Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	11	10	1258	6	1	1518
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	11	10	1258	6	1	1518
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	0					
Upstream signal (m)			152			
pX, platoon unblocked	0.70	0.70			0.70	
vC, conflicting volume	2022	632			1264	
vC1, stage 1 conf vol	1261					
vC2, stage 2 conf vol	761					
vCu, unblocked vol	2032	37			944	
tC, single (s)	*6.1	*6.1			*4.5	
tC, 2 stage (s)	5.1					
tF (s)	*3.2	*3.2			*3.0	
p0 queue free %	93	99			100	
cM capacity (veh/h)	148	748			371	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	11	10	839	425	507	1012
Volume Left	11	0	0	0	1	0
Volume Right	0	10	0	6	0	0
cSH	148	748	1700	1700	371	1700
Volume to Capacity	0.07	0.01	0.49	0.25	0.00	0.60
Queue Length 95th (m)	1.8	0.3	0.0	0.0	0.1	0.0
Control Delay (s)	31.2	9.9	0.0	0.0	0.1	0.0
Lane LOS	D	A			A	
Approach Delay (s)	21.1		0.0		0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	52.7%	ICU Level of Service	A
Analysis Period (min)	15		

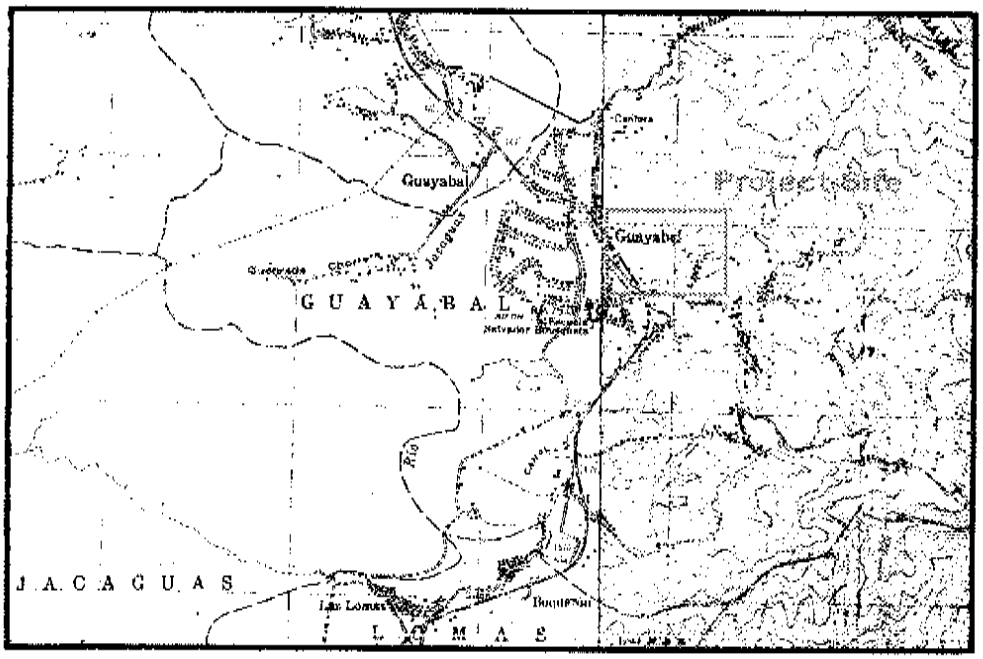
* User Entered Value

APÉNDICE 11 – Propuesta Hidrológica – Informe Científico de Vernon [illegible]

Propuesto

CANARICO QUARRIES, INC.
JUANA DÍAZ, PUERTO RICO

HYDROLOGIC-HYDRAULIC ANALYSIS FOR A BRIDGE ON ACCESS ROAD TO CANARICO QUARRIES JUANA DIAZ, PUERTO RICO



MAY 2008

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HYDROLOGIC-HYDRAULIC ANALYSIS FOR A BRIDGE ON ACCESS ROAD TO CANARICO QUARRIES JUANA DIAZ, PUERTO RICO

Casiano Ancalle, P.E.

May, 2008

I. INTRODUCTION

The project consists in the construction of a new road that will connect Canarico Quarries with State Road PR-149. in Guayabal Ward of Municipality of Juana Díaz. This new road, as proposed, will cross a watercourse by means of a bridge, few meters before its connection with the road PR-149. The segment of the watercourse where the bridge is located is the subject of this Hydrologic & Hydraulic Analysis.

According to the regulatory FEMA flood map, the project area is not located in floodable area.

Purpose of Study

The purpose of the study is to determinate the impact of the proposed bridge abutments on the 100-year flood water elevations of the watercourse. The proposed structure must not increase the water levels above those allowed by the Puerto Rico Planning Board Regulation No. 13

Approach

The following steps have been undertaken throughout the study:

Hydrologic Analysis: A hydrologic analysis of the watercourse drainage basin was made. The following parameters were determined for the hydrologic analysis: drainage areas, average soil curve number and runoff lag time. Based on these parameters, discharge for 100-years frequency storm was determined for existing conditions. More recurrent storm frequencies were also determined. HEC-1 model was used.

Hydraulic Analysis: A hydraulic analysis of the watercourse was made in order to determine the water surface elevations. The mathematical model HEC-RAS from the US Corps of Engineers was used.

Conclusions and recommendations were elaborated.

Authorization

Eng. Moisés Rivera on behalf of the owner authorized this study under a contract signed with CA Engineering, PSC, represented by its president, Casiano Ancalle.

II. PROJECT BACKGROUND

Location

The project site is located adjacent to state road PR-149, at Km 63.6, in the Municipality of Juana Diaz. Figure 1 shows the location of the site in the USGS quadrangle.

Topography

The general topography of the watershed conveying runoff to the project site is steep, slopes ranges from 12 to 60 percent, with elevations ranging from 72m at project site to 600m at *Cerro de las Cuevas*. The project site is located at the toe of the steeped slope topography of the watershed. Figure 2 shows the existing topography of the project area.

Water Bodies

The watercourse mentioned above is the only water body related to this study. Runoff captured in its 1,358-acre drainage basin flows through the bridge site.

Flooding

According to FEMA Flood map, Sheet C1680H and C1660H dated April 19 of 2005; the project site is located in Zone X, outside of the 100-year floodplain. See Figure 6.

Field Work

Field data used in this study was taken from the drawings provided by the owner. The topographic information found in the drawings was made by surveyor Julio C. Soto Serrano. This information was used for the hydraulic modeling. Results obtained in this study are strictly based on this information. Fieldwork is attached in a pocket at the end of this study as Appendix E.

Former Studies

No hydrologic-hydraulic studies for the area of the project have been found during the information research. This study is original in its conception, and the results found correspond to the parameters adopted during the hydrologic and hydraulic simulation.

Study Level

This study is intended as an aid to the design engineer in the preparation of the construction drawings for the recommended structures. Figures, schematics and drawings must not be used as construction drawings. The design engineer must elaborate the construction drawings in agreement with the recommendations of this study.

III. HYDROLOGIC ANALYSIS

Methodology

The computer program entitled Flood Hydrograph Package (HEC-1) developed by the U.S. Army Corps of Engineers [1990] was used for the hydrologic analysis. Using this program, the Unit Hydrograph method and the Runoff Curve Number (CN) method, both developed by the Soil Conservation Service (SCS), were applied to determine the design hydrograph. This was computed by a process of translating the rainfall excess into a runoff hydrograph known as convolution.

Peak discharges ranging in frequencies from 2, 10-, 25-, 50- and 100-year were estimated for the existing condition.

Drainage Areas and Runoff Pattern

The watershed for the bridge site has been delineated in the USGS quadrangle, and it was estimated to be of 1,358.41 acres. See Figure 3.

Curve Numbers

Curve numbers were computed using the NRCS methodology. Soil types and land uses were obtained from the SCS [1978] soil maps. According to the Soil Survey of the Ponce Area of Puerto Rico, the soil of the watershed was classified as Aguilita stony clay loam (**AhF**) (20 to 60% slopes), Quebrada silty clay loam (**QeF2**) (40 to 60% slopes), Aguilita gravelly clay loam (**AgF**)(20 to 60% slopes), Callabo silty clay loam (**CoF2**) (40 to 60% slopes), Quebrada silty clay loam (**QU**), Morada clay loam (**MtE2**) (20 to 40% slopes), Mucara silty clay (**MuE2**) (20 to 40% slopes), Montegarnde clay (**MsC**) (2 to 12% slopes), Toa silty clay loam (To), Caguabo gravelly clay loam (**CbF2**) (20 to 60 % slopes), Callabo silty clay loam (CoE) (20 to 40% slopes). All these belong to the Hydrologic Soil Group "B","C" and "D". A weighted curve number value for these soils was estimated based on an Antecedent Moisture Condition II (AMC II).

Appendix A shows the physiographic characteristics of the watershed and the weighted Curve Number (CN) estimations. Figure 5 shows the portion of the soil map corresponding to the watershed and project area.

Lag Time

The Lag Time (T_{Lag}) was estimated using the SCS method defined as:

$$T_{Lag} = \frac{L^{0.8}(S+1)^{0.7}}{1900\ Y^{0.5}}$$

where :

L	=	channel length (ft)
S	=	1000/CN - 10
Y	=	average watershed slope

Detailed Lag Time calculation is shown in Appendix A.

Rainfall Data

The variation of rainfall volume with time was required as part of the storm input for the SCS Curve Number method. Therefore, the development of a design storm with a given rainfall frequency and duration was necessary to compute the design hydrograph for the watershed. Rainfall data used in this study was obtained from NOAA's National Weather Service Atlas 14.

A rainfall event of 2-, 10-, 25, 50 and 100-years frequency for several durations was used and is shown in Table 1. Rainfall for 5 and 15 minutes was estimated by regression analysis. Details of these calculations are shown in Appendix A.

Table 1
Rainfall for 2, 10, 25, 50 y 100 years

Duration *Hrs.*	**Precipitation** *Inches*				
	2-yr	***10-yr***	***25-yr***	***50-yr***	***100-yr***
0.083	0.50	0.71	0.80	0.87	0.93
0.25	0.88	1.24	1.40	1.52	1.64
1	2.09	2.94	3.33	3.61	3.90
2	2.53	3.90	4.56	5.07	5.57
3	2.76	4.37	5.21	5.85	6.51
6	3.32	5.69	7.03	8.09	9.21
12	3.81	7.17	9.32	11.12	13.08
24	4.52	9.05	12.05	14.61	17.43

Depth-Area Adjustment

Point rainfall estimates obtained from NOAA's National Weather Service, ATLAS 14 represent values for areas up to 10 mi^2; therefore, a depth-area adjustment should be applied to the rainfall data when the watershed area is greater. In this case, the watershed consists of 2.123 mi^2. Hence, this adjustment was not applied.

Time Distribution of Rainfall

The triangular type methodology was used to distribute the rainfall depth in time. This method is considered acceptable for small areas.

Rainfall Extraction

Rainfall extraction such as the vegetative interception, the depressional storage, and the infiltration were estimated using the SCS's Runoff Curve Number method. Though this method is used to predict

runoff volume directly, the rainfall extraction is incorporated in the model as function of the curve number of the watershed.

Hydrologic Results

Following HEC-1 methodology, peak discharges were determined from the hydrographs developed for the watershed. Input and output data for the HEC-1 model are included in Appendix B. Table 2 shows the results of the hydrologic runs.

Table 2

Peak Discharges

Area	Peak Discharge, cfs				
	2-yr	*10-yr*	*25-yr*	*50-yr*	*100-yr*
E1	1,848	3,356	4,034	4,510	4,977

IV. HYDRAULIC ANALYSIS

A hydraulic analysis has been performed in order to determine the impact to the 100-year water surface elevations from the construction of the bridge, and also the related hydraulic parameters.

The hydraulic analysis was made using the mathematical model HEC-RAS developed by the US Corps of Engineers. For this model, the hydraulic regime is steady, uniform, and one-dimensional. The model accepts changes in the geometry of the watercourse, bank-bed-overbank friction coefficient and shapes of hydraulic structures.

The friction coefficient used in the modeling was obtained from visual inspection of the watercourses bed and banks; and crosschecked with the typical values provided by Barnes (1967) and Chow (1959).

Cross sections for the watercourse were taken from the fieldwork provided. This fieldwork is shown in Appendix E. Figure 7 depicts the location of the cross sections.

Roughness

Manning coefficients estimated for the watercourse are 0.055 for the channel and 0.065 for overbanks. These values reflect the changes in direction and the irregular shape of the channel bed, and the vegetation present in the courses.

Contraction and Expansion Coefficients

Coefficients of contraction and expansion used are those recommended by the HEC-RAS user's manual. Thus, coefficients of 0.1 and 0.3 respectively were used for gradual transitions.

Starting Water Surface Elevation

Since flow regime in the segment of study is both: subcritical and supercritical, two starting water elevations were considered for the hydraulic analysis: The elevation resulting from the slope area method for the subcritical run and critical depth for the supercritical run.

Existing Condition

The existing condition corresponds to the watercourse as it is presently. The existing condition run was performed using the cross sections provided by the survey work. Location of cross sections for this hydraulic run is shown in Figure 7.

The hydraulic analysis was based on the discharges obtained on the hydrologic analysis. Flow regime at the segment analyzed is mixed: subcritical at most of the segments of the watercourse and supercritical at some.

The computer output for the existing condition is included in Appendix C. The following Table 3 includes the summary of the results for 100-year discharge.

Table 3

Results for 100-year Discharge, Existing Condition

HEC-RAS Plan: **Exist.** River: WATERCOURSE Reach: 1 Profile: 100 YRS.

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)	
1	6	100 YRS.	140.93	72.82	76.43	75.29	76.55	0.00288	1.55	91.1	43.72	0.34
1	5	100 YRS.	140.93	72.68	76.41		76.54	0.003036	1.58	89.29	42.88	0.35
1	4.5	100 YRS.	140.93	72.55	76.29		76.48	0.004881	1.92	73.45	37.11	0.44
1	4	100 YRS.	140.93	72.36	76.2		76.4	0.004197	2	70.47	30.53	0.42
1	3	100 YRS.	140.93	72.29	75.38	75.28	76.25	0.024121	4.14	34.01	17.22	0.94
1	2	100 YRS.	140.93	72.19	75.13	75.13	75.81	0.028329	3.67	38.45	28.62	1.01
1	1	100 YRS.	140.93	72.08	75.14	74.5	75.35	0.007006	2.03	69.71	45.45	0.52

The results indicate that the water surface elevations for the 100 yrs. discharge remain within the watercourse channel.

Proposed Condition

The proposed condition incorporates and skewed bridge. The angle of skew will be about 50 degrees referred to the Road center line. Several geometry alternatives for the bridge were tried; considering hydraulic efficiency, economics and compliance with applicable Regulations. The trials resulted in 15-meter span.

The computer output for the existing condition is included in Appendix D. The following Table 4 includes the summary of the results for 100-year discharge.

Table 4

Results for 100-year Discharge, Proposed Condition

HEC-RAS Plan: Prop. River: WATERCOURSE Reach: 1 Profile: 100 YRS.

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)	
1	6	100 YRS.	140.93	72.82	76.71	75.29	76.81	0.00194	1.36	103.51	44.61	0.29
1	5	100 YRS.	140.93	72.68	76.7	75.29	76.8	0.001066	1.38	101.89	43.73	0.29
1	4.5		*Bridge*									
1	4	100 YRS.	140.93	72.36	76.24		76.36	0.001248	1.53	92.29	39.53	0.32
1	3	100 YRS.	140.93	72.29	75.38	75.28	76.25	0.024121	4.14	34.01	17.22	0.94
1	2	100 YRS.	140.93	72.19	75.13	75.13	75.81	0.028329	3.67	38.45	28.62	1.01
1	1	100 YRS.	140.93	72.08	75.14	74.5	75.35	0.007006	2.03	69.71	45.45	0.52

The resulting water surface elevations for the proposed condition were increased at sections 5 and 6 by 0.30 meters, but still are in compliance with the Puerto Rico Planning Board Regulation No. 13. The following Table 5 includes the water elevations comparison.

Table 5

100-year Discharge

Water Elevation Comparison

HEC-RAS River: WATERCOURSE Reach: 1 Profile: 100 YRS.

Reach	River Sta	Profile	Plan	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)	
1	6	100 YRS.	Prop.	140.93	72.82	76.71	75.29	76.81	0.00194	1.36	103.51	44.61	0.29
1	6	100 YRS.	Exist.	140.93	72.82	76.41	75.29	76.54	0.00297	1.56	90.2	43.65	0.35
1	5	100 YRS.	Prop.	140.93	72.68	76.7	75.29	76.8	0.001066	1.38	101.89	43.73	0.29
1	5	100 YRS.	Exist.	140.93	72.68	76.39		76.52	0.003135	1.59	88.37	42.82	0.35
1	4.5			Bridge									
1	4.5	100 YRS.	Exist.	140.93	72.55	76.27		76.46	0.005064	1.94	72.48	37.03	0.44
1	4	100 YRS.	Prop.	140.93	72.36	76.24		76.36	0.001248	1.53	92.29	39.53	0.32
1	4	100 YRS.	Exist.	140.93	72.36	76.26		76.38	0.002295	1.51	93.21	39.69	0.31
1	3	100 YRS.	Prop.	140.93	72.29	75.38	75.28	76.25	0.024121	4.14	34.01	17.22	0.94
1	3	100 YRS.	Exist.	140.93	72.29	75.38	75.28	76.25	0.024121	4.14	34.01	17.22	0.94
1	2	100 YRS.	Prop.	140.93	72.19	75.13	75.13	75.81	0.028329	3.67	38.45	28.62	1.01
1	2	100 YRS.	Exist.	140.93	72.19	75.13	75.13	75.81	0.028329	3.67	38.45	28.62	1.01
1	1	100 YRS.	Prop.	140.93	72.08	75.14	74.5	75.35	0.007006	2.03	69.71	45.45	0.52
1	1	100 YRS.	Exist.	140.93	72.08	75.14	74.5	75.35	0.007006	2.03	69.71	45.45	0.52

Bank and Bed Protection

The water velocities at the watercourse segment studied range between 1.37 to 4.14 meters per second. Velocities equal or higher than three (3) meter per second are of concern. The average velocity at the segment within the bridge area it is about 1.6 meters per second. The potential of erosion due to this velocity is low. However, protection with Reno Mattress is recommended to cover the channel bed at the segment of the abutments. See Figure 8 for details.

VI. CONCLUSIONS AND RECOMMENDATIONS

The following are the conclusions of this study:

1. Results indicate that the area considered in this study is not flooded during the 100-year discharge within the watercourse drainage basin.

2. The proposed 15 meter span bridge does not increment the 100-year water surface elevations of the watercourse above the maximum indicated in the PR Planning Board Regulation No. 13.

3. The flow velocity in the watercourse channel within the bridge area it is about 1.6 meters per second. The potential of erosion due to this velocity is low.

The following are the recommendations of this study:

1. The proposed bridge must be located at the stations indicated in this report. Any change of location will require a reevaluation of this study.

2. Protection of the bridge abutments will be provided as shown in Figure 8

3. The minimum clearance between the 100-year water surface elevation and the bridge low cord will be .60 meters.

Study Limits

All the recommendations specified in this study must be considered to assure the optimum performance of the proposed structures. The design engineer will be responsible for elaborating the drawings in conformance with the recommendations of this study.

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CERTIFICATION
HYDROLOGIC-HYDRAULIC STUDY

I hereby certify that the document "***Hydrologic and Hydraulic Study for Bridge on Access Road to Canarico Quarries in Juana Díaz, 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, May 27, 2008

Casiano Ancalle, P.E.
Lic. 11294

Estado Libre Asociado de Puerto Rico

Departamento de Estado

Secretaría Auxiliar de Juntas Examinadoras

certificamos que:

Casiano Ancalle Choque

esta autorizado a ejercer como

Ingeniero Licenciado

en Puerto Rico

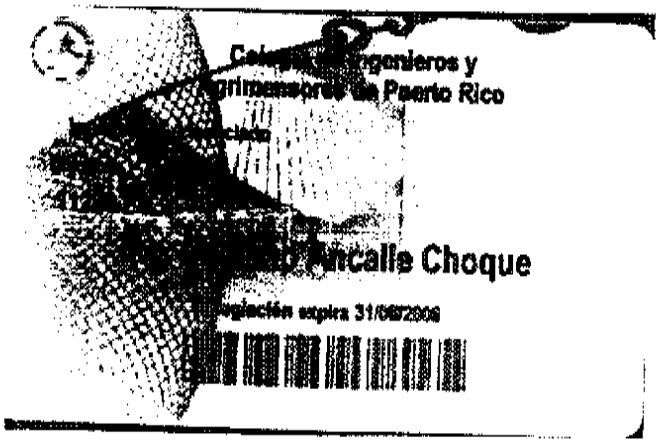
Licencia Num: **11294**

Expedición: **23 de abril de 2005**

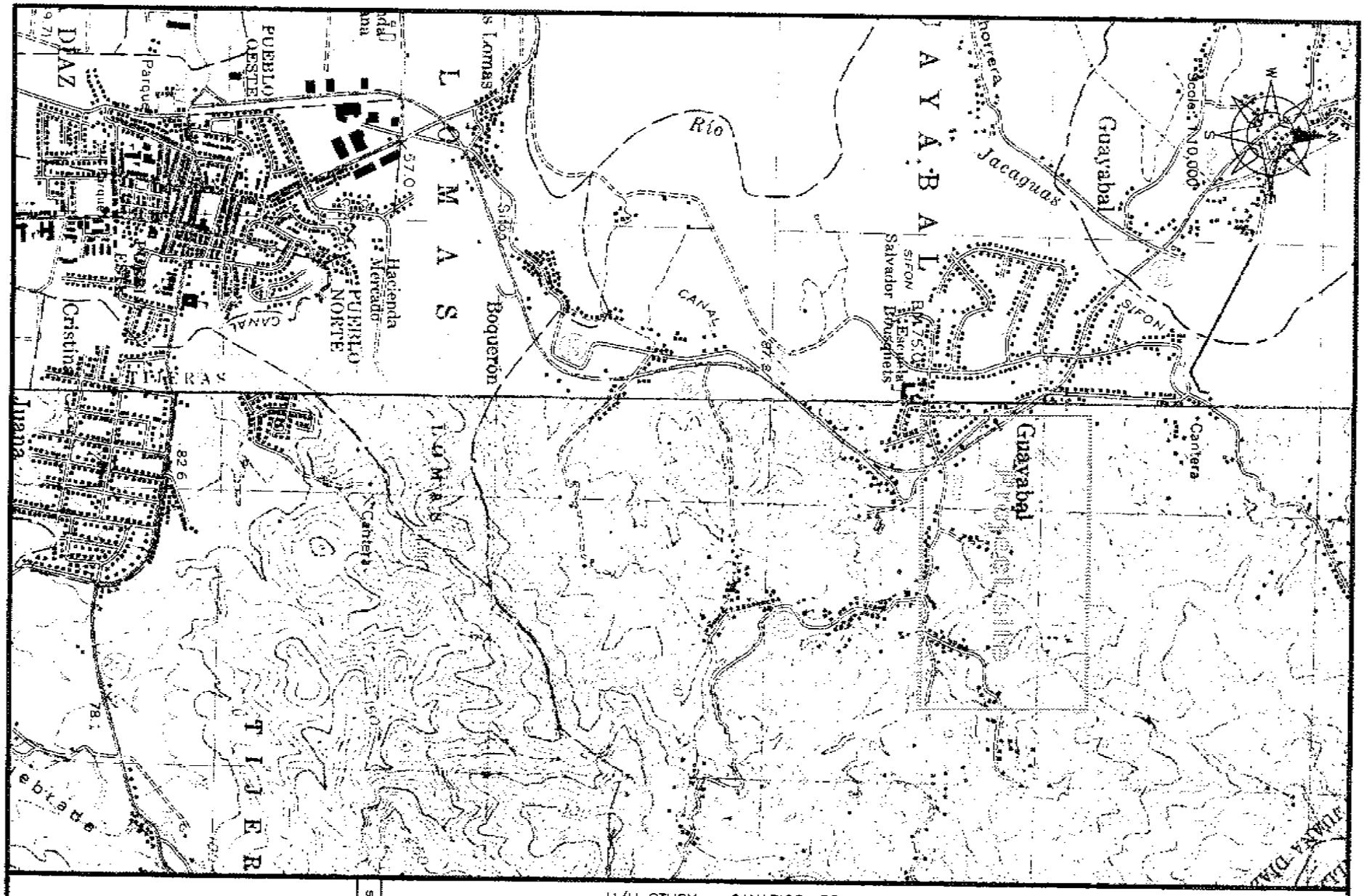
Expiración: **22 de abril de 2010**

Secretario Auxiliar

Presidente de la Junta



FIGURES



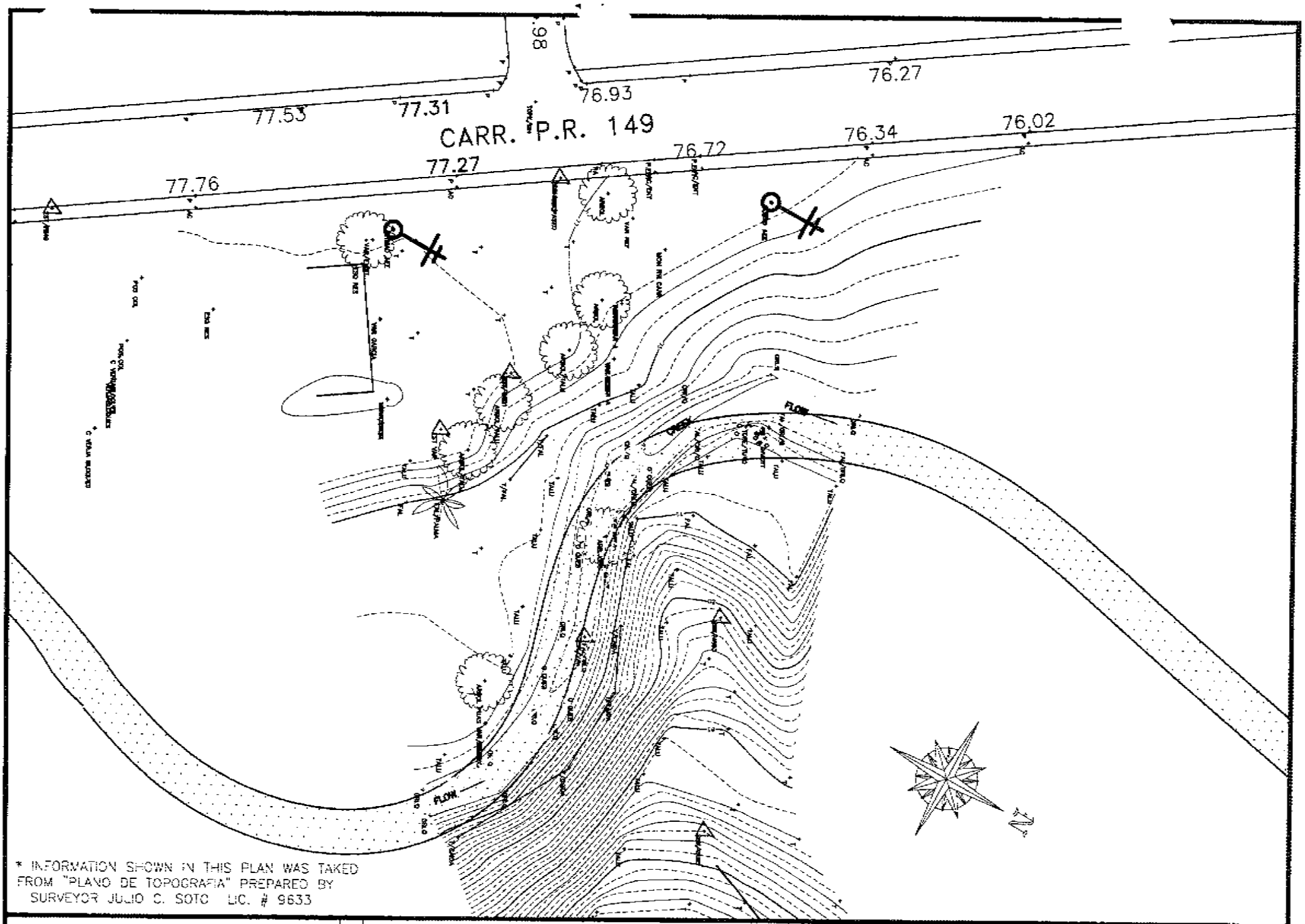
CA Engineering, PSC

Scale: 1:10,000

H/H STUDY – CANARICO, PR-149 Km. 63.6, JUANA DIAZ, PR

Figure 1

LOCATION MAP



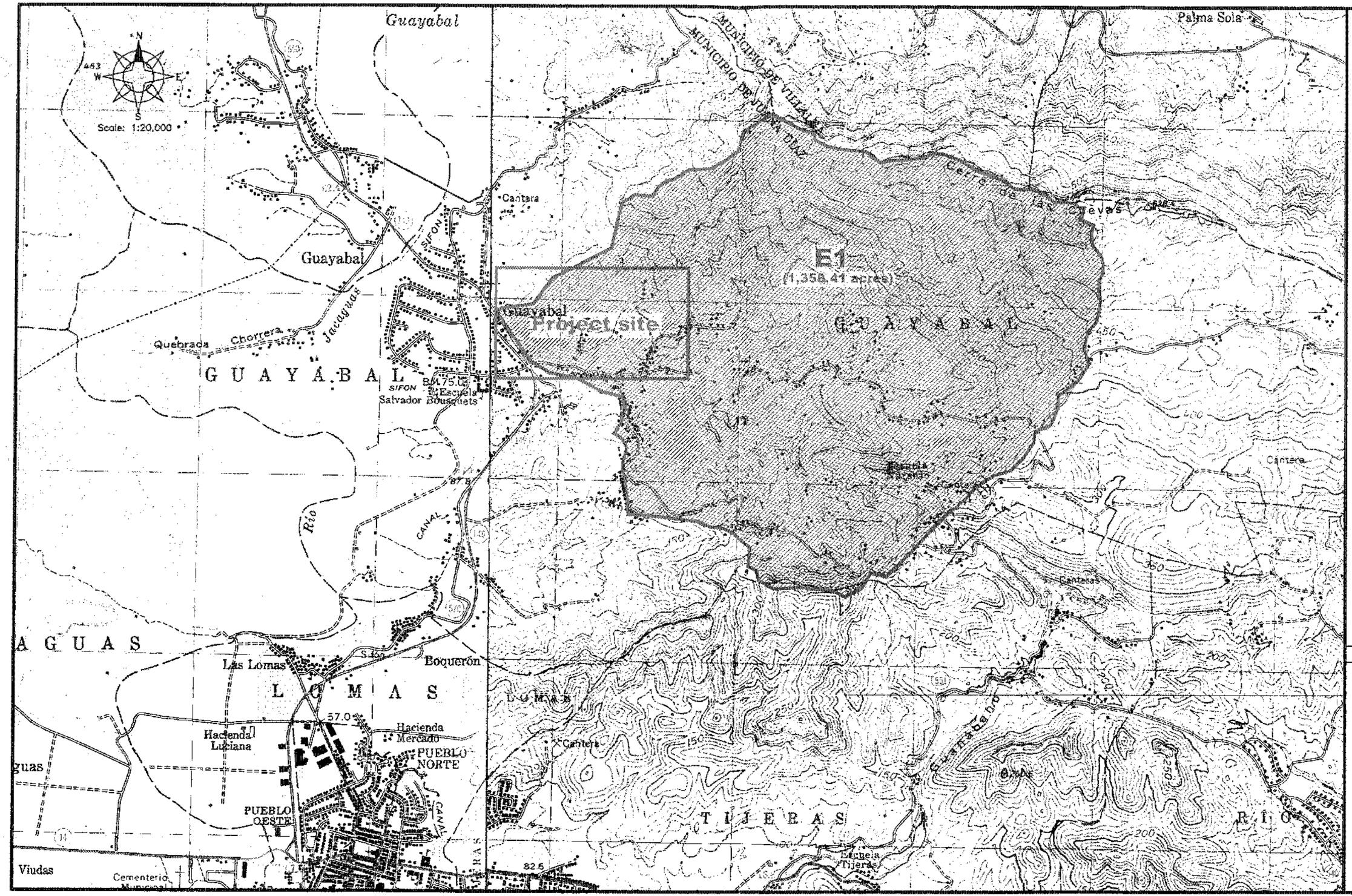
CA Engineering PSC

Scale: 1:500

H/H STUDY – CANARICO, PR-149 KM. 63.6, JUANA DIAZ, PR

Figure 2

TOPOGRAPHIC SITE PLAN



H/H STUDY – CANARICO, PR-149 KM 63.6 ,JUANA DIAZ, PR

Figure 3
EXISTING WATERSHED LIMIT

Scale: 1:20,000

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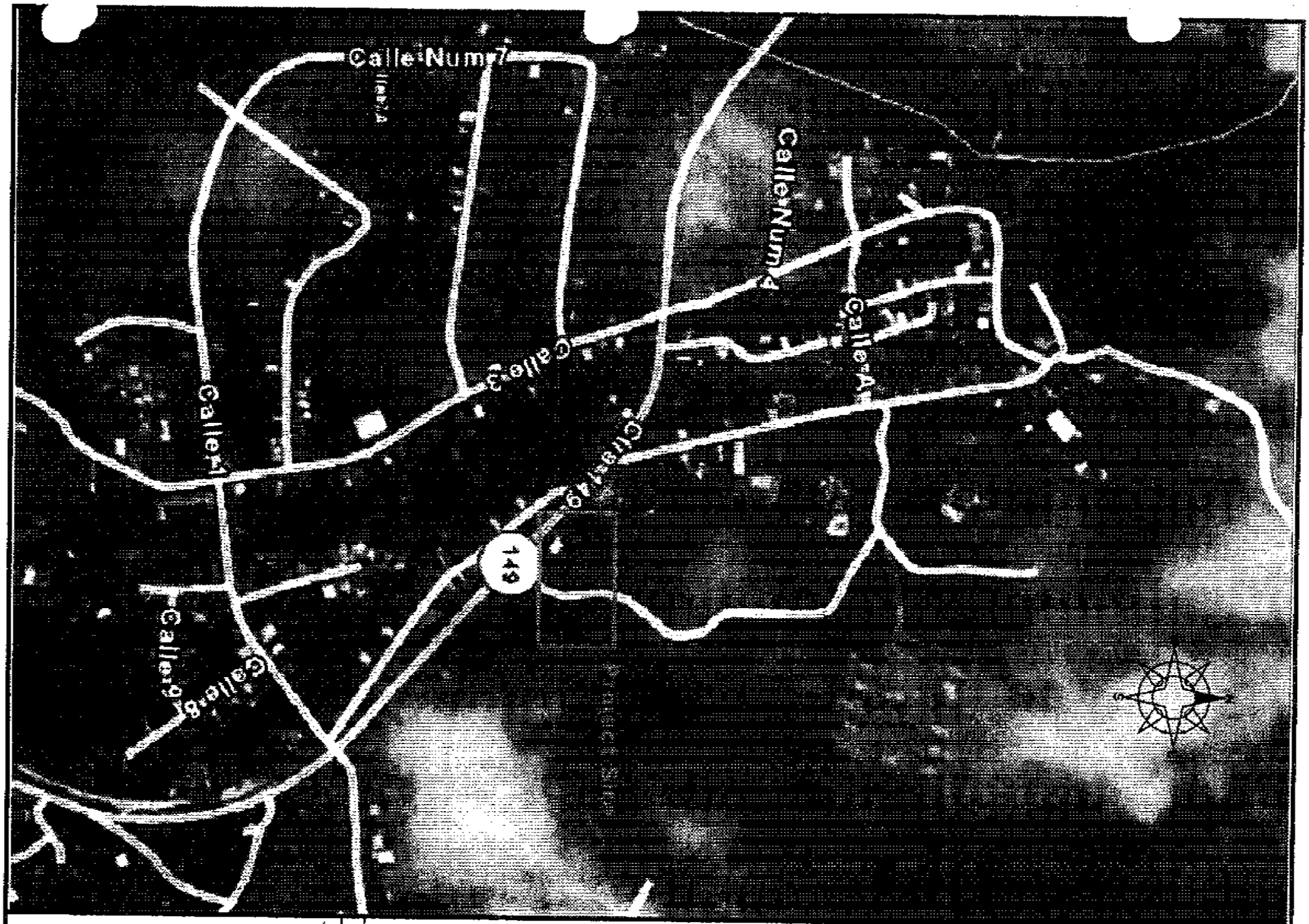


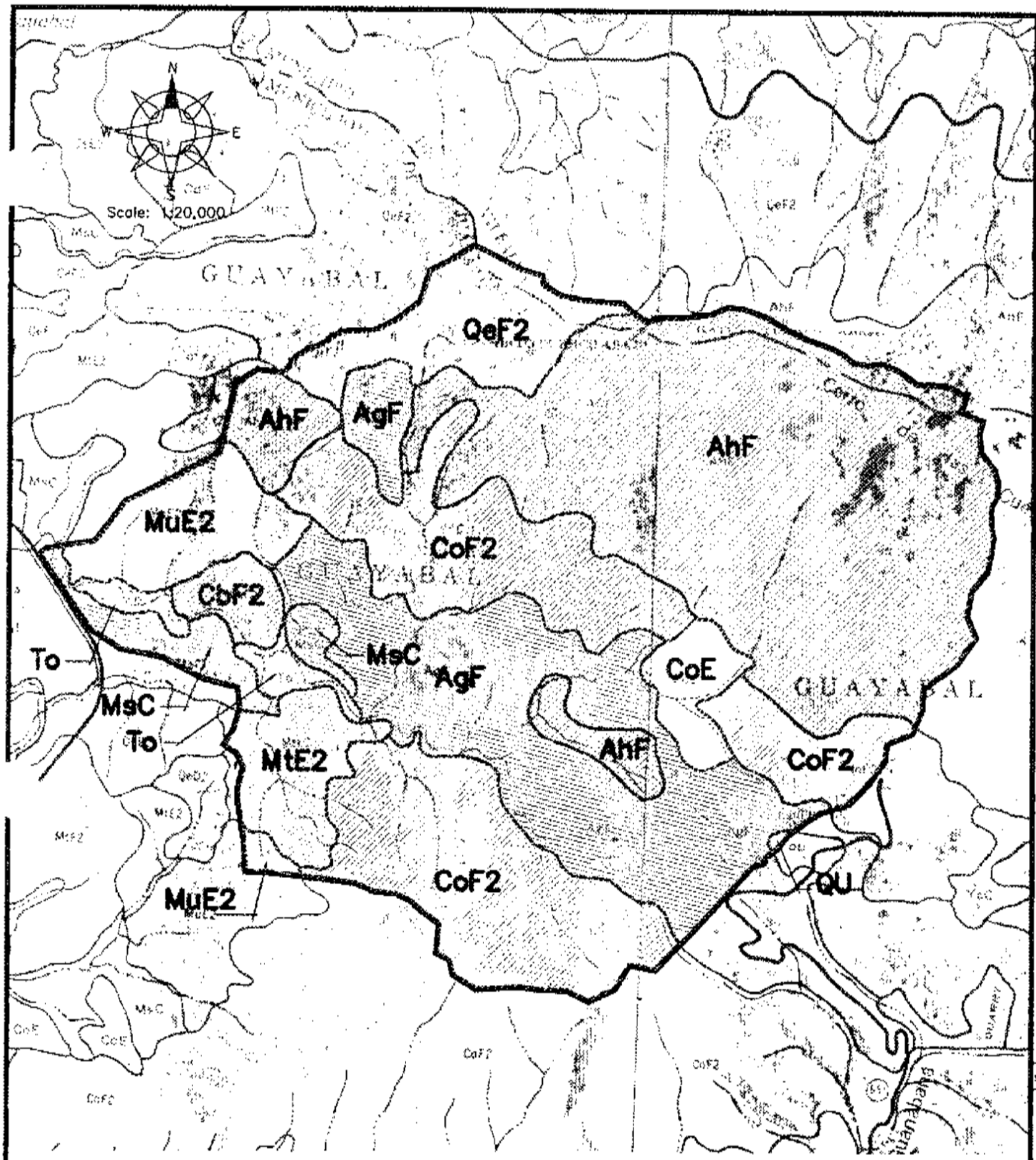
CA Engineering, PSC

Scale: N.T.S.

H/H STUDY – CANARICO, PR-149 KM. 63.6, JUANA DIAZ, PR

Figure 4

AERIAL PHOTOGRAPHY



SOIL CLASSIFICATION SCHEDULE			
No.	ID	NAME	SYMBOL
1	AhF	Aguilita stony clay Loam	
2	QeF2	Quebrada Silty clay loam	
3	AgF	Aguilita gravelly clay Loam	
4	CoF2	Callabo silty clay loam	
5	QU	Quebrada Silty clay	
6	MtE2	Morado clay Loam	
7	MuE2	Mucara Silty clay	
8	MsC	Montegrande Clay	
9	To	Toa Silty clay Loam	
10	CbF2	Caguabo Gravelly clay loam	
11	CoE	Callabo silty clay loam	

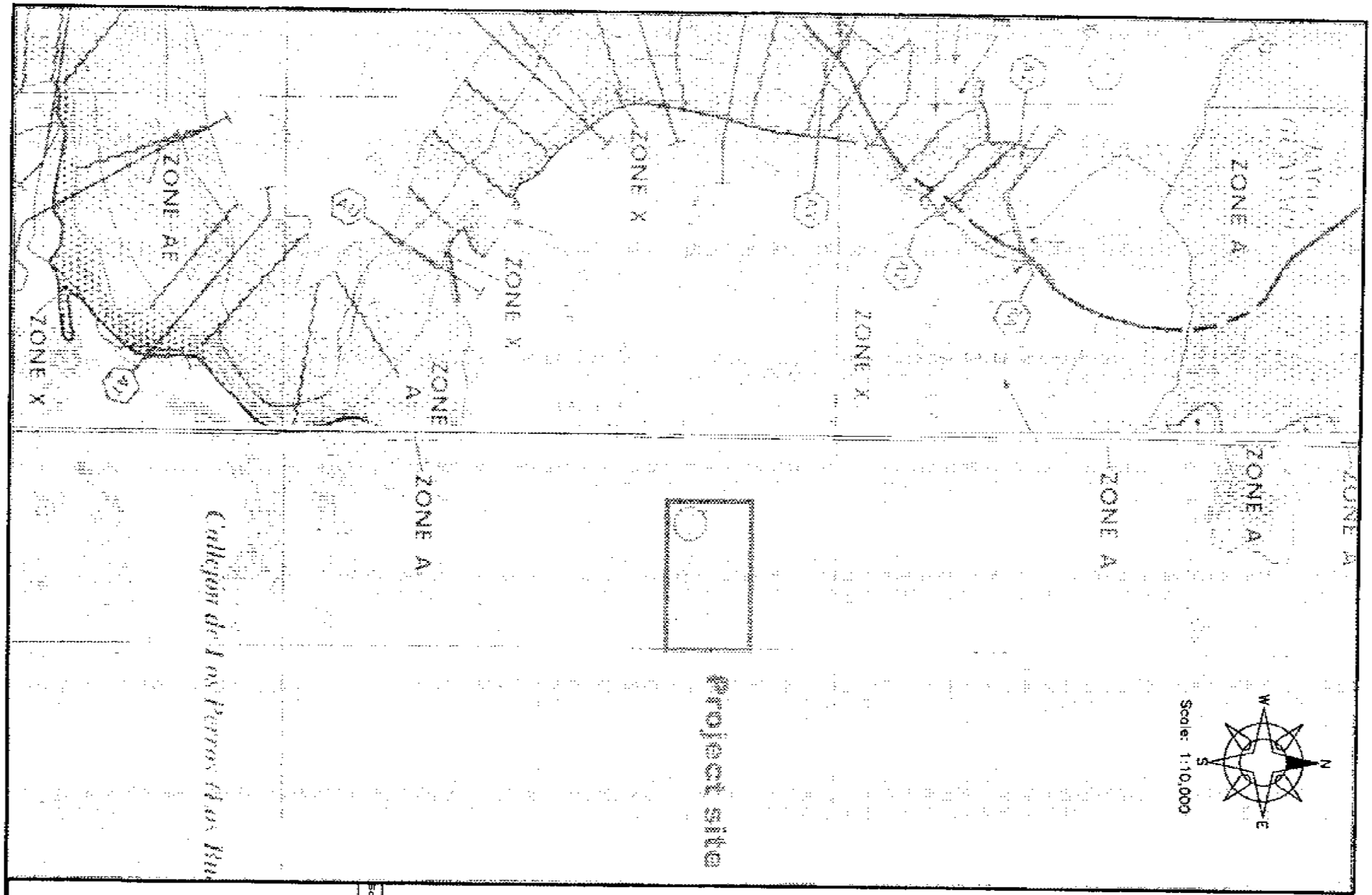
H/H STUDY - CANARICO, PR-149 KM. 63.6, JUANA DIAZ, PR

Figure 5

SOIL CLASSIFICATION MAP

Scale: 1:20,000

CA Engineering, PSC



CA Engineering, PSC

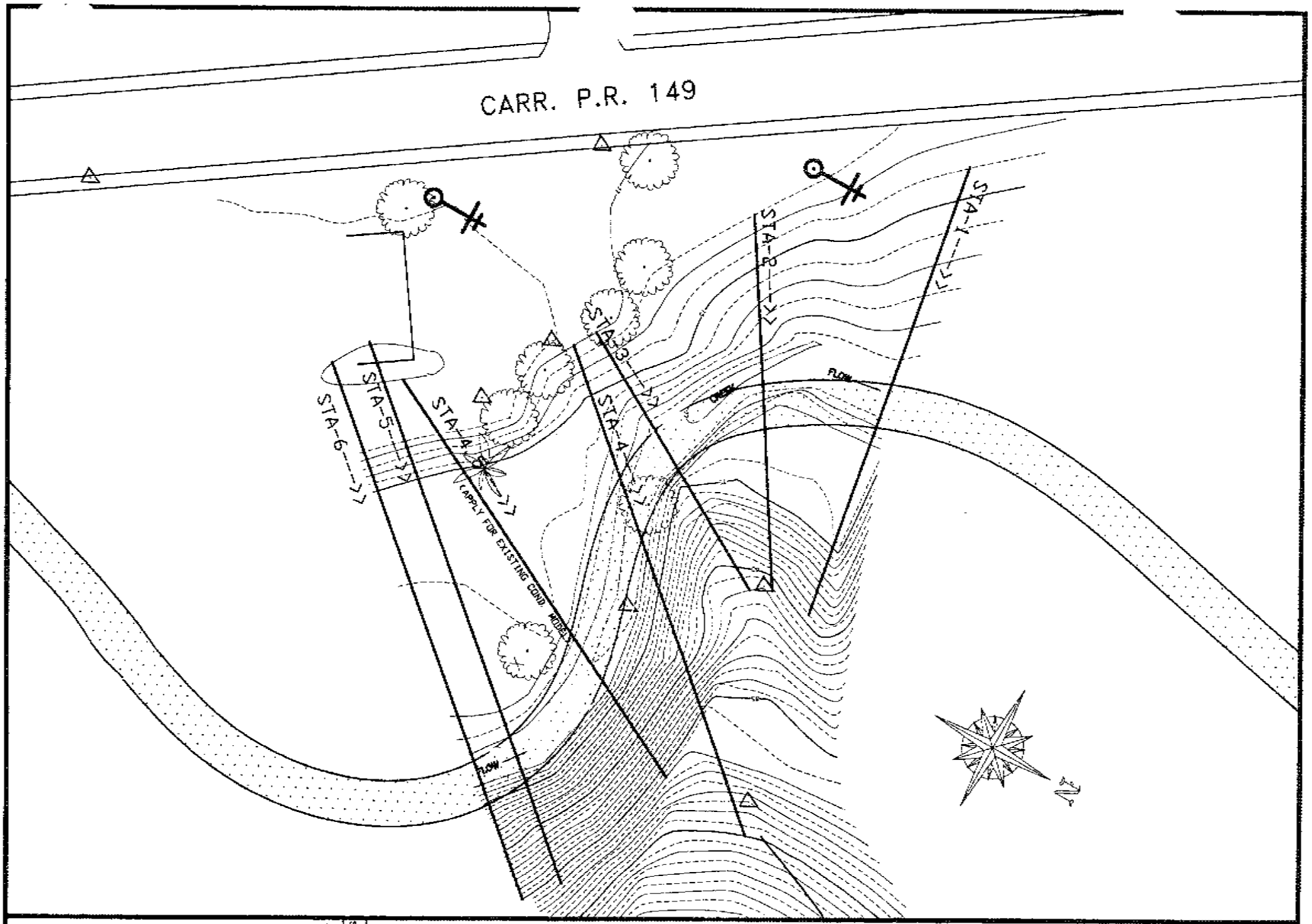
Scale: 1:10,000

H/H STUDY – CANARICO, PR–149 Km. 63.6, JUANA DIAZ, PR

PANEL C1660 & C1680

Figure 6

FEMA's FLOOD MAP



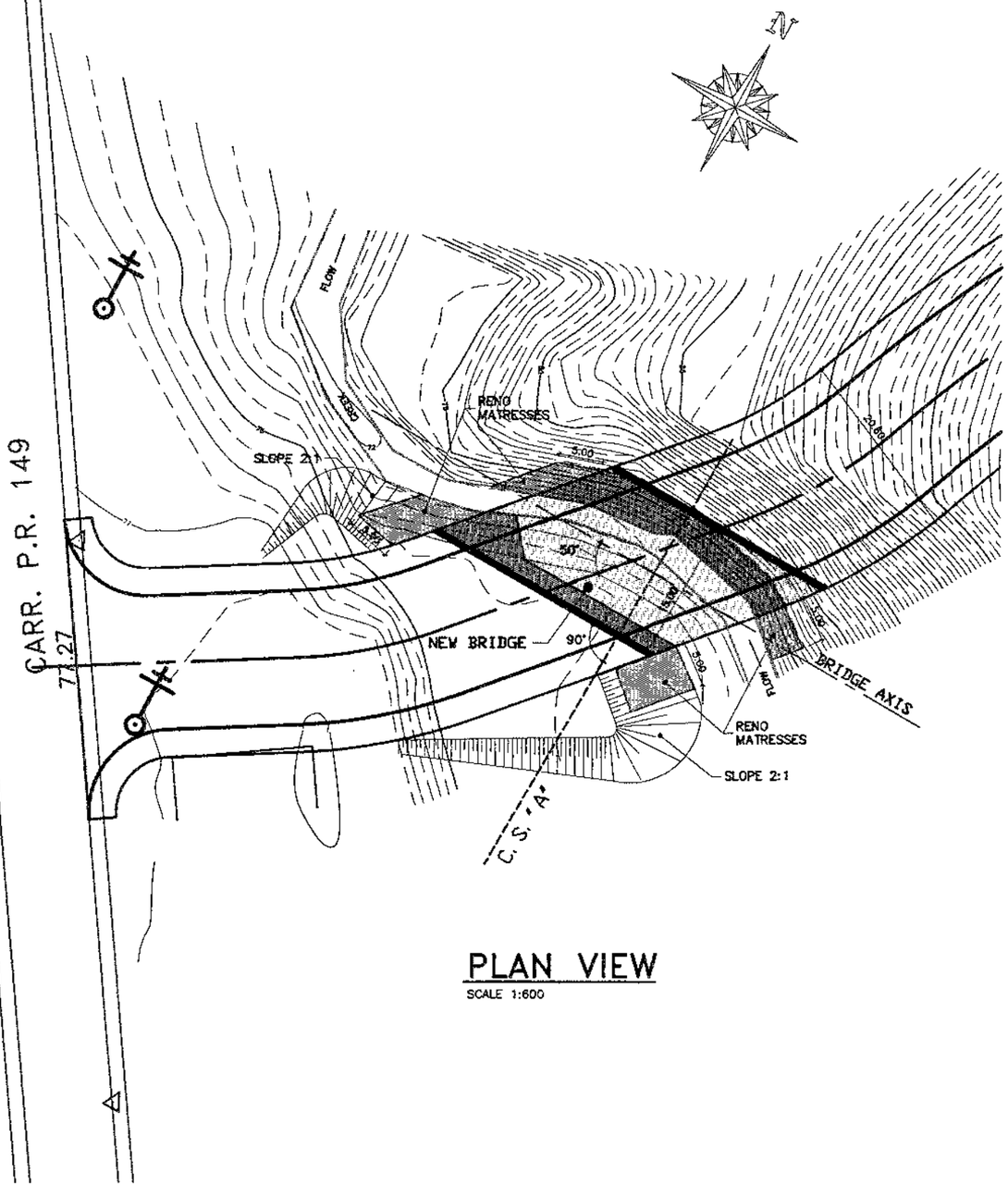
CA Engineering, PSC

Scale: 1:200'00

H/H STUDY – CANARICO, PR-149 KM. 63.6, JUANA DIAZ, PR

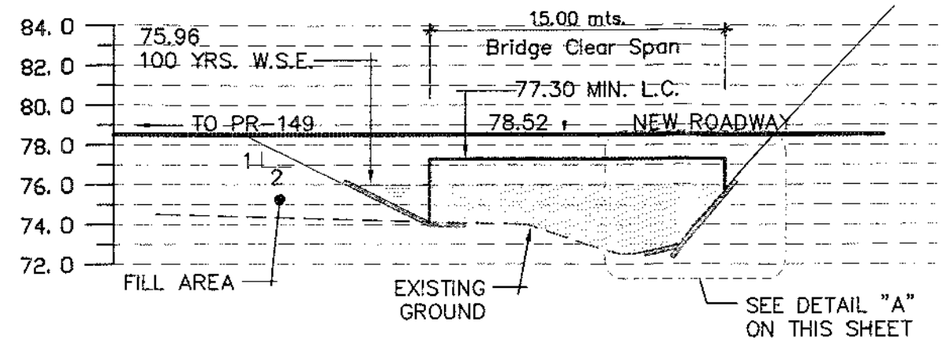
Figure 7

Location of CROSS SECTION



PLAN VIEW

SCALE 1:600

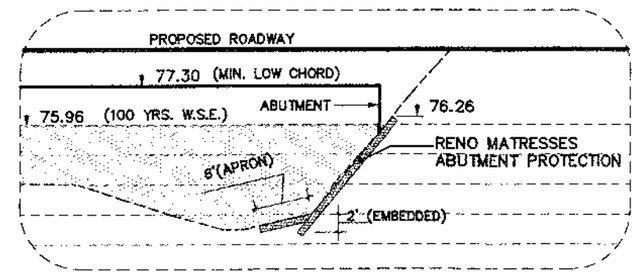


CROSS SECTION "A"-PROPOSED BRIDGE

H. S. =1: 300
V. S. =1: 300

NOTE:

THE BRIDGE ABUTMENTS WILL BE PROTECTED BY RENO MATRESSES LAID ON THE WATERCOURSE SLOPE UP TO 0.30 METERS ABOVE THE 100 YRS. W.S.E..THE RENO MATRESSES APRON WILL BE OF 6'00" LONG IN HORIZONTAL SET UP.



DETAIL "A"

SCALE 1:200

H/H STUDY - CANARICO, PR-149 KM 63.6 ,JUANA DIAZ, PR

Figure 8
PROPOSED BRIDGE-Plan & Section

Scale: AS SHOWN

CA Engineering, PSC

APPENDIXES

APPENDIX A

HYDROLOGIC PARAMETERS ESTIMATION

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Puerto Rico 18.0792 N 66.495 W 400 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 3, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006
Extracted: Tue Apr 15 2008

Precipitation Frequency Estimates (inches)

AEP* (1-in-Y)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.50	0.68	0.88	1.41	2.09	2.53	2.76	3.32	3.81	4.52	5.80	6.54	7.51	8.30	10.67	12.93	16.05	18.79
5	0.63	0.86	1.10	1.76	2.61	3.36	3.72	4.70	5.69	7.01	9.03	10.03	11.31	12.23	15.03	17.84	21.64	25.10
10	0.71	0.96	1.24	1.98	2.94	3.90	4.37	5.69	7.17	9.05	11.70	12.79	14.22	15.18	18.18	21.23	25.39	29.29
25	0.80	1.09	1.40	2.24	3.33	4.56	5.21	7.03	9.32	12.05	15.67	16.78	18.33	19.25	22.44	25.69	30.21	34.56
50	0.87	1.18	1.52	2.44	3.61	5.07	5.85	8.09	11.12	14.61	19.08	20.17	21.70	22.54	25.80	29.11	33.84	38.48
100	0.93	1.28	1.64	2.63	3.90	5.57	6.51	9.21	13.08	17.43	22.86	23.92	25.52	26.27	29.32	32.61	37.50	42.42
200	1.00	1.37	1.76	2.81	4.17	6.07	7.19	10.38	15.22	20.56	27.07	28.12	29.84	30.51	33.40	36.33	41.23	46.39
500	1.09	1.49	1.91	3.06	4.54	6.75	8.13	12.04	18.36	25.19	33.35	34.32	36.22	36.76	39.72	42.64	46.46	51.89
1000	1.16	1.58	2.03	3.25	4.82	7.28	8.87	13.38	20.97	29.10	38.67	39.54	41.54	41.92	44.89	47.67	51.40	56.13

* These precipitation frequency estimates are based on an annual maxima series. AEP is the Annual Exceedance Probability. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)

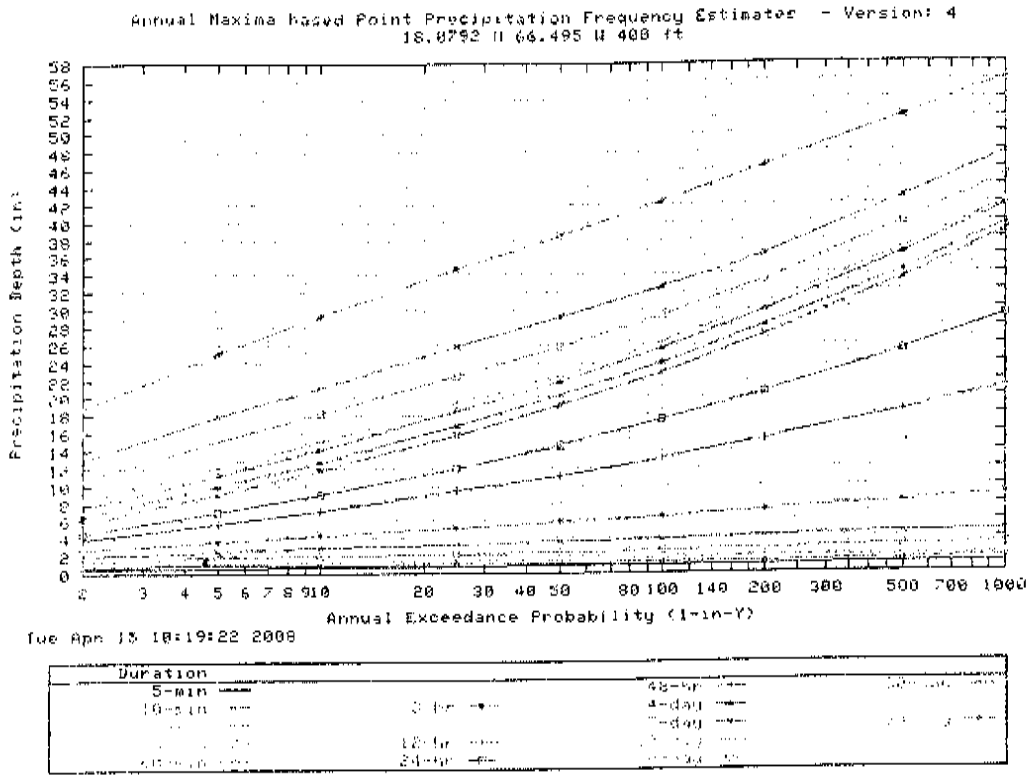
AEP** (1-in-Y)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.53	0.73	0.93	1.50	2.22	2.73	3.00	3.70	4.38	5.13	6.75	7.54	8.56	9.36	11.79	14.17	17.46	20.39
5	0.67	0.91	1.17	1.87	2.77	3.60	4.02	5.22	6.55	7.92	10.45	11.52	12.85	13.76	16.57	19.52	23.52	27.22
10	0.75	1.02	1.31	2.10	3.12	4.17	4.72	6.33	8.29	10.18	13.53	14.67	16.12	17.06	20.06	23.24	27.60	31.75
25	0.85	1.16	1.49	2.39	3.55	4.90	5.67	7.87	10.83	13.58	18.12	19.33	20.87	21.72	24.80	28.16	32.90	37.54
50	0.93	1.27	1.63	2.60	3.86	5.46	6.40	9.14	13.01	16.48	22.12	23.27	24.74	25.46	28.58	31.99	36.96	41.94
100	1.00	1.37	1.76	2.82	4.18	6.03	7.18	10.49	15.43	19.71	26.68	27.75	29.25	29.80	32.58	36.00	41.10	46.37
200	1.08	1.48	1.90	3.04	4.51	6.64	8.01	11.97	18.22	23.32	31.81	32.80	34.38	34.80	37.28	40.27	45.37	50.88
500	1.19	1.62	2.08	3.33	4.94	7.45	9.17	14.11	22.36	28.70	39.46	40.38	42.03	42.22	44.73	47.54	51.44	57.25
1000	1.27	1.73	2.22	3.56	5.28	8.10	10.10	15.85	25.85	33.32	46.06	46.75	48.50	48.98	50.88	53.51	57.21	62.22

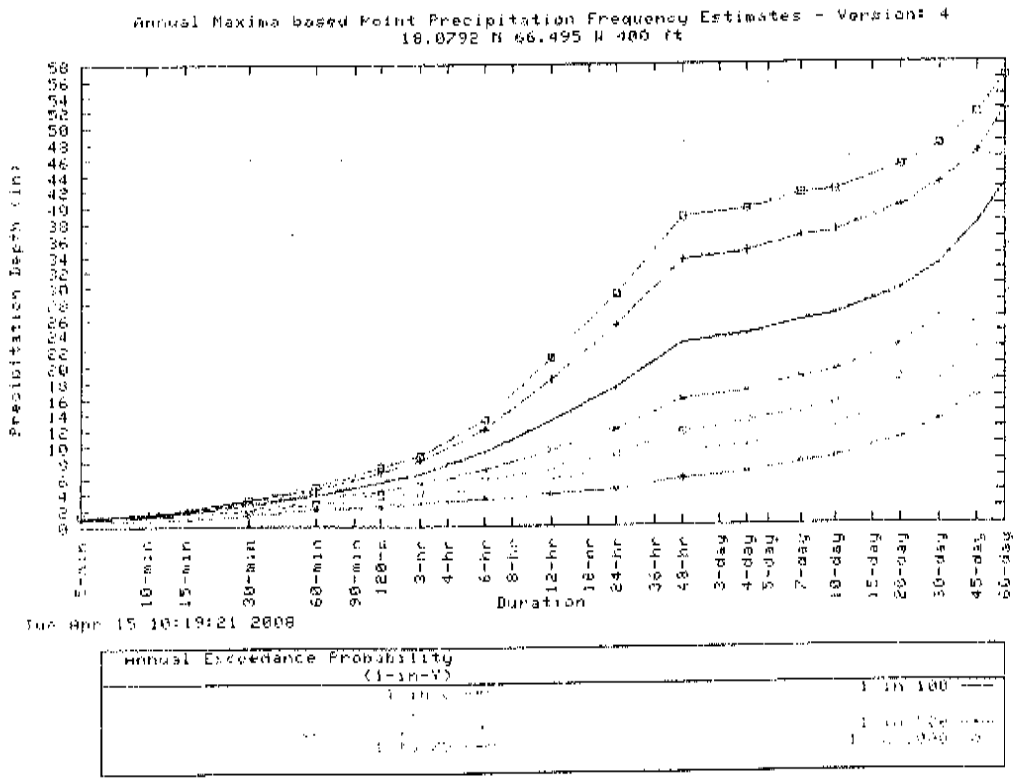
* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on an annual maxima series. AEP is the Annual Exceedance Probability.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

* Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)

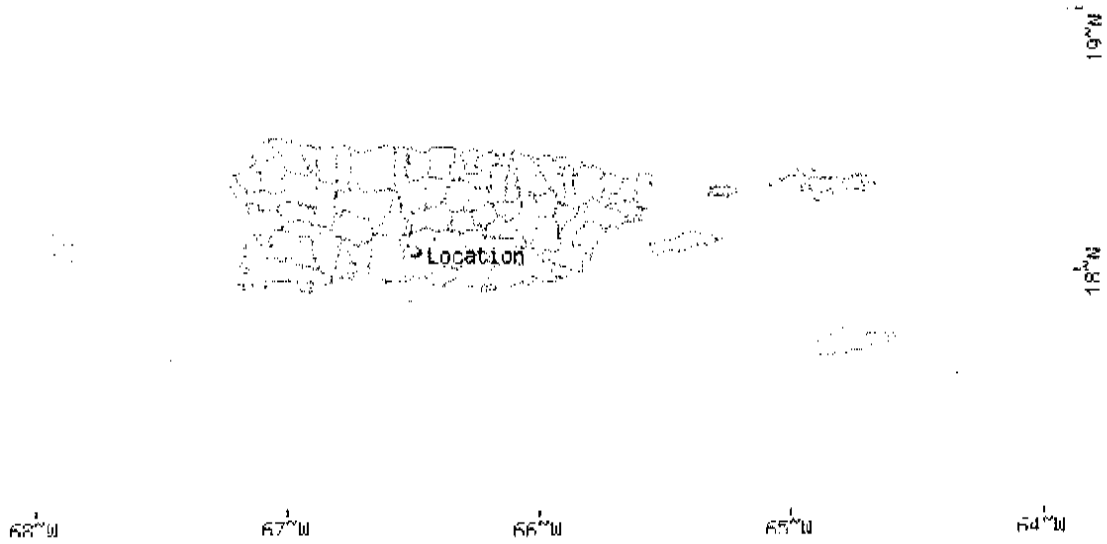
AEP** (1-in-Y)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.47	0.65	0.83	1.33	1.97	2.36	2.55	3.00	3.34	4.02	5.08	5.72	6.65	7.40	9.71	11.84	14.78	17.35
5	0.59	0.81	1.04	1.66	2.47	3.14	3.44	4.24	4.96	6.22	7.87	8.76	9.98	10.88	13.62	16.28	19.88	23.13
10	0.66	0.91	1.17	1.87	2.77	3.62	4.03	5.10	6.19	7.98	10.10	11.09	12.48	13.44	16.40	19.30	23.24	26.88
25	0.75	1.03	1.32	2.11	3.13	4.23	4.78	6.24	7.91	10.53	13.30	14.39	15.93	16.91	20.07	23.19	27.49	31.56
50	0.81	1.11	1.42	2.28	3.38	4.66	5.33	7.10	9.27	12.63	15.97	17.10	18.68	19.62	22.91	26.13	30.64	34.98
100	0.87	1.19	1.52	2.44	3.62	5.08	5.87	7.96	10.71	14.91	18.87	20.02	21.73	22.64	25.81	29.05	33.74	38.36
200	0.92	1.26	1.62	2.59	3.85	5.50	6.42	8.84	12.22	17.40	22.04	23.22	25.12	26.05	29.15	32.13	36.83	41.67
500	1.00	1.36	1.75	2.80	4.15	6.04	7.15	10.09	14.36	21.01	26.58	27.86	29.99	30.89	34.24	37.29	41.11	46.23
1000	1.05	1.44	1.84	2.95	4.38	6.44	7.72	11.05	16.07	23.98	30.35	31.67	33.94	34.82	38.29	41.37	45.18	49.66

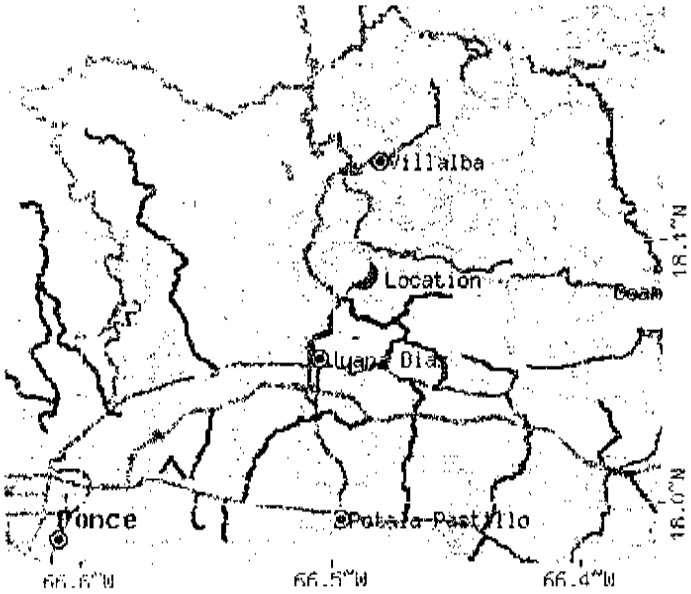
* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.
** These precipitation frequency estimates are based on an annual maxima series. AEP is the Annual Exceedance Probability.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.


Annual Maxima based Point Precipitation Frequency Estimates - Version: 4
18.0792 N 66.495 W 400 ft
Precipitation Depth (in)
Annual Exceedance Probability (1-in-Y)
Tue Apr 15 10:19:22 2008
Duration
5-min
10-min
48-hr
4-day


Annual Maxima based Point Precipitation Frequency Estimates - Version: 4
18.0792 N 66.495 W 400 ft
Precipitation Depth (in)
5-min
10-min
15-min
30-min
60-min
120-min
3-hr
4-hr
6-hr
12-hr
18-hr
24-hr
36-hr
48-hr
3-day
4-day
5-day
7-day
10-day
15-day
20-day
30-day
45-day
60-day
Duration
Tue Apr 15 10:19:21 2008
Annual Exceedance Probability
(1-in-Y)
1 in 100

Maps -





These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.

LEGEND

- State
- County
- Indian Resv
- Lake/Pond/Ocean
- Street
- Expressway
- Highway
- Connector
- Stream
- Military Area
- National Park
- Other Park
- City
- County

Scale 1:220503

Average--true scale depends on monitor resolution

Project: Canarico, Quarries
Location: Juana Díaz, Puerto Rico

PHYSIOGRAFIC INFORMATION:

Soil	Description	HSG	CN
AhE	Aquilita stony clay loam (20 to 60% slopes)	B	79
QeF2	Quebrada silty clay loam (40 to 60% slopes)	C	86
AqF	Aquilita gravelly clay loam (20 to 60% slopes)	B	79
CoF2	Callabo silty clay loam (40 to 60% slopes), eroded	C	86
Qu	Quebrada silty clay loam	C	86
MtE2	Morada clay loam (20 to 40% slopes) eroded	C	86
MuE2	Mucara silty clay (20 to 40% slopes) eroded	D	89
MsC	Montegarude clay (2 to 12% slopes)	D	89
To	Toa silty clay loam	C	86
CbF2	Caguabo gravelly clay loam (20 to 60 % slopes)erode	D	89
CoE	Callabo silty clay loam (20 to 40% slopes), eroded	C	86

PHYSIOGRAFIC INFORMATION: BASIN E-1

		Existing Conditions		
Soil	HSG	Curve Number	Area (meters^2)	Area (acre)
AhE	B	79	1,988,468.878	491.365
QeF2	C	86	298,321.137	73.717
AqF	B	79	1,035,637.098	255.913
CoF2	C	86	1,281,353.915	316.632
Qu	C	86	3,231.753	0.799
MtE2	C	86	203,408.235	50.264
MuE2	D	89	259,328.112	64.082
MsC	D	89	148,338.173	36.655
To	C	86	80,434.565	19.876
CbF2	D	89	84,381.968	20.851
CoE	C	86	114,338.878	28.254
Total (acres)				1,358.41
Total (km^2)				5.497
Total (mi^2)				2.123
Weighted CN				82.42

Project:

COMPUTATIONS FOR TIME OF CONCENTRATION - Kirpitch Equation

$Tc = 0.0078L^{0.77}/S^{0.385}$

Where: L in ft, S in ft/ft, Tc in min

EXISTING CONDITION

Higher Elevation		Lower Elevation		Distance		Time of Concentration		Lag Time
m	ft	m	ft	m	ft	min	hours	hours

Basin Area (E1)

600	1968.00	550	1804.00	175.00	574.00	1.6824	0.02804	0.01682
550	1804.00	500	1640.00	182.00	596.96	1.7603	0.02934	0.01760
500	1640.00	450	1476.00	101.00	331.28	0.8917	0.01486	0.00892
450	1476.00	400	1312.00	243.00	797.04	2.4580	0.04097	0.02458
400	1312.00	350	1148.00	227.00	744.56	2.2721	0.03787	0.02272
350	1148.00	300	984.00	218.00	715.04	2.1684	0.03614	0.02168
300	984.00	250	820.00	123.00	403.44	1.1196	0.01866	0.01120
250	820.00	220	721.60	146.00	478.88	1.6613	0.02769	0.01661
220	721.60	100	328.00	1,368.00	4,487.04	12.9126	0.21521	0.12913
100	328.00	72	236.16	2,055.00	6,740.40	36.1792	0.60299	0.36179
				4,838.00	15,868.64	63.1055	1.05176	**0.631**

APPENDIX B

HYDROLOGIC ANALYSIS RESULTS

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN   1998                *
*          VERSION 4.1                  *
*  KMTHS0200G                HEC-1.COM  *
*  RUN DATE   23APR08  TIME  14:20:43   *
*                                       *
*****************************************
```

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

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

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

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

```
                 1.0.....2.....3.....4.....5.....6.....7.....8.....9.....10

  ID       HYDROLOGIC ANALYSIS
  ID       PROJECT: Cantera Quarries, Juana Diaz, P.R.
  ID       TRIANGULAR DISTRIBUTION
  ID       FREQUENCY OF OCCURRENCE: 2, 10, 25, 50 AND 100 YEARS
  ID       CA ENGINEERING, APRIL 2008
  ID       EXISTING CONDITION
  IT     5                    289
  IO     4
  KK     E1
  KP     1
  BA   2.173
  LS     0   82.17
  UC   .031
  WT     15
  KM         RUNOFF COMPUTATION 2-YRS STORM IN BASIN
  PB                0.50    0.88    2.09    2.53    2.76    3.32    3.81    4.52
  KP     2
  KM         RUNOFF COMPUTATION 10-YRS STORM IN BASIN
  PB                0.71    1.24    2.94    3.90    4.37    5.69    7.17    9.05
  KP     3
  KM         RUNOFF COMPUTATION 25-YRS STORM IN BASIN
  PB                0.80    1.40    3.33    4.56    5.21    7.03    9.32   12.05
  KP     4
  KM         RUNOFF COMPUTATION 50-YRS STORM IN BASIN
  PB                0.87    1.52    3.61    5.07    5.85    8.09   11.12   14.63
  KP     5
  KM         RUNOFF COMPUTATION 100-YRS STORM IN BASIN
  PB                0.93    1.64    3.90    5.57    6.51    9.21   13.08   17.43
  ZZ
```

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

HYDROLOGIC ANALYSIS
PROJECT: Cantera Quarries, Juana Diaz, P.R.
TRIANGULAR DISTRIBUTION
FREQUENCY OF OCCURRENCE: 2, 10, 25, 50 AND 100 YEARS
CA ENGINEERING, APRIL 2008
EXISTING CONDITION

[illegible] OPTIONAL VARIABLES

IPRNT	1	PRINT CONTROL
IPLOT	3	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

[illegible] DATA

MINUTE	[illegible]	MINUTES IN COMPUTATION INTERVAL
[illegible]	[illegible]	STARTING DATE
[illegible]	0001	STARTING TIME
NQ	289	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	[illegible]	ENDING DATE
NDTIME	2400	ENDING TIME
ICENT	[illegible]	CENTURY MARK

COMPUTATION INTERVAL [illegible] MINUTES
TOTAL TIME BASE [illegible] HOURS

[illegible]
GLOBAL [illegible] [illegible] MINUTE
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] OF [illegible]
[illegible] [illegible]
[illegible] [illegible]

```
 1          MULTI-PLAN OPTION
                NPLAN          5  NUMBER OF PLANS

 JR         MULTI-RATIO OPTION
                RATIOS OF RUNOFF
               1.00

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            ..............
            *            *
 10 KK      *     C1     *
            *            *
            ..............

***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***

 11 KK        PLAN  1 FOR STATION       C1
                          RUNOFF COMPUTATION 2-YRS STORM IN BASIN

            SUBBASIN RUNOFF DATA

 12 KK        SUB-BASIN CHARACTERISTICS
                TAREA          2.12  SUBBASIN AREA

              PRECIPITATION DATA

 13 KP                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... RUNOFF ..... ............... TP-40 ...............  ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .50     .83    2.04    2.54    2.76    3.33    3.81    4.52     .00     .00     .00     .00

                                                STORM AREA =     2.12

 15 LS        SCS LOSS RATE
                STRTL          .13  INITIAL ABSTRACTION
               CRVNBR        62.42  CURVE NUMBER
               RTIMP          .00  PERCENT IMPERVIOUS AREA

 16 UC        SCS DIMENSIONLESS UNITGRAPH
                TLAG           .63  LAG

                                          ***

                                                UNIT HYDROGRAPH
                                           40 END-OF-PERIOD ORDINATES
              [illegible]    [illegible]    411.    766.   1054.   1323.   1480.   1574.   1496.   1317.
            [illegible]    [illegible]    [illegible]    665.    542.    441.    368.    302.    245.    201.
              163.    134.    109.     88.     73.     59.     49.     40.     32.     27.
               22.     18.     15.     13.     11.      8.      6.      4.      3.      1.

***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***  ***

 17 KK        PLAN  1 FOR STATION       C1
                          RUNOFF COMPUTATION 10-YRS STORM IN BASIN

            SUBBASIN RUNOFF DATA

 18 KK        SUBBASIN CHARACTERISTICS
                TAREA          2.12  SUBBASIN AREA

              PRECIPITATION DATA

 19 KP                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... RUNOFF ..... ............... TP-40 ...............  ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .83    1.31    3.34    3.90    4.37    5.09    7.17    9.05     .00     .00     .00     .00

                                                STORM AREA =     2.12

 20 LS        SCS LOSS RATE
                STRTL          .13  INITIAL ABSTRACTION
               CRVNBR        62.42  CURVE NUMBER
               RTIMP          .00  PERCENT IMPERVIOUS AREA
```

SCS DIMENSIONLESS UNITGRAPH
TLAG .64 LAG

***

UNIT HYDROGRAPH
40 END-OF-PERIOD ORDINATES

31.	218.	471.	706.	1054.	1323.	1480.	1524.	1496.	1377.
1178.	1036.	838.	665.	542.	441.	368.	302.	245.	201.
163.	134.	109.	88.	73.	59.	49.	40.	32.	27.
22.	18.	15.	13.	11.	8.	6.	4.	3.	1.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

PLAN 2 FOR STATION 21
RUNOFF COMPUTATION 25-YRS STORM IN BASIN

SUBBASIN RUNOFF DATA

SUBBASIN CHARACTERISTICS
TAREA 2.12 SUBBASIN AREA

PRECIPITATION DATA

DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

HYDRO-35			TP-40					TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
.30	1.40	3.63	4.56	5.21	7.03	9.32	12.05	.00	.00	.00	.00

STORM AREA = 2.12

SCS LOSS RATE
STRTL .43 INITIAL ABSTRACTION
CRVNBR 67.42 CURVE NUMBER
STIMP .00 PERCENT IMPERVIOUS AREA

SCS DIMENSIONLESS UNITGRAPH
TLAG .64 LAG

***

UNIT HYDROGRAPH
40 END-OF-PERIOD ORDINATES

31.	218.	471.	706.	1054.	1323.	1480.	1524.	1496.	1377.
1178.	1036.	838.	665.	542.	441.	368.	302.	245.	201.
163.	134.	109.	88.	73.	59.	49.	40.	32.	27.
22.	18.	15.	13.	11.	8.	6.	4.	3.	1.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

PLAN 4 FOR STATION 21
RUNOFF COMPUTATION 50-YRS STORM IN BASIN

SUBBASIN RUNOFF DATA

SUBBASIN CHARACTERISTICS
TAREA 2.12 SUBBASIN AREA

PRECIPITATION DATA

DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

HYDRO-35			TP-40					TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
.30	1.40	3.63	4.97	5.65	8.09	11.12	14.61	.00	.00	.00	.00

STORM AREA 2.12

SCS LOSS RATE
STRTL .43 INITIAL ABSTRACTION
CRVNBR 67.42 CURVE NUMBER
STIMP .00 PERCENT IMPERVIOUS AREA

SCS DIMENSIONLESS UNITGRAPH
TLAG .64 LAG

***

UNIT HYDROGRAPH
40 END-OF-PERIOD ORDINATES

27 KK PLAN 5 FOR STATION E1
RUNOFF COMPUTATION 100-YRS STORM IN BASIN

SUBBASIN RUNOFF DATA

12 BA SUBBASIN CHARACTERISTICS
TAREA 2.12 SUBBASIN AREA

PRECIPITATION DATA

29 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

HYDRO-35			TP-40					TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
.9[illegible]	[illegible]	3.[illegible]	5.57	6.51	9.[illegible]	13.08	17.43	.00	.00	.00	.00

STORM AREA 2.12

31 LS SCS LOSS RATE
STRTL .4[illegible] INITIAL ABSTRACTION
CRVNBR 8[illegible] CURVE NUMBER
RTIMP .00 PERCENT IMPERVIOUS AREA

32 UD SCS DIMENSIONLESS UNITGRAPH
TLAG .[illegible]3 LAG

***

UNIT HYDROGRAPH
40 END-OF-PERIOD ORDINATES

71.	2[illegible]8.	411.	706.	1054.	1323.	1480.	1534.	1496.	1377.
[illegible]	1058.	838.	665.	542.	441.	368.	302.	245.	201.
162.	134.	109.	90.	73.	59.	49.	40.	32.	27.
2[illegible].	[illegible]	15.	13.	11.	8.	6.	4.	3.	1.

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

RATIOS APPLIED TO FLOWS

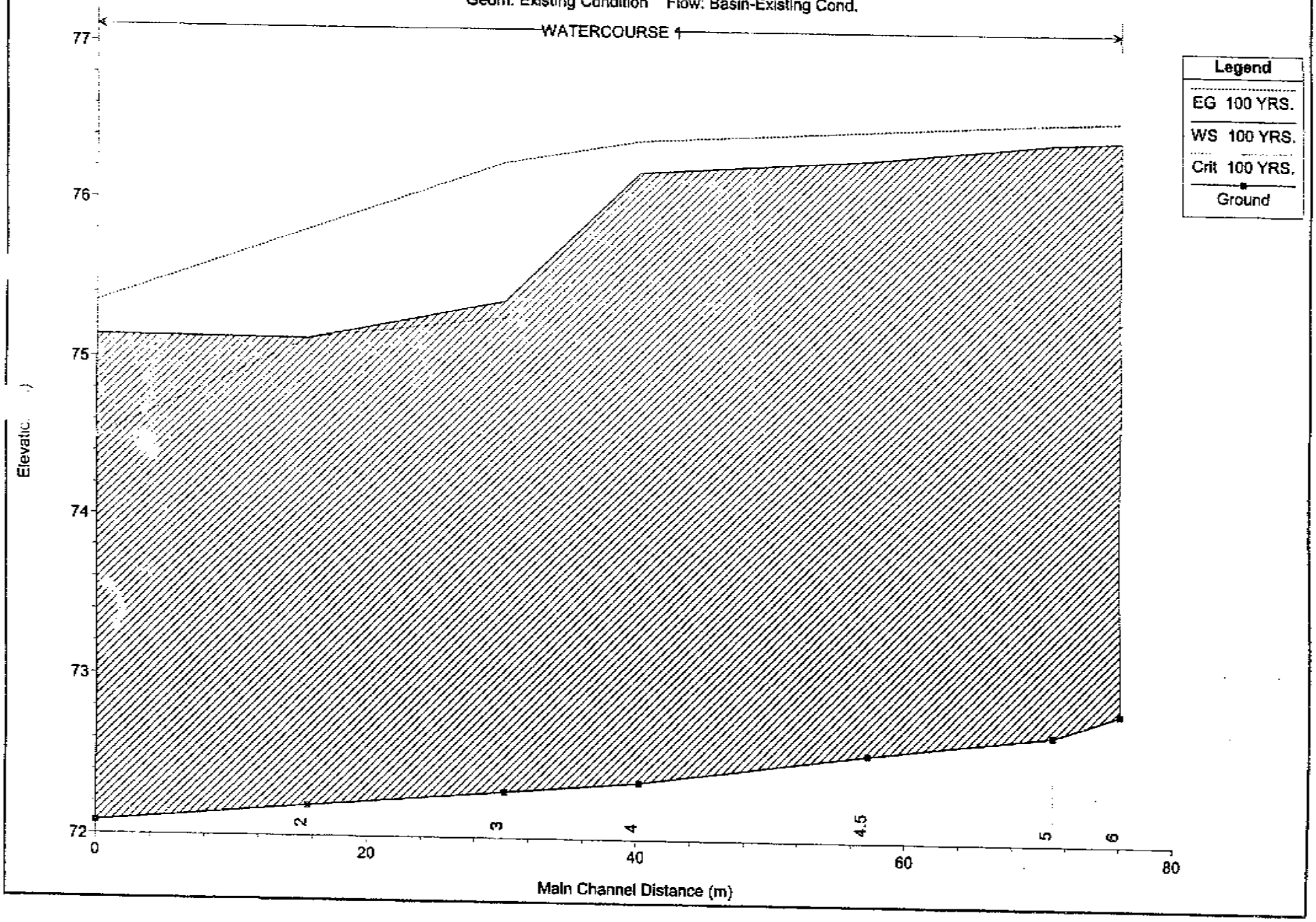
OPERATION	STATION	AREA	PLAN		RATIO 1 1.00
HYDROGRAPH AT	E1	2.12	1	FLOW	3848.
				TIME	12.75
			[illegible]	FLOW	[illegible]966.
				TIME	12.67
			[illegible]	FLOW	4034.
				TIME	12.67
			4	FLOW	4[illegible].
				TIME	12.67
			[illegible]	FLOW	[illegible]
				TIME	12.67

APPENDIX C

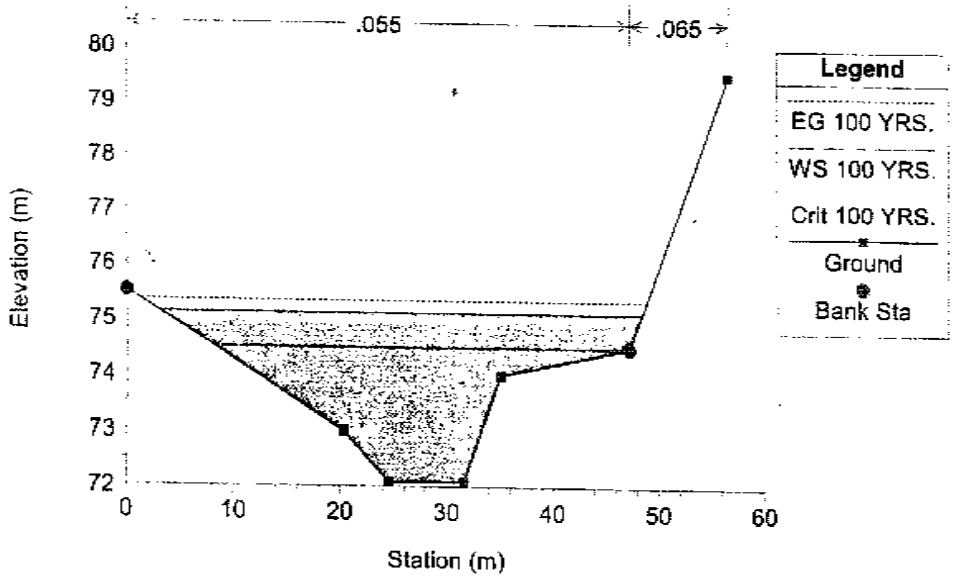
HYDRAULIC ANALYSIS RESULTS FOR EXISTING CONDITION

Canarico Quarries Plan: Existing Condition 5/2/2008

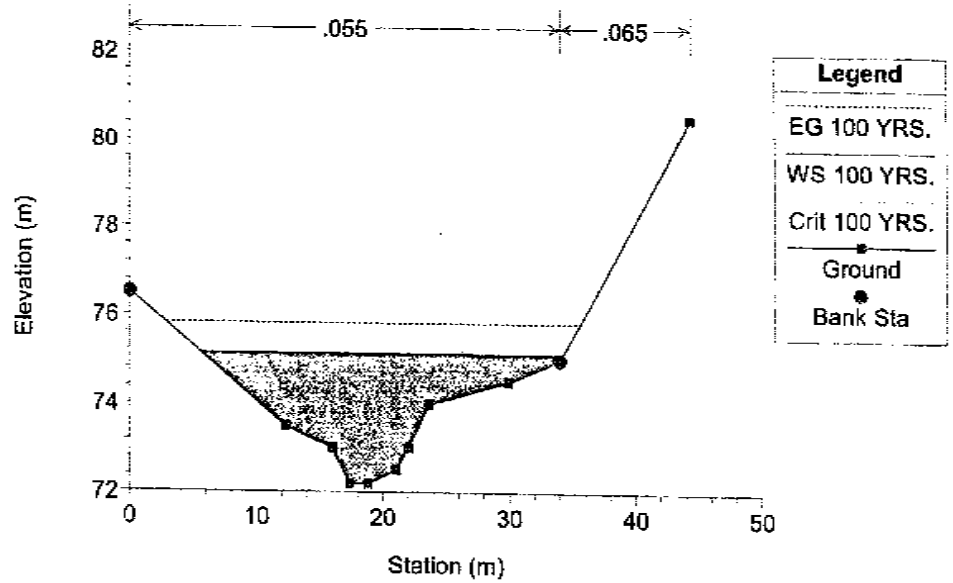
Geom: Existing Condition Flow: Basin-Existing Cond.



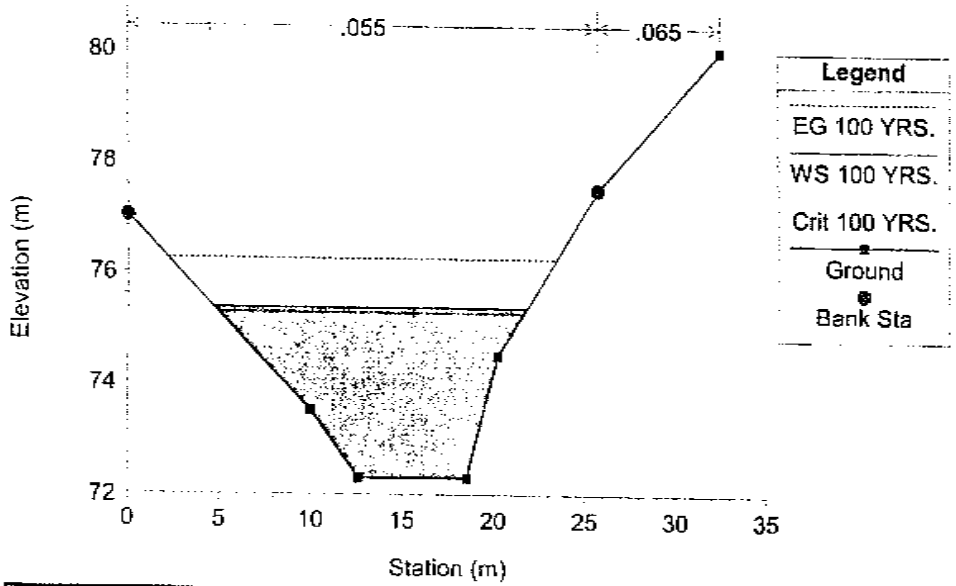
Canarico Quarries Plan: Existing Condition 5/12/2008
Geom: Existing Condition Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 1



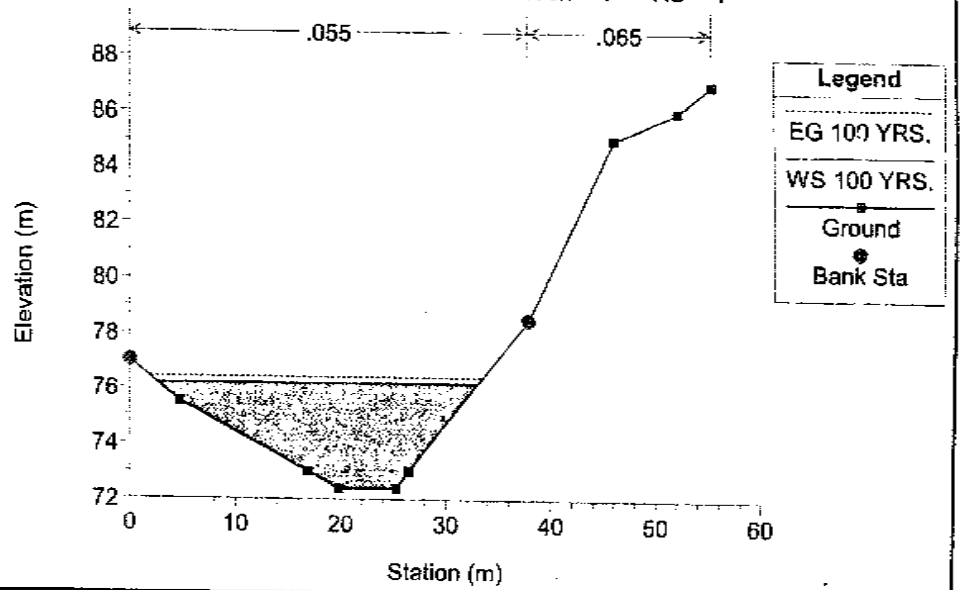
Canarico Quarries Plan: Existing Condition 5/12/2008
Geom: Existing Condition Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 2



Canarico Quarries Plan: Existing Condition 5/12/2008
Geom: Existing Condition Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 3



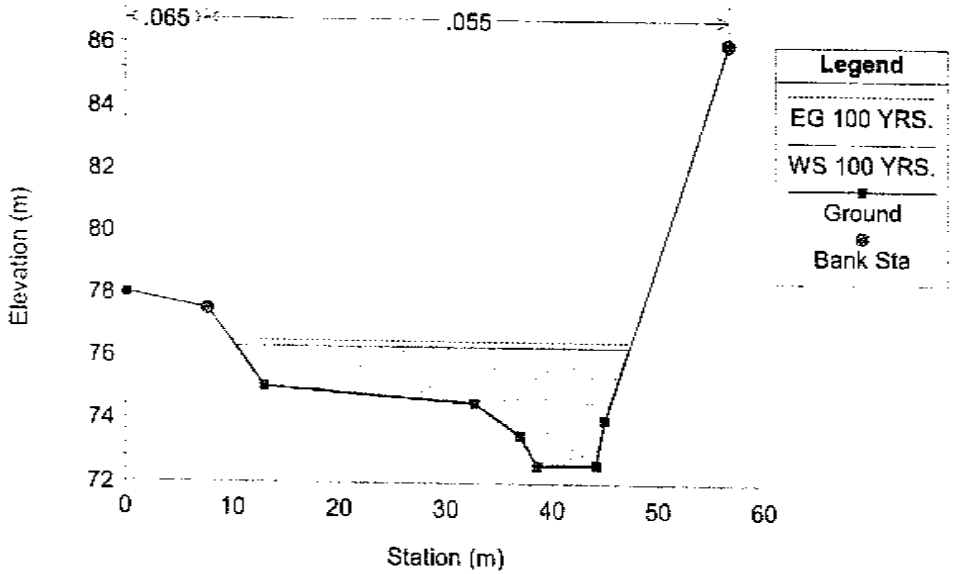
Canarico Quarries Plan: Existing Condition 5/12/2008
Geom: Existing Condition Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 4



Canarico Quarries Plan: Existing Condition 5/12/2008

Geom: Existing Condition Flow: Basin-Existing Cond.

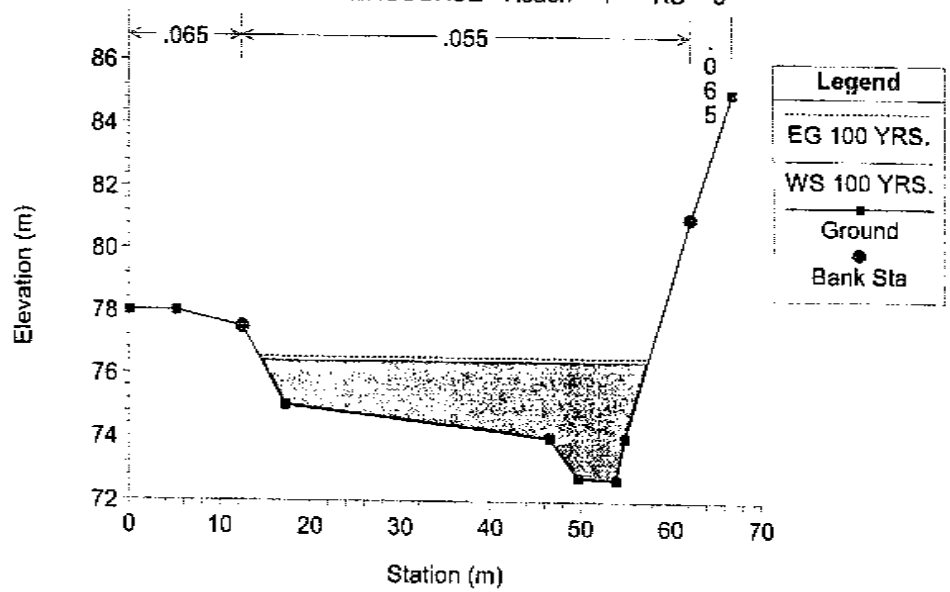
River = WATERCOURSE Reach = 1 RS = 4.5



Canarico Quarries Plan: Existing Condition 5/12/2008

Geom: Existing Condition Flow: Basin-Existing Cond.

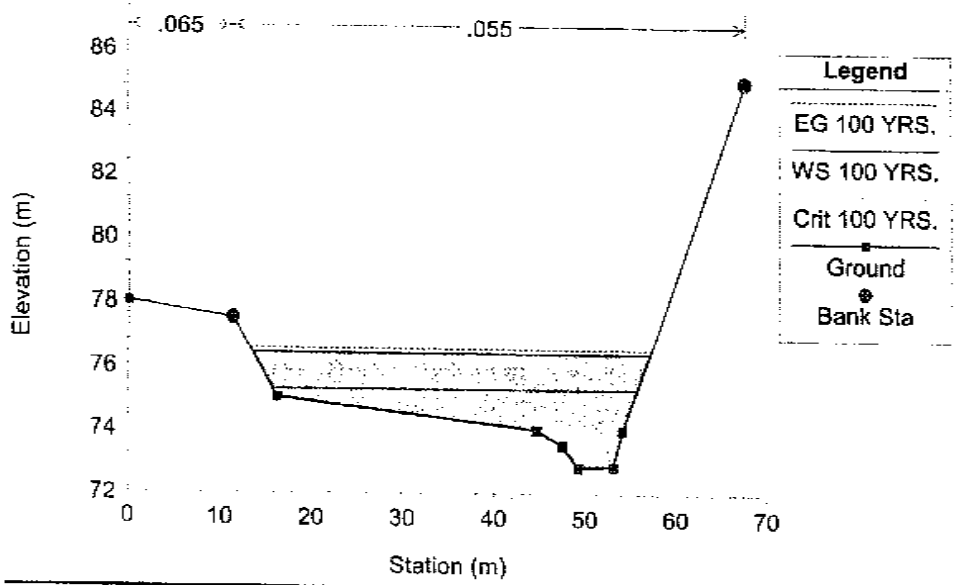
River = WATERCOURSE Reach = 1 RS = 5



Canarico Quarries Plan: Existing Condition 5/12/2008

Geom: Existing Condition Flow: Basin-Existing Cond.

River = WATERCOURSE Reach = 1 RS = 6



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: Canarico Quarries
Project File : cq.prj
Run Date and Time: 5/2/2008 12:13:01 PM

Project in ST units

Project Description:
H-H Study for New Bridge

PLAN DATA

Plan Title: Existing Condition
Plan File : p:\460-Canarico Quarries\ras\cq.p02

Geometry Title: Existing Condition
Geometry File : p:\460-Canarico Quarries\ras\cq.g02

Flow Title : Basin-Existing Cond.
Flow File : p:\460-Canarico Quarries\ras\cq.f02

Plan Summary Information:

Number of:	Cross Sections =	7	Multiple Openings =	0
	Culverts =	0	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: Mixed Flow

FLOW DATA

Flow Title: Basin-Existing Cond.
Flow File : p:\460-Canarico Quarries\ras\cq.f02

Flow Data (m3/s)

River	Reach	RS	100 YRS.	50 YRS.	25 YRS.	10 YRS.	2 YRS.
WATERCOURSE	1	6	140.93	127.71	114.53	95.03	[illegible]

Boundary Conditions

River	Reach	Profile	Upstream	Downstream

WATERCOURSE 1 100 YRS. Critical Normal S = 0.007

GEOMETRY DATA

Geometry Title: Existing Condition
Geometry File : p:\460-Canarico Quarries\ras\cq.g02

CROSS SECTION

RIVER: WATERCOURSE
REACH: 1 RS: 6

INPUT
Description:
Station Elevation Data num 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	78	11.32	77.5	16.2	75	44.63	74	47.46	73.5
49.28	72.82	53.13	72.85	54.18	74	67.48	85		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	11.32	.055	67.48	.065

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
11.32	67.48	5	5	5	.1	.3

CROSS SECTION OUTPUT Profile #100 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	76.55	Element			
Vel Head (m)	0.12	Wt. n-Val.		0.055	
W.S. Elev (m)	76.43	Reach Len. (m)	5.00	5.00	5.00
Crit W.S. (m)	75.29	Flow Area (m2)		91.10	
E.G. Slope (m/m)	0.002980	Area (m2)		91.10	
Q Total (m3/s)	140.93	Flow (m3/s)		140.93	
Top Width (m)	43.72	Top Width (m)		43.72	
Vel Total (m/s)	1.55	Avg. Vel. (m/s)		1.55	
Max Chl Dpth (m)	3.61	Hydr. Depth (m)		2.08	
Conv. Total (m3/s)	2626.1	Conv. (m3/s)		2626.1	
Length Wtd. (m)	5.00	Wetted Per. (m)		45.63	
Min Ch El (m)	72.82	Shear (N/m2)		56.38	
Alpha	1.00	Stream Power (N/m s)		87.23	
Frctn Loss (m)	0.01	Cum Volume (1000 m3)		4.69	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)		2.38	0.01

CROSS SECTION OUTPUT Profile #50 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	76.38	Element			
Vel Head (m)	0.12	Wt. n-Val.		0.055	
W.S. Elev (m)	76.26	Reach Len. (m)	5.00	5.00	5.00
Crit W.S. (m)	75.22	Flow Area (m2)		83.69	
E.G. Slope (m/m)	0.003079	Area (m2)		83.69	
Q Total (m3/s)	127.71	Flow (m3/s)		127.71	
Top Width (m)	43.18	Top Width (m)		43.18	
Vel Total (m/s)	1.53	Avg. Vel. (m/s)		1.53	
Max Chl Dpth (m)	3.44	Hydr. Depth (m)		1.94	
Conv. Total (m3/s)	2301.5	Conv. (m3/s)		2301.5	
Length Wtd. (m)	5.00	Wetted Per. (m)		44.39	
Min Ch El (m)	72.82	Shear (N/m2)		56.15	
Alpha	1.00	Stream Power (N/m s)		85.72	
Frctn Loss (m)	0.02	Cum Volume (1000 m3)		4.35	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)		2.44	0.01

CROSS SECTION OUTPUT Profile #25 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	76.29	Element			
Vel Head (m)	0.11	Wt. n-Val.		0.055	
W.S. Elev (m)	76.19	Reach Len. (m)	5.00	5.00	5.00
Crit W.S. (m)	75.14	Flow Area (m2)		76.11	
E.G. Slope (m/m)	0.003514	Area (m2)		76.11	
Q Total (m3/s)	114.[illegible]	Flow (m3/s)		114.[illegible]	
Top Width (m)	[illegible]	Top Width (m)		[illegible]	
Vel Total (m/s)	1.50	Avg. Vel. (m/s)		1.50	
Max Chl Dpth (m)	[illegible]	Hydr. Depth (m)		1.[illegible]	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		[illegible]	

			44.33	
Length Wtd. (m)	5.00	Wetted Per. (m)	55.80	
Min Ch El (m)	72.82	Shear (N/m2)	83.75	
Alpha	1.00	Stream Power (N/m s)	3.99	0.00
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	2.39	0.01
C & E Loss (m)	0.00	Cum SA (1000 m2)		

CROSS SECTION OUTPUT Profile #10 YRS.

			Left OB	Channel	Right OB
		Element		0.055	
E.G. Elev (m)	75.94	Wt. n-Val.	5.00	5.00	5.00
Vel Head (m)	0.11	Reach Len. (m)		65.55	
W.S. Elev (m)	75.84	Flow Area (m2)		65.55	
Crit W.S. (m)	75.03	Area (m2)		95.03	
E.G. Slope (m/m)	0.003667	Flow (m3/s)		41.83	
Q Total (m3/s)	95.03	Top Width (m)		1.45	
Top Width (m)	41.83	Avg. Vel. (m/s)		1.57	
Vel Total (m/s)	1.45	Hydr. Depth (m)		1569.2	
Max Chl Dpth (m)	3.02	Conv. (m3/s)		43.38	
Conv. Total (m3/s)	1569.2	Wetted Per. (m)		54.34	
Length Wtd. (m)	5.00	Shear (N/m2)		78.77	
Min Ch El (m)	72.82	Stream Power (N/m s)		3.47	0.00
Alpha	1.00	Cum Volume (1000 m3)		2.30	0.00
Frctn Loss (m)	0.02	Cum SA (1000 m2)			
C & E Loss (m)	0.00				

CROSS SECTION OUTPUT Profile #2 YRS.

			Left OB	Channel	Right OB
		Element		0.055	
E.G. Elev (m)	75.32	Wt. n-Val.	5.00	5.00	5.00
Vel Head (m)	0.08	Reach Len. (m)		40.91	
W.S. Elev (m)	75.23	Flow Area (m2)		40.91	
Crit W.S. (m)	74.66	Area (m2)		52.33	
E.G. Slope (m/m)	0.004982	Flow (m3/s)		39.93	
Q Total (m3/s)	52.33	Top Width (m)		1.28	
Top Width (m)	39.93	Avg. Vel. (m/s)		1.02	
Vel Total (m/s)	1.28	Hydr. Depth (m)		741.4	
Max Chl Dpth (m)	2.41	Conv. (m3/s)		41.12	
Conv. Total (m3/s)	741.4	Wetted Per. (m)		48.61	
Length Wtd. (m)	5.00	Shear (N/m2)		62.18	
Min Ch El (m)	72.82	Stream Power (N/m s)		2.17	
Alpha	1.00	Cum Volume (1000 m3)		1.93	
Frctn Loss (m)	0.03	Cum SA (1000 m2)			
C & E Loss (m)	0.00				

CROSS SECTION

RIVER: WATERCOURSE
REACH: 1 RS: [illegible]

INPUT
Description:

Station Elevation Data				num	10						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	78	5.17	98	12.48	77.5	17.29	75	46.64	74		
49.81	72.75	54.06	72.68	55.02	74	62.08	81	66.75	85		

Manning's n Values					3	
Sta	n Val	Sta	n Val	Sta	n Val	
0	.065	12.48	.055	62.08	.065	

Bank Sta: Left	Right	Coeff's : Left	Channel	Right	Coeff Contr.	Expan.
12.48	62.08	17.33	13.81	14.21	.1	.3

CROSS SECTION OUTPUT Profile #100 YRS.

			Left OB	Channel	Right OB
		Element		0.055	
E.G. Elev (m)	[illegible]	Wt. n-Val.	13.33	13.81	14.21
Vel Head (m)	[illegible]	Reach Len. (m)		89.29	
W.S. Elev (m)	[illegible]	Flow Area (m2)		89.29	
Crit W.S. (m)	[illegible]	Area (m2)		140.93	
E.G. Slope (m/m)	[illegible]	Flow (m3/s)		42.88	
Q Total (m3/s)	[illegible]	Top Width (m)		1.58	
Top Width (m)	[illegible]	Avg. Vel. (m/s)		2.08	
Vel Total (m/s)	[illegible]	Hydr. Depth (m)		2587.8	
Max Chl Dpth (m)	[illegible]	Conv. (m3/s)		45.15	
Conv. Total (m3/s)	[illegible]	Wetted Per. (m)		58.88	
Length Wtd. (m)	[illegible]	Shear (N/m2)		80.93	
Min Ch El (m)	[illegible]	Stream Power (N/m s)		4.24	0.00
Alpha	[illegible]	Cum Volume (1000 m3)			
Frctn Loss (m)	[illegible]				

CA Engineering

			2.27	0.01
C & E Loss (m)	0.01	Cum SA (1000 m2)		

CROSS SECTION OUTPUT Profile #50 YRS.

		Element	Left OB	Channel	Right OB
E.G. Elev (m)	76.36	Wt. n-Val.		0.055	
Vel Head (m)	0.12	Reach Len. (m)	13.33	13.81	14.21
W.S. Elev (m)	76.24	Flow Area (m2)		81.97	
Crit W.S. (m)		Area (m2)		81.97	
E.G. Slope (m/m)	0.003255	Flow (m3/s)		127.71	
Q Total (m3/s)	127.71	Top Width (m)		42.38	
Top Width (m)	42.38	Avg. Vel. (m/s)		1.56	
Vel Total (m/s)	1.56	Hydr. Depth (m)		1.93	
Max Chl Dpth (m)	3.56	Conv. (m3/s)		2238.5	
Conv. Total (m3/s)	2238.5	Wetted Per. (m)		44.53	
Length Wtd. (m)	13.81	Shear (N/m2)		58.75	
Min Ch El (m)	72.68	Stream Power (N/m s)		91.54	
Alpha	1.00	Cum Volume (1000 m3)		3.93	0.00
Frctn Loss (m)	0.06	Cum SA (1000 m2)		2.23	0.01
C & E Loss (m)	0.01				

CROSS SECTION OUTPUT Profile #25 YRS.

		Element	Left OB	Channel	Right OB
E.G. Elev (m)	76.18	Wt. n-Val.		0.055	
Vel Head (m)	0.12	Reach Len. (m)	13.33	13.81	14.21
W.S. Elev (m)	76.06	Flow Area (m2)		74.48	
Crit W.S. (m)		Area (m2)		74.48	
E.G. Slope (m/m)	0.003516	Flow (m3/s)		114.23	
Q Total (m3/s)	114.23	Top Width (m)		41.86	
Top Width (m)	41.86	Avg. Vel. (m/s)		1.53	
Vel Total (m/s)	1.53	Hydr. Depth (m)		1.78	
Max Chl Dpth (m)	3.38	Conv. (m3/s)		1926.4	
Conv. Total (m3/s)	1926.4	Wetted Per. (m)		43.89	
Length Wtd. (m)	13.81	Shear (N/m2)		58.51	
Min Ch El (m)	72.68	Stream Power (N/m s)		89.74	
Alpha	1.00	Cum Volume (1000 m3)		3.61	0.00
Frctn Loss (m)	0.06	Cum SA (1000 m2)		2.18	0.01
C & E Loss (m)	0.01				

CROSS SECTION OUTPUT Profile #10 YRS.

		Element	Left OB	Channel	Right OB
E.G. Elev (m)	75.92	Wt. n-Val.		0.055	
Vel Head (m)	0.11	Reach Len. (m)	13.33	13.81	14.21
W.S. Elev (m)	75.81	Flow Area (m2)		64.02	
Crit W.S. (m)		Area (m2)		64.02	
E.G. Slope (m/m)	0.003970	Flow (m3/s)		95.03	
Q Total (m3/s)	95.03	Top Width (m)		41.12	
Top Width (m)	41.12	Avg. Vel. (m/s)		1.48	
Vel Total (m/s)	1.48	Hydr. Depth (m)		1.56	
Max Chl Dpth (m)	3.13	Conv. (m3/s)		1517.8	
Conv. Total (m3/s)	1517.8	Wetted Per. (m)		42.99	
Length Wtd. (m)	13.81	Shear (N/m2)		57.24	
Min Ch El (m)	72.68	Stream Power (N/m s)		84.98	
Alpha	1.00	Cum Volume (1000 m3)		3.15	0.00
Frctn Loss (m)	0.07	Cum SA (1000 m2)		2.09	0.00
C & E Loss (m)	0.01				

CROSS SECTION OUTPUT Profile #2 YRS.

		Element	Left OB	Channel	Right OB
E.G. Elev (m)	[illegible]	Wt. n-Val.		0.055	
Vel Head (m)	[illegible]	Reach Len. (m)	13.33	13.81	14.21
W.S. Elev (m)	[illegible]	Flow Area (m2)		39.42	
Crit W.S. (m)		Area (m2)		39.42	
E.G. Slope (m/m)	[illegible]	Flow (m3/s)		52.33	
Q Total (m3/s)	[illegible]	Top Width (m)		39.32	
Top Width (m)	[illegible]	Avg. Vel. (m/s)		1.33	
Vel Total (m/s)	[illegible]	Hydr. Depth (m)		1.00	
Max Chl Dpth (m)	[illegible]	Conv. (m3/s)		700.7	
Conv. Total (m3/s)	[illegible]	Wetted Per. (m)		40.79	
Length Wtd. (m)	[illegible]	Shear (N/m2)		52.86	
Min Ch El (m)	[illegible]	Stream Power (N/m s)		70.17	
Alpha	[illegible]	Cum Volume (1000 m3)		1.97	
Frctn Loss (m)	[illegible]	Cum SA (1000 m2)		1.73	
C & E Loss (m)	[illegible]				

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

CA Engineering

CROSS SECTION

RIVER: WATERCOURSE
REACH: 1 RS: 4.5

INPUT
Description:
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	78	7.57	77.5	12.83	75	32.59	74.5	36.91	73.5
38.56	72.55	44.19	72.6	44.99	74	56.66	86		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	7.57	.055	56.66	.065

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
7.57	56.66	19.62	17.07	16.18	.1	.3

CROSS SECTION OUTPUT Profile #100 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	76.48	Element			
Vel Head (m)	0.19	Wt. n-Val.		0.055	
W.S. Elev (m)	76.29	Reach Len. (m)	19.62	17.07	16.18
Crit W.S. (m)		Flow Area (m2)		73.45	
E.G. Slope (m/m)	0.004881	Area (m2)		73.45	
Q Total (m3/s)	140.93	Flow (m3/s)		140.93	
Top Width (m)	37.11	Top Width (m)		37.11	
Vel Total (m/s)	1.92	Avg. Vel. (m/s)		1.92	
Max Chl Dpth (m)	3.74	Hydr. Depth (m)		1.98	
Conv. Total (m3/s)	2017.3	Conv. (m3/s)		2017.3	
Length Wtd. (m)	17.07	Wetted Per. (m)		39.56	
Min Ch El (m)	72.55	Shear (N/m2)		88.86	
Alpha	1.00	Stream Power (N/m s)		170.51	
Frctn Loss (m)	0.08	Cum Volume (1000 m3)		3.12	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)		1.72	0.01

CROSS SECTION OUTPUT Profile #50 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	76.30	Element			
Vel Head (m)	0.19	Wt. n-Val.		0.055	
W.S. Elev (m)	76.12	Reach Len. (m)	19.62	17.07	16.18
Crit W.S. (m)		Flow Area (m2)		66.91	
E.G. Slope (m/m)	0.005348	Area (m2)		66.91	
Q Total (m3/s)	127.71	Flow (m3/s)		127.71	
Top Width (m)	36.57	Top Width (m)		36.57	
Vel Total (m/s)	1.91	Avg. Vel. (m/s)		1.91	
Max Chl Dpth (m)	3.57	Hydr. Depth (m)		1.83	
Conv. Total (m3/s)	1746.4	Conv. (m3/s)		1746.4	
Length Wtd. (m)	17.07	Wetted Per. (m)		38.90	
Min Ch El (m)	72.55	Shear (N/m2)		90.20	
Alpha	1.00	Stream Power (N/m s)		172.17	
Frctn Loss (m)	0.08	Cum Volume (1000 m3)		2.90	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)		1.68	0.01

CROSS SECTION OUTPUT Profile #25 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	76.11	Element			
Vel Head (m)	0.18	Wt. n-Val.		0.055	
W.S. Elev (m)	75.93	Reach Len. (m)	19.62	17.07	16.18
Crit W.S. (m)		Flow Area (m2)		60.21	
E.G. Slope (m/m)	0.005939	Area (m2)		60.21	
Q Total (m3/s)	114.23	Flow (m3/s)		114.23	
Top Width (m)	36.00	Top Width (m)		36.00	
Vel Total (m/s)	1.90	Avg. Vel. (m/s)		1.90	
Max Chl Dpth (m)	3.38	Hydr. Depth (m)		1.67	
Conv. Total (m3/s)	1482.3	Conv. (m3/s)		1482.3	
Length Wtd. (m)	17.07	Wetted Per. (m)		38.21	
Min Ch El (m)	72.55	Shear (N/m2)		91.77	
Alpha	1.00	Stream Power (N/m s)		174.11	
Frctn Loss (m)	0.09	Cum Volume (1000 m3)		2.68	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)		1.64	0.01

CROSS SECTION OUTPUT Profile #10 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	75.85	Element			

Vel Head (m)	0.18	Wt. n-Val.			0.055	
W.S. Elev (m)	75.67	Reach Len. (m)		19.62	17.07	16.18
Crit W.S. (m)		Flow Area (m2)			50.83	
E.G. Slope (m/m)	0.006982	Area (m2)			50.93	
Q Total (m3/s)	95.03	Flow (m3/s)			95.03	
Top Width (m)	35.19	Top Width (m)			35.19	
Vel Total (m/s)	1.87	Avg. Vel. (m/s)			1.87	
Max Chl Dpth (m)	3.12	Hydr. Depth (m)			1.44	
Conv. Total (m3/s)	1137.3	Conv. (m3/s)			1137.3	
Length Wtd. (m)	17.07	Wetted Per. (m)			37.23	
Min Ch El (m)	72.55	Shear (N/m2)			93.48	
Alpha	1.00	Stream Power (N/m s)			174.77	
Frctn Loss (m)	0.09	Cum Volume (1000 m3)			2.36	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)			1.56	0.00

CROSS SECTION OUTPUT Profile #2 YRS.

E.G. Elev (m)	75.16	Element	Left OB	Channel	Right OB
Vel Head (m)	0.19	Wt. n-Val.		0.055	
W.S. Elev (m)	74.97	Reach Len. (m)	19.62	17.07	16.18
Crit W.S. (m)		Flow Area (m2)		26.98	
E.G. Slope (m/m)	0.015152	Area (m2)		26.98	
Q Total (m3/s)	52.33	Flow (m3/s)		52.33	
Top Width (m)	31.84	Top Width (m)		31.84	
Vel Total (m/s)	1.94	Avg. Vel. (m/s)		1.94	
Max Chl Dpth (m)	3.42	Hydr. Depth (m)		0.85	
Conv. Total (m3/s)	425.1	Conv. (m3/s)		425.1	
Length Wtd. (m)	17.07	Wetted Per. (m)		33.43	
Min Ch El (m)	72.55	Shear (N/m2)		119.89	
Alpha	1.00	Stream Power (N/m s)		232.56	
Frctn Loss (m)	0.11	Cum Volume (1000 m3)		1.51	
C & E Loss (m)	0.02	Cum SA (1000 m2)		1.24	

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

CROSS SECTION

RIVER: WATERCOURSE
REACH: 1 RS: 4

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	77	4.7	75.5	16.87	73	19.81	72.36	25.27	72.36
26.45	73	37.78	78.5	45.96	85	51.99	86	55.24	87

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	0	.055	37.78	.065

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	37.78	9.25	10	11	.1	.3

Skew Angle = 60

CROSS SECTION OUTPUT Profile #100 YRS.

E.G. Elev (m)	76.40	Element	Left OB	Channel	Right OB
Vel Head (m)	0.20	Wt. n-Val.		0.055	
W.S. Elev (m)	76.20	Reach Len. (m)	9.25	10.00	11.00
Crit W.S. (m)		Flow Area (m2)		70.47	
E.G. Slope (m/m)	0.004197	Area (m2)		70.47	
Q Total (m3/s)	140.93	Flow (m3/s)		140.93	
Top Width (m)	30.53	Top Width (m)		30.53	
Vel Total (m/s)	2.00	Avg. Vel. (m/s)		2.00	
Max Chl Dpth (m)	3.84	Hydr. Depth (m)		2.31	
Conv. Total (m3/s)	2175.3	Conv. (m3/s)		2175.3	
Length Wtd. (m)	10.00	Wetted Per. (m)		31.86	
Min Ch El (m)	72.36	Shear (N/m2)		91.05	
Alpha	1.00	Stream Power (N/m s)		182.09	
Frctn Loss (m)	0.08	Cum Volume (1000 m3)		1.89	0.00
C & E Loss (m)	0.07	Cum SA (1000 m2)		1.14	0.01

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

0.7 or greater than 1.4. This may indicate the need for additional c[illegible] section[illegible].

CROSS SECTION OUTPUT Profile #50 YRS.

E.G. Elev (m)	76.22	Element	Left OB	Channel	[illegible]ht OB
Vel Head (m)	0.20	Wt. n-Val.		0.055	
W.S. Elev (m)	76.02	Reach Len. (m)	9.25	10.00	[illegible]1.00
Crit W.S. (m)		Flow Area (m2)		65.22	
E.G. Slope (m/m)	0.004282	Area (m2)		65.22	
Q Total (m3/s)	127.71	Flow (m3/s)		127.71	
Top Width (m)	29.62	Top Width (m)		29.62	
Vel Total (m/s)	1.96	Avg. Vel. (m/s)		1.96	
Max Chl Dpth (m)	3.66	Hydr. Depth (m)		2.20	
Conv. Total (m3/s)	1951.7	Conv. (m3/s)		1951.7	
Length Wtd. (m)	10.00	Wetted Per. (m)		30.88	
Min Ch El (m)	72.36	Shear (N/m2)		88.67	
Alpha	1.00	Stream Power (N/m s)		173.64	
Frctn Loss (m)	0.08	Cum Volume (1000 m3)		1.78	0.00
C & E Loss (m)	0.06	Cum SA (1000 m2)		1.12	0.01

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

CROSS SECTION OUTPUT Profile #25 YRS.

E.G. Elev (m)	76.03	Element	Left OB	Channel	Right OB
Vel Head (m)	0.18	Wt. n-Val.		0.055	
W.S. Elev (m)	75.84	Reach Len. (m)	9.25	10.00	11.00
Crit W.S. (m)		Flow Area (m2)		59.96	
E.G. Slope (m/m)	0.004337	Area (m2)		59.96	
Q Total (m3/s)	114.23	Flow (m3/s)		114.23	
Top Width (m)	28.68	Top Width (m)		28.68	
Vel Total (m/s)	1.91	Avg. Vel. (m/s)		1.91	
Max Chl Dpth (m)	3.48	Hydr. Depth (m)		2.09	
Conv. Total (m3/s)	1734.5	Conv. (m3/s)		1734.5	
Length Wtd. (m)	10.00	Wetted Per. (m)		29.88	
Min Ch El (m)	72.36	Shear (N/m2)		85.36	
Alpha	1.00	Stream Power (N/m s)		162.63	
Frctn Loss (m)	0.08	Cum Volume (1000 m3)		1.66	0.00
C & E Loss (m)	0.06	Cum SA (1000 m2)		1.09	0.01

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

CROSS SECTION OUTPUT Profile #10 YRS.

E.G. Elev (m)	75.75	Element	Left OB	Channel	[illegible] OB
Vel Head (m)	0.17	Wt. n-Val.		0.055	
W.S. Elev (m)	75.58	Reach Len. (m)	9.25	10.00	[illegible]0
Crit W.S. (m)		Flow Area (m2)		52.70	
E.G. Slope (m/m)	0.004320	Area (m2)		52.70	
Q Total (m3/s)	95.03	Flow (m3/s)		95.03	
Top Width (m)	27.34	Top Width (m)		27.34	
Vel Total (m/s)	1.80	Avg. Vel. (m/s)		1.80	
Max Chl Dpth (m)	3.22	Hydr. Depth (m)		1.93	
Conv. Total (m3/s)	1445.8	Conv. (m3/s)		1445.8	
Length Wtd. (m)	10.00	Wetted Per. (m)		28.43	
Min Ch El (m)	72.36	Shear (N/m2)		78.53	
Alpha	1.00	Stream Power (N/m s)		141.40	
Frctn Loss (m)	0.07	Cum Volume (1000 m3)		1.47	
C & E Loss (m)	0.04	Cum SA (1000 m2)		1.03	

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

CROSS SECTION OUTPUT Profile #1 [illegible].

E.G. Elev (m)	[illegible]	Element	Left OB	Channel	R[illegible]
Vel Head (m)	[illegible]	Wt. n-Val.		[illegible]	
W.S. Elev (m)	[illegible]	Reach Len. (m)	[illegible]	[illegible]	
Crit W.S. (m)		Flow Area (m2)		[illegible]	
E.G. Slope (m/m)	[illegible]	Area (m2)		[illegible]	

Q Total (m3/s)	52.33	Flow (m3/s)	52.33
Top Width (m)	22.83	Top Width (m)	22.83
Vel Total (m/s)	1.46	Avg. Vel. (m/s)	1.46
Max Chl Dpth (m)	2.55	Hydr. Depth (m)	1.57
Conv. Total (m3/s)	857.0	Conv. (m3/s)	857.0
Length Wtd. (m)	10.00	Wetted Per. (m)	23.69
Min Ch El (m)	72.36	Shear (N/m2)	55.24
Alpha	1.00	Stream Power (N/m s)	80.75
Frctn Loss (m)	0.05	Cum Volume (1000 m3)	0.97
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.77

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

CROSS SECTION

RIVER: WATERCOURSE
REACH: 1 RS: 3

INPUT
Description:
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	77	9.97	73.5	12.63	72.29	18.58	72.29	20.26	74.5
25.69	77.5	32.46	80						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	0	.055	25.69	.065

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	25.69	15	14.55	13.8	.1	.3

CROSS SECTION OUTPUT Profile #100 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	76.25	Element			
Vel Head (m)	0.87	Wt. n-Val.		0.055	
W.S. Elev (m)	75.38	Reach Len. (m)	15.00	14.55	13.80
Crit W.S. (m)	75.28	Flow Area (m2)		34.01	
E.G. Slope (m/m)	0.024121	Area (m2)		34.01	
Q Total (m3/s)	140.93	Flow (m3/s)		140.93	
Top Width (m)	17.22	Top Width (m)		17.22	
Vel Total (m/s)	4.14	Avg. Vel. (m/s)		4.14	
Max Chl Dpth (m)	3.09	Hydr. Depth (m)		1.97	
Conv. Total (m3/s)	907.4	Conv. (m3/s)		907.4	
Length Wtd. (m)	14.55	Wetted Per. (m)		19.13	
Min Ch El (m)	72.29	Shear (N/m2)		420.56	
Alpha	1.00	Stream Power (N/m s)		1742.92	
Frctn Loss (m)	0.38	Cum Volume (1000 m3)		1.37	0.00
C & E Loss (m)	0.06	Cum SA (1000 m2)		0.90	0.01

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #50 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	76.08	Element			
Vel Head (m)	0.76	Wt. n-Val.		0.055	
W.S. Elev (m)	75.32	Reach Len. (m)	15.00	14.55	13.80
Crit W.S. (m)	75.13	Flow Area (m2)		32.98	
E.G. Slope (m/m)	0.021470	Area (m2)		32.98	
Q Total (m3/s)	127.71	Flow (m3/s)		127.71	
Top Width (m)	16.94	Top Width (m)		16.94	
Vel Total (m/s)	3.87	Avg. Vel. (m/s)		3.87	
Max Chl Dpth (m)	3.03	Hydr. Depth (m)		1.95	
Conv. Total (m3/s)	871.6	Conv. (m3/s)		871.6	
Length Wtd. (m)	14.55	Wetted Per. (m)		18.82	
Min Ch El (m)	72.29	Shear (N/m2)		368.95	
Alpha	1.00	Stream Power (N/m s)		1428.69	
Frctn Loss (m)	0.36	Cum Volume (1000 m3)		1.29	0.00
C & E Loss (m)	0.03	Cum SA (1000 m2)		0.88	0.01

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

CROSS SECTION OUTPUT Profile #25 YRS.

E.G. Elev (m)	75.90	Element	Left OB	Channel	Right OB
Vel Head (m)	0.66	Wt. n-Val.		0.055	
W.S. Elev (m)	75.24	Reach Len. (m)	15.00	14.55	13.80
Crit W.S. (m)		Flow Area (m2)		31.66	
E.G. Slope (m/m)	0.019134	Area (m2)		31.66	
Q Total (m3/s)	114.23	Flow (m3/s)		114.23	
Top Width (m)	16.57	Top Width (m)		16.57	
Vel Total (m/s)	3.61	Avg. Vel. (m/s)		3.61	
Max Chl Dpth (m)	2.95	Hydr. Depth (m)		1.91	
Conv. Total (m3/s)	825.8	Conv. (m3/s)		825.8	
Length Wtd. (m)	14.55	Wetted Per. (m)		18.42	
Min Ch El (m)	72.29	Shear (N/m2)		322.48	
Alpha	1.00	Stream Power (N/m s)		1163.68	
Frctn Loss (m)	0.34	Cum Volume (1000 m3)		1.20	0.00
C & E Loss (m)	0.02	Cum SA (1000 m2)		0.86	0.01

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

CROSS SECTION OUTPUT Profile #10 YRS.

E.G. Elev (m)	75.64	Element	Left OB	Channel	Right OB
Vel Head (m)	0.52	Wt. n-Val.		0.055	
W.S. Elev (m)	75.12	Reach Len. (m)	15.00	14.55	13.80
Crit W.S. (m)		Flow Area (m2)		29.75	
E.G. Slope (m/m)	0.015595	Area (m2)		29.75	
Q Total (m3/s)	95.03	Flow (m3/s)		95.03	
Top Width (m)	16.03	Top Width (m)		16.03	
Vel Total (m/s)	3.19	Avg. Vel. (m/s)		3.19	
Max Chl Dpth (m)	2.83	Hydr. Depth (m)		1.86	
Conv. Total (m3/s)	761.0	Conv. (m3/s)		761.0	
Length Wtd. (m)	14.55	Wetted Per. (m)		17.82	
Min Ch El (m)	72.29	Shear (N/m2)		255.24	
Alpha	1.00	Stream Power (N/m s)		815.41	
Frctn Loss (m)	0.31	Cum Volume (1000 m3)		1.06	0.00
C & E Loss (m)	0.01	Cum SA (1000 m2)		0.81	0.00

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

CROSS SECTION OUTPUT Profile #2 YRS.

E.G. Elev (m)	74.95	Element	Left OB	Channel	Right OB
Vel Head (m)	0.26	Wt. n-Val.		0.055	
W.S. Elev (m)	74.70	Reach Len. (m)	15.00	14.55	13.80
Crit W.S. (m)		Flow Area (m2)		23.36	
E.G. Slope (m/m)	0.008909	Area (m2)		23.36	
Q Total (m3/s)	52.33	Flow (m3/s)		52.33	
Top Width (m)	14.05	Top Width (m)		14.05	
Vel Total (m/s)	2.24	Avg. Vel. (m/s)		2.24	
Max Chl Dpth (m)	2.41	Hydr. Depth (m)		1.66	
Conv. Total (m3/s)	554.4	Conv. (m3/s)		554.4	
Length Wtd. (m)	14.55	Wetted Per. (m)		15.66	
Min Ch El (m)	72.29	Shear (N/m2)		130.29	
Alpha	1.00	Stream Power (N/m s)		291.86	
Frctn Loss (m)	0.22	Cum Volume (1000 m3)		0.68	
C & E Loss (m)	0.02	Cum SA (1000 m2)		0.59	

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

CROSS SECTION

RIVER: WATERCOURSE
REACH: 1 RS: 2

INPUT
Description:
Station Elevation Data num 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	76.5	12.8	74.5	12.89	73	17.39	72.19	18.8	72.19
21.04	72.5	22.04	73	23.67	74	29.95	74.5	33.99	75
44.3	80.3								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	0	.055	33.99	.065

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	33.99	16.58	15.62	14.88	.1	.3

CROSS SECTION OUTPUT Profile #100 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	75.81	Element			
Vel Head (m)	0.68	Wt. n-Val.		0.055	0.065
W.S. Elev (m)	75.13	Reach Len. (m)	16.58	15.62	14.88
Crit W.S. (m)	75.13	Flow Area (m2)		38.43	0.02
E.G. Slope (m/m)	0.028329	Area (m2)		38.43	0.02
Q Total (m3/s)	140.93	Flow (m3/s)		140.92	0.01
Top Width (m)	28.62	Top Width (m)		28.38	0.24
Vel Total (m/s)	3.67	Avg. Vel. (m/s)		3.67	0.38
Max Chl Dpth (m)	2.94	Hydr. Depth (m)		1.35	0.06
Conv. Total (m3/s)	837.3	Conv. (m3/s)		837.3	0.0
Length Wtd. (m)	15.62	Wetted Per. (m)		29.30	0.28
Min Ch El (m)	72.19	Shear (N/m2)		364.38	15.88
Alpha	1.00	Stream Power (N/m s)		1336.15	6.10
Frctn Loss (m)	0.20	Cum Volume (1000 m3)		0.84	0.00
C & E Loss (m)	0.14	Cum SA (1000 m2)		0.57	0.01

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #50 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	75.68	Element			
Vel Head (m)	0.65	Wt. n-Val.		0.055	0.065
W.S. Elev (m)	75.04	Reach Len. (m)	16.58	15.62	14.88
Crit W.S. (m)	75.04	Flow Area (m2)		35.77	0.00
E.G. Slope (m/m)	0.029017	Area (m2)		35.77	0.00
Q Total (m3/s)	127.71	Flow (m3/s)		127.71	0.00
Top Width (m)	28.06	Top Width (m)		27.99	0.07
Vel Total (m/s)	3.57	Avg. Vel. (m/s)		3.57	0.16
Max Chl Dpth (m)	2.85	Hydr. Depth (m)		1.28	0.02
Conv. Total (m3/s)	749.7	Conv. (m3/s)		749.7	0.0
Length Wtd. (m)	15.62	Wetted Per. (m)		28.00	0.07
Min Ch El (m)	72.19	Shear (N/m2)		353.18	4.42
Alpha	1.00	Stream Power (N/m s)		1257.34	0.72
Frctn Loss (m)	0.20	Cum Volume (1000 m3)		0.79	0.00
C & E Loss (m)	0.14	Cum SA (1000 m2)		0.56	0.01

Warning: The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #25 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	75.55	Element			
Vel Head (m)	0.61	Wt. n-Val.		0.055	
W.S. Elev (m)	74.93	Reach Len. (m)	16.58	15.62	14.88
Crit W.S. (m)	74.93	Flow Area (m2)		33.00	
E.G. Slope (m/m)	0.029053	Area (m2)		33.00	
Q Total (m3/s)	114.23	Flow (m3/s)		114.23	
Top Width (m)	27.06	Top Width (m)		27.06	
Vel Total (m/s)	3.46	Avg. Vel. (m/s)		3.46	

Max Chl Dpth (m)	2.34	Hydr. Depth (m)	1.22	
Conv. Total (m3/s)	670.2	Conv. (m3/s)	670.2	
Length Wtd. (m)	15.62	Wetted Per. (m)	27.95	
Min Ch El (m)	72.19	Shear (N/m2)	336.38	
Alpha	1.00	Stream Power (N/m s)	1164.62	
Frctn Loss (m)	0.20	Cum Volume (1000 m3)	0.73	0.00
C & E Loss (m)	0.13	Cum CA (1000 m2)	0.54	0.01

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

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

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

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

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

CROSS SECTION OUTPUT Profile #10 YR5.

			Left OB	Channel	Right OB
E.G. Elev (m)	75.33	Element			
Vel Head (m)	0.57	Wt. n-Val.		0.055	
W.S. Elev (m)	74.75	Reach Len. (m)	16.58	15.62	14.08
Crit W.S. (m)	74.75	Flow Area (m2)		28.31	
E.G. Slope (m/m)	0.329999	Area (m2)		28.31	
Q Total (m3/s)	95.03	Flow (m3/s)		95.03	
Top Width (m)	24.86	Top Width (m)		24.86	
Vel Total (m/s)	1.36	Avg. Vel. (m/s)		3.36	
Max Chl Dpth (m)	2.56	Hydr. Depth (m)		1.14	
Conv. Total (m3/s)	548.7	Conv. (m3/s)		548.7	
Length Wtd. (m)	15.62	Wetted Per. (m)		25.71	
Min Ch El (m)	72.19	Shear (N/m2)		323.82	
Alpha	1.00	Stream Power (N/m s)		1087.16	
Frctn Loss (m)	0.20	Cum Volume (1000 m3)		0.64	0.00
C & E Loss (m)	0.12	Cum CA (1000 m2)		0.52	0.00

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

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

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

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

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

CROSS SECTION OUTPUT Profile #[illegible] YR5.

			Left OB	Channel	Right OB
E.G. Elev (m)	74.71	Element			
Vel Head (m)	0.50	Wt. n-Val.		0.055	
W.S. Elev (m)	74.21	Reach Len. (m)	16.58	15.62	14.08
Crit W.S. (m)	74.21	Flow Area (m2)		16.75	
E.G. Slope (m/m)	0.[illegible]	Area (m2)		16.75	
Q Total (m3/s)	[illegible]	Flow (m3/s)		67.[illegible]	
Top Width (m)	16.91	Top Width (m)		16.91	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		3.12	
Max Chl Dpth (m)	[illegible]	Hydr. Depth (m)		0.99	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		[illegible]	
Length Wtd. (m)	15.62	Wetted Per. (m)		17.08	
Min Ch El (m)	72.19	Shear (N/m2)		294.71	
Alpha	1.00	Stream Power (N/m s)		[illegible]	
Frctn Loss (m)	[illegible]	Cum Volume (1000 m3)		[illegible]	
C & E Loss (m)	[illegible]	Cum CA (1000 m2)		0.36	

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

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

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

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

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

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

CROSS SECTION

RIVER: WATERCOURSE
REACH: 1 RS: 1

INPUT
Description:
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	75.5	20.22	73	24.57	72.08	31.64	72.08	35.03	74
47.19	74.5	56.47	79.5						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	0	.055	47.19	.065

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	47.19	0	0	0	.1	.3

CROSS SECTION OUTPUT Profile #100 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	75.35	Element			
Vel Head (m)	0.21	Wt. n-Val.		0.055	0.065
W.S. Elev (m)	75.14	Reach Len. (m)			
Crit W.S. (m)	74.50	Flow Area (m2)		69.33	0.38
E.G. Slope (m/m)	0.007006	Area (m2)		69.33	0.38
Q Total (m3/s)	140.93	Flow (m3/s)		140.72	0.21
Top Width (m)	45.45	Top Width (m)		44.27	1.18
Vel Total (m/s)	2.02	Avg. Vel. (m/s)		2.03	0.55
Max Chl Dpth (m)	3.06	Hydr. Depth (m)		1.57	0.32
Conv. Total (m3/s)	1683.8	Conv. (m3/s)		1681.3	2.5
Length Wtd. (m)		Wetted Per. (m)		45.01	1.35
Min Ch El (m)	72.08	Shear (N/m2)		105.82	19.30
Alpha	1.01	Stream Power (N/m s)		214.79	10.66
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

CROSS SECTION OUTPUT Profile #50 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	75.23	Element			
Vel Head (m)	0.20	Wt. n-Val.		0.055	0.065
W.S. Elev (m)	75.04	Reach Len. (m)			
Crit W.S. (m)	74.40	Flow Area (m2)		64.87	0.27
E.G. Slope (m/m)	0.007011	Area (m2)		64.87	0.27
Q Total (m3/s)	127.71	Flow (m3/s)		127.58	0.13
Top Width (m)	44.44	Top Width (m)		43.44	1.00
Vel Total (m/s)	1.96	Avg. Vel. (m/s)		1.97	0.49
Max Chl Dpth (m)	2.96	Hydr. Depth (m)		1.49	0.27
Conv. Total (m3/s)	1525.3	Conv. (m3/s)		1523.7	1.6
Length Wtd. (m)		Wetted Per. (m)		44.18	1.13
Min Ch El (m)	72.08	Shear (N/m2)		100.94	16.23
Alpha	1.01	Stream Power (N/m s)		198.52	7.99
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

CROSS SECTION OUTPUT Profile #25 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	75.11	Element			
Vel Head (m)	0.18	Wt. n-Val.		0.055	0.065
W.S. Elev (m)	74.93	Reach Len. (m)			
Crit W.S. (m)	74.27	Flow Area (m2)		60.19	0.17
E.G. Slope (m/m)	0.007011	Area (m2)		60.19	0.17
Q Total (m3/s)	114.33	Flow (m3/s)		114.16	0.17
Top Width (m)	43.36	Top Width (m)		42.56	0.79
Vel Total (m/s)	1.89	Avg. Vel. (m/s)		1.90	0.42
Max Chl Dpth (m)	2.85	Hydr. Depth (m)		1.41	0.21
Conv. Total (m3/s)	1364.2	Conv. (m3/s)		1363.1	0.9
Length Wtd. (m)		Wetted Per. (m)		43.23	0.90
Min Ch El (m)	72.08	Shear (N/m2)		96.59	12.94
Alpha	1.00	Stream Power (N/m s)		181.39	5.48
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

CROSS SECTION OUTPUT Profile #10 YRS.

E.G. Elev (m)	74.92	Element	Left OB	Channel	Right OB
Vel Head (m)	0.16	Wt. n-Val.		0.055	0.065
W.S. Elev (m)	74.76	Reach Len. (m)			
Crit W.S. (m)	74.04	Flow Area (m2)		53.26	0.06
E.G. Slope (m/m)	0.007002	Area (m2)		53.26	0.06
Q Total (m3/s)	95.03	Flow (m3/s)		95.01	0.02
Top Width (m)	41.71	Top Width (m)		41.22	0.49
Vel Total (m/s)	1.78	Avg. Vel. (m/s)		1.78	0.31
Max Chl Dpth (m)	2.68	Hydr. Depth (m)		1.29	0.13
Conv. Total (m3/s)	1135.6	Conv. (m3/s)		1135.4	0.2
Length Wtd. (m)		Wetted Per. (m)		41.94	0.55
Min Ch El (m)	72.08	Shear (N/m2)		87.19	7.92
Alpha	1.00	Stream Power (N/m s)		155.54	2.42
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

CROSS SECTION OUTPUT Profile #2 YRS.

E.G. Elev (m)	74.34	Element	Left OB	Channel	Right OB
Vel Head (m)	0.13	Wt. n-Val.		0.055	
W.S. Elev (m)	74.21	Reach Len. (m)			
Crit W.S. (m)	73.51	Flow Area (m2)		32.72	
E.G. Slope (m/m)	0.007003	Area (m2)		32.72	
Q Total (m3/s)	52.33	Flow (m3/s)		52.33	
Top Width (m)	29.67	Top Width (m)		29.67	
Vel Total (m/s)	1.60	Avg. Vel. (m/s)		1.60	
Max Chl Dpth (m)	2.13	Hydr. Depth (m)		1.10	
Conv. Total (m3/s)	625.4	Conv. (m3/s)		625.4	
Length Wtd. (m)		Wetted Per. (m)		30.35	
Min Ch El (m)	72.08	Shear (N/m2)		74.02	
Alpha	1.00	Stream Power (N/m s)		118.41	
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

SUMMARY OF MANNING'S N VALUES

River:WATERCOURSE

Reach	River Sta.	n1	n2	n3
1	6	.065	.055	.065
1	5	.065	.055	.065
1	4.5	.065	.055	.065
1	4	.065	.055	.065
1	3	.065	.055	.065
1	2	.065	.055	.065
1	1	.065	.055	.065

SUMMARY OF REACH LENGTHS

River: WATERCOURSE

Reach	River Sta.	Left	Channel	Right
1	6	5	5	5
1	5	13.33	13.51	14.11
1	4.5	19.62	17.07	16.19
1	4	9.25	10	11
1	3	15	14.15	13.2
1	2	16.58	15.62	14.88
1	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: WATERCOURSE

Reach	River Sta.	Contr.	Expan.
1	6	.1	.3
1	5	.1	.3
1	4.5	.1	.3
1	4	.1	.3
1	3	.1	.3
1	2	.1	.3
1	1	.1	.3

SEE STANDARD TABLE 1 ON NEXT PAGE

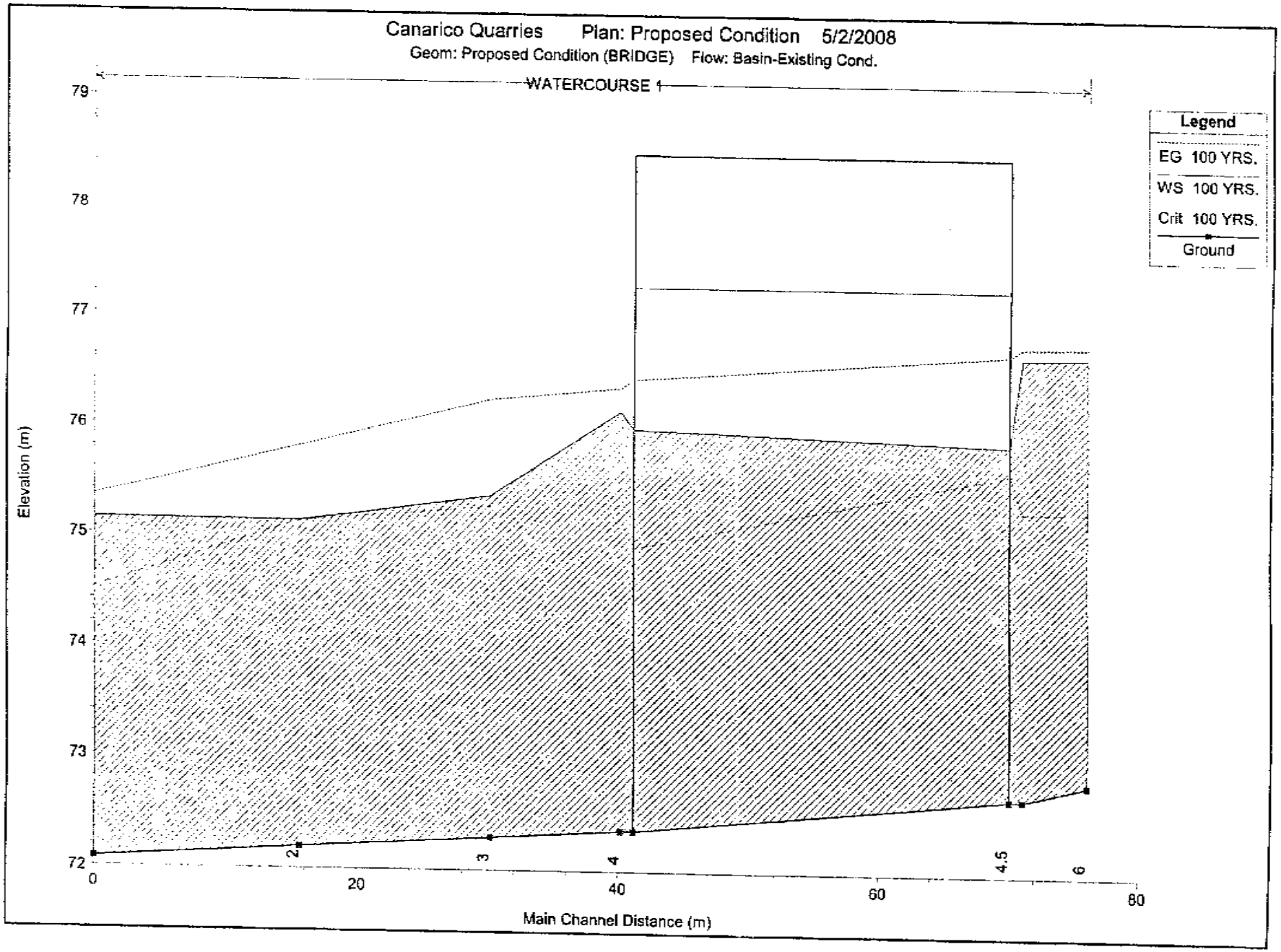
Profile Output Table-Standard Table 1

HEC-RAS Plan: Exist. River: WATERCOURSE Reach: 1

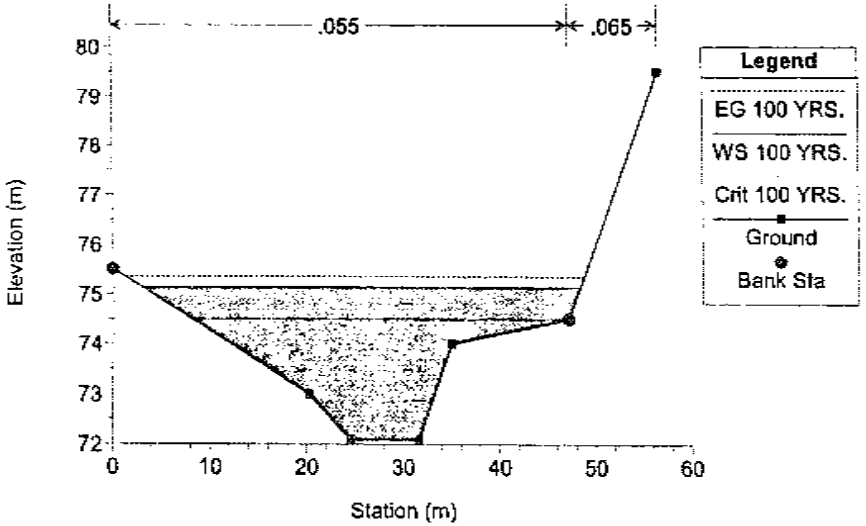
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
1	6	100 YRS.	140.93	72.82	76.43	75.29	76.55	0.00288	1.55	91.1	43.72	0.34
1	6	50 YRS.	127.71	72.82	76.26	75.22	76.38	0.003079	1.53	83.69	43.18	0.35
1	6	25 YRS.	114.23	72.82	76.09	75.14	76.2	0.003314	1.5	76.11	42.62	0.36
1	6	10 YRS.	95.03	72.82	75.84	75.03	75.94	0.003667	1.45	65.55	41.83	0.37
1	6	2 YRS.	52.33	72.82	75.23	74.66	75.32	0.004962	1.28	40.91	39.93	0.4
1	5	100 YRS.	140.93	72.68	76.41		76.54	0.003036	1.58	89.29	42.88	0.35
1	5	50 YRS.	127.71	72.68	76.24		76.36	0.003255	1.56	81.97	42.38	0.36
1	5	25 YRS.	114.23	72.68	76.06		76.18	0.003516	1.53	74.48	41.86	0.37
1	5	10 YRS.	95.03	72.68	75.81		75.92	0.00392	1.48	64.02	41.12	0.38
1	5	2 YRS.	52.33	72.68	75.2		75.29	0.005578	1.33	39.42	39.32	0.42
1	4.5	100 YRS	140.93	72.55	76.29		76.48	0.004881	1.92	73.45	37.11	0.44
1	4.5	50 YRS.	127.71	72.55	76.12		76.3	0.005346	1.91	66.91	36.57	0.45
1	4.5	25 YRS.	114.23	72.55	75.93		76.11	0.005939	1.9	60.21	36	0.47
1	4.5	10 YRS.	95.03	72.55	75.67		75.85	0.006982	1.87	50.83	35.19	0.5
1	4.5	2 YRS.	52.33	72.55	74.97		75.16	0.015152	1.94	26.98	31.84	0.67
1	4	100 YRS.	140.93	72.36	76.2		76.4	0.004197	2	70.47	30.53	0.42
1	4	50 YRS.	127.71	72.36	76.02		76.22	0.004282	1.96	65.22	29.62	0.42
1	4	25 YRS.	114.23	72.36	75.84		76.03	0.004337	1.91	59.96	28.68	0.42
1	4	10 YRS.	95.03	72.36	75.58		75.75	0.00432	1.8	52.7	27.34	0.41
1	4	2 YRS.	52.33	72.36	74.91		75.02	0.003728	1.46	35.8	22.83	0.37
1	3	100 YRS.	140.93	72.29	75.38	75.28	76.25	0.024121	4.14	34.01	17.22	0.94
1	3	50 YRS.	127.71	72.29	75.32	75.13	76.08	0.02147	3.87	32.98	16.94	0.89
1	3	25 YRS.	114.23	72.29	75.24		75.9	0.019134	3.61	31.56	16.57	0.83
1	3	10 YRS	95.03	72.29	75.12		75.64	0.015595	3.19	29.75	16.03	0.75
1	3	2 YRS.	52.33	72.29	74.7		74.95	0.008908	2.24	23.36	14.05	0.55
1	2	100 YRS.	140.93	72.19	75.13	75.13	75.81	0.028329	3.67	38.45	28.62	1.01
1	2	50 YRS	127.71	72.19	75.04	75.04	75.68	0.029017	3.57	35.77	28.06	1.01
1	2	25 YRS.	114.23	72.19	74.93	74.93	75.55	0.029053	3.46	33	27.06	1
1	2	10 YRS.	95.03	72.19	74.75	74.75	75.33	0.029998	3.36	28.31	24.86	1
1	2	2 YRS	52.33	72.19	74.21	74.21	74.71	0.031713	3.12	16.75	16.91	1
1	1	100 YRS	140.93	72.08	75.14	74.5	75.35	0.007006	2.03	69.71	45.45	0.52
1	1	50 YRS.	127.71	72.08	75.04	74.4	75.23	0.007011	1.97	65.14	44.44	0.51
1	1	25 YRS.	114.23	72.08	74.93	74.27	75.11	0.007011	1.9	60.36	43.36	0.51
1	1	10 YRS.	95.03	72.08	74.76	74.04	74.92.	0.007002	1.78	53.32	41.71	0.5
1	1	2 YRS.	52.33	72.08	74.21	73.51	74.34	0.007003	1.6	32.72	29.67	0.49

APPENDIX D

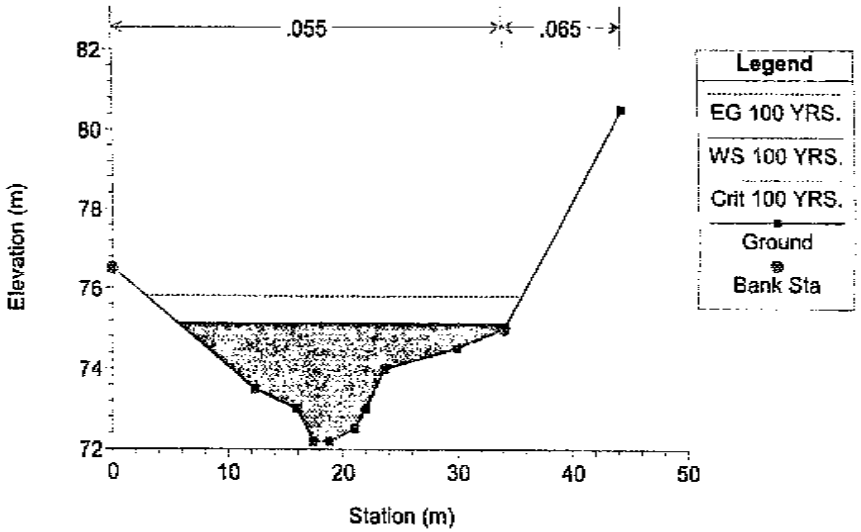
HYDRAULIC ANALYSIS RESULTS FOR PROPOSED CONDITION


Canarico Quarries Plan: Proposed Condition 5/2/2008
Geom: Proposed Condition (BRIDGE) Flow: Basin-Existing Cond.
WATERCOURSE 1
Legend
EG 100 YRS.
WS 100 YRS.
Crit 100 YRS.
Ground
Elevation (m)
79
78
77
76
75
74
73
72
0
20
40
60
80
2
3
4
4.5
6
Main Channel Distance (m)

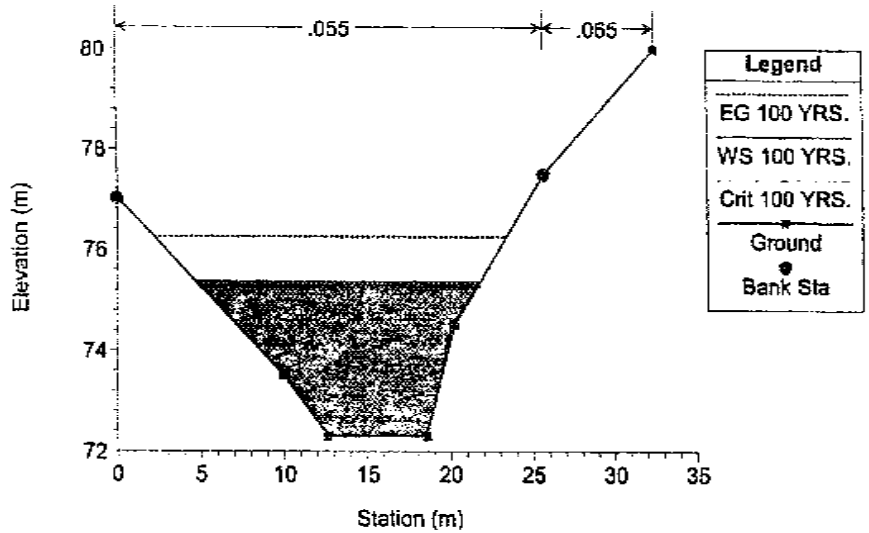
Canarico Quarries Plan: Proposed Condition 5/2/2008
Geom: Proposed Condition (BRIDGE) Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 1



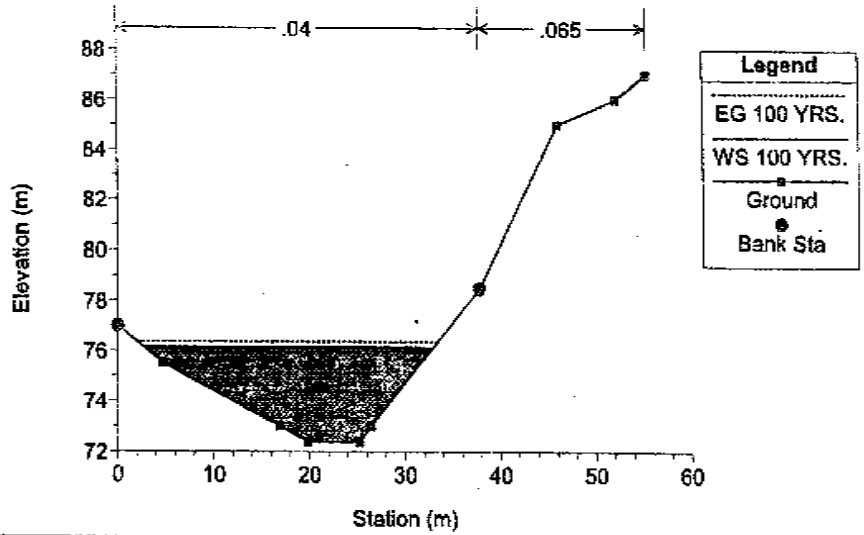
Canarico Quarries Plan: Proposed Condition 5/2/2008
Geom: Proposed Condition (BRIDGE) Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 2



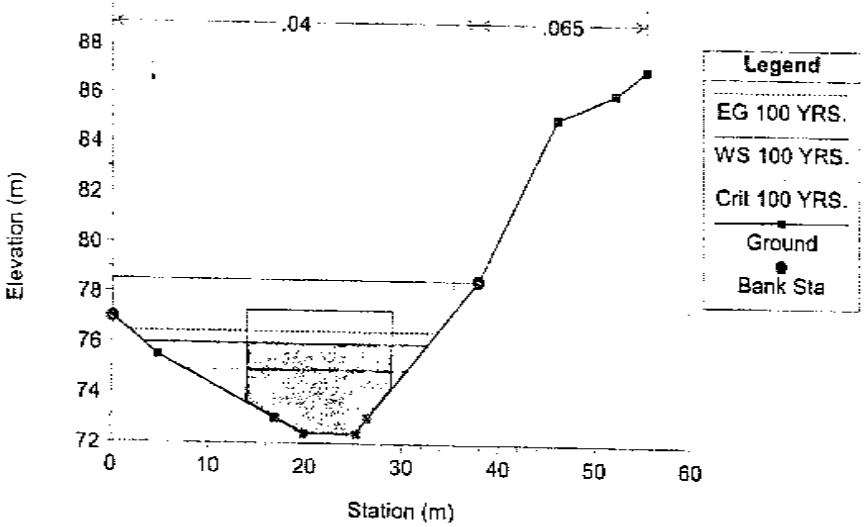
Canarico Quarries Plan: Proposed Condition 5/2/2008
Geom: Proposed Condition (BRIDGE) Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 3



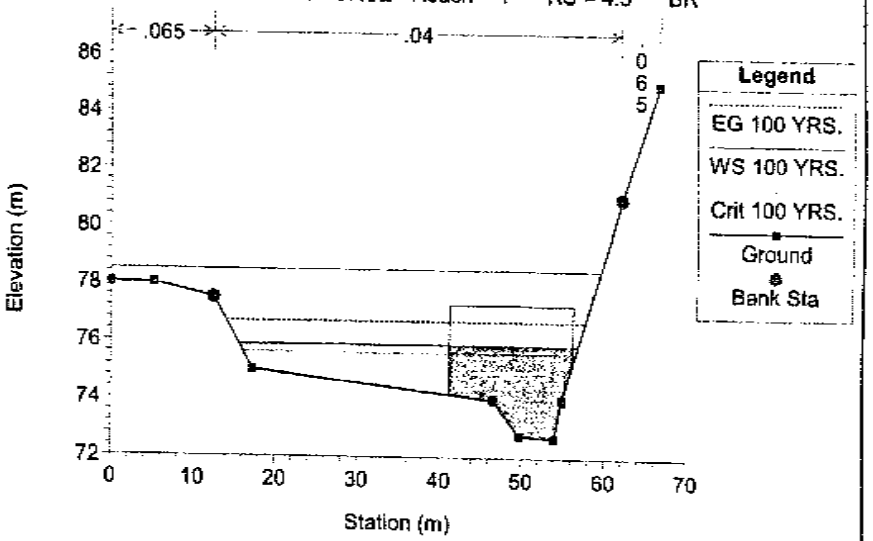
Canarico Quarries Plan: Proposed Condition 5/2/2008
Geom: Proposed Condition (BRIDGE) Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 4



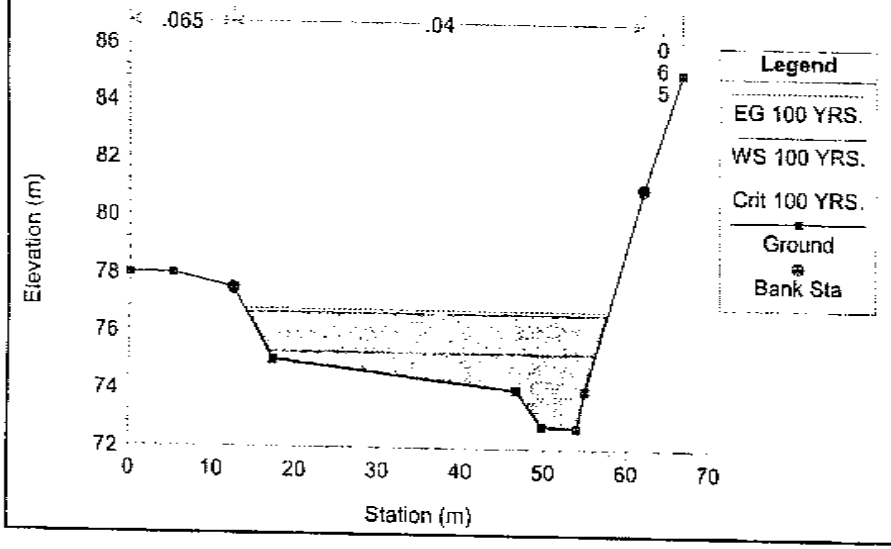
Canarico Quarries Plan: Proposed Condition 5/2/2008
Geom: Proposed Condition (BRIDGE) Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 4.5 BR



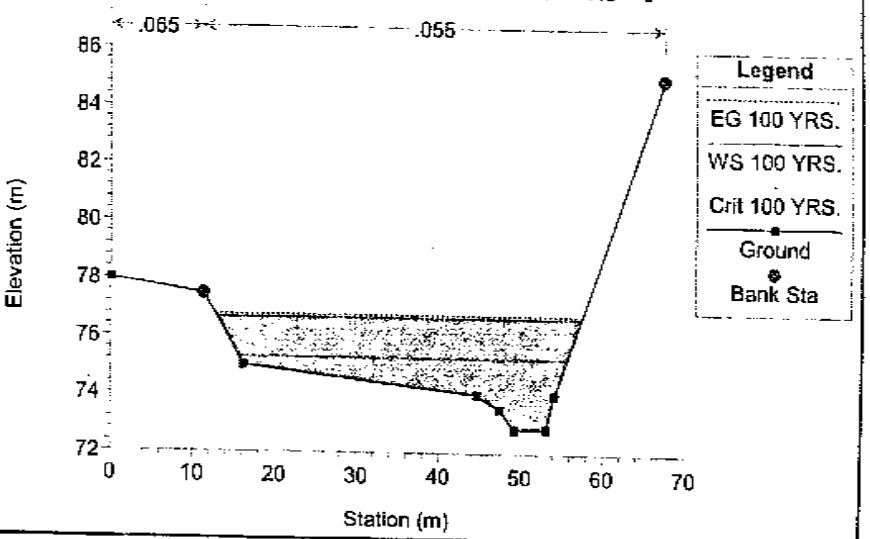
Canarico Quarries Plan: Proposed Condition 5/2/2008
Geom: Proposed Condition (BRIDGE) Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 4.5 BR



Canarico Quarries Plan: Proposed Condition 5/2/2008
Geom: Proposed Condition (BRIDGE) Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 5



Canarico Quarries Plan: Proposed Condition 5/2/2008
Geom: Proposed Condition (BRIDGE) Flow: Basin-Existing Cond.
River = WATERCOURSE Reach = 1 RS = 6



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: Canaries Quarries
Project File : rq.prj
New Date and Time: 5/1/2008 10:32:34 PM

Project in SI units

Project Description:
4 H Study for New Bridge

PLAN DATA

Plan Title: Proposed Condition
Plan File : c:\HGS-Canaries Quarries\ras\rq.p01

Geometry Title: Proposed Condition (PR1HGS)
Geometry File : c:\HGS-Canaries Quarries\ras\rq.g03

Flow Title : Peak-Existing Cond.
Flow File : c:\HGS-Canaries Quarries\ras\rq.f02

Plan Summary Information:
Number of: Cross Sections = 6 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 1 Lateral Structures = 0

Compute Parameters Information
Water Surface Calculation Tolerance = 0.005
Critical Depth Calculation Tolerance = 0.005
Maximum Number of Iterations = 20
Maximum Difference Tolerance = .3
Flow Tolerance Factor = .001

Computation Options
Critical Depth, mixed flow regime where necessary
Conveyance Calculation Method: at cross sections only
Friction Slope Method: Average Conveyance
Compute Critical Flow Profiles: Yes

[illegible]

Flow Title: [illegible]
Flow File: [illegible]

Flow Data (cms)

River	Reach	RS	2 yr (50%)	5 yr (20%)	10 yr (10%)	25 yr (4%)	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Plan	Reach	Profile	Upstream	Downstream
WATERCOURSE	1	100 YRS.	Critical	Normal S = 0.007

GEOMETRY DATA

Geometry Title: Proposed Condition (BRIDGE)
Geometry File : p:\4500-Canarico Quarries\ras\cq.g03

CROSS SECTION

PLAN: WATERCOURSE
REACH: 1 RS: 6

INPUT
Description:
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	78	11.82	77.5	16.2	75	44.63	74	47.46	73.5
49.28	71.85	55.13	72.85	58.18	74	67.48	85		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	11.82	.055	67.48	.065

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
11.82 67.48 5 5 5 .1 .3

CROSS SECTION OUTPUT Profile #100 YRS.

E.G. Elev (m)	76.79	Element	Left OB	Channel	Right OB
Vel Head (m)	.110	Wt. n-Val.		0.055	
W.S. Elev (m)	76.69	Reach Len. (m)	5.00	5.00	5.00
Crit W.S. (m)	75.79	Flow Area (m2)		102.58	
E.G. Slope (m/m)	0.010904	Area (m2)		102.58	
Q Total (m3/s)	177.93	Flow (m3/s)		140.93	
Top Width (m)	44.54	Top Width (m)		44.54	
Vel Total (m/s)	1.37	Avg. Vel. (m/s)		1.37	
Max Chl Dpth (m)	5.69	Hydr. Depth (m)		2.30	
Conv. Total (m3/s)	11545.1	Conv. (m3/s)		9155.7	
Length Chl. (m)	5.00	Wetted Per. (m)		46.61	
Min Ch El (m)	71.00	Shear (N/m2)		43.04	
Alpha	1.00	Stream Power (N/m s)		59.13	
Frwth Loss (m)	1.31	Cum Volume (1000 m3)		3.71	0.00
C & E Loss (m)	0.09	Cum CA (1000 m2)		1.84	0.01

CROSS SECTION OUTPUT Profile #50 YRS.

E.G. Elev (m)	75.29	Element	Left OB	Channel	Right OB
Vel Head (m)	.09	Wt. n-Val.		0.055	
W.S. Elev (m)	75.19	Reach Len. (m)	5.00	5.00	5.00
Crit W.S. (m)	74.[illegible]	Flow Area (m2)		93.63	
E.G. Slope (m/m)	[illegible]	Area (m2)		93.63	
Q Total (m3/s)	[illegible]	Flow (m3/s)		127.71	
Top Width (m)	[illegible]	Top Width (m)		43.90	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		1.36	
Max Chl Dpth (m)	[illegible]	Hydr. Depth (m)		2.13	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		7[illegible]	
Length Chl. (m)	[illegible]	Wetted Per. (m)		46.85	
Min Ch El (m)	[illegible]	Shear (N/m2)		43.50	
Alpha	[illegible]	Stream Power (N/m s)		59.23	
Frwth Loss (m)	[illegible]	Cum Volume (1000 m3)		3.48	0.00
C & E Loss (m)	[illegible]	Cum CA (1000 m2)		1.82	0.01

CROSS SECTION OUTPUT Profile #25 YRS.

E.G. Elev (m)	[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	[illegible]	Wt. n-Val.		0.055	
W.S. Elev (m)	[illegible]	Reach Len. (m)	[illegible]	[illegible]	5.00
Crit W.S. (m)	[illegible]	Flow Area (m2)		86.[illegible]	
E.G. Slope (m/m)	[illegible]	Area (m2)		86.[illegible]	
Q Total (m3/s)	[illegible]	Flow (m3/s)		[illegible]	
Top Width (m)	[illegible]	Top Width (m)		43.[illegible]	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		[illegible]	
Max Chl Dpth (m)	[illegible]	Hydr. Depth (m)		[illegible]	

Conv. Total (m3/s)	2330.5	Conv. (m3/s)	2330.5	
Length Wtd. (m)	5.00	Wetted Per. (m)	45.05	
Min Ch El (m)	73.32	Shear (N/m2)	44.12	
Alpha	1.00	Stream Power (N/m s)	59.74	
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	3.24	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	1.78	0.01

CROSS SECTION OUTPUT Profile #10 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	76.05	Element			
Vel Head (m)	0.09	Wt. n-Val.		0.055	
W.S. Elev (m)	75.96	Reach Len. (m)	5.00	5.00	5.00
Crit W.S. (m)	75.03	Flow Area (m2)		70.92	
E.G. Slope (m/m)	0.002862	Area (m2)		70.92	
Q Total (m3/s)	95.03	Flow (m3/s)		95.03	
Top Width (m)	42.23	Top Width (m)		42.23	
Vel Total (m/s)	1.34	Avg. Vel. (m/s)		1.34	
Max Chl Dpth (m)	3.14	Hydr. Depth (m)		1.68	
Conv. Total (m3/s)	1776.3	Conv. (m3/s)		1776.3	
Length Wtd. (m)	5.00	Wetted Per. (m)		42.87	
Min Ch El (m)	72.82	Shear (N/m2)		45.38	
Alpha	1.00	Stream Power (N/m s)		60.80	
Frctn Loss (m)	0.01	Cum Volume (1000 m3)		2.88	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)		1.72	0.00

CROSS SECTION OUTPUT Profile #2 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	75.25	Element			
Vel Head (m)	0.10	Wt. n-Val.		0.055	
W.S. Elev (m)	75.16	Reach Len. (m)	5.00	5.00	5.00
Crit W.S. (m)	74.66	Flow Area (m2)		37.81	
E.G. Slope (m/m)	0.006638	Area (m2)		37.81	
Q Total (m3/s)	52.33	Flow (m3/s)		52.33	
Top Width (m)	39.68	Top Width (m)		39.68	
Vel Total (m/s)	1.38	Avg. Vel. (m/s)		1.38	
Max Chl Dpth (m)	2.34	Hydr. Depth (m)		0.95	
Conv. Total (m3/s)	653.2	Conv. (m3/s)		653.2	
Length Wtd. (m)	5.00	Wetted Per. (m)		40.82	
Min Ch El (m)	72.82	Shear (N/m2)		58.29	
Alpha	1.00	Stream Power (N/m s)		80.67	
Frctn Loss (m)	0.02	Cum Volume (1000 m3)		1.93	
C & E Loss (m)	0.00	Cum SA (1000 m2)		1.44	

CROSS SECTION

RIVER: WATERCOURSE
REACH: 1 RS: 5

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	78	5.17	78	12.48	77.5	17.29	75	46.64	74
49.91	72.25	54.06	72.08	55.02	74	62.08	81	66.75	85

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	17.29	.035	62.08	.065

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.29	62.08	5.00	30.98	30.39	.1	.3

CROSS SECTION OUTPUT Profile #100 YRS.

			Left OB	Channel	Right OB
E.G. Elev (m)	[illegible]	Element			
Vel Head (m)	[illegible]	Wt. n-Val.		0.040	
W.S. Elev (m)	[illegible]	Reach Len. (m)	1.00	1.00	1.00
Crit W.S. (m)	[illegible]	Flow Area (m2)		100.97	
E.G. Slope (m/m)	[illegible]	Area (m2)		100.97	
Q Total (m3/s)	[illegible]	Flow (m3/s)		140.45	
Top Width (m)	[illegible]	Top Width (m)		13.67	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		1.40	
Max Chl Dpth (m)	[illegible]	Hydr. Depth (m)		[illegible]	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		[illegible]	
Length Wtd. (m)	[illegible]	Wetted Per. (m)		[illegible]	
Min Ch El (m)	[illegible]	Shear (N/m2)		[illegible]	
Alpha	[illegible]	Stream Power (N/m s)		[illegible]	

Frctn Loss (m)	0.00	Cum Volume (1000 m3)	3.20	0.00
C & E Loss (m)	0.07	Cum SA (1000 m2)	1.62	0.01

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

CROSS SECTION OUTPUT Profile #50 YRS.

E.G. Elev (m)	76.58	Element	Left OB	Channel	Right OB
Vel Head (m)	0.10	Wt. n-Val.		0.040	
W.S. Elev (m)	76.48	Reach Len. (m)	1.00	1.00	1.00
Crit W.S. (m)	75.21	Flow Area (m2)		92.16	
E.G. Slope (m/m)	0.001195	Area (m2)		92.16	
Q Total (m3/s)	127.71	Flow (m3/s)		127.71	
Top Width (m)	43.08	Top Width (m)		43.08	
Vel Total (m/s)	1.39	Avg. Vel. (m/s)		1.39	
Max Chl Dpth (m)	3.80	Hydr. Depth (m)		2.14	
Conv. Total (m3/s)	3694.6	Conv. (m3/s)		3694.6	
Length Wtd. (m)	1.00	Wetted Per. (m)		45.39	
Min Ch El (m)	72.68	Shear (N/m2)		23.79	
Alpha	1.00	Stream Power (N/m s)		32.97	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)		3.02	0.00
C & E Loss (m)	0.07	Cum SA (1000 m2)		1.60	0.01

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

CROSS SECTION OUTPUT Profile #25 YRS.

E.G. Elev (m)	76.26	Element	Left OB	Channel	Right OB
Vel Head (m)	0.10	Wt. n-Val.		0.040	
W.S. Elev (m)	76.17	Reach Len. (m)	1.00	1.00	1.00
Crit W.S. (m)	75.14	Flow Area (m2)		83.03	
E.G. Slope (m/m)	0.001323	Area (m2)		83.03	
Q Total (m3/s)	114.23	Flow (m3/s)		114.23	
Top Width (m)	42.45	Top Width (m)		42.45	
Vel Total (m/s)	1.38	Avg. Vel. (m/s)		1.38	
Max Chl Dpth (m)	3.59	Hydr. Depth (m)		1.96	
Conv. Total (m3/s)	3140.4	Conv. (m3/s)		3140.4	
Length Wtd. (m)	1.00	Wetted Per. (m)		44.62	
Min Ch El (m)	72.68	Shear (N/m2)		24.14	
Alpha	1.00	Stream Power (N/m s)		33.22	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)		2.82	0.00
C & E Loss (m)	0.06	Cum SA (1000 m2)		1.57	0.01

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

CROSS SECTION OUTPUT Profile #10 YRS.

E.G. Elev (m)	76.04	Element	Left OB	Channel	Right OB
Vel Head (m)	0.09	Wt. n-Val.		0.040	
W.S. Elev (m)	75.95	Reach Len. (m)	1.00	1.00	1.00
Crit W.S. (m)	75.03	Flow Area (m2)		69.75	
E.G. Slope (m/m)	0.001982	Area (m2)		69.75	
Q Total (m3/s)	95.23	Flow (m3/s)		95.03	
Top Width (m)	41.52	Top Width (m)		41.52	
Vel Total (m/s)	1.36	Avg. Vel. (m/s)		1.36	
Max Chl Dpth (m)	3.27	Hydr. Depth (m)		1.68	
Conv. Total (m3/s)	2989.2	Conv. (m3/s)		2989.2	
Length Wtd. (m)	1.00	Wetted Per. (m)		43.49	
Min Ch El (m)	72.68	Shear (N/m2)		41.38	
Alpha	1.00	Stream Power (N/m s)		38.90	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)		2.53	0.00
C & E Loss (m)	0.05	Cum SA (1000 m2)		1.51	0.00

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

CROSS SECTION OUTPUT Profile #2 YR3.

E.G. Elev (m)	75.73	Element	Left OB	Channel	Right OB
Vel Head (m)	0.11	Wt. n-Val.		0.040	
W.S. Elev (m)	75.12	Reach Len. (m)	1.00	1.00	1.00
Crit W.S. (m)	74.64	Flow Area (m2)		36.38	
E.G. Slope (m/m)	0.003821	Area (m2)		36.38	
Q Total (m3/s)	52.33	Flow (m3/s)		52.33	
Top Width (m)	39.10	Top Width (m)		39.10	
Vel Total (m/s)	1.44	Avg. Vel. (m/s)		1.44	
Max Chl Dpth (m)	2.44	Hydr. Depth (m)		0.93	
Conv. Total (m3/s)	846.0	Conv. (m3/s)		846.6	
Length Wt. (m)	1.00	Wetted Per. (m)		40.52	
Min Ch El (m)	72.68	Shear (N/m2)		33.65	
Alpha	1.00	Stream Power (N/m s)		48.40	
Frcn Loss (m)	0.01	Cum Volume (1000 m3)		1.75	
C & E Loss (m)	0.03	Cum DA (1000 m2)		1.25	

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

SUMMARY

RIVER: WATERCOURSE
REACH: 1 RS: 4.5

INPUT
Description:
Distance From Upstream XS = 1
Bridge Roadway Width = 38.88
Weir Coefficient = 1.44
Upstream Deck / Roadway Coordinates
num = 7

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
0	76.7	77.69	13	73.5	72.68	41.25	73.5	72.68
11.28	75.5	77.38	56.28	73.5	77.38	56.28	73.5	72.68
79.5	75.7	77.68						

Upstream Bridge Cross Section Data
Coarse Elevation Data num = 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	76	5.17	75	12.49	77.5	17.24	75	46.64	71
49.91	72.7	54.06	72.68	55.07	74	62.09	83	66.75	85

Warning: n Values num = 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	17.38	.04	62.68	.065

Bank Sta: Left = 17.38 Right = 62.68 Coeff Contr. = .3 Expan. = .5

Downstream Deck/Roadway Coordinates
num = 7

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
0	76.7	77.69	13	73.5	72.36	13.89	73.5	72.36
13.89	75.5	77.38	38.89	73.5	77.38	38.89	73.5	72.36
84.24	73.5	72.36						

Upstream Bridge Cross Section Data
Coarse Elevation Data num = 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	76	6.7	75.7	16.87	73	19.81	73.36	20.27	73.5
24.85	75	37.29	74.5	45.4	75	51.79	76	53.34	77

Warning: n Values num = 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	19.81	.04	37.29	.065

Bank Sta: Left = 19.81 Right = 37.29 Coeff Contr. = .3 Expan. = .5

Warning: Ineffective flow overlapping bridge opening. Ineffective flow extends beyond bridge opening.
Warning: Ineffective flow overlapping bridge opening. Ineffective flow extends beyond bridge opening.
Warning: Bridge opening is narrower than the main channel. Weir coefficient may need to be adjusted.
Warning: Weir coefficient may need to be adjusted.
Warning: Total weir flow is greater than 10% of the total flow. Results may be inaccurate.

Roadway Weight used in design
Weir Crest Shape → Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods - Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction Component to Momentum
Do not Add Weight Component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #100 YRF.

E.G. US. (m)	76.76	Element	Inside BR US	Inside BR DS
W.S. US. (m)	76.68	E.G. Elev (m)	76.71	76.45
Q Total (m3/s)	140.93	W.S. Elev (m)	76.68	76.32
Q Bridge (m3/s)	140.93	Crit W.S. (m)	75.63	74.82
Q Weir (m3/s)		Max Chl Dpth (m)	3.20	3.64
Weir Sta Lft (m)		Vel Total (m/s)	4.62	2.97
Weir Sta Rgt (m)		Flow Area (m2)	35.56	47.41
Weir Submerg		Froude # Chl	0.94	0.53
Weir Max Depth (m)		Specif Force (m3)	102.12	119.55
Min El Weir Flow (m)	79.00	Hydr Depth (m)	2.34	3.16
Min El Prs (m)	77.29	W.P. Total (m)	16.43	15.57
Delta WS (m)	0.41	Conv. Total (m3/s)	1452.7	1490.1
Delta EG (m)	0.32	Top Width (m)	15.00	15.00
BR Open Area (m2)	56.00	Frctn Loss (m)	0.26	0.00
BR Open Vel (m/s)	4.02	C & E Loss (m)	0.11	0.07
Coef of Q		Shear Total (N/m2)	196.42	95.67
Br Sm Method	Energy only	Power Total (N/m s)	791.77	384.41

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

BRIDGE OUTPUT Profile #50 YRF.

E.G. US. (m)	76.[illegible]	Element	Inside BR US	Inside BR DS
W.S. US. (m)	76.48	E.G. Elev (m)	76.51	76.[illegible]
Q Total (m3/s)	177.71	W.S. Elev (m)	75.94	75.85
Q Bridge (m3/s)	177.71	Crit W.S. (m)	75.[illegible]	73.78
Q Weir (m3/s)		Max Chl Dpth (m)	3.06	3.49
Weir Sta Lft (m)		Vel Total (m/s)	[illegible]	[illegible]
Weir Sta Rgt (m)		Flow Area (m2)	42.[illegible]	48.16
Weir Submerg		Froude # Chl	0.[illegible]	0.[illegible]
Weir Max Depth (m)		Specif Force (m3)	90.[illegible]	106.74
Min El Weir Flow (m)	79.00	Hydr Depth (m)	[illegible]	3.01
Min El Prs (m)	77.[illegible]	W.P. Total (m)	16.[illegible]	15.[illegible]
Delta WS (m)	0.[illegible]	Conv. Total (m3/s)	1[illegible]	[illegible]
Delta EG (m)	0.49	Top Width (m)	[illegible]	[illegible]
BR Open Area (m2)	56.00	Frctn Loss (m)	0.11	0.30
BR Open Vel (m/s)	3.[illegible]	C & E Loss (m)	[illegible]	[illegible]
Coef of Q		Shear Total (N/m2)	197.11	[illegible]
Br Sm Method	Energy only	Power Total (N/m s)	[illegible]	[illegible]

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

BRIDGE OUTPUT Profile #[illegible] YRF.

E.G. US. (m)	[illegible]	Element	Inside BR US	Inside BR DS
W.S. US. (m)	[illegible]	E.G. Elev (m)	[illegible]	[illegible]
Q Total (m3/s)	[illegible]	W.S. Elev (m)	[illegible]	[illegible]
Q Bridge (m3/s)	[illegible]	Crit W.S. (m)	[illegible]	[illegible]

[illegible]		Max Chl Depth (m)	[illegible]	[illegible]
[illegible]		Vel Total (m/s)	[illegible]	[illegible]
[illegible]		Flow Area (m²)	[illegible]	[illegible]
[illegible]		Froude # Chl	[illegible]	[illegible]
[illegible]		Specif Force (m³)	[illegible]	[illegible]
Min El Weir Flow (m)	[illegible]	Hydr Depth (m)	[illegible]	[illegible]
Min El Pre (m)	[illegible]	W.P. Total (m)	[illegible]	[illegible]
Delta EG (m)	0.36	Conv. Total (m³/s)	[illegible]	[illegible]
Delta WS (m)	0.46	Top Width (m)	[illegible]	[illegible]
BR Open Area (m²)	[illegible]	Frctn Loss (m)	0.14	0.02
BR Open Vel (m/s)	[illegible]	C & E Loss (m)	0.12	0.05
Total Q		Shear Total (N/m²)	[illegible]	[illegible]
Br Sol Method	Energy only	Power Total (N/m s)	[illegible]	[illegible]

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

[illegible] 012 YRS.

		Element	Inside BR US	Inside BR DS
[illegible]	[illegible]	W.S. Elev (m)	[illegible]	[illegible]
[illegible]	[illegible]	Crit W.S. (m)	[illegible]	[illegible]
[illegible]	[illegible]	Max Chl Depth (m)	[illegible]	[illegible]
[illegible]		Vel Total (m/s)	[illegible]	[illegible]
[illegible]		Flow Area (m²)	[illegible]	[illegible]
[illegible]		Froude # Chl	[illegible]	[illegible]
[illegible]		Specif Force (m³)	[illegible]	[illegible]
Min El Weir Flow (m)	[illegible]	Hydr Depth (m)	[illegible]	[illegible]
Min El Pre (m)	[illegible]	W.P. Total (m)	[illegible]	[illegible]
Delta EG (m)	[illegible]	Conv. Total (m³/s)	[illegible]	[illegible]
Delta WS (m)	[illegible]	Top Width (m)	[illegible]	[illegible]
BR Open Area (m²)	[illegible]	Frctn Loss (m)	[illegible]	[illegible]
BR Open Vel (m/s)	[illegible]	C & E Loss (m)	[illegible]	[illegible]
Total Q		Shear Total (N/m²)	[illegible]	[illegible]
Br Sol Method	Energy only	Power Total (N/m s)	[illegible]	[illegible]

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

[illegible] 025.

		Element	Inside BR US	Inside BR DS
[illegible]	[illegible]	W.S. Elev (m)	[illegible]	[illegible]
[illegible]	[illegible]	Crit W.S. (m)	[illegible]	[illegible]
[illegible]	[illegible]	Max Chl Depth (m)	[illegible]	[illegible]
[illegible]		Vel Total (m/s)	[illegible]	[illegible]
[illegible]		Flow Area (m²)	[illegible]	[illegible]
[illegible]		Froude # Chl	[illegible]	[illegible]
[illegible]		Specif Force (m³)	[illegible]	[illegible]
Min El Weir Flow (m)	[illegible]	Hydr Depth (m)	[illegible]	[illegible]
Min El Pre (m)	[illegible]	W.P. Total (m)	[illegible]	[illegible]
Delta EG (m)	[illegible]	Conv. Total (m³/s)	[illegible]	[illegible]
Delta WS (m)	[illegible]	Top Width (m)	[illegible]	[illegible]
BR Open Area (m²)	[illegible]	Frctn Loss (m)	[illegible]	[illegible]
BR Open Vel (m/s)	[illegible]	C & E Loss (m)	[illegible]	[illegible]
Total Q		Shear Total (N/m²)	[illegible]	[illegible]
Br Sol Method	Energy only	Power Total (N/m s)	[illegible]	[illegible]

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

[illegible]

Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	77	4.7	75.5	16.07	73	19.81	72.36	25.27	72.36
26.45	73	37.78	78.5	45.96	85	51.99	80	55.24	87

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	0	.04	37.78	.065

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	37.78	9.55	10	11	.1	.3

Skew Angle = 60

CROSS SECTION OUTPUT Profile #100 YRS.

E.G. Elev (m)	76.37	Element	Left OB	Channel	Right OB
Vel Head (m)	0.21	Wt. n-Val.		0.040	
W.S. Elev (m)	76.16	Reach Len. (m)	9.55	10.00	11.00
Crit W.S. (m)		Flow Area (m2)		69.75	
E.G. Slope (m/m)	0.002322	Area (m2)		69.35	
Q Total (m3/s)	140.93	Flow (m3/s)		140.93	
Top Width (m)	30.34	Top Width (m)		30.34	
Vel Total (m/s)	2.03	Avg. Vel. (m/s)		2.03	
Max Chl Dpth (m)	3.90	Hydr. Depth (m)		2.29	
Conv. Total (m3/s)	2924.7	Conv. (m3/s)		2924.7	
Length Wtd. (m)	10.00	Wetted Per. (m)		31.65	
Min Ch El (m)	72.36	Shear (N/m2)		49.89	
Alpha	1.00	Stream Power (N/m s)		101.38	
Frctn Loss (m)	0.05	Cum Volume (1000 m3)		1.89	0.00
C & E Loss (m)	0.07	Cum SA (1000 m2)		1.14	0.01

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

CROSS SECTION OUTPUT Profile #50 YRS.

E.G. Elev (m)	76.19	Element	Left OB	Channel	Right OB
Vel Head (m)	0.20	Wt. n-Val.		0.040	
W.S. Elev (m)	75.99	Reach Len. (m)	9.55	10.00	11.00
Crit W.S. (m)		Flow Area (m2)		66.17	
E.G. Slope (m/m)	0.002370	Area (m2)		64.17	
Q Total (m3/s)	127.71	Flow (m3/s)		127.71	
Top Width (m)	29.44	Top Width (m)		29.44	
Vel Total (m/s)	1.99	Avg. Vel. (m/s)		1.99	
Max Chl Dpth (m)	3.63	Hydr. Depth (m)		2.25	
Conv. Total (m3/s)	2623.3	Conv. (m3/s)		2623.3	
Length Wtd. (m)	10.00	Wetted Per. (m)		30.69	
Min Ch El (m)	72.36	Shear (N/m2)		48.60	
Alpha	1.00	Stream Power (N/m s)		96.75	
Frctn Loss (m)	0.05	Cum Volume (1000 m3)		1.77	0.00
C & E Loss (m)	0.06	Cum SA (1000 m2)		1.12	0.01

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

CROSS SECTION OUTPUT Profile #25 YRS.

E.G. Elev (m)	76.00	Element	Left OB	Channel	Right OB
Vel Head (m)	0.19	Wt. n-Val.		0.040	
W.S. Elev (m)	75.81	Reach Len. (m)	9.55	10.00	11.00
Crit W.S. (m)		Flow Area (m2)		59.19	
E.G. Slope (m/m)	0.002303	Area (m2)		57.40	
Q Total (m3/s)	111.23	Flow (m3/s)		111.23	
Top Width (m)	26.51	Top Width (m)		26.51	
Vel Total (m/s)	1.94	Avg. Vel. (m/s)		1.94	
Max Chl Dpth (m)	3.45	Hydr. Depth (m)		2.17	
Conv. Total (m3/s)	2313.7	Conv. (m3/s)		2313.7	
Length Wtd. (m)	10.00	Wetted Per. (m)		27.94	
Min Ch El (m)	72.36	Shear (N/m2)		46.71	
Alpha	1.00	Stream Power (N/m s)		90.62	
Frctn Loss (m)	0.05	Cum Volume (1000 m3)		1.66	0.00
C & E Loss (m)	0.06	Cum SA (1000 m2)		1.09	0.01

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

CROSS SECTION OUTPUT Profile #10 Yr. [illegible]

W.S. Elev (m)	[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	0.17	Wt. n-Val.		0.040	
W.S. Elev (m)	[illegible]	Reach Len. (m)	9.75	10.00	11.00
Crit W.S. (m)		Flow Area (m2)		51.89	
E.G. Slope (m/m)	[illegible]	Area (m2)		51.88	
Q Total (m3/s)	95.03	Flow (m3/s)		95.03	
Top Width (m)	27.18	Top Width (m)		27.18	
Vel Total (m/s)	1.83	Avg. Vel. (m/s)		1.83	
Max Chl Dpth (m)	[illegible]	Hydr. Depth (m)		1.91	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		[illegible]	
Length Wtd. (m)	10.00	Wetted Per. (m)		28.76	
Min Ch El (m)	[illegible]	Shear (N/m2)		40.00	
Alpha	1.00	Stream Power (N/m s)		73.23	
Frctn Loss (m)	[illegible]	Cum Volume (1000 m3)		[illegible]	0.07
C & E Loss (m)	[illegible]	Cum SA (1000 m2)		1.03	0.06

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

CROSS SECTION OUTPUT Profile #1 Yr. [illegible]

W.S. Elev (m)	[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	[illegible]	Wt. n-Val.		0.040	
W.S. Elev (m)	[illegible]	Reach Len. (m)	9.75	10.00	11.00
Crit W.S. (m)		Flow Area (m2)		[illegible]	
E.G. Slope (m/m)	[illegible]	Area (m2)		[illegible]	
Q Total (m3/s)	[illegible]	Flow (m3/s)		[illegible]	
Top Width (m)	[illegible]	Top Width (m)		[illegible]	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		[illegible]	
Max Chl Dpth (m)	[illegible]	Hydr. Depth (m)		[illegible]	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		[illegible]	
Length Wtd. (m)	[illegible]	Wetted Per. (m)		[illegible]	
Min Ch El (m)	[illegible]	Shear (N/m2)		30.04	
Alpha	[illegible]	Stream Power (N/m s)		[illegible]	
Frctn Loss (m)	[illegible]	Cum Volume (1000 m3)		[illegible]	
C & E Loss (m)	[illegible]	Cum SA (1000 m2)		[illegible]	

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

[illegible]

Max Ch. Depth (m)	2.04	Hydr. Depth (m)	1.87	
Conv. Total (m3/s)	907.4	Conv. (m3/s)	907.4	
Length Wtd. (m)	14.56	Wetted Per. (m)	18.13	
Min Ch El (m)	[illegible]	Shear (N/m2)	420.36	
Alpha	1.40	Stream Power (N/m s)	1742.92	
Frctn Loss (m)	0.36	Cum Volume (1000 m3)	1.77	0.00
C & E Loss (m)	0.06	Cum WA (1000 m2)	0.90	0.01

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #50 (RS.

W.S. Elev (m)	[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	0.10	Wt. n-Val.		0.055	
W.S. Elev (m)	[illegible]	Reach Len. (m)	15.00	14.55	13.80
Crit W.S. (m)	[illegible]	Flow Area (m2)		32.98	
E.G. Elev (m/s)	[illegible]	Area (m2)		32.98	
Q Total (m3/s)	[illegible]	Flow (m3/s)		127.71	
Top Width (m)	16.04	Top Width (m)		16.04	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		3.87	
Max Ch Depth (m)	[illegible]	Hydr. Depth (m)		1.94	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		871.6	
Length Wtd. (m)	14.58	Wetted Per. (m)		16.82	
Min Ch El (m)	[illegible]	Shear (N/m2)		364.05	
Alpha	1.00	Stream Power (N/m s)		1434.69	
Frctn Loss (m)	0.36	Cum Volume (1000 m3)		1.79	0.00
C & E Loss (m)	0.03	Cum WA (1000 m2)		0.98	0.01

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

CROSS SECTION OUTPUT Profile #[illegible] (RS.

W.S. Elev (m)	[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	[illegible]	Wt. n-Val.		0.052	
W.S. Elev (m)	[illegible]	Reach Len. (m)	11.00	14.55	13.80
Crit W.S. (m)		Flow Area (m2)		31.26	
E.G. Elev (m/s)	[illegible]	Area (m2)		31.26	
Q Total (m3/s)	[illegible]	Flow (m3/s)		116.73	
Top Width (m)	[illegible]	Top Width (m)		16.57	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		3.61	
Max Ch Depth (m)	[illegible]	Hydr. Depth (m)		1.91	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		[illegible]	
Length Wtd. (m)	[illegible]	Wetted Per. (m)		16.47	
Min Ch El (m)	[illegible]	Shear (N/m2)		333.38	
Alpha	[illegible]	Stream Power (N/m s)		1103.89	
Frctn Loss (m)	[illegible]	Cum Volume (1000 m3)		1.79	0.00
C & E Loss (m)	[illegible]	Cum WA (1000 m2)		0.96	0.01

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

CROSS SECTION OUTPUT Profile #[illegible]

W.S. Elev (m)	[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	[illegible]	Wt. n-Val.		0.05[illegible]	
W.S. Elev (m)	[illegible]	Reach Len. (m)	11.00	14.55	13.80
Crit W.S. (m)	[illegible]	Flow Area (m2)		30.[illegible]	
E.G. Elev (m/s)	[illegible]	Area (m2)		[illegible]	
Q Total (m3/s)	[illegible]	Flow (m3/s)		[illegible]	
Top Width (m)	[illegible]	Top Width (m)		[illegible]	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		[illegible]	
Max Ch Depth (m)	[illegible]	Hydr. Depth (m)		[illegible]	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		[illegible]	
Length Wtd. (m)	[illegible]	Wetted Per. (m)		[illegible]	
Min Ch El (m)	[illegible]	Shear (N/m2)		[illegible]	
Alpha	[illegible]	Stream Power (N/m s)		[illegible]	
Frctn Loss (m)	[illegible]	Cum Volume (1000 m3)		[illegible]	[illegible]
C & E Loss (m)	[illegible]	Cum WA (1000 m2)		[illegible]	[illegible]

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

[illegible]

E.G. Elev (m)	74.95	Element	Left OB	Channel	Right OB
Vel Head (m)	0.16	Wt. n-Val.		0.055	
W.S. Elev (m)	74.70	Reach Len. (m)	15.00	14.55	13.80
Crit W.S. (m)		Flow Area (m2)		23.36	
E.G. Slope (m/m)	0.008906	Area (m2)		23.36	
Q Total (m3/s)	52.33	Flow (m3/s)		52.33	
Top Width (m)	14.05	Top Width (m)		14.05	
Vel Total (m/s)	2.24	Avg. Vel. (m/s)		2.24	
Max Chl Dpth (m)	2.41	Hydr. Depth (m)		1.66	
Conv. Total (m3/s)	554.4	Conv. (m3/s)		554.4	
Length Wtd. (m)	14.55	Wetted Per. (m)		15.66	
Min Ch El (m)	72.39	Shear (N/m2)		130.29	
Alpha	1.00	Stream Power (N/m s)		291.86	
Frctn Loss (m)	0.22	Cum Volume (1000 m3)		0.68	
C & E Loss (m)	0.02	Cum SA (1000 m2)		0.59	

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

CROSS SECTION

RIVER: WATERCOURSE
REACH: 1 RS: 2

INPUT
Description:
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	76.5	12.74	73.5	15.99	73	17.39	72.19	18.8	72.19
21.04	72.5	22.04	73	23.67	74	29.95	74.5	33.99	75
44.3	80.5								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.065	[illegible]	.055	33.99	.065

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
0 33.99 14.55 15.62 14.80 .1 .3

CROSS SECTION OUTPUT Profile #100 YR.

E.G. Elev (m)	[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	[illegible]	Wt. n-Val.		0.055	0.065
W.S. Elev (m)	[illegible]	Reach Len. (m)	16.58	15.62	14.88
Crit W.S. (m)	[illegible]	Flow Area (m2)		38.43	0.02
E.G. Slope (m/m)	[illegible]	Area (m2)		38.43	0.02
Q Total (m3/s)	[illegible]	Flow (m3/s)		140.92	0.01
Top Width (m)	[illegible]	Top Width (m)		23.28	0.24
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		3.67	0.33
Max Chl Dpth (m)	[illegible]	Hydr. Depth (m)		1.35	0.06
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		937.3	0.0
Length Wtd. (m)	[illegible]	Wetted Per. (m)		29.30	0.28
Min Ch El (m)	[illegible]	Shear (N/m2)		364.38	15.48
Alpha	[illegible]	Stream Power (N/m s)		1336.15	6.10
Frctn Loss (m)	[illegible]	Cum Volume (1000 m3)		0.84	0.00
C & E Loss (m)	[illegible]	Cum SA (1000 m2)		0.57	0.01

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). Between the current and previous cross sections. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not enough energy to move upstream. The program defaulted to critical depth.

[illegible] OUTPUT [illegible] YR.

[illegible]	[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	[illegible]	Wt. n-Val.		[illegible]	[illegible]
W.S. Elev (m)	[illegible]	Reach Len. (m)	[illegible]	[illegible]	[illegible]
Crit W.S. (m)	[illegible]	Flow Area (m2)		[illegible]	[illegible]

[illegible]	[illegible]	Area (m2)	25.77	0.00
[illegible]	[illegible]	Flow (m3/s)	127.71	0.00
[illegible]	[illegible]	Top Width (m)	27.99	0.07
[illegible] Total (m/s)	3.57	Avg. Vel. (m/s)	3.57	0.16
Max Chl Depth (m)	[illegible]	Hydr. Depth (m)	1.28	0.02
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)	749.7	0.0
Length Wtd. (m)	[illegible]	Wetted Per. (m)	28.90	0.07
Min Ch El (m)	[illegible]	Shear (N/m2)	352.18	4.42
Alpha	1.30	Stream Power (N/m s)	1257.34	0.71
Friction Loss (m)	[illegible]	Cum Volume (1000 m3)	0.79	0.00
[illegible] (m)	[illegible]	Cum Area (1000 m2)	0.16	0.01

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

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

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

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

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

[illegible] (Section 420 YRC).

[illegible]	[illegible]	Element	Left OB	Channel	Right OB
[illegible]	[illegible]	Wt. [illegible]		0.055	
[illegible] (m)	[illegible]	Reach Len. (m)	16.50	15.62	14.08
[illegible] W.S. (m)	[illegible]	Flow Area (m2)		30.00	
[illegible] (m/s)	[illegible]	Area (m2)		30.00	
[illegible] (m3/s)	[illegible]	Flow (m3/s)		114.23	
Top Width (m)	[illegible]	Top Width (m)		27.06	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		3.46	
Max Chl Depth (m)	[illegible]	Hydr. Depth (m)		1.32	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		676.2	
Length Wtd. (m)	[illegible]	Wetted Per. (m)		27.95	
Min Ch El (m)	[illegible]	Shear (N/m2)		336.38	
Alpha	1.09	Stream Power (N/m s)		1164.52	
Friction Loss (m)	[illegible]	Cum Volume (1000 m3)		0.73	0.00
[illegible] (m)	[illegible]	Cum Area (1000 m2)		0.54	0.01

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

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

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

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

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

[illegible] (Section [illegible]).

[illegible]	[illegible]	Element	Left OB	Channel	Right OB
[illegible]	[illegible]	Wt. [illegible]		0.055	
[illegible] Elev (m)	[illegible]	Reach Len. (m)	16.50	15.62	14.08
[illegible] W.S. (m)	[illegible]	Flow Area (m2)		28.31	
[illegible] (m/s)	[illegible]	Area (m2)		28.31	
[illegible] (m3/s)	[illegible]	Flow (m3/s)		95.03	
Top Width (m)	[illegible]	Top Width (m)		24.86	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		3.36	
Max Chl Depth (m)	[illegible]	Hydr. Depth (m)		1.14	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		565.7	
Length Wtd. (m)	[illegible]	Wetted Per. (m)		25.31	
Min Ch El (m)	[illegible]	Shear (N/m2)		328.47	
Alpha	[illegible]	Stream Power (N/m s)		1097.0	
[illegible]	[illegible]	Cum Volume (1000 m3)		0.68	0.00
[illegible]	[illegible]	Cum Area (1000 m2)		0.50	[illegible]

[illegible]

[illegible] cross sections.

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

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

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

CROSS SECTION OUTPUT Profile # [illegible]

			Left OB	Channel	Right OB
W.S. Elev (m)	[illegible]	Element			
Vel Head (m)	[illegible]	Wt. n-Val.		0.055	
W.S. Elev (m)	74.[illegible]	Reach Len. (m)	16.55	16.82	14.98
Crit W.S. (m)	[illegible]	Flow Area (m2)		16.75	
E.G. Slope (m/m)	[illegible]	Area (m2)		16.75	
Q Total (m3/s)	[illegible]	Flow (m3/s)		52.03	
Top Width (m)	[illegible]	Top Width (m)		16.91	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		3.12	
Max Chl Dpth (m)	[illegible]	Hydr. Depth (m)		0.99	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		795.9	
Length Wtd. (m)	[illegible]	Wetted Per. (m)		17.68	
Min Ch El (m)	[illegible]	Shear (N/m2)		294.71	
Alpha	[illegible]	Stream Power (N/m s)		920.67	
Frctn Loss (m)	[illegible]	Cum Volume (1000 m3)		0.39	
C & E Loss (m)	[illegible]	Cum SA (1000 m2)		0.36	

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

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

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.3. This may indicate the need for additional cross sections.

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

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

CROSS SECTION

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] CROSS SECTION OUTPUT [illegible] 16.5

			Left OB	Channel	Right OB
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]

[illegible]

CROSS SECTION OUTPUT Profile #50 YRS.

E.G. Elev (m)	75.33	Element	Left OB	Channel	Right OB
Vel Head (m)	0.33	Wt. n-Vel.		0.055	0.065
W.S. Elev (m)	75.04	Reach Len. (m)			
Crit W.S. (m)	74.40	Flow Area (m2)		64.87	0.27
E.G. Slope (m/m)	0.007611	Area (m2)		64.87	0.27
Q Total (m3/s)	127.71	Flow (m3/s)		127.58	0.13
Top Width (m)	44.44	Top Width (m)		43.44	1.00
Vel Total (m/s)	1.96	Avg. Vel. (m/s)		1.97	0.49
Max Chl Depth (m)	3.96	Hydr. Depth (m)		1.49	0.27
Conv. Total (m3/s)	1523.3	Conv. (m3/s)		1523.7	1.6
Length Wtd. (m)		Wetted Per. (m)		43.18	1.13
Min Ch El (m)	70.08	Shear (N/m2)		100.94	16.23
Alpha	1.11	Stream Power (N/m s)		198.83	7.99
Frcth Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum CA (1000 m2)			

Note: Hydraulic jump has occurred between this cross section and the previous upstream section.

CROSS SECTION OUTPUT Profile #25 YRS.

E.G. Elev (m)	75.11	Element	Left OB	Channel	Right OB
Vel Head (m)	0.12	Wt. n-Vel.		0.055	0.065
W.S. Elev (m)	74.83	Reach Len. (m)			
Crit W.S. (m)	74.27	Flow Area (m2)		60.19	0.17
E.G. Slope (m/m)	0.007711	Area (m2)		60.19	0.17
Q Total (m3/s)	114.23	Flow (m3/s)		114.16	0.07
Top Width (m)	43.36	Top Width (m)		42.56	0.79
Vel Total (m/s)	1.89	Avg. Vel. (m/s)		1.90	0.42
Max Chl Depth (m)	3.85	Hydr. Depth (m)		1.41	0.21
Conv. Total (m3/s)	1364.2	Conv. (m3/s)		1363.4	0.9
Length Wtd. (m)		Wetted Per. (m)		43.29	0.60
Min Ch El (m)	70.08	Shear (N/m2)		95.59	12.74
Alpha	1.00	Stream Power (N/m s)		181.19	5.48
Frcth Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum CA (1000 m2)			

Note: Hydraulic jump has occurred between this cross section and the previous upstream section.

CROSS SECTION OUTPUT Profile #10 YRS.

E.G. Elev (m)	74.[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	0.1[illegible]	Wt. n-Vel.		0.055	0.065
W.S. Elev (m)	73.[illegible]	Reach Len. (m)			
Crit W.S. (m)	74.[illegible]	Flow Area (m2)		53.16	0.66
E.G. Slope (m/m)	0.007202	Area (m2)		53.[illegible]	0.66
Q Total (m3/s)	95.63	Flow (m3/s)		95.01	0.07
Top Width (m)	41.[illegible]	Top Width (m)		41.[illegible]	0.49
Vel Total (m/s)	1.[illegible]	Avg. Vel. (m/s)		1.78	0.11
Max Ch Depth (m)	[illegible]	Hydr. Depth (m)		1.[illegible]	0.17
Conv. Total (m3/s)	1[illegible]	Conv. (m3/s)		1135.1	1.[illegible]
Length Wtd. (m)		Wetted Per. (m)		41.94	0.51
Min Ch El (m)	71.[illegible]	Shear (N/m2)		87.19	7.92
Alpha	1.[illegible]	Stream Power (N/m s)		155.51	0.[illegible]
Frcth Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum CA (1000 m2)			

Note: Hydraulic jump has occurred between this cross section and the previous upstream section.

CROSS SECTION OUTPUT Profile # 1[illegible]

E.G. Elev (m)	71.[illegible]	Element	Left OB	Channel	Right OB
Vel Head (m)	[illegible]	Wt. n-Vel.		0.055	
W.S. Elev (m)	74.[illegible]	Reach Len. (m)			
Crit W.S. (m)	[illegible]	Flow Area (m2)		[illegible]	
E.G. Slope (m/m)	[illegible]	Area (m2)		[illegible]	
Q Total (m3/s)	[illegible]	Flow (m3/s)		[illegible]	
Top Width (m)	[illegible]	Top Width (m)		[illegible]	
Vel Total (m/s)	[illegible]	Avg. Vel. (m/s)		[illegible]	
Max Ch Depth (m)	[illegible]	Hydr. Depth (m)		[illegible]	
Conv. Total (m3/s)	[illegible]	Conv. (m3/s)		[illegible]	
Length Wtd. (m)		Wetted Per. (m)		[illegible]	
Min Ch El (m)	[illegible]	Shear (N/m2)		[illegible]	
Alpha	[illegible]	Stream Power (N/m s)		[illegible]	
Frcth Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum CA (1000 m2)			

Note: Hydraulic jump has occurred between this cross section and the previous upstream section.

SUMMARY OF MANNING'S N VALUES

River:WATERCOURSE

Reach	River Sta.	n1	n2	n3
1	6	.065	.055	.065
1	5	.065	.04	.065
1	4.5	Bridge		
1	4	.065	.04	.065
1	3	.065	.055	.065
1	2	.065	.055	.065
1	1	.065	.055	.065

SUMMARY OF REACH LENGTHS

River: WATERCOURSE

Reach	River Sta.	Left	Channel	Right
1	6	5	5	5
1	5	32.95	30.98	30.39
1	4.5	Bridge		
1	4	9.25	10	11
1	3	15	14.56	13.8
1	2	16.58	15.62	14.98
1	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: WATERCOURSE

Reach	River Sta.	Contr.	Expan.
1	6	.1	.3
1	5	.1	.3
1	4.5	Bridge	
1	4	.1	.3
1	3	.1	.3
1	2	.1	.3
1	1	.1	.3

SEE ATTACHED TABLE 1 ON NEXT PAGE

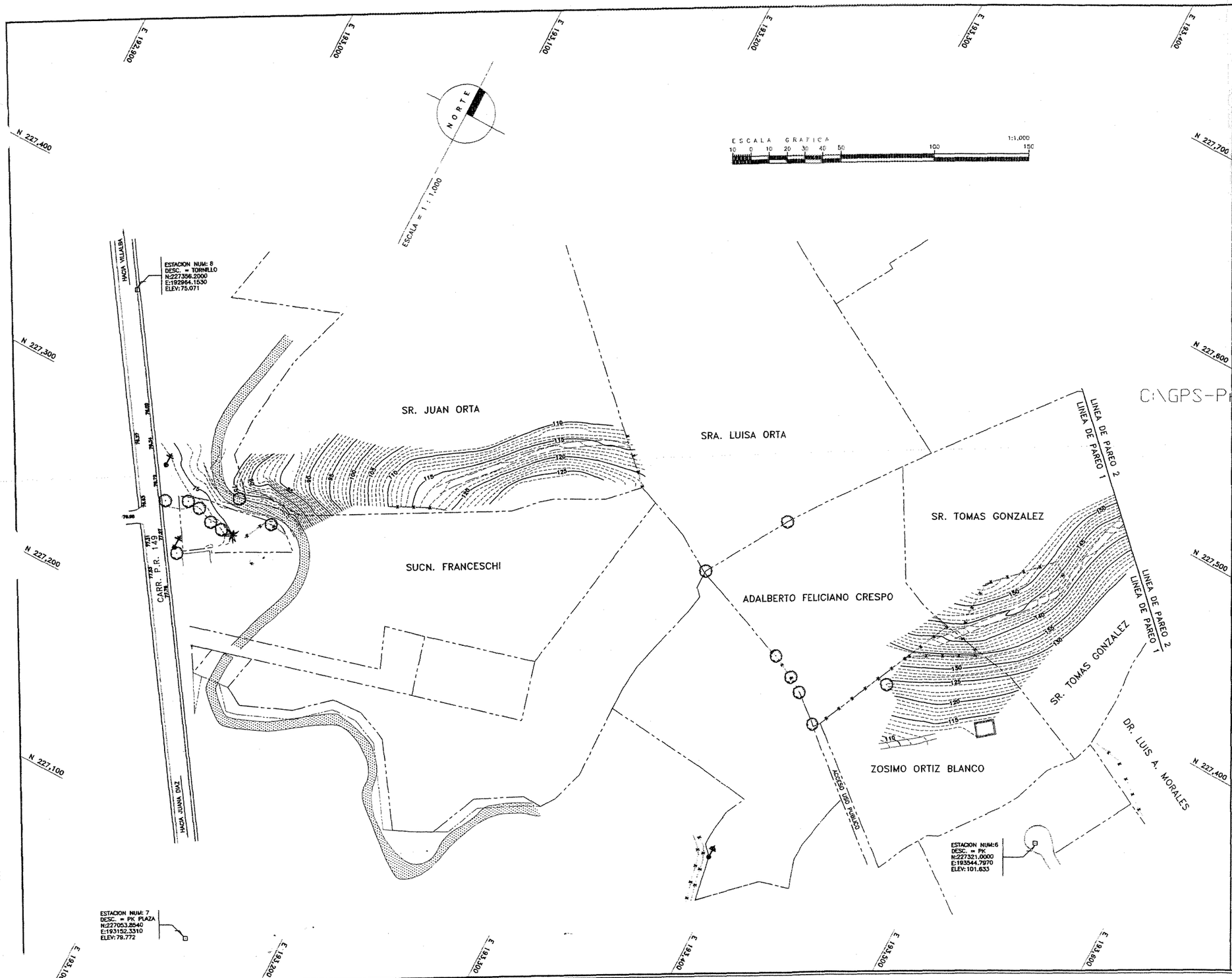
Profile Output Table-Standard Table 1

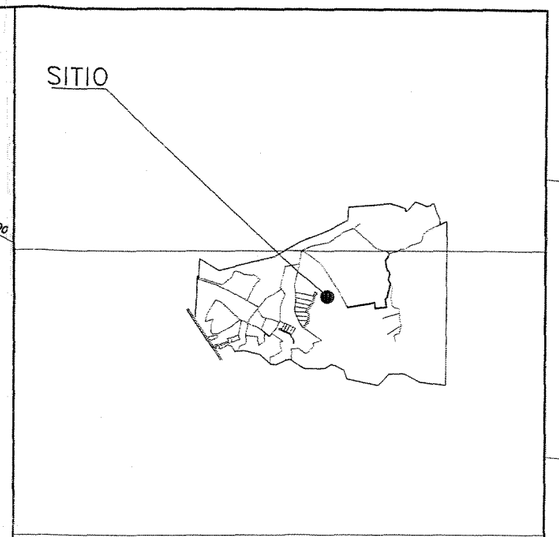
HEC-RAS Plan: Prop. River: WATERCOURSE Reach: 1

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
1	6	100 YRS.	140.93	72.82	76.71	75.29	76.81	0.00194	1.36	103.51	44.61	0.29
1	6	50 YRS.	127.71	72.82	76.51	75.22	76.61	0.002106	1.35	94.57	43.97	0.29
1	6	25 YRS	114.23	72.82	76.3	75.15	76.39	0.002319	1.34	85.32	43.3	0.3
1	6	10 YRS	95.03	72.82	75.99	75.03	76.08	0.002739	1.32	71.92	42.31	0.32
1	6	2 YRS.	52.33	72.82	75.18	74.66	75.27	0.005873	1.35	38.87	39.76	0.43
1	5	100 YRS.	140.93	72.68	76.7	75.29	76.8	0.001066	1.38	101.89	43.73	0.29
1	5	50 YRS.	127.71	72.68	76.5	75.21	76.6	0.001158	1.37	93.1	43.14	0.3
1	5	25 YRS	114.23	72.68	76.29	75.14	76.38	0.001277	1.36	83.99	42.52	0.31
1	5	10 YRS.	95.03	72.68	75.97	75.03	76.07	0.001512	1.34	70.76	41.59	0.33
1	5	2 YRS	52.33	72.68	75.15	74.64	75.25	0.003445	1.39	37.57	39.19	0.45
1	4.5		Bridge									
1	4	100 YRS	140.93	72.36	76.24		76.36	0.001248	1.53	92.29	39.53	0.32
1	4	50 YRS.	127.71	72.36	76.06		76.18	0.001274	1.5	85.4	38.35	0.32
1	4	25 YRS	114.23	72.36	75.88		75.99	0.001293	1.46	78.48	37.13	0.32
1	4	10 YRS.	95.03	72.36	75.62		75.71	0.001292	1.36	68.91	35.36	0.32
1	4	2 YRS.	52.33	72.36	74.93		75	0.001134	1.12	46.67	29.51	0.29
1	3	100 YRS.	140.93	72.29	75.38	75.28	76.25	0.024121	4.14	34.01	17.22	0.94
1	3	50 YRS.	127.71	72.29	75.32	75.13	76.08	0.02147	3.87	32.98	16.94	0.89
1	3	25 YRS.	114.23	72.29	75.24		75.9	0.019134	3.61	31.66	16.57	0.83
1	3	10 YRS	95.03	72.29	75.12		75.64	0.015595	3.19	29.75	16.03	0.75
1	3	2 YRS.	52.33	72.29	74.7		74.95	0.008908	2.24	23.36	14.05	0.55
1	2	100 YRS	140.93	72.19	75.13	75.13	75.81	0.028329	3.67	38.45	28.52	1.01
1	2	50 YRS.	127.71	72.19	75.04	75.04	75.68	0.029017	3.57	35.77	28.06	1.01
1	2	25 YRS.	114.23	72.19	74.93	74.93	75.55	0.029053	3.46	33	27.06	1
1	2	10 YRS	95.03	72.19	74.75	74.75	75.33	0.029998	3.36	28.31	24.86	1
1	2	2 YRS.	52.33	72.19	74.21	74.21	74.71	0.031713	3.12	16.75	16.91	1
1	1	100 YRS	140.93	72.08	75.14	74.5	75.35	0.007006	2.03	69.71	45.45	0.52
1	1	50 YRS	127.71	72.08	75.04	74.4	75.23	0.007011	1.97	65.14	44.44	0.51
1	1	25 YRS	114.23	72.08	74.93	74.27	75.11	0.007011	1.9	60.36	43.36	0.51
1	1	10 YRS	95.03	72.08	74.76	74.04	74.92	0.007002	1.78	53.32	41.71	0.5
1	1	2 YRS.	52.33	72.08	74.21	73.51	74.34	0.007003	1.6	32.72	29.67	0.49

APPENDIX E

FIELD WORK





C:\GPS-Pro Map\cd1\PONCE\18066a5k.tif

LEYENDA:

- LINEA DE PROPIEDAD
- 230 CONTORNO DE NIVEL A 5.00 METRO
- CONTORNOS DE NIVEL A 1.00 METRO
- CAMINO EN TIERRA
- CENTRO ZANJA
- ARBOL
- POSTE ELECTRICO

CERTIFICACION

YO, JULIO C. SOTO, CERTIFICO QUE LA INFORMACION AQUI PRESENTADA ES UNA FIEL REPRESENTACION DE LO ENCONTRADO FISICAMENTE EN EL TERRENO Y/O DE LAS INVESTIGACIONES REALIZADAS POR MI.

JULIO C. SOTO SERRANO
Agrimensor Licencia num. 9633

Lib. Cadd por: ALEXIS CARDONA Lic.3046
Fecha : 15/JULIO/2004
Escala : 1 : 1 , 0 0 0
Proy. Num. : JCS2354-1

PLANO TOPOGRAFICO PARA ESTUDIO DE ALINEACION FUTURO ACCESO, CANTERA CANARICO

LOCALIZADO EN EL BO. GUAYABAL,

JUANA DIAZ, PUERTO RICO

Agrim. Julio C. Soto Serrano, CSP
JCS
Servicios de Agrimensura
Agrimensor Lic. 9633
Calle Fortín Fernández Mim. 105

APÉNDICE 15 Plan de Corte Siembra y Forestación (Reglamento 25) en el Nuevo Acceso Propuesto

INVENTARIO DE ÁRBOLES

Preparado para:

Canarico Quarries, Inc.
Ing. Moisés Rivera Ramos
Bo. Guayabal, Carr. PR 5522, Km. 0.7
Juana Díaz, Puerto Rico

Preparado por:

Pedro J. Lavergne Vázquez
Agrónomo DRNA, PSF -254
HC-4 Box 8461
Aguas Buenas, Puerto Rico 00703-8811
Cel. (787) 409-1070

PEDRO J. LAVERGNE VÁZQUEZ
AGRÓNOMO
LICENCIA #3062 PSF #254
PUERTO RICO

Septiembre, 2008

Agro. Pedro J. Lavergne Vázquez
CAPR Lic. 3062, PSF 254
HC-4 Box 8461, Aguas Buenas, PR 00703
Cel. (787) 409-1070, Ofic. (787) 732-3551

Hon. Javier Vélez Arocho
Secretario
Departamento de Recursos Naturales
y Ambientales
PO Box 366147
San Juan, PR 00936-0147

Solicitud de Permiso de Corte, Siembra y Forestación
Proyecto: Canarico Quarries, Inc.(Nuevo acceso a Carr. Estatal 149)
Bo. Guayabal, Carr. PR 5522, km. 0.7
Juana Díaz, Puerto Rico

Estimado señor Secretario:

Le incluyo para evaluación, la Solicitud de Permiso de Corte de Arboles para el proyecto de referencia. Se incluye, para cumplir con los requisitos establecidos por el Reglamento de Corte, Siembra y Forestación para Puerto Rico un Memorial Explicativo del proyecto propuesto, mapa de localización, inventario de árboles a ser impactados y el plano de siembra correspondiente. De ser necesaria información adicional relacionada al proyecto, puede comunicarse con este servidor a su mejor conveniencia.

Cordialmente,

Agro. Pedro J. Lavergne Vázquez
Núm. de PSF 254

PEDRO J. LAVERGNE VÁZQUEZ
AGRÓNOMO
LICENCIA #3062 PSF #254
PUERTO RICO

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1.0 MEMORIAL EXPLICATIVO DEL PROYECTO

Canarico Quarries, Inc. empresa puertorriqueña que se dedica a la producción de agregado, proyecta establecer acceso directo a la Carr. Estatal 149, desde su operación en la cantera, localizada en el barrio Guayabal de Juana Díaz. Actualmente el acceso a la cantera Canarico se realiza a través de la carretera PR 552 y su Ramal 5552. La actividad de la cantera genera un volumen vehicular de más de 100 camiones diarios por lo que el peticionario vió la necesidad de diseñar y construir una vía de acceso a la cantera por terrenos de su propiedad con acceso exclusivo adquiridos con este propósito. Esta vía de acceso busca eliminar el tránsito de camiones en las carreteras PR 552 y 5552 donde se han desarrollado varias comunidades y viviendas, algunas de ellas a muy pocos metros de la vía de rodaje. El camino propuesto tendrá una longitud de dos kilómetros y comenzará en la carretera PR 149, km. 63.5 aproximadamente y se extenderá campo traviesa a través de los terrenos propiedad de la empresa hasta llegar a la cantera. La construcción del mencionado camino, obligará la remoción de vegetación arbórea por lo que este estudio busca el cumplimiento del Reglamento Núm. 25 JP-DRNA, Siembra, Corte, Poda y Forestación para dicha acción.

2.0 INTRODUCCIÓN

La vía de acceso proyectado tiene una longitud de dos kilómetros (2,000 metros) y veinte metros de ancho. Está dentro de una finca con 135 cuerdas de capacidad, que contiene una vegetación arbórea que nos presenta especies en transición del bosque seco de la costa y del bosque de la baja cordillera. La distribución natural de la mayor parte de las especies presentes en el área de estudio, tienden a ser definidas principalmente por los factores o variables de precipitación y suelo. En mi opinión, el drenaje excesivo (suelos rocosos) y la alta erosión por escorrentía acentúa la aridez del ambiente a un punto que algunas especies de árboles no pueden subsistir, aún cuando la precipitación anual es suficiente par que hubiese mayor diversidad en especies presentes. La región alta de Coamo y Juana Díaz, presenta una asociación de suelos descritos como Caguabo-Múcara-Quebrada, con pendientes moderadas a fuertes y de fácil drenaje. Esta asociación presenta suelos lómicos y arcillosos sobre roca dura o meteorizada. Los suelos de las laderas son de la Serie Quebrada, los cuales se han formado de material residual meteorizado de rocas volcánicas. Los suelos en las partes altas, se consideran de poca utilidad para la actividad agrícola por ser poco profundos y rocosos. Finalmente, debo mencionar que el proyecto de construcción del camino interno obliga el impacto directo a la vegetación arbórea a un área aproximada de 40,000 metros cuadrados.

3.0 METODOLOGÍA

3.1 INVESTIGACIÓN DE CAMPO

Dado al área extensa a impactar (40,000 mts.^{2}) el inventario de árboles se construirá usando el método de Parcelas de Estudio (Plots).

La recopilación de la información sobre los árboles existentes deben constituir un mínimo de 10% del área total bajo cubierta forestal a impactar por el proyecto. Se identificará los árboles con una altura mayor a seis (6') pies indistintamente de su diámetro o volumen de bio-masa. Se identifica el árbol (se le coloca cinta con número) por nombre común, nombre científico, se determina diámetro a la altura del pecho (con cinta de arboricultor), altura, condiciones generales y se hace comentarios específicos del árbol. También se señala su localización aproximada en plano de mensura o topográfico. Participaron con este servidor (identificación y recopilación de información) dos biólogos con amplio peritaje en el inventario y descripción de flora y fauna. Se establecieron en el campo cinco (5) Parcelas

de Estudio y se marcaron en Plano de Mensura. El área total de Estudio sobrepasa el 10% del área boscosa a impactar.

3.2 INVESTIGACIÓN BIBLIOGRAFICA

Para determinar la ausencia o presencia de especies amenazadas, críticos o en peligro de extinción, se examinaron las siguientes fuentes de información previo a las visitas de campo.

a) "Endangered and Theatened Wildlife and Plants", publicado por el Departamento del Interior de los Estados Unidos, Servicio de Pesca y Vida Silvestre (1997)

b) "Arboles y Plantas en Peligro de Extinción en P.R. ", Miner-Sola E., Serie Puerto Rico Ecológico Vol. III (1999),

c) "Rare and Endangered Plants of Puerto Rico – A Committee Reports", publicado por el Departamento de Agricultura de los E.U., Servicio de Conservación de Suelos (1975)

Se consultó personal de la División de Patrimonio Natural y la División de Recursos Terrestres del Departamento de Recursos Naturales y Ambientales, para cotejar los elementos críticos identificados en o cerca del predio o finca bajo estudio.

4.0 RESULTADOS DEL INVENTARIO

Según la información recopilada en el estudio se encontró que el predio inventariado está dominado por especies nativas y por otras que son naturalizadas. Se identificaron y evaluaron un total de 325 árboles con una altura mayor de seis (6) pies. Las especies dominantes son La Guácima (*Guazuma ulmifolia),* el Carbonero (*Albizia carbonaria*), Palo Blanco (*Casearia guianensis*), Hoja Menuda (*Eugenia rhombea*), el Higüerillo (*Vitex divaricata*), Corcho Bobo (*Pisonia albida*), el Palo Rubio (*Zanthoxylum monophyllum*), el Almácigo (*Bursera simaruba*), Sauco amarillo (*Tecoma stans*), la Quenepa (*Melicocca bijuga*), el Capulín (*Trema micrantha*) y el Tachuelo (*Pictotia aculeata*). Es importante mencionar que existen áreas grandes en la finca donde la Zarcilla (*Leucaena glauca*) a colonizado e invadido el área formando matorrales tupidos y puros con difícil acceso. Dado a su crecimiento rápido, fácil propagación y gran adaptación (crece sobre las rocas, en suelos pobres y sin sustento) se comporta como una planta indeseable. Otro árbol con el mismo comportamiento invasivo, es el Aroma (*Acacia farnesiana)* compitiendo con mucha eficiencia con otras especies desplazando aquellas con mayor valor ecológico.

RESULTADO INVENTARIO POR PARCELAS (PLOTS) DE ESTUDIO:

Parcela 1:	15mts. x 15mts. = 225 mts.^{2}	: 53 árboles
Parcela 2:	15mts. x 15mts. = 225 mts.^{2}	: 23 árboles
Parcela 3:	15mts. x 15mts. = 225 mts.^{2}	: 82 árboles
Parcela 4:	15mts. x 15 mts. = 225 mts.^{2}	: 74 árboles
Parcela 5:	115 mts. x 27 mts. = 3,105 mts.^{2}	: 93 árboles
TOTAL:	4005 mts.^{2}	325 árboles

Total de 325 árboles en 4,000 metros^2 (10% de la cabida) 325 + 4,000 = 0.081 (promedio de árboles por metro^2).

La extrapolación a la totalidad de árboles concluye que deben existir 3,250 árboles en 40,000 metros^2.

5.0 GUÍAS DE MITIGACIÓN

El Reglamento de Planificación Núm. 25 de 24 de noviembre de 1998, Reglamento de Siembra, Corte y Forestación para Puerto Rico dispone el trámite que rige para la obtención de las autorizaciones y permisos relativos al corte, poda y siembra. El Tópico 3, sección 4.03 del Reglamento establece los requisitos para el reemplazo de árboles, disponiendo que se requiere, la siembra de dos (2) árboles por cada uno (1) que corte. Por medio de la Orden Administrativa Núm. 2004-27 del DRNA, se ordena la adopción de las siguientes guías conforme a este caso el de Mitigación por Siembra en el mismo lugar del área considerada en el Permiso.

5.1 Las siembras comenzarán antes de que el proyecto sea completado.

5.2 El mantenimiento a la siembra se llevará a cabo durante toda la mitigación.

5.3 El tenedor del permiso será responsable de notificar por escrito al Departamento la fecha ha sido completada y la fecha del comienzo del período de mantenimiento. El tenedor del permiso debe garantizar un 80% de éxito de la siembra en el transcurso de un año luego de finalizada la mitigación; es decir, lo que se muera más allá del 20% dentro de ese término tiene que ser reemplazado.

5.4 Luego de transcurrido el año, un profesional de siembra certificará la mitigación y el DRNA corroborará la misma certificando el cumplimiento de los requisitos de la Mitigación. De no cumplirse con las condiciones especificadas en el permiso, el Departamento le requerirá al tenedor del permiso el cumplimiento conforme lo establecido.

5.5 Toda las disposiciones deben estar contenidas en el permiso de corte y poda, siempre que la mitigación sea aceptada.

5.1 ARBOLES RECOMENDADOS PARA LA SIEMBRA

Algunas consideraciones en la selección de árboles a sembrar son:

Espacio disponible
Fomentar valores estéticos
Albergue y/o alimento a la vida silvestre
Favorecer especies nativas y típicas de la zona ecológica

Nombre común	Nombre científico	Categoría	Distancia de siembra
Péndula	*Citharexylum fruticosum*	Pequeño	10'
Hoja Menuda	*Hoja Menuda*	Pequeño	10'
Guácima	*Guazuma ulmifolia*	Pequeño a Mediano	15'
Quenepa	*Melicoccus bijuga*	Mediano	20'
Mariposa	*Bauhinia monandra*	Pequeño	10'

Nombre común	Nombre científico	Categoría
Almácigo	*Bursera simaruba*	Mediano
Roble nativo	*Tabebuia heterophylla*	Mediano
Tintillo	*Randia aculeata*	Pequeño
Palma Real	*Roystonea borinquena*	Grande
Sauco amarillo	*Tecomans* stans	Pequeño
Higüerillo	*Vitex divaricata*	Pequeño
Tamarindo	*Tamarindus indica*	Mediano
Uva de playa	*Coccoloba uvifera*	Pequeño
Emajagüilla	*Thespesia populnea*	Pequeño

5.2 ASPECTOS A CONSIDERAR EN LA SELECCIÓN DEL ARBOL A

a) Tamaño del árbol

1. pequeño – hasta 20 pies
2. mediano – de 20 a 50 pies
3. grande – de más de 50 pies

b) Forma de la copa – redonda, ovalada, cónica, sombril columnar, achatada, llorona y pirámide.

c) Espacio disponible y uso futuro en el lugar de siembra

d) Propósito de la siembra – ornato (flores vistosas), som para la vida silvestre, rompevientos y otros.

e) Distancia mínima de siembra entre árboles de acuerdo (adulto) del árbol.

a. pequeño – 10 pies
b. mediano – 20 pies
c. grande – 30 pies

f) Aspectos del suelo como acidez (pH), drenaje y comp considerarse al momento de siembra. Pueden hacerse corregir estos aspectos.

6.0 ESTABLECIMIENTO Y MANEJO DE LOS ARBOLES

Se han usado extensamente tres métodos para el establecimiento algunas variaciones. El plantado sólido, usando el método de "Corona", es u usado en el pasado en los cerros de Puerto Rico para establecer guineos, cafe posiciones para la siembra se miden con una vara y se disponen alrededor d arriba y hacia abajo, a veces al azar, con el objeto de evitar las rocas, los tocor

Las "Coronas", unos círculos de aproximadamente un metro de diámetro, se talan y se labran con un azadón o con un machete. Los arbolitos se siembran inmediatamente o dentro de unos pocos días en el centro de la "Corona". Las malas hierbas y enredadera se controlan dentro de la corona con un azadón o con un machete a medida que sea necesario, mientras que el área entre árboles se corta solamente de manera ocasional (cada 2 meses aprox.) para prevenir el crecimiento de la maleza a una altura que sombree los arbolitos. Cuando los árboles sembrados crecen sobre la maleza que los rodea (aprox. 2 metros) el desyerbo se suspende, excepto cuando sea necesario para controlar las enredaderas. Es muy importante ser consistente en el desyerbo principalmente los primeros 6 meses. Un segundo método utilizado en Puerto Rico es la siembra bajo cubierta con liberación. En este método, las plántulas o las semillas se siembran bajo rodales de árboles. Una vez las plántulas se han establecido, el estrado superior será removido en una o varias etapas. El tercer método, usado en el pasado y que se está popularizando de nuevo, es el de plantado en líneas (callejones). Unas fajas, líneas o callejones de 2 a 5 metros de ancho se talan a través de un bosque secundario de poco valor. Los callejones se ven separados por entre 10 a 20 metros y el bosque o vegetación entre medio se deja intacto. Las "Coronas", con un esparcimiento de 3 metros a lo largo de los callejones se labran y se siembran plántulas de especies escogidas con un buen potencial de éxito (tolerancia poca iluminación inicialmente, se adapten al tipo de suelo, clima y otros). A medida que los árboles plantados crecen, el rodal circundante va siendo removido, reteniendo cualquier árbol de alto valor presente. El resultado de este proceso es un rodal maduro que está constituido de una mezcla de especies plantadas y de otras especies valiosas regeneradas de manera natural. En este proyecto, se sembrará las especies seleccionadas en ambos lados del camino propuesto. Se recomienda la siembra en dos hileras (Tresbolillo) de manera que forme un "seto vivo" disminuyendo el polvo fugitivo y el ruido que produce el tránsito de camiones. En las áreas de la finca (135 cds.) donde la Zarcilla (*Leucaena glanca*) a invadido y domina el rodal, establecer el 3er método de siembra llamado "plantado por callejones" según explicado anteriormente. Este método será utilizado también en las zonas de amortiguamiento, cerca de las colindancias de la finca.

6.1 SIEMBRA Y MANTENIMIENTO

Luego del análisis que menciono, antes de escoger el árbol adecuado para el lugar adecuado, me dispongo a la siembra. Esta actividad (siembra) debe hacerse tempranito en la mañana. Como herramienta indispensable debo tener un azadón y machete. Debo llevar agua (puede ser en pailas) para utilizarla en el hoyo durante la siembra y agua para mantener hidratados a los que participen en la actividad. Puedo aplicar 6 onzas de Superfosfato Triple (fósforo) por hoyo o plántula para estimular el crecimiento de raíces. En el centro de la "Corona" preparo un hoyo de un diámetro de dos veces mayor que el de la bola de raíces y con la misma profundidad. Saque el árbol del envase sin alterar las raíces, puede cortar aquellas raíces que sobresalen y dificulten colocar el árbol en el hoyo. Coloque el árbol en el hoyo asegurando que el tronco esté derecho. Utilice la misma tierra que sacó al hacer el hoyo. Mientras llena el hoyo, asiente la tierra y échele agua para evitar los borsillos o espacios de aire. Es importante observar que la base del tallo del árbol quede al nivel del suelo. Si el árbol es frágil, necesitará ponerle estacas para mantenerle derecho. Utilice material flexible para que el árbol pueda moverse con el viento. Debe hacerse visitas periódicas para inspeccionar los amarres y éstos no deben permanecer por más de un año. Se recomienda preparar un dique de tierra alrededor del árbol, a una distancia de dos pies del tronco (o tallo) para guardar el agua y que no se escape por la superficie. Precisamente gran parte de la supervivencia del árbol, depende del riego regular del mismo. Si se encuentra protegido contra la pérdida de humedad bastará con regarlo abundantemente una vez por semana. Los primeros 6 meses es indispensable el riego de agua periódicamente y con más importancia si hay sequía. Preparar un plan de abonamiento, utilizando abono con elementos menores y de liberación lenta (quedará activo hasta por 6 meses). La primera aplicación se hará en 6 semanas luego

de la siembra. Después del primer año, esparza 4 a 6 onzas de abono de gramíneas o frutales con análisis similares a 15-5-10-3 (con elementos o nutrientes menores) o 12-5-15-3 dos o tres durante el año (hágalo en tiempo lluvioso preferiblemente).

6.2 CONTROL DE PLAGAS Y ENFERMEDADES

Los insectos, animales (herbívoros), enfermedades y los yerbajos constituyen un grave problema para el éxito en la forestación. El control a tiempo de estas plagas y enfermedades ayudará grandemente a desarrollar árboles saludables y vigorosos. El examen periódico del árbol es importante para determinar el ataque o problemas causados por insectos, ácaros o enfermedades. Algunos de estos son:

a. Follaje masticado (en los bordes de las hojas principalmente).

b. Amarillez, moteado, salpicado, follaje seco o defoliación severa.

c. Distorsión y deformación de las hojas tiernas y las ramas.

d. Presencia o señales visuales de insectos o sus productos (revise el envés de las hojas).

e. Lesiones, manchas necróticas, agrietamiento, añublo o moho polvoriento en tronco, hojas y ramas.

f. Corteza y tallos roída por ratones (destruyen floema del árbol).

g. Hormigas bravas caminando por el arbolito, nidos u hormiguero en el tronco. Atacan la corteza y ramas nuevas además que cuidan los áfidos moscas blancas y queresas, (fumagina).

Existen otros síntomas que nos pueden señalar que existen algún problema con la salud del arbolito. Como prevención utilizaremos la aspersión de cualquiera de estos 3 plaguicidas, comenzando a los 3 meses de la siembra. Utilizando bomba de asperjar y haciendo uso de protección al aplicador (guantes de goma y mascarilla).

a. En un galón de agua añada lo siguiente: (plaguicida ecológico)

1) 4 onzas aceite mineral o vegetal
2) 3 onzas bicarbonato de soda
3) 1 onza jabón de fregar

Mezclar o agitar bien y asperjar los arbolitos, principalmente mojando el envés de las hojas.

b. En un galón de agua:

1) 1 onza de Malathion 57 EC (emulsión concentrada)
2) 4 onzas de hidróxido de cobre (Kocide 101)
3) 3 gotas de jabón de fregar

Mezclar o agitar bien y asperjar los arbolitos, principalmente mojando el envés de las hojas.

c. En un galón de agua (plaguicida botánico)

1) Aceite de Neem

Mezclar y agitar bien y asperjar los arbolitos, principalmente mojando el envés de las hojas.

6.3 PODA DE ARBOLES

La poda de árboles jóvenes estimula el desarrollo y crecimiento de árboles estructuralmente fuertes y saludables.

Razones importantes para podar son:

a. Ramas secas o enfermas

b. Arbolitos con co-dominancia deben ser podados para definir la rama líder.

c. Ramas con ángulos cerrados es indicativo de futuras zonas débiles. Para evitar problemas futuros, remueva una de las ramas.

d. Arboles juveniles que han sido deformados por el viento pueden ser corregidos en su crecimiento mediante poda.

e. Las ramas epidérmicas o chupones se caracterizan por sus ramas que crecen hacia adentro de la corona o en la base del árbol. Son de crecimiento rápido y están pobremente sujetas. Usualmente consumen más energía de la que producen por lo que son llamadas "chupones". Es recomendable removerlas lo antes posible.

f. Ramas que rozan entre sí pueden resultar en zonas de putrefacción de debilidad estructural. Se debe remover la más débil o mal formada.

Para la poda efectiva debe utilizar herramientas específicas para ésta labor. Tijeras de poda tipo pico de cotorra y serrote pequeño de mano son de gran utilidad principalmente en árboles juveniles. No usar machete para podar. Recomiendo aplicar "pintura de poda" en el corte para proteger el arbolito del ataque de hongos.

7.0 CONCLUSION

La guía de mitigación ordena la siembra de dos árboles por cada uno que se corte. Se estimó unos 3,250 árboles impactados en la construcción del acceso a la carr. 149. Sembrar en el mismo lugar del proyecto 6,500 árboles saludables, con altura mínima de seis pies (desde el tope del tiesto) será la acción más importante en este plan de mitigación. Cómo ya se informó, se sembrará árboles en ambos lados del acceso o camino proyectado. Recomiendo sembrar doble hilera de forma "tresbolillo" de

manera de prevenir la erosión y de crear un "seto vivo" para disminuir ruidos y polvos fugitivos. De sembrar todos categoría pequeño (distancia de siembra es 10 pies) se tomaría 2,664 árboles (camino de acceso). El restante (3,836 árbolitos) en las zonas de amortiguamiento y conservación se sembrará usando el método de "plantado por callejones.

Nosotros como consultores redactaremos y supervisaremos los procesos de siembra del mantenimiento a ofrecer (entiéndase riego, abonamiento, revisión de anclaje, control de plagas, enfermedades y otros), orientaremos a los directores de la operación de la cantera sobre las prácticas de conservación y de la necesidad de que sean implantadas por personal capacitado. Los trabajadores a no impactar las áreas protegidas y evitar los daños directos e indirectos a la vegetación (Ej. Tirar colillas de cigarrillos por los alrededores). Entendemos que el DRNA podrá enmendar y solicitar otros requisitos ellos crean necesarios, además estamos concientes de las penalidades y medidas punitivas por violar los términos de este reglamento.

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APENDICE

COLEGIO DE AGRONOMOS
DE PUERTO RICO

CERTIFICAMOS QUE

LIC.# 3062

AGRO. PEDRO J. LAVERGNE VAZQUEZ

ES MIEMBRO ACREDITADO DE ESTE COLEGIO
ESTA CREDENCIAL CADUCA EL
30 de junio de 2009

FIRMA DEL COLEGIADO

SECRETARIO

TESORERO

Estado Libre Asociado de Puerto Rico
Departamento de Recursos Naturales y Ambientales

CERTIFICADO DE PROFESIONAL DE SIEMBRA Y FORESTACIÓN

PSF-254

El Departamento de Recursos Naturales y Ambientales, bajo las disposiciones del Reglamento de Siembra, Corte y Forestación para Puerto Rico (Reglamento de Planificación Núm. 25), expide esta certificación a:

PEDRO J. LAVERGNE VÁZQUEZ

Y le autoriza a trabajar en la preparación de planos de siembra y forestación para el establecimiento, desarrollo y manejo de áreas verdes propuestas y/o existentes relacionadas a proyectos de desarrollo.

En reconocimiento de su preparación académica y experiencia en la siembra, cuido y manejo de árboles.

22 FEB 2007

Ernesto Díaz Velázquez
Administrador
Administración de Recursos Naturales

Fecha

ESTADO LIBRE ASOCIADO DE PUERTO RICO
DRNA
DEPARTAMENTO DE RECURSOS NATURALES Y AMBIENTALES

CARMELO
P.O. BOX 1052, SABANA SECA STA., P.R. 00952-1052 TEL. 251-9474 FAX 251-9420

11 de agosto de 2008

Hon. Javier Vélez Arocho
Secretario
Departamento de Recursos Naturales y Ambientales
P.O. Box 9066600
Puerta de Tierra Station
San Juan, PR 00906-6600

Atención : División de Permiso de Manejo de Arboles

Autorización para radicación Solicitud de Permiso de Corte, Siembra y Forestación
Camino Acceso a Canarico Quarries, Inc.
Carr. 5552 Km. 0.7
Bo. Guayabal
Juana Diaz, PR

Estimado señor Secretario :

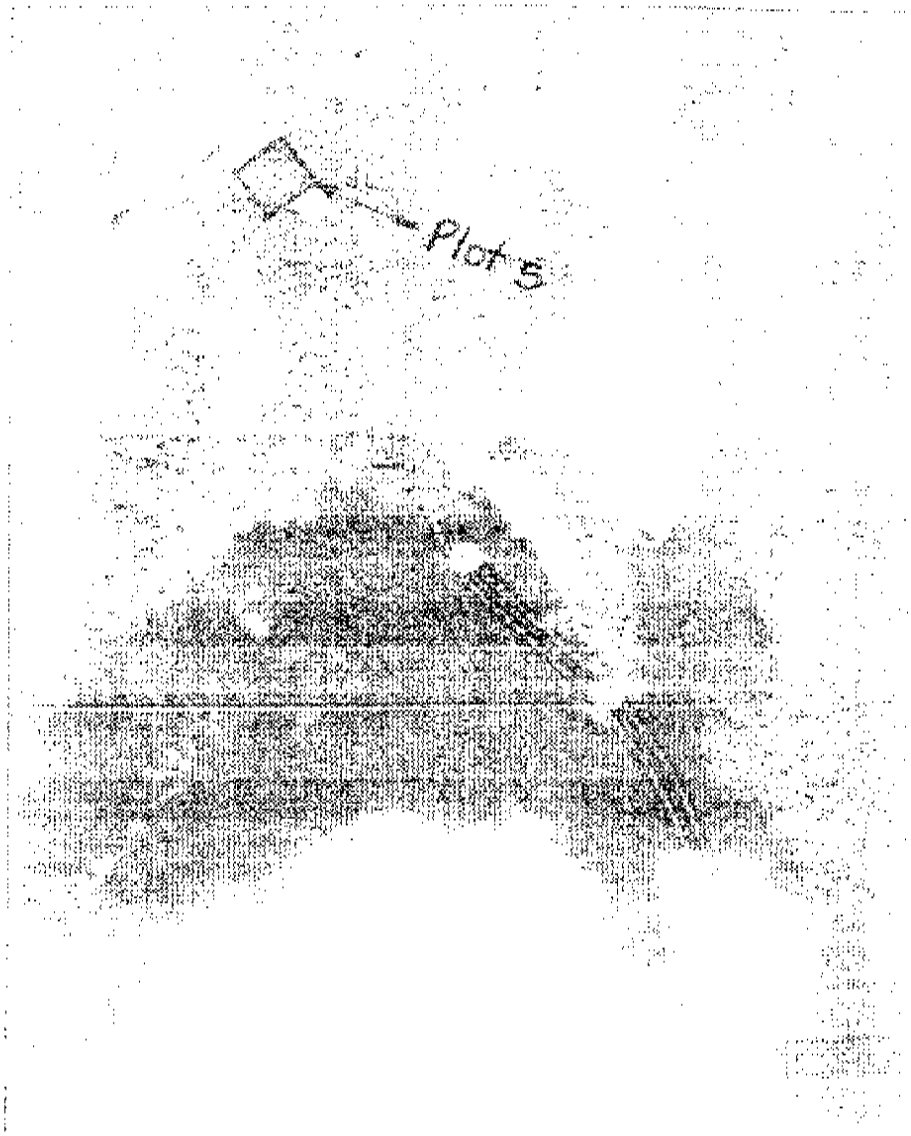
Yo, Moises Rivera Ramos, Gerente de Asuntos Ambientales de Canarico Quarries, Inc., certifico que el Agro. Pedro J. Lavergne Vazquez Profesional de Siembra Núm. 254 ha sido autorizado a gestionar todo lo referente a la solicitud de permiso de corte para el proyecto de referencia.

Cualquier duda o información adicional favor de comunicarse conmigo al (787) 632-9791.

Cordialmente,

Ing. Moises Rivera
EH&S Manager

N


Plot 5

TABLAS

9.5 TABLA I **Parcela de Estudio Núm. 1** **GPS: 18° 04' 52" N 66° 29' 02" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond.	Comentarios
1	Palo Rubio	*Zanthoxylum monophyllum*	3	12	B	Múltiples brotes, suprimido
2	Almácigo	*Burrera simaruba*	10	20	B	Cubierto por enredaderas
3	Palo Rubio	*Zanthoxylum monophyllum*	4	12	R	Múltiples brotes
4	Higüerillo	*Vitex divaricata*	2	10	R	Suprimido
5	Carbonero	*Albizia carbonaria*	2	8	P	Suprimido
6	Espino Rubial	*Zanthoxylum mostinicense*	5	12	R	Poco follaje, suprimido
7	Palo Blanco	*Cacearia guianensis*	2	10	P	Suprimido
8	Carbonero	*Albizia carbonaria*	3.5	12	R	Suprimido
9	Higüerillo	*Vitex divaricata*	4	12	R	Suprimido
10	Palo Blanco	*Casearia guianensis*	1	12	B	
11	Corcho Bobo	*Pisonia albida*	2.5	10	B	
12	Carbonero	*Albizia carbonaria*	2.5	10	P	Con comején
13	Carbonero	*Albizia carbonaria*	4	12	R	Fisura en el tronco
14	Carbonero	*Albizia carbonaria*	2.5	10	P	
15	Carbonero	*Albizia carbonaria*	3	10	P	Suprimido
16	Palo Blanco	*Casearia guianensis*	3	10	P	Suprimido
17	Carbonero	*Albizia carbonaria*	2.5	10	P	Suprimido
18	Sauco amarillo	*Tecoma stans*	1.5	12	R	
19	Hoja Menuda	*Eugenia rhombea*	4	12	B	
20	Hoja Menuda	*Eugenia rhombea*	3	10	B	
21	Tachuelo	*Pictetia aculeata*	1.5	10	R	Cubierto por enredaderas
22	Carbonero	*Albizia carbonaria*	5.5	15	R	Suprimido
23	Corcho Bobo	*Pisonia albida*	1	7	R	Suprimido
24	Carbonero	*Albizia carbonaria*	1	8	B	
25	Palo Blanco	*Casearia guianensis*	1.5	8	B	Suprimido
26	Hoja menuda	*Eugenia rhombea*	1	8	B	
27	Carbonero	*Albizia carbonaria*	3.5	12	R	Bifulcado, suprimido
28	Carbonero	*Albizia carbonaria*	3	11	R	Cubierto por enrredadera
29	Carbonero	*Albizia carbonaria*	4	15	P	
30	Carbonero	*Albizia carbonaria*	3	12	R	Esquina Oeste del cuadrante
31	Carbonero	*Albizia carbonaria*	3.5	15	R	Cubierto por enrredadera
32	Carbonero	*Albizia carbonaria*	3	10	R	
33	Carbonero	*Albizia carbonaria*	3	12	R	
34	Tachuelo	*Pictetia aculeata*	1	7	R	Cepa, cubierto por enrredadera
35	Tachuelo	*Pictetia aculeata*	1	7	R	Cepa, cubierto por enrredadera
36	Palo Rubio	*Zanthoxylum monophyllum*	4	15	B	Brotes epicórmicos
A 37	Palo Rubio	*Zanthoxylum monophyllum*	3	12	P	Múltiple brotes
A 38	Palo Rubio	*Zanthoxylum monophyllum*	2	10	R	Múltiple brotes
A 39	Almácigo Colorado	*Bursera simaruba*	2	11	B	2 brotes
A40	Almácigo Colorado	*Bursera simaruba*	8	15	B	Buen follaje
A41	Almácigo Colorado	*Bursera simaruba*	5.5	20	B	Buen follaje
A42	Corcho Bobo	*Pisonia albida*	8	22	P	Hueco en el tronco
A43	Almácigo colorado	*Busera simaruba*	6	20	B	
A44	Hoja Menuda	*Eugenia rhombea*	2	9	R	Suprimido
A45	Hoja Menuda	*Eugenia rhombea*	2	8	R	
A46	Carbonero	*Albizia carbonaria*	4	15	R	

Cont. TABLA I **Parcela de Estudio Núm. 2** **GPS: 18° 04' 52" N 66° 29' 02" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond.	Comentarios
A48	Roble Nativo	*Tabebuia heterophylla*	3	15	B	Múltiple brotes
A49	Roble Nativo	*Tabebuia heterophylla*	2	12	B	
A50	Higüerillo	*Vitex disaricata*	3.5	15	R	
A51	Carbonero	*Albizia carbonaria*	3.5	12	P	Ramas secas
A52	Tintillo	*Randia aculeata*	1	7	B	Juvenil
A53	Hoja Menuda	*Eugenia rhombea*	1.5	7	B	Buen follaje

TABLA 2 **Parcela de Estudio Núm. 2** **GPS 18° 05' 04" N 66° 29' 17" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
37	Hoja Menuda	*Eugenia rhombea*	3	8	R	
38	Guabá	*Inga vera*	9.5	30	B	Domina dosel
39	Guabá	*Inga vera*	9	20	B	Bifurcado
40	Tintillo	*Randia aculeata*	1	7	P	Brotes epicórmicos
41	Higüerillo	*Vitex divaricada*	2.5	20	R	Bifulcado
42	Tintillo	*Randia aculeata*	1.5	7	B	
43	Tintillo	*Randia aculeata*	1	8	B	
44	Higüerillo	*Vitex divaricata*	7	25	B	
45	Guabá	*Inga vera*	6	30	B	
46	Carbonero	*Albizia carbonaria*	4	15	R	Poco follaje
47	Guabá	*Inga vera*	4	16	R	
48	Guabá	*Inga vera*	1	10	R	Suprimido
49	Higüerillo	*Vitex divaricada*	3	20	R	
50	Guabá	*Inga vera*	3	15	P	
51	Hoja Menuda	*Eugenia rhombea*	2	12	R	
52	Higüerillo	*Vitex divaricada*	4	25	R	
53	Guabá	*Inga vera*	5	12	P	Poco follaje
54	Guabá	*Inga vera*	4.5	25	R	
55	Palo Rubio	*Zanthozylum monophyllum*	7	25	B	Bifulcado
56	Carbonero	*Albizia carbonaria*	6	26	B	Esquina Noroeste Cuadrante
57	Carbonero	*Albizia carbonaria*	2	8	R	
58	Carbonero	*Albizia carbonaria*	2	9	B	
59	Carbonero	*Albizia carbonaria*	2	9	R	
60	Almacigo blanco	*Bursera simaruba*	1	7	B	Juvenil

TABLA 3 **Parcela de Estudio Núm. 3** **GPS 18° 05' 04" N 66° 29' 17" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
61	Guácima	*Guazuma ulmifolia*	2	12	R	Inclinado, suprimido
62	Guácima	*Guazuma ulmifolia*	6.5	25	B	Buen follaje
63	Guácima	*Guazuma ulmifolia*	3	15	R	
64	Tintillo	*Randia aculeata*	1	7	R	Suprimido
65	Tintillo	*Randia aculeata*	1	8	R	Suprimido
66	Capulín	*Trema micrantha*	3	25	B	Ramas secas

Cont. TABLA 3 **Parcela de Estudio Núm. 3** **GPS 18° 05' 04" N 66° 29' 17" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
67	Palo Blanco	*Casearia guianensis*	1	12	B	
68	Guácima	*Guazuma ulmifolia*	6.5	20	R	
69	Carbonero	*Albizia carbonaria*	4.5	20	R	
70	Palo Blanco	*Casearia guianensis*	2	15	B	
71	Tintillo	*Randia aculeata*	1	7	R	
72	Corcho Bobo	*Pisonia albida*	4.5	20	B	
73	Cafeillo	*Casearia sylvesstri*	2	12	B	
74	Eugenia	*Eugenia sp.*	1	8	B	
75	Palo Blanco	*Casearia guianensis*	2	12	R	
76	Carbonero	*Albizia carbonaria*	3	18	P	
77	Palo Rubio	*Zanthoxylum monophyllum*	3	15	R	Múltiple brotes
78	Roble Nativo	*Tabebuia heterophylla*	2	10	R	Ataque de trípidos
79	Palo Rubio	*Zanthoxylum monophyllum*	4	20	B	
80	Palo Blanco	*Casearia guianensis*	1	6	B	
81	Tintillo	*Randia aculeata*	1	12	B	2 brotes
82	Roble Nativo	*Tabebuia heterophylla*	1.5	10	R	
83	Palo Blanco	*Casearia guianensis*	3	20	B	3 brotes
84	Guácima	*Guazuma ulmifolia*	8.5	15	B	
85	Hoja Menuda	*Eugenia rhombea*	3	20	B	2 brotes
86	Guácima	*Guazuma ulmifolia*	6	20	R	
87	Guácima	*Guazuma ulmifolia*	4	15	R	
88	Palo Blanco	*Casearia guianensis*	1	8	B	Buen follaje
89	Guácima	*Guazuma ulmifolia*	4.5	20	R	
90	Quenepa	*Melicocca bijuga*	1	8	B	
91	Palo Rubio	*Zanthoxyllum monophyllum*	4	20	R	Múltiples brotes
92	Quenepa	*Melicocca bijuga*	1	6	B	
93	Guácima	*Guazuma ulmifolia*	3.5	20	P	Enfermo, ramas secas
94	Eugenia	*Eugenia sp*	1	7	B	
95	Eugenia	*Eugenia sp.*	1.5	10	B	
96	Hoja Menuda	*Eugenia rhombea*	2	12	B	
97	Higuerillo	*Vitex divaricada*	6.5	30	B	Buen follaje
98	Palo Blanco	*Casearia guianensis*	1	8	B	
99	Cafeillo	*Casearia sylvestri*	2	12	B	
100	Camasey Felpa	*Miconia racemosa*	6	25	B	
101	Palo Blanco	*Casearia guianensis*	1.5	12	B	
102	Higüerillo	*Vitex divaricada*	4	20	B	
103	Palo Blanco	*Casearia guianensis*	1.5	12	B	
104	Palo Blanco	*Casearia guianensis*	1	11	B	
105	Palo Blanco	*Casearia guianensis*	1.5	13	B	
106	Quenepa	*Melicocca bijuga*	1	8	B	
107	Palo Blanco	*Casearia guianensis*	1	10	B	
108	Guácima	*Guazuma ulmifolia*	6	15	B	
109	Tintillo	*Randia aculeata*	1.5	9	B	
110	Palo Blanco	*Casearia guianensis*	1	12	B	
111	Hoja Menuda	*Eugenia rhombea*	2	12	B	
112	Tintillo	*Randia aculeata*	2	10	B	
113	Tintillo	*Randia aculeata*	2	12	B	
114	Corcho Bobo	*Pisonia albida*	4	20	B	

Cont. TABLA 3 **Parcela de Estudio Núm. 3** **GPS 18° 05' 04" N 66° 29' 17" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
115	Guácima	*Guazuma ulmifolia*	7	25	R	
116	Guácima	*Guazuma ulmifolia*	1	7	R	Brotes epicórmicos
117	Guácima	*Guazuma ulmifolia*	1	7	B	
118	Palo Blanco	*Casearia guianensis*	2	10	B	
119	Palo Blanco	*Casearia guianensis*	2	11	B	
120	Palo Blanco	*Casearia guianensis*	1.5	6	B	
121	Quenepa	*Melicocca bijuga*	1	6	B	
122	Hoja Menuda	*Eugenia rhombea*	2	15	P	Ramas secas
123	Quenepa	*Melicocca bijuga*	1.5	8	B	
124	Higüerillo	*Vitex divaricada*	6	20	R	Múltiple brotes
125	Higüerillo	*Vitex divaricada*	1	7	B	
126	Hoja Menuda	*Eugenia rhombea*	2	8	B	
127	Guácima	*Guazuma ulmifolia*	6	20	R	Poco follaje
128	Tintillo	*Randia aculeata*	1	7	P	Enfermo, clorótico
129	Quenepa	*Melicocca bijuga*	1.5	9	R	Suprimido
130	Palo Rubio	*Zanthozylum monophyllum*	5	22	B	
131	Palo Blanco	*Casearia guianensis*	1	7	P	Inclinado, suprimido
132	Quenepa	*Melicocca bijuga*	1	8	B	
133	Quenepa	*Melicocca bijuga*	1	6	B	
134	Eugenia	*Eugenia sp.*	2	15	B	
135	Guácima	*Guazuma ulmifolia*	8	25	R	
136	Quenepa	*Melicocca bijuga*	2	10	B	
137	Guácima	*Guazuma ulmifolia*	5	20	R	Comején
138	Palo Blanco	*Casearia guianensis*	1.5	8	B	
139	Quenepa	*Melicocca bijuga*	1	7	B	
140	Guácima	*Guazuma ulmifolia*	8	15	R	Ramas secas
141	Quenepa	*Melicocca bijuga*	1.5	8	B	
142	Quenepa	*Melicocca bijuga*	2	10	B	
143	Palo Blanco	*Casearia guianensis*	1	8	B	

TABLA 4 **Parcela de Estudio Num. 4** **GPS: 18° 15' 04" N 66° 29' 17" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
144	Tintillo	*Randia aculeata*	1	8	B	
145	Tintillo	*Randia aculeata*	1	7	B	Múltiple brotes
146	Palo Rubio	*Zanthozylum monophyllum*	3	15	B	
147	Hoja Menuda	*Eugenia rhombea*	2	15	B	
148	Palo Blanco	*Casearia quianensis*	2	10	B	
149	Almacigo Colorado	*Bursera dimaruba*	3	12	B	Buen follaje
150	Higüerillo	*Vitex divaricada*	4	15	R	Brotes epicórmicos
151	Guácima	*Guazuma ulmifolia*	4	15	B	
152	Guácima	*Guazuma ulmifolia*	3	10	B	
153	Hoja Menuda	*Eugenia rhombea*	2	15	B	
154	Cafeillo	*Casearia sylvestri*	2	10	B	Suprimido
155	Hoja Menuda	*Eugenia rhombea*	1	10	B	
156	Guácima	*Guazuma ulmifolila*	7	25	B	
157	Palo Blanco	*Casearia guianensis*	1	12	B	

cont. TABLA 4 **Parcela de Estudio Num. 4** **GPS: 18° 15' 04" N 66° 29' 17" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
158	Hoja Menuda	*Eugenia rhombea*	2	15	R	Poco follaje
159	Hoja Menuda	*Eugenia rhombea*	3	18	B	
160	Hoja Menuda	*Eugenia rhombea*	2	15	B	
161	Hoja Menuda	*Eugenia rhombea*	2	14	B	Suprimido
162	Hoja Menuda	*Eugenia rhombea*	2	15	B	
163	Hoja Menuda	*Eugenia rhombea*	2.5	15	B	
164	Palo Blanco	*Casearia gianensis*	2	12	B	Suprimido
165	Moca	*Andira inermes*	1	7	P	Atacado por insectos
166	Tintillo	*Randia aculeata*	1	7	P	Poco follaje, inclinado
167	Tintillo	*Randia aculeata*	2	9	R	Suprimido
168	Tintillo	*Randia aculeata*	1.5	8	R	Suprimido
169	Guácima	*Guazuma ulmifolia*	5	20	P	Comején
170	Hoja Menuda	*Eugenia rhombea*	2	10	P	Ramas rotas, poco follaje
171	Guácima	*Guazuma ulmifolia*	5	21	R	Suprimido
172	Palo Blanco	*Casearia guianensis*	2	12	R	Múltiple brotes
173	Quenepa	*Melicocca bijuga*	5	20	B	
174	Moca	*Andira inermes*	4	15	B	
175	Hoja Menuda	*Eugenia rhombea*	2	15	B	
176	Palo Blanco	*Casearia guianensis*	2	10	B	
177	Hoja Menuda	*Eugenia rhombea*	1	7	B	
178	Cafeillo	*Casearia sylvestri*	2	10	B	Suprimido
179	Hoja Menuda	*Eugenia rhombea*	2	15	B	Suprimido
180	Tintillo	*Randia aculeata*	1	7	B	
181	Corcho Bobo	*Pisonia albida*	5.5	25	B	
182	Corcho Bobo	*Pisonia albida*	6	28	B	
183	Palo Blanco	*Casearia guianensis*	1.5	12	B	
184	Palo Blanco	*Casearia guianensis*	1	10	B	
185	Hoja Menuda	*Eugenia rhombea*	2	12	B	
186	Higüerillo	*Vitex divaricada*	2	12	B	
187	Palo Blanco	*Casearia guianensis*	1.5	12	B	
188	Hoja Menuda	*Eugenia rhombea*	1	10	B	Suprimido
189	Corcho Bobo	*Pisonia albida*	5	25	B	
190	Quenepa	*Melicocca bijuga*	1.5	12	B	
191	Guácima	*Guazuma ulmifolia*	5	21	P	Ramas rotas, brotes epicórmicos
192	Guácima	*Guazuma ulmifolia*	1.5	12	P	Poco follaje, ataque de insectos
193	Higüerillo	*Vitex divaricada*	2	15	B	
194	Hoja Menuda	*Eugenia rhombea*	2	18	B	
195	Tintillo	*Randia aculeata*	1	7	B	
196	Cafeillo	*Casearia sylvestri*	1.5	10	B	
197	Palo Blanco	*Casearia guianensis*	1.5	8	B	
198	Palo Blanco	*Casearia guianensis*	1.5	8	B	Suprimido
199	Palo Blanco	*Casearia guianensis*	2	10	P	Suprimido

cont. TABLA 4 **Parcela de Estudio Num. 4** **GPS: 18° 15' 04" N 66° 29' 17" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
200	Guácima	*Guazuma ulmifolia*	4	12	P	Suprimido
201	Moca	*Andira inermes*	3	8	P	Suprimido
202	Hoja Menuda	*Eugenia rhombea*	2	10	P	Enfermo, ramas secas
203	Hoja Menuda	*Eugenia rhombea*	3	10	R	
204	Hoja Menuda	*Eugenia rhombea*	2	10	R	
205	Quenepa	*Melicocca bijuga*	2	10	R	Suprimido
206	Guácima	*Guazuma ulmifolia*	3	15	P	Fisura en el tronco
207	Guanábana	*Anonna muricata*	1	7	R	Poco follaje
208	Guácima	*Guazuma ulmifolia*	6	15	P	
209	Guácima	*Guazuma ulmifolia*	8	28	R	Domina el dosel, múltiple brotes
210	Moca	*Andira inermes*	5	20	R	
211	Corcho Bobo	*Pisonia albida*	1.5	10	B	
212	Guácima	*Guazuma ulmifolia*	6	21	R	Múltiple brotes
213	Palo Blanco	*Casearia guianensis*	1.5	8	P	Suprimido
214	Palo Blanco	*Casearia guianensis*	2	12	P	
215	Eugenia	*Eugenia sp.*	2.5	15	R	
216	Eugenia	*Eugenia sp.*	2	12	R	
217	Palo Blanco	*Casearia guianensis*	2	8	P	Comején, cepa
218	Palo Blanco	*Casearia guianensis*	2.5	15	B	

TABLA 5 **Parcela de Estudio Num. 5** **GPS: 18° 04' 46" N 66° 29' 57" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
219	Guanábana	*Annona muricata*	5.5	12	R	Múltiple brotes
220	Sauco Amarillo	*Tecoma Stans*	2	10	B	Ramas rotas
221	Casia de Siam	*Cassia siamea*	10.5	35	R	Múltiple brotes
222	Casia de Siam	*Cassia siamea*	13	38	R	Comején
223	Capulín	*Trema micrantha*	2	8	B	
224	Flamboyán Rojo	*Delonix regia*	2	8	B	Florecido
225	Flamboyán Rojo	*Delonix regia*	1.5	10	B	Florecido
226	Casia de Siam	*Cassia siamea*	7	25	B	
227	Casia de Siam	*Cassia siamea*	11	30	B	
228	Flamboyán	*Delonix regia*	13	35	B	Florecido
229	Quenepa	*Melicocca bijuga*	15	28	R	Múltiple brotes
230	Flamboyán	*Delonix regia*	1	7	B	Florecido
231	Casia de Siam	*Cassia siamea*	9	28	B	
232	Tulipán Africano	*Spathodea campanulata*	11	40	R	Múltiple brotes, comején
233	Quenepa	*Melicocca bijuga*	4	25	B	Múltiple brotes, comején
234	Carbonero	*Albiziacarbonaria*	4.5	12	R	Inclinado
235	Casia de Siam	*Cassia siamea*	3	8	B	Apice cortado
236	Capulín	*Trema micrantha*	3	12	B	
237	Tulipán Africano	*Spathodea campanulata*	6	15	R	Múltiple brotes
238	Tulipán Africano	*Spathodea campanulata*	21	30	B	
239	Palma Real	*Roystonea borinquena*	14	35	B	Buen Follaje
240	Laurel Avispillo	*Cinnamomum elongatum*	2	10	B	
241	Caoba Sta. Cruz *		2	12	B	*Es un híbrido entre C. Hondureña y C. Dominicana

cont. TABLA 5 **Parcela de Estudio Num. 5** **GPS: 18° 04' 46" N 66° 29' 57" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
242	Capulín	*Trema micrantha*	12	15	B	2 brotes
243	Quenepa	*Melicocca bijuga*	1	8	B	
244	Casia de Siam	*Cassia siamea*	3.5	20	B	
245	Quenepa	*Melicocca bijuga*	1.5	12	P	Múltiple brotes
246	Corcho Bobo	*Pisonia albida*	2	13	R	Ataque de insectos
247	Casia de Siam	*Cassia siamea*	9	30	B	
248	Flamboyán	*Delonix regia*	13	30	B	Florecido
249	Almendra	*Terminalia catappa*	2.5	30	B	Inclinado
250	Flamboyán	*Delonix regia*	5	20	B	Florecido
251	Guamá	*Inga laurina*	4	15	P	Torcido, comején
252	Corcho Bobo	*Pisonia albida*	4	30	R	Comején
253	Jobillo	*Spondias mombin*	24	35	B	
254	Corcho Bobo	*Pisonia albida*	2	12	B	
255	Corcho Bobo	*Pisonia albida*	1.5	10	B	
256	Corcho Bobo	*Pisonia albida*	2	11	B	
257	Carbonero	*Albizia carbonaria*	2	10	P	Suprimido, comején
258	Carbonero	*Albizia carbonaria*	2.5	11	P	Suprimido, comején
259	Carbonero	*Albizia carbonaria*	2	12	P	Suprimido, comején
260	Capulín	*Trema micrantha*	3	18	B	
261	Corcho Bobo	*Pisonia albida*	1.5	7	B	
262	Guácima	*Guazuma ulmifolia*	3	18	P	Ramas enfermas,comején
263	Guácima	*Guazuma ulmifolia*	7	23	R	
264	Guácima	*Guazuma ulmifolia*	5	20	R	Múltiple brotes, suprimido
265	Carbonero	*Albizia carbonaria*	13	30	R	Comején en tronco
266	Guácima	*Guazuma ulmifolia*	6.5	20	R	Inclinado, brotes epicórmicos
267	Carbonero	*Albizia carbonario*	5.5	25	B	
268	Carbonero	*Albizia carbonario*	2	15	B	
269	Carbonero	*Albizia carbonario*	6	25	B	
270	Carbonero	*Albizia carbonario*	3	18	R	Inclinado
271	Jobillo	*Spondias mombin*	6	20	R	Comején
272	Carbonero	*Albizia carbonaria*	4	15	B	
273	Palo Rubio	*Zanthoxylum monophyllum*	4	18	P	Múltiple brotes
274	Guácima	*Guazuma ulmifolia*	6	15	B	Con semillas
275	Guácima	*Guazuma ulmifolia*	4	13	B	Con semillas
276	Guácima	*Guazuma ulmifolia*	5.5	18	B	
277	Guácima	*Guazuma ulmifolia*	5	15	P	Tronco doblado, suprimido
278	Guácima	*Guazuma ulmifolia*	6	18	R	
279	Carbonero	*Albizia carbonaria*	5	15	R	
280	Carbonero	*Albizia carbonaria*	6	18	R	Suprimido
281	Jobillo	*Spondias mombin*	16	23	R	
282	Guácima	*Guazuma ulmifolia*	8	22	P	Ramas secas
283	Palo Rubio	*Zanthozylum monophyllum*	10.5	22	P	Múltiple brotes
284	Albizia	*Albizia procera*	5	10	P	Suprimido, comején
285	Guácima	*Guazuma ulmifolia*	2	12	R	Suprimido
286	Albizia	*Albizia procera*	3	15	P	Comején, suprimido
287	Sauco Cimarrón	*Turpinia paniculada*	2	15	R	Con bejucos, suprimido
288	Guácima	*Guazuma ulmifolia*	6	23	R	

cont. TABLA 5 **Parcela de Estudio Num. 5** **GPS: 18° 04' 46" N 66° 29' 57" O**

Núm	Nombre Común	Nombre Científico	DAP	Altura	Cond	Comentarios
289	Albizia	*Albizia procera*	8	25	R	Comején
290	Jobillo	*Spondias mombin*	4	12	P	Ramas secas
291	Guácima	*Guazuma ulmifolia*	6	15	R	Con semillas
292	Guayaba	*Psidium guajava*	3	12	B	
293	Guácima	*Guazuma ulmifolia*	5	12	R	
294	Guácima	*Guazuma ulmifolia*	3	12	R	
295	Guácima	*Guazuma ulmifolia*	2	10	R	
296	Palo Rubio	*Zanthoxylum monophyllum*	8	15	P	Múltiple brotes, ramas secas
297	Palo Rubio	*Zanthoxylum monophyllum*	4	12	R	Múltiple brotes, ramas secas
298	Jobillo	*Spondias mombin*	5.5	15	R	
299	Albicia	*Albizia procera*	5	15	R	Comején
300	Albicia	*Albizia procera*	4	20	R	Poco follaje
301	Jobillo	*Spondias mombin*	19	30	R	Con enredaderas
302	Jobillo	*Spondias mombin*	13.5	20	R	
303	Jobillo	*Spondias mombin*	3.5	12	R	
304	Jobillo	*Spondias mombin*	6	20	R	Ramas secas
305	Jobillo	*Spondias mombin*	7	22	R	
306	Carbonero	*Albizia carbonaria*	3.5	10	B	
307	Jobillo	*Spondias mombin*	7	21	B	
308	Jobillo	*Spondias mombin*	6	20	B	

Leyenda:

Cond. = condición general del árbol
B= bueno
R= regular
P= pobre

DAP= diámetro a la altura del pecho en pulgadas
ALTURA= altura del árbol en pies

9.6

RESUMEN DE ESPECIES ARBÓREAS INVENTARIADAS

NOMBRE COMÚN	NOMBRE CIENTÍFICO	CANTIDAD	POR CIENTO
1. Guácima	*Guazuma ulmifolia*	36	11.0
2. Carbonero	*Albizia carbonaria*	40	12.3
3. Palo Blanco	*Caseraria guanensis*	35	10.7
4. Hoja Menuda	*Eugenia rhombea*	32	9.8
5. Palo Rubio	*Zanthoxylum monophyllum*	20	6.2
6. Quenepa	*Melicocca bijuga*	19	5.8
7. Tintillo	*Randia aculeata*	18	5.5
8. Corcho Bobo	*Pisonia albida*	15	4.6
9. Jobillo	*Spondias Bombin*	13	4.0
10. Higüerillo	*Vitex divaricata*	12	3.7
11. Eugenia sp.	*Eugenia sp.*	10	3.0
12. Guaba	*Inga vera*	9	2.8
13. Casia de Siam	*Cassia siamea*	8	2.5
14. Albicias	*Albizia procera*	7	2.2
15. Flamboyán	*Delonix vegia*	6	1.8
16. Almácigo	*Bursera simaruba*	5	1.5
17. Moca	*Andira inermes*	5	1.5
18. Capulín	*Trema micrantha*	4	1.2
19. Roble nativo	*Tabebuia heterophy*	4	1.2
20. Cafeillo	*Casearia sylvestri*	3	.92
21. Tachuelo	*Picteria aculeata*	3	.92
22. Tulipán africano	*Spathodea campanulata*	3	.92
23. Sauco Amarillo	*Tecoma Stans*	2	.62
24. Guayaba	*Psidium gujaba*	2	.62
25. Guanábana	*Anonna muricata*	2	.62
26. Caoba Santa Cruz	* *hibrido Caoba dominicana y Hondureña*	1	.31
27. Espino Rubial	*Zauthxylum martinicense*	1	.31
28. Avispillo	*Nectandra coriacea*	1	.31
29. Palma Real	*Roystonea borinquena*	1	.31
30. Péndula	*Citharexylum frusticosum*	1	.31
31.Almendra	*Terminalia catappa*	1	.31
32.Guamá	*Inga laurina*	1	.31
33. Camasey Felpa	*Miconia racemosa*	1	.31
TOTAL	**33 especies**	**325**	**100%**