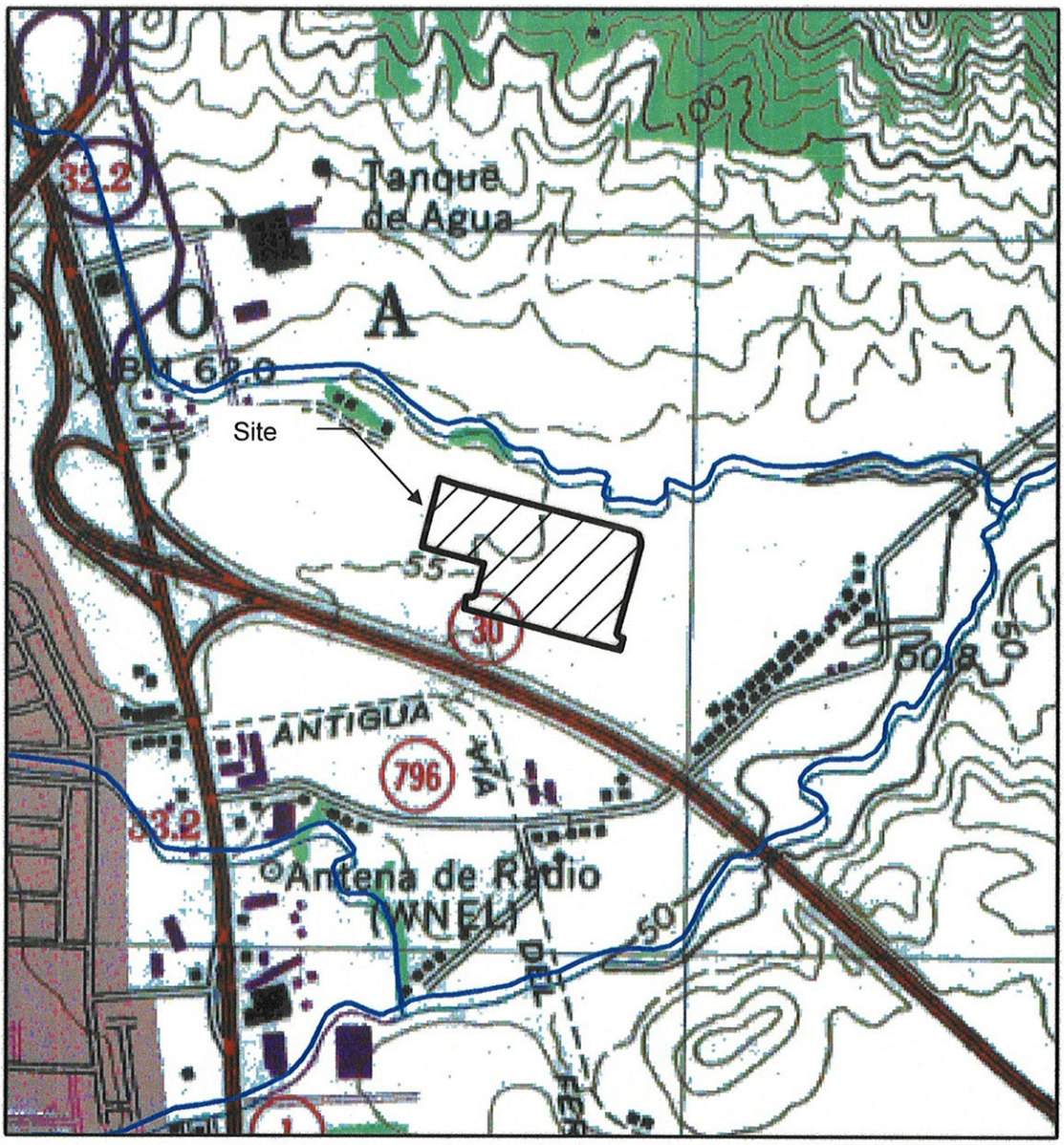
HYDROLOGIC-HYDRAULIC STUDY
UNNAMED STREAM
TREN URBANO MAINTENANCE YARD
CAGUAS, PR



March 17, 2008

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1. INTRODUCTION

1.1. Project Description and Location

The Tren Urbano - Caguas project proposes the construction of a maintenance yard for the train system located in Barrio Bairoa, north of PR-30 in the municipality of Caguas. An unnamed stream flows along the northern limit of the project site.

Figure 1 shows the project site location on the USGS topographic map and the project layout is presented in Figure 2 .

1.2. Scope and Purpose of Report

This document constitutes the hydrologic-hydraulic study for the proposed project. This report contains the results of the hydraulic analysis of the unnamed stream to determine the 100-yr peak discharges and flood levels along the reach adjacent to the project site under existing and proposed conditions. The study also determines the floodway limits along the unnamed stream, in compliance with Planning Board regulations. This report should be used as the basis for civil design of the project.

1.3. Report Limitations and Warnings

Client is reminded that stream channels are considered jurisdictional "waters of the United States", and wherever impacts are made to jurisdictional waters an Army permit should be obtained. This HH study does not address jurisdictional issues or any aspect of Army permitting.

The Department of Natural and Environmental Resources requires a maintenance easement on either side of a stream channel of at least 5 m, and possibly larger. This easement must be deeded to the Department. It shall be the responsibility of the Owner and the Site Engineer to consult with the Department and to incorporate any required easements into the site drawings.

Site designer has the obligation to contact us if any questions arise concerning interpretation of recommendations given in this report.

1.4. Authorization

Preparation of this report was authorized by Elías Behar-Ybarra by written agreement with Gregory L. Morris Engineering, PSC.

1.5. Personnel Involved in Project

Owner:	Municipio Autónomo de Caguas
Project Engineer/Architect:	Behar-Ybarra Consulting Group
Report Preparers:	Gregory L. Morris, P.E., Ph.D.
	Laisha Pomales
	Jose D. Miranda, P.E.

2. STUDY AREA DESCRIPTION

2.1. Topography and Water Bodies

The principal flooding source in the area is an unnamed stream that flows north of the project site. The unnamed stream flows east adjacent to the site before flowing under PR-796 and discharging into Río Bairoa 70 meters downstream of PR-796 as shown in Figure 3.

2.2. Prior Studies and Floodplain Mapping

Figure 4 shows the FEMA Flood Insurance Rate Map (FIRM), panel 745H with an effective date of April 19, 2005. As seen in the figure, Río Bairoa has been previously studied in the area of confluence with the unnamed stream. However, the unnamed stream has not been studied in detail, and flood levels have not been established in the area of the project site.

2.3. Field Observations

The site was visited during May 2007. The following conditions were observed:

- Three 60-inch diameter pipes are located in the stream 720 meters upstream of PR-796, 520 meters downstream the site. The pipe entrances were observed to be obstructed with tall grass and sediments.
- A 4.64 m x 2.12 m box culvert is located 500 meters upstream of PR-796, 700 meters downstream the site.
- The unnamed stream crosses under PR-796 through a 4.66 m x 3.21 m box culvert, 1,200 meters downstream, the site.
- Hydraulic conditions in the river were observed to estimate hydraulic roughness coefficients. The channel overbanks are heavily vegetated with tall grass, trees and brush.
- The unnamed stream flows through a series of culverts that runs under the existing Municipal Public Works facilities. The proposed project will not extend or modify this structure.

2.4. Field Data

Topographic survey and cross sections of the unnamed stream referenced to mean sea level were taken by Surveyor Antonio Melendez, Jr on May 2007.

3. HYDROLOGIC ANALYSIS

3.1. Study Approach and Methodology

The discharge was computed by the Natural Resources Conservation Service's unit hydrograph (UH) methodology with a peaking factor of 484, as implemented in the ICPR modeling software (Streamline Technologies v3.0, Winter Park, Florida). The analysis was performed for the 100-yr event.

3.2. Watershed Delimitation

Watershed limits for the unnamed stream were determined using the USGS topographic quadrangle for Aguas Buenas. The 193 ha drainage area tributary to PR-796 is shown in Figure 5.

3.3. Rainfall Depths

A hyetograph was constructed using the 100-year rainfall depths as reported by the US Department of Commerce (2006) in NOAA Atlas 14. The 100-yr rainfall depths used to construct the hyetograph are shown in Table 1.

Table 1: 100-yr, 24 hour Rainfall Depths (NOAA 14).

Duration, hrs	Rainfall Depths	
	in	mm
0.5	2.46	62.5
1	3.65	92.7
2	5.75	146.1
3	6.71	170.4
6	9.23	234.4
12	12.26	311.4
24	15.30	388.6

3.4. Soils Types and Curve Number

The Curve Number represents the runoff potential within the watershed and is estimated based on soil type (hydrologic soil group), land use and antecedent moisture condition (AMC). In this study AMC-II was used. The soil types within the watershed of the unnamed stream were obtained from the Soil Survey Geographic data base, the most detailed level of soil mapping prepared by the Natural Resources Conservation Service (NRCS) and available in GIS format. Soils within the study area are shown in Figure 6.

Land use conditions were verified based on recent aerial photography. Appendix A shows weighted curve number calculations.

3.5. Time of Concentration

The time of concentration (Tc) is defined as the time required, given uniform rain, for 100% of the tributary area to influence discharge at the basin outlet. Time of concentration was computed using NRCS TR-55 methodologies.

For the initial 300 feet of overland flow Tc was computed using the Sheet Flow equation for travel time as:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}(s)^{0.4}}$$

where;

Tt = Travel time (hr.)
n = Manning's roughness coefficient
L = Flow length (ft.)
P_2 = 2-year, 24-hr rainfall (5.50 in)
s = Mean slope for the flow length (ft/ft)

For the remaining flow length to the outlet point, Tc was computed using the Shallow Concentrated Flow equation for travel time as:

$$T_t = \frac{L}{3600 * V}$$

where;

Tt = Travel Time (min.)
L = Flow length (ft)
V = Average velocity (cfs); compute as:

$$V_{unpaved} = \sqrt{\frac{s}{0.0039}} \qquad V_{paved} = \sqrt{\frac{s}{0.0024}}$$

Appendix B includes the time of concentration calculations. Table 2 shows the hydrologic parameters determined for the Unnamed Stream watershed.

Table 2: Hydrologic Parameters for Unnamed Stream Watershed.

Drainage Area (ha)	CN	Tc (min)
193.5	84	40.2

3.6. Results of Hydrologic Analysis

Table 3 presents peak discharges obtained for the unnamed stream. Complete hydrologic simulation input data and results is contained in Appendix C.

Table 3: 100-yr Peak Discharges for the Unnamed Stream.

Peak Discharge (m^3/s)	Peak Discharge (ft^3/s)
53.7	1,896.0

3.7. Verification of Hydrology

López et al. (1979) from the USGS used data on peak flood discharges in watersheds around Puerto Rico to develop a regional regression equation to estimate peak runoff at ungaged sites. The following equation was used to verify the 100-year peak discharge produced by the unnamed creek watershed:

$$Q_{100} = 286 * A^{0.832} * P^{0.531}$$

where:

Q = peak discharge (ft^3/s)

A = drainage area (mi^2)

P = annual rainfall (in/yr), 66.5 in/yr

The annual rainfalls for the watersheds tributary to the study reach are based on the isohyetal map of long term mean annual rainfall prepared by Black & Veatch Consulting Engineers (1970). Table 4 compares peak discharges obtained with ICPR and those obtained with the verification method. Based on verification computations, the peak discharge produced by ICPR was accepted as reasonable.

Table 4: Comparison of 100-yr Peak Discharges Obtained with ICPR and Regression Method.

ICPR (m^3/s)	Verification (m^3/s)
53.7	59.0

3.8. Comparison of Historical Floods in Puerto Rico

Historical peak flood discharges registered at USGS gages in Puerto Rico have been plotted as a function of watershed area in Figure 7. Most floods plotted in the graph do not represent flood peaks having a 100-year return interval, but comparison of predicted flood peaks against historical peak floods on the island helps evaluate whether the obtained values are reasonable. The discharge predicted by ICPR falls within the upper range of observed peaks, which is reasonable.

4. HYDRAULIC ANALYSIS

4.1. Study Approach and Methodology

The Corp of Engineers' HEC-RAS (v3.1.2) software was used to determine the 100-year water surface elevations along the unnamed stream study reach. The HEC-RAS program uses uniform, steady and one-dimensional flow to estimate the effects produced by changes in geometry, roughness and flow. The program also considers hydraulic structures like culverts and bridges. Given the type of analysis and the one-dimensional flow regimen, HEC-RAS is considered the appropriate model for this analysis. The HEC-RAS models were performed for the 100-yr event under a sub-critical flow regime. The downstream water surface elevation was set a 51.4 m-msl, which is the flood level at Río Bairoa as published by FEMA (Figure 4).

4.2. Models Prepared

The following hydraulic model was prepared:

1) Existing Condition Model. An Existing Condition Model was prepared to simulate the present hydraulic conditions based on current field survey data. Input data and results of the existing condition model can be seen in Appendix D.

2) Floodway Encroachment Model. The Floodway Encroachment Model determines the floodway limit along the unnamed stream using Type-4 encroachment methods. Encroachment limits shall not increase the existing flood levels by more than 0.3 meters as compared to the existing condition. Input data and results of the proposed condition model can be seen in Appendix E.

4.3. Layout of the Hydraulic System

Cross section locations were selected based on topographic mapping and field reconnaissance to best represent the hydraulic characteristics of the stream along the study reach. Cross section locations are shown in Figure 8 in the USGS topographic quadrangle. Table 5 presents the cross section names used in the model and those used by surveyor.

Table 5: Cross Section names used in HEC-RAS Model and those by Surveyor.

Model Cross Section Name	Surveyor Cross Section Name	Description
23	0+30.59	
20	0+52.04	
17	1+43.75	
16	3+7.56	Located 285 m upstream of project site.
15.9		Built from topographic contours. U/S face of 3 -60" diameter pipes. Located on project site
15.1		Built from topographic contours. D/S face of 3 -60" diameter pipes. Located on project site
15	5+79.11	Located on project site
14.1	7+50.77	Located on project site
14		Copy of 7+50.77. U/S face of 4.66 m x 2.12 m culvert.
13		Copy of 7+56.31. D/S face of 4.66 m x 2.12 m culvert.
12.9	7+56.31	
12	9+29.87	
11	11+25.3	
10	12+56.42	
9		Copy of 12+74.11. U/S face of PR-796 box culvert.
8	12+74.11	D/S face of PR-796 box culvert.
7	12+89.87	
6	13+3.44	Located 50 m D/S of PR-796.

4.4. Hydraulic Modeling Coefficients

Manning's n-value indicates the relative roughness in the channel and the energy loss due to friction and turbulence (boundary and form losses). Manning's n-values were estimated based on field observations and checked with reference to Barnes (1967) and Chow (1959). The n-values were selected based on channel form, bed material and vegetation.

The values employed for coefficient of expansion and contractions along the reach are those recommended in the HEC-RAS user's manual. These coefficients of expansion and contraction increase for bridge section characterized by abrupt transitions. Table 6 shows the hydraulic coefficients and n-values used in modeling.

Table 6: Coefficient Used in Hydraulic Model

Parameter		Value
Manning's n-value		
	Main channel	0.04
	Overbanks	0.08
Coefficient of contraction		
	Gradual transition	0.1
	Abrupt transition	0.3
Coefficient of expansion		
	Gradual transition	0.3
	Abrupt transition	0.5

4.5. Results of Hydraulic Modeling

Figure 9 shows the 100-year floodway limits along the unnamed stream. Table 7 compares existing and encroachment condition model water surface elevations for each cross section in the model. Table 8 shows the stations where the encroachment limits were established.

Table 7: 100- yr Water Surface Elevation at the Unnamed Stream.

Cross Section	100-year Water Surface Elevations (m-msl)		Difference
	Existing	Encroachment	
23	58.31	58.36	0.05
20	57.95	57.95	0.00
17	56.77	56.78	0.01
16	55.17	55.28	0.11
15.9 (Project Site)	54.33	54.61	0.28
15.1 (Project Site)	53.66	53.71	0.05
15 (Project Site)	53.61	53.64	0.03
14.1 (Project Site)	52.56	52.77	0.21

Cross Section	100-year Water Surface Elevations (m-msl)		Difference
	Existing	Encroachment	
14	52.69	52.87	0.18
13	52.71	52.85	0.14
12.9	52.49	52.52	0.03
12	51.53	51.81	0.28
11	51.51	51.79	0.28
10	51.49	51.78	0.29
9	51.47	51.76	0.29
8	51.39	51.69	0.30
7	51.40	51.70	0.30
6	51.40	51.70	0.30

Table 8: Cross Section Station for Floodway Encroachment

Cross Section	Left Station	Right Station	Top Width (m)
23	63.80	87.93	24.13
20	60.18	82.47	22.29
17	67.71	86.44	18.73
16	32.73	69.91	37.18
15.9	28.44	48.93	20.49
15.1	6.74	18.55	11.81
15	15.75	44.03	28.27
14.1	49.03	82.42	33.38
14			
13			
12.9	54.93	87.38	30.45
12	12.27	27.95	15.69
11	19.60	61.88	42.27
10	43.11	100.06	56.95
9	46.26	92.05	45.79
8	46.26	92.05	45.79
7	55.06	118.93	63.88
6	44.99	127.78	82.79

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

1. The maximum increase in 100-year water surface elevation caused by the floodway encroachment in the Unnamed Stream is 0.30 m, in compliance with Planning Board Regulation # 13.

2. Downstream water surface elevations along the Unnamed Stream are controlled by backwater flood levels from Río Bairoa during a 100-yr event, which were taken from the Río Bairoa Flood Insurance Study published by FEMA.

3. The maximum 100-yr water surface elevation along the project site is 54.61 m-msl. All proposed structures in the maintenance yard should be placed at least 0.6 meters above the 100-year water surface elevation in the stream.

6. CERTIFICATION

I hereby certify that the document "Hydrologic-Hydraulic Study Unnamed Stream Tren Urbano Maintenance Yard, Caguas, PR" has been prepared in accordance with the best hydrologic and hydraulic practices as described in this document and that, based on the studies and field measurements provided by other parties, results are true and correct.

Certified today March 17, 2008

José D. Miranda, P.E.

7. REFERENCES

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Bonnin, G. M. and Martin, D. 2006. "Precipitation-Frequency Atlas of the United States". NOAA Atlas 14, Volume 3, Version 3.0: Puerto Rico and the U.S. Virgin Islands. National Weather Service, Silver Spring, MD.

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U.S. Army Corps of Engineers. 2001. "HEC-RAS v3.0 River Analysis System, Hydraulic Reference Manual". Hydrologic Engineering Center, Davis, CA.

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FIGURES

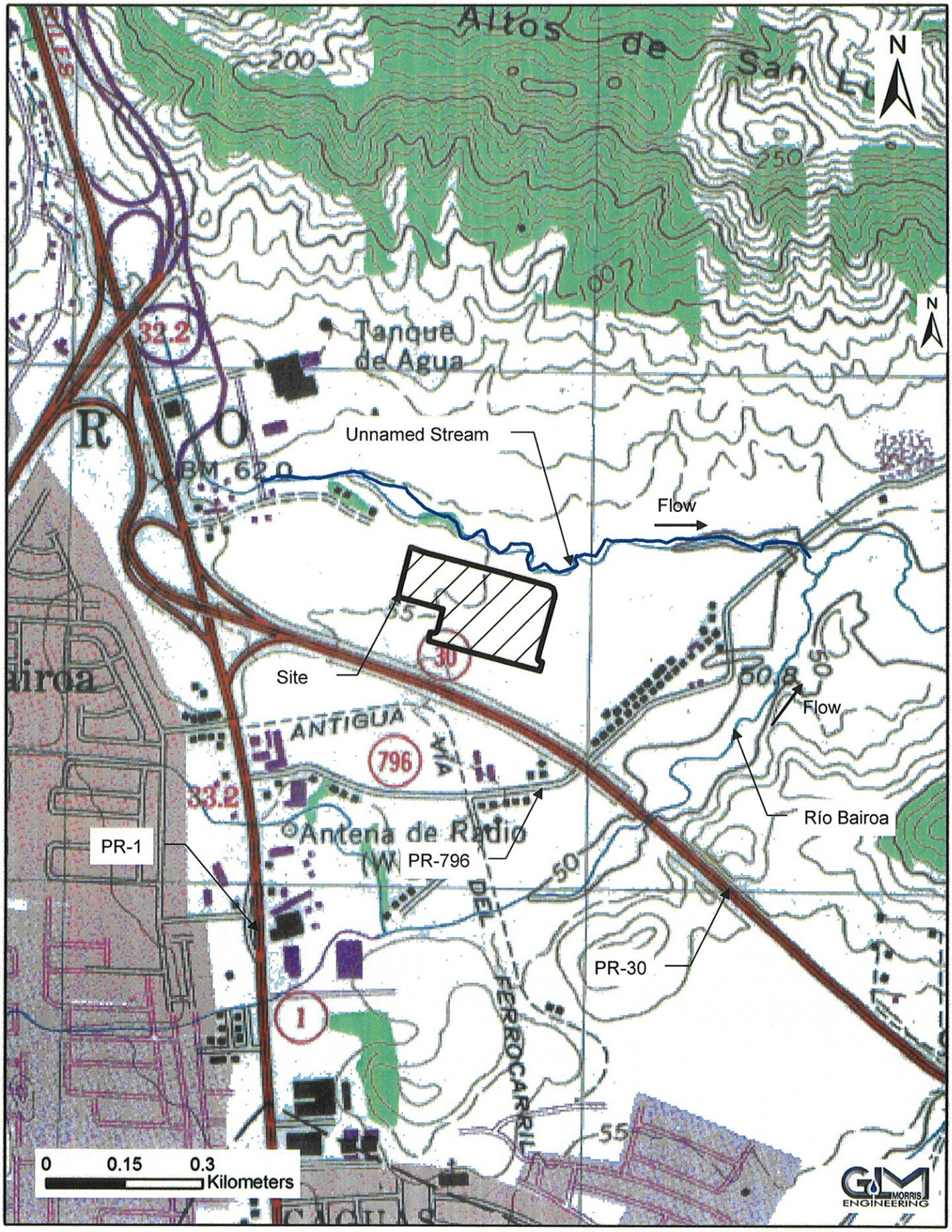


Figure 1: Site location on Aguas Buenas USGS topographic map (scale 1:10,000).

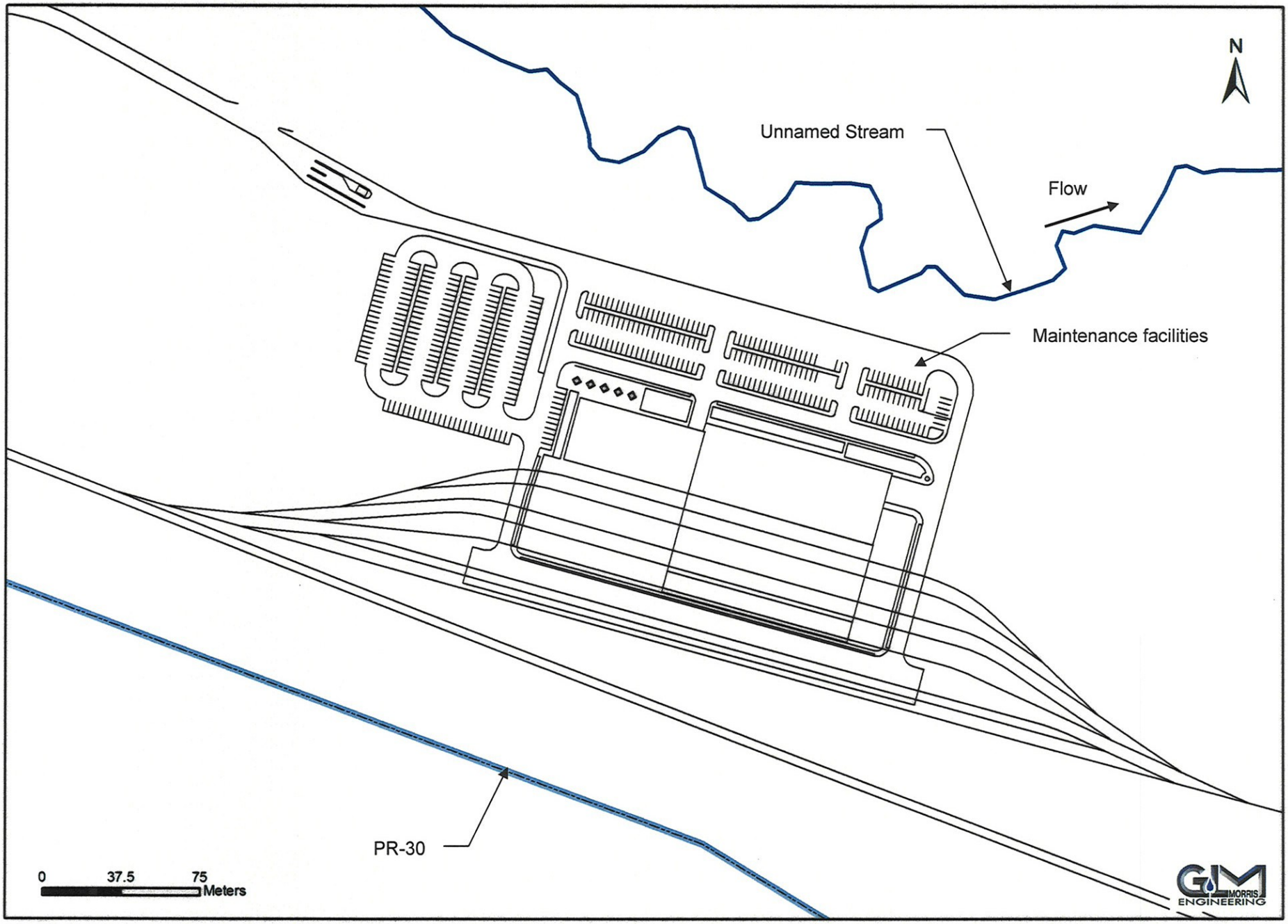


Figure 2: Proposed project layout (scale 1:3,000).

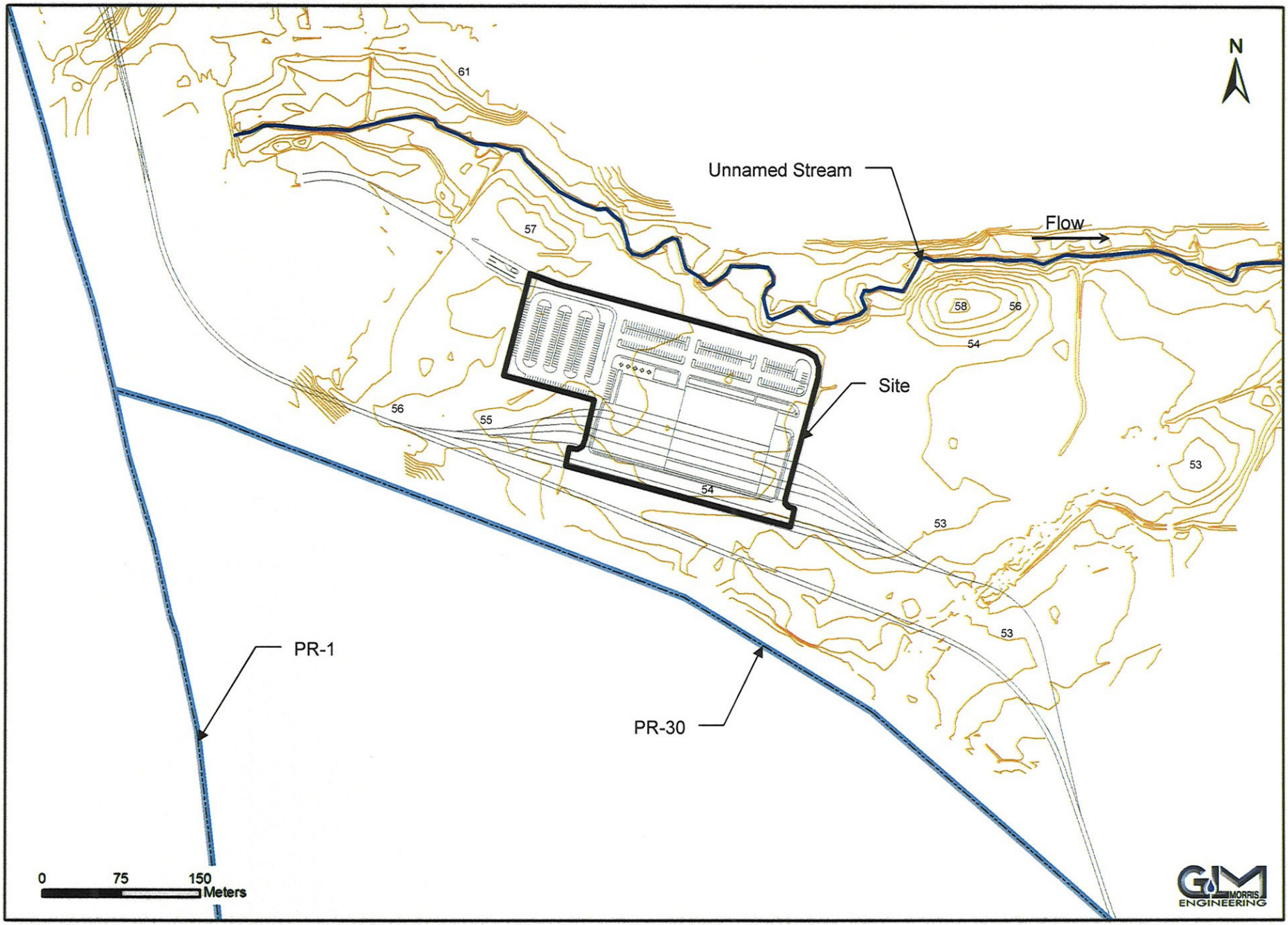


Figure 3: Topography features of project area (scale 1:5,000).

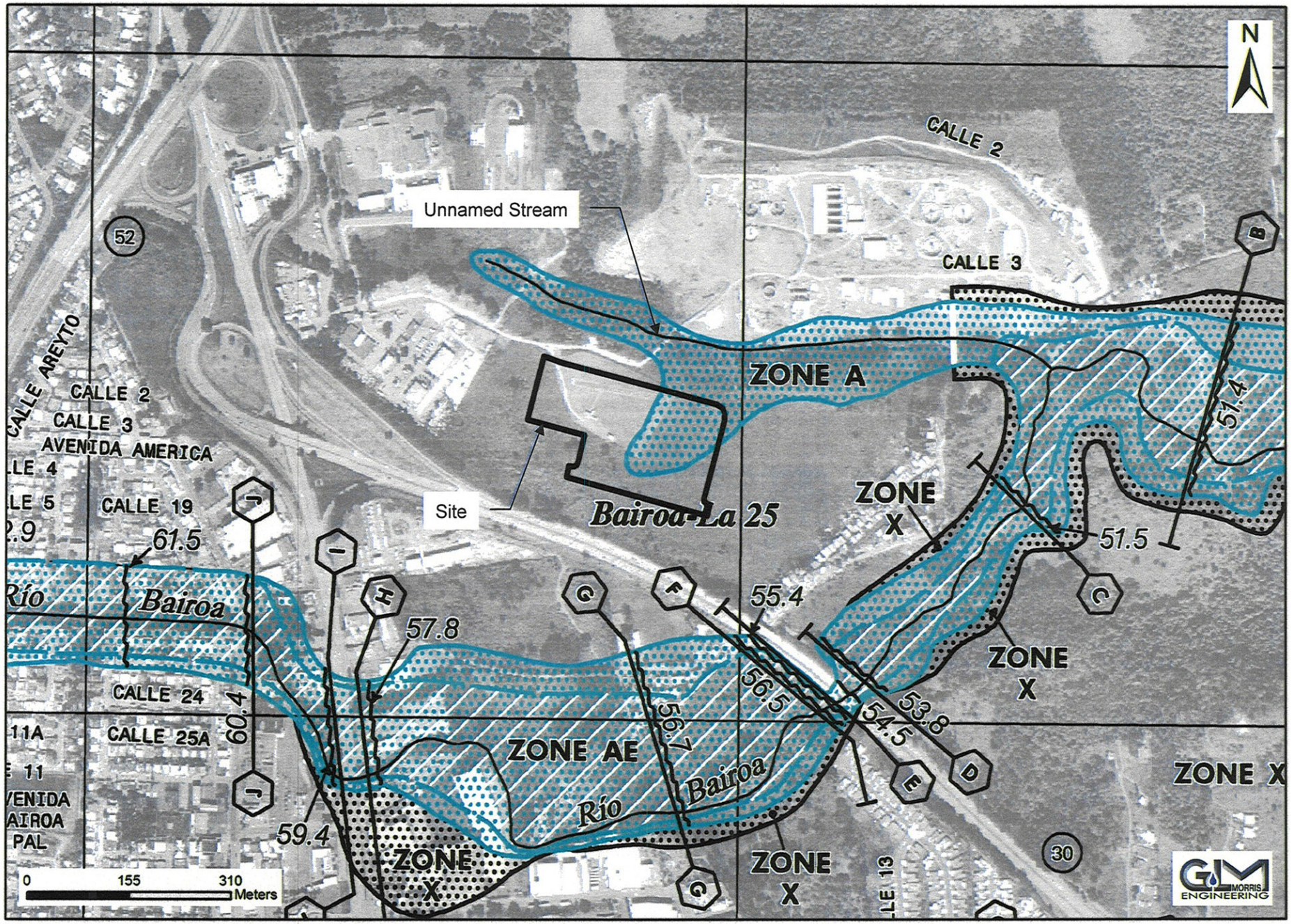


Figure 4: FEMA FIRM panel 745H, dated April 19, 2005 (Not to scale).

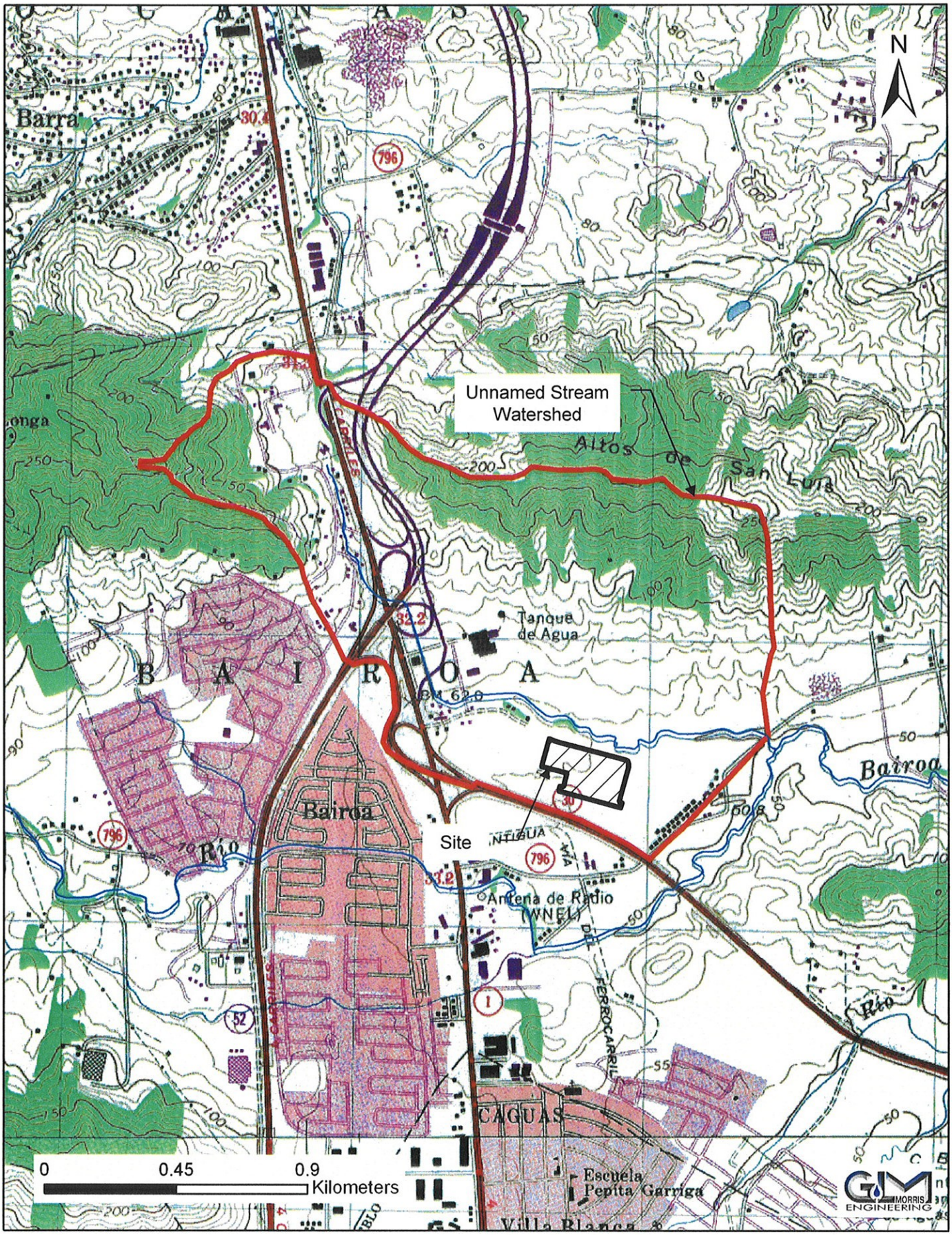


Figure 5: Unnamed Stream watershed limits (scale 1:18,000).

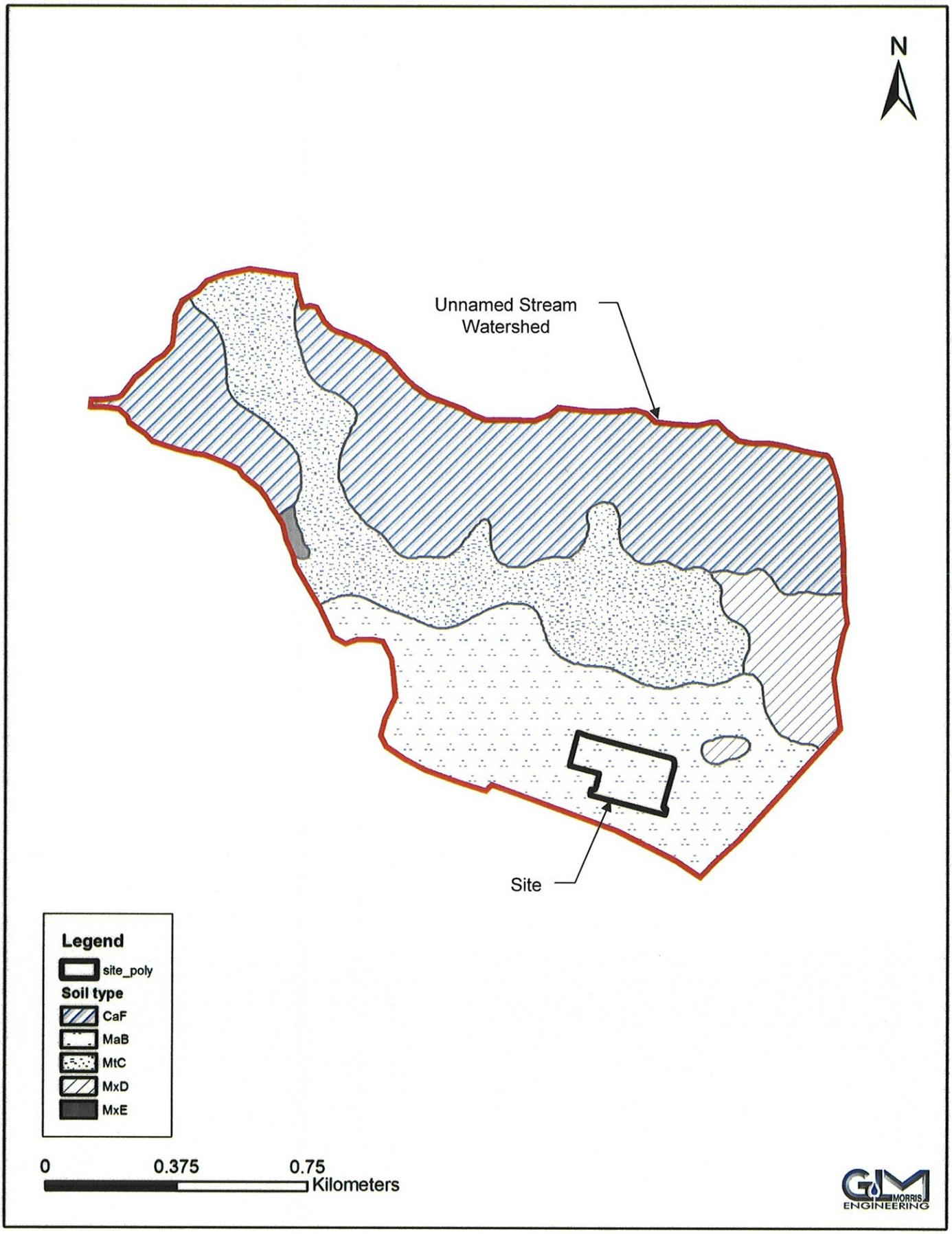


Figure 6: Soil types found in watershed (scale 1:15,000)

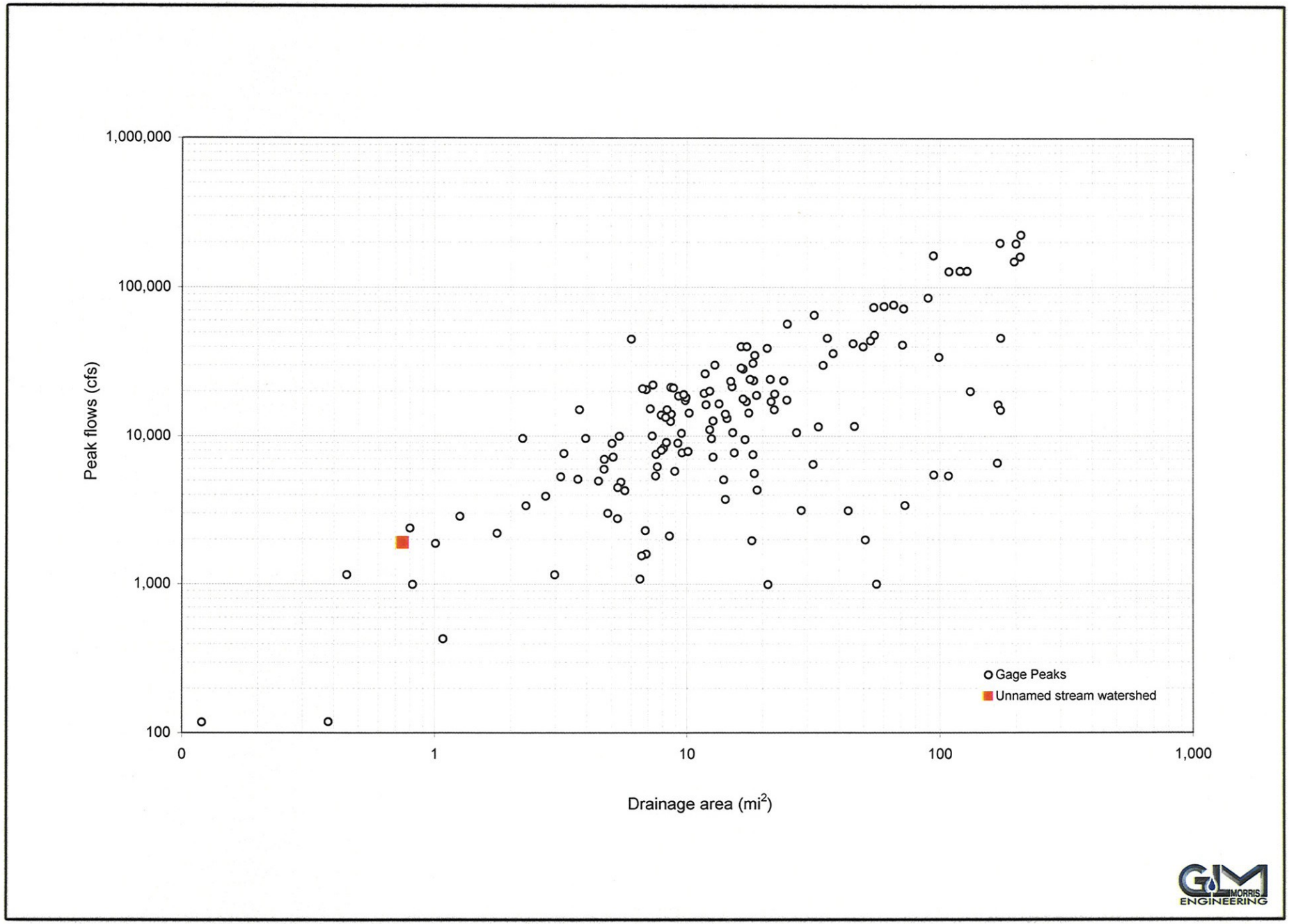


Figure 7: Historical peak runoffs at USGS station vs drainage area.

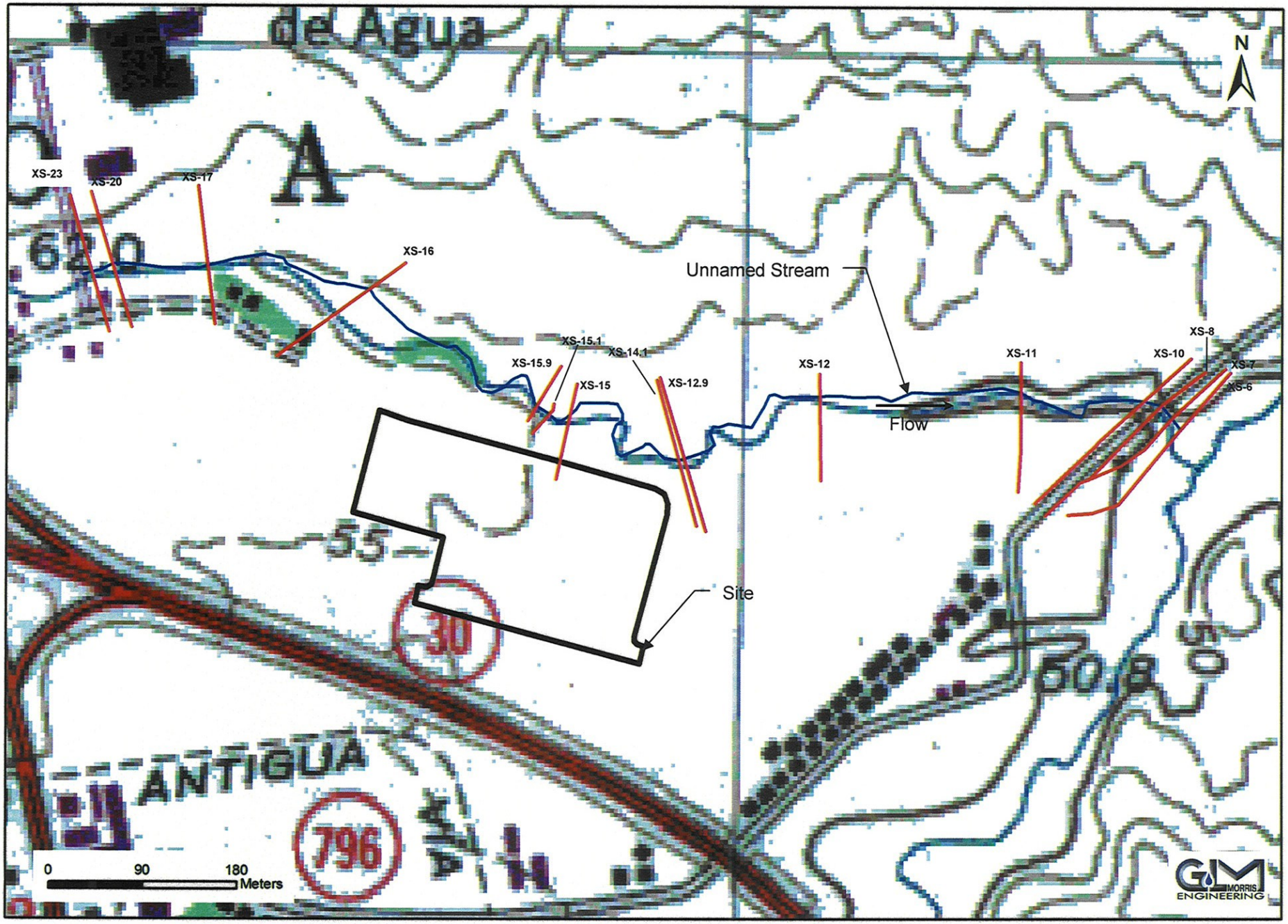


Figure 8: Cross sections location (scale 1:5,000).

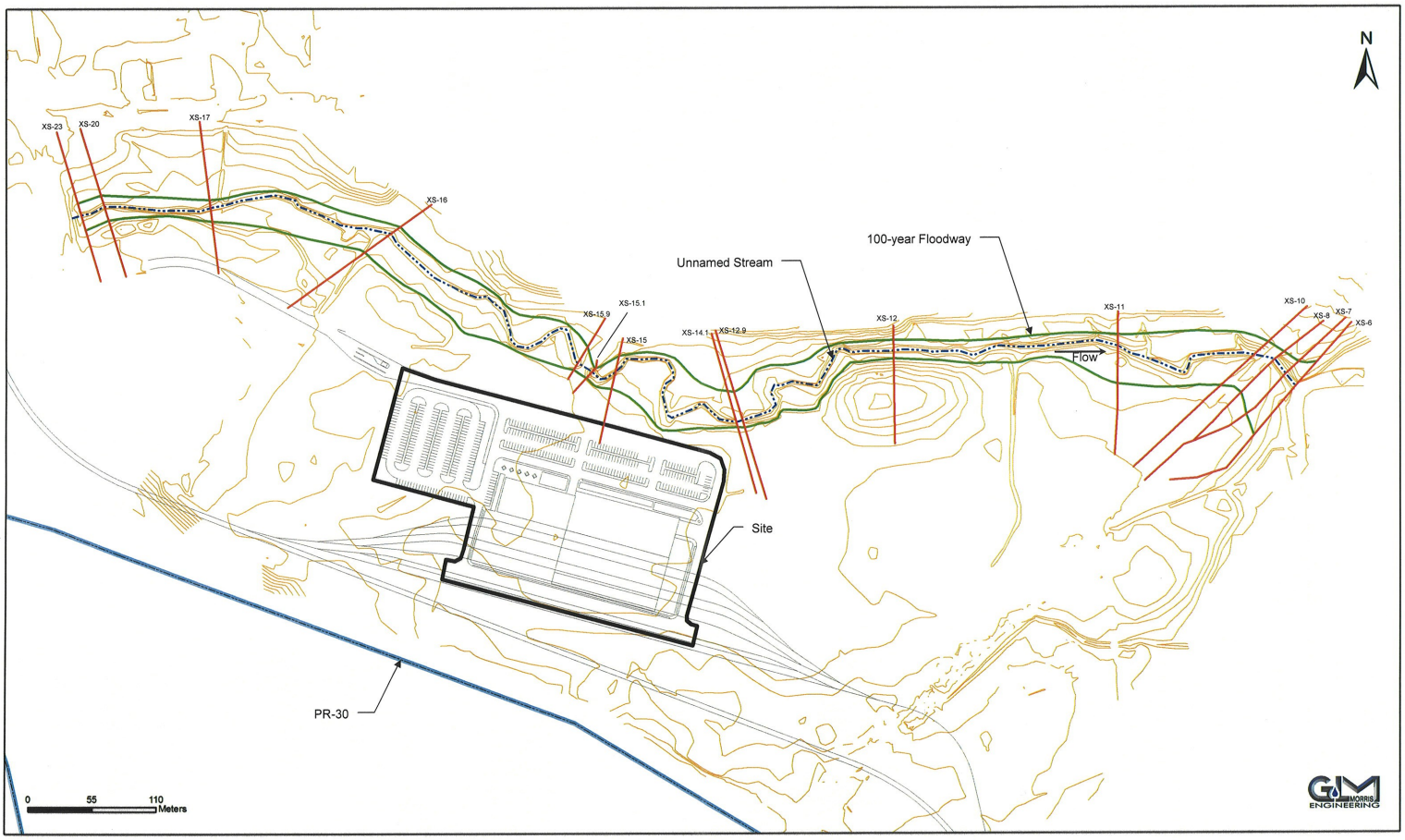


Figure 9: 100-year Floodway limits (scale 1:3,000).

Appendix A

Curve Number Calculations

Unnamed Stream Curve Number Calculations

Land_use	MUSYM	HYDGRPDCD	Area	Area (ac)	Grp area (ac)	CN	CN*area
Bushes and grassland	CaF	D	516	1.28			
Bushes and grassland	CaF	D	527	1.30	2.577357	77	198.4565
Pastureland	CaF	D	14446	35.70	35.69751	84	2998.591
Road	CaF	D	8457	20.90			
Road	CaF	D	38437	94.98			
Road	CaF	D	7120	17.59	133.474	98	13080.45
Rural high density	CaF	D	11	0.03			
Rural high density	CaF	D	3941	9.74			
Rural high density	CaF	D	22832	56.42			
Rural high density	CaF	D	8605	21.26	87.44976	85	7433.229
Woodland low density	CaF	D	5	0.01			
Woodland low density	CaF	D	14810	36.60			
Woodland low density	CaF	D	514133	1270.47			
Woodland low density	CaF	D	112765	278.65			
Woodland low density	CaF	D	8083	19.97	1605.711	83	133274
Bushes and grassland	MaB	D	82	0.20			
Bushes and grassland	MaB	D	2168	5.36			
Bushes and grassland	MaB	D	24694	61.02			
Bushes and grassland	MaB	D	323898	800.38	866.9657	77	66756.36
Industry	MaB	D	27740	68.55			
Industry	MaB	D	64809	160.15			
Industry	MaB	D	9920	24.51			
Industry	MaB	D	1868	4.62			
Industry	MaB	D	259	0.64			
Industry	MaB	D	23865	58.97	317.44	93	29521.92
Pastureland	MaB	D	413	1.02	1.020564	84	85.7274
Road	MaB	D	2421	5.98			
Road	MaB	D	2438	6.02			
Road	MaB	D	8278	20.46			
Road	MaB	D	13096	32.36			
Road	MaB	D	7107	17.56	82.38647	98	8073.874
Rural high density	MaB	D	24713	61.07			
Rural high density	MaB	D	8100	20.02	81.0842	85	6892.157
Bushes and grassland	MtC	D	5	0.01			
Bushes and grassland	MtC	D	233	0.58			
Bushes and grassland	MtC	D	49491	122.30			
Bushes and grassland	MtC	D	51768	127.92	250.8092	77	19312.31
Industry	MtC	D	33641	83.13			
Industry	MtC	D	373	0.92			
Industry	MtC	D	4755	11.75			
Industry	MtC	D	15911	39.32	135.1197	93	12566.14
Pasture	MtC	D	157	0.39			
Pastureland	MtC	D	123	0.30	0.691908	84	58.12027
Road	MtC	D	1305	3.22			
Road	MtC	D	7089	17.52			
Road	MtC	D	4626	11.43			
Road	MtC	D	473	1.17			
Road	MtC	D	4331	10.70			
Road	MtC	D	157	0.39	44.43285	98	4354.419
Rural high density	MtC	D	189489	468.25	468.2463	85	39800.93
Woodland low density	MtC	D	2792	6.90			
Woodland low density	MtC	D	14018	34.64			
Woodland low density	MtC	D	97664	241.34			
Woodland low density	MtC	D	591	1.46			
Woodland low density	MtC	D	3642	9.00			
Woodland low density	MtC	D	2010	4.97	298.3038	83	24759.21
Bushes and grassland	MxD	D	8172	20.19			
Bushes and grassland	MxD	D	12446	30.76			
Bushes and grassland	MxD	D	29849	73.76	124.709	77	9602.593
Industry	MxD	D	50703	125.29	125.2922	93	11652.17
Woodland low density	MxD	D	27427	67.77	67.77486	83	5625.313
Rural high density	MxE	D	4773	11.79	11.79456	85	1002.538
Woodland low density	MxE	D	1816	4.49	4.487518	83	372.484
				SUM	4745.468	SUM	397421
						CN	83.75
						Use	84

Appendix B

Time of Concentration Calculations

Time of Concentration: **Unnamed stream existing condition**

Segment	Length (m)	U/S Elev (m)	D/S Elev (m)	Slope	2-yr Precip (in)	n-value	Avg. Flow Depth (m)	Vel (m/s)	Froude No	Tc (min)	Tc (hrs)
1 Sheet Flow (L<300 ft)	91.44	85	83	0.022	6.98	0.240	---	0.07	---	22.45	0.37
2 Shallow Conc. Flow	245	83	76	0.029	---	---	---	0.8	---	4.95	0.08
3 Channel Flow (Manning)	294	76	70	0.020	---	0.050	0.75	2.4	0.87	2.08	0.03
4 Channel Flow (Manning)	1,802	70	50	0.011	---	0.040	1.10	2.8	0.85	10.70	0.18
Total Distance	2,432								Total Time of Conc.	40.2	0.67

Appendix C

Hydrologic Simulation Input Data and Results

Basins

Name: Unnamed creek
Group: BASE
Node: Node
Type: SCS Unit Hydrograph
Status: Onsite

Unit Hydrograph: Uh484
Rainfall File: TU NOAA 1
Rainfall Amount(cm): 38.860
Area(ha): 193.470
Curve Number: 84.000
DCIA(%): 0.000
Peaking Factor: 484.000
Storm Duration(hrs): 24.000
Time of Conc(min): 40.200
Time Shift(hrs): 0.000
Max Allowable Q(cms): 28316.822

Hydrology Simulations

Name: 100-yr
Filename: P:\Caguas\Water Resources\TU Caguas\ICPR\Unnamed creek\Existing\100-y

Override Defaults: No

Time(hrs)	Print Inc(min)
10.000	10.000
13.000	1.000
24.000	10.000

Boundary Conditions

Unnamed stream Hydrologic Analysis

Simulation	Basin	Group	Time Max hrs	Flow Max cms	Volume cm	Volume m3
100-yr	Unnamed creek	BASE	12.328	53.735	33.51264	8357.018

Unnamed stream Hydrologic Analysis

Simulation	Basin	Group	Time Max hrs	Flow Max cms	Volume cm	Volume m3
100-yr	Unnamed creek	BASE	12.328	53.735	33.51264	8357.018

Basin Name: Unnamed creek
Group Name: BASE
Simulation: 100-yr
Node Name: Node
Basin Type: SCS Unit Hydrograph

Unit Hydrograph:	Uh484
Peaking Fator:	484.000
Spec Time Inc (min):	5.360
Comp Time Inc (min):	5.360
Rainfall File:	TU NOAA 1
Rainfall Amount (cm):	38.860
Storm Duration (hrs):	24.000
Status:	Onsite
Time of Conc (min):	40.200
Time Shift (hrs):	0.000
Area (ha):	193.470
Vol of Unit Hyd (cm):	2.543
Curve Number:	84.000
DCIA (%):	0.000
Time Max (hrs):	12.328
Flow Max (cms):	53.735
Runoff Volume (cm):	33.512
Runoff Volume (m3):	648357.018

Appendix D

Hydraulic Simulation Input Data and Results for Existing Condition Model

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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

PROJECT DATA
Project Title: Existing Model
Project File : Existing_Model.prj
Run Date and Time: 3/14/2008 3:27:27 PM

Project in SI units

PLAN DATA

Plan Title: Existing
Plan File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Existing_Model.p02

Geometry Title: Existing
Geometry File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Existing_Model.g01

Flow Title : Existing
Flow File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Existing_Model.f02

Plan Summary Information:
Number of: Cross Sections = 18 Multiple Openings = 0
Culverts = 3 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculation tolerance = 0.003
Maximum number of iterations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

Encroachment Data
Equal Conveyance = False
Left Offset = 0
Right Offset = 0

River = Unnamed stream Reach = PR-876 Bridge

RS	Profile	Method	Value1	Value2
23	PF 2	4	.09	
20	PF 2	4	.05	
17	PF 2	4	.015	
16	PF 2	4	.11	

15.9	PF 2	4	.13
15.1	PF 2	4	.11
15	PF 2	4	.03
14.1	PF 2	4	.08
14	PF 2	4	.15
13	PF 2	4	.1
12.9	PF 2	4	.15
12	PF 2	4	.02
11	PF 2	4	.14
10	PF 2	4	.03
9	PF 2	4	.05
8	PF 2	4	.05
7	PF 2	4	.001
6	PF 2	4	.001

FLOW DATA

Flow Title: Existing
Flow File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Existing_Model.f02

Flow Data (m3/s)

River	Reach	RS	100-yr
Unnamed stream	PR-876 Bridge	23	53.7

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Unnamed stream	PR-876 Bridge	100-yr		Known WS = 51.4

GEOMETRY DATA

Geometry Title: Existing
Geometry File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Existing_Model.g01

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 23

INPUT
Description: 0+30.59
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	61.17	7.74	61.36	22.32	61	32.09	60.55	56.32	57.91
72.02	57.14	73.22	55.98	74.81	55.84	76.43	55.9	79.99	57.2
89.3	57.3	98.09	58.83	123.19	59.45	131.1	59.56	133.8	59.6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	72.02	.04	79.99	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
72.02	79.99	21.49	21.26	21.51	.1	.3

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 20

INPUT
Description: 0+52.04

Station Elevation Data	num=	19							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	60.8	17.46	60.59	31.91	60	53.1	58.39	61.19	56.97
66.44	57.22	69.54	55.62	70.47	55.59	71.42	55.77	72.75	57.15
83.72	57.17	89.24	58.73	97.59	59.76	101.94	59	123.24	59.22
131.16	59.23	132.25	59.34	133.28	59.23	133.7	59.24		

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.08	66.44	.04	72.75	.08

Bank Sta: Left	Right	Lengths: Left Channel		Right	Coeff Contr.	Expan.
66.44	72.75	92.71	90.86	91.32	.1	.3

Left Levee Station= 66.44 Elevation= 57.22
Right Levee Station= 72.75 Elevation= 57.15

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 17

INPUT
Description: 1+43.75

Station Elevation Data	num=	18							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	60.78	5.53	60.52	12.49	58.89	46.32	57.07	62.71	56.73
71.35	55.97	74.16	54.5	75.41	54.35	76.69	54.4	78.35	56.22
86.51	56.08	96.39	59.59	107.62	59.96	117.96	59.42	124.19	58.15
127.14	58.01	131.42	58.13	132.45	58.22				

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.08	71.35	.04	78.35	.08

Bank Sta: Left	Right	Lengths: Left Channel		Right	Coeff Contr.	Expan.
71.35	78.35	169.38	163.77	157.3	.1	.3

Right Levee Station= 78.35 Elevation= 56.22

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 16

INPUT
Description: 3+7.56

Station Elevation Data	num=	19							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	57.24	4.68	56.82	11.65	55.65	39.48	54.35	41.37	53.09
42.66	52.96	43.93	53.1	46.93	54.27	71.23	53.96	73.71	53.92
80.03	55	88.84	55.79	110.12	55.96	115.2	56.58	131.75	57.37
133.32	58.15	145.39	57.17	146.6	57.32	152.95	57.44		

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.08	39.48	.04	46.93	.08

Bank Sta: Left	Right	Lengths: Left Channel		Right	Coeff Contr.	Expan.
39.48	46.93	232.4	233.23	234.2	.1	.3

Left Levee Station= 39.51 Elevation= 54.33
Right Levee Station= 46.93 Elevation= 54.27

```
CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 15.9

INPUT
Description: Pipes upstream
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0      55    16.2      54   28.44   53.49   41.18      53   42.05   52.16
   46.28   52.16    47.2   52.16   47.89      53   48.93  53.562   49.74      54
   54.45   54.88   60.78      55

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   28.44     .04   48.93     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         28.44   48.93             14.6    14.3    13.8             .3       .5



CULVERT
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 15.5

INPUT
Description:
Distance from Upstream XS =      .68
Deck/Roadway Width        =    12.95
Weir Coefficient          =     1.44
Upstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
      40    54.2       0   49.74    54.2       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0      55    16.2      54   28.44   53.49   41.18      53   42.05   52.16
   46.28   52.16    47.2   52.16   47.89      53   48.93  53.562   49.74      54
   54.45   54.88   60.78      55

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   28.44     .04   48.93     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         28.44   48.93             .3       .5

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       7   53.75       0    18.4   53.75       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   54.79    4.44   54.75    6.11      54    7.79      53       9   51.43
   10.27   51.43   10.67   51.43   11.89   51.43   14.01   51.43   16.53      53
   19.76      54   35.71      55

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08    7.79     .04   16.53     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
          7.79   16.53             .3       .5

Upstream Embankment side slope             =       0 horiz. to 1.0 vertical
Downstream Embankment side slope           =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
```

```
Elevation at which weir flow begins          =
Energy head used in spillway design          =
Spillway height used in design               =
Weir crest shape                             = Broad Crested

Number of Culverts =  3

Culvert Name      Shape      Rise    Span
Culvert #1       Circular   1.524
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 2 - Groove end entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
               .01   12.95     .013     .013        0                  .4               1
Upstream   Elevation =  52.53
           Centerline Station =  42.05
Downstream Elevation =  52.03
           Centerline Station =  9.23

Culvert Name      Shape      Rise    Span
Culvert #2       Circular   1.524
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 2 - Groove end entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
               .68   12.95     .013     .013        0                  .4               1
Upstream   Elevation =  52.19
           Centerline Station =  44.69
Downstream Elevation =  52.14
           Centerline Station =  10.93

Culvert Name      Shape      Rise    Span
Culvert #3       Circular   1.524
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 2 - Groove end entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
               .01   12.95     .013     .013        0                  .4               1
Upstream   Elevation =  52.16
           Centerline Station =  46.32
Downstream Elevation =  51.43
           Centerline Station =  12.71



CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 15.1

INPUT
Description: Pipe downstream
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   54.79    4.44   54.75    6.11      54    7.79      53       9   51.43
   10.27   51.43   10.67   51.43   11.89   51.43   14.01   51.43   16.53      53
   19.76      54   35.71      55

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08    7.79     .04   16.53     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          7.79   16.53             22.9      24    25.2             .3       .5



CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 15

INPUT
```

```
Description: 5+79.11
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   54.87   12.79   53.05   27.67   52.88   30.04   50.85   30.81   50.76
   33.41   51.09   36.23   53.23   45.79   53.34   67.74   54.58   76.13    54.8
   86.46   54.88   93.97   54.83

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   27.67     .04   36.23     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         27.67   36.23           165.81  170.66  172.82            .1       .3


CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 14.1

INPUT
Description: 7+50.77
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   55.05   14.97   52.59   44.93      52   64.29   51.86   76.56    52.3
   77.81   48.81   79.24   48.81   80.23   48.81   81.31   52.33   88.81      53
   98.89   53.81  111.07   53.83   142.8   53.81

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   76.56     .04   81.31     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         76.56   81.31                   1       1       1            .1       .3
Left Levee      Station=   76.56      Elevation=   52.36
Right Levee     Station=   81.31      Elevation=   52.33


CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 14

INPUT
Description: 7+50.77 Copy
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   55.05   14.97   52.59   44.93      52   64.29   51.86   76.56    52.3
   76.85   48.81   77.81   48.81   79.24   48.81   80.23   48.81   81.31   48.81
    81.6   48.81   88.81      53   98.89   53.81  111.07   53.83   142.8   53.81

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   76.56     .04   88.81     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         76.56   88.81            4.73    4.85    4.93            .3       .5
Left Levee      Station=   76.56      Elevation=    52.3


CULVERT
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 13.5

INPUT
Description:
Distance from Upstream XS =      .01
Deck/Roadway Width        =     4.83
Weir Coefficient          =     1.44
Upstream  Deck/Roadway Coordinates
```

```
    num=       2
      Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
   76.29   52.28       0   88.81   52.33       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   55.05   14.97   52.59   44.93      52   64.29   51.86   76.56    52.3
   76.85   48.81   77.81   48.81   79.24   48.81   80.23   48.81   81.31   48.81
    81.6   48.81   88.81      53   98.89   53.81  111.07   53.83   142.8   53.81

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   76.56     .04   88.81     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         76.56   88.81            .3       .5
Left Levee      Station=   76.56      Elevation=    52.3

Downstream  Deck/Roadway Coordinates
    num=       2
      Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       78   52.24       0  100.18    52.3       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   56.25    6.86   54.19   12.06   53.83   21.92   53.36   41.97   51.88
   56.89   51.66   69.57   51.75   78.92   52.24   79.18   48.74   80.36   48.74
   81.54   48.74   83.28   48.74   83.76   48.74   83.91   48.74  101.38  52.244
  109.04   53.78   132.4   53.84  154.31   53.58

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   78.92     .04  101.38     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         78.92  101.38            .3       .5
Left Levee      Station=   78.92      Elevation=   52.24

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

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1           Box     2.1    4.73
FHWA Chart # 58- Rectangular concrete
FHWA Scale # 1 - Side tapered; Less favorable edges
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                .01    4.83     .013     .013        0                  .4                1
Upstream   Elevation =  48.81
           Centerline Station =  79.24
Downstream Elevation =  48.74
           Centerline Station =  81.54



CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 13

INPUT
Description: 7+56.31 Copy
Station Elevation Data    num=      18
```

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	56.25	6.86	54.19	12.06	53.83	21.92	53.36	41.97	51.88
56.89	51.66	69.57	51.75	78.92	52.24	79.18	48.74	80.36	48.74
81.54	48.74	83.28	48.74	83.76	48.74	83.91	48.74	101.38	52.244
109.04	53.78	132.4	53.84	154.31	53.58				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	78.92	.04	101.38	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
78.92	101.38	1	1	.3	.5

Left Levee Station= 78.92 Elevation= 52.24

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 12.9

INPUT
Description: 7+56.31
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	56.25	6.86	54.19	12.06	53.83	21.92	53.36	41.97	51.88
56.89	51.66	69.57	51.75	78.92	52.24	80.36	48.74	81.54	48.74
83.28	48.74	83.76	52.28	109.04	53.78	132.4	53.84	154.31	53.58

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	78.92	.04	83.76	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
78.92	83.76	174.14	172.45 170.75	.1	.3

Left Levee Station= 78.92 Elevation= 52.24

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 12

INPUT
Description: 9+29.87
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	55.49	10.3	51.19	15.87	50.61	20.92	48.46	21.89	48.39
22.59	48.5	24.71	50.55	29.82	51.2	40.48	55.69	54.18	57.48
71.68	57.87	102.16	54.17						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	15.87	.04	24.71	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
15.87	24.71	195.37	195.43 195.57	.1	.3

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 11

INPUT
Description: 11+25.30
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	52.79	7.24	51.97	16.52	50.48	25.8	49.4	28.58	47.33
30.14	47.2	32.25	47.32	32.7	48.18	35.42	49.421	37.63	50.43
56.95	50.47	85.85	51	124	52				

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08    25.8     .04   35.42     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          25.8   35.42             135.17  130.98  126.61            .1       .3


CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 10

INPUT
Description: 12+56.42
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   54.12    5.47   54.01   26.28   51.93   52.19    50.5   59.55   46.53
   61.54   46.64   63.35   46.74   66.25   49.07    73.6    49.5   84.93   49.69
  108.23   50.15  121.91      51  203.18      52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   52.19     .04   66.25     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         52.19   66.25              7.03     7.6    7.25            .1       .3


CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 9

INPUT
Description: 12+74.11 Copy
Station Elevation Data    num=      21
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   53.21   10.45   52.69   20.16   52.19   25.17   52.04   33.18   51.58
   41.43   51.65   46.72   51.27   50.85   46.73   53.04   46.73   55.24   46.73
   57.16   48.74   61.49   50.39    69.4   51.04   76.13   51.06   88.12   50.78
   99.51   50.78  114.54   51.07  115.29   51.07  140.69   51.49  164.82   51.51
  172.69   51.65

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   46.72     .04    69.4     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         46.72    69.4              8.95    8.95    8.95            .3       .5


CULVERT
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 8.5

INPUT
Description:
Distance from Upstream XS =      .36
Deck/Roadway Width        =     8.24
Weir Coefficient          =     1.44
Upstream  Deck/Roadway Coordinates
    num=      13
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0   53.08        0    10.8   52.41        0   20.02   52.01        0
    28.4   51.84        0   38.88   51.51        0   47.21   51.31        0
   63.97   51.12        0   68.32   51.13        0   76.38   51.08        0
   88.68   50.99        0   99.73   50.89        0  103.88   50.91        0
  115.29   51.01        0
```

```
Upstream Bridge Cross Section Data
Station Elevation Data    num=      21
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   53.21   10.45   52.69   20.16   52.19   25.17   52.04   33.18   51.58
   41.43   51.65   46.72   51.27   50.85   46.73   53.04   46.73   55.24   46.73
   57.16   48.74   61.49   50.39    69.4   51.04   76.13   51.06   88.12   50.78
   99.51   50.78  114.54   51.07  115.29   51.07  140.69   51.49  164.82   51.51
  172.69   51.65

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   46.72     .04    69.4     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         46.72    69.4             .3       .5

Downstream  Deck/Roadway Coordinates
    num=      13
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0   53.08       0    10.8   52.41       0   20.02   52.01       0
    28.4   51.84       0   38.88   51.51       0   47.21   51.31       0
   63.97   51.12       0   68.32   51.13       0   76.38   51.08       0
   88.68   50.99       0   99.73   50.89       0  103.88   50.91       0
  115.29   51.01       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      20
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   53.21   10.45   52.69   20.16   52.19   25.17   52.04   33.18   51.58
   41.43   51.65   46.72   51.27   50.85   46.54   53.04   46.54   55.24   46.54
   57.16   48.74   61.49   50.39    69.4   51.04   76.13   51.06   88.12   50.78
   99.51   50.78  114.54   51.07  140.69   51.49  164.82   51.51  172.69   51.65

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   46.72     .04    69.4     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         46.72    69.4             .3       .5

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

Number of Culverts =  1

Culvert Name      Shape      Rise    Span
Culvert #1            Box    3.21    4.66
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                .36    8.24     .013     .013        0                  .4                1
Upstream   Elevation =  46.86
           Centerline Station =  52.97
Downstream Elevation =  46.54
           Centerline Station =  52.97



CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 8

INPUT
Description: 12+74.11
Station Elevation Data    num=      20
```

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	53.21	10.45	52.69	20.16	52.19	25.17	52.04	33.18	51.58
41.43	51.65	46.72	51.27	50.85	46.54	53.04	46.54	55.24	46.54
57.16	48.74	61.49	50.39	69.4	51.04	76.13	51.06	88.12	50.78
99.51	50.78	114.54	51.07	140.69	51.49	164.82	51.51	172.69	51.65

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	46.72	.04	69.4	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
46.72	69.4	15.76	15.76	.3	.5

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 7

INPUT
Description: 12+89.87
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	54	15.29	53	36.4	51.69	52.3	51	61.58	49.86
69.08	46.4	70.72	46.32	72.36	46.24	74.71	48.84	92.05	49.89
110.07	50.47	137.43	51.09	170.86	51.51	179.38	51.65	195.46	51.76
209	51.84	224.8	51.96						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	61.58	.04	92.05	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
61.58	92.05	13.05	13.57	13.7	.1	.3

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 6

INPUT
Description: 13+3.44
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	53.75	21.89	52	38.15	51	61.54	50	67.85	49.79
70.39	46.13	72.92	46.05	75.46	45.98	78.15	48.69	92.63	47.64
107.04	49.24	129.54	50	164.85	50.4	176.09	51.01	191.03	51.31
214.52	51.44								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	67.85	.04	78.15	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
67.85	78.15	0	0	0	.1	.3

Left Levee Station= 67.85 Elevation= 49.79
Right Levee Station= 78.15 Elevation= 48.69

SUMMARY OF MANNING'S N VALUES

River:Unnamed stream

Reach	River Sta.	n1	n2	n3
PR-876 Bridge	23	.08	.04	.08
PR-876 Bridge	20	.08	.04	.08
PR-876 Bridge	17	.08	.04	.08
PR-876 Bridge	16	.08	.04	.08
PR-876 Bridge	15.9	.08	.04	.08
PR-876 Bridge	15.5	Culvert		
PR-876 Bridge	15.1	.08	.04	.08
PR-876 Bridge	15	.08	.04	.08
PR-876 Bridge	14.1	.08	.04	.08
PR-876 Bridge	14	.08	.04	.08
PR-876 Bridge	13.5	Culvert		
PR-876 Bridge	13	.08	.04	.08
PR-876 Bridge	12.9	.08	.04	.08
PR-876 Bridge	12	.08	.04	.08
PR-876 Bridge	11	.08	.04	.08
PR-876 Bridge	10	.08	.04	.08
PR-876 Bridge	9	.08	.04	.08
PR-876 Bridge	8.5	Culvert		
PR-876 Bridge	8	.08	.04	.08
PR-876 Bridge	7	.08	.04	.08
PR-876 Bridge	6	.08	.04	.08

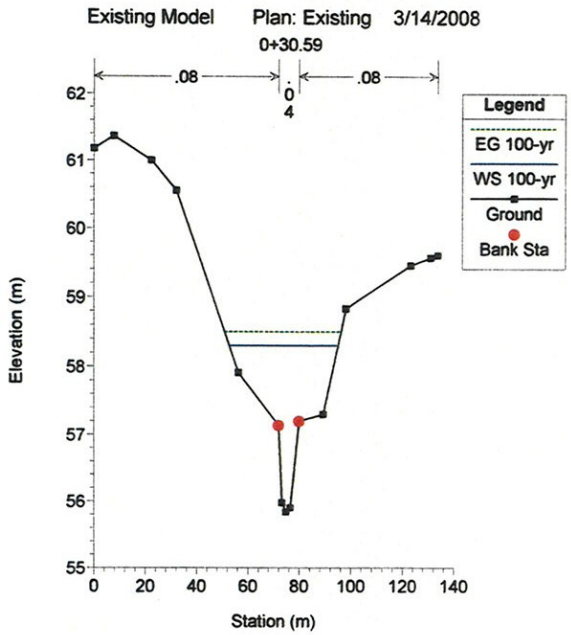
SUMMARY OF REACH LENGTHS

River: Unnamed stream

Reach	River Sta.	Left	Channel	Right
PR-876 Bridge	23	21.49	21.26	21.51
PR-876 Bridge	20	92.71	90.86	91.32
PR-876 Bridge	17	169.38	163.77	157.3
PR-876 Bridge	16	232.4	233.23	234.2
PR-876 Bridge	15.9	14.6	14.3	13.8
PR-876 Bridge	15.5	Culvert		
PR-876 Bridge	15.1	22.9	24	25.2
PR-876 Bridge	15	165.81	170.66	172.82
PR-876 Bridge	14.1	1	1	1
PR-876 Bridge	14	4.73	4.85	4.93
PR-876 Bridge	13.5	Culvert		
PR-876 Bridge	13	1	1	1
PR-876 Bridge	12.9	174.14	172.45	170.75
PR-876 Bridge	12	195.37	195.43	195.57
PR-876 Bridge	11	135.17	130.98	126.61
PR-876 Bridge	10	7.03	7.6	7.25
PR-876 Bridge	9	8.95	8.95	8.95
PR-876 Bridge	8.5	Culvert		
PR-876 Bridge	8	15.76	15.76	15.76
PR-876 Bridge	7	13.05	13.57	13.7
PR-876 Bridge	6	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Unnamed stream

Reach	River Sta.	Contr.	Expan.
PR-876 Bridge	23	.1	.3
PR-876 Bridge	20	.1	.3
PR-876 Bridge	17	.1	.3
PR-876 Bridge	16	.1	.3
PR-876 Bridge	15.9	.3	.5
PR-876 Bridge	15.5	Culvert	
PR-876 Bridge	15.1	.3	.5
PR-876 Bridge	15	.1	.3
PR-876 Bridge	14.1	.1	.3
PR-876 Bridge	14	.3	.5
PR-876 Bridge	13.5	Culvert	
PR-876 Bridge	13	.3	.5
PR-876 Bridge	12.9	.1	.3
PR-876 Bridge	12	.1	.3
PR-876 Bridge	11	.1	.3
PR-876 Bridge	10	.1	.3
PR-876 Bridge	9	.3	.5
PR-876 Bridge	8.5	Culvert	
PR-876 Bridge	8	.3	.5
PR-876 Bridge	7	.1	.3
PR-876 Bridge	6	.1	.3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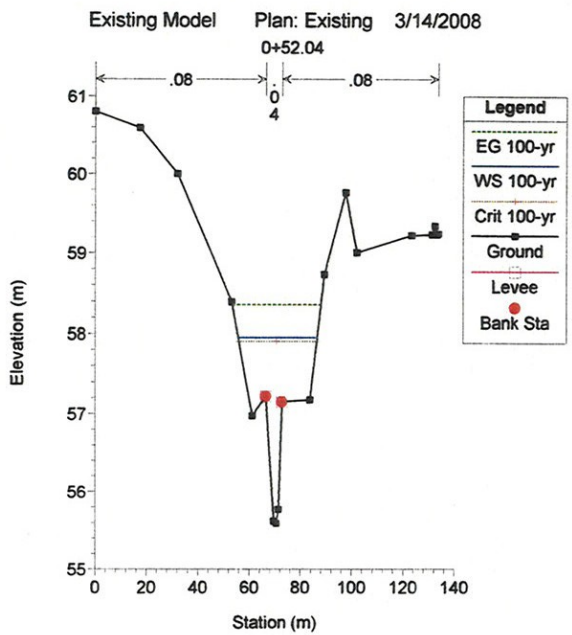
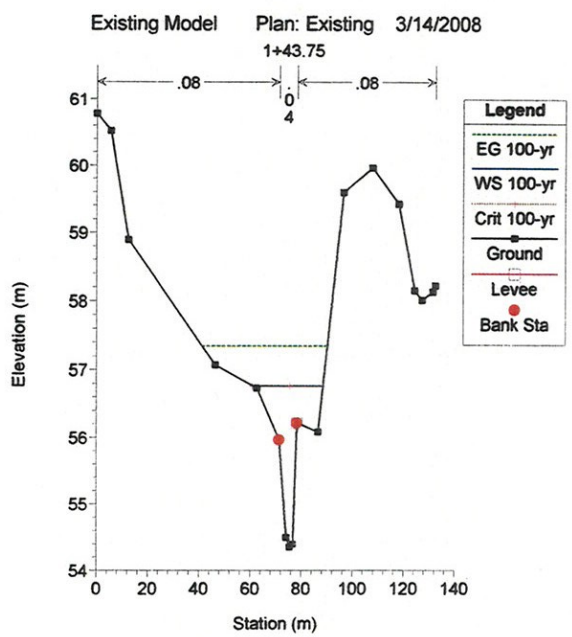
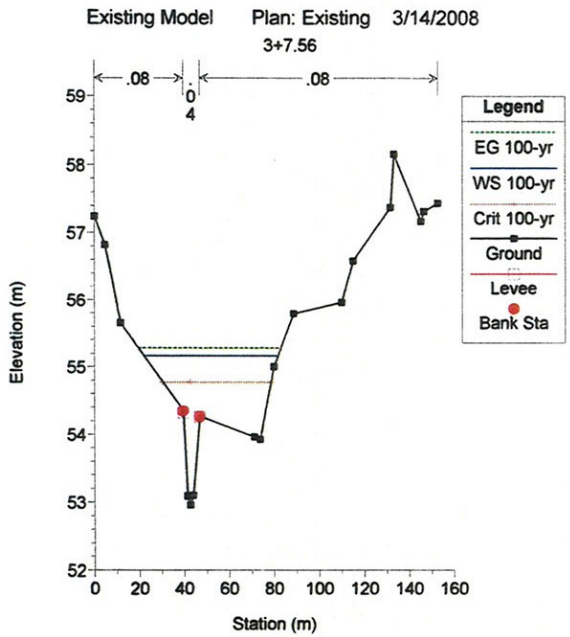
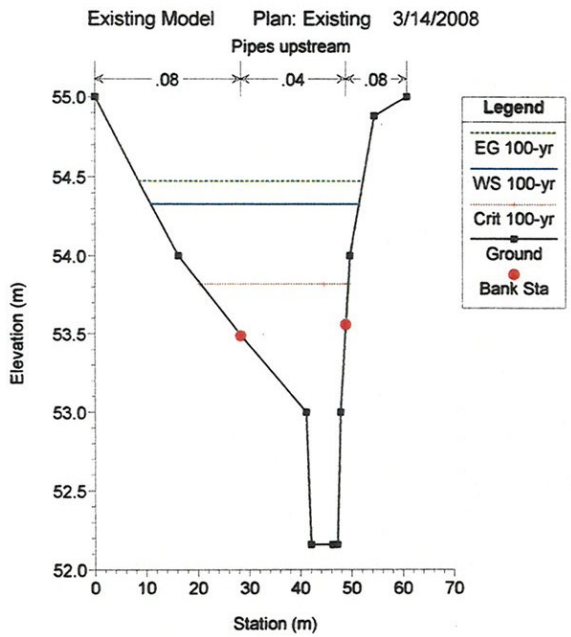
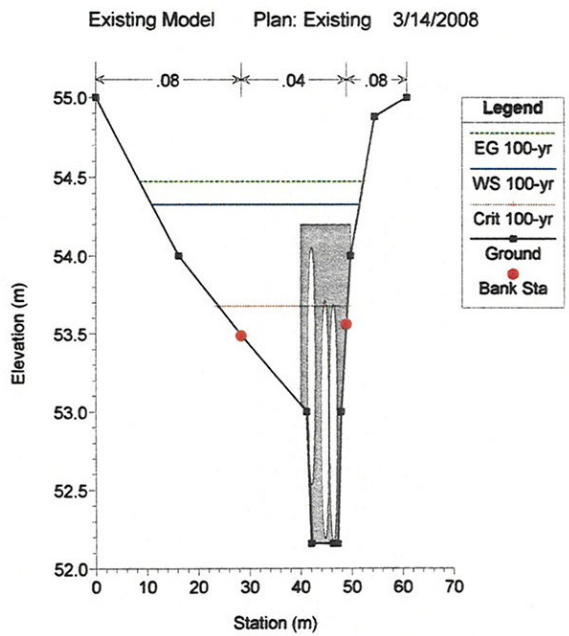
0+30.59
.08
.08
0
4
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)

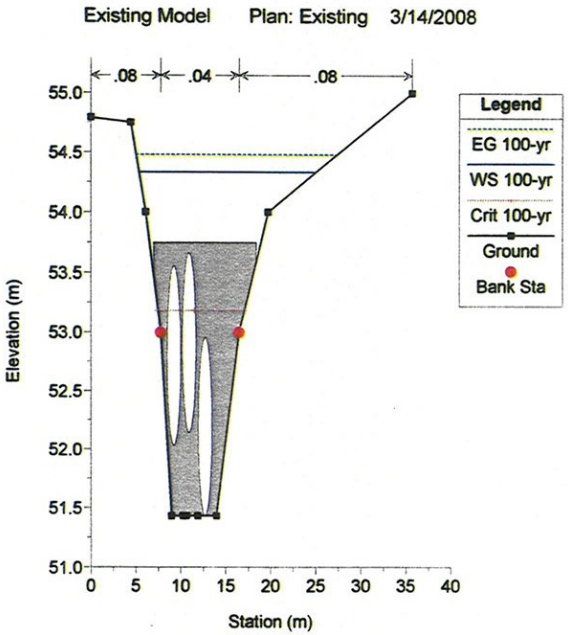

Existing Model Plan: Existing 3/14/2008
0+52.04
.08
.08
0
4
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)

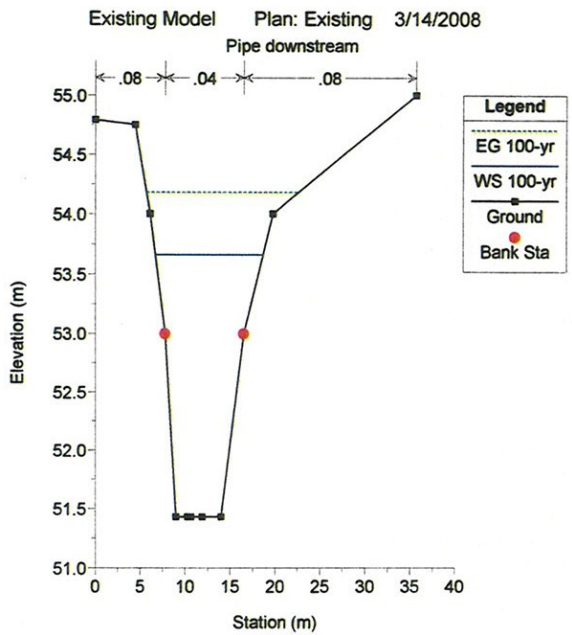

Existing Model Plan: Existing 3/14/2008
1+43.75
.08
.08
0
4
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)

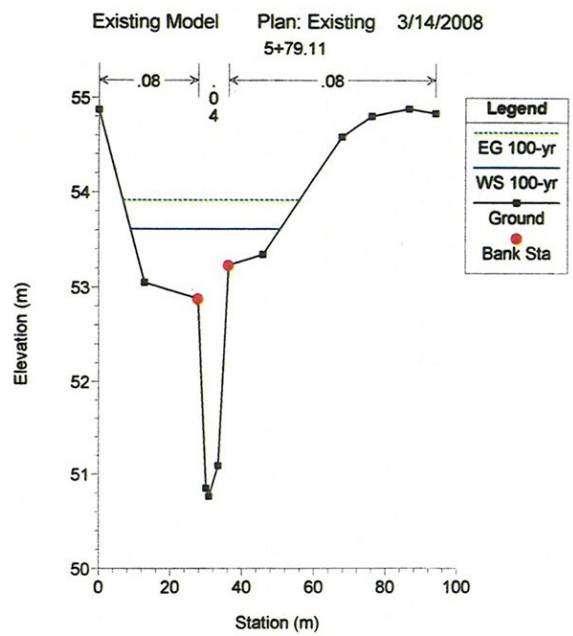

Existing Model Plan: Existing 3/14/2008
3+7.56
.08
.08
0
4
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)

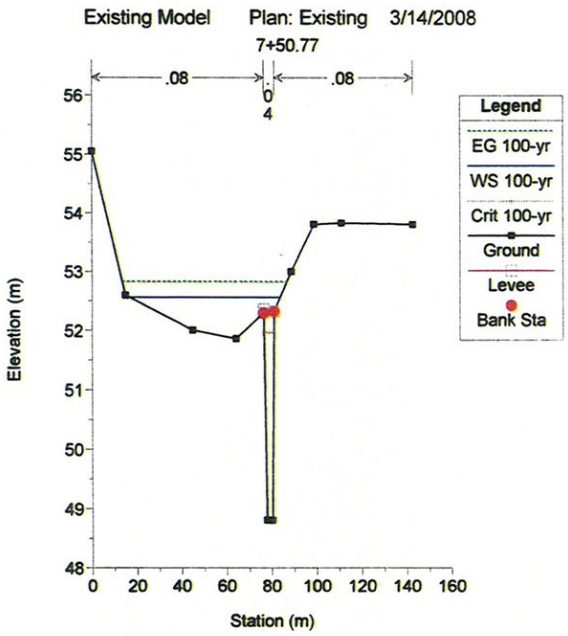

Existing Model Plan: Existing 3/14/2008
Pipes upstream
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
Pipe downstream
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
5+79.11
.08
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)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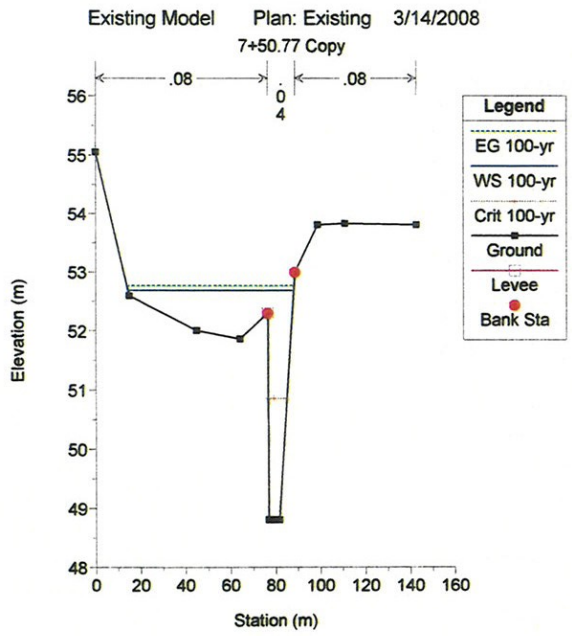
7+50.77
.08
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)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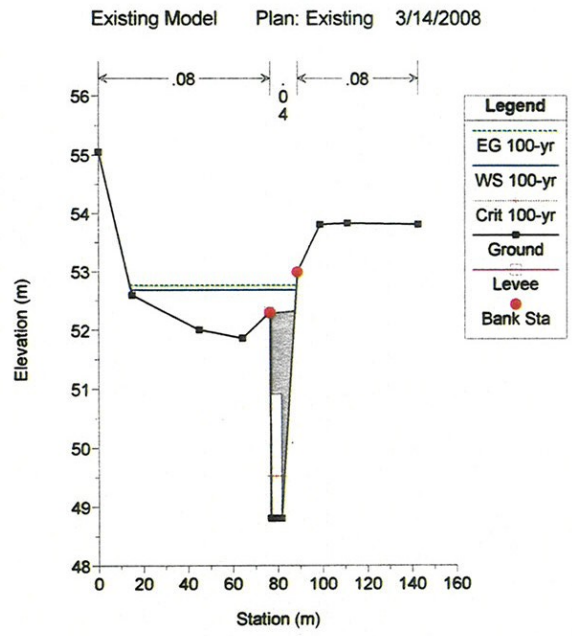
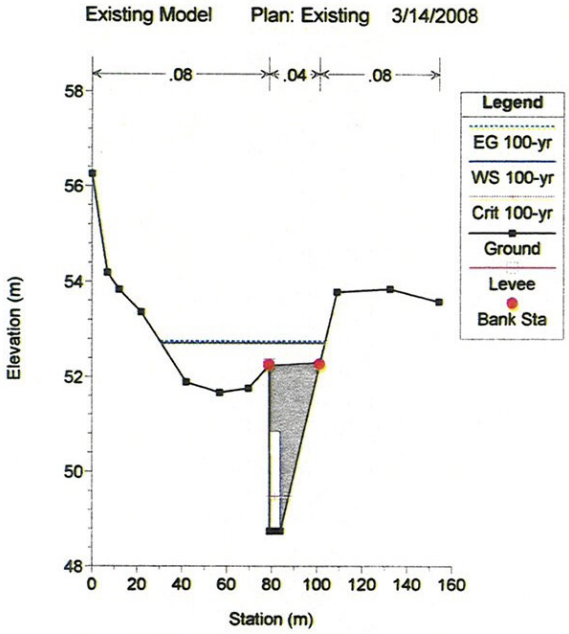
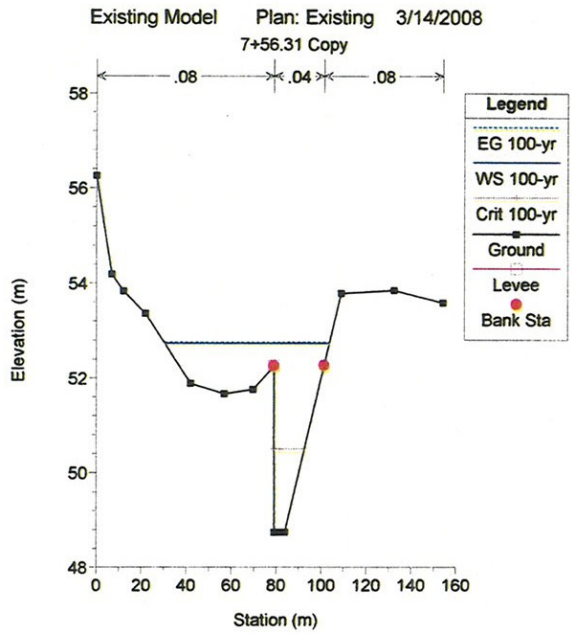
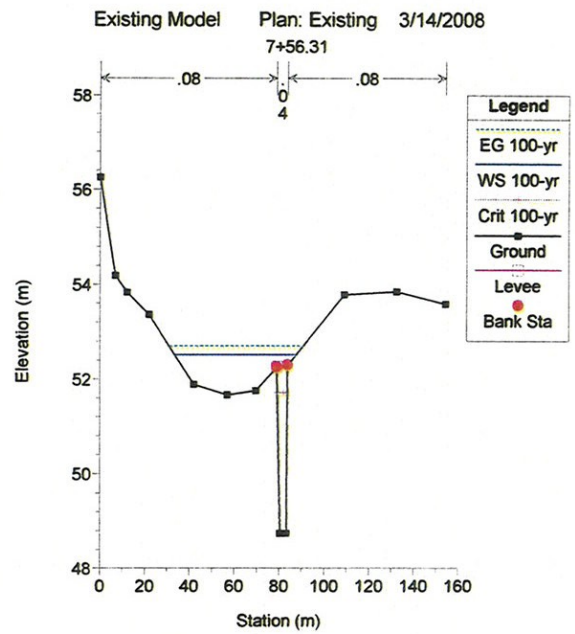
7+50.77 Copy
.08
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
.08
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
7+56.31 Copy
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)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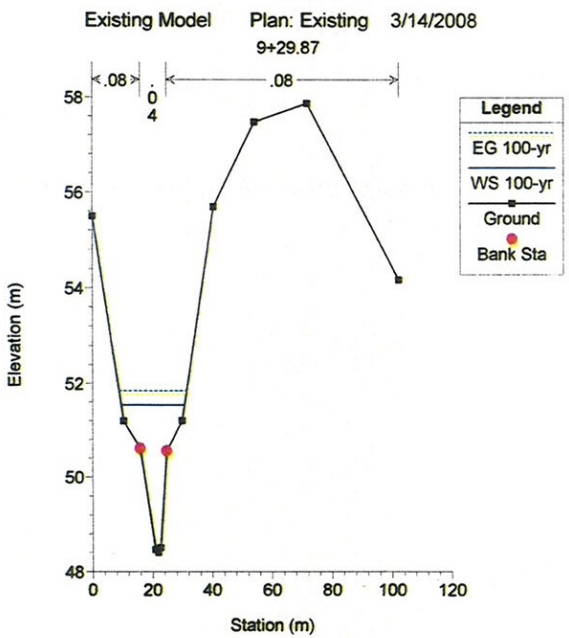
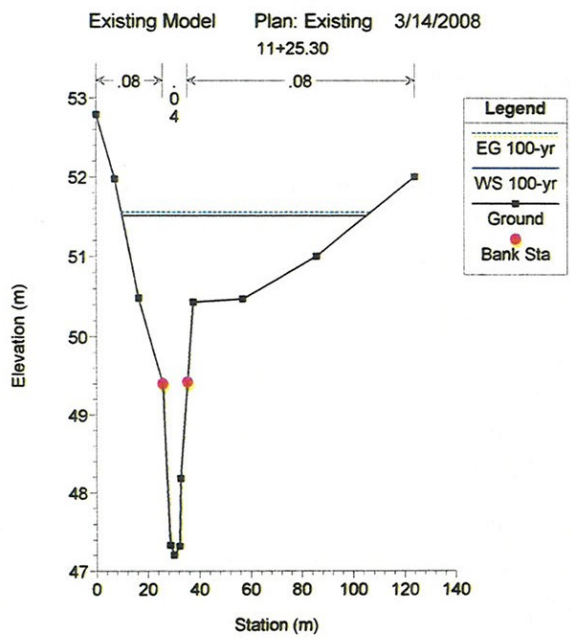
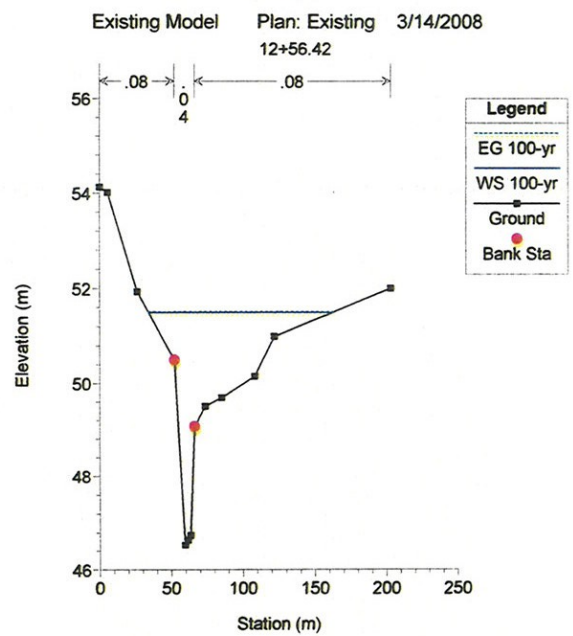
7+56.31
.08
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
9+29.87
.08
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
11+25.30
.08
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)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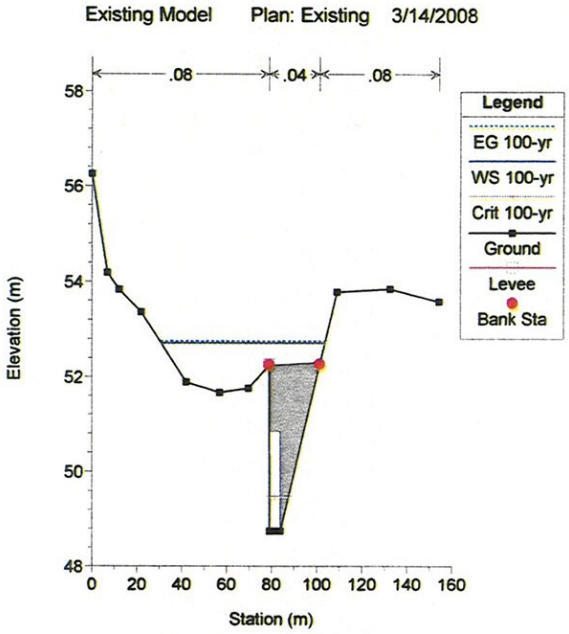
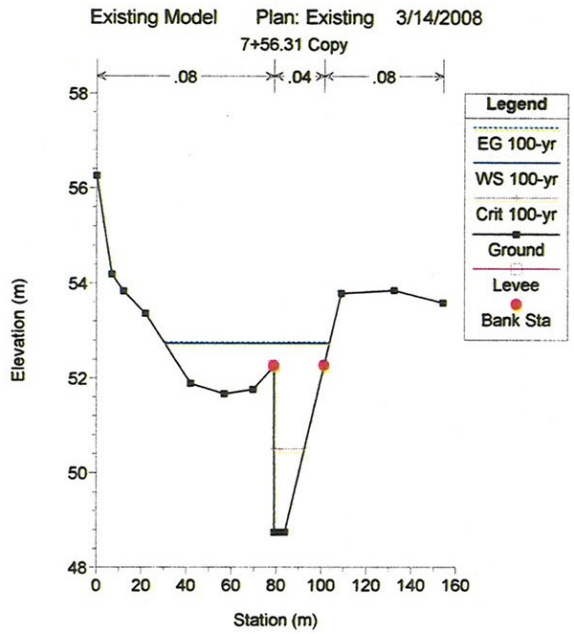
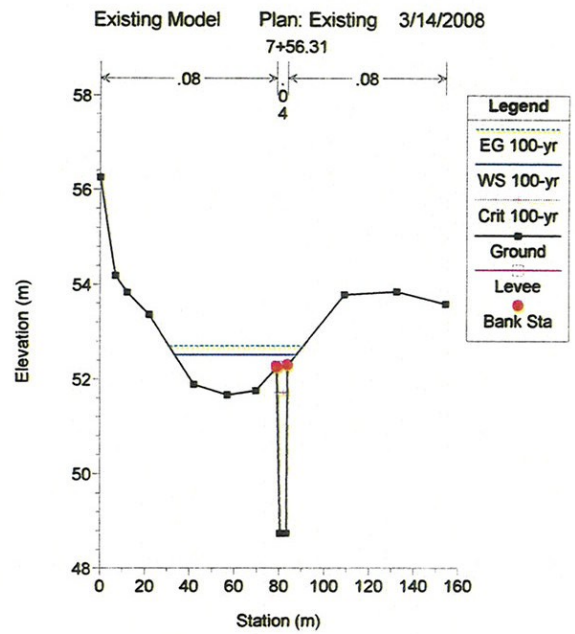
12+56.42
.08
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
7+56.31 Copy
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)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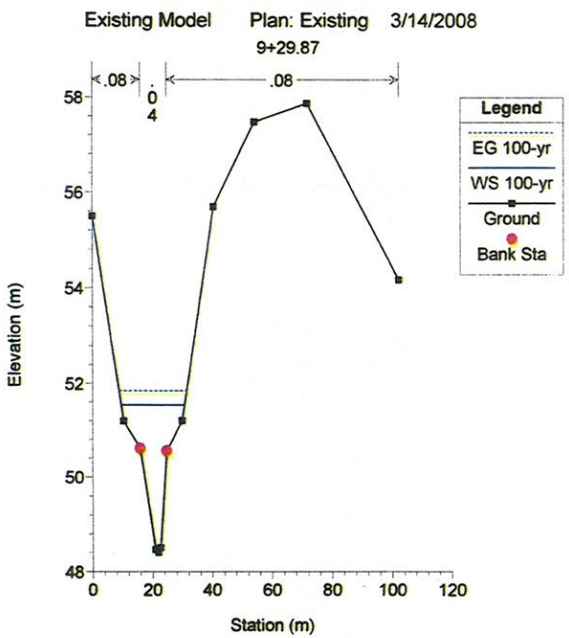
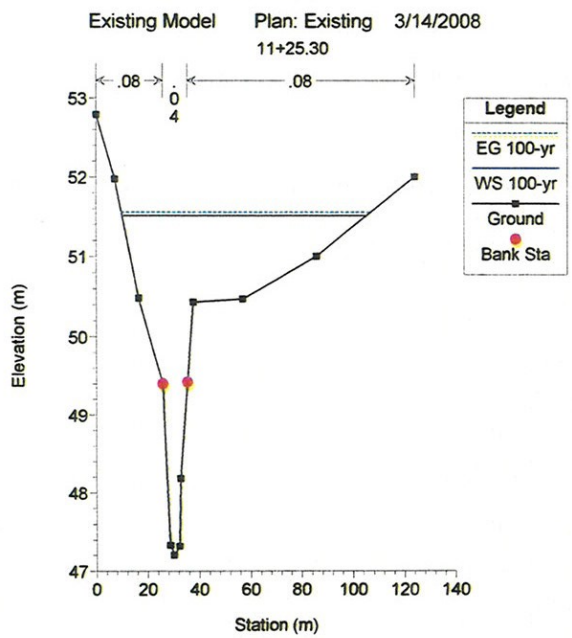
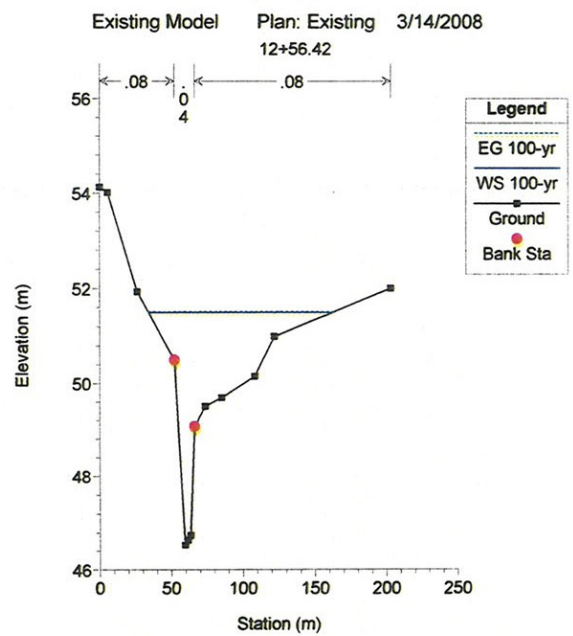
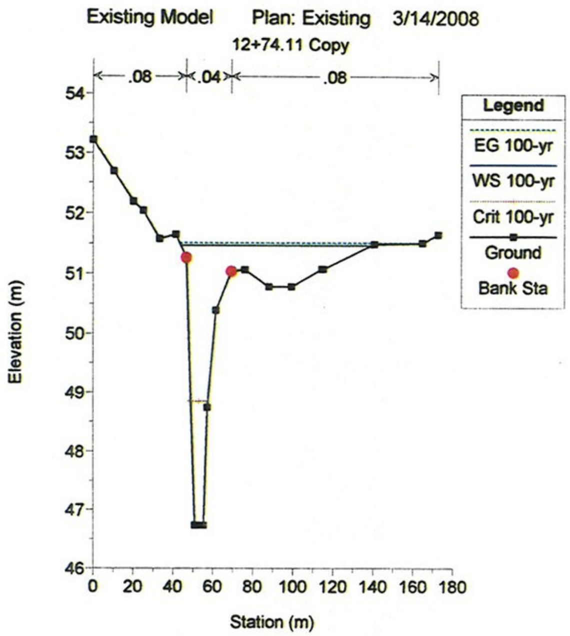
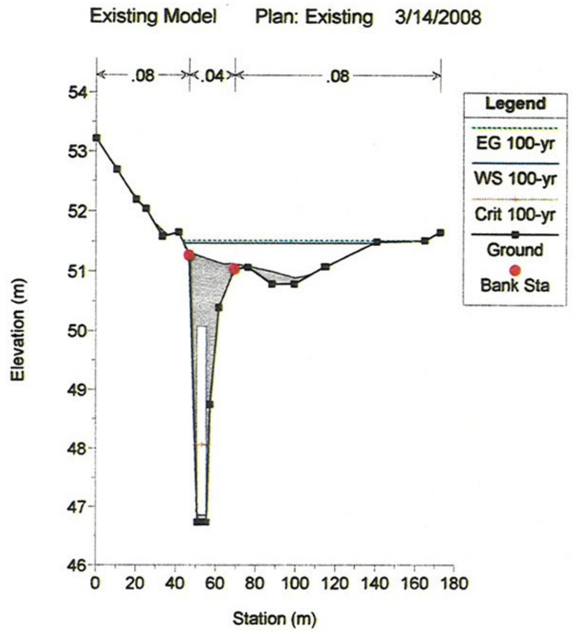
7+56.31
.08
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)

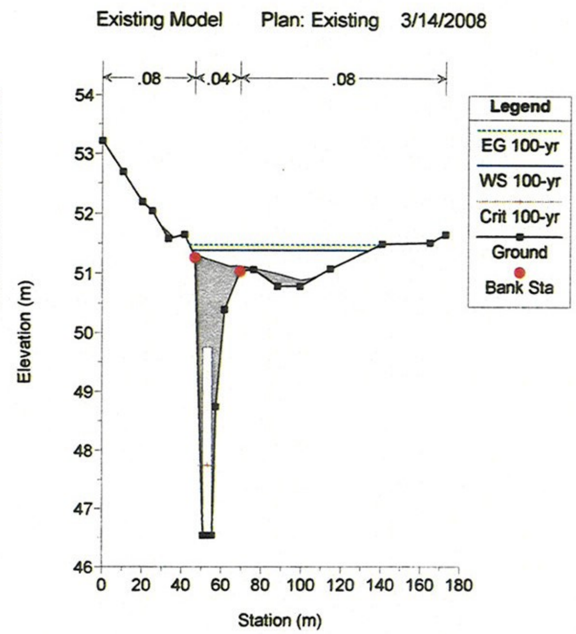

Existing Model Plan: Existing 3/14/2008
9+29.87
.08
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)

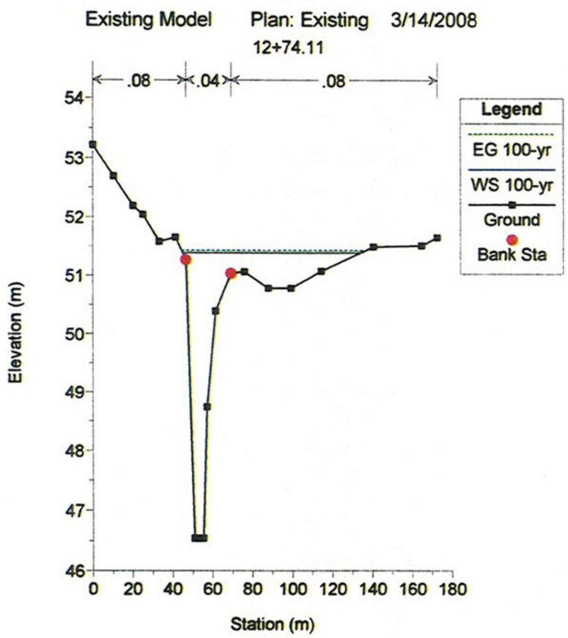

Existing Model Plan: Existing 3/14/2008
11+25.30
.08
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)

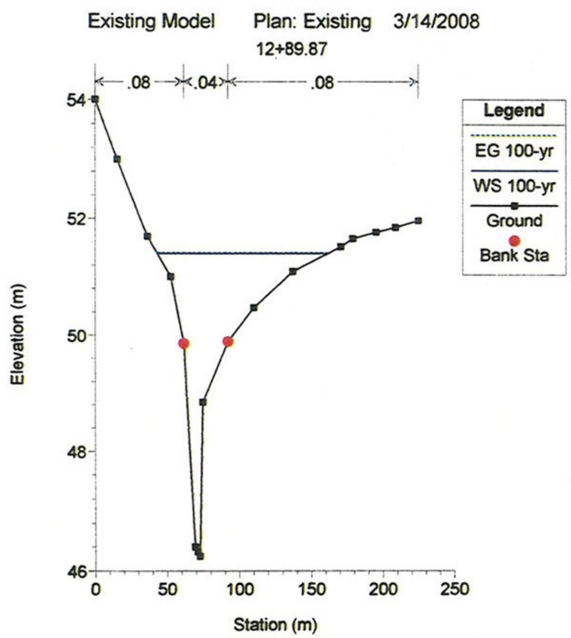

Existing Model Plan: Existing 3/14/2008
12+56.42
.08
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)

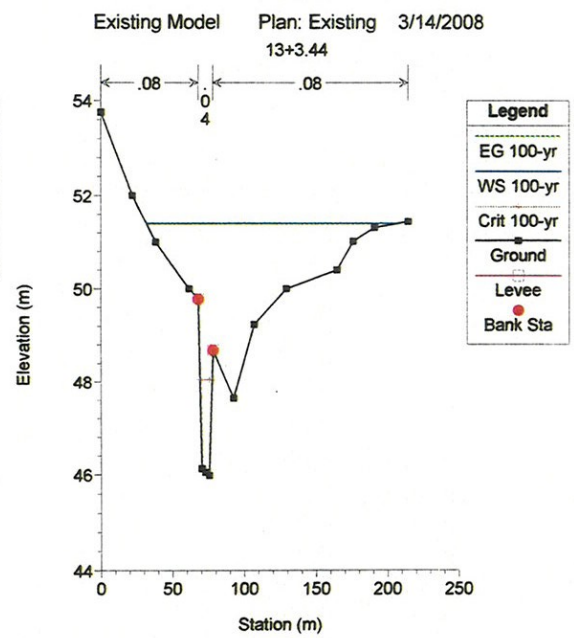

Existing Model Plan: Existing 3/14/2008
12+74.11 Copy
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)

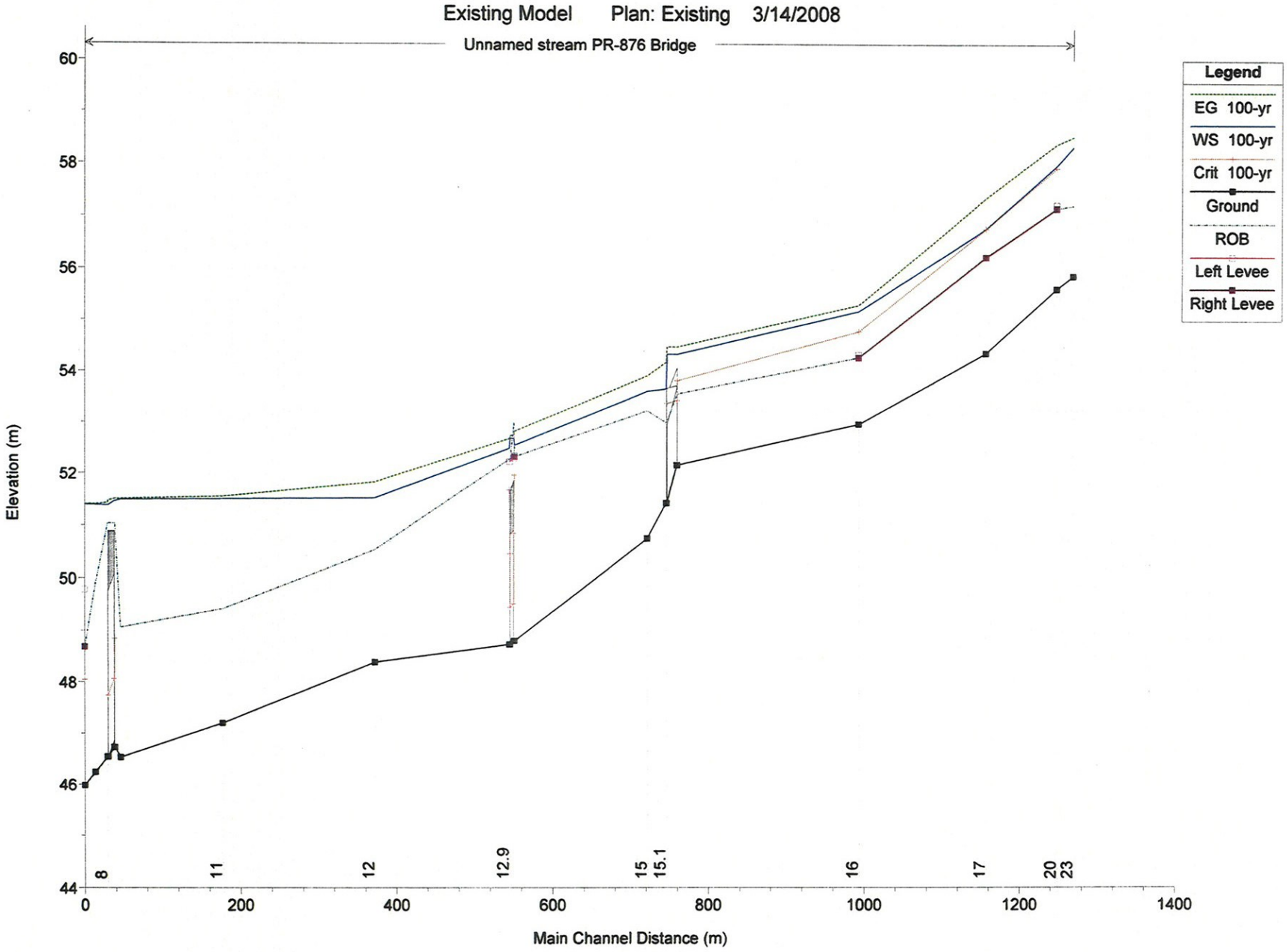

Existing Model Plan: Existing 3/14/2008
12+74.11
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
12+89.87
.08
.04
.08
Legend
EG 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (m)
Station (m)


Existing Model Plan: Existing 3/14/2008
13+3.44
.08
0
4
.08
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)

HEC-RAS Plan: Existing River: Unnamed stream Reach: PR-876 Bridge Profile: 100-yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
PR-876 Bridge	23	100-yr	53.70	55.84	58.31		58.50	0.003766	2.32	41.87	42.41	0.52
PR-876 Bridge	20	100-yr	53.70	55.59	57.95	57.91	58.36	0.010231	3.34	28.08	30.89	0.80
PR-876 Bridge	17	100-yr	53.70	54.35	56.77	56.77	57.35	0.011686	3.63	22.02	27.47	0.86
PR-876 Bridge	16	100-yr	53.70	52.96	55.17	54.78	55.29	0.003733	2.06	53.12	59.95	0.51
PR-876 Bridge	15.9	100-yr	53.70	52.16	54.33	53.83	54.48	0.003230	1.74	37.67	40.69	0.47
PR-876 Bridge	15.5		Culvert									
PR-876 Bridge	15.1	100-yr	53.70	51.43	53.66		54.18	0.008373	3.21	17.63	11.98	0.74
PR-876 Bridge	15	100-yr	53.70	50.76	53.61		53.91	0.005311	2.62	31.87	41.75	0.59
PR-876 Bridge	14.1	100-yr	53.70	48.81	52.56	51.98	52.83	0.007699	2.73	39.84	67.18	0.51
PR-876 Bridge	14	100-yr	53.70	48.81	52.69	50.86	52.77	0.001195	1.37	65.92	73.90	0.27
PR-876 Bridge	13.5		Culvert									
PR-876 Bridge	13	100-yr	53.70	48.74	52.71	50.48	52.74	0.000347	0.79	96.56	72.92	0.16
PR-876 Bridge	12.9	100-yr	53.70	48.74	52.49	51.69	52.69	0.005451	2.35	43.22	53.72	0.43
PR-876 Bridge	12	100-yr	53.70	48.39	51.53		51.84	0.004307	2.54	26.69	21.13	0.55
PR-876 Bridge	11	100-yr	53.70	47.20	51.51		51.56	0.000460	1.12	102.69	95.24	0.19
PR-876 Bridge	10	100-yr	53.70	46.53	51.49		51.51	0.000176	0.72	156.74	127.93	0.12
PR-876 Bridge	9	100-yr	53.70	46.73	51.47	48.86	51.51	0.000538	0.93	83.19	95.47	0.19
PR-876 Bridge	8.5		Culvert									
PR-876 Bridge	8	100-yr	53.70	46.54	51.39		51.43	0.000590	0.96	76.74	89.07	0.20
PR-876 Bridge	7	100-yr	53.70	46.24	51.40		51.41	0.000139	0.56	138.68	118.60	0.11
PR-876 Bridge	6	100-yr	53.70	45.98	51.40	48.05	51.41	0.000081	0.52	262.67	175.65	0.08


Existing Model Plan: Existing 3/14/2008
Unnamed stream PR-876 Bridge
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
Ground
ROB
Left Levee
Right Levee
Elevation (m)
60
58
56
54
52
50
48
46
44
0
200
400
600
800
1000
1200
1400
Main Channel Distance (m)
8
11
12
12.9
15
15.1
16
17
20
23

Appendix E

Hydraulic Simulation Input Data and Results for Floodway Encroachment Model

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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

PROJECT DATA
Project Title: Encroachment Model
Project File : Encroachment.prj
Run Date and Time: 3/14/2008 3:06:54 PM

Project in SI units

PLAN DATA

Plan Title: TU Caguas Propose
Plan File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Encroachment.p02

Geometry Title: TU_Caguas Propose
Geometry File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Encroachment.g01

Flow Title : TU Caguas Propose
Flow File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Encroachment.f02

Plan Summary Information:

Number of:	Cross Sections	= 18	Multiple Openings	=	0
	Culverts	= 3	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	= 0.003
Critical depth calculation tolerance	= 0.003
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.1
Flow tolerance factor	= 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

Encroachment Data
Equal Conveyance = False
Left Offset = 0
Right Offset = 0

River = Unnamed stream Reach = PR-876 Bridge

RS	Profile	Method	Value1	Value2
23	PF 2	4	.09	
20	PF 2	4	.05	
17	PF 2	4	.015	
16	PF 2	4	.11	

15.9	PF 2	4	.13
15.1	PF 2	4	.11
15	PF 2	4	.03
14.1	PF 2	4	.08
14	PF 2	4	.15
13	PF 2	4	.1
12.9	PF 2	4	.15
12	PF 2	4	.02
11	PF 2	4	.14
10	PF 2	4	.03
9	PF 2	4	.05
8	PF 2	4	.05
7	PF 2	4	.001
6	PF 2	4	.001

FLOW DATA

Flow Title: TU Caguas Propose
Flow File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Encroachment.f02

Flow Data (m3/s)

River	Reach	RS	100-yr	PF 2
Unnamed stream	PR-876 Bridge	23	53.7	53.7

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Unnamed stream	PR-876 Bridge	100-yr		Known WS = 51.4
Unnamed stream	PR-876 Bridge	PF 2		Known WS = 51.7

GEOMETRY DATA

Geometry Title: TU_Caguas Propose
Geometry File : p:\Caguas\Water Resources\TU Caguas\Tren Urbano (Cambio Layout- Feb. 2008)\HEC-2008\Encroachment.g01

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 23

INPUT
Description: 0+30.59
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	61.17	7.74	61.36	22.32	61	32.09	60.55	56.32	57.91
72.02	57.14	73.22	55.98	74.81	55.84	76.43	55.9	79.99	57.2
89.3	57.3	98.09	58.83	123.19	59.45	131.1	59.56	133.8	59.6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	72.02	.04	79.99	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
72.02	79.99	21.49	21.26	21.51	.1	.3

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 20

INPUT
Description: 0+52.04
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	60.8	17.46	60.59	31.91	60	53.1	58.39	61.19	56.97
66.44	57.22	69.54	55.62	70.47	55.59	71.42	55.77	72.75	57.15
83.72	57.17	89.24	58.73	97.59	59.76	101.94	59	123.24	59.22
131.16	59.23	132.25	59.34	133.28	59.23	133.7	59.24		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	66.44	.04	72.75	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
66.44	72.75	92.71 90.86	91.32	.1	.3

Left Levee Station= 66.44 Elevation= 57.22
Right Levee Station= 72.75 Elevation= 57.15

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 17

INPUT
Description: 1+43.75
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	60.78	5.53	60.52	12.49	58.89	46.32	57.07	62.71	56.73
71.35	55.97	74.16	54.5	75.41	54.35	76.69	54.4	78.35	56.22
86.51	56.08	96.39	59.59	107.62	59.96	117.96	59.42	124.19	58.15
127.14	58.01	131.42	58.13	132.45	58.22				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	71.35	.04	78.35	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
71.35	78.35	169.38 163.77	157.3	.1	.3

Right Levee Station= 78.35 Elevation= 56.22

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 16

INPUT
Description: 3+7.56
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	57.24	4.68	56.82	11.65	55.65	39.48	54.35	41.37	53.09
42.66	52.96	43.93	53.1	46.93	54.27	71.23	53.96	73.71	53.92
80.03	55	88.84	55.79	110.12	55.96	115.2	56.58	131.75	57.37
133.32	58.15	145.39	57.17	146.6	57.32	152.95	57.44		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	39.48	.04	46.93	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
39.48	46.93	232.4 233.23	234.2	.1	.3

Left Levee Station= 39.51 Elevation= 54.33
Right Levee Station= 46.93 Elevation= 54.27

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 20

INPUT
Description: 0+52.04
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	60.8	17.46	60.59	31.91	60	53.1	58.39	61.19	56.97
66.44	57.22	69.54	55.62	70.47	55.59	71.42	55.77	72.75	57.15
83.72	57.17	89.24	58.73	97.59	59.76	101.94	59	123.24	59.22
131.16	59.23	132.25	59.34	133.28	59.23	133.7	59.24		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	66.44	.04	72.75	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
66.44	72.75	92.71 90.86	91.32	.1	.3

Left Levee Station= 66.44 Elevation= 57.22
Right Levee Station= 72.75 Elevation= 57.15

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 17

INPUT
Description: 1+43.75
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	60.78	5.53	60.52	12.49	58.89	46.32	57.07	62.71	56.73
71.35	55.97	74.16	54.5	75.41	54.35	76.69	54.4	78.35	56.22
86.51	56.08	96.39	59.59	107.62	59.96	117.96	59.42	124.19	58.15
127.14	58.01	131.42	58.13	132.45	58.22				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	71.35	.04	78.35	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
71.35	78.35	169.38 163.77	157.3	.1	.3

Right Levee Station= 78.35 Elevation= 56.22

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 16

INPUT
Description: 3+7.56
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	57.24	4.68	56.82	11.65	55.65	39.48	54.35	41.37	53.09
42.66	52.96	43.93	53.1	46.93	54.27	71.23	53.96	73.71	53.92
80.03	55	88.84	55.79	110.12	55.96	115.2	56.58	131.75	57.37
133.32	58.15	145.39	57.17	146.6	57.32	152.95	57.44		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	39.48	.04	46.93	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
39.48	46.93	232.4 233.23	234.2	.1	.3

Left Levee Station= 39.51 Elevation= 54.33
Right Levee Station= 46.93 Elevation= 54.27

```
CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 15.9

INPUT
Description: Pipes upstream
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0      55    16.2      54   28.44   53.49   41.18      53   42.05   52.16
   46.28   52.16    47.2   52.16   47.89      53   48.93  53.562   49.74      54
   54.45   54.88   60.78      55

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   28.44     .04   48.93     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         28.44   48.93             14.6    14.3    13.8             .3       .5



CULVERT
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 15.5

INPUT
Description:
Distance from Upstream XS =      .68
Deck/Roadway Width        =   12.95
Weir Coefficient          =    1.44
Upstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
      40    54.2       0   49.74    54.2       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0      55    16.2      54   28.44   53.49   41.18      53   42.05   52.16
   46.28   52.16    47.2   52.16   47.89      53   48.93  53.562   49.74      54
   54.45   54.88   60.78      55

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   28.44     .04   48.93     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         28.44   48.93             .3       .5

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       7   53.75       0    18.4   53.75       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   54.79    4.44   54.75    6.11      54    7.79      53       9   51.43
   10.27   51.43   10.67   51.43   11.89   51.43   14.01   51.43   16.53      53
   19.76      54   35.71      55

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08    7.79     .04   16.53     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
          7.79   16.53             .3       .5

Upstream Embankment side slope             =       0 horiz. to 1.0 vertical
Downstream Embankment side slope           =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
```

```
Elevation at which weir flow begins          =
Energy head used in spillway design          =
Spillway height used in design               =
Weir crest shape                             = Broad Crested

Number of Culverts =  3

Culvert Name      Shape       Rise    Span
Culvert #1       Circular   1.524
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 2 - Groove end entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
               .01   12.95     .013     .013        0                  .4               1
Upstream   Elevation =  52.53
           Centerline Station =  42.05
Downstream Elevation =  52.03
           Centerline Station =  9.23

Culvert Name      Shape       Rise    Span
Culvert #2       Circular   1.524
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 2 - Groove end entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
               .68   12.95     .013     .013        0                  .4               1
Upstream   Elevation =  52.19
           Centerline Station =  44.69
Downstream Elevation =  52.14
           Centerline Station =  10.93

Culvert Name      Shape       Rise    Span
Culvert #3       Circular   1.524
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 2 - Groove end entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
               .01   12.95     .013     .013        0                  .4               1
Upstream   Elevation =  52.16
           Centerline Station =  46.32
Downstream Elevation =  51.43
           Centerline Station =  12.71



CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge       RS: 15.1

INPUT
Description: Pipe downstream
Station Elevation Data     num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   54.79    4.44   54.75    6.11      54    7.79      53       9   51.43
   10.27   51.43   10.67   51.43   11.89   51.43   14.01   51.43   16.53      53
   19.76      54   35.71      55

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08    7.79     .04   16.53     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          7.79   16.53             22.9      24    25.2             .3       .5
```

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 15

INPUT
Description: 5+79.11

Station Elevation Data	num=	12							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	54.87	12.79	53.05	27.67	52.88	30.04	50.85	30.81	50.76
33.41	51.09	36.23	53.23	45.79	53.34	67.74	54.58	76.13	54.8
86.46	54.88	93.97	54.83						

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.08	27.67	.04	36.23	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
27.67	36.23	165.81	170.66	172.82	.1	.3

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 14.1

INPUT
Description: 7+50.77

Station Elevation Data	num=	13							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	55.05	14.97	52.59	44.93	52	64.29	51.86	76.56	52.3
77.81	48.81	79.24	48.81	80.23	48.81	81.31	52.33	88.81	53
98.89	53.81	111.07	53.83	142.8	53.81				

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.08	76.56	.04	81.31	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
76.56	81.31	1	1	1	.1	.3

Left Levee Station= 76.56 Elevation= 52.36
Right Levee Station= 81.31 Elevation= 52.33

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 14

INPUT
Description: 7+50.77 Copy

Station Elevation Data	num=	15							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	55.05	14.97	52.59	44.93	52	64.29	51.86	76.56	52.3
76.85	48.81	77.81	48.81	79.24	48.81	80.23	48.81	81.31	48.81
81.6	48.81	88.81	53	98.89	53.81	111.07	53.83	142.8	53.81

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.08	76.56	.04	88.81	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
76.56	88.81	4.73	4.85	4.93	.3	.5

Left Levee Station= 76.56 Elevation= 52.3

```
CULVERT
RIVER: Unnamed stream
REACH: PR-876 Bridge       RS: 13.5

INPUT
Description:
Distance from Upstream XS =      .01
Deck/Roadway Width        =     4.83
Weir Coefficient          =     1.44
Upstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
   76.29   52.28       0   88.81   52.33       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   55.05   14.97   52.59   44.93      52   64.29   51.86   76.56    52.3
   76.85   48.81   77.81   48.81   79.24   48.81   80.23   48.81   81.31   48.81
    81.6   48.81   88.81      53   98.89   53.81  111.07   53.83   142.8   53.81

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   76.56     .04   88.81     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         76.56   88.81             .3       .5
Left Levee      Station=   76.56      Elevation=    52.3

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
      78   52.24       0  100.18    52.3       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   56.25    6.86   54.19   12.06   53.83   21.92   53.36   41.97   51.88
   56.89   51.66   69.57   51.75   78.92   52.24   79.18   48.74   80.36   48.74
   81.54   48.74   83.28   48.74   83.76   48.74   83.91   48.74  101.38  52.244
  109.04   53.78   132.4   53.84  154.31   53.58

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   78.92     .04  101.38     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         78.92  101.38             .3       .5
Left Levee      Station=   78.92      Elevation=   52.24

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

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1           Box     2.1    4.73
FHWA Chart # 58- Rectangular concrete
FHWA Scale # 1 - Side tapered; Less favorable edges
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
               .01    4.83     .013     .013        0                  .4                1
Upstream   Elevation =  48.81
           Centerline Station =  79.24
Downstream Elevation =  48.74
           Centerline Station =  81.54
```

```
CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge       RS: 13

INPUT
Description: 7+56.31 Copy
Station Elevation Data     num=      18
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0    56.25     6.86    54.19    12.06    53.83    21.92    53.36    41.97    51.88
   56.89    51.66    69.57    51.75    78.92    52.24    79.18    48.74    80.36    48.74
   81.54    48.74    83.28    48.74    83.76    48.74    83.91    48.74   101.38   52.244
  109.04    53.78    132.4    53.84   154.31    53.58

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .08    78.92      .04   101.38      .08

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
         78.92   101.38                 1        1        1             .3        .5
Left Levee       Station=    78.92       Elevation=    52.24



CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge       RS: 12.9

INPUT
Description: 7+56.31
Station Elevation Data     num=      15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0    56.25     6.86    54.19    12.06    53.83    21.92    53.36    41.97    51.88
   56.89    51.66    69.57    51.75    78.92    52.24    80.36    48.74    81.54    48.74
   83.28    48.74    83.76    52.28   109.04    53.78    132.4    53.84   154.31    53.58

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .08    78.92      .04    83.76      .08

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
         78.92    83.76           174.14   172.45   170.75             .1        .3
Left Levee       Station=    78.92       Elevation=    52.24



CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge       RS: 12

INPUT
Description: 9+29.87
Station Elevation Data     num=      12
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0    55.49     10.3    51.19    15.87    50.61    20.92    48.46    21.89    48.39
   22.59     48.5    24.71    50.55    29.82     51.2    40.48    55.69    54.18    57.48
   71.68    57.87   102.16    54.17

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .08    15.87      .04    24.71      .08

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
         15.87    24.71           195.37   195.43   195.57             .1        .3



CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge       RS: 11
```

```
INPUT
Description: 11+25.30
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   52.79    7.24   51.97   16.52   50.48    25.8    49.4   28.58   47.33
   30.14    47.2   32.25   47.32    32.7   48.18   35.42  49.421   37.63   50.43
   56.95   50.47   85.85      51     124      52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08    25.8     .04   35.42     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          25.8   35.42           135.17  130.98  126.61            .1       .3


CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 10

INPUT
Description: 12+56.42
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   54.12    5.47   54.01   26.28   51.93   52.19    50.5   59.55   46.53
   61.54   46.64   63.35   46.74   66.25   49.07    73.6    49.5   84.93   49.69
  108.23   50.15  121.91      51  203.18      52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   52.19     .04   66.25     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         52.19   66.25            7.03     7.6    7.25            .1       .3


CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 9

INPUT
Description: 12+74.11 Copy
Station Elevation Data    num=      21
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   53.21   10.45   52.69   20.16   52.19   25.17   52.04   33.18   51.58
   41.43   51.65   46.72   51.27   50.85   46.73   53.04   46.73   55.24   46.73
   57.16   48.74   61.49   50.39    69.4   51.04   76.13   51.06   88.12   50.78
   99.51   50.78  114.54   51.07  115.29   51.07  140.69   51.49  164.82   51.51
  172.69   51.65

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   46.72     .04    69.4     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         46.72    69.4            8.95    8.95    8.95            .3       .5


CULVERT
RIVER: Unnamed stream
REACH: PR-876 Bridge      RS: 8.5

INPUT
Description:
Distance from Upstream XS =      .36
Deck/Roadway Width        =     8.24
Weir Coefficient          =     1.44
Upstream  Deck/Roadway Coordinates
```

```
    num=      13
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0   53.08       0    10.8   52.41       0   20.02   52.01       0
    28.4   51.84       0   38.88   51.51       0   47.21   51.31       0
   63.97   51.12       0   68.32   51.13       0   76.38   51.08       0
   88.68   50.99       0   99.73   50.89       0  103.88   50.91       0
  115.29   51.01       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=      21
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   53.21   10.45   52.69   20.16   52.19   25.17   52.04   33.18   51.58
   41.43   51.65   46.72   51.27   50.85   46.73   53.04   46.73   55.24   46.73
   57.16   48.74   61.49   50.39    69.4   51.04   76.13   51.06   88.12   50.78
   99.51   50.78  114.54   51.07  115.29   51.07  140.69   51.49  164.82   51.51
  172.69   51.65

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   46.72     .04    69.4     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         46.72    69.4             .3       .5

Downstream  Deck/Roadway Coordinates
    num=      13
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0   53.08       0    10.8   52.41       0   20.02   52.01       0
    28.4   51.84       0   38.88   51.51       0   47.21   51.31       0
   63.97   51.12       0   68.32   51.13       0   76.38   51.08       0
   88.68   50.99       0   99.73   50.89       0  103.88   50.91       0
  115.29   51.01       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      20
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   53.21   10.45   52.69   20.16   52.19   25.17   52.04   33.18   51.58
   41.43   51.65   46.72   51.27   50.85   46.54   53.04   46.54   55.24   46.54
   57.16   48.74   61.49   50.39    69.4   51.04   76.13   51.06   88.12   50.78
   99.51   50.78  114.54   51.07  140.69   51.49  164.82   51.51  172.69   51.65

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08   46.72     .04    69.4     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
         46.72    69.4             .3       .5

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

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1           Box    3.21    4.66
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                .36    8.24     .013     .013        0                  .4                1
Upstream   Elevation =  46.86
           Centerline Station =  52.97
Downstream Elevation =  46.54
           Centerline Station =  52.97
```

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 8

INPUT
Description: 12+74.11
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	53.21	10.45	52.69	20.16	52.19	25.17	52.04	33.18	51.58
41.43	51.65	46.72	51.27	50.85	46.54	53.04	46.54	55.24	46.54
57.16	48.74	61.49	50.39	69.4	51.04	76.13	51.06	88.12	50.78
99.51	50.78	114.54	51.07	140.69	51.49	164.82	51.51	172.69	51.65

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	46.72	.04	69.4	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
46.72	69.4	15.76	15.76	.3	.5

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 7

INPUT
Description: 12+89.87
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	54	15.29	53	36.4	51.69	52.3	51	61.58	49.86
69.08	46.4	70.72	46.32	72.36	46.24	74.71	48.84	92.05	49.89
110.07	50.47	137.43	51.09	170.86	51.51	179.38	51.65	195.46	51.76
209	51.84	224.8	51.96						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	61.58	.04	92.05	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
61.58	92.05	13.05	13.57	13.7	.1	.3

CROSS SECTION
RIVER: Unnamed stream
REACH: PR-876 Bridge RS: 6

INPUT
Description: 13+3.44
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	53.75	21.89	52	38.15	51	61.54	50	67.85	49.79
70.39	46.13	72.92	46.05	75.46	45.98	78.15	48.69	92.63	47.64
107.04	49.24	129.54	50	164.85	50.4	176.09	51.01	191.03	51.31
214.52	51.44								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	67.85	.04	78.15	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
67.85	78.15	0	0	0	.1	.3

Left Levee Station= 67.85 Elevation= 49.79
Right Levee Station= 78.15 Elevation= 48.69

SUMMARY OF MANNING'S N VALUES

River:Unnamed stream

Reach	River Sta.	n1	n2	n3
PR-876 Bridge	23	.08	.04	.08
PR-876 Bridge	20	.08	.04	.08
PR-876 Bridge	17	.08	.04	.08
PR-876 Bridge	16	.08	.04	.08
PR-876 Bridge	15.9	.08	.04	.08
PR-876 Bridge	15.5	Culvert		
PR-876 Bridge	15.1	.08	.04	.08
PR-876 Bridge	15	.08	.04	.08
PR-876 Bridge	14.1	.08	.04	.08
PR-876 Bridge	14	.08	.04	.08
PR-876 Bridge	13.5	Culvert		
PR-876 Bridge	13	.08	.04	.08
PR-876 Bridge	12.9	.08	.04	.08
PR-876 Bridge	12	.08	.04	.08
PR-876 Bridge	11	.08	.04	.08
PR-876 Bridge	10	.08	.04	.08
PR-876 Bridge	9	.08	.04	.08
PR-876 Bridge	8.5	Culvert		
PR-876 Bridge	8	.08	.04	.08
PR-876 Bridge	7	.08	.04	.08
PR-876 Bridge	6	.08	.04	.08

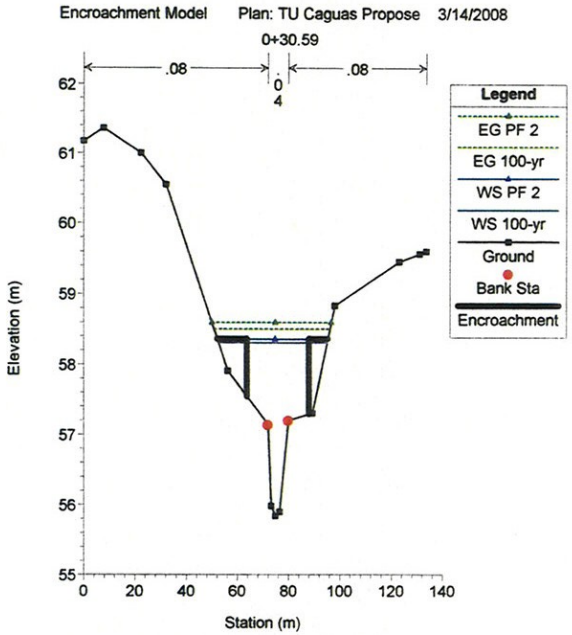
SUMMARY OF REACH LENGTHS

River: Unnamed stream

Reach	River Sta.	Left	Channel	Right
PR-876 Bridge	23	21.49	21.26	21.51
PR-876 Bridge	20	92.71	90.86	91.32
PR-876 Bridge	17	169.38	163.77	157.3
PR-876 Bridge	16	232.4	233.23	234.2
PR-876 Bridge	15.9	14.6	14.3	13.8
PR-876 Bridge	15.5	Culvert		
PR-876 Bridge	15.1	22.9	24	25.2
PR-876 Bridge	15	165.81	170.66	172.82
PR-876 Bridge	14.1	1	1	1
PR-876 Bridge	14	4.73	4.85	4.93
PR-876 Bridge	13.5	Culvert		
PR-876 Bridge	13	1	1	1
PR-876 Bridge	12.9	174.14	172.45	170.75
PR-876 Bridge	12	195.37	195.43	195.57
PR-876 Bridge	11	135.17	130.98	126.61
PR-876 Bridge	10	7.03	7.6	7.25
PR-876 Bridge	9	8.95	8.95	8.95
PR-876 Bridge	8.5	Culvert		
PR-876 Bridge	8	15.76	15.76	15.76
PR-876 Bridge	7	13.05	13.57	13.7
PR-876 Bridge	6	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Unnamed stream

Reach	River Sta.	Contr.	Expan.
PR-876 Bridge	23	.1	.3
PR-876 Bridge	20	.1	.3
PR-876 Bridge	17	.1	.3
PR-876 Bridge	16	.1	.3
PR-876 Bridge	15.9	.3	.5
PR-876 Bridge	15.5	Culvert	
PR-876 Bridge	15.1	.3	.5
PR-876 Bridge	15	.1	.3
PR-876 Bridge	14.1	.1	.3
PR-876 Bridge	14	.3	.5
PR-876 Bridge	13.5	Culvert	
PR-876 Bridge	13	.3	.5
PR-876 Bridge	12.9	.1	.3
PR-876 Bridge	12	.1	.3
PR-876 Bridge	11	.1	.3
PR-876 Bridge	10	.1	.3
PR-876 Bridge	9	.3	.5
PR-876 Bridge	8.5	Culvert	
PR-876 Bridge	8	.3	.5
PR-876 Bridge	7	.1	.3
PR-876 Bridge	6	.1	.3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.08
0
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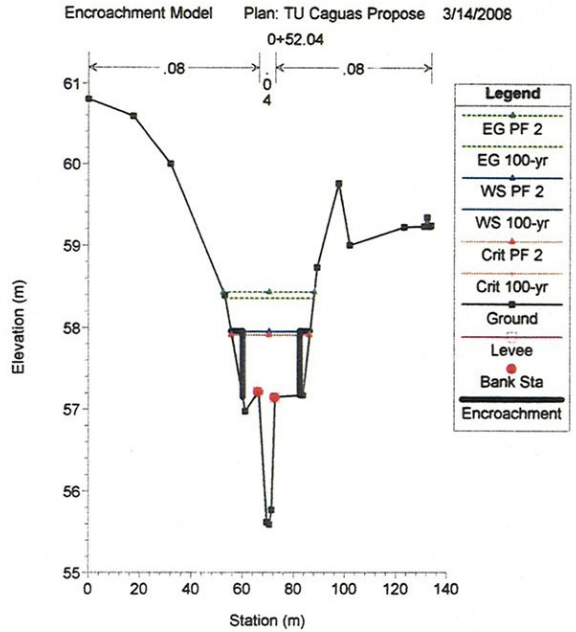
Legend
EG PF 2
EG 100-yr
WS PF 2
WS 100-yr
Ground
Bank Sta
Encroachment
Elevation (m)
Station (m)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Plan: TU Caguas Propose 3/14/2008
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4
Legend
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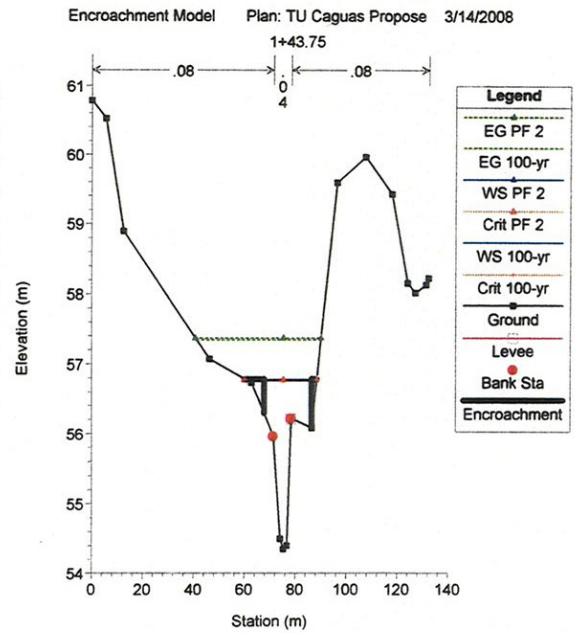
EG 100-yr
WS PF 2
WS 100-yr
Crit PF 2
Crit 100-yr
Ground
Levee
Bank Sta
Encroachment
Elevation (m)
Station (m)


Encroachment Model
Plan: TU Caguas Propose 3/14/2008
1+43.75
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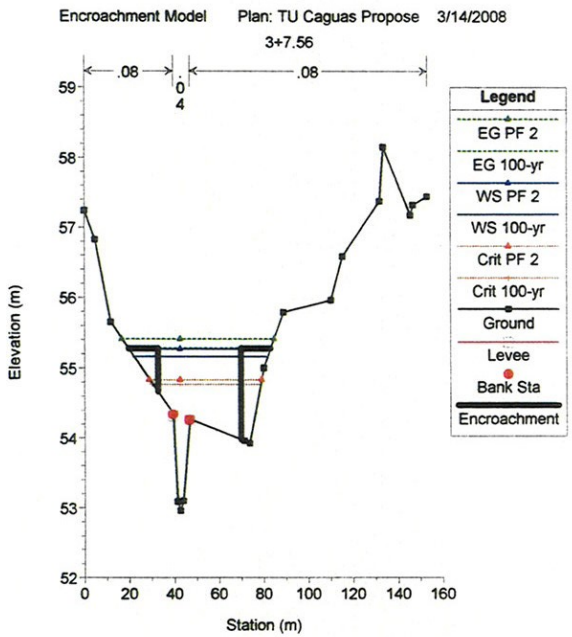
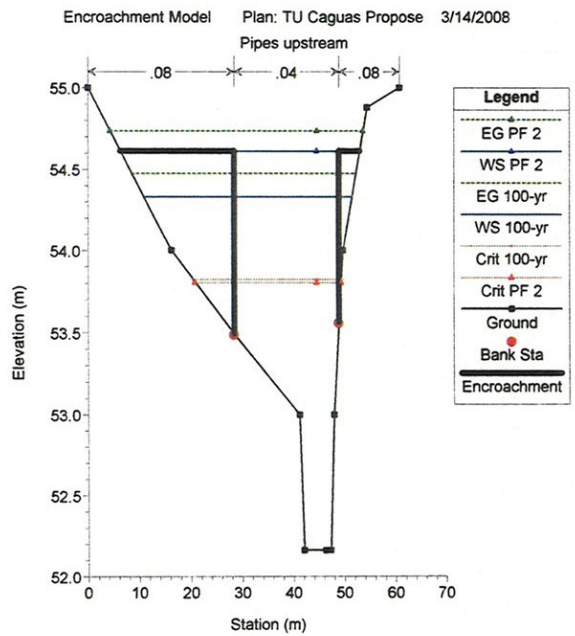
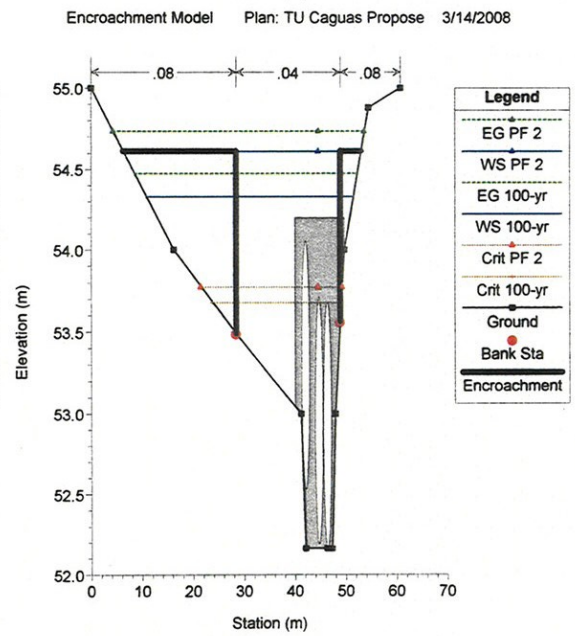
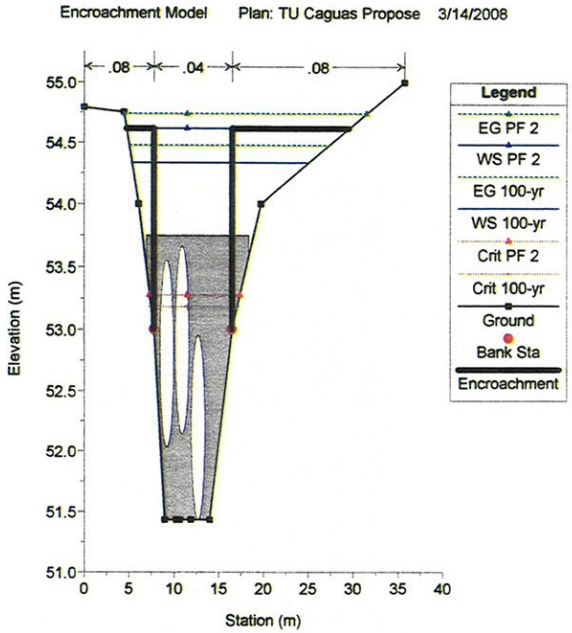
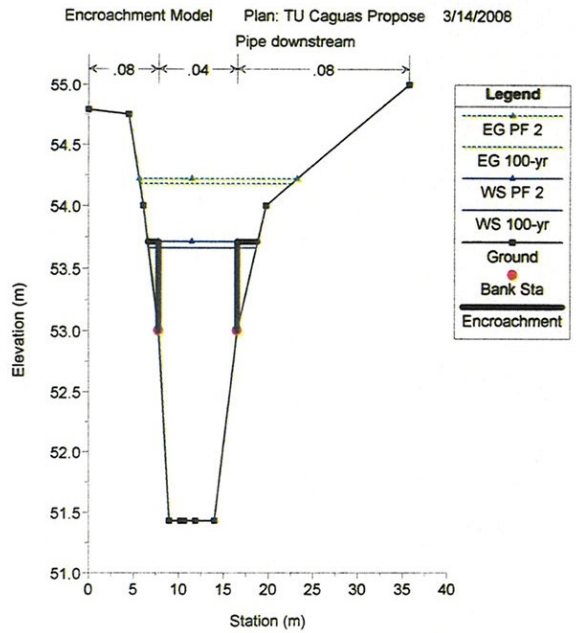
.08
0
4
Legend
EG PF 2
EG 100-yr
WS PF 2
Crit PF 2
WS 100-yr
Crit 100-yr
Ground
Levee
Bank Sta
Encroachment
Elevation (m)
Station (m)

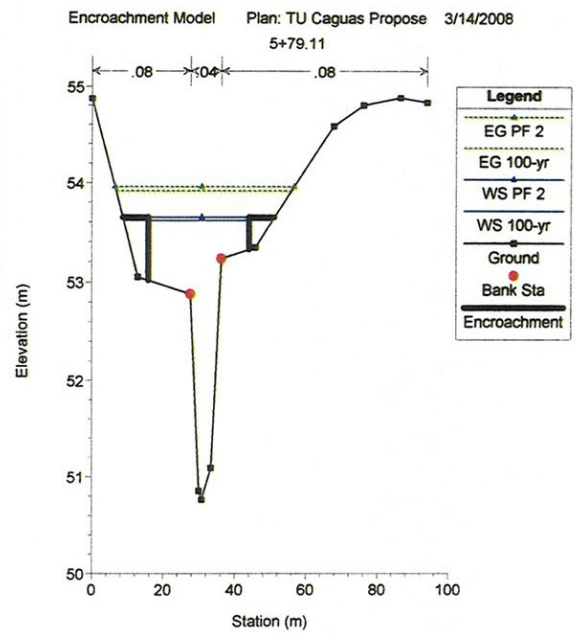

Encroachment Model
Plan: TU Caguas Propose 3/14/2008
3+7.56
.08
.08
0
4
Legend
EG PF 2
EG 100-yr
WS PF 2
WS 100-yr
Crit PF 2
Crit 100-yr
Ground
Levee
Bank Sta
Encroachment
Elevation (m)
Station (m)

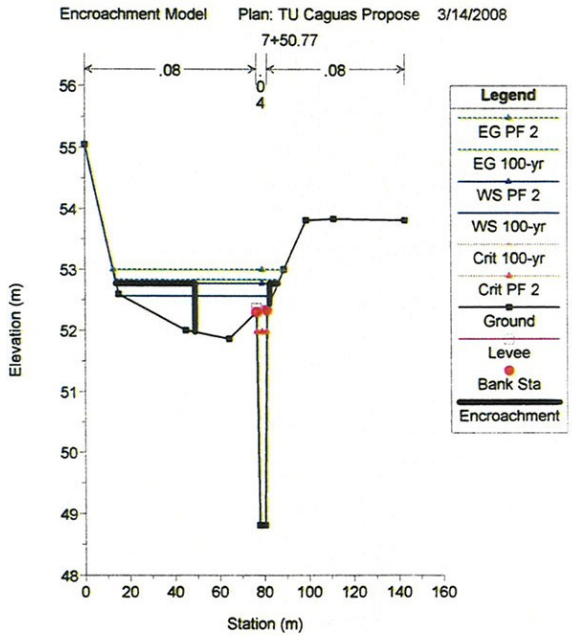

Encroachment Model
Plan: TU Caguas Propose 3/14/2008
Pipes upstream
.08
.04
.08
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Crit 100-yr
Crit PF 2
Ground
Bank Sta
Encroachment
Elevation (m)
Station (m)

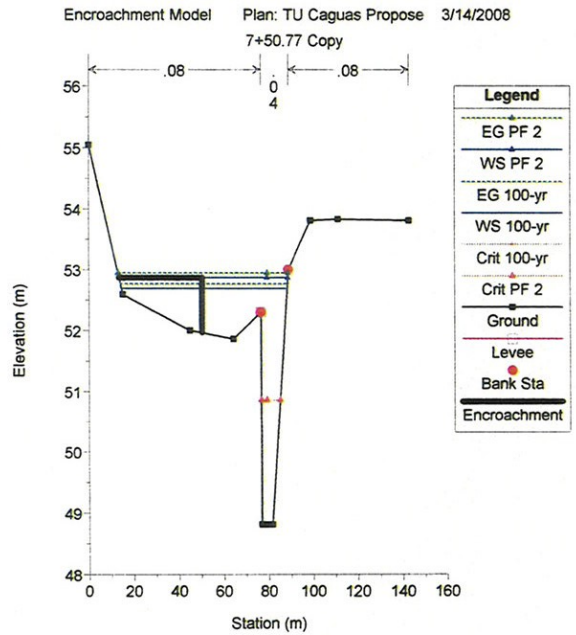

Encroachment Model
Plan: TU Caguas Propose 3/14/2008
.08
.04
.08
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Crit PF 2
Crit 100-yr
Ground
Bank Sta
Encroachment
Elevation (m)
Station (m)

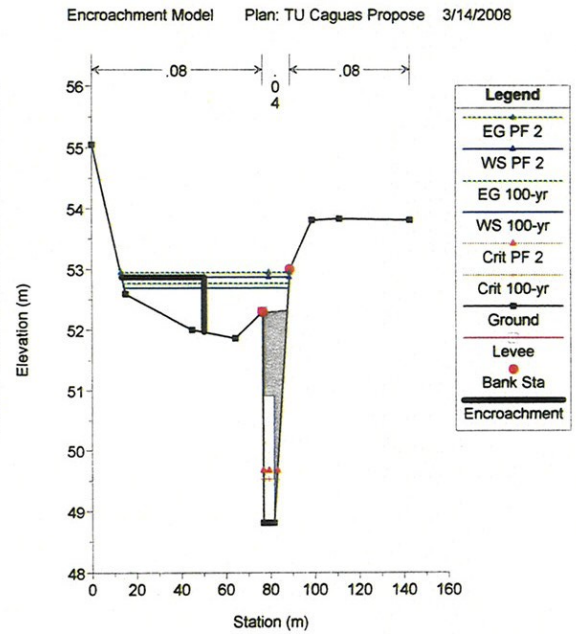

Encroachment Model Plan: TU Caguas Propose 3/14/2008
.08
.04
.08
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Crit PF 2
Crit 100-yr
Ground
Bank Sta
Encroachment
Elevation (m)
Station (m)

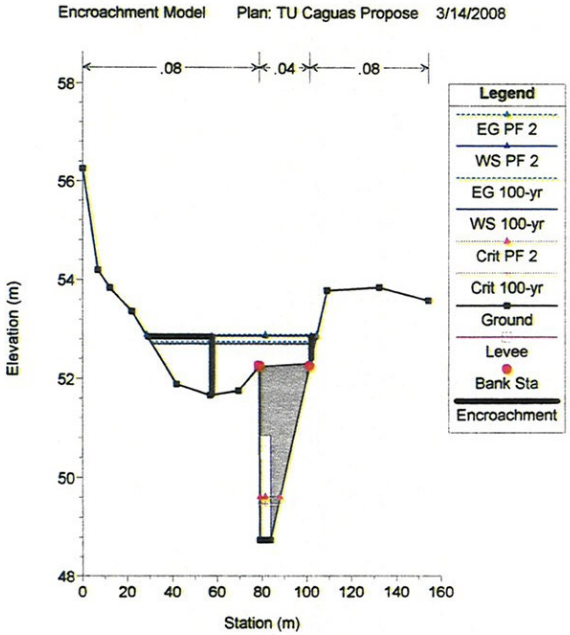

Encroachment Model Plan: TU Caguas Propose 3/14/2008
Pipe downstream
.08
.04
.08
Legend
EG PF 2
EG 100-yr
WS PF 2
WS 100-yr
Ground
Bank Sta
Encroachment
Elevation (m)
Station (m)

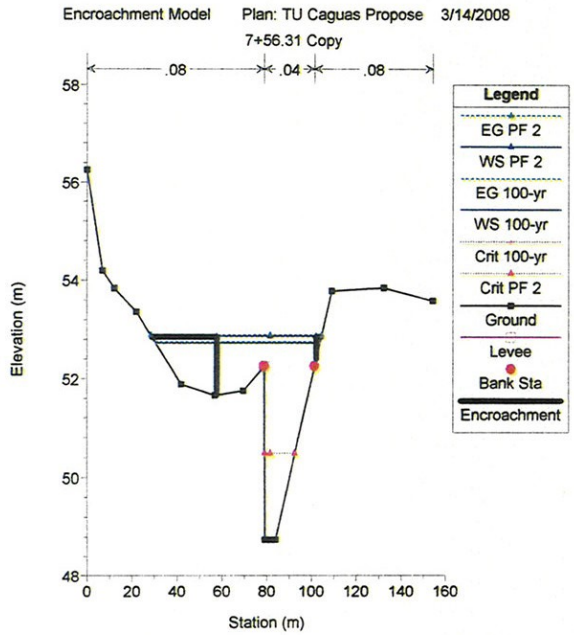

Encroachment Model Plan: TU Caguas Propose 3/14/2008
5+79.11
.08
.04
.08
Legend
EG PF 2
EG 100-yr
WS PF 2
WS 100-yr
Ground
Bank Sta
Encroachment
Elevation (m)
Station (m)

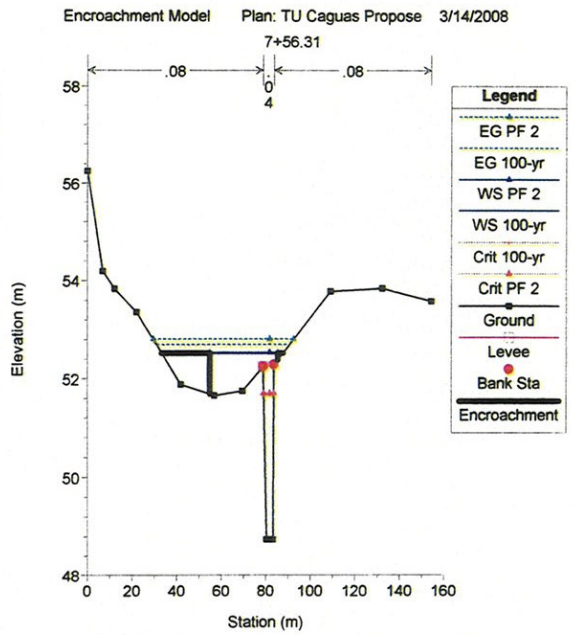

Encroachment Model Plan: TU Caguas Propose 3/14/2008
7+50.77
.08
.08
Legend
EG PF 2
EG 100-yr
WS PF 2
WS 100-yr
Crit 100-yr
Crit PF 2
Ground
Levee
Bank Sta
Encroachment
Elevation (m)
Station (m)

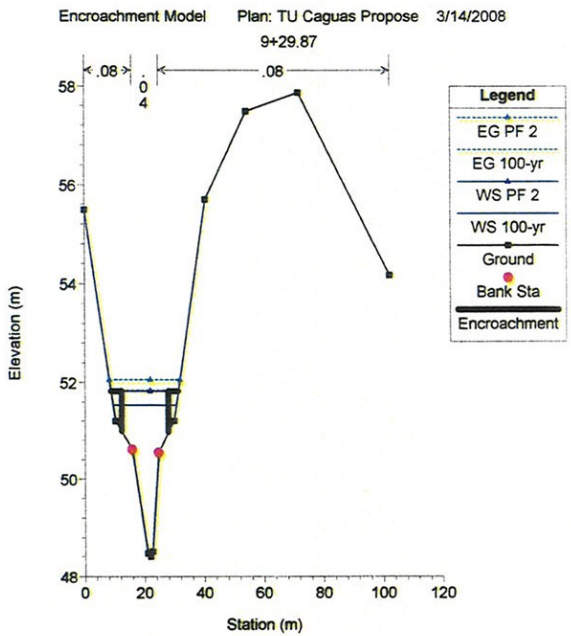

Encroachment Model Plan: TU Caguas Propose 3/14/2008
7+50.77 Copy
.08
.08
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Crit 100-yr
Crit PF 2
Ground
Levee
Bank Sta
Encroachment
Elevation (m)
Station (m)

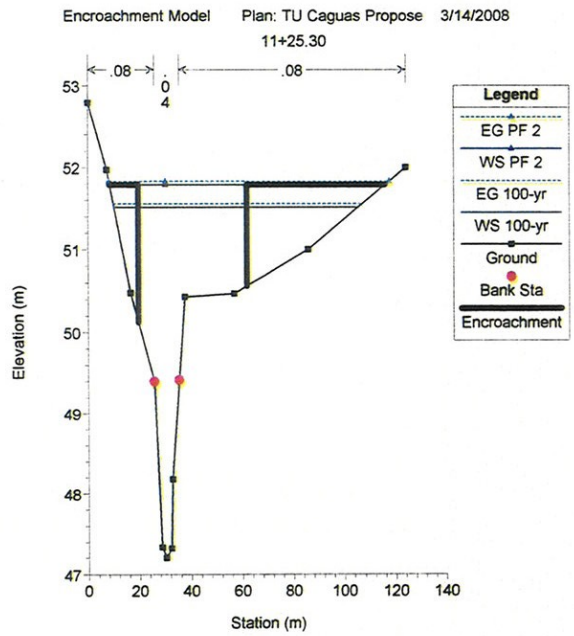

Encroachment Model Plan: TU Caguas Propose 3/14/2008
.08
.08
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Crit PF 2
Crit 100-yr
Ground
Levee
Bank Sta
Encroachment
Elevation (m)
Station (m)

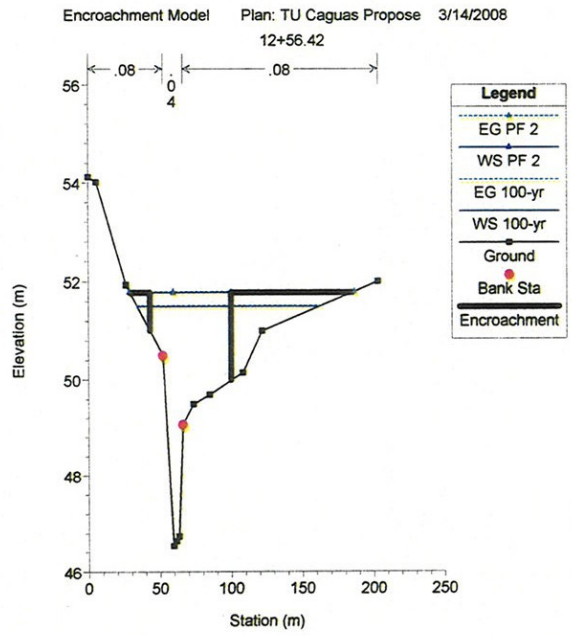

Encroachment Model Plan: TU Caguas Propose 3/14/2008
.08
.04
.08
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Crit PF 2
Crit 100-yr
Ground
Levee
Bank Sta
Encroachment
Elevation (m)
Station (m)


Encroachment Model Plan: TU Caguas Propose 3/14/2008
7+56.31 Copy
.08
.04
.08
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Crit 100-yr
Crit PF 2
Ground
Levee
Bank Sta
Encroachment
Elevation (m)
Station (m)


Encroachment Model Plan: TU Caguas Propose 3/14/2008
7+56.31
.08
.08
Legend
EG PF 2
EG 100-yr
WS PF 2
WS 100-yr
Crit 100-yr
Crit PF 2
Ground
Levee
Bank Sta
Encroachment
Elevation (m)
Station (m)


Encroachment Model Plan: TU Caguas Propose 3/14/2008
9+29.87
.08
.08
Legend
EG PF 2
EG 100-yr
WS PF 2
WS 100-yr
Ground
Bank Sta
Encroachment
Elevation (m)
Station (m)


Encroachment Model Plan: TU Caguas Propose 3/14/2008
11+25.30
.08
.08
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Ground
Bank Sta
Encroachment
Elevation (m)
Station (m)

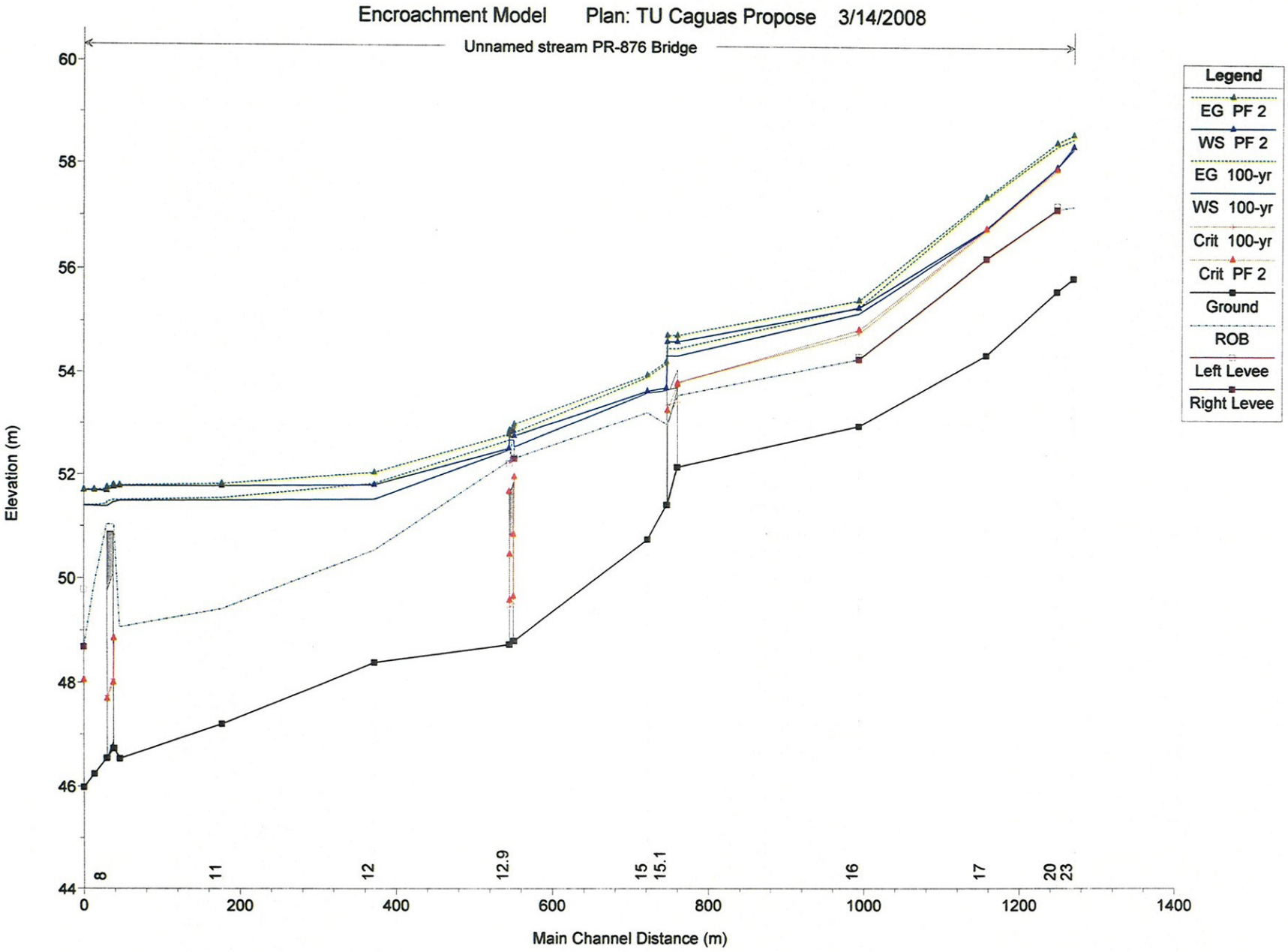

Encroachment Model Plan: TU Caguas Propose 3/14/2008
12+56.42
.08
.08
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Ground
Bank Sta
Encroachment
Elevation (m)
Station (m)

HEC-RAS Plan: TU Caguas Pr River: Unnamed stream Reach: PR-876 Bridge

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(m)	(m)	(m)	(m)	(m3/s)	(m3/s)	(m3/s)	(m)	(m)	(m)	(m)
PR-876 Bridge	23	100-yr	58.31		58.50	42.41	7.64	37.34	8.71		72.02	79.99	
PR-876 Bridge	23	PF 2	58.36	0.05	58.60	24.13	6.32	40.40	6.98	63.80	72.02	79.99	87.93
PR-876 Bridge	20	100-yr	57.95		58.36	30.89	6.96	36.96	9.78		66.44	72.75	
PR-876 Bridge	20	PF 2	57.95	0.00	58.44	22.29	6.06	39.20	8.44	60.18	66.44	72.75	82.47
PR-876 Bridge	17	100-yr	56.77		57.35	27.47	2.42	46.07	5.20		71.35	78.35	
PR-876 Bridge	17	PF 2	56.78	0.02	57.38	18.73	2.21	46.68	4.81	67.71	71.35	78.35	86.44
PR-876 Bridge	16	100-yr	55.17		55.29	59.95	3.01	26.14	24.54		39.48	46.93	
PR-876 Bridge	16	PF 2	55.28	0.11	55.42	37.18	3.14	29.05	21.51	32.73	39.48	46.93	69.91
PR-876 Bridge	15.9	100-yr	54.33		54.48	40.69	3.41	50.07	0.22		28.44	48.93	
PR-876 Bridge	15.9	PF 2	54.61	0.28	54.74	20.49		53.70		28.44	28.44	48.93	48.93
PR-876 Bridge	15.5		Culvert										
PR-876 Bridge	15.1	100-yr	53.66		54.18	11.98	0.18	53.15	0.37		7.79	16.53	
PR-876 Bridge	15.1	PF 2	53.71	0.05	54.22	8.74		53.70		7.79	7.79	16.53	16.53
PR-876 Bridge	15	100-yr	53.61		53.91	41.75	6.70	45.59	1.41		27.67	36.23	
PR-876 Bridge	15	PF 2	53.64	0.03	53.96	28.27	5.72	46.67	1.31	15.75	27.67	36.23	44.03
PR-876 Bridge	14.1	100-yr	52.56		52.83	67.18	16.17	37.46	0.07		76.56	81.31	
PR-876 Bridge	14.1	PF 2	52.77	0.21	52.99	33.38	16.95	36.57	0.18	49.03	76.56	81.31	82.42
PR-876 Bridge	14	100-yr	52.69		52.77	73.90	9.79	43.91			76.56	88.81	
PR-876 Bridge	14	PF 2	52.87	0.18	52.95	38.30	8.41	45.29		50.28	76.56	88.81	94.67
PR-876 Bridge	13.5		Culvert										
PR-876 Bridge	13	100-yr	52.71		52.74	72.92	7.55	46.11	0.05		78.92	101.38	
PR-876 Bridge	13	PF 2	52.85	0.14	52.88	44.38	4.71	48.94	0.04	57.75	78.92	101.38	102.13
PR-876 Bridge	12.9	100-yr	52.49		52.69	53.72	18.78	34.84	0.08		78.92	83.76	
PR-876 Bridge	12.9	PF 2	52.52	0.03	52.80	30.45	13.67	39.92	0.10	54.93	78.92	83.76	85.38
PR-876 Bridge	12	100-yr	51.53		51.84	21.13	2.06	49.65	2.00		15.87	24.71	
PR-876 Bridge	12	PF 2	51.81	0.28	52.05	15.69	2.15	49.51	2.03	12.27	15.87	24.71	27.95
PR-876 Bridge	11	100-yr	51.51		51.56	95.24	5.20	37.31	11.20		25.80	35.42	
PR-876 Bridge	11	PF 2	51.79	0.28	51.83	42.27	4.21	38.89	10.60	19.60	25.80	35.42	61.88

HEC-RAS Plan: TU Caguas Pr River: Unnamed stream Reach: PR-876 Bridge (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(m)	(m)	(m)	(m)	(m3/s)	(m3/s)	(m3/s)	(m)	(m)	(m)	(m)
PR-876 Bridge	10	100-yr	51.49		51.51	127.93	0.93	36.57	16.20		52.19	66.25	
PR-876 Bridge	10	PF 2	51.78	0.29	51.80	56.95	1.29	35.78	16.63	43.11	52.19	66.25	100.06
PR-876 Bridge	9	100-yr	51.47		51.51	95.47	0.02	48.59	5.09		46.72	69.40	
PR-876 Bridge	9	PF 2	51.76	0.29	51.79	45.79	0.02	49.79	3.89	46.26	46.72	69.40	92.05
PR-876 Bridge	8.5		Culvert										
PR-876 Bridge	8	100-yr	51.39		51.43	89.07	0.00	49.74	3.96		46.72	69.40	
PR-876 Bridge	8	PF 2	51.69	0.30	51.72	45.79	0.02	50.25	3.43	46.26	46.72	69.40	92.05
PR-876 Bridge	7	100-yr	51.40		51.41	118.60	1.11	48.09	4.50		61.58	92.05	
PR-876 Bridge	7	PF 2	51.70	0.30	51.71	63.88	1.31	46.90	5.50	55.06	61.58	92.05	118.93
PR-876 Bridge	6	100-yr	51.40		51.41	175.65	3.28	24.26	26.16		67.85	78.15	
PR-876 Bridge	6	PF 2	51.70	0.30	51.71	82.79	4.05	22.98	26.67	44.99	67.85	78.15	127.78


Encroachment Model Plan: TU Caguas Propose 3/14/2008
Unnamed stream PR-876 Bridge
Legend
EG PF 2
WS PF 2
EG 100-yr
WS 100-yr
Crit 100-yr
Crit PF 2
Ground
ROB
Left Levee
Right Levee
Elevation (m)
Main Channel Distance (m)
60
58
56
54
52
50
48
46
44
0
200
400
600
800
1000
1200
1400
8
11
12
12.9
15
15.1
16
17
20
23