

**SAND CREEK - CENTER TRIBUTARY  
CHANNEL ANALYSIS REPORT  
FOR  
SOLACE APARTMENTS**

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Project No. 25174.00**

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**PCD File NO. SP201**

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# OVERVIEW

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This report was prepared to provide design information for the existing Sand Creek -Center Tributary Drainageway as part of the Solace Apartment development. This document is the Channel Analysis report for the Solace Apartments. The Sand Creek-Center Tributary Drainageway has been studied as part of a Flood Insurance Study (FIS) for El Paso County Colorado, Volume 7 of 8, revised December 7, 2018 and Sand Creek Drainage Basin Planning Study, dated January 1993. Existing flow rates from the Sand Creek Planning Study were used as the basis for the design of the existing channel condition.

## GENERAL LOCATION AND DESCRIPTION

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### Location

The proposed Solace Apartments, known as “Solace” from herein, is a parcel of land located in Section 7, Township 14 South, Range 65 West of the 6<sup>th</sup> Principal Meridian in El Paso County, Colorado. Solace is a 28.99 acre, urban, multifamily-development and is comprised of 16 apartment buildings and associated infrastructure. Solace is bound by existing industrial developments to the North and vacant land to the West. Galley Road bounds the property to the south and existing light industrial businesses to the east. A vicinity map of the area is presented in Appendix A.

### Description of Property

Solace is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling range land condition. In general, Solace slopes from northwest to southeast. The existing conditions of the Sand Creek -Center Tributary Drainageway on the site are heavily wooded for the length of the channel throughout the Solace site.

Per an NRCS web soil survey of the area, Solace is made up of Type B soils with a very small percentage of Type A in the northwest corner of the property. This Type B soil is a blendon sandy loam. This soil type has a moderate infiltration rate when thoroughly wet. It also consists of moderately deep or deep, moderately well drained or well drained soil. A soil survey map has been presented in Appendix A.

### Floodplain Statement

Based on the FEMA FIRM Map numbers 08041C0751G & 08041C0752G, dated December 7, 2018, a portion of the existing drainageway lies within Zone AE and Zone X. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event and is a flood hazard area. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The FIRM Map has been presented in Appendix A. Currently a portion of the Solace site lies within Zone AE at the extension of Paonia Street to Galley Road, as seen in FEMA FIRM Map number 08041C0752G.

## PREVIOUS SAND CREEK STUDIES

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Solace lies within Sand Creek Drainage Basin based on the “*Sand Creek Drainage Basin Planning Study*” prepared by Kiowa Engineering in January 1993.

The Sand Creek Drainage Basin covers approximately 54 square miles in unincorporated El Paso County, CO. The Sand Creek Drainage Basin is tributary to Fountain Creek. In its existing condition, the basin is comprised of developed land with the exception of the Solace Parcel which is comprised of rolling rangeland with fair to good vegetative cover associated with Colorado’s semi-arid climate. The natural Drainageway within the site limits is typically deep and narrow with a well-defined flow path in most areas. Anticipated land use for the Solace parcel includes multifamily residential and open space.

As part of its drainage research, JR Engineering reviewed the following drainage studies, reports and LOMRs:

- Sand Creek Drainage Basin Planning Study prepared by Kiowa Engineering Corporation in January 1993.
- Flood Insurance Study– El Paso County, Colorado & Incorporated Areas Vol 7 of 8, December 2018.
- LOMR- Case No. 05-08-0368P Federal Emergency Management Agency, May 23, 2007.

The *Sand Creek Drainage Basin Planning Study* was used to establish a stormwater management plan for the existing and future stormwater infrastructure needs within the Sand Creek Drainage Basin. The *Sand Creek Drainage Basin Planning Study* conducted a hydrologic analysis using a runoff model named the Soil Conservation Service (SCS) Computer Program for the Project Formulation Hydrology (TR20). Based on provided drainage maps and analysis, in its existing condition, the Sand Creek-Center Tributary Drainageway contains a 100-year flow of 720 cfs at upstream station 1053 then jumps to 960 cfs at station 1030 in Sand Creek along Solace’s east property line. The flow then changes again at station 1014, to a value of 956 cfs, where the flow from the secondary drainageway on Paonia Street converges with the Sand Creek Drainageway, this flow was based on JR Engineering analysis. These flows were used in the model as they were depicted as being the flows present in the project section of the Sand Creek Tributary Drainageway as called out in *Sand Creek Drainage Basin Planning Study*. The major Sand Creek-Center Tributary Drainageway conveys the stormwater south along the eastern property line where it ultimately outfalls into the Fountain Creek. JR Engineering also performed a hydrologic analysis to determine the flows in the Sand Creek-Center Tributary Drainageway and arrived at similar results to those shown in the *Sand Creek Drainage Basin Planning Study*, thus verifying the validity of these flows. These basin calculations show that the 720-960 cfs, based on the *Sand Creek Drainage Basin Planning Study*, are still valid for this existing condition, a summary table of the flows in the Sand Creek Drainageway based on various studies can be found below.

Please indicate that the northern developments and the secondary drainageway flows shall be captured. The inlet shall take into account the total flow from the secondary drainage way

SOLACE APARTMENTS		
Sand Creek Center Tributary Flow Summary Table		
Report/Study	Location	Flow (cfs)
<i>Sand Creek DBPS, Kiowa Engineering, Rev. March 1996, Table III-2</i>	DP 45, @ Galley Rd. Crossing	1,340
<i>Sand Creek DBPS, Kiowa Engineering, Rev. March 1996, CTP-2</i>	@ STA 125+00	960
<i>Sand Creek DBPS, Kiowa Engineering, Rev. March 1996, CTP-2</i>	@ STA 132+30	720
<i>Flood Insurance Study, El Paso County, Rev. December 7, 2018</i>	Section N, @ Galley Road	723
<i>JR Engineering October 2019</i>	@ Galley Road	956

FEMA prepared a revised FIS for El Paso County Colorado, Volume 7 of 8, dated December 7, 2018. The effective floodplain for the site is shown on the FIRM 08041C0752G, revised to reflect LOMR, dated May 23, 2007. The study area of the FIS where the Sand Creek Drainageway crosses Galley Road, was found to overtop the culverts and flow onto the road. According to the FIS, this crossing has a 10% annual chance of flooding and is located in Zone AE of the FIRM. This location is a Special Flood Hazard Area (SFHA) inundated by the 100-year flood, Zone AE (base flood elevations determined). The *Sand Creek Drainage Basin LOMR* was executed on May 23, 2007. The LOMR revised the flood zone on the area south of Galley Road. See FIRM Map Panel 08041C0752G for limits of LOMR study and revised flood zones, presented in Appendix C.

To the west of the Sand Creek-Center Tributary Drainageway is a secondary Drainageway that captures the flow coming from the west side of Paonia Street. This drainage way is located at the proposed extension of Paonia Street to meet Galley Road. According to *Sand Creek Drainage Basin LOMR*, the flow present in this secondary drainageway in a 1-percent-annual-chance flood event is 792 cfs. Offsite flows also contribute to this second drainageway. In order to mitigate offsite flows from coming onto the site, an inlet has been proposed at the northern property line to capture any offsite flows coming from the northern developments along the existing Paonia Street. This inlet will capture flows traveling down the west side of Paonia Street. **Flows on the east side will be transported to the Sand Creek Drainageway via an existing concrete channel located along the northern property line of the site.** The proposed inlet and storm sewer will convey the captured flows directly to the Sand Creek Drainageway. This outfall will incorporate an energy dissipation structure that utilizes grouted boulders in order to reduce the velocities of the flows prior to entering the drainageway. This energy dissipation structure will prevent erosion and any other negative impacts to the drainageway. A detail of this structure can be found in Appendix C.

Channel Detention  
The *Sand Creek*  
Center Tributary  
crossing structure

There appears to be an issue with this design. Currently the grade downstream of the existing Paonia St appears to be higher allowing the offsite/secondary drainageway flow from the east side of the road to enter this existing concrete channel. In your proposed condition, it does not appear that the flow would enter this existing concrete channel as Paonia St. will be extended downstream at a descending grade. The majority of the secondary drainageways flow will bypass this existing concrete channel. Please identify how this flow will be diverted to the main channel to the east. Hydraulics for the diversion of the secondary drainageway flow shall be provided with the final drainage report.

determined that the existing crossing structures were inadequate for the demands of the Drainageway and would require improvements to expand the capacity of these structures. These results can be seen in Table IV-1 Summary of Hydraulic Structures – Crossings: Sand Creek Drainage Basin Planning Study shown below. The Study proposed improvements to the existing crossing structures by replacing them with 3-8’Wx 5’H Concrete Box Culverts.

LOCATION	REACH #	SIZE	TYPE	CAPACITY	CAPACITY	COMMENTS
				EXISTING	FUTURE (1)	
Airport Road	CT-1	5-6'x8'	BOX CULVERT	ADEQUATE	ADEQUATE	
Pikes Peak Ave.	CT-1	NONE		INADEQUATE	INADEQUATE	POWERS BLVD. OVERTOPPED FREQUENTLY BETWEEN BIJOU ST. AND PIKES PEAK AVE.
Powers Blvd.	CT-1	VARIOUS	METAL PIPE	INADEQUATE	INADEQUATE	
Platte Ave (US 24)	CT-1	8'x4'	BOX CULVERT	INADEQUATE	INADEQUATE	APPROACH CHANNEL IN NEED OF REALIGNMENT
Terminal Avenue	CT-2	2-4'x8'	BOX CULVERT	INADEQUATE	INADEQUATE	
Galley Road	CT-2	3-42"x72"	METAL ARCH PIPE	INADEQUATE	INADEQUATE	
Omaha Boulevard	CT-2	2-36"x57"	METAL ARCH PIPE	INADEQUATE	INADEQUATE	

The study also found the existing channel for the Sand Creek-Center Tributary Drainageway between Galley Road and Paonia Street to be inadequate for the given flow rate. The report says that the existing channel has limited maintenance access, leading to the channel degrading and being filled with obstructions. Those findings can be seen in Table IV-2 Summary of Hydraulic Structures – Channels: Sand Creek Drainage Basin Planning Study. The *Sand Creek Drainage Basin Planning Study* recommended improvements to the existing channel by lining the channel with concrete.

LOCATION FROM / TO	REACH #	DIMENSIONS			TYPE	CAPACITY (1)		COMMENTS
		TW (ft)	SS	DEPTH (ft)		ADQ	INADQ	
CENTER TRIBUTARY								
East Fork Sand Creek to Airport Road	CT-1	45	2:1	6	Riprap lined trapezoidal channel	X	X	Riprap has failed or is non-existent along some portions of this segment of the Center Tributary
Pikes Peak to Bijou St.	CT-1			N/A	Rubble lined ditches along Powers Blvd.			Flow passes over and along Powers Blvd. street section on a frequent basis. Road closures common.
Bijou St. to Platte Ave.	CT-1			N/A	Unlined, natural.			Overbanks vegetated, channel dry with sand invert, no vegetation. Channel eroded at outlet of US24 culvert.
Platte Ave. to Terminal Ave.	CT-2	15-25	1:1	4-6	Trapezoidal concrete lined.	X		Channel has adequate capacity.
Terminal Avenue to Galley Road	CT-2	21	1:1	5	Trapezoidal concrete lined.	X		Channel has adequate capacity.
Galley Road to Paonia Ct. (ext)	CT-2	30-40	varies	4-5	Unimproved segment.		X	Channel is degraded and filled with debris. Poor maintenance access.
Paonia Ct. to Omaha Blvd.	CT-2	21	1:1	5	Trapezoidal concrete lined channel.	X		Maintenance access poor. Debris and trash in channel.

The GeoHecRas model results completed with this report contain similar findings to those in the drainage basin planning study. Average velocities of 10-12 fps for a majority of the channel reach exceed allowable limits for an unprotected channel. The current Galley road crossing structures lack of capacity also leads to overtopping of the road during these events. This report confirms that both this Sand Creek channel reach and Galley Road crossing structures are inadequate for the 100-yr storm event.

## Channel Improvement Recommendations

The *Sand Creek Drainage Basin Planning Study (DBPS)* concluded that the Sand Creek-Center Tributary Drainageway channel, in its current state, is inadequate to handle the historical flows tributary to the channel. This report falls in line, indicating that improvements shall be made to the channel in order to provide adequate capacity and prevent erosion. In the DBPS improvements are also designated for the crossing structures at Galley Road to provide adequate capacity and prevent overtopping of the road. Upon further investigation, this report found that overtopping of the Galley Road appears to be addressed via the overflow structure and associate downstream bank protections shown in Figure 1. This weir was analyzed to determine the effectiveness to safely pass overtopping flows. From the HEC-RAS model, it was determined that approximately 581 cfs overtops the roadway during a 100-year event. The weir in its current configuration could only adequately pass approximately 40 cfs of this flow. On the north side of the Galley road crossing, there is a section of roadway without curb & gutter; this allows the water transported along the north half of galley road to directly flow into the Sand Creek Center Tributary Drainageway. A picture of this curb opening is shown below in figure 2.



Figure 1: Existing Drainage Structures at Galley Road (Viewed from South)



Figure 2: Curb Opening on North Half of the Galley Road Crossing (Looking to the North)

This analysis notes existing overtopping, further discussion with the county engineer to discuss potential solutions is recommended. One possible solution is that the existing culverts be replaced to prevent overtopping at Galley Road by upsizing to a larger culvert(s). Ultimately, culvert improvements will be necessary when the County deems the historic overtopping of Galley Road

FYI: The developer may be required to construct the improvements identified in the DBPS to adequately convey the flow across Galley Rd if the development is exacerbating the situation at this location.

above acceptable tolerance. Currently, no adjacent structures are impacted by this overtopping. Weir calculations can be found in the appendix.

Based upon the findings to the *Sand Creek Drainage Basin Planning Study* and the conforming GeoHecRas modeling contained in this report, potential recommended channel improvements include:

- Widening of the channel west bank to reduce flow depth, thus corresponding velocities
- Lining portions of the channel with riprap or other protective surfaces
- Adding check structures and potentially drop structures to reduce channel grade
- Replacing existing culverts at Galley Road to prevent roadway overtopping

## CONCEPT COST ESTIMATE

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Below is Conceptual Cost Estimate for the proposed channel improvements to the Sand Creek-Center Tributary Drainageway.]

**Table 3: Cost Opinion-Public Reimbursable**

<b>PUBLIC DRAINAGE FACILITIES</b>				
<b>Item</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extended Cost</b>
Clearing & Grubbing	2	AC	\$5,000.00	\$10,000.00
Channel Widening Earthwork (Cut)	7000	CY	\$3.00	\$21,000.00
Riprap Lining (Type M)	5100	CY	\$85.00	\$433,500.00
Drop Structures	2	EA	\$20,000.00	\$40,000.00
			Sub-Total	\$504,500.00
			10% Eng. And Contingency	\$50,450.00
			Grand Total	\$554,950.00

## DRAINAGE DESIGN CRITERIA

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### Development Criteria Reference

Storm drainage analysis techniques were taken from the “*City of Colorado Spring/El Paso County Drainage Criteria Manual*” Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the “*Urban Storm Drainage Criteria Manual*” Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the “*Colorado Springs Drainage Criteria Manual (CCSDCM)*”, dated May 2014, as adopted by El Paso County.



## Hydrologic Criteria

The hydrologic analysis for this project is based on the *Sand Creek Drainage Basin Planning Study*. The flow rates for the 100-yr storm event were taken from sheets CTP-2 & CTP-3 of this study. The Baseline Flows from the *Sand Creek Drainage Basin Planning Study* are included in Appendix C.

## Hydraulic Criteria

GeoHecRas was used as the primary analysis method for the site. GeoHecRas was used to model existing flows within the Sand Creek-Center Tributary Drainageway. This model was used to verify flood plains and analyze any overtopping that may occur within the project site. The 100-year water surface profiles for the model were analyzed from the north property line of the site to the area 100 feet south of the Galley Road Crossing. Hydraulic computations for the models are contained in Appendix B. In the model the value for the roughness coefficient (n) were based upon those shown in Table 12-2 of the City of Colorado Springs Drainage Criteria Manual, Volume 1, assuming a value of  $n = 0.05$  for the sides of the channel, and a value of  $n = 0.025$  for the bottom of the channel. The flows of the channel were determined using the sheet CTP-2 of the *Sand Creek Drainage Basin Planning Study*, with the flow 720 cfs being used at the upstream end of the channel till river station 1031 where the flow changes to 960 cfs, and once again at the Galley Road crossing to 1340 cfs. These can be seen in the GeoHecRas output table. Geometry of the channel and the crossing structure at Galley Road was determined from survey conducted by JR Engineering's internal survey department. The Galley road crossing structure was modeled in the GeoHecRas model; its geometric parameters were determined using survey obtained data to the crossing. The sizes of the 48" CMP culverts in the crossing were also determined from survey data.

## SUMMARY

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This analysis of the Sand Creek-Center Tributary Drainageway remains consistent with previous studies. Velocities in the drainageway are of concern and require channel improvements, such as widening and riprap lining to ensure the Sand Creek Drainageway remains stable during a 100-yr event. This report meets the latest El Paso County Drainage Criteria requirements for this site. The results of JR Engineering's GeoHecRas model for the channel appear accurate as the water surface elevations of the channel match up very closely to the elevations called out in the FEMA FIS along the channel. The overtopping elevation at Galley Road shown in the model matches the elevation shown in the FEMA floodplain map of 6249, showing that the GeoHecRas model results are valid.

### Review 1 Comment:

Add a narrative describing the parameters used for the GeoHecRas model such as:

- the manning's n value. Include a table with the manning's n values and it's respective characteristics.
- The boundary conditions used (upstream & downstream).

### Review 2: Unresolved

- Per the review 1 comment include a table with the respective characteristics of the manning's n values. was the min, normal, or max coefficient value chosen? straight or winding channel? etc.
- identify the downstream boundary condition

## REFERENCES:

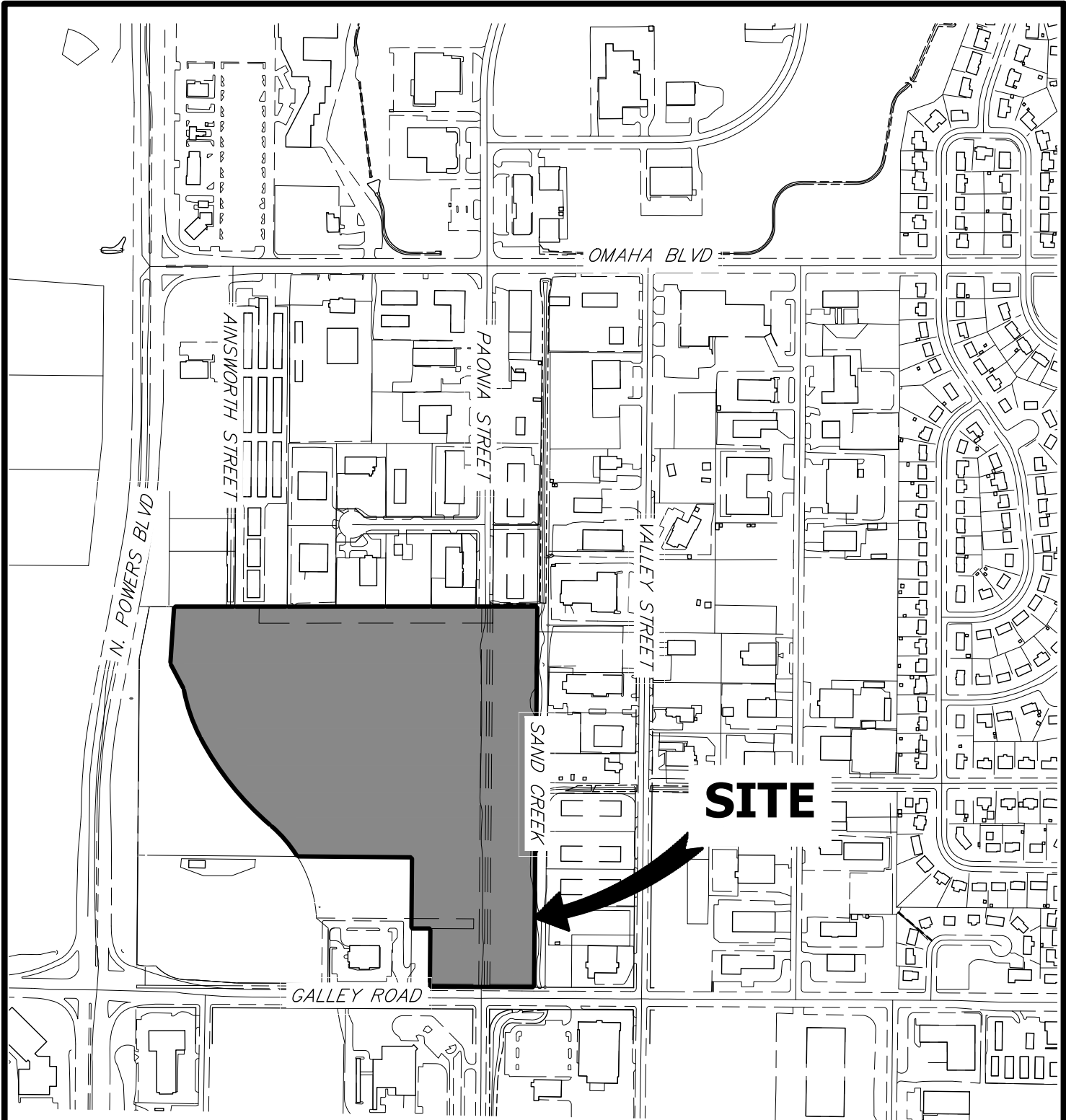
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1. El Paso County Drainage Criteria Manual Volume 1, El Paso County, CO, 1994.
2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.
3. Flood Insurance Study- El Paso County, Colorado & Incorporated Areas Vol 7 of 8, Federal Emergency Management Agency, December 7, 2018.
4. Sand Creek Drainage Basin Planning Study, Kiowa Engineering, January 1993.
5. Sand Creek Drainage Basin LOMR, Federal Emergency Management Agency, May 23, 2007.

**APPENDIX A**

**FIGURES AND EXHIBITS**

X:\2510000.all\2517400\Drawings\Blocks\Vicinity Map - Drainage.dwg, 8.5x11 Portrait, 12/17/2019 11:14:34 AM, Phillips



**SITE**



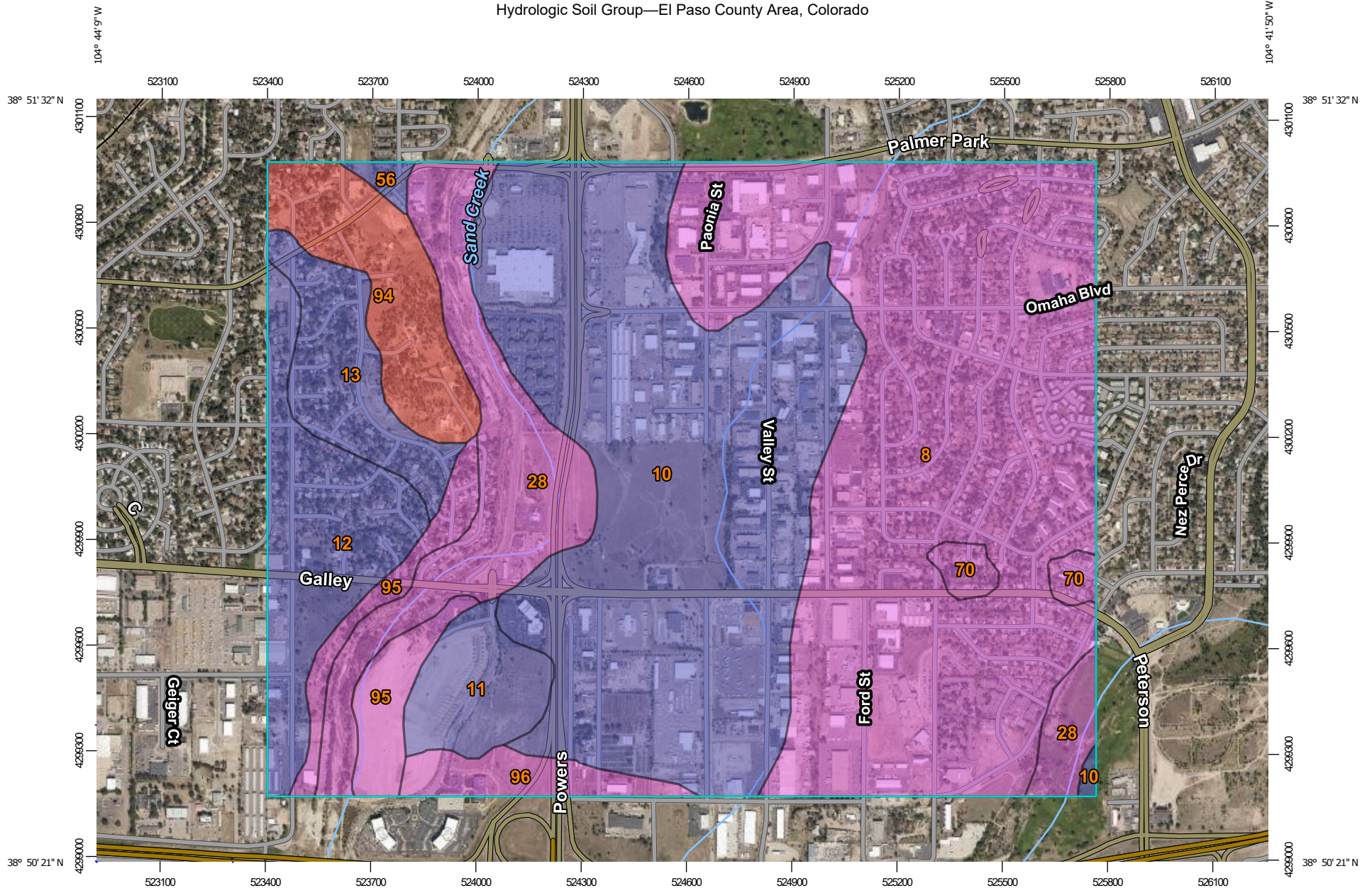
ORIGINAL SCALE: 1" = 500'

VICINITY MAP  
 SOLACE APARTMENTS  
 JOB NO. 15504.03  
 4/27/2018

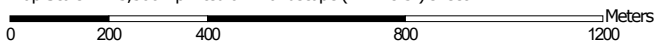


Centennial 303-740-9393 • Colorado Springs 719-593-2593  
 Fort Collins 970-491-9888 • [www.jrengineering.com](http://www.jrengineering.com)

Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:15,300 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



### MAP LEGEND

**Area of Interest (AOI)**









 Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**





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

**Soil Rating Lines**

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

**Soil Rating Points**






-  A
-  A/D
-  B
-  B/D

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

**Water Features**

 Streams and Canals

**Transportation**

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

**Background**

 Aerial Photography

### MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: El Paso County Area, Colorado  
 Survey Area Data: Version 17, Sep 13, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	373.7	35.4%
10	Blendon sandy loam, 0 to 3 percent slopes	B	321.4	30.5%
11	Bresser sandy loam, cool, 0 to 3 percent slopes	B	31.9	3.0%
12	Bresser sandy loam, cool, 3 to 5 percent slopes	B	69.8	6.6%
13	Bresser sandy loam, cool, 5 to 9 percent slopes	B	41.4	3.9%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	96.1	9.1%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	3.7	0.3%
70	Pits, gravel	A	10.3	1.0%
94	Travessilla-Rock outcrop complex, 8 to 90 percent slopes	D	51.5	4.9%
95	Truckton loamy sand, 1 to 9 percent slopes	A	35.7	3.4%
96	Truckton sandy loam, 0 to 3 percent slopes	A	19.7	1.9%
<b>Totals for Area of Interest</b>			<b>1,055.2</b>	<b>100.0%</b>

## Description

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

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

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

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

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

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

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

## Rating Options

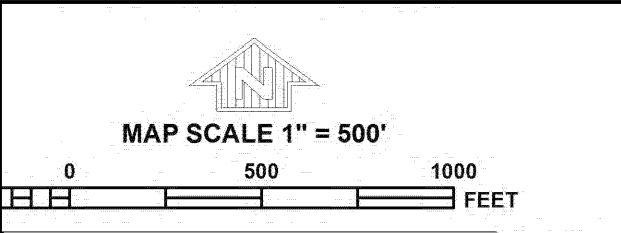
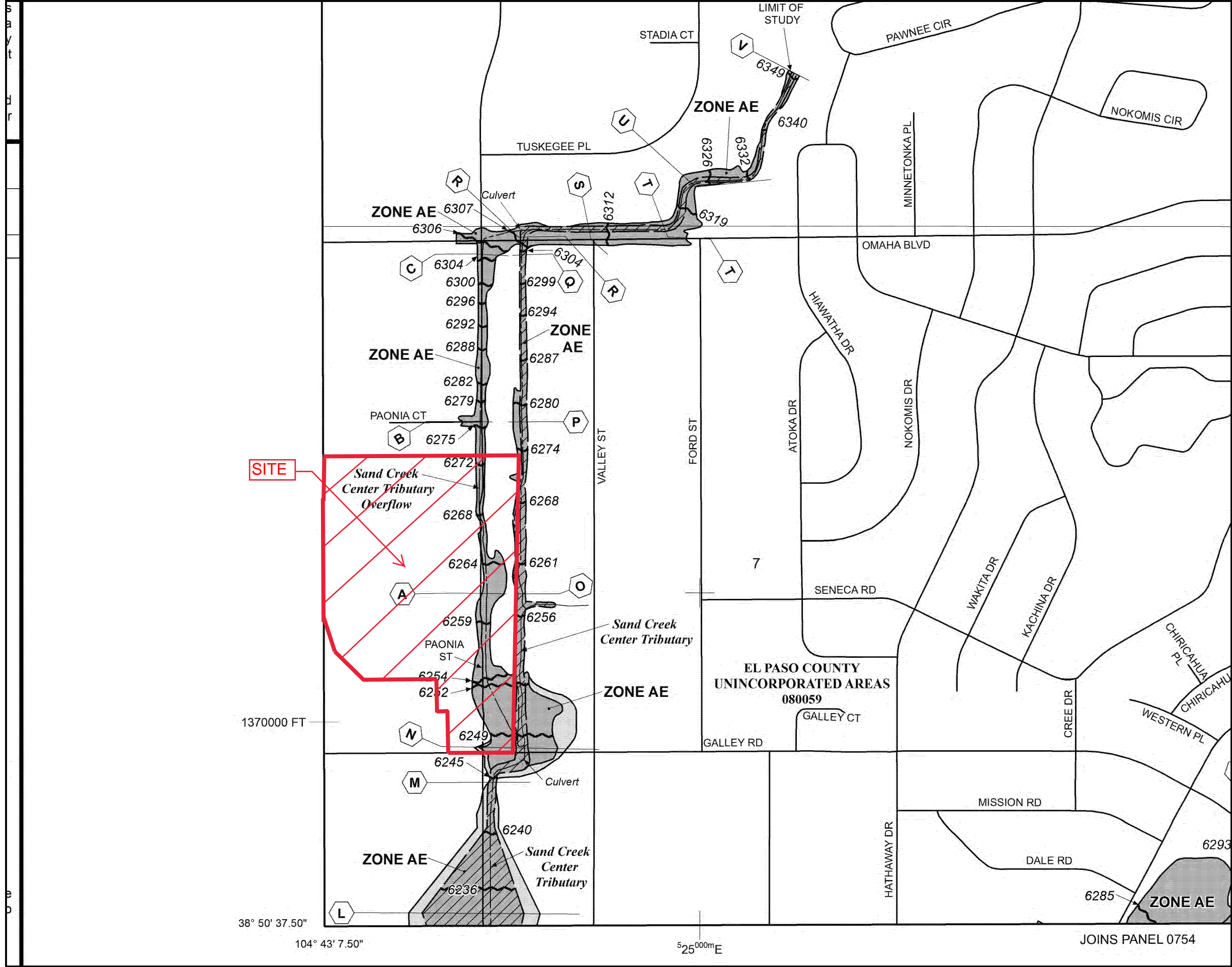
*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher



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**NFP**

**PANEL 0752G**

**FIRM**  
FLOOD INSURANCE RATE MAP  
EL PASO COUNTY,  
COLORADO  
AND INCORPORATED AREAS

**PANEL 752 OF 1300**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0752	G
EL PASO COUNTY	080059	0752	G

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

**MAP NUMBER**  
08041C0752G

**MAP REVISED**  
DECEMBER 7, 2018

Federal Emergency Management Agency

**NATIONAL FLOOD INSURANCE PROGRAM**

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

JOINS PANEL 0754

**NOTES TO USERS**

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

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

**Coastal Base Flood Elevations** shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov/> or contact the National Geodetic Survey at the following address:

NGS Information Services  
 NOAA, NINGS12  
 National Geodetic Survey  
 SSMC-3, #9202  
 1315 East-West Highway  
 Silver Spring, MD 20910-3282

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

**Base Map** information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

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

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

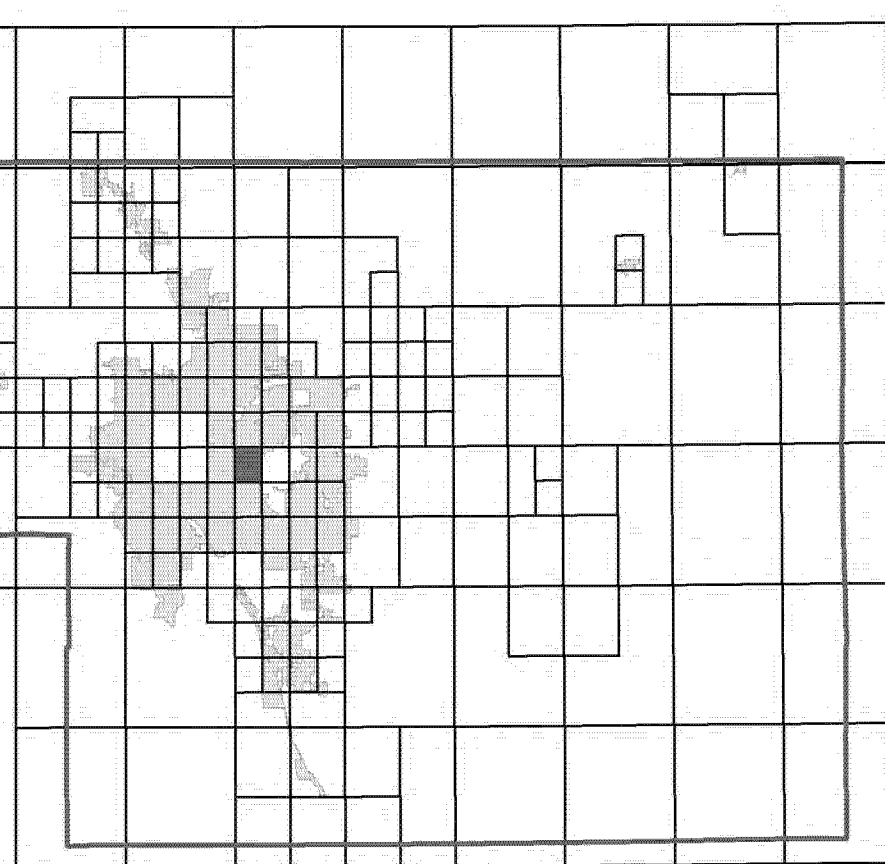
Contact **FEMA Map Service Center (MSC)** via the FEMA Map Information eXchange (FIMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at <http://www.msc.fema.gov/>.

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

**El Paso County Vertical Datum Offset Table**

Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

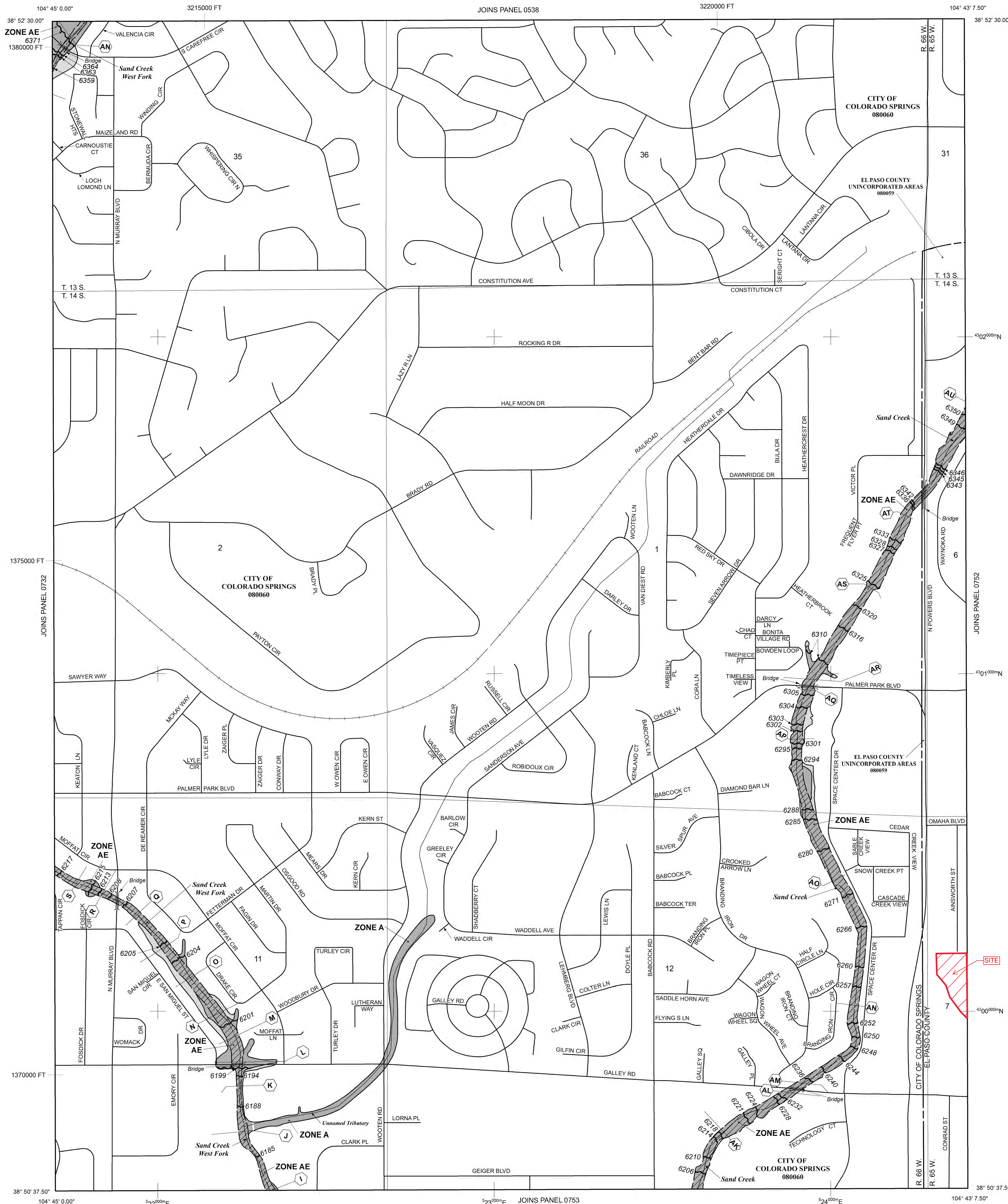
**Panel Location Map**



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).



Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



**LEGEND**

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

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

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

**FLOODWAY AREAS IN ZONE AE**

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

**OTHER FLOOD AREAS**

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

**OTHER AREAS**

**ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.

**ZONE D** Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

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

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 Base Flood Elevation line and value; elevation in feet\* (EL 987)

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

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

A-A Cross section line

23-23 Transsect line

97° 07' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

4750000N 1000-meter Universal Transverse Mercator grid ticks, zone 13

6000000 FT 5000-foot grid ticks; Colorado State Plane coordinate system, central zone (FIPSZONE 0902), Lambert Conformal Conic Projection

DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

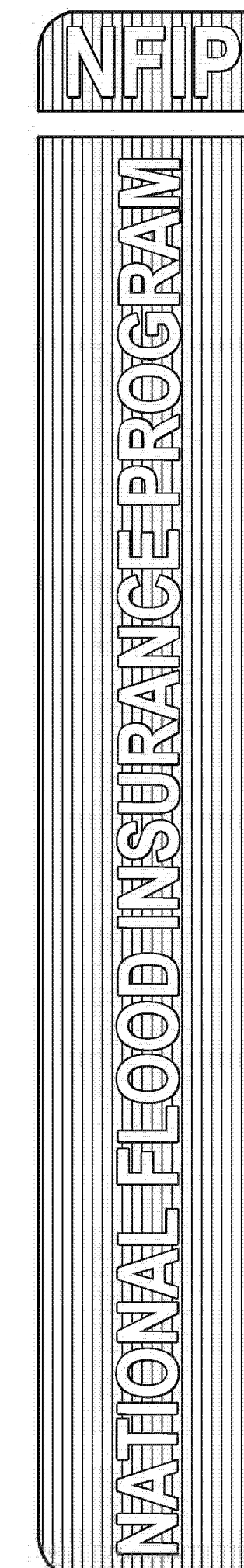
For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS



**PANEL 0751G**

**FIRM**  
**FLOOD INSURANCE RATE MAP**  
**EL PASO COUNTY, COLORADO AND INCORPORATED AREAS**

**PANEL 751 OF 1300**  
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

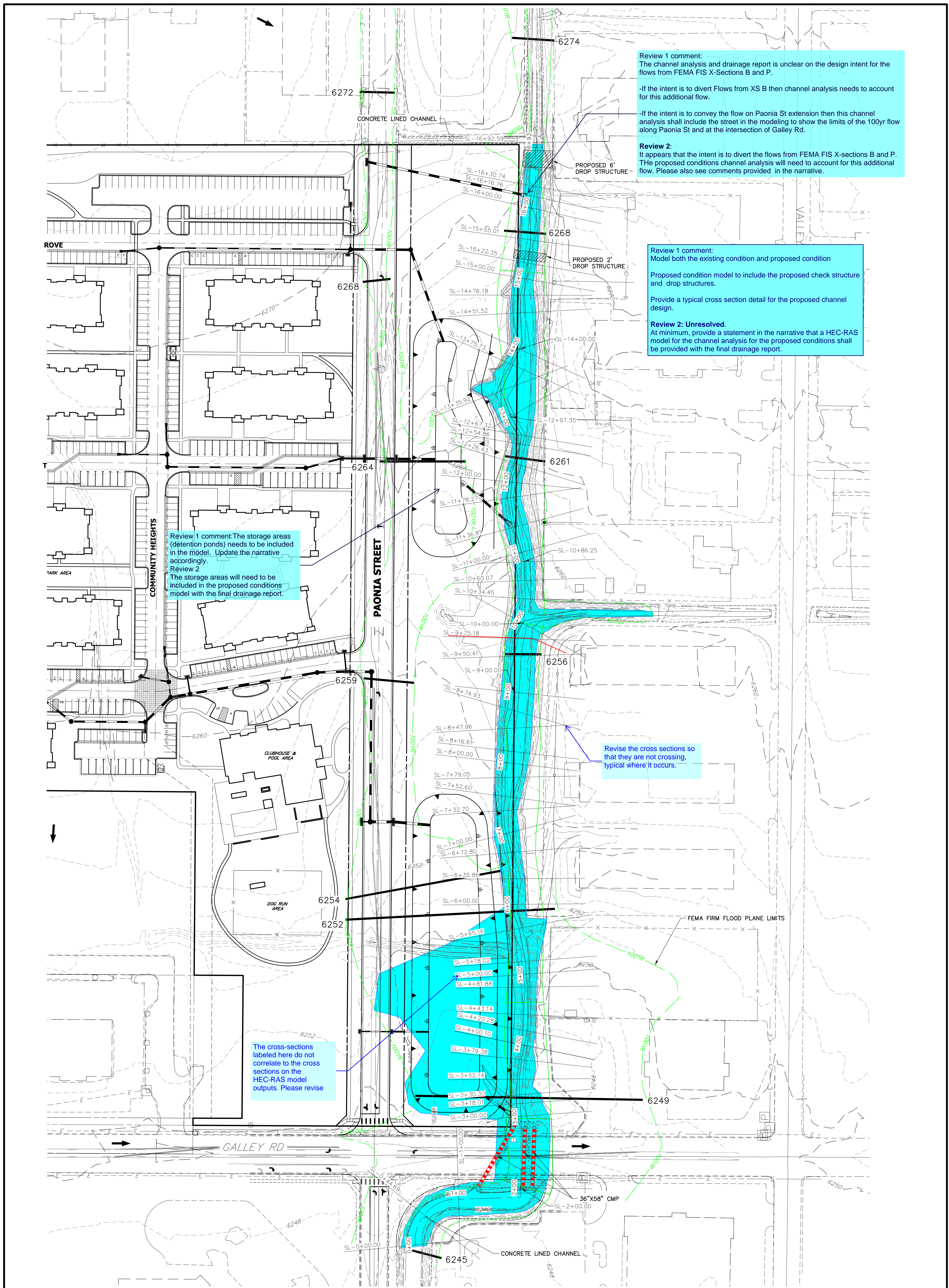
COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	08060	0751	G
EL PASO COUNTY	08059	0751	G

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

**MAP NUMBER 08041C0751G**

**MAP REVISED DECEMBER 7, 2018**

Federal Emergency Management Agency



**Review 1 comment:**  
The channel analysis and drainage report is unclear on the design intent for the flows from FEMA FIS X-Sections B and P.  
-If the intent is to divert Flows from XS B then channel analysis needs to account for this additional flow.  
-If the intent is to convey the flow on Paonia St extension then this channel analysis shall include the street in the modeling to show the limits of the 100yr flow along Paonia St and at the intersection of Galley Rd.

**Review 2:**  
It appears that the intent is to divert the flows from FEMA FIS X-sections B and P. The proposed conditions channel analysis will need to account for this additional flow. Please also see comments provided in the narrative.

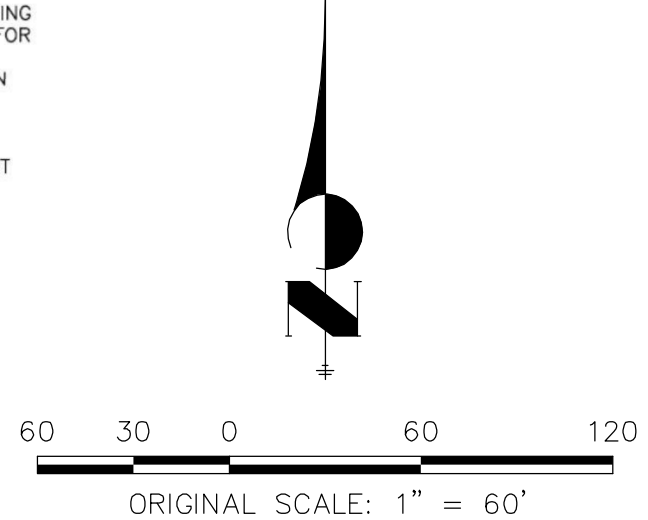
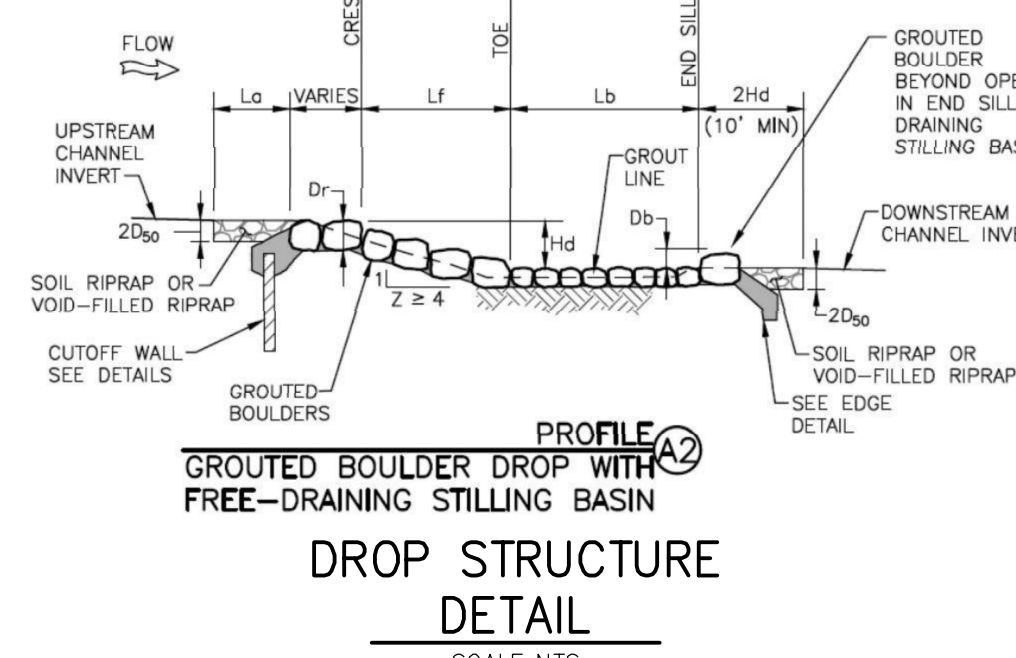
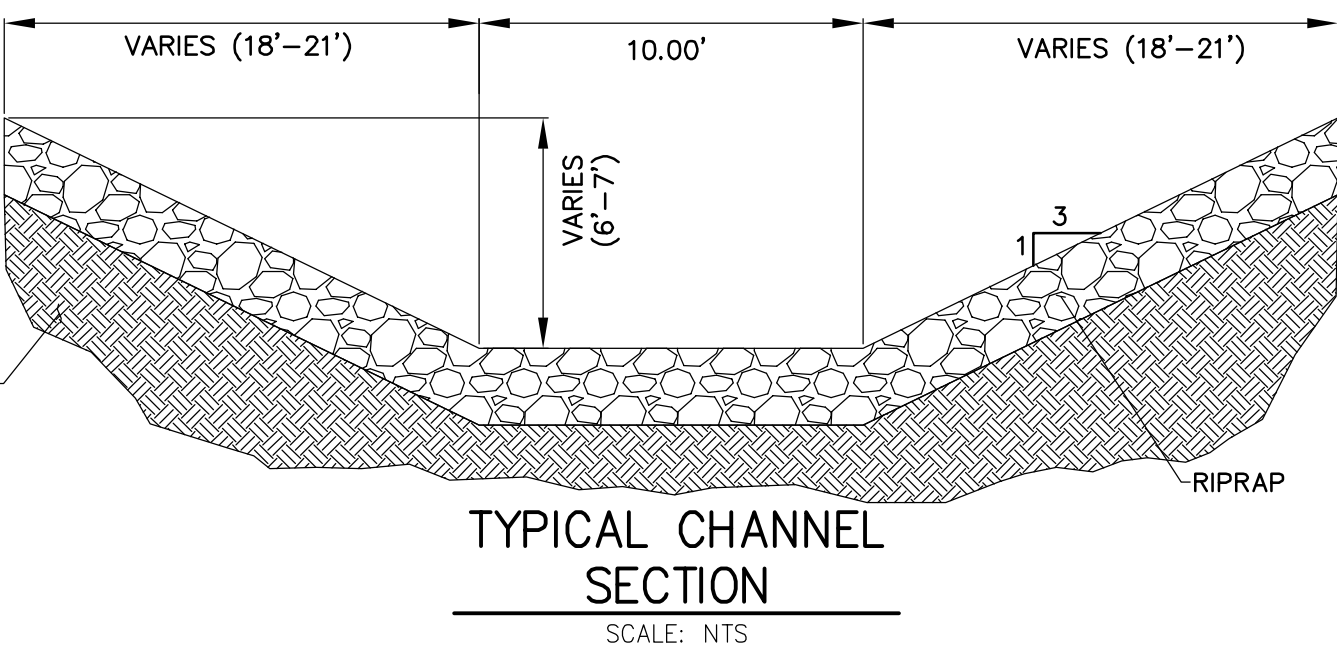
**Review 1 comment:**  
Model both the existing condition and proposed condition  
Proposed condition model to include the proposed check structure and drop structures.  
Provide a typical cross section detail for the proposed channel design.

**Review 2: Unresolved.**  
At minimum, provide a statement in the narrative that a HEC-RAS model for the channel analysis for the proposed conditions shall be provided with the final drainage report.

**Review 1 comment:** The storage areas (detention ponds) needs to be included in the model. Update the narrative accordingly.  
**Review 2:** The storage areas will need to be included in the proposed conditions model with the final drainage report.

Revise the cross sections so that they are not crossing, typical where it occurs.

The cross-sections labeled here do not correlate to the cross sections on the HEC-RAS model outputs. Please revise



X:\25174000\Drawings\Presentations\25174000 EX Flood Map Enbl.dwg 24:05 Title Paonia\_4302020 2:34:50 PM, 11/1/2020

**APPENDIX B**

**HYDRAULIC CALCULATIONS**

Sand Creek Center Tributary Upstream of Gally Road.txt

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

\*\*\*\*\*

Element Count

\*\*\*\*\*

Number of rain gages ..... 1  
 Number of subcatchments ... 1  
 Number of nodes ..... 1  
 Number of links ..... 0  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

\*\*\*\*\*

Raingage Summary

\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
100Year	100YR_24_Hour_Type_2	CUMULATIVE	15 min.

\*\*\*\*\*

Subcatchment Summary

\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage
EX_SandCreekCenter SCCT	486.00	14000.00	2.00	2.0000	100Year

\*\*\*\*\*

Node Summary

\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
SCCT	OUTFALL	0.00	0.00	0.0	

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*

Analysis Options

\*\*\*\*\*

Flow Units ..... CFS  
 Process Models:  
 Rainfall/Runoff ..... YES  
 RDI ..... NO  
 Snowmelt ..... NO  
 Groundwater ..... NO  
 Flow Routing ..... NO

Sand Creek Center Tributary Upstream of Gally Road.txt

Water Quality ..... NO  
 Infiltration Method ..... HORTON  
 Starting Date ..... 04/11/2019 00: 00: 00  
 Ending Date ..... 04/12/2019 00: 00: 00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00: 01: 00  
 Wet Time Step ..... 00: 05: 00  
 Dry Time Step ..... 01: 00: 00

\*\*\*\*\*  
 Control Actions Taken  
 \*\*\*\*\*

*****	Vol ume	Depth
Runoff Quanti ty Conti nui ty	acre-feet	i nches
*****	-----	-----
Total Preci pi tati on .....	211. 410	5. 220
Evaporati on Loss .....	0. 000	0. 000
Infi ltrati on Loss .....	169. 021	4. 173
Surface Runoff .....	42. 648	1. 053
Fi nal Storage .....	0. 065	0. 002
Conti nui ty Error (%) .....	-0. 153	

*****	Vol ume	Vol ume
Flow Routi ng Conti nui ty	acre-feet	10^6 gal
*****	-----	-----
Dry Weather Inflow .....	0. 000	0. 000
Wet Weather Inflow .....	42. 646	13. 897
Groundwater Inflow .....	0. 000	0. 000
RDII Inflow .....	0. 000	0. 000
External Inflow .....	0. 000	0. 000
External Outflow .....	42. 646	13. 897
Floodi ng Loss .....	0. 000	0. 000
Evaporati on Loss .....	0. 000	0. 000
Exfi ltrati on Loss .....	0. 000	0. 000
Ini ti al Stored Vol ume .....	0. 000	0. 000
Fi nal Stored Vol ume .....	0. 000	0. 000
Conti nui ty Error (%) .....	0. 000	

\*\*\*\*\*  
 Subcatchment Runoff Summary  
 \*\*\*\*\*

-----			-----					
Total	Peak	Runoff	Total	Total	Total	Total	Total	
Runoff	Runoff	Coeff	Preci p	Runon	Evap	Infi l	Runoff	
Subcatchment	Subcatchment	CFS	i n	i n	i n	i n	i n	
10^6 gal	10^6 gal							
-----			-----					
EX_SandCreekCenter	13. 90	956. 31	0. 202	5. 22	0. 00	0. 00	4. 17	1. 05

Sand Creek Center Tributary Upstream of Gally Road.txt  
Analysis begun on: Wed Oct 09 08:37:59 2019  
Analysis ended on: Wed Oct 09 08:37:59 2019  
Total elapsed time: < 1 sec

L	Asmall	Am	A	Z	Am/A	Z	Am/A
	9900	137.26	349.17	486.43	0.717822		

W            L+2L(1-Z)  
15487.13

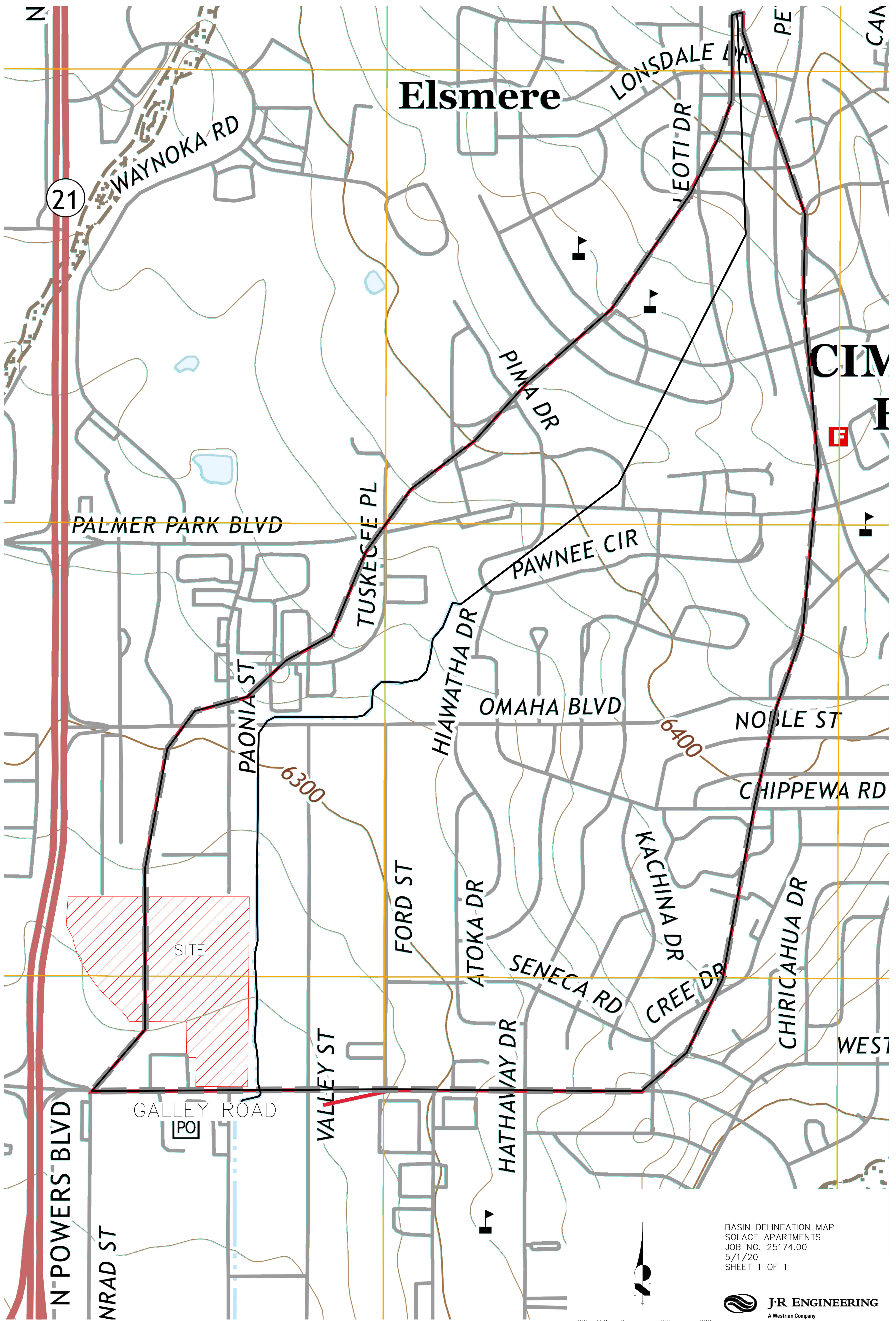
W = A/L  
2140.292

Area in SQ MI  
0.760047



# SOLACE APARTMENTS

## BASIN DELINEATION MAP



\*NOTE: BASIN SHOWN ON MAP IS BASED USGS MAP CONTOURS

300 150 0 300 600  
ORIGINAL SCALE: 1" = 300'

BASIN DELINEATION MAP  
SOLACE APARTMENTS  
JOB NO. 25174.00  
5/1/20  
SHEET 1 OF 1

**J-R ENGINEERING**  
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593  
Fort Collins 970-491-9888 • www.jrengineering.com

X:\251006\251740\Drawings\Working\Digital\Basin Delineation.dwg, 24x36 Title Portal, 5/1/2020 11:27:26 AM, mmmu...a

HEC-RAS Plan: Default Scenario River: Channel 01 Reach: CH01 Profile: Sand Creek

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
CH01	1053	Sand Creek	760.00	6265.00	6269.26	6269.26	6270.04	0.003762	8.51	179.27	110.42	0.77
CH01	1052	Sand Creek	760.00	6258.00	6262.11	6262.11	6263.78	0.005804	10.49	77.83	25.50	0.96
CH01	1051	Sand Creek	760.00	6257.00	6261.64	6261.64	6263.29	0.006883	10.30	74.47	24.12	0.98
CH01	1050	Sand Creek	760.00	6257.00	6261.55	6261.55	6263.17	0.005614	10.36	81.50	27.77	0.96
CH01	1049	Sand Creek	760.00	6257.00	6260.93	6260.93	6262.50	0.005917	10.15	80.51	28.71	0.97
CH01	1048	Sand Creek	760.00	6255.00	6259.52	6259.52	6261.19	0.005730	10.51	80.21	27.19	0.97
CH01	1047	Sand Creek	760.00	6254.00	6258.20	6258.20	6259.83	0.006013	10.34	79.30	27.50	0.98
CH01	1046	Sand Creek	760.00	6253.00	6257.62	6257.33	6258.86	0.004369	9.10	93.85	32.59	0.85
CH01	1045	Sand Creek	760.00	6253.00	6257.94		6258.62	0.002044	6.71	123.65	36.54	0.59
CH01	1044	Sand Creek	760.00	6252.00	6258.04		6258.47	0.000942	5.39	158.77	38.15	0.42
CH01	1043	Sand Creek	760.00	6252.00	6258.17		6258.40	0.000450	3.84	219.34	49.10	0.29
CH01	1042	Sand Creek	760.00	6252.00	6258.25		6258.35	0.000192	2.60	333.13	72.33	0.19
CH01	1041	Sand Creek	760.00	6251.00	6258.15	6254.86	6258.33	0.000342	3.46	250.00	54.53	0.26
CH01	1040	Sand Creek	760.00	6251.00	6257.48		6258.25	0.001509	7.34	129.48	31.17	0.53
CH01	1039	Sand Creek	720.00	6250.00	6256.03	6256.03	6258.09	0.005145	12.17	78.63	22.88	0.93
CH01	1038	Sand Creek	720.00	6250.00	6254.65	6254.65	6256.48	0.005632	11.04	74.30	23.99	0.96
CH01	1037	Sand Creek	720.00	6249.00	6254.26	6254.26	6256.12	0.005266	11.39	78.61	25.24	0.94
CH01	1036	Sand Creek	720.00	6249.00	6254.18	6253.87	6255.67	0.004153	10.16	86.85	27.64	0.84
CH01	1035	Sand Creek	720.00	6248.00	6254.49		6255.37	0.001997	8.12	123.42	33.33	0.60
CH01	1034	Sand Creek	720.00	6248.00	6253.87	6253.37	6255.23	0.003530	9.97	96.29	27.50	0.78
CH01	1033	Sand Creek	720.00	6248.00	6253.90	6253.27	6255.15	0.003218	9.54	100.27	28.48	0.75
CH01	1032	Sand Creek	720.00	6248.00	6254.02	6252.85	6254.99	0.002212	8.21	107.83	28.30	0.63
CH01	1031	Sand Creek	720.00	6247.00	6252.93	6252.93	6254.82	0.005902	11.67	81.05	24.65	0.92
CH01	1030	Sand Creek	960.00	6247.00	6253.53		6254.38	0.001956	8.14	169.51	45.64	0.61
CH01	1029	Sand Creek	960.00	6247.00	6253.61		6254.29	0.001452	7.08	180.40	43.93	0.52
CH01	1028	Sand Creek	960.00	6247.00	6253.63	6251.57	6254.24	0.001217	6.58	184.56	43.62	0.48
CH01	1027	Sand Creek	960.00	6247.00	6253.56		6254.17	0.001232	7.01	201.11	46.32	0.50
CH01	1026	Sand Creek	960.00	6247.00	6253.62		6254.11	0.000969	5.82	199.63	47.17	0.43
CH01	1025	Sand Creek	960.00	6247.00	6253.70	6250.88	6254.05	0.000644	4.85	227.01	48.43	0.35
CH01	1024	Sand Creek	960.00	6246.00	6253.67	6250.42	6254.02	0.000576	4.98	235.21	46.35	0.34
CH01	1023	Sand Creek	960.00	6246.00	6253.62	6250.47	6254.01	0.000626	5.21	225.63	43.80	0.35
CH01	1022	Sand Creek	960.00	6246.00	6253.61		6254.00	0.000607	5.19	221.85	41.91	0.35
CH01	1021	Sand Creek	960.00	6246.00	6253.17		6253.94	0.001350	7.37	164.92	36.16	0.51
CH01	1020	Sand Creek	960.00	6246.00	6252.32	6251.61	6253.82	0.003159	10.30	118.91	30.63	0.76
CH01	1019	Sand Creek	960.00	6246.00	6252.49	6251.34	6253.62	0.002313	9.03	140.23	36.35	0.66
CH01	1018	Sand Creek	960.00	6246.00	6251.44	6251.44	6253.45	0.004819	12.21	109.12	31.63	0.94
CH01	1017	Sand Creek	960.00	6245.00	6251.26	6250.03	6252.37	0.002324	8.73	133.16	32.49	0.65
CH01	1016	Sand Creek	960.00	6245.00	6250.14	6250.14	6252.15	0.005299	11.66	96.28	28.21	0.95
CH01	1015	Sand Creek	960.00	6244.00	6250.38	6248.09	6250.77	0.000839	5.11	215.92	53.82	0.39
CH01	1014	Sand Creek	956.00	6244.00	6250.35	6248.71	6250.72	0.000950	5.78	370.06	207.76	0.42
CH01	1013	Sand Creek	956.00	6244.00	6249.89	6249.89	6250.66	0.001931	8.21	274.84	196.01	0.61
CH01	1012	Sand Creek	956.00	6244.00	6248.95	6248.95	6251.16	0.005865	12.67	104.90	38.16	1.02
CH01	1011	Sand Creek	956.00	6244.00	6249.28	6249.28	6250.05	0.002387	8.46	279.17	203.66	0.66
CH01	1010	Sand Creek	956.00	6244.00	6249.16	6249.16	6249.97	0.002504	8.54	254.79	169.44	0.67
CH01	1009	Sand Creek	956.00	6242.00	6249.14	6247.90	6249.85	0.001612	7.93	276.71	166.57	0.55
CH01	1008	Sand Creek	956.00	6242.00	6247.80	6247.80	6249.73	0.004748	11.73	106.54	31.47	0.91
CH01	1007	Sand Creek	956.00	6242.00	6248.22	6247.39	6249.22	0.002263	9.17	222.13	127.82	0.66
CH01	1006	Sand Creek	956.00	6242.00	6248.59	6247.92	6249.01	0.001105	6.67	368.21	181.76	0.46
CH01	1005	Sand Creek	956.00	6242.00	6248.64	6246.43	6248.97	0.000738	5.28	352.19	168.51	0.38
CH01	1004	Sand Creek	956.00	6242.00	6248.76	6245.39	6248.91	0.000242	3.31	399.38	160.30	0.22
CH01	1003.56		Culvert									
CH01	1003	Sand Creek	956.00	6239.00	6244.43	6242.22	6244.82	0.000233	4.99	191.73	160.51	0.40
CH01	1002	Sand Creek	956.00	6240.00	6243.32	6243.32	6244.68	0.001891	9.35	102.20	38.15	1.01
CH01	1001	Sand Creek	956.00	6239.00	6242.61	6242.61	6244.01	0.001806	9.51	100.52	34.95	0.99
CH01	1000	Sand Creek	956.00	6239.00	6242.44	6242.44	6243.85	0.001879	9.55	100.10	35.71	1.01

Sol ace (v2). rep

HEC-RAS Versi on 4. 1. 0 Jan 2010  
U. S. Army Corps of Engi neers  
Hydrol ogi c Engi neeri ng Center  
609 Second Street  
Davi s, Cal i forni a

```
X      X  XXXXXX      XXXX      XXXX      XX      XXXX
X      X  X          X      X      X  X      X
X      X  X          X          X  X      X  X      X
XXXXXXXX XXXX      X          XXX XXXX      XXXXXX      XXXX
X      X  X          X          X  X      X  X      X
X      X  X          X      X      X  X      X  X      X
X      X  XXXXXX      XXXX      X      X      X  X      XXXXX
```

PROJECT DATA

Project Title: HEC-RAS Model  
Project File : Sol ace (v2). prj  
Run Date and Time: 4/29/2020 8: 07: 52 AM

Project in English units

Project Description:

CRS Info=<Spatial Reference> <CoordinateSystem Code="WGS84\_Mercator"  
Unit="Foot" AcadCode="" /> <Registration OffsetX="0" OffsetY="0" OffsetZ="0"  
ScaleX="1" ScaleY="1" ScaleZ="1" /></Spatial Reference>

PLAN DATA

Plan Title: Default Scenario  
Plan File : X:\2510000. al I\2517400\Drawings\Working Dwg\JaredP\Sol ace (v2). p01

Geometry Title: Default Geometry  
Geometry File : X:\2510000. al I\2517400\Drawings\Working  
Dwg\JaredP\Sol ace (v2). g01

Flow Title : Default Steady Flow  
Flow File : X:\2510000. al I\2517400\Drawings\Working  
Dwg\JaredP\Sol ace (v2). f01

Plan Description:  
Default Scenario

Plan Summary Information:

Number of:	Cross Sections	=	54	Multiple Openings	=	0
	Culverts	=	1	Inline Structures	=	0
	Bridges	=	0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.33
Flow tolerance factor	=	0.001

Sol ace (v2). rep

Computati on Opti ons

Critical depth computed only where necessary  
 Conveyance Calculati on Method: At breaks in n values only  
 Fricti on Slope Method: Average Conveyance  
 Computati onal Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Default Steady Flow  
 Flow File : X:\2510000.al\2517400\Drawings\Working Dwg\JaredP\Sol ace (v2). f01

Flow Data (cfs)

River	Reach	RS	Sand Creek
Channel 01	CH01	1053	760
Channel 01	CH01	1039	720
Channel 01	CH01	1030	960
Channel 01	CH01	1014	1340

Boundary Condi ti ons

River	Reach	Profile	Upstream
Downstream			
Channel 01 Critical	CH01	Sand Creek	Normal S = 0.058173

GEOMETRY DATA

Geometry Title: Default Geometry  
 Geometry File : X:\2510000.al\2517400\Drawings\Working Dwg\JaredP\Sol ace (v2). g01

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1053

INPUT

Descripti on:

Stati on Elevati on Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6275	2.69	6275	4.55	6274	34.15	6274	56.66	6274
79.08	6273	83.52	6272	85.81	6271	88.09	6270	90.1	6269
91.94	6268	93.76	6267	95.58	6266	97.43	6265	99.97	6265
105.99	6265	107.76	6266	109.47	6267	111.16	6268	111.82	6268
138.42	6268	192.47	6268	200	6268				

Manni ng' s n Val ues num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	93.76	.025	109.47	.05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

93.76 109.47 Sol ace (v2).rep  
61.74 61.74 61.74 .1 .3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6270.04	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.78	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6269.26	Reach Len. (ft)	61.74	61.74
61.74				
Crit W. S. (ft)	6269.26	Flow Area (sq ft)	4.66	59.80
114.80				
E. G. Slope (ft/ft)	0.003762	Area (sq ft)	4.66	59.80
114.80				
Q Total (cfs)	760.00	Flow (cfs)	8.40	509.17
242.43				
Top Width (ft)	110.42	Top Width (ft)	4.18	15.71
90.53				
Vel Total (ft/s)	4.24	Avg. Vel. (ft/s)	1.80	8.51
2.11				
Max Chl Dpth (ft)	4.26	Hydr. Depth (ft)	1.12	3.81
1.27				
Conv. Total (cfs)	12391.2	Conv. (cfs)	136.9	8301.6
3952.7				
Length Wtd. (ft)	61.74	Wetted Per. (ft)	4.75	16.75
92.06				
Min Ch El (ft)	6265.00	Shear (lb/sq ft)	0.23	0.84
0.29				
Alpha	2.78	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.29	Cum Volume (acre-ft)	0.87	5.85
2.16				
C & E Loss (ft)	0.09	Cum SA (acres)	0.58	1.22
1.29				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: The cross-section end points had to be extended vertically for the computed water surface.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Channel 01  
REACH: CH01 RS: 1052

INPUT  
Description:  
Station Elevation Data num= 33

Sol ace (v2). rep									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6273	8.5	6273	32.72	6273	58.42	6273	63.91	6273
70.65	6273	75.07	6273	76.92	6272	78.43	6271	79.93	6270
81.44	6269	82.94	6268	84.44	6267	85.95	6266	87.45	6265
88.96	6264	90.46	6263	91.96	6262	93.47	6261	94.97	6260
96.48	6259	97.98	6258	100.61	6258	107.94	6258	112.82	6259
114.08	6260	115.61	6261	117.14	6262	118.67	6263	120.2	6264
121.56	6265	127.83	6266	200	6266				

Manning's n Values num= 3  
 Sta n Val Sta n Val Sta n Val  
 0 .05 94.97 .025 114.08 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 94.97 114.08 14 14 14 .1 .3  
 Left Levee Station= 75.59 Elevation= 6273

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6263.78	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.68	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6262.11	Reach Len. (ft)	14.00	14.00
14.00				
Crit W. S. (ft)	6262.11	Flow Area (sq ft)	3.33	71.11
3.39				
E. G. Slope (ft/ft)	0.005804	Area (sq ft)	3.33	71.11
3.39				
Q Total (cfs)	760.00	Flow (cfs)	6.90	746.04
7.06				
Top Width (ft)	25.50	Top Width (ft)	3.17	19.11
3.22				
Vel Total (ft/s)	9.76	Avg. Vel. (ft/s)	2.07	10.49
2.08				
Max Chl Dpth (ft)	4.11	Hydr. Depth (ft)	1.05	3.72
1.05				
Conv. Total (cfs)	9975.8	Conv. (cfs)	90.6	9792.5
92.6				
Length Wtd. (ft)	14.00	Wetted Per. (ft)	3.80	20.16
3.85				
Min Ch El (ft)	6258.00	Shear (lb/sq ft)	0.32	1.28
0.32				
Alpha	1.13	Stream Power (lb/ft s)	200.00	75.59
0.00				
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	0.87	5.76
2.08				
C & E Loss (ft)	0.01	Cum SA (acres)	0.58	1.19
1.23				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth

for the water surface and continued on with the calculations.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated

water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

Sol ace (v2). rep

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1051

INPUT

Description:

Station	Elevation	Data	num=	24	Station	Elevation	Station	Elevation	Station	Elevation
0	6271	72.2	6271	74.17	6270	76.15	6269	78.13	6268	
80.12	6267	82.1	6266	84.09	6265	86.07	6264	88.06	6263	
90.04	6262	92.03	6261	94.01	6260	95.94	6257	100.04	6257	
104.55	6257	112.05	6260	113.69	6261	115.54	6262	117.39	6263	
119.24	6264	121.09	6265	142.84	6266	200	6266			

Manning's n	Values	num=	3	Station	n Val	Station	n Val
0	.05	92.03	.025	113.69	.05		

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	92.03	113.69	71.68	16.76	16.76		.1	.3
Left Levee		Station=		Elevation=	6271			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6263.29	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.65	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6261.64	Reach Len. (ft)	16.76	16.76
16.76				
Crit W. S. (ft)	6261.64	Flow Area (sq ft)	0.41	73.68
0.38				
E. G. Slope (ft/ft)	0.006883	Area (sq ft)	0.41	73.68
0.38				
Q Total (cfs)	760.00	Flow (cfs)	0.44	759.16
0.40				
Top Width (ft)	24.12	Top Width (ft)	1.27	21.66
1.18				
Vel Total (ft/s)	10.21	Avg. Vel. (ft/s)	1.07	10.30
1.06				
Max Chl Dpth (ft)	4.64	Hydr. Depth (ft)	0.32	3.40
0.32				
Conv. Total (cfs)	9160.6	Conv. (cfs)	5.2	9150.6
4.8				
Length Wtd. (ft)	16.76	Wetted Per. (ft)	1.42	24.39
1.35				
Min Ch El (ft)	6257.00	Shear (lb/sq ft)	0.12	1.30
0.12				
Alpha	1.02	Stream Power (lb/ft s)	200.00	71.68
0.00				
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	0.87	5.73
2.08				
C & E Loss (ft)	0.01	Cum SA (acres)	0.58	1.18
1.23				

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

Solace (v2).rep

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1050

INPUT

Description:

Station		Elevation		Data		num= 28					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6271	37.48	6271	63.08	6270	71.73	6269	74.37	6268		
76.12	6267	77.86	6266	79.61	6265	81.45	6264	83.29	6263		
85.14	6262	86.99	6261	88.83	6260	90.68	6259	92.81	6258		
97.73	6257	100.21	6257	100.3	6257	103.19	6258	110.11	6259		
111.49	6260	112.88	6261	114.43	6262	116.28	6263	118.13	6264		
126.77	6265	195.06	6266	200	6266						

Manning's n		Values		num= 3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	90.68	.025	110.11	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	90.68	110.11		45.02	45.02		.1	.3
Left Levee		Station=	37.06	Elevation=	6271.12			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6263.17	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.62	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6261.55	Reach Len. (ft)	45.02	45.02
45.02				
Crit W. S. (ft)	6261.55	Flow Area (sq ft)	6.01	70.96
4.53				
E. G. Slope (ft/ft)	0.005614	Area (sq ft)	6.01	70.96
4.53				
Q Total (cfs)	760.00	Flow (cfs)	14.46	735.31
10.23				
Top Width (ft)	27.77	Top Width (ft)	4.71	19.43
3.63				
Vel Total (ft/s)	9.32	Avg. Vel. (ft/s)	2.40	10.36
2.26				
Max Chl Dpth (ft)	4.55	Hydr. Depth (ft)	1.28	3.65
1.25				
Conv. Total (cfs)	10143.0	Conv. (cfs)	193.0	9813.5
136.5				
Length Wtd. (ft)	45.02	Wetted Per. (ft)	5.36	19.99
4.43				
Min Chl El (ft)	6257.00	Shear (lb/sq ft)	0.39	1.24
0.36				
Alpha	1.20	Stream Power (lb/ft s)	200.00	37.06
0.00				
Frctn Loss (ft)	0.26	Cum Volume (acre-ft)	0.86	5.71
2.08				
C & E Loss (ft)	0.01	Cum SA (acres)	0.58	1.18
1.23				

Warning: The energy equation could not be balanced within the specified number of



iterations. The program used critical depth for the water surface and continued on with the calculations.  
 Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1049

INPUT

Description:

Station	Elevation	Data	num=	25	Station	Elevation	Station	Elevation	Station	Elevation
0	6270	46.25	6270	54.98	6269	66.55	6268	75.83	6267	6267
77.89	6266	79.95	6265	82.02	6264	84.08	6263	86.14	6262	6262
88.2	6261	90.27	6260	92.33	6259	94.39	6258	96.33	6257	6257
100.06	6257	103.86	6257	112.05	6258	113.75	6259	115.46	6260	6260
117.17	6261	118.88	6262	120.59	6263	128.77	6264	200	6264	6264

Manning's n	Val	num=	3	Station	Val
0	.05	92.33	.025	113.75	.05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	92.33	113.75		32.7	32.7	32.7		.1	.3
Left Levee		Station=	45.99	Elevation=	6270.04				

CROSS SECTION OUTPUT Profile #Sand Creek

E. G.	Elev (ft)	6262.50	Element	Left OB	Channel
Right OB					
Vel Head (ft)	1.57	Wt. n-Val.	0.050	0.025	
0.050					
W. S. Elev (ft)	6260.93	Reach Len. (ft)	32.70	32.70	
32.70					
Crit W. S. (ft)	6260.93	Flow Area (sq ft)	3.84	73.48	
3.19					
E. G. Slope (ft/ft)	0.005917	Area (sq ft)	3.84	73.48	
3.19					
Q Total (cfs)	760.00	Flow (cfs)	7.99	745.56	
6.45					
Top Width (ft)	28.71	Top Width (ft)	3.99	21.42	
3.30					
Vel Total (ft/s)	9.44	Avg. Vel. (ft/s)	2.08	10.15	
2.02					
Max Chl Dpth (ft)	3.93	Hydr. Depth (ft)	0.96	3.43	
0.97					
Conv. Total (cfs)	9880.0	Conv. (cfs)	103.8	9692.3	
83.8					
Length Wtd. (ft)	32.70	Wetted Per. (ft)	4.43	22.23	
3.82					
Min Ch El (ft)	6257.00	Shear (lb/sq ft)	0.32	1.22	
0.31					
Alpha	1.13	Stream Power (lb/ft s)	200.00	45.99	
0.00					
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)	0.86	5.63	
2.07					

C & E Loss (ft) 1.22 Sol ace (v2).rep 0.01 Cum SA (acres) 0.57 1.16

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.  
 Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.  
 Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1048

INPUT

Description:

Station		Elevation Data		num= 29							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6270	1.46	6270	52.09	6269	59.97	6268	72.07	6267		
76.95	6266	78.67	6265	80.39	6264	82.11	6263	83.83	6262		
85.55	6261	87.27	6260	88.99	6259	90.71	6258	92.43	6257		
94.48	6256	99.96	6255	100.05	6255	100.12	6255.01	106.7	6256		
111.53	6257	113.02	6258	114.5	6259	115.99	6260	117.47	6261		
118.96	6262	120.44	6263	141.56	6264	200	6264				

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	92.43	.025	111.53	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	92.43	111.53		22.36	22.36		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

	E. G. Elev (ft)	6261.19	Element	Left OB	Channel
Right OB					
Vel Head (ft)	0.050	1.66	Wt. n-Val.	0.050	0.025
W. S. Elev (ft)	22.36	6259.52	Reach Len. (ft)	22.36	22.36
Crit W. S. (ft)	4.73	6259.52	Flow Area (sq ft)	5.47	70.01
E. G. Slope (ft/ft)	4.73	0.005730	Area (sq ft)	5.47	70.01
Q Total (cfs)	10.98	760.00	Flow (cfs)	13.05	735.98
Top Width (ft)	3.75	27.19	Top Width (ft)	4.34	19.10
Vel Total (ft/s)	2.32	9.47	Avg. Vel. (ft/s)	2.38	10.51
Max Chl Dpth (ft)	1.26	4.52	Hydr. Depth (ft)	1.26	3.67
Conv. Total (cfs)		10040.3	Conv. (cfs)	172.4	9722.9

Sol ace (v2).rep

145.0					
Length Wtd. (ft)	22.36	Wetted Per. (ft)	5.02	19.60	
4.52					
Min Ch El (ft)	6255.00	Shear (lb/sq ft)	0.39	1.28	
0.37					
Alpha	1.19	Stream Power (lb/ft s)	200.00	0.00	
0.00					
Frctn Loss (ft)	0.13	Cum Volume (acre-ft)	0.86	5.58	
2.07					
C & E Loss (ft)	0.01	Cum SA (acres)	0.57	1.14	
1.22					

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1047

INPUT

Description:

Station	Elevation	Data	num=	30						
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta
0	6269	21.81	6269	45.48	6268	69.97	6267	72	6266	
74.03	6265	76.05	6264	78.08	6263	80.07	6262	81.79	6261	
83.82	6260	86.15	6259	88.47	6258	90.8	6257	93.13	6256	
95.45	6255	97.93	6254	100.01	6254	102.86	6254	108.69	6255	
113.96	6256	114.67	6257	115.37	6258	116.07	6259	116.77	6260	
117.55	6261	119.04	6262	132.35	6263	194.66	6264	200	6264	

Manning's n Values	num=	3
Sta n Val	Sta n Val	Sta n Val
0 .05	93.13	.025 113.96 .05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
93.13	113.96	23.82	23.82	23.82	.1		.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6259.83	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.63	Wt. n-Val.	0.050	0.025
0.050				
W. S. El ev (ft)	6258.20	Reach Len. (ft)	23.82	23.82
23.82				
Crit W. S. (ft)	6258.20	Flow Area (sq ft)	5.64	71.95
1.71				
E. G. Slope (ft/ft)	0.006013	Area (sq ft)	5.64	71.95
1.71				

		Sol ace (v2). rep		
Q Total (cfs)	760.00	Flow (cfs)	13.09	743.99
2.92				
Top Width (ft)	27.50	Top Width (ft)	5.12	20.83
1.55				
Vel Total (ft/s)	9.58	Avg. Vel. (ft/s)	2.32	10.34
1.70				
Max Chl Dpth (ft)	4.20	Hydr. Depth (ft)	1.10	3.45
1.10				
Conv. Total (cfs)	9801.2	Conv. (cfs)	168.8	9594.8
37.6				
Length Wtd. (ft)	23.82	Wetted Per. (ft)	5.58	21.41
2.69				
Min Ch El (ft)	6254.00	Shear (lb/sq ft)	0.38	1.26
0.24				
Alpha	1.14	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	0.85	5.54
2.07				
C & E Loss (ft)	0.12	Cum SA (acres)	0.57	1.13
1.22				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1046

INPUT

Description:

Station		Elevation		Data		num= 31					
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6269	13.89	6269	43.98	6268	63.69	6267	65.67	6266		
67.66	6265	69.4	6264	71.12	6263	72.83	6262	74.55	6261		
76.27	6260	77.98	6259	79.7	6258	81.56	6257	83.78	6256		
86	6255	94.58	6254	99.71	6253	100	6253	100.15	6253		
104.81	6254	108.39	6255	110.15	6256	111.91	6257	113.67	6258		
115.42	6259	121.98	6260	125.13	6261	126.48	6262	149.72	6263		
200	6263										

Manning's n Values		num= 3	
Sta	n Val	Sta	n Val
0	.05	86	.025
		108.39	.05

Bank	Sta: Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	86	108.39		24.71	24.71		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6258.86	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.24	Wt. n-Val.	0.050	0.025

Sol ace (v2). rep

0.050				
W. S. Elev (ft)	6257.62	Reach Len. (ft)	24.71	24.71
24.71				
Crit W. S. (ft)	6257.33	Flow Area (sq ft)	7.54	80.28
6.03				
E. G. Slope (ft/ft)	0.004369	Area (sq ft)	7.54	80.28
6.03				
Q Total (cfs)	760.00	Flow (cfs)	16.93	730.15
12.92				
Top Width (ft)	32.59	Top Width (ft)	5.59	22.39
4.61				
Vel Total (ft/s)	8.10	Avg. Vel. (ft/s)	2.24	9.10
2.14				
Max Chl Dpth (ft)	4.62	Hydr. Depth (ft)	1.35	3.59
1.31				
Conv. Total (cfs)	11498.4	Conv. (cfs)	256.1	11046.8
195.5				
Length Wtd. (ft)	24.71	Wetted Per. (ft)	6.18	22.79
5.30				
Min Ch El (ft)	6253.00	Shear (lb/sq ft)	0.33	0.96
0.31				
Alpha	1.21	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	0.85	5.50
2.07				
C & E Loss (ft)	0.17	Cum SA (acres)	0.56	1.12
1.22				

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.  
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
 This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1045

INPUT

Description:

Station Elevation Data			num=	30					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6269	6.8	6269	44.04	6268	63.04	6267	64.67	6266
66.3	6265	67.93	6264	69.56	6263	71.19	6262	72.82	6261
74.45	6260	76.07	6259	77.7	6258	79.34	6257	81.06	6256
82.78	6255	93.95	6254	99	6253	99.94	6253	101.33	6253
108.77	6254	110.19	6255	111.6	6256	113.02	6257	114.43	6258
115.84	6259	117.25	6260	118.66	6261	126.32	6262	200	6262

Manning's n Values			num=	3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	82.78	.025	110.19	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	82.78	110.19		51.49	51.49	.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

		Sol ace (v2). rep		
E. G. El ev (ft)	6258. 62	El ement	Left OB	Channel
Right OB				
Vel Head (ft)	0. 68	Wt. n-Val .	0. 050	0. 025
0. 050				
W. S. El ev (ft)	6257. 94	Reach Len. (ft)	51. 49	51. 49
51. 49				
Crit W. S. (ft)		Flow Area (sq ft)	7. 38	110. 18
6. 09				
E. G. Slope (ft/ft)	0. 002044	Area (sq ft)	7. 38	110. 18
6. 09				
Q Total (cfs)	760. 00	Flow (cfs)	11. 68	739. 09
9. 24				
Top Width (ft)	36. 54	Top Width (ft)	4. 98	27. 41
4. 15				
Vel Total (ft/s)	6. 15	Avg. Vel. (ft/s)	1. 58	6. 71
1. 52				
Max Chl Dpth (ft)	4. 94	Hydr. Depth (ft)	1. 48	4. 02
1. 47				
Conv. Total (cfs)	16809. 9	Conv. (cfs)	258. 2	16347. 3
204. 3				
Length Wtd. (ft)	51. 49	Wetted Per. (ft)	5. 78	27. 94
5. 08				
Min Ch El (ft)	6253. 00	Shear (lb/sq ft)	0. 16	0. 50
0. 15				
Alpha	1. 16	Stream Power (lb/ft s)	200. 00	0. 00
0. 00				
Frctn Loss (ft)	0. 07	Cum Volume (acre-ft)	0. 84	5. 44
2. 06				
C & E Loss (ft)	0. 07	Cum SA (acres)	0. 56	1. 10
1. 21				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
REACH: CH01 RS: 1044

INPUT

Descripti on:

Stati on		El evati on		Data		num=		32	
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6269	12. 13	6269	30. 16	6268	43. 9	6267	57. 73	6266
60. 05	6265	62. 12	6264	64. 13	6263	66. 13	6262	68. 13	6261
70. 13	6260	72. 14	6259	74. 14	6258	76. 14	6257	78. 15	6256
80. 15	6255	82. 15	6254	91. 38	6253	95. 84	6252	99. 94	6252
101. 63	6252	105. 06	6253	108. 35	6254	109. 16	6255	109. 97	6256
110. 81	6257	112. 16	6258	113. 5	6259	114. 84	6260	116. 19	6261
117. 53	6262	200	6262						

Manni ng' s n Val ues		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
0	. 05	82. 15	. 025	108. 35	. 05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	82. 15	108. 35		24. 27	24. 27		. 1	. 3

CROSS SECTION OUTPUT Profile #Sand Creek

Sol ace (v2). rep

E. G. El ev (ft)	6258. 47	El ement	Left OB	Channel
Ri ght OB				
Vel Head (ft)	0. 44	Wt. n-Val .	0. 050	0. 025
0. 050				
W. S. El ev (ft)	6258. 04	Reach Len. (ft)	24. 27	24. 27
24. 27				
Crit W. S. (ft)		Fl ow Area (sq ft)	16. 33	135. 50
6. 94				
E. G. Slope (ft/ft)	0. 000942	Area (sq ft)	16. 33	135. 50
6. 94				
Q Total (cfs)	760. 00	Fl ow (cfs)	22. 09	730. 62
7. 29				
Top Width (ft)	38. 15	Top Width (ft)	8. 09	26. 20
3. 86				
Vel Total (ft/s)	4. 79	Avg. Vel. (ft/s)	1. 35	5. 39
1. 05				
Max Chl Dpth (ft)	6. 04	Hydr. Depth (ft)	2. 02	5. 17
1. 80				
Conv. Total (cfs)	24766. 6	Conv. (cfs)	719. 7	23809. 3
237. 5				
Length Wtd. (ft)	24. 27	Wetted Per. (ft)	9. 04	26. 66
5. 63				
Min Ch El (ft)	6252. 00	Shear (lb/sq ft)	0. 11	0. 30
0. 07				
Alpha	1. 22	Stream Power (lb/ft s)	200. 00	0. 00
0. 00				
Frctn Loss (ft)	0. 02	Cum Volume (acre-ft)	0. 83	5. 30
2. 06				
C & E Loss (ft)	0. 06	Cum SA (acres)	0. 55	1. 07
1. 21				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
 This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1043

INPUT

Descripti on:

Stati on El evati on Data	num=	33								
Sta El ev Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta
0 6268 13. 44	6268	30. 38	6267	45. 62	6266	49. 55	6265			
51. 61 6264 53. 68	6263	55. 75	6262	57. 81	6261	60. 16	6260			
62. 52 6259 64. 88	6258	67. 25	6257	69. 61	6256	71. 97	6255			
74. 33 6254 81. 4	6253	92. 62	6252	99. 88	6252	100. 99	6252			
102. 43 6253 109. 87	6254	110. 68	6255	111. 54	6256	112. 47	6257			
113. 41 6258 114. 34	6259	115. 28	6260	116. 21	6261	117. 15	6262			
135. 85 6262 176	6262	200	6262							

Manni ng' s n Val ues	num=	3		
Sta n Val Sta	n Val	Sta	n Val	
0 . 05 74. 33	. 025	109. 87	. 05	

Bank Sta: Left Ri ght	Lengths: Left Channel Ri ght	Coeff Contr.	Expan.
74. 33 109. 87	39. 09 39. 09 39. 09	. 1	. 3

Sol ace (v2). rep

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6258.40	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.22	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6258.17	Reach Len. (ft)	39.09	39.09
39.09				
Crit W. S. (ft)		Flow Area (sq ft)	20.56	191.31
7.48				
E. G. Slope (ft/ft)	0.000450	Area (sq ft)	20.56	191.31
7.48				
Q Total (cfs)	760.00	Flow (cfs)	20.03	734.24
5.73				
Top Width (ft)	49.10	Top Width (ft)	9.86	35.54
3.70				
Vel Total (ft/s)	3.46	Avg. Vel. (ft/s)	0.97	3.84
0.77				
Max Chl Dpth (ft)	6.17	Hydr. Depth (ft)	2.09	5.38
2.02				
Conv. Total (cfs)	35817.4	Conv. (cfs)	943.9	34603.4
270.1				
Length Wtd. (ft)	39.09	Wetted Per. (ft)	10.71	36.03
5.58				
Min Ch El (ft)	6252.00	Shear (lb/sq ft)	0.05	0.15
0.04				
Alpha	1.19	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.82	5.21
2.05				
C & E Loss (ft)	0.04	Cum SA (acres)	0.55	1.06
1.21				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
REACH: CH01 RS: 1042

INPUT

Description:

Station	Elevation	Data	num=	31						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
0	6268	4.33	6268	16.84	6267	31.1	6266	33.26	6265	6265
35.31	6264	37.36	6263	39.41	6262	41.53	6261	43.78	6260	6260
46.03	6259	48.28	6258	50.53	6257	52.78	6256	55.03	6255	6255
57.28	6254	65.64	6253	87.39	6252	98.85	6252	101.92	6252	6252
103.97	6253	106.02	6254	112.17	6255	114.6	6256	117.02	6257	6257
119.45	6258	121.87	6259	124.3	6260	126.34	6261	191.49	6261	6261
200	6261									

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	57.28	.025	106.02	.05



Sol ace (v2).rep

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
57.28	106.02	39.32	39.32	39.32	.1		.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6258.35	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.10	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6258.25	Reach Len. (ft)	39.32	39.32
39.32				
Crit W. S. (ft)		Flow Area (sq ft)	20.30	276.99
35.84				
E. G. Slope (ft/ft)	0.000192	Area (sq ft)	20.30	276.99
35.84				
Q Total (cfs)	760.00	Flow (cfs)	12.99	720.36
26.65				
Top Width (ft)	72.33	Top Width (ft)	9.56	48.74
14.03				
Vel Total (ft/s)	2.28	Avg. Vel. (ft/s)	0.64	2.60
0.74				
Max Chl Dpth (ft)	6.25	Hydr. Depth (ft)	2.12	5.68
2.55				
Conv. Total (cfs)	54906.2	Conv. (cfs)	938.5	52042.5
1925.2				
Length Wtd. (ft)	39.32	Wetted Per. (ft)	10.46	49.28
14.75				
Min Ch El (ft)	6252.00	Shear (lb/sq ft)	0.02	0.07
0.03				
Alpha	1.24	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.80	5.00
2.03				
C & E Loss (ft)	0.01	Cum SA (acres)	0.54	1.02
1.20				

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1041

INPUT

Descripti on:

Station	Elevation	Data	num=	41							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6268	7.93	6268	22.65	6267	36.67	6266	44.41	6265		
46.63	6264	48.85	6263	51.08	6262	53.3	6261	55.53	6260		
57.75	6259	59.97	6258	62.2	6257	64.42	6256	66.67	6255		
68.91	6254	78.22	6253	95.05	6252	98.38	6251	99.61	6251		
101.25	6251	103.81	6252	105.83	6253	107.31	6254	108.96	6255		
110.61	6256	112.26	6257	113.91	6258	115.57	6259	117.22	6260		
118.87	6261	120.52	6262	130.26	6262	142.02	6261	144.73	6261		
150.81	6262	160.04	6263	176.22	6263	182.39	6262	186.13	6261		
200	6261										

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
0	.05	68.91	.025
		105.83	.05

Sol ace (v2).rep  
 Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 Right Levee Station= 119.99 30.04 30.04 30.04 .1 .3  
 Right Levee Station= 119.99 El evati on= 6262.12

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6258.33	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.18	Wt. n-Val.	0.050	0.025
0.050				
W. S. El ev (ft)	6258.15	Reach Len. (ft)	30.04	30.04
30.04				
Crit W. S. (ft)	6254.86	Flow Area (sq ft)	19.30	209.59
21.11				
E. G. Slope (ft/ft)	0.000342	Area (sq ft)	19.30	209.59
21.11				
Q Total (cfs)	760.00	Flow (cfs)	16.26	724.39
19.35				
Top Width (ft)	54.53	Top Width (ft)	9.28	36.92
8.33				
Vel Total (ft/s)	3.04	Avg. Vel. (ft/s)	0.84	3.46
0.92				
Max Chl Dpth (ft)	7.15	Hydr. Depth (ft)	2.08	5.68
2.53				
Conv. Total (cfs)	41108.1	Conv. (cfs)	879.6	39181.8
1046.7				
Length Wtd. (ft)	30.04	Wetted Per. (ft)	10.17	37.57
9.80				
Min Ch El (ft)	6251.00	Shear (lb/sq ft)	0.04	0.12
0.05				
Alpha	1.24	Stream Power (lb/ft s)	200.00	0.00
119.99				
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.78	4.78
2.01				
C & E Loss (ft)	0.06	Cum SA (acres)	0.53	0.98
1.19				

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.  
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
 This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1040

INPUT

Description:

Station	El evati on	Data	num=	32						
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta
0	6266	49.91	6266	72.29	6265	74.11	6264	75.93	6263	
77.75	6262	79.57	6261	81.32	6260	82.96	6259	84.61	6258	
86.26	6257	87.9	6256	89.55	6255	91.2	6254	92.85	6253	
94.49	6252	96.75	6251	100.07	6251	104.31	6251	106.93	6252	
108.71	6253	110.48	6254	112.25	6255	114.02	6256	115.79	6257	
117.56	6258	119.33	6259	121.5	6260	123.71	6261	153.94	6261	
163.11	6261	200	6261							

Sol ace (v2). rep

Manning's n Values num= 3  
 Sta n Val Sta n Val Sta n Val  
 0 .05 92.85 .025 108.71 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 92.85 108.71 12.64 12.64 12.64 .1 .3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6258.25	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.77	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6257.48	Reach Len. (ft)	12.64	12.64
12.64				
Crit W. S. (ft)		Flow Area (sq ft)	16.54	95.19
17.75				
E. G. Slope (ft/ft)	0.001509	Area (sq ft)	16.54	95.19
17.75				
Q Total (cfs)	760.00	Flow (cfs)	29.46	698.55
31.99				
Top Width (ft)	31.17	Top Width (ft)	7.38	15.86
7.93				
Vel Total (ft/s)	5.87	Avg. Vel. (ft/s)	1.78	7.34
1.80				
Max Chl Dpth (ft)	6.48	Hydr. Depth (ft)	2.24	6.00
2.24				
Conv. Total (cfs)	19564.0	Conv. (cfs)	758.3	17982.2
823.5				
Length Wtd. (ft)	12.64	Wetted Per. (ft)	8.63	16.80
9.11				
Min Ch El (ft)	6251.00	Shear (lb/sq ft)	0.18	0.53
0.18				
Alpha	1.44	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	0.77	4.67
1.99				
C & E Loss (ft)	0.13	Cum SA (acres)	0.53	0.96
1.18				

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.  
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
 This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1039

INPUT

Descripti on:

Station	Elevation	Data	num=	37							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6266	11.31	6266	70.12	6265	73.22	6264	75.04	6263		
76.86	6262	78.69	6261	80.51	6260	82.33	6259	84.15	6258		
85.97	6257	87.79	6256	89.61	6255	91.43	6254	93.26	6253		

Solace (v2).rep									
95.08	6252	96.86	6251	99.33	6250	99.54	6250	100.74	6250
103.51	6251	105.09	6252	106.46	6253	107.83	6254	109.21	6255
110.58	6256	111.95	6257	113.32	6258	114.7	6259	116.22	6260
117.88	6261	145.88	6261	147.62	6261	149.56	6262	183.55	6262
192.63	6261	200	6261						

Manning's n Values num= 3  
 Station Val Station Val Station Val  
 0 .05 95.08 .025 105.09 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 95.08 105.09 28.44 28.44 28.44 .1 .3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6258.09	Element	Left OB	Channel
Right OB				
Vel Head (ft)	2.06	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6256.03	Reach Len. (ft)	28.44	28.44
28.44				
Crit W. S. (ft)	6256.03	Flow Area (sq ft)	14.80	52.69
11.14				
E. G. Slope (ft/ft)	0.005145	Area (sq ft)	14.80	52.69
11.14				
Q Total (cfs)	720.00	Flow (cfs)	46.11	641.05
32.85				
Top Width (ft)	22.88	Top Width (ft)	7.34	10.01
5.53				
Vel Total (ft/s)	9.16	Avg. Vel. (ft/s)	3.12	12.17
2.95				
Max Chl Dpth (ft)	6.03	Hydr. Depth (ft)	2.02	5.26
2.01				
Conv. Total (cfs)	10037.9	Conv. (cfs)	642.8	8937.2
457.9				
Length Wtd. (ft)	28.44	Wetted Per. (ft)	8.38	10.93
6.84				
Min Ch El (ft)	6250.00	Shear (lb/sq ft)	0.57	1.55
0.52				
Alpha	1.58	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.15	Cum Volume (acre-ft)	0.77	4.65
1.99				
C & E Loss (ft)	0.07	Cum SA (acres)	0.52	0.96
1.18				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

Sol ace (v2). rep

RIVER: Channel 01  
 REACH: CH01

RS: 1038

INPUT

Description:

Station	Elevation	Data	num=	32	Station	Elevation	Station	Elevation	Station	Elevation
0	6265	.89	6265	71.4	6264	73.07	6263	74.74	6262	
76.41	6261	78.08	6260	79.75	6259	81.42	6258	83.09	6257	
84.76	6256	86.44	6255	88.11	6254	89.78	6253	91.45	6252	
93.2	6251	96.75	6250	100.14	6250	102.56	6250	105	6251	
106.65	6252	108.29	6253	109.94	6254	111.58	6255	113.22	6256	
114.86	6257	116.5	6258	118.14	6259	119.78	6260	162.88	6261	
194.23	6261	200	6261							

Manning's n	Val	num=	3	Station	Val
0	.05	91.45	.025	106.65	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	91.45	106.65		26.37	26.37		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6256.48	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.82	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6254.65	Reach Len. (ft)	26.37	26.37
26.37				
Crit W. S. (ft)	6254.65	Flow Area (sq ft)	5.88	62.64
5.78				
E. G. Slope (ft/ft)	0.005632	Area (sq ft)	5.88	62.64
5.78				
Q Total (cfs)	720.00	Flow (cfs)	14.29	691.69
14.02				
Top Width (ft)	23.99	Top Width (ft)	4.43	15.20
4.36				
Vel Total (ft/s)	9.69	Avg. Vel. (ft/s)	2.43	11.04
2.42				
Max Chl Dpth (ft)	4.65	Hydr. Depth (ft)	1.33	4.12
1.33				
Conv. Total (cfs)	9593.7	Conv. (cfs)	190.4	9216.5
186.8				
Length Wtd. (ft)	26.37	Wetted Per. (ft)	5.16	16.08
5.11				
Min Ch El (ft)	6250.00	Shear (lb/sq ft)	0.40	1.37
0.40				
Alpha	1.25	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)	0.76	4.61
1.98				
C & E Loss (ft)	0.00	Cum SA (acres)	0.52	0.95
1.18				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: During the standard step iterations, when the assumed water surface was set

equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1037

INPUT

Description:

Station	Elevation	Data	num=	32	Station	Elevation	Station	Elevation	Station	Elevation
0	6264	60.2	6264	69.23	6263	71.58	6262	73.93	6261	76.01
76.01	6260	77.88	6259	79.75	6258	81.62	6257	83.49	6256	85.36
85.36	6255	87.23	6254	89.1	6253	90.97	6252	92.84	6251	94.71
94.71	6250	98.27	6249	100.12	6249	101.1	6249	103.64	6250	105.61
105.61	6251	107.57	6252	109.53	6253	111.49	6254	113.45	6255	115.37
115.37	6256	117.16	6257	118.95	6258	120.74	6259	122.53	6260	152.83
152.83	6260	200	6260							

Manning's n	Values	num=	3
0	.05	92.84	.025
		105.61	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	92.84	105.61		21.74	21.74		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

Parameter	Value	Element	Left OB	Channel
E. G. Elev (ft)	6256.12	Element		
Right OB				
Vel Head (ft)	1.87	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6254.26	Reach Len. (ft)	21.74	21.74
21.74				
Crit W. S. (ft)	6254.26	Flow Area (sq ft)	9.91	58.31
10.39				
E. G. Slope (ft/ft)	0.005266	Area (sq ft)	9.91	58.31
10.39				
Q Total (cfs)	720.00	Flow (cfs)	27.20	664.10
28.70				
Top Width (ft)	25.24	Top Width (ft)	6.09	12.77
6.38				
Vel Total (ft/s)	9.16	Avg. Vel. (ft/s)	2.74	11.39
2.76				
Max Chl Dpth (ft)	5.26	Hydr. Depth (ft)	1.63	4.57
1.63				
Conv. Total (cfs)	9922.1	Conv. (cfs)	374.8	9151.7
395.5				
Length Wtd. (ft)	21.74	Wetted Per. (ft)	6.90	13.59
7.16				
Min Ch El (ft)	6249.00	Shear (lb/sq ft)	0.47	1.41
0.48				
Alpha	1.43	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	0.76	4.58
1.98				
C & E Loss (ft)	0.11	Cum SA (acres)	0.52	0.94
1.17				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.  
 Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1036

INPUT

Description:

Station	Elevation	Data	num=	31	Station	Elevation	Station	Elevation	Station	Elevation
0	6264	44.59	6264	64.98	6263	67.26	6262	69.54	6261	71.82
71.82	6260	74.1	6259	76.39	6258	78.67	6257	80.95	6256	83.23
83.23	6255	85.51	6254	87.79	6253	90.07	6252	92.36	6251	94.55
94.55	6250	97.25	6249	99.84	6249	102.14	6249	104.91	6250	106.78
106.78	6251	108.66	6252	110.53	6253	112.41	6254	114.28	6255	116.15
116.15	6256	118.03	6257	119.9	6258	121.78	6259	174.79	6259	200
200	6259									

Manning's n	Val	Station	num=	3	Station	Val
0	.05	92.36	.025	106.78	.05	

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	92.36	106.78		41.42	41.42	41.42	.1		.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G.	Elev (ft)	6255.67	Element	Left OB	Channel
Right OB	Vel Head (ft)	1.50	Wt. n-Val.	0.050	0.025
0.050	W. S. Elev (ft)	6254.18	Reach Len. (ft)	41.42	41.42
41.42	Crit W. S. (ft)	6253.87	Flow Area (sq ft)	11.54	65.84
9.48	E. G. Slope (ft/ft)	0.004153	Area (sq ft)	11.54	65.84
9.48	Q Total (cfs)	720.00	Flow (cfs)	28.40	668.87
22.74	Top Width (ft)	27.64	Top Width (ft)	7.26	14.42
5.96	Vel Total (ft/s)	8.29	Avg. Vel. (ft/s)	2.46	10.16
2.40	Max Chl Dpth (ft)	5.18	Hydr. Depth (ft)	1.59	4.57
1.59	Conv. Total (cfs)	11172.3	Conv. (cfs)	440.7	10378.8
352.8	Length Wtd. (ft)	41.42	Wetted Per. (ft)	7.92	15.24
6.76	Min Ch El (ft)	6249.00	Shear (lb/sq ft)	0.38	1.12

Sol ace (v2).rep

0.36	Alpha	1.40	Stream Power (lb/ft s)	200.00	0.00
0.00	Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	0.75	4.55
1.97	C & E Loss (ft)	0.18	Cum SA (acres)	0.51	0.93
1.17					

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.  
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
 This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1035

INPUT

Descripti on:

Station	Elevation	Data	num=	32							
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6264	19.09	6264	45.49	6263	65.15	6262	67.06	6261		
68.97	6260	70.88	6259	72.79	6258	74.7	6257	76.61	6256		
78.6	6255	80.69	6254	82.79	6253	84.88	6252	87.82	6251		
91.46	6250	95.09	6249	99.1	6248	99.27	6248	100.59	6248		
103	6249	104.83	6250	106.65	6251	108.47	6252	110.29	6253		
112.12	6254	113.94	6255	115.76	6256	117.58	6257	119.4	6258		
194.11	6258	200	6258								

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
0	.05	91.46	.025
		104.83	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	91.46	104.83		36.85	36.85		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6255.37	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.88	Wt. n-Val.	0.050	0.025
0.050				
W. S. El ev (ft)	6254.49	Reach Len. (ft)	36.85	36.85
36.85				
Crit W. S. (ft)		Flow Area (sq ft)	29.77	75.33
18.33				
E. G. Slope (ft/ft)	0.001997	Area (sq ft)	29.77	75.33
18.33				
Q Total (cfs)	720.00	Flow (cfs)	69.92	611.89
38.19				
Top Width (ft)	33.33	Top Width (ft)	11.79	13.37
8.18				
Vel Total (ft/s)	5.83	Avg. Vel. (ft/s)	2.35	8.12
2.08				
Max Chl Dpth (ft)	6.49	Hydr. Depth (ft)	2.53	5.63
2.24				
Conv. Total (cfs)	16113.6	Conv. (cfs)	1564.8	13694.1



Sol ace (v2).rep

854.7				
Length Wtd. (ft)	36.85	Wetted Per. (ft)	12.65	14.08
9.33				
Min Ch El (ft)	6248.00	Shear (lb/sq ft)	0.29	0.67
0.24				
Alpha	1.67	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	0.73	4.48
1.96				
C & E Loss (ft)	0.05	Cum SA (acres)	0.50	0.92
1.16				

CROSS SECTION

RIVER: Channel 01  
REACH: CH01

RS: 1034

INPUT

Description:

Station	Elevation	Data	num=	36						
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta
0	6264	1.28	6264	39.1	6263	67.59	6262	72.81	6261	6261
74.65	6260	76.5	6259	78.08	6258	79.48	6257	80.87	6256	6256
82.27	6255	83.67	6254	85.06	6253	86.46	6252	89.27	6251	6251
93.21	6250	96.78	6249	99.21	6248	99.98	6248	101.55	6248	6248
104.18	6249	105.65	6250	107.12	6251	108.6	6252	110.07	6253	6253
111.55	6254	113.18	6255	114.91	6256	116.65	6257	118.38	6258	6258
120.12	6259	121.85	6260	134.74	6260	156.85	6259	181.92	6258	6258
200	6258									

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
0	.05	93.21	.025
		105.65	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	93.21	105.65		13.77	13.77		.1	.3
Right Levee		Station=	121.38	Elevation=	6260.11			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6255.23	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.36	Wt. n-Val.	0.050	0.025
0.050				
W. S. El ev (ft)	6253.87	Reach Len. (ft)	13.77	13.77
13.77				
Crit W. S. (ft)	6253.37	Flow Area (sq ft)	22.36	62.90
11.02				
E. G. Slope (ft/ft)	0.003530	Area (sq ft)	22.36	62.90
11.02				
Q Total (cfs)	720.00	Flow (cfs)	66.39	626.99
26.62				
Top Width (ft)	27.50	Top Width (ft)	9.36	12.44
5.70				
Vel Total (ft/s)	7.48	Avg. Vel. (ft/s)	2.97	9.97
2.41				
Max Chl Dpth (ft)	5.87	Hydr. Depth (ft)	2.39	5.06
1.93				
Conv. Total (cfs)	12117.6	Conv. (cfs)	1117.4	10552.2

Solace (v2).rep

448.0					
Length Wtd. (ft)	13.77	Wetted Per. (ft)	10.25	13.27	
6.89					
Min Ch El (ft)	6248.00	Shear (lb/sq ft)	0.48	1.05	
0.35					
Alpha	1.57	Stream Power (lb/ft s)	200.00	0.00	
121.38					
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)	0.71	4.42	
1.95					
C & E Loss (ft)	0.03	Cum SA (acres)	0.50	0.91	
1.16					

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1033

INPUT

Description:

Station	Elevation	Data	num=	35							
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6263	12.39	6263	60.04	6262	74.96	6261	76.33	6260		
77.69	6259	79.06	6258	80.43	6257	81.8	6256	83.17	6255		
84.53	6254	85.9	6253	87.27	6252	89.32	6251	93.39	6250		
97.45	6249	99.11	6248	99.95	6248	101.9	6248	104.72	6249		
106.39	6250	108.11	6251	109.85	6252	111.59	6253	113.32	6254		
115.06	6255	116.8	6256	118.53	6257	120.27	6258	122.01	6259		
123.74	6260	149.65	6260	158.81	6259	187.69	6258	200	6258		

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	93.39	.025	106.39	.05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	93.39	106.39		26.23	26.23	26.23	.1	.3	
Right Levee	Station=	123.9		Elevation=	6260.08				

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6255.15	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.25	Wt. n-Val.	0.050	0.025
0.050				
W. S. El ev (ft)	6253.90	Reach Len. (ft)	26.23	26.23
26.23				
Crit W. S. (ft)	6253.27	Flow Area (sq ft)	21.23	65.87
13.16				
E. G. Slope (ft/ft)	0.003218	Area (sq ft)	21.23	65.87
13.16				
Q Total (cfs)	720.00	Flow (cfs)	60.37	628.18
31.45				
Top Width (ft)	28.48	Top Width (ft)	8.72	13.00
6.76				
Vel Total (ft/s)	7.18	Avg. Vel. (ft/s)	2.84	9.54
2.39				
Max Chl Dpth (ft)	5.90	Hydr. Depth (ft)	2.43	5.07

Solace (v2).rep

1.95									
Conv. Total (cfs)	12692.0	Conv. (cfs)	1064.3	11073.4					
554.4									
Length Wtd. (ft)	26.23	Wetted Per. (ft)	9.70	13.85					
7.80									
Min Ch El (ft)	6248.00	Shear (lb/sq ft)	0.44	0.96					
0.34									
Alpha	1.56	Stream Power (lb/ft s)	200.00	0.00					
123.90									
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	0.70	4.40					
1.94									
C & E Loss (ft)	0.08	Cum SA (acres)	0.49	0.91					
1.16									

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1032

INPUT

Description:

Station	Elevation	Data	num=	34						
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta
0	6262	43.18	6262	72.98	6261	75.05	6260	76.57	6259	6259
78.1	6258	79.63	6257	81.15	6256	82.68	6255	84.21	6254	6254
85.74	6253	87.26	6252	88.79	6251	90.83	6250	94.75	6249	6249
98.23	6248	99.95	6248	101.77	6248	104.57	6249	106.18	6250	6250
107.75	6251	109.33	6252	110.89	6253	112.45	6254	114	6255	6255
115.56	6256	117.12	6257	118.67	6258	120.26	6259	138.67	6260	6260
165.04	6260	171.83	6259	178.61	6258	200	6258			

Manning's n Values	num=	3
Sta n Val	Sta n Val	Sta n Val
0 .05	90.83 .025	106.18 .05

Bank Sta: Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
90.83	106.18	25.6	25.6	25.6	.1	.3
Right Levee	Station=	138.69	Elevation=	6259.96		

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6254.99	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.97	Wt. n-Val.	0.050	0.025
0.050				
W. S. El ev (ft)	6254.02	Reach Len. (ft)	25.60	25.60
25.60				
Crit W. S. (ft)	6252.85	Flow Area (sq ft)	14.15	80.99
12.70				
E. G. Slope (ft/ft)	0.002212	Area (sq ft)	14.15	80.99
12.70				
Q Total (cfs)	720.00	Flow (cfs)	29.45	665.29
25.26				
Top Width (ft)	28.30	Top Width (ft)	6.65	15.35
6.30				
Vel Total (ft/s)	6.68	Avg. Vel. (ft/s)	2.08	8.21

Sol ace (v2). rep

1. 99					
Max Chl Dpth (ft)	6. 02	Hydr. Depth (ft)	2. 13	5. 28	
2. 01					
Conv. Total (cfs)	15309. 9	Conv. (cfs)	626. 2	14146. 6	
537. 1					
Length Wtd. (ft)	25. 60	Wetted Per. (ft)	7. 79	16. 07	
7. 48					
Min Ch El (ft)	6248. 00	Shear (lb/sq ft)	0. 25	0. 70	
0. 23					
Alpha	1. 41	Stream Power (lb/ft s)	200. 00	0. 00	
138. 69					
Frctn Loss (ft)	0. 09	Cum Volume (acre-ft)	0. 69	4. 36	
1. 94					
C & E Loss (ft)	0. 09	Cum SA (acres)	0. 49	0. 90	
1. 15					

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.  
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
 This may indicate the need for additional cross sections.  
 Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1031

INPUT

Description:

Station	Elevation	Data	num=	40							
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6260	2. 37	6260	14. 77	6261	14. 87	6261	15. 95	6260		
32. 14	6260	46. 06	6261	65. 58	6261	76. 15	6260	77. 7	6259		
79. 16	6258	80. 62	6257	82. 09	6256	83. 55	6255	85. 01	6254		
86. 48	6253	87. 94	6252	89. 4	6251	90. 87	6250	92. 4	6249		
95. 98	6248	99. 79	6247	100. 08	6247	100. 11	6247. 02	101. 63	6248		
101. 66	6247	103. 17	6249	104. 87	6250	107. 03	6251	109. 2	6252		
111. 37	6253	113. 54	6254	115. 7	6255	117. 87	6256	120. 04	6257		
122. 2	6258	134. 6	6259	168. 47	6259	178. 97	6258	200	6258		

Manning's n Values	num=	3	
Sta	n Val	Sta	n Val
0	. 05	92. 4	. 025
		103. 17	. 05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	92. 4	103. 17		34. 57	34. 57		. 1	. 3
Right Levee		Station=	134. 78	Elevation=	6259. 04			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6254. 82	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1. 88	Wt. n-Val.	0. 050	0. 025
0. 050				
W. S. El ev (ft)	6252. 93	Reach Len. (ft)	34. 57	34. 57
34. 57				
Crit W. S. (ft)	6252. 93	Flow Area (sq ft)	11. 56	54. 33

Sol ace (v2). rep

15. 15					
E. G. Slope (ft/ft)	0. 005902	Area (sq ft)	11. 56	54. 33	
15. 15					
Q Total (cfs)	720. 00	Flow (cfs)	36. 79	634. 14	
49. 07					
Top Width (ft)	24. 65	Top Width (ft)	5. 82	10. 77	
8. 06					
Vel Total (ft/s)	8. 88	Avg. Vel. (ft/s)	3. 18	11. 67	
3. 24					
Max Chl Dpth (ft)	5. 93	Hydr. Depth (ft)	1. 99	5. 04	
1. 88					
Conv. Total (cfs)	9371. 8	Conv. (cfs)	478. 9	8254. 2	
638. 7					
Length Wtd. (ft)		Wetted Per. (ft)	7. 03	13. 30	
8. 97					
Min Ch El (ft)	6247. 00	Shear (lb/sq ft)	0. 61	1. 51	
0. 62					
Alpha	1. 54	Stream Power (lb/ft s)	200. 00	0. 00	
134. 78					
Frctn Loss (ft)		Cum Volume (acre-ft)	0. 68	4. 32	
1. 93					
C & E Loss (ft)		Cum SA (acres)	0. 48	0. 89	
1. 15					

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1030

INPUT

Description:

Station	Elevation	Data	num=	37							
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6260	. 33	6260	5. 84	6261	7. 54	6261	18. 41	6260		
28. 94	6259	42. 14	6259	57. 53	6259	60. 15	6258	62. 77	6257		
65. 38	6256	68	6255	70. 62	6254	73. 12	6253	75. 2	6252		
78. 81	6251	84. 64	6250	90. 46	6249	95. 4	6248	99. 24	6247. 06		
99. 5	6247	100. 54	6247	104. 94	6248	107. 65	6249	109. 81	6250		
111. 98	6251	114. 14	6252	116. 31	6253	118. 47	6254	120. 63	6255		
122. 59	6256	124. 17	6257	125. 75	6258	155. 42	6259	173. 56	6259		
186. 25	6258	200	6258								

Manning's n Values	num=	3
Sta n Val	Sta n Val	Sta n Val
0 . 05	90. 46 . 025	107. 65 . 05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	90. 46	107. 65		24. 7	24. 7		. 1	. 3

CROSS SECTION OUTPUT Profile #Sand Creek

Solace (v2).rep

E. G. Elev (ft)	6254.39	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.86	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6253.53	Reach Len. (ft)	24.70	24.70
24.70				
Crit W. S. (ft)		Flow Area (sq ft)	50.89	96.49
22.18				
E. G. Slope (ft/ft)	0.001954	Area (sq ft)	50.89	96.49
22.18				
Q Total (cfs)	960.00	Flow (cfs)	127.64	785.27
47.09				
Top Width (ft)	45.65	Top Width (ft)	18.66	17.19
9.80				
Vel Total (ft/s)	5.66	Avg. Vel. (ft/s)	2.51	8.14
2.12				
Max Chl Dpth (ft)	6.53	Hydr. Depth (ft)	2.73	5.61
2.26				
Conv. Total (cfs)	21714.7	Conv. (cfs)	2887.3	17762.4
1065.1				
Length Wtd. (ft)	24.70	Wetted Per. (ft)	19.29	17.70
10.79				
Min Ch El (ft)	6247.00	Shear (lb/sq ft)	0.32	0.67
0.25				
Alpha	1.72	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.66	4.26
1.91				
C & E Loss (ft)	0.05	Cum SA (acres)	0.47	0.88
1.14				

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1029

INPUT

Description:

Station	Elevation	Data	num=	33							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6260	8.5	6260	21.1	6259	33.66	6259	53.13	6259		
56.47	6258	59.14	6257	61.26	6256	63.39	6255	65.51	6254		
67.63	6253	69.76	6252	71.88	6251	76.72	6250	82.86	6249		
90.04	6248	98.53	6247	99.37	6247	100.25	6247	101.68	6248		
103.25	6249	104.78	6250	106.3	6251	107.82	6252	109.34	6253		
110.86	6254	112.39	6255	113.91	6256	115.43	6257	116.95	6258		
175.74	6258	180.53	6257	200	6257						

Manning's n	Val	Sta	num=	3		
Sta	n Val	Sta	n Val	Sta	n Val	
0	.05	82.86	.025	103.25	.05	

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	82.86	103.25		24.82	24.82	24.82		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6254.29	Element	Left OB	Channel
-----------------	---------	---------	---------	---------

Sol ace (v2). rep

Right OB				
Vel Head (ft)	0.68	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6253.61	Reach Len. (ft)	24.82	24.82
24.82				
Crit W. S. (ft)		Flow Area (sq ft)	47.53	116.71
16.20				
E. G. Slope (ft/ft)	0.001452	Area (sq ft)	47.53	116.71
16.20				
Q Total (cfs)	960.00	Flow (cfs)	105.61	825.97
28.42				
Top Width (ft)	43.93	Top Width (ft)	16.52	20.39
7.02				
Vel Total (ft/s)	5.32	Avg. Vel. (ft/s)	2.22	7.08
1.75				
Max Chl Dpth (ft)	6.61	Hydr. Depth (ft)	2.88	5.72
2.31				
Conv. Total (cfs)	25197.3	Conv. (cfs)	2772.0	21679.3
746.0				
Length Wtd. (ft)	24.82	Wetted Per. (ft)	17.29	21.12
8.40				
Min Ch El (ft)	6247.00	Shear (lb/sq ft)	0.25	0.50
0.17				
Alpha	1.54	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	0.63	4.20
1.90				
C & E Loss (ft)	0.02	Cum SA (acres)	0.46	0.87
1.14				

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1028

INPUT

Descripti on:

Station	Elevation	Data	num=	34							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6261	4.63	6261	6.34	6261	16.21	6260	29.31	6259		
42.82	6259	57.07	6259	59.36	6258	61.65	6257	63.93	6256		
66.22	6255	68.51	6254	70.79	6253	73.08	6252	75.37	6251		
77.75	6250	82.74	6249	89.79	6248	98.12	6247	99.78	6247		
100.64	6247	103.47	6248	105.4	6249	107.04	6250	108.68	6251		
110.32	6252	111.96	6253	113.6	6254	115.24	6255	116.88	6256		
118.52	6257	147.5	6257	183.09	6256	200	6256				

Manning's n Values	num=	3	
Sta	n Val	Sta	n Val
0	.05	82.74	.025
		105.4	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
82.74	105.4	50.43	50.43	50.43	.1	.3	
Right Levee	Station=	118.31	Elevation=	6257.04			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6254.24	Element	Left OB	Channel
Right OB				





Sol ace (v2).rep				
W. S. Elev (ft)	6253.56	Reach Len. (ft)	25.05	25.05
25.05		Flow Area (sq ft)	62.23	107.93
Crit W. S. (ft)		Area (sq ft)	62.23	107.93
31.00		Flow (cfs)	143.78	756.86
E. G. Slope (ft/ft)	0.001232	Top Width (ft)	17.85	17.32
31.00		Avg. Vel. (ft/s)	2.31	7.01
Q Total (cfs)	960.00	Hydr. Depth (ft)	3.49	6.23
59.36		Conv. (cfs)	4097.1	21567.0
Top Width (ft)	46.33	Wetted Per. (ft)	18.87	17.51
11.15		Shear (lb/sq ft)	0.25	0.47
Vel Total (ft/s)	4.77	Stream Power (lb/ft s)	200.00	0.00
1.91		Cum Volume (acre-ft)	0.55	3.99
Max Chl Dpth (ft)	6.56	Cum SA (acres)	0.44	0.83
2.78				
Conv. Total (cfs)	27355.4			
1691.3				
Length Wtd. (ft)	25.05			
12.46				
Min Ch El (ft)	6247.00			
0.19				
Alpha	1.75			
0.00				
Frctn Loss (ft)	0.03			
1.87				
C & E Loss (ft)	0.04			
1.12				

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1026

INPUT

Description:

Station Elevation Data num= 31											
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6259	1.86	6259	3.56	6259	24.55	6258	41.74	6258		
59.89	6258	62.23	6257	64.57	6256	67.1	6255	69.63	6254		
72.16	6253	74.7	6252	77.23	6251	79.76	6250	82.25	6249		
94.31	6248	98.06	6247	100.12	6247	102.86	6247	107.23	6248		
109.11	6249	110.98	6250	112.86	6251	114.73	6252	116.61	6253		
118.48	6254	120.35	6255	122.23	6256	145.89	6256	178.65	6255		
200	6255										

Manning's n Values num= 3					
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	82.25	.025	109.11	.05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	82.25	109.11		27.07	27.07	27.07		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6254.11	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.49	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6253.62	Reach Len. (ft)	27.07	27.07
27.07				

		Sol ace (v2).rep	
Crit W. S. (ft)		Flow Area (sq ft)	26.84 152.83
20.00			
E. G. Slope (ft/ft)	0.000968	Area (sq ft)	26.84 152.83
20.00			
Q Total (cfs)	960.00	Flow (cfs)	41.23 889.06
29.72			
Top Width (ft)	47.18	Top Width (ft)	11.66 26.86
8.66			
Vel Total (ft/s)	4.81	Avg. Vel. (ft/s)	1.54 5.82
1.49			
Max Chl Dpth (ft)	6.62	Hydr. Depth (ft)	2.30 5.69
2.31			
Conv. Total (cfs)	30854.2	Conv. (cfs)	1325.0 28574.1
955.1			
Length Wtd. (ft)	27.07	Wetted Per. (ft)	12.54 27.39
9.81			
Min Ch El (ft)	6247.00	Shear (lb/sq ft)	0.13 0.34
0.12			
Alpha	1.36	Stream Power (lb/ft s)	200.00 0.00
0.00			
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.52 3.91
1.85			
C & E Loss (ft)	0.04	Cum SA (acres)	0.43 0.82
1.12			

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1025

INPUT

Descripti on:

Station	Elevation	Data	num=	31	Station	Elevation	Station	Elevation	Station	Elevation
0	6259	.25	6259	19.85	6258	37.45	6258	54.65	6258	6258
56.95	6257	59.25	6256	61.55	6255	63.85	6254	66.15	6253	6253
68.45	6252	70.75	6251	73.08	6250	75.51	6249	88.48	6248	6248
94.3	6247	99.96	6247	103.22	6247	106.22	6248	107.41	6249	6249
108.59	6250	109.78	6251	110.97	6252	112.15	6253	113.34	6254	6254
114.59	6255	116	6256	121.62	6256	153.28	6255	191.19	6254	6254
200	6254									

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
0	.05	75.51	.025
		107.41	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
Right	75.51	107.41	116.08	31.34	31.34	.1	.3	
Levee		Station=		Elevation=	6256.08			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6254.05	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.35	Wt. n-Val.	0.050	0.025
0.050				
W. S. El ev (ft)	6253.70	Reach Len. (ft)	31.34	31.34
31.34				
Crit W. S. (ft)	6250.88	Flow Area (sq ft)	26.01	187.98

Sol ace (v2). rep

13. 07	E. G. Slope (ft/ft)	0. 000644	Area (sq ft)	26. 01	187. 98
13. 07	Q Total (cfs)	960. 00	Flow (cfs)	32. 98	912. 47
14. 55	Top Width (ft)	48. 43	Top Width (ft)	10. 96	31. 90
5. 57	Vel Total (ft/s)	4. 23	Avg. Vel. (ft/s)	1. 27	4. 85
1. 11	Max Chl Dpth (ft)	6. 70	Hydr. Depth (ft)	2. 37	5. 89
2. 35	Conv. Total (cfs)	37836. 8	Conv. (cfs)	1299. 9	35963. 3
573. 6	Length Wtd. (ft)	31. 34	Wetted Per. (ft)	11. 93	32. 55
7. 29	Min Ch El (ft)	6247. 00	Shear (lb/sq ft)	0. 09	0. 23
0. 07	Alpha	1. 26	Stream Power (lb/ft s)	200. 00	0. 00
116. 08	Frctn Loss (ft)	0. 02	Cum Volume (acre-ft)	0. 51	3. 81
1. 84	C & E Loss (ft)	0. 00	Cum SA (acres)	0. 42	0. 80
1. 11					

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1024

INPUT

Description:

Station		Elevation		Data		num=		32	
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6258	18. 72	6258	32. 3	6257	35. 38	6257	45. 25	6258
50. 06	6258	62. 78	6257	64. 75	6256	66. 72	6255	68. 69	6254
70. 66	6253	72. 63	6252	74. 6	6251	76. 57	6250	78. 42	6249
81. 18	6248	95. 1	6247	97. 98	6246	100. 32	6246	103. 02	6246
106. 31	6247	107. 72	6248	109. 12	6249	110. 53	6250	111. 94	6251
113. 35	6252	114. 76	6253	116. 17	6254	117. 57	6255	147. 16	6255
182. 38	6254	200	6254						

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
0	. 05	81. 18	. 025	107. 72	. 05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff Contr.	Expan.
	81. 18	107. 72		16. 62	16. 62	16. 62	. 1	. 3
Right Levee	Station=		117. 47	Elevation=		6255. 01		

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6254. 02	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0. 36	Wt. n-Val.	0. 050	0. 025
0. 050				
W. S. El ev (ft)	6253. 67	Reach Len. (ft)	16. 62	16. 62

Sol ace (v2). rep

16. 62				
Crit W. S. (ft)	6250. 42	Flow Area (sq ft)	35. 23	177. 43
22. 60				
E. G. Slope (ft/ft)	0. 000576	Area (sq ft)	35. 23	177. 43
22. 60				
Q Total (cfs)	960. 00	Flow (cfs)	48. 48	883. 37
28. 15				
Top Width (ft)	46. 36	Top Width (ft)	11. 84	26. 54
7. 98				
Vel Total (ft/s)	4. 08	Avg. Vel. (ft/s)	1. 38	4. 98
1. 25				
Max Chl Dpth (ft)	7. 67	Hydr. Depth (ft)	2. 98	6. 69
2. 83				
Conv. Total (cfs)	39999. 1	Conv. (cfs)	2020. 1	36806. 2
1172. 9				
Length Wtd. (ft)	16. 62	Wetted Per. (ft)	13. 14	27. 21
9. 79				
Min Ch El (ft)	6246. 00	Shear (lb/sq ft)	0. 10	0. 23
0. 08				
Al pha	1. 38	Stream Power (lb/ft s)	200. 00	0. 00
117. 47				
Frctn Loss (ft)	0. 01	Cum Volume (acre-ft)	0. 49	3. 68
1. 83				
C & E Loss (ft)	0. 00	Cum SA (acres)	0. 41	0. 78
1. 11				

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1023

INPUT

Descripti on:

Stati on	El evati on	Data	num=	30							
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6258	13. 96	6258	28. 53	6257	36. 96	6257	64. 82	6257		
66. 66	6256	68. 35	6255	70. 04	6254	71. 73	6253	73. 42	6252		
75. 11	6251	76. 8	6250	78. 49	6249	82	6248	93. 01	6247		
98. 14	6246	99. 91	6246	102. 84	6246	105. 81	6247	107. 12	6248		
108. 43	6249	109. 74	6250	111. 05	6251	112. 36	6252	113. 67	6253		
114. 98	6254	116. 32	6255	136. 81	6255	171. 48	6254	200	6254		

Manni ng' s n	Val ues	num=	3
Sta	n Val	Sta	n Val
0	. 05	82	. 025
		107. 12	. 05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	82	107. 12		20. 93	20. 93	20. 93		. 1	. 3
Right Levee		Stati on=	116. 64	El evati on=	6255. 01				

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6254. 01	El ement	Left OB	Channel
Right OB				
Vel Head (ft)	0. 39	Wt. n-Val .	0. 050	0. 025
0. 050				
W. S. El ev (ft)	6253. 62	Reach Len. (ft)	20. 93	20. 93
20. 93				
Crit W. S. (ft)	6250. 47	Flow Area (sq ft)	36. 03	168. 94

Sol ace (v2). rep

20. 70	E. G. Slope (ft/ft)	0. 000626	Area (sq ft)	36. 03	168. 94
20. 70	Q Total (cfs)	960. 00	Flow (cfs)	53. 61	880. 08
26. 31	Top Width (ft)	43. 81	Top Width (ft)	11. 32	25. 12
7. 36	Vel Total (ft/s)	4. 25	Avg. Vel. (ft/s)	1. 49	5. 21
1. 27	Max Chl Dpth (ft)	7. 62	Hydr. Depth (ft)	3. 18	6. 73
2. 81	Conv. Total (cfs)	38371. 2	Conv. (cfs)	2143. 0	35176. 6
1051. 6	Length Wtd. (ft)	20. 93	Wetted Per. (ft)	12. 73	25. 76
9. 27	Min Ch El (ft)	6246. 00	Shear (lb/sq ft)	0. 11	0. 26
0. 09	Alpha	1. 38	Stream Power (lb/ft s)	200. 00	0. 00
116. 64	Frctn Loss (ft)	0. 01	Cum Volume (acre-ft)	0. 47	3. 61
1. 82	C & E Loss (ft)	0. 00	Cum SA (acres)	0. 41	0. 77
1. 10					

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1022

INPUT

Description:

Station	Elevation	Data	num=	28					
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6258	10. 36	6258	24. 98	6257	37. 67	6257	64. 69	6257
67. 95	6256	69. 47	6255	71	6254	72. 52	6253	74. 04	6252
75. 56	6251	77. 09	6250	78. 61	6249	81. 27	6248	89. 74	6247
96. 26	6246	99. 86	6246	102. 35	6246	105. 21	6247	106. 47	6248
107. 72	6249	108. 98	6250	110. 24	6251	111. 49	6252	112. 75	6253
114	6254	152. 25	6254	200	6254				

Manning's n	Values	num=	3		
Sta	n Val	Sta	n Val	Sta	n Val
0	. 05	81. 27	. 025	106. 47	. 05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	81. 27	106. 47		26. 45	26. 45	26. 45	. 1		. 3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6254. 00	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0. 39	Wt. n-Val.	0. 050	0. 025
0. 050				
W. S. El ev (ft)	6253. 61	Reach Len. (ft)	26. 45	26. 45
26. 45				
Crit W. S. (ft)		Flow Area (sq ft)	29. 75	172. 41

Sol ace (v2). rep

19.73	E. G. Slope (ft/ft)	0.000606	Area (sq ft)	29.75	172.41
19.73	Q Total (cfs)	960.00	Flow (cfs)	41.66	893.97
24.37	Top Width (ft)	41.91	Top Width (ft)	9.67	25.20
7.04	Vel Total (ft/s)	4.33	Avg. Vel. (ft/s)	1.40	5.19
1.24	Max Chl Dpth (ft)	7.61	Hydr. Depth (ft)	3.08	6.84
2.80	Conv. Total (cfs)	38987.8	Conv. (cfs)	1692.1	36306.1
989.7	Length Wtd. (ft)	26.45	Wetted Per. (ft)	11.23	25.85
9.00	Min Ch El (ft)	6246.00	Shear (lb/sq ft)	0.10	0.25
0.08	Alpha	1.34	Stream Power (lb/ft s)	200.00	0.00
0.00	Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.46	3.53
1.81	C & E Loss (ft)	0.04	Cum SA (acres)	0.40	0.76
1.10					

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
 This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1021

INPUT

Description:

Station	Elevation	Data	num=	27
Sta	El ev	Sta	El ev	Sta
0	6257	15.61	6257	29.13
75.78	6255	77.54	6254	79.3
84.57	6250	86.33	6249	88.23
100.19	6246	101.69	6246	105.02
110.09	6250	111.78	6251	113.47
139.8	6254	200	6254	

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
0	.05	88.23	.025
		106.71	.05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	88.23	106.71		19.84	19.84	19.84	.1		.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6253.94	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.77	Wt. n-Val.	0.050	0.025
0.050				
W. S. El ev (ft)	6253.17	Reach Len. (ft)	19.84	19.84
19.84				

		Sol ace (v2).rep			
Crit W. S. (ft)		Flow Area (sq ft)	24.12	118.42	
22.41					
E. G. Slope (ft/ft)	0.001349	Area (sq ft)	24.12	118.42	
22.41					
Q Total (cfs)	960.00	Flow (cfs)	45.63	872.23	
42.13					
Top Width (ft)	36.16	Top Width (ft)	9.22	18.48	
8.46					
Vel Total (ft/s)	5.82	Avg. Vel. (ft/s)	1.89	7.37	
1.88					
Max Chl Dpth (ft)	7.17	Hydr. Depth (ft)	2.62	6.41	
2.65					
Conv. Total (cfs)	26138.4	Conv. (cfs)	1242.5	23748.8	
1147.2					
Length Wtd. (ft)	19.84	Wetted Per. (ft)	10.57	19.11	
9.92					
Min Ch El (ft)	6246.00	Shear (lb/sq ft)	0.19	0.52	
0.19					
Alpha	1.46	Stream Power (lb/ft s)	200.00	0.00	
0.00					
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.44	3.44	
1.80					
C & E Loss (ft)	0.07	Cum SA (acres)	0.40	0.74	
1.10					

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.  
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
REACH: CH01 RS: 1020

INPUT

Description:

Station		Elevation Data		num= 28							
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6257	8.1	6257	26.17	6256	33.88	6256	74.06	6256		
75.87	6255	77.71	6254	79.85	6253	81.99	6252	84.13	6251		
86.27	6250	88.41	6249	90.55	6248	92.69	6247	96.99	6246		
99.59	6246	101.62	6246	103.8	6247	105.35	6248	106.88	6249		
108.41	6250	109.93	6251	111.46	6252	112.99	6253	114.51	6254		
121.27	6254	160.95	6253	200	6253						

Manning's n Values		num= 3	
Sta	n Val	Sta	n Val
0	.05	90.55	.025
		105.35	.05

Bank	Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
	90.55	105.35	32.65	32.65	32.65		.1	.3
Right	Levee	Station=	114.96	Elevation=	6253.95			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6253.83	Element	Left OB	Channel
Right OB				

		Solace (v2).rep		
Vel Head (ft)	0.050	1.51	Wt. n-Val.	0.050 0.025
W. S. Elev (ft)	32.65	6252.32	Reach Len. (ft)	32.65 32.65
Crit W. S. (ft)	14.25	6251.61	Flow Area (sq ft)	19.96 84.74
E. G. Slope (ft/ft)	14.25	0.003156	Area (sq ft)	19.96 84.74
Q Total (cfs)	35.30	960.00	Flow (cfs)	52.12 872.58
Top Width (ft)	6.60	30.64	Top Width (ft)	9.24 14.80
Vel Total (ft/s)	2.48	8.07	Avg. Vel. (ft/s)	2.61 10.30
Max Chl Dpth (ft)	2.16	6.32	Hydr. Depth (ft)	2.16 5.73
Conv. Total (cfs)	628.4	17088.2	Conv. (cfs)	927.8 15532.1
Length Wtd. (ft)	7.89	32.65	Wetted Per. (ft)	10.20 15.65
Min Ch El (ft)	0.36	6246.00	Shear (lb/sq ft)	0.39 1.07
Alpha	114.96	1.49	Stream Power (lb/ft s)	200.00 0.00
Frctn Loss (ft)	1.79	0.09	Cum Volume (acre-ft)	0.43 3.39
C & E Loss (ft)	1.09	0.11	Cum SA (acres)	0.39 0.74

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1019

INPUT

Description:

Station		Elevation Data		num= 25		Elev		Sta		Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6256	20.93	6256	43.29	6256	72.59	6256	74.92	6255		
77.24	6254	79.56	6253	81.88	6252	84.2	6251	86.52	6250		
88.85	6249	91.17	6248	93.49	6247	95.54	6246	99.84	6246		
102.02	6246	104.98	6247	107.19	6248	109.4	6249	111.61	6250		
113.82	6251	116.03	6252	118.24	6253	144.28	6253	200	6253		

Manning's n Values		num= 3	
Sta	n Val	Sta	n Val
0	.05	91.17	.025
		107.19	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	91.17	107.19		27.27	27.27	.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6253.62	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.14	Wt. n-Val.	0.050	0.025



Sol ace (v2). rep

0.050					
W. S. Elev (ft)	6252.49	Reach Len. (ft)	27.27	27.27	
27.27					
Crit W. S. (ft)	6251.34	Flow Area (sq ft)	23.38	94.62	
22.25					
E. G. Slope (ft/ft)	0.002312	Area (sq ft)	23.38	94.62	
22.25					
Q Total (cfs)	960.00	Flow (cfs)	54.11	854.69	
51.19					
Top Width (ft)	36.36	Top Width (ft)	10.42	16.02	
9.92					
Vel Total (ft/s)	6.85	Avg. Vel. (ft/s)	2.31	9.03	
2.30					
Max Chl Dpth (ft)	6.49	Hydr. Depth (ft)	2.24	5.91	
2.24					
Conv. Total (cfs)	19966.2	Conv. (cfs)	1125.4	17776.1	
1064.7					
Length Wtd. (ft)	27.27	Wetted Per. (ft)	11.34	16.84	
10.88					
Min Ch El (ft)	6246.00	Shear (lb/sq ft)	0.30	0.81	
0.29					
Alpha	1.56	Stream Power (lb/ft s)	200.00	0.00	
0.00					
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	0.41	3.33	
1.77					
C & E Loss (ft)	0.09	Cum SA (acres)	0.39	0.73	
1.09					

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.  
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
 This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1018

INPUT

Description:

Station Elevation Data			num=	29						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
0	6254	2.3	6254	16.19	6254	28.88	6253	43.79	6253	6253
50.18	6254	55.28	6255	79.19	6255	81.1	6254	83.01	6253	6253
84.91	6252	86.82	6251	88.73	6250	90.63	6249	92.54	6248	6248
94.45	6247	96.52	6246	99.68	6246	104.44	6246	107.3	6247	6247
109.62	6248	111.94	6249	114.27	6250	116.59	6251	118.91	6252	6252
121.24	6253	131.69	6253	194.67	6252	200	6252			

Manning's n Values			num=	3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	94.45	.025	107.3	.05

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	94.45	107.3		36.97	36.97	36.97		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

Solace (v2).rep				
		Element	Left OB	Channel
E. G. Elev (ft)	6253.45			
Right OB				
Vel Head (ft)	2.01	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6251.44	Reach Len. (ft)	36.97	36.97
36.97				
Crit W. S. (ft)	6251.44	Flow Area (sq ft)	18.80	67.43
22.88				
E. G. Slope (ft/ft)	0.004819	Area (sq ft)	18.80	67.43
22.88				
Q Total (cfs)	960.00	Flow (cfs)	60.88	823.23
75.89				
Top Width (ft)	31.63	Top Width (ft)	8.47	12.85
10.31				
Vel Total (ft/s)	8.80	Avg. Vel. (ft/s)	3.24	12.21
3.32				
Max Chl Dpth (ft)	5.44	Hydr. Depth (ft)	2.22	5.25
2.22				
Conv. Total (cfs)	13829.3	Conv. (cfs)	877.0	11859.1
1093.2				
Length Wtd. (ft)	36.97	Wetted Per. (ft)	9.56	13.25
11.22				
Min Ch El (ft)	6246.00	Shear (lb/sq ft)	0.59	1.53
0.61				
Alpha	1.67	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	0.40	3.28
1.76				
C & E Loss (ft)	0.27	Cum SA (acres)	0.38	0.72
1.08				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth

for the water surface and continued on with the calculations.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

#### CROSS SECTION

RIVER: Channel 01  
REACH: CH01

RS: 1017

#### INPUT

Description:

Station	Elevation	Data	num=	28	Station	Elevation	Station	Elevation	Station	Elevation
0	6255	13.47	6255	23.7	6254	34.32	6253	44.94	6252	6251
46.33	6252	52.92	6253	81.23	6253	82.38	6252	83.53	6251	6250
84.67	6250	85.82	6249	86.97	6248	88.29	6247	89.34	6247	6247

89.8	6246	97.38	6245	100.07	6245	101.13	6245	104.31	6246
106.48	6247	108.65	6248	110.82	6249	112.99	6250	115.16	6251
117.33	6252	164.82	6252	200	6252				

Solace (v2).rep

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
0	.05	88.29	.025
		106.48	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	88.29	106.48		35.86	35.86		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6252.37	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.10	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6251.27	Reach Len. (ft)	35.86	35.86
35.86				
Crit W. S. (ft)		Flow Area (sq ft)	11.13	102.69
19.81				
E. G. Slope (ft/ft)	0.002303	Area (sq ft)	11.13	102.69
19.81				
Q Total (cfs)	960.00	Flow (cfs)	22.42	893.62
43.96				
Top Width (ft)	32.54	Top Width (ft)	5.07	18.19
9.27				
Vel Total (ft/s)	7.18	Avg. Vel. (ft/s)	2.01	8.70
2.22				
Max Chl Dpth (ft)	6.27	Hydr. Depth (ft)	2.19	5.65
2.14				
Conv. Total (cfs)	20004.9	Conv. (cfs)	467.2	18621.6
916.1				
Length Wtd. (ft)	35.86	Wetted Per. (ft)	6.64	19.27
10.21				
Min Ch El (ft)	6245.00	Shear (lb/sq ft)	0.24	0.77
0.28				
Alpha	1.37	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	0.39	3.20
1.74				
C & E Loss (ft)	0.05	Cum SA (acres)	0.38	0.70
1.07				

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1016

INPUT

Description:

Station	Elevation	Data	num=	24
Sta	Elev	Sta	Elev	Sta
0	6253	2.12	6253	9.81
79.62	6252	81.02	6251	83.13
89.44	6247	91.55	6246	93.65
102.93	6245	104.5	6246	106.07
110.77	6250	112.63	6251	167.97
				6253
				39.24
				6250
				85.23
				6245
				95.87
				6245
				100.13
				6248
				109.2
				6249
				6251

Manning's n Values  
 Station Val Sta num= Solace (v2).rep  
 0 .05 89.44 .025 3  
 106.07 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 89.44 106.07 34.77 34.77 34.77 .1 .3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6252.23	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.58	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6250.64	Reach Len. (ft)	34.77	34.77
34.77				
Crit W. S. (ft)	6250.14	Flow Area (sq ft)	13.95	86.46
10.44				
E. G. Slope (ft/ft)	0.003691	Area (sq ft)	13.95	86.46
10.44				
Q Total (cfs)	960.00	Flow (cfs)	35.08	900.16
24.76				
Top Width (ft)	30.19	Top Width (ft)	7.66	16.63
5.89				
Vel Total (ft/s)	8.66	Avg. Vel. (ft/s)	2.51	10.41
2.37				
Max Chl Dpth (ft)	5.64	Hydr. Depth (ft)	1.82	5.20
1.77				
Conv. Total (cfs)	15801.0	Conv. (cfs)	577.3	14816.0
407.6				
Length Wtd. (ft)	34.77	Wetted Per. (ft)	8.48	17.66
6.93				
Min Ch El (ft)	6245.00	Shear (lb/sq ft)	0.38	1.13
0.35				
Alpha	1.36	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	0.38	3.13
1.73				
C & E Loss (ft)	0.41	Cum SA (acres)	0.37	0.69
1.07				

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.  
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.  
 This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1015

INPUT

Description:

Station	Elevation	Data	num=	24						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
0	6252	41.71	6252	51.52	6252	63.57	6251	66.13	6250	
68.69	6249	71.25	6248	77.31	6247	81.67	6247	88.83	6246	
93.38	6245	97.77	6244	100.13	6244	110.29	6244	111.77	6245	
112.57	6246	113.37	6247	114.17	6248	114.97	6249	115.77	6250	

124.24    6251   135.02    6251   Sol ace (v2).rep    196.06    6250    200    6250  
 Manni ng' s n Val ues    num=    3  
     Sta   n Val    Sta   n Val    Sta   n Val  
     0    .05   77.31   .025   111.77   .05  
 Bank Sta: Left    Right    Lengths: Left Channel    Right    Coeff Contr.    Expan.  
           77.31   111.77            47.17   47.17            .1            .3  
 Right Levee    Stati on=   123.9    El evati on= 6250.97

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6251.79	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.21	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6251.58	Reach Len. (ft)	47.17	47.17
47.17				
Crit W. S. (ft)	6248.09	Flow Area (sq ft)	42.62	220.28
103.40				
E. G. Slope (ft/ft)	0.000370	Area (sq ft)	42.62	220.28
103.40				
Q Total (cfs)	960.00	Flow (cfs)	38.64	857.60
63.76				
Top Width (ft)	143.36	Top Width (ft)	20.67	34.46
88.23				
Vel Total (ft/s)	2.62	Avg. Vel. (ft/s)	0.91	3.89
0.62				
Max Chl Dpth (ft)	7.57	Hydr. Depth (ft)	2.06	6.39
1.17				
Conv. Total (cfs)	49907.6	Conv. (cfs)	2008.7	44584.2
3314.7				
Length Wtd. (ft)	47.17	Wetted Per. (ft)	21.34	35.06
92.30				
Min Ch El (ft)	6244.00	Shear (lb/sq ft)	0.05	0.15
0.03				
Alpha	1.98	Stream Power (lb/ft s)	200.00	0.00
123.90				
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.36	3.00
1.68				
C & E Loss (ft)	0.00	Cum SA (acres)	0.36	0.67
1.03				

Warning: The cross-section end points had to be extended vertically for the computed water surface.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01                      RS: 1014  
 REACH: CH01

INPUT

Descripti on:

Stati on	Elevati on	Data	num=	27						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Elev
0	6251	54.91	6251	71.51	6252	80.1	6252	82.12	6251	
84.14	6250	86.15	6249	88.17	6248	90.18	6247	92.2	6246	

94.21	6245	97.46	6244	100.05	6244	105.84	6244	109.03	6245
112.22	6246	115.41	6247	118.6	6248	121.5	6249	198	6249
259.42	6249	283.96	6250	304.67	6251	307.36	6252	311.65	6252
323.64	6252	327.17	6252						

Solace (v2).rep

Manning's n Values num= 3  
 Station Val Sta n Val Sta n Val  
 0 .05 92.2 .025 112.22 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 92.2 112.22 18.03 18.03 18.03 .1 .3  
 Left Levee Station= 80.62 Elevation= 6252

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6251.76	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.23	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6251.53	Reach Len. (ft)	18.03	18.03
18.03				
Crit W. S. (ft)	6250.19	Flow Area (sq ft)	30.85	139.78
458.58				
E. G. Slope (ft/ft)	0.000583	Area (sq ft)	30.85	139.78
458.58				
Q Total (cfs)	1340.00	Flow (cfs)	40.54	716.45
583.01				
Top Width (ft)	225.06	Top Width (ft)	11.16	20.02
193.88				
Vel Total (ft/s)	2.13	Avg. Vel. (ft/s)	1.31	5.13
1.27				
Max Chl Dpth (ft)	7.53	Hydr. Depth (ft)	2.77	6.98
2.37				
Conv. Total (cfs)	55489.9	Conv. (cfs)	1678.8	29668.6
24142.5				
Length Wtd. (ft)	18.03	Wetted Per. (ft)	12.45	20.71
194.50				
Min Ch El (ft)	6244.00	Shear (lb/sq ft)	0.09	0.25
0.09				
Alpha	3.26	Stream Power (lb/ft s)	327.17	80.62
0.00				
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.32	2.81
1.38				
C & E Loss (ft)	0.00	Cum SA (acres)	0.34	0.64
0.88				

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01 RS: 1013  
 REACH: CH01

INPUT

Description:

Station	Elevation	Data	num=	26					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6250	53.3	6250	70.52	6251	77.1	6252	80.96	6252

Sol ace (v2). rep									
82.9	6251	84.84	6250	86.78	6249	88.69	6248	90.6	6247
92.5	6246	94.41	6245	96.46	6244	99.82	6244	105.95	6244
109.14	6245	112.24	6246	114.95	6247	117.67	6248	120.38	6249
182.02	6249	261.2	6249	283.42	6250	312.44	6251	315.01	6252
329	6252								

Manning's n Values num= 3  
 Station Val Station Val Station Val  
 0 .05 94.41 .025 109.14 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 94.41 109.14 18.13 18.13 18.13 .1 .3  
 Left Levee Station= 81.18 Elevation= 6252.02

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6251.75	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.26	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6251.49	Reach Len. (ft)	18.13	18.13
18.13				
Crit W. S. (ft)	6250.36	Flow Area (sq ft)	40.25	107.68
474.59				
E. G. Slope (ft/ft)	0.000697	Area (sq ft)	40.25	107.68
474.59				
Q Total (cfs)	1340.00	Flow (cfs)	63.69	625.56
650.75				
Top Width (ft)	231.74	Top Width (ft)	12.46	14.73
204.55				
Vel Total (ft/s)	2.15	Avg. Vel. (ft/s)	1.58	5.81
1.37				
Max Chl Dpth (ft)	7.49	Hydr. Depth (ft)	3.23	7.31
2.32				
Conv. Total (cfs)	50763.2	Conv. (cfs)	2412.9	23697.9
24652.4				
Length Wtd. (ft)	18.13	Wetted Per. (ft)	14.05	15.11
205.38				
Min Ch El (ft)	6244.00	Shear (lb/sq ft)	0.12	0.31
0.10				
Alpha	3.62	Stream Power (lb/ft s)	329.00	81.18
0.00				
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.30	2.76
1.19				
C & E Loss (ft)	0.09	Cum SA (acres)	0.34	0.63
0.79				

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01

RS: 1012

Sol ace (v2). rep

INPUT

Descripti on:

Station		Elevation		Data		num= 22			
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6250	69.89	6250	75.34	6251	83.66	6251	85.48	6250
87.3	6249	89.12	6248	90.94	6247	92.76	6246	94.58	6245
96.4	6244	99.02	6244	99.89	6244	102.32	6244	105.72	6244
108.45	6245	111.18	6246	113.9	6247	116.63	6248	126.01	6244
178.22	6249	200	6249						

Manning's n		Values		num= 3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	94.58	.025	108.45	.05

Bank	Sta: Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	94.58	108.45		38.75	38.75		.1	.3
Left Levee		Station=	83.13	Elevation=	6251.05			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6251.64	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.18	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6250.46	Reach Len. (ft)	38.75	38.75
38.75				
Crit W. S. (ft)	6250.46	Flow Area (sq ft)	27.12	87.31
158.71				
E. G. Slope (ft/ft)	0.002765	Area (sq ft)	27.12	87.31
158.71				
Q Total (cfs)	1340.00	Flow (cfs)	75.81	911.49
352.71				
Top Width (ft)	115.36	Top Width (ft)	9.94	13.87
91.55				
Vel Total (ft/s)	4.91	Avg. Vel. (ft/s)	2.80	10.44
2.22				
Max Chl Dpth (ft)	6.46	Hydr. Depth (ft)	2.73	6.29
1.73				
Conv. Total (cfs)	25481.2	Conv. (cfs)	1441.5	17332.7
6707.0				
Length Wtd. (ft)	38.75	Wetted Per. (ft)	11.34	14.30
93.59				
Min Ch El (ft)	6244.00	Shear (lb/sq ft)	0.41	1.05
0.29				
Alpha	3.15	Stream Power (lb/ft s)	200.00	83.13
0.00				
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.29	2.72
1.06				
C & E Loss (ft)	0.19	Cum SA (acres)	0.33	0.63
0.73				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: The cross-section end points had to be extended vertically for the computed water surface.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The cross section had to be extended vertically during the critical depth



Solace (v2).rep

calculations.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
REACH: CH01

RS: 1011

INPUT

Description:

Station		Elevation		Data		num= 26			
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6249	15.65	6249	46.18	6249	47.93	6249	71.04	6249
73.6	6249	79.56	6250	85.53	6251	86.79	6251	88.06	6250
89.33	6249	90.59	6248	91.86	6247	93.13	6246	94.4	6245
95.73	6244	99.92	6244	106.62	6244	109.26	6245	111.9	6246
114.54	6247	117.18	6248	192.85	6248	282.84	6249	317.41	6250
334.44	6251								

Manning's n		Values		num= 3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	94.4	.025	109.26	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	94.4	109.26		22.91	22.91		.1	.3
Left Levee		Station=	85.92	Elevation=	6251			

CROSS SECTION OUTPUT Profile #Sand Creek

	E. G. Elev (ft)		Element	Left OB	Channel
Right OB	6250.61				
Vel Head (ft)	0.55		Wt. n-Val.	0.050	0.025
0.050					
W. S. Elev (ft)	6250.07		Reach Len. (ft)	22.91	22.91
22.91					
Crit W. S. (ft)	6249.74		Flow Area (sq ft)	16.28	88.16
345.19					
E. G. Slope (ft/ft)	0.001770		Area (sq ft)	16.28	88.16
345.19					
Q Total (cfs)	1340.00		Flow (cfs)	32.22	706.30
601.49					
Top Width (ft)	230.57		Top Width (ft)	6.42	14.86
209.28					
Vel Total (ft/s)	2.98		Avg. Vel. (ft/s)	1.98	8.01
1.74					
Max Chl Dpth (ft)	6.07		Hydr. Depth (ft)	2.53	5.93
1.65					
Conv. Total (cfs)	31846.3		Conv. (cfs)	765.7	16785.7
14294.9					
Length Wtd. (ft)	22.91		Wetted Per. (ft)	8.18	15.38
209.85					
Min Ch El (ft)	6244.00		Shear (lb/sq ft)	0.22	0.63

Sol ace (v2).rep

0.18	Alpha	3.97	Stream Power (lb/ft s)	334.44	85.92
0.00	Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.27	2.64
0.83	C & E Loss (ft)	0.03	Cum SA (acres)	0.33	0.61
0.60					

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1010

INPUT

Description:

Station	Elevation	Data	num=	24						
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta
0	6249	10.53	6249	19.32	6249	67.86	6249	76.69	6250	
87.83	6250	89.13	6249	90.43	6248	91.74	6247	93.04	6246	
94.34	6245	95.64	6244	99.69	6244	107.05	6244	109.94	6245	
112.82	6246	115.71	6247	118.44	6248	185.16	6248	224.2	6248	
253.66	6249	283.19	6250	319.46	6251	331.72	6251			

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val
0	.05	94.34	.025
		109.94	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	94.34	109.94		20.32	20.32		.1	.3
Left Levee		Station=	87.32	Elevation=	6250			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6250.55	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.46	Wt. n-Val.	0.050	0.025
0.050				
W. S. El ev (ft)	6250.09	Reach Len. (ft)	20.32	20.32
20.32				
Crit W. S. (ft)	6249.66	Flow Area (sq ft)	96.93	92.89
315.91				
E. G. Slope (ft/ft)	0.001514	Area (sq ft)	96.93	92.89
315.91				
Q Total (cfs)	1340.00	Flow (cfs)	111.88	690.74
537.38				
Top Width (ft)	286.41	Top Width (ft)	94.34	15.60
176.47				
Vel Total (ft/s)	2.65	Avg. Vel. (ft/s)	1.15	7.44
1.70				
Max Chl Dpth (ft)	6.09	Hydr. Depth (ft)	1.03	5.95
1.79				
Conv. Total (cfs)	34443.6	Conv. (cfs)	2875.8	17754.8
13813.0				
Length Wtd. (ft)	20.32	Wetted Per. (ft)	97.18	16.11
177.02				
Min Ch El (ft)	6244.00	Shear (lb/sq ft)	0.09	0.54

Solace (v2).rep

0.17	Alpha	4.24	Stream Power (lb/ft s)	331.72	87.32
0.00	Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.24	2.59
0.66	C & E Loss (ft)	0.05	Cum SA (acres)	0.30	0.61
0.50					

Warning: Multiple water surfaces were found that could balance the energy equation. The program selected the water surface whose main channel velocity head was the closest to the previously computed cross section.  
 Warning: The cross-section end points had to be extended vertically for the computed water surface.  
 Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1009

INPUT

Description:

Station	Elevation	Data	num=	29	Station	Elevation	Station	Elevation	Station	Elevation
0	6248	.03	6248	62.69	6249	71.41	6250	80.61	6251	6251
82.6	6251	84.21	6250	85.83	6249	87.45	6248	89.07	6247	6247
90.68	6246	92.3	6245	93.92	6244	95.53	6243	99.36	6242	6242
100.04	6242	100.53	6242	105.02	6243	107.63	6244	110.25	6245	6245
112.73	6246	114.76	6247	116.78	6248	159.88	6248	225.22	6248	6248
248.79	6249	273.98	6250	318.25	6251	328.32	6252			

Manning's n	Values	num=	3	Station	n Val	Station	n Val
0	.05	93.92	.025	107.63	.05		

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	93.92	107.63		20.61	20.61	.1	.3
Left Levee		Station=	82.57	Elevation=	6251		

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6250.46	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.96	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6249.50	Reach Len. (ft)	20.61	20.61
20.61				
Crit W. S. (ft)	6249.50	Flow Area (sq ft)	24.49	92.36
222.75				
E. G. Slope (ft/ft)	0.002186	Area (sq ft)	24.49	92.36
222.75				
Q Total (cfs)	1340.00	Flow (cfs)	59.97	885.27
394.76				
Top Width (ft)	176.40	Top Width (ft)	8.90	13.71
153.79				
Vel Total (ft/s)	3.95	Avg. Vel. (ft/s)	2.45	9.59
1.77				

		Sol ace (v2).rep		
Max Chl Dpth (ft)	7.50	Hydr. Depth (ft)	2.75	6.74
1.45				
Conv. Total (cfs)	28657.3	Conv. (cfs)	1282.5	18932.4
8442.4				
Length Wtd. (ft)	20.61	Wetted Per. (ft)	10.47	14.42
154.67				
Min Ch El (ft)	6242.00	Shear (lb/sq ft)	0.32	0.87
0.20				
Alpha	3.98	Stream Power (lb/ft s)	328.32	82.57
0.00				
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	0.21	2.55
0.53				
C & E Loss (ft)	0.15	Cum SA (acres)	0.27	0.60
0.42				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth

for the water surface and continued on with the calculations.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

#### CROSS SECTION

RIVER: Channel 01  
REACH: CH01

RS: 1008

#### INPUT

Description:

Station		Elevation		Data		num=		26	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6248	1.8	6248	72.8	6249	78.62	6249	81.28	6248
83.94	6247	86.6	6246	89.27	6245	91.93	6244	94.59	6243
98	6242	99.79	6242	101.91	6242	104.19	6243	106.2	6244
108.21	6245	110.22	6246	112.23	6247	114.24	6248	129.68	6248
153.86	6247	170.71	6247	229.2	6248	246.25	6249	259.55	6250
322.79	6251								

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.05	91.93	.025	106.2	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	91.93	106.2		27.23	27.23	.1	.3
Left Levee	Station=	78.66		Elevation=	6249.02		
Right Levee	Station=	113.29		Elevation=	6248.04		

#### CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6250.04	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.46	Wt. n-Val.	0.050	0.025
0.050				

Sol ace (v2).rep				
W. S. Elev (ft)	6249.59	Reach Len. (ft)	27.23	27.23
27.23				
Crit W. S. (ft)	6249.19	Flow Area (sq ft)	124.36	98.39
289.99				
E. G. Slope (ft/ft)	0.001226	Area (sq ft)	124.36	98.39
289.99				
Q Total (cfs)	1340.00	Flow (cfs)	155.38	716.12
468.50				
Top Width (ft)	254.03	Top Width (ft)	91.93	14.27
147.83				
Vel Total (ft/s)	2.61	Avg. Vel. (ft/s)	1.25	7.28
1.62				
Max Chl Dpth (ft)	7.58	Hydr. Depth (ft)	1.35	6.89
1.96				
Conv. Total (cfs)	38274.2	Conv. (cfs)	4438.2	20454.5
13381.6				
Length Wtd. (ft)	27.23	Wetted Per. (ft)	94.50	15.04
149.88				
Min Ch El (ft)	6242.00	Shear (lb/sq ft)	0.10	0.50
0.15				
Alpha	4.31	Stream Power (lb/ft s)	322.79	78.66
113.29				
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.17	2.50
0.41				
C & E Loss (ft)	0.03	Cum SA (acres)	0.25	0.59
0.35				

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1007

INPUT

Description:

Station	Elevation	Data	num=	26	Station	Elevation	Station	Elevation	Station	Elevation
-62.09	6248	-34.14	6249	-3.95	6249	79.16	6248	81.62	6247	
84.07	6246	86.52	6245	88.97	6244	91.61	6243	94.54	6242	
99.87	6242	102.91	6242	104.7	6243	106.49	6244	108.27	6245	
110.06	6246	111.84	6247	113.63	6248	114.91	6248	130.21	6247	
142.27	6246	149.74	6246	176.96	6248	233.57	6249	253.9	6250	
316.75	6251									

Manning's n	Station	Value	num=	3	Station	Value
	-62.09	.05		91.61	.025	104.7
						.05

Bank	Sta: Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	91.61	104.7		21.84	21.84		.1	.3
Left Levee	Station=	-4.59		Elevation=	6249.04			
Right Levee	Station=	113.56		Elevation=	6248			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6249.98	Element	Left OB	Channel
Right OB				

Sol ace (v2).rep				
Vel Head (ft)	0.72	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6249.26	Reach Len. (ft)	21.84	21.84
21.84				
Crit W. S. (ft)	6249.26	Flow Area (sq ft)	139.09	92.64
224.69				
E. G. Slope (ft/ft)	0.001644	Area (sq ft)	139.09	92.64
224.69				
Q Total (cfs)	1340.00	Flow (cfs)	155.25	805.70
379.05				
Top Width (ft)	300.90	Top Width (ft)	153.70	13.09
134.11				
Vel Total (ft/s)	2.94	Avg. Vel. (ft/s)	1.12	8.70
1.69				
Max Chl Dpth (ft)	7.26	Hydr. Depth (ft)	0.90	7.08
1.68				
Conv. Total (cfs)	33045.8	Conv. (cfs)	3828.7	19869.4
9347.7				
Length Wtd. (ft)	21.84	Wetted Per. (ft)	156.03	13.52
135.66				
Min Ch El (ft)	6242.00	Shear (lb/sq ft)	0.09	0.70
0.17				
Alpha	5.39	Stream Power (lb/ft s)	316.75	-4.59
113.56				
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.09	2.44
0.25				
C & E Loss (ft)	0.02	Cum SA (acres)	0.17	0.58
0.26				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth

for the water surface and continued on with the calculations.

Warning: The cross-section end points had to be extended vertically for the computed water surface.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

#### CROSS SECTION

RIVER: Channel 01  
REACH: CH01

RS: 1006

#### INPUT

Description:

Station Elevation Data											
num= 32											
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-53.69	6249	-34.86	6249	-.99	6249	44.19	6249	70.07	6249		
75.81	6248	79.8	6247	83.8	6246	87.8	6245	91.07	6244		
94.29	6243	97.4	6242	99.9	6242	105.66	6242	107.22	6243		
108.78	6244	110.34	6245	111.9	6246	113.57	6247	113.84	6247		
117.5	6247	120.43	6246	128.3	6246	129.92	6247	131.66	6247		
150.43	6247	187.95	6247	219.78	6247	241.12	6248	263.06	6249		
279.7	6250	309.42	6251								

Manning's n Values

num= 3

Sol ace (v2).rep

Sta	n Val	Sta	n Val	Sta	n Val			
-53.69	.05	94.29	.025	107.22	.05			
Bank Sta: Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.	
94.29	107.22	113.29	12.29	12.29	.1	.3		
Right Levee	Station=		Elevation=	6247				

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6249.47	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.64	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6248.83	Reach Len. (ft)	12.29	12.29
12.29				
Crit W. S. (ft)	6248.45	Flow Area (sq ft)	61.12	85.91
263.80				
E. G. Slope (ft/ft)	0.001726	Area (sq ft)	61.12	85.91
263.80				
Q Total (cfs)	1340.00	Flow (cfs)	140.90	732.79
466.31				
Top Width (ft)	188.14	Top Width (ft)	23.21	12.93
151.99				
Vel Total (ft/s)	3.26	Avg. Vel. (ft/s)	2.31	8.53
1.77				
Max Chl Dpth (ft)	6.82	Hydr. Depth (ft)	2.63	6.64
1.74				
Conv. Total (cfs)	32255.8	Conv. (cfs)	3391.7	17639.3
11224.8				
Length Wtd. (ft)	12.29	Wetted Per. (ft)	23.96	13.38
153.98				
Min Ch El (ft)	6242.00	Shear (lb/sq ft)	0.27	0.69
0.18				
Alpha	3.89	Stream Power (lb/ft s)	309.42	0.00
113.29				
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.04	2.40
0.13				
C & E Loss (ft)	0.03	Cum SA (acres)	0.13	0.58
0.19				

CROSS SECTION

RIVER: Channel 01  
REACH: CH01

RS: 1005

INPUT

Description:

Station	Elevation	Data	num=	31							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-78.74	6248	-55.76	6248	-33.18	6248	4.16	6248	32.39	6249		
67.57	6249	71.58	6248	75.58	6247	79.59	6246	83.59	6245		
87.6	6244	91.6	6243	95.61	6242	100	6242	105.59	6242		
108.06	6243	110.29	6244	112.53	6245	113.13	6245	117.1	6245		
120.4	6246	123.04	6247	125.68	6248	129	6248	172.53	6247		
183.96	6247	201.04	6247	220.75	6248	247.05	6249	270.77	6250		
412.8	6251										

Manning's n	Values	num=	3
Sta	n Val	Sta	n Val

-78.74 .05 87.6 .025 Sol ace (v2).rep  
110.29 .05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	87.6	110.29		18.04 18.04	18.04		.1	.3
Left Levee		Station=	67.77	Elevation=	6249.02			
Right Levee		Station=	125.29	Elevation=	6248.02			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6249.42	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.54	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6248.88	Reach Len. (ft)	18.04	18.04
18.04				
Crit W. S. (ft)	6247.28	Flow Area (sq ft)	47.63	143.44
202.13				
E. G. Slope (ft/ft)	0.001181	Area (sq ft)	47.63	143.44
202.13				
Q Total (cfs)	1340.00	Flow (cfs)	86.37	982.95
270.67				
Top Width (ft)	175.74	Top Width (ft)	19.53	22.69
133.51				
Vel Total (ft/s)	3.41	Avg. Vel. (ft/s)	1.81	6.85
1.34				
Max Chl Dpth (ft)	6.88	Hydr. Depth (ft)	2.44	6.32
1.51				
Conv. Total (cfs)	38990.8	Conv. (cfs)	2513.2	28601.7
7876.0				
Length Wtd. (ft)	18.04	Wetted Per. (ft)	20.13	23.34
134.63				
Min Ch El (ft)	6242.00	Shear (lb/sq ft)	0.17	0.45
0.11				
Alpha	3.02	Stream Power (lb/ft s)	412.80	67.77
125.29				
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.03	2.37
0.06				
C & E Loss (ft)	0.08	Cum SA (acres)	0.12	0.57
0.15				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
REACH: CH01 RS: 1004

INPUT

Description:

Station	Elevation	Data	num=	23						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
0	6248	7.73	6248	31.32	6249	59.21	6249	63.93	6248	
68.66	6247	73.38	6246	80.37	6242	84.72	6242	88.86	6242	
94.06	6242	99.1	6242	105.34	6242	109.25	6242	112.6	6242	
114.73	6242	116.96	6242	119.57	6242	122.19	6245	124.81	6247	



Sol ace (v2).rep  
200 6248

134.25 6249 149.68 6248

Manning's n Values num= 3  
 Sta n Val Sta n Val Sta n Val  
 0 .05 80.37 .025 119.57 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 80.37 119.57 111.48 111.48 111.48 .1 .3

Ineffective Flow num= 2  
 Sta L Sta R Elev Permanent  
 67.58 81.09 6247.14 F  
 99.48 111.11 6246.96 F

Left Levee Station= 58.84 Elevati on= 6249  
 Right Levee Station= 134.23 Elevati on= 6249

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6249.33	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.28	Wt. n-Val.	0.050	0.025
0.050				
W. S. Elev (ft)	6249.05	Reach Len. (ft)	111.48	111.48
111.48				
Crit W. S. (ft)	6246.26	Flow Area (sq ft)	79.38	276.18
93.40				
E. G. Slope (ft/ft)	0.000417	Area (sq ft)	79.38	276.18
93.40				
Q Total (cfs)	1340.00	Flow (cfs)	46.84	1232.20
60.96				
Top Width (ft)	200.00	Top Width (ft)	80.37	39.20
80.43				
Vel Total (ft/s)	2.98	Avg. Vel. (ft/s)	0.59	4.46
0.65				
Max Chl Dpth (ft)	7.05	Hydr. Depth (ft)	0.99	7.05
1.16				
Conv. Total (cfs)	65605.8	Conv. (cfs)	2293.3	60327.9
2984.5				
Length Wtd. (ft)	111.48	Wetted Per. (ft)	82.81	39.20
83.77				
Min Ch El (ft)	6242.00	Shear (lb/sq ft)	0.02	0.18
0.03				
Alpha	2.06	Stream Power (lb/ft s)	200.00	58.84
134.23				
Frctn Loss (ft)		Cum Volume (acre-ft)		2.28
C & E Loss (ft)		Cum SA (acres)	0.10	0.56
0.10				

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CULVERT

RIVER: Channel 01  
 REACH: CH01 RS: 1003.56

INPUT  
 Description:  
 Distance from Upstream XS = 6

Solace (v2).rep

Deck/Roadway Width = 56  
 Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates  
 num= 2  
 Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord  
 8.3 6247 0 177.68 6247 0

Upstream Bridge Cross Section Data

Station Elevation Data num= 19  

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6249.5	63.93	6248	68.66	6247	73.38	6246	80.37	6242
84.72	6242	88.86	6242	94.06	6242	99.1	6242	105.34	6242
109.25	6242	112.6	6242	114.73	6242	116.96	6242	119.57	6242
122.19	6245	124.81	6247	134.25	6248	400	6250		

Manning's n Values num= 3  

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	80.37	.025	119.57	.05

Bank Sta: Left Right Coeff Contr. Expan.  
 80.37 119.57 .1 .3

Ineffective Flow num= 2  

Sta L	Sta R	Elev	Permanent
67.58	81.09	6247.14	F
99.48	111.11	6246.96	F

Left Levee Station= 58.84 Elevation= 6249  
 Right Levee Station= 134.23 Elevation= 6249

Downstream Deck/Roadway Coordinates  
 num= 2  
 Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord  
 -17.03 6247 0 300 6247 0

Downstream Bridge Cross Section Data

Station Elevation Data num= 19  

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6248.5	21.8	6248	32.35	6247	40.76	6246	42.97	6245
45.2	6244	47.41	6243	49.66	6242	51.91	6241	54.17	6240
73.76	6239	184.57	6240	190.47	6241	195.17	6242	199.34	6243
203.17	6244	206.8	6245	210.31	6247	400	6249.5		

Manning's n Values num= 2  

Sta	n Val	Sta	n Val
0	.013	400	.05

Bank Sta: Left Right Coeff Contr. Expan.  
 0 400 .1 .3

Ineffective Flow num= 3  

Sta L	Sta R	Elev	Permanent
32.52	51.28	6247	F
73.8	116.58	6247	F
133.46	279.06	6247	F

Upstream Embankment side slope = 3 hori z. to 1.0 vertical  
 Downstream Embankment side slope = 3 hori z. to 1.0 vertical  
 Maximum allowable submergence for weir flow = .98  
 Elevation at which weir flow begins =  
 Energy head used in spillway design =  
 Spillway height used in design =  
 Weir crest shape = Broad Crested

Number of Culverts = 3

Sol ace (v2).rep

Culvert Name      Shape      Rise      Span  
 Culvert #1      Circular      4  
 FHWA Chart # 2 - Corrugated Metal Pipe Culvert  
 FHWA Scale # 3 - Pipe projecting from fill  
 Solution Criteria = Highest U.S. EG  
 Culvert Upstrm Dist   Length      Top n   Bottom n   Depth Blocked   Entrance Loss Coef  
 Exit Loss Coef  
                          10      100      .024      .024      0                           .5  
 .5  
 Upstream      El evati on = 6241.91  
                          Centerline Station = 116.96  
 Downstream      El evati on = 6240.16  
                          Centerline Station = 122.87

Culvert Name      Shape      Rise      Span  
 Culvert #2      Circular      4  
 FHWA Chart # 2 - Corrugated Metal Pipe Culvert  
 FHWA Scale # 3 - Pipe projecting from fill  
 Solution Criteria = Highest U.S. EG  
 Culvert Upstrm Dist   Length      Top n   Bottom n   Depth Blocked   Entrance Loss Coef  
 Exit Loss Coef  
                          20      80      .024      .024      0                           .5  
 .5  
 Upstream      El evati on = 6242.06  
                          Centerline Station = 94.06  
 Downstream      El evati on = 6239.73  
                          Centerline Station = 69.23

Culvert Name      Shape      Rise      Span  
 Culvert #3      Circular      4  
 FHWA Chart # 2 - Corrugated Metal Pipe Culvert  
 FHWA Scale # 3 - Pipe projecting from fill  
 Solution Criteria = Highest U.S. EG  
 Culvert Upstrm Dist   Length      Top n   Bottom n   Depth Blocked   Entrance Loss Coef  
 Exit Loss Coef  
                          20      80      .024      .024      0                           .5  
 .5  
 Upstream      El evati on = 6242.32  
                          Centerline Station = 81.95  
 Downstream      El evati on = 6240.7  
                          Centerline Station = 56.1

CULVERT OUTPUT   Profile #Sand Creek   Culv Group:   Culvert #1

Q Culv Group (cfs)	119.88	Culv Full Len (ft)	100.00
# Barrels	1	Culv Vel US (ft/s)	9.54
Q Barrel (cfs)	119.88	Culv Vel DS (ft/s)	9.54
E. G. US. (ft)	6249.33	Culv Inv El Up (ft)	6241.91
W. S. US. (ft)	6249.05	Culv Inv El Dn (ft)	6240.16
E. G. DS (ft)	6245.83	Culv Frctn Ls (ft)	2.37
W. S. DS (ft)	6245.27	Culv Exit Loss (ft)	0.43
Del ta EG (ft)	3.51	Culv Entr Loss (ft)	0.71
Del ta WS (ft)	3.77	Q Weir (cfs)	963.91
E. G. IC (ft)	6249.07	Weir Sta Lft (ft)	6.24
E. G. OC (ft)	6249.34	Weir Sta Rgt (ft)	314.10
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	6245.91	Weir Max Depth (ft)	2.35
Culv WS Outlet (ft)	6244.16	Weir Avg Depth (ft)	1.04
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	319.17
Culv Crt Depth (ft)	3.30	Min El Weir Flow (ft)	6247.01

CULVERT OUTPUT   Profile #Sand Creek   Culv Group:   Culvert #2

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Q Culv Group (cfs)	128.12	Culv Full Len (ft)	80.00
# Barrels	1	Culv Vel US (ft/s)	10.20
Q Barrel (cfs)	128.12	Culv Vel DS (ft/s)	10.20
E. G. US. (ft)	6249.33	Culv Inv El Up (ft)	6242.06
W. S. US. (ft)	6249.05	Culv Inv El Dn (ft)	6239.73
E. G. DS (ft)	6245.83	Culv Frctn Ls (ft)	2.17
W. S. DS (ft)	6245.27	Culv Exit Loss (ft)	0.53
Delta EG (ft)	3.51	Culv Entr Loss (ft)	0.81
Delta WS (ft)	3.77	Q Weir (cfs)	963.91
E. G. IC (ft)	6249.91	Weir Sta Lft (ft)	6.24
E. G. OC (ft)	6249.33	Weir Sta Rgt (ft)	314.10
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	6246.06	Weir Max Depth (ft)	2.35
Culv WS Outlet (ft)	6243.73	Weir Avg Depth (ft)	1.04
Culv Nml Depth (ft)	3.15	Weir Flow Area (sq ft)	319.17
Culv Crt Depth (ft)	3.39	Min El Weir Flow (ft)	6247.01

Note: During the supercritical calculations a hydraulic jump occurred inside of the culvert.

Note: The culvert inlet is submerged and the culvert flows full over part or all of its length. Therefore, the culvert inlet equations are not valid and the supercritical result has been discarded. The outlet answer will be used.

CULVERT OUTPUT Profile #Sand Creek Culv Group: Culvert #3

Q Culv Group (cfs)	128.09	Culv Full Len (ft)	80.00
# Barrels	1	Culv Vel US (ft/s)	10.19
Q Barrel (cfs)	128.09	Culv Vel DS (ft/s)	10.19
E. G. US. (ft)	6249.33	Culv Inv El Up (ft)	6242.32
W. S. US. (ft)	6249.05	Culv Inv El Dn (ft)	6240.70
E. G. DS (ft)	6245.83	Culv Frctn Ls (ft)	2.17
W. S. DS (ft)	6245.27	Culv Exit Loss (ft)	0.53
Delta EG (ft)	3.51	Culv Entr Loss (ft)	0.81
Delta WS (ft)	3.77	Q Weir (cfs)	963.91
E. G. IC (ft)	6250.19	Weir Sta Lft (ft)	6.24
E. G. OC (ft)	6249.33	Weir Sta Rgt (ft)	314.10
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	6246.32	Weir Max Depth (ft)	2.35
Culv WS Outlet (ft)	6244.70	Weir Avg Depth (ft)	1.04
Culv Nml Depth (ft)	4.00	Weir Flow Area (sq ft)	319.17
Culv Crt Depth (ft)	3.39	Min El Weir Flow (ft)	6247.01

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

Note: During supercritical analysis, the culvert direct step method went to critical depth. The program then assumed critical depth at the outlet.

Note: During the supercritical calculations a hydraulic jump occurred inside of the culvert.

Note: The culvert inlet is submerged and the culvert flows full over part or all of its length. Therefore, the culvert inlet equations are not valid and the supercritical result has been discarded. The outlet answer will be used.

CROSS SECTION

RIVER: Channel 01

REACH: CH01

RS: 1003

INPUT

Description:

Station	Elevation	Data	num=	22	Station	Elevation	Station	Elevation	Station	Elevation
0	6248	21.8	6248	32.35	6247	40.76	6246	42.97	6245	6245
45.2	6244	47.41	6243	49.66	6242	51.91	6241	54.17	6240	6240
73.76	6239	184.57	6240	190.47	6241	195.17	6242	199.34	6243	6243
203.17	6244	206.8	6245	210.31	6246	224.76	6246	253.74	6246	6246
271.6	6246	280	6246							

Manning's n	Values	num=	3	Station	n Val
0	.013	0	.013	280	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
0	280	87.73	87.73	87.73	.1	.3	

Ineffective Flow	num=	3	Permanent
Sta L Sta R	Elev		
32.52 51.28	6247	F	
73.8 116.58	6247	F	
133.46 279.06	6247	F	

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6245.83	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.55	Wt. n-Val.		0.013
W. S. Elev (ft)	6245.27	Reach Len. (ft)	87.73	87.73
87.73				
Crit W. S. (ft)	6242.88	Flow Area (sq ft)		224.85
E. G. Slope (ft/ft)	0.000269	Area (sq ft)		851.39
Q Total (cfs)	1340.00	Flow (cfs)		1340.00
Top Width (ft)	165.40	Top Width (ft)		165.40
Vel Total (ft/s)	5.96	Avg. Vel. (ft/s)		5.96
Max Chl Dpth (ft)	6.27	Hydr. Depth (ft)		5.71
Conv. Total (cfs)	81667.5	Conv. (cfs)		81667.5
Length Wtd. (ft)	87.73	Wetted Per. (ft)		39.70
Min Ch El (ft)	6239.00	Shear (lb/sq ft)		0.10
Alpha	1.00	Stream Power (lb/ft s)	280.00	0.00
0.00				
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)		1.29
C & E Loss (ft)	0.11	Cum SA (acres)		0.30

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.  
 Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance)

is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1002

INPUT

Description:

Station	Elevation	Data	num=	23	Station	Elevation	Station	Elevation	Station	Elevation
0	6247	69.1	6247	73.6	6246	75.65	6245	77.68	6244	6244
79.67	6243	81.66	6242	83.64	6241	85.63	6240	100.5	6240	6240
108.93	6240	111.47	6241	114	6242	116.54	6243	118.57	6244	6244
120.46	6245	123.16	6246	126.21	6247	134.04	6247	136.7	6247	6247
188.78	6247	189.12	6247	200	6247					

Manning's n	Values	num=	3	Station	n Val
0	.05	.013	200		.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	0	200		55.7	55.7		.1	.3

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6245.67	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.62	Wt. n-Val.		0.013
W. S. Elev (ft)	6244.05	Reach Len. (ft)	55.70	55.70
55.70				
Crit W. S. (ft)	6244.05	Flow Area (sq ft)		131.22
E. G. Slope (ft/ft)	0.001796	Area (sq ft)		131.22
Q Total (cfs)	1340.00	Flow (cfs)		1340.00
Top Width (ft)	41.09	Top Width (ft)		41.09
Vel Total (ft/s)	10.21	Avg. Vel. (ft/s)		10.21
Max Chl Dpth (ft)	4.05	Hydr. Depth (ft)		3.19
Conv. Total (cfs)	31619.7	Conv. (cfs)		31619.7
Length Wtd. (ft)	55.70	Wetted Per. (ft)		42.87
Min Ch El (ft)	6240.00	Shear (lb/sq ft)		0.34
Alpha	1.00	Stream Power (lb/ft s)	200.00	0.00
0.00				
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)		0.30
C & E Loss (ft)	0.00	Cum SA (acres)		0.09

Solace (v2).rep

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.  
 Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Channel 01  
 REACH: CH01 RS: 1001

INPUT

Description:

Station	Elevation	Data	num=	24	Station	Elevation	Station	Elevation	Station	Elevation
0	6247	65.79	6247	74.92	6246	76.87	6245	78.82	6244	
80.77	6243	82.71	6242	84.65	6241	86.58	6240	88.52	6239	
100.37	6239	109.32	6239	111.3	6240	113.29	6241	115.28	6242	
117.27	6243	119.25	6244	121.23	6245	123.21	6246	130.1	6247	
155.95	6248	162.6	6248	172.56	6247.64	200	6247.64			

Manning's n	Values	num=	3
Station	n Val	Station	n Val
0	.05	0	.013
200		200	.05

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	0	200		43.68	43.68		.1	.3
Right Levee		Station=	130.04	Elevation=	6246.94			

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. Elev (ft)	6245.06	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.66	Wt. n-Val.		0.013
W. S. Elev (ft)	6243.40	Reach Len. (ft)	43.68	43.68
43.68				
Crit W. S. (ft)	6243.40	Flow Area (sq ft)		129.49
E. G. Slope (ft/ft)	0.001722	Area (sq ft)		129.49
Q Total (cfs)	1340.00	Flow (cfs)		1340.00
Top Width (ft)	38.07	Top Width (ft)		38.07
Vel Total (ft/s)	10.35	Avg. Vel. (ft/s)		10.35
Max Chl Dpth (ft)	4.40	Hydr. Depth (ft)		3.40
Conv. Total (cfs)	32290.7	Conv. (cfs)		32290.7
Length Wtd. (ft)	43.68	Wetted Per. (ft)		40.18
Min Ch El (ft)	6239.00	Shear (lb/sq ft)		0.35
Alpha	1.00	Stream Power (lb/ft s)	200.00	0.00
130.04				

Frctn Loss (ft)	0.08	Sol ace (v2). rep Cum Volume (acre-ft)	0.13
C & E Loss (ft)	0.00	Cum SA (acres)	0.04

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Channel 01  
REACH: CH01 RS: 1000

INPUT

Description:

Station	Elevation	Data	num=	24					
Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev	Sta	El ev
0	6248	66.41	6248	67.11	6248	71.69	6248	71.94	6248
76.05	6247	77.77	6246	79.49	6245	81.24	6244	82.98	6243
84.73	6242	86.47	6241	88.22	6240	89.96	6239	112.41	6239
114.55	6240	116.7	6241	118.84	6242	120.74	6243	122.56	6244
124.38	6245	126.2	6246	150.86	6246.68	200	6246.68		

Manning's n Values	num=	3
Sta n Val	Sta n Val	Sta n Val
0 .05	0 .013	200 .05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
0	200	0	0	0	.1	.3	

CROSS SECTION OUTPUT Profile #Sand Creek

E. G. El ev (ft)	6244.89	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.69	Wt. n-Val.		0.013
W. S. El ev (ft)	6243.20	Reach Len. (ft)		
Crit W. S. (ft)	6243.20	Flow Area (sq ft)		128.39
E. G. Slope (ft/ft)	0.001794	Area (sq ft)		128.39
Q Total (cfs)	1340.00	Flow (cfs)		1340.00
Top Width (ft)	38.47	Top Width (ft)		38.47
Vel Total (ft/s)	10.44	Avg. Vel. (ft/s)		10.44
Max Chl Dpth (ft)	4.20	Hydr. Depth (ft)		3.34
Conv. Total (cfs)	31640.1	Conv. (cfs)		31640.1



Sol ace (v2).rep

Length Wtd. (ft)		Wetted Per. (ft)		40.55
Min Ch El (ft)	6239.00	Shear (lb/sq ft)		0.35
Alpha	1.00	Stream Power (lb/ft s)	200.00	0.00
0.00		Cum Volume (acre-ft)		
Frctn Loss (ft)		Cum SA (acres)		
C & E Loss (ft)				

SUMMARY OF MANNING' S N VALUES

Ri ver: Channel 01

Reach	Ri ver Sta.	n1	n2	n3
CH01	1053	.05	.025	.05
CH01	1052	.05	.025	.05
CH01	1051	.05	.025	.05
CH01	1050	.05	.025	.05
CH01	1049	.05	.025	.05
CH01	1048	.05	.025	.05
CH01	1047	.05	.025	.05
CH01	1046	.05	.025	.05
CH01	1045	.05	.025	.05
CH01	1044	.05	.025	.05
CH01	1043	.05	.025	.05
CH01	1042	.05	.025	.05
CH01	1041	.05	.025	.05
CH01	1040	.05	.025	.05
CH01	1039	.05	.025	.05
CH01	1038	.05	.025	.05
CH01	1037	.05	.025	.05
CH01	1036	.05	.025	.05
CH01	1035	.05	.025	.05
CH01	1034	.05	.025	.05
CH01	1033	.05	.025	.05
CH01	1032	.05	.025	.05
CH01	1031	.05	.025	.05
CH01	1030	.05	.025	.05
CH01	1029	.05	.025	.05
CH01	1028	.05	.025	.05
CH01	1027	.05	.025	.05
CH01	1026	.05	.025	.05
CH01	1025	.05	.025	.05
CH01	1024	.05	.025	.05
CH01	1023	.05	.025	.05
CH01	1022	.05	.025	.05
CH01	1021	.05	.025	.05
CH01	1020	.05	.025	.05
CH01	1019	.05	.025	.05
CH01	1018	.05	.025	.05
CH01	1017	.05	.025	.05
CH01	1016	.05	.025	.05
CH01	1015	.05	.025	.05
CH01	1014	.05	.025	.05
CH01	1013	.05	.025	.05

		Sol ace (v2). rep		
CH01	1012	.05	.025	.05
CH01	1011	.05	.025	.05
CH01	1010	.05	.025	.05
CH01	1009	.05	.025	.05
CH01	1008	.05	.025	.05
CH01	1007	.05	.025	.05
CH01	1006	.05	.025	.05
CH01	1005	.05	.025	.05
CH01	1004	.05	.025	.05
CH01	1003.56	Cul vert		
CH01	1003	.013	.013	.05
CH01	1002	.05	.013	.05
CH01	1001	.05	.013	.05
CH01	1000	.05	.013	.05

SUMMARY OF REACH LENGTHS

Ri ver: Channel 01

Reach	Ri ver Sta.	Left	Channel	Ri ght
CH01	1053	61.74	61.74	61.74
CH01	1052	14	14	14
CH01	1051	16.76	16.76	16.76
CH01	1050	45.02	45.02	45.02
CH01	1049	32.7	32.7	32.7
CH01	1048	22.36	22.36	22.36
CH01	1047	23.82	23.82	23.82
CH01	1046	24.71	24.71	24.71
CH01	1045	51.49	51.49	51.49
CH01	1044	24.27	24.27	24.27
CH01	1043	39.09	39.09	39.09
CH01	1042	39.32	39.32	39.32
CH01	1041	30.04	30.04	30.04
CH01	1040	12.64	12.64	12.64
CH01	1039	28.44	28.44	28.44
CH01	1038	26.37	26.37	26.37
CH01	1037	21.74	21.74	21.74
CH01	1036	41.42	41.42	41.42
CH01	1035	36.85	36.85	36.85
CH01	1034	13.77	13.77	13.77
CH01	1033	26.23	26.23	26.23
CH01	1032	25.6	25.6	25.6
CH01	1031	34.57	34.57	34.57
CH01	1030	24.7	24.7	24.7
CH01	1029	24.82	24.82	24.82
CH01	1028	50.43	50.43	50.43
CH01	1027	25.05	25.05	25.05
CH01	1026	27.07	27.07	27.07
CH01	1025	31.34	31.34	31.34
CH01	1024	16.62	16.62	16.62
CH01	1023	20.93	20.93	20.93
CH01	1022	26.45	26.45	26.45
CH01	1021	19.84	19.84	19.84
CH01	1020	32.65	32.65	32.65
CH01	1019	27.27	27.27	27.27
CH01	1018	36.97	36.97	36.97
CH01	1017	35.86	35.86	35.86
CH01	1016	34.77	34.77	34.77
CH01	1015	47.17	47.17	47.17

		Sol ace (v2). rep		
CH01	1014	18.03	18.03	18.03
CH01	1013	18.13	18.13	18.13
CH01	1012	38.75	38.75	38.75
CH01	1011	22.91	22.91	22.91
CH01	1010	20.32	20.32	20.32
CH01	1009	20.61	20.61	20.61
CH01	1008	27.23	27.23	27.23
CH01	1007	21.84	21.84	21.84
CH01	1006	12.29	12.29	12.29
CH01	1005	18.04	18.04	18.04
CH01	1004	111.48	111.48	111.48
CH01	1003.56	Cul vert		
CH01	1003	87.73	87.73	87.73
CH01	1002	55.7	55.7	55.7
CH01	1001	43.68	43.68	43.68
CH01	1000	0	0	0

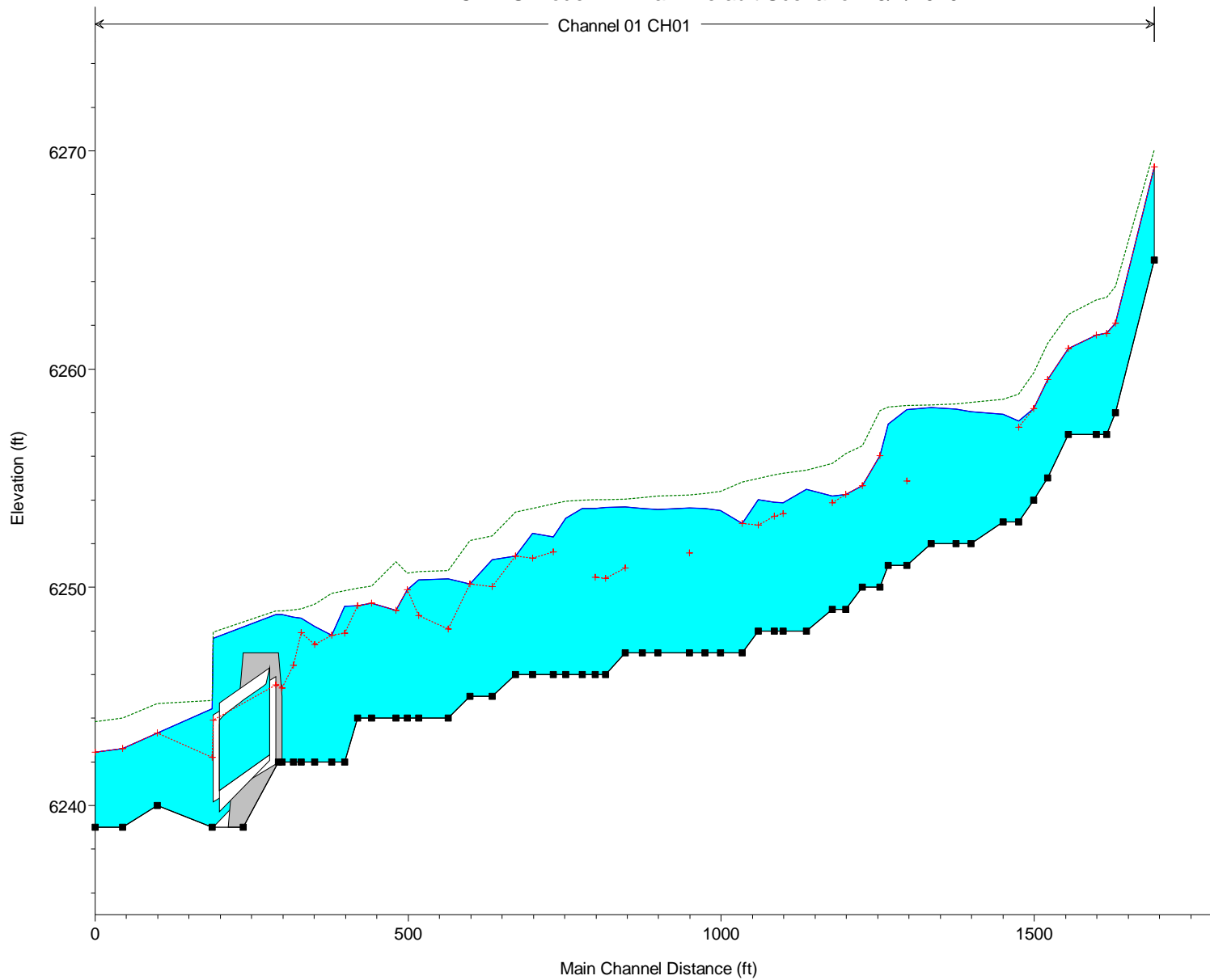
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS  
 River: Channel 01

Reach	River Sta.	Contr.	Expan.
CH01	1053	.1	.3
CH01	1052	.1	.3
CH01	1051	.1	.3
CH01	1050	.1	.3
CH01	1049	.1	.3
CH01	1048	.1	.3
CH01	1047	.1	.3
CH01	1046	.1	.3
CH01	1045	.1	.3
CH01	1044	.1	.3
CH01	1043	.1	.3
CH01	1042	.1	.3
CH01	1041	.1	.3
CH01	1040	.1	.3
CH01	1039	.1	.3
CH01	1038	.1	.3
CH01	1037	.1	.3
CH01	1036	.1	.3
CH01	1035	.1	.3
CH01	1034	.1	.3
CH01	1033	.1	.3
CH01	1032	.1	.3
CH01	1031	.1	.3
CH01	1030	.1	.3
CH01	1029	.1	.3
CH01	1028	.1	.3
CH01	1027	.1	.3
CH01	1026	.1	.3
CH01	1025	.1	.3
CH01	1024	.1	.3
CH01	1023	.1	.3
CH01	1022	.1	.3
CH01	1021	.1	.3
CH01	1020	.1	.3
CH01	1019	.1	.3
CH01	1018	.1	.3
CH01	1017	.1	.3

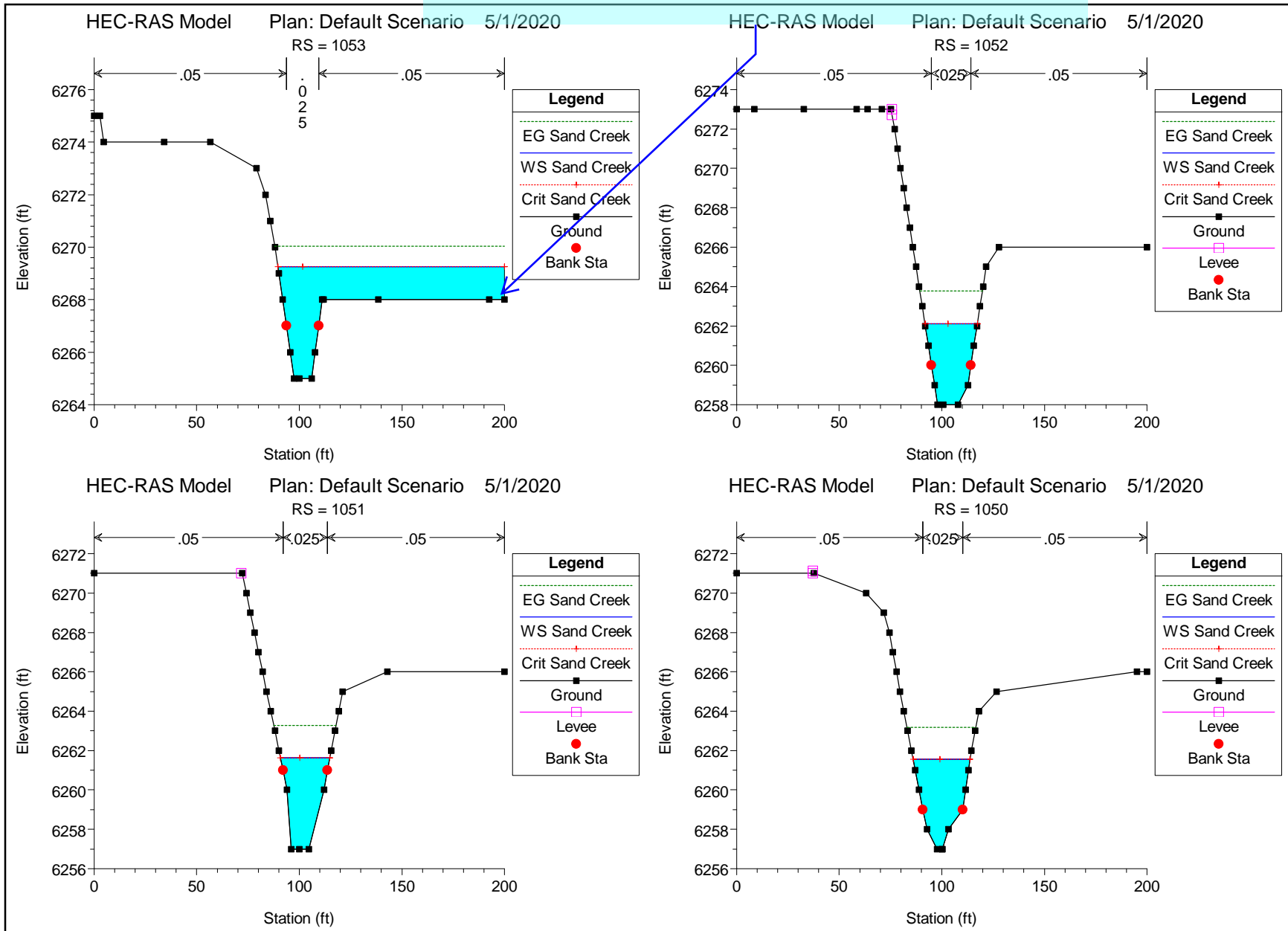
		Sol ace (v2). rep	
CH01	1016	. 1	. 3
CH01	1015	. 1	. 3
CH01	1014	. 1	. 3
CH01	1013	. 1	. 3
CH01	1012	. 1	. 3
CH01	1011	. 1	. 3
CH01	1010	. 1	. 3
CH01	1009	. 1	. 3
CH01	1008	. 1	. 3
CH01	1007	. 1	. 3
CH01	1006	. 1	. 3
CH01	1005	. 1	. 3
CH01	1004	. 1	. 3
CH01	1003. 56	Cul vert	
CH01	1003	. 1	. 3
CH01	1002	. 1	. 3
CH01	1001	. 1	. 3
CH01	1000	. 1	. 3

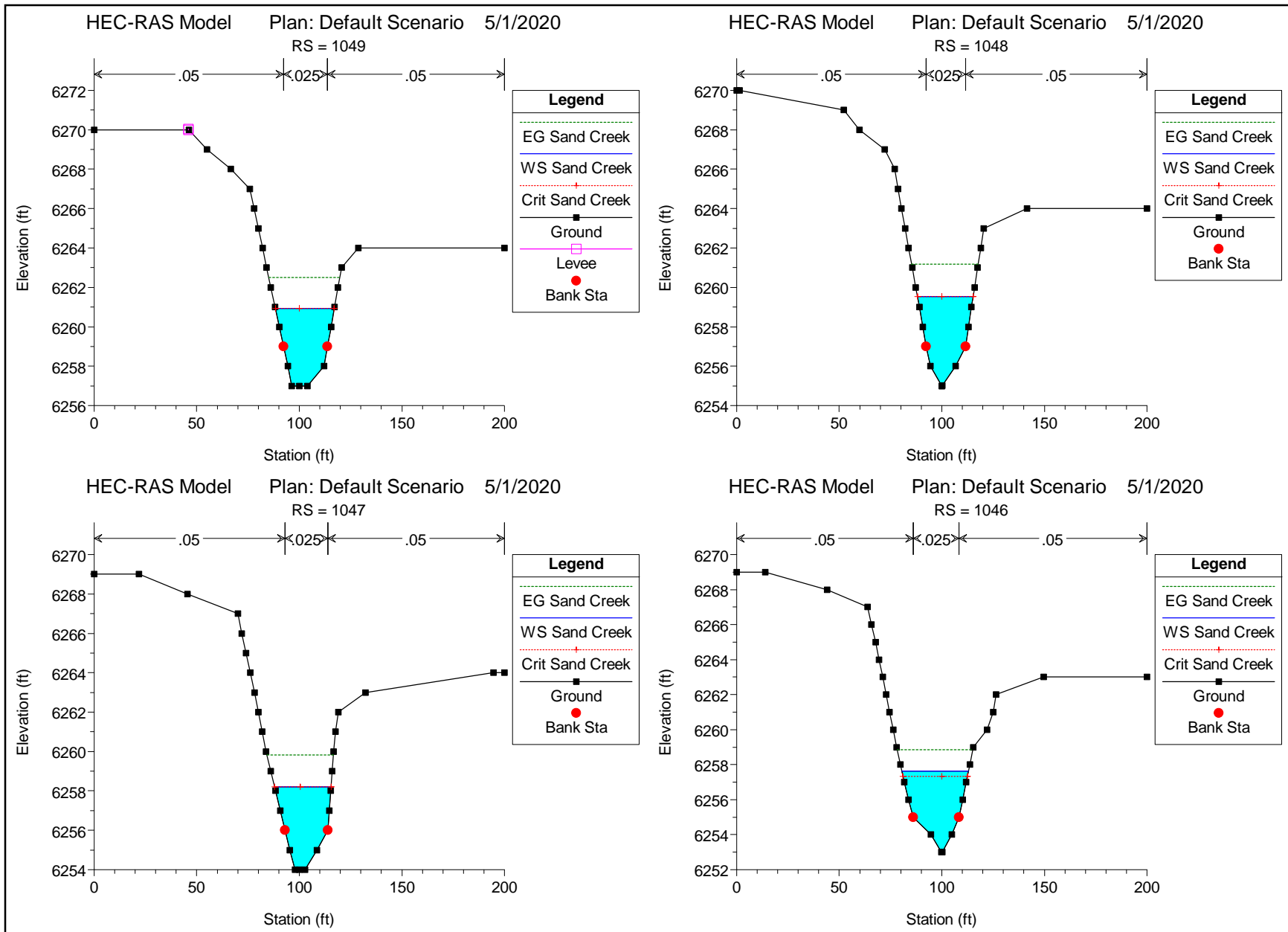
HEC-RAS Model Plan: Default Scenario 5/1/2020

Channel 01 CH01

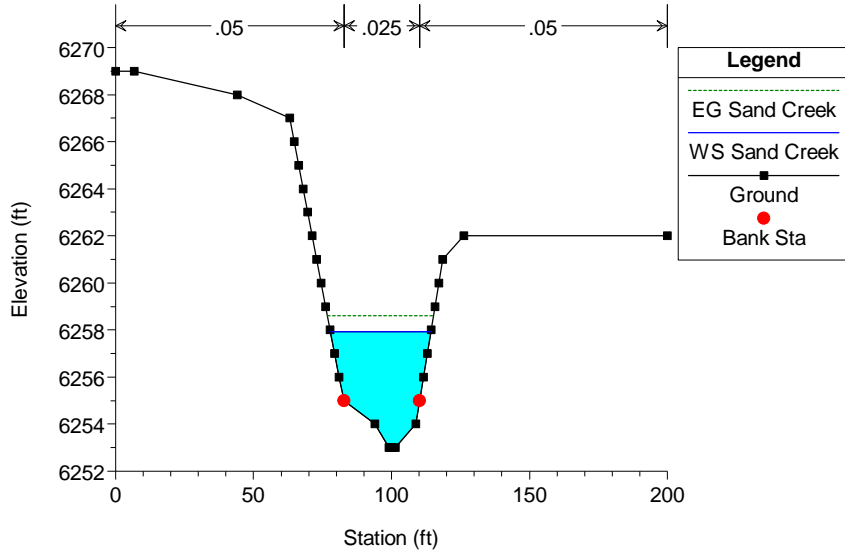


Extend the cross section further out. The hydraulics does not appear to provide an accurate representation of the existing conditions/extend of the 100yr flow

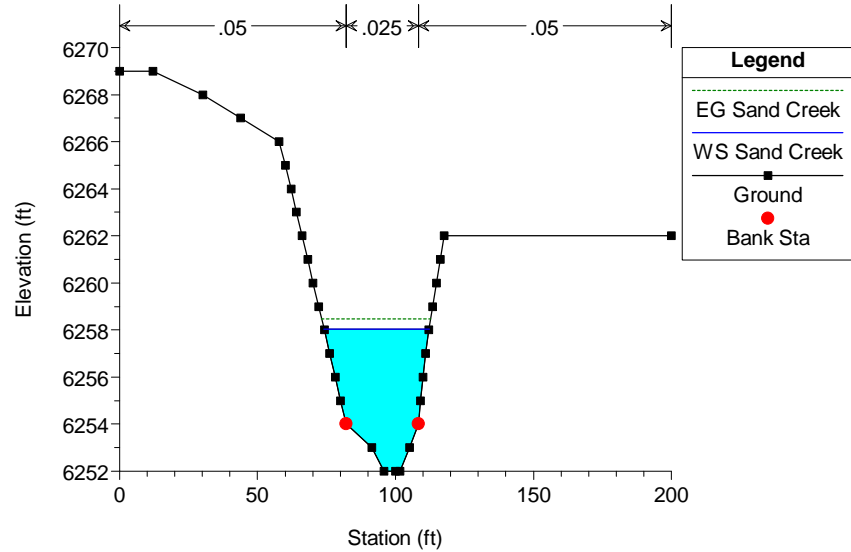




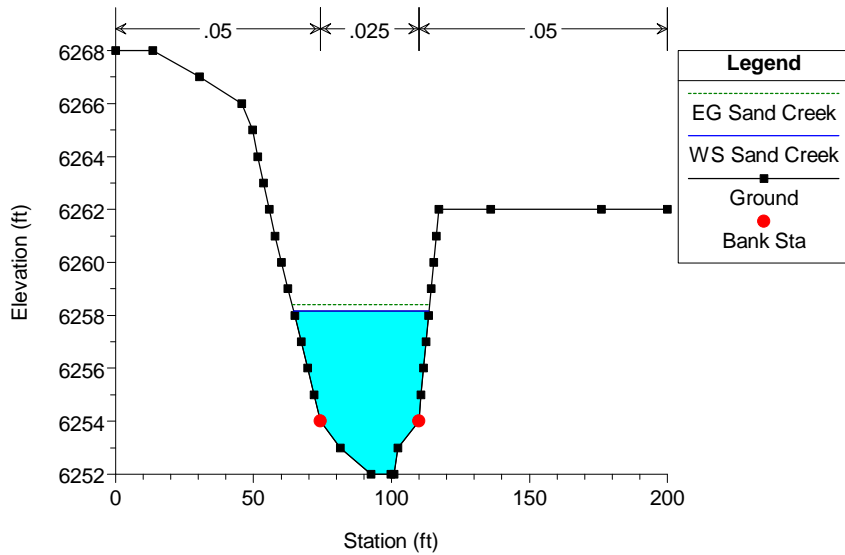
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1045



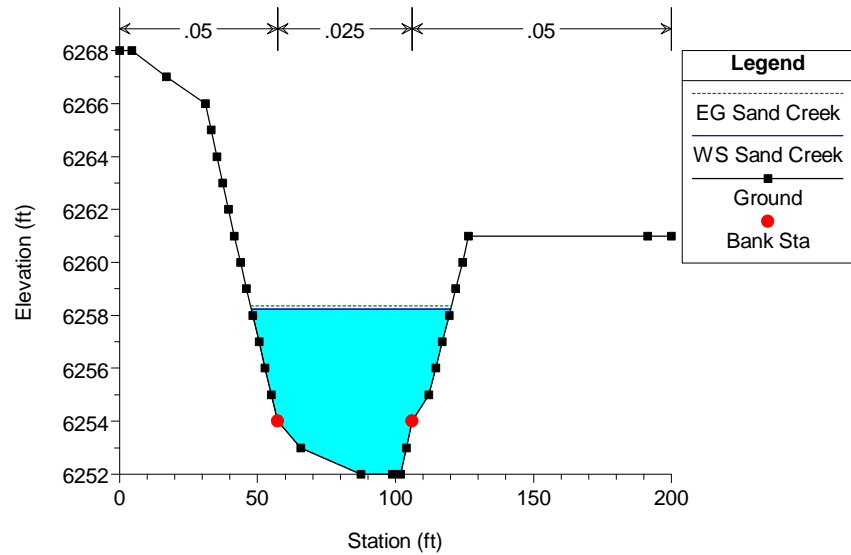
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1044



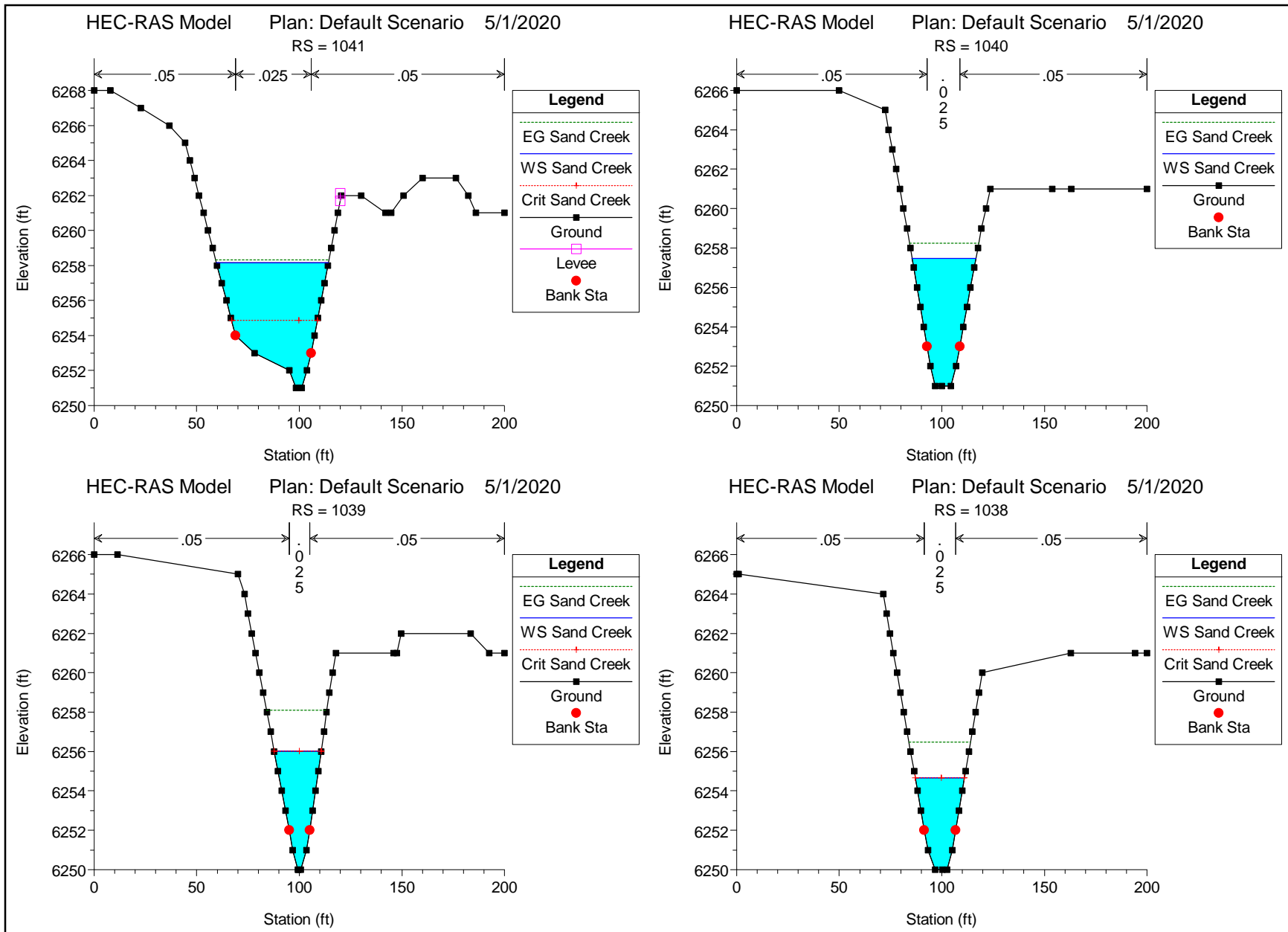
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1043

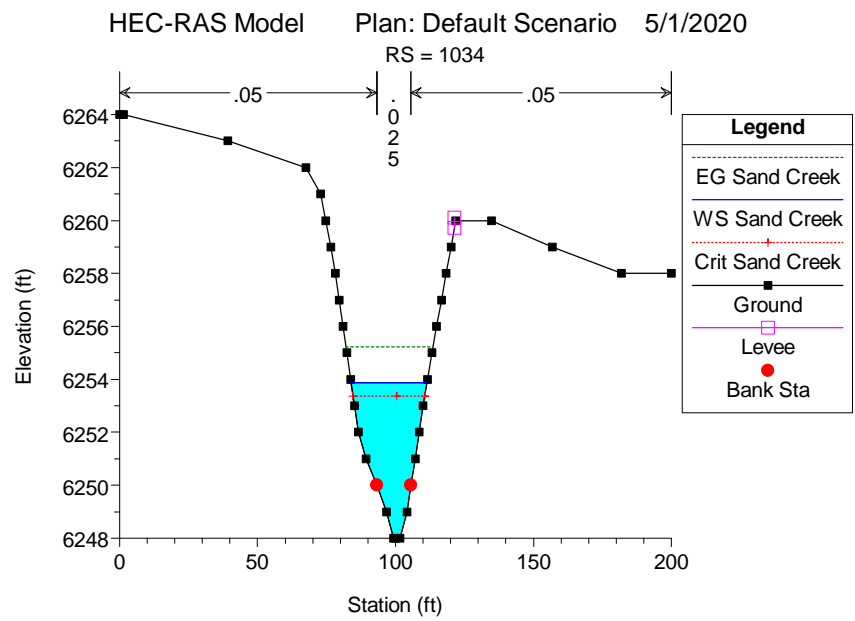
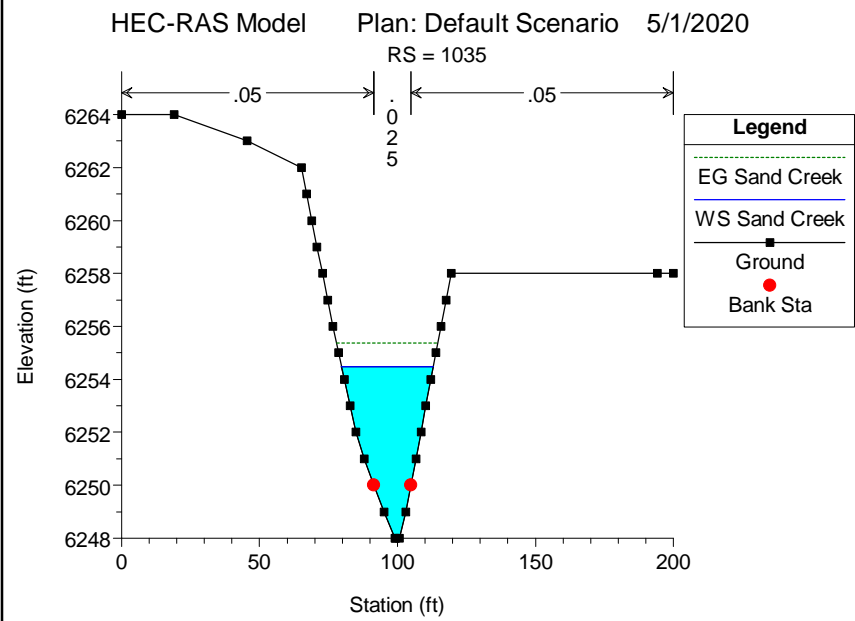
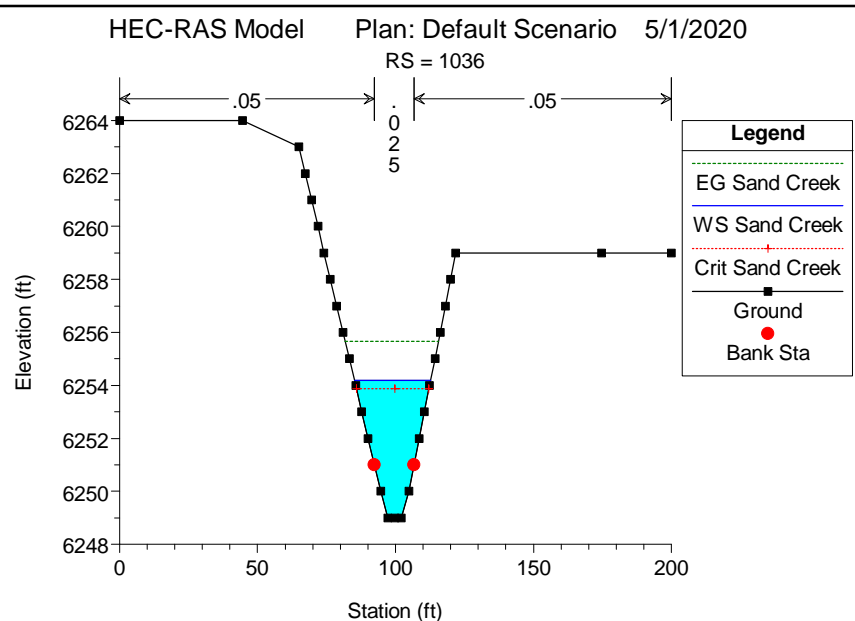
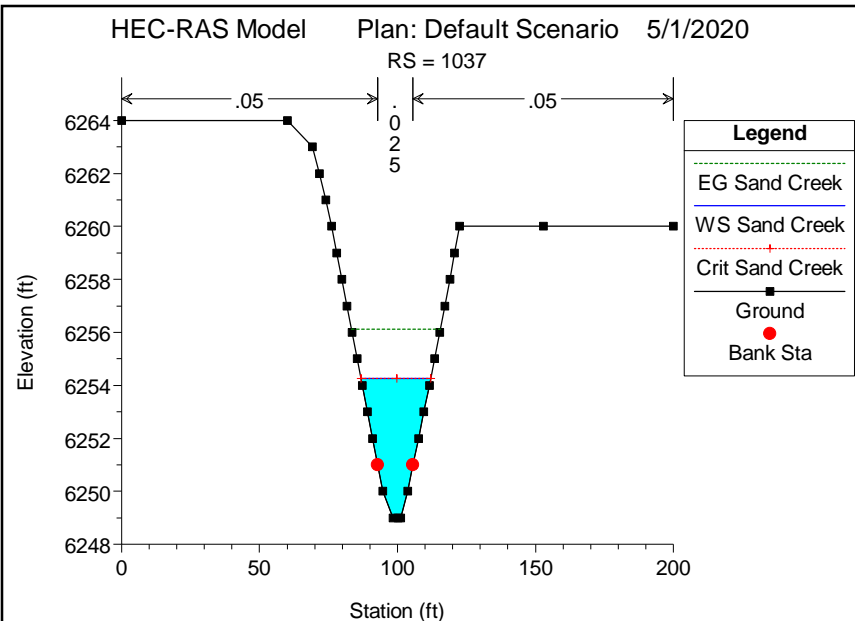


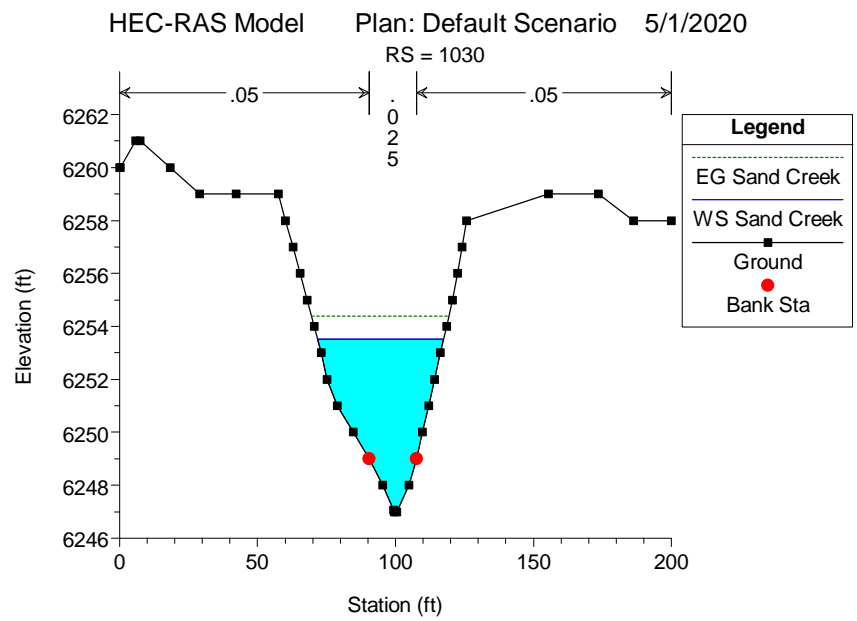
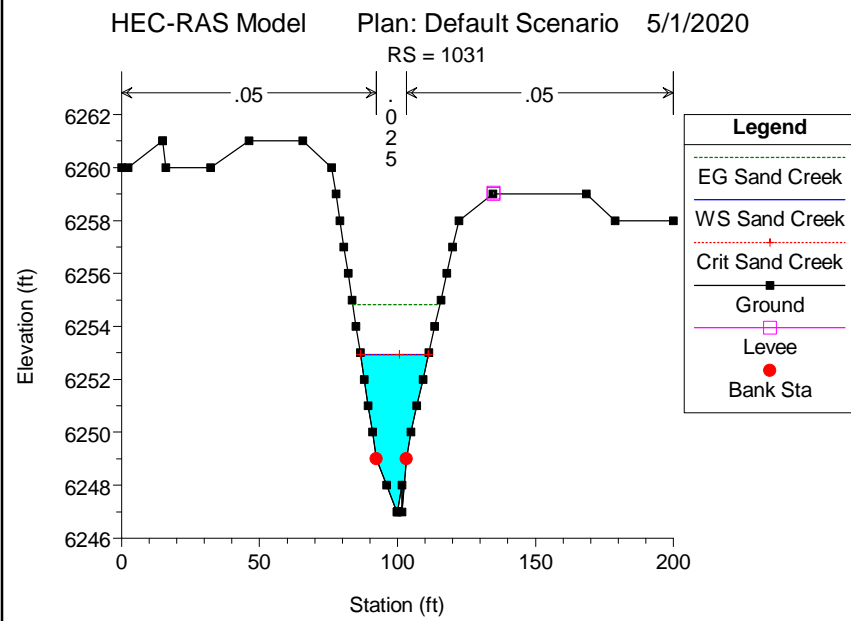
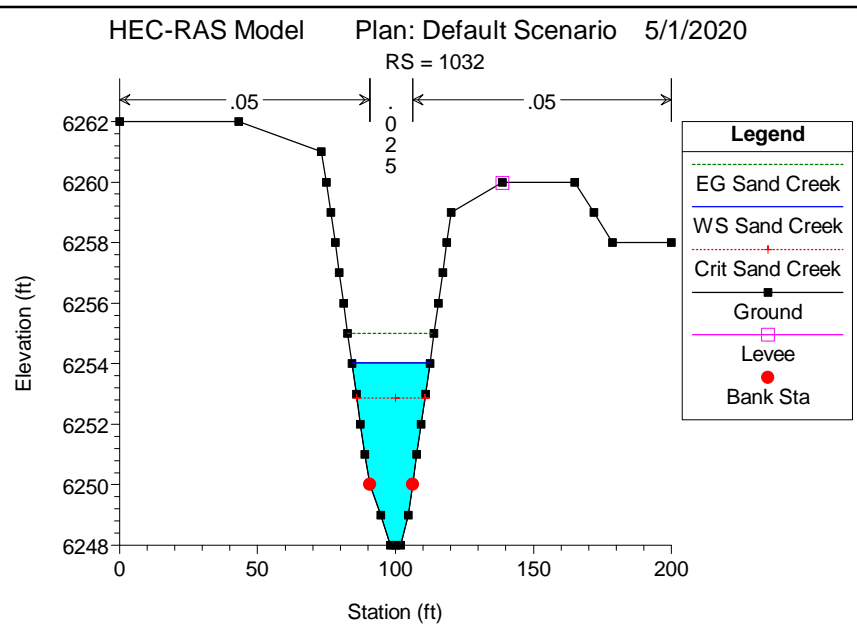
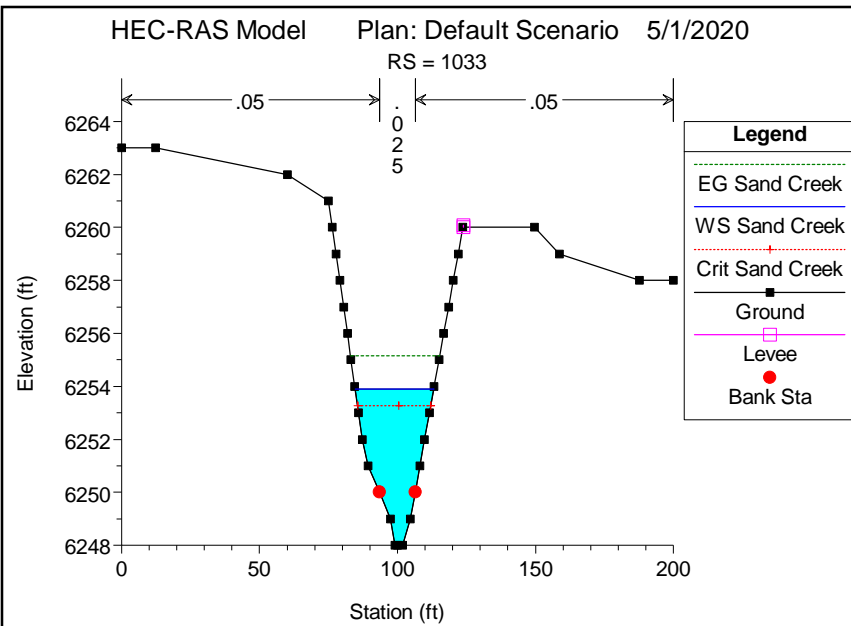
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1042



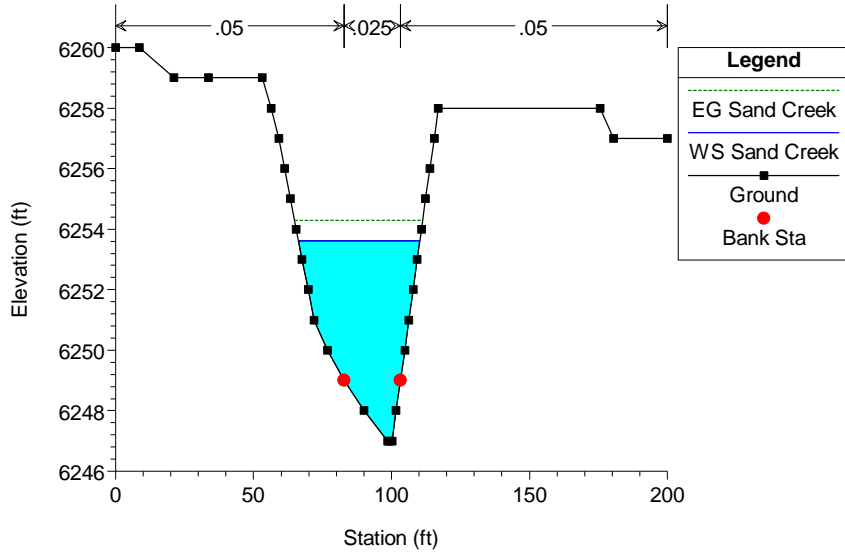




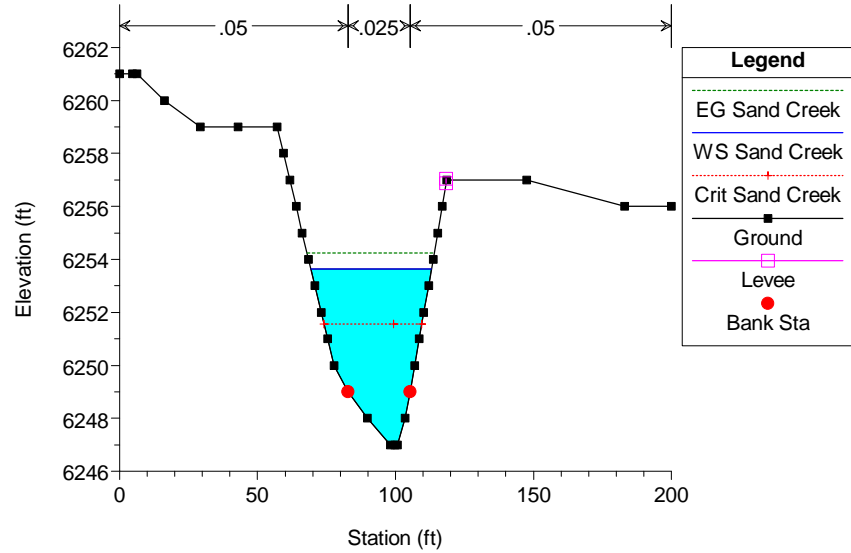




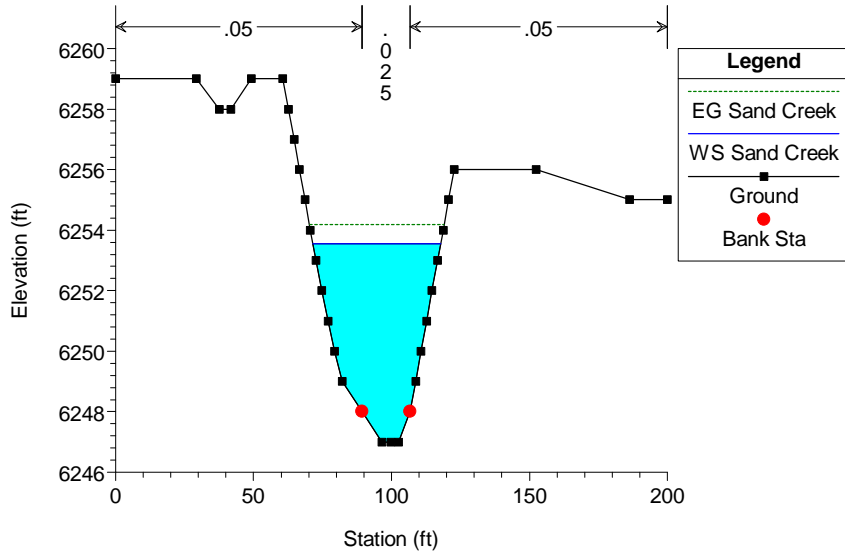
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1029



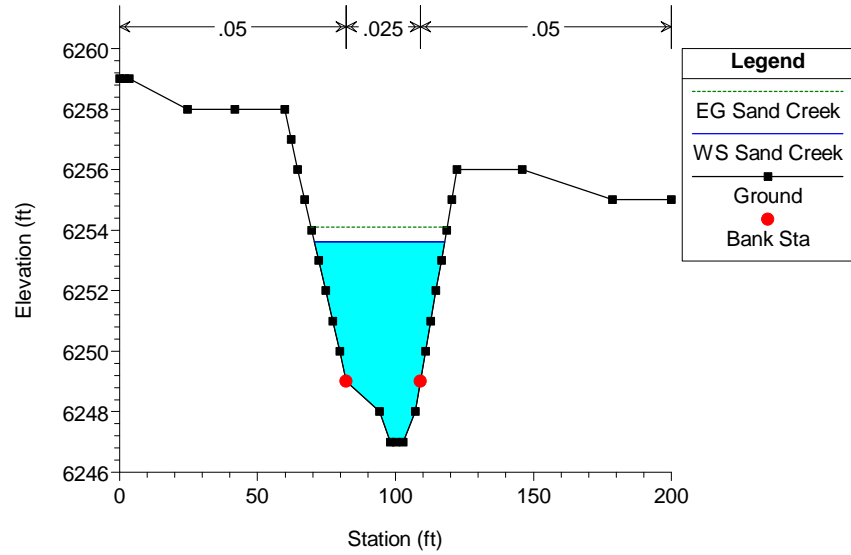
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1028



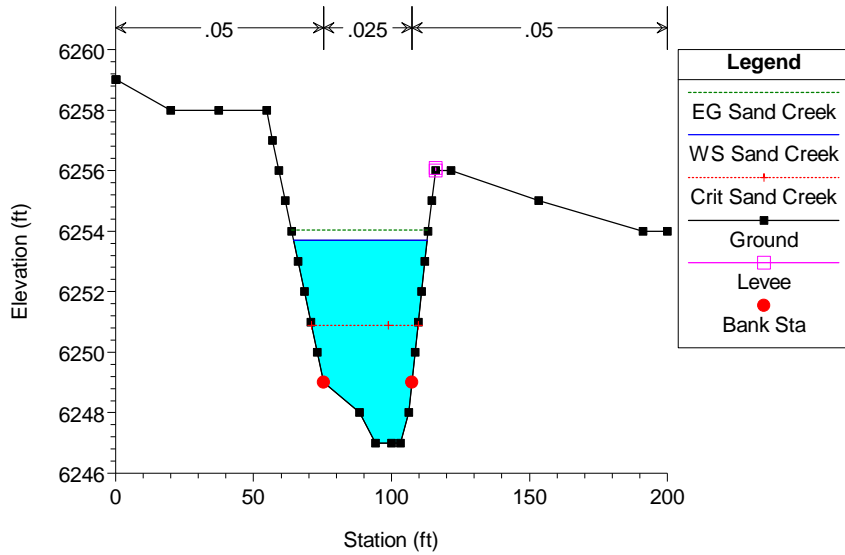
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1027



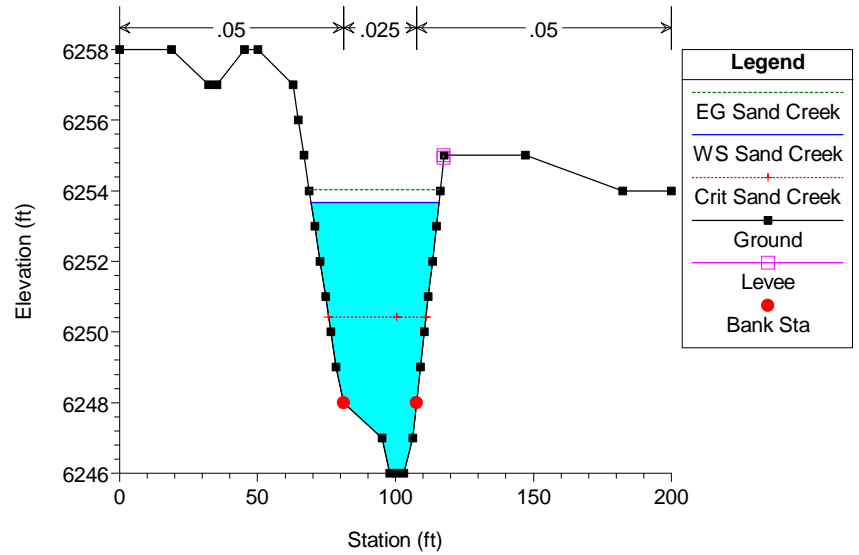
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1026



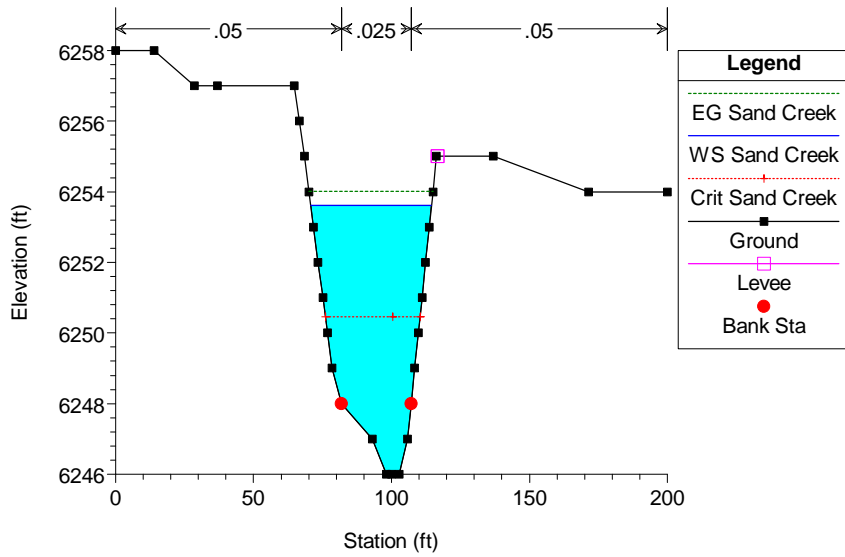
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1025



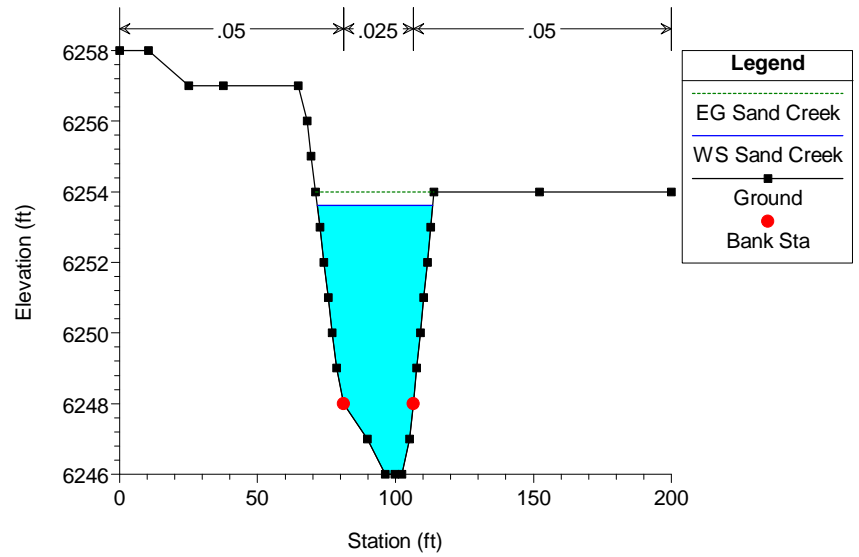
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1024



HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1023

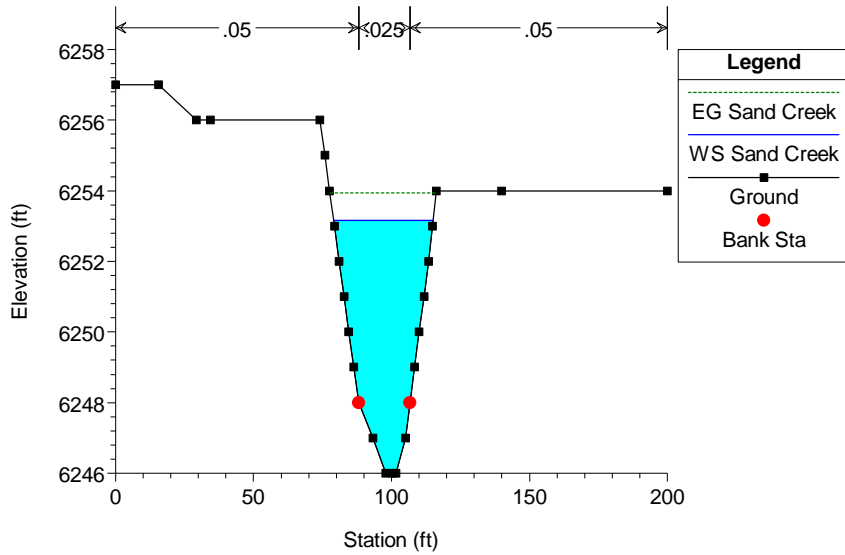


HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1022



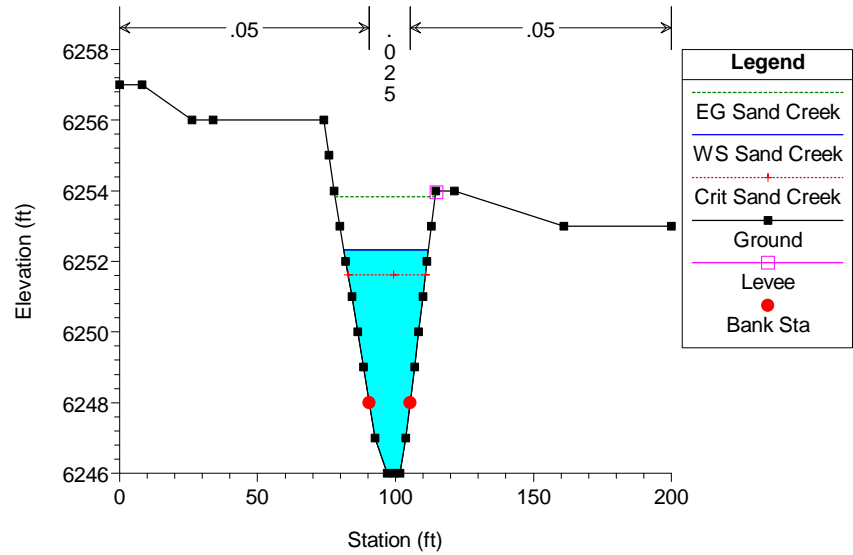
HEC-RAS Model Plan: Default Scenario 5/1/2020

RS = 1021



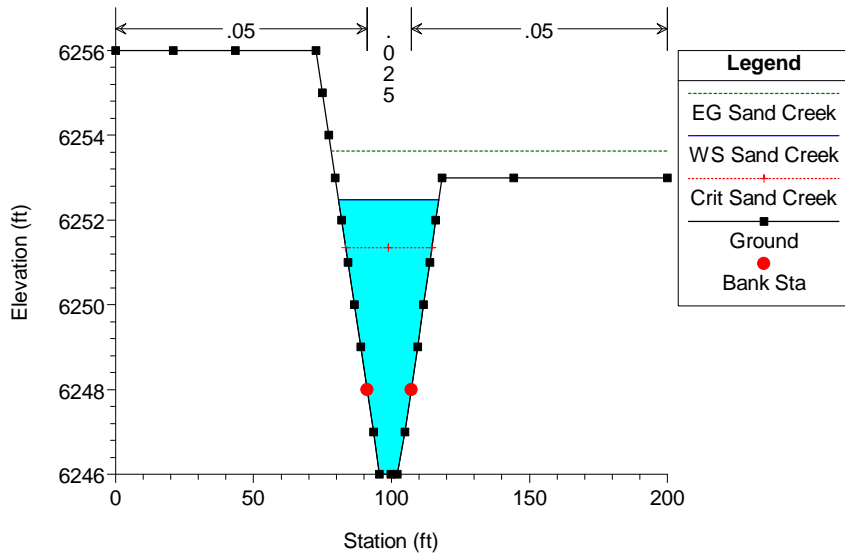
HEC-RAS Model Plan: Default Scenario 5/1/2020

RS = 1020



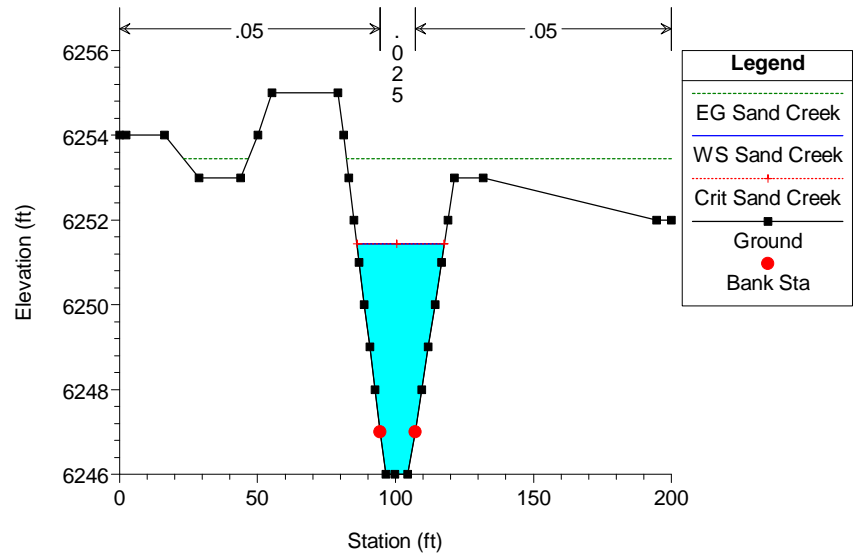
HEC-RAS Model Plan: Default Scenario 5/1/2020

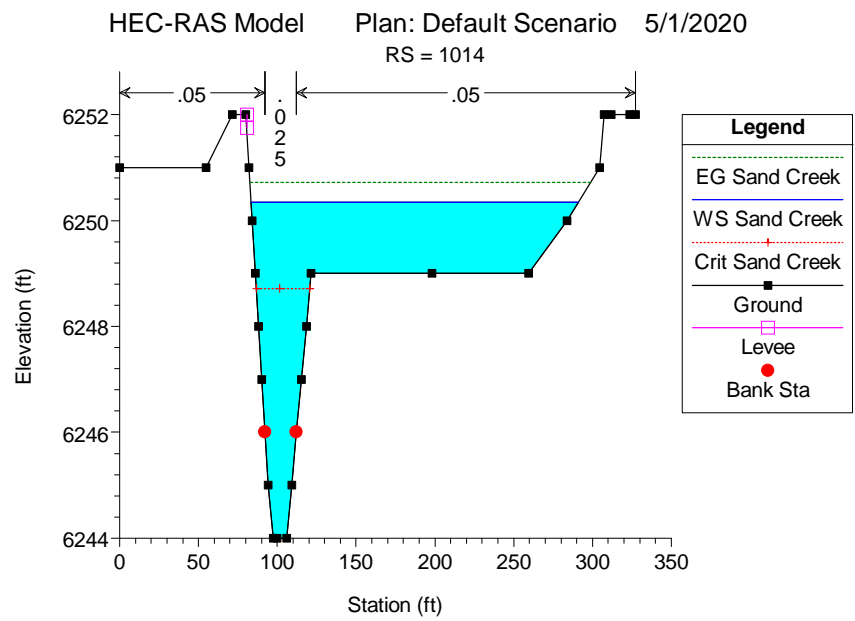
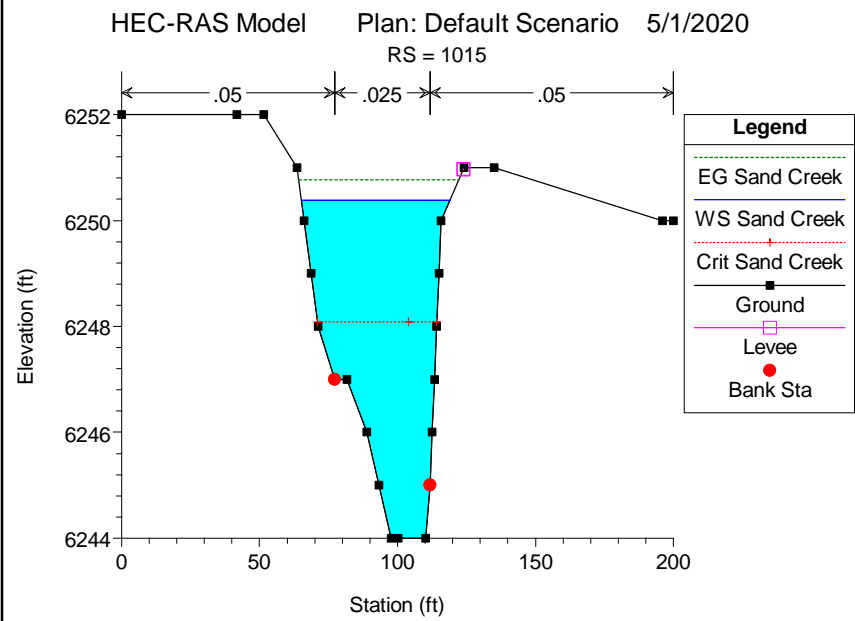
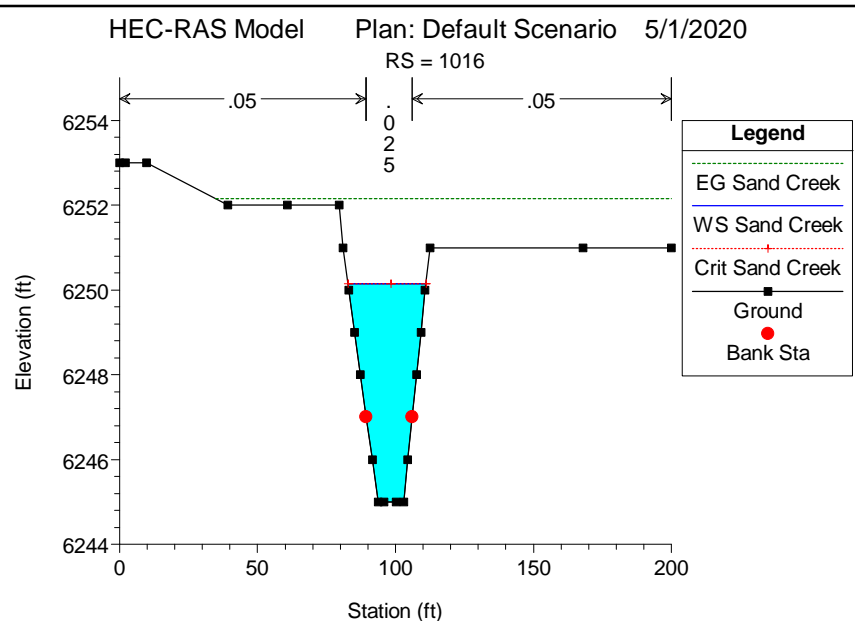
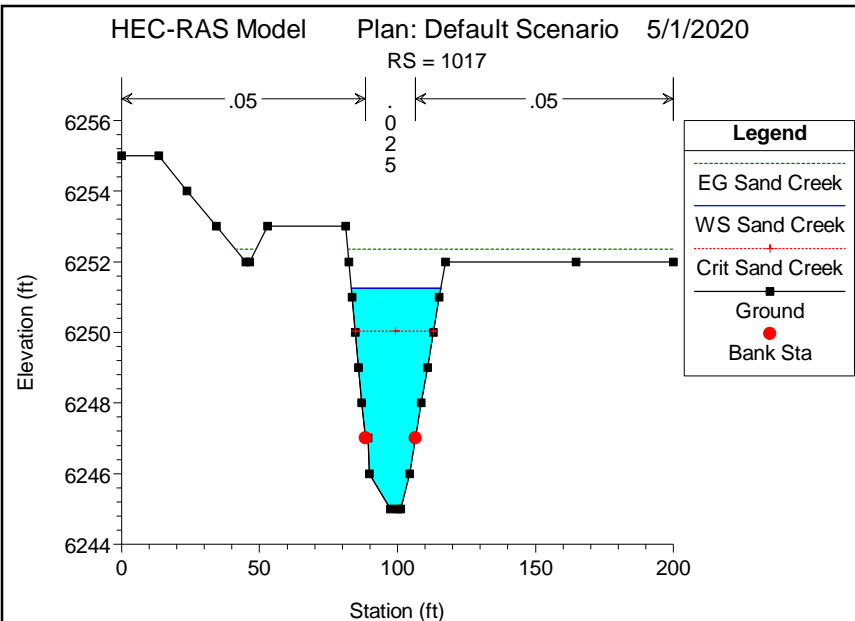
RS = 1019



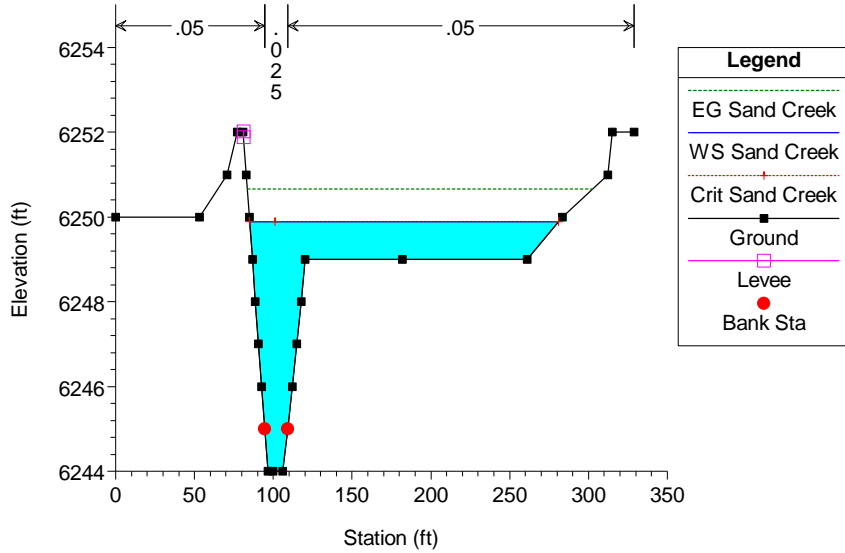
HEC-RAS Model Plan: Default Scenario 5/1/2020

RS = 1018

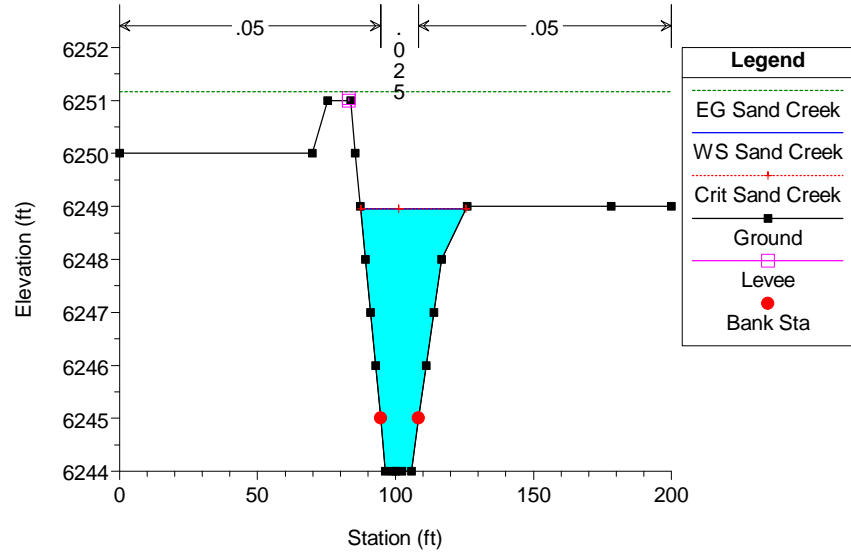




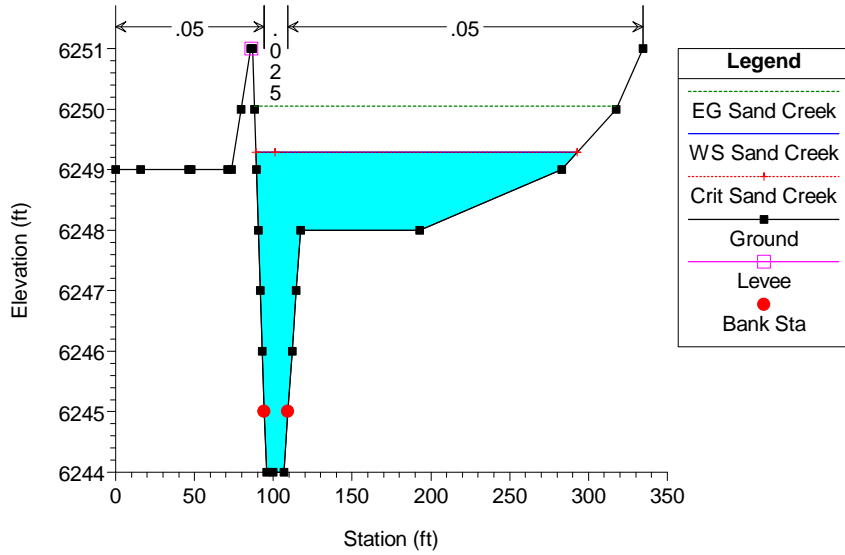
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1013



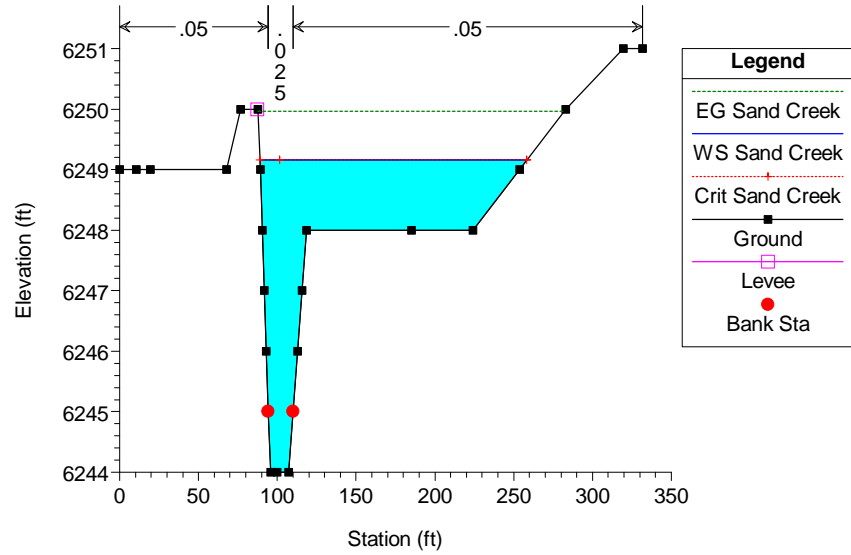
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1012



HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1011

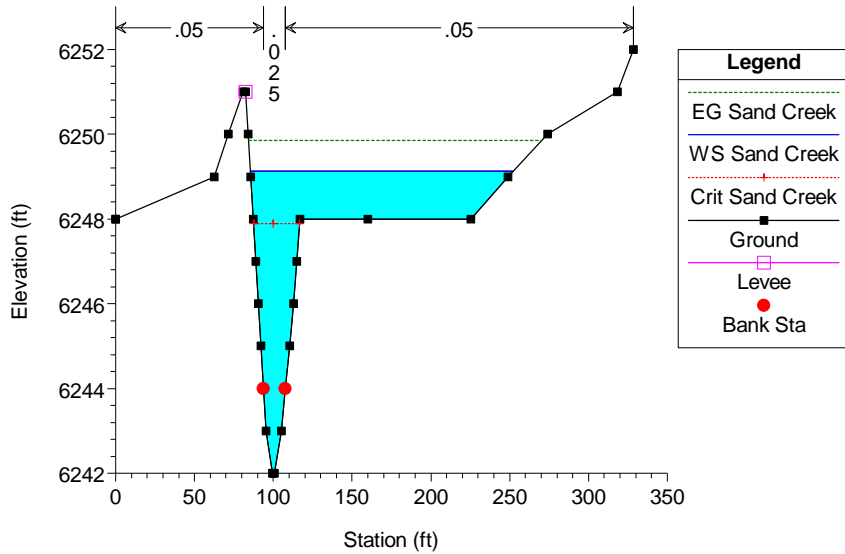


HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1010

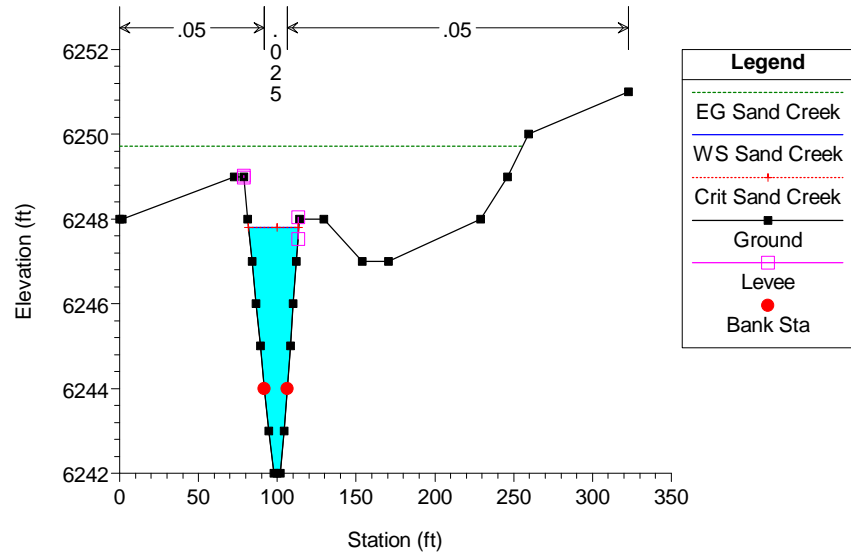




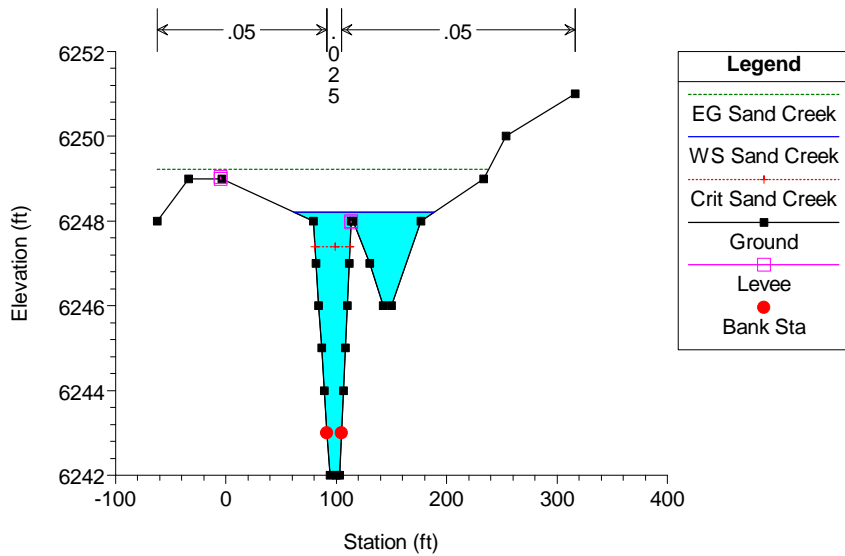
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1009



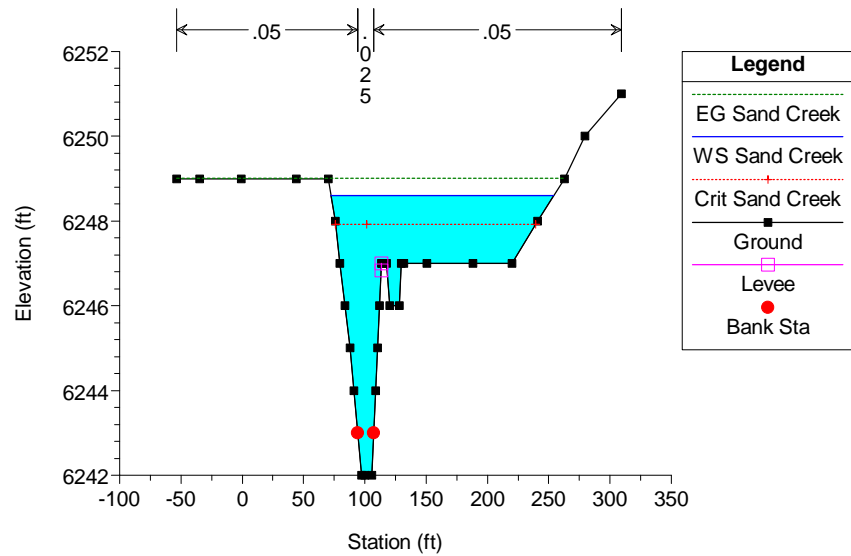
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1008

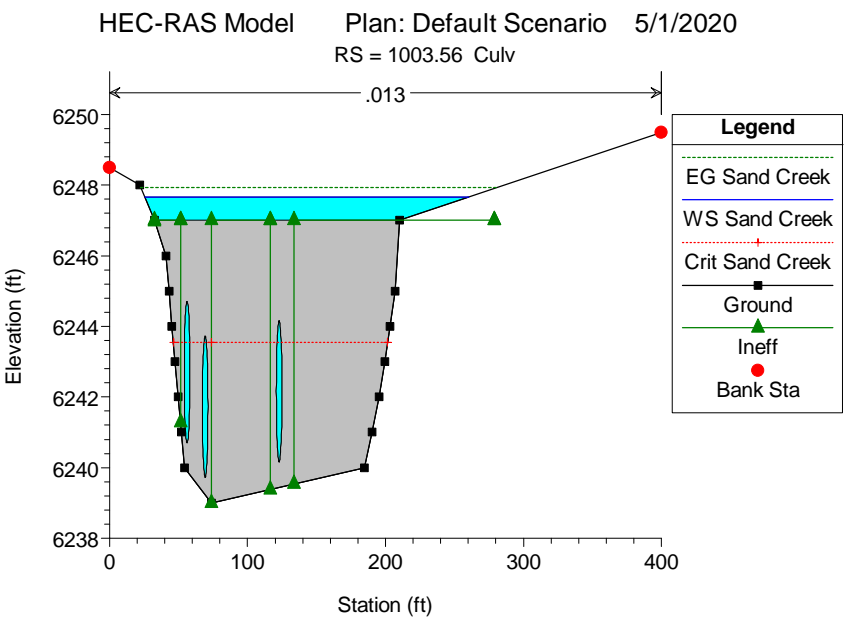
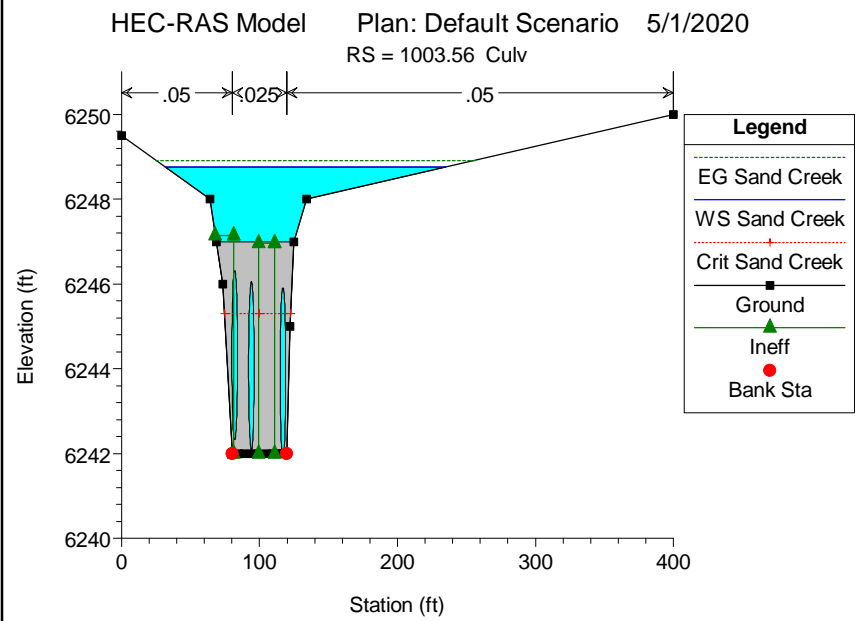
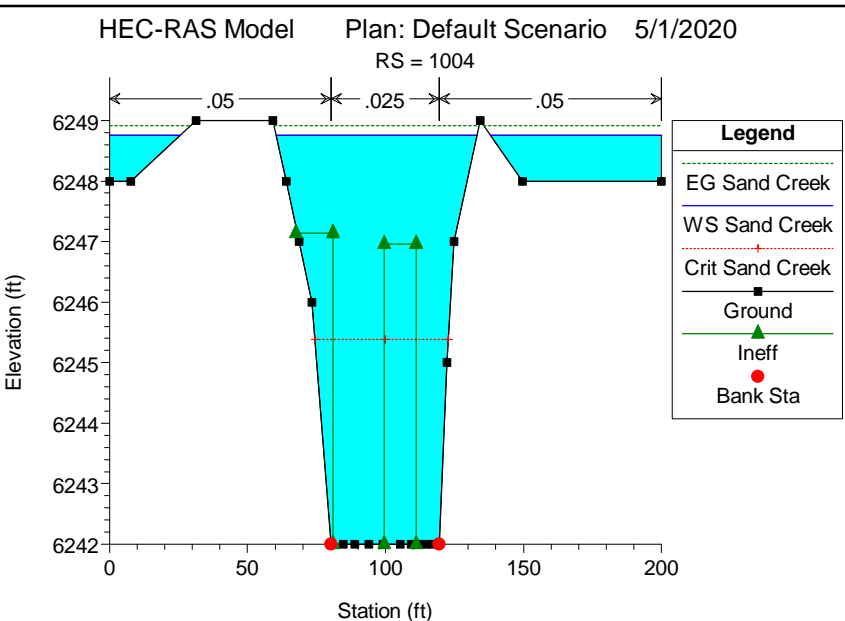
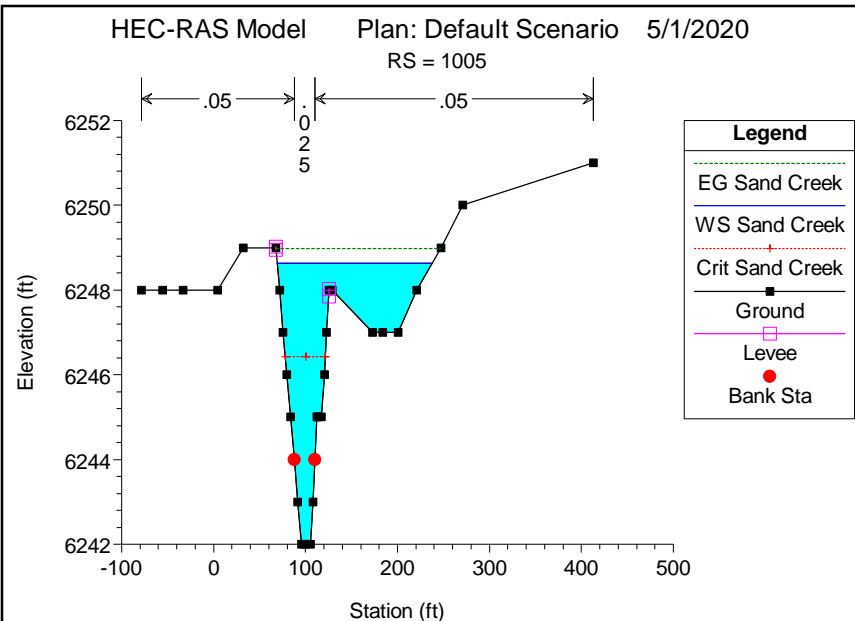


HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1007

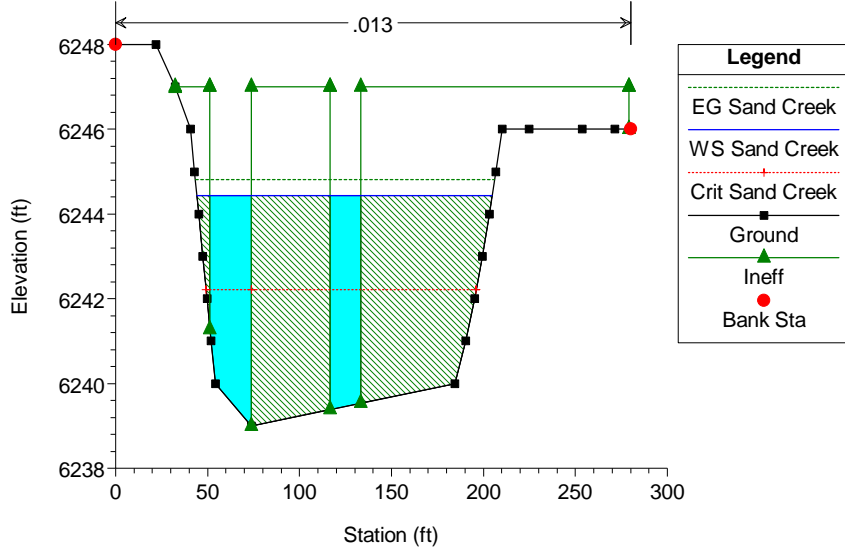


HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1006

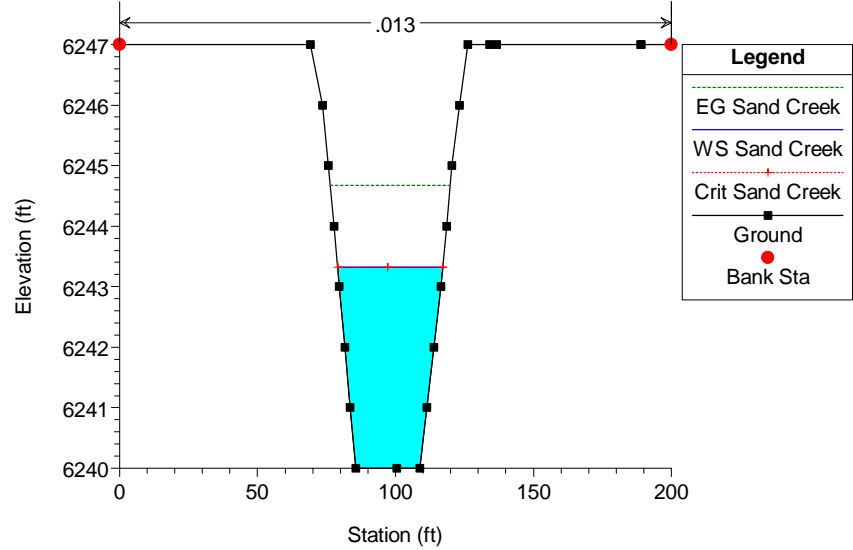




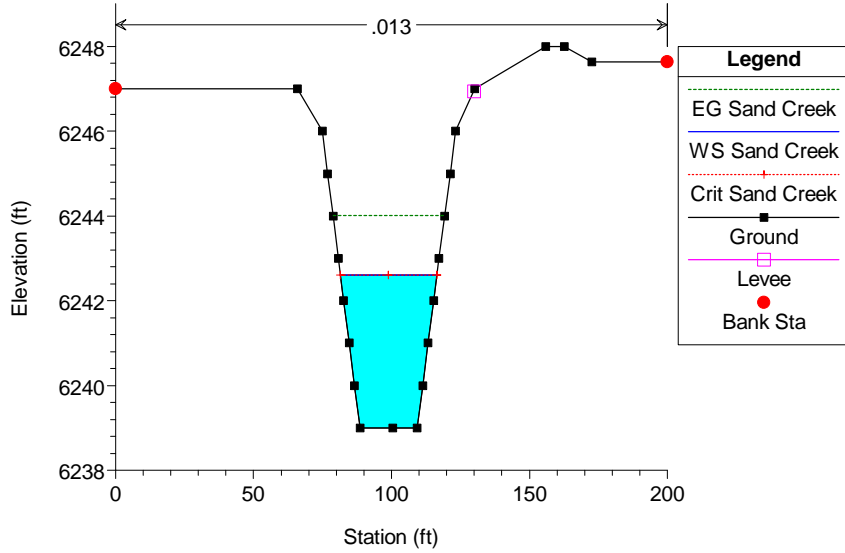
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1003



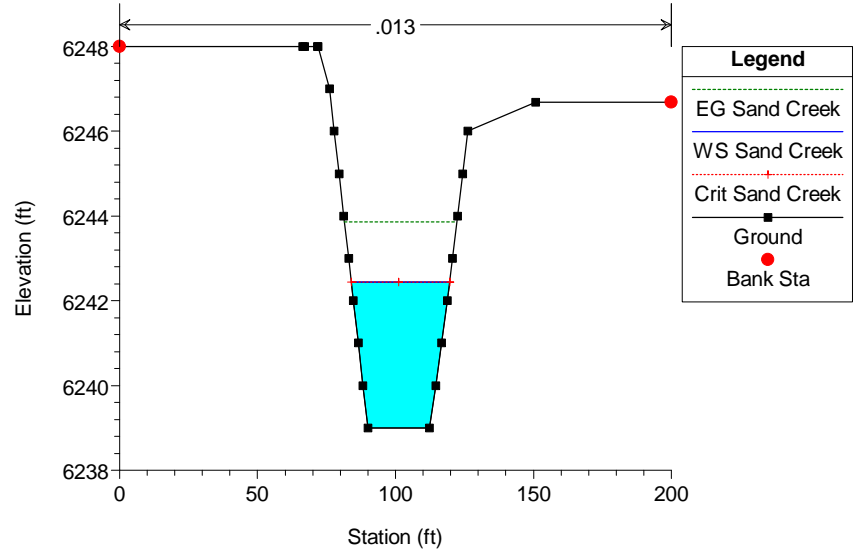
HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1002



HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1001



HEC-RAS Model Plan: Default Scenario 5/1/2020  
RS = 1000





**APPENDIX C**

**REFERENCE MATERIALS**



# Federal Emergency Management Agency

Washington, D.C. 20472

JAN 30 2007

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

The Honorable Sallie Clark  
Chair, El Paso County  
Board of Commissioners  
27 East Vermijo Avenue  
Colorado Springs, CO 80903

IN REPLY REFER TO:

Case No.: 05-08-0368P  
Community Name: El Paso County, CO  
Community No.: 080059  
Effective Date of  
This Revision: **MAY 23 2007**

Dear Ms. Clark:

The Flood Insurance Study report and Flood Insurance Rate Map for your community have been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Federal Insurance and Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Denver, Colorado, at (303) 235-4830, or the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Sincerely,

Patrick, F. Sacbibit, P.E., CFM, Project Engineer  
Engineering Management Section  
Mitigation Division

For: William R. Blanton Jr., CFM, Chief  
Engineering Management Section  
Mitigation Division

List of Enclosures:

Letter of Map Revision Determination Document  
Annotated Flood Insurance Rate Map  
Annotated Flood Insurance Study Report

cc: The Honorable Lionel Rivera  
Mayor, City of Colorado Springs

Regional Floodplain Administrator  
Pikes Peak Regional Building Department

J. F. Sato and Associates, Inc.

Engineering and Surveying, Inc.



# Federal Emergency Management Agency

Washington, D.C. 20472

## LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas)	CHANNELIZATION CULVERT	FLOODWAY HYDRAULIC ANALYSIS NEW TOPOGRAPHIC DATA BASEMAP CHANGES
	COMMUNITY NO.: 080059		
IDENTIFIER	Sand Creek Center Tributary and East Fork LOMR	APPROXIMATE LATITUDE & LONGITUDE: 38.846, -104.720 SOURCE: USGS QUADRANGLE      DATUM: NAD 27	
ANNOTATED MAPPING ENCLOSURES		ANNOTATED STUDY ENCLOSURES	
TYPE: FIRM*	NO.: 08041C0752 F      DATE: March 17, 1997	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999	
TYPE: FIRM	NO.: 08041C0753 F      DATE: March 17, 1997	PROFILE(S): 206P	
TYPE: FIRM	NO.: 08041C0754 F      DATE: March 17, 1997	FLOODWAY DATA TABLE: 5	

Enclosures reflect changes to flooding sources affected by this revision.

\* FIRM - Flood Insurance Rate Map; \*\* FBFM - Flood Boundary and Floodway Map; \*\*\* FHBM - Flood Hazard Boundary Map

### FLOODING SOURCE(S) & REVISED REACH(ES)

Sand Creek Center Tributary – from approximately 1,350 feet upstream of East Frontage Road to just upstream of Galley Road

### SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Sand Creek Center Tributary	Zone AE	Zone AE	YES	YES
	Floodway	Floodway	YES	YES
	BFES*	BFES	NONE	YES
	Zone X (shaded)	Zone X (shaded)	YES	YES

\* BFES - Base Flood Elevations

### DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Patrick F. Sacbibit, P.E., CFM, Project Engineer  
Engineering Management Section  
Mitigation Division



Federal Emergency Management Agency  
Washington, D.C. 20472

**LETTER OF MAP REVISION  
DETERMINATION DOCUMENT (CONTINUED)**

**OTHER COMMUNITIES AFFECTED BY THIS REVISION**

**CID Number:** 080060      **Name:** City of Colorado Springs, Colorado

**AFFECTED MAP PANELS**

TYPE: FIRM      NO.: 08041C0753 F      DATE: March 17, 1997  
TYPE: FIRM      NO.: 08041C0754 F      DATE: March 17, 1997

**AFFECTED PORTIONS OF THE FLOOD INSURANCE STUDY REPORT**

DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999  
PROFILE(S): 205P, 206P, 209P, and 210P  
FLOODWAY DATA TABLE: 5

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Patrick F. Sacbbit, P.E., CFM, Project Engineer  
Engineering Management Section  
Mitigation Division





# Federal Emergency Management Agency

Washington, D.C. 20472

## LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

### COMMUNITY INFORMATION

#### APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

We provide the floodway designation to your community as a tool to regulate floodplain development. Therefore, the floodway revision we have described in this letter, while acceptable to us, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

#### COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

A handwritten signature in black ink, appearing to read "P. Sacbibit".

Patrick F. Sacbibit, P.E., CFM, Project Engineer  
Engineering Management Section  
Mitigation Division



Federal Emergency Management Agency  
Washington, D.C. 20472

**LETTER OF MAP REVISION  
DETERMINATION DOCUMENT (CONTINUED)**

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson  
Director, Federal Insurance and Mitigation Division  
Federal Emergency Management Agency, Region VIII  
Denver Federal Center, Building 710  
P.O. Box 25267  
Denver, CO 80225-0267  
(303) 235-4830

**STATUS OF THE COMMUNITY NFIP MAPS**

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

A handwritten signature in black ink, appearing to read "P. Sacbibit".

Patrick F. Sacbibit, P.E., CFM, Project Engineer  
Engineering Management Section  
Mitigation Division



# Federal Emergency Management Agency

Washington, D.C. 20472

## LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

### PUBLIC NOTIFICATION OF REVISION

#### PUBLIC NOTIFICATION

FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	BFE (FEET NGVD 29)		MAP PANEL NUMBER(S)
		EFFECTIVE	REVISED	
Sand Creek Center Tributary	Approximately 1,350 feet upstream of East Frontage Road	6,170	6,165	08041C0753 F
	Just downstream of Terminal Avenue	6,216	6,213	08041C0754 F

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised BFEs presented in this LOMR may be changed.

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below.

LOCAL NEWSPAPER      Name: *El Paso County News*  
    Dates: 02/14/2007      02/21/2007

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Patrick F. Sacbibit, P.E., CFM, Project Engineer  
 Engineering Management Section  
 Mitigation Division

**CHANGES ARE MADE IN DETERMINATIONS OF BASE FLOOD ELEVATIONS FOR THE CITY OF COLORADO SPRINGS AND THE UNINCORPORATED AREAS OF EL PASO COUNTY, COLORADO, UNDER THE NATIONAL FLOOD INSURANCE PROGRAM**

On March 17, 1997, the Department of Homeland Security's Federal Emergency Management Agency identified Special Flood Hazard Areas (SFHAs) in the City of Colorado Springs and in the unincorporated areas of El Paso County, Colorado, through issuance of a Flood Insurance Rate Map (FIRM). The Mitigation Division has determined that modification of the elevations of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) for certain locations in these communities is appropriate. The modified Base Flood Elevations (BFEs) revise the FIRM for the communities.

The changes are being made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and are in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65.

A hydraulic analysis was performed to incorporate new topographic data for Sand Creek Center Tributary from just upstream of Airport Road to just upstream of Galley Road and for Sand Creek East Fork from approximately 970 feet downstream of Powers Boulevard to just downstream of Stewart Avenue. This has resulted in a revised delineation of the regulatory floodway, increases and decreases in SFHA width, and increased and decreased BFEs for both aforementioned flooding sources. The table below indicates existing and modified BFEs for selected locations along the affected lengths of the flooding source(s) cited above.

Location	Existing BFE (feet)*	Modified BFE (feet)*
<b>Sand Creek Center Tributary:</b>		
<sup>1</sup> Approximately 150 feet upstream of Airport Road	6,109	6,108
<sup>1</sup> Approximately 1,250 feet upstream of East Frontage Road	6,168	6,164
<sup>2</sup> Approximately 1,350 feet upstream of East Frontage Road	6,170	6,165
<sup>2</sup> Just downstream of Terminal Avenue	6,216	6,213
<b>Sand Creek East Fork:</b>		
<sup>1</sup> Approximately 810 feet downstream of Powers Boulevard	6,099	6,096
<sup>1</sup> Approximately 140 feet downstream of Stewart Avenue	6,206	6,205

\*National Geodetic Vertical Datum, rounded to nearest whole foot

<sup>1</sup>City of Colorado Springs

<sup>2</sup>Unincorporated areas of El Paso County

Under the above-mentioned Acts of 1968 and 1973, the Mitigation Division must develop criteria for floodplain management. To participate in the National Flood Insurance Program (NFIP), the community must use the modified BFEs to administer the floodplain management measures of the NFIP. These modified BFEs will also be used to calculate the appropriate flood insurance premium rates for new buildings and their contents and for the second layer of insurance on existing buildings and contents.

Upon the second publication of notice of these changes in this newspaper, any person has 90 days in which he or she can request, through the Chief Executive Officer of the community, that the Mitigation Division reconsider the determination. Any request for reconsideration must be based on knowledge of

changed conditions or new scientific or technical data. All interested parties are on notice that until the 90-day period elapses, the Mitigation Division's determination to modify the BFEs may itself be changed.

Any person having knowledge or wishing to comment on these changes should immediately notify:

The Honorable Sallie Clark  
Chair, El Paso County  
Board of Commissioners  
27 East Vermijo Avenue  
Colorado Springs, CO 80903

OR

The Honorable Lionel Rivera  
Mayor, City of Colorado Springs  
P.O. Box 1575  
Colorado Springs, CO 80901

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			INCREASE	
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WATER SURFACE ELEVATION			
						WITHOUT FLOODWAY	WITH FLOODWAY		
						FEET (NGVD)			
Sand Creek East Fork	A	100	455	11.9	6,038.7	6,038.7	6,038.7	0.0	
	B	100	446	12.2	6,054.3	6,054.3	6,054.3	0.0	
	C	100	450	12.0	6,069.9	6,069.9	6,069.9	0.0	
	D	100	449	12.1	6,085.1	6,085.1	6,085.1	0.0	
	E	4,870	102	446	12.0	6,095.1	6,095.1	6,095.1	0.0
	F	6,188	70	489	10.9	6,118.5	6,118.5	6,118.5	0.0
	G	7,403	71	396	13.5	6,136.0	6,136.0	6,136.0	0.0
	H	7,931	148	507	10.5	6,158.8	6,158.8	6,158.8	0.0
	I	8,943	98	444	12.0	6,169.0	6,169.0	6,169.0	0.0
	J	9,666	86	423	12.6	6,177.0	6,177.0	6,177.0	0.0
	K	10,721	81	415	12.8	6,193.3	6,193.3	6,193.3	0.0
	L	11,347	166	526	10.1	6,207.3	6,207.3	6,207.3	0.0
	M	11,375	173	632	8.4	6,207.9	6,207.9	6,207.9	0.0
	N	12,610	367	699	7.6	6,228.8	6,228.8	6,228.8	0.1
	O	13,720	188	570	10.0	6,241.7	6,241.7	6,241.7	0.0
	P	14,805	125	479	11.1	6,257.9	6,257.9	6,257.9	0.0
	Q	14,885	125	601	8.9	6,259.9	6,259.9	6,259.9	1.0
	R	15,850	228	582	9.2	6,268.7	6,268.7	6,268.7	0.0
	S	16,325	300	678	7.9	6,277.3	6,277.3	6,277.3	0.2
	T	16,995	321	690	7.7	6,291.4	6,291.4	6,292.0	0.6
	U	17,065	326	667	8.0	6,291.4	6,291.4	6,292.1	0.7
	V	17,915	388	1,598	3.3	6,293.4	6,293.4	6,294.0	0.6
	W	18,995	367	683	7.8	6,307.2	6,307.2	6,307.6	0.4
	X	20,525	413	706	7.5	6,326.4	6,326.4	6,327.1	0.7
	Y	22,125	255	620	8.6	6,348.7	6,348.7	6,348.8	0.1
	Z	23,105	397	706	7.6	6,359.9	6,359.9	6,359.9	0.0
AA	24,835	431	705	7.4	6,383.7	6,383.7	6,383.7	0.0	
AB	26,505	353	667	7.8	6,401.0	6,401.0	6,401.5	0.5	

Revised Data

Revised by LOMR dated OCT 07 2004

<sup>1</sup> Feet above confluence with Sand Creek

FEDERAL EMERGENCY MANAGEMENT AGENCY  
**EL PASO COUNTY, CO**  
**AND INCORPORATED AREAS**

FLOODWAY DATA

**SAND CREEK EAST FORK**

TABLE 5

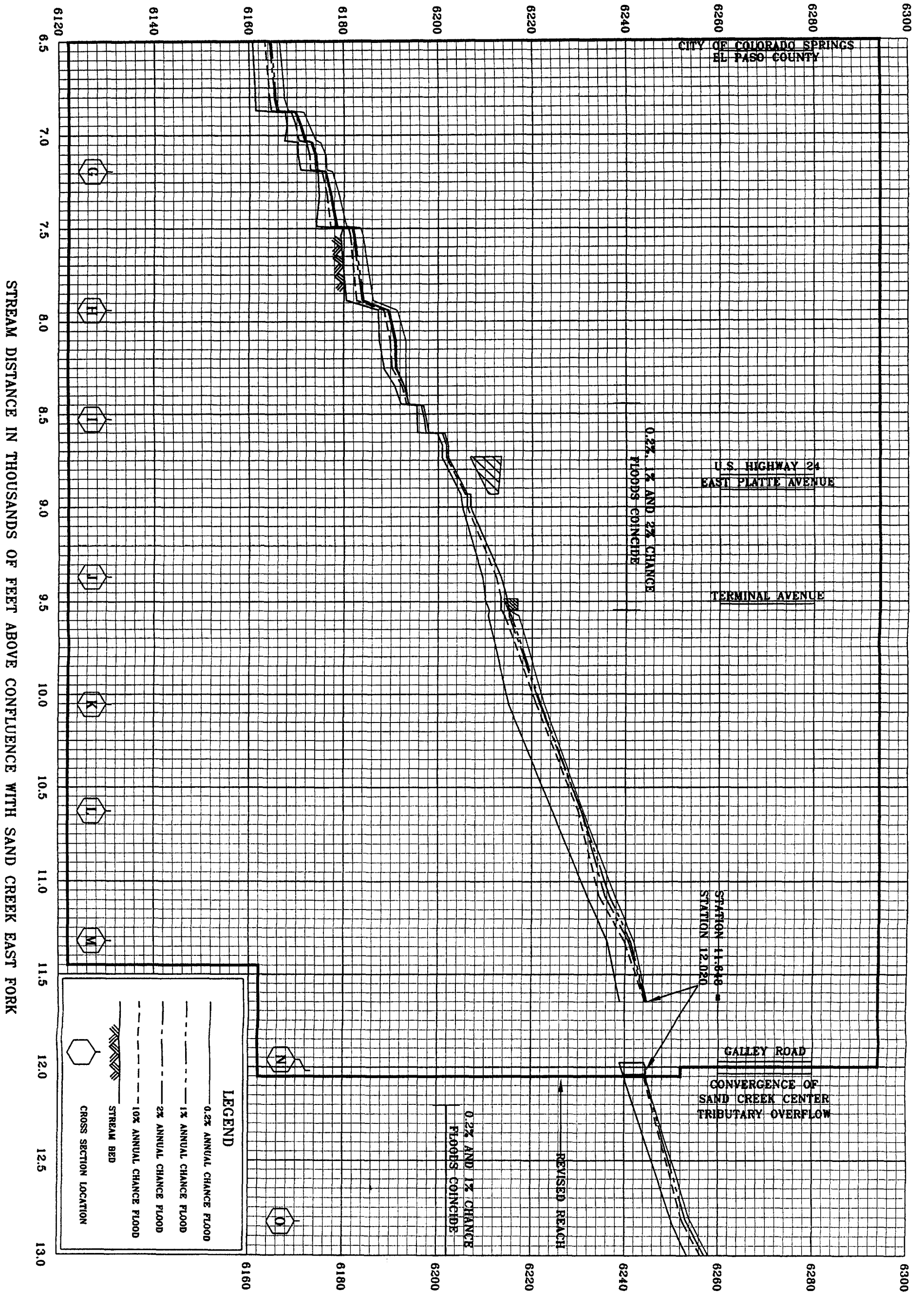
FLOODING SOURCE		FLOODWAY				BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY FEET (NGVD)	WITH FLOODWAY FEET (NGVD)	INCREASE
Sand Creek Center Tributary								
A	940	40	92	8.6	6,106.5	6,106.5	6,106.5	0.0
B	990	40	118	6.7	6,107.2	6,107.2	6,107.2	0.0
C	2,238	91	120	6.6	6,120.2	6,120.2	6,120.2	0.0
D	3,948	46	95	8.0	6,138.3	6,138.3	6,138.3	0.0
E	4,547	170	159	4.8	6,147.4	6,147.4	6,147.4	0.0
F	5,539	52	97	7.8	6,156.8	6,156.8	6,156.8	0.0
G	7,191	63	104	7.3	6,176.2	6,176.2	6,176.2	0.0
H	7,940	52	00	7.8	6,189.6	6,189.6	6,189.6	0.0
I	8,527	40		7.8	6,197.6	6,197.6	6,197.6	0.0
J	9,366	17	42	9.0	6,213.4	6,213.4	6,213.4	0.0
K	10,055	232	278	4.0	6,221.9	6,221.9	6,221.9	0.0
L	10,627	539	469	2.4	6,230.6	6,230.6	6,230.6	0.0
M	11,321	31	79	9.1	6,241.1	6,241.1	6,241.1	0.0
N	11,648	60	99	7.3	6,244.6	6,244.6	6,244.6	0.8
O	12,840	29	85	9.6	6,253.8	6,253.8	6,253.8	0.0
P	13,730	27	83	9.9	6,273.6	6,273.6	6,273.6	0.0
Q	14,592	26	68	9.3	6,299.7	6,299.7	6,299.7	0.0
R	14,670	40	61	6.9	6,304.2	6,304.2	6,305.2	1.0
S	15,050	20	63	10.1	6,307.6	6,307.6	6,308.1	0.5
T	15,460	25	68	9.5	6,310.8	6,310.8	6,311.4	0.6
U	15,750	20	41	7.8	6,319.6	6,319.6	6,319.6	0.0
V	16,670	20	39	8.1	6,346.0	6,346.0	6,346.0	0.0

Flow rate = 792 cfs

Flow rate = 822 cfs

<sup>1</sup> Feet Above confluence with Sand Creek East Fork

ELEVATION IN FEET (NGVD 29)



FEDERAL EMERGENCY MANAGEMENT AGENCY  
EL PASO COUNTY, CO  
AND INCORPORATED AREAS

FLOOD PROFILES

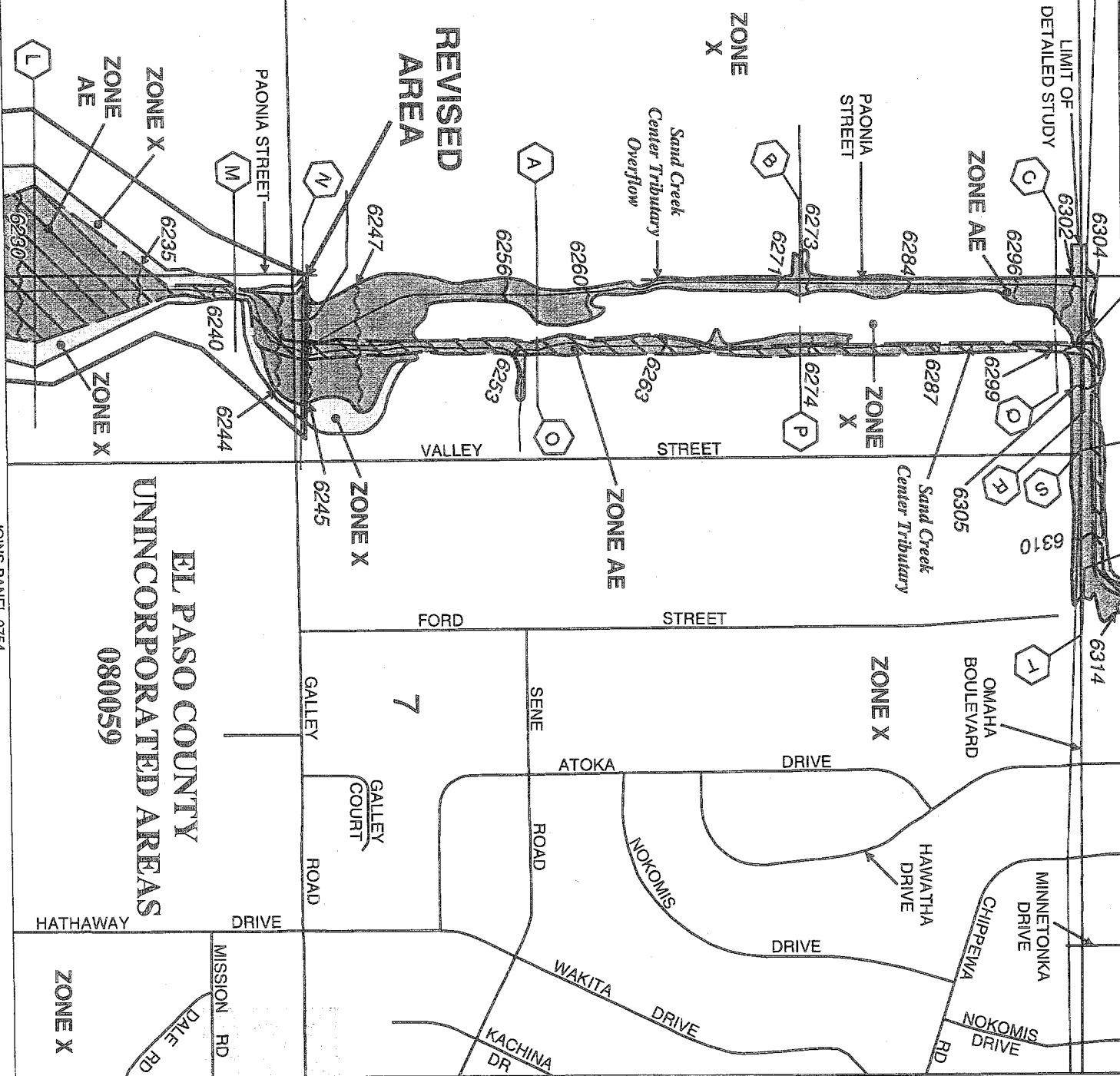
SAND CREEK CENTER TRIBUTARY

MAY 23 2007



38°50'37"

104°43'07"



EL PASO COUNTY  
UNINCORPORATED AREAS  
080059

- Legend**
- 1% annual chance (100-Year) Floodplain
  - 1% annual chance (100-Year) Floodway
  - 0.2% annual chance (500-Year) Floodplain



APPROXIMATE SCALE IN FEET



NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
FLOOD INSURANCE RATE MAP

EL PASO COUNTY,  
COLORADO AND  
UNINCORPORATED AREAS

**PANEL 752 OF 1300**  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:  
COMMUNITY NUMBER PANEL SHEET  
COLORADO SPRINGS, CITY OF 080059 0752 F  
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0752 F






MAP NUMBER  
08041C0752 F  
EFFECTIVE DATE:  
MARCH 17, 1997

Federal Emergency Management Agency

MAY 29 2007

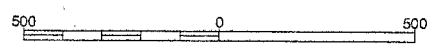
**EL PASO COUNTY  
UNINCORPORATED AREAS  
080059**

**Legend**

-  1% annual chance (100-Year) Floodplain
-  1% annual chance (100-Year) Floodway
-  0.2% annual chance (500-Year) Floodplain



APPROXIMATE SCALE IN FEET



**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM  
FLOOD INSURANCE RATE MAP**

**EL PASO COUNTY,  
COLORADO  
AND INCORPORATED AREAS**

**PANEL 753 OF 1300**  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

**CONTAINS:**

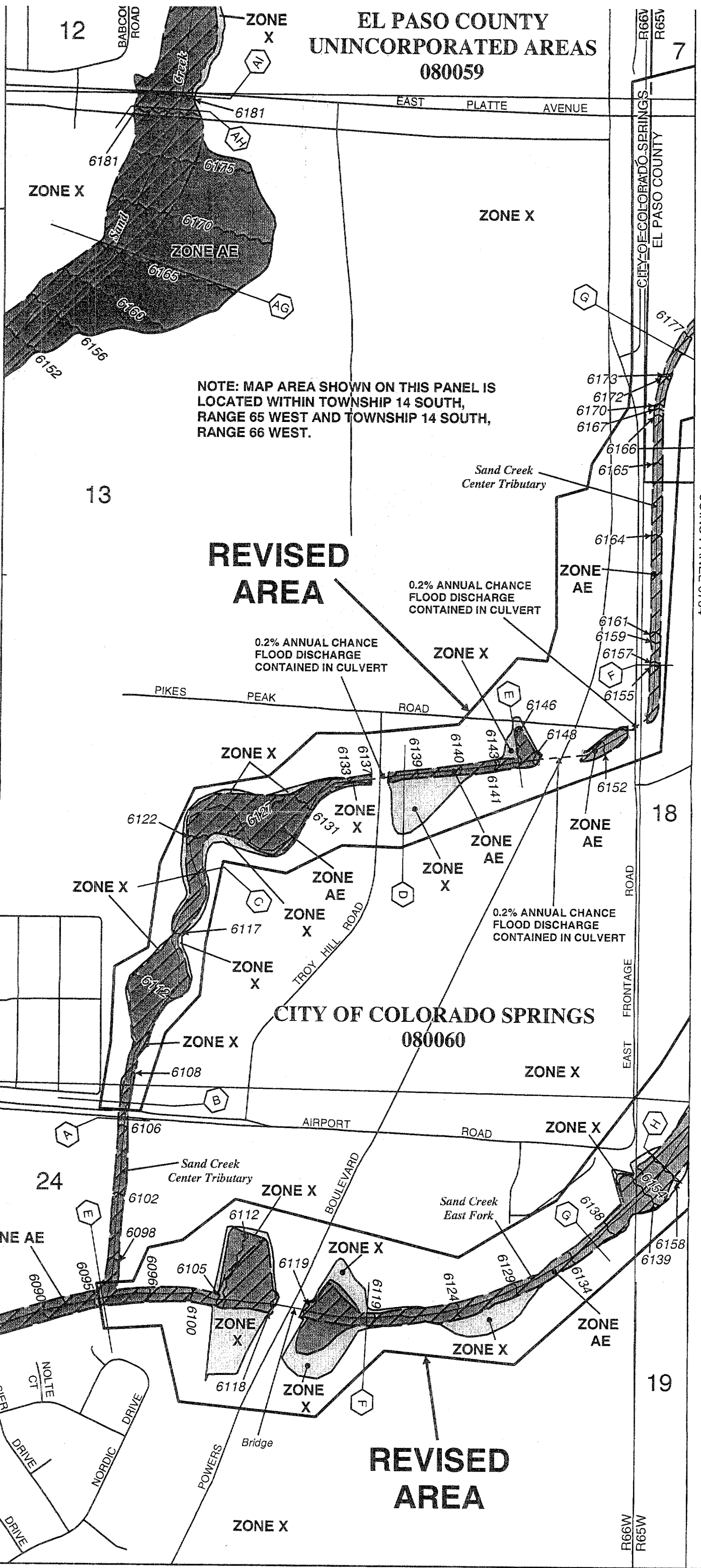
COMMUNITY	NUMBER	PANEL SUFFIX
COLORADO SPRINGS, CITY OF	080060	0753 F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0753 F

**REVISOR'S NOTE:**  
REVISOR'S NOTE TO REFLECT LOMR EFFECTIVE MAY 23 2007

**MAP NUMBER  
08041C0753 F**

**EFFECTIVE DATE:  
MARCH 17, 1997**

Federal Emergency Management Agency






104°43'07"  
38°50'37"

JOINS PANEL 0752

# EL PASO COUNTY UNINCORPORATED AREAS 080059

### Legend

-  1% annual chance (100-Year) Floodplain
-  1% annual chance (100-Year) Floodway
-  0.2% annual chance (500-Year) Floodplain



APPROXIMATE SCALE IN FEET  
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

## FIRM FLOOD INSURANCE RATE MAP

EL PASO COUNTY,  
COLORADO  
AND INCORPORATED AREAS

PANEL 754 OF 1300  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:  
COMMUNITY NUMBER PANEL SUFFIX

COLORADO SPRINGS, CITY OF 080060 0754 F  
EL PASO COUNTY,  
UNINCORPORATED AREAS 080059 0754 F

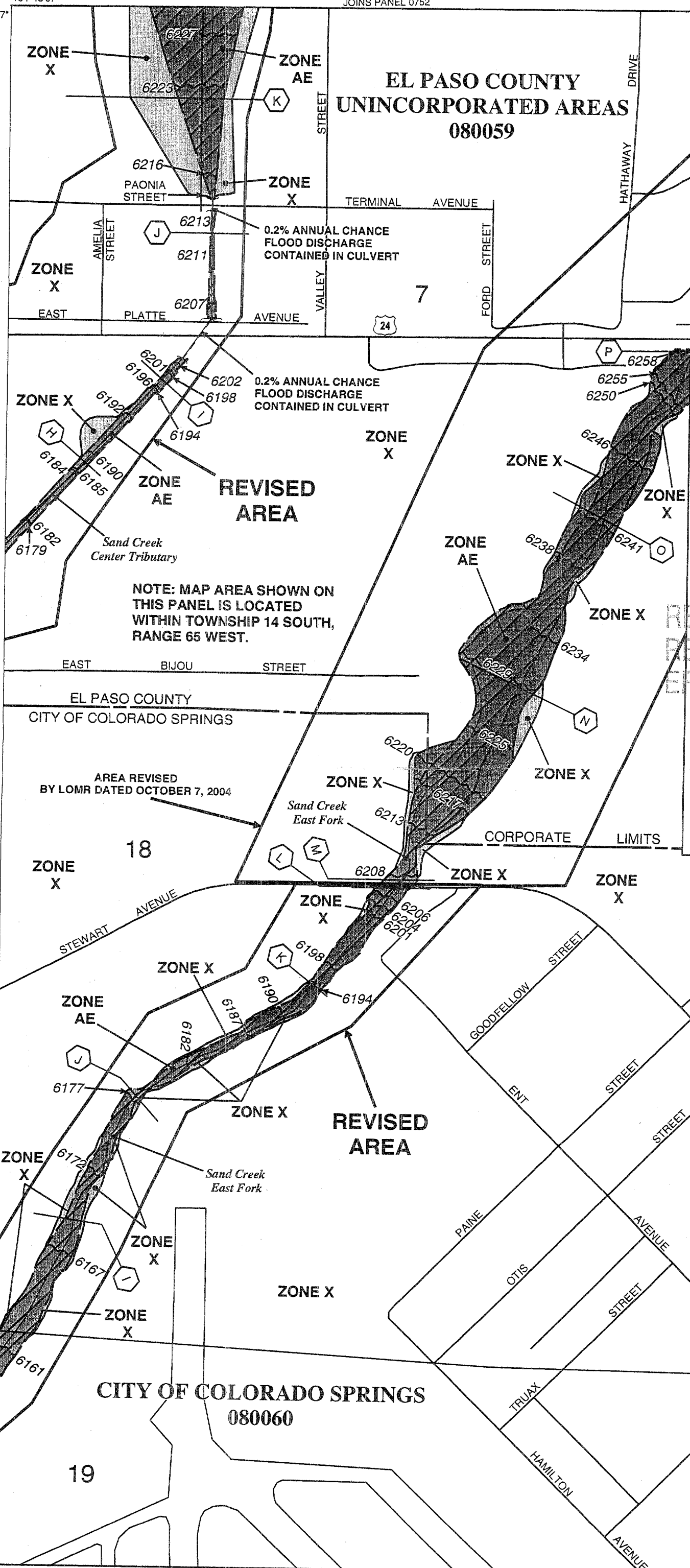
REVISED TO  
REFLECT LOMR  
EFFECTIVE MAY 23 2007

MAP NUMBER  
08041C0754 F

EFFECTIVE DATE:  
MARCH 17, 1997



Federal Emergency Management Agency



JOINS PANEL 0753

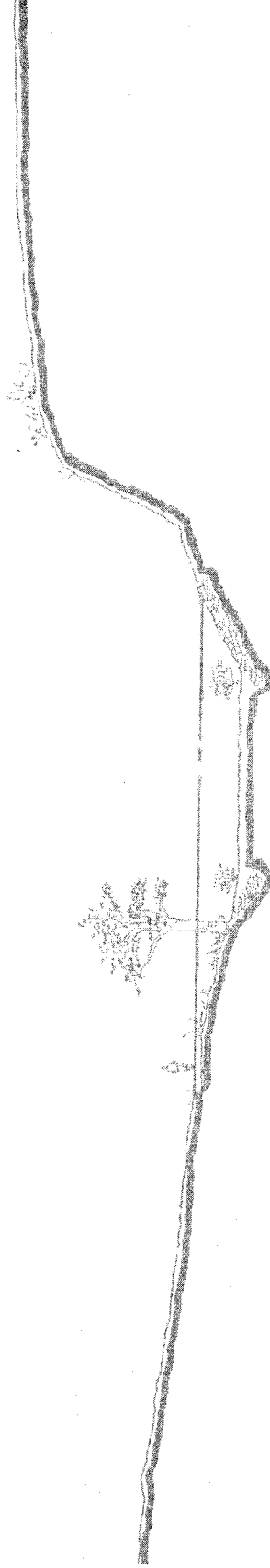
CITY OF COLORADO SPRINGS  
080060

19

**SAND CREEK DRAINAGE BASIN PLANNING STUDY**

**PRELIMINARY DESIGN REPORT**

**CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO**



**PREPARED FOR:**

City of Colorado Springs  
Department of Comprehensive Planning, Development and Finance  
Engineering Division  
30 S. Nevada  
Colorado Springs, Colorado 80903

**PREPARED BY:**

Kowa Engineering Corporation  
1011 North Weber  
Colorado Springs, CO 80903

SAND CREEK  
DRAINAGE BASIN PLANNING STUDY  
PRELIMINARY DESIGN REPORT

Prepared for:

City of Colorado Springs  
Department of Comprehensive Planning, Development And Finance  
Engineering Division - MAIL CODE 435  
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Resolution No. 189-95

**A RESOLUTION ADOPTING THE SAND CREEK DRAINAGE BASIN PLANNING STUDY AND ESTABLISHING A DRAINAGE FEE, A DETENTION POND CAPITAL FEE, A DETENTION POND LAND FEE, AND AN ARTERIAL BRIDGE FEE FOR THE BASIN.**

WHEREAS, the City Engineering Division of the City of Colorado Springs Department of Planning and Development has reviewed the Sand Creek Drainage Basin Planning Study as prepared by Kiowa Engineering Corporation, Colorado Springs, Colorado dated November 2, 1995, and

WHEREAS, the City/County Drainage Board has recommended approval of the above study at their November 2, 1995, meeting;

WHEREAS, the Sand Creek Drainage Basin includes unplatted land within the City limits;

NOW THEREFORE, BE IT RESOLVED by the City Council of the City of Colorado Springs:


Section 1. That the Sand Creek Drainage Basin Planning Study, dated November 1995, by Kiowa Engineering Corporation is adopted for use. City Engineering will utilize that study to assist in evaluating subdivision drainage reports.

Section 2. That a Sand Creek Drainage Basin Fee be established as \$4,895/acre, that a Sand Creek Detention Pond Capital Fee be established as \$1,213/acre, that a Sand Creek Detention Pond Land Fee be established as \$167/acre, and that a Sand Creek Arterial Bridge Fee be established as \$323/acre, as part of.

Dated at Colorado Springs, Colorado, this \_\_\_\_\_ 28th \_\_\_\_\_ day of \_\_\_\_\_ November \_\_\_\_\_, 1995.

  
Mayor

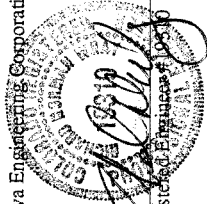

ATTEST:

  
City Clerk

**ENGINEER'S STATEMENT:**

The attached SAND CREEK DRAINAGE BASIN PLANNING STUDY report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports. I accept responsibility for any liability caused by any negligent acts, errors and omissions on my part in preparing this report.

Kiowa Engineering Corporation, 1011 North Weber St., Suite 200, Colorado Springs, CO 80903

  
  
Registered Engineer No. 10530  
Date: 7/26/96

## I. INTRODUCTION

### Authorization

The preliminary design of the drainageway and roadway crossing facilities within the Sand Creek Drainage Basin was authorized under the terms of Agreement Number 90-85 between the City of Colorado Springs (City) and Kiowa Engineering Corporation. The agreement was approved by the Colorado Springs City Council, April 10, 1990. Subsequent to this agreement, a change order to the contract to allow for the inclusion of technical information contained in the draft East Fork Sand Creek Drainage Basin Planning Study was approved July, 1993.

### Purpose and Scope

The purpose of the study is to identify feasible stormwater management plans to satisfy the existing and future needs within the Sand Creek Drainage Basin. The Sand Creek basin is to be referred to throughout this study and is inclusive of the Sand Creek mainstem and East Fork Sand Creek watersheds. The specific scope of work for this study included the following tasks:

1. Meet with the City to: insure compliance with the services required by this agreement, obtain existing data and general information from participating entities, solicit desires of participating entities and other interested agencies or groups in order to develop alternate plans, procure current information relative to development plans in the basin, procure information relative to right-of-way limitations, proposed stormwater projects, potential hazards due to flooding, and avoid duplication of effort whenever possible by utilizing existing information available from other agencies.
2. Contact the City, County, individuals, and other agencies who have knowledge and/or interest in the study area.
3. Utilize City policies and criteria and applicable information wherever possible.
4. Perform hydraulic and hydrologic analyses within the study area.
5. Identify environmental setting of basin.
6. Identify existing and potential drainage and/or flooding problems.
7. Develop improvement alternatives to reduce existing and potential flooding problems, and to mitigate the impact of stormwater runoff upon environmentally significant areas along the drainageway(s).
8. Examine the operation and maintenance aspects of feasible alternatives.

9. Conduct an economic analysis of each alternative.
10. Recommend and prepare a preliminary design for a selected alternative plan.
11. Develop drainage and bridge fees for the basin.
12. Prepare a written report discussing all items examined in the study.
13. Conduct presentations to public and private entities in order to define project goals, and to involve agencies with specific interest to help define feasible alternatives.

### Summary of Data Obtained

Listed below are the technical reports collected for the review as part of preparing this study:

1. Soil Survey for El Paso County, Colorado, dated June 1981.
2. "City of Colorado Springs/El Paso County Drainage Criteria Manual", prepared by City of Colorado Springs, El Paso County, and HDR Infrastructure, Inc., dated May 1987.
3. "Flood Insurance Studies for Colorado Springs, and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), revised 1989.
4. Flood Insurance Restudy, Hydrology Report and Hydrologic Analyses, prepared by RCI, Inc., 1989.
5. Sand Creek Drainage Basin Planning Study prepared by Simons, Li & Associates, Inc., dated July, 1985.
6. Flood Hazard Analysis, Sand Creek, City of Colorado Springs and El Paso County, Colorado, prepared by the Soil Conservation Service, dated December, 1973.
7. Banning-Lewis Ranch Master Drainage Plan, prepared by MSM Consultants, Inc., dated June 1981.
8. Sand Creek Drainage Basin Study, prepared by United Planning and Engineering Company, October, 1977.
9. Draft East Fork Sand Creek Drainage Basin Planning Study, prepared by Kiowa Engineering Corporation, January, 1989.
10. Drainage Basin Inventory, Sand Creek Drainage Basin, prepared by Oliver E. Watts, P.E., June 1990.

In addition to the above listed reports there were a number of drainage study reports, sketch plans, preliminary and final design drawings, land use and zoning maps, development

plans, and existing drainage facility maps that were collected from the City, County, and other local agencies.

Reports which were prepared previous to the preliminary design report include the "Sand Creek Drainage Basin Planning Study Hydrology Report," and the "Sand Creek Drainage Basin Planning Study Development of Alternatives Report." These reports were prepared as part of the overall planning effort and have been referred to throughout this report. The Hydrology Report summarized peak flow data for existing and future basin development conditions without improvements in the basin, and established the base line hydrologic conditions from which the alternative planning then proceeded. The Development of Alternatives report evaluated the various combinations of drainageway improvements for the basin, taking into account environmental, cost, construction, right-of-way, maintenance and implementation factors for each feasible alternate plan. These reports are on file with the City Engineering Division, as well as technical addenda for each report. Both of these reports covered only the mainstem of the Sand Creek Basin. The similar information prepared for the draft East Fork Sand Creek Drainage Basin Planning Study has been summarized in this preliminary design report.

#### Mapping and Surveying

Mapping used in the planning effort for the mainstem of Sand Creek consisted of USGS 7-1/2 minute quadrangles, and 2-foot contour interval, 1-inch to 200-foot scale planimetric topographic maps. For the area of the basin north of Woodmen Road, aerial topographic mapping was compiled in May 1990. For the balance of the basin, the City of Colorado Springs Department of Public Utilities provided topographic mapping compiled from aerial photographs dated 1989. This mapping has been prepared as part of the Facility Inventory Management System (FIMS). The aerial topographic mapping was used in the drainage inventory, hydrologic/hydraulic analyses, and in the alternative planning phases of this project. All topographic mapping was based upon USGS vertical datum.

For the East Fork Sand Creek basin, mapping from the FIMS office and two-foot contour interval topography prepared in 1987 for the Banning-Lewis Ranch property were used in the preparation of the preliminary design. Where topographic mapping was not available, USGS quadrangle maps were used.

Stream cross-section data was obtained from the aerial mapping described above. These sections were verified against the cross-sections compiled in the 1986 City of Colorado Springs Flood Insurance Study (FIS), wherever possible.

Drainageway site inspections were conducted throughout the study area, and photographs were taken documenting the key drainage features.

#### **The following general conditions have been placed upon the use of the FIMS topographic mapping:**

-- Use of these products is restricted to the project for which the FIMS products are provided.

-- Only the body content found within the headline of the borrowed maps may appear in any report/publication developed for your study. Also, the labeling that appears on any photographs provided shall not appear in any such report/publication.

-- All FIMS' products provided to contractors involved in the subject study shall be retrieved by your department upon conclusion of the study and either returned to FIMS or destroyed.

-- The report(s) developed in which the FIMS' products are used shall include the following disclaimer statement:

"The maps and photographs included in this report were developed for purposes of the Colorado Springs Department of Utilities and are for internal use only. The Colorado Springs Department of Utilities makes no warranty, expressed or implied, as to the completeness, accuracy, or content of such products or any reproductions thereof. Any other use is not recommended and occurs at the risk of the user; such user is solely responsible and/or liable for the use of such products.

Original maps and photographs are the property of the Colorado Springs Department of Utilities. All rights are reserved. These maps and photographs or any associated record may not, wholly or in part, be reproduced, stored, or transmitted in any form or by any means, electronic, mechanical, photocopying, or otherwise, without the express prior written permission of the Colorado Springs Department of Utilities.

Regardless of the existence of purpoed copies of these official maps and photographs which may from time to time be made or published, there is only one set of official maps and photographs, which are those kept and maintained by the Colorado Springs Department of Utilities."

#### Project Coordination

Throughout the course of the study, meetings were held with representatives of City, County, State, and Federal agencies with an interest in drainageway planning in general. The primary reason for the coordination effort was to obtain technical information and to identify concerns with regard to the development of drainageway facilities within the basin. During the course of preparing the Development of Alternatives report, the planning constraints and concepts were discussed with the agencies and interested individuals and their input used to refine the feasible alternatives and to eventually identify a recommended drainageway plan for further design evaluation. The complete mailing list and project correspondence is contained in Appendix A of this report.

Coordination with a similar list of agencies and individuals was conducted during the preparation of the draft East Fork Sand Creek Drainage Basin Planning study. This study was authorized and conducted for Artes Properties, Inc. Meetings with state and federal agencies, the City and the County were involved in a series of meetings during the development of the alternative planning concepts and the preliminary design for the East Fork Sand Creek basin.

Acknowledgements

During the preparation of the study, several government agencies and interested individuals were routinely involved in the coordination activities. Representatives from the Colorado Division of Wildlife, U.S. Army Corps of Engineers (COE), and various City Departments provided valuable commentary during the development of the alternative plans. A listing of the individuals and agencies routinely coordinated with during the study has been presented below:

<u>Name</u>	<u>Agency</u>
Alan Morrice	El Paso County Department of Public Works
John Fisher	El Paso County Land Use Department
Sue Johnson	El Paso County Parks Department
Rick O'Connor	El Paso County Planning Department
Hugh King	City of Colorado Springs Street Division
Gary Haynes	City Engineering Division
Bruce Thorson	City Engineering Division
Ken Sampley	City Engineering Division
Steve Jacobsen	City Engineering Division
Christine Lytle	City Engineering Division
Bruce Goforth	Colorado Division of Wildlife
Dan Bunting	Regional Building Department
Sarah Fowler	Environmental Protection Agency
John Liou	Federal Emergency Management Agency
Dave Frick	RCI, Inc., Fort Collins, Colorado
Bill Noonan	U.S. Fish and Wildlife
Anita Culp	U.S. Army Corps of Engineers
John Maynard	Aiken/Audobon Society
John Covert	Palmer Foundation
Peter Kernikump	City Planning Department
Jim Rees	Department of Planning and Development
Fred Mais	City Parks and Recreation
Diana Medina	City of Colorado Springs
Dan Tippie	Department of Public Utilities Gas Division
Russ Nicklin	City of Colorado Springs
Wes Tyson	Department of Public Utilities Wastewater Division
	Department of Public Utilities Water Division
	City Attorney's Office

## II. STUDY AREA DESCRIPTION

The Sand Creek drainage basin is a left-bank tributary to the Fountain Creek lying in the west-central portions of El Paso County. Sand Creek's drainage area at Fountain Creek is approximately 54 square miles of which approximately 18.8 square miles are inside the City of Colorado Springs corporate limits. The basin is divided into five major sub-basins, the Sand Creek mainstem, the East Fork Sand Creek, the Central Tributary to East Fork, the West Fork, and the East Fork Subtributary. Figure II-1 shows the location of the Sand Creek basin.

### Basin Description

The Sand Creek basin covers a total of 54 square miles in unincorporated El Paso County and Colorado Springs, Colorado. Of this total, approximately 28 square miles is encompassed by the Sand Creek basin, and 26 square miles for the East Fork Sand Creek basin. The basin trends in generally a south to southwesterly direction, entering the Fountain Creek approximately two miles upstream of the Academy Boulevard bridge over Fountain Creek. Two main tributaries drain the basin, those being the mainstem of Sand Creek and East Fork Sand Creek. Development presence is most evident along the mainstem. At this time, approximately 25 percent of the basin is developed. This alternative evaluation focuses upon the Sand Creek basin only.

The maximum basin elevation is approximately 7,620 feet above mean sea level, and falls to approximately 5,790 feet at the confluence with Fountain Creek. The headwaters of the basin originate in the conifer covered areas of The Black Forest. The middle eastern portions of the basin are typified by rolling range land with fair to good vegetative cover associated with semi-arid climates.

### Climate

This area of El Paso County can be described, in general as high plains, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry. Precipitation ranges from 14 to 16 inches per year, with the majority of this precipitation occurring in spring and summer in the form of rainfall. Thunderstorms are common during the summer months, and are typified by quick-moving low pressure cells which draw moisture from the Gulf of Mexico into the region. Average temperatures range from about 30°F in the winter

to 75° in the summer. The relative humidity ranges from about 25 percent in the summer to 45 percent in the winter.

### Soils and Geology

Soils within the Sand Creek basin vary between soil types A through D, as identified by the U. S. Department of Agriculture, Soil Conservation Service. The predominant soil groupings are in the Truckton and Bresser soil associations. The soils consist of deep, well drained soils that formed in alluvium and residuum, derived from sedimentary rock. The soils have high to moderate infiltration rates, and are extremely susceptible to wind and water erosion where poor vegetation cover exists. In undeveloped areas, the predominance of Type A and B soils give this basin a lower runoff per unit area as compared to basins with soils dominated by Types C and D. Presented on Figure II-2 is the Hydrologic Soil distribution map for the Sand Creek basin.

### Property Ownership and Impervious Land Densities

Property ownership along the major drainage way within the Sand Creek basin vary from public to private. Along the developed reaches, drainage right-of-ways and greenbelts have been dedicated during the development of the adjacent residential and commercial land. Where development has not occurred, the drainageways remain under private ownership with no delineated drainage right-of-way or easements. There are several public parks which abut the mainstem of Sand Creek. Roadway and utility easements abutting or crossing the major drainageways occur most frequently in the developed portions of the basin.

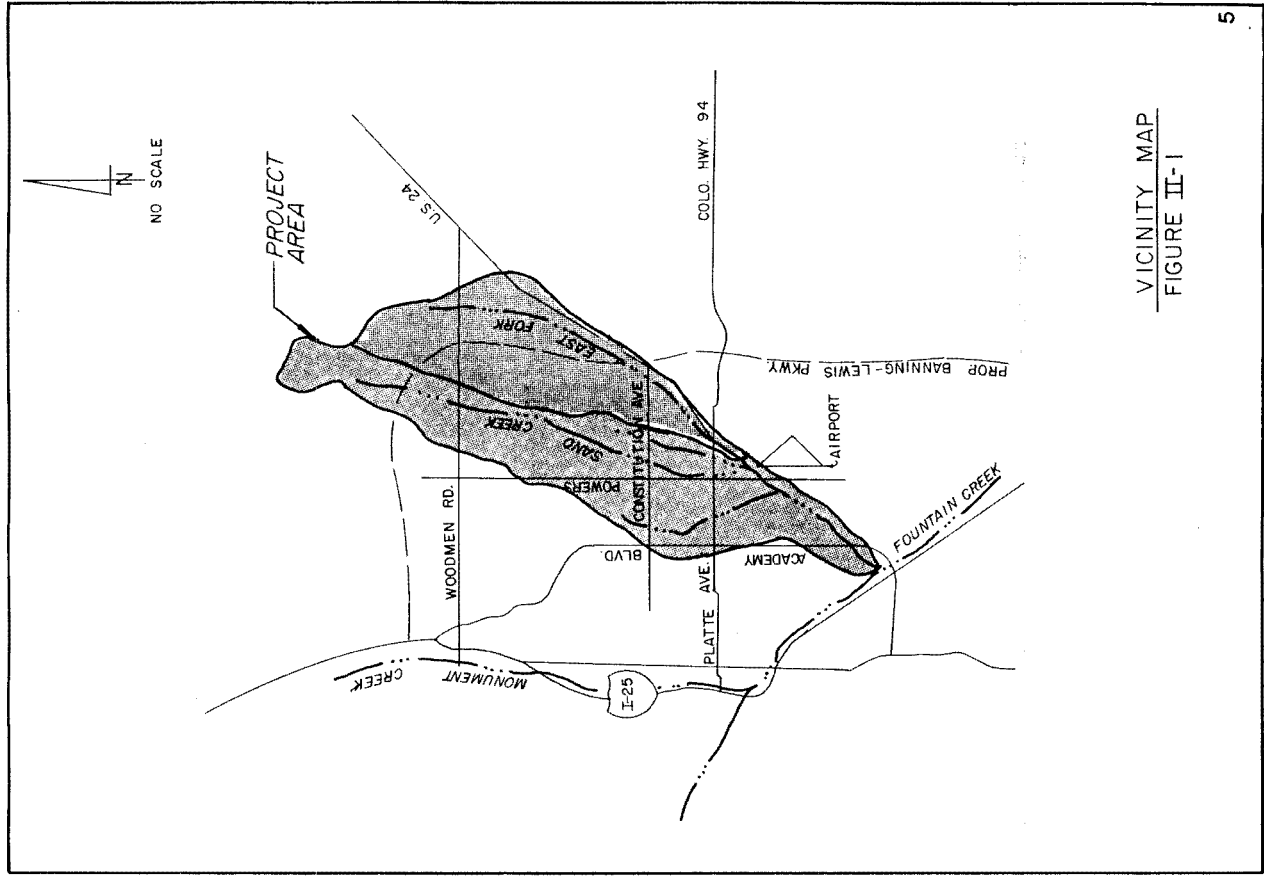
Land use information for the existing and future conditions were reviewed as part of the planning effort. This information is used in the hydrologic analysis to predict runoff rates and volumes for the purposes of facility evaluation. The identification of land uses abutting the drainageways is also useful in the identification of feasible plans for stabilization and aesthetic treatment of the creek. Presented on Figure II-3 is the proposed land use map used in the evaluation of impervious land densities discussed in the hydrologic section of this report. Figure II-3 is not intended to reflect the future zoning or land use policies of the City or the County.

The land use information within the Banning-Lewis Ranch property was obtained from Aries Properties during the time the draft East Fork Sand Creek Drainage Basin Planning Study was being prepared. The land use information was again reviewed with the City of Colorado Springs Department of Planning and was found to be appropriate for use in the estimation of hydrology for the East Fork Basin. The location of future arterial streets and roadways within

the Banning Lewis property were obtained from the Banning-Lewis Ranch master plan. The location of roadways offsite from the Banning Lewis-Ranch were obtained from the El Paso County Major Transportation Plan dated 1988.

#### **Park Land and Open Space**

An inventory of park land and public open space was prepared. Many times, the combination of the drainageway and adjacent park lands can be used to visually extend the limits of a park or open space. The drainageway can also act to link parks and other land uses within the basin if multiple use trails are incorporated into the channel section(s). The Sand Creek drainageway has been identified as a major trail corridor within the City of Colorado Springs Trails Plan. Park land designated within the Banning-Lewis Ranch master plan were taken into account during the siting of stormwater facilities within the Banning-Lewis property.



VICINITY MAP  
FIGURE II-1

TABLE IV-1. SUMMARY OF HYDRAULIC STRUCTURES - CROSSINGS  
SAND CREEK DRAINAGE BASIN PLANNING STUDY

LOCATION	REACH #	SIZE	TYPE	CAPACITY EXISTING	CAPACITY FUTURE (1)	COMMENTS
Airport Road	CT-1	5-6'x8'	BOX CULVERT	ADEQUATE	ADEQUATE	
Pikes Peak Ave.	CT-1	NONE		INADEQUATE	INADEQUATE	POWERS BLVD. OVERTOPPED FREQUENTLY BETWEEN BLOU ST. AND PIKES PEAK AVE.
Powers Blvd.	CT-1	VARIOUS	METAL PIPE	INADEQUATE	INADEQUATE	
Platte Ave (US 24)	CT-1	8'x4'	BOX CULVERT	INADEQUATE	INADEQUATE	APPROACH CHANNEL IN NEED OF REALIGNMENT
Terminal Avenue	CT-2	2-4'x3'	BOX CULVERT	INADEQUATE	INADEQUATE	
Galley Road	CT-2	3-42'x72"	METAL ARCH PIPE	INADEQUATE	INADEQUATE	
Omaha Boulevard	CT-2	2-36'x37"	METAL ARCH PIPE	INADEQUATE	INADEQUATE	
Powers Boulevard	EFSC-2	90' clear span	CONCRETE BRIDGE	ADEQUATE	ADEQUATE	NEW BRIDGE
Stewart Street	EFSC-2	140'	CONCRETE BRIDGE	ADEQUATE	ADEQUATE	
US 24/Platte Ave	EFSC-2	290'	CONCRETE AND TIMBER BRIDGE	ADEQUATE	ADEQUATE	LIMITED BANK PROTECTION AT INLET AND OUTLET OF BRIDGE
Peterson Road	EFSC-2	4-36"	METAL PIPE	INADEQUATE	INADEQUATE	
Marksheffel Road	EFSC-2	2-36"	METAL PIPE	INADEQUATE	INADEQUATE	

TABLE IV-2: SUMMARY OF HYDRAULIC STRUCTURES - CHANNELS  
SAND CREEK DRAINAGE BASIN PLANNING STUDY

LOCATION FROM / TO	REACH #	DIMENSIONS (ft)		TYPE	CAPACITY (1) ADQ. INADQ.	COMMENTS
		TW	SS DEPTH			
CENTER TRIBUTARY						
East Fork Sand Creek to Airport Road	CT-1	45	2:1 6	Riprap lined trapezoidal channel	X	Riprap has failed or is non-existent along some portions of this segment of the Center Tributary
Pikes Peak to Bijou St.	CT-1		N/A	Rubble lined ditches along Powers Blvd.		Flow passes over and along Powers Blvd. street section on a frequent basis. Road closures common.
Bijou St. to Platte Ave.	CT-1		N/A	Unlined, natural.		Overbanks vegetated, channel dry with sand invert, no vegetation. Channel eroded at outlet of US24 culvert.
Platte Ave. to Terminal Ave.	CT-2	15-25	1:1 4-6	Trapezoidal concrete lined.	X	Channel has adequate capacity.
Terminal Avenue to Galley Road	CT-2	21	1:1 5	Trapezoidal concrete lined.	X	Channel has adequate capacity.
Galley Road to Pacoma Ct. (ext)	CT-2	30-40	varies 4-5	Unimproved segment.	X	Channel is degraded and filled with debris. Poor maintenance access.
Pacoma Ct. to Omaha Blvd.	CT-2	21	1:1 5	Trapezoidal concrete lined channel.	X	Maintenance access poor. Debris and trash in channel.
Omaha Blvd. to Palmer Park Blvd.	CT-2	19	1:1 4	"	X	Storm sewers outfall to channel near Palmer Park.



## VI. DEVELOPMENT OF ALTERNATIVES AND RECOMMENDED PLAN

---

The concepts which are available for handling stormwater runoff within the Sand Creek basin have been presented and discussed in detail in the Sand Creek Drainage Basin Planning Study Development of Alternatives Report and the draft East Fork Sand Creek Drainage Basin Planning Study. The process of combining the various channel treatment options, detention schemes and roadway crossing structures into a contiguous plan for all of the reaches is presented in this chapter of the report. As a result of the evaluation of the flood control, environmental, open space, operations and maintenance, and implementation concerns within the Sand Creek basin, the following concepts were identified as having sufficient feasibility to warrant further evaluation and review:

- Channel Concepts:
  - Floodplain Preservation
  - Channelization, 10- or 100-year
  - Selective Improvements
- Detention:
  - Regional detention systems

**Channel Concepts:** The channel concepts listed above have been evaluated with respect to the parameters listed in the previous chapter. A concept's feasibility depends upon its impact, positive or negative, upon the evaluation parameters. *The floodplain preservation* concept has been considered to be the same as the "*do-nothing*" alternative. The floodplain preservation concept would involve the regulation of the floodplain limits, generally as depicted on the effective City of Colorado Springs and El Paso County Flood Insurance Rate Maps. Regulation of the floodplain so that future encroachments are minimized and the floodproofing of structures which are currently within the 100-year floodplain would presumably be the methods used to address the flood hazard concerns along Sand Creek. In the upper reaches of Sand Creek, the ownership or easements associated with the 100-year floodplain (or greater limits to allow for an erosion buffer zone) would be a primary issue in regards to implementation of such a concept. Detention in the upper reaches of the basin Sand Creek basin and in the East Fork Sand Creek basin will maintain the 100-year floodplain at existing limits within the lower reaches of Sand Creek. The "do-nothing" concept is feasible wherever

the existing drainageway improvements are of adequate capacity to convey flood flows. *Channelization* would involve the lining of the Creek into a more confined flow area, and could be done for either the *100-year or 10-year* flood discharges. Several typical channel concepts have been presented. The primary bank lining material would probably be riprap. Grade control and/or drop structures would be required in a channelization concept so that the flood velocities could be controlled to a level requiring medium to heavy riprap. Soil cement offers an alternative to riprap and concrete for the construction of drops or grade control structures. Revegetation would occur wherever the native vegetation was disturbed by the channel construction. Willows at the toe of the riprap banks would be a minimum replacement. *Selective linings* would involve the construction of grade controls, drop structures, bank linings, storm sewer outlet control structures selectively sited to resist stream erosion or to reduce potential flooding damages. Areas of future concern such as at the outside bends of the creek, or at the outlets of bridges or culverts which will cross the drainageway would be subject to selective improvements.

**Detention Concepts:** The two general detention concepts evaluated were onsite versus regional detention. During the evaluation process, it was determined that the onsite detention concept has a low feasibility relative to a regional concept. This is because, (1) onsite detention has a unpredictable impact upon lowering peak discharges from urbanized areas to historic conditions (reference, Urbonas and Glidden, "Effect of Detention on Flows in Major Drainageways" ASCE Water Forum '81, 1981), (2) an onsite concept has little impact upon maintaining or enhancing water quality, (3) the number of onsite detention basins, their locations and size cannot be accurately determined in the undeveloped portions of the basin at this time, and (4) onsite detention would present a substantial maintenance responsibility to the jurisdictions involved. For these reasons the onsite detention concept was eliminated and regional detention basin concepts were developed. In the analysis of the channel concepts, regional detention facilities were assumed to be in place.

### Channel Alternatives

Presented on Table VI-1 is a matrix of channel alternatives which were evaluated. All reaches of Sand Creek and the East Fork of Sand Creek had at least three alternatives analyzed. Presented on Tables VI-2 through VI-6 are comparative evaluations of the floodplain preservation (do-nothing), channelization and selective lining concepts, for the mainstem Sand Creek basin, by reach. The purpose of the evaluation process was to identify the relative advantages and disadvantages of each concept within each reach.

Presented on Figure VI-1 are the alternative channel concept plans for each reach of the East Fork Sand Creek Basin. Alternative 1, "prismatic or composite" channel shown on Figure VI-1 is synonymous with the "channelization" concept developed for the mainstem Sand Creek basin. Alternative 2, "stabilized floodplain section" shown on Figure VI-1 is synonymous with the "selective improvement" concept developed for the mainstem of Sand Creek. Floodplain preservation or the "do-nothing" concept was evaluated for all reaches of the East Fork.

For the channelization and selective improvement concepts, cost comparisons have been completed. Similarly, cost estimates for each of the detention concepts were developed. The cost of property acquisition for land lying outside of the 100-year floodplain limits and for detention basins will have to be accounted for during the calculation of the drainage basin fee for the Sand Creek basin. The cost evaluation and detailed discussion related to the various channelization and detention concepts are contained within the Sand Creek Drainage Basin Planning Study Development of Alternatives Report and the draft East Fork Sand Creek Drainage Basin Planning Study.

#### Impact Upon Habitat

For each of the channel alternatives evaluated within the mainstem Sand Creek basin an estimate of each alternative's potential for disturbance of the habitat was made. The acreages presented previously on Table V-1 for the Class I and Class II habitat zones were used in determining the extent of disturbance which a particular alternative may entail if implemented within a given reach. Since it is the goal of planning process to identify concepts which will avoid disturbances to the existing habitat wherever practical, alternatives which would have a greater level of disturbance compared to another must have provisions for mitigating the disturbance. Typical disturbances caused by channelization would include loss of native toe and/or bank vegetation, filling of historic floodplains which may contain wetland or riparian habitat, or degradation of water quality to downstream areas resulting from flow concentrations within unlined areas. Selective improvements could create very similar disturbances as channelization, however because the improvements can be selectively sited, avoidance of disturbances is easier to achieve. The floodplain preservation concept has the potential for disturbance to habitat. The loss of toe and bank vegetation can occur over time from natural erosion of the invert and banks which are unlined. This is currently the situation in Reach 1 of Sand Creek.

For those concepts requiring mitigation, the cost of habitat mitigation needs to be included in the total cost for a particular concept if a fair comparison is to be made. A

comparison of the estimated potential disturbance acreages of the Class I and II habitat was made for each of the alternative channelization schemes. From this evaluation it was determined that the greatest total Class I and Class II habitat disturbance would result from the implementation of the 100-year channelization concept. The disturbances to the habitat could be mitigated by the re-establishment of the toe vegetation, and by replacing riparian habitat along the overbanks of the channel. The total disturbance for a 10-year channel concept is reduced from the case of the 100-year channel. Greater opportunities for habitat preservation and replacement are afforded by a 10-year concept since a residual 100-year floodplain would remain.

The least total disturbance acreage occurs for the floodplain preservation or a selective improvement concept. Some loss of habitat would occur naturally, mainly along the toe and at low channel benches due to the long-term degradation of the invert, and localized bank erosion. Water quality for the downstream reaches would not be improved by a floodplain preservation concept alone because of increasing rates of sediment transport due to increasing low flows and unlined banks and/or inverts. After a bank or invert failure, it would be anticipated that the native vegetation would eventually replace itself over a period of years.

Implementation of a selective improvement plan would result in a slight reduction in potential disturbance area as compared to the floodplain preservation concept. This is because selective improvements, if constructed prior to the onset of active bank and invert erosion, would prevent the loss of native habitat along the existing low flow banks and in floodplain areas. Disturbances due to construction could be better controlled with a selective improvement concept.

Though the above impacts were not specifically quantified for the East Fork basin, the relative advantages and disadvantages between the channelization concepts with regard to habitat impact for the East Fork are basically the same as for the mainstem Sand Creek. Since the East Fork basin is mostly undeveloped and the drainageways relatively unencroached at this time, there is an opportunity to select channel concepts which will result in little or no adverse impact to the existing habitat. In fact, some opportunity for enhancement of the habitat areas is possible in the future by developing channelization plans which will take advantage of the flood control, erosion control and water quality benefits that can be afforded by the natural floodplain zones and detention areas.

100-year peak discharge to levels. This will allow for the channel improvements to be constructed within the existing right-of way.

**Reaches SC-5 and SC-6:** A selective channel improvement concept has been recommended for these reaches. Detention in Reach SC-8 of the basin will maintain flows to historic peak discharge levels, however the low flows will increase in frequency and volume. For this reason it has been recommended to provide riprap channel linings at selective locations to at least the 10-year water surface and install grade controls. This will prevent the long-term degradation of the invert. A residual 100-year floodplain will remain and will offer opportunities for habitat replacement and open space preservation. Land adjacent to the drainageway is currently undeveloped or unplatted at this time which makes the feasibility of implementing this concept greater in comparison to the urbanized reaches of the creek.

**Reaches SC-7 and SC-8:** A selective improvement concept involving the localized lining of channel banks and grade control construction has been recommended for these reaches. The feasibility of this concept stems from the fact that flows will be reduced because of detention. Numerous individual rural ownerships cross the drainageway, however no habitable structures lie within the 100-year floodplain. Because of this, the economic feasibility of channelization concepts is low. Non-structural measures can be used to limit encroachments into floodprone areas. Additionally, the City of Colorado Springs Comprehensive plan recommends that the floodplains be maintained as open space. Potential habitat disturbances can be avoided with a selective plan, or simply replaced as part of the particular construction activity which caused the disturbance.

**Reach SC-9:** A floodplain preservation concept has been recommended for this reach. Little increase in urbanization is anticipated in this reach, and for this reason the existing drainageway is expected to remain stable. Localized improvements may be necessary to limit erosion caused by flow concentrations at culverts or storm sewers. Private ownership of the drainageway is anticipated to continue which lower the feasibility of channel concepts which require permanent right-of-ways or easements for construction and maintenance.

**Reaches WF-1 through WF-3:** A 100-year channel concept has been recommended for these reaches primarily because of the potential for flooding damages. Several roadway crossings are in need of replacement because of the flood hazard the constrictions create. Some open space enhancement potential exists for this concept since these reaches have been degraded visually by debris accumulation, bank sloughing and sedimentation. Little opportunity exists for widening the drainageway because the

#### Development of the Recommended Plan

Presented on Table VI-7 is a matrix representing the recommended plan for each major drainageway reach. The selection of a recommended channel treatment scheme has been based upon the qualitative and quantitative information presented in the Sand Creek Drainage Basin Planning Study Development of Alternatives report and the draft East Fork Sand Creek Drainage Basin Planning Study. Contained within the Technical Addendum to the Sand Creek Drainage Basin Planning Study Development of Alternatives report, is the alternative hydrologic, hydraulic and conceptual cost data used in the evaluation and comparison of each of the alternatives within the mainstem Sand Creek basin.

#### Discussion of Recommended Plan

The recommendation of a particular channel treatment or detention scheme has been based upon the qualitative and quantitative data presented. For each reach the flood hazard, environmental, cost, operations and maintenance and open space aspects of the drainageway were weighed for each alternative concept.

**Reach SC-1:** For this reach a 10-year channel section was recommended for further evaluation. With the implementation of regional detention in the upper basin, the 100-year floodplain will generally be confined within the existing banks, excepting at roadway crossings lacking 100-year capacity. It is recommended that a 10-year low flow channel be constructed within the invert of the existing channel through the construction of benches and sand bars. As urbanization continues towards the full development scenario, the base flow and annual flows will increase in volume and frequency. For this reason, the low flow area must be stabilized to protect the existing channel banks from undermining and subsequent bank sloughing. The benched areas offer an opportunity for habitat replacement and enhancement. At some locations within this reach, a residual 100-year floodplain will remain which will have to be regulated. The residual 100-year floodplain offers some potential for open space preservation and enhancement. This is particularly true in the portion of the reach downstream of Hancock Expressway.

**Reaches SC-2 through SC-4:** A 100-year channel concept has been recommended primarily because of the potential for flooding damages which exists in these reaches. Habitat disturbed by the construction of channel linings and grade control structures could be replaced along the channel toes and on the overbanks. The replacement of the Waynoka Road crossing will reduce the potential for flood damages in areas adjacent to these roadways. The detention within the upper reaches will limit the

drainageway is confined within narrow right-of-ways between existing urban developments.

**Reaches CT-1 and CT-2:** A 100-year channel concept has been recommended because of flood hazard considerations. Urbanization has altered and blocked the natural drainage path for the majority of these reaches. A limited amount of habitat native to the drainageways was found during the environmental review. Revegetation at the top of the channel banks and along the toe of the riprap banks offers some opportunity for open space visual enhancement. The existing flow path has been visually degraded by debris dumping, excessive sediment deposition and sloughing of unprotected banks.

**Reach EFSC-1:** A 100-year riprap channel has been proposed for this reach of the East Fork. This reach passes through predominantly developed portions of Colorado Springs. Along some segments of this reach riprap has been placed, however the integrity and the continuity of the riprap lining is poor and in need of replacement. Check and drop structures are also recommended within this reach. This reach will be impacted significantly in the future by long duration stormwater releases from the detention basins lying in the reaches upstream of Reach EFSC-2.

**Reach EFSC-2:** This reach passes through mostly undeveloped areas of Colorado Springs and El Paso County. New bridges are needed at Marksheffel Road, Peterson Road and at an un-named roadway within Peterson Air Force Base. From the confluence with the Center Tributary to Marksheffel Road a 100-year riprap channel concept is recommended. Above Marksheffel Road to the confluence with the East Fork Sub-tributary, a 10-year channel concept and with floodplain preservation is recommended. Channel drop structures and checks are also required to limit the future degradation of the invert. As with reach EFSC-1, this reach will be impacted by stormwater releases from the East Fork Sand Creek detention basins.

**Reach EFSC-3:** A 10-year riprap lined channel and 100-year floodplain preservation is recommended. Future stormwater discharges through this reach will be limited to historic levels by the upstream regional detention basins. Check structures are recommended to counteract the degrading effect of the long duration discharges from the upstream detention basins. The concept through this reach is to leave the channel bottom width at its current location, thereby limiting the encroachment of fill into the floodway.

**Reach EFSC-4:** The most significant feature of the recommended plans in this reach is regional detention basin EFSC-#1. This basin will be the lowest flow control point along the East Fork Creek acting to limit discharges to historic levels from the development within the Banning-Lewis Ranch. A 10-year riprap channel is recommended for the segments of the reach above and below detention basin EFSC-#1.

Bridges will be required for proposed Stapleton Drive, Banning-Lewis Parkway and North Carefree Circle. This reach will pass through commercial and industrial areas. The incorporation of the future drainageway and detention basin into a linear open space use is recommended.

**Reach EFSC-5:** As with reach EFSC-4, the most significant feature of this reach basin is the EFSC-#2 region detention basin. This detention basin is located at an existing embankment which maintains a permanent pool. It is recommended that the detention basin be designed to maintain the permanent pool so that the water quality benefits of a "wet" basin are maximized. The recommended section is a 10-year riprap channel with 100-year floodplain preservation. Check and drop structures are recommended to flatten the gradient of the drainageway and to slow the developed stream velocities to manageable levels. This reach passes through commercial and single-family areas. As with reach EFSC-4, it is recommended that the drainageway and detention basin be incorporated into a linear open space use in the future. A 100-year bridge is needed at proposed Barnes Road.

**Reach EFSC-6:** This reach includes regional detention basin EFSC-#3. Similar to detention basin EFSC-#2, this detention basin has been sited at an existing embankment which maintains a permanent pool. The permanent pool should be maintained in the design of the regional basin as part of a water quality measure for the basin. A 10-year riprap channel with floodplain preservation is recommended for this reach. Channel drops and checks are recommended to limit the long-term degradation of the invert. A 100-year capacity bridge is required at future Bridlespur Road.

**Reach EFSC-7:** This reach contains detention basin EFSC-#4. This detention basin is a dry basin, and would be formed by the construction of an embankment and an outlet structure. The embankment and outlet structure could be combined with the roadway improvements for Bridlespur Road. A twin box culvert is proposed at future Bridlespur Road. A 10-year low flow channel and floodplain preservation concept is recommended from the detention basin to future Dublin Road. Above Dublin, a 100-year riprap channel is recommended, extending upstream to Woodmen Road.

**Reach EFSC-8:** This reach begins at Woodmen Road, and extends northward into the Black Forest area. The recommended improvements for this reach are selective riprap linings with grade control structures. A 100-year box culvert is recommended for Woodmen Road. A 100-year capacity box culvert is recommended for proposed Research Parkway.

**Reach EFST-1:** This reach begins at the confluence with the mainstem of East Fork Sand Creek, and extends northward to future Barnes Road. Contained in this reach is regional detention basin EFST-#1, located upstream of the existing Chicago and Rock Island railroad embankment. The recommended channel improvement is a 100-year riprap channel with grade control and drop structures, up to the outlet of EFST-#1 detention basin. Above the regional detention basin, a 10-year capacity low flow channel and grade control is recommended to Barnes Road. A 100-year capacity box culvert is recommended for proposed Barnes Road. The existing channel improvements within the Markshoeffel Industrial Park which is located just south of the Chicago and Rock Island Railroad are recommended to remain.

**Reach EFST-2:** This reach begins at the proposed Barnes Road and extends northward to approximately 3/4-mile north of proposed Dublin Road. The recommended channel improvement is a 100-year riprap channel with drops, aligned parallel to future Stapleton Drive. Culverts with a 100-year capacity are recommended at future Bridlespur Road and Dublin Road.

**Reach TR-1:** This reach begins at the confluence with the East Fork Sub-tributary and extends northward through the Toy Ranches Subdivision, a rural subdivision within El Paso County. The recommended channel improvement is selective riprap linings with grade control. A new culvert is proposed at Tamlin Road and at future Bridlespur Road (existing Huber Road). The drainage way crosses through private property within the Toy Ranches subdivision, and easements will have to be obtained from property owners to construct and maintain the proposed channel improvements for this reach.

**Reach TR-2:** This reach begins at the confluence with reach TR-1, and extends northward through the Toy Ranches Subdivision. The recommended channel improvement is selective riprap linings with grade control. A new culvert is proposed at future Bridlespur Road. As with TR-1, the drainage way crosses through private property within the Toy Ranches subdivision, and easements will have to be obtained from property owners to construct and maintain the proposed channel improvements for this reach.

**Reach TR-3:** This reach begins at the north boundary of the Toy Ranches Subdivision. Regional detention basin TR-#1 is contained within this reach. This regional detention basin is needed in order to maintain future peak discharges which enter the Toy Ranches Subdivision to existing levels. The recommended channel improvement is selective riprap linings with grade control. A new culvert is proposed at future Dublin Road.

**Reach EB-1:** This reach of East Bierstadt Creek begins at the confluence with the mainstem of East Fork Sand Creek, just upstream of future Barnes Road. The recommended channel improvement is a 10-year riprap channel with 100-year floodplain preservation and grade control structures. This reach ends at the confluence with West Bierstadt Creek.

**Reach EB-2:** This reach begins at the confluence with West Bierstadt Creek, approximately 3/4-mile upstream of future Barnes Road. The recommended channel improvement is a 100-year riprap channel and drop structures. Culverts with a 100-year capacity are proposed at a future un-named arterial roadway and a future Bridlespur and Dublin roads. A new culvert is proposed under the existing Chicago Rock Island and Pacific railroad grade.

**Reach WB-1:** This reach begins at the confluence with East Bierstadt Creek and extends northward to the existing Chicago and Rock Island and Pacific railroad grade. The recommended channel improvement is a 100-year riprap channel and drop structures. Culverts with a 100-year capacity are proposed at a future un-named arterial roadway and a future Bridlespur Road.

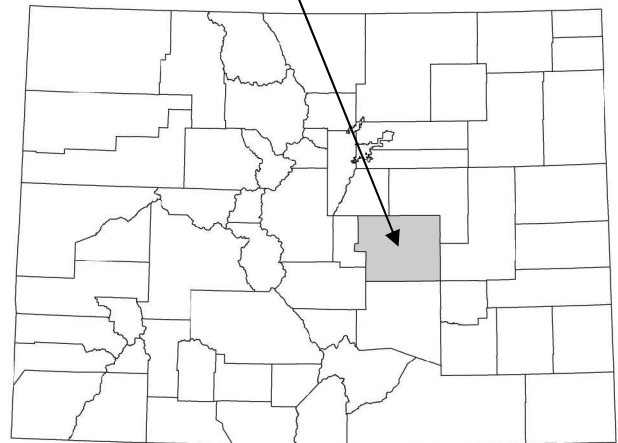
**Reach WB-2:** This reach begins at the existing Chicago and Rock Island and Pacific railroad grade and extends northward to approximately one mile north of Woodmen Road. Below Woodmen Road, the recommended channel improvement is a 100-year riprap channel and drop structures. North of Woodmen Road, the recommended drainage way improvements are selective riprap banks with grade control structures. Culverts with a 100-year capacity are proposed at a future Dublin Road and at Woodmen Road.

# FLOOD INSURANCE STUDY



## EL PASO COUNTY, COLORADO, AND INCORPORATED AREAS

El Paso County



COMMUNITY NAME	COMMUNITY NUMBER
CALHAN, TOWN OF	080192
COLORADO SPRINGS, CITY OF	080060
EL PASO COUNTY (UNINCORPORATED AREAS)	080059
FOUNTAIN, CITY OF	080061
GREEN MOUNTAIN FALLS, TOWN OF	080062
MANITOU SPRINGS, CITY OF	080063
MONUMENT, TOWN OF	080064
PALMER LAKE, TOWN OF	080065
RAMAH, TOWN OF	080066

Revised: December 7, 2018



Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER  
08041CV007A

NOTICE TO  
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS report may be revised and republished at any time. In addition, part of this FIS report may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS report components.

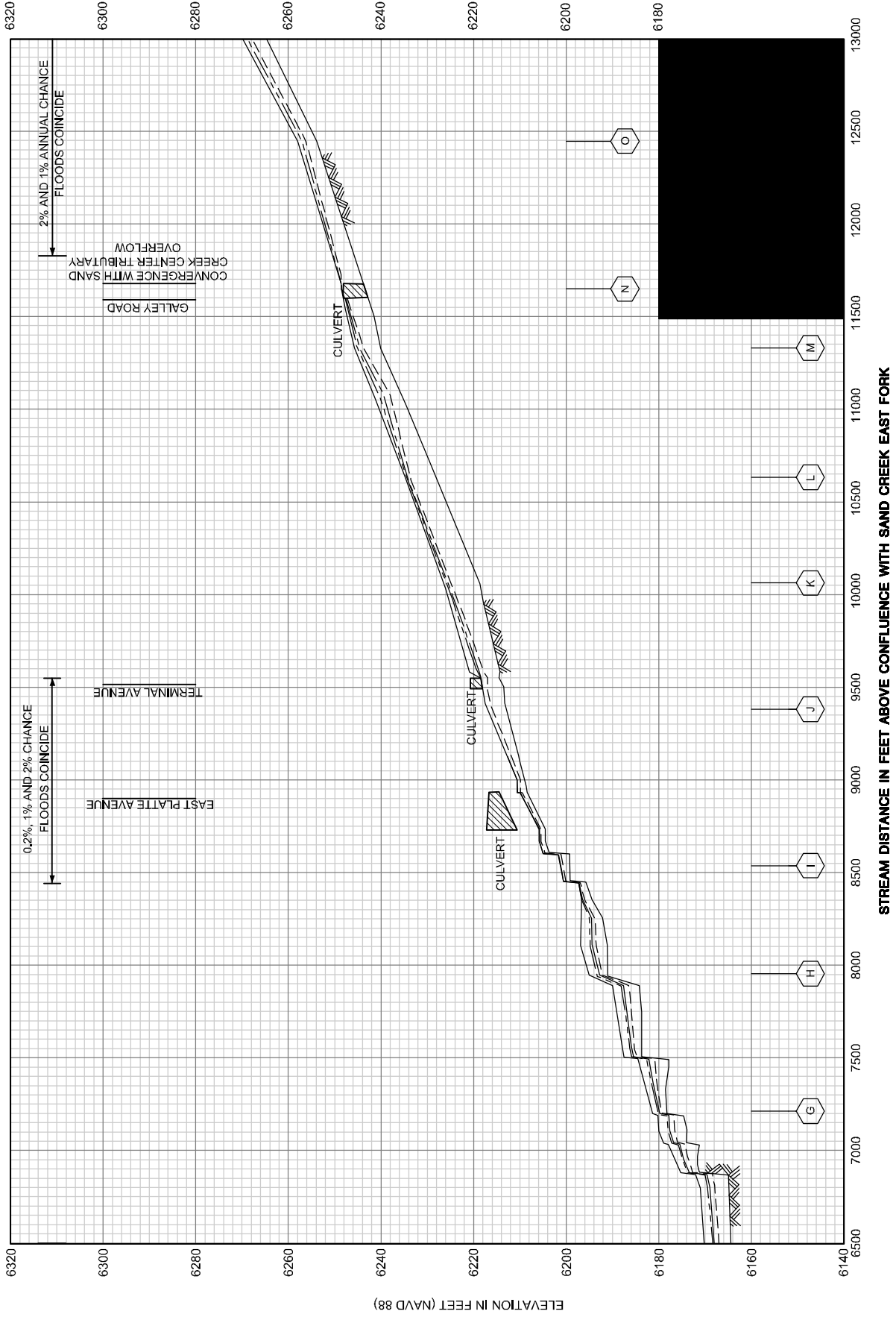
This FIS report was revised on December 7, 2018. Users should refer to Section 10.0, Revisions Description, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this report should be aware that the information presented in Section 10.0 superseded information in Sections 1.0 through 9.0 of this FIS report.

Initial Countywide FIS Report Effective Date: March 17, 1997

First Revised Countywide FIS Report Effective Date: August 23, 1999 - to add base flood elevations, to add special flood hazard areas, and to change special flood hazard areas.

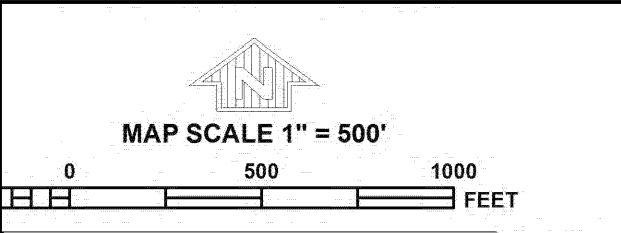
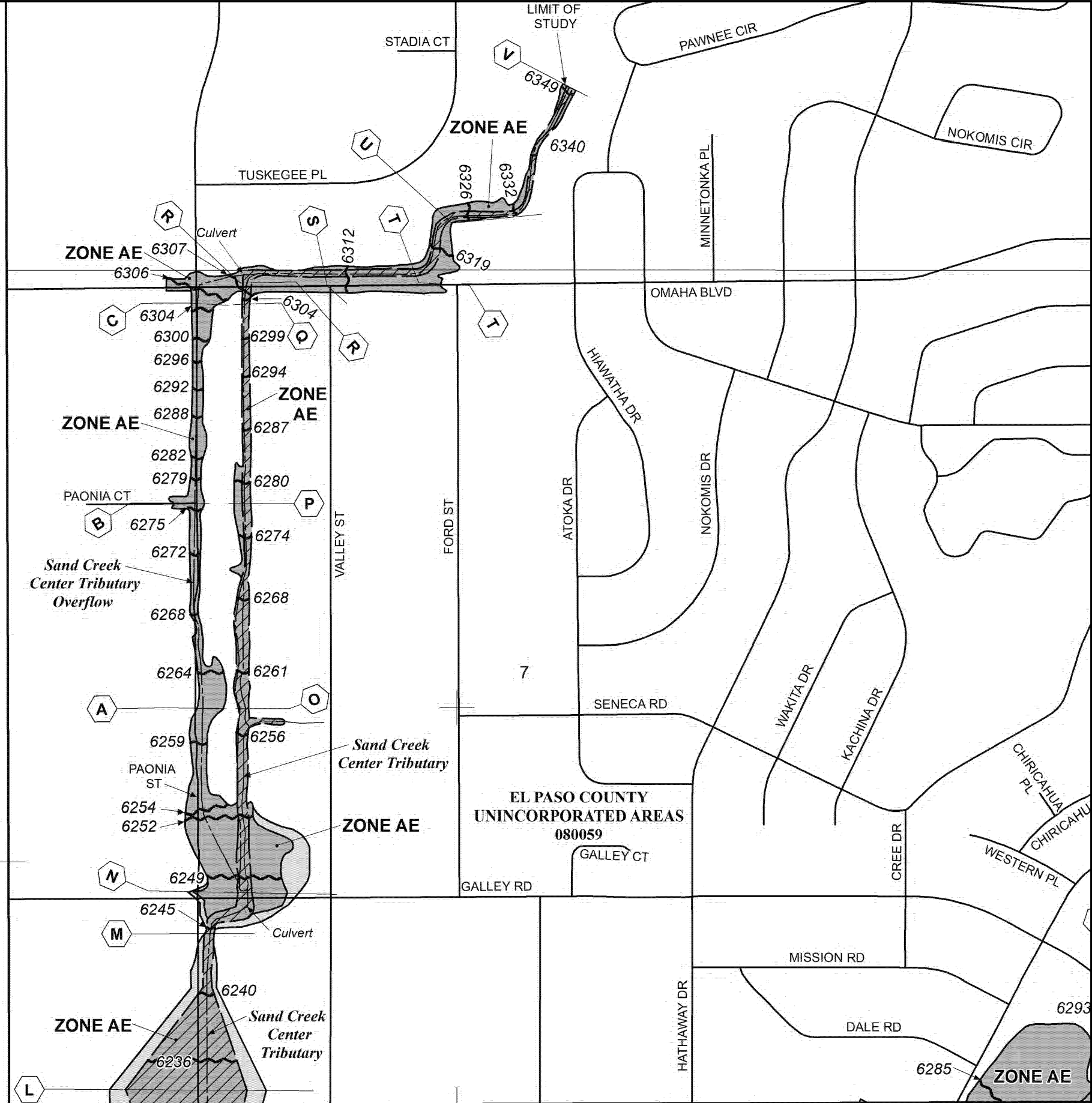
Second Revised Countywide FIS Report Effective Date: December 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

FLOOD PROFILES





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**NFP**

**PANEL 0752G**

**FIRM**  
FLOOD INSURANCE RATE MAP  
EL PASO COUNTY,  
COLORADO  
AND INCORPORATED AREAS

**PANEL 752 OF 1300**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0752	G
EL PASO COUNTY	080059	0752	G

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

**MAP NUMBER**  
08041C0752G

**MAP REVISED**  
DECEMBER 7, 2018

Federal Emergency Management Agency

**NATIONAL FLOOD INSURANCE PROGRAM**

1370000 FT

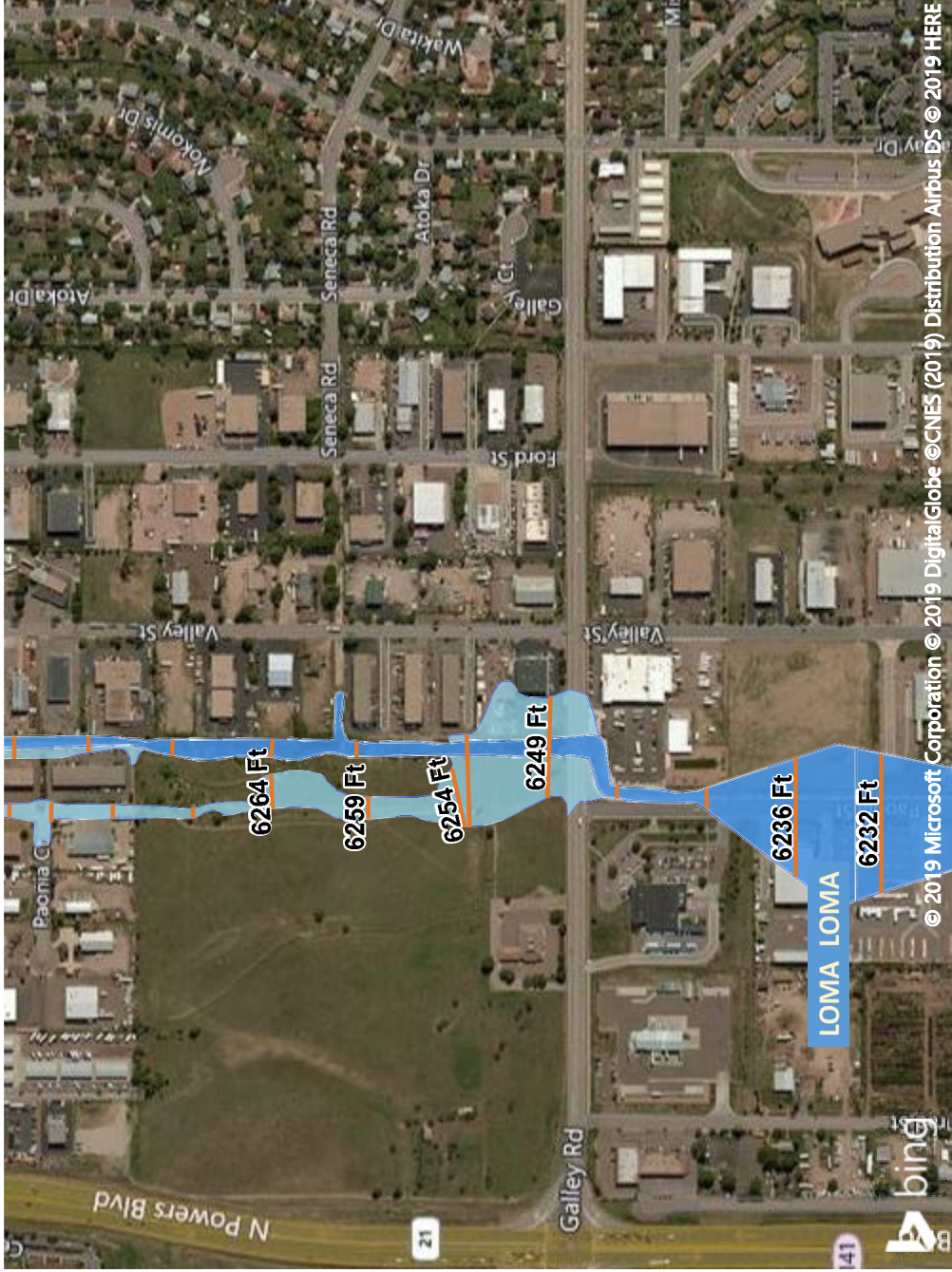
38° 50' 37.50"

104° 43' 7.50"

525000m E

JOINS PANEL 0754

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)



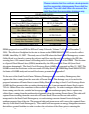
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# Sand Creek Center Tributary Channel Analysis\_V2.pdf Markup Summary

Daniel Torres (12)

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**Author:** Daniel Torres  
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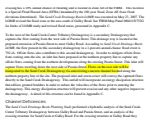
Please indicate that the northern developments and the secondary drainageway flows shall be captured. The inlet shall take into account the total flow from the secondary drainage way



**Page Label:** 5  
**Subject:** Callout  
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**Author:** Daniel Torres  
**Date:** 6/11/2020 8:42:36 PM  
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There appears to be an issue with this design. Currently the grade downstream of the existing Paonia St appears to be higher allowing the offsite/secondary drainageway flow from the east side of the road to enter this existing concrete channel. In your proposed condition, it does not appear that the flow would enter this existing concrete channel as Paonia St. will be extended downstream at a descending grade. The majority of the secondary drainageways flow will bypass this existing concrete channel. Please identify how this flow will be diverted to the main channel to the east.

Hydraulics for the diversion of the secondary drainageway flow shall be provided with the final drainage report.



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**Author:** Daniel Torres  
**Date:** 6/11/2020 8:42:40 PM  
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. Flows on the east side will be transported to the Sand Creek Drainageway via and existing concrete channel loca



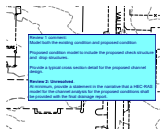
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**Author:** Daniel Torres  
**Date:** 6/11/2020 8:42:43 PM  
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FYI: The developer may be required to construct the improvements identified in the DBPS to adequately convey the flow across Galley Rd if the development is exacerbating the situation at this location.



**Page Label:** 9  
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**Author:** Daniel Torres  
**Date:** 6/11/2020 8:42:48 PM  
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Review 1 Comment:  
Add a narrative describing the parameters used for the GeoHecRas model such as:  
- the manning's n value. Include a table with the manning's n values and it's respective characteristics.  
- The boundary conditions used (upstream & downstream).  
Review 2: Unresolved  
-Per the review 1 comment include a table with the respective characteristics of the manning's n values. was the min, normal, or max coefficient value chosen? straight or winding channel? etc.  
- identify the downstream boundary condition



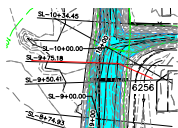
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**Author:** Daniel Torres  
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Review 1 comment:  
Model both the existing condition and proposed condition  
  
Proposed condition model to include the proposed check structure and drop structures.  
  
Provide a typical cross section detail for the proposed channel design.  
  
Review 2: Unresolved.  
At minimum, provide a statement in the narrative that a HEC-RAS model for the channel analysis for the proposed conditions shall be provided with the final drainage report.



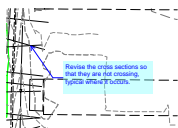
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**Date:** 6/11/2020 8:43:08 PM  
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The cross-sections labeled here do not correlate to the cross sections on the HEC-RAS model outputs. Please revise



**Page Label:** 19  
**Subject:** PolyLine  
**Lock:** Locked  
**Author:** Daniel Torres  
**Date:** 6/11/2020 8:43:09 PM  
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Revise the cross sections so that they are not crossing, typical where it occurs.



**Page Label:** 19  
**Subject:** Callout  
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**Date:** 6/11/2020 8:43:09 PM  
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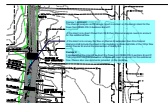


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**Author:** Daniel Torres  
**Date:** 6/11/2020 8:43:10 PM  
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Review 1 comment: The storage areas (detention ponds) need to be included in the model. Update the narrative accordingly.

Review 2

The storage areas will need to be included in the proposed conditions model with the final drainage report.



**Page Label:** 19  
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Review 1 comment:

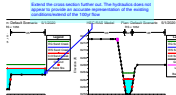
The channel analysis and drainage report is unclear on the design intent for the flows from FEMA FIS X-Sections B and P.

-If the intent is to divert Flows from XS B then channel analysis needs to account for this additional flow.

-If the intent is to convey the flow on Paonia St extension then this channel analysis shall include the street in the modeling to show the limits of the 100yr flow along Paonia St and at the intersection of Galley Rd.

Review 2:

It appears that the intent is to divert the flows from FEMA FIS X-sections B and P. The proposed conditions channel analysis will need to account for this additional flow. Please also see comments provided in the narrative.



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**Subject:** Callout  
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**Author:** Daniel Torres  
**Date:** 6/11/2020 8:43:18 PM  
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**Space:**

Extend the cross section further out. The hydraulics does not appear to provide an accurate representation of the existing conditions/extend of the 100yr flow