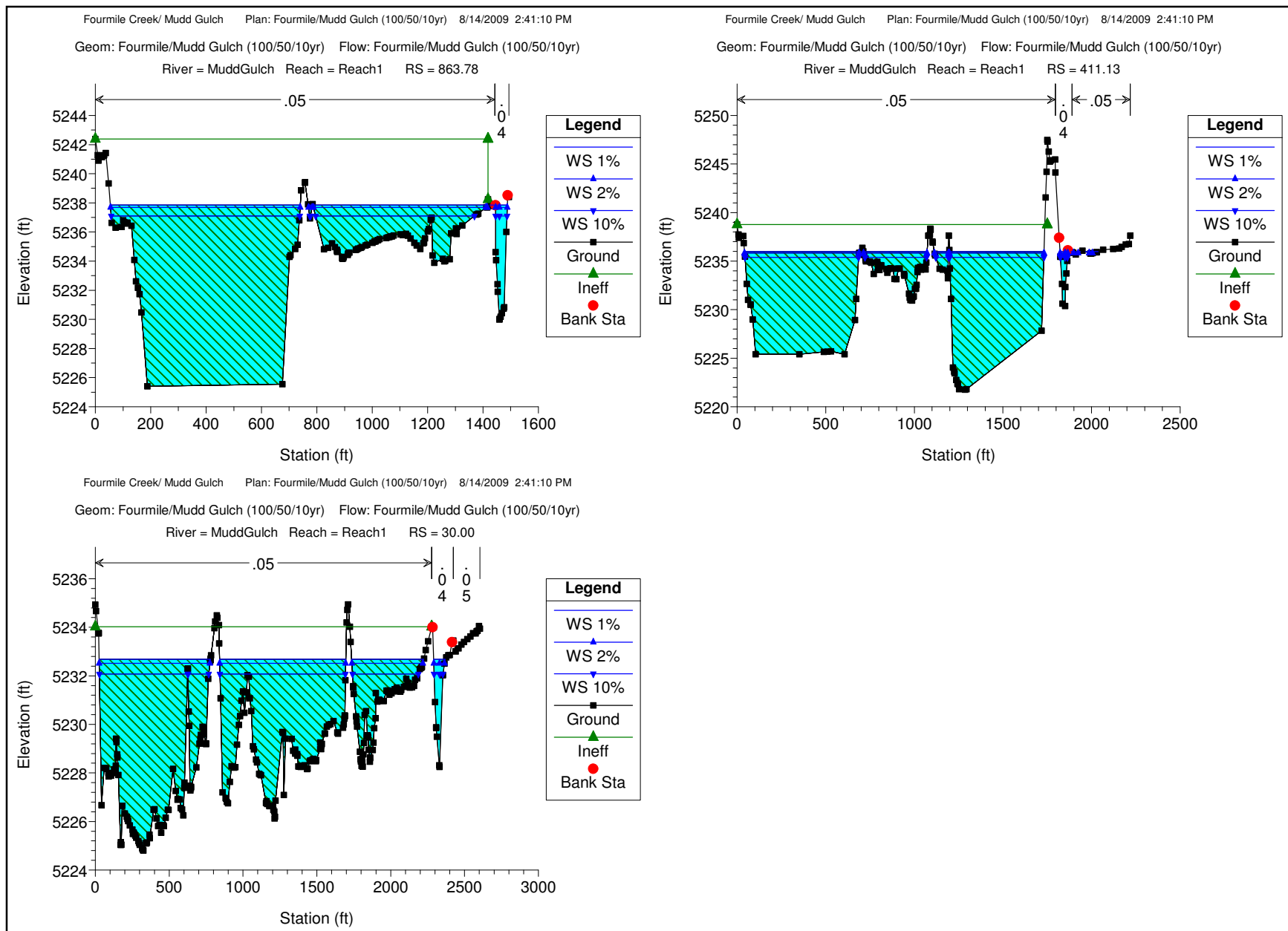




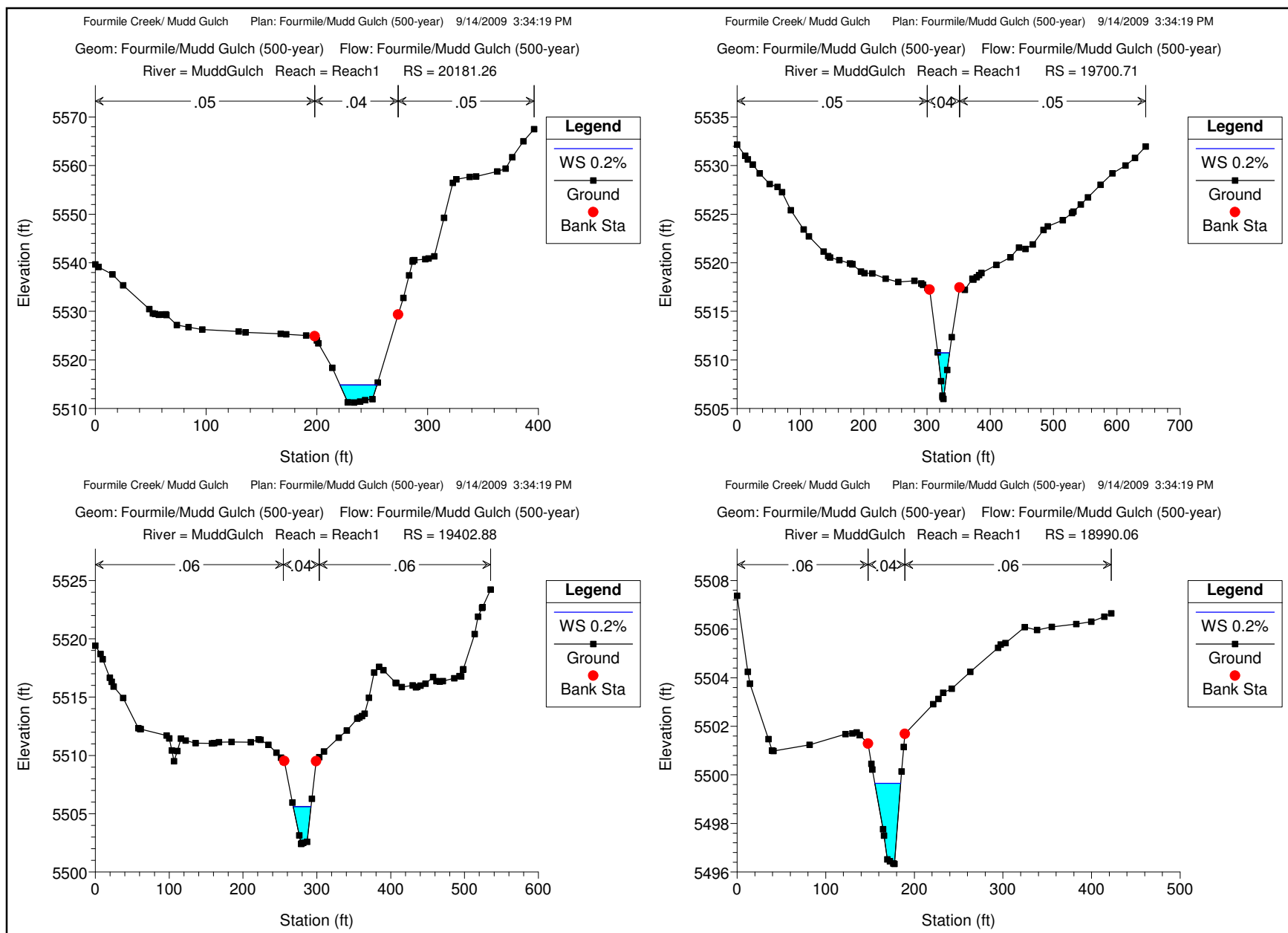


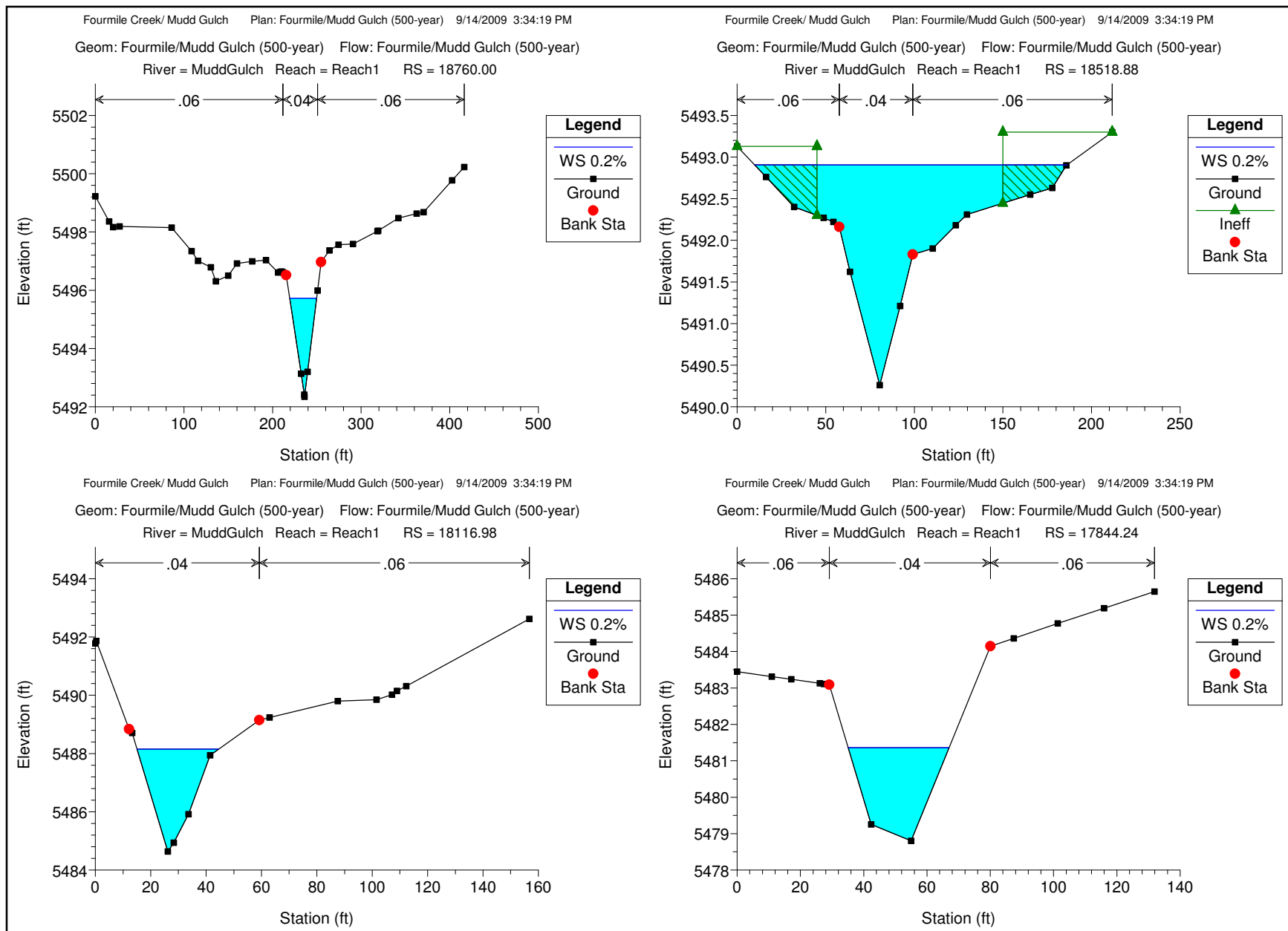


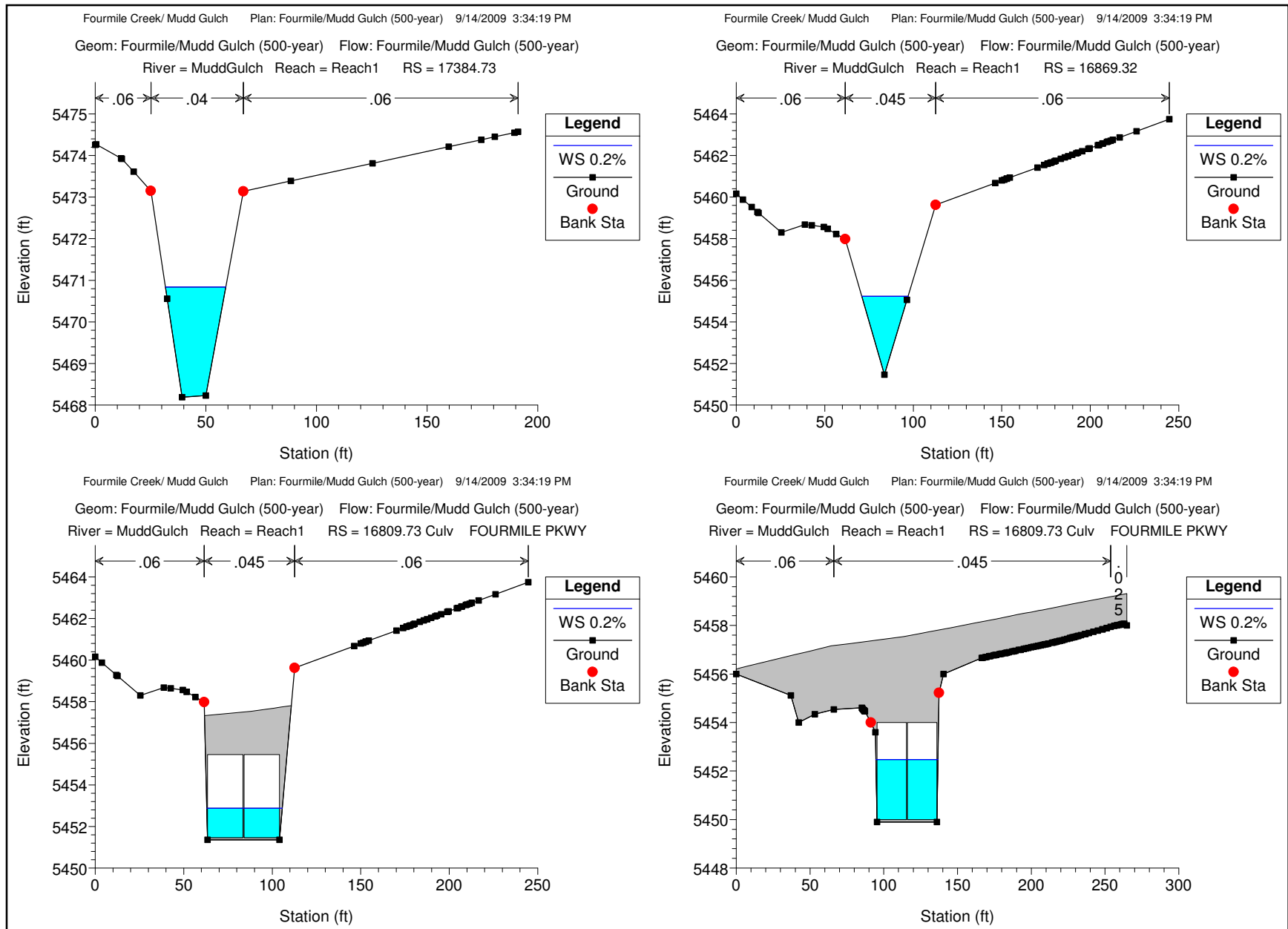


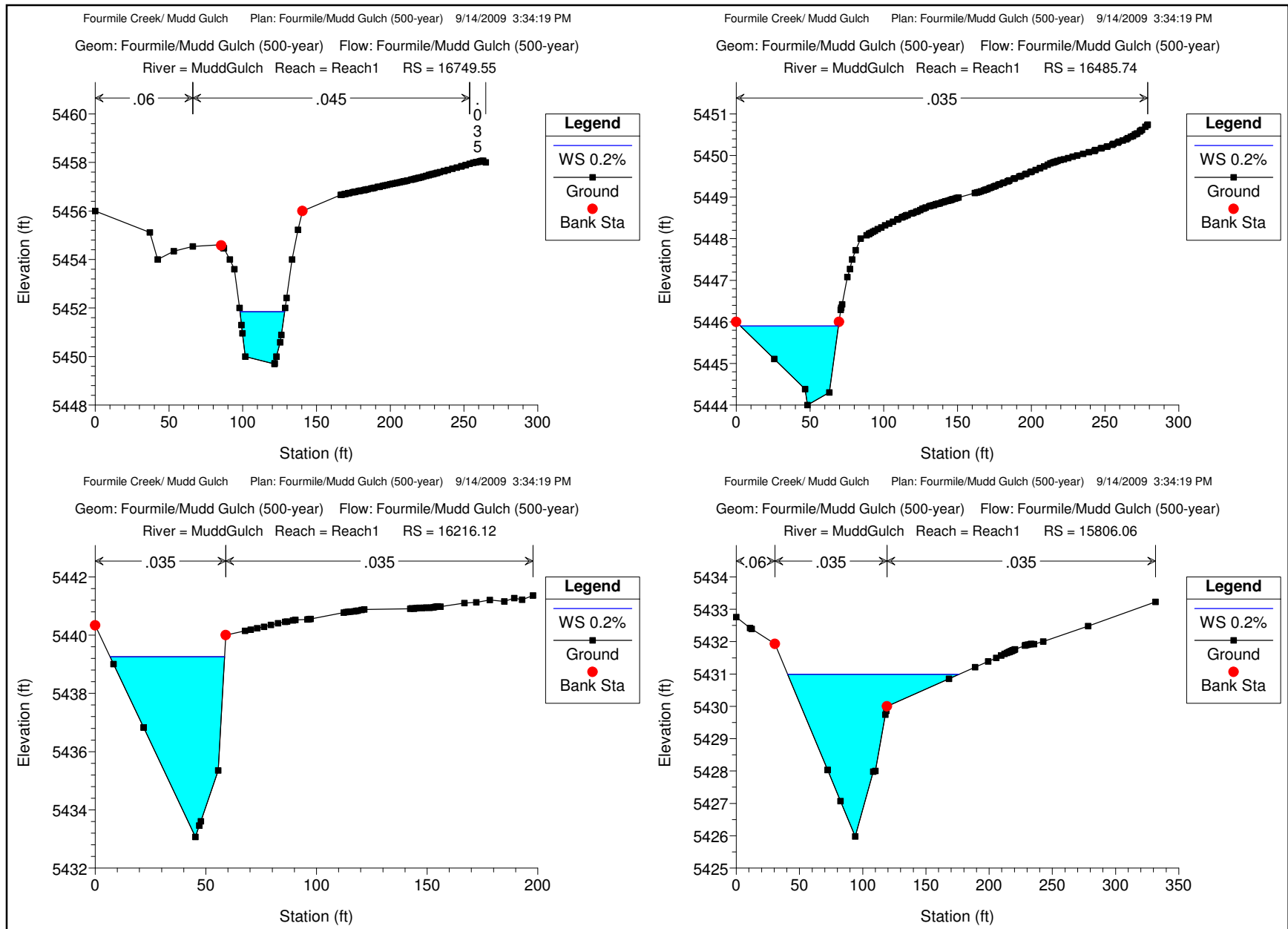


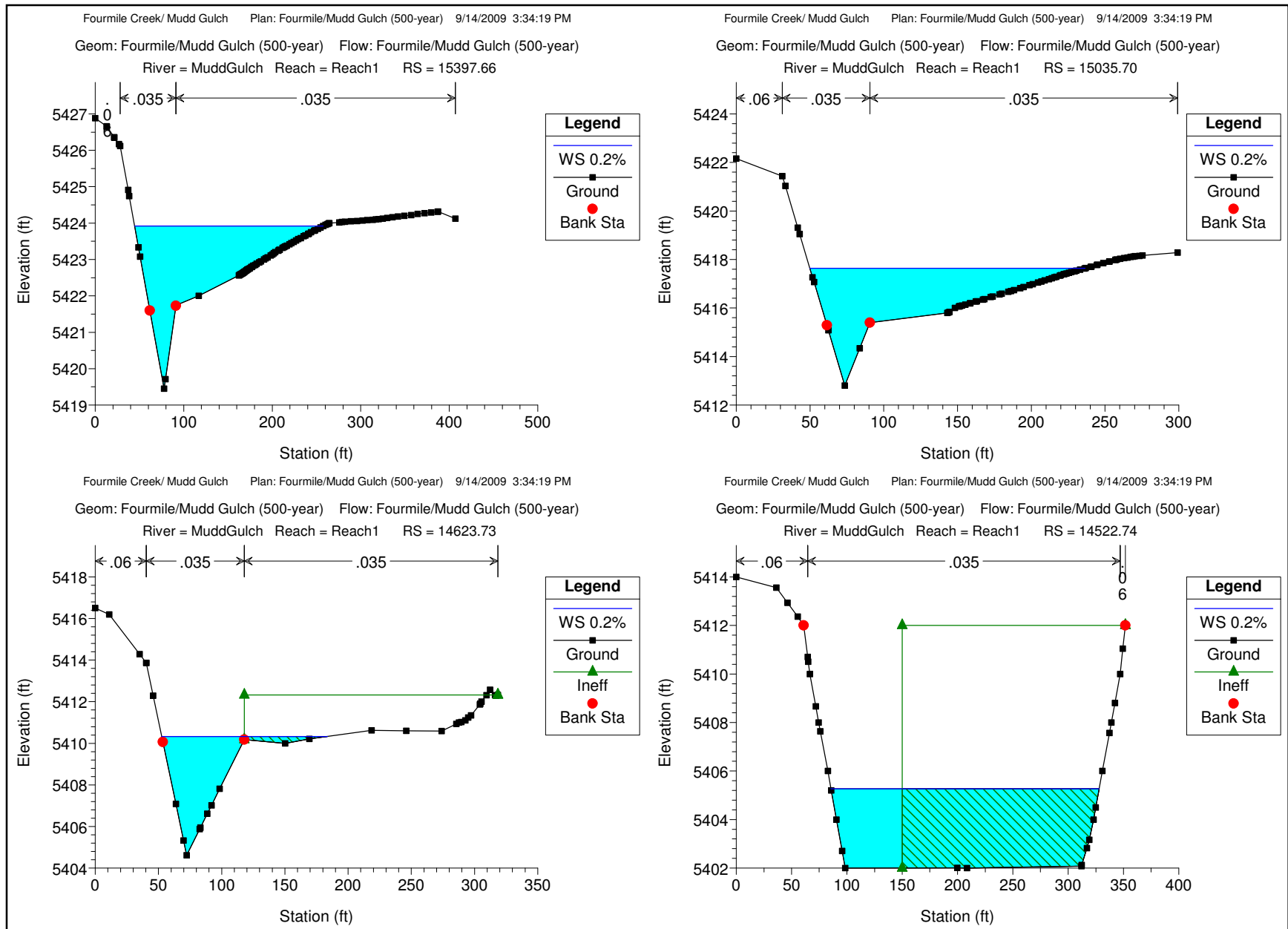
CROSS-SECTION PLOTS
(MUDD GULCH, 500-YEAR)

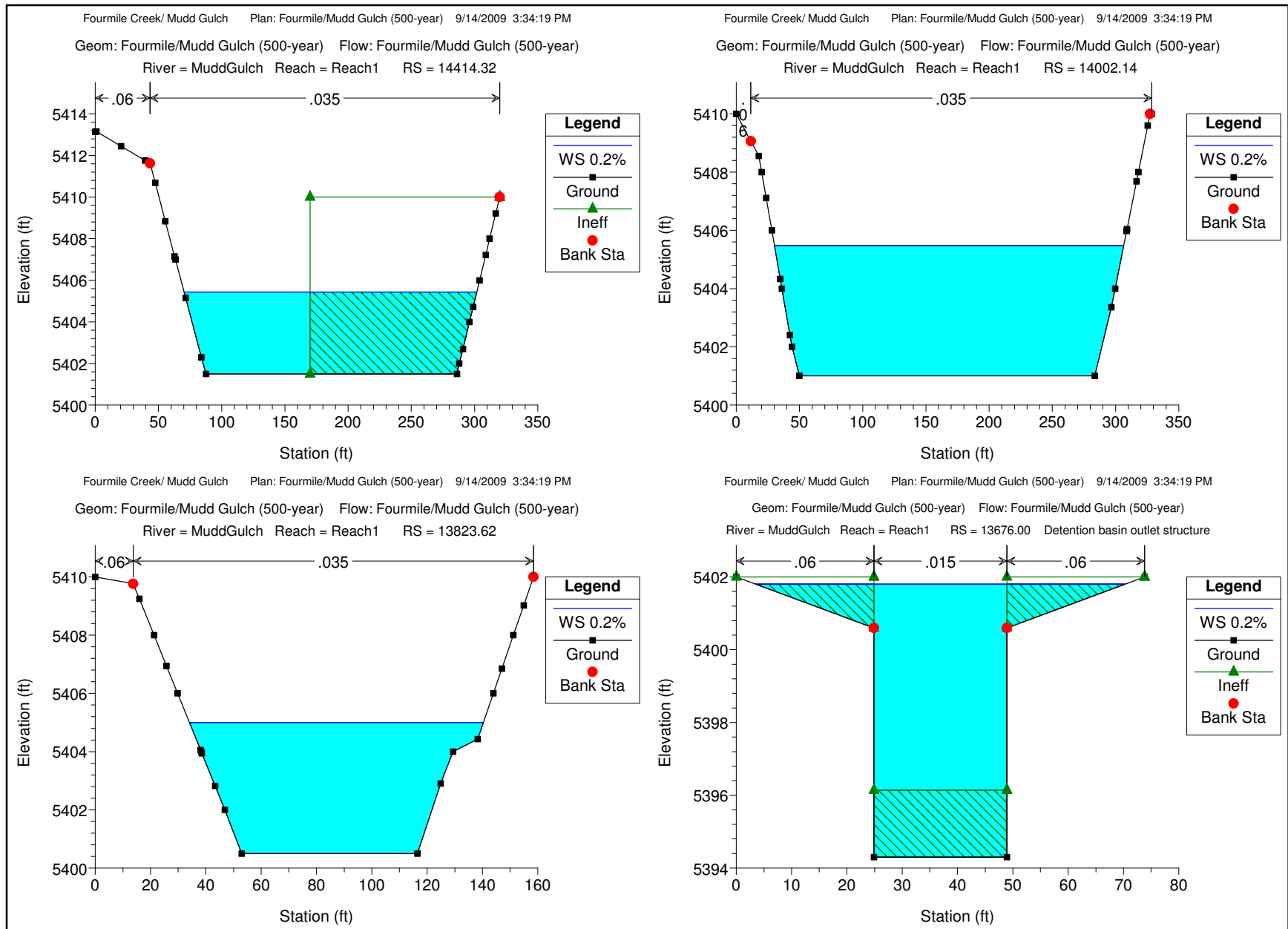


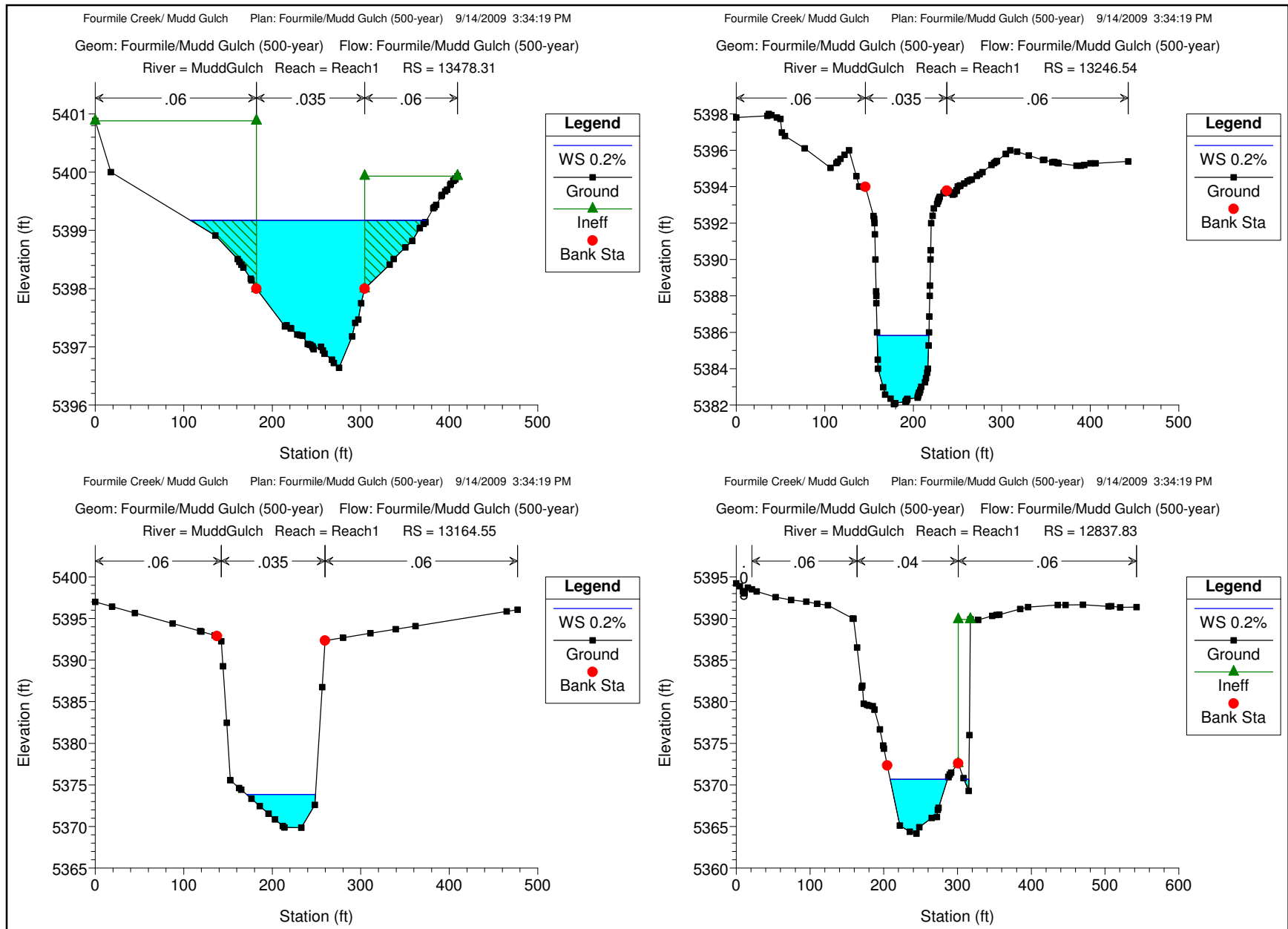


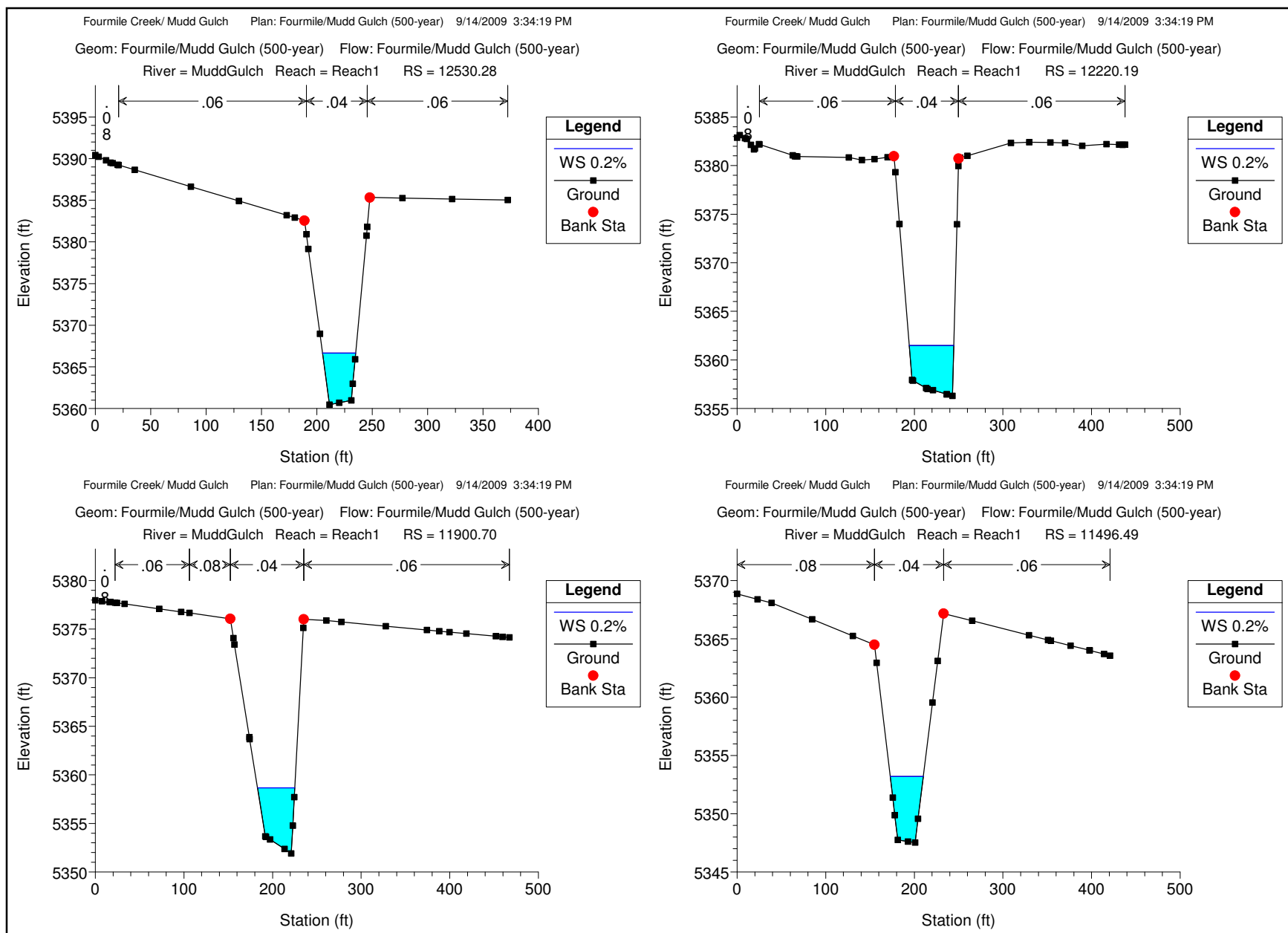


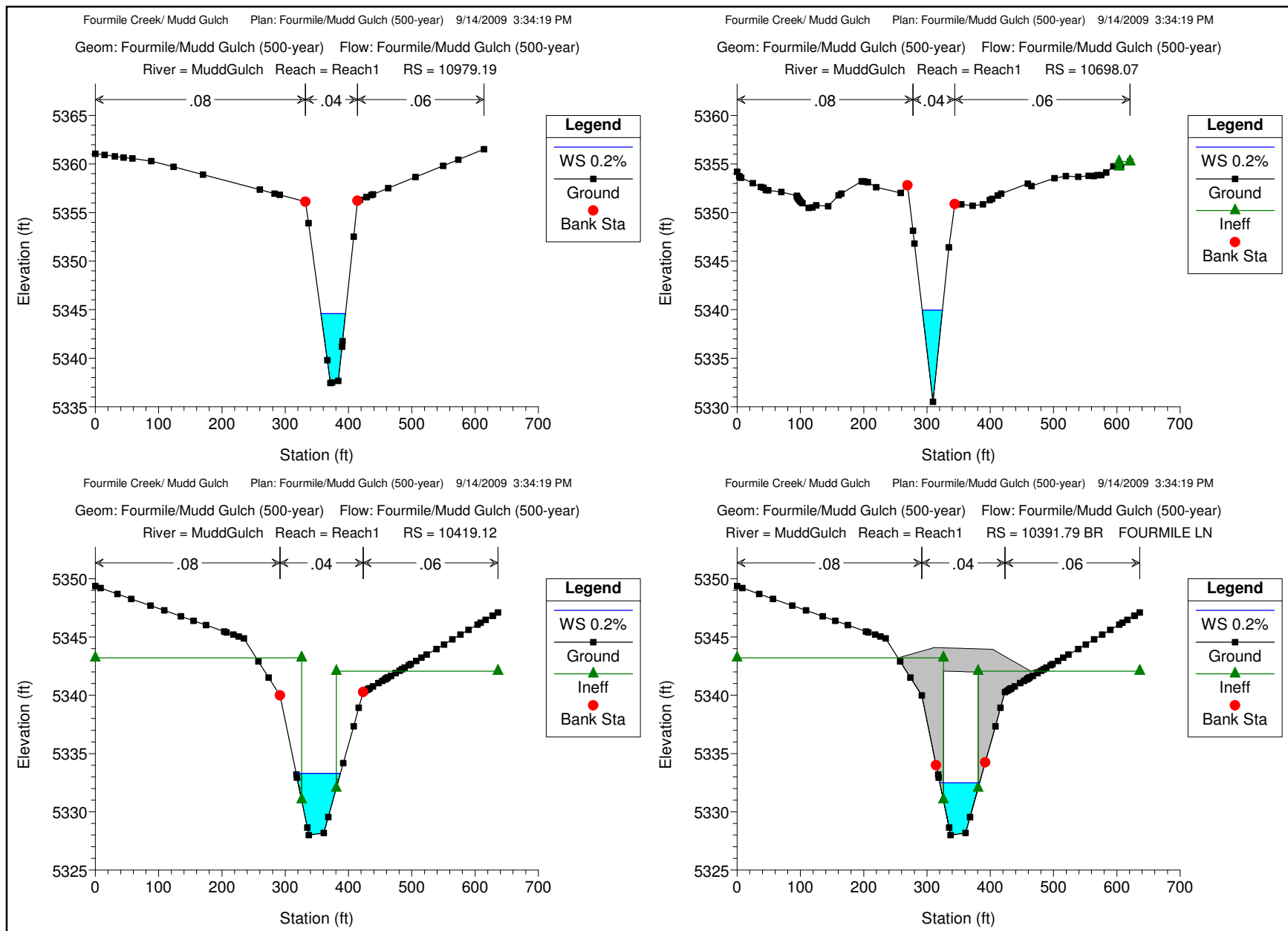


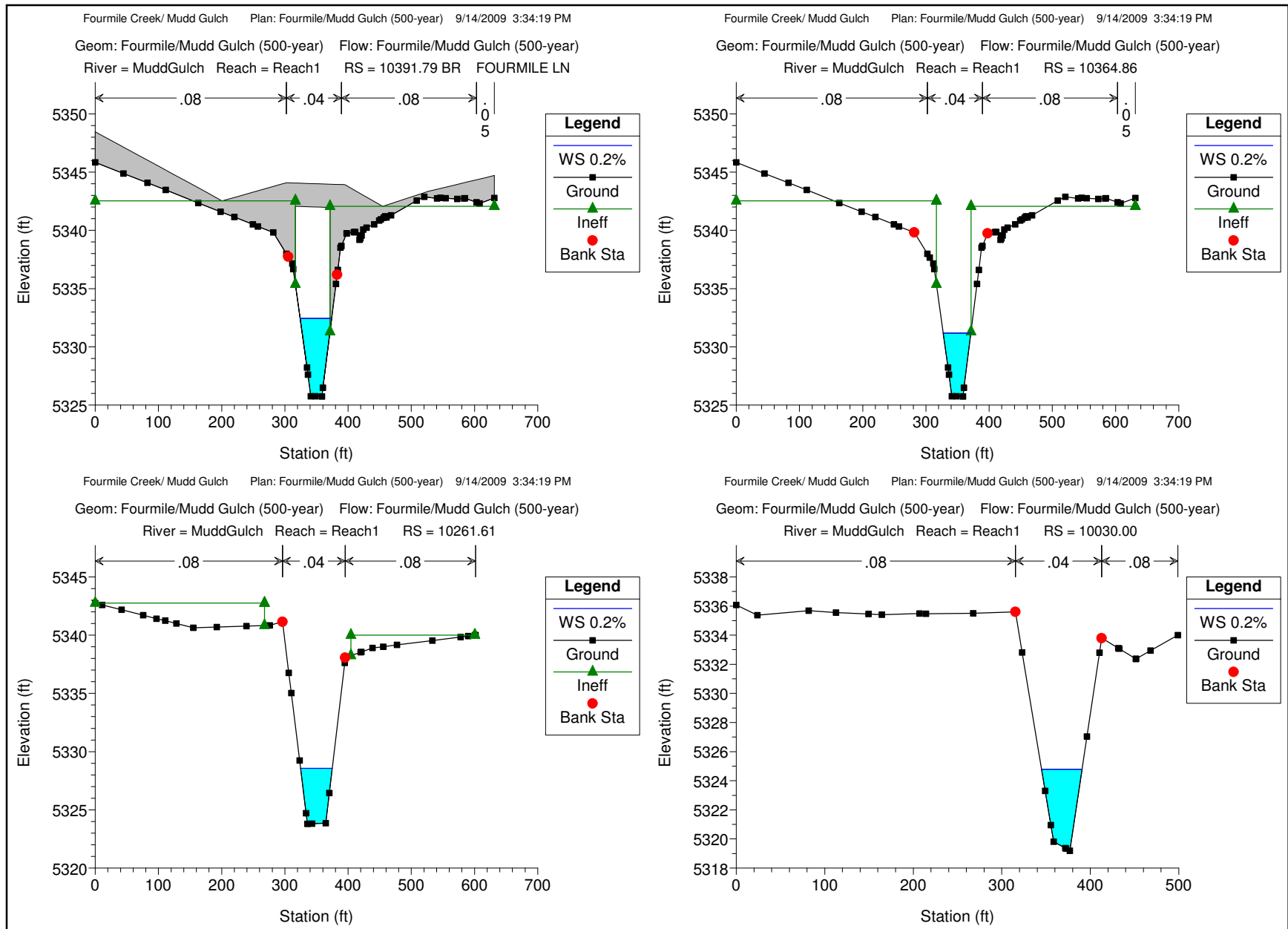


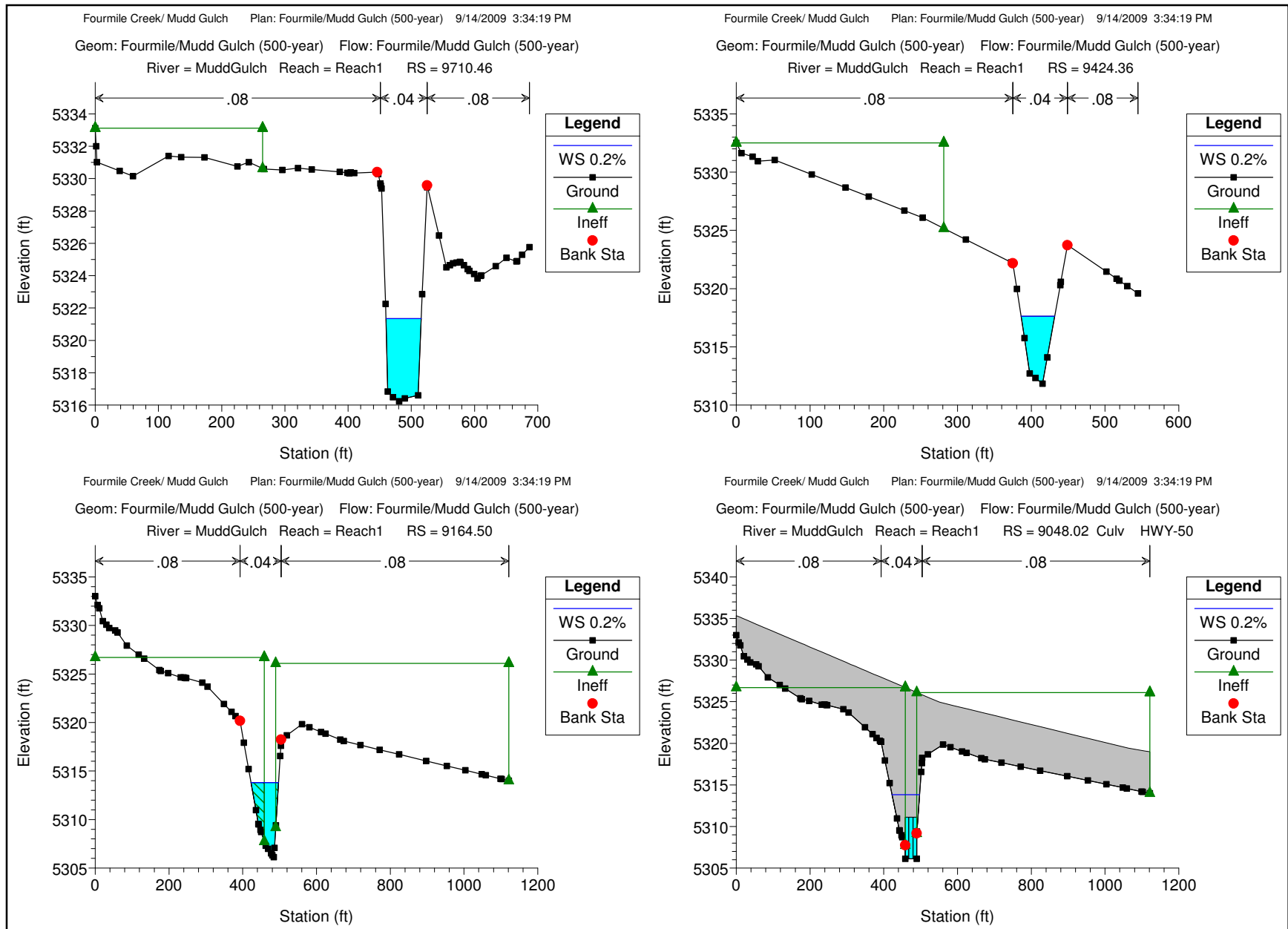


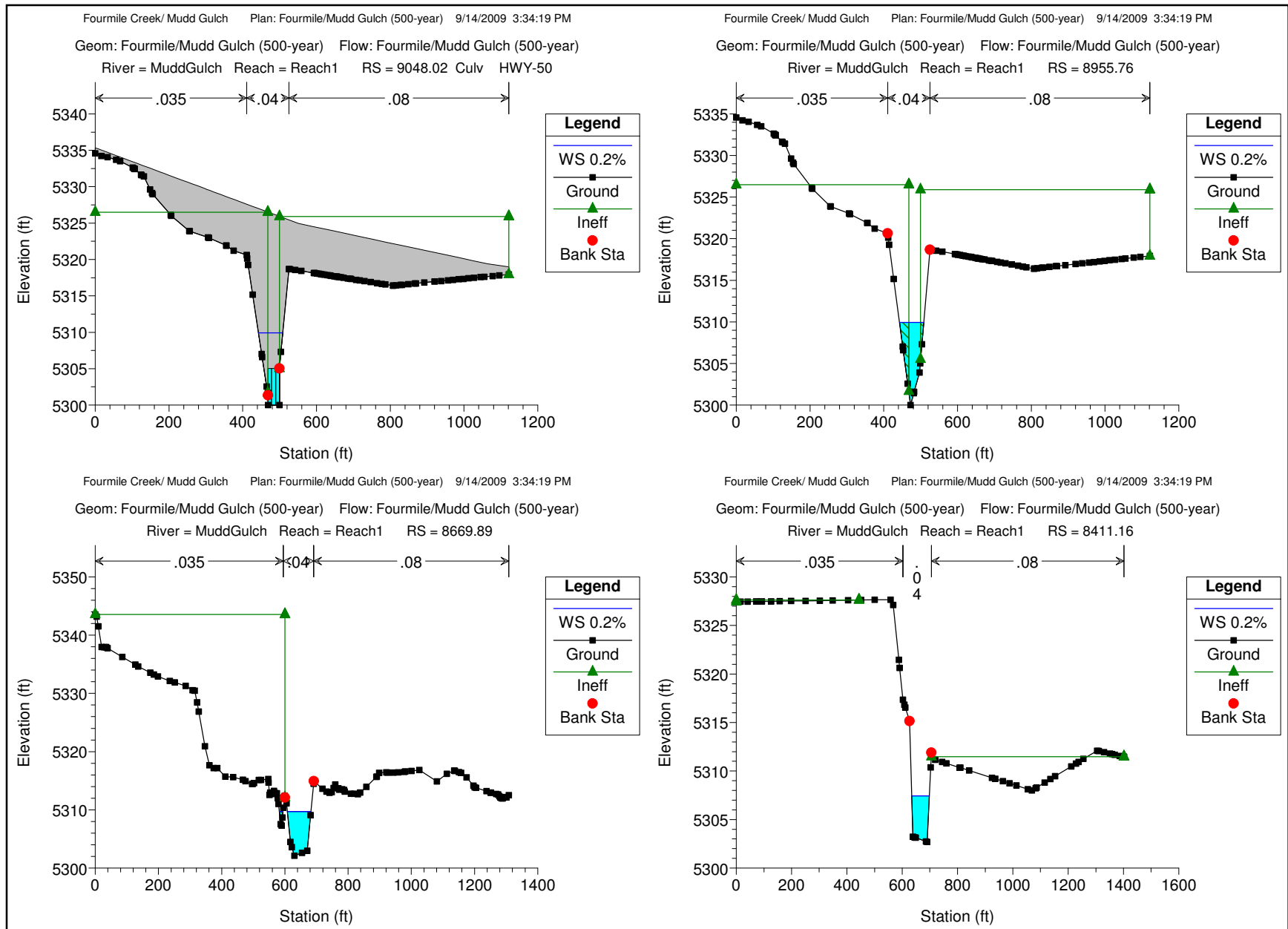


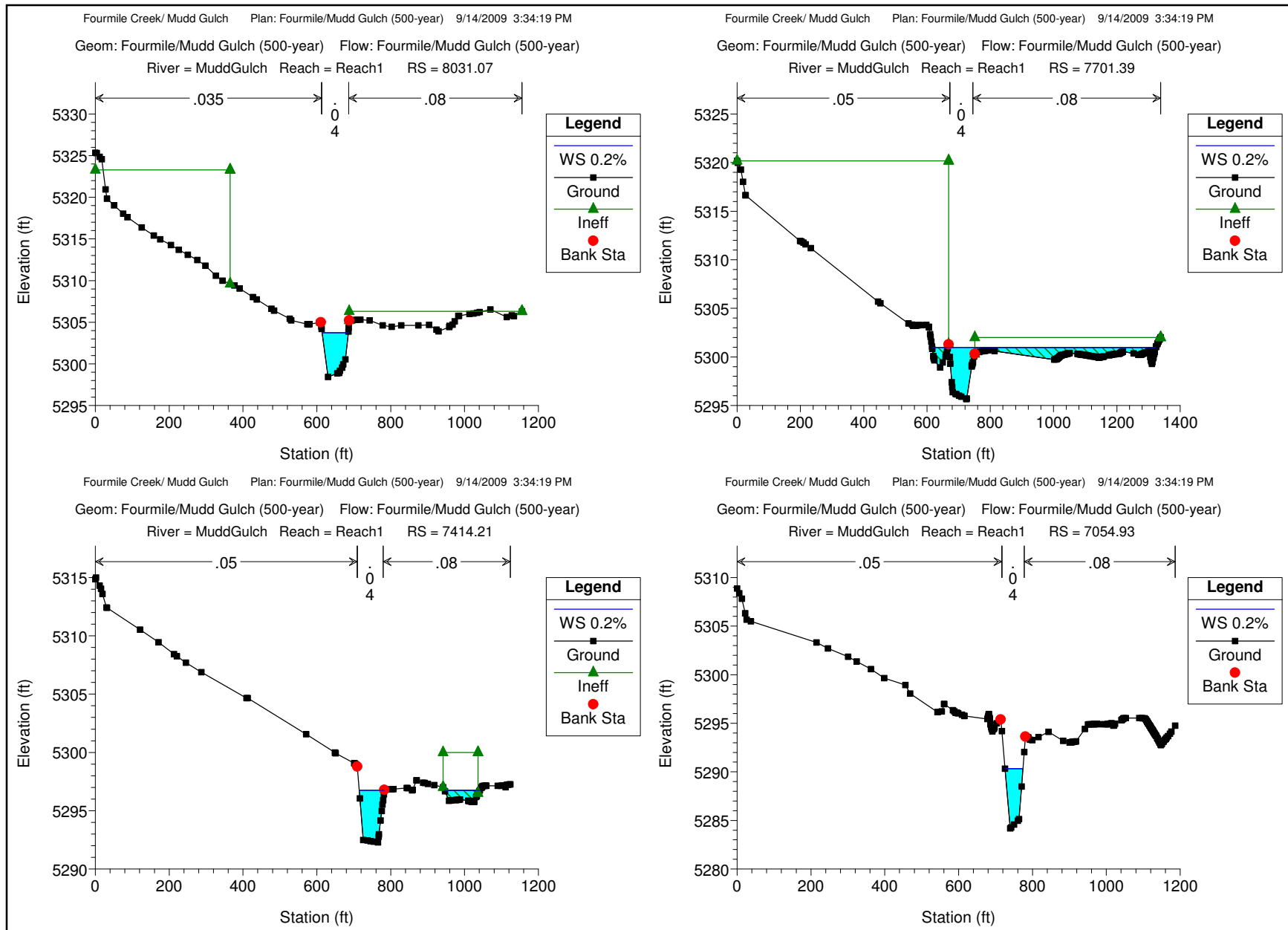


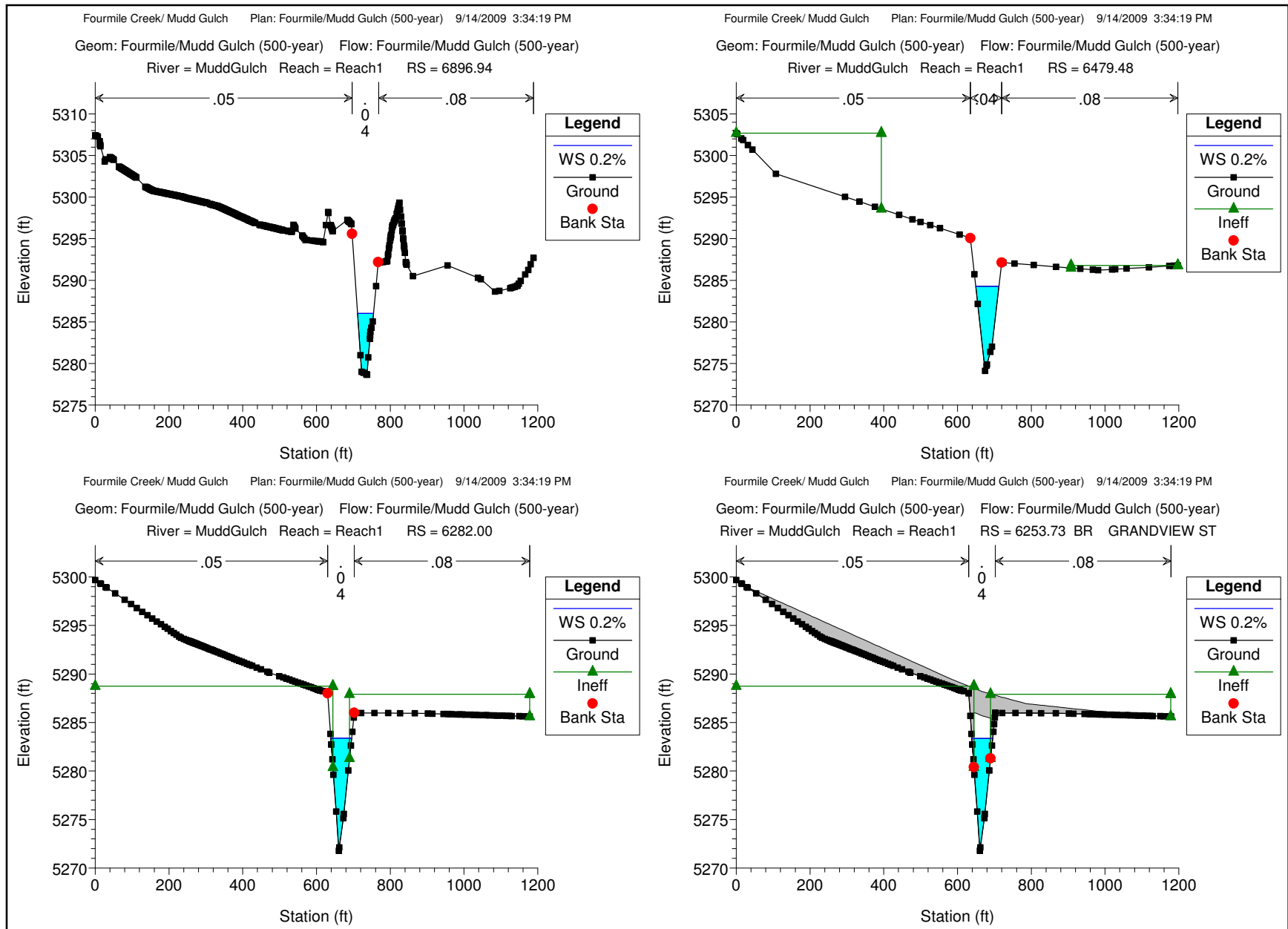


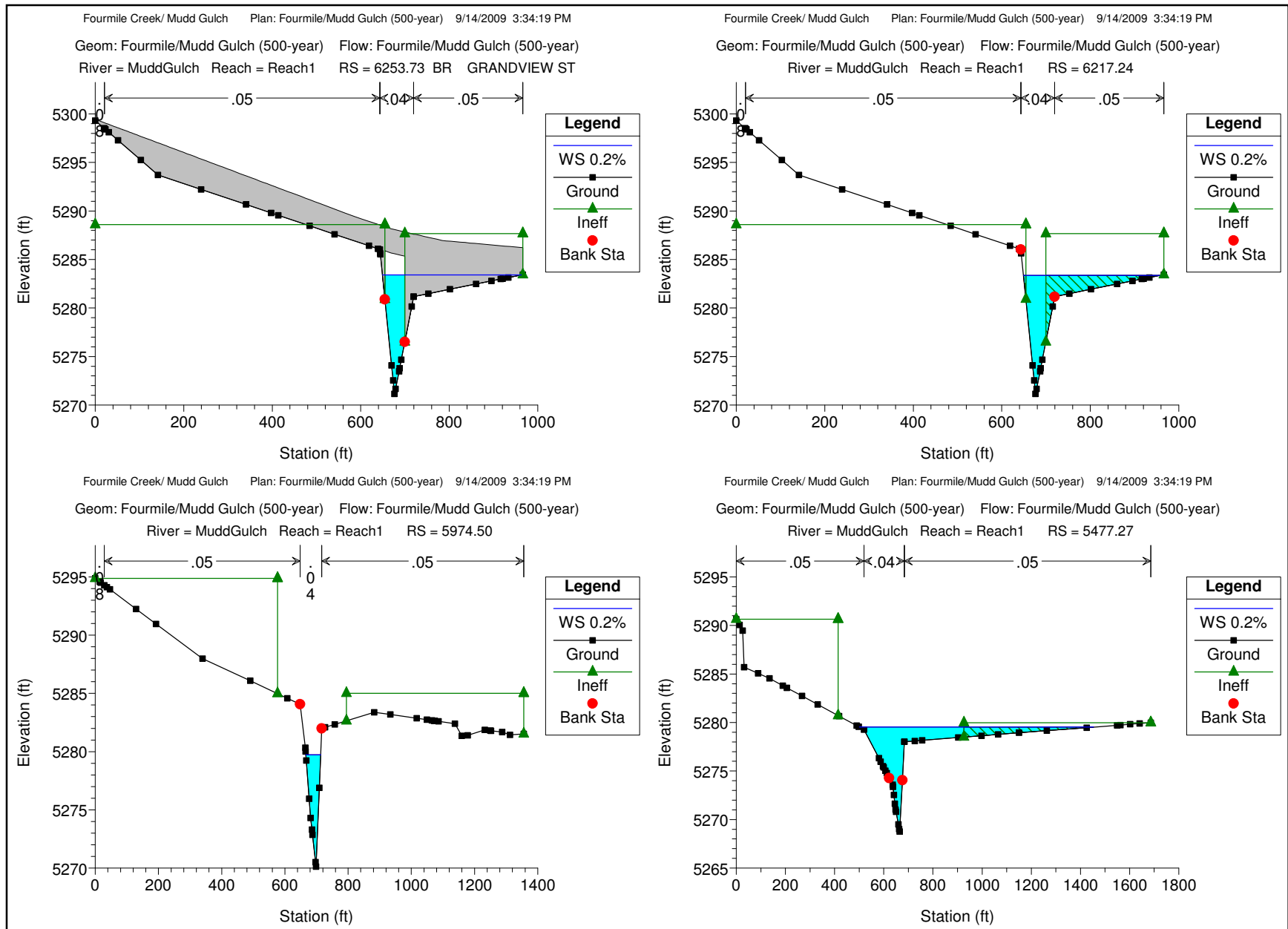


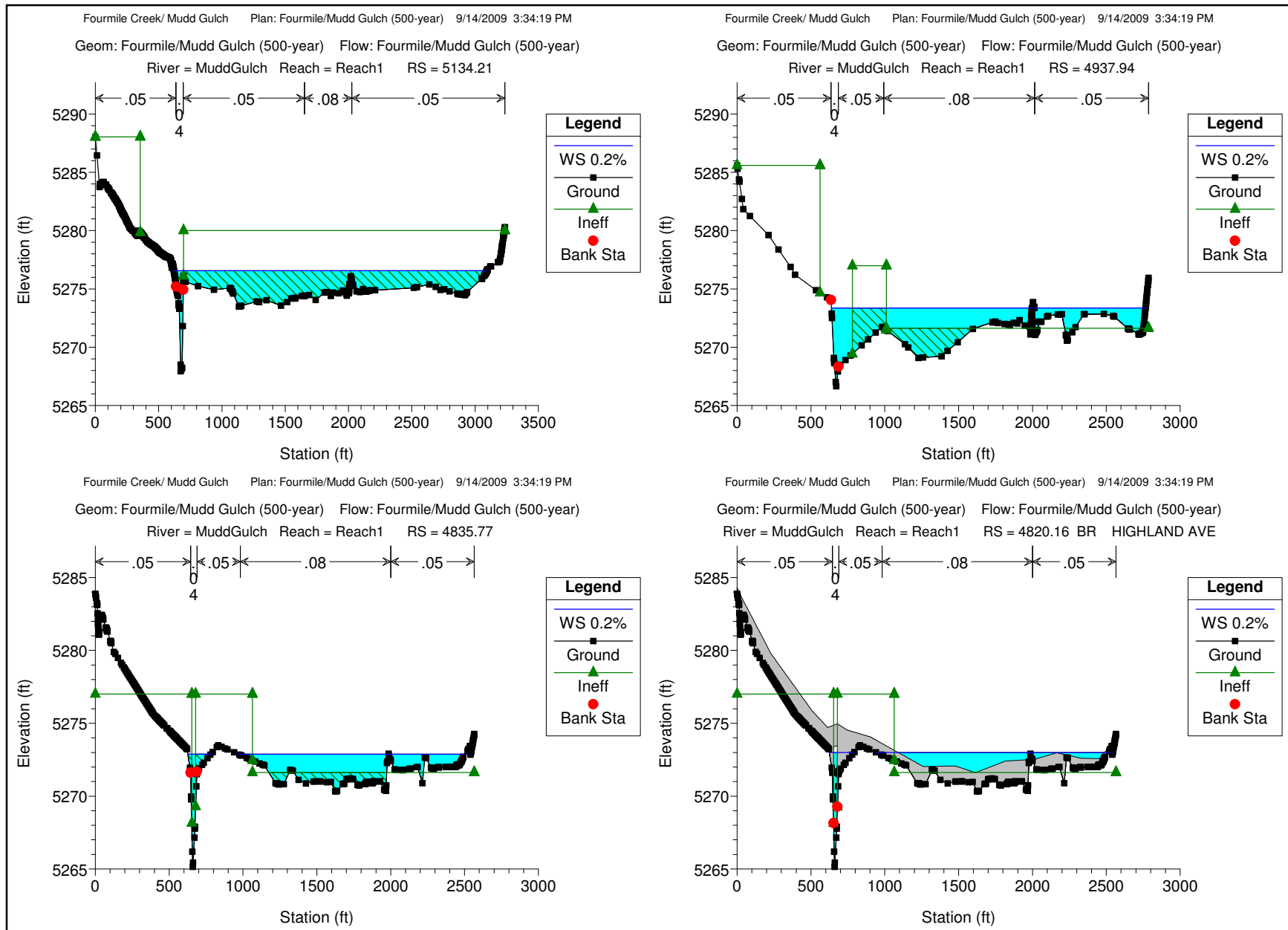


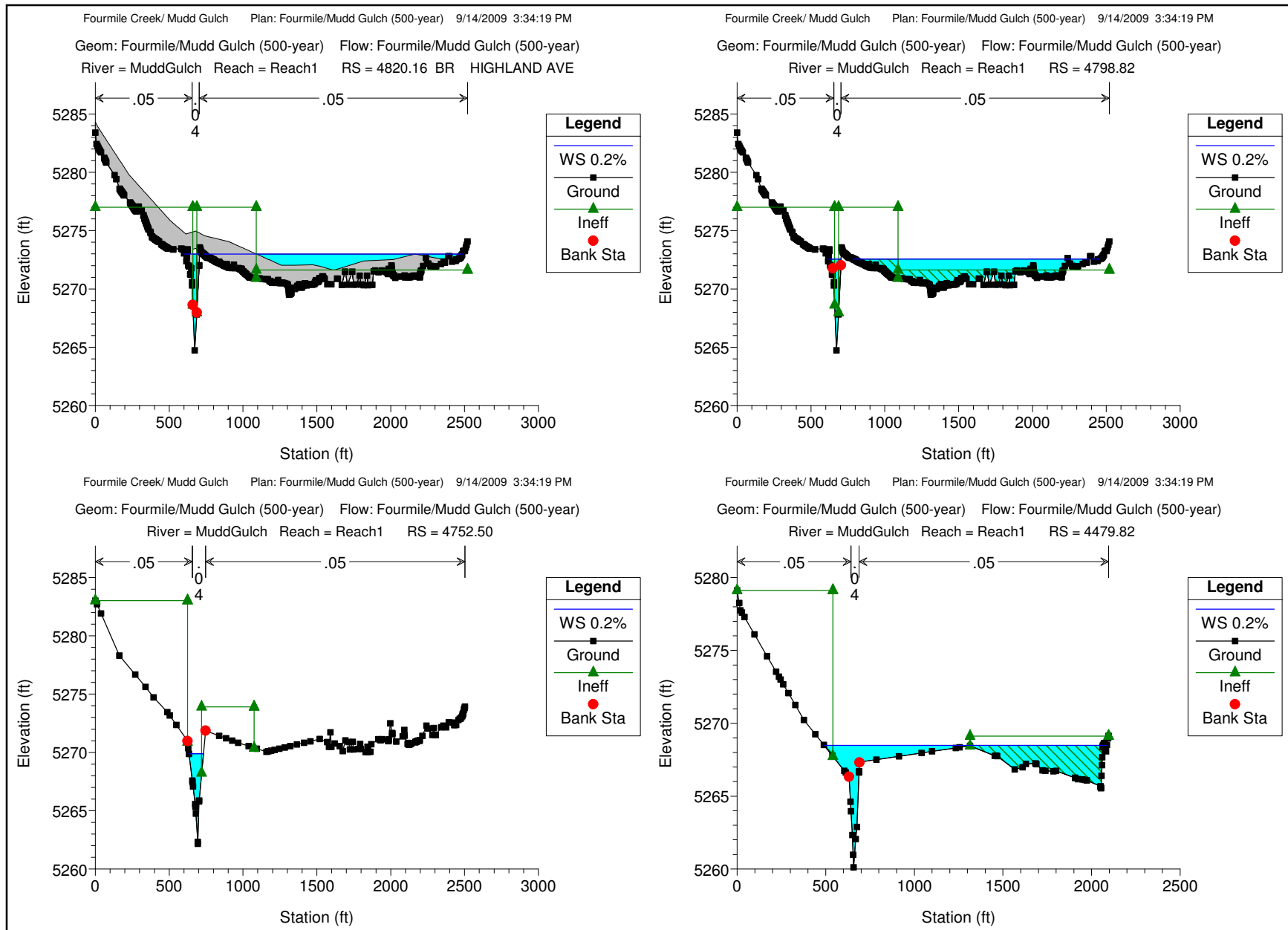


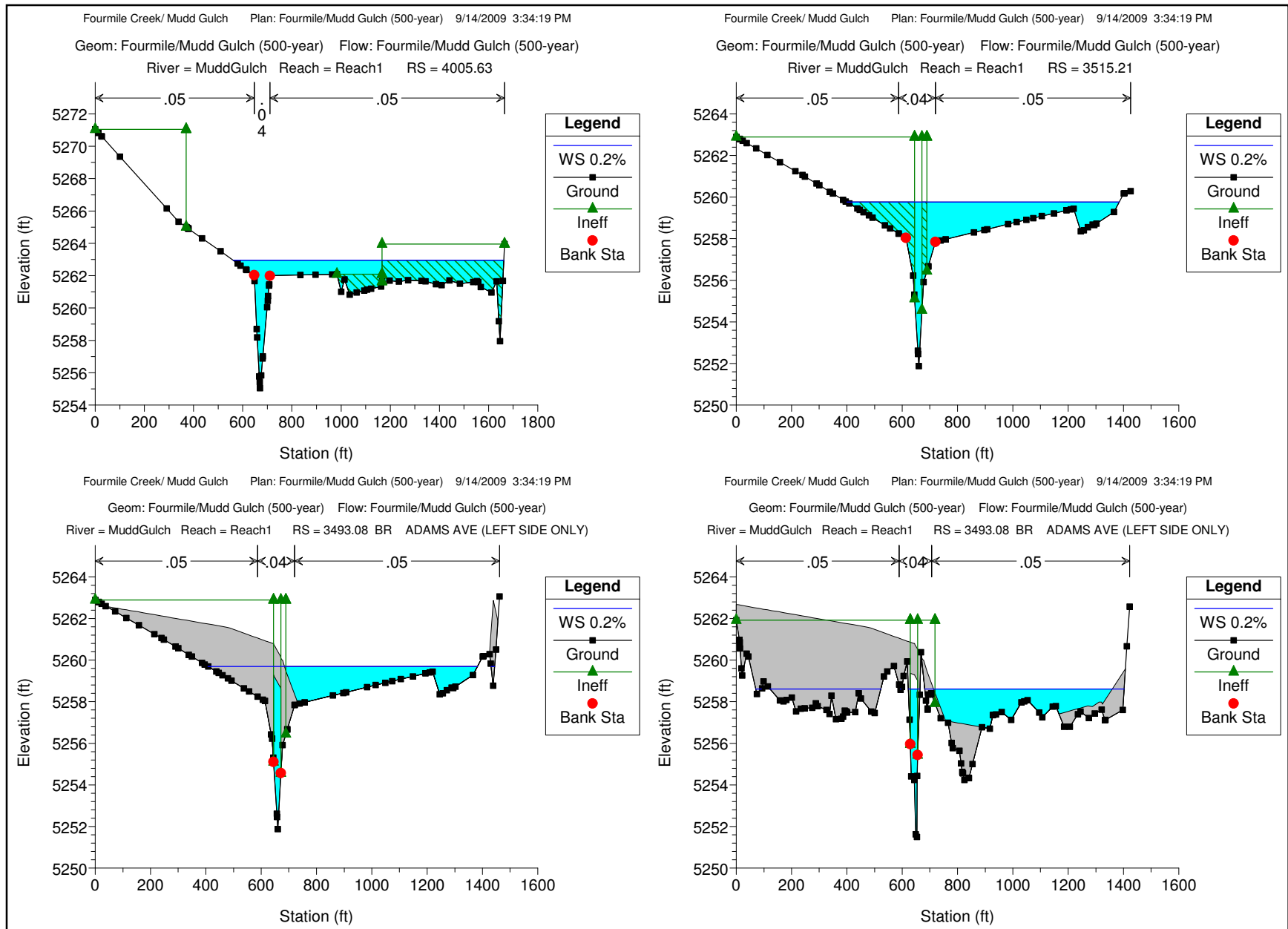


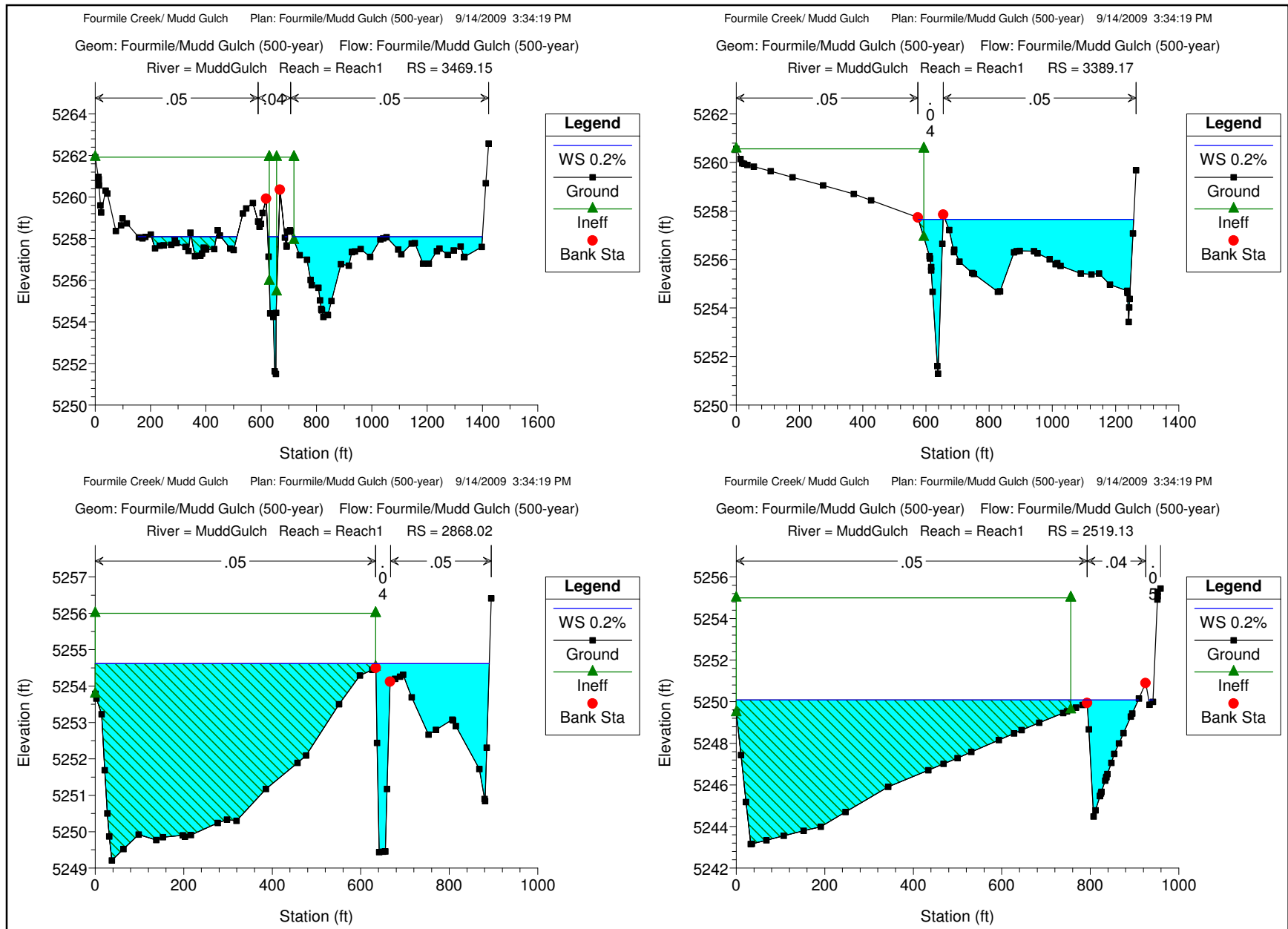


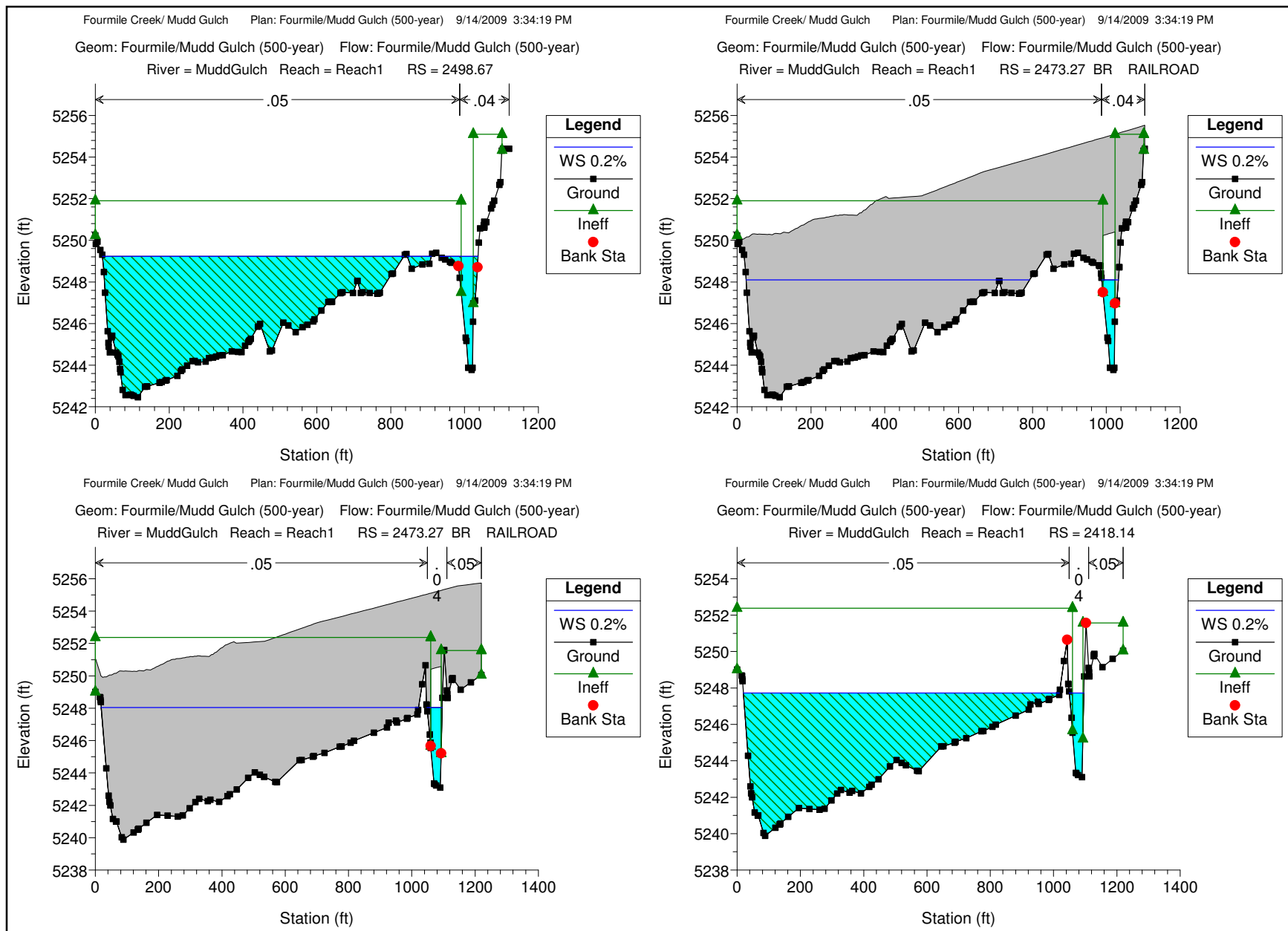


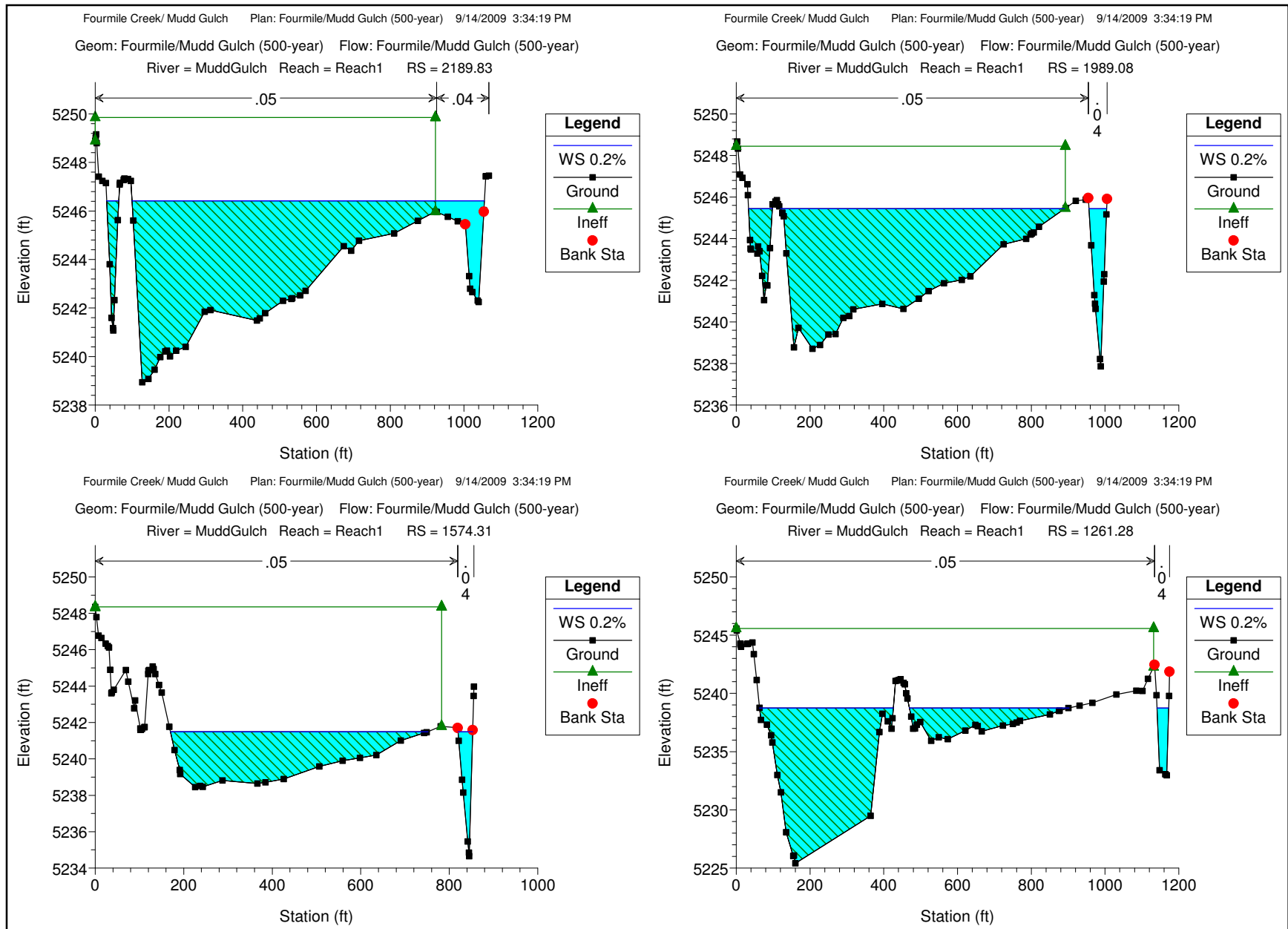


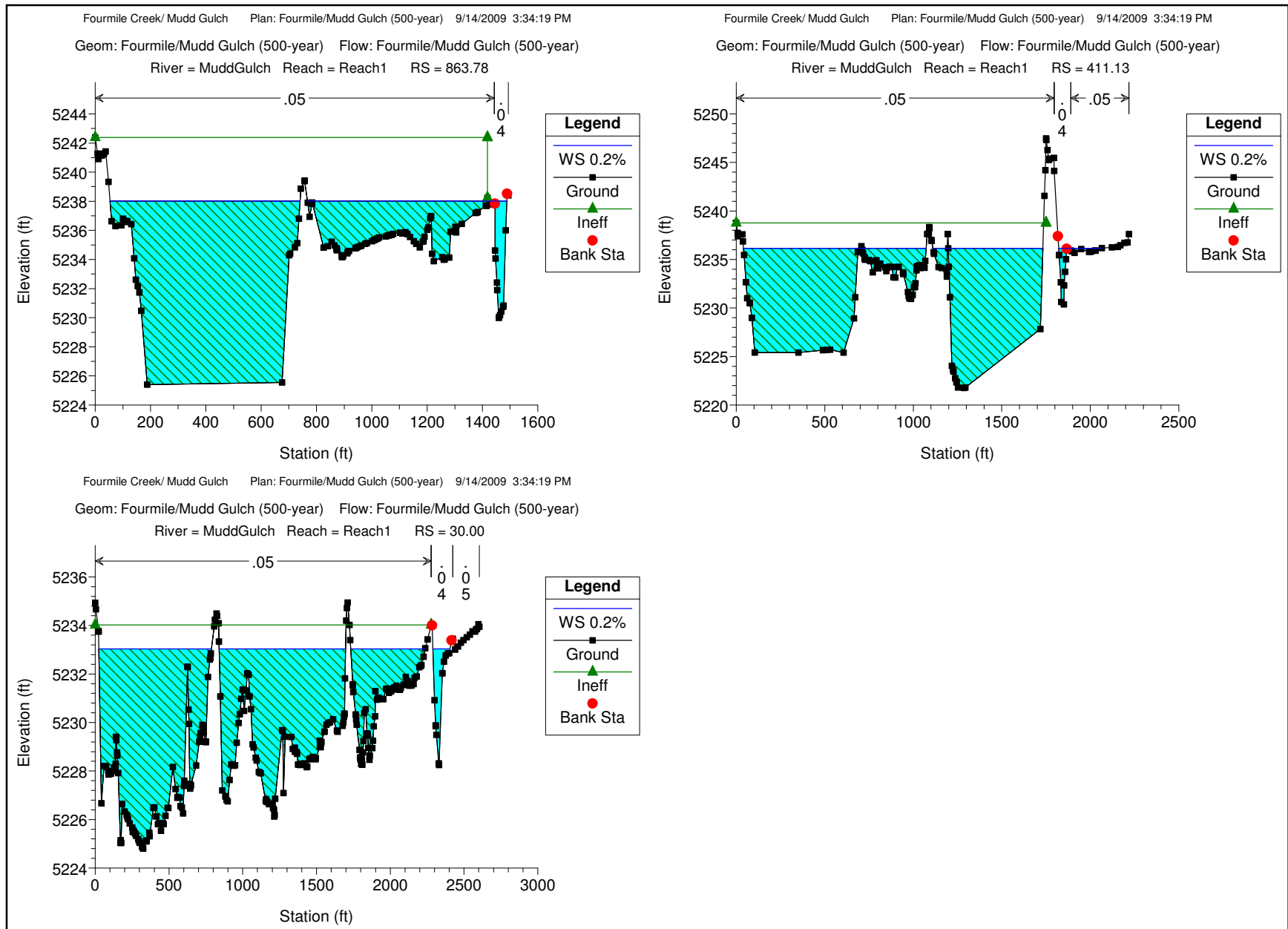




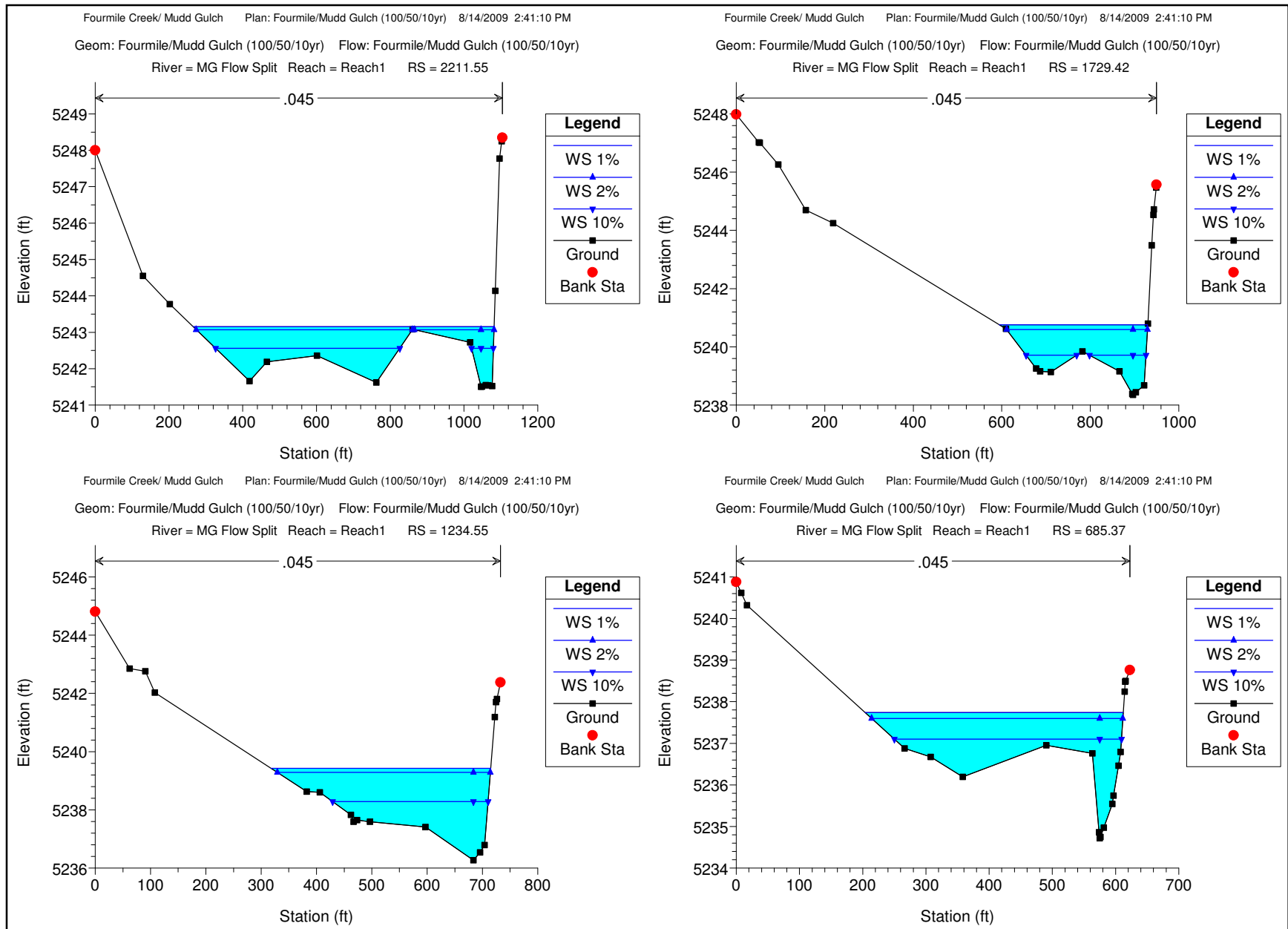


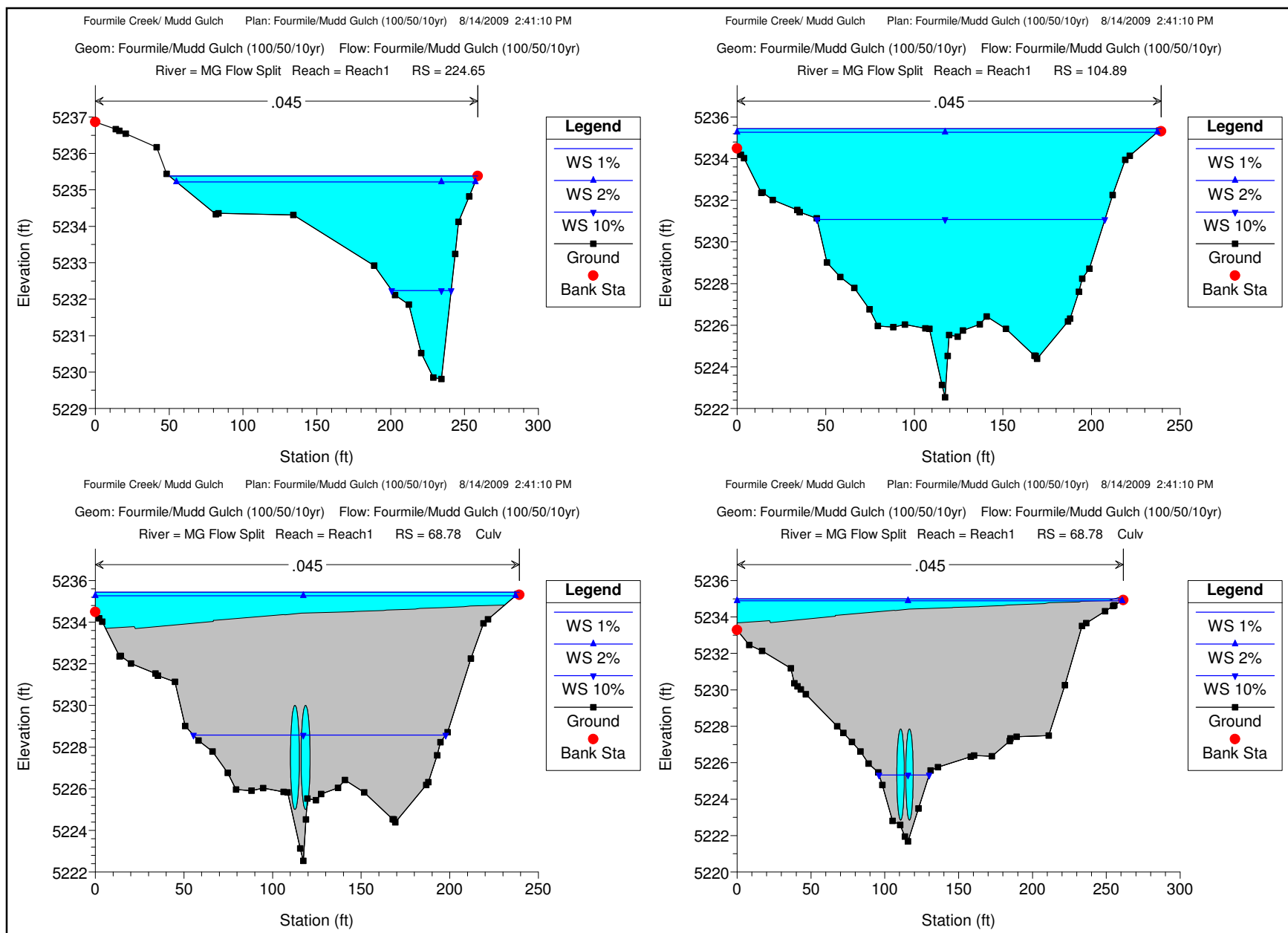






CROSS-SECTION PLOTS
(MUDD GULCH FLOW SPLIT, 100-50-10-YEAR)

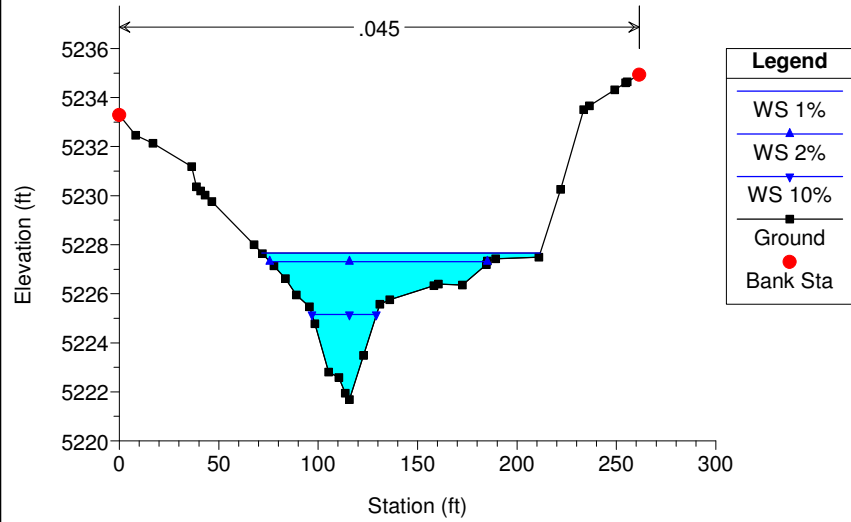




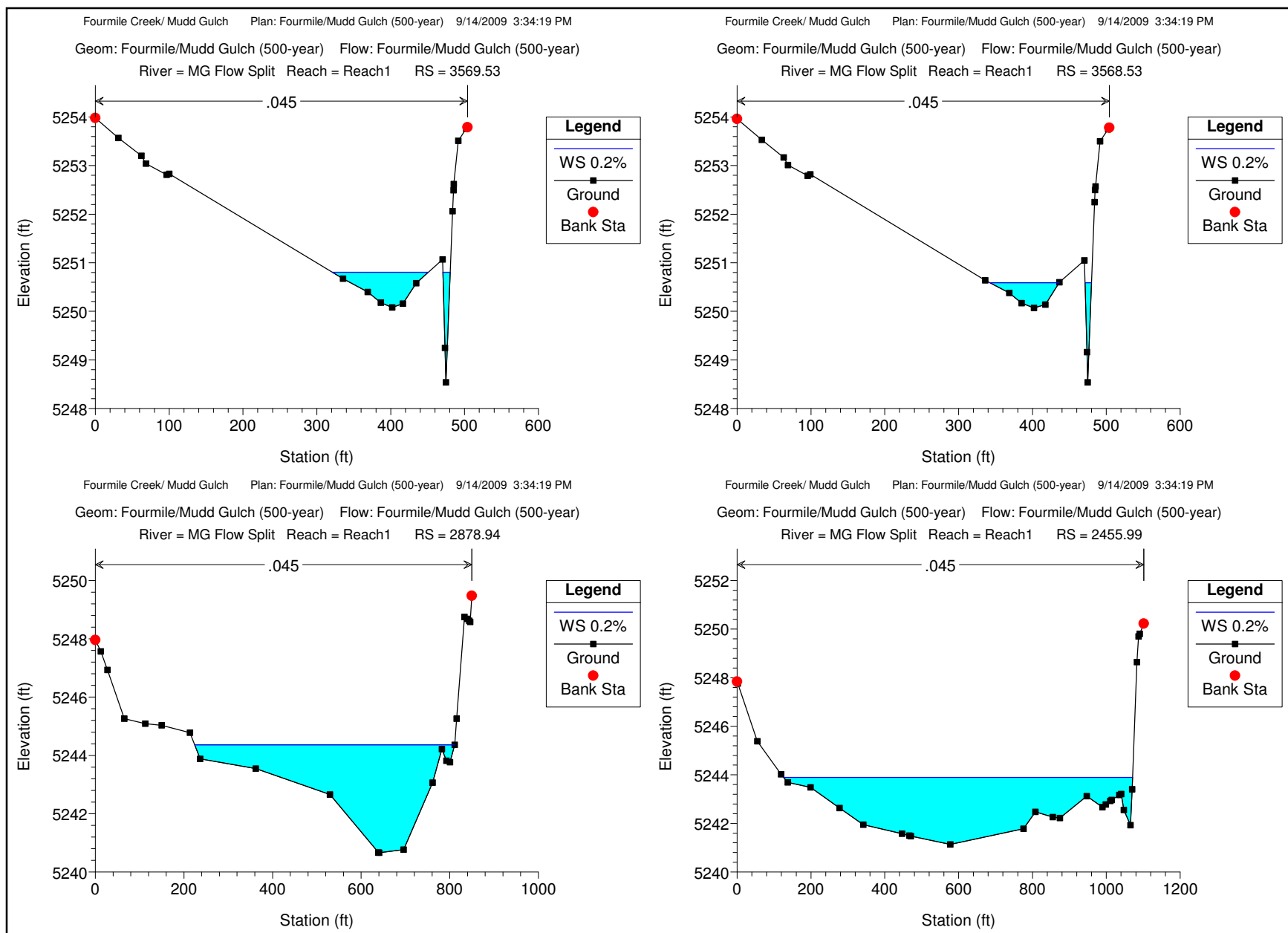
Fourmile Creek/ Mudd Gulch Plan: Fourmile/Mudd Gulch (100/50/10yr) 8/14/2009 2:41:10 PM

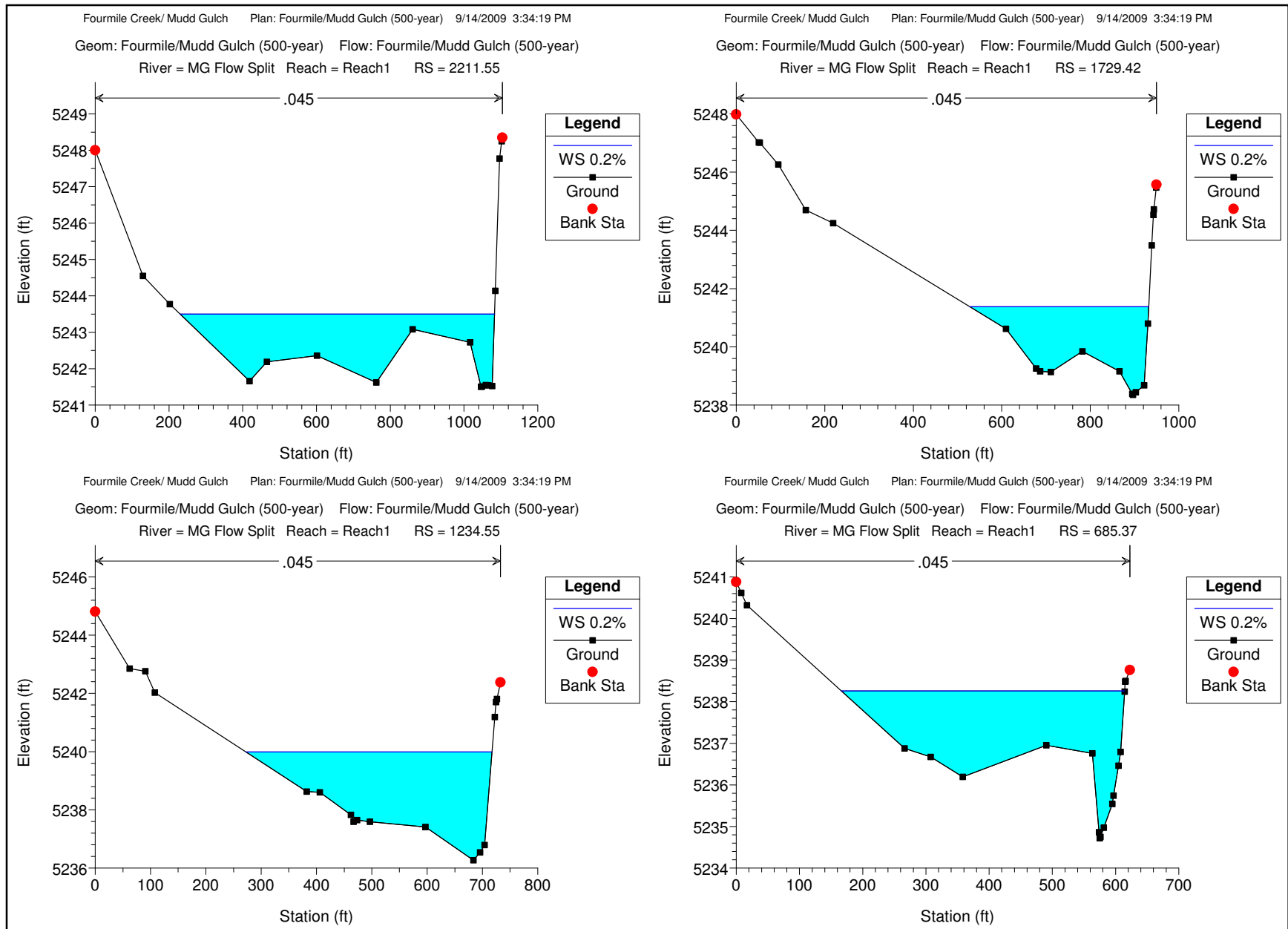
Geom: Fourmile/Mudd Gulch (100/50/10yr) Flow: Fourmile/Mudd Gulch (100/50/10yr)

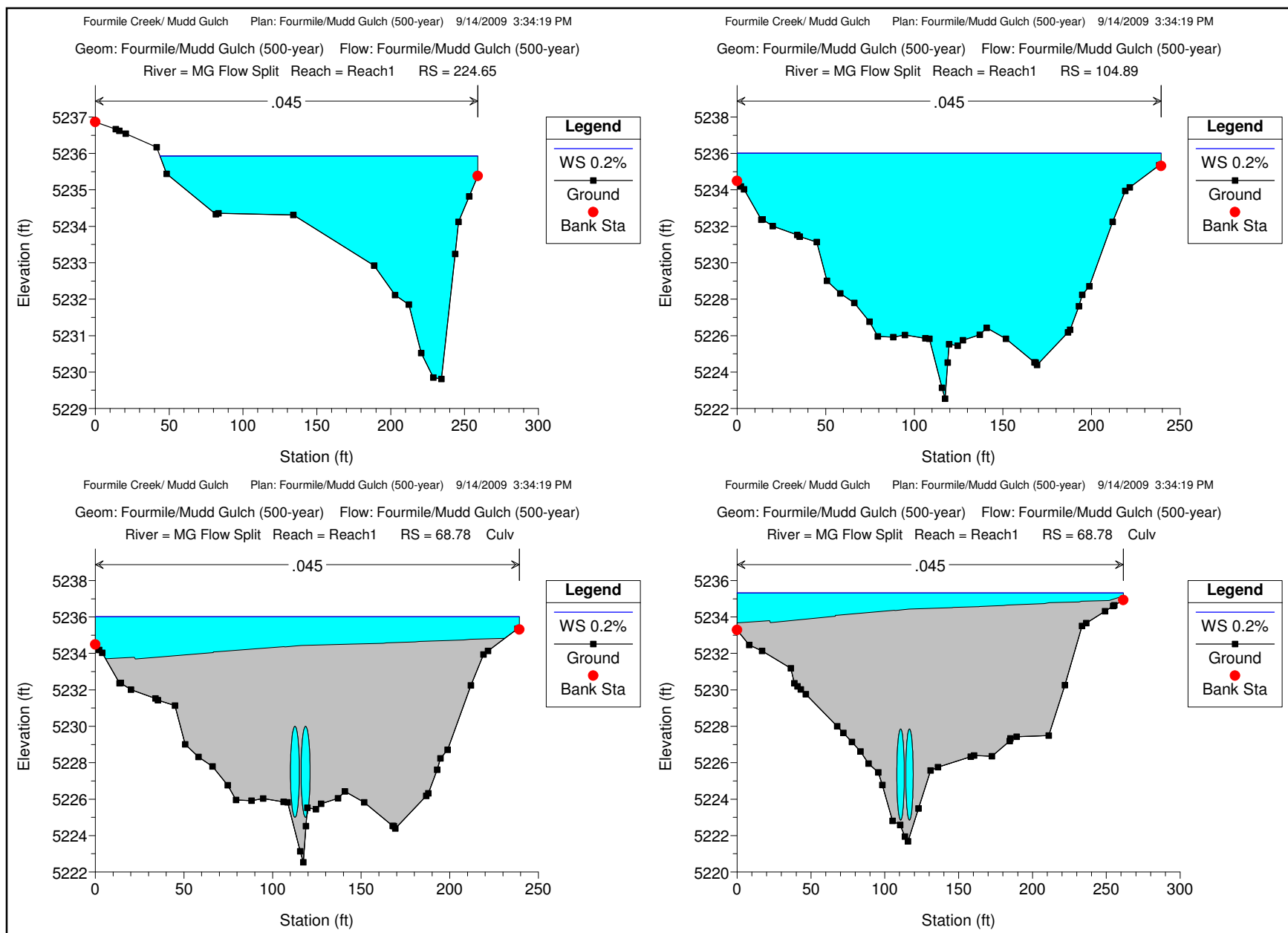
River = MG Flow Split Reach = Reach1 RS = 14.14



CROSS-SECTION PLOTS
(MUDD GULCH FLOW SPLIT, 500-YEAR)



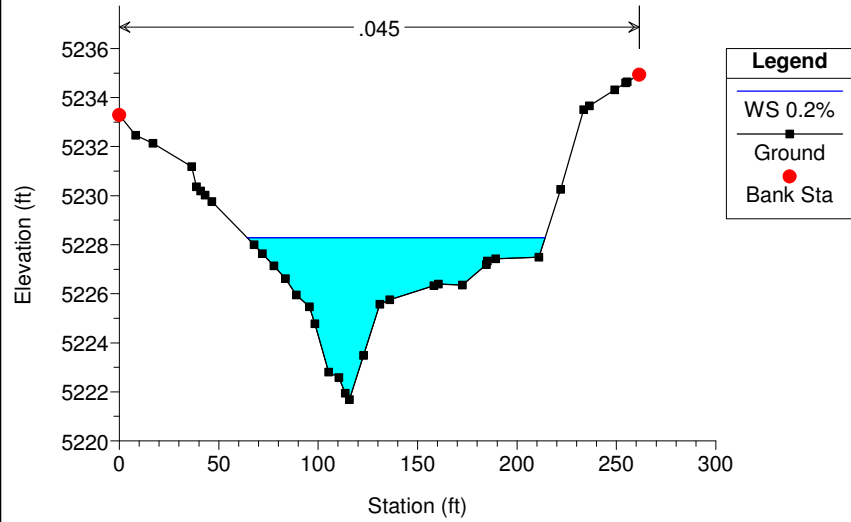




Fourmile Creek/ Mudd Gulch Plan: Fourmile/Mudd Gulch (500-year) 9/14/2009 3:34:19 PM

Geom: Fourmile/Mudd Gulch (500-year) Flow: Fourmile/Mudd Gulch (500-year)

River = MG Flow Split Reach = Reach1 RS = 14.14



Section 4

Draft Flood Insurance Study

4.1. FIS Report Narrative Revisions

The Flood Insurance Study text will be provided when the Physical Map Revision is complete.

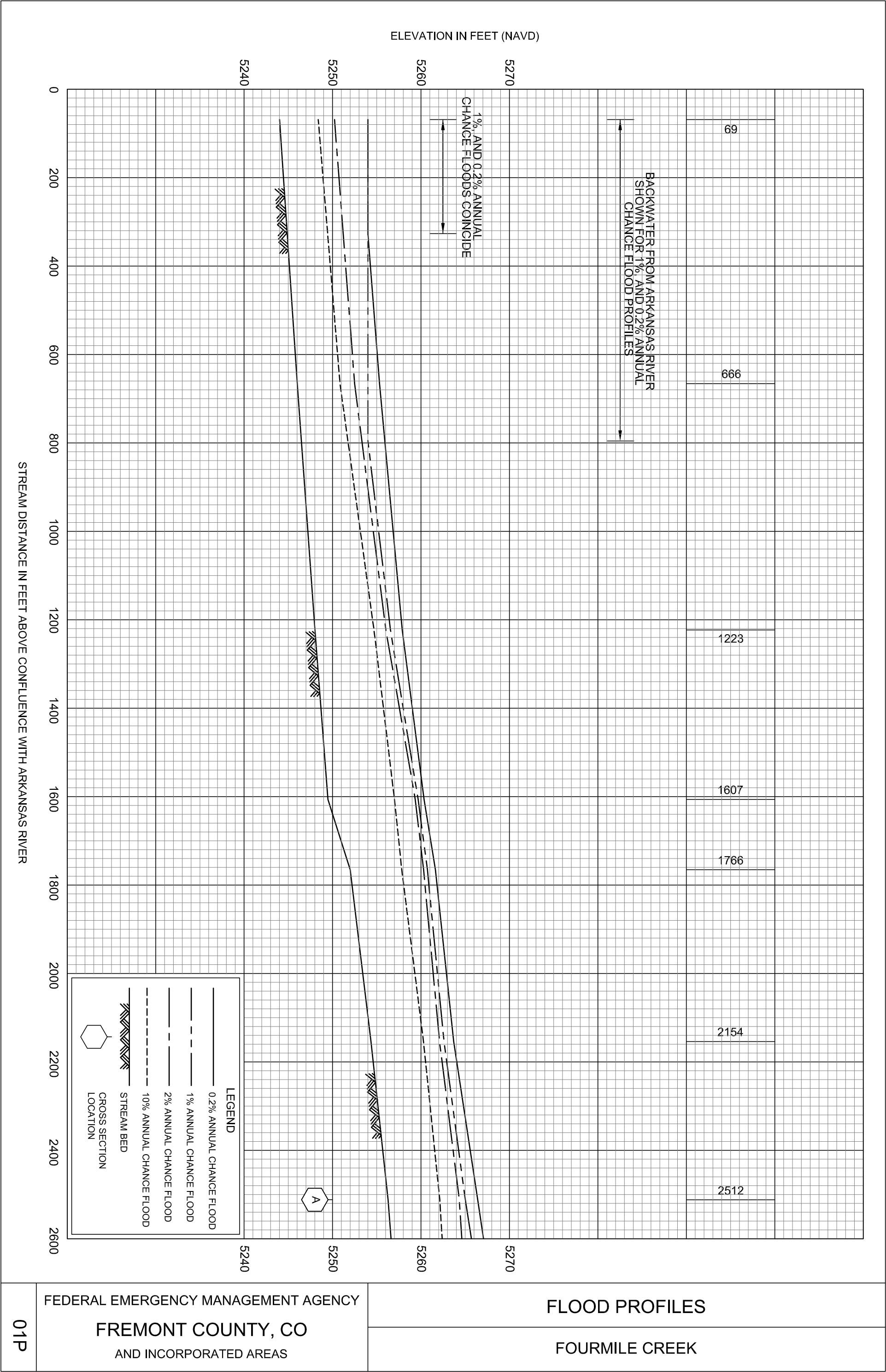
4.2. Flood Profiles

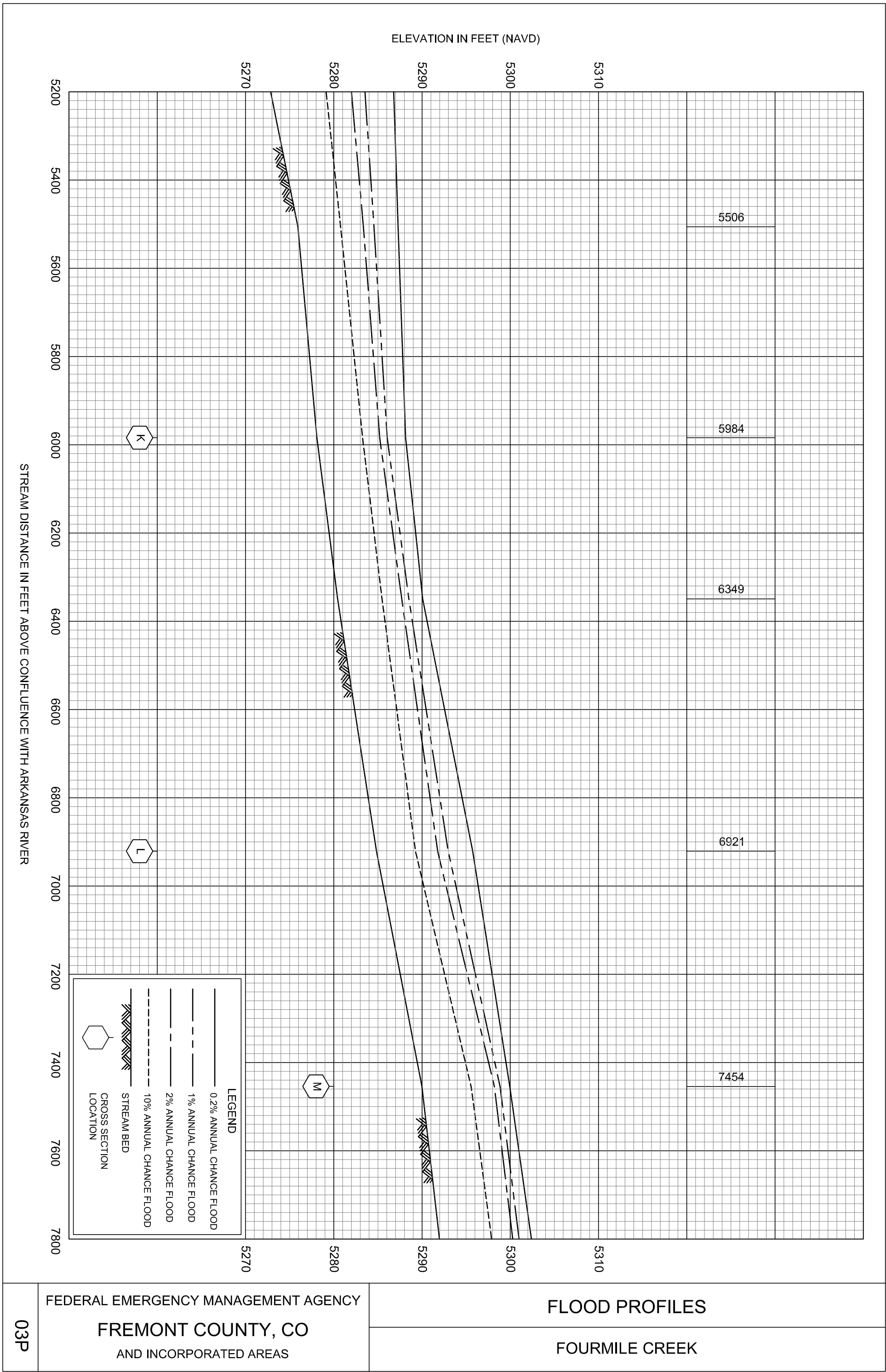
Flood Profiles are attached at the end of this section.

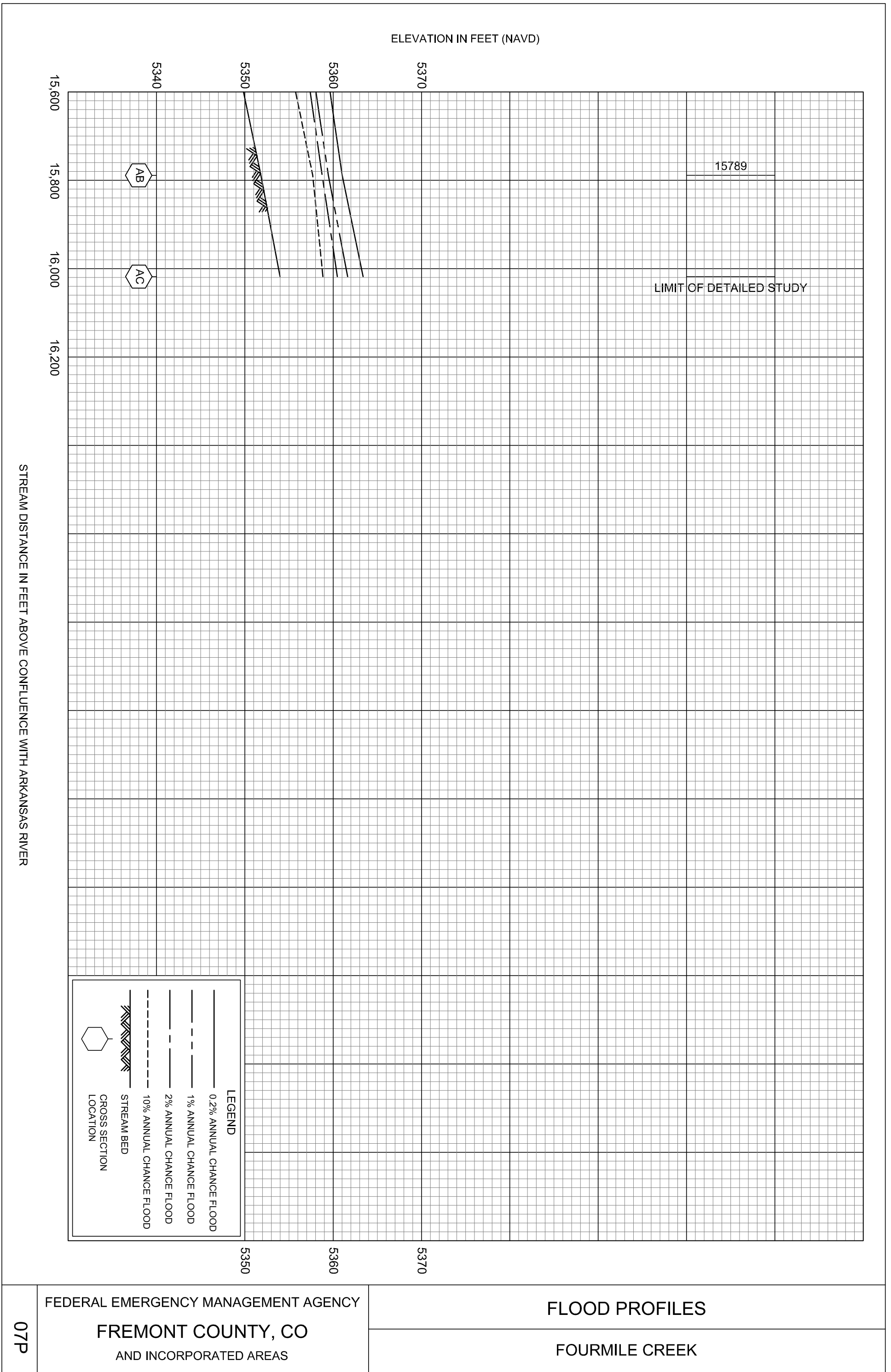
4.3. Floodway Data Tables

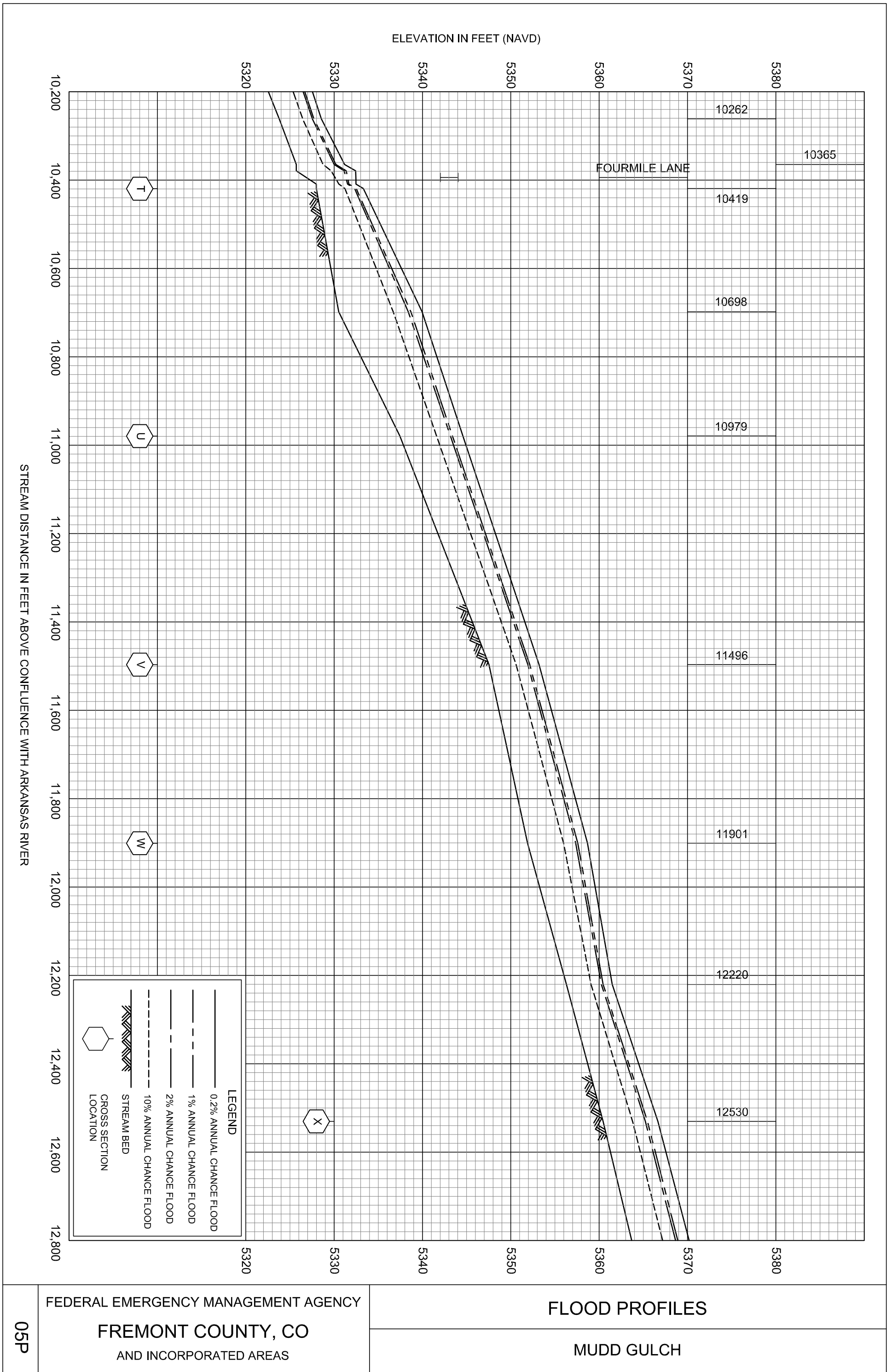
Floodway Data Tables are attached at the end of this section.

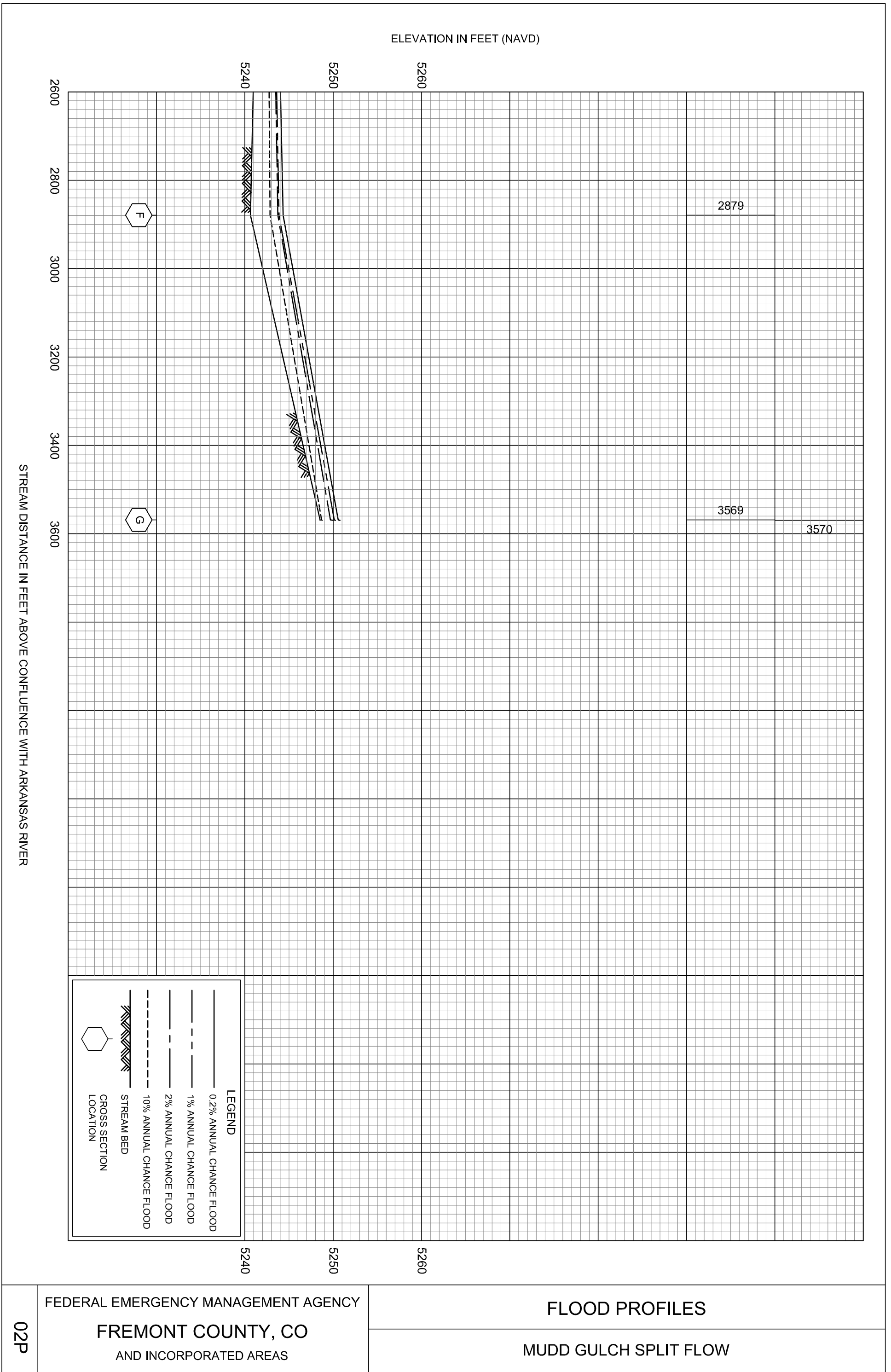
FLOOD PROFILES











FLOODWAY DATA TABLES

Table 4 – Floodway Data Table

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
FOURMILE CREEK								
A	2512.02	168.8	938.62	7.48	5265.01	5265.01	5265.23	0.22
B	2953.71	95.11	687.45	10.21	5268.47	5268.47	5268.47	0.00
C	3121.18	258.2	1080.5	6.5	5269.94	5269.94	5270.09	0.15
D	3432.09	327.35	1321.84	5.31	5271.33	5271.33	5271.41	0.08
E	3756.25	333.57	902.94	7.77	5272.52	5272.52	5272.56	0.04
F	4050.69	130.16	590.9	11.96	5274.91	5274.91	5275.01	0.10
G	4111.69	130.16	1080	6.7	5277.46	5277.46	5277.54	0.08
H	4394.51	99.55	1032.65	7.19	5282.23	5282.23	5282.32	0.09
I	4711.74	333.04	2244.25	3.13	5283.33	5283.33	5283.44	0.11
J	5147.36	238.13	1090.13	6.44	5283.36	5283.36	5283.57	0.21
K	5984.11	232.13	761.65	9.22	5286.06	5286.06	5286.12	0.06
L	6921.01	113.73	556.85	12.61	5292.97	5292.97	5293.07	0.10
M	7454.19	201.12	790.68	8.88	5298.85	5298.85	5299.08	0.23
N	8139.05	190.05	712.91	9.85	5303.78	5303.78	5303.94	0.16
O	8569.65	179.5	1454.28	5.44	5306.53	5306.53	5307.21	0.68
P	8684.3	180.31	1353.11	5.21	5307.90	5307.90	5308.47	0.57
Q	9338.16	190	826.89	8.49	5309.74	5309.74	5309.88	0.14
R	10292.38	136.95	921.28	7.62	5317.13	5317.13	5317.78	0.65
S	10930.27	135.35	679.69	10.33	5320.48	5320.48	5320.97	0.49
T	11451.47	114.79	664.03	10.57	5324.89	5324.89	5325.52	0.63
U	11997.88	134.67	781.25	8.99	5328.92	5328.92	5329.87	0.95
V	12788.01	122.56	746.42	9.4	5337.42	5337.42	5337.69	0.27

¹Feet Above Confluence With Arkansas River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

FREMONT COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

FOURMILE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
FOURMILE CREEK								
W	13318.55	138.17	595.16	11.8	5340.83	5340.83	5340.91	0.08
X	13545.88	305.25	1284.29	5.47	5344.24	5344.24	5344.22	-0.02
Y	14082.25	207.92	670.62	10.47	5346.75	5346.75	5346.79	0.04
Z	14576.82	222.72	931.68	7.53	5351.37	5351.37	5351.42	0.05
AA	15380.94	232.65	864.87	8.12	5356.43	5356.43	5356.96	0.53
AB	15788.95	382.7	1500.24	4.68	5359.46	5359.46	5360.36	0.90
AC	16018.02	354.95	999.12	7.03	5361.64	5361.64	5361.68	0.04

¹Feet Above Confluence With Arkansas River

TABLE 4	FEDERAL EMERGENCY MANAGEMENT AGENCY FREMONT COUNTY, CO AND INCORPORATED AREAS	FLOODWAY DATA
		FOURMILE CREEK

Table 4 – Floodway Data Table

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MUDD GULCH								
A	1261.28	31.16	136.82	7.54	5238.55	5238.55	5238.56	0.01
B	1989.08	46.95	2465.56	5.65	5245.22	5245.22	5245.22	0.00
C	2189.83	132.1	3016.41	5.59	5246.23	5246.23	5246.23	0.00
D	2498.67	33	3219.7	6.92	5249.11	5249.11	5249.11	0.00
E	2868.02	219.64	2198.27	5.89	5254.12	5254.12	5254.12	0.00
F	3389.17	642.85	1126.96	1.95	5257.25	5257.25	5257.25	0.00
G	3515.21	612.8	997.29	2.6	5259.66	5259.66	5259.72	0.06
H	4005.63	61.46	208.58	10.5	5261.69	5261.69	5261.71	0.02
I	4479.82	59.04	264.52	8.28	5267.64	5267.64	5267.75	0.11
J	4835.77	550	1289.45	2.48	5272.60	5272.60	5273.13	0.53
K	5477.27	53.28	368.11	5.95	5278.38	5278.38	5278.70	0.32
L	5974.5	49.36	265.06	8.27	5279.27	5279.27	5280.26	0.99
M	6282	45	257.25	6.77	5281.72	5281.72	5281.86	0.14
N	6896.94	38.71	152.64	11.29	5284.91	5284.91	5284.91	0.00
O	7054.93	44.03	159.5	10.81	5289.30	5289.30	5289.30	0.00
P	7701.39	77.08	244.6	7.05	5300.08	5300.08	5300.07	-0.01
Q	8669.89	70.61	354.16	3.66	5308.53	5308.53	5308.53	0.00
R	9164.5	31	215.15	8.74	5311.75	5311.75	5311.75	0.00
S	9710.46	53.99	198.66	6.53	5320.38	5320.38	5320.38	0.00
T	10419.12	55	191.05	6.96	5332.51	5332.51	5332.51	0.00
U	10979.19	34.42	137.46	9.44	5343.40	5343.40	5343.40	0.00
V	11496.49	34.03	120.66	10.75	5352.14	5352.14	5352.14	0.00

¹Feet Above Confluence With Arkansas River

TABLE 4	FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOODWAY DATA
	FREMONT COUNTY, CO AND INCORPORATED AREAS	MUDD GULCH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MUDD GULCH								
W	11900.7	39.42	162.74	7.97	5357.58	5357.58	5357.58	0.00
X	12530.28	27.84	112.86	11.49	5365.47	5365.47	5365.47	0.01
Y	13164.55	70.5	153.58	8.44	5373.20	5373.20	5373.20	0.00
Z	13478.31	122.24	183.85	7.05	5398.75	5398.75	5398.75	0.00
AA	14002.14	265.98	819.79	1.58	5404.27	5404.27	5404.27	0.00
AB	14414.32	94.95	593.65	5.18	5404.32	5404.32	5404.32	0.00
AC	14623.73	58.03	144.58	8.97	5409.60	5409.60	5409.60	0.00
AD	15397.66	29.43	115.15	11.26	5423.61	5423.61	5424.47	0.87
AE	16216.12	45.4	132.54	9.79	5438.36	5438.36	5438.35	-0.01
AF	16869.32	22.6	36.83	7.33	5454.72	5454.72	5454.72	0.00
AG	17384.73	24.33	37.84	7.14	5470.37	5470.37	5470.37	0.00
AH	18116.98	23.45	37.25	7.25	5487.62	5487.62	5487.61	-0.01
AI	18760	26.49	39.11	6.9	5495.29	5495.29	5495.29	0.00
AJ	19402.88	21.49	38.52	7.01	5505.08	5505.08	5505.08	0.00
AK	20181.26	31.1	71.49	3.78	5514.18	5514.18	5514.18	0.01

¹Feet Above Confluence With Arkansas River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

**FREMONT COUNTY, CO
AND INCORPORATED AREAS**

FLOODWAY DATA

MUDD GULCH

Table 4 – Floodway Data Table

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MUDD GULCH SPLIT								
A	224.65	208.99	396.56	3.2	5235.38	5235.38	5235.38	0.00
B	685.37	408.27	450.06	2.82	5237.74	5237.74	5237.74	0.00
C	1234.55	397.12	666.04	1.91	5239.43	5239.43	5239.43	0.00
D	1729.42	335.43	432.81	2.93	5240.76	5240.76	5240.76	0.00
E	2211.55	816.04	679.83	1.87	5243.15	5243.15	5243.15	0.00
F	2878.94	552.56	715.86	1.73	5243.89	5243.89	5243.89	0.00
G	3568.53	35.52	6.61	2.6	5250.15	5250.15	5250.15	0.00

¹Feet Above Confluence With Arkansas River

TABLE 4	FEDERAL EMERGENCY MANAGEMENT AGENCY FREMONT COUNTY, CO AND INCORPORATED AREAS	FLOODWAY DATA
		MUDD GULCH SPLIT FLOW

Section 5

Mapping Information

5.1. Work Map

ArcMap Version 9.2 (ESRI, 2006) was used to create the hydraulic work maps for Fourmile Creek and Mudd Gulch. The maps included aerial photography (Spring 2005) from Fremont County, stream centerlines, HEC-RAS cross sections, FlowMaster cross sections, lateral weirs, BFE lines, floodways, the 1% annual chance floodplains, the 0.2% annual chance floodplains, 2-ft contours, and the effective 100-year flood zones (Zone AE and Zone A). A hardcopy of the hydraulic work maps (total of six sheets) may be found at the end of this section.

5.2. Floodplain Mapping

The floodplains of Fourmile Creek and Mudd Gulch for 100 and 500-year flow events were generated using HEC-GeoRAS. This involves the subtraction of the ground terrain from the water surface elevations exported from HEC-RAS. After a detailed examination of the floodplains, small modifications were made to floodplain widths at several cross-sections to ensure that the appropriate widths were represented at each composite cross section. These small modifications are necessary since survey data and County breaklines were incorporated into one terrain in this study. While most of the survey data points are on the cross-sections, overbank areas between cross-sections are represented by County breakline data. This modification ensures a smooth floodplain and avoids abrupt changes in floodplain widths. The 100-year floodplain widths have been modified at nine cross-sections (five on Fourmile Creek and four on Mudd Gulch) and were identified by an asterisk after the cross-section label on work maps.

Just upstream of Highway 50, the 500-year flow is not contained in Fourmile Creek, and a significant amount of flow breaks out to the west and overtops Highway 50. This overtopping will inundate the residential area downstream of Highway 50 and west of Fourmile Creek on the north side of the Railroad. Consequently, the 500-year floodplain is extended west from Fourmile Creek to the Railroad between cross-section 7454 and 5147. It should be noted that the floodplain was extended west in this area even though HEC-RAS results show this flow as contained in the main channel downstream of cross-section 7454. This is a limitation in the hydraulic model because it is a one-dimensional model and does not account for the flow that overtops Highway 50 upstream. Please refer to Sheet 3 and Sheet 4 of the work maps for the location of these cross-sections (extended cross sections in dashed lines)

5.3. Mapping Related to the Lateral Weirs

One breakout occurred on Fourmile Creek over lateral weirs 7820 and 7454 when the 100-year profile was run. These lateral weirs connect cross-sections 7820, 7454, and 6921 (please refer to Sheet 4 of work map). The 1% annual chance flow rate of this breakout was 163 cfs. FlowMaster was used to compute the flood depth at a cross-section

downstream of this breakout since a floodway was not required (Please refer to Data DVD for the FlowMaster model). The cross-section for normal depth calculation is identified on Sheet 4 of the work map. Since average depth of this flooding was 0.22 ft, the mapping downstream of this breakout shows a Zone X floodplain on the hydraulic work map.

There are two locations on Fourmile Creek where breakouts occurred when the 500-year profile was run. One is the location where the 100-year breakout occurred. This time the total lateral weir flow split increased from 163 to 2,492 cfs. This lateral flow split will flow overland down to the Railroad and then flow into Mudd Gulch. For this reason, the area between Fourmile Creek and Mudd Gulch has been mapped as a Shaded Zone X floodplain. The second breakout is at lateral structures between cross-section 5147 and 4395. At this location, the total weir flow is 1,627 cfs. Following a similar flow path as the first breakout upstream, this flow will also impact the area east of Fourmile Creek before flowing into Mudd Gulch. For this reason, the area downstream of these cross sections between Fourmile Creek and Mudd Gulch has been mapped as a Shaded Zone X floodplain.

A single breakout occurred on Mudd Gulch for both the 100 and 500-year flood events in the area upstream of the Railroad and east of Mackenzie Avenue. Since the overtopping flow caused a flow depth higher than 1.0 ft east of Mackenzie Avenue, a detailed model was developed to map this overtopping area accurately. This was done by adding a separate reach named Mudd Gulch Flow Split to the hydraulic model. The flows overtopping Mackenzie Avenue between Adams Avenue and the Railroad are accounted for along this reach that flows southeast on the north side of Railroad. The flows that weir over Mackenzie Avenue for the 100 and 500-year flood events are 1,272 and 2,110 cfs, respectively. Please refer to Sheet 5 and Sheet 6 of the work map for Mudd Gulch Flow Split floodplain mapping.

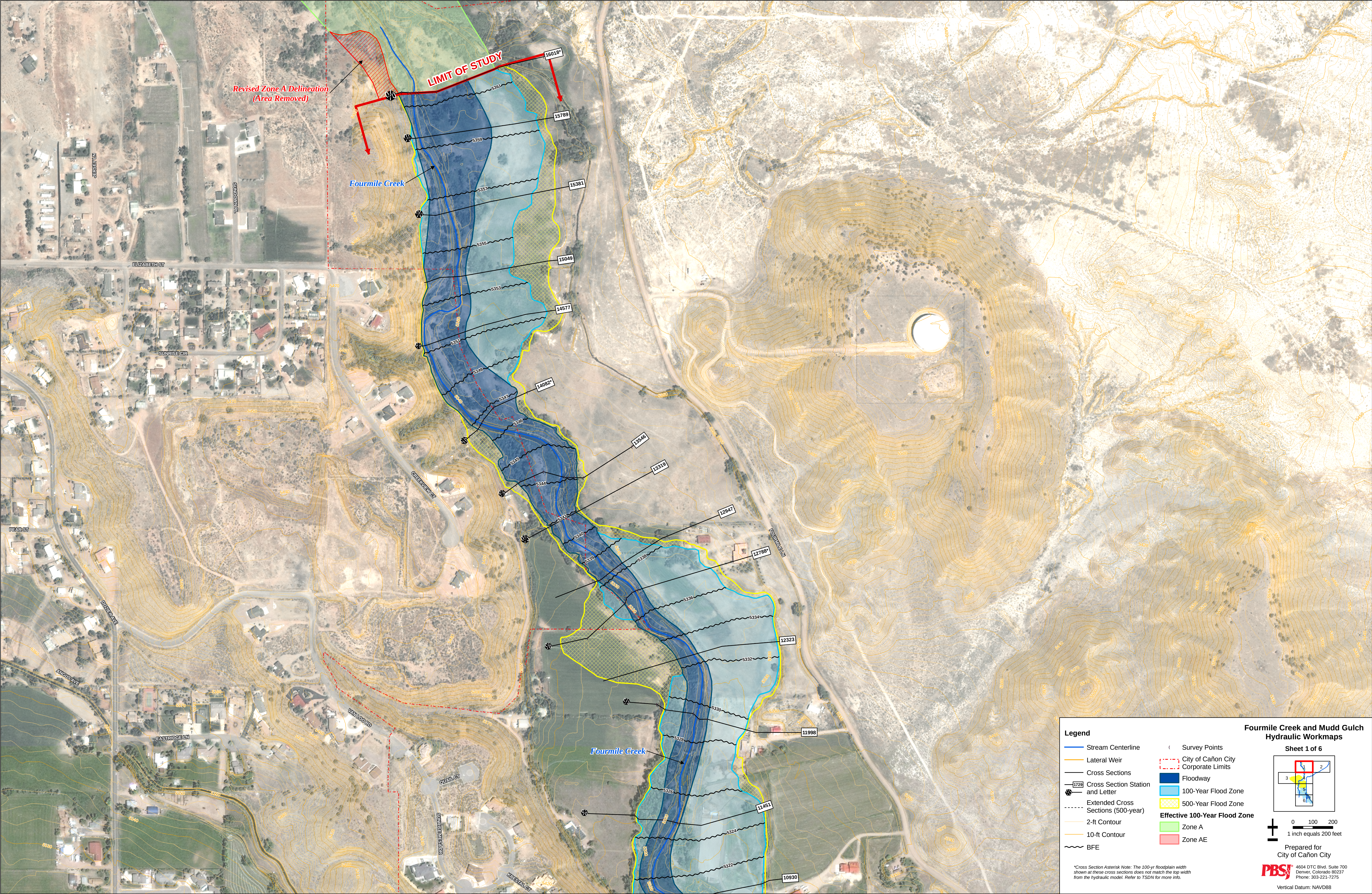
5.4. Tie-in to Effective Mapping

Both Fourmile Creek and Mudd Gulch drain into Arkansas River which is effectively mapped as a Zone AE. The water surface elevation of Arkansas River at Fourmile Creek and Mudd Gulch confluences is 5254 and 5238 feet, respectively. These water surface elevations were obtained from the profiles shown in the 2007 Flood Insurance Study for Fremont County and have been maintained on the floodplain maps. In order to get an accurate tie-in, the HEC-RAS model was extended downstream until the confluence point with Arkansas River. For mapping purposes, only the cross-sections that are outside the floodplain of Arkansas River are presented on work maps. The cross-sections inside Arkansas River floodplain serve as auxiliary elements to help reduce the boundary effects on actual mapping zone in riverine modeling.

The upstream limit of detailed study for Fourmile Creek ties into an effective Zone A at cross-section 16018. However, the modeling was extended upstream by putting another cross-section (16382) beyond the limit of study (please refer to HEC-RAS model). Effective Zone A has been modified between these two cross-sections. Please refer to Sheet 1 of work map for the area that has been removed from Zone A for tie-in purposes.

There is no detailed or approximate study for the upstream limit of study for Mudd Gulch. However, there is a Zone A located upstream of Mudd Gulch Dam. The effective Zone A delineation was revised in this area to be consistent with the geometry of and peak water surface within Mudd Gulch Dam.

WORK MAPS

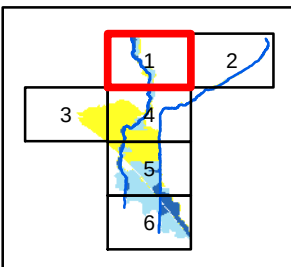


Legend

- Stream Centerline
- Lateral Weir
- Cross Sections
- Cross Section Station and Letter
- Extended Cross Sections (500-year)
- 2-ft Contour
- 10-ft Contour
- BFE
- Survey Points
- City of Cañon City Corporate Limits
- Floodway
- 100-Year Flood Zone
- 500-Year Flood Zone
- Effective 100-Year Flood Zone**
- Zone A
- Zone AE

Fourmile Creek and Mudd Gulch Hydraulic Workmaps

Sheet 1 of 6



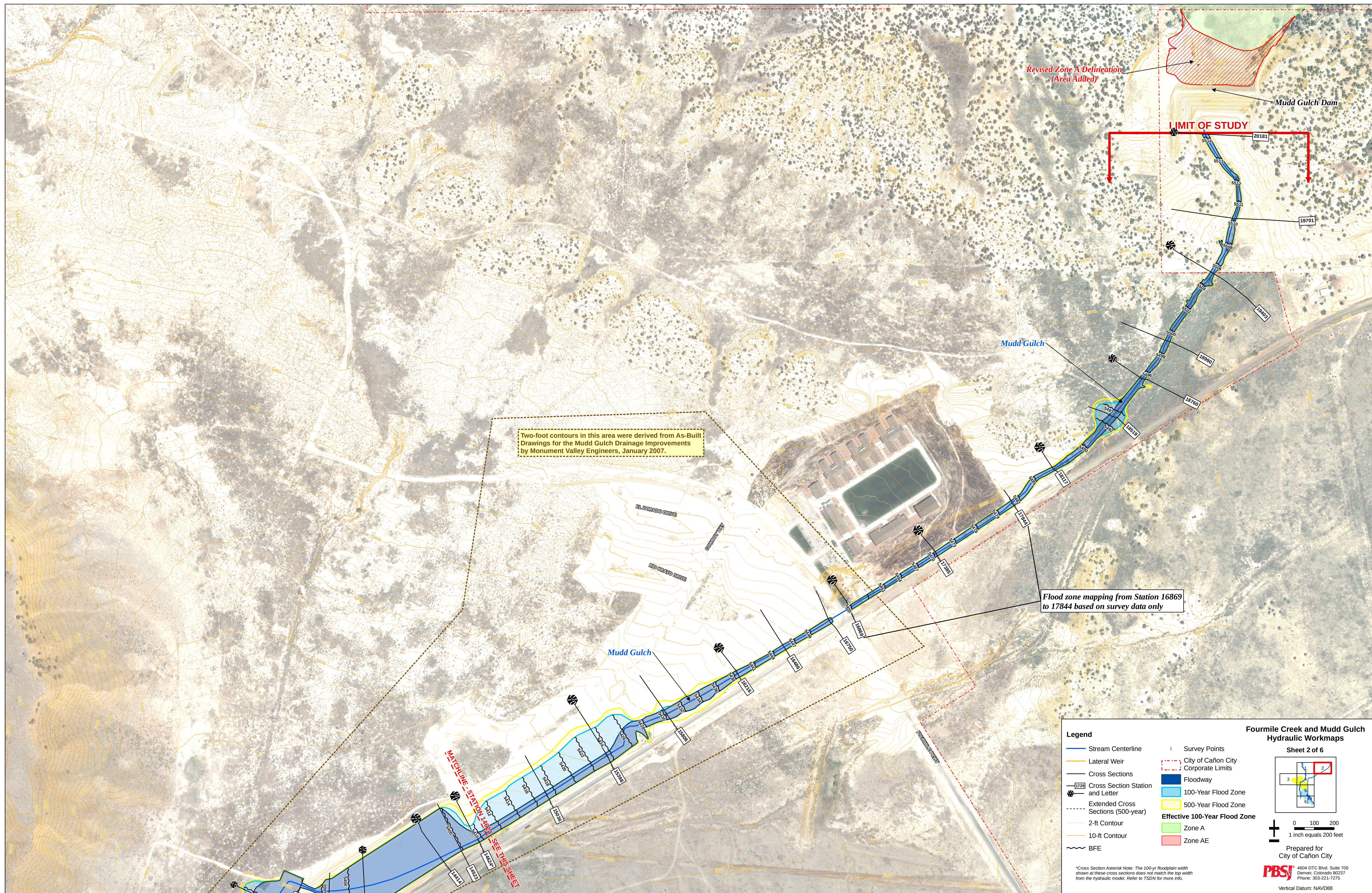
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1 inch equals 200 feet

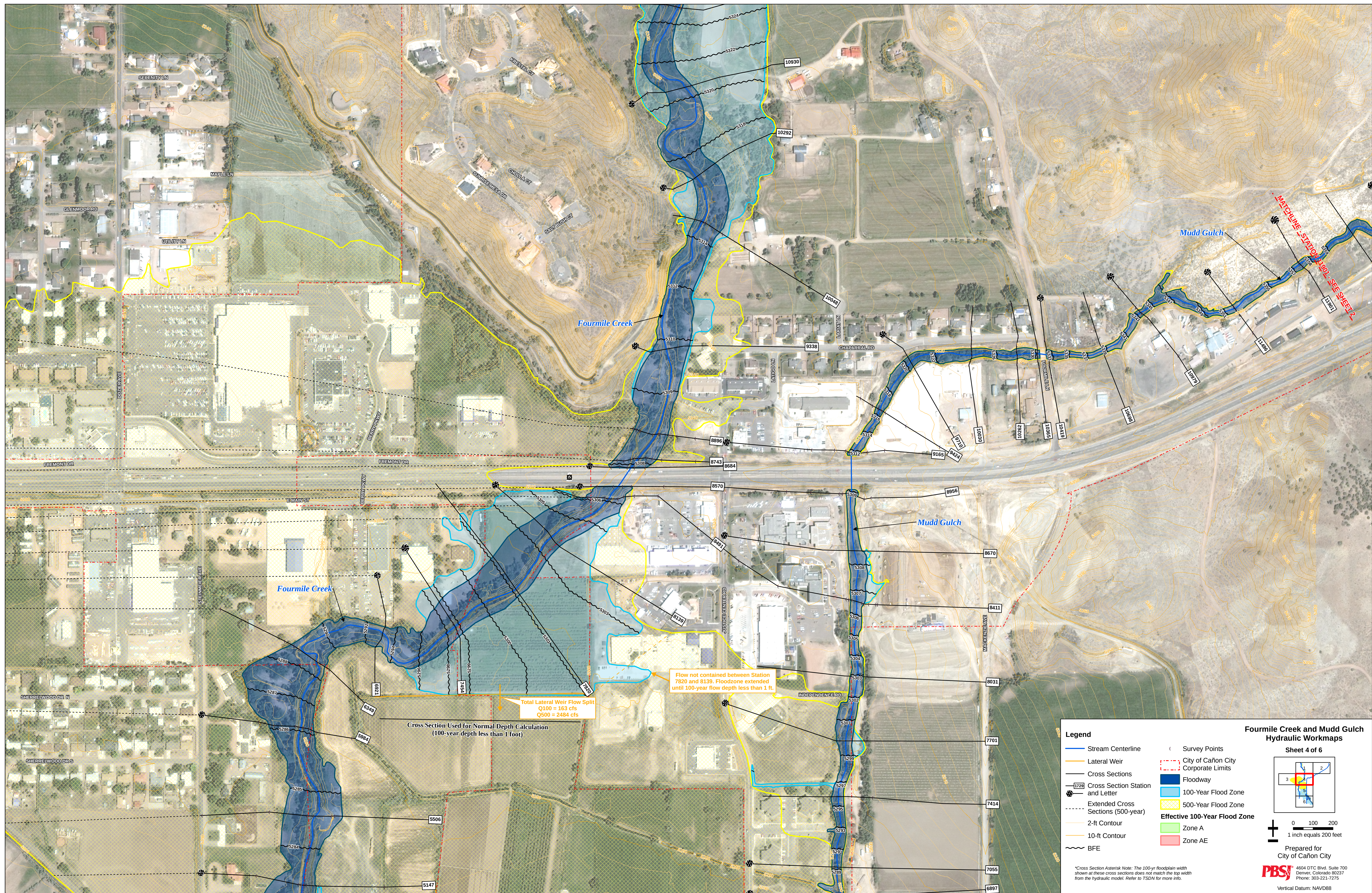
Prepared for
City of Cañon City

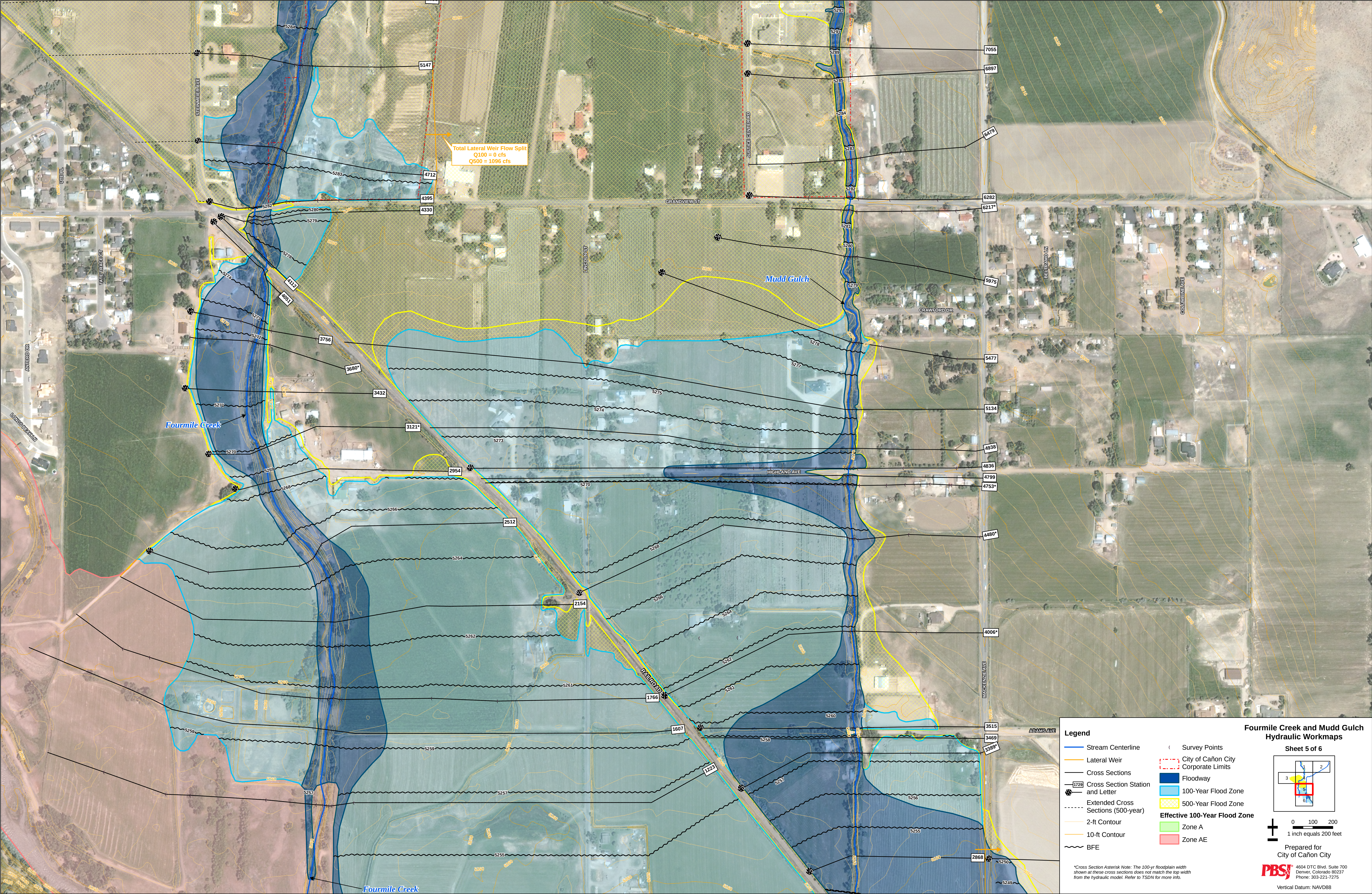
PBSJ
4604 DTC Blvd, Suite 700
Denver, Colorado 80227
Phone: 303-221-7275

Vertical Datum: NAVD88

*Cross Section Asterisk Note: The 100-yr floodplain width shown at these cross sections does not match the top width from the hydraulic model. Refer to TSDN for more info.







Total Lateral Weir Flow Split
Q100 = 0 cfs
Q500 = 1096 cfs

Legend

- Stream Centerline
- Lateral Weir
- Cross Sections
- Cross Section Station and Letter
- Extended Cross Sections (500-year)
- 2-ft Contour
- 10-ft Contour
- BFE
- Survey Points
- City of Cañon City Corporate Limits
- Floodway
- 100-Year Flood Zone
- 500-Year Flood Zone
- Effective 100-Year Flood Zone
- Zone A
- Zone AE

Fourmile Creek and Mudd Gulch Hydraulic Workmaps

Sheet 5 of 6

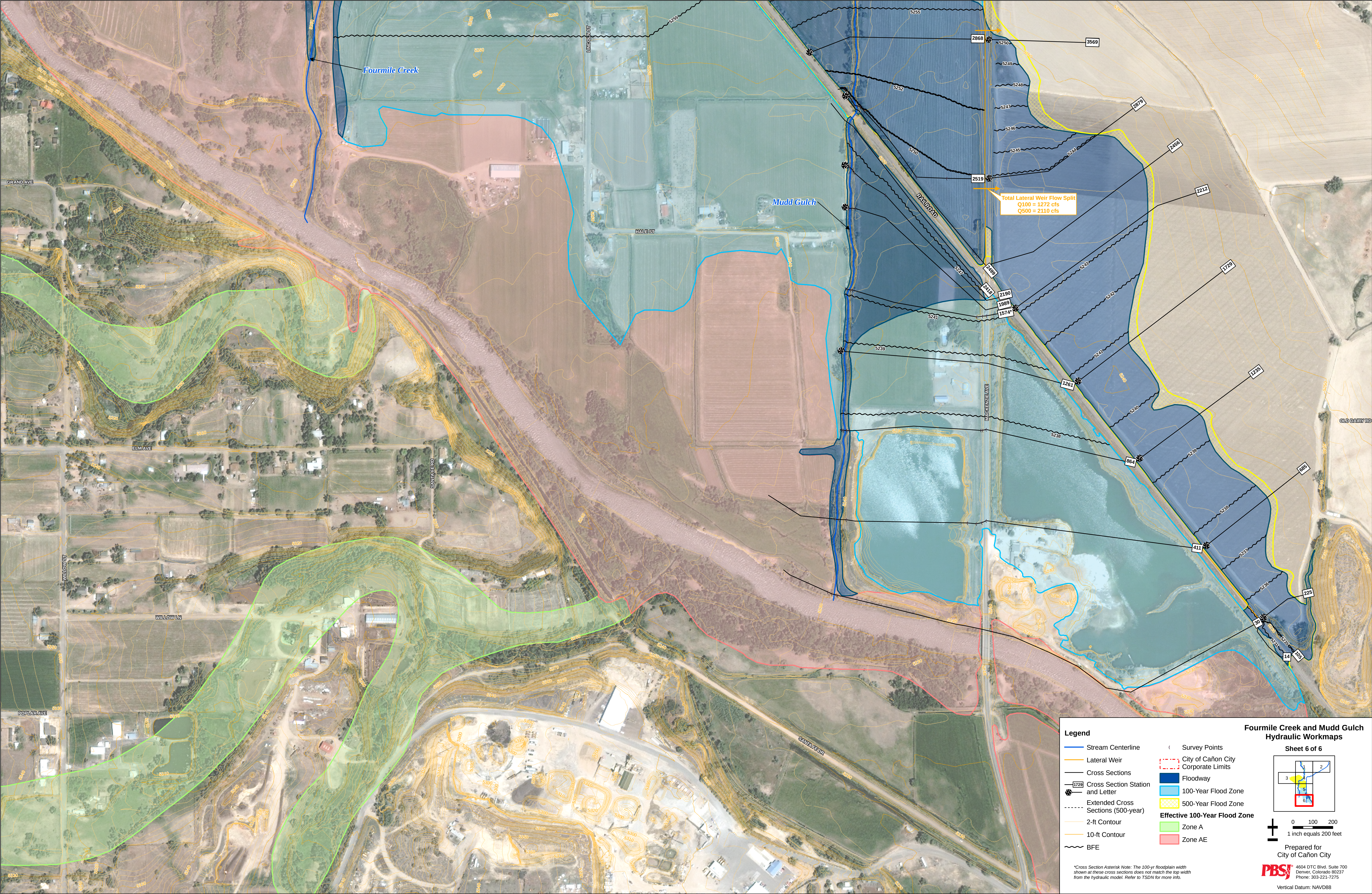
0 100 200
1 inch equals 200 feet

Prepared for
City of Cañon City

PBSJ
4604 DTC Blvd, Suite 700
Denver, Colorado 80237
Phone: 303-221-7275

Vertical Datum: NAVD88

*Cross Section Asterisk Note: The 100-yr floodplain width shown at these cross sections does not match the top width from the hydraulic model. Refer to TSDN for more info.

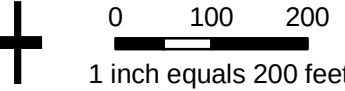
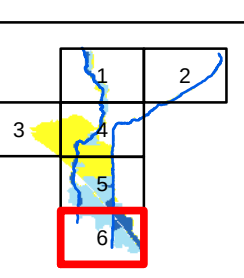


Legend

- Stream Centerline
- Lateral Weir
- Cross Sections
- Cross Section Station and Letter
- Extended Cross Sections (500-year)
- 2-ft Contour
- 10-ft Contour
- BFE
- Survey Points
- City of Cañon City Corporate Limits
- Floodway
- 100-Year Flood Zone
- 500-Year Flood Zone
- Effective 100-Year Flood Zone**
- Zone A
- Zone AE

Fourmile Creek and Mudd Gulch Hydraulic Workmaps

Sheet 6 of 6



Prepared for
City of Cañon City

PBS
4604 DTC Blvd, Suite 700
Denver, Colorado 80237
Phone: 303-221-7275

Vertical Datum: NAVD88

*Cross Section Asterisk Note: The 100-yr floodplain width shown at these cross sections does not match the top width from the hydraulic model. Refer to TSDN for more info.

Section 6

Miscellaneous Reference Materials

6.1. QAQC Documentation

PBS&J quality assurance and quality documentation for the hydraulic modeling is attached at the end of this section.

6.2. Site Visit Photographs

Field investigation photos and can be found on the Data DVD provided with this document.

6.3. Survey Field Notes

Survey field notes and structure drawings can be found on the Data DVD provided with this document.

6.4. References

A list of the reference documents (please refer to the Data DVD) used in the development of this study follows:

1. Analysis of the Magnitude and Frequency of Floods in Colorado. U.S. Department of the Interior, U.S. Geological Survey (USGS), Denver, 2000.
2. Flood Insurance Study for Fremont County (and Incorporated Areas), Colorado, Federal Emergency Management Agency, September, 2007.
3. Mudd Gulch Detention Dam Drawings, Sangre De Cristo RC&D Project, Fremont County, Colorado, 1971.
4. Mudd Gulch Drainage Improvements (Detention Pond), As-Built Drawings, Monument Valley Engineers, Inc., 2007.
5. Open-Channel Hydraulics. Ven Te Chow, 1959, McGraw-Hill, New York, NY.
6. Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds. Natural Resources Conservation Service (NRCS), June 1986.

QA/QC DOCUMENTATION



QC Review: HEC-RAS Model & Floodplain Delineation

Stream Name: Fourmile Creek

Project Number: 100001092

QUALITY CONTROL TRACKING			
READY FOR QC		LTP:	OA
		DATE:	02/24/09
QC REVIEW		QCR:	HD
		DATE:	03/15/09
CONCURRENCE		LTP:	OA
		DATE:	03/16/09
QC SIGNOFF		QCR:	HD
		DATE:	03/30/09

Comment: 10-year flow in the LOB should be ineffective at XS 15380. Also ineffective area should be placed for 100-year between station 227-271.

Response: Ineffective areas are added for 10 and 100-year flows in the LOB.

Comment: Check whether ineffective areas are needed U/S and D/S of XS 15048 (Based on floodplain width).

Response: The flows are able to contract and expand within the expansion ratios. No ineffective area is needed.

Comment: The channel Manning's n should not be more than 0.045.

Response: Noted. Necessary changes have been made accordingly.

Comment: Add a XS between 13545 and 12947 where the floodplain is narrow.

Response: XS 13318.55 is added where the floodplain is narrow.

Comment: Add an ineffective flow area for 50-year flow at XS 10930.

Response: The ineffective area is added between stations 731.45 and 820 for 50-year flow.

Comment: Add a XS between 12788 and 11997.

Response: XS 12322.54 is added.

Comment: The dip in the profile between XS 7454.19 and 8490.80 needs to be removed.

Response: The dip is removed.

Comment: XS 7819.74 needs ineffective area for 50-year flow in LOB.

Response: An ineffective area in the LOB for 50-year flow and in the ROB for 10-year flow is added.

Comment: Ineffective areas are needed at XS 7454 based on floodplain width in XS 6921.



Response: Ineffective area in the ROB at XS 7454.19 is moved closer to the channel considering the contraction ratio of 1:1.

Comment: XS 6921 may have ineffective area in LOB for 500-year.

Response: The flows are able to contract and expand within the expansion ratios. No ineffective area is needed.

Comment: XS 5506 needs ineffective area in LOB.

Response: An ineffective area is added at station 309.55 for 500-year flow.

Comment: Manning's n of 0.08 is used in ROB between XS 7819 and 4050. Please confirm.

Response: Because the ROB for these cross sections composed of Residential/Developed areas, the Manning's n value of 0.08 is used.

Comment: 500-year WSE at XS 2512 is very close to 100-year. Try to resolve this.

Response: Necessary adjustments to the model were made to resolve this issue.

Comment: Check the invert elevation at XS 3680.22 and 3432.09.

Response: The survey elevation of 5261.18 for thalweg at XS 3680.22 was significantly lower than the survey data for thalweg upstream at XS 3756.25 (thalweg: 5264.29). For this reason, only the thalweg elevation is raised to 5263.24 at XS 3680.22.

Comment: Try to resolve the stair stepping in WSE between XS 2512 and 4050.

Response: The severity of the stair stepping has been resolved after the previous comments had been addressed.

Comment: 10-year flow in LOB should be ineffective at XS 1765.

Response: An ineffective area is added for 10-year flow between stations 919.35 and 1200 at XS 1765.52

Comment: The dip at XS 14576.82 in the profile should be rectified.

Response: The number of survey points was limited at this cross section to define a representative cross section. For this reason, survey points were not burned into the TIN. Since the downstream XS 14082.26 uses survey points to define the cross section, an inconsistency occurred between these two cross sections. The thalweg of XS 14576.82 is now adjusted to the survey elevation of 5342.00.

Comment: The dip at XS 9338.66 in the profile should be rectified.

Response: No survey points are available at this location. The profile was adjusted manually to avoid any terracing in WSE. The invert elevation of 5302.08 was used.



QC Review: HEC-RAS Model & Floodplain Delineation

Stream Name: Mudd Gulch

Project Number: 100001092

QUALITY CONTROL TRACKING			
READY FOR QC		LTP:	OA
		DATE:	02/24/09
QC REVIEW		QCR:	HD
		DATE:	02/24/09
CONCURRENCE		LTP:	OA
		DATE:	03/10/09
QC SIGNOFF		QCR:	HD
		DATE:	03/30/09

Comment: Check Manning's n of 0.07 for banks at XS 20181.26 and 19700.71.

Response: Overbank Manning's n values have been reduced from 0.07 to 0.05.

Comment: Ineffective areas should be placed at XS 18518.88.

Response: Ineffective areas are added considering expansion (3:1) and contraction (1:1) ratios.

Comment: Manning's n for the channel changes between section 17384.74 and 17844.24 (0.04 to 0.045). Why?

Response: Manning's n for the channel has been revised to 0.04 at XS 17384.73. The Manning's n value of 0.045 is being used for the riprap section just upstream of culvert under Formile Parkway.

Comment: Culvert at Station 16809.73 should be close to 85ft.

Response: Culvert length is modified from 60ft to 85ft.

Comment: Add a XS between XS 16216.12 – XS 16749.55.

Response: XS 16485.74 has been added between these two cross sections. Now the channel downstream reach length for XS 16749.55 (263.81ft) is lower than 500ft.

Comment: Consider revising the right/left overbank station for XS 16216/15806.06.

Response: The right and left bank stations have been revised for XS 16216.12 and 15806.06.

Comment: Consider increase the Manning's n for section 13164.55-16216.12

Response: The Manning's n value for the channel increased from 0.025 to 0.035 except for XS 13676.00 which is the outlet structure for the detention basin.

Comment: Use ineffective areas through the detention basin.

Response: Ineffective areas are added considering expansion (3:1) and contraction (1:1) ratios through the detention basin.

Comment: Manning's n distribution for XS 13478.31 does not look right. Please revise.



Response: The Manning's n distribution has been revised so that the main channel Manning's n has a value of 0.035.

Comment: Section 13478.31 needs an ineffective area.

Response: Ineffective areas are added.

Comment: The distance between XS 13164.55 and XS 12530.28 is more than 500 ft. Add sections.

Response: XS 12837.83 has been added between these two cross sections. Now the channel downstream reach length for XS 13164.55 (326.72 ft) is lower than 500 ft.

Comment: Consider raising the roadway deck at the center for Fourmile Lane Bridge. It seems there is an error in the survey data. In addition to that it will not impact any hydraulics of the floodplain. The elevation should be 5343.87 instead of 5340.87. The picture of the bridge does not show the steep dip in the roadway profile.

Response: The roadway centerline survey data at the embankments are used to get the correct roadway profile. Now, the bridge profile does match the field photo.

Comment: Consider revising the internal bridge XS for Hwy-50.

Response: The internal bridge cross sections are revised.

Comment: Add a XS between 8955.76 and 8411. The location of the XS should be such that flow is fully active.

Response: XS 8669.89 has been added between these two cross sections. Now the channel downstream reach length for XS 8955.76 (285.87 ft) is lower than 500 ft.

Comment: Make sure that the ineffective flow areas are reasonable for all flow conditions.

Response: Checked.

Comment: Ineffective area in the vicinity of Highland Avenue should be modified as discussed during internal meeting on 02/24/09.

Response: Ineffective areas are placed considering the overtopping over the right overbank (West of Mudd Gulch).

Comment: Make sure profiles for respective flood events do not intersect.

Response: Checked.

Comment: The contraction and expansion coefficients around structures need to be revised to 0.3 and 0.5, respectively.

Response: The revision has been made accordingly.

DIGITAL DATA CD