

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

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RECORD OF CHANGES

Rev No.	Description of Changes	Pages Revised	Pages Added	Pages Replaced
0	Original Issue	N/A	N/A	N/A
1	Add Attachment 11	4		
1	Delete Item 2 "Probable Maximum Runoff Peak Qp(max)" in Table 6	17		
1	Add paragraphs for inclusion of additional PMF case with CN=96 and Tc=4.17 hours. Revise Table 7 to include additional PMF case.	18		
1	Revised Figures 5,6,7,8 to include water level line for the additional PMF			19, 20
1	Add rail road water level for the additional PMF(shaded). Correct version 0 water levels at west end of rail road on page 21. As shaded	21		
1	Re-address result/conclusion for inclusion of additional PMF.			
1	Revise Figure 9 to include additional PMF water surface elev. and flood boundaries	23		

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1, OBJECTIVES

The objective of the calculation is to determine water surface elevation in the flood way crossing the 3-mile portion of the proposed rail spur. The 100-year and the PMF (Probable Maximum Flow) flood events are evaluated based on the existing natural ground topography.

2, REFERENCES

1. U.S. Department of Commerce, National Oceanic And Atmospheric Administration, 1977, "Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainage" Hydrometeorological Report No. 49.
2. "Runoff Estimates for small Rural Watersheds and Development of a Sound Design Method" 1977, Federal Highway Administration. Report No. FHWA-RD-77-159.
3. "Nationwide Summary of U.S. Geological Survey Regional Regression Equations for Estimating Magnitude and Frequency of Flood for Ungaged Sites" 1993. U.S. Geological Survey, Water-Resources Investigation Report 94-4002.
4. U.S.Army Corps of Engineers, Hydrologic Center, "HEC-RAS, River Analysis System", 1997.
5. Calculation 05996.01-G(B)-10, Rev 0, "HEC-RAS Micro Computer Version 1.2 Software Test", May 20, 1997.
6. U.S.Army Corps of Engineers, Office of the Chief Engineers, "HEC-1, Flood Hydrograph Package", 1981.
7. Calculation 05996.01-G(B)-08, Rev 1, "HEC-1 Flood Hydrograph Package, Micro Computer Version 4.0 Software Test, QS 2-7", May 20, 1997.
8. "Engineering Hydrology" by Victor M. Ponce.
9. USGS topographic maps (1:24,000 scale):
 - (1) Hickman Knolls
 - (2) Tabbys Peak
 - (3) Tabby's Peak, SW
 - (4) Tabby's Peak, SE
10. "Time of Concentration vs Drainage Area for Mountain Watershed in Utah", U.S. Corps of Engineers (Provided by Water Resource Dept., State of Utah).
11. Calculation 0599602-G(B)-17, rev 1 "PFSF Flood Analysis With Proposed Access Road and Rail Road".

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3, DESCRIPTION

The estimation of the flood level elevation involves two steps:

- (1) Perform hydrological analysis to determine PMF and the 100-year flood flows.
- (2) Perform hydraulic analysis to calculate water surface elevation of the flows.

3.1, Determine Probable Maximum Flood (PMF) Flow

The first step to determine PMF is to calculate Probable Maximum Precipitation (PMP) using data and procedures provided in Reference 1. The PMP is then input to the HEC-1 program (Reference 6) to calculate the runoff hydrograph. The peak value of the hydrograph is taken as the PMF flow.

This calculation use the following HEC-1 program input options:

- (1) The Soil Conservation Service (SCS) Curve Number 70 is assumed to account for the infiltration and other precipitation losses.
- (2) Conversion from precipitation excess (precipitation - infiltration and other losses) to runoff hydrograph is accomplished by using SCS dimensionless unit hydrograph method (a HEC-1 input option). The unit hydrograph for the 64 square mile basin is synthesized based on the dimensionless hydrograph through the "lag time" parameter. In this calculation, the lag time parameter is approximated = 0.6 times T_c , the concentration time.
- (3) The concentration time is estimated in Section 5.

3.2, Determine 100-year Flood Flow

The 100-year flow is the design basis for the railroad embankment, culverts, or the trestles.

Two methods are used to estimate the 100-year flood flow:

- (1) FHWA method - FHWA (Federal Highway Administration) has developed a method to estimate peak runoff based on hydrological analysis of many small watersheds. The step-by-step procedure of this method is described in Ref. 2.
- (2) USGS Method - The USGS has also developed flood-regionalization procedure to predict the magnitude of peak runoff. The 50 states are divided into several "hydrophysiographic" zones. Within each zone, regression equations are developed to compute peak runoff for various return periods of flood.

The larger flow calculated from the 2 methods is taken as the 100-year flood flow.

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3.3, Water Surface Elevation

Water surface elevation is calculated using HEC-RAS program (References. 4 and 5). The geometry of the flood way channel is from the USGS topographic maps (Ref. 9). Only the targeted portion of the flood way that runs through the proposed 3-mile-long railroad is analyzed.

3.4, Computer Programs

As mentioned above, the HEC-1 Program is used to perform hydrological analysis for the PMF. The HEC-RAS program is used to calculate water surface for both PMF and 100-year flood. The two programs have been test and qualified by Stone & Webster (References 4, 5, 6, and 7) for used in the QA Category 1 analysis.

4, DRAINAGE BASIN

The drainage area in which the runoff concentrates to the proposed 3-mile railroad is outlined in Figure 1. The area is about 64 square miles and the centroid of the area is located at:

Latitude: 40°21'
Longitude: 112°52'

The distance from the farthest point of the basin boundary to the railroad is about 9 miles.

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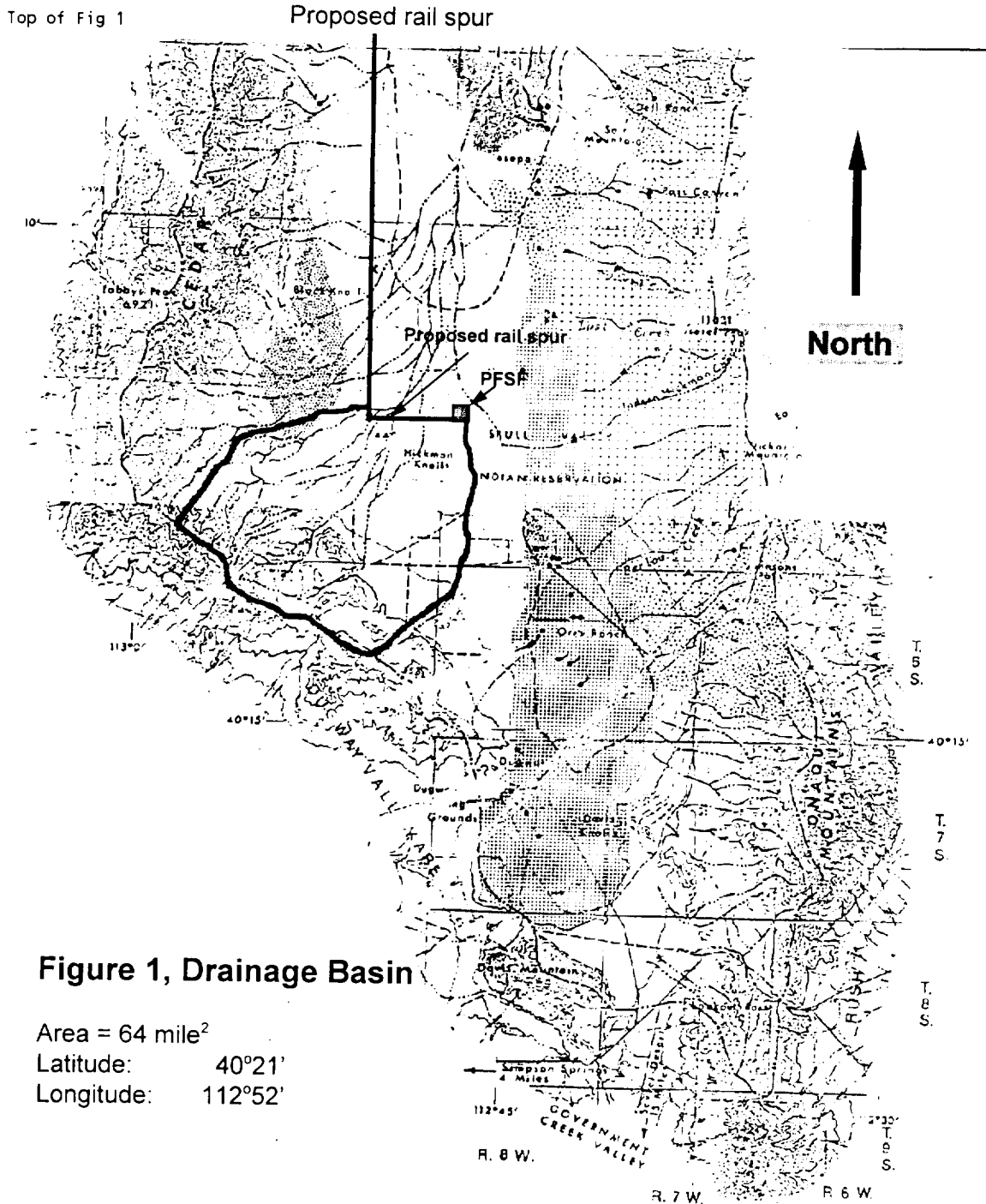


Figure 1, Drainage Basin

Area = 64 mile²

Latitude: 40°21'

Longitude: 112°52'

Base from Army Map Service 1:250,000
series: Toocle (1962)

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS
DATUM IS MEAN SEA LEVEL

End of Figure 1

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5, CONCENTRATION TIME

The concentration time is estimated using two methods as follows:

- (1) Using Hathaway Equation (Ref. 8), the concentration time is calculated in Table 1. The 'n' term in the equation is to account for the soil types.

$$T_c = 4.26 \text{ hours}$$

Table 1

PFSF, Calculate Concentration Time Using Hathaway Equation

Hathaway Formula: $T_c = 0.0606 \times (L \times n)^{0.467} / S^{0.234}$, n is the roughness for various types of surface
L is in kilo-meter, s=slope, m/m
Tc is in hour.

From Elev 1 ft	To Elev 2 ft	L mile	L ft	L Km	S	n	Tc hour
6220	4900	4.8	25344	7.7	0.052083	0.6	2.48 Timber land
4900	4550	4.0	21120	6.4	0.016572	0.2	1.78 Pasture
Total		8.8					4.26

- (2) The second method uses the regression equation (Figure 2) developed by U.S. Corps of Engineers (Ref. 10).

$$T_c = 0.6 \times \text{Area}^{0.466}, \text{ Area is in Mile}^2, T_c \text{ in hours.}$$

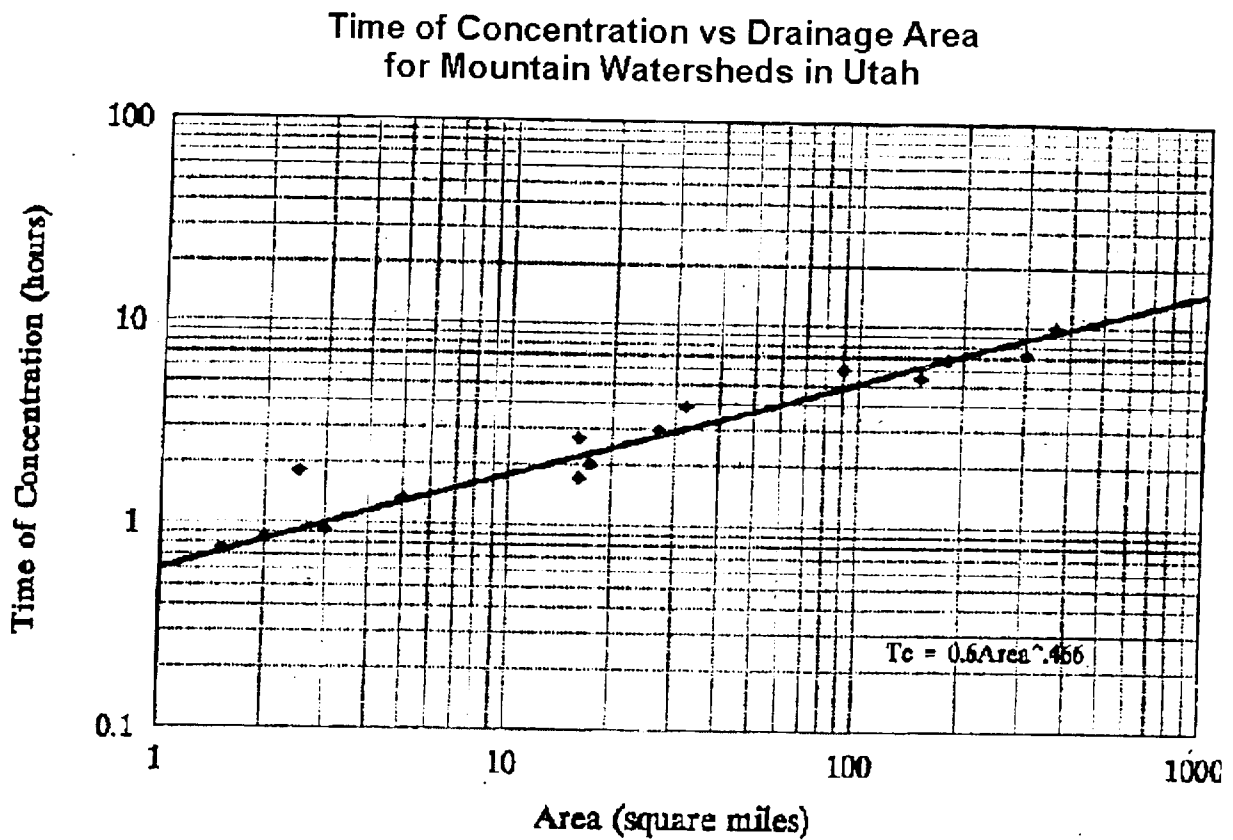
$$T_c = 0.6 \times \text{Area}^{0.466} = 0.6 \times 64^{0.466} = 4.17 \text{ hours}$$

- (3) Result of Concentration Time : **Tc = 4.17 hours**

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Figure 2



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6, PMF

As described in Ref. 1, two possible types of PMF may occur in the basin: (1) General Storm PMF - A combined effect of the convergence precipitation and the orographic precipitation. The convergence precipitation is caused by cooling of the moist air as the air current is lifted. The orographic precipitation is caused by lifting of moist horizontal air current over the mountain range or other natural barrier. (2) Local PMF - While the general storm PMF is usually a major concern, precipitation during a summer thunder storm having the greatest potential rainfall intensity and short durations may produce a larger runoff. This type of runoff is termed as local storm PMF in Reference 1.

6.1, General Storm PMF

Table 2 computes general storm PMP for the 6, 12, 18, 24, 48, and 72 hours in the item designates as "C, Total PMP", and the results are plotted in Figure 3. The values of the 3-hour interval precipitation are read from the figure and listed in Table 3 with the 6 calculated PMP's.

Table 3 also calculates 3-hour incremental precipitation. The 4-18 hour incremental, which is equal to the sum of the 3-hour incremental within the 18 hour, are calculated to be 7.20, 2.47, 1.66, and 0.87 inches. It indicates that the magnitude of the 4 18-hour increments are in the descending order.

For the HEC-1 input, the 4 18-hour incremental is re-distributed in the 3-1-2-4 sequence. The resulting HEC-1 input data is listed in the last column of Table 3.

HEC-1 program input and output is included in Attachment 1. The result of the peak runoff hydrograph is

$$Q_{\text{general PMF}} = 20,972 \text{ cfs.}$$

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Table 2, Determining General Storm PMP (Refer all figures and tables to Ref. 1)

PFSF, General Storm PMP Computation

Based on NOAA Report No. 49 "Probable Maximum Precipitation Estimates, Basin Drainages, Colorado River and Great Basin Drainages".

Drainage: Floodway at 3-mile-long Rail Crossing
Area (mi²): 64 mi²

Latitude: 40°21'
Longitude: 112°52'

Month: August

A. Convergence PMP

- | | | |
|-------------------------------|----------------|---------|
| 1. Drainage average value | Fig 2.5 - 2.16 | 10.5 in |
| 2. Reduction for barrier elev | Fig 2.18 | 55 % |
| 3. Barrier-elev reduced PMP | 1 x 2 | 5.8 in |

		Duration (hrs)					
		6	12	18	24	48	72
4. Duration variation	Fig 2.25 - 2.27, & Table 2.7	68	85	94	100	116	123 %
5. Convergence PMP for indicated duration	3 x 4	3.9	4.9	5.4	5.8	6.7	7.1 in
6. Incremental 10 mi ² PMP	Successive - of 5	3.9	1.0	0.5	0.3	0.9	0.4 in
7. Area reduction	Fig 2.28 & 2.29	86	95.5	97.5	99	100	100 %
8. Areally reduced PMP	6 x 7	3.4	1.0	0.5	0.3	0.9	0.4 in
9. Drainage average PMP	Accu 8	3.4	4.3	4.8	5.2	6.1	6.5 in

B. Orographic PMP

- | | | |
|---|-----------------|--------|
| 1. Drainage average orographic index | Fig 3.11a - d | 3.2 in |
| 2. Areal reduction | Fig 3.20 | 95 % |
| 3. Adjustment for month | Fig 3.12 - 3.17 | 100 % |
| 4. Areally & seasonally adjustmmented PMP | 1 x 2 x 3 | 3.0 in |

		Duration (hrs)					
		6	12	18	24	48	72
5. Durational variation	Table 3.9	29.5	56.5	79.5	100	159.5	188 %
6. Orographic PMP for given duration	4 x 5	0.9	1.7	2.4	3.0	4.8	5.7 in

C. Total PMP

- | | | | | | | | |
|---|-----|-----|-----|-----|------|------|----|
| 1. A9+B6 | 4.2 | 6.0 | 7.2 | 8.2 | 10.9 | 12.2 | in |
| 2. PMP for other duration from smooth curve fitted to plot of computed data | | | | | | | |
| 3. Compare with local-storm PMP | | | | | | | |

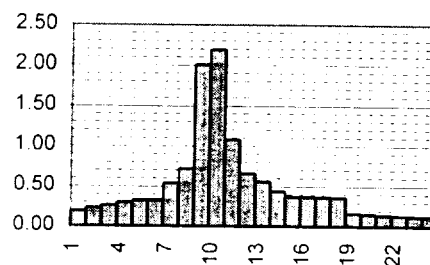
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Table 3, General Storm, incremental precipitation for HEC-1 input

Determination of 3 hour Precipitation, Precipitation Incremental and Hyetograph

Time Hour	Precipitation in		3-hour Incremental in	18-hour Incremental in	HEC-1 input Hyetograph in
0	0.00				
3	2.19	1	2.19		0.20
6	4.20		2.01		0.23
9	5.28		1.08		0.26
12	6.00		0.72		0.31
15	6.66		0.66		0.33
18	7.20		0.54	7.20	0.33
21	7.76	2	0.56		0.54
24	8.20		0.44		0.72
27	8.57		0.37		2.01
30	8.94		0.37		2.19
33	9.31		0.37		1.08
36	9.67		0.36	2.47	0.66
39	10.00	3	0.33		0.56
42	10.33		0.33		0.44
45	10.64		0.31		0.37
48	10.90		0.26		0.37
51	11.14		0.23		0.37
54	11.33		0.20	1.66	0.36
57	11.50	4	0.16		0.16
60	11.64		0.15		0.16
63	11.77		0.13		0.15
66	11.90		0.13		0.14
69	12.04		0.14		0.13
72	12.20		0.16	0.87	0.13

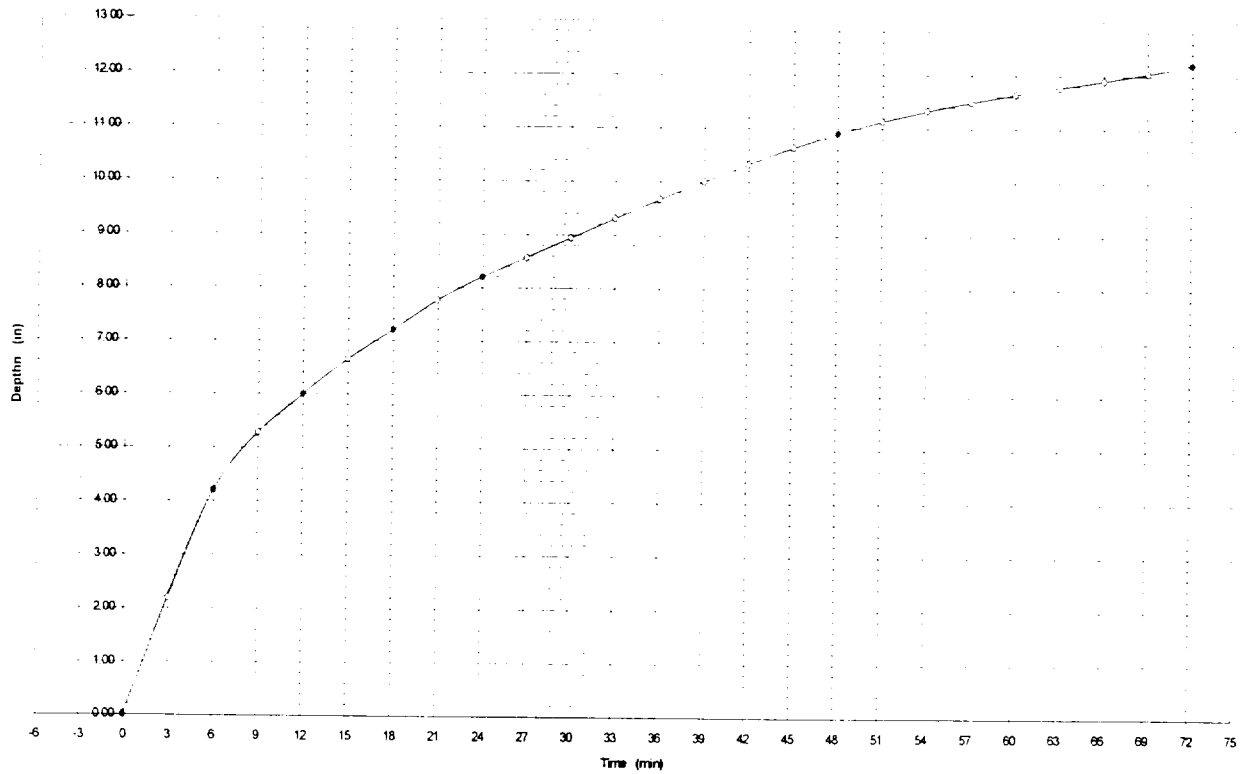


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Figure 3

General Storm PMP



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6.2, Local Storm PMF

Table 4 computes local storm PMP for the ¼, 2/4, ¾, 1, 2, 3, 4, 5, and 6 hours in the row designates as “7, Area reduced PMP”. The 9 calculated values are plotted in Figure 4. The 15 minute precipitation depths are read from the curve and listed in Table 5.

Table 5 also calculates the 15-min and the 1-hour increment. The magnitudes of the incremental precipitations are in the descending order.

For the HEC-1 input, the 6 1-hour increments is re-distributed in the order of 5-3-1-2-4-6 sequence in the last column.

The HEC-1 program input and output is shown in Attachment 2. The result of the peak runoff hydrograph is

$$Q_{\text{Local PMF}} = 68,500 \text{ cfs.}$$

Table 4, computation of Local Storm PMP

PFSS, Local Storm PMP Computation													
Based on NOAA Report No. 49 "Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages"													
Drainage: Floodway at 3-mile-long rail crossing			Latitude: 40°21'										
Area (mi ²):		64 mi ²	Longitude: 112°52'		Minimum Elev: 4470 ft								
1 Average 1-hr 1 mi2 PMP for drange			Fig 4.5, Page 115		9.8 in								
2a. Reduction for elev													
No adjustment up to 5000'													
5% decrease/1000' above 5000'					100.0 %								
2b. 1 x 2a					9.8 in								
3 Average 6/1 hour ratio for drainage			Fig 4.7 - Page 118		1.3								
					Duration (hrs)								
					0.25	0.50	0.75	1.00	2.00	3.00	4.00	5.00	6.00
4. Durational variation for 6/1-hr ratio of 3			Table 4.4, Page 120		74	89	95	100	114	121	125	128	130 %
5. 1-mi2 PMP for indicated durations			2b x 4		7.3	8.7	9.3	9.8	11.2	11.9	12.3	12.5	12.7 in
6 Areal reduction			Fig 4.9, Page 123		58.0	65.0	68.0	70.0	74.0	76.0	77	79	80 %
7 Area reduced PMP			5 x 6		4.2	5.7	6.3	6.9	8.3	9.0	9.4	9.9	10.2 in
8. Incremental PMP			Success (-) in 7										
			15 min increments										
					4.2	1.5	0.7	0.5					
								6.9	1.4	0.7	0.4	0.5	0.3 in

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Table 5, Local thunder Storm, incremental precipitation for HEC-1 input

Determination of 15 min Precipitation, Precipitation Incremental and Hyetograph

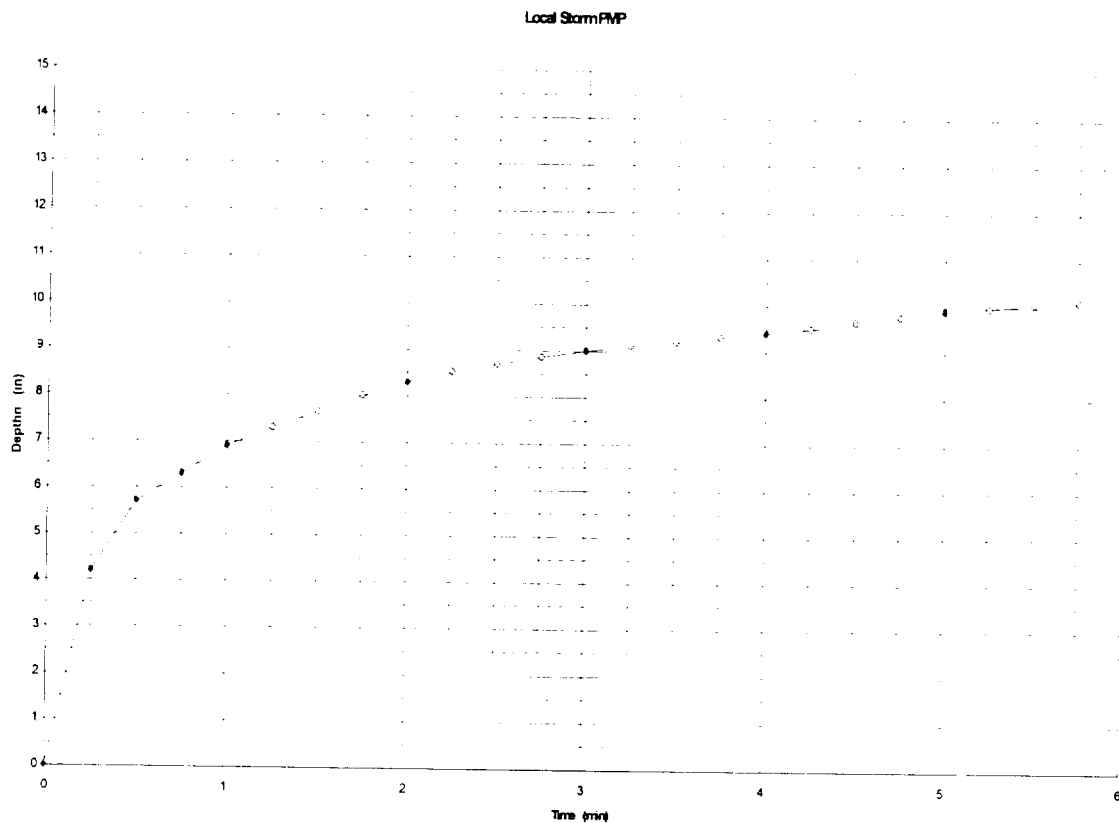
Time Hour	Precipitation in		15-min Increment in	1-hour Increment in	5-3-1-2-4-6 HEC-1 Hyetograph in
0	0				
0.25	4.20	1	4.20		5
0.50	5.70		1.50		0.10
0.75	6.30		0.60		0.12
1.00	6.90		0.60	6.90	0.13
1.25	7.30	2	0.40		0.15
1.50	7.65		0.35		3
1.75	8.00		0.35		0.14
2.00	8.30		0.30	1.40	0.16
2.25	8.53	3	0.23		0.17
2.50	8.70		0.17		1
2.75	8.86		0.16		0.60
3.00	9.00		0.14	0.70	1.50
3.25	9.12	4	0.12		4.20
3.50	9.20		0.08		0.60
3.75	9.31		0.11		2
4.00	9.40		0.09	0.40	0.40
4.25	9.50	5	0.10		0.35
4.50	9.65		0.15		0.35
4.75	9.77		0.12		0.30
5.00	9.90		0.13	0.50	4
5.25	9.97	6	0.07		0.12
5.50	10.06		0.09		0.11
5.75	10.11		0.05		0.09
6.00	10.20		0.09	0.30	0.08
					0.09
					0.07
					0.05



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Figure 4



6.3, Result of PMF Flow

From Sections 6.1 and 6.2, the result of runoff for the general storm PMF and the local storm PMF is

$$\begin{aligned}Q_{\text{Local Storm PMF}} &= 68,500 \text{ cfs.} \\Q_{\text{General Storm PMF}} &= 20,972 \text{ cfs.}\end{aligned}$$

Since the peak runoff caused by a local thunder storm is larger than that of a general storm, the PMF flow to be used for the water surface profile calculation is

$$Q_{\text{PMF}} = 68,500 \text{ cfs.}$$

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7, 100-YEAR FLOOD FLOW

Methods for estimating 100-year flood flow, Q_{100} , were described in Section 3. The computation procedure is shown in Table 6. The result is

$$Q_{100} = 1,400 \text{ cfs}$$

Table 6, Calculation of 100-year flow using FHWA and USGS methods

PFSF

Determination of the 100-year Flow

FHWA Method

1 Area= 64 sq mi
Latitude= 40°21'
Longitude= 112°52'

This item does not apply
to this calculation and is deleted in rev 1.

2 Probable Maximum Runoff Peak $Q_p(\max)$

log(Area)= 1.81
Exp= 5.28
 $Q_p(\max)$ = 190806.8 cfs

Probable Maximum runoff peak

3 Hydrophysiographic Parameters

3a	R=	16	Iso-rodent factor Appendix C-49
3b	DH=	1630 ft	Elevation different. 6100-4470
3c	S=	0	Water storage
3d	Zone	17	Hydrophysiographic zone, Appendix B-49
3e	L=	8.33 miles	Length of main channel
3f	P60=	1 inch	10-year, 60-min rainfall, Appendix D-49
3g	LL=	65 miles	Cumulative channel length
3h	P10=	3.29 inch	10-year, 10-min rainfall intensity, Appendix E-49

4 10-year Runoff Q_{10}

Q_{10} =	699 cfs	3 parameter equation
Q_{10} =	543 cfs	5 parameter equation
Q_{10} =	433 cfs	7 parameter equation

5 Skip

6	Q_{100} =	1390.6	3 parameter equation
	Q_{100} =	1073.5	5 parameter equation
	Q_{100} =	849.1	7 parameter equation

USGS Method

$$Q_{100} = 68.1 \times \text{Area}^{0.63}$$

A= 64.0 mi²
 Q_{100} = 935.5 cfs

Conclusion Q_{100} =1400 cfs

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8, WATER SURFACE ELEVATION

Water surface elevations of the PMF flood and the 100-year flood are calculated using HEC-RAS program (Ref. 4). The location of the 4 cross-sections, A, B, C, and D, are shown in Figure 9. The geometry of the cross-sections are from USGS topographic maps (1/24,000 scale), (Ref. 9).

Based on SCS curve number CN = 70 and concentration time $T_c = 4.17$ hours, the PMF flow: Q_{PMF} is determined = 68,500 cfs (Section 6.3). This calculation also analyzes an additional case assuming a more conservative CN = 96 and the same $T_c = 4.17$ hours, which resulted in $Q_{PMF} = 102,000$ cfs. The computation of this flow is documented in Attachment 1 of Reference 11.

The flows to be used for the water surface profile computation are summarized below:

QPMF (CN=96, $T_c=4.17$ hours):	102,000 cfs
QPMF (CN=70, $T_c=4.17$ hours):	68,500 cfs
Q100:	1,400 cfs

The result of the water surface profile is listed in Table 7. Plots of the flood limit is shown in Figure 9, and water levels for the 4 cross sections are shown in Figures 5 to 8.

The HEC-RAS program input and out listing is documented in Attachments 5.

Table 7, Summary of HEC-RAS Result -Water Surface Profile

	River Sta	Section	Profile	Q Total (cfs)	W.S. Elev (ft)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
West	9000	A	PMF CN=96	102000.00	4521.50	20468.55	13953.74	0.72
West	9000	A	PMF CN=70	68500.00	4521.18	16051.76	13836.12	0.70
West	9000	A	100-yr Q	1400.00	4520.33	4396.99	13520.86	0.10
West	5000	B	PMF CN=96	102000.00	4481.46	16987.01	12193.87	0.89
West	5000	B	PMF CN=70	68500.00	4481.17	13440.93	11973.78	0.84
West	5000	B	100-yr Q	1400.00	4480.10	1087.56	11173.24	0.73
West	2000	C	PMF CN=96	102000.00	4462.37	22650.49	10497.66	0.54
West	2000	C	PMF CN=70	68500.00	4461.87	17437.58	10092.58	0.52
West	2000	C	100-yr Q	1400.00	4460.16	1362.04	8725.78	0.46
West	0	D	PMF CN=96	102000.00	4454.26	21916.52	9970.69	0.55
West	0	D	PMF CN=70	68500.00	4453.68	16407.09	8776.07	0.54
West	0	D	100-yr Q	1400.00	4450.45	927.70	2285.89	0.42

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Figure 5

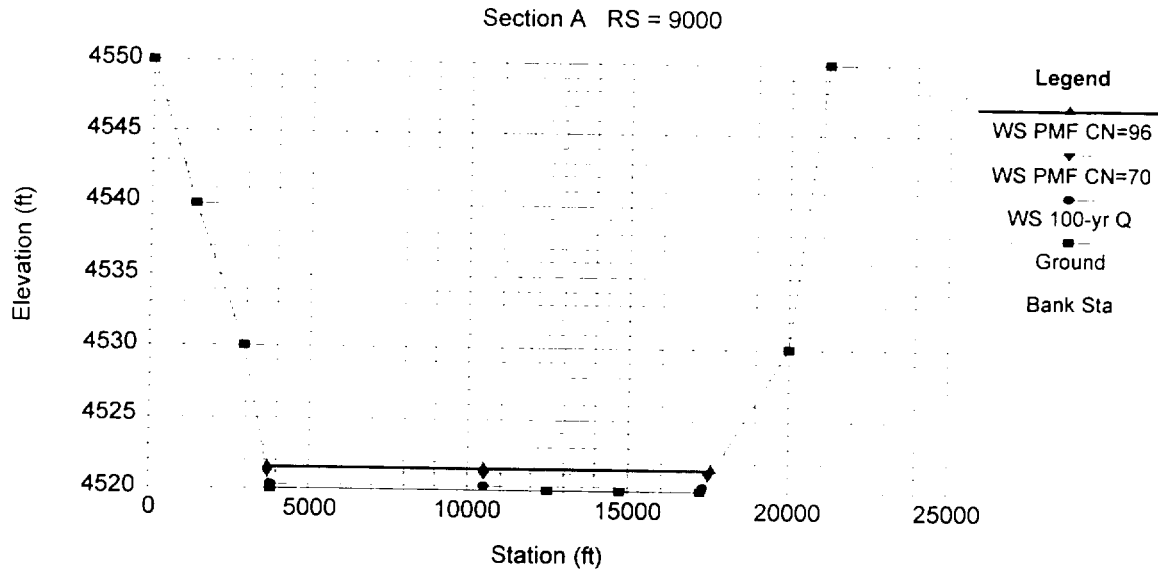
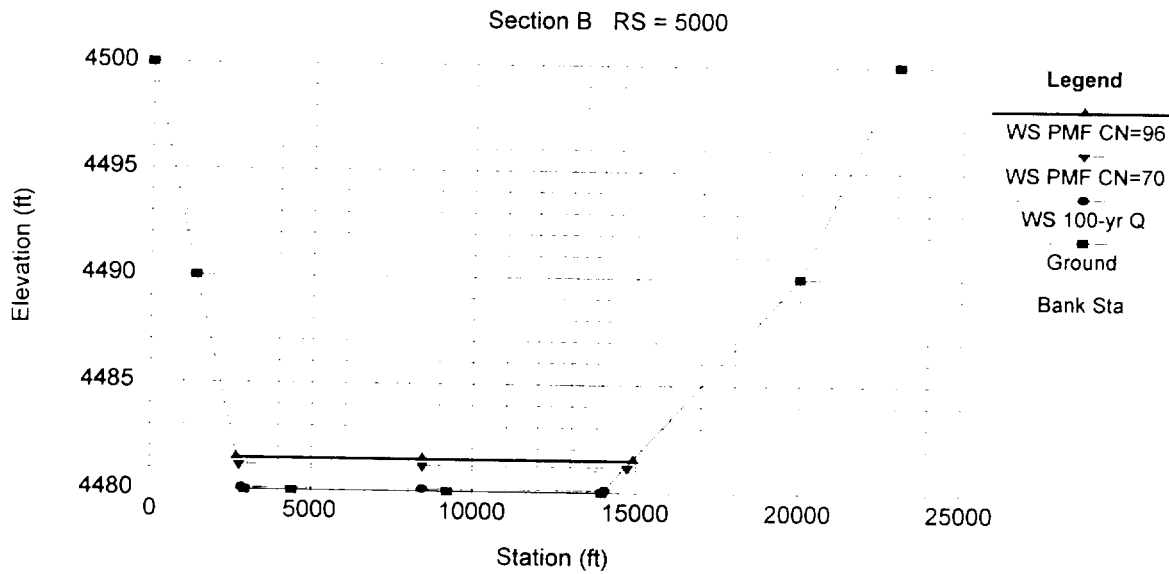


Figure 6



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Figure 7

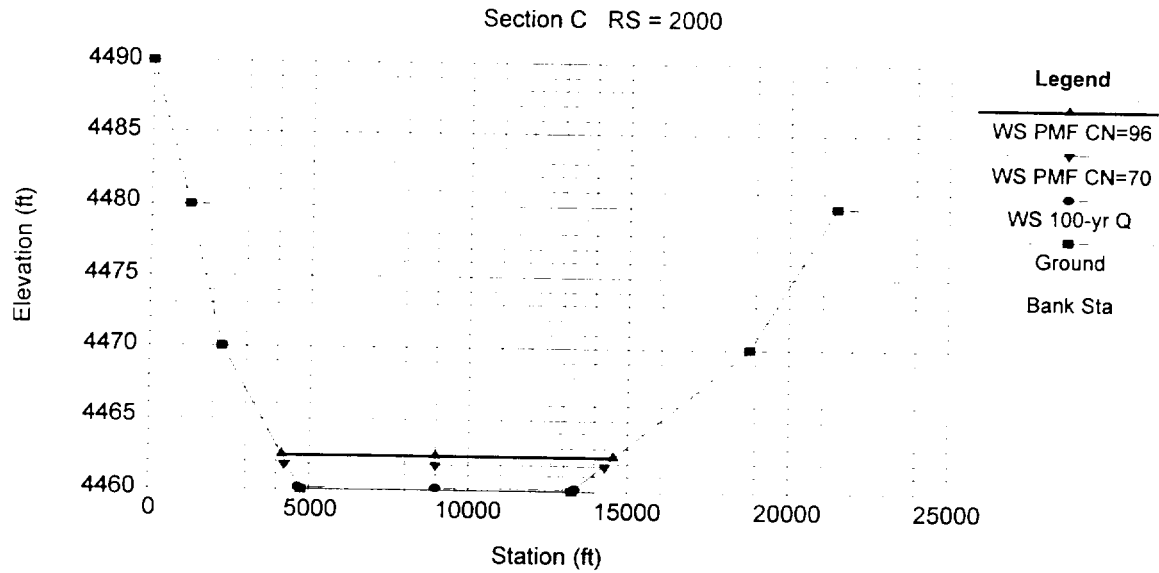
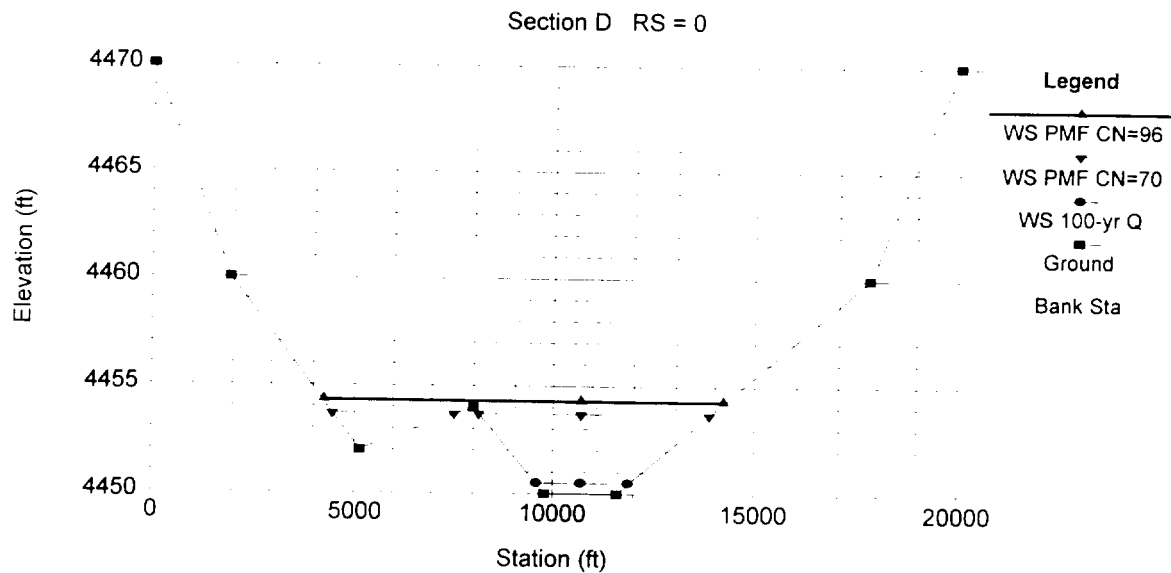


Figure 8



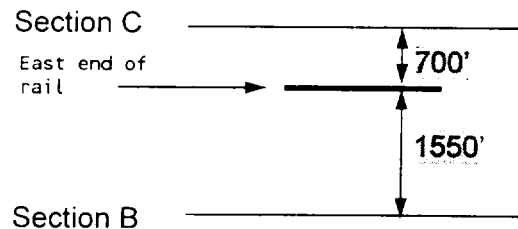
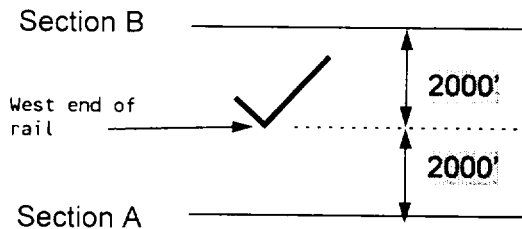
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9, WATER LEVEL AT THE EAST-WEST PORTION OF THE RAIL LINE

Flood level at the rail road is interpolated from the adjacent cross sections where water surface elevation are computed (refer to Table 7 and Figure 9).

		W.S.elev at west end (ft)		W.S.elev at east end (ft)
$Q_{PMF} = 102,000$ cfs	Section A	4521.50	Section B	4481.46
	Rail	4501.48	Rail	4468.31
	Section B	4481.46	Section C	4462.37
$Q_{PMF} = 68,500$ cfs	Section A	4521.18	Section B	4481.17
	Rail	4501.18	Rail	4467.87
	Section B	4481.17	Section C	4461.87
$Q_{100} = 1,400$ cfs	Section A	4520.33	Section B	4480.10
	Rail	4500.22	Rail	4466.36
	Section B	4480.10	Section C	4460.16



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10, RESULT AND CONCLUSION

The result of the hydrological computation indicated that the peak runoff of the PMF and the 100-year flood are:

PMF using CN=96 and Tc=4.17 hours	Q = 102,000 cfs
PMF using CN=70 and Tc=4.17 hours	Q = 68,500 cfs
100-year flood	Q ₁₀₀ = 1400 cfs

Water levels near the PFSF site (Table 7, River Station 2000, Section C):

PMF, Q = 102,000 cfs	4462.37 ft
PMF, Q = 68,500 cfs	4461.87 ft
100-year flood	4460.16 ft

The PFSF grade elevation at the same cross section is about $(4476+4462)/2 = 4469$ ft, which is 7 ft above the flood level.

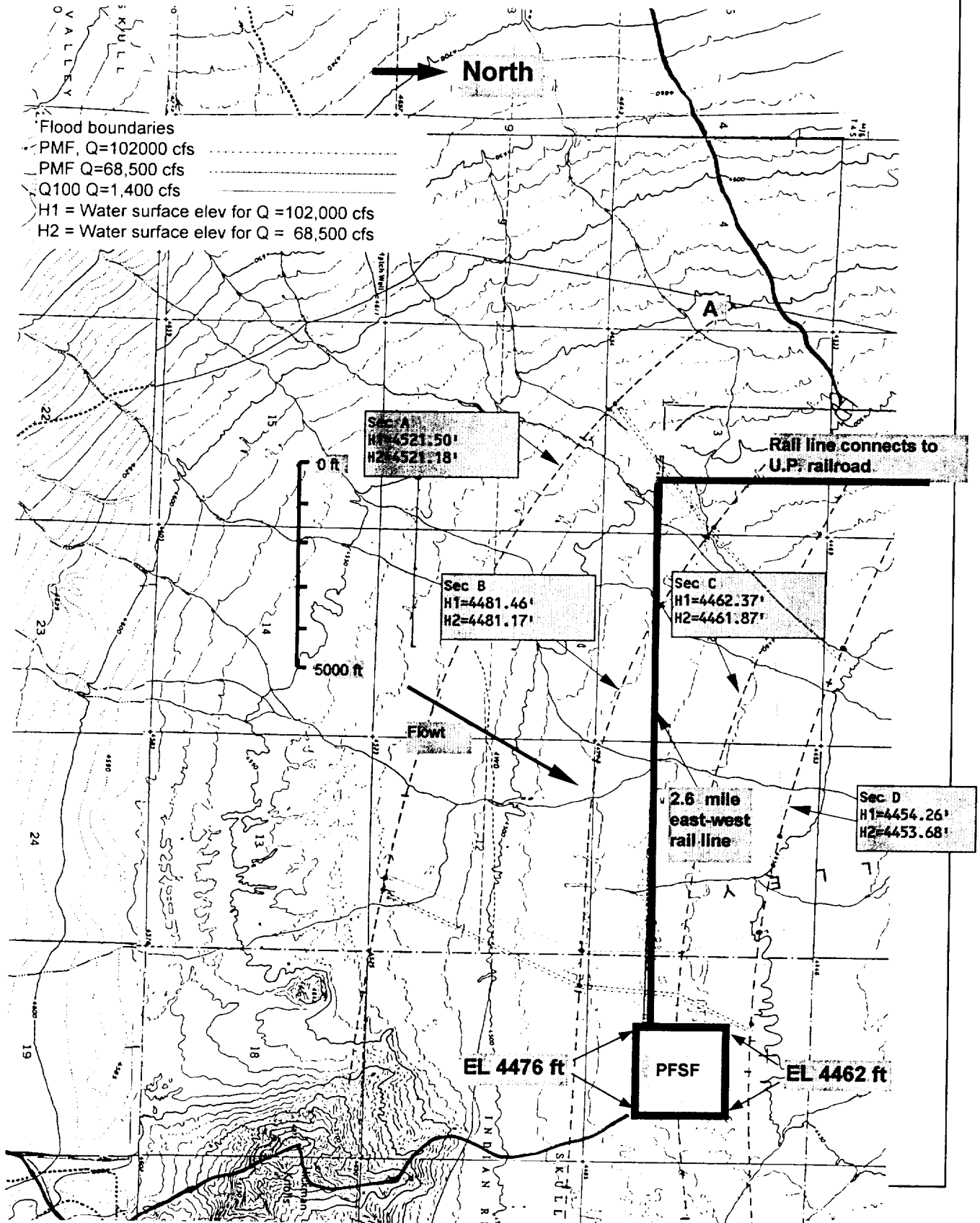
The estimated water levels at the proposed 3-mile-long railroad are:

	West End	East End
PMF, Q=102,000 cfs	4501.48 ft	4468.31 ft
PMF, Q= 68,500 cfs	4501.18ft	4467.87 ft
100-year flood event	4500.22 ft	4466.36 ft

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Figure 9, HEC-RAS Cross Sections and Calculated Floodway Boundaries.



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ATTACHMENT 1, GENERAL STORM PMF, HEC-1 INPUT

ID PFSF (Private Fuel Storage Facility Project)
ID General PMF AT the 3-mile-long rail spur
ID
ID
IT 60 200
IO 2
PG 60
IN 180
PI 0.20 0.23 0.26 0.31 0.33 0.33 0.54 0.72 2.01 2.19
PI 1.08 0.66 0.56 0.44 0.37 0.37 0.37 0.36 0.16 0.16
PI 0.15 0.14 0.13 0.13
KK 010
KM SCS DIMENSIONLESS UNIT HYDROGRAPH
BA 64.0
BF -1 1.06
PR 60
LS 0 70 1
UD 2.5
ZZ

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G(B)

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16, rev 1

OPTIONAL TASK CODE
NA

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ATTACHMENT 2, GENERAL STORM PMF, HEC-1 OUTPUT

```

*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* SEPTEMBER 1990
* VERSION 4.0
*
* RUN DATE 03/08/1999 TIME 11:03:32
*
*****

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*****
*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

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

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

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

1

HEC-1 INPUT

PAGE 1

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1	ID PFSF (Private Fuel Storage Facility Project)
2	ID General PMF AT the 3-mile-long rail spur
3	ID
4	ID
5	IT 60 200
6	IO 2
7	PG 60
8	IN 180
9	PI 0.20 0.23 0.26 0.31 0.33 0.33 0.54 0.72 2.01 2.19

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10	PI	1.08	0.66	0.56	0.44	0.37	0.37	0.37	0.36	0.16	0.16
11	PI	0.15	0.14	0.13	0.13						
12	KK	010									
13	KM	SCS DIMENSIONLESS UNIT HYDROGRAPH									
14	BA	64.0									
15	BF	-1		1.06							
16	PR	60									
17	LS	0	70	1							
18	UD	2.5									
19	ZZ										

 *
 * FLOOD HYDROGRAPH PACKAGE (HEC-1) *
 * SEPTEMBER 1990 *
 * VERSION 4.0 *
 *
 * RUN DATE 03/08/1999 TIME 11:03:32 *
 *

 *
 * U.S. ARMY CORPS OF ENGINEERS *
 * HYDROLOGIC ENGINEERING CENTER *
 * 609 SECOND STREET *
 * DAVIS, CALIFORNIA 95616 *
 * (916) 756-1104 *
 *

PFSF (Private Fuel Storage Facility Project)
 General PMF AT the 3-mile-long rail spur

6 IO OUTPUT CONTROL VARIABLES
 IPRNT 2 PRINT CONTROL
 IPLOT 0 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE

8 IN TIME DATA FOR INPUT TIME SERIES
 JXMIN 180 TIME INTERVAL IN MINUTES
 JXDATE 1 0 STARTING DATE
 JXTIME 0 STARTING TIME

IT HYDROGRAPH TIME DATA
 NMIN 60 MINUTES IN COMPUTATION INTERVAL
 IDATE 1 0 STARTING DATE
 ITIME 0000 STARTING TIME
 NQ 200 NUMBER OF HYDROGRAPH ORDINATES
 NDDATE 9 0 ENDING DATE
 NDTIME 0700 ENDING TIME
 ICENT 19 CENTURY MARK

COMPUTATION INTERVAL 1.00 HOURS
 TOTAL TIME BASE 199.00 HOURS

ENGLISH UNITS

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

*** **

* *
12 KK * 010 *
* *

SCS DIMENSIONLESS UNIT HYDROGRAPH

SUBBASIN RUNOFF DATA

14 BA SUBBASIN CHARACTERISTICS
TAREA 64.00 SUBBASIN AREA

15 BF BASE FLOW CHARACTERISTICS
STRFQ 64.00 INITIAL FLOW
QRCSN .00 BEGIN BASE FLOW RECESSION
RTIOR 1.06000 RECESSION CONSTANT

PRECIPITATION DATA

16 PR RECORDING STATIONS 60
0 PW WEIGHTS 1.00

17 LS SCS LOSS RATE
STRFL .86 INITIAL ABSTRACTION
CRVNBR 70.00 CURVE NUMBER
RTIMP 1.00 PERCENT IMPERVIOUS AREA

18 UD SCS DIMENSIONLESS UNITGRAPH
TLAG 2.50 LAG

PRECIPITATION STATION DATA

STATION	TOTAL	AVG. ANNUAL	WEIGHT
60	12.20	.00	1.00

TEMPORAL DISTRIBUTIONS

STATION 60, WEIGHT = 1.00

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.07	.07	.07	.08	.08	.08	.09	.09	.09	.10
.10	.10	.11	.11	.11	.11	.11	.11	.18	.18
.18	.24	.24	.24	.67	.67	.67	.73	.73	.73
.36	.36	.36	.22	.22	.22	.19	.19	.19	.15
.15	.15	.12	.12	.12	.12	.12	.12	.12	.12
.12	.12	.12	.12	.05	.05	.05	.05	.05	.05
.05	.05	.05	.05	.05	.05	.04	.04	.04	.04
.04	.04								

UNIT HYDROGRAPH
15 END-OF-PERIOD ORDINATES

2378.	7925.	10337.	8614.	5100.	2894.	1726.	1003.	569.	338.
196.	114.	72.	34.	0.					

HYDROGRAPH AT STATION 010

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	.00	.00	.00	64.	*	5		0400	101	.00	.00	.00	0.
1		0100	2	.07	.07	.00	62.	*	5		0500	102	.00	.00	.00	0.
1		0200	3	.07	.07	.00	64.	*	5		0600	103	.00	.00	.00	0.
1		0300	4	.07	.07	.00	67.	*	5		0700	104	.00	.00	.00	0.
1		0400	5	.08	.08	.00	70.	*	5		0800	105	.00	.00	.00	0.
1		0500	6	.08	.08	.00	72.	*	5		0900	106	.00	.00	.00	0.
1		0600	7	.08	.08	.00	72.	*	5		1000	107	.00	.00	.00	0.
1		0700	8	.09	.09	.00	72.	*	5		1100	108	.00	.00	.00	0.
1		0800	9	.09	.09	.00	71.	*	5		1200	109	.00	.00	.00	0.
1		0900	10	.09	.09	.00	71.	*	5		1300	110	.00	.00	.00	0.
1		1000	11	.10	.10	.00	70.	*	5		1400	111	.00	.00	.00	0.
1		1100	12	.10	.10	.00	71.	*	5		1500	112	.00	.00	.00	0.
1		1200	13	.10	.10	.01	83.	*	5		1600	113	.00	.00	.00	0.
1		1300	14	.11	.10	.01	130.	*	5		1700	114	.00	.00	.00	0.
1		1400	15	.11	.09	.02	225.	*	5		1800	115	.00	.00	.00	0.
1		1500	16	.11	.09	.02	361.	*	5		1900	116	.00	.00	.00	0.
1		1600	17	.11	.09	.02	518.	*	5		2000	117	.00	.00	.00	0.
1		1700	18	.11	.08	.03	683.	*	5		2100	118	.00	.00	.00	0.
1		1800	19	.11	.08	.03	847.	*	5		2200	119	.00	.00	.00	0.
1		1900	20	.18	.12	.06	1061.	*	5		2300	120	.00	.00	.00	0.
1		2000	21	.18	.11	.07	1411.	*	6		0000	121	.00	.00	.00	0.
1		2100	22	.18	.11	.07	1848.	*	6		0100	122	.00	.00	.00	0.
1		2200	23	.24	.13	.11	2348.	*	6		0200	123	.00	.00	.00	0.
1		2300	24	.24	.12	.12	2954.	*	6		0300	124	.00	.00	.00	0.
2		0000	25	.24	.11	.13	3613.	*	6		0400	125	.00	.00	.00	0.
2		0100	26	.67	.27	.40	4846.	*	6		0500	126	.00	.00	.00	0.
2		0200	27	.67	.23	.44	7519.	*	6		0600	127	.00	.00	.00	0.
2		0300	28	.67	.19	.48	11035.	*	6		0700	128	.00	.00	.00	0.
2		0400	29	.73	.17	.56	14470.	*	6		0800	129	.00	.00	.00	0.
2		0500	30	.73	.15	.58	17373.	*	6		0900	130	.00	.00	.00	0.
2		0600	31	.73	.13	.60	19788.	*	6		1000	131	.00	.00	.00	0.

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2	0700	32	.36	.06	.30	20972.	*	6	1100	132	.00	.00	.00	0.
2	0800	33	.36	.05	.31	19906.	*	6	1200	133	.00	.00	.00	0.
2	0900	34	.36	.05	.31	17653.	*	6	1300	134	.00	.00	.00	0.
2	1000	35	.22	.03	.19	15329.	*	6	1400	135	.00	.00	.00	0.
2	1100	36	.22	.03	.19	13202.	*	6	1500	136	.00	.00	.00	0.
2	1200	37	.22	.03	.19	11321.	*	6	1600	137	.00	.00	.00	0.
2	1300	38	.19	.02	.16	9850.	*	6	1700	138	.00	.00	.00	0.
2	1400	39	.19	.02	.17	8806.	*	6	1800	139	.00	.00	.00	0.
2	1500	40	.19	.02	.17	8051.	*	6	1900	140	.00	.00	.00	0.
2	1600	41	.15	.02	.13	7454.	*	6	2000	141	.00	.00	.00	0.
2	1700	42	.15	.02	.13	6880.	*	6	2100	142	.00	.00	.00	0.
2	1800	43	.15	.02	.13	6352.	*	6	2200	143	.00	.00	.00	0.
2	1900	44	.12	.01	.11	5904.	*	6	2300	144	.00	.00	.00	0.
2	2000	45	.12	.01	.11	5510.	*	7	0000	145	.00	.00	.00	0.
2	2100	46	.12	.01	.11	5175.	*	7	0100	146	.00	.00	.00	0.
2	2200	47	.12	.01	.11	4927.	*	7	0200	147	.00	.00	.00	0.
2	2300	48	.12	.01	.11	4785.	*	7	0300	148	.00	.00	.00	0.
3	0000	49	.12	.01	.11	4711.	*	7	0400	149	.00	.00	.00	0.
3	0100	50	.12	.01	.11	4670.	*	7	0500	150	.00	.00	.00	0.
3	0200	51	.12	.01	.11	4650.	*	7	0600	151	.00	.00	.00	0.
3	0300	52	.12	.01	.11	4642.	*	7	0700	152	.00	.00	.00	0.
3	0400	53	.12	.01	.11	4634.	*	7	0800	153	.00	.00	.00	0.
3	0500	54	.12	.01	.11	4612.	*	7	0900	154	.00	.00	.00	0.
3	0600	55	.12	.01	.11	4586.	*	7	1000	155	.00	.00	.00	0.
3	0700	56	.05	.00	.05	4420.	*	7	1100	156	.00	.00	.00	0.
3	0800	57	.05	.00	.05	3926.	*	7	1200	157	.00	.00	.00	0.
3	0900	58	.05	.00	.05	3290.	*	7	1300	158	.00	.00	.00	0.
3	1000	59	.05	.00	.05	2762.	*	7	1400	159	.00	.00	.00	0.
3	1100	60	.05	.00	.05	2450.	*	7	1500	160	.00	.00	.00	0.
3	1200	61	.05	.00	.05	2273.	*	7	1600	161	.00	.00	.00	0.
3	1300	62	.05	.00	.05	2161.	*	7	1700	162	.00	.00	.00	0.
3	1400	63	.05	.00	.05	2076.	*	7	1800	163	.00	.00	.00	0.
3	1500	64	.05	.00	.05	2011.	*	7	1900	164	.00	.00	.00	0.
3	1600	65	.05	.00	.04	1957.	*	7	2000	165	.00	.00	.00	0.
3	1700	66	.05	.00	.04	1906.	*	7	2100	166	.00	.00	.00	0.
3	1800	67	.05	.00	.04	1860.	*	7	2200	167	.00	.00	.00	0.
3	1900	68	.04	.00	.04	1817.	*	7	2300	168	.00	.00	.00	0.
3	2000	69	.04	.00	.04	1773.	*	8	0000	169	.00	.00	.00	0.
3	2100	70	.04	.00	.04	1731.	*	8	0100	170	.00	.00	.00	0.
3	2200	71	.04	.00	.04	1699.	*	8	0200	171	.00	.00	.00	0.
3	2300	72	.04	.00	.04	1680.	*	8	0300	172	.00	.00	.00	0.
4	0000	73	.04	.00	.04	1670.	*	8	0400	173	.00	.00	.00	0.
4	0100	74	.00	.00	.00	1569.	*	8	0500	174	.00	.00	.00	0.
4	0200	75	.00	.00	.00	1248.	*	8	0600	175	.00	.00	.00	0.
4	0300	76	.00	.00	.00	831.	*	8	0700	176	.00	.00	.00	0.
4	0400	77	.00	.00	.00	485.	*	8	0800	177	.00	.00	.00	0.
4	0500	78	.00	.00	.00	280.	*	8	0900	178	.00	.00	.00	0.
4	0600	79	.00	.00	.00	163.	*	8	1000	179	.00	.00	.00	0.
4	0700	80	.00	.00	.00	94.	*	8	1100	180	.00	.00	.00	0.
4	0800	81	.00	.00	.00	54.	*	8	1200	181	.00	.00	.00	0.
4	0900	82	.00	.00	.00	31.	*	8	1300	182	.00	.00	.00	0.
4	1000	83	.00	.00	.00	17.	*	8	1400	183	.00	.00	.00	0.
4	1100	84	.00	.00	.00	9.	*	8	1500	184	.00	.00	.00	0.

STONE & WEBSTER ENGINEERING CORPORATION
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4	1200	85	.00	.00	.00	5.	*	8	1600	185	.00	.00	.00	0.
4	1300	86	.00	.00	.00	2.	*	8	1700	186	.00	.00	.00	0.
4	1400	87	.00	.00	.00	0.	*	8	1800	187	.00	.00	.00	0.
4	1500	88	.00	.00	.00	0.	*	8	1900	188	.00	.00	.00	0.
4	1600	89	.00	.00	.00	0.	*	8	2000	189	.00	.00	.00	0.
4	1700	90	.00	.00	.00	0.	*	8	2100	190	.00	.00	.00	0.
4	1800	91	.00	.00	.00	0.	*	8	2200	191	.00	.00	.00	0.
4	1900	92	.00	.00	.00	0.	*	8	2300	192	.00	.00	.00	0.
4	2000	93	.00	.00	.00	0.	*	9	0000	193	.00	.00	.00	0.
4	2100	94	.00	.00	.00	0.	*	9	0100	194	.00	.00	.00	0.
4	2200	95	.00	.00	.00	0.	*	9	0200	195	.00	.00	.00	0.
4	2300	96	.00	.00	.00	0.	*	9	0300	196	.00	.00	.00	0.
5	0000	97	.00	.00	.00	0.	*	9	0400	197	.00	.00	.00	0.
5	0100	98	.00	.00	.00	0.	*	9	0500	198	.00	.00	.00	0.
5	0200	99	.00	.00	.00	0.	*	9	0600	199	.00	.00	.00	0.
5	0300	100	.00	.00	.00	0.	*	9	0700	200	.00	.00	.00	0.

TOTAL RAINFALL = 12.20, TOTAL LOSS = 3.93, TOTAL EXCESS = 8.27

PEAK FLOW	TIME		6-HR	24-HR	72-HR	199.00-HR
+	(CFS)	(HR)				
		(CFS)				
+	20972.	31.00	18432.	10489.	4751.	1722.
		(INCHES)	2.678	6.095	8.283	8.299
		(AC-FT)	9140.	20804.	28273.	28326.

CUMULATIVE AREA = 64.00 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
+									
+	HYDROGRAPH AT								
	010	20972.	31.00	18432.	10489.	4751.	64.00		

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

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ATTACHMENT 3, LOCAL STORM PMF, HEC-1 INPUT

ID PFSF (Private Fuel Storage Facility Project)
ID LOCAL PMF AT 3-MILE-LONG RAIL SPUR
ID
ID
IT 5 200
IO 2
PG 60
IN 15
PI 0.10 0.12 0.13 0.15 0.14 0.16 0.17 0.23 0.60 1.50
PI 4.20 0.60 0.40 0.35 0.35 0.30 0.12 0.11 0.09 0.08
PI 0.09 0.09 0.07 0.05
KK 010
KM SCS DIMENSIONLESS UNIT HYDROGRAPH
BA 64.0
BF -1 1.06
PR 60
LS 0 70 1
UD 2.5
ZZ

ATTACHMENT 4, LOCAL STORM PMF, HEC-1 OUTPUT

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*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* SEPTEMBER 1990
* VERSION 4.0
*
* RUN DATE 03/08/1999 TIME 11:53:14
*
*****

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*****
*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
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X X XXXXXXX XXXX X
X X X X X XX
X X X X X
XXXXXXX XXXX X XXXXX X
X X X X X
X X X X X
X X XXXXXXX XXXX XXX

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

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

1

HEC-1 INPUT

PAGE 1

LINE	ID	1	2	3	4	5	6	7	8	9	10	
1	ID	PFSF (Private Fuel Storage Facility Project)										
2	ID	LOCAL PMF AT 3-MILE-LONG RAIL SPUR										
3	ID											
4	ID											
5	IT	5	200									
6	IO	2										
7	PG	60										
8	IN	15										
9	PI	0.10	0.12	0.13	0.15	0.14	0.16	0.17	0.23	0.60	1.50	
10	PI	4.20	0.60	0.40	0.35	0.35	0.30	0.12	0.11	0.09	0.08	
11	PI	0.09	0.09	0.07	0.05							
12	KK	010										
13	KM	SCS DIMENSIONLESS UNIT HYDROGRAPH										
14	BA	64.0										
15	BF	-1	1.06									
16	PR	60										
17	LS	0	70	1								
18	UD	2.5										
19	ZZ											

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*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* SEPTEMBER 1990
* VERSION 4.0
*
* RUN DATE 03/08/1999 TIME 11:53:14
*
*****

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```

*****
*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

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PFSF (Private Fuel Storage Facility Project)
 LOCAL PMF AT 3-MILE-LONG RAIL SPUR

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NA

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6 IO OUTPUT CONTROL VARIABLES
 IPRNT 2 PRINT CONTROL
 IPLOT 0 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE

8 IN TIME DATA FOR INPUT TIME SERIES
 JXMIN 15 TIME INTERVAL IN MINUTES
 JXDATE 1 0 STARTING DATE
 JXTIME 0 STARTING TIME

IT HYDROGRAPH TIME DATA
 NMIN 5 MINUTES IN COMPUTATION INTERVAL
 IDATE 1 0 STARTING DATE
 ITIME 0000 STARTING TIME
 NQ 200 NUMBER OF HYDROGRAPH ORDINATES
 NDDATE 1 0 ENDING DATE
 NDTIME 1635 ENDING TIME
 ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
 TOTAL TIME BASE 16.58 HOURS

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

*** **

 *
 12 KK * 010 *
 *

SCS DIMENSIONLESS UNIT HYDROGRAPH

SUBBASIN RUNOFF DATA

14 BA SUBBASIN CHARACTERISTICS
 TAREA 64.00 SUBBASIN AREA

15 BF BASE FLOW CHARACTERISTICS
 STRTQ 64.00 INITIAL FLOW
 ORCSN .00 BEGIN BASE FLOW RECESSON

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RTIOR 1.06000 RECESSION CONSTANT

PRECIPITATION DATA

16 PR RECORDING STATIONS 60
0 PW WEIGHTS 1.00

17 LS SCS LOSS RATE
STRTL .86 INITIAL ABSTRACTION
CRVNR 70.00 CURVE NUMBER
RTIMP 1.00 PERCENT IMPERVIOUS AREA

18 UD SCS DIMENSIONLESS UNITGRAPH
TLAG 2.50 LAG

PRECIPITATION STATION DATA

STATION	TOTAL	AVG. ANNUAL	WEIGHT
60	10.20	.00	1.00

TEMPORAL DISTRIBUTIONS

STATION	60,	WEIGHT	=	1.00						
.03	.03	.03	.04	.04	.04	.04	.04	.04	.04	.05
.05	.05	.05	.05	.05	.05	.05	.05	.05	.06	.06
.06	.08	.08	.08	.20	.20	.20	.20	.50	.50	.50
1.40	1.40	1.40	.20	.20	.20	.13	.13	.13	.13	.12
.12	.12	.12	.12	.12	.10	.10	.10	.10	.04	.04
.04	.04	.04	.04	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.02	.02	.02	.02	.02
.02	.02									

UNIT HYDROGRAPH

152 END-OF-PERIOD ORDINATES

120.	239.	359.	630.	909.	1189.	1540.	1899.	2258.	2718.
3197.	3675.	4282.	4920.	5558.	6286.	7044.	7802.	8476.	9114.
9752.	10261.	10699.	11138.	11457.	11697.	11936.	12066.	12105.	12145.
12145.	12105.	12066.	11936.	11697.	11457.	11202.	10923.	10644.	10350.
10031.	9712.	9369.	8970.	8572.	8153.	7674.	7195.	6733.	6334.
5935.	5554.	5275.	4996.	4721.	4481.	4242.	4005.	3805.	3606.
3406.	3261.	3115.	2970.	2824.	2678.	2533.	2411.	2291.	2171.
2052.	1932.	1812.	1724.	1645.	1565.	1485.	1405.	1326.	1260.
1200.	1140.	1080.	1020.	961.	910.	867.	823.	779.	735.
691.	654.	624.	594.	564.	534.	505.	478.	456.	434.
412.	390.	368.	348.	332.	316.	300.	284.	268.	253.
241.	229.	217.	205.	193.	182.	174.	166.	158.	150.
142.	134.	129.	124.	119.	115.	110.	105.	100.	96.
91.	86.	81.	76.	72.	67.	62.	58.	54.	50.
46.	42.	38.	34.	30.	26.	22.	18.	14.	10.
6.	2.								

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HYDROGRAPH AT STATION 010

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	.00	.00	.00	64.	*	1		0820	101	.00	.00	.00	21042.
1		0005	2	.03	.03	.00	64.	*	1		0825	102	.00	.00	.00	20056.
1		0010	3	.03	.03	.00	64.	*	1		0830	103	.00	.00	.00	19093.
1		0015	4	.03	.03	.00	63.	*	1		0835	104	.00	.00	.00	18154.
1		0020	5	.04	.04	.00	63.	*	1		0840	105	.00	.00	.00	17259.
1		0025	6	.04	.04	.00	63.	*	1		0845	106	.00	.00	.00	16418.
1		0030	7	.04	.04	.00	63.	*	1		0850	107	.00	.00	.00	15634.
1		0035	8	.04	.04	.00	64.	*	1		0855	108	.00	.00	.00	14878.
1		0040	9	.04	.04	.00	64.	*	1		0900	109	.00	.00	.00	14143.
1		0045	10	.04	.04	.00	65.	*	1		0905	110	.00	.00	.00	13431.
1		0050	11	.05	.05	.00	65.	*	1		0910	111	.00	.00	.00	12746.
1		0055	12	.05	.05	.00	66.	*	1		0915	112	.00	.00	.00	12095.
1		0100	13	.05	.05	.00	67.	*	1		0920	113	.00	.00	.00	11480.
1		0105	14	.05	.05	.00	69.	*	1		0925	114	.00	.00	.00	10889.
1		0110	15	.05	.05	.00	70.	*	1		0930	115	.00	.00	.00	10319.
1		0115	16	.05	.05	.00	72.	*	1		0935	116	.00	.00	.00	9769.
1		0120	17	.05	.05	.00	75.	*	1		0940	117	.00	.00	.00	9245.
1		0125	18	.05	.05	.00	77.	*	1		0945	118	.00	.00	.00	8752.
1		0130	19	.05	.05	.00	80.	*	1		0950	119	.00	.00	.00	8293.
1		0135	20	.06	.06	.00	84.	*	1		0955	120	.00	.00	.00	7859.
1		0140	21	.06	.06	.00	87.	*	1		1000	121	.00	.00	.00	7444.
1		0145	22	.06	.05	.00	92.	*	1		1005	122	.00	.00	.00	7049.
1		0150	23	.08	.07	.01	97.	*	1		1010	123	.00	.00	.00	6674.
1		0155	24	.08	.07	.01	103.	*	1		1015	124	.00	.00	.00	6325.
1		0200	25	.08	.07	.01	112.	*	1		1020	125	.00	.00	.00	6003.
1		0205	26	.20	.16	.04	125.	*	1		1025	126	.00	.00	.00	5699.
1		0210	27	.20	.15	.05	146.	*	1		1030	127	.00	.00	.00	5408.
1		0215	28	.20	.14	.06	177.	*	1		1035	128	.00	.00	.00	5129.
1		0220	29	.50	.30	.20	237.	*	1		1040	129	.00	.00	.00	4863.
1		0225	30	.50	.25	.25	335.	*	1		1045	130	.00	.00	.00	4613.
1		0230	31	.50	.22	.28	477.	*	1		1050	131	.00	.00	.00	4379.
1		0235	32	1.40	.47	.93	765.	*	1		1055	132	.00	.00	.00	4159.
1		0240	33	1.40	.33	1.07	1225.	*	1		1100	133	.00	.00	.00	3946.
1		0245	34	1.40	.24	1.16	1873.	*	1		1105	134	.00	.00	.00	3743.
1		0250	35	.20	.03	.17	2705.	*	1		1110	135	.00	.00	.00	3549.
1		0255	36	.20	.03	.17	3754.	*	1		1115	136	.00	.00	.00	3365.
1		0300	37	.20	.03	.17	5037.	*	1		1120	137	.00	.00	.00	3193.
1		0305	38	.13	.02	.12	6465.	*	1		1125	138	.00	.00	.00	3032.
1		0310	39	.13	.02	.12	8055.	*	1		1130	139	.00	.00	.00	2877.
1		0315	40	.13	.02	.12	9821.	*	1		1135	140	.00	.00	.00	2728.
1		0320	41	.12	.01	.10	11769.	*	1		1140	141	.00	.00	.00	2586.
1		0325	42	.12	.01	.10	13929.	*	1		1145	142	.00	.00	.00	2452.
1		0330	43	.12	.01	.10	16319.	*	1		1150	143	.00	.00	.00	2326.
1		0335	44	.12	.01	.10	18929.	*	1		1155	144	.00	.00	.00	2207.
1		0340	45	.12	.01	.10	21784.	*	1		1200	145	.00	.00	.00	2094.

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1	0345	46	.12	.01	.10	24902.	*	1	1205	146	.00	.00	.00	1985.
1	0350	47	.10	.01	.09	28196.	*	1	1210	147	.00	.00	.00	1881.
1	0355	48	.10	.01	.09	31651.	*	1	1215	148	.00	.00	.00	1784.
1	0400	49	.10	.01	.09	35272.	*	1	1220	149	.00	.00	.00	1693.
1	0405	50	.04	.00	.04	38878.	*	1	1225	150	.00	.00	.00	1610.
1	0410	51	.04	.00	.04	42382.	*	1	1230	151	.00	.00	.00	1530.
1	0415	52	.04	.00	.04	45762.	*	1	1235	152	.00	.00	.00	1454.
1	0420	53	.04	.00	.03	48973.	*	1	1240	153	.00	.00	.00	1381.
1	0425	54	.04	.00	.03	51963.	*	1	1245	154	.00	.00	.00	1313.
1	0430	55	.04	.00	.03	54702.	*	1	1250	155	.00	.00	.00	1251.
1	0435	56	.03	.00	.03	57210.	*	1	1255	156	.00	.00	.00	1194.
1	0440	57	.03	.00	.03	59468.	*	1	1300	157	.00	.00	.00	1139.
1	0445	58	.03	.00	.03	61446.	*	1	1305	158	.00	.00	.00	1087.
1	0450	59	.03	.00	.02	63170.	*	1	1310	159	.00	.00	.00	1037.
1	0455	60	.03	.00	.02	64638.	*	1	1315	160	.00	.00	.00	989.
1	0500	61	.03	.00	.02	65821.	*	1	1320	161	.00	.00	.00	942.
1	0505	62	.03	.00	.03	66779.	*	1	1325	162	.00	.00	.00	897.
1	0510	63	.03	.00	.03	67551.	*	1	1330	163	.00	.00	.00	853.
1	0515	64	.03	.00	.03	68118.	*	1	1335	164	.00	.00	.00	810.
1	0520	65	.03	.00	.03	68455.	*	1	1340	165	.00	.00	.00	769.
1	0525	66	.03	.00	.03	68517.	*	1	1345	166	.00	.00	.00	729.
1	0530	67	.03	.00	.03	68278.	*	1	1350	167	.00	.00	.00	690.
1	0535	68	.02	.00	.02	67811.	*	1	1355	168	.00	.00	.00	652.
1	0540	69	.02	.00	.02	67206.	*	1	1400	169	.00	.00	.00	616.
1	0545	70	.02	.00	.02	66456.	*	1	1405	170	.00	.00	.00	581.
1	0550	71	.02	.00	.02	65572.	*	1	1410	171	.00	.00	.00	547.
1	0555	72	.02	.00	.02	64560.	*	1	1415	172	.00	.00	.00	515.
1	0600	73	.02	.00	.02	63410.	*	1	1420	173	.00	.00	.00	483.
1	0605	74	.00	.00	.00	62121.	*	1	1425	174	.00	.00	.00	452.
1	0610	75	.00	.00	.00	60682.	*	1	1430	175	.00	.00	.00	421.
1	0615	76	.00	.00	.00	59081.	*	1	1435	176	.00	.00	.00	391.
1	0620	77	.00	.00	.00	57329.	*	1	1440	177	.00	.00	.00	361.
1	0625	78	.00	.00	.00	55462.	*	1	1445	178	.00	.00	.00	332.
1	0630	79	.00	.00	.00	53473.	*	1	1450	179	.00	.00	.00	303.
1	0635	80	.00	.00	.00	51398.	*	1	1455	180	.00	.00	.00	275.
1	0640	81	.00	.00	.00	49363.	*	1	1500	181	.00	.00	.00	247.
1	0645	82	.00	.00	.00	47385.	*	1	1505	182	.00	.00	.00	221.
1	0650	83	.00	.00	.00	45473.	*	1	1510	183	.00	.00	.00	196.
1	0655	84	.00	.00	.00	43650.	*	1	1515	184	.00	.00	.00	174.
1	0700	85	.00	.00	.00	41935.	*	1	1520	185	.00	.00	.00	156.
1	0705	86	.00	.00	.00	40321.	*	1	1525	186	.00	.00	.00	143.
1	0710	87	.00	.00	.00	38738.	*	1	1530	187	.00	.00	.00	133.
1	0715	88	.00	.00	.00	37195.	*	1	1535	188	.00	.00	.00	123.
1	0720	89	.00	.00	.00	35693.	*	1	1540	189	.00	.00	.00	115.
1	0725	90	.00	.00	.00	34227.	*	1	1545	190	.00	.00	.00	107.
1	0730	91	.00	.00	.00	32803.	*	1	1550	191	.00	.00	.00	99.
1	0735	92	.00	.00	.00	31430.	*	1	1555	192	.00	.00	.00	93.
1	0740	93	.00	.00	.00	30109.	*	1	1600	193	.00	.00	.00	86.
1	0745	94	.00	.00	.00	28846.	*	1	1605	194	.00	.00	.00	80.
1	0750	95	.00	.00	.00	27652.	*	1	1610	195	.00	.00	.00	75.
1	0755	96	.00	.00	.00	26477.	*	1	1615	196	.00	.00	.00	70.
1	0800	97	.00	.00	.00	25325.	*	1	1620	197	.00	.00	.00	65.
1	0805	98	.00	.00	.00	24197.	*	1	1625	198	.00	.00	.00	61.

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER

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0599602

DIVISION AND GROUP
G(B)

CALCULATION NUMBER
16, rev 1

OPTIONAL TASK CODE
NA

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1	0810	99	.00	.00	.00	23103.	*	1	1630	199	.00	.00	.00	58.
1	0815	100	.00	.00	.00	22050.	*	1	1635	200	.00	.00	.00	54.
							*							

TOTAL RAINFALL = 10.20, TOTAL LOSS = 3.76, TOTAL EXCESS = 6.44

PEAK FLOW	TIME		6-HR	24-HR	72-HR	16.58-HR
+	(CFS)	(HR)				
		(CFS)				
+	68517.	5.42	40836.	16086.	16086.	16086.
		(INCHES)	5.932	6.459	6.459	6.459
		(AC-FT)	20249.	22046.	22046.	22046.

CUMULATIVE AREA = 64.00 SQ MI

1

RUNOFF SUMMARY
 FLOW IN CUBIC FEET PER SECOND
 TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+				6-HOUR	24-HOUR	72-HOUR	
+	HYDROGRAPH AT						
	010	68517.	5.42	40836.	16086.	16086.	64.00

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

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ATTACHMENT 5, HEC-RAS HYDRAULIC REPORT FOR Q = 102,000, 68,500, AND 1,400 CFS

HEC-RAS Version 2.0 April 1997
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

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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
XXXXXXXX XXXX   X       XXX XXXX XXXXXX XXXX
X   X  X       X       X   X   X   X   X
X   X  X       X   X   X   X   X   X   X
X   X  XXXXXX   XXXX   X   X   X   X   XXXXX

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PROJECT DATA

Project Title: PFSF 3-mile-long rail spur, rev 1
Project File : 3_mile_1.prj
Run Date and Time: 5/18/99 4:45:46 PM

Project in English units

Project Description:

1, CN=96, Tc=4.17 hr, Q=102,000 cfs 2, CN=70, Tc=4.17 hr, Q=68,500 cfs
3, Q100 = 1,400 cfs.

FLOW DATA

Flow Title: PMF Q=102,000, 68,500 and Q100=1400 cfs
Flow File : c:\pfsf\c16_1\ras\3_mile_1.f01

Flow Data (cfs)

River	Reach	RS	PMF CN=96	PMF CN=70	100-yr Q
PFSF 3mile Rail	West	9000	102000	68500	1400

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
PFSF 3mile Rail	West	PMF CN=96		Normal S = 0.0042

GEOMETRY DATA

Geometry Title: Natural topo
Geometry File : c:\pfsf\c16_1\ras\3_mile_1.g01

CROSS SECTION RIVER: PFSF 3mile Rail
REACH: West RS: 9000

INPUT

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W/O NUMBER 0599602	DIVISION AND GROUP G(B)	CALCULATION NUMBER 16, rev 1	OPTIONAL TASK CODE 345W	PAGE 39 of 44

Description: Section A

Station Elevation Data		num= 9							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4550	1400	4540	2900	4530	3800	4520	12500	4520
14700	4520	17200	4520	20000	4530	21200	4550		

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.035	3800	.035	17200	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	3800	17200		4000	4000	.1	.3

CROSS SECTION OUTPUT Profile #PMF CN=96

W.S. Elev (ft)	4521.50	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.	0.035	0.035	0.035
E.G. Elev (ft)	4521.88	Reach Len. (ft)	4000.00	4000.00	4000.00
Crit W.S. (ft)		Flow Area (sq ft)	100.79	20054.20	313.57
E.G. Slope (ft/ft)	0.008170	Area (sq ft)	100.79	20054.20	313.57
Q Total (cfs)	102000.00	Flow (cfs)	318.78	100689.40	991.79
Top Width (ft)	13953.74	Top Width (ft)	134.69	13400.00	419.04
Vel Total (ft/s)	4.98	Avg. Vel. (ft/s)	3.16	5.02	3.16
Max Chl Dpth (ft)	1.50	Hydr. Depth (ft)	0.75	1.50	0.75
Conv. Total (cfs)	1128450.0	Conv. (cfs)	3526.7	1113951.0	10972.4
Length Wtd. (ft)	4000.00	Wetted Per. (ft)	134.70	13400.00	419.05
Min Ch El (ft)	4520.00	Shear (lb/sq ft)	0.38	0.76	0.38
Alpha	1.01	Stream Power (lb/ft s)	1.21	3.83	1.21
Frctn Loss (ft)	39.84	Cum Volume (acre-ft)	17.45	3935.84	154.48
C & E Loss (ft)	0.02	Cum SA (acres)	23.76	2263.62	164.43

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 OUTPUT Profile #PMF CN=70

W.S. Elev (ft)	4521.18	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.	0.035	0.035	0.035
E.G. Elev (ft)	4521.46	Reach Len. (ft)	4000.00	4000.00	4000.00
Crit W.S. (ft)		Flow Area (sq ft)	62.52	15794.73	194.51
E.G. Slope (ft/ft)	0.008212	Area (sq ft)	62.52	15794.73	194.51
Q Total (cfs)	68500.00	Flow (cfs)	169.07	67804.91	526.02
Top Width (ft)	13836.12	Top Width (ft)	106.08	13400.00	330.04
Vel Total (ft/s)	4.27	Avg. Vel. (ft/s)	2.70	4.29	2.70
Max Chl Dpth (ft)	1.18	Hydr. Depth (ft)	0.59	1.18	0.59
Conv. Total (cfs)	755916.0	Conv. (cfs)	1865.8	748245.4	5804.8
Length Wtd. (ft)	4000.00	Wetted Per. (ft)	106.09	13400.00	330.04
Min Ch El (ft)	4520.00	Shear (lb/sq ft)	0.30	0.60	0.30
Alpha	1.01	Stream Power (lb/ft s)	0.82	2.59	0.82
Frctn Loss (ft)	39.88	Cum Volume (acre-ft)	11.05	3086.76	96.59
C & E Loss (ft)	0.01	Cum SA (acres)	18.91	2228.93	130.21

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 OUTPUT Profile #100-yr Q

W.S. Elev (ft)	4520.33	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.035	0.035	0.035
E.G. Elev (ft)	4520.33	Reach Len. (ft)	4000.00	4000.00	4000.00
Crit W.S. (ft)		Flow Area (sq ft)	4.80	4377.25	14.94
E.G. Slope (ft/ft)	0.000251	Area (sq ft)	4.80	4377.25	14.94
Q Total (cfs)	1400.00	Flow (cfs)	0.96	1396.03	3.00
Top Width (ft)	13520.86	Top Width (ft)	29.40	13400.00	91.46
Vel Total (ft/s)	0.32	Avg. Vel. (ft/s)	0.20	0.32	0.20
Max Chl Dpth (ft)	0.33	Hydr. Depth (ft)	0.16	0.33	0.16

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Conv. Total (cfs)	88394.3	Conv. (cfs)	60.9	88143.9	189.5
Length Wtd. (ft)	4000.00	Wetted Per. (ft)	29.40	13400.00	91.47
Min Ch El (ft)	4520.00	Shear (lb/sq ft)	0.00	0.01	0.00
Alpha	1.00	Stream Power (lb/ft s)	0.00	0.00	0.00
Frctn Loss (ft)	39.88	Cum Volume (acre-ft)	0.28	387.15	1.31
C & E Loss (ft)	0.00	Cum SA (acres)	2.53	2055.42	13.87

Warning - The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.

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: PFSF 3mile Rail
REACH: West RS: 5000

INPUT

Description: Section B

Station Elevation Data		num=	8						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4500	1400	4490	2900	4480	4400	4480	9200	4480
14000	4480	20000	4490	23000	4500				

Manning's n Values		num=	3		
Sta	n Val	Sta	n Val	Sta	n Val
0	.035	2900	.035	14000	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
2900	14000	3000	3000	3000	.1	.3

CROSS SECTION OUTPUT Profile #PMF CN=96

W.S. Elev (ft)	4481.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.57	Wt. n-Val.	0.035	0.035	0.035
E.G. Elev (ft)	4482.03	Reach Len. (ft)	3000.00	3000.00	3000.00
Crit W.S. (ft)	4481.37	Flow Area (sq ft)	159.54	16189.31	638.16
E.G. Slope (ft/ft)	0.012526	Area (sq ft)	159.54	16189.31	638.16
Q Total (cfs)	102000.00	Flow (cfs)	614.15	98929.21	2456.64
Top Width (ft)	12193.87	Top Width (ft)	218.77	11100.00	875.10
Vel Total (ft/s)	6.00	Avg. Vel. (ft/s)	3.85	6.11	3.85
Max Chl Dpth (ft)	1.46	Hydr. Depth (ft)	0.73	1.46	0.73
Conv. Total (cfs)	911383.5	Conv. (cfs)	5487.5	883945.6	21950.4
Length Wtd. (ft)	3000.00	Wetted Per. (ft)	218.78	11100.00	875.10
Min Ch El (ft)	4480.00	Shear (lb/sq ft)	0.57	1.14	0.57
Alpha	1.02	Stream Power (lb/ft s)	2.20	6.97	2.20
Frctn Loss (ft)	19.26	Cum Volume (acre-ft)	5.49	2271.77	110.78
C & E Loss (ft)	0.07	Cum SA (acres)	7.53	1138.73	105.01

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.

CROSS SECTION OUTPUT Profile #PMF CN=70

W.S. Elev (ft)	4481.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.41	Wt. n-Val.	0.035	0.035	0.035
E.G. Elev (ft)	4481.57	Reach Len. (ft)	3000.00	3000.00	3000.00
Crit W.S. (ft)	4481.03	Flow Area (sq ft)	101.80	12931.93	407.19
E.G. Slope (ft/ft)	0.012091	Area (sq ft)	101.80	12931.93	407.19
Q Total (cfs)	68500.00	Flow (cfs)	331.47	66842.65	1325.88
Top Width (ft)	11973.78	Top Width (ft)	174.76	11100.00	699.02

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Vel Total (ft/s)	5.10	Avg. Vel. (ft/s)	3.26	5.17	3.26
Max Chl Dpth (ft)	1.17	Hydr. Depth (ft)	0.58	1.17	0.58
Conv. Total (cfs)	622951.8	Conv. (cfs)	3014.4	607879.6	12057.8
Length Wtd. (ft)	3000.00	Wetted Per. (ft)	174.76	11100.00	699.02
Min Ch El (ft)	4480.00	Shear (lb/sq ft)	0.44	0.88	0.44
Alpha	1.01	Stream Power (lb/ft s)	1.43	4.55	1.43
Frctn Loss (ft)	19.42	Cum Volume (acre-ft)	3.51	1767.81	68.96
C & E Loss (ft)	0.05	Cum SA (acres)	6.02	1104.04	82.96

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.

CROSS SECTION OUTPUT Profile #100-yr Q

W.S. Elev (ft)	4480.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.03	Wt. n-Val.	0.035	0.035	0.035
E.G. Elev (ft)	4480.12	Reach Len. (ft)	3000.00	3000.00	3000.00
Crit W.S. (ft)	4480.08	Flow Area (sq ft)	0.72	1083.98	2.86
E.G. Slope (ft/ft)	0.020494	Area (sq ft)	0.72	1083.98	2.86
Q Total (cfs)	1400.00	Flow (cfs)	0.58	1397.10	2.32
Top Width (ft)	11173.24	Top Width (ft)	14.65	11100.00	58.59
Vel Total (ft/s)	1.29	Avg. Vel. (ft/s)	0.81	1.29	0.81
Max Chl Dpth (ft)	0.10	Hydr. Depth (ft)	0.05	0.10	0.05
Conv. Total (cfs)	9779.5	Conv. (cfs)	4.1	9759.3	16.2
Length Wtd. (ft)	3000.00	Wetted Per. (ft)	14.65	11100.00	58.59
Min Ch El (ft)	4480.00	Shear (lb/sq ft)	0.06	0.12	0.06
Alpha	1.00	Stream Power (lb/ft s)	0.05	0.16	0.05
Frctn Loss (ft)	19.94	Cum Volume (acre-ft)	0.02	136.40	0.49
C & E Loss (ft)	0.00	Cum SA (acres)	0.50	930.54	6.98

Warning - The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
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: PFSF 3mile Rail
REACH: West RS: 2000

INPUT

Description: Section C

Station Elevation Data		num=	7						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4490	1200	4480	2200	4470	4700	4460	13300	4460
18800	4470	21500	4480						

Manning's n Values		num=	3						
Sta	n Val	Sta	n Val	Sta	n Val				
0	.035	2200	.035	13300	.035				

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
2200	13300	2000	2000	2000	.1	.3

CROSS SECTION OUTPUT Profile #PMF CN=96

W.S. Elev (ft)	4462.37	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.		0.035	0.035
E.G. Elev (ft)	4462.69	Reach Len. (ft)	2000.00	2000.00	2000.00
Crit W.S. (ft)	4461.59	Flow Area (sq ft)		21103.14	1547.35
E.G. Slope (ft/ft)	0.003903	Area (sq ft)		21103.14	1547.35

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Q Total (cfs)	102000.00	Flow (cfs)	97401.55	4598.45
Top Width (ft)	10497.66	Top Width (ft)	9193.02	1304.64
Vel Total (ft/s)	4.50	Avg. Vel. (ft/s)	4.62	2.97
Max Chl Dpth (ft)	2.37	Hydr. Depth (ft)	2.30	1.19
Conv. Total (cfs)	1632680.0	Conv. (cfs)	1559074.0	73605.9
Length Wtd. (ft)	2000.00	Wetted Per. (ft)	9193.02	1304.64
Min Ch El (ft)	4460.00	Shear (lb/sq ft)	0.56	0.29
Alpha	1.02	Stream Power (lb/ft s)	2.58	0.86
Frctn Loss (ft)	8.10	Cum Volume (acre-ft)	987.60	35.52
C & E Loss (ft)	0.00	Cum SA (acres)	439.94	29.95

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 OUTPUT Profile #PMF CN=70

W.S. Elev (ft)	4461.87	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.		0.035	0.035
E.G. Elev (ft)	4462.11	Reach Len. (ft)	2000.00	2000.00	2000.00
Crit W.S. (ft)	4461.25	Flow Area (sq ft)		16480.33	957.25
E.G. Slope (ft/ft)	0.004016	Area (sq ft)		16480.33	957.25
Q Total (cfs)	68500.00	Flow (cfs)		66041.14	2458.86
Top Width (ft)	10092.58	Top Width (ft)		9066.43	1026.15
Vel Total (ft/s)	3.93	Avg. Vel. (ft/s)		4.01	2.57
Max Chl Dpth (ft)	1.87	Hydr. Depth (ft)		1.82	0.93
Conv. Total (cfs)	1080908.0	Conv. (cfs)		1042108.0	38800.0
Length Wtd. (ft)	2000.00	Wetted Per. (ft)		9066.43	1026.15
Min Ch El (ft)	4460.00	Shear (lb/sq ft)		0.46	0.23
Alpha	1.02	Stream Power (lb/ft s)		1.83	0.60
Frctn Loss (ft)	8.16	Cum Volume (acre-ft)		754.99	21.98
C & E Loss (ft)	0.00	Cum SA (acres)		409.61	23.56

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 OUTPUT Profile #100-yr Q

W.S. Elev (ft)	4460.16	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.035	0.035
E.G. Elev (ft)	4460.17	Reach Len. (ft)	2000.00	2000.00	2000.00
Crit W.S. (ft)	4460.09	Flow Area (sq ft)		1355.24	6.80
E.G. Slope (ft/ft)	0.006954	Area (sq ft)		1355.24	6.80
Q Total (cfs)	1400.00	Flow (cfs)		1395.58	4.42
Top Width (ft)	8725.78	Top Width (ft)		8639.31	86.47
Vel Total (ft/s)	1.03	Avg. Vel. (ft/s)		1.03	0.65
Max Chl Dpth (ft)	0.16	Hydr. Depth (ft)		0.16	0.08
Conv. Total (cfs)	16788.3	Conv. (cfs)		16735.3	53.0
Length Wtd. (ft)	2000.00	Wetted Per. (ft)		8639.31	86.47
Min Ch El (ft)	4460.00	Shear (lb/sq ft)		0.07	0.03
Alpha	1.00	Stream Power (lb/ft s)		0.07	0.02
Frctn Loss (ft)	9.68	Cum Volume (acre-ft)		52.41	0.16
C & E Loss (ft)	0.00	Cum SA (acres)		250.81	1.99

Warning - The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.

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: PFSF 3mile Rail
REACH: West RS: 0

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER					PAGE 43 of 44
J.O. OR W.O NUMBER 0599602	DIVISION AND GROUP G(B)	CALCULATION NUMBER 16, rev 1	OPTIONAL TASK CODE 345W		

INPUT

Description: Section D

Station		Elevation Data		num=	8				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4470	1900	4460	5200	4452	8000	4454	9800	4450
11600	4450	17800	4460	20000	4470				

Manning's n Values		num=	3		
Sta	n Val	Sta	n Val	Sta	n Val
0	.035	1900	.035	17800	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	1900	17800		0	0	.1	.3

CROSS SECTION OUTPUT Profile #PMF CN=96

W.S. Elev (ft)	4454.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.		0.035	
E.G. Elev (ft)	4454.59	Reach Len. (ft)			
Crit W.S. (ft)	4453.34	Flow Area (sq ft)		21916.52	
E.G. Slope (ft/ft)	0.004205	Area (sq ft)		21916.52	
Q Total (cfs)	102000.00	Flow (cfs)		102000.00	
Top Width (ft)	9970.69	Top Width (ft)		9970.69	
Vel Total (ft/s)	4.65	Avg. Vel. (ft/s)		4.65	
Max Chl Dpth (ft)	4.26	Hydr. Depth (ft)		2.20	
Conv. Total (cfs)	1573002.0	Conv. (cfs)		1573002.0	
Length Wtd. (ft)		Wetted Per. (ft)		9970.70	
Min Ch El (ft)	4450.00	Shear (lb/sq ft)		0.58	
Alpha	1.00	Stream Power (lb/ft s)		2.69	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

CROSS SECTION OUTPUT Profile #PMF CN=70

W.S. Elev (ft)	4453.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.27	Wt. n-Val.		0.035	
E.G. Elev (ft)	4453.95	Reach Len. (ft)			
Crit W.S. (ft)	4452.77	Flow Area (sq ft)		16407.09	
E.G. Slope (ft/ft)	0.004199	Area (sq ft)		16407.09	
Q Total (cfs)	68500.00	Flow (cfs)		68500.00	
Top Width (ft)	8776.07	Top Width (ft)		8776.07	
Vel Total (ft/s)	4.18	Avg. Vel. (ft/s)		4.18	
Max Chl Dpth (ft)	3.68	Hydr. Depth (ft)		1.87	
Conv. Total (cfs)	1057092.0	Conv. (cfs)		1057092.0	
Length Wtd. (ft)		Wetted Per. (ft)		8776.08	
Min Ch El (ft)	4450.00	Shear (lb/sq ft)		0.49	
Alpha	1.00	Stream Power (lb/ft s)		2.05	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Warning - Divided flow computed for this cross-section.

CROSS SECTION OUTPUT Profile #100-yr Q

W.S. Elev (ft)	4450.45	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.04	Wt. n-Val.		0.035	
E.G. Elev (ft)	4450.49	Reach Len. (ft)			
Crit W.S. (ft)	4450.26	Flow Area (sq ft)		927.70	
E.G. Slope (ft/ft)	0.004205	Area (sq ft)		927.70	
Q Total (cfs)	1400.00	Flow (cfs)		1400.00	
Top Width (ft)	2285.89	Top Width (ft)		2285.89	
Vel Total (ft/s)	1.51	Avg. Vel. (ft/s)		1.51	
Max Chl Dpth (ft)	0.45	Hydr. Depth (ft)		0.41	
Conv. Total (cfs)	21589.3	Conv. (cfs)		21589.3	
Length Wtd. (ft)		Wetted Per. (ft)		2285.89	

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Min Ch El (ft)	4450.00	Shear (lb/sq ft)	0.11
Alpha	1.00	Stream Power (lb/ft s)	0.16
Frctn Loss (ft)		Cum Volume (acre-ft)	
C & E Loss (ft)		Cum SA (acres)	

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.

SUMMARY OF MANNING'S N VALUES

River: PFSF 3mile Rail

Reach	River Sta.	n1	n2	n3
West	9000	.035	.035	.035
West	5000	.035	.035	.035
West	2000	.035	.035	.035
West	0	.035	.035	.035

SUMMARY OF REACH LENGTHS

River: PFSF 3mile Rail

Reach	River Sta.	Left	Channel	Right
West	9000	4000	4000	4000
West	5000	3000	3000	3000
West	2000	2000	2000	2000
West	0	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: PFSF 3mile Rail

Reach	River Sta.	Contr.	Expan.
West	9000	.1	.3
West	5000	.1	.3
West	2000	.1	.3
West	0	.1	.3