FLOODPLAIN STUDY OF FCD PROPERTY FOR CAVE BUTTES DEVELOPMENT

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Prepared For:

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009-6399

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May 10, 2000

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LARSON
Date Signed
ARIZONA, U.S.A.

JN 45-100238

I. Introduction

This report documents a preliminary floodplain investigation of a property owned by the Maricopa County Flood Control District (FCD). This property, consisting of Parcels H2643, H2644, H2645, and H2646, is located southeast of the Cave Buttes Dam and west of Cave Creek Road. A location map of the study site is shown in **Exhibit 1**. The property parcels have a total area of 275 acres and are currently evaluated for the opportunity of residential development. The floodplain study presented in this report was conducted to identify the characteristics of flooding within the MCFCD property and provide a delineation of the 100-year floodplain under existing conditions.

II. Study Site Description

The study area is of typical Sonoran desert with numerous low flow washes. As illustrated by the aerial photograph in **Exhibit 2**, flooding within the FCD property is primarily caused by a group of washes which traverse the property in an easterly direction. The washes spread over a cross-section as wide as 1,100 feet and begin as the low flow channel below the levee for the Cave Creek Dam Recreation Area, located approximately 5,000 feet northeast of the FCD property. Construction of the levee south of the Cave Creek Dam Recreation Area provides interception and detention of runoffs generated by the upstream watershed and has substantially reduced peak flow rates through the FCD property. The flows carried by the washes initially travel in a southwesterly direction before entering the FCD property and then change their course to the westerly direction. The width of the washes sharply narrows towards downstream as the washes converge to a single, incised channel west of Cave Creek Dam Road. The channel eventually discharges into Cave Creek approximately 700 feet west of the roadway crossing. The Cave Creek Dam Road crossing consists of a 10 ft. diameter double cell reinforced concrete culvert.

The bed and bank materials of the washes consist mostly of erodible soils like sand, gravel, and cobbles. Bank erosion appears to be very common in the washes and is most likely the primary cause for lateral movements of the washes. The density of vegetation varies from sparse to moderate with greater densities occurring along the washes. The types of vegetation are primarily desert scrub and Sonoran riparian woodland.

III. Hydrology Information

A hydrologic analysis of the watershed contributing to the FCD property was prepared by the Hydrology Branch, Engineering Division of FCD. The total peak discharge associated with a 100-year, 24-hour storm was estimated to be 1,092 cfs for the flows entering the east boundary of the FCD property. This value was used for the hydraulic analysis of the floodplain over the entire

property.

IV. Hydraulic Analysis

Hydraulic characteristics of the washes affecting the FCD property were evaluated under the 100-year storm runoff peak discharge. The U.S. Army Corps of Engineers'HEC-RAS (River Analysis System) computer program was employed to perform the hydraulic computations. The results of the analysis were used to identify the 100-year flood boundary and associated hydraulic parameters including flow velocities and water surface elevations. The hydraulic model was developed with the following data and assumptions:

• Cross-sections

Cross-sectional data of the floodplain washes were prepared based upon the aerial topographic map provided by FCD. The cross-sections were located 100 to 300 foot apart to closely represent the geometry of the floodplain and flow patterns. The most downstream cross-section is located at the confluence of Cave Creek and the most upstream cross-section about 800 feet northeast of the east property boundary. The cross-section locations are shown in **Exhibit 3**.

• Cave Creek Road Dam Culvert

Cave Creek Road crosses the floodplain washes near the west boundary of the FCP property. The crossing has a 10-ft. diameter double cell reinforced concrete culvert to convey flows under the roadway. Geometry of the culvert was obtained from a field survey and incorporated into the hydraulic model.

• Wash Roughness Coefficient

The Manning's channel roughness coefficient was estimated based upon observations in the field and the guidelines from *Open Channel Hydraulics* by V.T. Chow. Considering the characteristics of scattered vegetation and bed and bank materials, an average roughness value of 0.05 was estimated for the washes.

• Split Flow Assumptions

Due to the unstable characteristic of the low flow washes, it is difficult to determine which washes the flows would be concentrated in during a major flood event. As mentioned above, the floodplain begins as a single channel and then splits into multiple low flow washes downstream, which eventually converge back to a single channel. Upstream of Section 15 (**Exhibit 3**), the floodplain is divided predominately by a northern channel and a southern channel. In order to be conservative, rather than develop a split flow model, two modeling scenarios were prepared: 1) flows are 100%

concentrated in the northern channel; and 2) flows are all carried by the southern channel. The combined results of these two scenarios would produce the maximum estimate of the floodplain width.

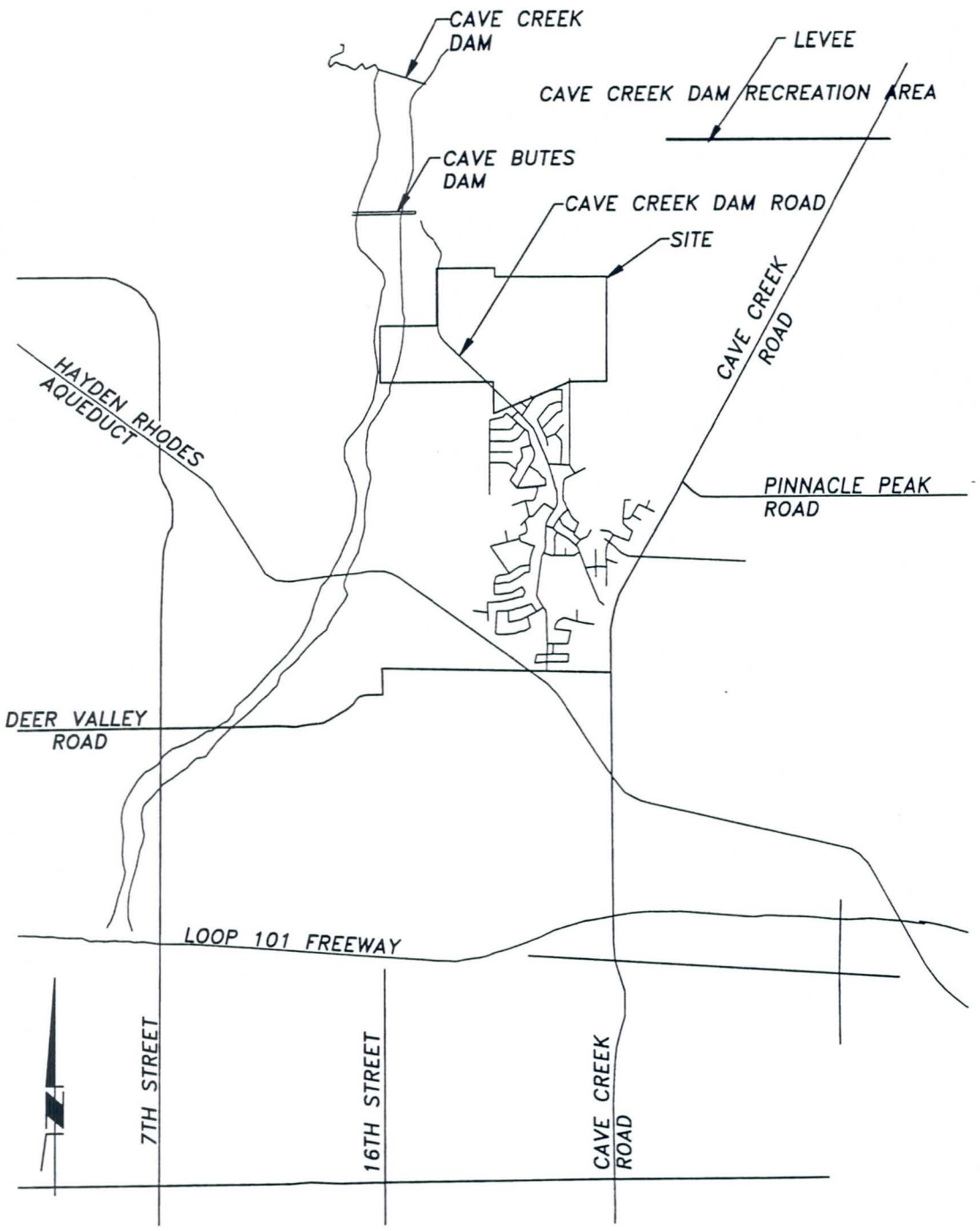
Based upon the above assumptions, the water surface profile associated with the 100-year flood peak discharge was computed and the floodplain boundary delineated, as presented in **Exhibit 4**. A summary of the computed maximum hydraulic parameters is provided in the table below.

Table 1 FCD Property 100-year Flood Peak Hydraulic Characteristics						
Section Number	Notes	Invert Elevation (feet)	Water Surface Elevation (feet)		Flow Velocity (ft/sec)	
1	Cave Creek Confluence	1538.00	1544.44		7.09	
2		1541.00	1547.40		8.97	
3		1543.00	1549.90		6.28	
4		1546.00	1551.68		4.88	
5	Cave Creek Dam Rd. (D/S)	1548.00	1552.62		6.80	
6	Cave Creek Dam Rd. (U/S)	1549.00	1557.65		3.18	
7		1550.99	1557.82		0.87	
8		1550.00	1557.83		0.83	
9		1552.00	1557.85		0.90	
10		1554.00	1557.93		1.51	
11		1556.50	1559.10		5.71	
12		1559.50	1562.33		1.75	
13		1562.00	1564.55		3.07	
14		1564.00	1567.25		2.17	
15	Two-channel Scenario assumed for upstream sections	1568.00	1571.71	1571.71	4.51	4.51
16		1572.00	1577.78	1576.76	2.28	2.97
17		1574.00	1579.10	1579.21	4.22	3.03
18		1576.22	1581.28	1579.86	4.39	9.01
19	East Property Limit	1579.40	1584.77	1583.21	4.82	2.06
20		1580.00	1586.24	1583.65	4.76	1.39
21		1584.00	1588.75	1587.10	5.62	5.48
22	Study Reach Limit	1586.00	1591.80	1591.18	3.32	2.52

For cross-sections upstream of Section 15, the computation was performed based upon the north and south channel scenarios to account for unpredictable changes of flow directions. The computed water surface elevations and flow velocities corresponding to the north and south channel scenarios are both listed in the above table.

V. Conclusion

The floodplain study of the FCD property as documented in this report indicates that the 100-year flood would spread as wide as over 1,000 feet due to the dynamic alluvial valley and relatively flat topography. Flood flows are typically carried by numerous low flow washes whose paths may vary from time to time. The FCD report proposed a concrete lined as well as a soft channel alternatives to convey flood flows and eliminate the flood hazard for the proposed development. The proposed channel alignment appears to follow the existing paths of two major low flow washes. Due to the unstable nature of the floodplain washes, it is recommended that a funneling system be incorporated at the upstream end to extend to the entire width of the estimated 100-year floodplain in order to capture all the flows entering the property along the east boundary.

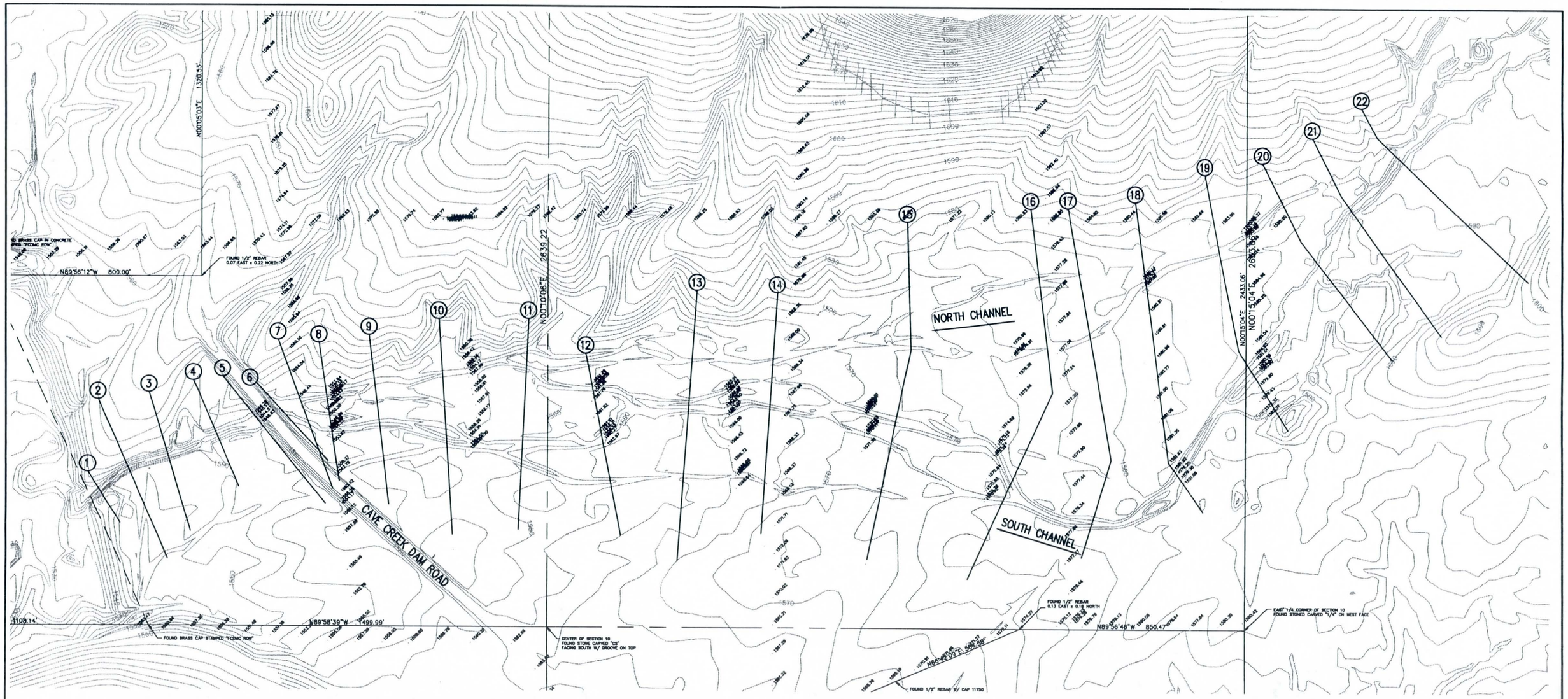


EXHIBIT#1 STUDY SITE LOCATION

EXHIBIT 2
FCD PROPERTY AERIAL PHOTOGRAPH

SCALE: 1" = 500'

0 500 1000 1500



Robert Bein, William Frost & Associates
PROFESSIONAL ENGINEERS, PLANNERS & SURVEYORS

PREPARED UNDER THE SUPERVISION OF:

DATE:
RCE

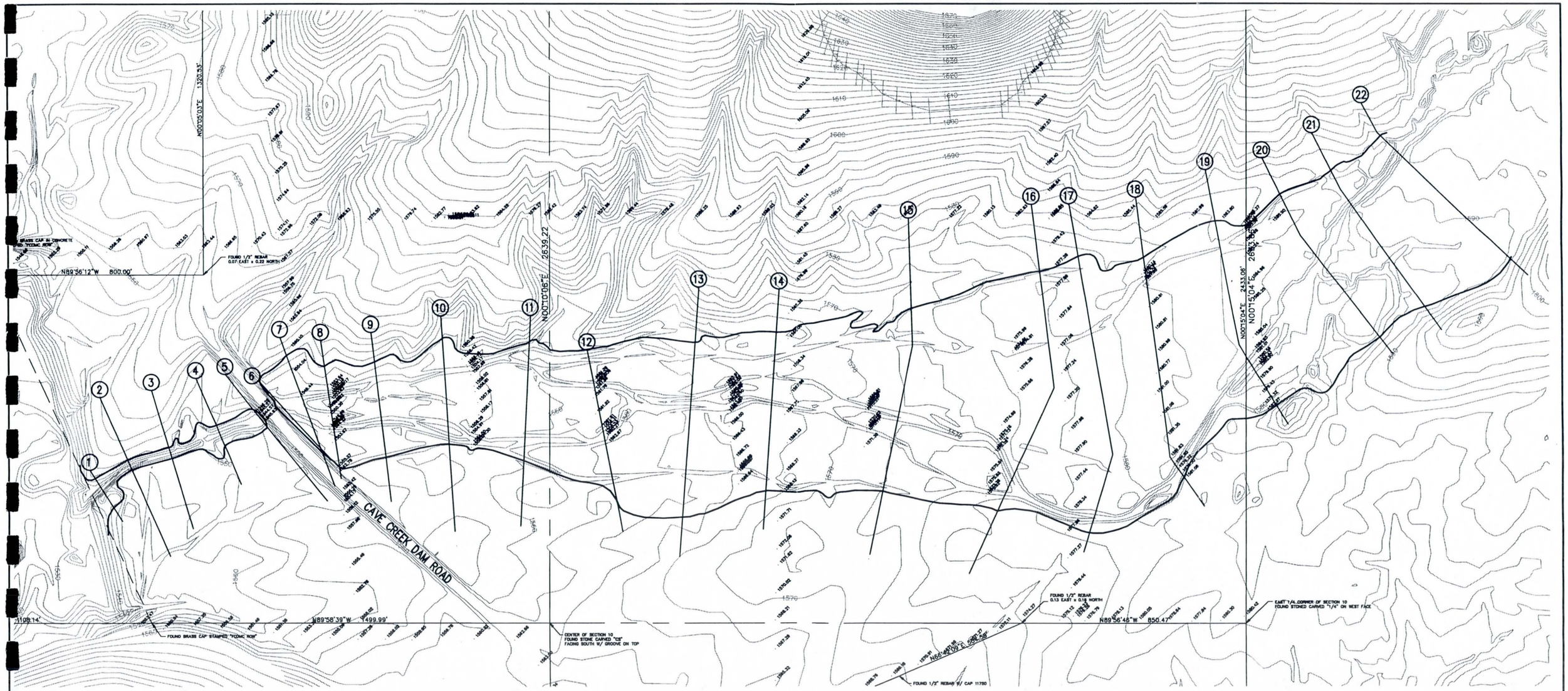
JOB No.	46-100238
DRAWING No.	
DATE:	4/2000
DESIGN:	JUN.W
DRAWN:	GHO
CHECKED:	-
P.M.	-
SCALE:	-

NO.	DATE	APVD.	REVISIONS

FCD PROPERTY FLOODPLAIN
HEC-RAS CROSS-SECTIONS

EXHIBIT 3

SHEET
OF



GRAPHIC SCALE: 1"=120'

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DATE:
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JOB No.	45-100238
DRAWING No.	
DATE:	4/2000
DESIGN:	J.H. W
DRAWN	GHO
CHECKED:	-
P.M.	-
SCALE:	-

NO.	DATE	APVD.	REVISIONS

FCD PROPERTY 100 YEAR FLOODPLAIN

EXHIBIT 4

SHEET
OF
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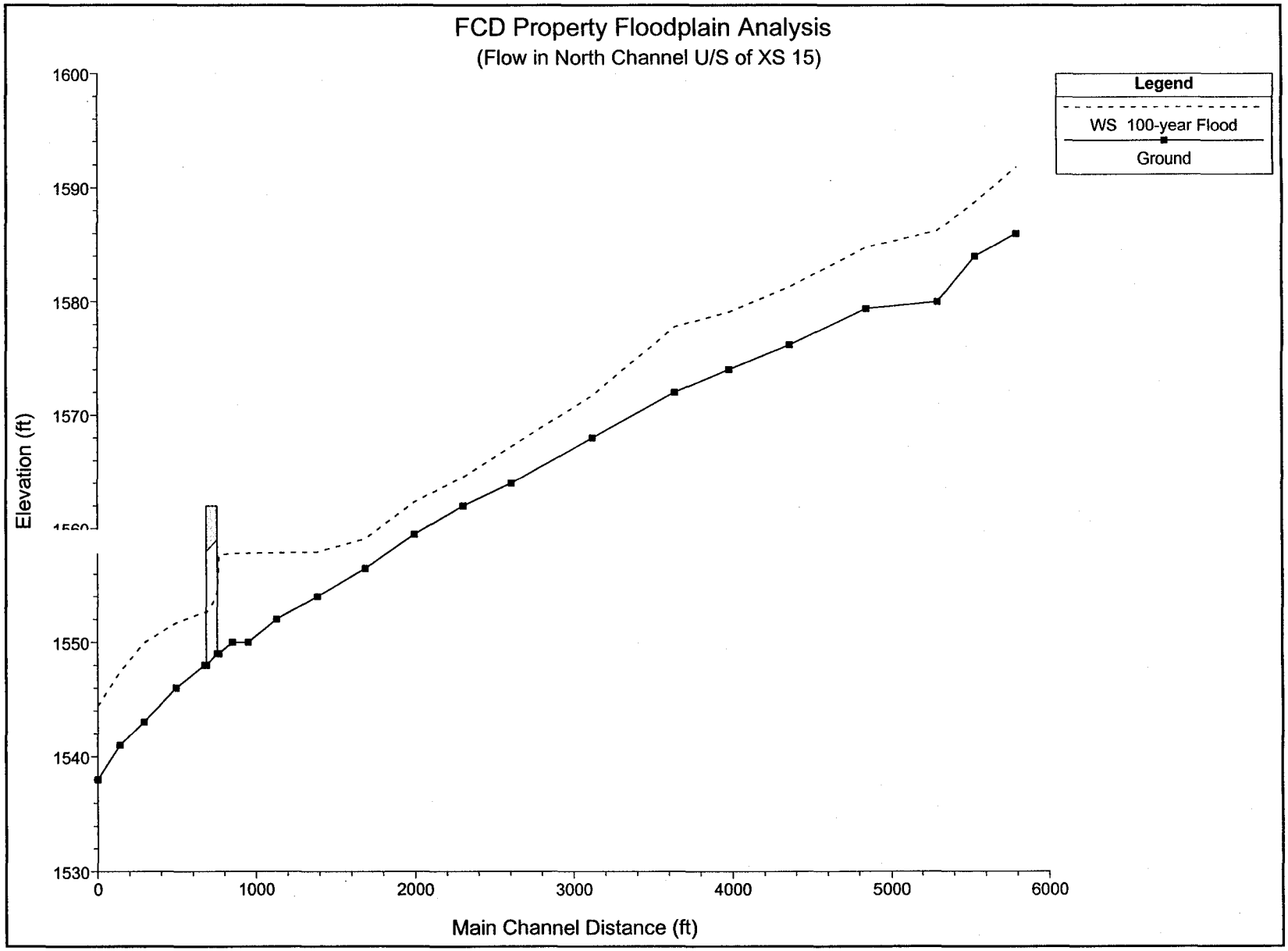
TECHNICAL APPENDIX 1

FCD PROPERTY FLOODPLAIN ANALYSIS
HEC-RAS DATA LISTINGS
NORTH CHANNEL FLOW SCENARIO


FCD Property Floodplain Analysis
(Flow in North Channel U/S of XS 15)
Legend
WS 100-year Flood
Ground
Elevation (ft)
1600
1590
1580
1570
1550
1540
1530
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)

HEC-RAS Plan: FCD Property River: Cave Buttes Trib Reach: 1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	1	1100.00	1538.00	1544.44	1544.44	1545.22	0.032188	7.09	155.15	99.17	1.00
1	2	1100.00	1541.00	1547.40		1548.65	0.017889	8.97	122.66	33.61	0.83
1	3	1100.00	1543.00	1549.90		1550.52	0.008665	6.28	175.26	49.32	0.59
1	4	1100.00	1546.00	1551.68	1550.10	1552.05	0.006368	4.88	225.30	75.23	0.50
1	5	1100.00	1548.00	1552.62	1551.12	1553.34	0.006795	6.80	161.81	138.61	0.56
1	5.5	Culvert									
1	6	1100.00	1549.00	1557.65	1551.85	1557.81	0.000645	3.18	345.96	473.67	0.19
1	7	1100.00	1550.00	1557.82	1551.66	1557.83	0.000070	0.87	1268.78	287.34	0.06
1	8	1100.00	1550.00	1557.83		1557.84	0.000086	0.83	1323.01	247.47	0.06
1	9	1100.00	1552.00	1557.85		1557.86	0.000186	0.90	1220.39	367.04	0.09
1	10	1100.00	1554.00	1557.93		1557.96	0.000993	1.51	730.31	357.13	0.19
1	11	1100.00	1556.50	1559.10	1559.10	1559.60	0.036629	5.71	192.75	191.11	1.00
1	12	1100.00	1559.50	1562.33		1562.38	0.003856	1.75	628.63	679.69	0.32
1	13	1100.00	1562.00	1564.55		1564.69	0.018681	3.07	358.80	546.07	0.67
1	14	1100.00	1564.00	1567.25		1567.33	0.004944	2.18	505.59	475.36	0.37
1	15	1100.00	1568.00	1571.71		1572.02	0.021365	4.51	243.76	229.35	0.77
1	16	1100.00	1572.00	1577.78	1577.17	1577.86	0.006859	2.28	482.87	542.03	0.43
1	17	1100.00	1574.00	1579.10	1579.10	1579.37	0.042922	4.22	260.61	459.08	0.99
1	18	1100.00	1576.22	1581.28	1581.28	1581.58	0.043026	4.39	250.33	415.76	1.00
1	19	1100.00	1579.40	1584.77	1584.77	1585.13	0.041098	4.82	228.18	318.65	1.00
1	20	1100.00	1580.00	1586.24	1586.24	1586.59	0.040989	4.76	230.98	327.28	1.00
1	21	1100.00	1584.00	1588.75	1588.75	1589.24	0.036436	5.62	195.81	197.57	0.99
1	22	1100.00	1586.00	1591.80	1590.51	1591.97	0.004796	3.32	331.78	161.48	0.41

HEC-RAS Version 2.1 October 1997
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
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PROJECT DATA
Project Title: FCD Property Floodplain Analysi
Project File : caveex1.prj
Run Date and Time: 5/10/2000 2:52:06 PM

Project in English units

Project Description:
FCD Property Floodplain Analysis - Flows in North Channel Only

PLAN DATA

Plan Title: FCD Property Floodplain Analysis
Plan File : c:\projects\cave\caveex1.p01

Geometry Title: FCD Property Wash Geometry
Geometry File : c:\projects\cave\caveex1.g01

Flow Title : FCD Property Floodplain Analysis
Flow File : c:\projects\cave\caveex1.f01

Plan Summary Information:

Number of:	Cross Sections =	22	Mulitple Openings =	0
	Culverts =	1	Inline Weirs =	0
	Bridges =	0		

Computational Information

Water surface calculation tolerance =	0.01
Critical depth calculaton tolerance =	0.01
Maximum number of interations =	20
Maximum difference tolerance =	0.3
Flow tolerance factor =	0.001

Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: FCD Property Floodplain Analysis
Flow File : c:\projects\cave\caveex1.f01

Flow Data (cfs)

River	Reach	RS	100-year Flood
Cave Buttes Trib1		22	1100

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Cave Buttes Trib1		100-year Flood	Critical	Critical

GEOMETRY DATA

Geometry Title: FCD Property Wash Geometry
Geometry File : c:\projects\cave\caveex1.g01

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 22

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1594	25	1592	50	1590	160	1589	240	1590
310	1590.7	460	1591	550	1592	580	1590	590	1588
610	1586	630	1590	665	1590	720	1592	745	1594

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	745	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	745	260	260	260	.1	.3

Left Levee Station= 550 Elevation= 1592

CROSS SECTION OUTPUT Profile #100-year Flood

			Left OB	Channel	Right OB
W.S. Elev (ft)	1591.80	Element			
Vel Head (ft)	0.17	Wt. n-Val.		0.050	
E.G. Elev (ft)	1591.97	Reach Len. (ft)	260.00	260.00	260.00
Crit W.S. (ft)	1590.51	Flow Area (sq ft)		331.78	
E.G. Slope (ft/ft)	0.004796	Area (sq ft)		331.78	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	161.48	Top Width (ft)		161.48	
Vel Total (ft/s)	3.32	Avg. Vel. (ft/s)		3.32	
Max Chl Dpth (ft)	5.80	Hydr. Depth (ft)		2.05	
Conv. Total (cfs)	15883.7	Conv. (cfs)		15883.7	
Length Wtd. (ft)	260.00	Wetted Per. (ft)		162.27	
Min Ch El (ft)	1586.00	Shear (lb/sq ft)		0.61	
Alpha	1.00	Stream Power (lb/ft s)		2.03	
Frctn Loss (ft)	2.70	Cum Volume (acre-ft)		56.85	

C & E Loss (ft)	0.03	Cum SA (acres)	45.81

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 21

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1594	60	1588	150	1586.5	275	1586	300	1584
310	1586	360	1589	535	1589	555	1584	570	1588
670	1588	700	1588	790	1590	850	1592		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	850	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	850	240	240	240	.1	.3

Left Levee Station= 535 Elevation= 1589

CROSS SECTION OUTPUT Profile #100-year Flood

			Left OB	Channel	Right OB
W.S. Elev (ft)	1588.75	Element			
Vel Head (ft)	0.49	Wt. n-Val.		0.050	
E.G. Elev (ft)	1589.24	Reach Len. (ft)	240.00	240.00	240.00
Crit W.S. (ft)	1588.75	Flow Area (sq ft)		195.81	
E.G. Slope (ft/ft)	0.036436	Area (sq ft)		195.81	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	197.57	Top Width (ft)		197.57	
Vel Total (ft/s)	5.62	Avg. Vel. (ft/s)		5.62	
Max Chl Dpth (ft)	4.75	Hydr. Depth (ft)		0.99	
Conv. Total (cfs)	5762.7	Conv. (cfs)		5762.7	
Length Wtd. (ft)	240.00	Wetted Per. (ft)		198.69	
Min Ch El (ft)	1584.00	Shear (lb/sq ft)		2.24	
Alpha	1.00	Stream Power (lb/ft s)		12.59	
Frctn Loss (ft)	0.32	Cum Volume (acre-ft)		55.27	
C & E Loss (ft)	0.03	Cum SA (acres)		44.73	

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 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.

Warning - The parabolic search method failed to converge on critical depth. The program will try the cross section slice/secant method to find critical depth.

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

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 20

INPUT
Description:
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1590	40	1588	65	1586	100	1582	120	1580
265	1580	300	1582	340	1582	360	1582	370	1584
390	1586	400	1587	425	1584	440	1583	460	1584
470	1586	620	1586	650	1585.5	670	1586	700	1586.5
720	1586	740	1584	750	1586	830	1588	880	1590

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	880	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	880	450	450	450	.1	.3

Left Levee Station= 400 Elevation= 1587

CROSS SECTION OUTPUT Profile #100-year Flood

			Left OB	Channel	Right OB
W.S. Elev (ft)	1586.24	Element			
Vel Head (ft)	0.35	Wt. n-Val.		0.050	
E.G. Elev (ft)	1586.59	Reach Len. (ft)	450.00	450.00	450.00
Crit W.S. (ft)	1586.24	Flow Area (sq ft)		230.98	
E.G. Slope (ft/ft)	0.040989	Area (sq ft)		230.98	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	327.28	Top Width (ft)		327.28	
Vel Total (ft/s)	4.76	Avg. Vel. (ft/s)		4.76	
Max Chl Dpth (ft)	6.24	Hydr. Depth (ft)		0.71	
Conv. Total (cfs)	5433.3	Conv. (cfs)		5433.3	
Length Wtd. (ft)	450.00	Wetted Per. (ft)		327.99	
Min Ch El (ft)	1580.00	Shear (lb/sq ft)		1.80	
Alpha	1.00	Stream Power (lb/ft s)		8.58	
Frctn Loss (ft)	0.06	Cum Volume (acre-ft)		54.10	
C & E Loss (ft)	0.04	Cum SA (acres)		43.29	

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 - Divided flow computed for this cross-section.
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, water surface was used.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 19

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1584	30	1580	50	1582	70	1580	100	1579.4
130	1580	185	1582	215	1582	225	1581	235	1582
245	1584	300	1584	370	1585.5	520	1584.3	650	1584
685	1582	710	1584	890	1586	940	1588		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	940	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	940	485	485	485	.1	.3

Left Levee Station= 370 Elevation= 1585.5

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1584.77	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.36	Wt. n-Val.		0.050	
E.G. Elev (ft)	1585.13	Reach Len. (ft)	485.00	485.00	485.00
Crit W.S. (ft)	1584.77	Flow Area (sq ft)		228.18	
E.G. Slope (ft/ft)	0.041098	Area (sq ft)		228.18	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	318.65	Top Width (ft)		318.65	
Vel Total (ft/s)	4.82	Avg. Vel. (ft/s)		4.82	
Max Chl Dpth (ft)	5.37	Hydr. Depth (ft)		0.72	
Conv. Total (cfs)	5426.0	Conv. (cfs)		5426.0	
Length Wtd. (ft)	485.00	Wetted Per. (ft)		318.80	
Min Ch El (ft)	1579.40	Shear (lb/sq ft)		1.84	
Alpha	1.00	Stream Power (lb/ft s)		8.85	
Frctn Loss (ft)	0.29	Cum Volume (acre-ft)		51.73	
C & E Loss (ft)	0.03	Cum SA (acres)		39.95	

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.

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

CROSS SECTION RIVER: Cave Buttes Trib

REACH: 1 RS: 18

INPUT

Description:

Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1582	110	1581.1	130	1576.3	140	1576.25	150	1576.22
170	1581.82	200	1581.83	280	1581.35	360	1581.08	450	1581
520	1581.77	600	1580.98	680	1580.81	775	1580.81	870	1580.36
880	1579.01	890	1578.94	900	1580.14	1040	1582	1090	1584

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	1090	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	1090	380	380	380	.1	.3

Left Levee Station= 520 Elevation= 1581.77

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1581.28	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.		0.050	
E.G. Elev (ft)	1581.58	Reach Len. (ft)	380.00	380.00	380.00
Crit W.S. (ft)	1581.28	Flow Area (sq ft)		250.33	
E.G. Slope (ft/ft)	0.043026	Area (sq ft)		250.33	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	415.76	Top Width (ft)		415.76	
Vel Total (ft/s)	4.39	Avg. Vel. (ft/s)		4.39	
Max Chl Dpth (ft)	5.06	Hydr. Depth (ft)		0.60	
Conv. Total (cfs)	5303.1	Conv. (cfs)		5303.1	
Length Wtd. (ft)		Wetted Per. (ft)		415.93	
Min Ch El (ft)	1576.22	Shear (lb/sq ft)		1.62	
Alpha	1.00	Stream Power (lb/ft s)		7.10	
Frctn Loss (ft)		Cum Volume (acre-ft)		49.06	
C & E Loss (ft)		Cum SA (acres)		35.86	

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 - The parabolic search method failed to converge on critical depth. The program will try the cross section slice/secant method to find critical depth.

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

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 17

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1579	45	1578	55	1574	90	1578	120	1579
240	1578	405	1579.5	580	1579	770	1578	800	1578
870	1579.5	1020	1578	1100	1580	1155	1582		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	1155	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	1155	340	340	340	.1	.3

Left Levee Station= 405 Elevation= 1579.5

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1579.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.		0.050	
E.G. Elev (ft)	1579.37	Reach Len. (ft)	340.00	340.00	340.00
Crit W.S. (ft)	1579.10	Flow Area (sq ft)		260.61	
E.G. Slope (ft/ft)	0.042922	Area (sq ft)		260.61	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	459.08	Top Width (ft)		459.08	
Vel Total (ft/s)	4.22	Avg. Vel. (ft/s)		4.22	
Max Chl Dpth (ft)	5.10	Hydr. Depth (ft)		0.57	
Conv. Total (cfs)	5309.5	Conv. (cfs)		5309.5	
Length Wtd. (ft)		Wetted Per. (ft)		459.11	
Min Ch El (ft)	1574.00	Shear (lb/sq ft)		1.52	
Alpha	1.00	Stream Power (lb/ft s)		6.42	

Frctn Loss (ft)		Cum Volume (acre-ft)	46.83
C & E Loss (ft)		Cum SA (acres)	32.05

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 - Divided flow computed for this cross-section.
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 - The parabolic search method failed to converge on critical depth. The program will try the cross section slice/secant method to find critical depth.
Note - Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 16

INPUT
Description:
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1576.5	50	1576	65	1574	80	1574	90	1576
110	1574	130	1572	150	1574	175	1576	205	1576
260	1578	280	1578	510	1576.5	690	1576	720	1577.5
805	1578	850	1577.5	900	1578.2	920	1578	960	1576
970	1578	1100	1580	1140	1582				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	1140	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	1140	520	520	520	.1	.3

Left Levee Station= 260 Elevation= 1578

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1577.78	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.08	Wt. n-Val.		0.050	
E.G. Elev (ft)	1577.86	Reach Len. (ft)	520.00	520.00	520.00
Crit W.S. (ft)	1577.17	Flow Area (sq ft)		482.87	
E.G. Slope (ft/ft)	0.006859	Area (sq ft)		482.87	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	542.03	Top Width (ft)		542.03	
Vel Total (ft/s)	2.28	Avg. Vel. (ft/s)		2.28	
Max Chl Dpth (ft)	5.78	Hydr. Depth (ft)		0.89	
Conv. Total (cfs)	13281.5	Conv. (cfs)		13281.5	
Length Wtd. (ft)	520.00	Wetted Per. (ft)		542.29	
Min Ch El (ft)	1572.00	Shear (lb/sq ft)		0.38	
Alpha	1.00	Stream Power (lb/ft s)		0.87	
Frctn Loss (ft)	5.81	Cum Volume (acre-ft)		43.93	
C & E Loss (ft)	0.02	Cum SA (acres)		28.14	

Warning - Divided flow computed for this cross-section.
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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 15

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1572.5	90	1572	110	1570	120	1572	280	1572
290	1570	315	1572	370	1570	380	1568	400	1570
500	1572	660	1572	670	1571.3	680	1572	750	1573
800	1572	850	1573	900	1572	970	1574	1030	1576

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	1030	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	1030	510	510	510	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1571.71	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.		0.050	
E.G. Elev (ft)	1572.02	Reach Len. (ft)	510.00	510.00	510.00
Crit W.S. (ft)		Flow Area (sq ft)		243.76	
E.G. Slope (ft/ft)	0.021365	Area (sq ft)		243.76	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	229.35	Top Width (ft)		229.35	
Vel Total (ft/s)	4.51	Avg. Vel. (ft/s)		4.51	
Max Chl Dpth (ft)	3.71	Hydr. Depth (ft)		1.06	
Conv. Total (cfs)	7525.6	Conv. (cfs)		7525.6	
Length Wtd. (ft)	510.00	Wetted Per. (ft)		230.22	
Min Ch El (ft)	1568.00	Shear (lb/sq ft)		1.41	
Alpha	1.00	Stream Power (lb/ft s)		6.37	
Frctn Loss (ft)	4.63	Cum Volume (acre-ft)		39.60	
C & E Loss (ft)	0.07	Cum SA (acres)		23.54	

Warning - Divided flow computed for this cross-section.
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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 14

INPUT
Description:
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1570	70	1568	150	1566	430	1566	440	1564
450	1566	540	1568	600	1568	620	1566	710	1568
810	1570								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	810	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	810	305	305	305	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1567.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.07	Wt. n-Val.		0.050	
E.G. Elev (ft)	1567.33	Reach Len. (ft)	305.00	305.00	305.00
Crit W.S. (ft)		Flow Area (sq ft)		505.59	
E.G. Slope (ft/ft)	0.004944	Area (sq ft)		505.59	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	475.36	Top Width (ft)		475.36	
Vel Total (ft/s)	2.18	Avg. Vel. (ft/s)		2.18	
Max Chl Dpth (ft)	3.25	Hydr. Depth (ft)		1.06	
Conv. Total (cfs)	15644.9	Conv. (cfs)		15644.9	
Length Wtd. (ft)	305.00	Wetted Per. (ft)		475.86	
Min Ch El (ft)	1564.00	Shear (lb/sq ft)		0.33	
Alpha	1.00	Stream Power (lb/ft s)		0.71	
Frctn Loss (ft)	2.63	Cum Volume (acre-ft)		35.21	
C & E Loss (ft)	0.01	Cum SA (acres)		19.41	

Warning - Divided flow computed for this cross-section.
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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 13

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1566	90	1564	210	1564	215	1562.5	220	1564
305	1565	400	1564	450	1564	465	1562	485	1564
490	1564	500	1562	510	1564	580	1564	620	1563
660	1564	780	1566	810	1568				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	810	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	810	310	310	310	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1564.55	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.15	Wt. n-Val.		0.050	
E.G. Elev (ft)	1564.69	Reach Len. (ft)	310.00	310.00	310.00
Crit W.S. (ft)		Flow Area (sq ft)		358.80	
E.G. Slope (ft/ft)	0.018681	Area (sq ft)		358.80	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	546.07	Top Width (ft)		546.07	
Vel Total (ft/s)	3.07	Avg. Vel. (ft/s)		3.07	
Max Chl Dpth (ft)	2.55	Hydr. Depth (ft)		0.66	
Conv. Total (cfs)	8048.1	Conv. (cfs)		8048.1	

Length Wtd. (ft)	310.00	Wetted Per. (ft)	547.18
Min Ch El (ft)	1562.00	Shear (lb/sq ft)	0.76
Alpha	1.00	Stream Power (lb/ft s)	2.34
Frctn Loss (ft)	2.29	Cum Volume (acre-ft)	32.18
C & E Loss (ft)	0.03	Cum SA (acres)	15.83

Warning - Divided flow computed for this cross-section.
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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 12

INPUT
Description:
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
.0	1564	90	1562	155	1562	215	1562	235	1560
240	1559.5	250	1560	260	1562	375	1562	390	1560
440	1560	470	1562	580	1560	600	1560	610	1562
680	1562	690	1561	700	1562	720	1562	735	1560
750	1562	780	1564	800	1566				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	800	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	800	310	310	310	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1562.33	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.05	Wt. n-Val.		0.050	
E.G. Elev (ft)	1562.38	Reach Len. (ft)	310.00	310.00	310.00
Crit W.S. (ft)		Flow Area (sq ft)		628.63	
E.G. Slope (ft/ft)	0.003856	Area (sq ft)		628.63	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	679.69	Top Width (ft)		679.69	
Vel Total (ft/s)	1.75	Avg. Vel. (ft/s)		1.75	
Max Chl Dpth (ft)	2.83	Hydr. Depth (ft)		0.92	
Conv. Total (cfs)	17714.2	Conv. (cfs)		17714.2	
Length Wtd. (ft)	310.00	Wetted Per. (ft)		680.83	
Min Ch El (ft)	1559.50	Shear (lb/sq ft)		0.22	
Alpha	1.00	Stream Power (lb/ft s)		0.39	
Frctn Loss (ft)	2.72	Cum Volume (acre-ft)		28.67	
C & E Loss (ft)	0.05	Cum SA (acres)		11.47	

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 11

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1562	90	1560	100	1558	115	1558	150	1558
170	1556.5	190	1558	205	1560	395	1559.5	460	1558
490	1560	520	1560	525	1558	540	1558	550	1560
570	1562								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	570	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	570	300	300	300	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1559.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.51	Wt. n-Val.		0.050	
E.G. Elev (ft)	1559.60	Reach Len. (ft)	300.00	300.00	300.00
Crit W.S. (ft)	1559.10	Flow Area (sq ft)		192.75	
E.G. Slope (ft/ft)	0.036629	Area (sq ft)		192.75	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	191.11	Top Width (ft)		191.11	
Vel Total (ft/s)	5.71	Avg. Vel. (ft/s)		5.71	
Max Chl Dpth (ft)	2.60	Hydr. Depth (ft)		1.01	
Conv. Total (cfs)	5747.5	Conv. (cfs)		5747.5	
Length Wtd. (ft)	300.00	Wetted Per. (ft)		191.77	
Min Ch El (ft)	1556.50	Shear (lb/sq ft)		2.30	
Alpha	1.00	Stream Power (lb/ft s)		13.12	
Frctn Loss (ft)	0.88	Cum Volume (acre-ft)		25.75	
C & E Loss (ft)	0.14	Cum SA (acres)		8.37	

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 - Divided flow computed for this cross-section.
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: Cave Buttes Trib
REACH: 1 RS: 10

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1560	60	1558	70	1556	80	1554	90	1554
110	1554	126	1556	150	1556	210	1556	230	1556
320	1556	335	1554	350	1556	420	1558		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	420	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	420	255	255	255	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1557.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.04	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.96	Reach Len. (ft)	255.00	255.00	255.00
Crit W.S. (ft)		Flow Area (sq ft)		730.31	
E.G. Slope (ft/ft)	0.000993	Area (sq ft)		730.31	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	357.13	Top Width (ft)		357.13	
Vel Total (ft/s)	1.51	Avg. Vel. (ft/s)		1.51	
Max Chl Dpth (ft)	3.93	Hydr. Depth (ft)		2.04	
Conv. Total (cfs)	34913.5	Conv. (cfs)		34913.5	
Length Wtd. (ft)	255.00	Wetted Per. (ft)		357.94	
Min Ch El (ft)	1554.00	Shear (lb/sq ft)		0.13	
Alpha	1.00	Stream Power (lb/ft s)		0.19	
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)		22.57	
C & E Loss (ft)	0.01	Cum SA (acres)		6.49	

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: Cave Buttes Trib
REACH: 1 RS: 9

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1558	20	1556	125	1554	130	1552	145	1552
160	1554	230	1554	290	1554	320	1554	350	1556
370	1558	390	1560						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	390	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	390	180	180	180	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1557.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.86	Reach Len. (ft)	180.00	180.00	180.00
Crit W.S. (ft)		Flow Area (sq ft)		1220.39	
E.G. Slope (ft/ft)	0.000186	Area (sq ft)		1220.39	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	367.04	Top Width (ft)		367.04	
Vel Total (ft/s)	0.90	Avg. Vel. (ft/s)		0.90	
Max Chl Dpth (ft)	5.85	Hydr. Depth (ft)		3.32	
Conv. Total (cfs)	80679.2	Conv. (cfs)		80679.2	
Length Wtd. (ft)	180.00	Wetted Per. (ft)		367.82	
Min Ch El (ft)	1552.00	Shear (lb/sq ft)		0.04	
Alpha	1.00	Stream Power (lb/ft s)		0.03	
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)		16.86	

C & E Loss (ft)	0.00	Cum SA (acres)	4.37

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: Cave Buttes Trib
REACH: 1 RS: 8

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1554	10	1552	20	1550	70	1550	80	1552
120	1552	130	1552	135	1550	140	1550	150	1550
160	1552	180	1554	220	1556	250	1558	290	1560

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	290	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	290	100	100	100	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1557.83	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.84	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		1323.01	
E.G. Slope (ft/ft)	0.000086	Area (sq ft)		1323.01	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	247.47	Top Width (ft)		247.47	
Vel Total (ft/s)	0.83	Avg. Vel. (ft/s)		0.83	
Max Chl Dpth (ft)	7.83	Hydr. Depth (ft)		5.35	
Conv. Total (cfs)	118551.6	Conv. (cfs)		118551.6	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		252.69	
Min Ch El (ft)	1550.00	Shear (lb/sq ft)		0.03	
Alpha	1.00	Stream Power (lb/ft s)		0.02	
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)		11.60	
C & E Loss (ft)	0.00	Cum SA (acres)		3.10	

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

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 7

INPUT
Description:
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1554	20	1552	40	1550	90	1550	120	1550
145	1552	235	1554	260	1556	290	1558		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	290	.05

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

0	290	87	87	87	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	0	1560	190	290	1560

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1557.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.83	Reach Len. (ft)	87.00	87.00	87.00
Crit W.S. (ft)	1551.66	Flow Area (sq ft)		1268.78	
E.G. Slope (ft/ft)	0.000070	Area (sq ft)		1558.76	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	287.34	Top Width (ft)		287.34	
Vel Total (ft/s)	0.87	Avg. Vel. (ft/s)		0.87	
Max Chl Dpth (ft)	7.82	Hydr. Depth (ft)		6.68	
Conv. Total (cfs)	131814.8	Conv. (cfs)		131814.8	
Length Wtd. (ft)	87.00	Wetted Per. (ft)		194.11	
Min Ch El (ft)	1550.00	Shear (lb/sq ft)		0.03	
Alpha	1.00	Stream Power (lb/ft s)		0.02	
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)		8.30	
C & E Loss (ft)	0.01	Cum SA (acres)		2.48	

Warning - The cross-section end points had to be extended vertically for the computed water surface.
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: Cave Buttes Trib
REACH: 1 RS: 6

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1560	55	1560	90	1558	180	1555	260	1554
300	1552	320	1549	360	1549	380	1552	425	1554
500	1556	590	1558						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	590	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	590	90	90	90	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	320	1559	360	590	1559

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1557.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.16	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.81	Reach Len. (ft)	90.00	90.00	90.00
Crit W.S. (ft)	1551.85	Flow Area (sq ft)		345.96	
E.G. Slope (ft/ft)	0.000645	Area (sq ft)		1644.08	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	473.67	Top Width (ft)		473.67	
Vel Total (ft/s)	3.18	Avg. Vel. (ft/s)		3.18	
Max Chl Dpth (ft)	8.65	Hydr. Depth (ft)		8.65	

Conv. Total (cfs)	43320.0	Conv. (cfs)	43320.0
Length Wtd. (ft)	90.00	Wetted Per. (ft)	40.00
Min Ch El (ft)	1549.00	Shear (lb/sq ft)	0.35
Alpha	1.00	Stream Power (lb/ft s)	1.11
Frctn Loss (ft)		Cum Volume (acre-ft)	5.10
C & E Loss (ft)		Cum SA (acres)	1.72

CULVERT RIVER: Cave Buttes Trib
REACH: 1 RS: 5.5

INPUT
Description:
Distance from Upstream XS = 10
Deck/Roadway Width = 70
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew =
Upstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
.0	1562	1559	320	1562	1559	360	1562	1559
590	1562	1559						

Upstream Bridge Cross Section Data
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1560	55	1560	90	1558	180	1555	260	1554
300	1552	320	1549	360	1549	380	1552	425	1554
500	1556	590	1558						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	590	.05

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	590	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	320	1559	360	590	1559

Downstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	1562	1558	135	1562	1558	170	1562	1558
270	1562	1558						

Downstream Bridge Cross Section Data
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1554	110	1552	120	1550	135	1548	155	1548
170	1548	185	1550	205	1552	235	1554	270	1556

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	270	.05

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	270	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev

0	135	1558	170	270	1558

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins = 1562
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span
Culvert #1	Circular	10	

FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG

Culvert	Upstrm Dist	Length	n Value	Entrance Loss Coef	Exit Loss Coef
	10	70	.015	.4	1

Number of Barrels = 2
Upstream Elevation = 1549
Centerline Stations

Sta.	Sta.
333	347

Downstream Elevation = 1548
Centerline Stations

Sta.	Sta.
145.5	159.5

CULVERT OUTPUT Profile #100-year Flood
Culvert ID : Culvert #1

Culv Q (cfs)	1100.00	Culv Vel In (ft/s)	12.13
# Barrels	2	Culv Vel Out (ft/s)	15.79
Q Barrel (cfs)	550.00	Culv Inv El Up (ft)	1549.00
W.S. US. (ft)	1557.65	Culv Inv El Dn (ft)	1548.00
E.G. US. (ft)	1557.81	Culv Frctn Ls (ft)	0.47
Delta WS (ft)	5.03	Culv Ext Lss (ft)	3.09
Delta EG (ft)	4.47	Culv Ent Lss (ft)	0.91
E.G. IC (ft)	1557.30	Q Weir (cfs)	
E.G. OC (ft)	1557.81	Weir Sta Lft (ft)	
Culv WS In (ft)	1554.61	Weir Sta Rgt (ft)	
Culv WS Out (ft)	1552.56	Weir Submerg	
Culv Nml Depth (ft)	3.90	Weir Max Depth (ft)	
Culv Crt Depth (ft)	5.61	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	1562.00

Warning - Since the culvert has supercritical flow, the program should be run in mixed flow in order to check if the cross section downstream of the culvert has supercritical flow.
Note - The flow in the culvert is entirely supercritical.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 5

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1554	110	1552	120	1550	135	1548	155	1548

170	1548	185	1550	205	1552	235	1554	270	1556

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	270	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	270	180	180	180	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	135	1558	170	270	1558

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1552.62	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.72	Wt. n-Val.		0.050	
E.G. Elev (ft)	1553.34	Reach Len. (ft)	180.00	180.00	180.00
Crit W.S. (ft)	1551.12	Flow Area (sq ft)		161.81	
E.G. Slope (ft/ft)	0.006795	Area (sq ft)		332.78	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	138.61	Top Width (ft)		138.61	
Vel Total (ft/s)	6.80	Avg. Vel. (ft/s)		6.80	
Max Chl Dpth (ft)	4.62	Hydr. Depth (ft)		4.62	
Conv. Total (cfs)	13344.6	Conv. (cfs)		13344.6	
Length Wtd. (ft)	180.00	Wetted Per. (ft)		35.00	
Min Ch El (ft)	1548.00	Shear (lb/sq ft)		1.96	
Alpha	1.00	Stream Power (lb/ft s)		13.33	
Frctn Loss (ft)	1.19	Cum Volume (acre-ft)		3.05	
C & E Loss (ft)	0.10	Cum SA (acres)		1.09	

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 4

INPUT
Description:
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1552	20	1550	40	1546	50	1546	70	1550
80	1552								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	80	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	80	205	205	205	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
0	0	1550

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1551.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.		0.050	
E.G. Elev (ft)	1552.05	Reach Len. (ft)	205.00	205.00	205.00
Crit W.S. (ft)	1550.10	Flow Area (sq ft)		225.30	

E.G. Slope (ft/ft)	0.006368	Area (sq ft)	225.30
Q Total (cfs)	1100.00	Flow (cfs)	1100.00
Top Width (ft)	75.23	Top Width (ft)	75.23
Vel Total (ft/s)	4.88	Avg. Vel. (ft/s)	4.88
Max Chl Dpth (ft)	5.68	Hydr. Depth (ft)	2.99
Conv. Total (cfs)	13784.7	Conv. (cfs)	13784.7
Length Wtd. (ft)	205.00	Wetted Per. (ft)	76.27
Min Ch El (ft)	1546.00	Shear (lb/sq ft)	1.17
Alpha	1.00	Stream Power (lb/ft s)	5.73
Frctn Loss (ft)	1.51	Cum Volume (acre-ft)	1.90
C & E Loss (ft)	0.02	Cum SA (acres)	0.65

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 - The parabolic search method failed to converge on critical depth. The program will try the cross section slice/secant method to find critical depth.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 3

INPUT
Description:
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1550.5	60	1550	75	1546	80	1544	85	1543
90	1544	110	1550	160	1552				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	160	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	160	150	150	150	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1549.90	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.61	Wt. n-Val.		0.050	
E.G. Elev (ft)	1550.52	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)		Flow Area (sq ft)		175.26	
E.G. Slope (ft/ft)	0.008665	Area (sq ft)		175.26	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	49.32	Top Width (ft)		49.32	
Vel Total (ft/s)	6.28	Avg. Vel. (ft/s)		6.28	
Max Chl Dpth (ft)	6.90	Hydr. Depth (ft)		3.55	
Conv. Total (cfs)	11816.8	Conv. (cfs)		11816.8	
Length Wtd. (ft)	150.00	Wetted Per. (ft)		51.29	
Min Ch El (ft)	1543.00	Shear (lb/sq ft)		1.85	
Alpha	1.00	Stream Power (lb/ft s)		11.60	
Frctn Loss (ft)	1.81	Cum Volume (acre-ft)		0.96	
C & E Loss (ft)	0.06	Cum SA (acres)		0.36	

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 2

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1550	75	1550.5	130	1550	145	1542	150	1541
155	1542	170	1548	180	1550	210	1552	260	1554

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	260	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	260	140	140	140	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1547.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.25	Wt. n-Val.		0.050	
E.G. Elev (ft)	1548.65	Reach Len. (ft)	140.00	140.00	140.00
Crit W.S. (ft)		Flow Area (sq ft)		122.66	
E.G. Slope (ft/ft)	0.017889	Area (sq ft)		122.66	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	33.61	Top Width (ft)		33.61	
Vel Total (ft/s)	8.97	Avg. Vel. (ft/s)		8.97	
Max Chl Dpth (ft)	6.40	Hydr. Depth (ft)		3.65	
Conv. Total (cfs)	8224.4	Conv. (cfs)		8224.4	
Length Wtd. (ft)	140.00	Wetted Per. (ft)		36.19	
Min Ch El (ft)	1541.00	Shear (lb/sq ft)		3.78	
Alpha	1.00	Stream Power (lb/ft s)		33.94	
Frctn Loss (ft)	3.29	Cum Volume (acre-ft)		0.45	
C & E Loss (ft)	0.14	Cum SA (acres)		0.21	

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 1

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1548	30	1546	65	1544	105	1544	115	1546
120	1546	130	1544	140	1540	145	1538	150	1540
160	1542	175	1544	195	1548				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	195	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	195	0	0	0	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1544.44	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.78	Wt. n-Val.		0.050	
E.G. Elev (ft)	1545.22	Reach Len. (ft)			
Crit W.S. (ft)	1544.44	Flow Area (sq ft)		155.15	
E.G. Slope (ft/ft)	0.032188	Area (sq ft)		155.15	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	99.17	Top Width (ft)		99.17	
Vel Total (ft/s)	7.09	Avg. Vel. (ft/s)		7.09	
Max Chl Dpth (ft)	6.44	Hydr. Depth (ft)		1.56	
Conv. Total (cfs)	6131.2	Conv. (cfs)		6131.2	
Length Wtd. (ft)		Wetted Per. (ft)		101.18	
Min Ch El (ft)	1538.00	Shear (lb/sq ft)		3.08	
Alpha	1.00	Stream Power (lb/ft s)		21.85	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Warning - Divided flow computed for this cross-section.

SUMMARY OF MANNING'S N VALUES

River:Cave Buttes Trib

Reach	River Sta.	n1	n2	n3
1	22	.05	.05	.05
1	21	.05	.05	.05
1	20	.05	.05	.05
1	19	.05	.05	.05
1	18	.05	.05	.05
1	17	.05	.05	.05
1	16	.05	.05	.05
1	15	.05	.05	.05
1	14	.05	.05	.05
1	13	.05	.05	.05
1	12	.05	.05	.05
1	11	.05	.05	.05
1	10	.05	.05	.05
1	9	.05	.05	.05
1	8	.05	.05	.05
1	7	.05	.05	.05
1	6	.05	.05	.05
1	5.5	Culvert		
1	5	.05	.05	.05
1	4	.05	.05	.05
1	3	.05	.05	.05
1	2	.05	.05	.05
1	1	.05	.05	.05

SUMMARY OF REACH LENGTHS

River: Cave Buttes Trib

Reach	River Sta.	Left	Channel	Right

1	22	260	260	260
1	21	240	240	240
1	20	450	450	450
1	19	485	485	485
1	18	380	380	380
1	17	340	340	340
1	16	520	520	520
1	15	510	510	510
1	14	305	305	305
1	13	310	310	310
1	12	310	310	310
1	11	300	300	300
1	10	255	255	255
1	9	180	180	180
1	8	100	100	100
1	7	87	87	87
1	6	90	90	90
1	5.5	Culvert		
1	5	180	180	180
1	4	205	205	205
1	3	150	150	150
1	2	140	140	140
1	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Cave Buttes Trib

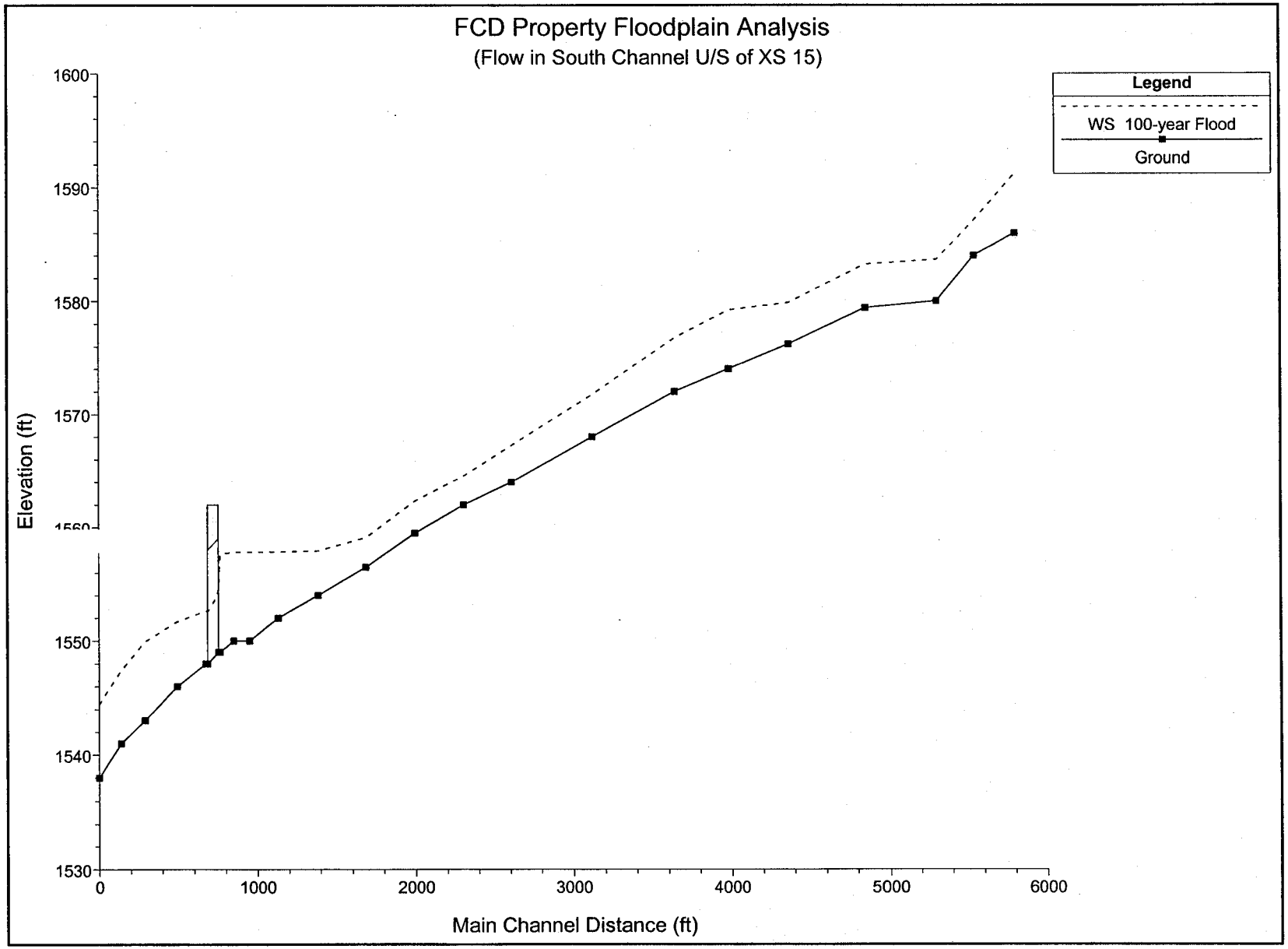
Reach	River Sta.	Contr.	Expan.
1	22	.1	.3
1	21	.1	.3
1	20	.1	.3
1	19	.1	.3
1	18	.1	.3
1	17	.1	.3
1	16	.1	.3
1	15	.1	.3
1	14	.1	.3
1	13	.1	.3
1	12	.1	.3
1	11	.1	.3
1	10	.1	.3
1	9	.1	.3
1	8	.1	.3
1	7	.1	.3
1	6	.1	.3
1	5.5	Culvert	
1	5	.1	.3
1	4	.1	.3
1	3	.1	.3
1	2	.1	.3
1	1	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	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)	Fr
1	1	1100.00	1538.00	1544.44	1544.44	1545.22	0.032188	7.09	155.15	99.17	
1	2	1100.00	1541.00	1547.40		1548.65	0.017889	8.97	122.66	33.61	
1	3	1100.00	1543.00	1549.90		1550.52	0.008665	6.28	175.26	49.32	
1	4	1100.00	1546.00	1551.68	1550.10	1552.05	0.006368	4.88	225.30	75.23	
1	5	1100.00	1548.00	1552.62	1551.12	1553.34	0.006795	6.80	161.81	138.61	
1	5.5	Culvert									
1	6	1100.00	1549.00	1557.65	1551.85	1557.81	0.000645	3.18	345.96	473.67	
1	7	1100.00	1550.00	1557.82	1551.66	1557.83	0.000070	0.87	1268.78	287.34	
1	8	1100.00	1550.00	1557.83		1557.84	0.000086	0.83	1323.01	247.47	
1	9	1100.00	1552.00	1557.85		1557.86	0.000186	0.90	1220.39	367.04	
1	10	1100.00	1554.00	1557.93		1557.96	0.000993	1.51	730.31	357.13	
1	11	1100.00	1556.50	1559.10	1559.10	1559.60	0.036629	5.71	192.75	191.11	
1	12	1100.00	1559.50	1562.33		1562.38	0.003856	1.75	628.63	679.69	
1	13	1100.00	1562.00	1564.55		1564.69	0.018681	3.07	358.80	546.07	
1	14	1100.00	1564.00	1567.25		1567.33	0.004944	2.18	505.59	475.36	
1	15	1100.00	1568.00	1571.71		1572.02	0.021365	4.51	243.76	229.35	
1	16	1100.00	1572.00	1577.78	1577.17	1577.86	0.006859	2.28	482.87	542.03	
1	17	1100.00	1574.00	1579.10	1579.10	1579.37	0.042922	4.22	260.61	459.08	
1	18	1100.00	1576.22	1581.28	1581.28	1581.58	0.043026	4.39	250.33	415.76	
1	19	1100.00	1579.40	1584.77	1584.77	1585.13	0.041098	4.82	228.18	318.65	
1	20	1100.00	1580.00	1586.24	1586.24	1586.59	0.040989	4.76	230.98	327.28	
1	21	1100.00	1584.00	1588.75	1588.75	1589.24	0.036436	5.62	195.81	197.57	
1	22	1100.00	1586.00	1591.80	1590.51	1591.97	0.004796	3.32	331.78	161.48	

TECHNICAL APPENDIX 2

FCD PROPERTY FLOODPLAIN ANALYSIS
HEC-RAS DATA LISTINGS
SOUTH CHANNEL FLOW SCENARIO


FCD Property Floodplain Analysis
(Flow in South Channel U/S of XS 15)
Legend
WS 100-year Flood
Ground
Elevation (ft)
1600
1590
1580
1570
1560
1550
1540
1530
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)

HEC-RAS Plan: FCD Property River: Cave Buttes Trib Reach: 1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	1	1100.00	1538.00	1544.44	1544.44	1545.22	0.032188	7.09	155.15	99.17	1.00
1	2	1100.00	1541.00	1547.40		1548.65	0.017889	8.97	122.66	33.61	0.83
1	3	1100.00	1543.00	1549.90		1550.52	0.008665	6.28	175.26	49.32	0.59
1	4	1100.00	1546.00	1551.68	1550.10	1552.05	0.006368	4.88	225.30	75.23	0.50
1	5	1100.00	1548.00	1552.62	1551.12	1553.34	0.006795	6.80	161.81	138.61	0.56
1	5.5	Culvert									
1	6	1100.00	1549.00	1557.65	1551.85	1557.81	0.000645	3.18	345.96	473.67	0.19
1	7	1100.00	1550.00	1557.82	1551.66	1557.83	0.000070	0.87	1268.78	287.34	0.06
1	8	1100.00	1550.00	1557.83		1557.84	0.000086	0.83	1323.01	247.47	0.06
1	9	1100.00	1552.00	1557.85		1557.86	0.000186	0.90	1220.39	367.04	0.09
1	10	1100.00	1554.00	1557.93		1557.96	0.000993	1.51	730.31	357.13	0.19
1	11	1100.00	1556.50	1559.10	1559.10	1559.60	0.036629	5.71	192.75	191.11	1.00
1	12	1100.00	1559.50	1562.33		1562.38	0.003856	1.75	628.63	679.69	0.32
1	13	1100.00	1562.00	1564.55		1564.69	0.018681	3.07	358.80	546.07	0.67
1	14	1100.00	1564.00	1567.25		1567.33	0.004944	2.18	505.59	475.36	0.37
1	15	1100.00	1568.00	1571.71		1572.02	0.021365	4.51	243.76	229.35	0.77
1	16	1100.00	1572.00	1576.75	1575.45	1576.89	0.005207	2.97	370.03	225.75	0.41
1	17	1100.00	1574.00	1579.21	1578.75	1579.35	0.010828	3.03	363.00	372.97	0.54
1	18	1100.00	1576.22	1579.86	1579.86	1581.12	0.027050	9.01	122.04	47.81	0.99
1	19	1100.00	1579.40	1583.21	1581.54	1583.28	0.001615	2.06	534.12	235.17	0.24
1	20	1100.00	1580.00	1583.65	1581.16	1583.68	0.000553	1.39	792.41	282.67	0.15
1	21	1100.00	1584.00	1587.10	1587.10	1587.57	0.037259	5.48	200.60	214.32	1.00
1	22	1100.00	1586.00	1591.18	1590.52	1591.28	0.007331	2.52	435.64	440.64	0.45

HEC-RAS Version 2.1 October 1997
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

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

PROJECT DATA
Project Title: FCD Property Floodplain Analysi
Project File : caveex2.prj
Run Date and Time: 5/10/2000 3:13:16 PM

Project in English units

Project Description:
FCD Property Floodplain Analysis - Flows in South Channel Only

PLAN DATA

Plan Title: FCD Property Floodplain Analysis
Plan File : c:\projects\cave\caveex2.p01

Geometry Title: FCD Property Floodplain Geometry
Geometry File : c:\projects\cave\caveex2.g01

Flow Title : FCD Property Floodpalin Analysis
Flow File : c:\projects\cave\caveex2.f01

Plan Summary Information:

Number of:	Cross Sections =	22	Mulitple Openings =	0
	Culverts =	1	Inline Weirs =	0
	Bridges =	0		

Computational Information

Water surface calculation tolerance =	0.01
Critical depth calculaton tolerance =	0.01
Maximum number of interations =	20
Maximum difference tolerance =	0.3
Flow tolerance factor =	0.001

Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: FCD Property Floodpalin Analysis
Flow File : c:\projects\cave\caveex2.f01

Flow Data (cfs)

River	Reach	RS	100-year Flood
Cave Buttes Trib1		22	1100

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Cave Buttes Trib1		100-year Flood	Critical	Critical

GEOMETRY DATA

Geometry Title: FCD Property Floodplain Geometry
Geometry File : c:\projects\cave\caveex2.g01

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 22

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1594	25	1592	50	1590	160	1589	240	1590
310	1590.7	460	1591	550	1592	580	1590	590	1588
610	1586	630	1590	665	1590	720	1592	745	1594

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	745	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	745	260	260	260	.1	.3

Right Levee Station= 550 Elevation= 1592

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1591.18	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.		0.050	
E.G. Elev (ft)	1591.28	Reach Len. (ft)	260.00	260.00	260.00
Crit W.S. (ft)	1590.52	Flow Area (sq ft)		435.64	
E.G. Slope (ft/ft)	0.007331	Area (sq ft)		435.64	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	440.64	Top Width (ft)		440.64	
Vel Total (ft/s)	2.52	Avg. Vel. (ft/s)		2.52	
Max Chl Dpth (ft)	5.18	Hydr. Depth (ft)		0.99	
Conv. Total (cfs)	12847.3	Conv. (cfs)		12847.3	
Length Wtd. (ft)	260.00	Wetted Per. (ft)		440.71	
Min Ch El (ft)	1586.00	Shear (lb/sq ft)		0.45	
Alpha	1.00	Stream Power (lb/ft s)		1.14	
Frctn Loss (ft)	3.67	Cum Volume (acre-ft)		63.37	

C & E Loss (ft)	0.04	Cum SA (acres)	38.00

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 21

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1594	60	1588	150	1586.5	275	1586	300	1584
310	1586	360	1589	535	1589	555	1584	570	1588
670	1588	700	1588	790	1590	850	1592		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	850	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	850	240	240	240	.1	.3

Right Levee Station= 535 Elevation= 1589

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1587.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.47	Wt. n-Val.		0.050	
E.G. Elev (ft)	1587.57	Reach Len. (ft)	240.00	240.00	240.00
Crit W.S. (ft)	1587.10	Flow Area (sq ft)		200.60	
E.G. Slope (ft/ft)	0.037259	Area (sq ft)		200.60	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	214.32	Top Width (ft)		214.32	
Vel Total (ft/s)	5.48	Avg. Vel. (ft/s)		5.48	
Max Chl Dpth (ft)	3.10	Hydr. Depth (ft)		0.94	
Conv. Total (cfs)	5698.7	Conv. (cfs)		5698.7	
Length Wtd. (ft)	240.00	Wetted Per. (ft)		214.64	
Min Ch El (ft)	1584.00	Shear (lb/sq ft)		2.17	
Alpha	1.00	Stream Power (lb/ft s)		11.92	
Frctn Loss (ft)	0.42	Cum Volume (acre-ft)		61.48	
C & E Loss (ft)	0.13	Cum SA (acres)		36.04	

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 - 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.

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

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 20

INPUT
Description:
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1590	40	1588	65	1586	100	1582	120	1580
265	1580	300	1582	340	1582	360	1582	370	1584
390	1586	400	1587	425	1584	440	1583	460	1584
470	1586	620	1586	650	1585.5	670	1586	700	1586.5
720	1586	740	1584	750	1586	830	1588	880	1590

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	880	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	880	450	450	450	.1	.3

Right Levee Station= 400 Elevation= 1587

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1583.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.03	Wt. n-Val.		0.050	
E.G. Elev (ft)	1583.68	Reach Len. (ft)	450.00	450.00	450.00
Crit W.S. (ft)	1581.16	Flow Area (sq ft)		792.41	
E.G. Slope (ft/ft)	0.000553	Area (sq ft)		792.41	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	282.67	Top Width (ft)		282.67	
Vel Total (ft/s)	1.39	Avg. Vel. (ft/s)		1.39	
Max Chl Dpth (ft)	3.65	Hydr. Depth (ft)		2.80	
Conv. Total (cfs)	46773.4	Conv. (cfs)		46773.4	
Length Wtd (ft)	450.00	Wetted Per. (ft)		283.09	
Min Ch El (ft)	1580.00	Shear (lb/sq ft)		0.10	
Alpha	1.00	Stream Power (lb/ft s)		0.13	
Frctn Loss (ft)	0.40	Cum Volume (acre-ft)		58.74	
C & E Loss (ft)	0.00	Cum SA (acres)		34.67	

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: Cave Buttes Trib
REACH: 1 RS: 19

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1584	30	1580	50	1582	70	1580	100	1579.4
130	1580	185	1582	215	1582	225	1581	235	1582
245	1584	300	1584	370	1585.5	520	1584.3	650	1584
685	1582	710	1584	890	1586	940	1588		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	940	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	940	485	485	485	.1	.3

Right Levee Station= 370 Elevation= 1585.5

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1583.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.07	Wt. n-Val.		0.050	
E.G. Elev (ft)	1583.28	Reach Len. (ft)	485.00	485.00	485.00
Crit W.S. (ft)	1581.54	Flow Area (sq ft)		534.12	
E.G. Slope (ft/ft)	0.001615	Area (sq ft)		534.12	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	235.17	Top Width (ft)		235.17	
Vel Total (ft/s)	2.06	Avg. Vel. (ft/s)		2.06	
Max Chl Dpth (ft)	3.81	Hydr. Depth (ft)		2.27	
Conv. Total (cfs)	27373.5	Conv. (cfs)		27373.5	
Length Wtd. (ft)	485.00	Wetted Per. (ft)		235.85	
Min Ch El (ft)	1579.40	Shear (lb/sq ft)		0.23	
Alpha	1.00	Stream Power (lb/ft s)		0.47	
Frctn Loss (ft)	2.04	Cum Volume (acre-ft)		51.89	
C & E Loss (ft)	0.12	Cum SA (acres)		32.00	

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 18

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1582	110	1581.1	130	1576.3	140	1576.25	150	1576.22
170	1581.82	200	1581.83	280	1581.35	360	1581.08	450	1581
520	1581.77	600	1580.98	680	1580.81	775	1580.81	870	1580.36
880	1579.01	890	1578.94	900	1580.14	1040	1582	1090	1584

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	1090	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	1090	380	380	380	.1	.3

Right Levee Station= 520 Elevation= 1581.77

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1579.86	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.26	Wt. n-Val.		0.050	
E.G. Elev (ft)	1581.12	Reach Len. (ft)	380.00	380.00	380.00
Crit W.S. (ft)	1579.86	Flow Area (sq ft)		122.04	
E.G. Slope (ft/ft)	0.027050	Area (sq ft)		122.04	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	47.81	Top Width (ft)		47.81	
Vel Total (ft/s)	9.01	Avg. Vel. (ft/s)		9.01	
Max Chl Dpth (ft)	3.64	Hydr. Depth (ft)		2.55	
Conv. Total (cfs)	6688.2	Conv. (cfs)		6688.2	
Length Wtd. (ft)		Wetted Per. (ft)		48.73	

Min Ch El (ft)	1576.22	Shear (lb/sq ft)	4.23
Alpha	1.00	Stream Power (lb/ft s)	38.12
Frctn Loss (ft)		Cum Volume (acre-ft)	48.24
C & E Loss (ft)		Cum SA (acres)	30.42

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 - 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.

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

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 17

INPUT
Description:

Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1579	45	1578	55	1574	90	1578	120	1579
240	1578	405	1579.5	580	1579	770	1578	800	1578
870	1579.5	1020	1578	1100	1580	1155	1582		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	1155	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	1155	340	340	340	.1	.3

Right Levee Station= 405 Elevation= 1579.5

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1579.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.		0.050	
E.G. Elev (ft)	1579.35	Reach Len. (ft)	340.00	340.00	340.00
Crit W.S. (ft)	1578.75	Flow Area (sq ft)		363.00	
E.G. Slope (ft/ft)	0.010828	Area (sq ft)		363.00	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	372.97	Top Width (ft)		372.97	
Vel Total (ft/s)	3.03	Avg. Vel. (ft/s)		3.03	
Max Chl Dpth (ft)	5.21	Hydr. Depth (ft)		0.97	
Conv. Total (cfs)	10571.1	Conv. (cfs)		10571.1	
Length Wtd. (ft)	340.00	Wetted Per. (ft)		374.22	
Min Ch El (ft)	1574.00	Shear (lb/sq ft)		0.66	
Alpha	1.00	Stream Power (lb/ft s)		1.99	
Frctn Loss (ft)	2.46	Cum Volume (acre-ft)		46.12	
C & E Loss (ft)	0.00	Cum SA (acres)		28.59	

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

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 16

INPUT
Description:
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1576.5	50	1576	65	1574	80	1574	90	1576
110	1574	130	1572	150	1574	175	1576	205	1576
260	1578	280	1578	510	1576.5	690	1576	720	1577.5
805	1578	850	1577.5	900	1578.2	920	1578	960	1576
970	1578	1100	1580	1140	1582				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	1140	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	1140	520	520	520	.1	.3

Right Levee Station= 260 Elevation= 1578

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1576.75	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.		0.050	
E.G. Elev (ft)	1576.89	Reach Len. (ft)	520.00	520.00	520.00
Crit W.S. (ft)	1575.45	Flow Area (sq ft)		370.03	
E.G. Slope (ft/ft)	0.005207	Area (sq ft)		370.03	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	225.75	Top Width (ft)		225.75	
Vel Total (ft/s)	2.97	Avg. Vel. (ft/s)		2.97	
Max Chl Dpth (ft)	4.75	Hydr. Depth (ft)		1.64	
Conv. Total (cfs)	15243.3	Conv. (cfs)		15243.3	
Length Wtd. (ft)	520.00	Wetted Per. (ft)		226.73	
Min Ch El (ft)	1572.00	Shear (lb/sq ft)		0.53	
Alpha	1.00	Stream Power (lb/ft s)		1.58	
Frctn Loss (ft)	4.85	Cum Volume (acre-ft)		43.26	
C & E Loss (ft)	0.02	Cum SA (acres)		26.25	

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

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 15

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1572.5	90	1572	110	1570	120	1572	280	1572
290	1570	315	1572	370	1570	380	1568	400	1570
500	1572	660	1572	670	1571.3	680	1572	750	1573
800	1572	850	1573	900	1572	970	1574	1030	1576

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	1030	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	1030	510	510	510	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1571.71	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.		0.050	
E.G. Elev (ft)	1572.02	Reach Len. (ft)	510.00	510.00	510.00
Crit W.S. (ft)		Flow Area (sq ft)		243.76	
E.G. Slope (ft/ft)	0.021365	Area (sq ft)		243.76	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	229.35	Top Width (ft)		229.35	
Vel Total (ft/s)	4.51	Avg. Vel. (ft/s)		4.51	
Max Chl Dpth (ft)	3.71	Hydr. Depth (ft)		1.06	
Conv. Total (cfs)	7525.6	Conv. (cfs)		7525.6	
Length Wtd. (ft)	510.00	Wetted Per. (ft)		230.22	
Min Ch El (ft)	1568.00	Shear (lb/sq ft)		1.41	
Alpha	1.00	Stream Power (lb/ft s)		6.37	
Frctn Loss (ft)	4.63	Cum Volume (acre-ft)		39.60	
C & E Loss (ft)	0.07	Cum SA (acres)		23.54	

Warning - Divided flow computed for this cross-section.
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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 14

INPUT
Description:
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1570	70	1568	150	1566	430	1566	440	1564
450	1566	540	1568	600	1568	620	1566	710	1568
810	1570								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	810	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	810	305	305	305	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1567.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.07	Wt. n-Val.		0.050	
E.G. Elev (ft)	1567.33	Reach Len. (ft)	305.00	305.00	305.00
Crit W.S. (ft)		Flow Area (sq ft)		505.59	
E.G. Slope (ft/ft)	0.004944	Area (sq ft)		505.59	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	475.36	Top Width (ft)		475.36	
Vel Total (ft/s)	2.18	Avg. Vel. (ft/s)		2.18	
Max Chl Dpth (ft)	3.25	Hydr. Depth (ft)		1.06	

Conv. Total (cfs)	15644.9	Conv. (cfs)	15644.9
Length Wtd. (ft)	305.00	Wetted Per. (ft)	475.86
Min Ch El (ft)	1564.00	Shear (lb/sq ft)	0.33
Alpha	1.00	Stream Power (lb/ft s)	0.71
Frctn Loss (ft)	2.63	Cum Volume (acre-ft)	35.21
C & E Loss (ft)	0.01	Cum SA (acres)	19.41

Warning - Divided flow computed for this cross-section.
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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 13

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1566	90	1564	210	1564	215	1562.5	220	1564
305	1565	400	1564	450	1564	465	1562	485	1564
490	1564	500	1562	510	1564	580	1564	620	1563
660	1564	780	1566	810	1568				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	810	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	810	310	310	310	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1564.55	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.15	Wt. n-Val.		0.050	
E.G. Elev (ft)	1564.69	Reach Len. (ft)	310.00	310.00	310.00
Crit W.S. (ft)		Flow Area (sq ft)		358.80	
E.G. Slope (ft/ft)	0.018681	Area (sq ft)		358.80	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	546.07	Top Width (ft)		546.07	
Vel Total (ft/s)	3.07	Avg. Vel. (ft/s)		3.07	
Max Chl Dpth (ft)	2.55	Hydr. Depth (ft)		0.66	
Conv. Total (cfs)	8048.1	Conv. (cfs)		8048.1	
Length Wtd. (ft)	310.00	Wetted Per. (ft)		547.18	
Min Ch El (ft)	1562.00	Shear (lb/sq ft)		0.76	
Alpha	1.00	Stream Power (lb/ft s)		2.34	
Frctn Loss (ft)	2.29	Cum Volume (acre-ft)		32.18	
C & E Loss (ft)	0.03	Cum SA (acres)		15.83	

Warning - Divided flow computed for this cross-section.
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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 12

INPUT
Description:
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1564	90	1562	155	1562	215	1562	235	1560
240	1559.5	250	1560	260	1562	375	1562	390	1560
440	1560	470	1562	580	1560	600	1560	610	1562
680	1562	690	1561	700	1562	720	1562	735	1560
750	1562	780	1564	800	1566				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	800	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	800	310	310	310	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1562.33	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.05	Wt. n-Val.		0.050	
E.G. Elev (ft)	1562.38	Reach Len. (ft)	310.00	310.00	310.00
Crit W.S. (ft)		Flow Area (sq ft)		628.63	
E.G. Slope (ft/ft)	0.003856	Area (sq ft)		628.63	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	679.69	Top Width (ft)		679.69	
Vel Total (ft/s)	1.75	Avg. Vel. (ft/s)		1.75	
Max Chl Dpth (ft)	2.83	Hydr. Depth (ft)		0.92	
Conv. Total (cfs)	17714.2	Conv. (cfs)		17714.2	
Length Wtd. (ft)	310.00	Wetted Per. (ft)		680.83	
Min Ch El (ft)	1559.50	Shear (lb/sq ft)		0.22	
Alpha	1.00	Stream Power (lb/ft s)		0.39	
Frctn Loss (ft)	2.72	Cum Volume (acre-ft)		28.67	
C & E Loss (ft)	0.05	Cum SA (acres)		11.47	

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 11

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1562	90	1560	100	1558	115	1558	150	1558
170	1556.5	190	1558	205	1560	395	1559.5	460	1558
490	1560	520	1560	525	1558	540	1558	550	1560
570	1562								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	570	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	570	300	300	300	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1559.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.51	Wt. n-Val.		0.050	
E.G. Elev (ft)	1559.60	Reach Len. (ft)	300.00	300.00	300.00
Crit W.S. (ft)	1559.10	Flow Area (sq ft)		192.75	
E.G. Slope (ft/ft)	0.036629	Area (sq ft)		192.75	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	191.11	Top Width (ft)		191.11	
Vel Total (ft/s)	5.71	Avg. Vel. (ft/s)		5.71	
Max Chl Dpth (ft)	2.60	Hydr. Depth (ft)		1.01	
Conv. Total (cfs)	5747.5	Conv. (cfs)		5747.5	
Length Wtd. (ft)	300.00	Wetted Per. (ft)		191.77	
Min Ch El (ft)	1556.50	Shear (lb/sq ft)		2.30	
Alpha	1.00	Stream Power (lb/ft s)		13.12	
Frctn Loss (ft)	0.88	Cum Volume (acre-ft)		25.75	
C & E Loss (ft)	0.14	Cum SA (acres)		8.37	

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 - Divided flow computed for this cross-section.
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: Cave Buttes Trib
REACH: 1 RS: 10

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1560	60	1558	70	1556	80	1554	90	1554
110	1554	126	1556	150	1556	210	1556	230	1556
320	1556	335	1554	350	1556	420	1558		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	420	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	420	255	255	255	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1557.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.04	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.96	Reach Len. (ft)	255.00	255.00	255.00
Crit W.S. (ft)		Flow Area (sq ft)		730.31	
E.G. Slope (ft/ft)	0.000993	Area (sq ft)		730.31	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	357.13	Top Width (ft)		357.13	
Vel Total (ft/s)	1.51	Avg. Vel. (ft/s)		1.51	
Max Chl Dpth (ft)	3.93	Hydr. Depth (ft)		2.04	

Conv. Total (cfs)	34913.5	Conv. (cfs)	34913.5
Length Wtd. (ft)	255.00	Wetted Per. (ft)	357.94
Min Ch El (ft)	1554.00	Shear (lb/sq ft)	0.13
Alpha	1.00	Stream Power (lb/ft s)	0.19
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	22.57
C & E Loss (ft)	0.01	Cum SA (acres)	6.49

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: Cave Buttes Trib
REACH: 1 RS: 9

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1558	20	1556	125	1554	130	1552	145	1552
160	1554	230	1554	290	1554	320	1554	350	1556
370	1558	390	1560						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	390	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	390	180	180	180	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1557.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.86	Reach Len. (ft)	180.00	180.00	180.00
Crit W.S. (ft)		Flow Area (sq ft)		1220.39	
E.G. Slope (ft/ft)	0.000186	Area (sq ft)		1220.39	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	367.04	Top Width (ft)		367.04	
Vel Total (ft/s)	0.90	Avg. Vel. (ft/s)		0.90	
Max Chl Dpth (ft)	5.85	Hydr. Depth (ft)		3.32	
Conv. Total (cfs)	80679.2	Conv. (cfs)		80679.2	
Length Wtd. (ft)	180.00	Wetted Per. (ft)		367.82	
Min Ch El (ft)	1552.00	Shear (lb/sq ft)		0.04	
Alpha	1.00	Stream Power (lb/ft s)		0.03	
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)		16.86	
C & E Loss (ft)	0.00	Cum SA (acres)		4.37	

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: Cave Buttes Trib
REACH: 1 RS: 8

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1554	10	1552	20	1550	70	1550	80	1552
120	1552	130	1552	135	1550	140	1550	150	1550

160	1552	180	1554	220	1556	250	1558	290	1560

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	290	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	290	100	100	100	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1557.83	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.84	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)		1323.01	
E.G. Slope (ft/ft)	0.000086	Area (sq ft)		1323.01	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	247.47	Top Width (ft)		247.47	
Vel Total (ft/s)	0.83	Avg. Vel. (ft/s)		0.83	
Max Chl Dpth (ft)	7.83	Hydr. Depth (ft)		5.35	
Conv. Total (cfs)	118551.6	Conv. (cfs)		118551.6	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		252.69	
Min Ch El (ft)	1550.00	Shear (lb/sq ft)		0.03	
Alpha	1.00	Stream Power (lb/ft s)		0.02	
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)		11.60	
C & E Loss (ft)	0.00	Cum SA (acres)		3.10	

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

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 7

INPUT
Description:
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1554	20	1552	40	1550	90	1550	120	1550
145	1552	235	1554	260	1556	290	1558		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	290	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	290	87	87	87	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	0	1560	190	290	1560

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1557.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.83	Reach Len. (ft)	87.00	87.00	87.00
Crit W.S. (ft)	1551.66	Flow Area (sq ft)		1268.78	
E.G. Slope (ft/ft)	0.000070	Area (sq ft)		1558.76	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	287.34	Top Width (ft)		287.34	
Vel Total (ft/s)	0.87	Avg. Vel. (ft/s)		0.87	

Max Chl Dpth (ft)	7.82	Hydr. Depth (ft)	6.68
Conv. Total (cfs)	131814.8	Conv. (cfs)	131814.8
Length Wtd. (ft)	87.00	Wetted Per. (ft)	194.11
Min Ch El (ft)	1550.00	Shear (lb/sq ft)	0.03
Alpha	1.00	Stream Power (lb/ft s)	0.02
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	8.30
C & E Loss (ft)	0.01	Cum SA (acres)	2.48

Warning - The cross-section end points had to be extended vertically for the computed water surface.
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: Cave Buttes Trib
REACH: 1 RS: 6

INPUT
Description:
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1560	55	1560	90	1558	180	1555	260	1554
300	1552	320	1549	360	1549	380	1552	425	1554
500	1556	590	1558						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	590	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	590	90	90	90	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	320	1559	360	590	1559

CROSS SECTION OUTPUT Profile #100-year Flood

			Left OB	Channel	Right OB
W.S. Elev (ft)	1557.65	Element			
Vel Head (ft)	0.16	Wt. n-Val.		0.050	
E.G. Elev (ft)	1557.81	Reach Len. (ft)	90.00	90.00	90.00
Crit W.S. (ft)	1551.85	Flow Area (sq ft)		345.96	
E.G. Slope (ft/ft)	0.000645	Area (sq ft)		1644.08	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	473.67	Top Width (ft)		473.67	
Vel Total (ft/s)	3.18	Avg. Vel. (ft/s)		3.18	
Max Chl Dpth (ft)	8.65	Hydr. Depth (ft)		8.65	
Conv. Total (cfs)	43320.0	Conv. (cfs)		43320.0	
Length Wtd. (ft)	90.00	Wetted Per. (ft)		40.00	
Min Ch El (ft)	1549.00	Shear (lb/sq ft)		0.35	
Alpha	1.00	Stream Power (lb/ft s)		1.11	
Frctn Loss (ft)		Cum Volume (acre-ft)		5.10	
C & E Loss (ft)		Cum SA (acres)		1.72	

CULVERT RIVER: Cave Buttes Trib
REACH: 1 RS: 5.5

INPUT
Description:
Distance from Upstream XS = 10
Deck/Roadway Width = 70

Weir Coefficient = 2.6
Bridge Deck/Roadway Skew =
Upstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	1562	1559	320	1562	1559	360	1562	1559
590	1562	1559						

Upstream Bridge Cross Section Data
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1560	55	1560	90	1558	180	1555	260	1554
300	1552	320	1549	360	1549	380	1552	425	1554
500	1556	590	1558						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	590	.05

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	590	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	320	1559	360	590	1559

Downstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	1562	1558	135	1562	1558	170	1562	1558
270	1562	1558						

Downstream Bridge Cross Section Data
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1554	110	1552	120	1550	135	1548	155	1548
170	1548	185	1550	205	1552	235	1554	270	1556

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	270	.05

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	270	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	135	1558	170	270	1558

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins = 1562
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span
Culvert #1	Circular	10	

FHWA Chart # 1 - Concrete Pipe Culvert

FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG

Culvert	Upstrm Dist	Length	n Value	Entrance Loss Coef	Exit Loss Coef
	10	70	.015	.4	1

Number of Barrels = 2
Upstream Elevation = 1549
Centerline Stations

Sta.	Sta.
333	347

Downstream Elevation = 1548
Centerline Stations

Sta.	Sta.
145.5	159.5

CULVERT OUTPUT Profile #100-year Flood
Culvert ID : Culvert #1

Culv Q (cfs)	1100.00	Culv Vel In (ft/s)	12.13
# Barrels	2	Culv Vel Out (ft/s)	15.79
Q Barrel (cfs)	550.00	Culv Inv El Up (ft)	1549.00
W.S. US. (ft)	1557.65	Culv Inv El Dn (ft)	1548.00
E.G. US. (ft)	1557.81	Culv Frctn Ls (ft)	0.47
Delta WS (ft)	5.03	Culv Ext Lss (ft)	3.09
Delta EG (ft)	4.47	Culv Ent Lss (ft)	0.91
E.G. IC (ft)	1557.30	Q Weir (cfs)	
E.G. OC (ft)	1557.81	Weir Sta Lft (ft)	
Culv WS In (ft)	1554.61	Weir Sta Rgt (ft)	
Culv WS Out (ft)	1552.56	Weir Submerg	
Culv Nml Depth (ft)	3.90	Weir Max Depth (ft)	
Culv Crt Depth (ft)	5.61	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	1562.00

Warning - Since the culvert has supercritical flow, the program should be run in mixed flow in order to check if the cross section downstream of the culvert has supercritical flow.
Note - The flow in the culvert is entirely supercritical.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 5

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1554	110	1552	120	1550	135	1548	155	1548
170	1548	185	1550	205	1552	235	1554	270	1556

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	270	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	270	180	180	180	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	135	1558	170	270	1558

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1552.62	Element	Left OB	Channel	Right OB

Vel Head (ft)	0.72	Wt. n-Val.		0.050	
E.G. Elev (ft)	1553.34	Reach Len. (ft)	180.00	180.00	180.00
Crit W.S. (ft)	1551.12	Flow Area (sq ft)		161.81	
E.G. Slope (ft/ft)	0.006795	Area (sq ft)		332.78	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	138.61	Top Width (ft)		138.61	
Vel Total (ft/s)	6.80	Avg. Vel. (ft/s)		6.80	
Max Chl Dpth (ft)	4.62	Hydr. Depth (ft)		4.62	
Conv. Total (cfs)	13344.6	Conv. (cfs)		13344.6	
Length Wtd. (ft)	180.00	Wetted Per. (ft)		35.00	
Min Ch El (ft)	1548.00	Shear (lb/sq ft)		1.96	
Alpha	1.00	Stream Power (lb/ft s)		13.33	
Frctn Loss (ft)	1.19	Cum Volume (acre-ft)		3.05	
C & E Loss (ft)	0.10	Cum SA (acres)		1.09	

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 4

INPUT
Description:
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1552	20	1550	40	1546	50	1546	70	1550
80	1552								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	80	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	80	205	205	205	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
0	0	1550

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1551.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.		0.050	
E.G. Elev (ft)	1552.05	Reach Len. (ft)	205.00	205.00	205.00
Crit W.S. (ft)	1550.10	Flow Area (sq ft)		225.30	
E.G. Slope (ft/ft)	0.006368	Area (sq ft)		225.30	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	75.23	Top Width (ft)		75.23	
Vel Total (ft/s)	4.88	Avg. Vel. (ft/s)		4.88	
Max Chl Dpth (ft)	5.68	Hydr. Depth (ft)		2.99	
Conv. Total (cfs)	13784.7	Conv. (cfs)		13784.7	
Length Wtd. (ft)	205.00	Wetted Per. (ft)		76.27	
Min Ch El (ft)	1546.00	Shear (lb/sq ft)		1.17	
Alpha	1.00	Stream Power (lb/ft s)		5.73	
Frctn Loss (ft)	1.51	Cum Volume (acre-ft)		1.90	
C & E Loss (ft)	0.02	Cum SA (acres)		0.65	

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 - The parabolic search method failed to converge on critical depth. The program will try the cross section slice/secant method to find critical depth.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 3

INPUT
Description:
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1550.5	60	1550	75	1546	80	1544	85	1543
90	1544	110	1550	160	1552				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	160	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	160	150	150	150	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

W.S. Elev (ft)	1549.90	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.61	Wt. n-Val.		0.050	
E.G. Elev (ft)	1550.52	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)		Flow Area (sq ft)		175.26	
E.G. Slope (ft/ft)	0.008665	Area (sq ft)		175.26	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	49.32	Top Width (ft)		49.32	
Vel Total (ft/s)	6.28	Avg. Vel. (ft/s)		6.28	
Max Chl Dpth (ft)	6.90	Hydr. Depth (ft)		3.55	
Conv. Total (cfs)	11816.8	Conv. (cfs)		11816.8	
Length Wtd. (ft)	150.00	Wetted Per. (ft)		51.29	
Min Ch El (ft)	1543.00	Shear (lb/sq ft)		1.85	
Alpha	1.00	Stream Power (lb/ft s)		11.60	
Frctn Loss (ft)	1.81	Cum Volume (acre-ft)		0.96	
C & E Loss (ft)	0.06	Cum SA (acres)		0.36	

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 2

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1550	75	1550.5	130	1550	145	1542	150	1541
155	1542	170	1548	180	1550	210	1552	260	1554

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	260	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	260	140	140	140	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

			Left OB	Channel	Right OB
W.S. Elev (ft)	1547.40	Element			
Vel Head (ft)	1.25	Wt. n-Val.		0.050	
E.G. Elev (ft)	1548.65	Reach Len. (ft)	140.00	140.00	140.00
Crit W.S. (ft)		Flow Area (sq ft)		122.66	
E.G. Slope (ft/ft)	0.017889	Area (sq ft)		122.66	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	33.61	Top Width (ft)		33.61	
Vel Total (ft/s)	8.97	Avg. Vel. (ft/s)		8.97	
Max Chl Dpth (ft)	6.40	Hydr. Depth (ft)		3.65	
Conv. Total (cfs)	8224.4	Conv. (cfs)		8224.4	
Length Wtd. (ft)	140.00	Wetted Per. (ft)		36.19	
Min Ch El (ft)	1541.00	Shear (lb/sq ft)		3.78	
Alpha	1.00	Stream Power (lb/ft s)		33.94	
Frctn Loss (ft)	3.29	Cum Volume (acre-ft)		0.45	
C & E Loss (ft)	0.14	Cum SA (acres)		0.21	

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.

CROSS SECTION RIVER: Cave Buttes Trib
REACH: 1 RS: 1

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1548	30	1546	65	1544	105	1544	115	1546
120	1546	130	1544	140	1540	145	1538	150	1540
160	1542	175	1544	195	1548				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	195	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	195	0	0	0	.1	.3

CROSS SECTION OUTPUT Profile #100-year Flood

			Left OB	Channel	Right OB
W.S. Elev (ft)	1544.44	Element			
Vel Head (ft)	0.78	Wt. n-Val.		0.050	
E.G. Elev (ft)	1545.22	Reach Len. (ft)			
Crit W.S. (ft)	1544.44	Flow Area (sq ft)		155.15	
E.G. Slope (ft/ft)	0.032188	Area (sq ft)		155.15	
Q Total (cfs)	1100.00	Flow (cfs)		1100.00	
Top Width (ft)	99.17	Top Width (ft)		99.17	
Vel Total (ft/s)	7.09	Avg. Vel. (ft/s)		7.09	
Max Chl Dpth (ft)	6.44	Hydr. Depth (ft)		1.56	
Conv. Total (cfs)	6131.2	Conv. (cfs)		6131.2	
Length Wtd. (ft)		Wetted Per. (ft)		101.18	
Min Ch El (ft)	1538.00	Shear (lb/sq ft)		3.08	
Alpha	1.00	Stream Power (lb/ft s)		21.85	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Warning - Divided flow computed for this cross-section.

SUMMARY OF MANNING'S N VALUES

River:Cave Buttes Trib

Reach	River Sta.	n1	n2	n3
1	22	.05	.05	.05
1	21	.05	.05	.05
1	20	.05	.05	.05
1	19	.05	.05	.05
1	18	.05	.05	.05
1	17	.05	.05	.05
1	16	.05	.05	.05
1	15	.05	.05	.05
1	14	.05	.05	.05
1	13	.05	.05	.05
1	12	.05	.05	.05
1	11	.05	.05	.05
1	10	.05	.05	.05
1	9	.05	.05	.05
1	8	.05	.05	.05
1	7	.05	.05	.05
1	6	.05	.05	.05
1	5.5	Culvert		
1	5	.05	.05	.05
1	4	.05	.05	.05
1	3	.05	.05	.05
1	2	.05	.05	.05
1	1	.05	.05	.05

SUMMARY OF REACH LENGTHS

River: Cave Buttes Trib

Reach	River Sta.	Left	Channel	Right
1	22	260	260	260
1	21	240	240	240
1	20	450	450	450
1	19	485	485	485
1	18	380	380	380
1	17	340	340	340
1	16	520	520	520
1	15	510	510	510
1	14	305	305	305
1	13	310	310	310
1	12	310	310	310
1	11	300	300	300
1	10	255	255	255
1	9	180	180	180
1	8	100	100	100

1	7	87	87	87
1	6	90	90	90
1	5.5	Culvert		
1	5	180	180	180
1	4	205	205	205
1	3	150	150	150
1	2	140	140	140
1	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Cave Buttes Trib

Reach	River Sta.	Contr.	Expan.
1	22	.1	.3
1	21	.1	.3
1	20	.1	.3
1	19	.1	.3
1	18	.1	.3
1	17	.1	.3
1	16	.1	.3
1	15	.1	.3
1	14	.1	.3
1	13	.1	.3
1	12	.1	.3
1	11	.1	.3
1	10	.1	.3
1	9	.1	.3
1	8	.1	.3
1	7	.1	.3
1	6	.1	.3
1	5.5	Culvert	
1	5	.1	.3
1	4	.1	.3
1	3	.1	.3
1	2	.1	.3
1	1	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	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)	Fr
1	1	1100.00	1538.00	1544.44	1544.44	1545.22	0.032188	7.09	155.15	99.17	
1	2	1100.00	1541.00	1547.40		1548.65	0.017889	8.97	122.66	33.61	
1	3	1100.00	1543.00	1549.90		1550.52	0.008665	6.28	175.26	49.32	
1	4	1100.00	1546.00	1551.68	1550.10	1552.05	0.006368	4.88	225.30	75.23	
1	5	1100.00	1548.00	1552.62	1551.12	1553.34	0.006795	6.80	161.81	138.61	
1	5.5	Culvert									
1	6	1100.00	1549.00	1557.65	1551.85	1557.81	0.000645	3.18	345.96	473.67	
1	7	1100.00	1550.00	1557.82	1551.66	1557.83	0.000070	0.87	1268.78	287.34	
1	8	1100.00	1550.00	1557.83		1557.84	0.000086	0.83	1323.01	247.47	
1	9	1100.00	1552.00	1557.85		1557.86	0.000186	0.90	1220.39	367.04	
1	10	1100.00	1554.00	1557.93		1557.96	0.000993	1.51	730.31	357.13	
1	11	1100.00	1556.50	1559.10	1559.10	1559.60	0.036629	5.71	192.75	191.11	

1	12	1100.00	1559.50	1562.33		1562.38	0.003856	1.75	628.63	679.69
1	13	1100.00	1562.00	1564.55		1564.69	0.018681	3.07	358.80	546.07
1	14	1100.00	1564.00	1567.25		1567.33	0.004944	2.18	505.59	475.36
1	15	1100.00	1568.00	1571.71		1572.02	0.021365	4.51	243.76	229.35
1	16	1100.00	1572.00	1576.75	1575.45	1576.89	0.005207	2.97	370.03	225.75
1	17	1100.00	1574.00	1579.21	1578.75	1579.35	0.010828	3.03	363.00	372.97
1	18	1100.00	1576.22	1579.86	1579.86	1581.12	0.027050	9.01	122.04	47.81
1	19	1100.00	1579.40	1583.21	1581.54	1583.28	0.001615	2.06	534.12	235.17
1	20	1100.00	1580.00	1583.65	1581.16	1583.68	0.000553	1.39	792.41	282.67
1	21	1100.00	1584.00	1587.10	1587.10	1587.57	0.037259	5.48	200.60	214.32
1	22	1100.00	1586.00	1591.18	1590.52	1591.28	0.007331	2.52	435.64	440.64