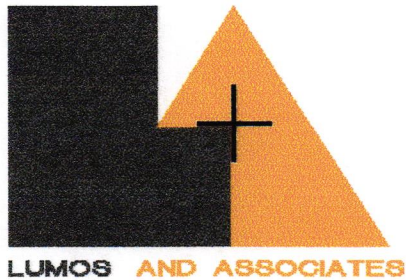


**DRAINAGE ANALYSIS
of
ROSEWOOD WASH
RENO, NEVADA**

Prepared for:

CITY OF RENO

Prepared by:



**Lumos and Associates, Inc.
5401 Longley Lane, Suite 15
Reno, Nevada 89511**

Job Number: 4616

May 27, 1999



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FIGURES

Figure 1. Study Area Location Map

Figure 2. Study Area Existing Facilities

APPENDICES

1. Projected Flows and HEC-1 output
2. HEC-RAS output
3. Culvert Capacities Nomographs and Calculations

1.0 INTRODUCTION

The Rosewood Wash runs from the western slopes of Mount Rose through south central Reno to Virginia Lake. For approximately the lower 3,000 feet, the Wash has been channelized and passes through the back yards of single family homes and under four streets before entering Virginia Lake.

A proposed development on the northwest corner of Plumas Street and Plumb Lane will increase the capacity of the channel through the property; however, the capacity of the existing 10'x3' RCB under Plumas Street will still not be adequate to convey a 100-year storm event.

The City is concerned about the capacity of the existing channel and box culverts downstream from Plumas Street to Virginia Lake, and also about the capacity of the existing culvert crossing under Plumb Lane immediately upstream from the proposed development.

The City of Reno has retained Lumos and Associates to evaluate the capacity of the existing Rosewood Wash drainage facilities from Plumas Street to Virginia Lake and the existing culvert crossing under Plumb Lane just west of Plumas Street, and to make recommendations for improvements to this reach of the Wash. The total length of the Wash to be studied is approximately 3,000 feet, and is shown in Figure 1.

2.0 EXISTING DRAINAGE SYSTEM

The project reach starts at the entrance to the culvert just west of the Plumas Street and Plumb Lane intersection. That culvert comprises of two RCP's – one 48" Dia. RCP and one 68"x43" arch RCP. Both pipes share the same reinforced concrete headwall structure. Upstream of the inlet is undeveloped ground with natural vegetation (mostly weeds and shrubs).

The arch pipe runs in the northeast direction under Plumb Lane to a manhole, and coming out of the manhole is a 54" Dia. RCP. This RCP then makes two 45-degree turns and runs to the north before outleting to an open channel on the lot occupying the northwest corner of the Plumas/Plumb intersection (the proposed development). The 48" Dia. Pipe runs along a different path under Plumb, and it eventually emerges at the same location of as the 54" RCP. See Figure 2.

The part of the Rosewood Wash from the outlets of the two RCP's to a 10'x3' RCB under Plumas is a V-shaped channel with natural grass banks. Sediment deposition at the downstream end of the RCB is pronounced because the flow is blocked by a mature evergreen tree. For about 290 feet downstream, the channel is lined with grouted riprap. Further downstream the flow enters a rectangular reinforced concrete channel. It then runs to another grouted riprap lined channel before entering a 10'x3' RCB under Plumb Lane.

The RCB runs in a southeast direction under Plumb and outlets on the south side into a trapezoidal concrete channel. The channel flows south for approximately 100 feet, then makes a 90-degree turn to the East. The flow then enters another V-shaped channel with natural grass banks. Further downstream the channel changes to grouted riprap on one side and loose rocks on the other. The flow then enters a 10'x3' RCB under Hillcrest Drive. It then outlets to a rectangular channel with grouted riprap side walls and a dirt bottom. The channel narrows to 8 feet and passes very close to two houses just before the culvert under Lakeside Drive. The culvert under Lakeside Drive comprises of two 6'x2.5' RCB's. It outlets to a well-maintained channel that carries runoff straight into Virginia Lake.

The end of the project reach is the outlet of the two 6'x2.5' RCB's. Total drop in elevation for the project reach is approximately 42 feet in a length of 3,000 feet for an average slope of 1.4%.

3.0 HYDROLOGY

The study area is part of the downstream corridor for the Rosewood Wash basins described in the Winzler and Kelly (W&K) report. The analysis performed by Glen Daley of the City of Reno recalculated some of the basins contained in the W&K analysis and resulted in more conservative values for the amount of runoff in those basins. The W&K report and the Daley analysis calculated flows to the intersection of Belford Road and Sharon Way. The report titled "Drainage Report for Plumas Quail Park" by Lumos & Associates used the Daley flow of 737 cfs as part of the analysis since it was the more conservative (i.e. higher) of the two. An additional contributory area between the Belford/Sharon intersection and the study reach was analyzed for the 100-year storm event using the HEC-1 computer analysis, and the results of that analysis were added to the flows determined in the previous studies. As shown in Table 1 below, the estimated 100-year peak flow tributary to the study reach is 843 cfs.

Table 1 – 100-Year Peak Flow

Elapsed Time, Hrs	12.3	12.4	12.5	12.6	12.7
CFS per Daley	550	687	737	711	641
Additional Basin CFS	151	132	106	85	62
Total CFS	701	819	843	796	703

Peak flow for lower frequency storms were calculated by using a HEC-1 model of Rosewood Wash. The rainfall for a hypothetical storm was developed using methods and rainfall data contained in the Washoe County Drainage Manual. The subbasins, time of concentration and CN values developed by Glen Daley were used in the model. It was then calibrated to the 100-year peak flow by adjusting the CN numbers.

The model was then run for lower frequency storms yielding the results in Table 2.

Table 2

STORM EVENT	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
PEAK FLOW(CFS)	143	262	381	562	694	843

The complete HEC-1 model is contained in Appendix 2 along with the back up calculations.

4.0 EXISTING CHANNEL AND CULVERT CAPACITY

The HEC-RAS V2.1 computer program was used to model the flow in the Wash, and through the existing culverts from the downstream end of the 10'x3' RCB under Plumas to Virginia Lake. The capacity of the existing 48" RCP and 68"x43" arch RCP under Plumb Lane was determined from inlet control nomographs. The capacity of the existing channel through the parcel on the northwest corner of Plumas and Plumb was determined from the most restrictive cross section and the average slope using Flowmaster (a computer drainage program). Because channel linings varies from section to section, different Manning's coefficients were used. The following Table 3 summaries the capacities of culverts and channel sections along the project reach. Please note that the flow rates shown indicate capacities without overtopping banks or culverts.

Table 3 - Existing Capacities

CULVERT	CAPACITY (CFS)	OPEN CHANNEL SECTION	CAPACITY (CFS)
Plumb #1	205	Between Plumb #1 and Plumas	380
Plumas	330	Between Plumas and Plumb #2	250
Plumb #2	150	Between Plumb #2 and Hillcrest	160
Hillcrest	165	Between Hillcrest and Lakeside	130
Lakeside	90		

5.0 CHANNEL AND CULVERT IMPROVEMENT OPTIONS

A review of Table 3 indicates that the culverts generally have a lower capacity than the channel segments immediately upstream of them. This means that once the culvert capacity is exceeded, road overtopping and flooding occurs. This happens at several locations in the study reach in an established pattern.

Table 3 also indicates that the section with the least capacity is the double 6'x2.5' box culvert under Lakeside Drive and the open channel immediately upstream. Two factors contribute to the low capacity: 1) the channel slope is small (less than one percent); 2) the channel narrows to only 8 feet at River Stations 19 and 20, where it passes between two houses only 14 feet apart from building corner to building corner.

The Plumb #1 RCP's and the Plumas RCB can be upsized and reconstructed to handle larger flows; however, unless downstream channel segments and culverts are also upsized, downstream flood impacts will be increased which will adversely impact downstream properties.

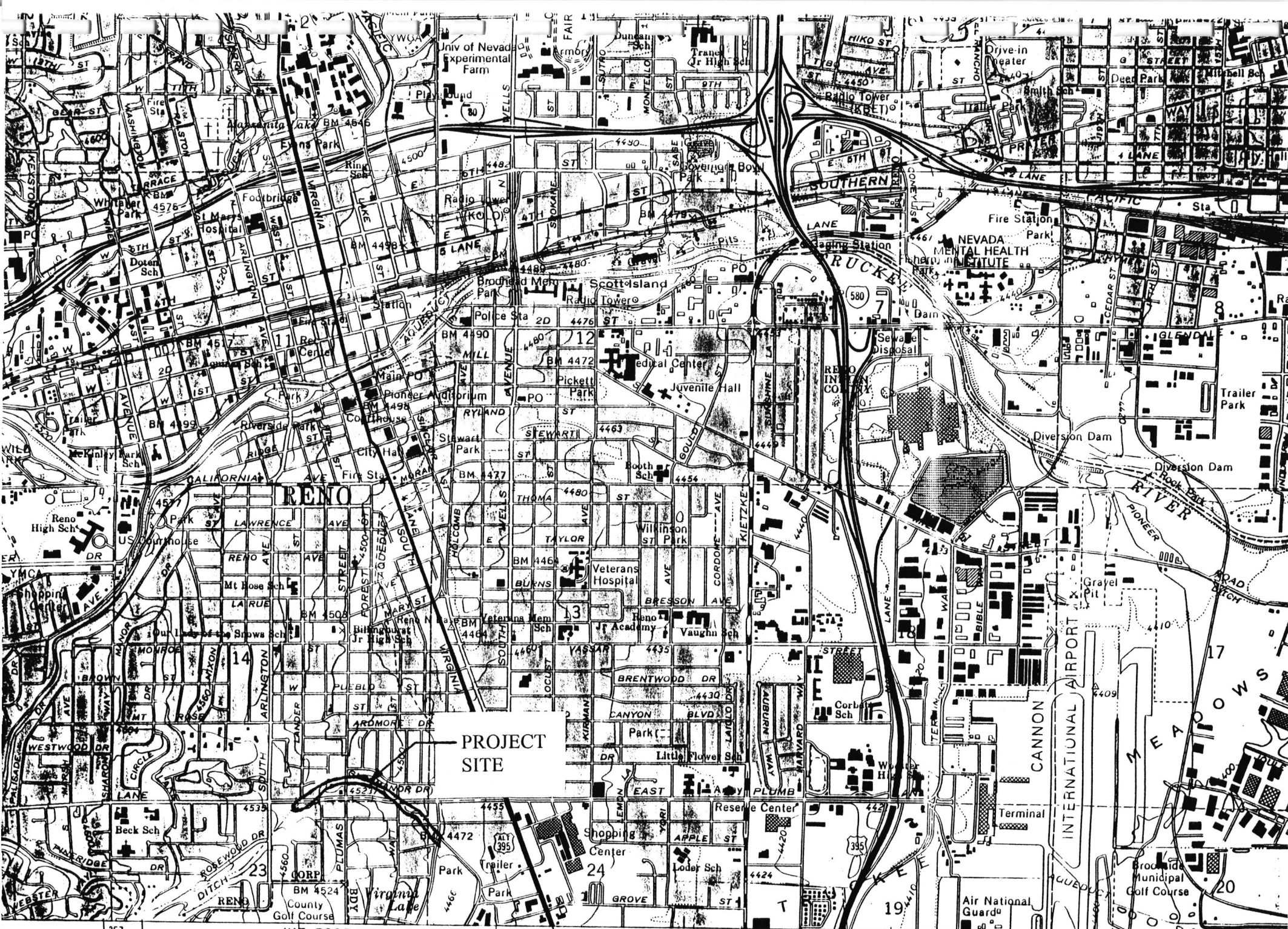
To improve the entire study reach to handle the 100 year flow would require substantial improvements including replacing all five culverts, constructing concrete lined open channels, relocating conflicting utility lines and structures, and acquiring additional right-of-way. At the lower end of the reach, 100 year flow capacity is not possible without acquiring at least one residential lot, and demolishing the existing single family home on the lot. The construction cost would be very high with this option.

The "leave things the way they are" option does not solve the flooding problem; however, the existing flooding pattern will be maintained. Periodic preventive maintenance, such as clearing debris inside culverts, removing obstructions at culvert entrances and outlets, removing boulders and overgrown vegetation in the channels, etc., can be done to reduce the extent of flooding.

If the City decides to make channel and culvert improvements at some time in the future, the logical place to begin is at the downstream end of the study reach between Lakeside Drive and Plumb Lane, where the existing culvert and channel capacities are the lowest.

6.0 REFERENCES

- a) *"Belford Road and Sharon Way Deficiency Analysis"*, dated August, 1985, Winzler and Kelly.
- b) *"Belford Road Improvement Hydrological Analysis"*, by Glen Daley, City of Reno.
- c) *"Preliminary Hydrologic Analysis for Plumas Quail Office Park"*, dated January, 1997, Mountain West Consulting.
- d) *"Drainage Report for Plumas Quail Park"*, dated November 7, 1998, by Lumos & Associates, Inc.
- e) U.S. Geological Survey, Reno Quadrangle, Nevada – Washoe County, 7.5 minute Series Map, 1978.
- f) Haestad Methods' *"Flowmaster"* Computer Program.
- g) HEC-RAS V2.1 computer program, Haestad Methods Implementation.
- h) *"Washoe County Hydrologic Criteria and Drainage Manual"*, dated December 2, 1996.



257

(MT. ROSE NE)
200' IV NE

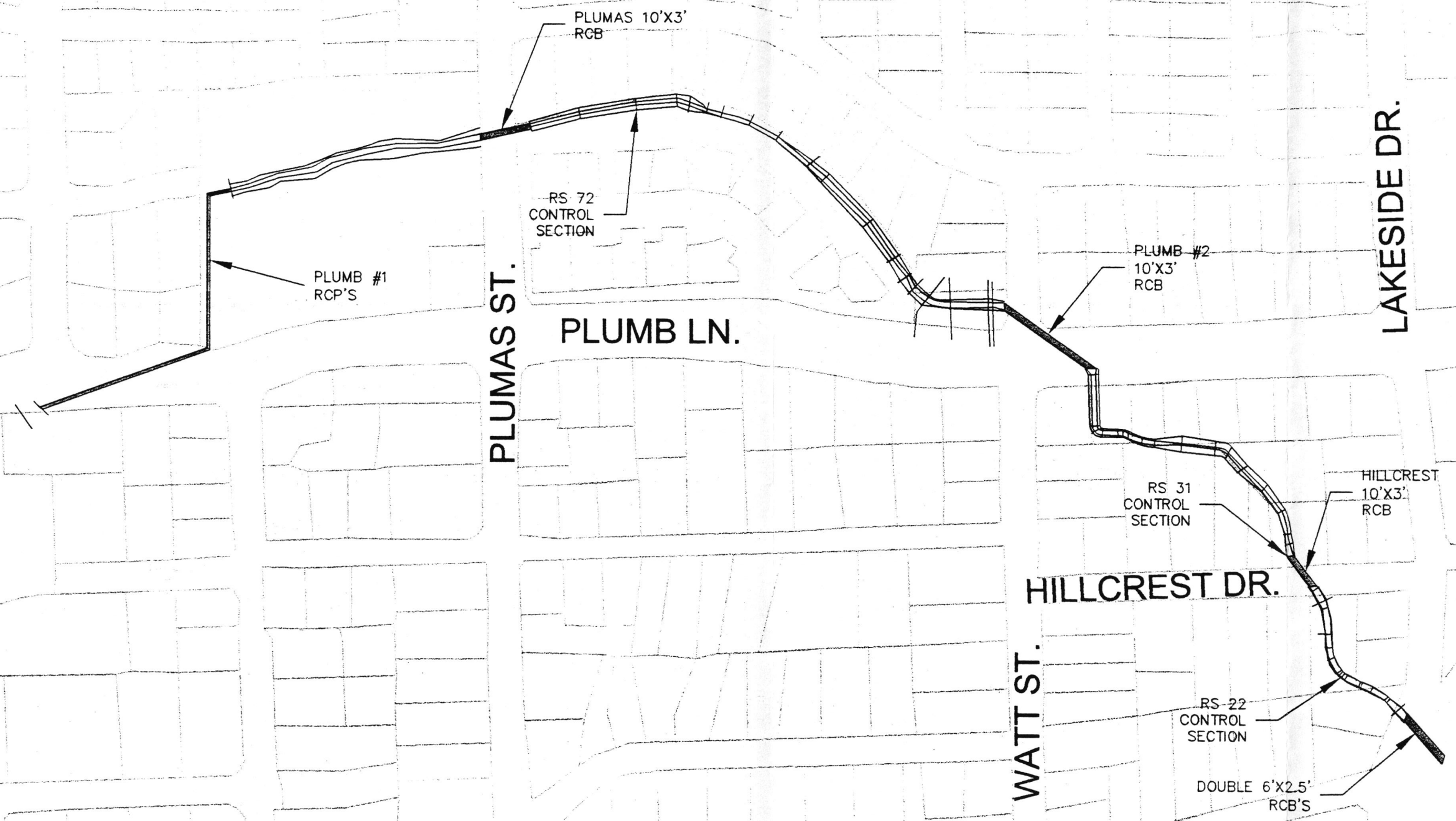
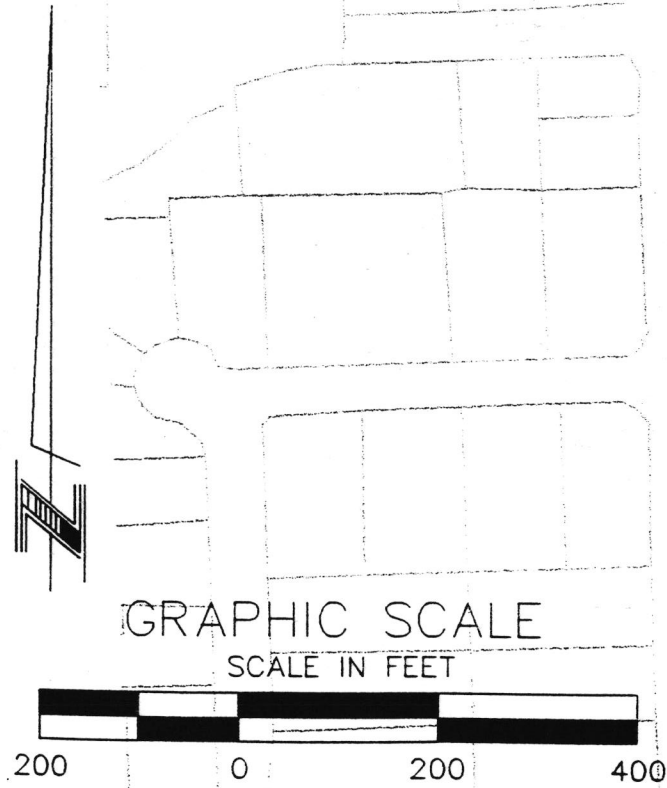
1 MI. TO N. V. 17 & 27
CARSON CITY 28 MI.

R. 19 E. 47'30"

R. 20 E. 261

• INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRG
262 263000m E.

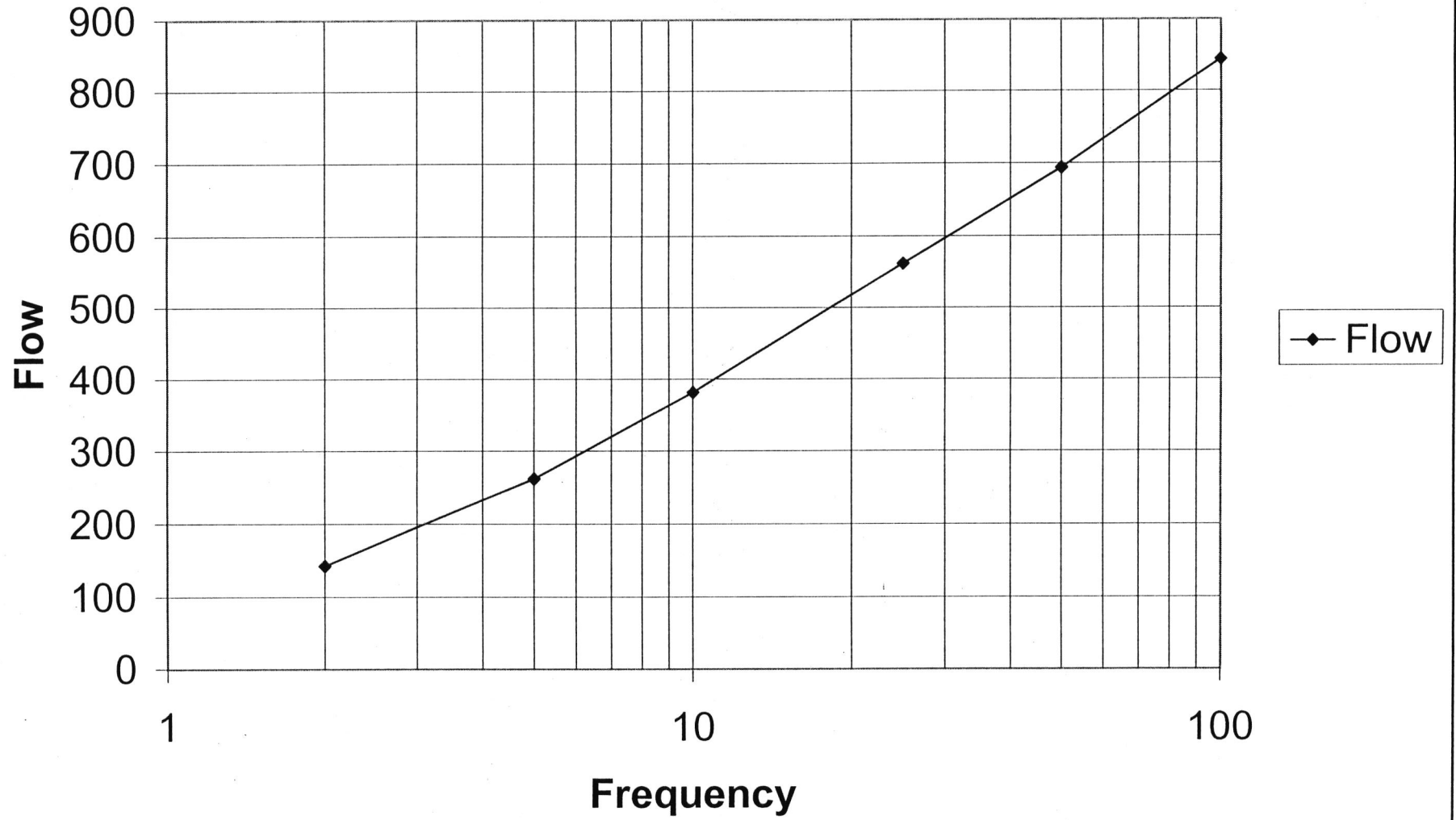
FIGURE 1



APPENDIX 1

Projected Flows and HEC-1 output

Rosewood Wash





Lumos and Associates, Inc.

CIVIL ENGINEERING
PLANNING
SURVEYING
MATERIALS TESTING

800 E. College Parkway
Carson City, NV 89706
(702) 883-7077

5401 Longley Lane, Suite 13,
Reno, NV 89511
(702) 827-6111

137 Keddie Street
Fallon, NV 89406
(702) 423-2188

Client: City of Reno Sheet Of
Description: Rosewood Wash
Combine Data for HEC-1 Use Job No. 4616.000
By: Ralph H. Johnson Date 5/99
Checked By: Date

Data From WELC as modified by Glen Dally
Areas 1-9 Area 10-13

$T_c - 1 = .37$ hrs
 $T_t - 1 = .43$
 $.80$ hrs

$T_c - 10 = .36$ hrs
 $T_t - 10 = .30$
 $.66$ hrs

Log: 6 = .48 hrs

Log: 10 = .40 hrs

#	Area	CN	Area	#	Area	CN	Area
1	124.90	82		10	51.35	84	
2	23.25	83		11	29.40	80	
3	79.30	84		12	61.58	82	
4	68.13	85		13	118.45	84	
5	160.70	82					
6	114.69	86		Σ	260.78		217.88
7	87.65	80		Weighted			83.5
8	40.50	83		S_j mi	.4075		
9	71.50	84					

Σ 791.32 ' 68075

Weighted

S_j mi 1.2364

82.2

Added for Project

$T_c = 24$ min = .40 hrs

Pipe Velocity = 6' / sec $Q \approx 800$

Log = .6 = .24 hrs

5 - 1.5

Length 4600 ft

25 - 2.1

$S_s =$

50 - 2.4

Area = 120 Sq m

100 - 2.6

CN = 87

[2.9]

Rainfall Depths and IDF Curve for Washoe County, Nevada
NOAA Atlas Depths

2yr	2yr	2yr
1hr	6hr	24hr
0.30	0.75	1.30

Return Period	1 Hour Depths	6 Hour Depths	24 Hour Depths
2	0.300	0.750	1.300
5	0.408	0.975	1.664
10	0.516	1.140	1.950
25	0.696	1.358	2.327
50	0.873	1.530	2.613
100	1.086	1.695	2.886

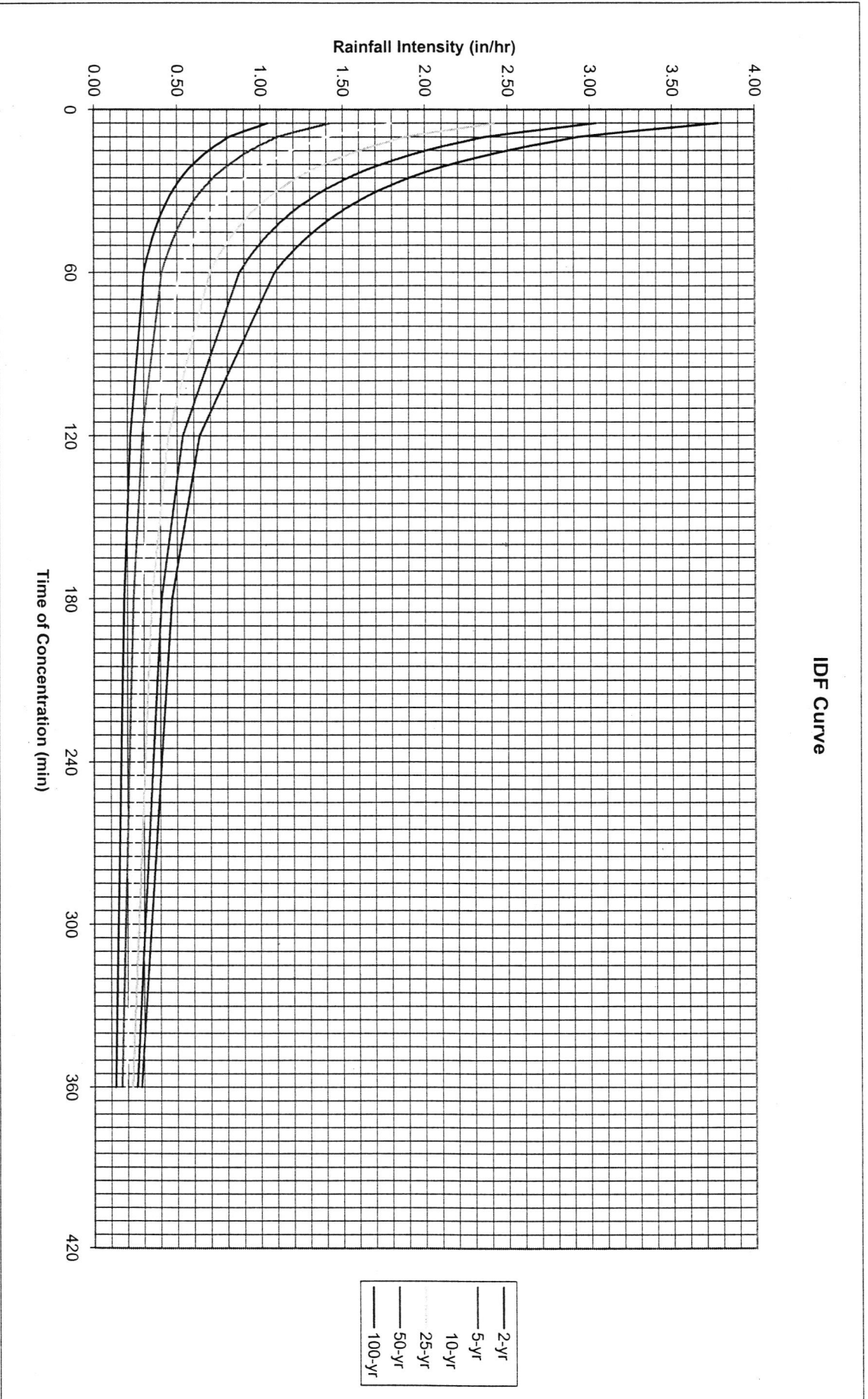
Dur.	Regional Growth Factors					
	2	5	10	25	50	100
1	1.00	1.36	1.72	2.32	2.91	3.62
6	1.00	1.30	1.52	1.81	2.04	2.26
24	1.00	1.28	1.50	1.79	2.01	2.22
Conversion to less than 1 hour						
	5	10	15	30	60	
	0.33	0.49	0.6	0.82	1	

RI	Duration									
	5 min	10 min	15 min	30 min	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr
	5	10	15	30	60	120	180	360	720	1440
2	0.099	0.147	0.180	0.246	0.300	0.435	0.537	0.750	1.025	1.300
5	0.135	0.200	0.245	0.335	0.408	0.578	0.706	0.975	1.320	1.664
10	0.170	0.253	0.310	0.423	0.516	0.703	0.844	1.140	1.545	1.950
25	0.230	0.341	0.418	0.571	0.696	0.894	1.044	1.358	1.842	2.327
50	0.288	0.428	0.524	0.716	0.873	1.069	1.219	1.530	2.072	2.613
100	0.358	0.532	0.652	0.891	1.086	1.268	1.406	1.695	2.291	2.886

RI	Intensity-Duration-Frequency (IDF) Curve									
	5 min	10 min	15 min	30 min	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr
	5	10	15	30	60	120	180	360	720	1440
2	1.188	0.882	0.720	0.492	0.300	0.217	0.179	0.125	0.085	0.054
5	1.616	1.200	0.979	0.669	0.408	0.289	0.235	0.163	0.110	0.069
10	2.043	1.517	1.238	0.846	0.516	0.351	0.281	0.190	0.129	0.081
25	2.756	2.046	1.670	1.141	0.696	0.447	0.348	0.226	0.154	0.097
50	3.457	2.567	2.095	1.432	0.873	0.535	0.406	0.255	0.173	0.109
100	4.301	3.193	2.606	1.781	1.086	0.634	0.469	0.283	0.191	0.120

idf

IDF Curve



FLOOD HYDROGRAPH PACKAGE (HEC-1) *
MAY 1991 *
VERSION 4.0.1E *
RUN DATE 05/07/1999 TIME 14:50:08 *

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

2 YEAR 24 HOUR EVENT

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IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

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ITIME 0000 STARTING TIME
NQ 300 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 2 0 ENDING DATE
NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL 0.08 HOURS
TOTAL TIME BASE 24.92 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

5 KK *****
* 1-9 *

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12 KK *****
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* TOTAL *

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ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

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	1-9	86.	12.58	33.	12.	12.	1.24		
HYDROGRAPH AT	10-13	40.	12.50	13.	5.	5.	0.41		
2 COMBINED AT	1-13	124.	12.50	46.	17.	16.	1.64		
HYDROGRAPH AT	PRJ	28.	12.33	7.	3.	3.	0.20		
2 COMBINED AT	TOTAL	143.	12.50	53.	19.	19.	1.84		

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* VERSION 4.0.1E *
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* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *

5 YEAR 24 HOUR EVENT

3 IO

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NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL 0.08 HOURS
TOTAL TIME BASE 24.92 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

5 KK

* 1-9 *

7 KO

OUTPUT CONTROL VARIABLES

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12 KK

* 10-13 *

14 KO

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TIMINT 0.083 TIME INTERVAL IN HOURS

19 KK * 1-13 *

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23 KK * PRJ *

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30 KK * TOTAL *

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ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
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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 STAG
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	1-9	161.	12.58	56.	20.	19.	1.24		
HYDROGRAPH AT	10-13	70.	12.50	22.	8.	7.	0.41		
2 COMBINED AT	1-13	230.	12.50	78.	28.	27.	1.64		
HYDROGRAPH AT	PRJ	49.	12.25	11.	4.	4.	0.20		
2 COMBINED AT	TOTAL	262.	12.50	89.	32.	30.	1.84		

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

10 YEAR 24 HOUR EVENT

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NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL 0.08 HOURS
TOTAL TIME BASE 24.92 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

* *
5 KK * 1-9 *
* *

7 KO OUTPUT CONTROL VARIABLES
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ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

* *
12 KK * 10-13 *
* *

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QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

19 KK

* 1-13 *

21 KO OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IPLT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
ICUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

23 KK

* PRJ *

25 KO OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IPLT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
ICUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

30 KK

* TOTAL *

32 KO OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IPLT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
ICUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

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 STAG
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	1-9	237.	12.58	76.	27.	26.	1.24		
HYDROGRAPH AT	10-13	100.	12.50	28.	10.	10.	0.41		
2 COMBINED AT	1-13	335.	12.50	104.	37.	36.	1.64		
HYDROGRAPH AT	PRJ	69.	12.25	15.	5.	5.	0.20		
2 COMBINED AT	TOTAL	381.	12.50	119.	42.	41.	1.84		

* NORMAL END OF HEC-1 ***

*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* MAY 1991 *
* VERSION 4.0.1E *
*
* RUN DATE 05/07/1999 TIME 14:41:42 *
*

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

05 YEAR 24 HOUR EVENT

3 IO OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN 5 MINUTES IN COMPUTATION INTERVAL
IDATE 1 0 STARTING DATE
ITIME 0000 STARTING TIME
NQ 300 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 2 0 ENDING DATE
NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL 0.08 HOURS
TOTAL TIME BASE 24.92 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

5 KK

*
* 1-9 *
*

7 KO

OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

12 KK

*
* 10-13 *
*

14 KO

OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

* *
9 KK * 1-13 *
* *

21 KO OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

* *
23 KK * PRJ *
* *

25 KO OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

* *
30 KK * TOTAL *
* *

32 KO OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

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 STAG
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	1-9	367.	12.58	103.	37.	35.	1.24		
HYDROGRAPH AT	10-13	152.	12.50	38.	14.	13.	0.41		
2 COMBINED AT	1-13	516.	12.50	141.	50.	48.	1.64		
HYDROGRAPH AT	PRJ	67.	12.33	14.	5.	5.	0.20		
2 COMBINED AT	TOTAL	562.	12.50	155.	55.	53.	1.84		

* NORMAL END OF HEC-1 ***

* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* MAY 1991 *
* VERSION 4.0.1E *
* RUN DATE 05/07/1999 TIME 14:43:07 *

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

50 YEAR 24 HOUR EVENT

3 IO

OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

IT

HYDROGRAPH TIME DATA

NMIN 5 MINUTES IN COMPUTATION INTERVAL
IDATE 1 0 STARTING DATE
ITIME 0000 STARTING TIME
NQ 300 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 2 0 ENDING DATE
NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL 0.08 HOURS
TOTAL TIME BASE 24.92 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

5 KK

* 1-9 *

7 KO

OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

12 KK

* 10-13 *

14 KO

OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

9 KK

* 1-13 *

21 KO

OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

23 KK

* PRJ *

25 KO

OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

30 KK

* TOTAL *

32 KO

OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

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 6-HOUR PERIOD	24-HOUR PERIOD	72-HOUR PERIOD	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAG
HYDROGRAPH AT	1-9	438.	12.50	126.	44.	43.	1.24		
HYDROGRAPH AT	10-13	182.	12.42	46.	16.	16.	0.41		
2 COMBINED AT	1-13	618.	12.50	172.	60.	58.	1.64		
HYDROGRAPH AT	PRJ	127.	12.25	24.	8.	8.	0.20		
2 COMBINED AT	TOTAL	694.	12.42	195.	69.	66.	1.84		

* NORMAL END OF HEC-1 ***


```
*****  
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *  
* MAY 1991 *  
* VERSION 4.0.1E *  
* RUN DATE 05/07/1999 TIME 14:36:51 *  
*****
```

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

100 YEAR 24 HOUR EVENT

3 IO

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

IT

HYDROGRAPH TIME DATA
NMIN 5 MINUTES IN COMPUTATION INTERVAL
IDATE 1 0 STARTING DATE
ITIME 0000 STARTING TIME
NQ 300 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 2 0 ENDING DATE
NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL 0.08 HOURS
TOTAL TIME BASE 24.92 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

5 KK

```
*****  
* 1-9 *  
*****
```

7 KO

OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

12 KK

```
*****  
* 10-13 *  
*****
```

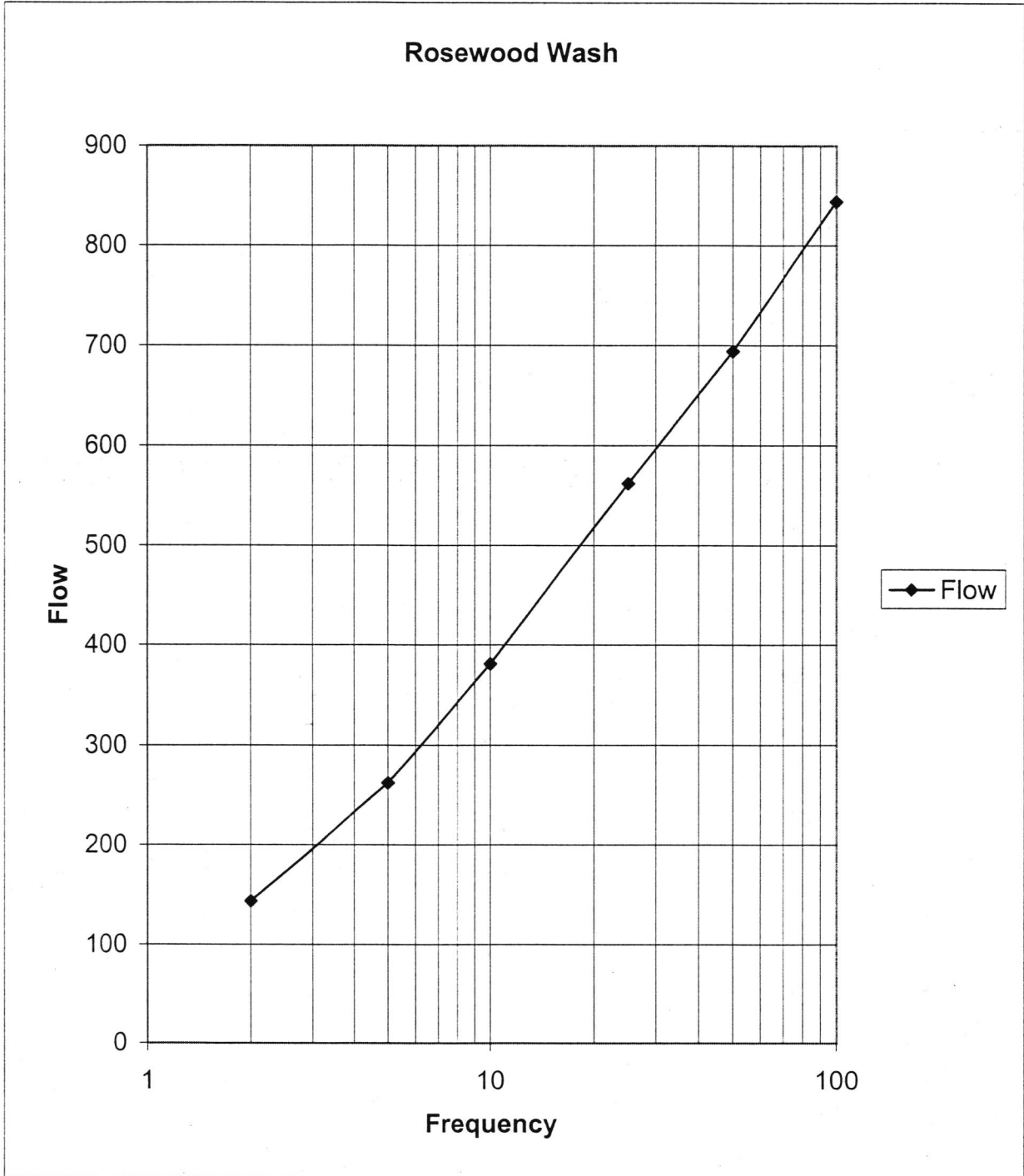
14 KO

OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
IPNCH 0 PUNCH COMPUTED HYDROGRAPH
IOUT 22 SAVE HYDROGRAPH ON THIS UNIT
ISAV1 1 FIRST ORDINATE PUNCHED OR SAVED
ISAV2 300 LAST ORDINATE PUNCHED OR SAVED
TIMINT 0.083 TIME INTERVAL IN HOURS

ROSEWOOD WASH
Flow-Frequency Curve

Completed Flow at the Upstream End of Culverts
in Rosewood Wash west of Plumas on the
north side of Plum for a 24 hour storm

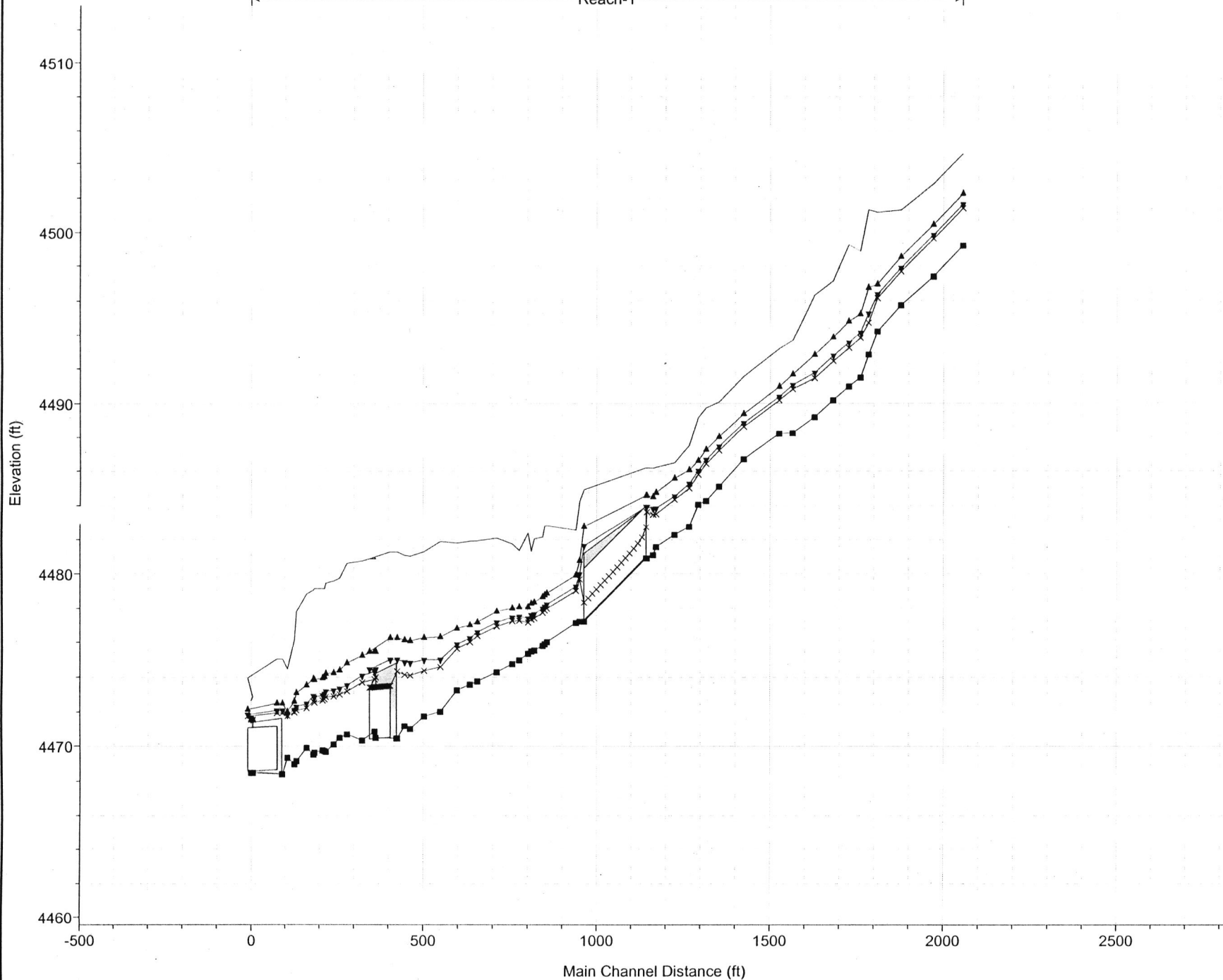
Frequency	2	5	10	25	50	100
Flow	143	262	381	562	694	844



APPENDIX 2
HEC-RAS output

Rosewood Wash Imported Plan 01 5/17/99

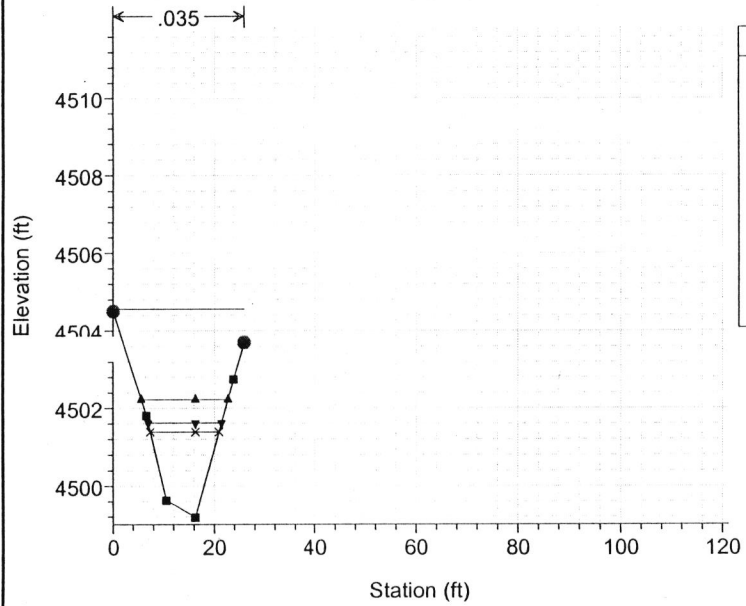
Reach-1



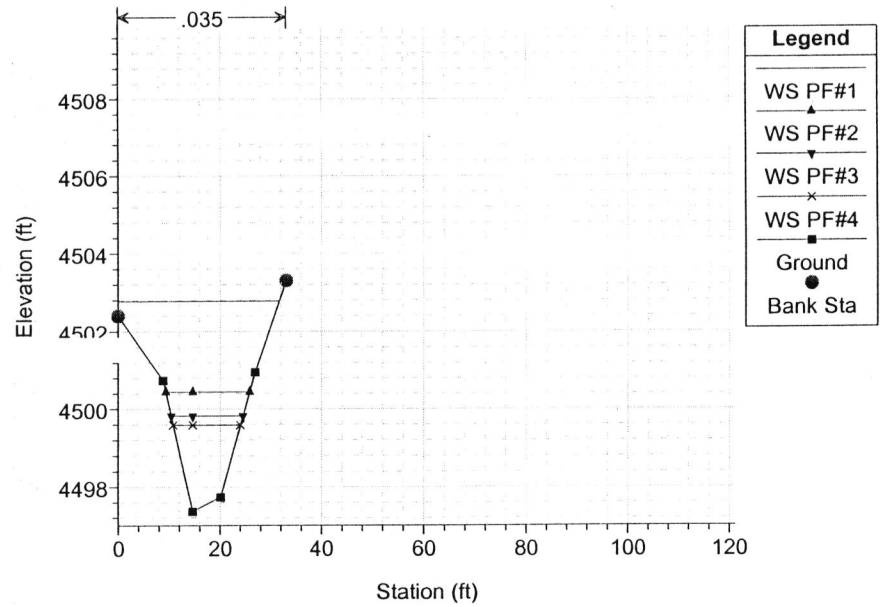
Legend	
PF#1(843cfs)	▲
PF#2(250cfs)	▼
PF#3(160cfs)	×
PF#4(130cfs)	■
Ground	

1 in Horiz. = 400 ft 1 in Vert. = 8 ft

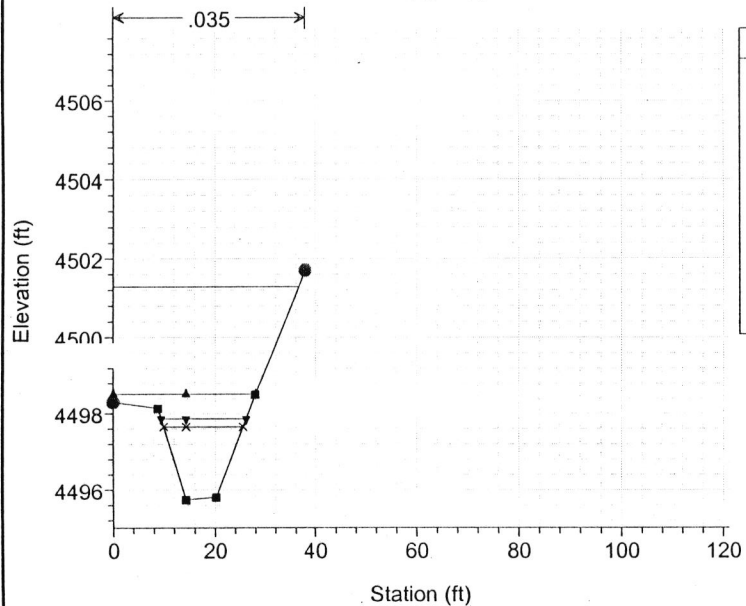
Rosewood Wash Imported Plan 01 5/17/99
RS = 74



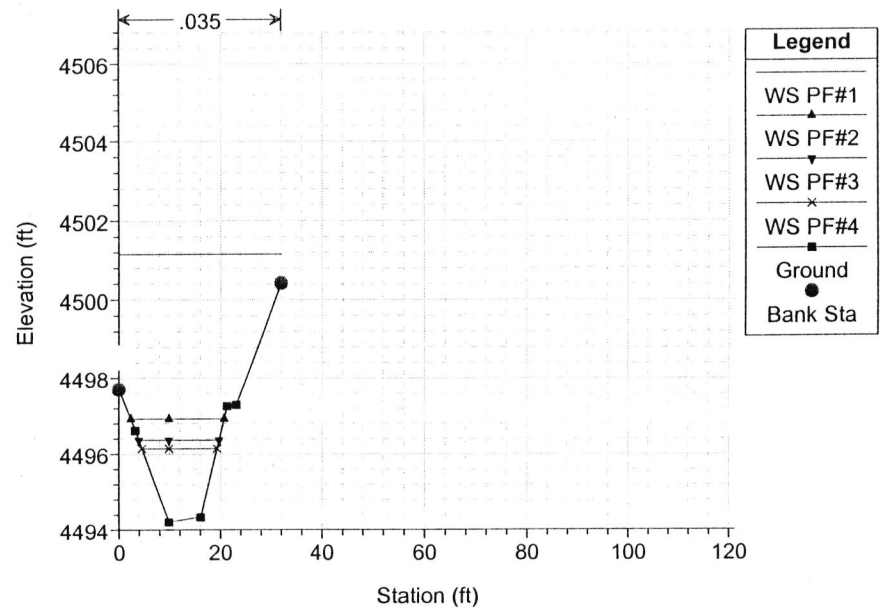
Rosewood Wash Imported Plan 01 5/17/99
RS = 73



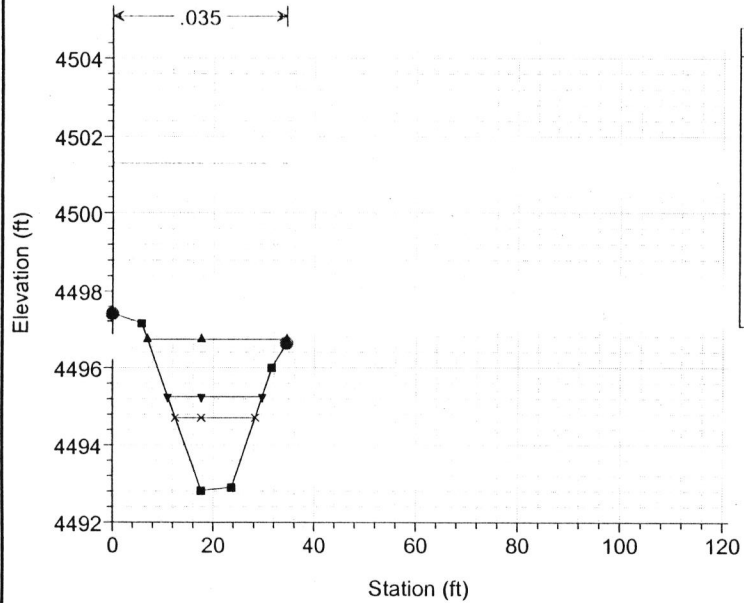
Rosewood Wash Imported Plan 01 5/17/99
RS = 72



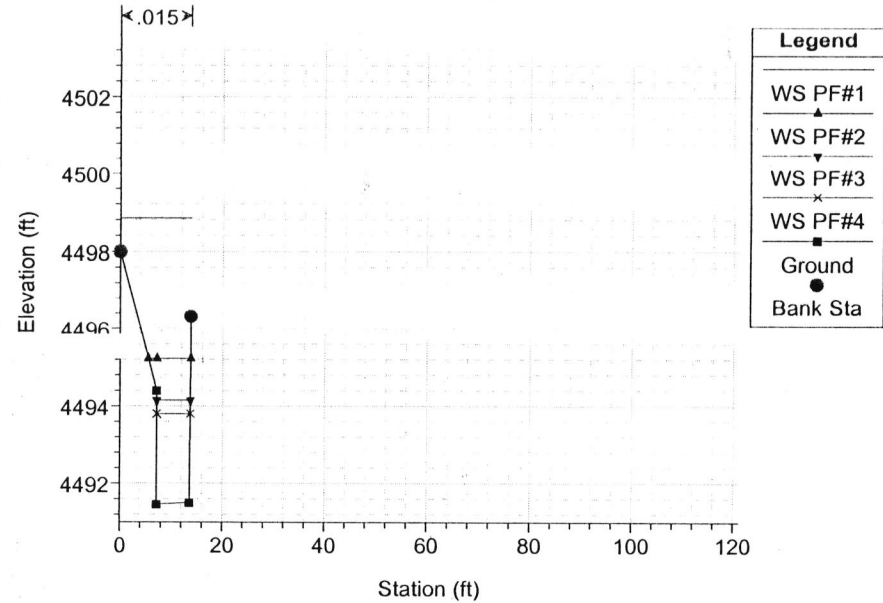
Rosewood Wash Imported Plan 01 5/17/99
RS = 71



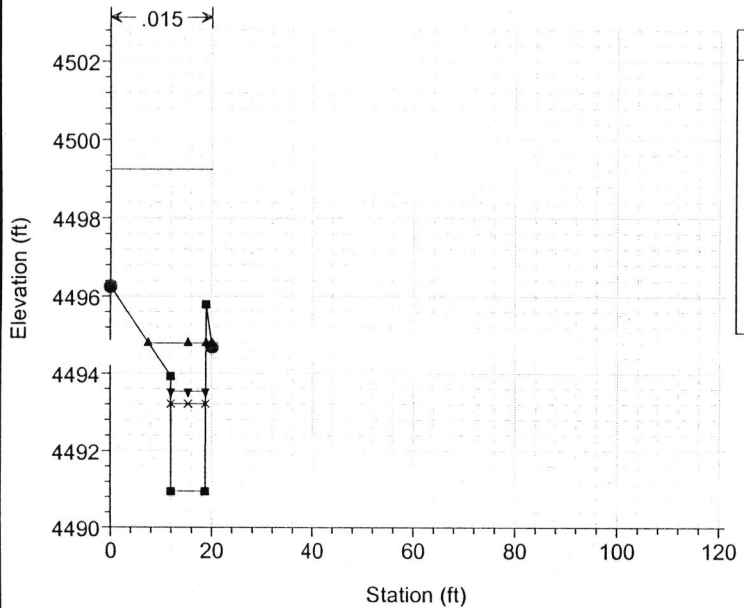
Rosewood Wash Imported Plan 01 5/17/99
RS = 70



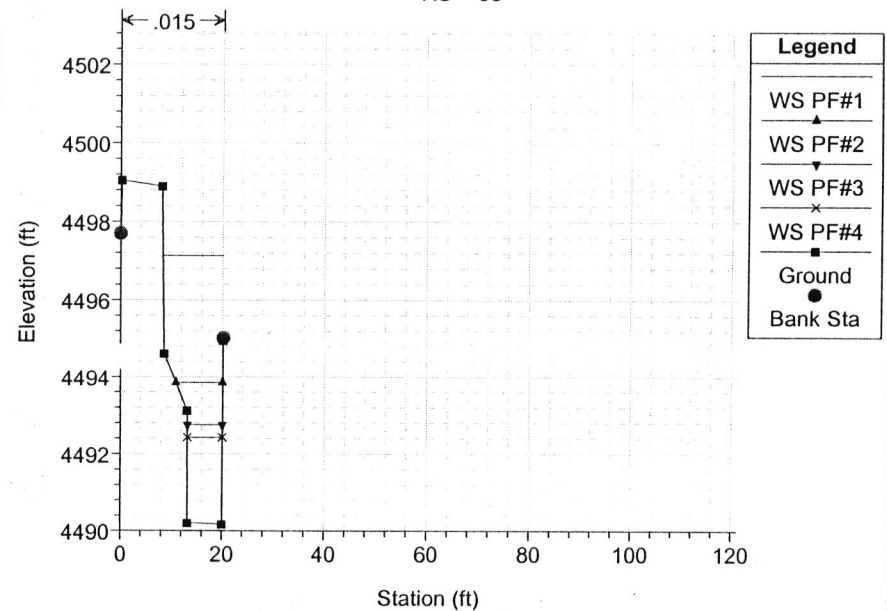
Rosewood Wash Imported Plan 01 5/17/99
RS = 69



Rosewood Wash Imported Plan 01 5/17/99
RS = 68

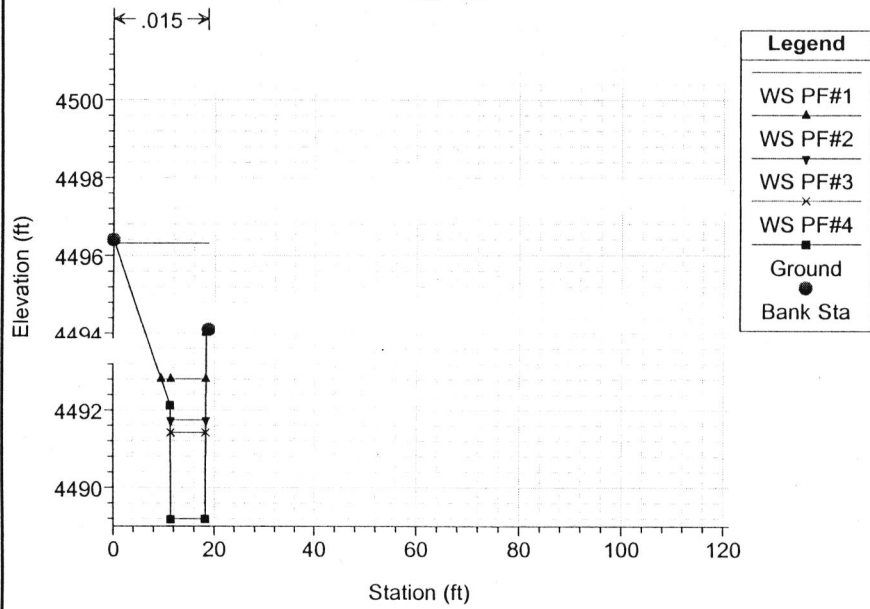


Rosewood Wash Imported Plan 01 5/17/99
RS = 66

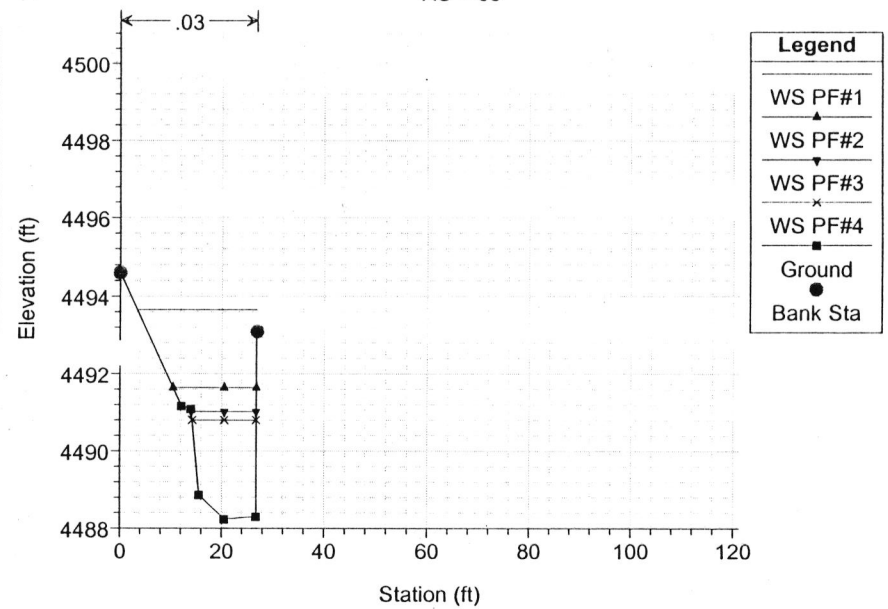


1 in Horiz. = 40 ft 1 in Vert. = 5 ft

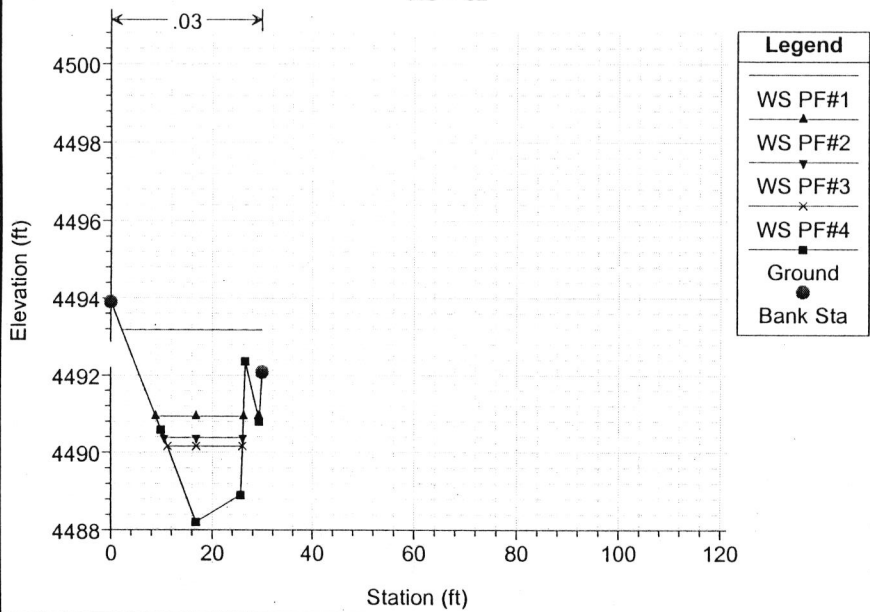
Rosewood Wash Imported Plan 01 5/17/99
RS = 65



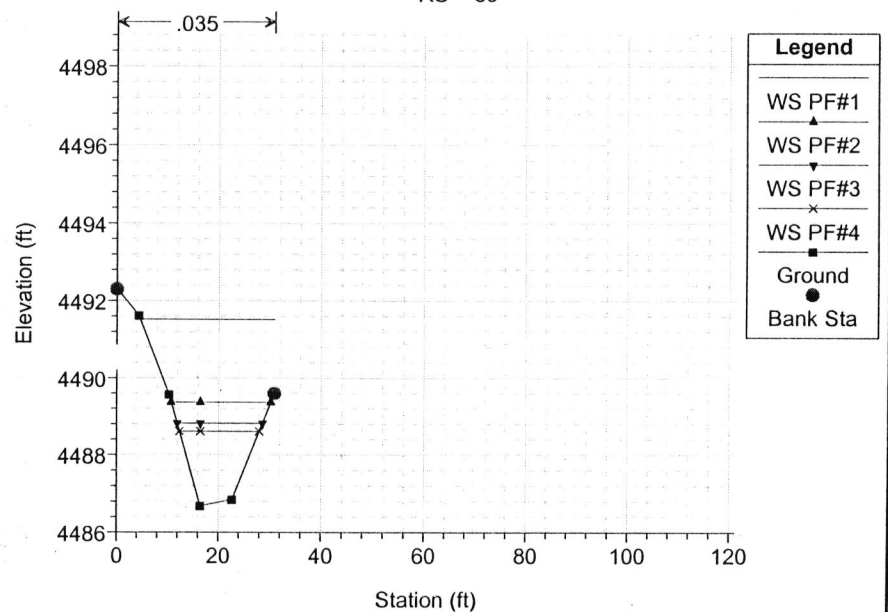
Rosewood Wash Imported Plan 01 5/17/99
RS = 63



Rosewood Wash Imported Plan 01 5/17/99
RS = 62



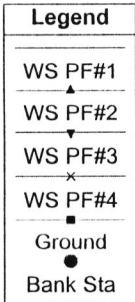
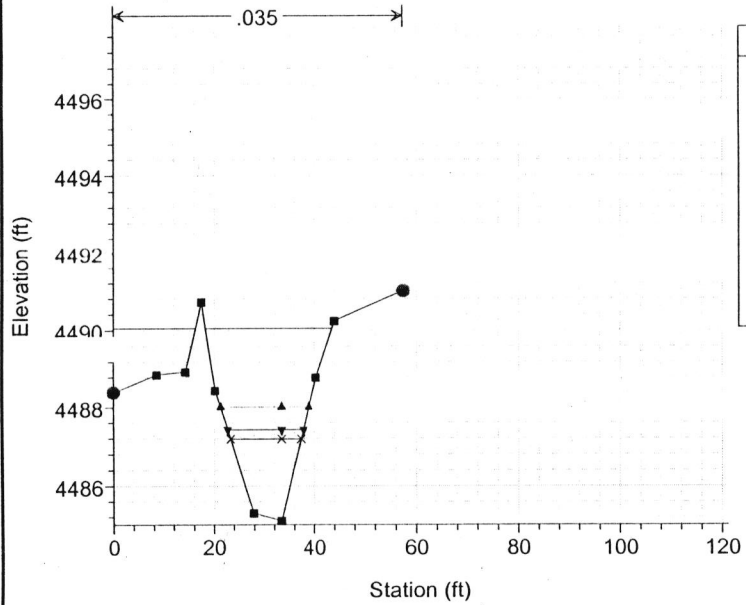
Rosewood Wash Imported Plan 01 5/17/99
RS = 60



1 in Horiz. = 40 ft 1 in Vert. = 5 ft

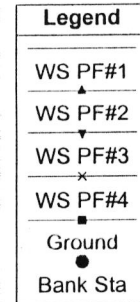
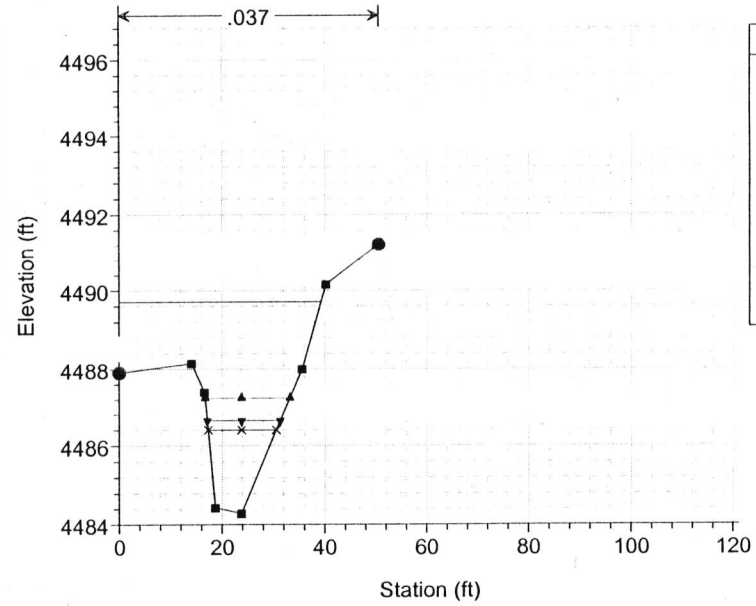
Rosewood Wash Imported Plan 01 5/17/99

RS = 59



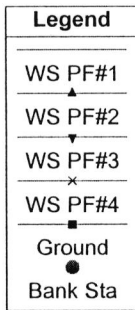
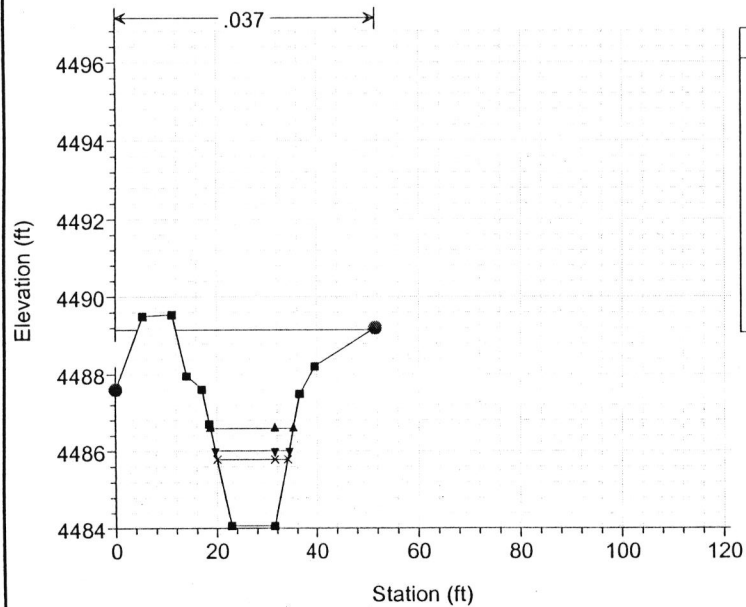
Rosewood Wash Imported Plan 01 5/17/99

RS = 58



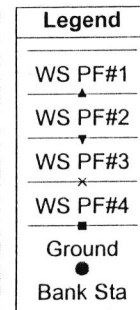
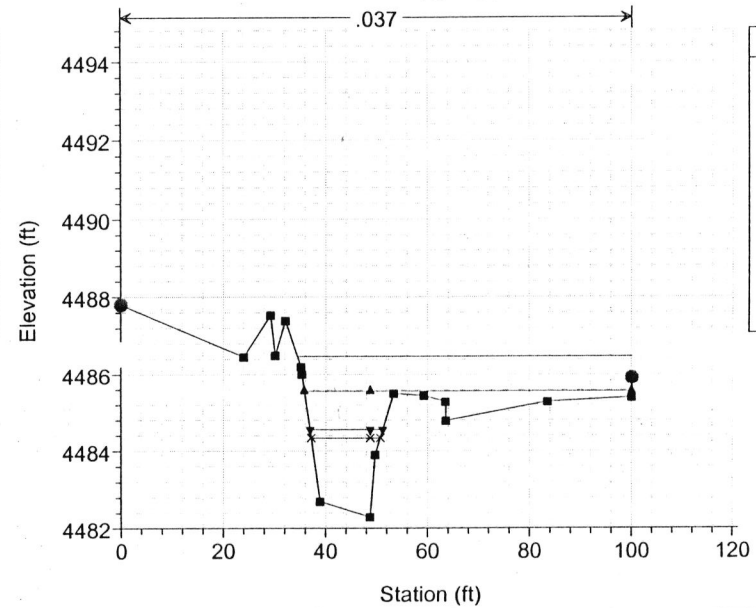
Rosewood Wash Imported Plan 01 5/17/99

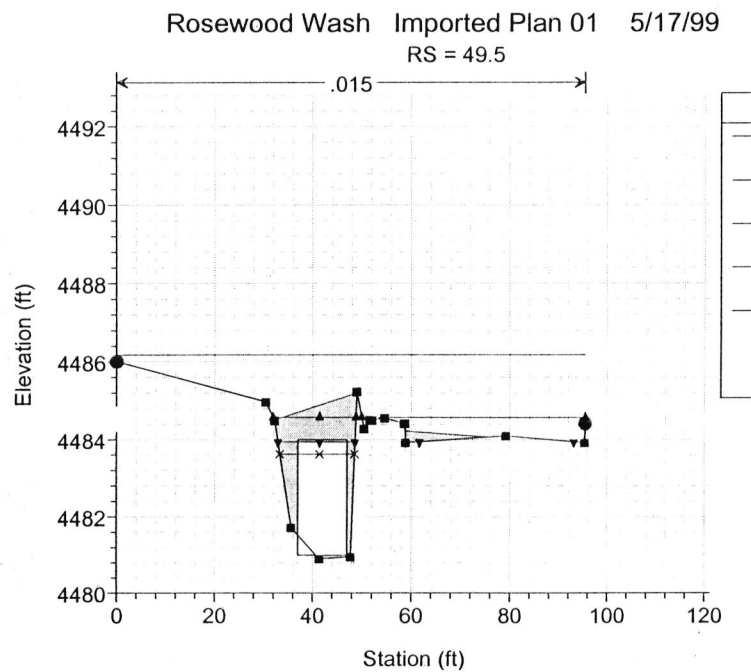
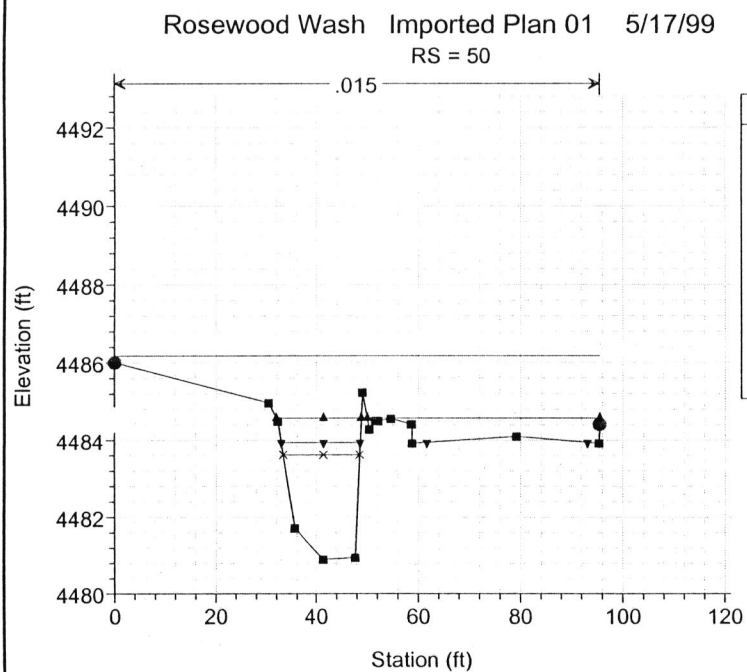
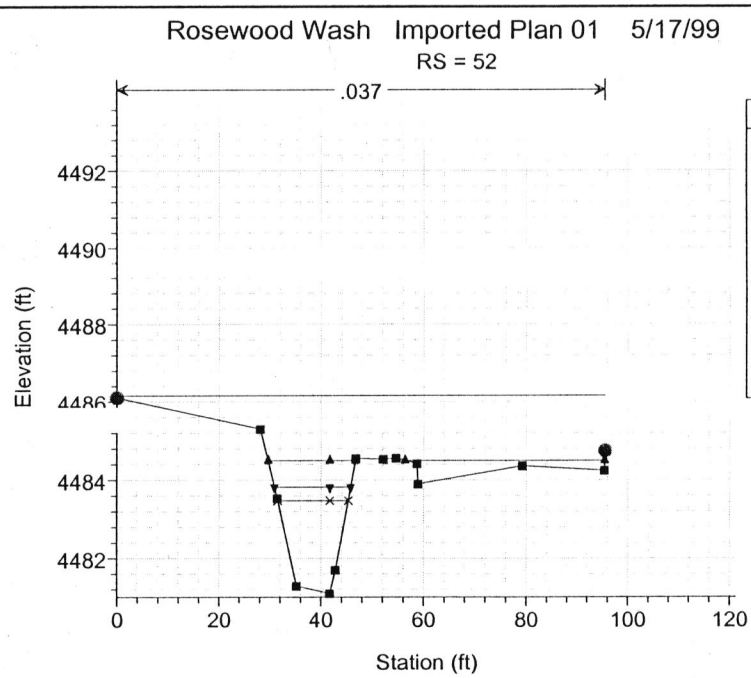
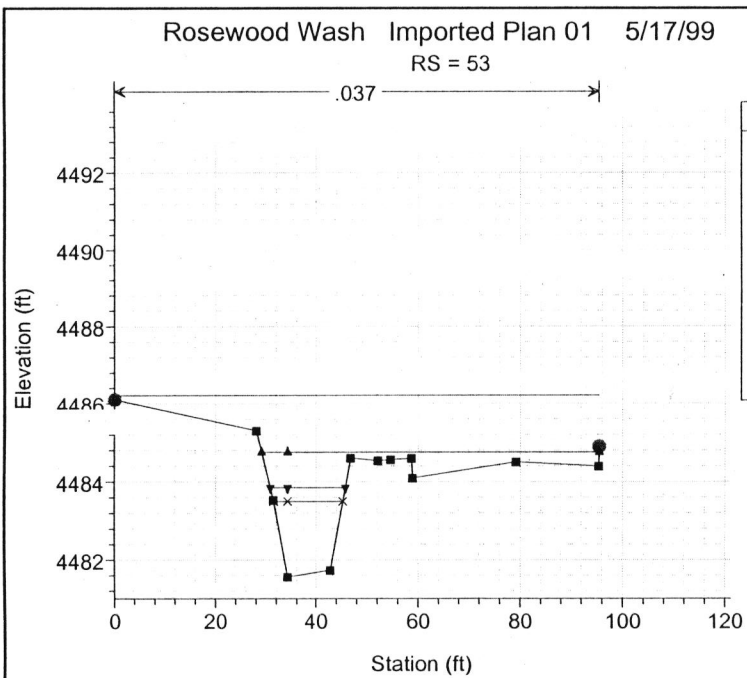
RS = 57



Rosewood Wash Imported Plan 01 5/17/99

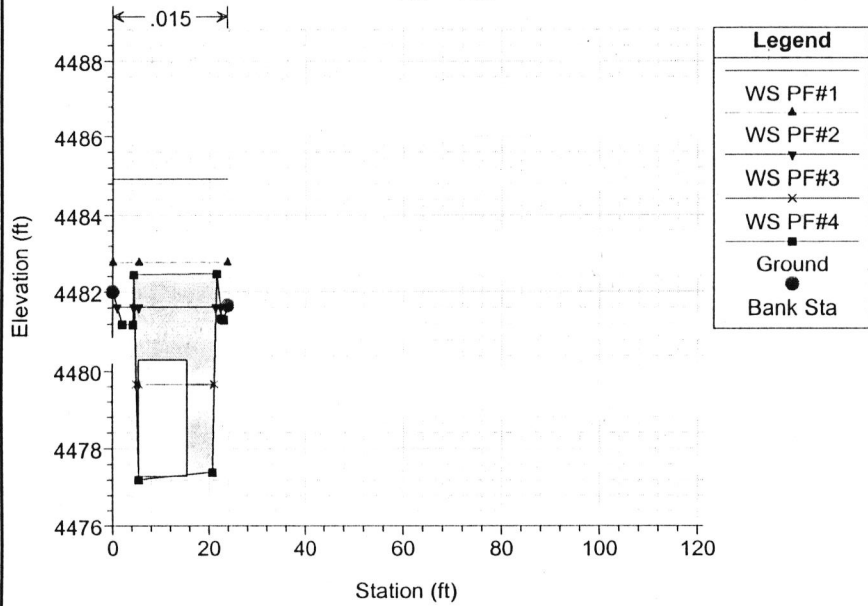
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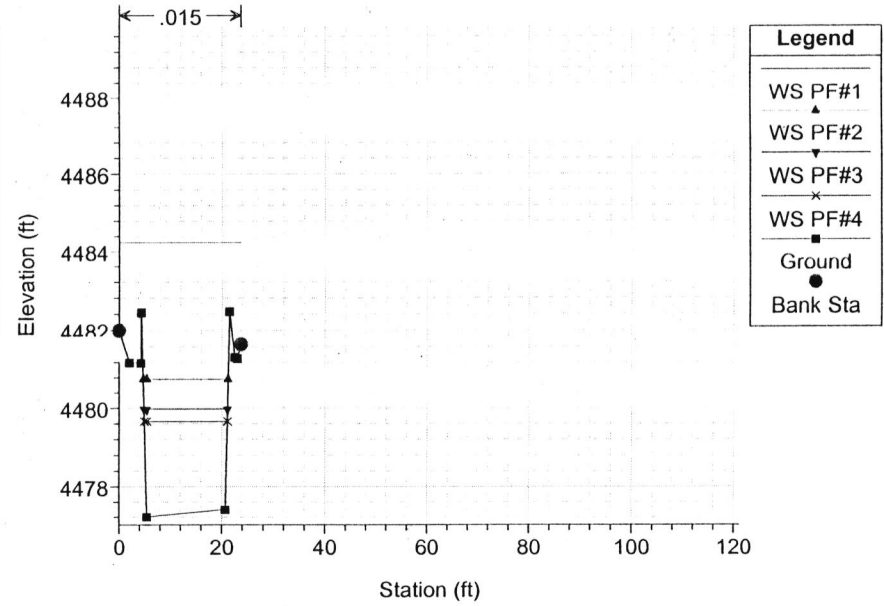


1 in Horiz. = 40 ft 1 in Vert. = 5 ft

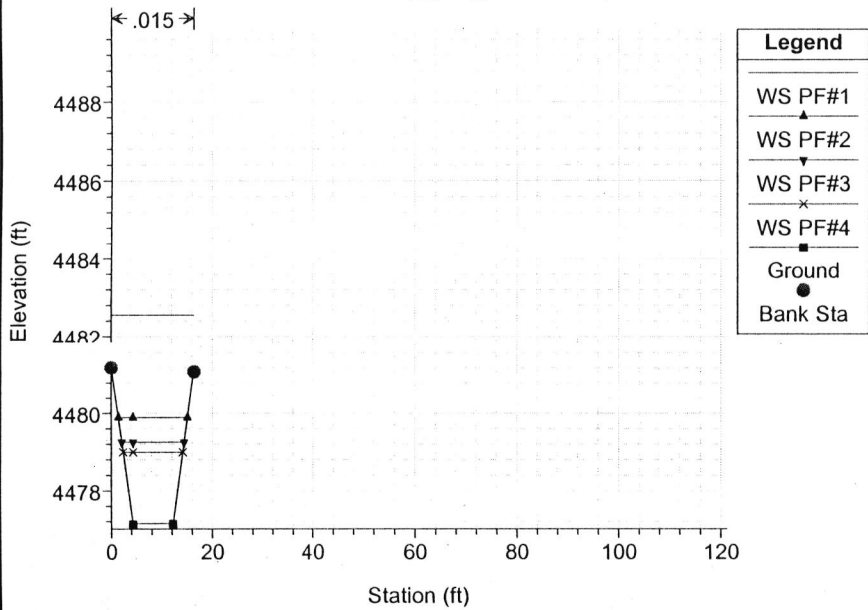
Rosewood Wash Imported Plan 01 5/17/99
RS = 49.5



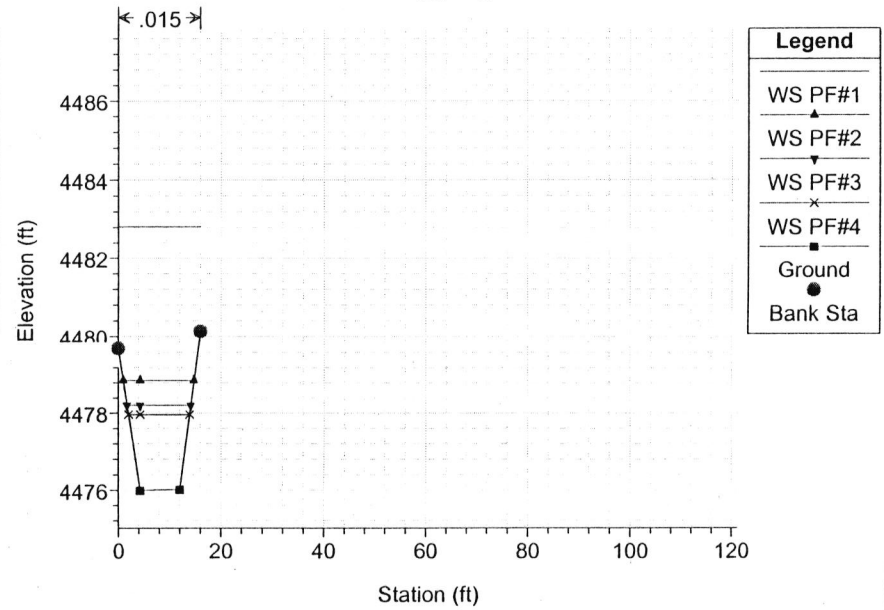
Rosewood Wash Imported Plan 01 5/17/99
RS = 49



Rosewood Wash Imported Plan 01 5/17/99
RS = 48

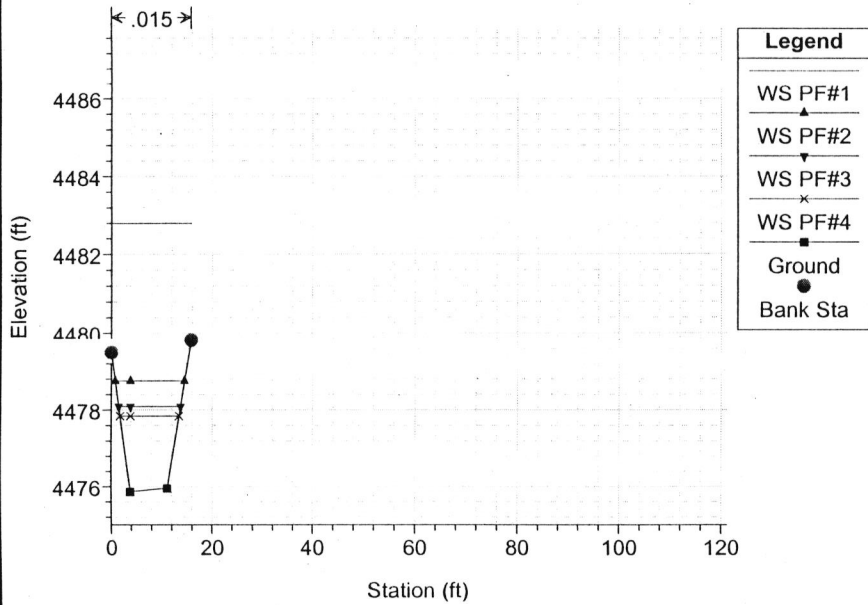


Rosewood Wash Imported Plan 01 5/17/99
RS = 47

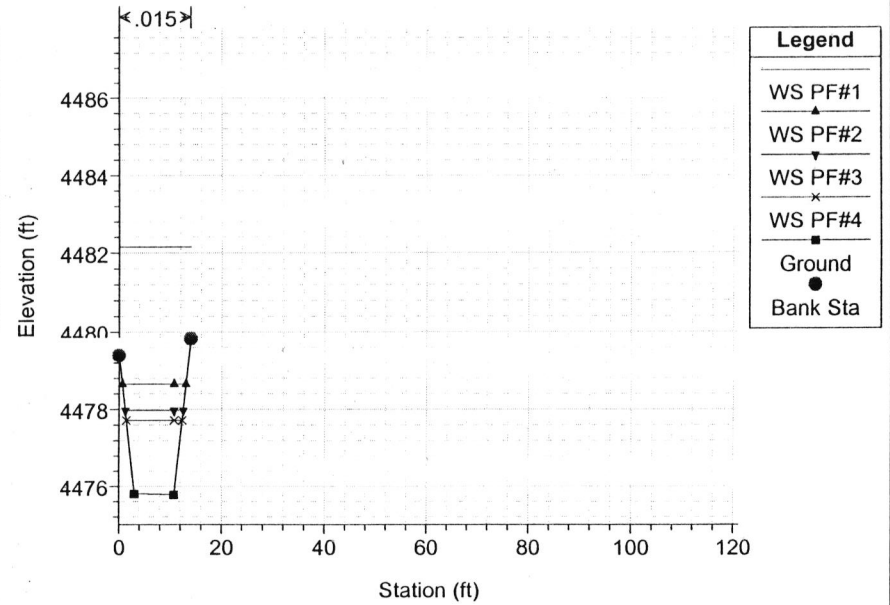


1 in Horiz. = 40 ft 1 in Vert. = 5 ft

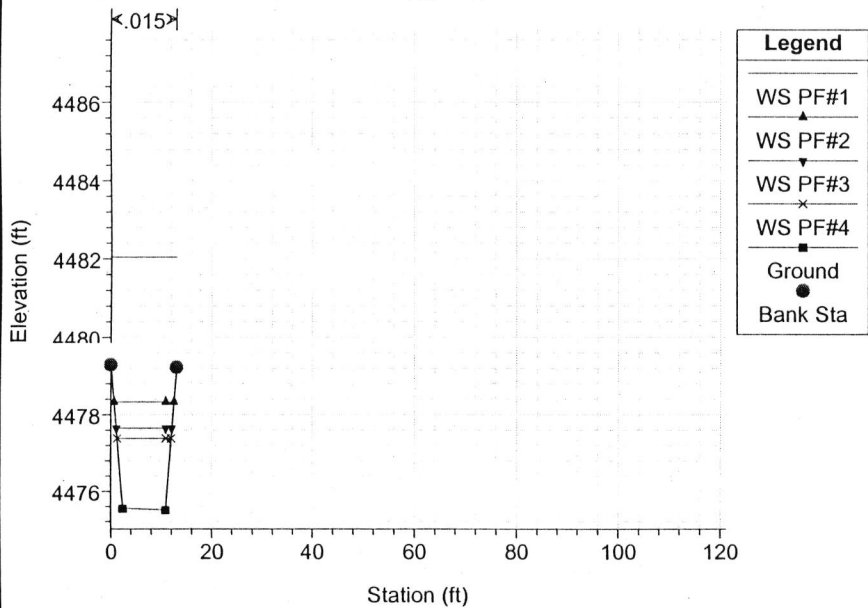
Rosewood Wash Imported Plan 01 5/17/99
RS = 46



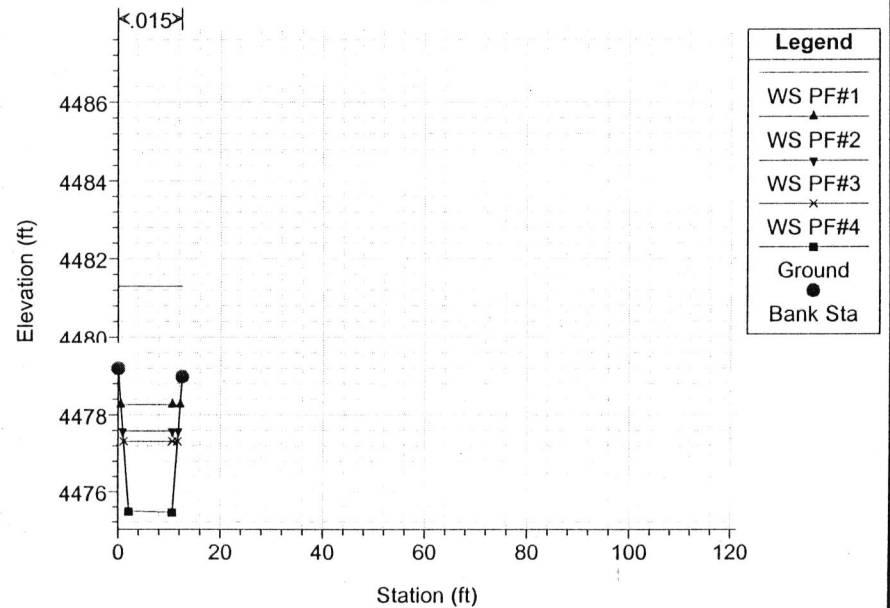
Rosewood Wash Imported Plan 01 5/17/99
RS = 45



Rosewood Wash Imported Plan 01 5/17/99
RS = 44

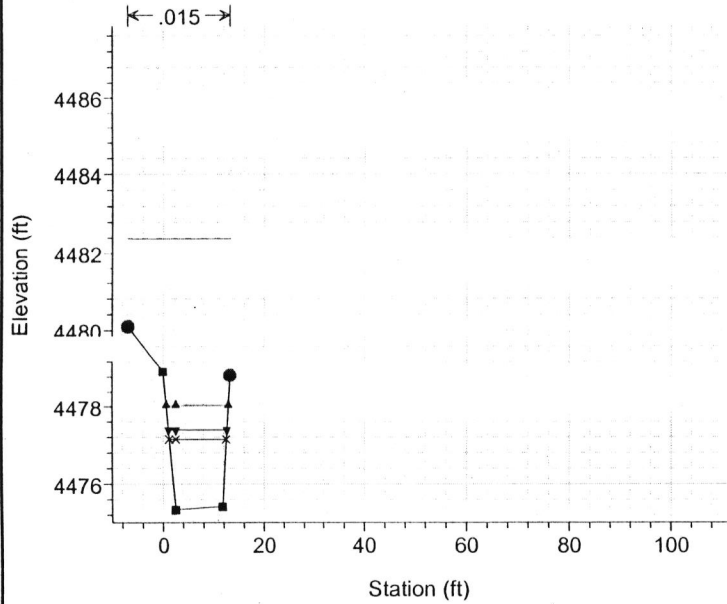


Rosewood Wash Imported Plan 01 5/17/99
RS = 43

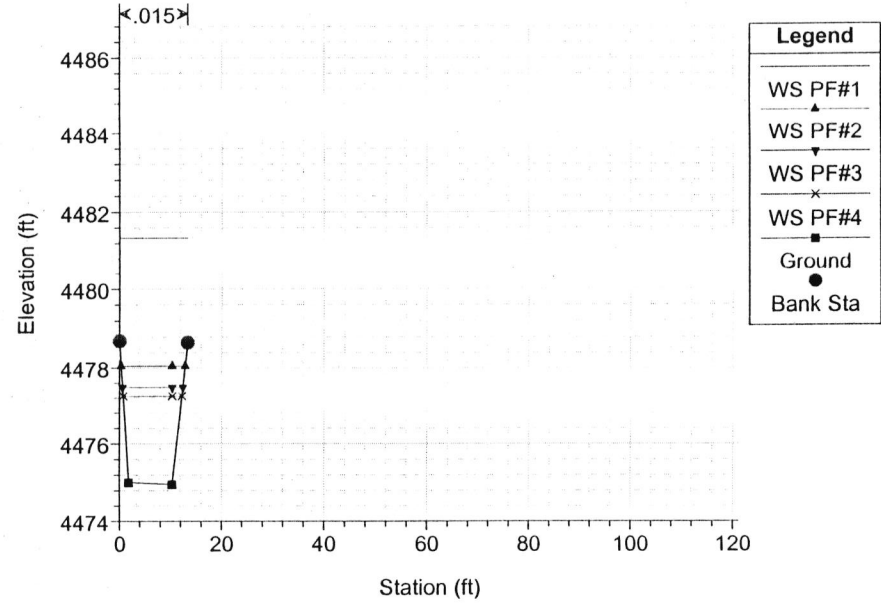


1 in Horiz. = 40 ft 1 in Vert. = 5 ft

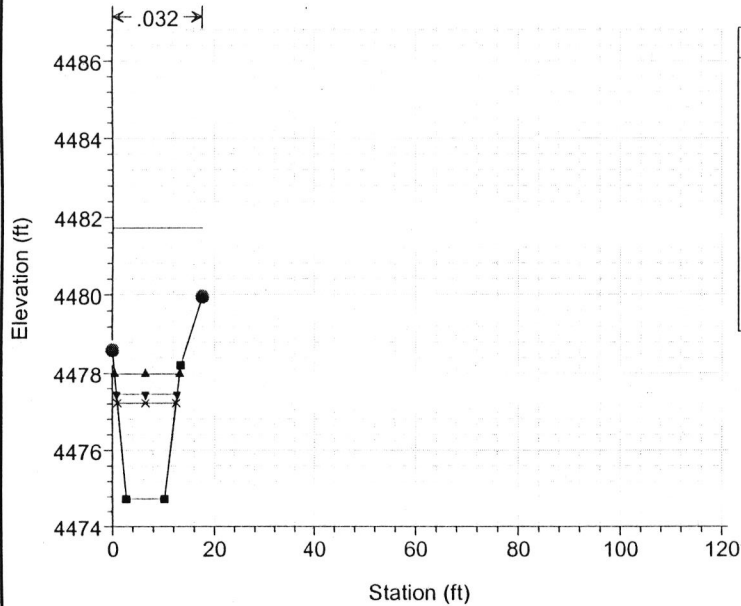
Rosewood Wash Imported Plan 01 5/17/99
RS = 42



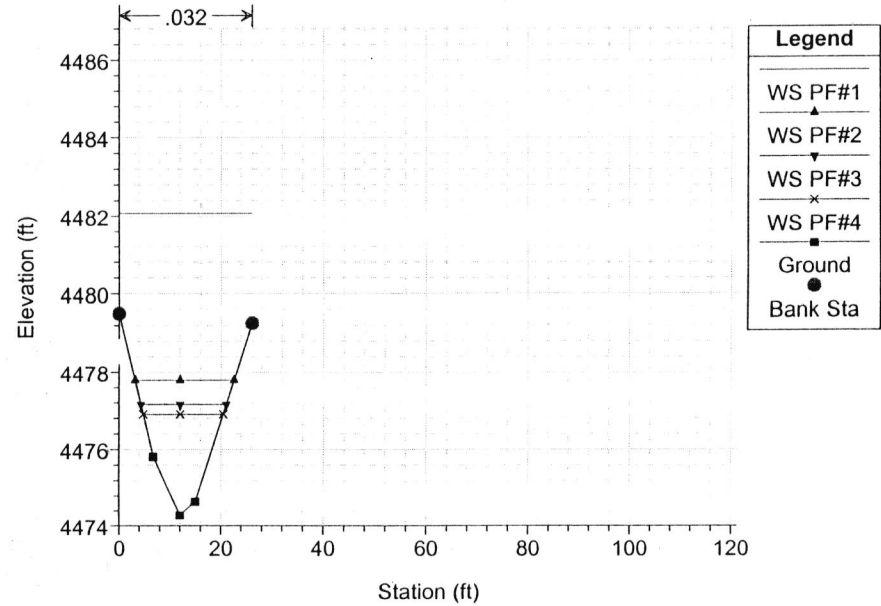
Rosewood Wash Imported Plan 01 5/17/99
RS = 41



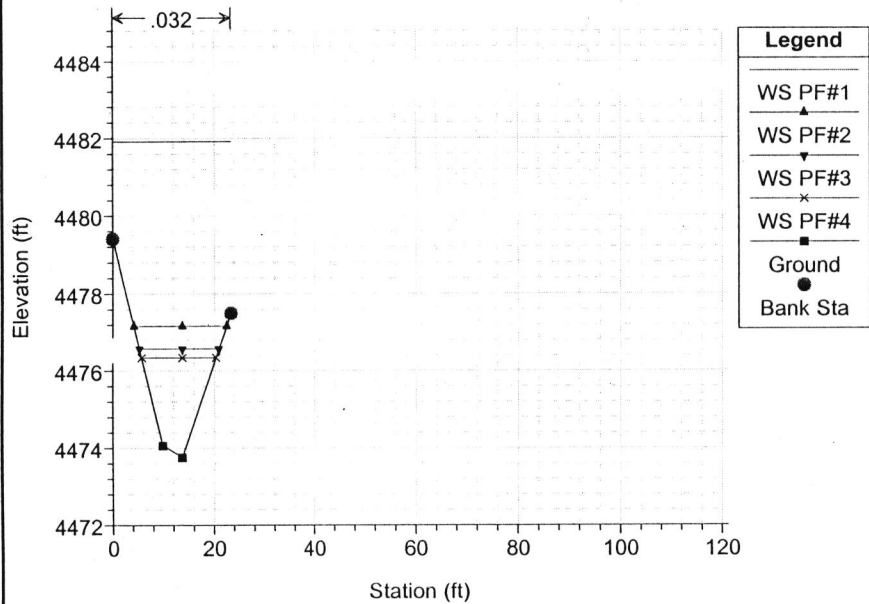
Rosewood Wash Imported Plan 01 5/17/99
RS = 40



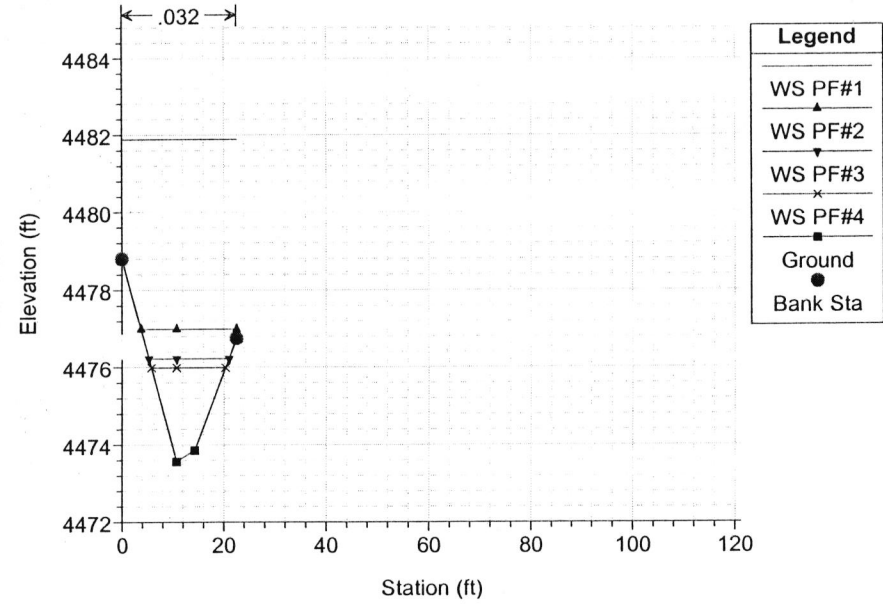
Rosewood Wash Imported Plan 01 5/17/99
RS = 39



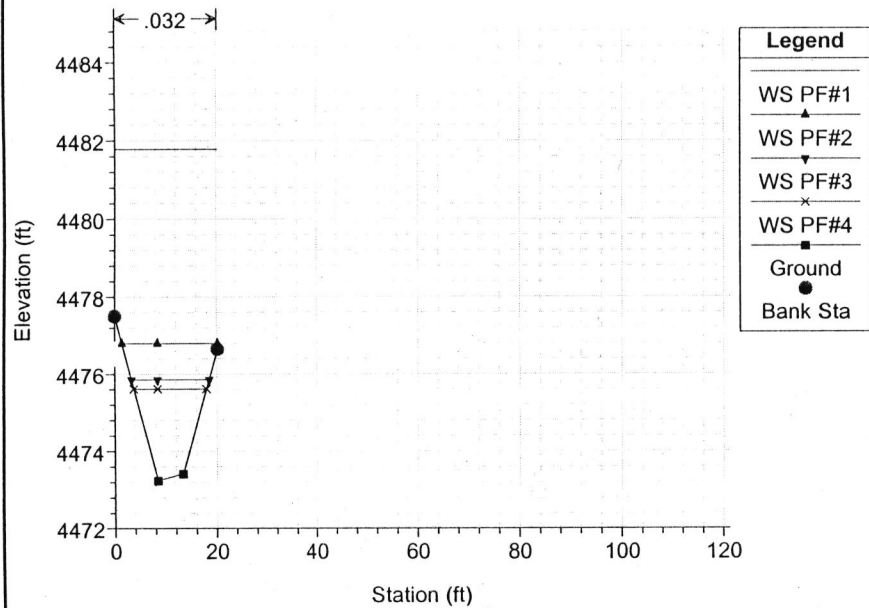
Rosewood Wash Imported Plan 01 5/17/99
RS = 38



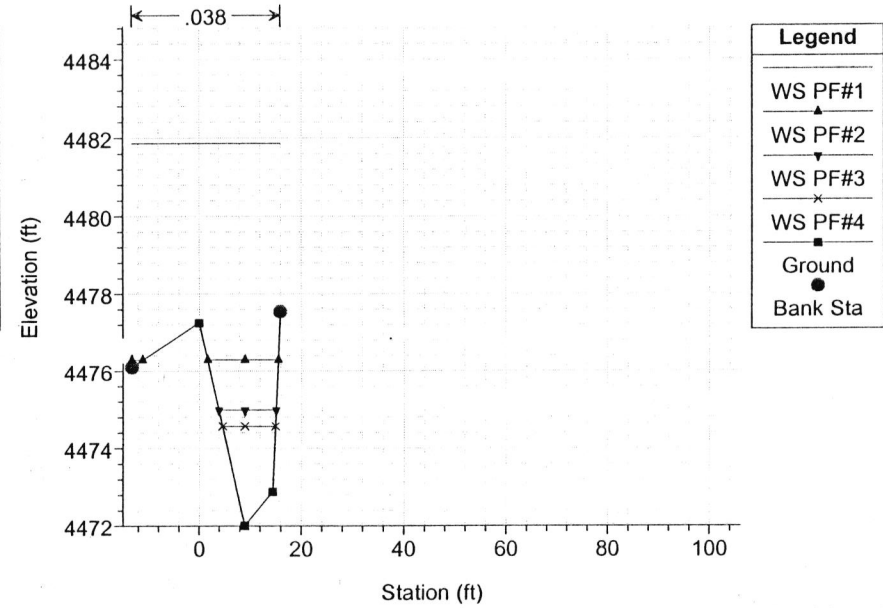
Rosewood Wash Imported Plan 01 5/17/99
RS = 37



Rosewood Wash Imported Plan 01 5/17/99
RS = 36

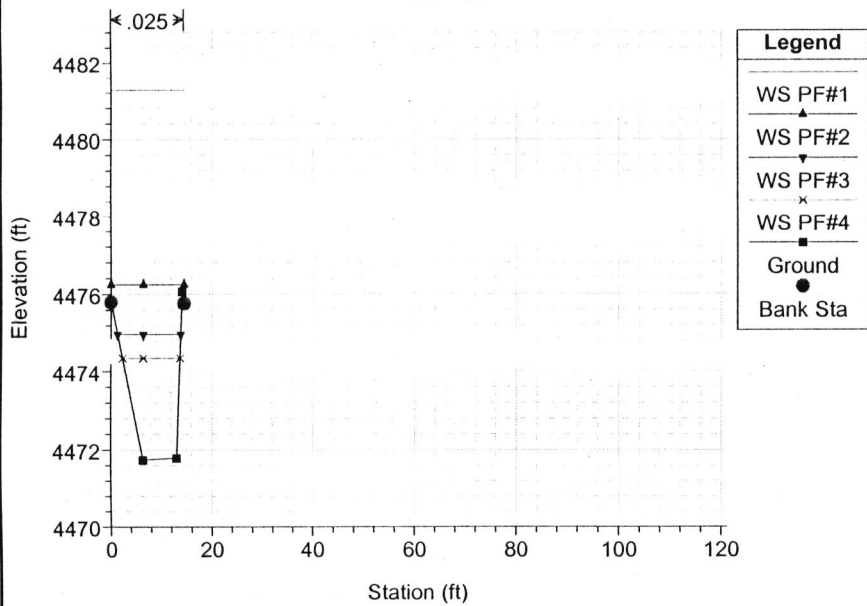


Rosewood Wash Imported Plan 01 5/17/99
RS = 35

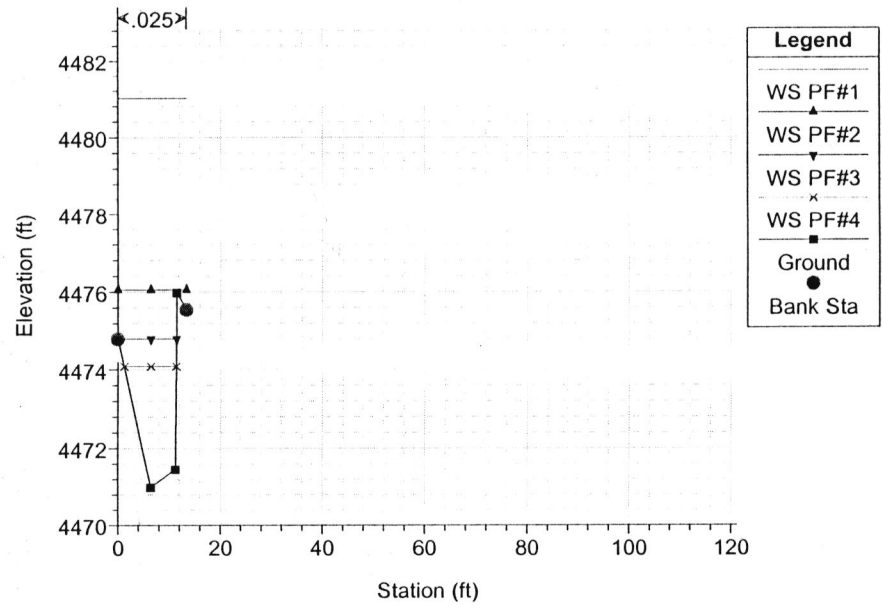


1 in Horiz. = 40 ft 1 in Vert. = 5 ft

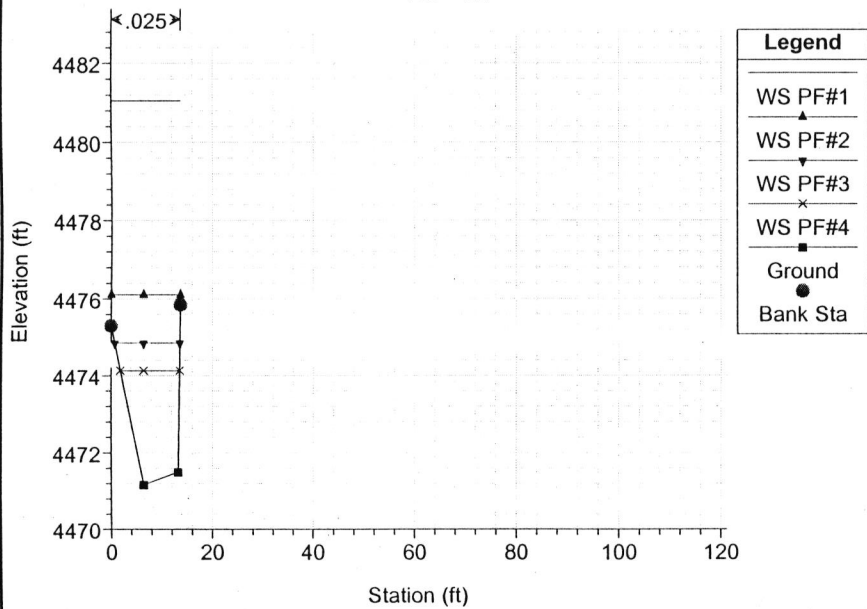
Rosewood Wash Imported Plan 01 5/17/99
RS = 34



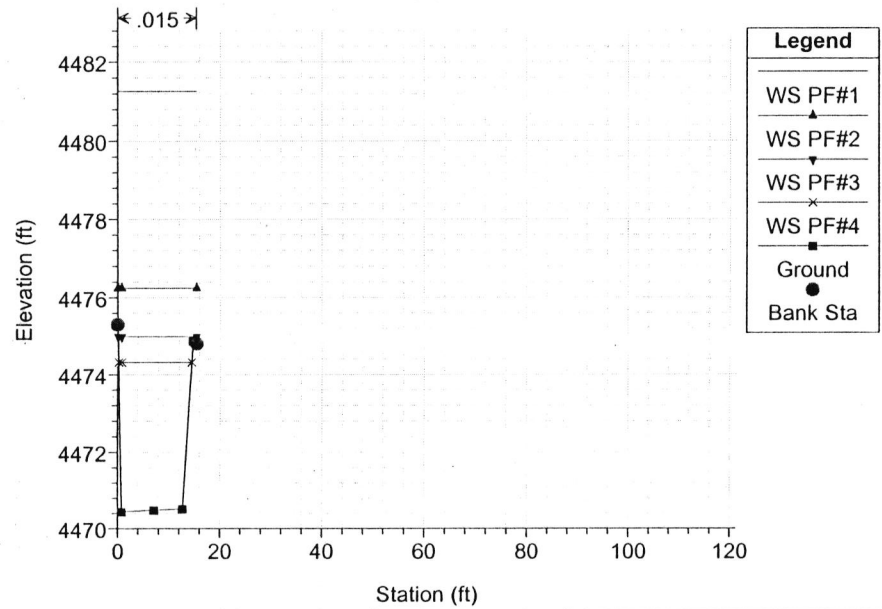
Rosewood Wash Imported Plan 01 5/17/99
RS = 33



Rosewood Wash Imported Plan 01 5/17/99
RS = 32

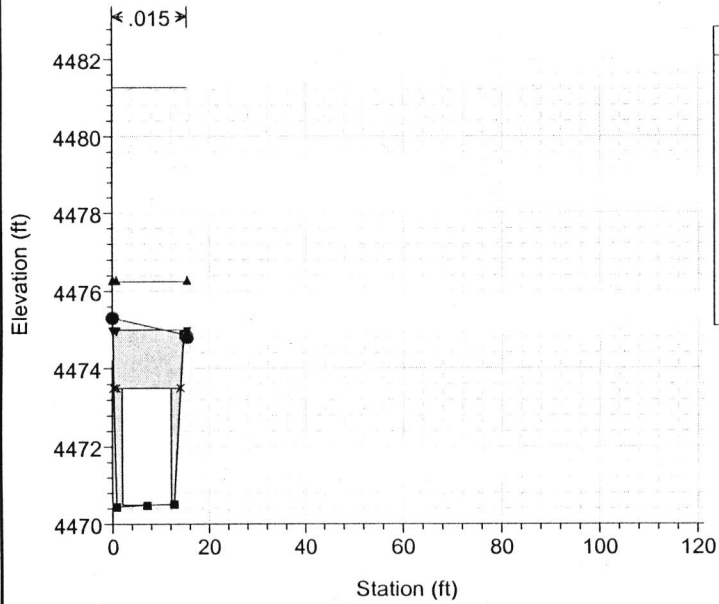


Rosewood Wash Imported Plan 01 5/17/99
RS = 31

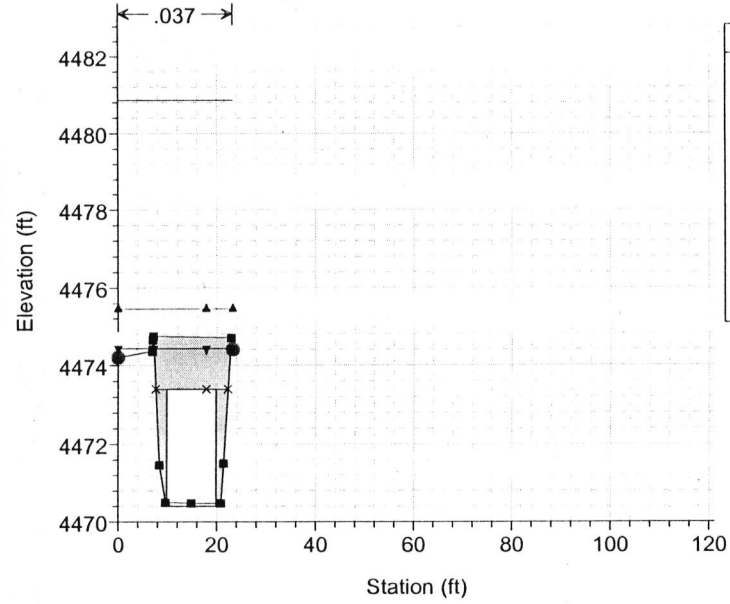


1 in Horiz. = 40 ft 1 in Vert. = 5 ft

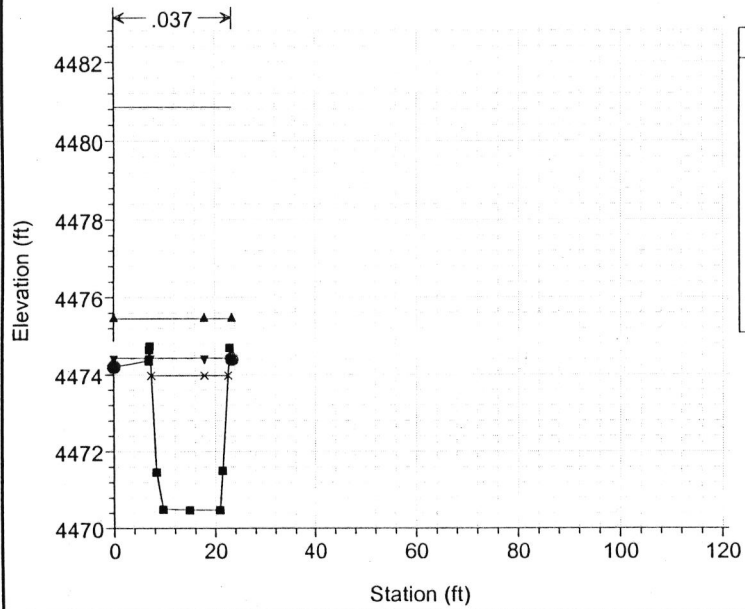
Rosewood Wash Imported Plan 01 5/17/99
RS = 30.5



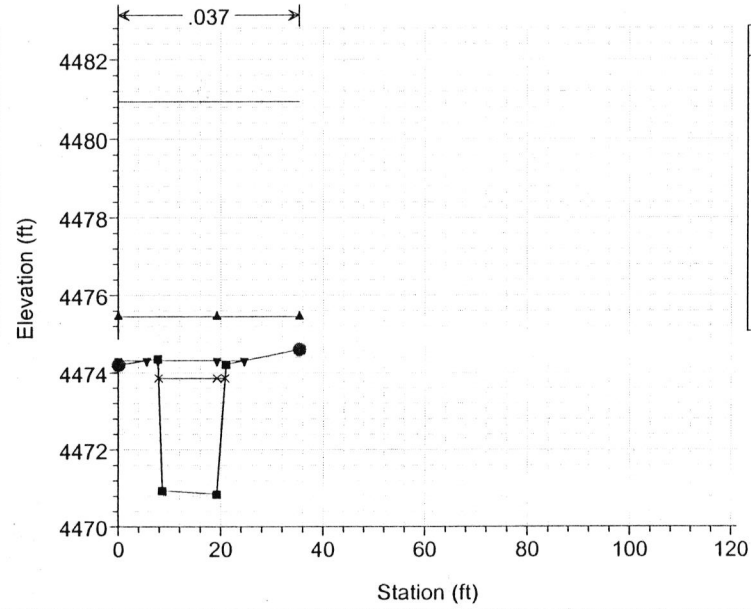
Rosewood Wash Imported Plan 01 5/17/99
RS = 30.5



Rosewood Wash Imported Plan 01 5/17/99
RS = 30

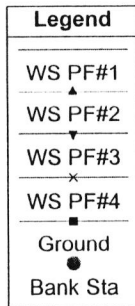
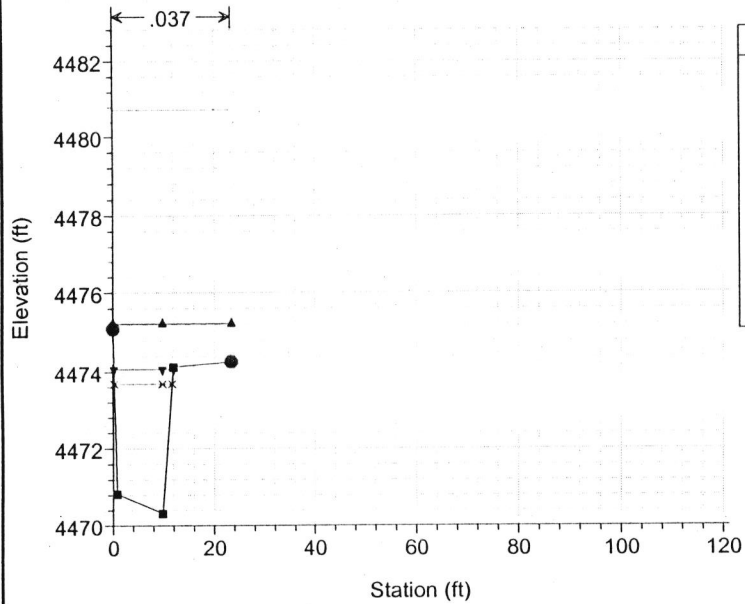


Rosewood Wash Imported Plan 01 5/17/99
RS = 29

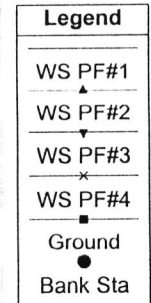
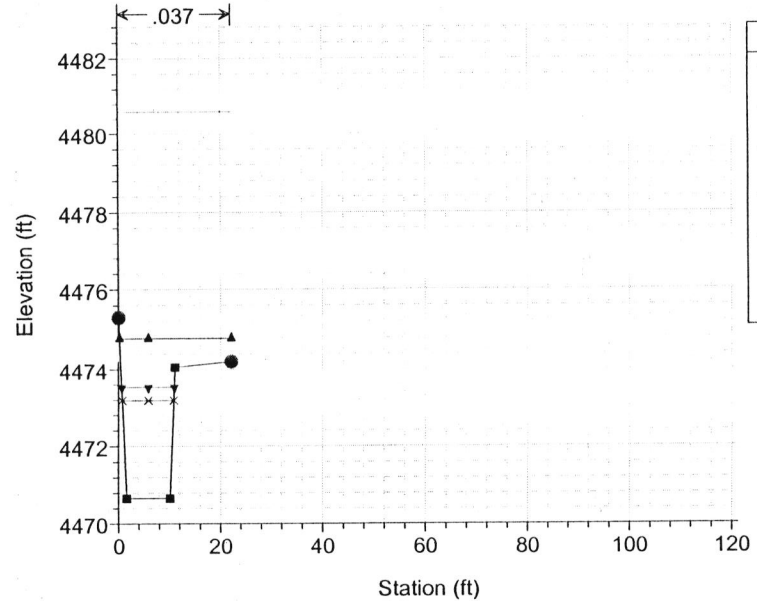


1 in Horiz. = 40 ft 1 in Vert. = 5 ft

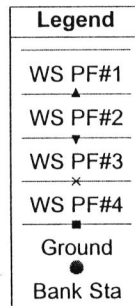
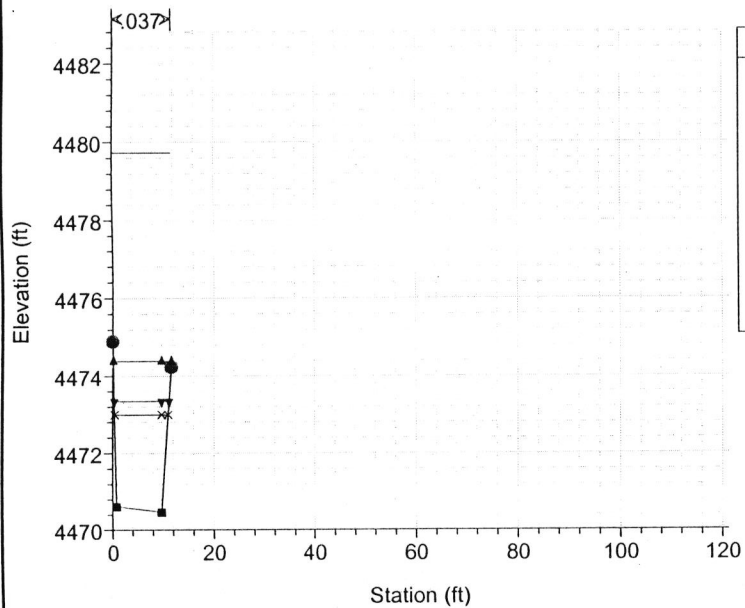
Rosewood Wash Imported Plan 01 5/17/99
RS = 28



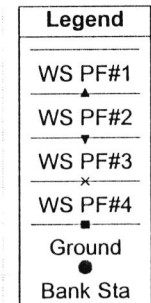
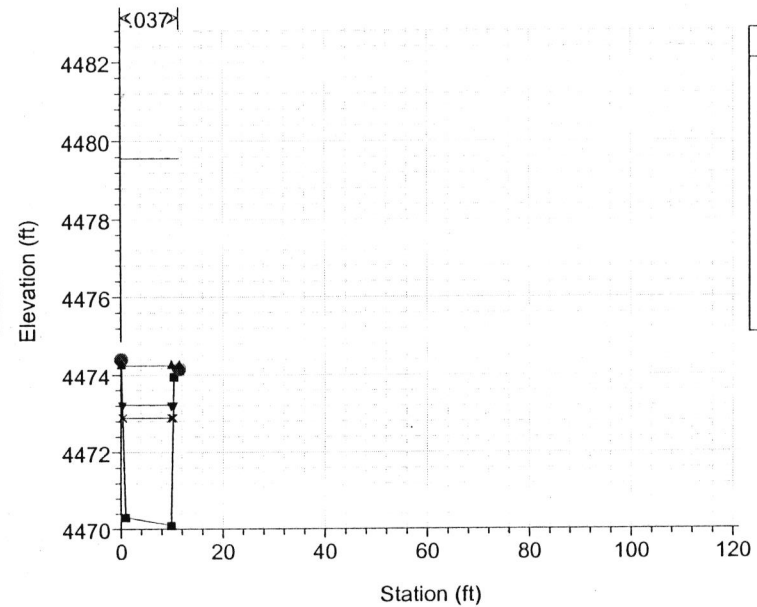
Rosewood Wash Imported Plan 01 5/17/99
RS = 27



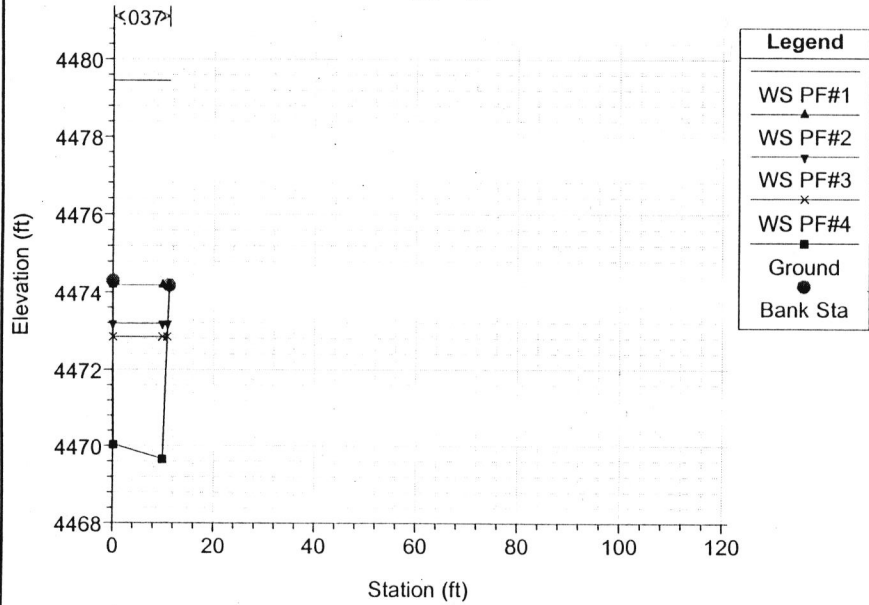
Rosewood Wash Imported Plan 01 5/17/99
RS = 26



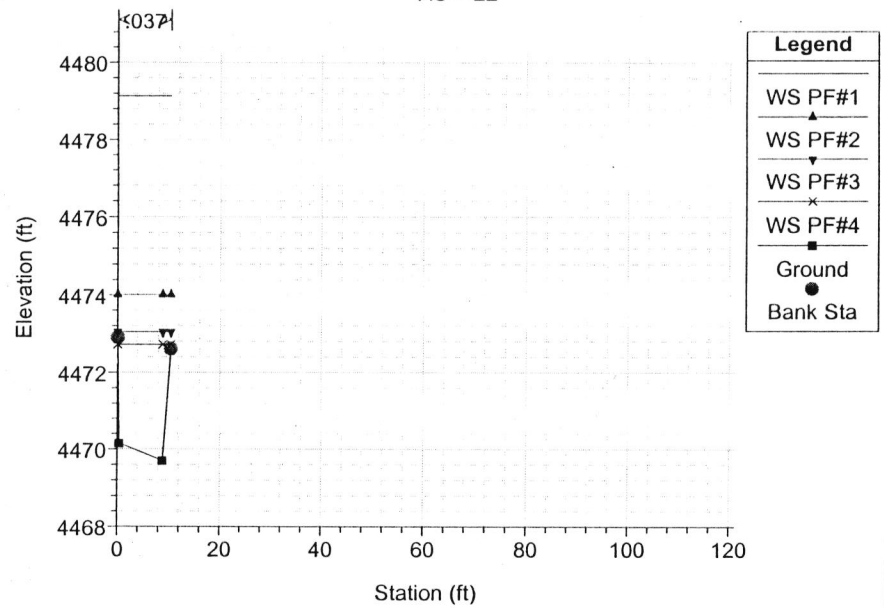
Rosewood Wash Imported Plan 01 5/17/99
RS = 25



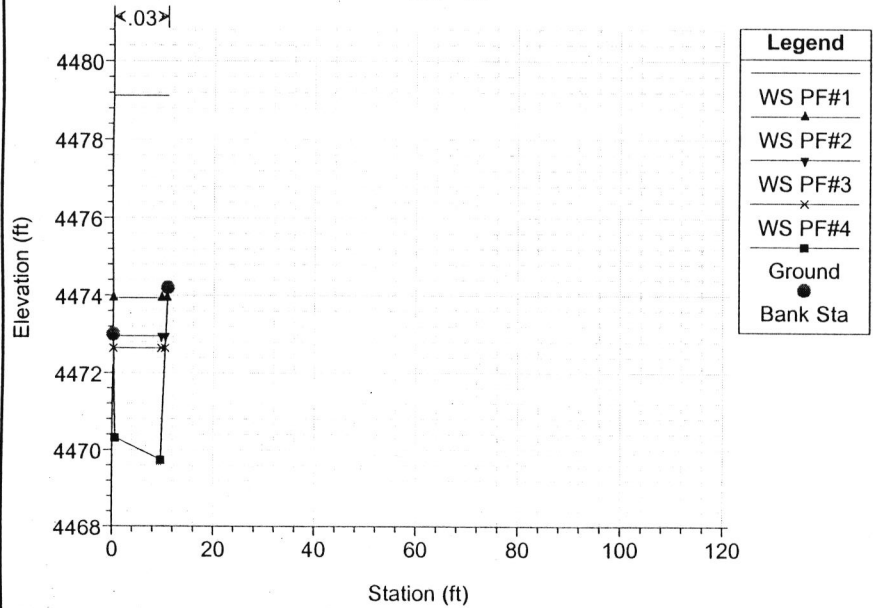
Rosewood Wash Imported Plan 01 5/17/99
RS = 24



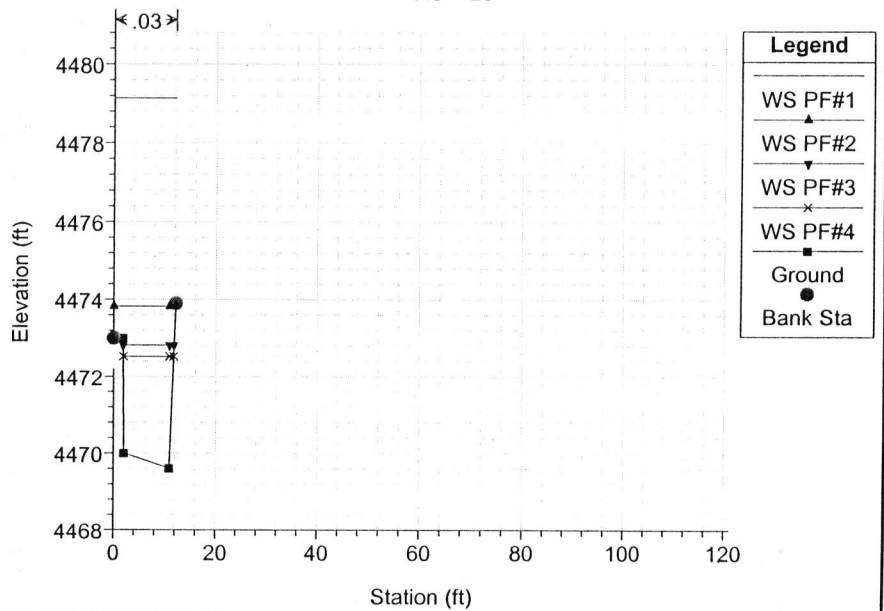
Rosewood Wash Imported Plan 01 5/17/99
RS = 22



Rosewood Wash Imported Plan 01 5/17/99
RS = 21

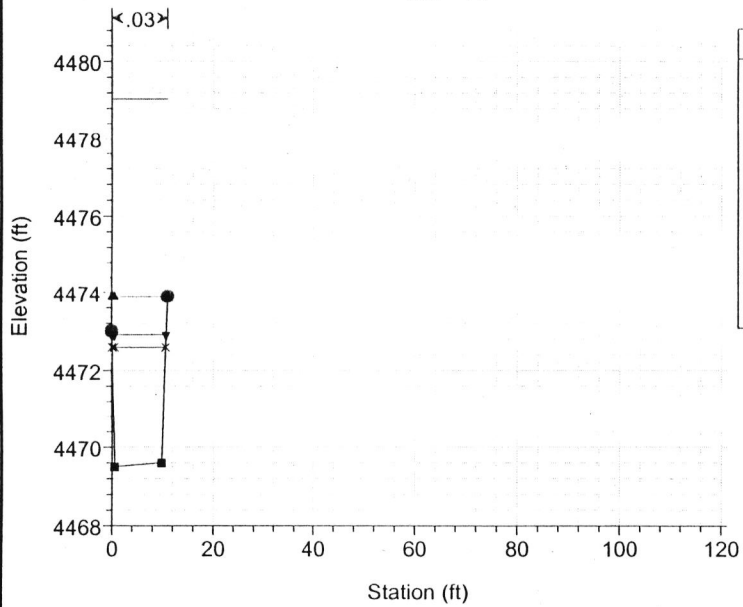


Rosewood Wash Imported Plan 01 5/17/99
RS = 20

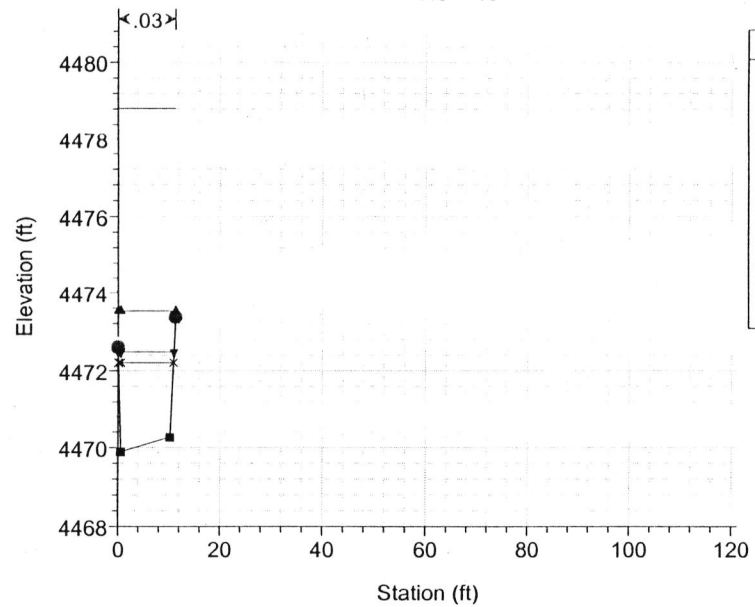


1 in Horiz. = 40 ft 1 in Vert. = 5 ft

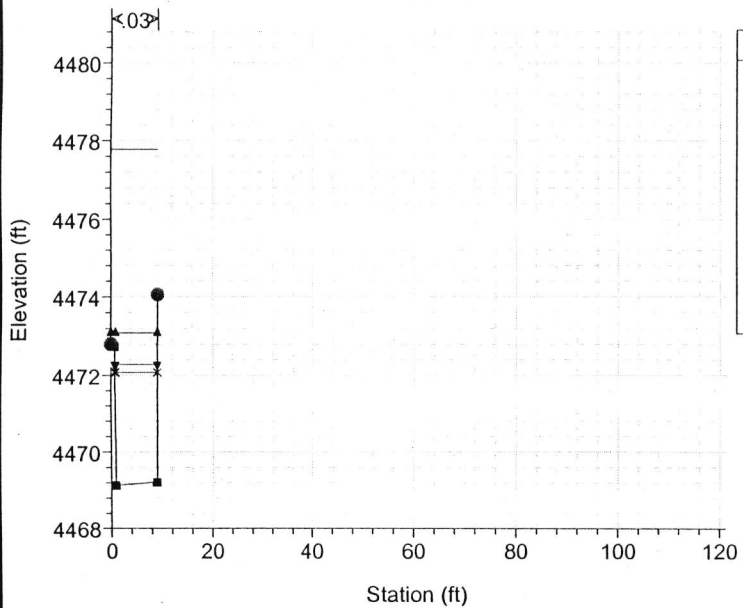
Rosewood Wash Imported Plan 01 5/17/99
RS = 19



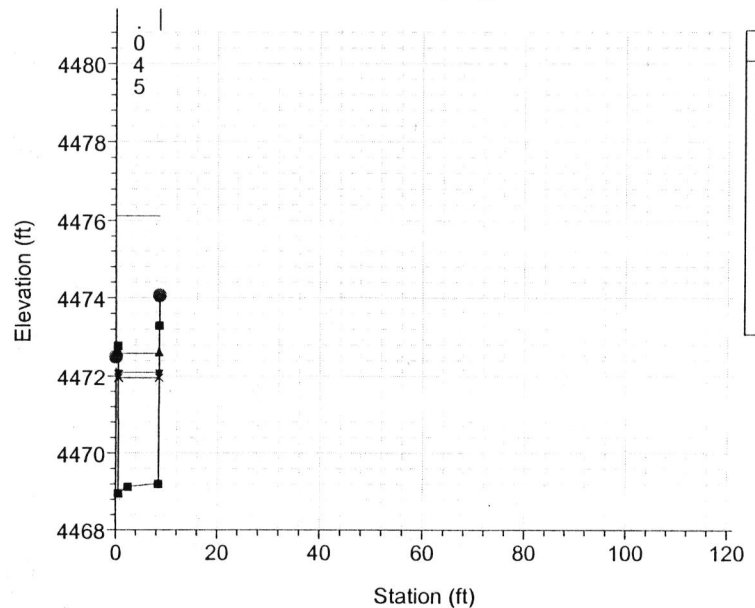
Rosewood Wash Imported Plan 01 5/17/99
RS = 18



Rosewood Wash Imported Plan 01 5/17/99
RS = 17

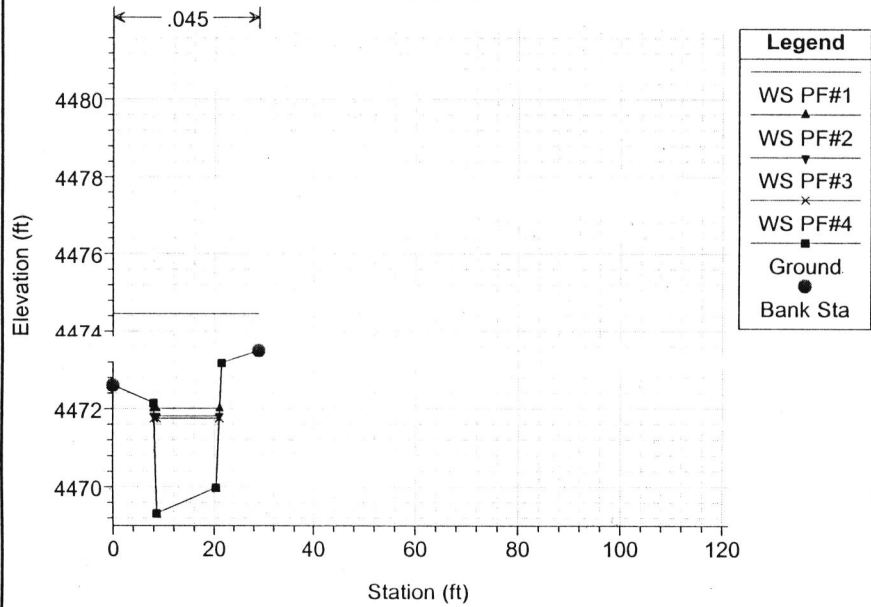


Rosewood Wash Imported Plan 01 5/17/99
RS = 16

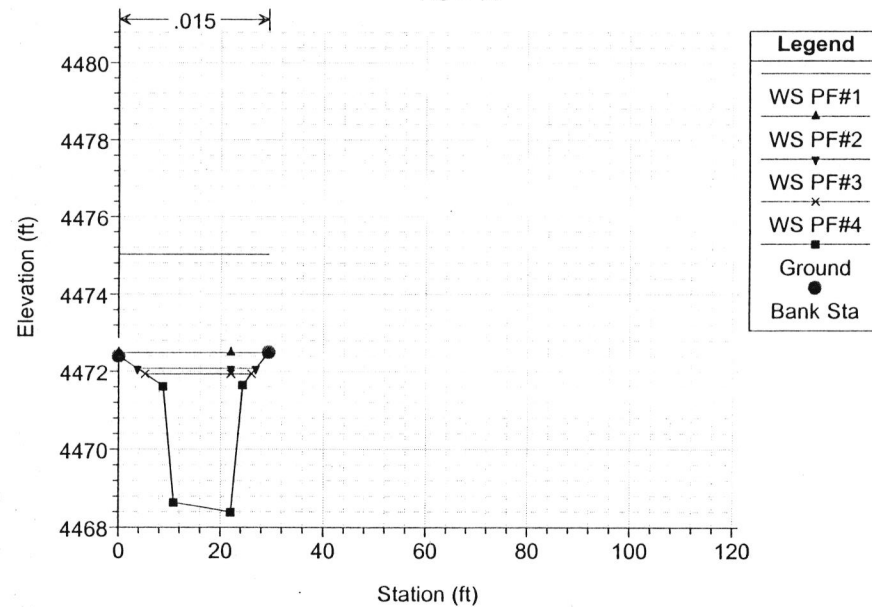


1 in Horiz. = 40 ft 1 in Vert. = 5 ft

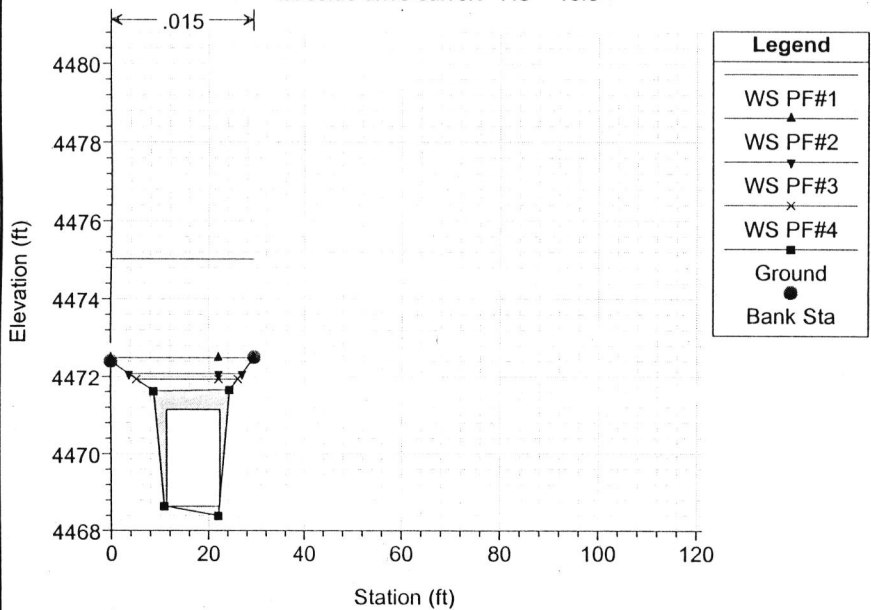
Rosewood Wash Imported Plan 01 5/17/99
RS = 15



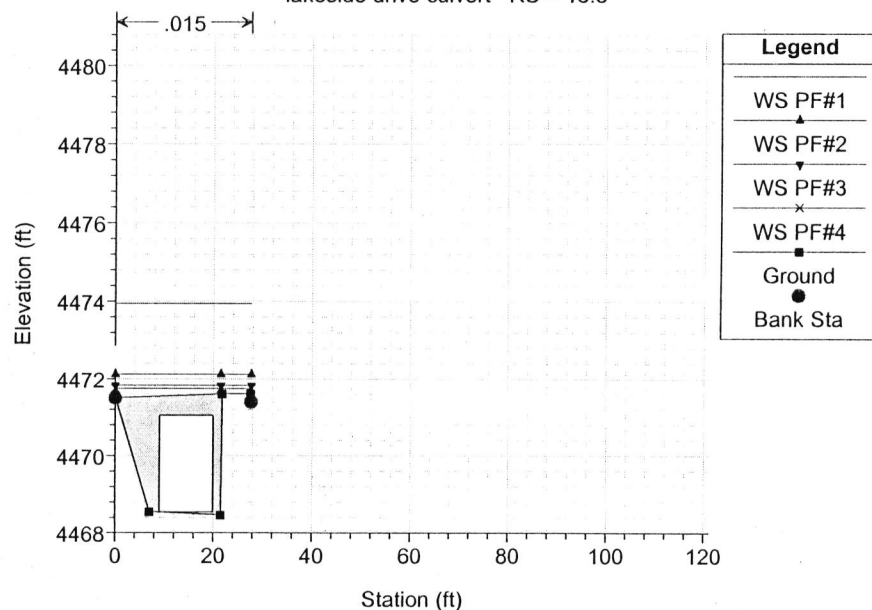
Rosewood Wash Imported Plan 01 5/17/99
RS = 14



Rosewood Wash Imported Plan 01 5/17/99
lakeside drive culvert RS = 13.5

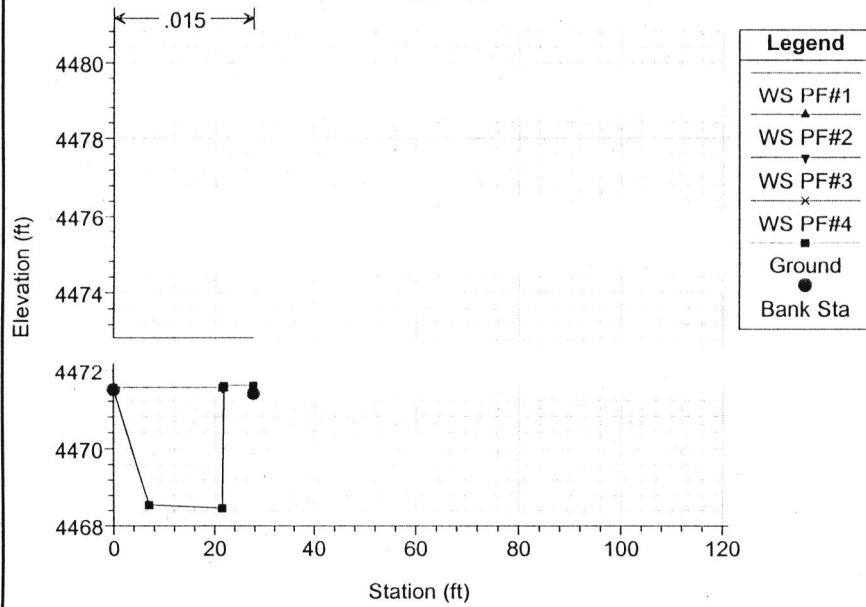


Rosewood Wash Imported Plan 01 5/17/99
lakeside drive culvert RS = 13.5



1 in Horiz. = 40 ft 1 in Vert. = 5 ft

Rosewood Wash Imported Plan 01 5/17/99
RS = 13



APPENDIX 3

Culvert Capacities Nomographs and Calculations

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1

Reach	River Sta	E.G. US. (ft)	W.S. US. (ft)	E.G. IC (ft)	E.G. OC (ft)	Min Top Rd (ft)	Culv Q (cfs)	Q Weir (cfs)	Delta WS (ft)	Culv Vel In (ft/s)	Culv Vel Out (ft/s)
Reach-1	49.5 Culvert #1	4484.11	4483.86	4484.11	4484.04	4483.92	148.58	1.42	4.00	7.82	13.09
Reach-1	30.5 Culvert #1	4474.85	4474.74	4473.63	4474.85	4474.80	150.00	0.00	0.48	5.00	5.00
Reach-1	13.5 Culvert #1	4472.18	4472.03	4471.34	4472.18	4471.62	130.88	19.12	0.48	4.80	4.80

River Sta 49.5 → Plumb #2

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1

Reach	River Sta	E.G. US. (ft)	W.S. US. (ft)	E.G. IC (ft)	E.G. OC (ft)	Min Top Rd (ft)	Culv Q (cfs)	Q Weir (cfs)	Delta WS (ft)	Culv Vel In (ft/s)	Culv Vel Out (ft/s)
Reach-1	49.5 Culvert #1	4484.25	4483.97	4484.25	4484.17	4483.92	158.40	6.60	3.95	7.99	13.37
Reach-1	30.5 Culvert #1	4475.25	4475.14	4473.80	4475.25	4474.80	161.76	3.24	0.58	5.39	5.39
Reach-1	13.5 Culvert #1	4472.27	4472.10	4471.46	4472.27	4471.62	139.88	25.12	0.54	5.13	5.13

River Sta 30.5 → Hillcrest Culvert

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1

Reach	River Sta	E.G. US. (ft)	W.S. US. (ft)	E.G. IC (ft)	E.G. OC (ft)	Min Top Rd (ft)	Culv Q (cfs)	Q Weir (cfs)	Delta WS (ft)	Culv Vel In (ft/s)	Culv Vel Out (ft/s)
Reach-1	49.5 Culvert #1	4483.23	4483.03	4483.23	4483.18	4483.92	90.00		3.85	6.62	11.13
Reach-1	30.5 Culvert #1	4473.56	4473.47	4472.73	4473.56	4474.80	90.00		0.11	3.13	3.04
Reach-1	13.5 Culvert #1	4471.82	4471.76	4470.69	4471.82	4471.62	86.57	3.43	0.21	3.18	3.18

River Sta 13.5 → Lakeside Culvert

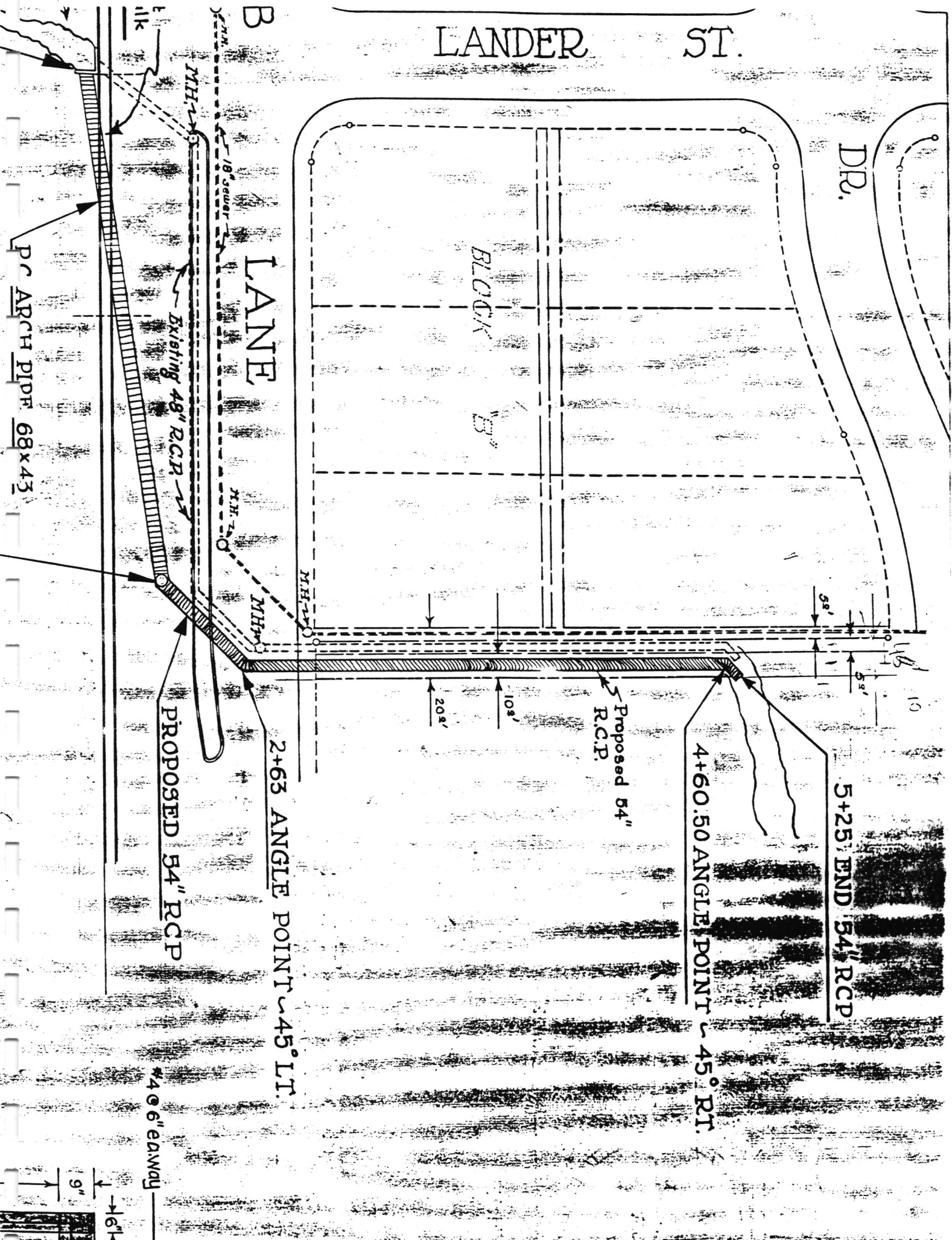
LANDER ST.

DR.

BLOCK
"B"

LANE

B



PC ARCH PIPE 68x43

Existing 48" R.C.P.

PROPOSED 54" RCP

2+63 ANGLE POINT ~45° LT.

Proposed 54" R.C.P.

4+60.50 ANGLE POINT ~45° RT.

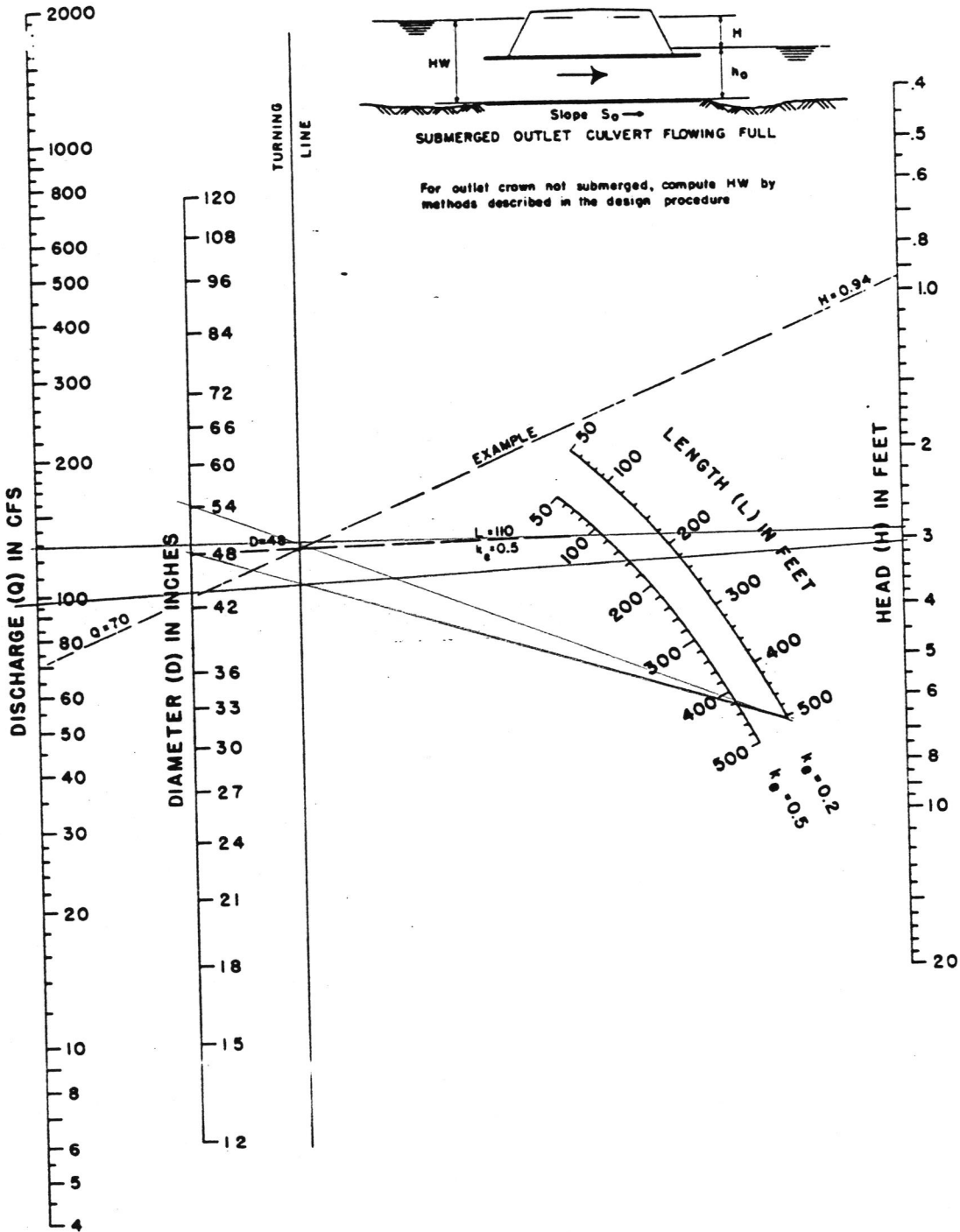
5+25 END 54" RCP

4 @ 6" ea way

9"

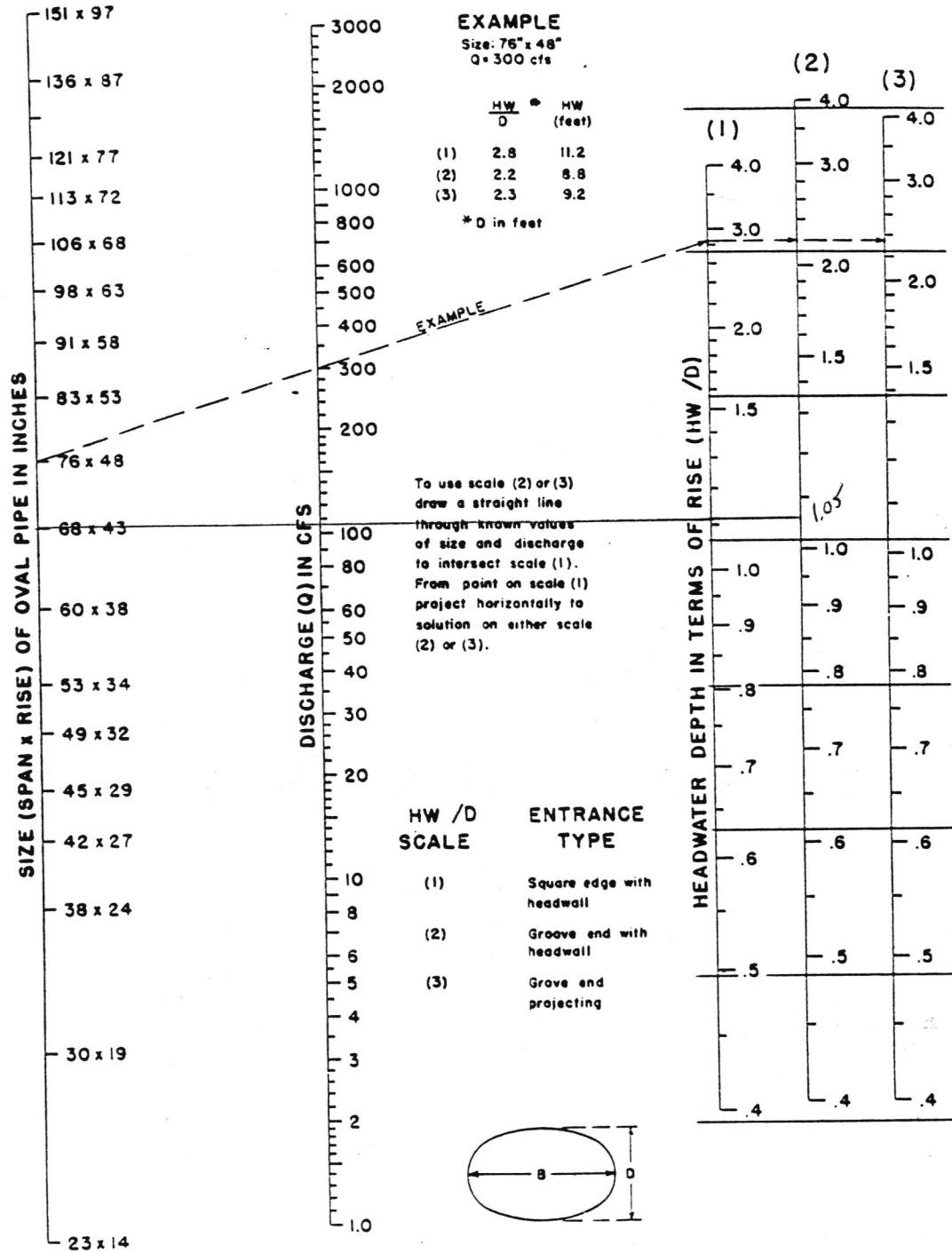
6"

CHART 5



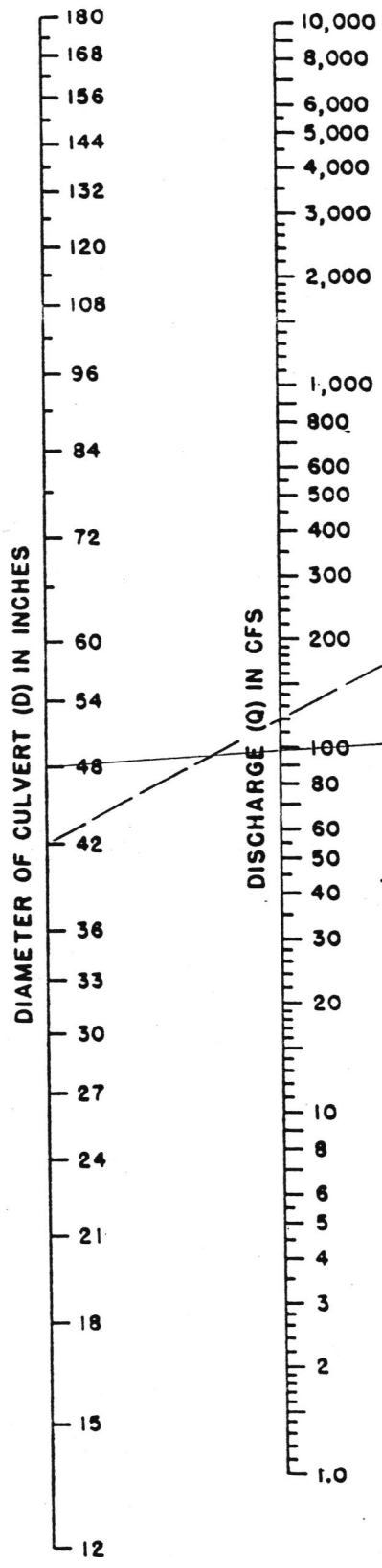
HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL $n = 0.012$

CHART 29



HEADWATER DEPTH FOR OVAL CONCRETE PIPE CULVERTS LONG AXIS HORIZONTAL WITH INLET CONTROL


CHART 1



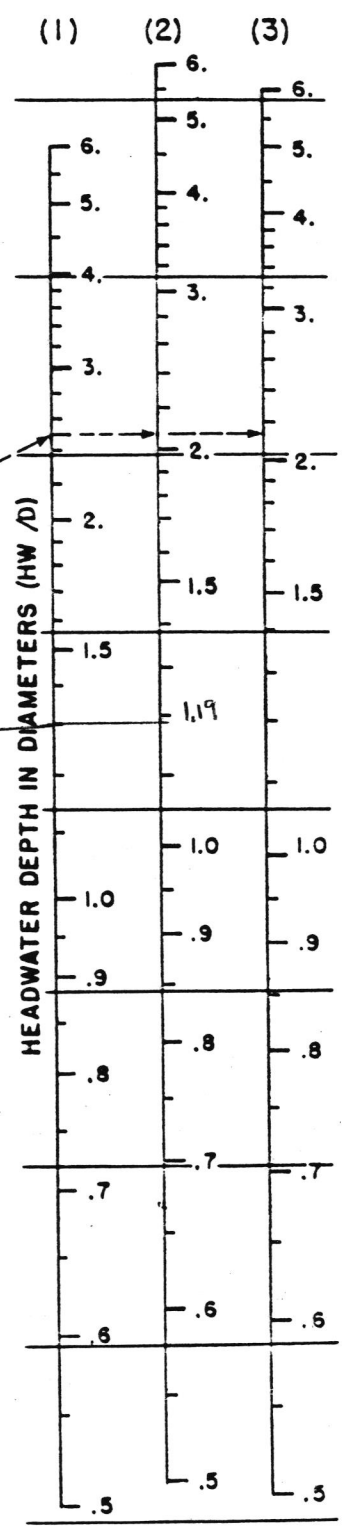
EXAMPLE
 $D=42$ inches (3.5 feet)
 $Q=120$ cfs

	$\frac{HW}{D}$	HW feet
(1)	2.5	8.8
(2)	2.1	7.4
(3)	2.2	7.7

⁴D in feet

$\frac{HW}{D}$ SCALE	ENTRANCE TYPE
(1)	Square edge with headwall
(2) 	Groove end with headwall
(3)	Groove and projecting

To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated.



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

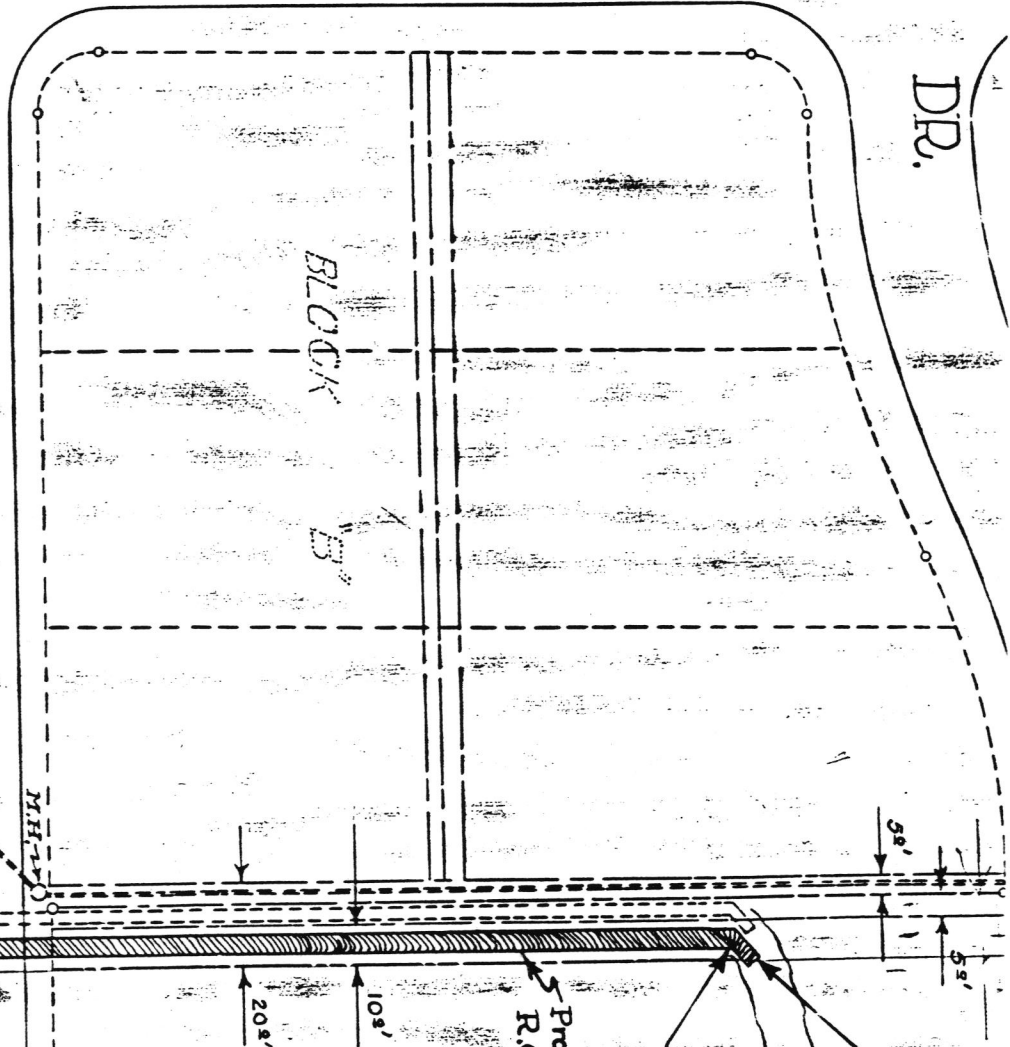
HEADWATER SCALES 283
 REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

Preceding page blank

LANDER ST.

DR.



B

LANE

BLOCK B'

RC ARCH PIPE 68x43

Existing 48" R.C.P.

PROPOSED 54" RCP

2+63 ANGLE POINT ~ 45° LT.

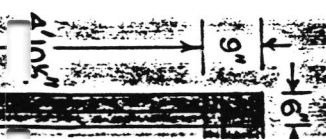
Proposed 54" R.C.P.

4+60.50 ANGLE POINT ~ 45° RT.

5+25 END 54" RCP

4 @ 6' EAWAY

P. 13 PROPOSED M.H.





Lumos and Associates, Inc.

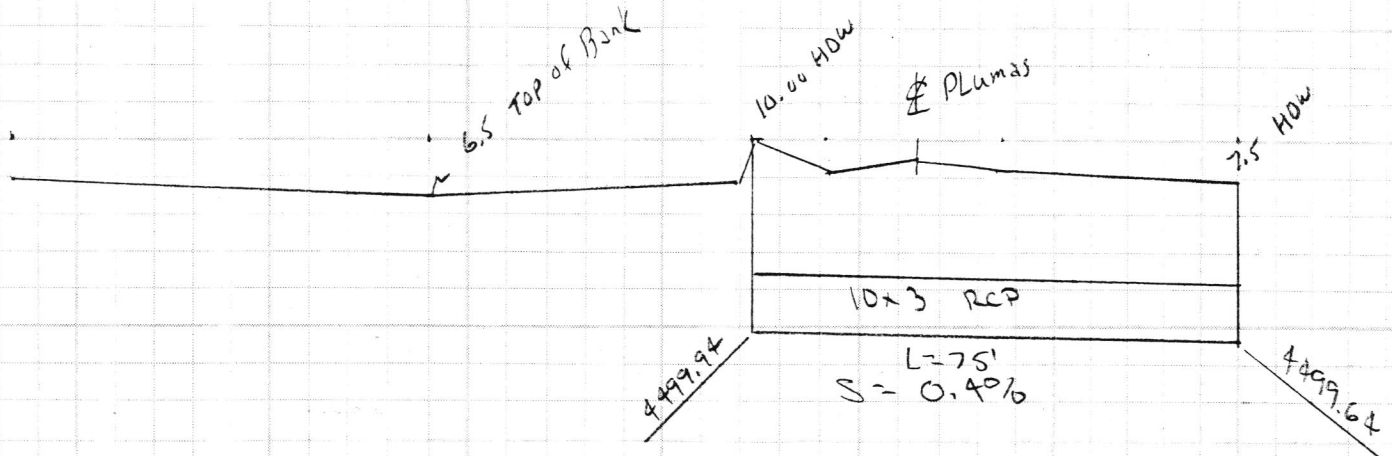
**CIVIL ENGINEERING
PLANNING
SURVEYING
MATERIALS TESTING**

800 E. College Parkway
Carson City, NV 89706
(702) 883-7077

5401 Longley Lane, Suite 13,
Reno, NV 89511
(702) 827-6111

137 Keddle Street
Fallon, NV 89406
(702) 423-2188

Client: City of Reno Sheet Of
Description: Rosewood Crossing Plumas
north of Plun Job No. 4616.000
By: Ralph Hogaboom Date
Checked By: Date



Outlet Control assume Top of RCP @ Exit
 $H = (4506.9 - 4502.62) = 3.86$ $C_c = .2$ $L = 75$ $Q = 380$ cfs

Inlet Control
 $HW/D = (4506.9 - 4499.94) / 3 = 2.19$ Chump Corner = 10x33 $Q = 330$ cfs

Inlet Control Governs @ 330 cfs

Channel between Plun and Plumas capacity is 370 cfs
 (see work sheets)



CHART 8

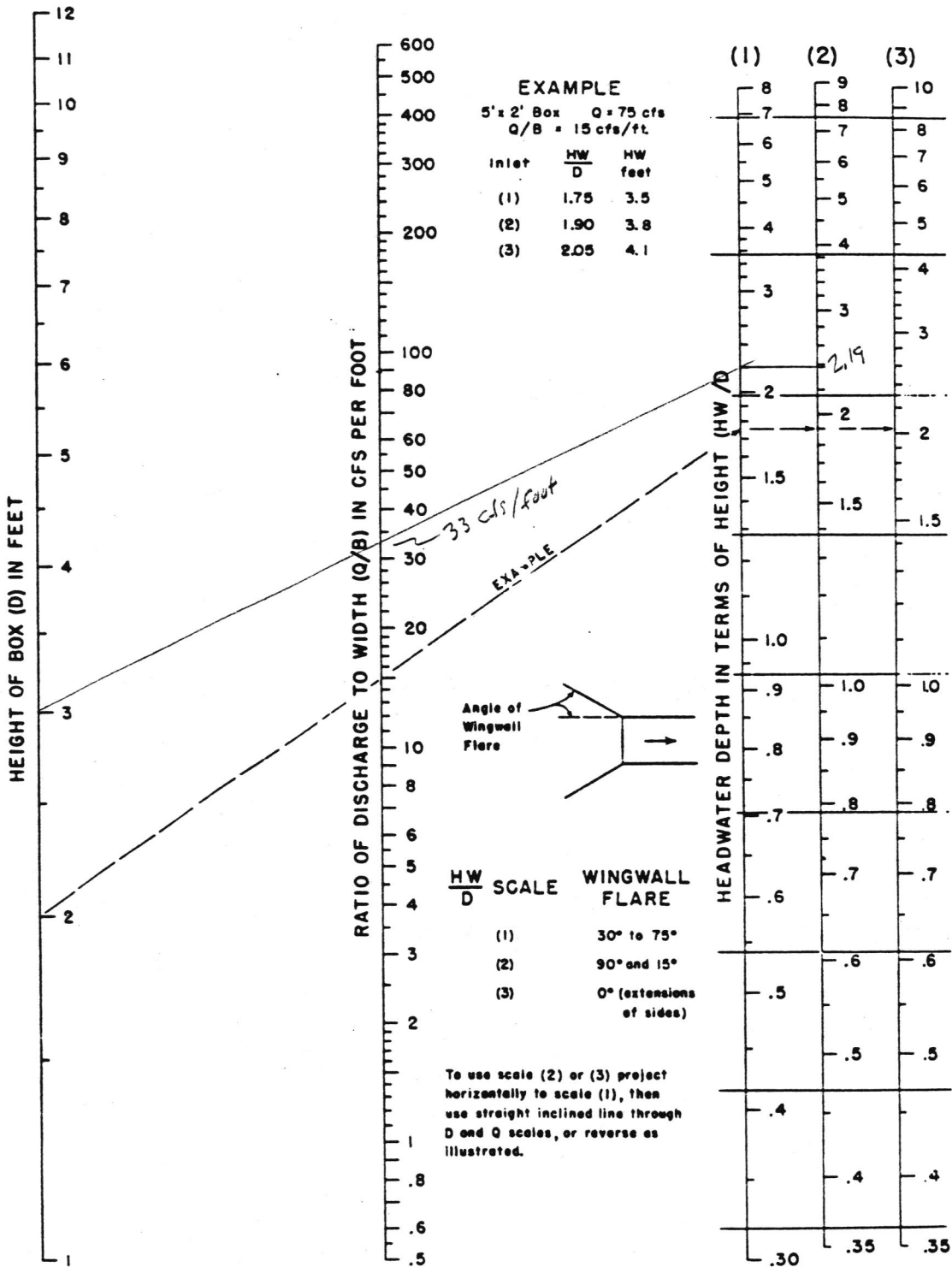
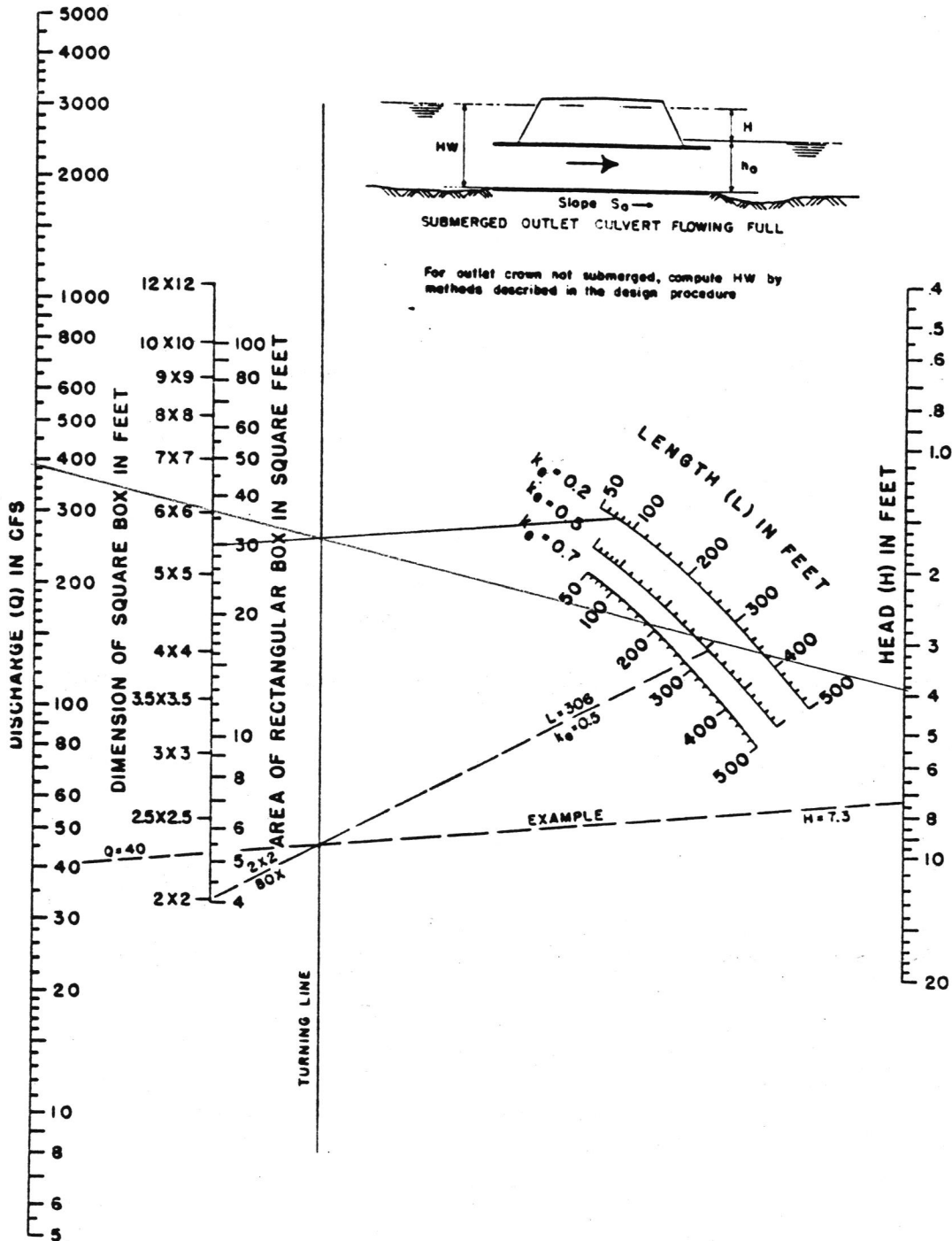




CHART 15



HEAD FOR
 CONCRETE BOX CULVERTS
 FLOWING FULL
 $n = 0.012$

upper end of channel
Worksheet for Irregular Channel

Project Description	
Project File	untitled.fm2
Worksheet	Rosewood - across Ribeiro
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data				
Channel Slope	0.033000 ft/ft			
Water Surface Elevation	4,510.00	ft		
Elevation range: 4,505.00 ft to 4,510.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	4,510.00	0.00	24.30	0.030
9.50	4,506.00			
13.00	4,505.00			
14.60	4,506.00			
24.30	4,510.00			

Results		
Wtd. Mannings Coefficient	0.030	
Discharge	970.26	cfs
Flow Area	61.35	ft ²
Wetted Perimeter	26.33	ft
Top Width	24.30	ft
Height	5.00	ft
Critical Depth	4,511.15	ft
Critical Slope	0.010574	ft/ft
Velocity	15.82	ft/s
Velocity Head	3.89	ft
Specific Energy	4,513.89	ft
Froude Number	1.75	
Flow is supercritical.		

downstream end
Worksheet for Irregular Channel

Project Description	
Project File	untitled.fm2
Worksheet	rosewood across Ribeiro
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data				
Channel Slope	0.020000 ft/ft			
Water Surface Elevation	4,506.50	ft		
Elevation range: 4,500.00 ft to 4,507.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	4,506.50	0.00	31.80	0.030
1.50	4,506.00			
4.75	4,505.00			
15.10	4,500.00			
31.80	4,507.00			

Results		
Wtd. Mannings Coefficient	0.030	
Discharge	1,348.76	cfs
Flow Area	95.42	ft ²
Wetted Perimeter	33.29	ft
Top Width	30.61	ft
Height	6.50	ft
Critical Depth	4,507.33	ft
Critical Slope	0.009803	ft/ft
Velocity	14.13	ft/s
Velocity Head	3.10	ft
Specific Energy	4,509.60	ft
Froude Number	1.41	
Flow is supercritical.		
