URS

Environmental Evaluation of the Water Options in the Indio River Watershed
Project No.SAA-117595
Final Report - Annex

Prepared for:
Panama Canal Authority

Prepared by:
URS Holdings, Inc.

Panama – May, 2004

ANNEX – 1

TEAM MEMBERS

Project Director - Ron Giovannelli
Mr. Giovannelli has over 25 years of experience managing, coordinating and directing hydraulic resource and engineering projects. His technical experience centers on ideology**, hydraulics, water quality, groundwater, water supply, wastewater management and environmental impact assessments.

Project Manager and Senior Ecologist – Alberto Vega
Mr. Vega's more than 25 years of professional experience include implementation of sustainable development, resource conservation and environmental planning projects. His experience centers on environmental impact assessments, resource conservation, basin management, water quality control of lakes and dams, institutional development and environmental policy.

Office Manager Panama - Juan Vallarino
Mr. Vallarino, the URS office manager in Panama, has a degree in Civil Engineering and a Masters in Environmental engineering specializing in management of hazardous waste and ISO 14000 environmental audits. Mr. Vallarino has participated and managed several environmental projects for national and international clients.

Quality control coordinator (QA/QC) - John Rañon, P.E.
Mr. Rañon is a civil engineer with over 28 years of experience in infrastructure projects. For over 13 years he directed a civil engineering and landscaping firm in Tampa that planned, designed and provided administrative service for construction to clients in more than 300 projects.

QA/QC Environmental Aspects - Luis Ferrate
Dr. Ferrate, PhD in geography, works as an independent environmental consultant. Presently he advises on environmental policy, management, design and strategy for national and regional programs concerning social crisis and natural phenomena, and he inspects the design and implementation of environmental projects and programs or planning.

QA/QC – Social Aspects - Stephen McGaughey
Dr. McGaughey, PhD in economics, works as an independent consultant. His most recent clients were the Inter American Development Banks in Dominican Republic and in El Salvador. His expertise centers on sustainable development programs and policy, natural resources and environment, rural development and agricultural policy, among others.

Geotechnician - Ramón Martínez
Dr. Martínez, PhD in geotechnical engineering, is a college professor and has more than 18 years experience in his field. He was involved in the management and direction of geotechnic and interdisciplinary projects in the US and various Latin-American countries. His experience centers on soil engineering and the creation of geotechnic structures.

Hydrologist/ Sediment Removal - Fernando Miralles
Dr. Miralles is a senior hydraulics engineer with more than 10 years experience in simulation modeling and remote sensors of water resources in basins and urban systems, in piping hydraulics, and in the analysis of water distribution and quality

control. Furthermore he is a faculty member at the Massachusetts Institute of Technology (MIT), Northeastern University and the University of Miami.

Group leader of Biological Sciences and Senior Zoologist - Dr. Douglas Reagan
Dr. Reagan, PhD in zoology, has more than 25 years experience in zoology and terrestrial ecology. Currently he leads a Technical Management of Ecosystems group for URS and participates as a senior consultant in environmental impact studies, effects on natural resources and environmental evaluation projects.

Botanist - Dr. Ricardo Calvo
Dr. Calvo, PhD in Biology, has more than 15 years experience in investigation of plant ecology and environmental consulting. His expertise is plant ecology and botany, environmental studies, analysis and mitigation of impact, management and licensing of natural resources, and ecological and environmental modeling and planning.

Aquatic Ecologist - Dr. Manuel Basterrechea
Dr. Basterrechea is a PhD in Civil and Environmental Engineering. He has more than 20 years of experience and has acted as senior consultant on a wide variety of natural resource and environmental efforts for various national and international organizations such as: IDB, AID, Unicef, PAHO, etc.

Sociologist / Anthropologist - Dr. Gerald Murray
Dr. Murray, PhD in Anthropology, is an associate professor of anthropology at the University of Florida. He has published two books and 21 articles and prepared 56 briefs on applied anthropology for various agencies in more than 13 countries.

Sociologist / Public Participation Planner – Carmen Quintero
Dr. Quintero, PhD in sociology, has vast experience in the production of continuing education workshops, the design of opinion polls and population polling and studies. She is a professor of sociology and the University of Panama and has served as Chief of Staff of Social Investigation for the Ministry of Housing.

Economist - Dr. Gustavo Arcia
Dr. Arcia, PhD in Agro Economics and Applied Econometrics, works as senior consultant in policy for social and economic sectors for international development agencies and organizations such as the World Bank and the Inter American Development Bank.

Marine / Fishing Resources - Rigoberto González
Mr. González has a Masters in Marine Biology and has participated in various national and international projects. He did research for the Center of Marine Sciences and Ichthyology of the University of Panama and for the flora and fauna inventory of the Coiba Island National Park. He was a biologist in the department of rivers and lakes of the national aquaculture directorate for the ministry of agricultural development, as well as for the Entomology Unit of the Panama Canal Commission, and he was a species consultant on endangered fish species in continental waters of El Salvador, among others.

Simulation and Modeling - Clinton Thurlow
Mr. Thurlow is a Coastal Resources engineer with more than 10 years experience in computerized numeric models applicable to physical processes in tropical and

subtropical environments. He's well acquainted with applications developed by USACE and was in charge of the programs WMS and HEC-RES RESSIM used for the identification of options and performance evaluation, respectively.

Archaeologist - Emlen Myers

Dr. Myers, PhD in anthropology currently works as group leader and manager of the Cultural Resources Group of the National Capital of URS. His field of expertise centers on archeology, anthropology and cultural history, Latin-American archeology, cultural resource management, integration of cultural resources in studies on environmental planning and development, and implementation of protection programs for cultural resources.

ANNEX 2-A

METHODOLOGY FOR THE CREATION OF A SURFACE FLOW MODEL FOR THE INDIO, THE CAÑO SUCIO AND THE TOABRE RIVERS IN THE ROCC BASIN

1. Introduction

To analyze the possible environmental effects associated with the development of utility options of hydraulic resources in these river's basins, a model was developed to estimate average annual runoff at any point in the main rivers and their tributaries. The final result was summarized in a map of the average annual runoff with runoff isohyets spaced at intervals of 250mm/year. In order to estimate annual runoff of any subbasin or microbasin in the surveyed area one must superimpose its area on the runoff map and integrate the value of the total runoff.

2. Model Development

Conceptually, the model was developed on the basis of the relationships that explain water flow in ecosystems according to the ecological classification system known as Life Zones. Average annual runoff (mm/year) results from the difference of precipitation (**P**) minus real evapotranspiration (**ETR**). These calculations were made via digital processing of images of various variables that are converted to digital values in areas of 10 x 10 meters, what is known as a pixel (picture element). Some of the images needed for the model, a digital topographic model of the site provided by the ACP generated by radar imaging from IF-SAR was used as a fundamental variable.

The application of the model to the existing data, including value assignations of P and ETR to each 10 x 10 meter pixel, was done with the help of the modeling and simulation capabilities of the ERDAS IMAGINE software package using the Model Maker module.

To select only the areas covered by the pixels that correspond to each of the surveyed subbasins, the corresponding vectorial coverage of the subbasins of the Toabré, Caño Sucio and Indio rivers were used. This insured that all calculations and estimates were perfomed solely in the area of interest of the study.

2.1 Estimating Precipitation (P)

The image of precipitation for each pixel was generated from an isohyetal map provided by the ACP as a vector file (figure 1). This map was rasterized with a spatial resolution similar to the 10 x 10 m digital land model with the help of the ERDAS IMAGINE topographical analysis model, creating a three dimensional surface based on lines of equal precipitation.

2.2 Estimating Real Evapotranspiration (ETR)

Real evapotranspiration (ERT) was determined based on a nomogram of water movement in the natural ecosystem according to Life Zones. The ERT curve for the range of incidental climate factors for the surveyed area can be approximated using the following equation:

(1) **ERT = EPT*(1-(0.4-ETP/P)^2)*0.92)**

EPT is the potential evapotranspiration and P is precipitation

It is important to consider that the real evapotranspiration obtained by this equation corresponds to the climax vegetation in that life zone, known as Climatic or Zone Association . Ecosystems intervened by man normally have less real evapotranspiration due to the reduced plant biomass. This can be corrected by stating that where the ecosystem's mature vegetation is forest it is a function of height of the dominant vegetation multiplied by four if the vegetation is shrubbland and by eight if it's grassland. The relationship used for correcting the actual use of lands equation is as follows:

(2) **ERT-VE = (1+(HVE/HVM) x ERT-VM/2**

Where: **ERT-VE** is the real evapotranspiration of the existing vegetation;
HVE is the dominant altitude of the existing vegetation. When the vegetation is grassland the altitude is multiplied by 8 and when it's shrubbland it's multiplied by 4;
HVM is the altitude of the mature vegetation; and
ERT-VM is the real evapotranspiration of the mature vegetation

2.2.1 Estimating Potential Evapotranspiration (EPT)

In the system of Life Zones, the Potential Evapotranspiration is a function of the biotemperature (T_{bio}) and a constant (58.93) defined by the following equation:

(3) **$EPT = 58.93 * T_{bio}$**

It is therefore necessary to define biotemperature as well as a practical way to estimate it.

2.2.2 Estimating Biotemperature

The concept of biotemperature in the Life Zones system refers to the range of temperatures at which the ecosystem can effectively photosynthesize. The Life Zones system suggests zero and thirty degrees for this range. The rationale is that temperatures under zero paralyze the photosynthesis machinery and temperatures over thirty render negative photosynthesis.

The latter is especially true for species that have a C3 carbon fixation system, in other words, most forest species found in the moist tropics.

To calculate biotemperature, values outside the range have a value of zero. Therefore estimating biotemperature requires detailed (hourly) information of the site of interest. That information is not normally available and so to make an approximation the Life Zones suggests an empiric equation that estimates adjustments in average, monthly or annual temperatures, according to the latitude of the place of interest. That is equation is as follows:

(4) T_{bio} =T-(3*Latitud/100)*(T-24)^2)

Where **T** is the temperature in degrees centigrade and the latitude is expressed as a decimal. The relation can be applied only to temperatures above 24 degrees centigrade.

Therefore it is necessary to generate temperature (**T**) values for each 10 x 10 m pixel.

2.2.3 Estimating Temperature Values

The average annual temperature (in degrees Celsius, °C) of the surface air was calculated with the help of **altothermic equations** developed by the department of Hydrometeorology of the IRHE. The necessary temperature information for the development of these equations was obtained from select weather stations that had at least five years of continuous thermal readings available from 1978 to 1983. The altothermic formula used in estimating temperature is:

(5) **T = 26.9006 – 0.0055(H).**

Where **H** is altitude of the locality expressed in meters above sea level. The numbers (26.9006 y 0.0055) correspond with the average value of the monthly formulas calculated by IRHE

Applied to pixels of 10 x 10 meters this relation generates a raster temperature map (Figure 2) used as a starting point to estimate the potential evapotranspiration and then real evapotranspiration.

The temperature (T) image was generated by applying the mentioned coefficients over the image of the digital land model (H), which explains why the resulting temperature image maintains the geometric characteristics of spatial resolution and projection of the digital land model, in other words, the same 10 x 10 m pixel size and the same geographic projection, which allows the superimposition of other images (UTM, Esferoide Clark** 1866, NAD 27 / Canal Zone).

2.2.4 Procedures for Simulation

Once the procedure to calculate each of the aforementioned pertinent variables had been defined, calculations were made on each variable with ERDAS IMAGINE software. Each variable was stored as an independent image that covered the whole area of interest.

The first consideration for the simulations was the woodland that covered the entire area and then adjustments were made considering the use of that area as described in sections 1.2. Furthermore the simulation was done both using the correction by latitude and without that correction. This last variant was considered convenient given that the region of study is has a lower average temperature compared with other regions within the same latitude, temperature is expected to fluctuate less with little or no time fraction superior to the critical value of 30 degrees centigrade.

The EPT, ERT and runoff calculations were based on the spatial resolution of the 10 x 10 m pixel size that represents 100 square meters per pixel. All the pixels of the image were automatically classified based on the magnitude of the variable represented by the image. The information generated not only an image but also a table in which the first column represents the frequency, or histogram for each of the classes, which when multiplied by 100 equals the accumulated surface of each of the classes present. Finally, the total estimated value of the area of study of each variable is obtained by multiplying the surface product in each class by the magnitude of the variable in each class.

3. Results

The application of these procedures and the integration of runoff values in the dam sites** of each of the water options considered by the ACP produced estimated runoff values for each of the options. The simulation was run with and without latitude correction and the results are summarized in Table 1.

The top of Table 1 shows the results assuming that the studied area was completely covered by mature forest vegetation. In both cases, as one can observe from the same table, the runoff value is less than the values recorded with percentages of 90% and 80% for simulations with and without latitude correction, respectively. The explanation for this is the higher evapotranspiration in mature forest vegetation, in comparison to the existing mosaic of current uses, that reduces runoff water.

The bottom of the same table shows the average annual runoff volume calculated by the model using the present values of plant coverage with and without latitude correction. In both cases the values approximated the average of runoff registered at each of the three basins. The total value is closer to the registered value obtained without latitude correction and explains the 99.64% runoff. Therefore this option was selected to generate a isohyetal map

of average annual runoff (Figure 3). The precision of this model is high and it is considered a tool that can be used to estimate runoff in areas with insufficient information or a deficient meteorological network.

The structure of the vegetation mosaic is indicated in the map by the average height of the layer of water running off annually. On the contrary, in a mature natural ecosystem that is completely covered with forest vegetation the limits of the isohyets indicate a more gradual change (Figure 4).

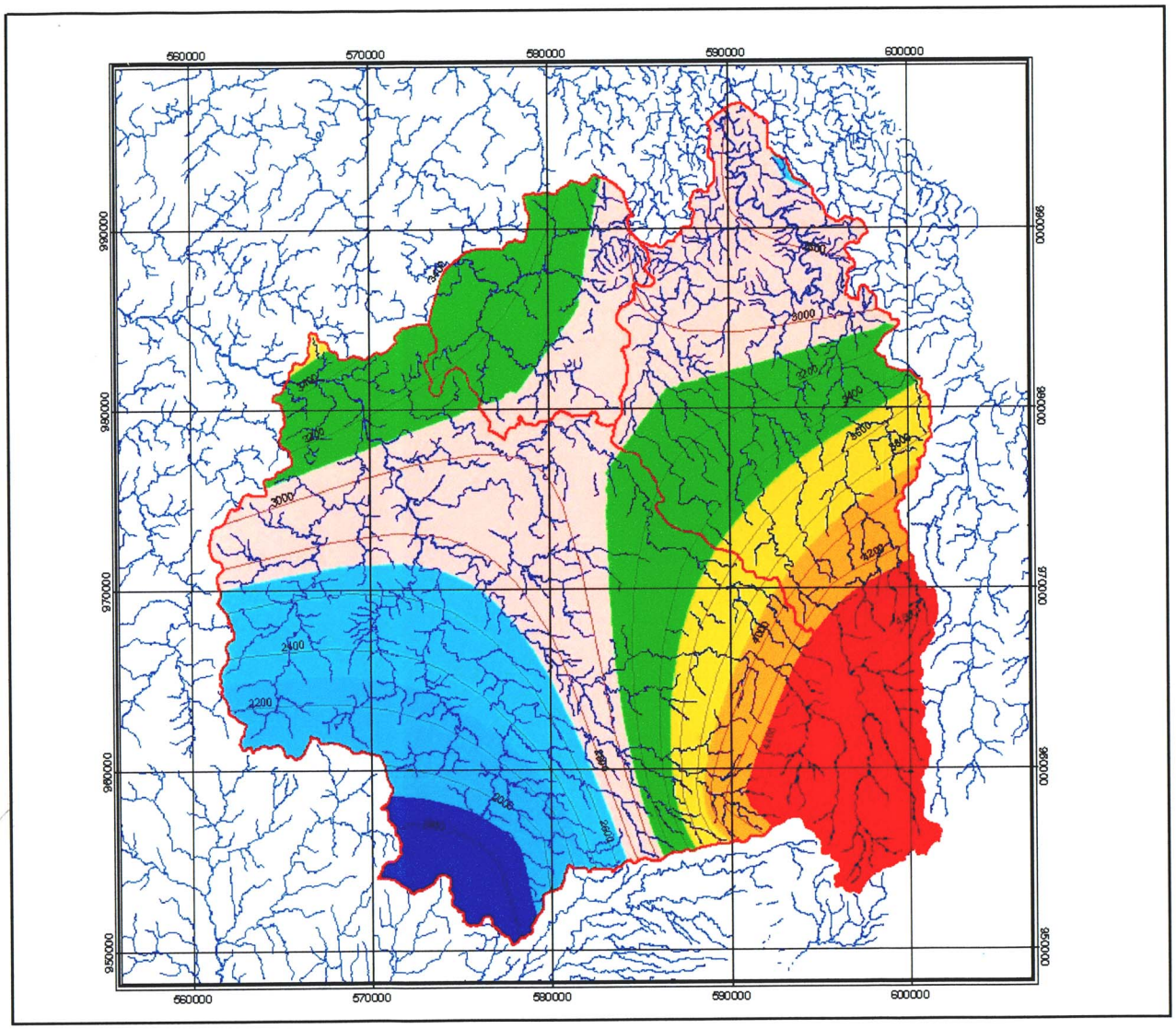
The fact that estimated discharge without latitude correction for biotemperature is closer to the existing information about flows, suggests that maybe the conditions in the area do not justify the use of that correction. In is a known fact that seasonality in the area of study is less than in the rest of the country. Therefore, daytime temperature behavior was obtained to determine if there is any evidence that justifies not using correction. Specifically the number of hours during the day when temperatures were above 30°C.

Information was available from various stations. The most representative of the whole study area was Fort Sherman. One year of information recorded at this station was chosen at random, March 16, 1998 to March 15, 1999 (Figure 5). In this figure one can see that the number of days with temperatures above the 30°C limit is insignificant. The behavior during a whole day of this year (June 11, 1998), also selected at random, shows that in effect, the temperature never reached mentioned limit (Figure 6). Therefore latitude correction is considered to be unnecessary.

A similar analysis was done for hourly temperature information on the Island of Barro Colorado (Figures 7 and 8) that also indicate low incidence of temperatures over 30°C, although more frequent than at Sherman. This can be explained by the milder seasonality on the Caribbean coast directly west of the Canal.

One must note that in all the model simulations the calculated runoff for the Rio Indio was above the value of the other two rivers. In the case of the model run selected to plot the average annual runoff map, the flow of Rio Indio was 5.46% higher than the average value measured in that same river. In the case of rivers Caño Sucio and Toabré the calculated flow from the model was slightly lower than the flow estimated from records, with values of 92.82% and 97.20% respectively.

This could be interpreted as an indication of a probable presence of an underground northeast flow by which the part of the water that falls and infiltrates the basin of Rio Indio is transferred to the base flow of the other rivers. Currently there is not enough information to reject or confirm this theory.



AVERAGE ANNUAL RAINFALL (mm)
IN THE OCCIDENTAL REGION

LEGEND

- Isolines
- Hydrographic System
- Subbasin Boundary

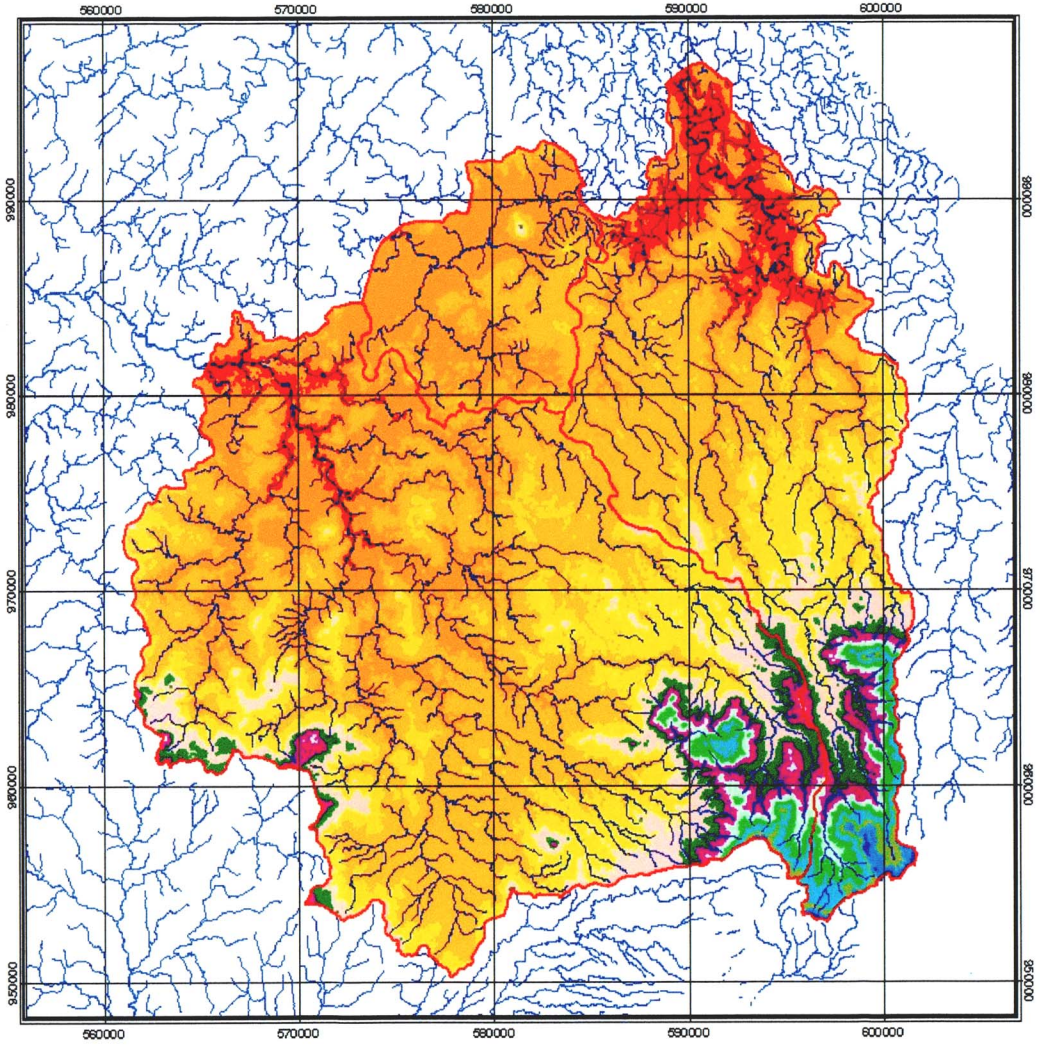
- 1500 - 1900 mm
- 1900 - 2300 mm
- 2300 - 2700 mm
- 2700 - 3100 mm
- 3100 - 3500 mm
- 3500 - 3900 mm
- 3900 - 4300 mm
- 4300 - 4700 mm

N
W E

Clark 1866 Spheroid
1927 North American Datum
UTM Zone 17

5 0 5 Km

SCALE 1:250,000



AVERAGE ANNUAL TEMPERATURE (°C)
IN THE OCCIDENTAL REGION

LEGEND

HYDROGRAPHIC SYSTEM

SUBBASIN BOUNDARY

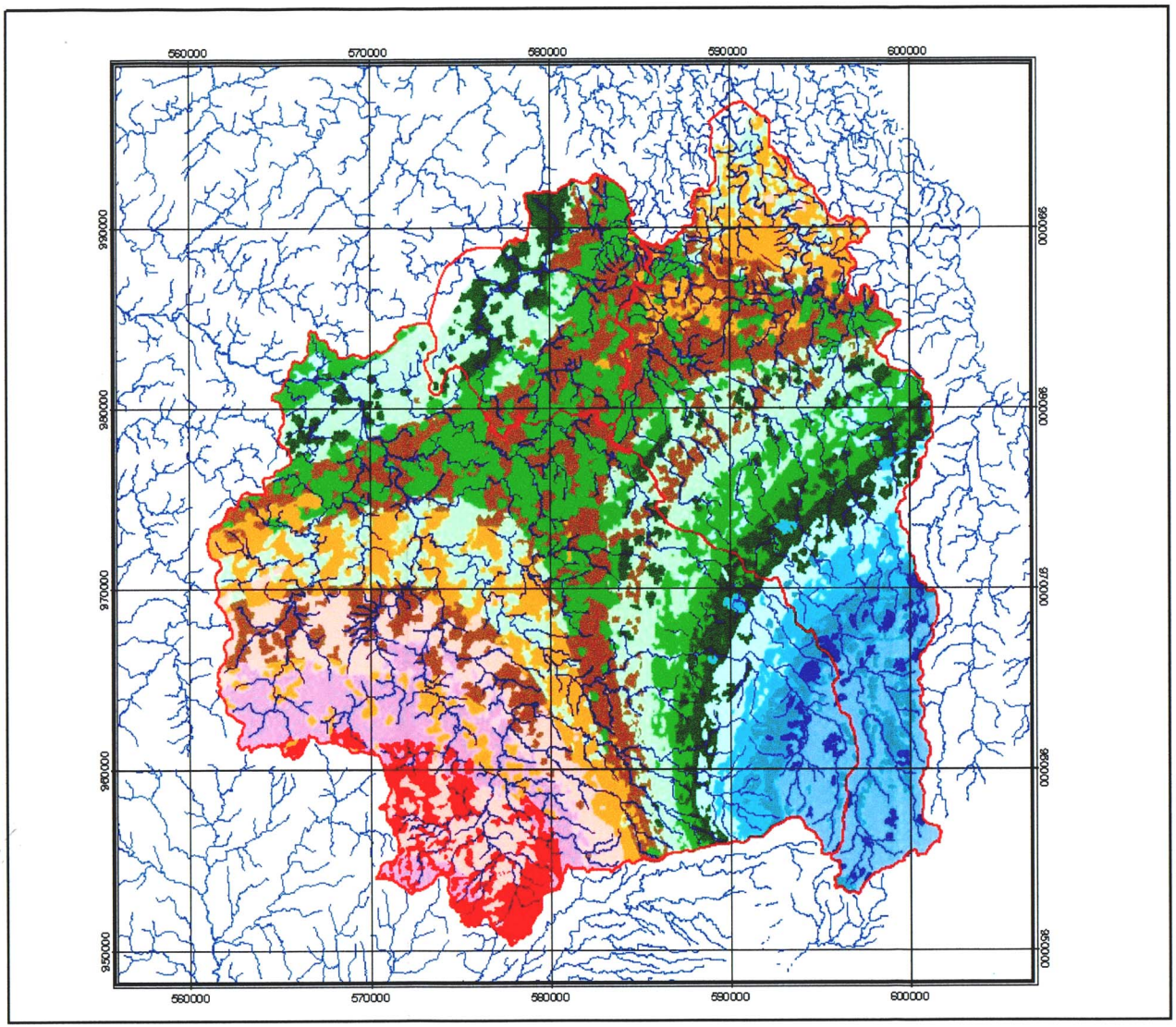
- 20.5 - 21.0 °C
- 21.0 - 21.5 °C
- 21.5 - 22.0 °C
- 22.0 - 22.5 °C
- 22.5 - 23.0 °C
- 23.0 - 23.5 °C
- 23.5 - 24.0 °C
- 24.0 - 24.5 °C
- 24.5 - 25.0 °C
- 25.0 -25.5 °C
- 25.5 - 26.0 °C
- 26.0 - 26.5 °C
- 26.5 - 27.0 °C

N
W E

Clark 1866 Spheroid
1927 North American Datum
UTM Zone 17

5 0 5 Km

SCALE 1:250,000



AVERAGE ANNUAL RUN OFF (mm)
IN THE OCCIDENTAL REGION

LEGEND

Hydrographic System

Subbasin Boundary

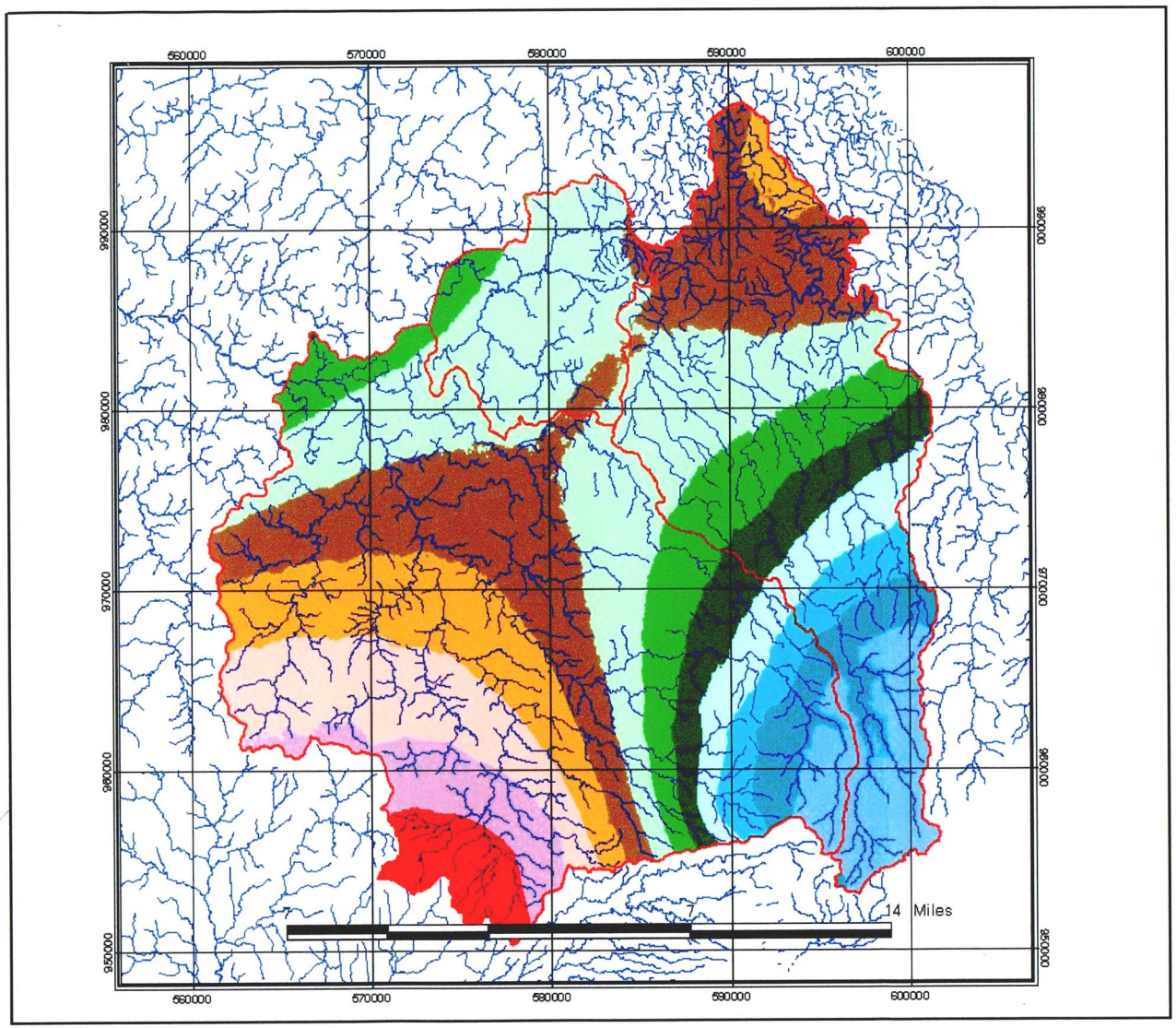
- 500 - 750
- 750 - 1000
- 1000 - 1250
- 1250 - 1500
- 1500 - 1750
- 1750 - 2000
- 2000 - 2250
- 2250 - 2500
- 2500 - 2750
- 2750 - 3000
- 3000 - 3250
- 3250 - 3500
- 3500 - 4000

N
W E

Clark 1866 Spheroid
1927 North American Datum
UTM Zone 17

5 0 5 Km

SCALE 1:250,000



AVERAGE ANNUAL RUN OFF (mm)
IN THE OCCIDENTAL REGION

LEGEND

Hydrographic System

Subbasin Boundary

- 500 - 750
- 750 - 1000
- 1000 - 1250
- 1250 - 1500
- 1500 - 1750
- 1750 - 2000
- 2000 - 2250
- 2250 - 2500
- 2500 - 2750
- 2750 - 3000
- 3000 - 3250
- 3250 - 3500
- 3500 - 4000

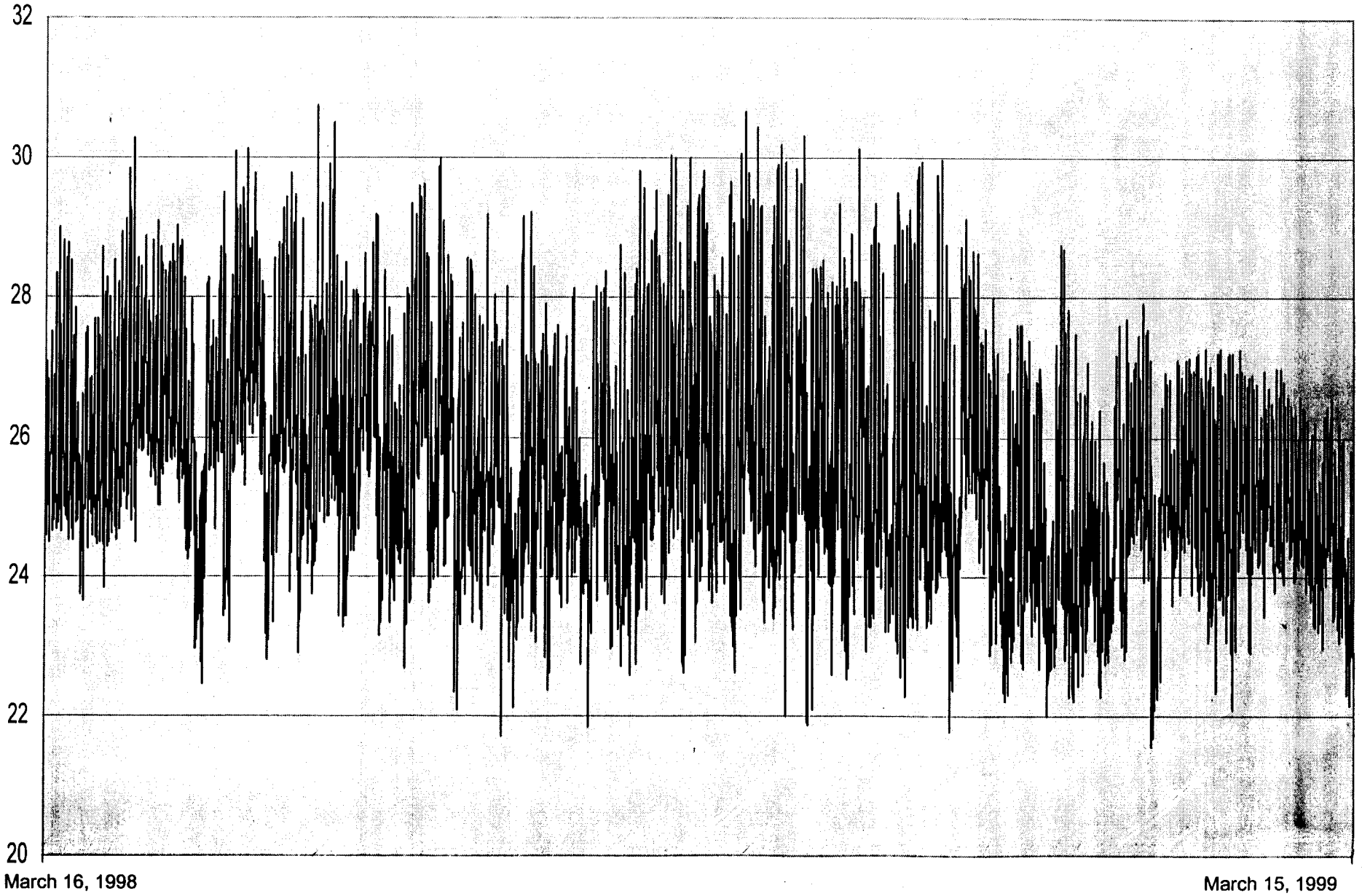
N
W
E

Clark 1866 Spheroid
1927 North American Datum
UTM Zone 17

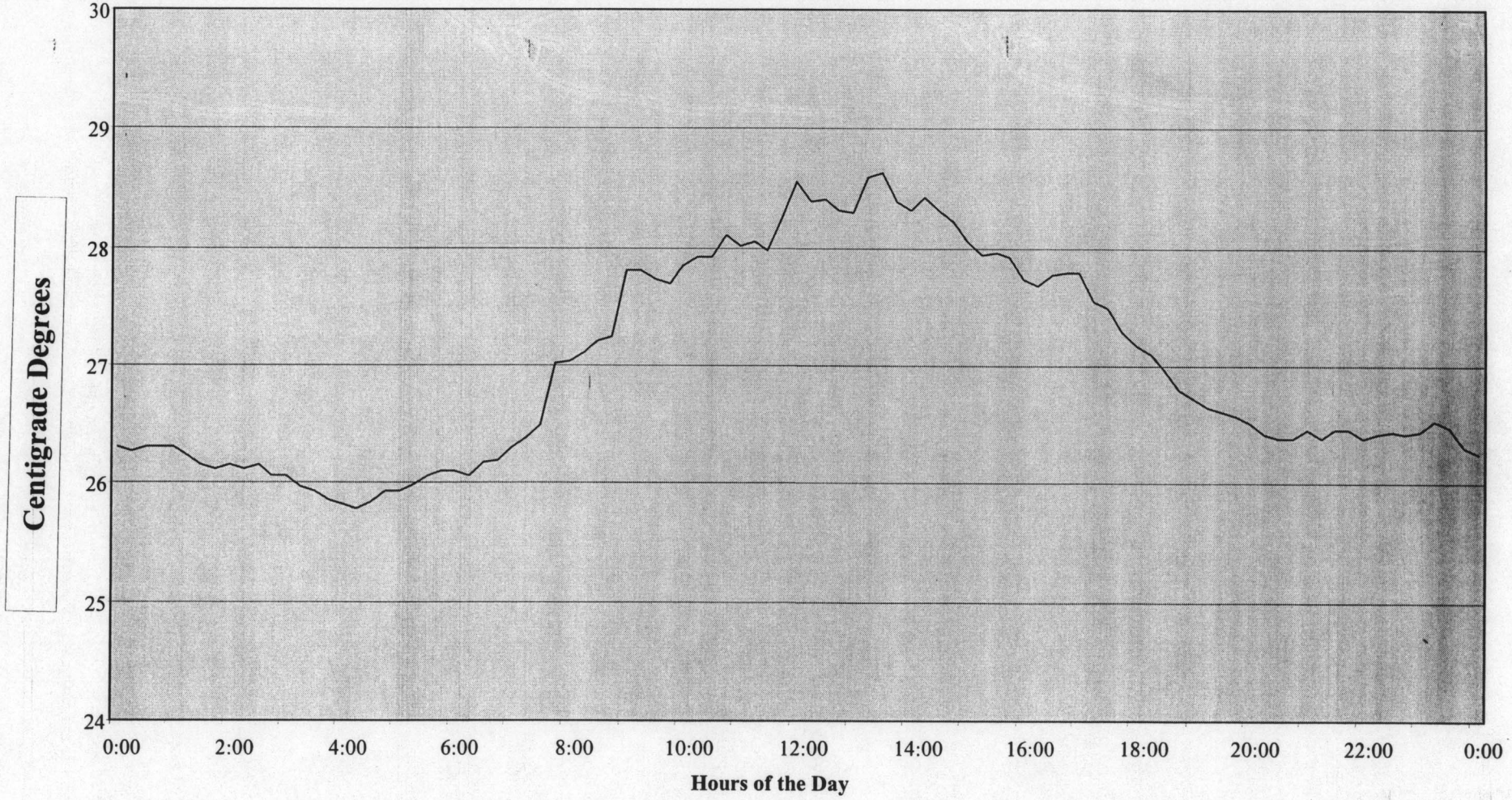
5 0 5 Km

SCALE 1:250,000

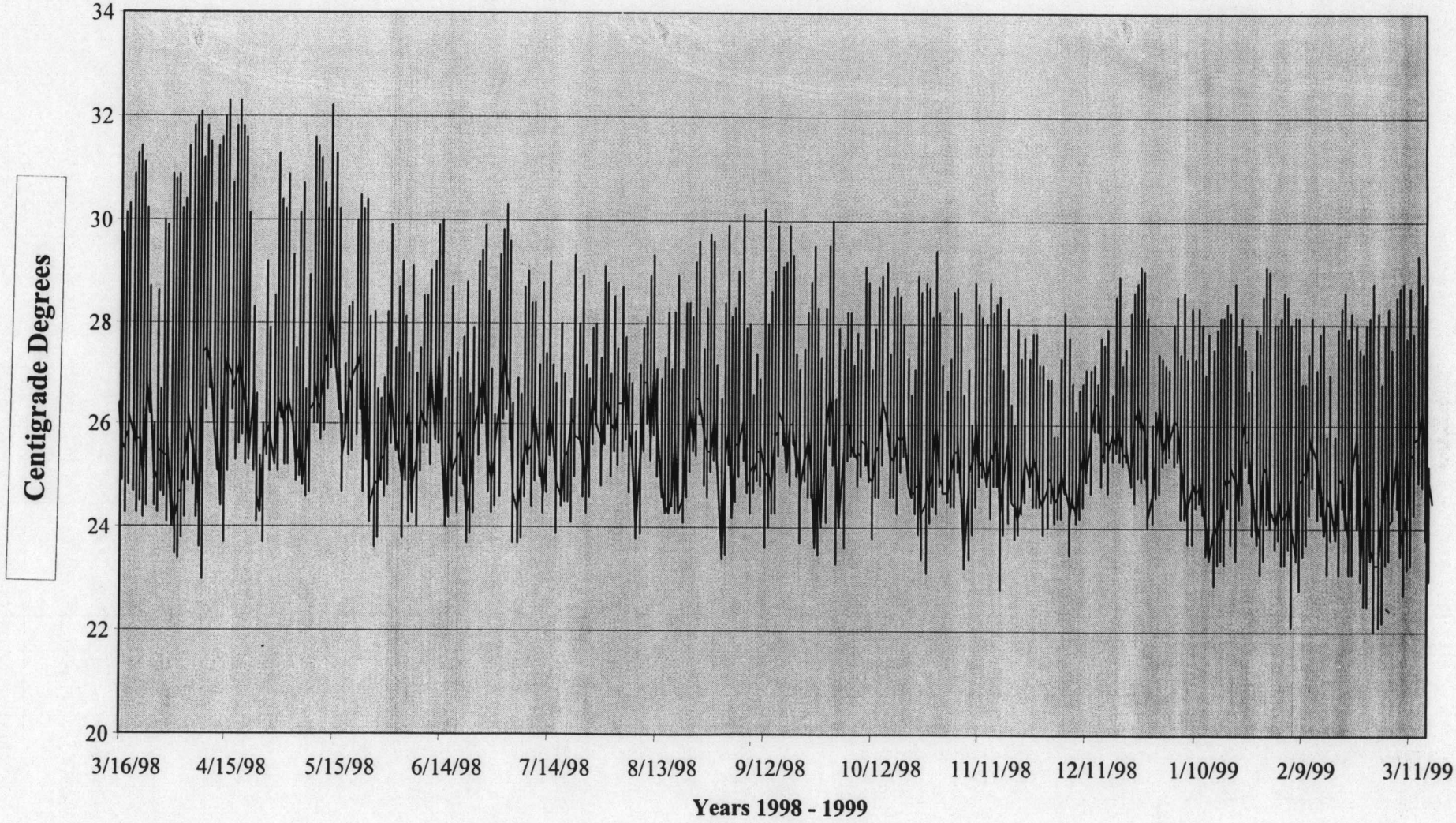
Hourly Temperature in Fort Sherman in centigrade degrees.
Period: March 16, 1998 – March 15, 1999



Daily Evolution of the Temperature in Fort Sherman, Province of Colon.
June 11, 1998



Hourly Temperature in Barro Colorado Island in centigrade degrees
Period: March 16, 1998 – March 15, 1999



Daily Evolution of the Temperature in Barro Colorado Island
June 11, 1998

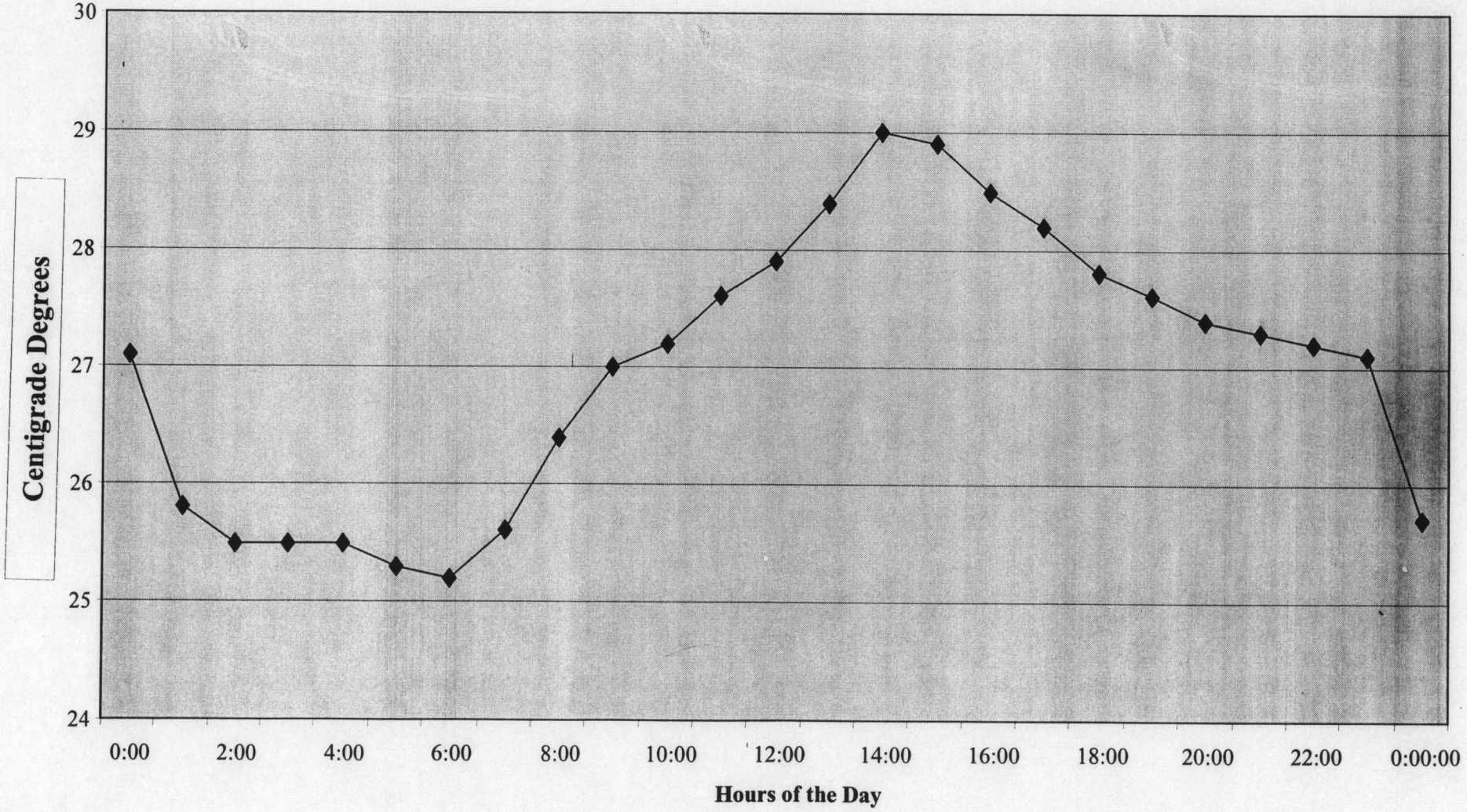


Table 1:
Summary of results obtained by the runoff model and its comparison to average registered rivers and extrapolated to the stopping points in the three options Indio, Caño Sucio y Toabré

River	Reported		Calculated by Model based on Life Zones – Forest Coverage					
			Corrected by Latitude			Without Latitude Correction		
	MMC/YEAR	MCS	MMC/YEAR	MCS	Comparison	MMC/YEAR	MCS	Comparison
Indio	813.63	25.80	804.54	25.51	98.88%	786.30	24.93	96.64%
Caño Sucio	233.37	7.40	184.37	5.85	79.00%	177.22	5.62	75.94%
Toabre	1,286.67	40.80	1,112.51	35.28	86.46%	1,058.00	33.55	82.23%
TOTAL	2,333.66	74.00	2,101.42	66.64	90.05%	2,021.52	64.10	86.62%

River	Reported		Calculated by Model based on Life Zones – Current Land Use					
			Corrected by Latitude			Without Latitude Correction		
	MMC/YEAR	MCS	MMC/YEAR	MCS	Comparison	MMC/YEAR	MCS	Comparison
Indio	813.63	25.80	880.39	27.92	108.21%	858.05	27.21	105.46%
Caño Sucio	233.37	7.40	239.70	7.60	102.71%	216.62	6.87	92.82%
Toabre	1,286.67	40.80	1,273.32	40.38	98.96%	1,250.62	39.66	97.20%
TOTAL	2,333.66	74.00	2,393.41	75.89	102.56%	2,325.30	73.73	99.64%

ANNEX 2-B

Panama Canal

Proposal and Evaluation

Of

Upper Watershed Options

Letter Report

By

URS

March 5, 2004

Table of Contents

Basin Options

Basin Properties

The following table provides a list of basin properties, including basin area, anticipated stage elevation, and associated storage.

Table 1. Sub-Basin Maximum Stage Properties

Name	Basin Area (km^2)	Design Stage Elevation (m)	Storage at Design Stage Elevation (millions of cubic meters)	Basin Bottom Elevation at Control Structure (m)	Main Control Structure Crest Width (m)	Required Structure Height (m)
Toabre 1	52	315	250	212	1,360	103
Toabre 2	30	500	450	318	1,340	182
Indio 1	12	310	150	217	855	93
Indio 2	56	480	800	286	1,330	194
Indio 2B	60.9	400	370	257	1,260	143
Teria 1	94.0	155	570	46	1,680	109
Teria 2	35.6	260	245	166	400	99

Table 2. Basin Sedimentation Properties

Basin Name	Basin Area (km^2)	Sediment Load (1.3 mm per year for 100 years) (millions of cubic meters)
Toabre 1 w/o 2	22	2.9
Toabre 1	52	6.8
Toabre 2	30	3.9
Indio 1 w/o 2	12	1.6
Indio 1	68	8.8
Indio 2	56	7.3
Indio 2B	60.9	7.9
Teria 1 w/o 2	58.4	7.6
Teria 1	94	12.2
Teria 2	35.6	4.6

Table 3. Viable Option Basin Properties

Option	Basin Area (km2)	Design Stage Elevation (m)	Design Max Drain Elevation (m)	Max Storage at Design Stage Elevation MCM	Usable Storage at Design Stage Elevation MCM	Estimated Mean Annual Discharge MCM/yr	Mean Annual Runoff (m/yr)	Residence Time (yr)
A. Teria 1	94.0	130	90	270	220	233.8	2.49	0.94
A. Teria 2	35.6	265	225	245	200	105.6	2.97	1.89
Total A	94.0	N/A	N/A	515	420	233.8	2.49	1.80
B. Teria 1	94.0	130	90	270	220	233.8	2.49	0.94
B. Teria 2	35.6	265	220	245	210	105.6	2.97	1.99
B. Indio 2B	60.9	300	295	30	20	203.2	3.34	0.10
Total B	154.9	695	N/A	545	450	437.0	2.82	1.03

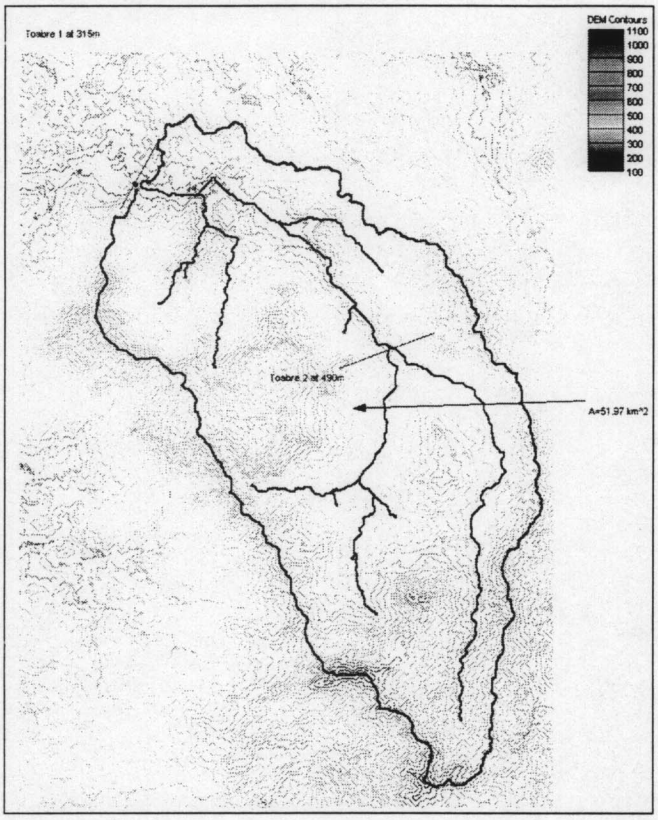
MCM: Million of Cubic Meters

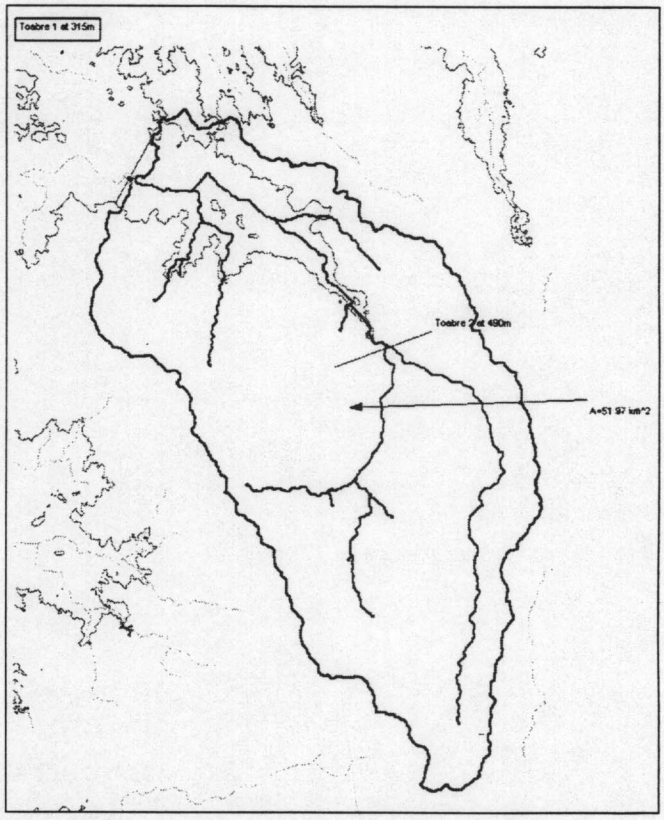
Working Options:

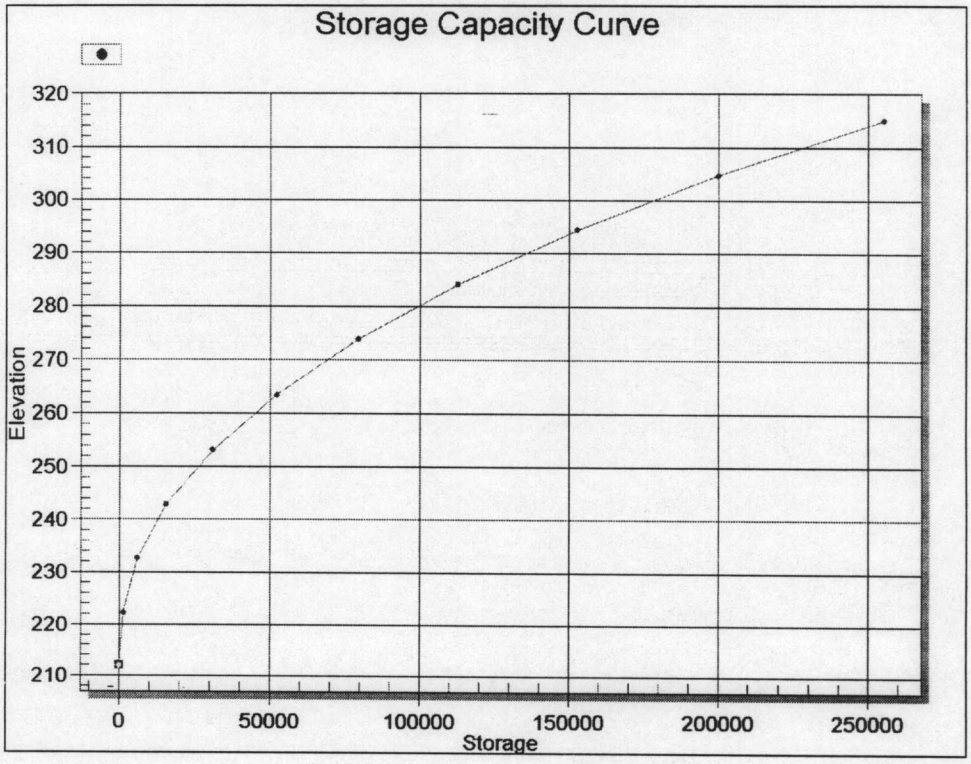
A: Teria 1 and Teria 2: Set Teria 1 to the max stage level of 130m, draining to 90m, generating 220mcm of usable storage and replenishing every 1.71 years. Set Teria 2 to a max stage of 265m; draining to 225m and generating 200mcm usable storage conveyed directly to Teria 1 via the existing river. Total usable storage will be 600mcm replenished every 1.77 years on average, with a max total storage of 815mcm.

B: Teria 1 + Teria 2 and Indio 2B: Set Teria 1 to the max stage level of 130m, draining to 90m, generating just over 240MCM of usable storage and replenishing every 1.03 years. Set Teria 2 to a max stage of 265m; draining to 220m and generating 210mcm usable storage conveyed directly to Teria 1 via the existing river. Set Indio 2B to max stage of 300m, draining to 295m; generating 20mcm of usable storage conveyed via a 1km long aqueduct to Teria watershed. Total usable storage will be 450mcm replenished every 1.08 years on average, with a max total storage of 565mcm.

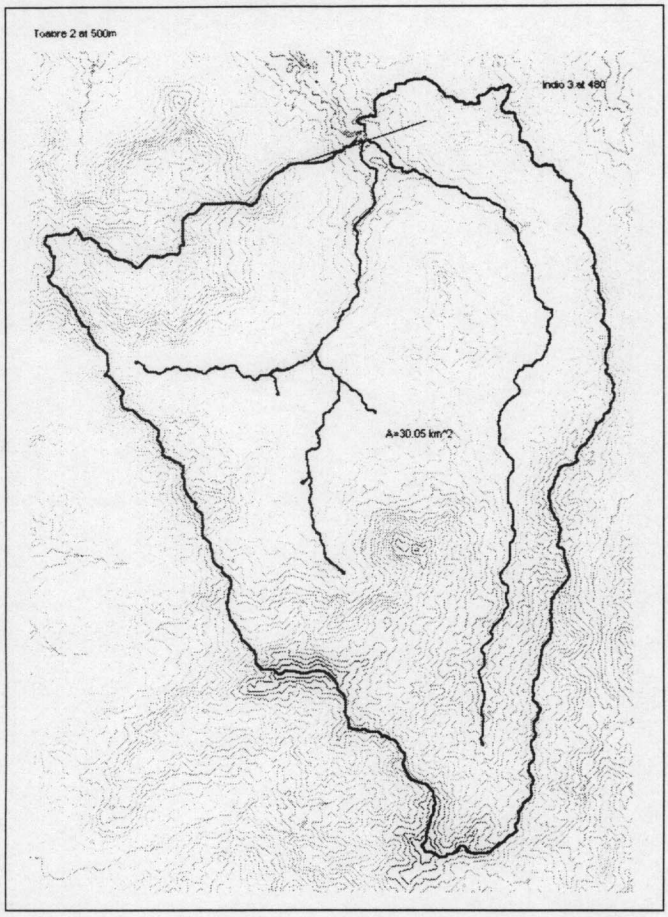
Toabre 1

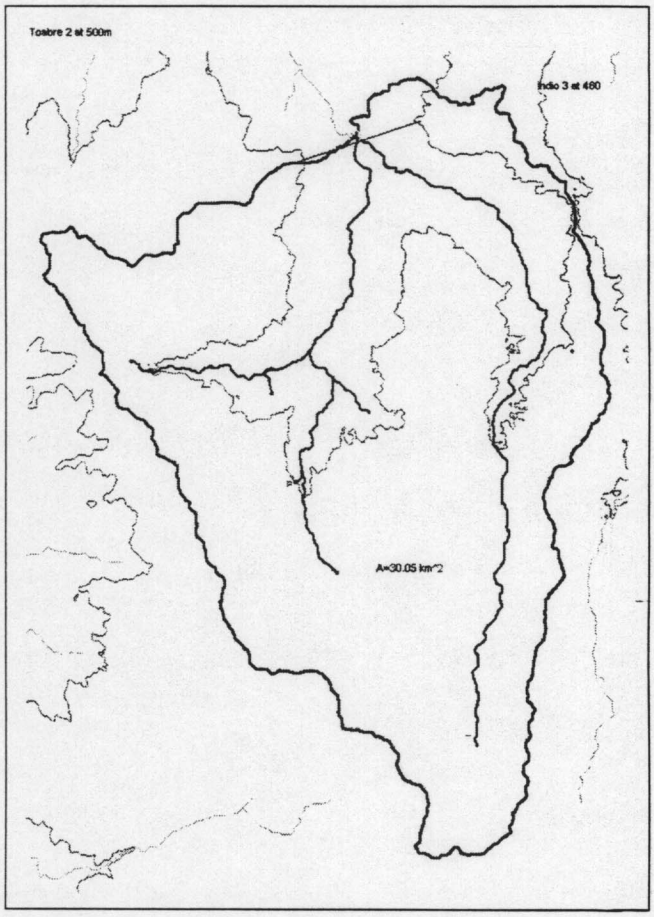

Toabre 1 at 315m
DEM Contours
1100
1000
900
800
700
600
500
400
300
200
100
Toabre 2 at 490m
A=51.97 km^2

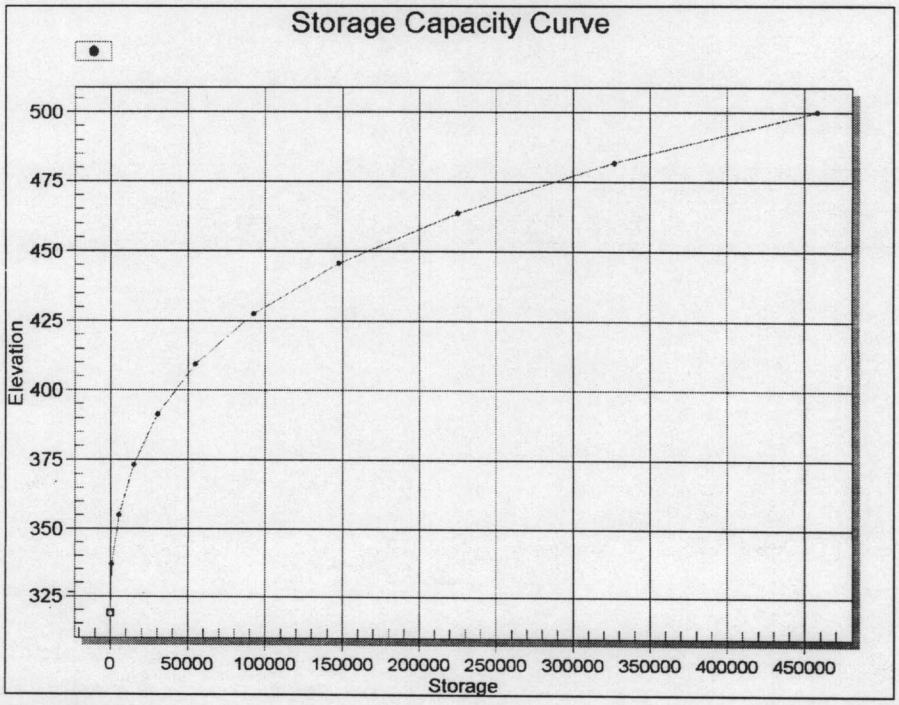

Toabre 1 at 315m
Toabre 2 at 490m
A=51.97 km^2


Storage Capacity Curve
Elevation
320
310
300
290
280
270
260
250
240
230
220
210
0
50000
100000
150000
200000
250000
Storage

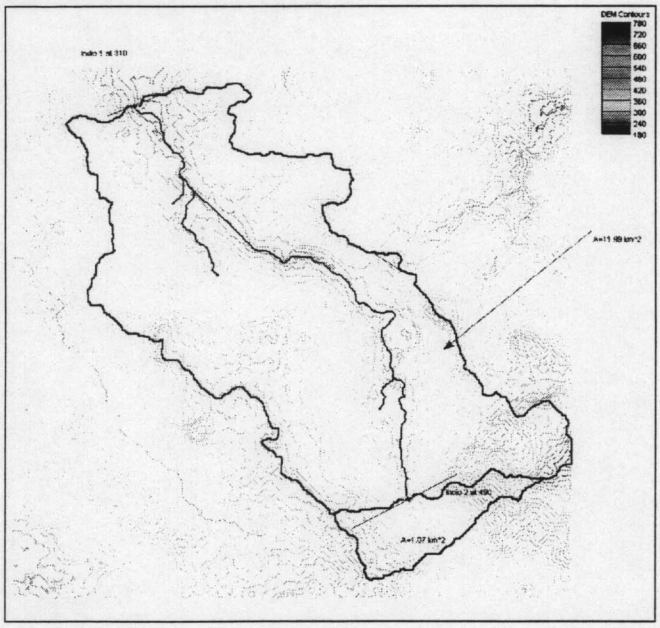
Toabre 2

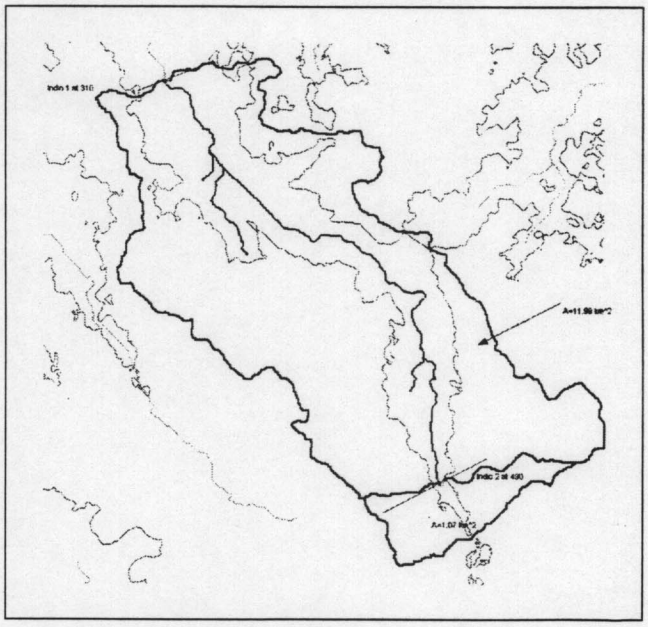

Toabre 2 at 500m
Indio 3 at 480
A=30.05 km^2

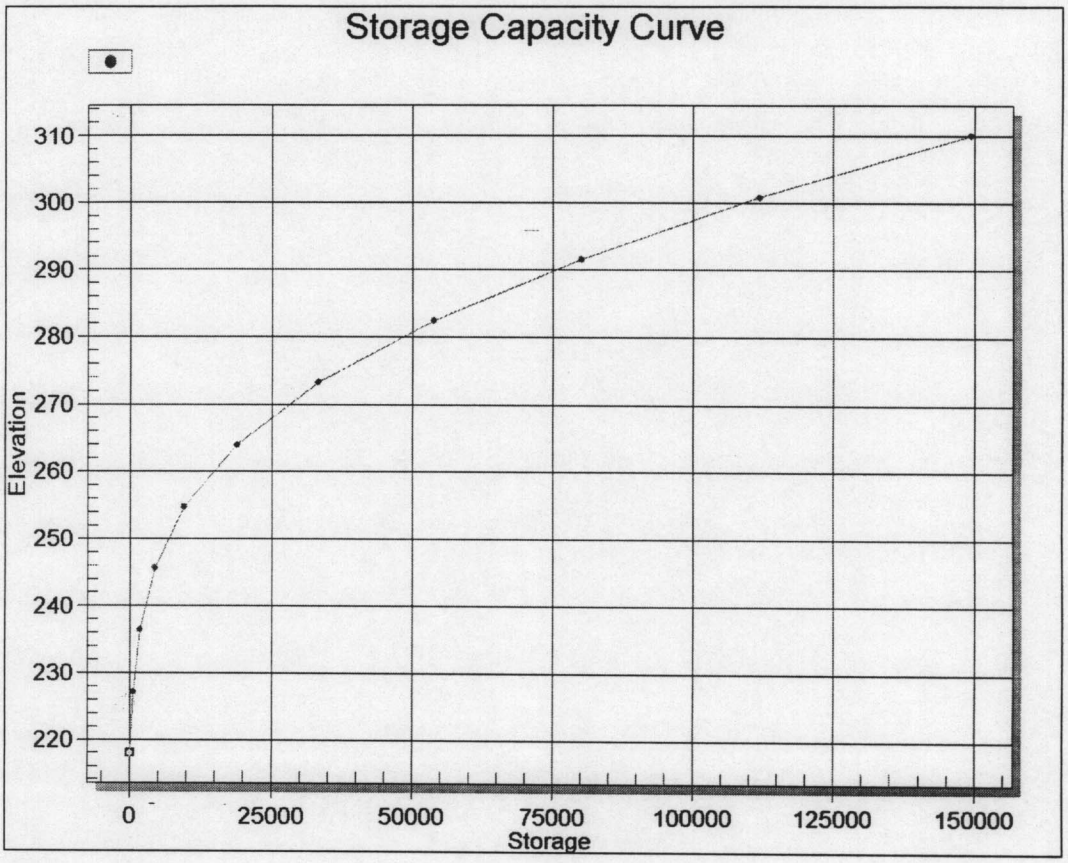

Toabre 2 at 500m
Indio 3 at 480
A=30.05 km^2


Storage Capacity Curve
Elevation
500
475
450
425
400
375
350
325
0
50000
100000
150000
200000
250000
300000
350000
400000
450000
Storage

Indio 1

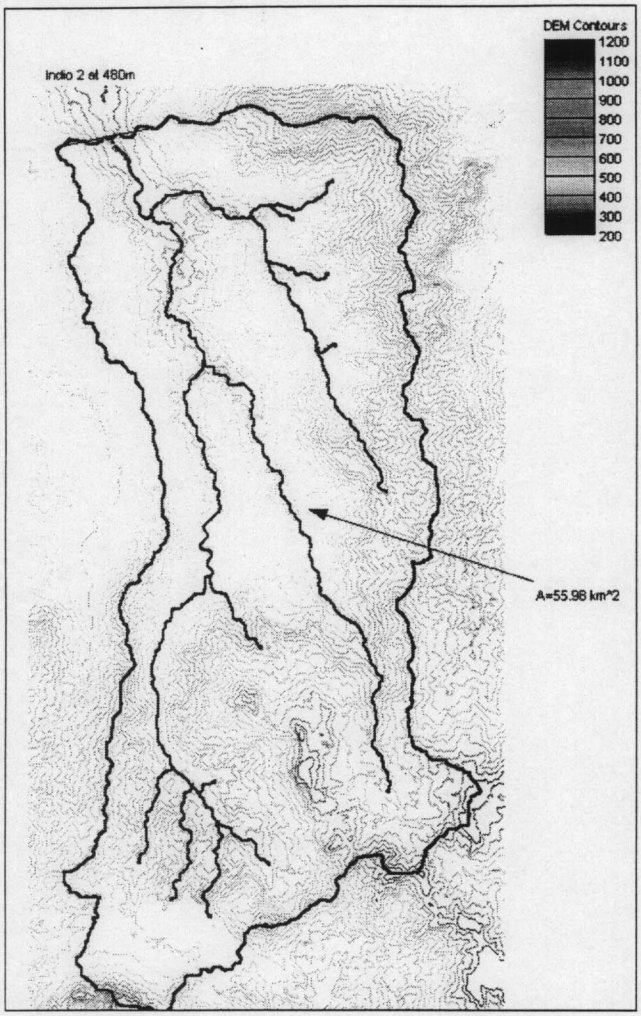

DEM Contours
780
720
660
600
540
480
420
360
300
240
180

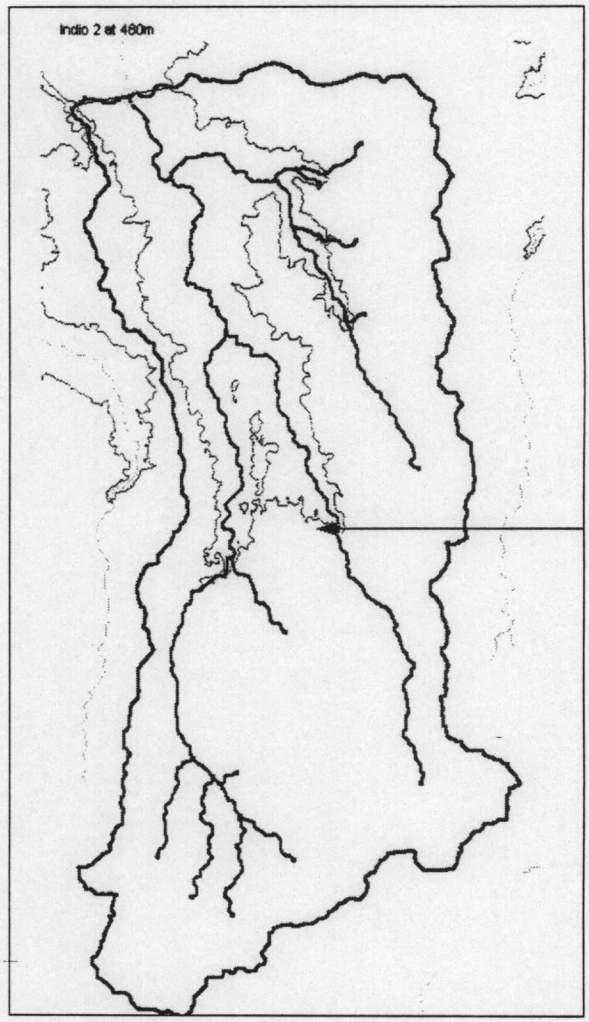


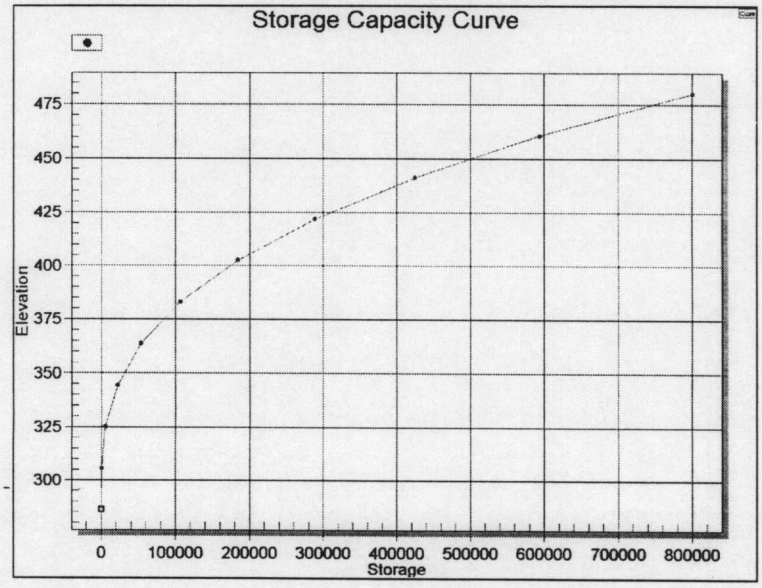

Storage Capacity Curve
Elevation
310
300
290
280
270
260
250
240
230
220
0
25000
50000
75000
100000
125000
150000
Storage

URS

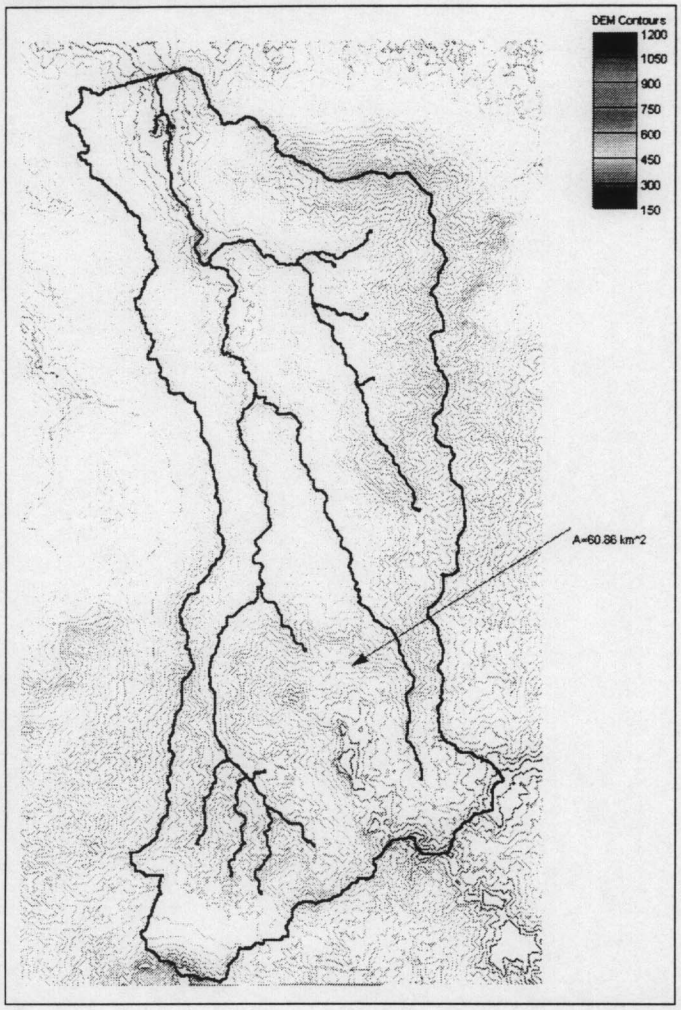
Indio 2

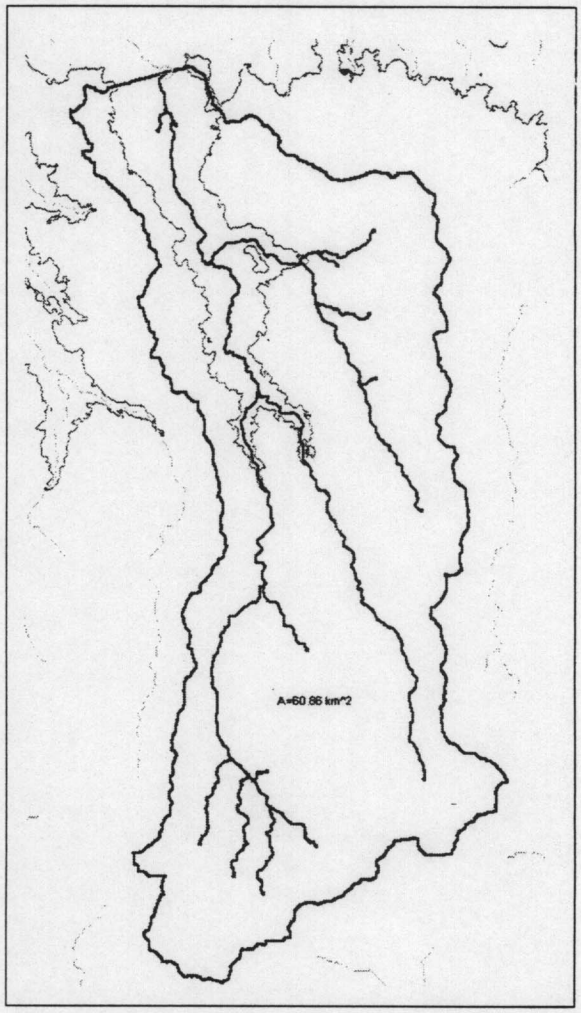

DEM Contours
1200
1100
1000
900
800
700
600
500
400
300
200
Indio 2 at 480m
A=55.98 km^2

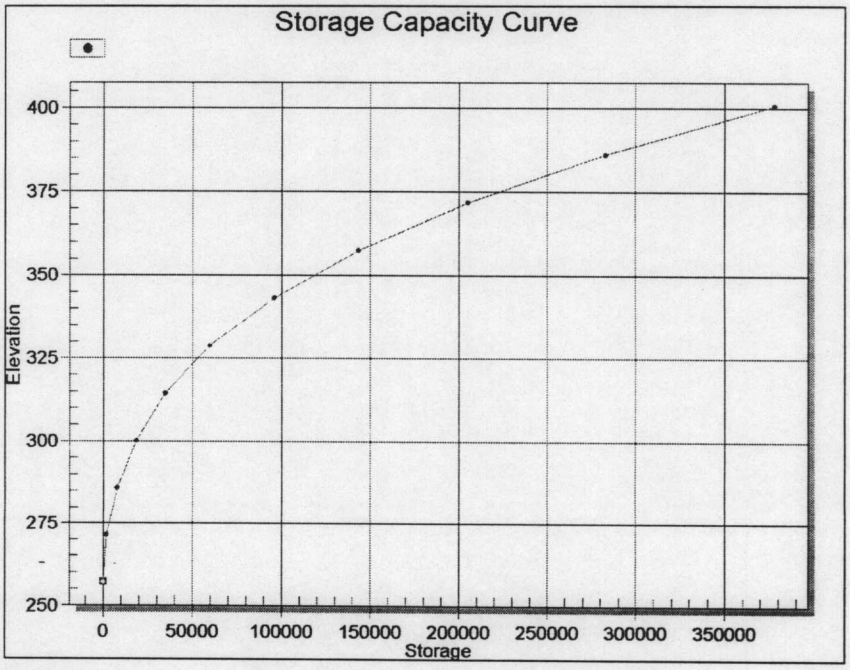

Indio 2 at 480m


Storage Capacity Curve
Elevation
475
450
425
400
375
350
325
300
0
100000
200000
300000
400000
500000
600000
700000
800000
Storage

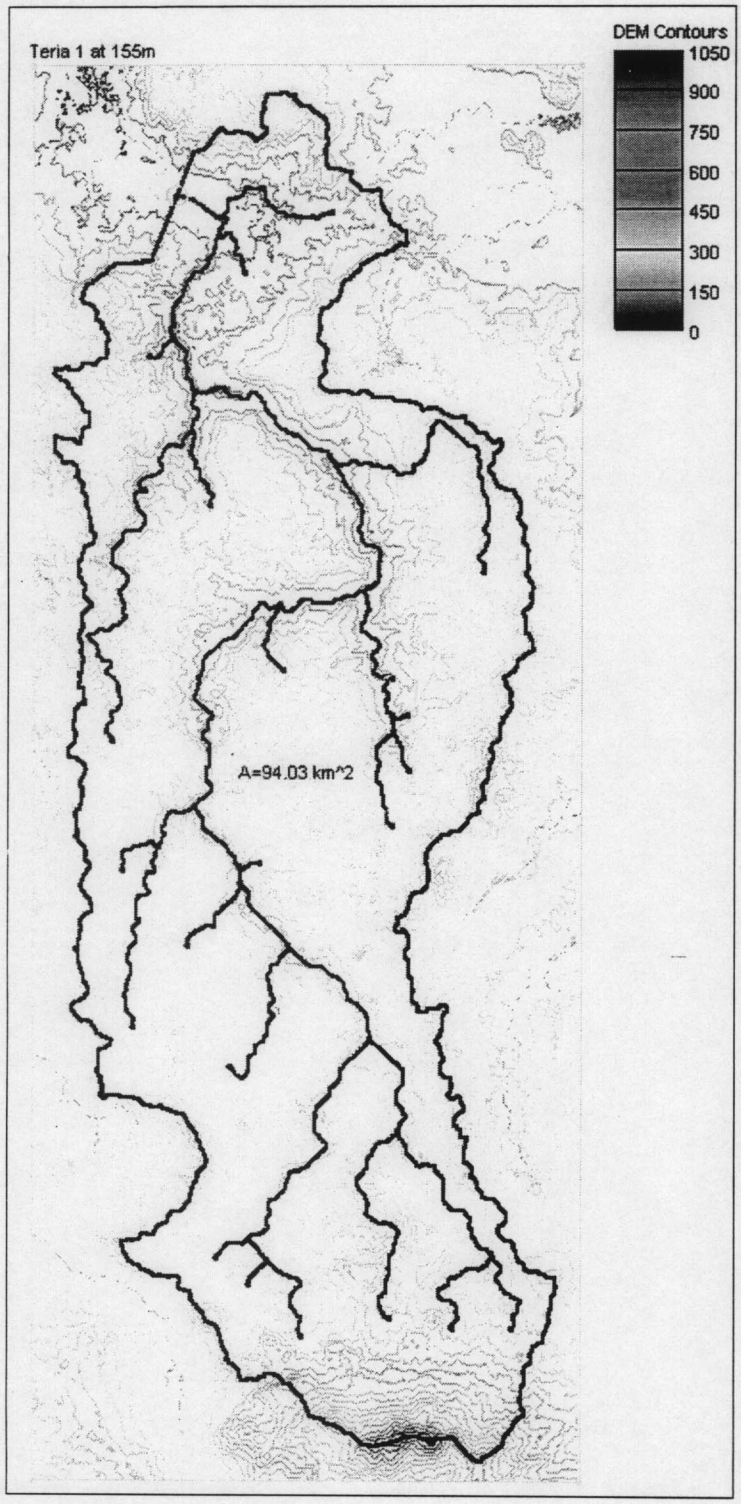
Indio 2B

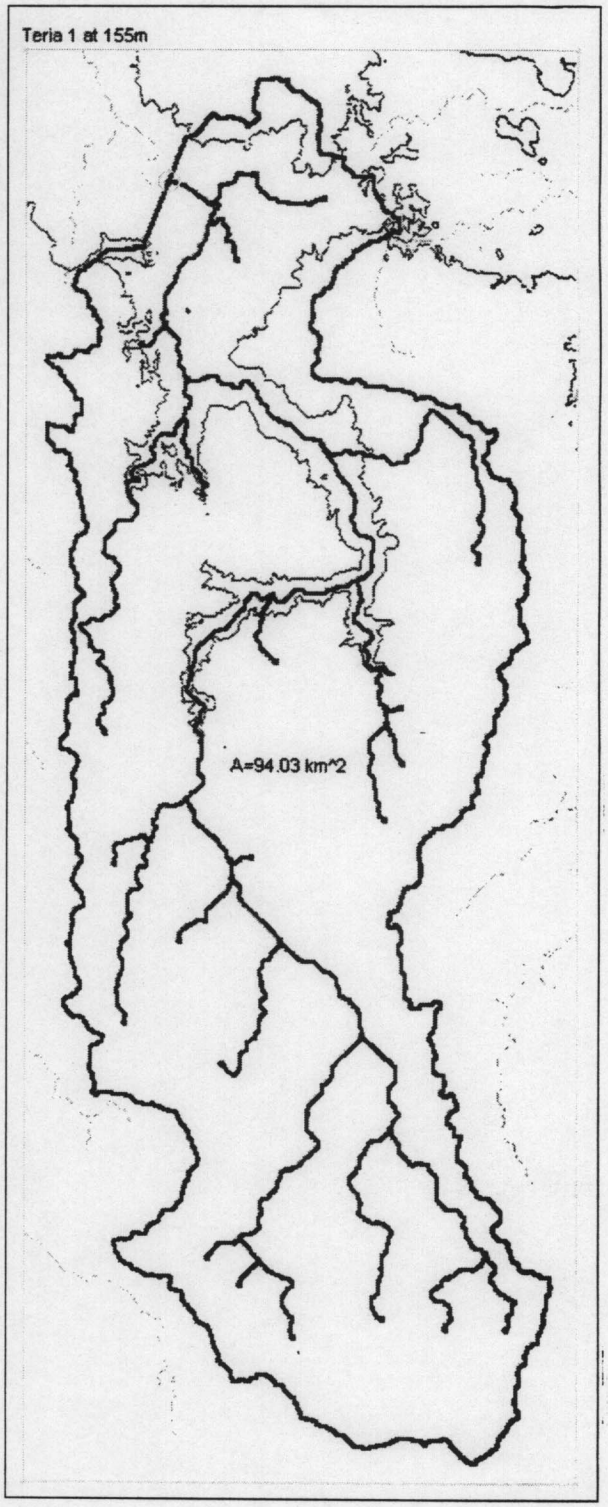

DEM Contours
1200
1050
900
750
600
450
300
150
A=60.86 km^2

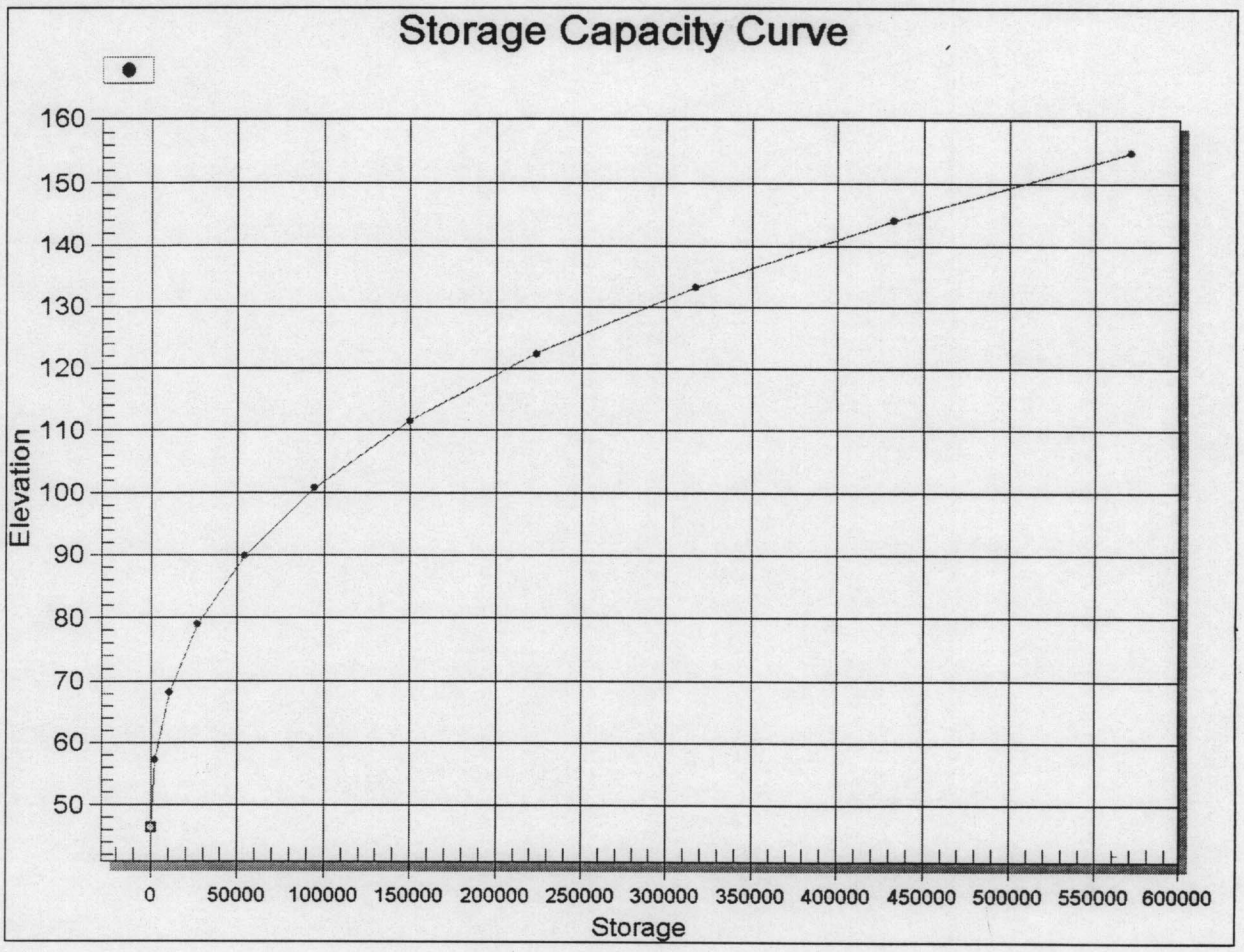

A=60.86 km^2


Storage Capacity Curve
Elevation
400
375
350
325
300
275
250
0
50000
100000
150000
200000
250000
300000
350000
Storage

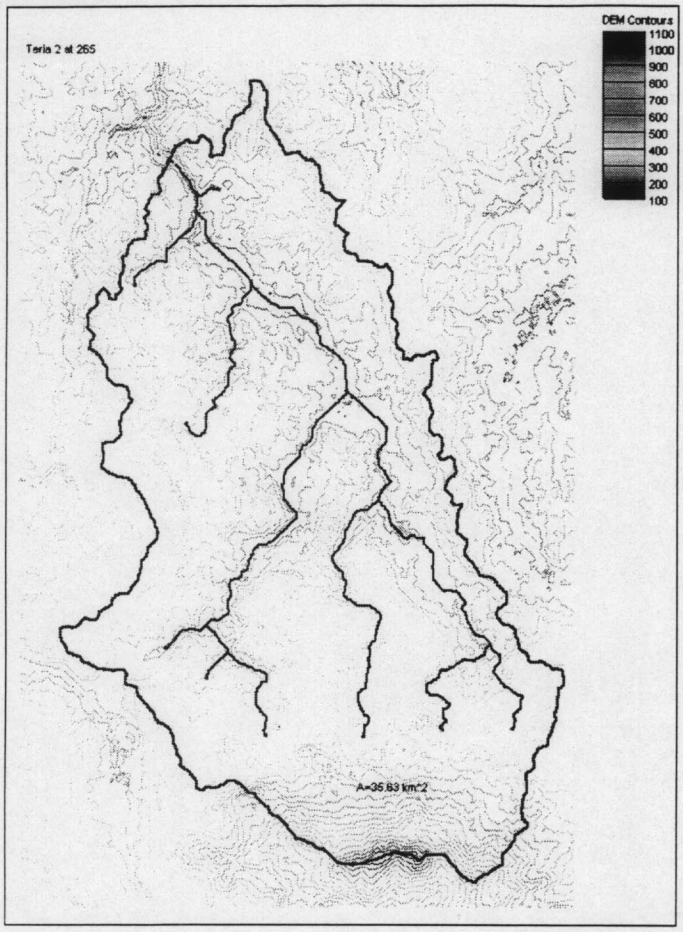
Teria 1

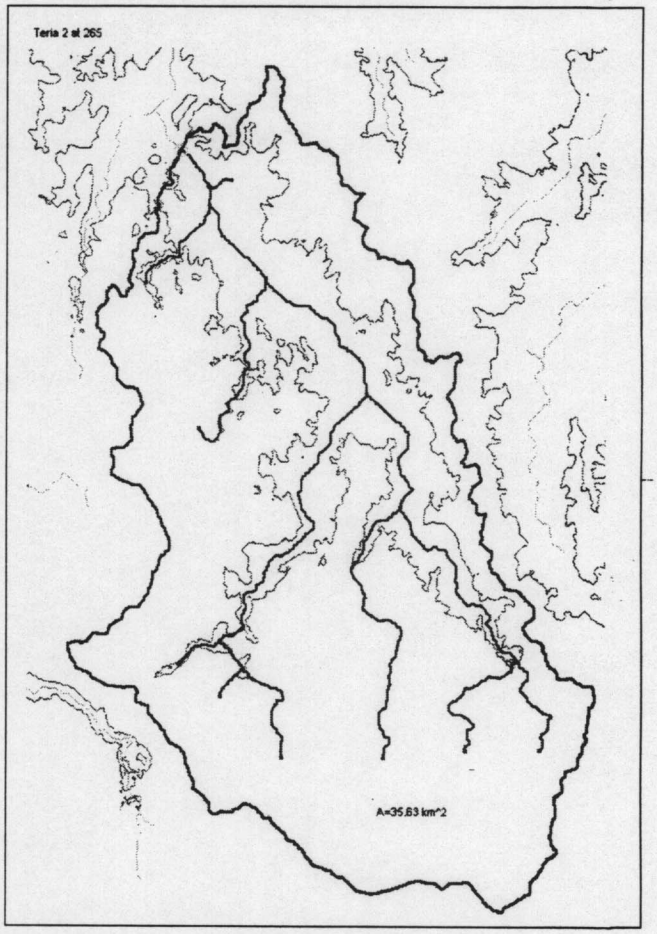

Teria 1 at 155m
DEM Contours
1050
900
750
600
450
300
150
0
A=94.03 km^2

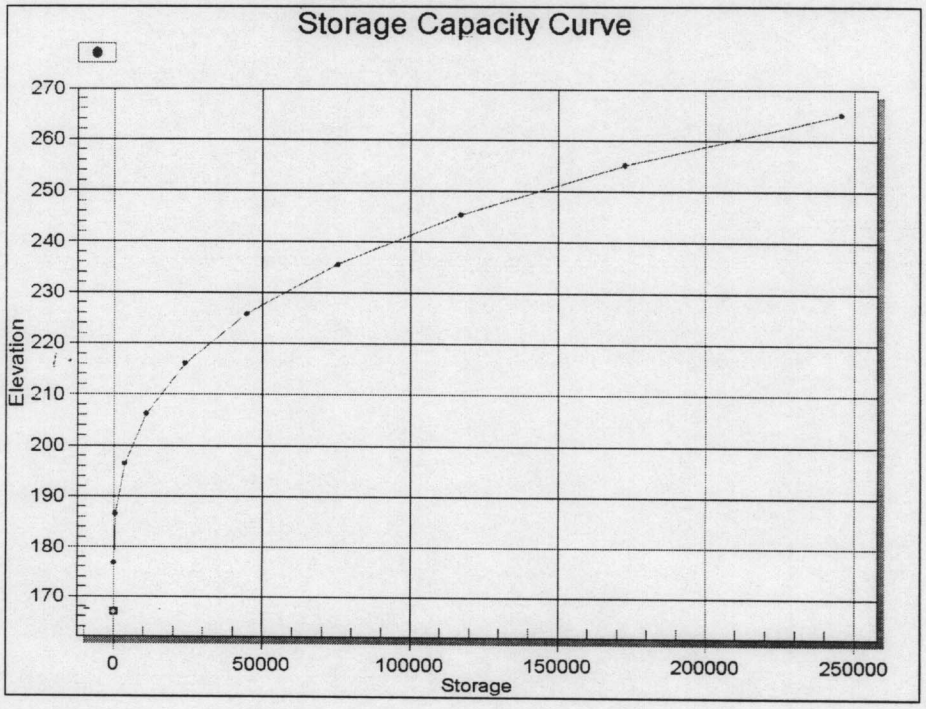

Teria 1 at 155m
A=94.03 km^2


Storage Capacity Curve
Elevation
160
150
140
130
120
110
100
90
80
70
60
50
0
50000
100000
150000
200000
250000
300000
350000
400000
450000
500000
550000
600000
Storage

Teria 2

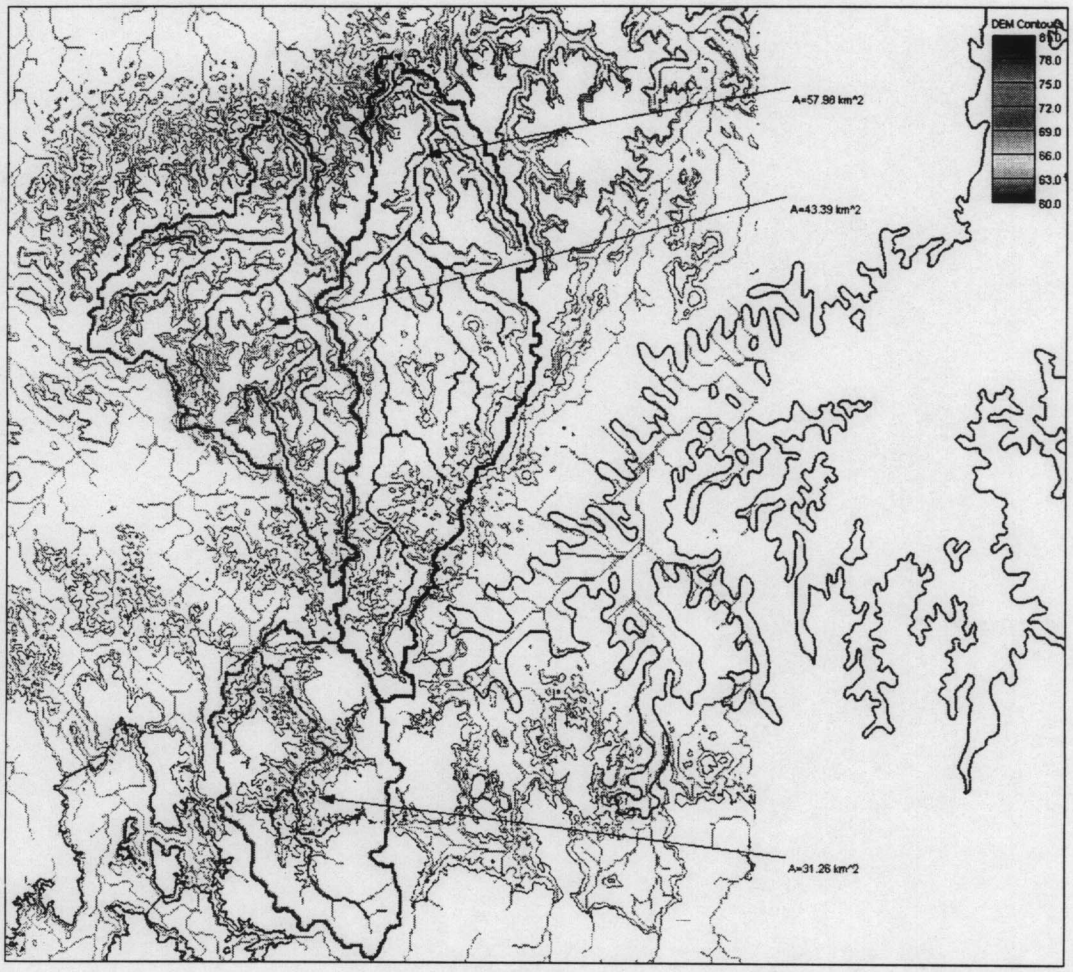

Teria 2 at 265
DEM Contours
1100
1000
900
800
700
600
500
400
300
200
100
A=35.83 km^2

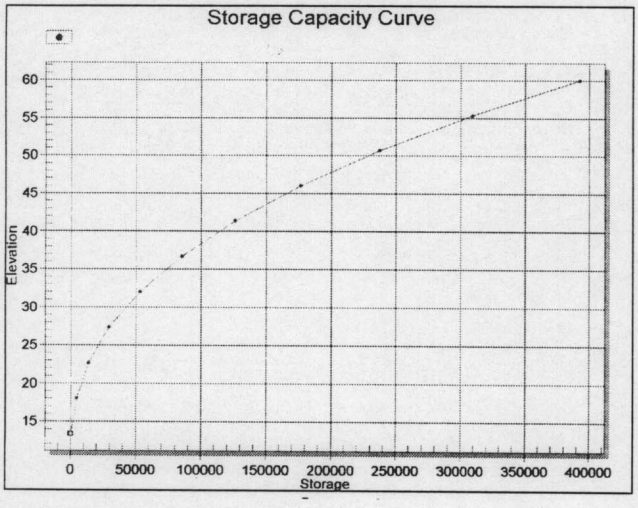

Teria 2 at 265
A=35.83 km^2

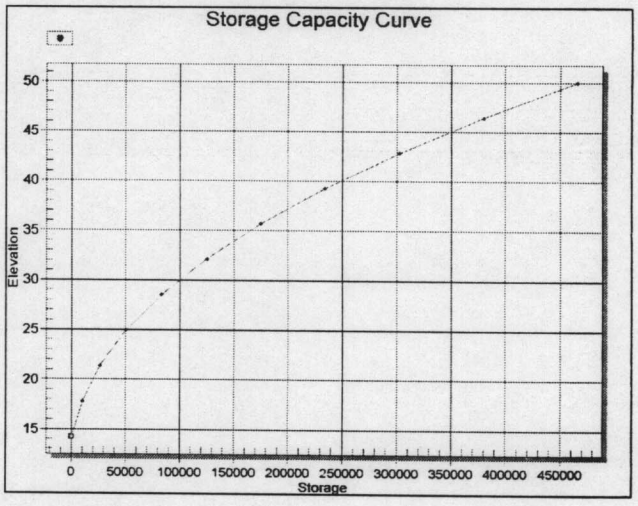

Storage Capacity Curve
Elevation
270
260
250
240
230
220
210
200
190
180
170
0
50000
100000
150000
200000
250000
Storage

URS

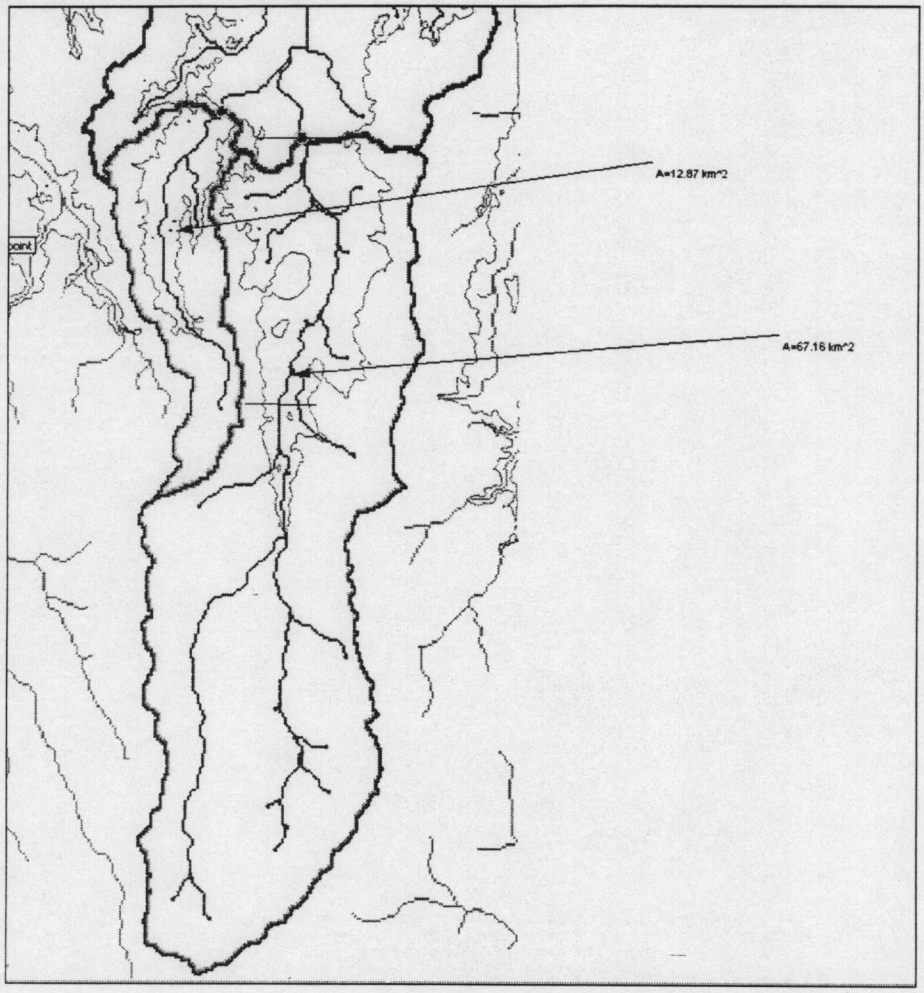
North Gatun Options

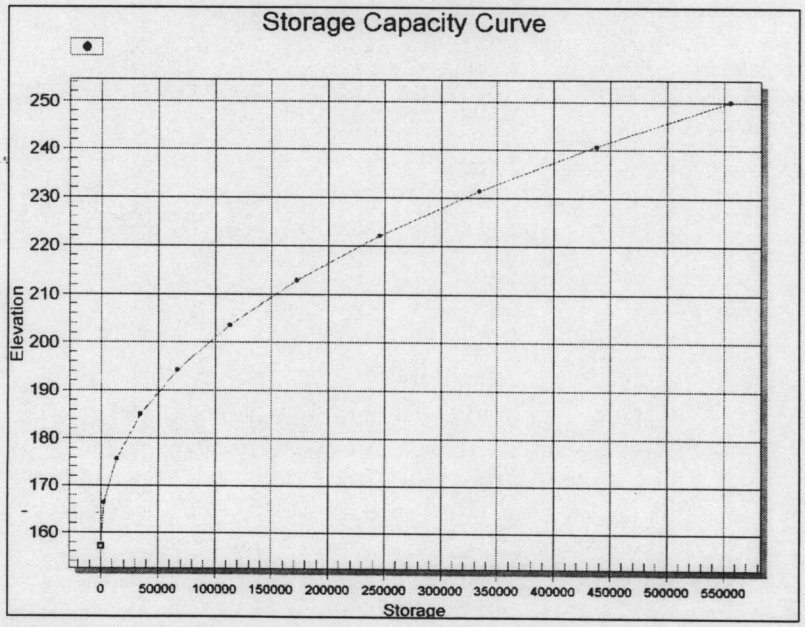






Ciri River Options





ANNEX 2-C

Conceptual Level Cost Estimate for URS Alternatives 11 and 12
Panama Canal Water Supply Options Environmental Assessment
By: Nicole Hunter and Sal Todaro (URS Denver)
Date: February 13- March 1, 2004

The following report provides preliminary cost estimates for Teria 1, Teria 2 and Indio 2B dams and appurtenant work, as well as the combined cost for Options 11 and 12. Costs are based on the Rio Indio Water Supply Project supplied by MWH/TAMS. Table 1 summarizes dam properties for comparison purposes in the cost estimate. Graphically the profiles are included in Attachment 1

Table 1 Dam Properties

Location	Initial Structure Height (m)	Crest Length (m)	Rockfill Shell Volume (million m^3)
Rio Indio	**76**		**2.7**
Teria 1	109	1,680	14.6
Teria 2	94	400	1.7
Indio 2B	143	1,260	16.2

An "all in" unit price of $19.52/m was calculated for the main dam based on the volume of the rockfill shell and cost of the Rio Indio dam. This includes the concrete face slab, fill, silty sand, filter fine rockfill, rockfill and coarse rockfill. This cost was proportioned using corresponding rockfill volumes for the Teria 1, Teria 2, and Indio 2B dams. The Rio Indio cross-section was used for all three dams. Assumed depth to top of rock was assumed to be 4-meters for all cases. Dam quantities were calculated using average end areas. Heights and lengths were taken from the All Dam Profile Data Values spreadsheet provided. Quantities were determined based on these profiles. Sections were cut approximately every 100 feet for Teria 1 and Indio 2B, and approximately every 50 feet for Teria 2. Maximum sections were also calculated for each. Refer to attached spreadsheets. Refer to the dam quantities spreadsheets for details.

Saddle dams were sized using a cross section for an earthfill dam from Rio Indio. The Rio Indio saddle dams were assumed to be the same size and estimated to be approximately 840,000 cubic meters. The cross section was assumed to be the same for all saddle dams at Teria 1 and 2. Lengths and heights of the dam embankment were estimated from the All Dam Profile Data Values spreadsheet provided. Quantities were calculated in the same way as the main dam quantities. The cost estimate includes two saddle dams at Teria 2 and three saddle dams at Teria

1. It was assumed that the cost provided for Rio Indio included two saddle dams. The all in price per cubic meter of saddle dam was $4.42. Refer to saddle dam spreadsheets for details.

The dimensions of the interbasin water transfer tunnel (Teria 1 to Ciri o Ciricio River) to be used in both Options 11 and 12 were assumed to be the same as the Rio Indio transfer tunnel. The length of the tunnel is approximately 4km. This is about half the distance of the Rio Indio, and therefore approximately half the price. The cost of a canal transferring water from the Indio 2B reservoir to the Teria River basin was also included. This was estimated based on the cost of canals for the Caño Sucio and Toabré projects considering differences in canal length and cross section.

Value of the land was estimated to be $1,000/ha according to the ACP for the Rio Indio area. This same value was applied to Teria 1, Teria 2 and Indio 2B for land acquisition costs. Land acquisition includes the reservoir area plus a 20 percent increase to account for borrow areas, construction roads, structures, disposal areas, construction camp and other temporary construction. Reservoir and basin areas are summarized in Table 2 below. Resettlement costs were not accounted for in the estimate. These areas are thought to have few inhabitants. General costs were calculated using the ratio of the land acquisition cost to the general costs of Rio Indio.

Table 2 – Reservoir Values

Location	Reservoir Area (km^2)	Basin Area (km^2)
Rio Indio	**45.6**	**381**
Teria 1	13.76	94.0
Teria 2	8.24	35.6
Indio 2B	7.26	60.9

Diversion and spillway costs were estimated using the ratios of the peak PMF for each dam compared to the Rio Indio peak PMF. Peak PMF was calculated for Teria 1, Teria 2, and Indio 2B and is summarized in Table 3. There is no information available on the 50-year flood for the Teria and Indio areas, so the area of the diversion tunnel was computed using the area of the Rio Indio tunnel times a ratio of the peak PMF inflows. A minimum finished diameter of 2.5 m was used. The cost of the spillway and diversion was estimated using the ratios of the peak PMF for each case compared to the Rio Indio spillway cost.

Table 3 – Peak PMF Values

Location	Catchment Area (km^2)	PMF Peak (m^3/s)
Rio Indio	**381**	**4,345**
Teria 1	94.0	2,450
Teria 2	35.6	1,600
Indio 2B	60.9	2,000

The cost for the low-level outlet works, minimum release facility and operation facilities were assumed to be the similar to the Rio Indio project, and therefore the same price. It is assumed that the minimum release facility will be at a similar depth below the crest.

A contingency of 30 percent was added to these estimates versus the 17 percent contingence on Rio Indio because of the greater number of uncertainties associated with the preliminary estimates. An engineering and administration fee of 15-percent was added to the cost of each of the dams, which is similar to that of the Rio Indio estimate.

Summary Costs for Options 11 and 12

Cost estimates were developed using costs and assumptions similar to those used for the MWH Rio Indio estimate so that project costs could be compared. Therefore, wherever possible, the Rio Indio cost estimate was used as a basis for these cost estimates.

Two options were prepared using this information. Option 11 consists of Teria 1 and Teria 2 and Option 12 consists of Teria 1 and Indio 2B. The option descriptions and associated costs as provided are presented below.

Option 11: Teria 1 and Teria 2: Set Teria 1 to the max stage level of 155m, draining to 115m, generating just over 400mcm of usable storage and replenishing every 1.7-years. Set Teria 2 to a max stage of 265m; draining to 225m and generating 200mcm usable storage conveyed directly to Teria 1 via the existing river. Total usable storage will be 600mcm replenished every 1.7 years on average, with a max total storage of 815mcm.

Option 12: Teria 1 + Teria 2 and Indio 2B: Set Teria 1 to the max stage level of 130m, draining to 90m, generating just over 240MCM of usable storage and replenishing every 1.03 years. Set Teria 2 to a max stage of 265m; draining to 220m and generating 210mcm usable storage conveyed directly to Teria 1 via the existing river. Set Indio 2B to max stage of 300m, draining to 295m; generating 20mcm of usable storage conveyed via a 1km long aqueduct to Teria

watershed. Total usable storage will be 450mcm replenished every 1.08 years on average, with a max total storage of 565mcm.

Table 4 provides a summary of the combined construction costs for the two options. Refer to Prelimary Cost Estimate Spreadsheet for details on the cost estimate for each of the three dams/reservoirs. The construction cost of the Rio Indio option by MWH/Tams is provided for comparison purposes. The table also includes the cost of each option per unit usable (live) storage.

Table 4 – Summary of Construction Costs

	RIO INDIO	OPTION 11	OPTION 12
Construction Cost ($ M)	**230**	**350**	**401**
Usable Storage (MCM)	1,294	420	430
Unit Cost ($/MCM)	177,743	833,333	932,558

Attachment 1: Control Structure Report

Table of Contents

Basin Options

Basin Properties

The following table provides a list of basin properties, including basin area, anticipated stage elevation, and associated storage.

Table 1. Viable Option Basin Properties

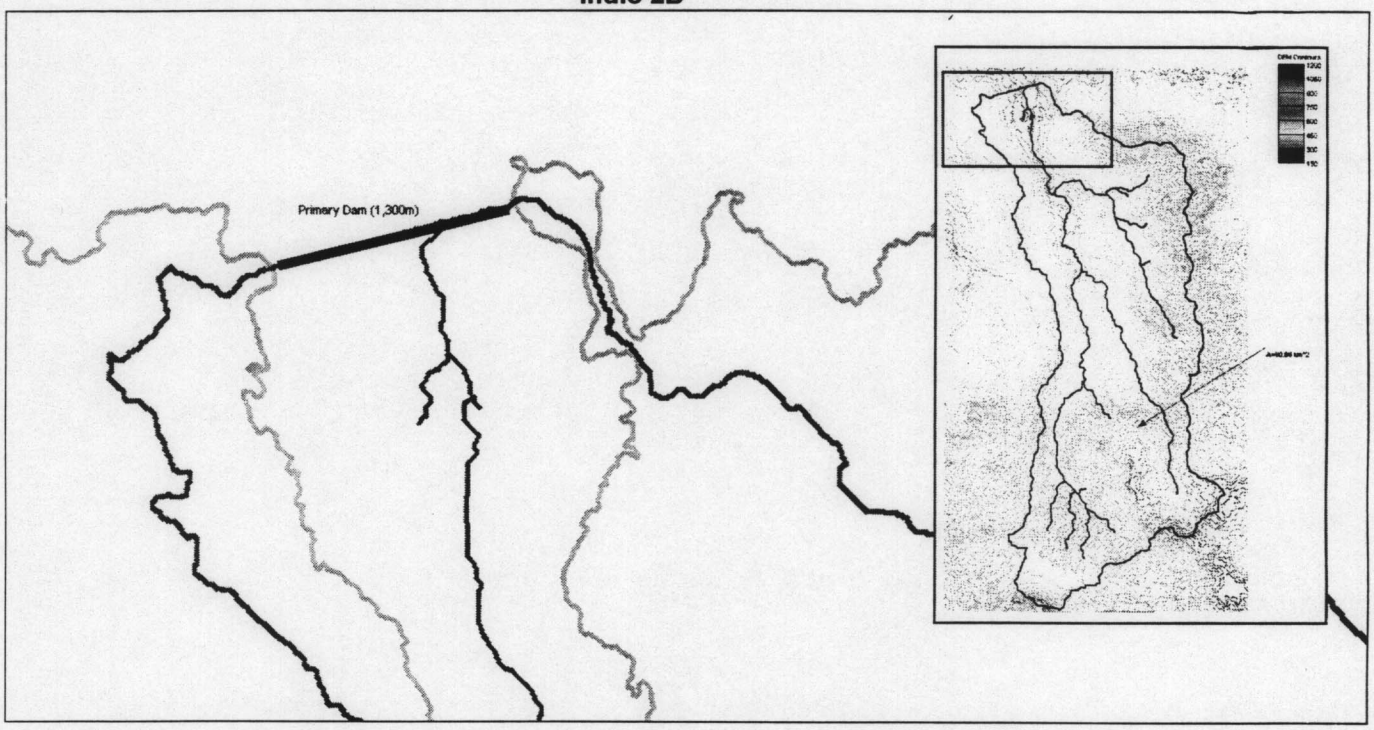
	(km2)	(m)	(m)	MCM	MCM	MCM/yr	(m/yr)	(yr)
A. Teria 1	94.0	130	90	270	220	233.8	2.49	0.94
A. Teria 2	35.6	265	225	245	200	105.6	2.97	1.89
Total A	94.0	N/A	N/A	515	420	233.8	2.49	1.80
B. Teria 1	94.0	130	90	270	220	233.8	2.49	0.94
B. Teria 2	35.6	265	220	245	210	105.6	2.97	1.99
B. Indio 2B	60.9	300	295	30	20	203.2	3.34	0.10
Total B	154.9	695	N/A	545	450	437.0	2.82	1.03

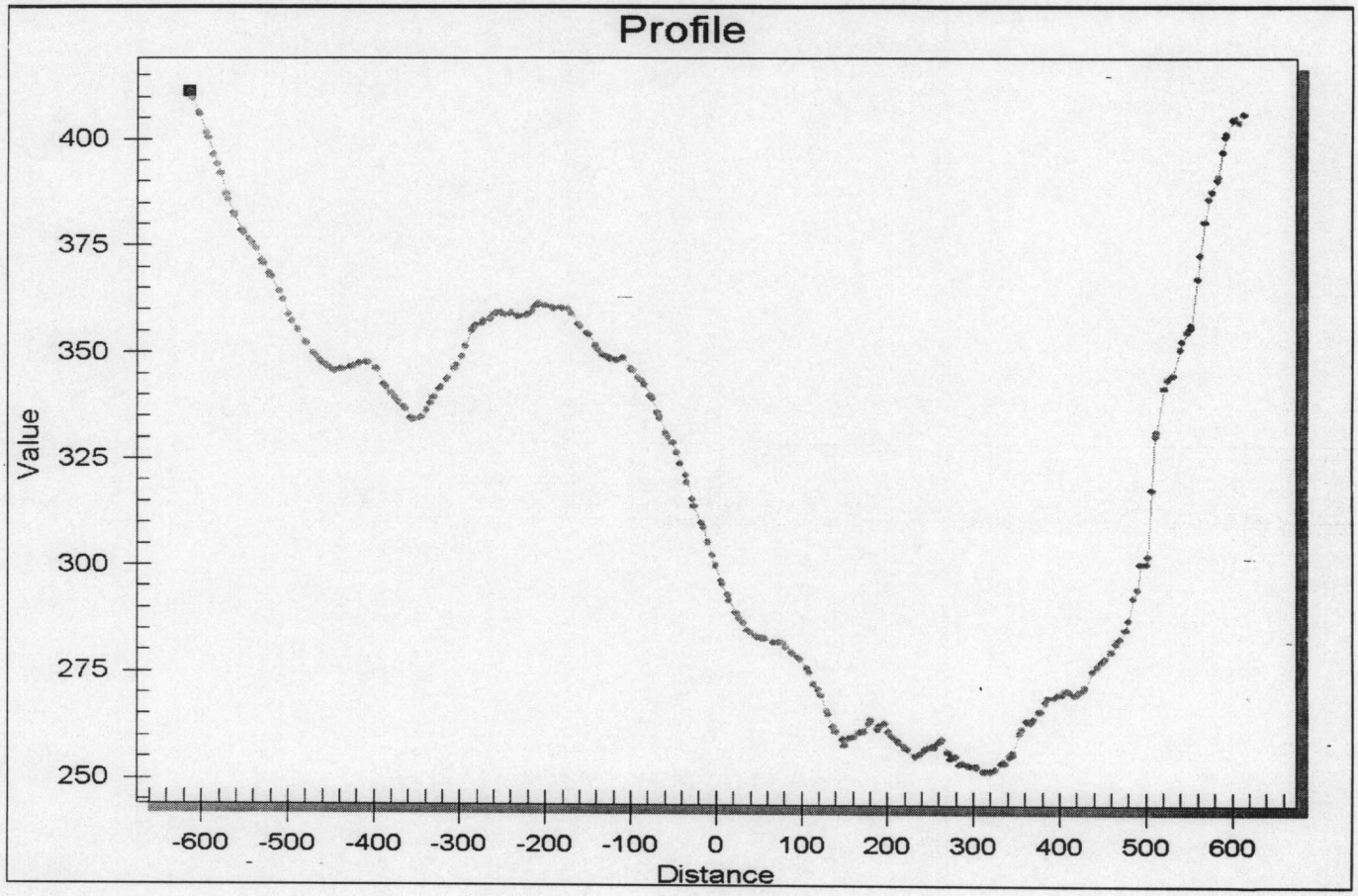
Final Working Options:

A: Teria 1 and Teria 2: Set Teria 1 to the max stage level of 155m, draining to 115m, generating just over 400mcm of usable storage and replenishing every 1.7-years. Set Teria 2 to a max stage of 265m; draining to 225m and generating 200mcm usable storage conveyed directly to Teria 1 via the existing river. Total usable storage will be 600mcm replenished every 1.7 years on average, with a max total storage of 815mcm.

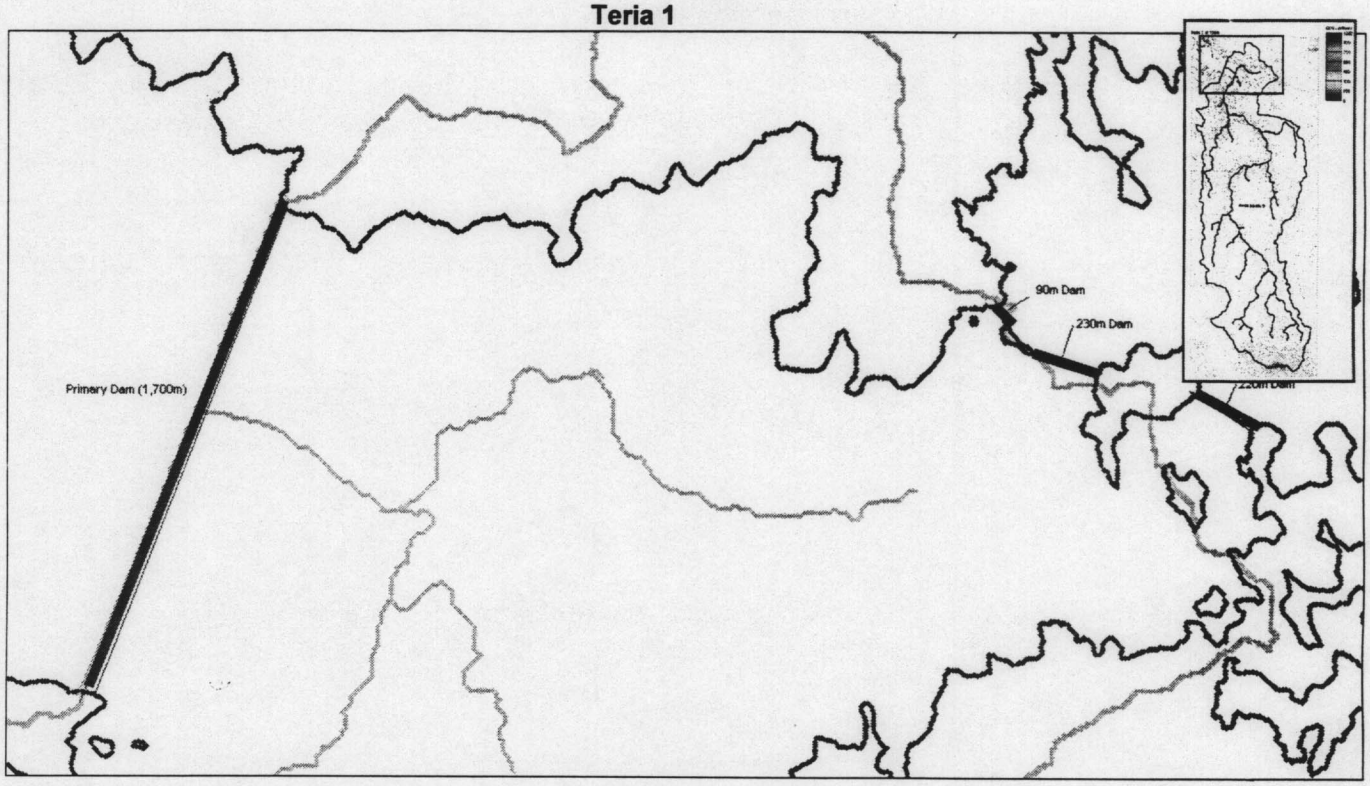
B: Teria 1 + Teria 2 and Indio 2B: Set Teria 1 to the max stage level of 130m, draining to 90m, generating just over 240MCM of usable storage and replenishing every 1.03 years. Set Teria 2 to a max stage of 265m; draining to 220m and generating 210mcm usable storage conveyed directly to Teria 1 via the existing river. Set Indio 2B to max stage of 300m, draining to 295m; generating 20mcm of usable storage conveyed via a 1km long aqueduct to Teria watershed. Total usable storage will be 450mcm replenished every 1.08 years on average, with a max total storage of 565mcm.

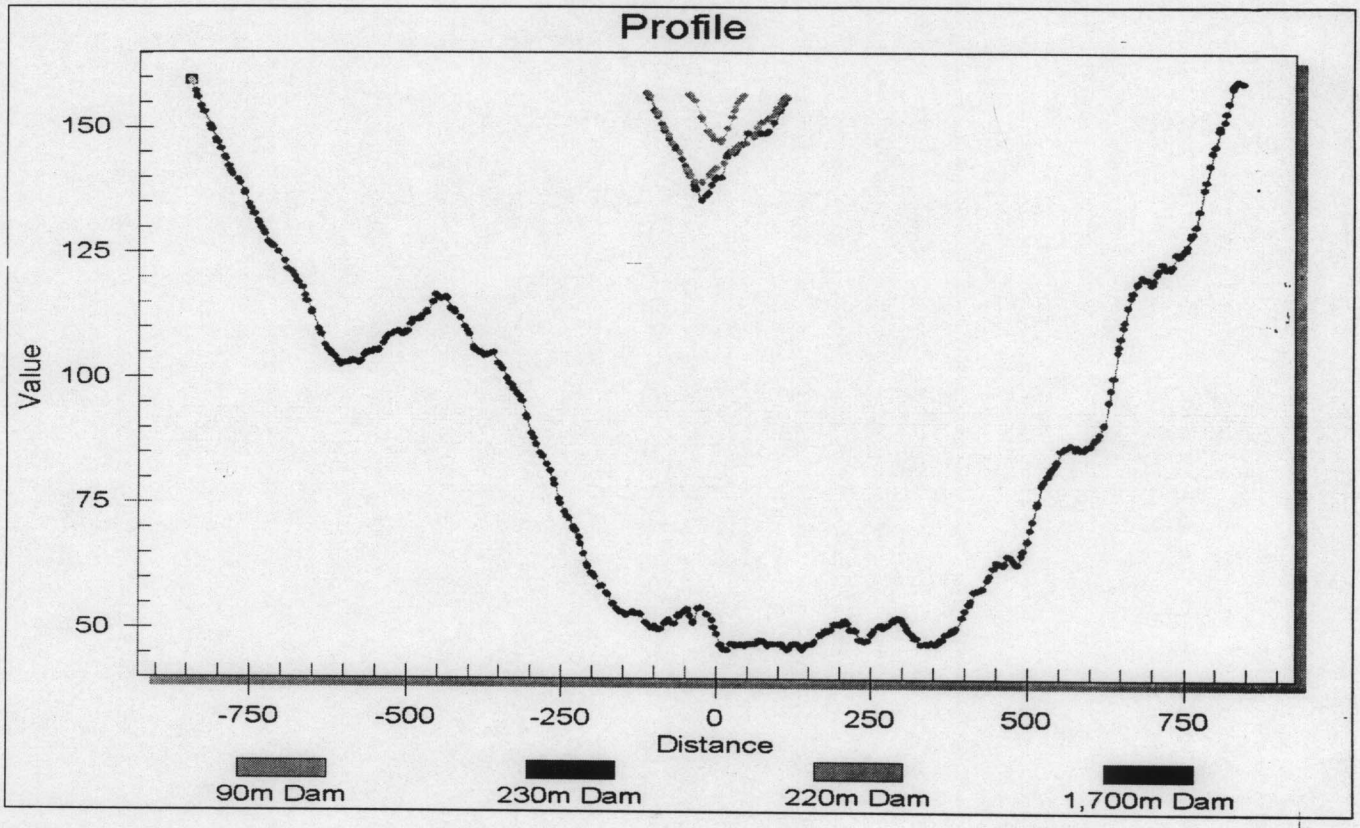
Indio 2B


Primary Dam (1,300m)

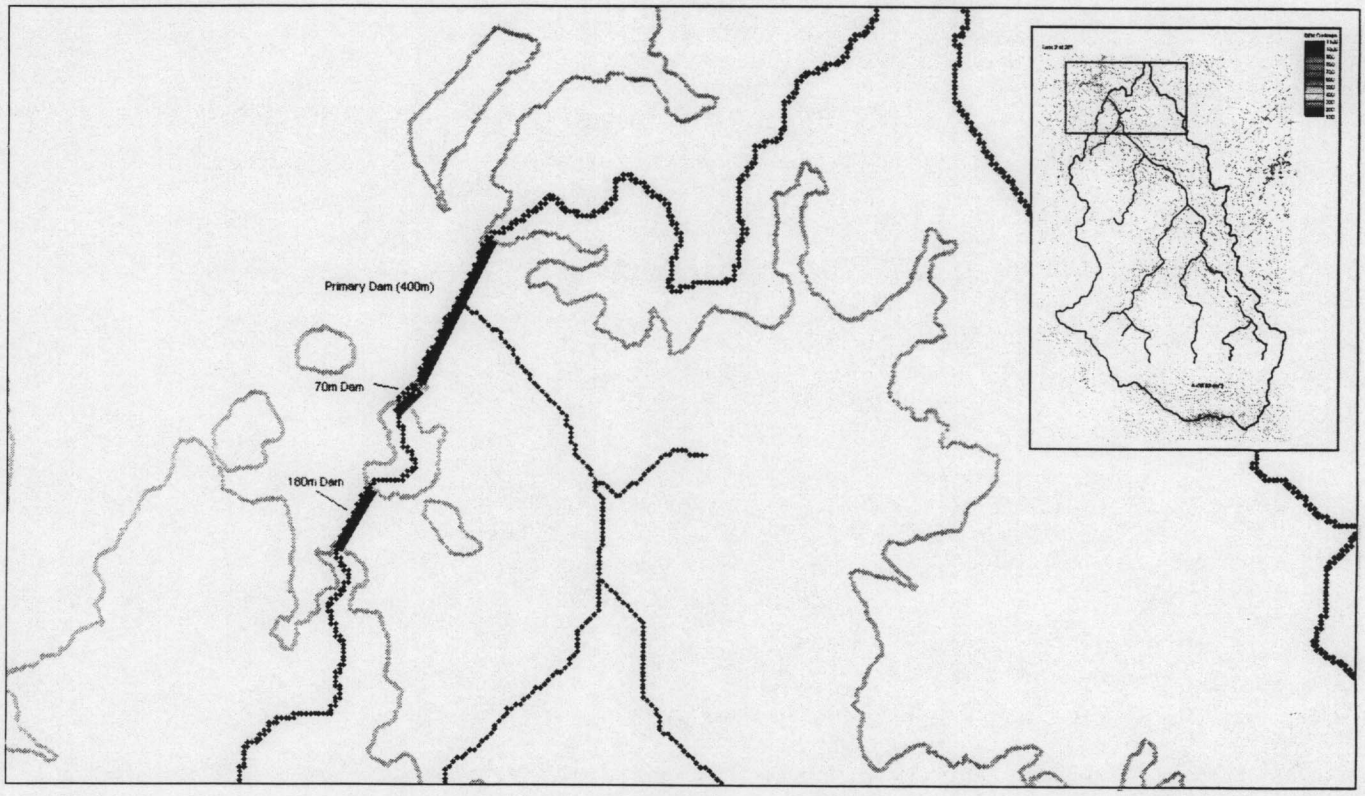

Profile
Value
400
375
350
325
300
275
250
-600
-500
-400
-300
-200
-100
0
100
200
300
400
500
600
Distance

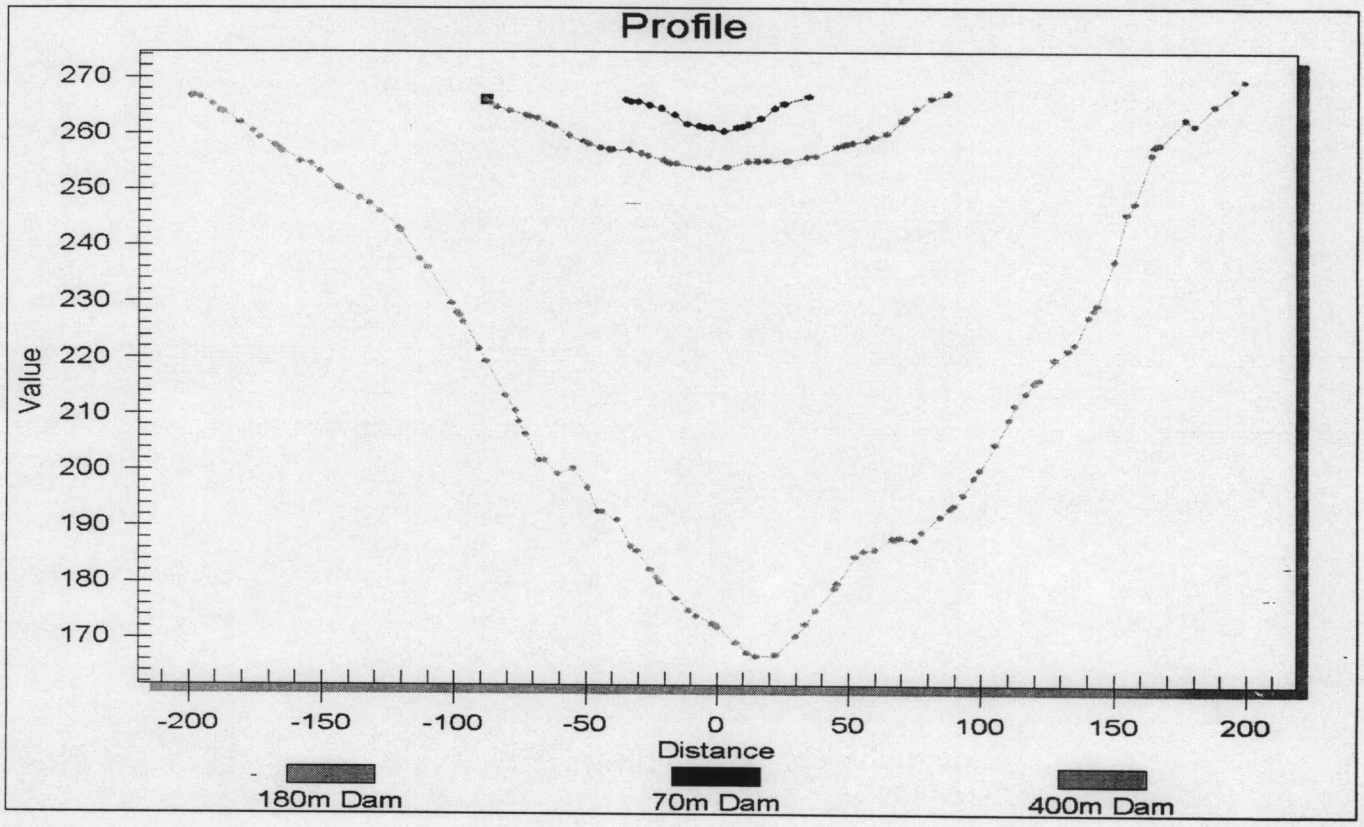
Teria 1


90m Dam
230m Dam
Primary Dam (1,700m)


Profile
150
125
100
75
50
Value
-750
-500
-250
0
250
500
750
Distance
90m Dam
230m Dam
220m Dam
1,700m Dam

Teria 2


Primary Dam (400m)
70m Dam
180m Dam


Profile
Value
270
260
250
240
230
220
210
200
190
180
170
-200
-150
-100
-50
0
50
100
150
200
Distance
180m Dam
70m Dam
400m Dam

PRELIMINARY COST ESTIMATE

	Rio Indio	Teria 1	Teria 1 (145m)	Teria 1 (130m)	Teria 1 (115m)	Teria 2	Teria 2 (285m)	Indio 2B	Indio 2B (375m)	Indio 2B (360m)	Indio 2B (300m)
Volume of Rockfill Shell (m^3)	Vol = 2.7 million	Vol = 14.6 million	Vol = 11.2 mil	Vol = 7.3 mil	Vol = 4.5 mil	Vol = 1.7 million	Vol = 3.3 mil	Vol = 16.2 million	Vol = 8.7 mil	Vol = 6.2 mil	Vol = 1 mil
PMF (m^3/s)	PMF = 4,345	PMF = 2,450				PMF = 1,600	incl. 410 & 500	PMF = 2,000			
Item						Estimated Cost					
Land Acquisition	$ 6,100,000	$ 1,651,200	$ 1,651,200	$ 1,651,200	$ 1,651,200	$ 988,800	$ 988,800	$ 871,200	$ 871,200	$ 871,200	$ 871,200
Resettlement (2)	$ 20,600,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
General Costs including Construction and Permanent Access (3)	$ 23,839,000	6,452,943.74	6,452,944	6,452,944	6,452,944	3,864,263	3,864,263	3,404,678	3,404,678	3,404,678	3,404,678
Diversion (4)	$ 3,603,000	2,437,933.26	2,437,933.26	2,437,933.26	2,437,933.26	1,592,119.68	1,592,119.68	1,990,149.60	1,990,149.60	1,990,149.60	1,990,149.60
Main Dam (5)	$ 52,704,000	$ 284,992,000	$ 218,624,000	$ 142,496,000	$ 87,840,000	$ 33,184,000	$ 64,416,000	$ 316,224,000	$ 169,824,000	$ 121,024,000	$ 19,520,000
Spillway (6)	$ 6,043,000	4,088,934.41	4,088,934.41	4,088,934.41	4,088,934.41	2,670,324.51	2,670,324.51	3,337,905.64	3,337,905.64	3,337,905.64	3,337,905.64
Low-level Outlet (7)	$ 3,049,000	$ 3,049,000	$ 3,049,000	$ 3,049,000	$ 3,049,000	$ 3,049,000	$ 3,049,000	$ 3,049,000	$ 3,049,000	$ 3,049,000	$ 3,049,000
Saddle Dams (8)	$ 7,427,000	$ 499,725	$ 499,725	$ 499,725	$ 499,725	$ 134,395	$ 177,397	N/A	N/A	N/A	N/A
Interbasin Water Transfer Tunnel (9)	$ 46,765,000	$ 22,402,395	$ 22,402,395	$ 22,402,395	$ 22,402,395	N/A	N/A	N/A	N/A	N/A	N/A
Canal (10)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$ 900,000	$ 900,000	$ 900,000	$ 900,000
Minimum Release Facility (11)	$ 837,000	$ 837,000	$ 837,000	$ 837,000	$ 837,000	$ 837,000	$ 837,000	$ 837,000	$ 837,000	$ 837,000	$ 837,000
Operation Facilities (12)	$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000
Subtotal Direct Cost	$ 172,106,000	$ 327,550,132	$ 261,182,132	$ 185,054,132	$ 130,398,132	$ 47,458,902	$ 78,733,904	$ 331,752,933	$ 185,352,933	$ 136,552,933	$ 35,048,933
Contingency (13)	$ 28,868,000	$ 98,265,040	$ 78,354,640	$ 55,516,240	$ 39,119,440	$ 14,237,670	$ 23,620,171	$ 99,525,880	$ 55,605,880	$ 40,965,880	$ 10,514,680
Direct Cost	$ 200,974,000	$ 425,815,171	$ 339,536,771	$ 240,570,371	$ 169,517,572	$ 61,696,572	$ 102,354,075	$ 431,278,813	$ 240,958,813	$ 177,518,813	$ 45,563,613
Engineering and Administration (14)	$ 30,056,000	$ 51,097,821	$ 40,744,413	$ 28,868,445	$ 20,342,109	$ 9,254,486	$ 12,282,489	$ 51,753,458	$ 28,915,058	$ 21,302,258	$ 5,487,634
Construction Cost (2004 price level)	$ 231,030,000	$ 476,912,992	$ 380,281,184	$ 269,438,816	$ 189,859,680	$ 70,951,058	$ 114,636,564	$ 483,032,271	$ 269,873,871	$ 198,821,071	$ 51,031,247
Rounded Construciton Costs (2004 price level)	**$ 230,430,000**	**$ 476,910,000**	**$ 380,280,000**	$ 269,440,000	**$ 189,860,000**	**$ 70,950,000**	**$ 114,640,000**	**$ 483,030,000**	$ 269,870,000	**$ 198,820,000**	$ 51,030,000
New Dam Cost Comparison	$ 230,430,000				$ 189,860,000		$ 114,640,000			$ 198,820,000	$ 51,030,000

1. Land acquisition costs include reservoir area plus 20% for borrow areas, construction roads, structures, disposal areas, construction camp and other temporary structures using and average estimated cost of $1000/ha from the ACP.
2. Resettlement costs are not estimated. Assume few families to be relocated in these area. Settlement costs listed as 20.6 million in Rio Indio Report.
3. Assume general costs are equal to the ratio of the land acquisition and general costs of Rio Indio.
4. Estimated cost for the diversion is based on tunnel area using the peak PMF because information is not available for the 50-year flood. Minimum tunnel diameter assumed to be 2.5m diameter finished.
5. Estimated cost for the main dam derived from Rio Indio estimated costs based on the volume of the rockfill shell. Price per cubic meters = $19.52.
6. Estimated costs fot the spillway calculated using ratios of the peak PMF compared to the cost of Rio Indio. A factor of 1.2 was applied here to account for unknowns.
7. Estimated cost of the low-level outlet works is equal to the cost for Rio Indio to convert the diversion tunnel to a low-level outlet works. Assume that the outlet works will be similar in all cases.
8. Estimated cost for the saddle dam derived from Rio Indio costs based on the volume of fill. Fill volume was approximated using cross section from Exhibit 4-4 (~840,000 m^3).
   It is assumed that the cost of the saddle dam includes both saddle dams for Rio Indio, so the cost is divided by 2. Price per cubic meter of saddle dam = $4.42.
   Refer to Saddle Dam spreadsheets for clarification.
9. Estimated cost for the tunnel (from Teria 1 to Gatun Lake) is based on Rio Indio cost estimate using ratios of tunnel lengths. Assume similar tunnels. Excavation unknown.
10. Canal estimate performed by URS Tampa.
11. Estimated cost for the minimum release facility is equal to the estimated cost of the Rio Indio, assuming minimum realease is at the same depth below the dam crest. This is the high level outlet works similar to the Rio Indio design.
12. Estimated cost for the operation facilities is equal to the estimated cost of the Rio Indio.
13. Contingency of 30%. Contingency is higher than that used for Rio Indio due to the large amount of unknowns in this estimate.
14. Engineering and administration fees of 15%.
15. Gross storage values were not provided. Numbers are rough estimate based on the information provided, including dam profiles and reservoir areas.

COMBINATIONS

	Total Cost ($)	Main Dam Cost ($)	Elevation (m)	Storage (MCM)
Rio Indio	230,430,000	52,704,000	85	1294
Teria 1 (115m)	189,860,000	87,840,000	115	175
Teria 1 (130m)	269,440,000	142,496,000	130	290
Teria 1 (145m)	380,280,000	218,624,000	145	450
Teria 1 (155m)	476,910,000	284,992,000	155	570
Teria 2 (260m)	70,950,000	33,184,000	260	245
Teria 2 (285m)	114,640,000	64,416,000	285	430
Indio 2B (300m)	51,030,000	19,520,000	300	20
Indio 2B (360m)	198,820,000	121,024,000	360	160
Indio 2B (375m)	269,870,000	169,824,000	375	223
Indio 2B (400m)	483,030,000	316,224,000	400	370
Rio Indio	230,430,000	52,704,000		1294
Teria 1(155) + Teria 2(260)	547,860,000	318,176,000		815
Teria 1(155) + Teria 2(285)	591,550,000	349,408,000		1,000
Teria 1(145) + Teria 2(260)	451,230,000	251,808,000		695
Teria 1(145) + Teria 2(285)	494,920,000	283,040,000		880
Teria 1(130) + Teria 2(260)	340,390,000	175,680,000		535
Teria 1(130) + Teria 2(285)	384,080,000	206,912,000		720
Teria 1(115) + Teria 2(260)	260,810,000	121,024,000		420
Teria 1(115) + Teria 2(285)	304,500,000	152,256,000		605
Teria 1(155) + Indio 2B(400)	959,940,000	601,216,000		940
Teria 1(155) + Indio 2B(375)	746,780,000	454,816,000		793
Teria 1(155) + Indio 2B(360)	675,730,000	406,016,000		730
Teria 1(145) + Indio 2B(400)	863,310,000	534,848,000		820
Teria 1(145) + Indio 2B(375)	650,150,000	388,448,000		673
Teria 1(145) + Indio 2B(360)	579,100,000	339,648,000		610
Teria 1(130) + Indio 2B(400)	752,470,000	458,720,000		660
Teria 1(130) + Indio 2B(375)	539,310,000	312,320,000		513
Teria 1(130) + Indio 2B(360)	468,260,000	263,520,000		450
Teria 1(115) + Indio 2B(400)	672,890,000	404,064,000		545
Teria 1(115) + Indio 2B(375)	459,730,000	257,664,000		398
Teria 1(115) + Indio 2B(360)	388,680,000	208,864,000		335

Numbers are based on **total** storage volume provided by Storage Capacity Curves.
There was no total storage volume provided for Teria 2 at elevation 285m. This was estimated using the Storage Capacity Curves provided. Full storage capacity assumed to be reached when water level at the top of the parapet wall.

ANNEX 2-D

Panama Canal
Hydrologic Modeling
of
ROCC Water Options
Letter Report

By

URS

March 30, 2004

Introduction

This appendix is provided to summarize the results presented in the comparative evaluation of hydrologic options for potential expansion of water supply to the Panama Canal. These results, specifically, are based on hydrologic simulation of each of the twelve water options analyzed in this project. The simulations are used to determine the amount of water supplied to the canal, expressed in units of volume per time, e.g., lockages/day, MCM/yr.

Hydrologic Simulation Procedure

The twelve water options were modeled using the HEC-5 simulation program, developed by the US Army Corps of Engineers. A base model was provided by the ACP. This base model contained the following information about the hydrologic characteristics of the water supply system, which were used to model the twelve water options proposed in this project.

(a) Reservoir characteristics (volume, area, elevation, discharge) for Lake Gatún, Lake Madden, and the reservoir at Río Indio.
(b) Inflow time series into Lake Gatún, Lake Madden, and the reservoir at Río Indio.
(c) Flow diversions from the outlets at Lake Gatún, Lake Madden, and the reservoir at Río Indio.
(d) Evaporation rates for Lake Gatún, Lake Madden, and the reservoir at Río Indio.
(e) Operating rules for releases from Lake Gatún, Lake Madden, and the reservoir at Río Indio.
(f) Water demands on the system from the Panama Canal.

This base model was modified to simulate the twelve water options proposed for the ROCC supply to the Panama Canal:

1. **Indio 80-40**
2. **Indio 45-40**
3. **Alto Indio 50-40**
4. **Alto Indio 45-40**
5. **Caño Sucio 100-90 and Indio 80-40**
6. **Caño Sucio 100-90 and Indio 45-40**
7. **Toabré 95-50 and Indio 80-40**
8. **Toabré 95-50 and Indio 45-40**
9. **Toabré 100-90, Caño Sucio 100-90 and Indio 80-40**
10. **Toabré 100-90, Caño Sucio 100-90 and Indio 45-40**
11. **Teria River**
12. **Teria and Cabecera Indio**

These modifications were done to incorporate the information presented in items (a)-(f) above for each of the water options 1-12. In the case of option 1 (Indio 80-40), the simulation was done to verify the results provided by previous reports [USACE, 1999: *Panama Canal Reconnaisance Study: Identification, Definition and Evaluation of Water Supply Projects, Volume 1*, prepared by the US Army Corps of Engineers, December 1999].

A summary of the hydrologic parameters used for each water option is presented in **Table 1**.

Table 1-A, HEC5 Input Data for Gatun (ID#40)
(data from Original ACOE HEC-5 run)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	*Monthly Diversion Pedro Miguel Locks (cfs)	*Monthly Diversion Gatun Locks (cfs)	*Water Supply M&I (cfs)
0	0	0	40	4.24	81.5	87.0	87.8	1,578	1,625	123
833,700	0	56,544	50	4.59	81.5	86.3	87.8	1,603	1,596	126
1,781,700	0	70,404	60	5.37	81.5	85.4	87.8	1,624	1,586	123
2,729,700	1,890	84,264	70	5.25	81.5	84.7	87.8	1,563	1,543	127
3,393,300	42,790	93,966	77	3.30	81.5	84.7	86.5	1,497	1,474	117
3,488,100	58,878	95,353	78	2.90	81.5	84.7	86.5	1,421	1,395	127
3,584,200	69,463	96,740	79	3.04	81.5	84.7	86.5	1,416	1,404	121
3,681,600	80,672	98,127	80	3.13	81.5	84.7	86.5	1,435	1,424	124
3,780,300	92,479	99,414	81	2.88	81.5	85.0	86.5	1,389	1,395	115
3,880,300	104,860	100,702	82	2.87	81.5	85.9	86.8	1,439	1,529	124
3,981,600	117,796	101,990	83	2.67	81.5	87.3	87.4	1,394	1,448	123
4,084,200	131,268	103,277	84	3.35	81.5	87.5	87.8	1,486	1,476	119
4,188,100	145,260	104,566	85							
4,293,300	159,756	105,853	86							
4,399,800	174,743	107,141	87							
4,507,600	190,208	108,382	88							
4,616,700	206,139	109,670	89							
4,727,200	222,525	110,957	90							
5,279,700	300,000	117,392	95							
5,832,300	350,000	123,827	100							
6,384,700	400,000	130,262	105							

* Note: Data is 5 year average from 1993 to 1997 as computed by Army Corps.

Table 1-B, HEC5 Input Data for Madden (ID#50)
(data from Original ACOE HEC-5 run)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	*Water Supply M&I (cfs)
0	1,000	0	140	4.944	190.00	249.00	252.00	185
16,000	10,000	1,600	160	5.14	190.00	243.00	252.00	188.00
54,400	15,000	3,840	180	5.85	190.00	233.00	252.00	190.00
127,250	20,000	4,608	190	5.03	190.00	221.00	245.00	190.00
136,890	22,000	4,800	192	3.37	190.00	217.00	245.00	191.00
146,510	23,000	4,992	194	2.88	190.00	215.00	245.00	188.00
156,700	24,000	5,184	196	3.24	190.00	217.00	245.00	188.00
167,290	25,000	5,376	198	3.21	190.00	222.00	245.00	187.00
178,350	26,000	5,568	200	2.89	190.00	228.00	245.00	187.00
184,080	26,150	5,792	201	3.00	190.00	236.00	248.00	180.00
189,992	26,300	6,016	202	2.58	190.00	247.00	251.00	182.00
195,914	26,400	6,144	203	3.67	190.00	252.00	252.00	183.00
202,066	26,500	6,272	204					
208,356	26,750	6,400	205					
214,761	27,000	6,528	206					
221,281	27,150	6,624	207					

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Table 1-B Continued, HEC5 Input Data for Madden (ID#50)
(data from Original ACOE HEC-5 run)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	*Water Supply M&I (cfs)		
227,916	27,300	6,720	208							
234,665	27,400	6,784	209							
241,529	27,500	6,848	210							
248,520	27,650	6,976	211							
255,579	27,800	7,104	212							
262,764	27,900	7,168	213							
270,041	28,000	7,296	214							
277,433	28,150	7,488	215							
284,963	28,300	7,616	216							
292,654	28,400	7,744	217							
300,505	28,500	7,936	218							
308,517	28,650	8,064	219							
316,667	28,800	8,198	220							
333,370	29,000	8,480	222							
350,573	29,300	8,762	224							
368,297	29,500	9,043	226							
386,639	29,800	9,318	228							
405,556	30,000	9,587	230							
425,000	30,100	9,856	232							
444,904	34,100	10,125	234							
465,289	41,100	10,394	236							
486,226	50,400	10,630	238							
507,782	60,700	10,912	240							
529,880	74,000	11,168	242							
552,525	88,000	11,424	244							
575,781	103,700	11,680	246							
599,472	120,800	11,936	248							
623,577	139,300	12,179	250							
648,140	159,200	12,422	252							
673,255	180,600	12,666	254							
698,852	203,500	12,909	256							
724,908	227,700	13,146	258							
751,400	253,600	13,376	260							
778,340	281,001	13,606	262							
805,624	310,000	13,837	264							
832,668	340,700	14,080	266							
859,711	373,100	14,304	268							
886,754	407,100	14,528	270							

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Table 1-C, HEC5 Input Data for Indio (ID# 200)

(Indio 80 data from Original ACOE HEC-5 run)

					Indio 80			Indio 45		
Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)
33,544	0	1,573	66	4.41	131.2	262.00	262.47	131.2	148	148
229,649	2,021	4,371	131	4.62	131.2	257.57	262.47	131.2	147	148
318,191	2,355	5,401	148	5.23	131.2	252.45	262.47	131.2	146	148
406,733	2,646	6,425	164	4.86	131.2	247.43	262.47	131.2	146	148
528,932	2,909	7,026	180	3.59	131.2	242.41	262.47	131.2	145	148
651,131	3,150	7,624	197	3.13	131.2	237.39	262.47	131.2	145	148
708,070	3,241	8,014	203	3.29	131.2	237.39	262.47	131.2	145	148
765,009	3,330	8,404	210	3.15	131.2	242.41	262.47	131.2	145	148
821,947	3,416	8,794	217	3.08	131.2	247.43	262.47	131.2	146	148
878,890	3,501	9,185	223	3.13	131.2	252.45	262.47	131.2	146	148
935,825	3,583	9,575	230	2.83	131.2	257.57	262.47	131.2	147	148
1,004,440	3,663	9,915	236	3.31	131.2	262.00	262.47	131.2	148	148
1,073,040	3,742	10,255	243							
1,141,660	3,820	10,595	249							
1,210,270	3,895	10,935	256							
1,278,880	3,969	11,275	262							
1,384,200	4,060	11,671	271							
1,489,530	4,149	12,059	279							
1,700,190	4,321	12,842	295							

Table 1-D, HEC5 Input Data for ALTO INDIO (ID# 200)

					Alto Indio 50			Alto Indio 45		
Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)
0	809	510	70	4.41	131	164	164	131	148	148
400	955	660	79	4.62	131	163	164	131	147	148
1,000	1,102	820	87	5.23	131	161	164	131	147	148
2,500	1,249	970	96	4.86	131	160	164	131	146	148
5,100	1,395	1,120	104	3.59	131	159	164	131	145	148
9,800	1,542	1,260	113	3.13	131	158	164	131	145	148
16,100	1,688	1,410	122	3.29	131	158	164	131	145	148
23,900	1,835	1,590	130	3.15	131	159	164	131	145	148
33,400	1,982	1,750	139	3.08	131	160	164	131	146	148
44,400	2,128	1,870	148	3.13	131	161	164	131	147	148
57,200	2,275	2,010	156	2.83	131	163	164	131	147	148
72,200	2,422	2,160	165	3.31	131	164	164	131	148	148
89,000	2,568	2,290	173							
108,300	2,715	2,410	182							
130,300	2,861	2,540	191							
155,100	3,008	2,680	199							
182,100	3,155	2,810	208							
211,400	3,301	2,940	217							
242,800	3,448	3,080	225							
276,000	3,595	3,210	234							

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Table 1-E, HEC5 Input Data for CANO SUCIO (ID# 300)

					Cano Sucio 100/90					
Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)			
0	3,600	0	279	4.41	295	328	328			
1,700	3,700	310	287	4.62	295	327	328			
3,400	3,800	620	295	5.23	295	325	328			
13,100	3,900	1,110	303	4.86	295	324	328			
22,700	4,000	1,610	312	3.59	295	323	328			
40,900	4,100	2,340	320	3.13	295	322	328			
59,200	4,100	3,060	328	3.29	295	322	328			
95,700	4,300	4,520	344	3.15	295	323	328			
				3.08	295	324	328			
				3.13	295	325	328			
				2.83	295	327	328			
				3.31	295	328	328			

Table 1-F, HEC5 Input Data for TOABRE (ID# 400)

					Toabre 95-50			Toabre 100-90		
Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)
73,000	1,800	1,480	164	4.41	164	311	311.7	295	328	328
89,200	2,100	1,980	180	4.62	164	306	311.7	295	327	328
121,600	2,400	2,590	197	5.23	164	300	311.7	295	325	328
162,100	2,700	3,210	213	4.86	164	295	311.7	295	324	328
194,600	3,000	3,950	230	3.59	164	289	311.7	295	323	328
283,700	3,200	4,820	246	3.13	164	283	311.7	295	322	328
381,000	3,500	5,560	262	3.29	164	283	311.7	295	322	328
486,400	3,600	6,420	279	3.15	164	289	311.7	295	323	328
583,700	3,800	7,910	295	3.08	164	295	311.7	295	324	328
744,200	4,000	9,640	312	3.13	164	300	311.7	295	325	328
916,100	4,100	11,370	328	2.83	164	306	311.7	295	327	328
1,094,500	4,300	13,590	344	3.31	164	311	311.7	295	328	328
1,378,200	4,500	16,060	361							
1,662,000	4,700	18,780	377							
1,945,700	4,800	21,750	394							

Table 1-G, HEC5 Input Data for TERIA 1 (ID# 500)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)			
0	3,000	5	152	4.41	377	508	508.5			
1,692	3,200	119	188	4.62	377	504	508.5			
8,616	3,500	266	223	5.23	377	498	508.5			
21,574	3,600	484	259	4.86	377	493	508.5			
43,907	3,800	768	295	3.59	377	488	508.5			
76,484	4,000	1,071	330	3.13	377	483	508.5			

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Table 1-G Continued, HEC5 Input Data for TERIA 1 (ID# 500)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)
121,547	4,100	1,458	366	3.29	377	483	508.5
181,037	4,300	1,897	402	3.15	377	488	508.5
257,067	4,500	2,381	437	3.08	377	493	508.5
350,664	4,700	2,875	473	3.13	377	498	508.5
462,258	4,800	3,388	509	2.83	377	504	508.5
				3.31	377	508	508.5

Table 1-H, HEC5 Input Data for Teria 2 (ID# 600)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)
0	3,000	0	548	4.41	740	870	870
12	3,200	2	580	4.62	740	865	870
406	3,500	31	612	5.23	740	860	870
2,933	3,600	126	644	4.86	740	855	870
8,847	3,800	252	677	3.59	740	850	870
19,433	4,000	416	709	3.13	740	845	870
36,345	4,100	643	741	3.29	740	845	870
61,457	4,300	912	773	3.15	740	850	870
95,390	4,500	1,210	806	3.08	740	855	870
140,880	4,700	1,624	838	3.13	740	860	870
200,391	4,800	2,075	870	2.83	740	865	870
				3.31	740	870	870

Table 1-I, HEC5 Input Data for Indio 2 (ID#700)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)
0	3,000	5	842	4.41	1,180	1,312	1,312
1,514	3,200	64	889	4.62	1,180	1,307	1,312
6,342	3,500	144	936	5.23	1,180	1,302	1,312
15,021	3,600	226	983	4.86	1,180	1,297	1,312
28,055	3,800	347	1,030	3.59	1,180	1,292	1,312
48,133	4,000	520	1,077	3.13	1,180	1,287	1,312
77,573	4,100	724	1,124	3.29	1,180	1,287	1,312
116,127	4,300	932	1,171	3.15	1,180	1,292	1,312
165,887	4,500	1,200	1,218	3.08	1,180	1,297	1,312
228,992	4,700	1,484	1,265	3.13	1,180	1,302	1,312
305,699	4,800	1,784	1,312	2.83	1,180	1,307	1,312
				3.31	1,180	1,312	1,312

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Constant Diversion Flow Rates per Option		
	Cubic Meters per Second	Cubic Feet per Second
Indio	2.6	91.8
Cano Sucio	0.75	26.5
Toabre	4.1	144.8
Teria1	0.74	26.1
Teria2	0.34	12.0
Indio2	0.64	22.6

Hydrologic Reliability Calculation

Hydrologic reliability of the Panama Canal system is defined as the ability to provide sufficient water for unrestricted operation. Unrestricted operation for the Panama Canal would be its ability to pass all requested navigation without draft restrictions and to meet all M&I water supply needs during the designated period. The hydrologic reliability is represented by a ratio of the volume of water provided to the volume of water demanded for canal operations during the designated period with no draft restrictions.

$$Hydrologic\ Reliability = \left[\frac{\sum Vol\_Provided}{\sum Vol\_Demanded} \right] x100\%$$

In the past, when water shortages have been experienced, the Panama Canal has continued to provide passage to all requesting vessels. This generally resulted in the lake elevation becoming so low that draft restrictions had to be imposed on large vessels. Draft restrictions obviously reduce the capacity of the vessels, and thus, results in a significant economic impact on world shipping. As future demands for both navigation and M&I water increase, the frequency of shortages is also expected to increase.

Current conditions in the Panama Canal permit vessels to load to a maximum draft of 39.5-ft (12.0-m) when Gatun Lake is equal or above elevation 81.5-ft (24.8-m) MSL. This operation allows the system to meet all demands but allows Lake Gatún to drop to levels below elevation 81.5-ft (24.8-m) MSL. Each time Gatun Lake drops below elevation 81.5-ft (24.8-m) MSL indicates a period that draft restrictions are required. This serves as a good indicator of the systems current reliability [USACE, 1999]. As demand for additional water increases, the ability of the Panama Canal to reliably transit vessels through the system will decrease. The current high reliability that the Panama Canal enjoys can only be maintained if water saving methods are developed or facilities are constructed that provide additional water supply and storage.

The level of hydrologic reliability for the 1948-1999 period is approximately 99.6 percent. We have used this hydrologic reliability as a target to determine the amount of water provided by each of the twelve supply options. The hydrologic reliability procedure then involves the calculation of the amount of water that each individual option can provide, subjected to 99.6 percent hydrologic reliability. This reliability is measured as the percentage of time during the 1948-1999 period during which the water level at Lake Gatún is at or above 81.5-ft (24.8-m) MSL. This is done by varying, for each option, the demand of water from the system until the target hydrologic reliability is met.

A summary of the hydrologic reliability calculations is presented in **Table 2.** For the purposes of relative comparison between the performance of the different water options, **Figures 1-12** show the simulated elevations of Lake Gatún for each option at a given demand level (chosen for these plots as 56.7 locks/day). All electronic files pertaining to the hydrologic reliability calculation are provided attached to this report.

Table 2:

Quantity of water provided by each hydrologic option at 99.6 percent hydrologic reliability

Option	Description	Locks/day	MCM/yr
1	Indio 80-40	**15.5**	**1177**
2	Indio 45-40	**1.4**	**106**
3	Alto Indio 50-40	**0.7**	**53**
4	Alto Indio 45-40	**0.3**	**23**
5	Caño Sucio 100-90 + Indio 80-40	**18**	**1367**
6	Caño Sucio 100-90 + Indio 45-40	**3.9**	**296**
7	Toabre 95-50 + Indio 80-40	**31.2**	**2369**
8	Toabre 95-50 + Indio 45-40	**17.1**	**1298**
9	Toabre 100-90 + Caño Sucio 100-90 + Indio 80-40	**26.2**	**1989**
10	Toabre 100-90 + Caño Sucio 100-90 + Indio 45-40	**12.1**	**919**
11	Teria Basin	**5.1**	**387**
12	Teria Basin + Cabecera Indio	**5.3**	**402**

Figure 1
Option 1: Indio 80-40
Total Demand = 56.7 locks/day

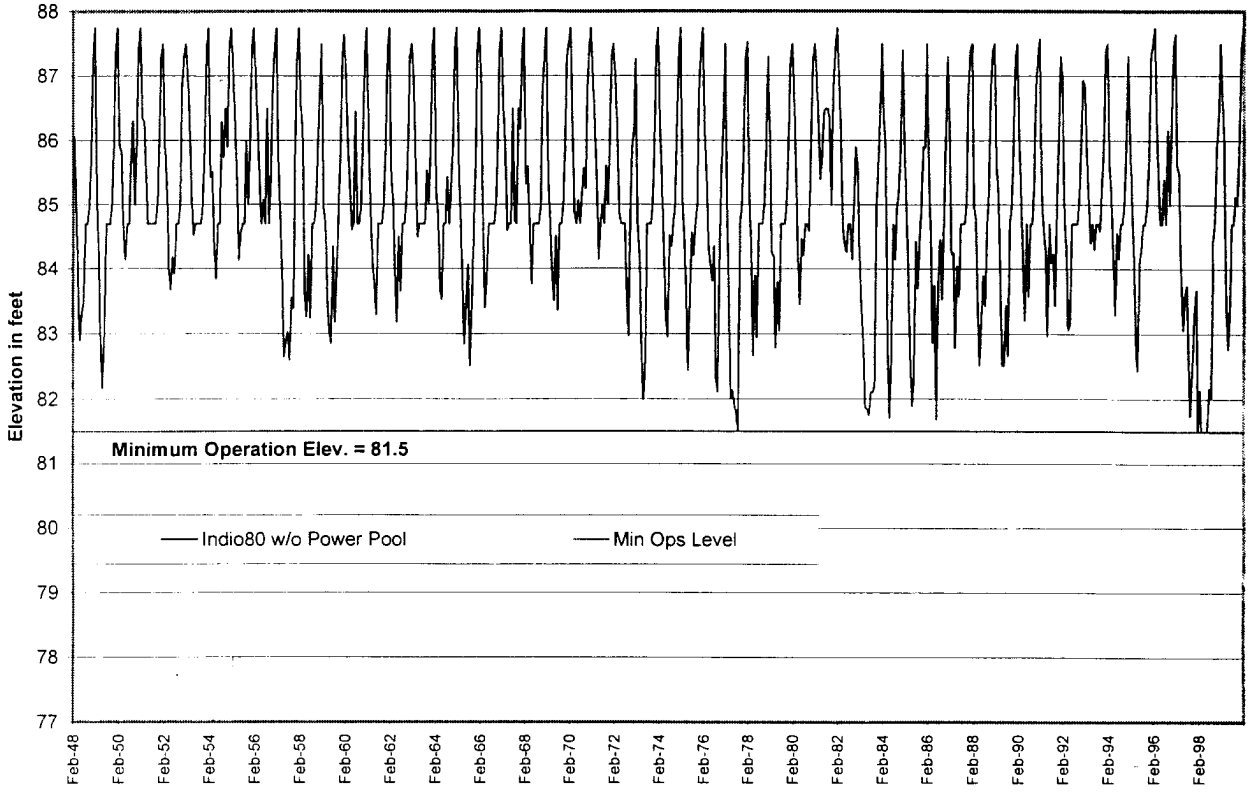

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Figure 2
Option 2: Indio 45-40
Total Demand = 56.7 locks/day

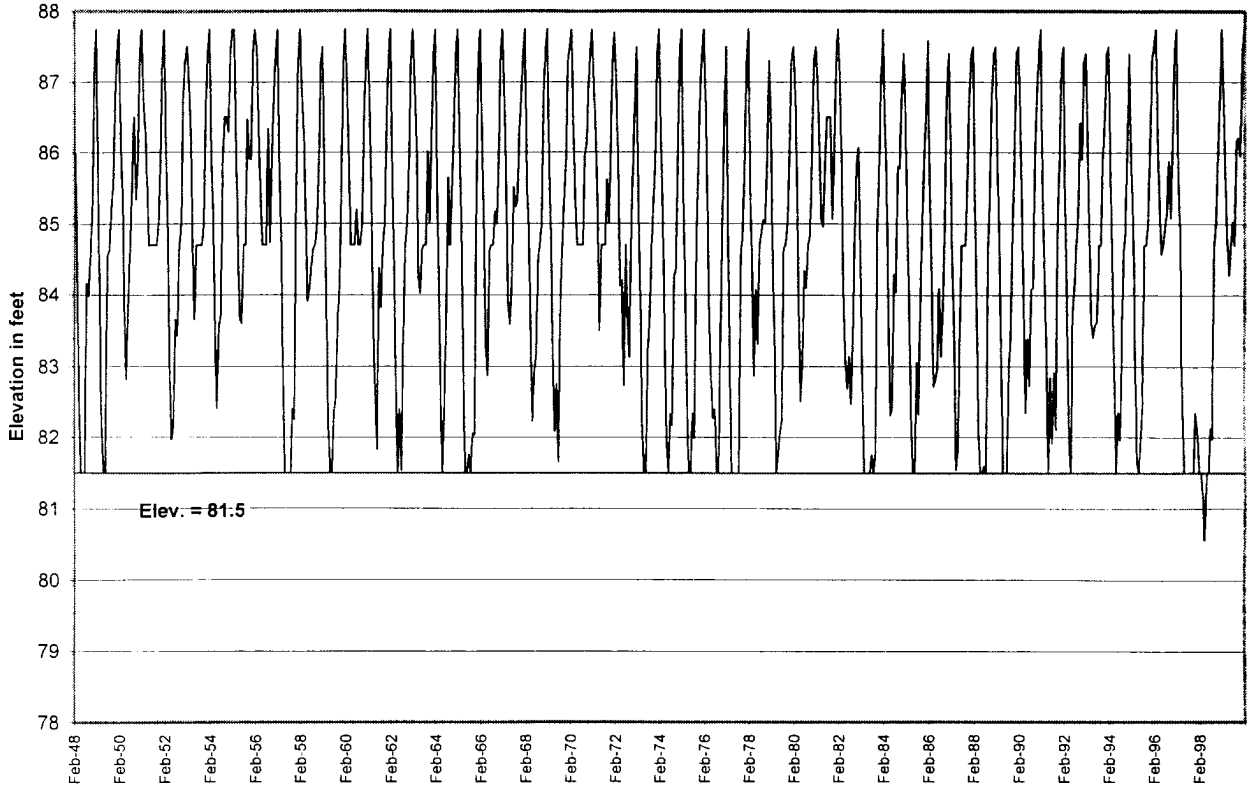

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Figure 3
Option 3: Alto Indio 50-40
Total Demand = 56.7 locks/day

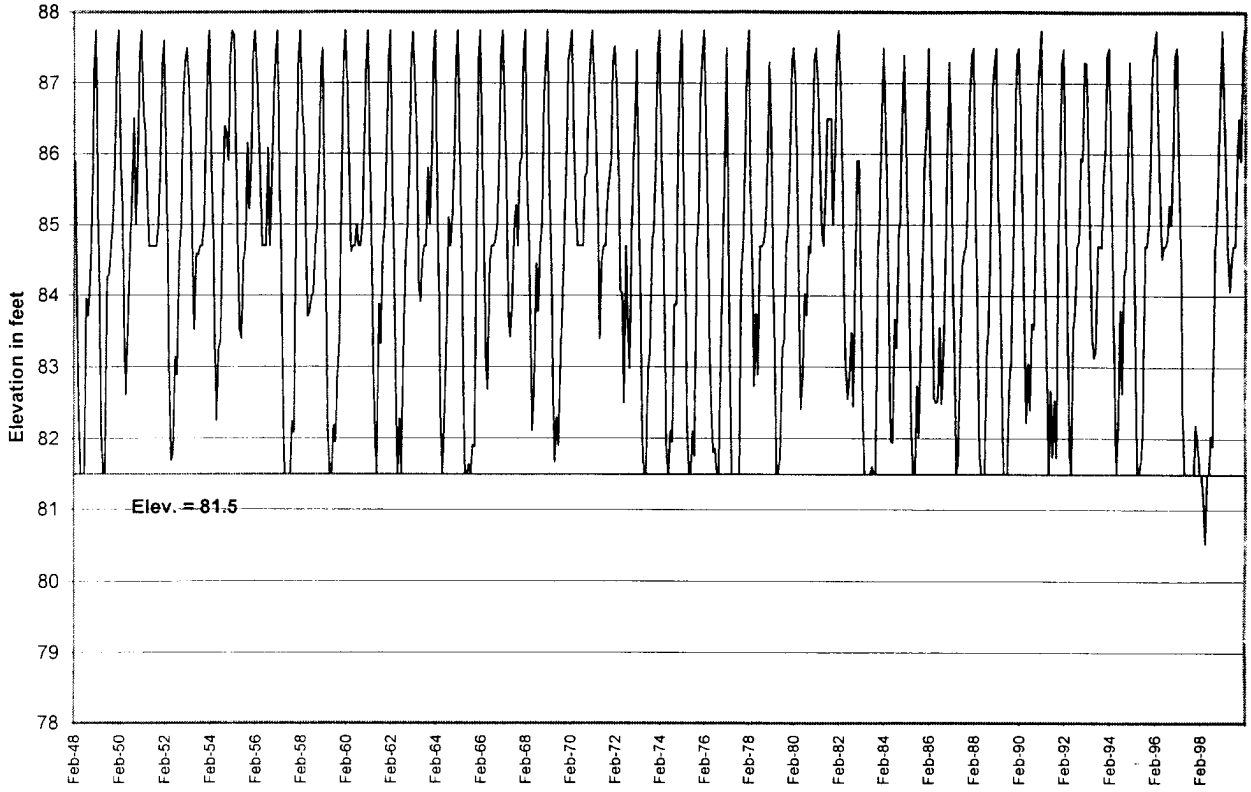

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Figure 4
Option 4: Alto Indio 45-40
Total Demand = 56.7 locks/day

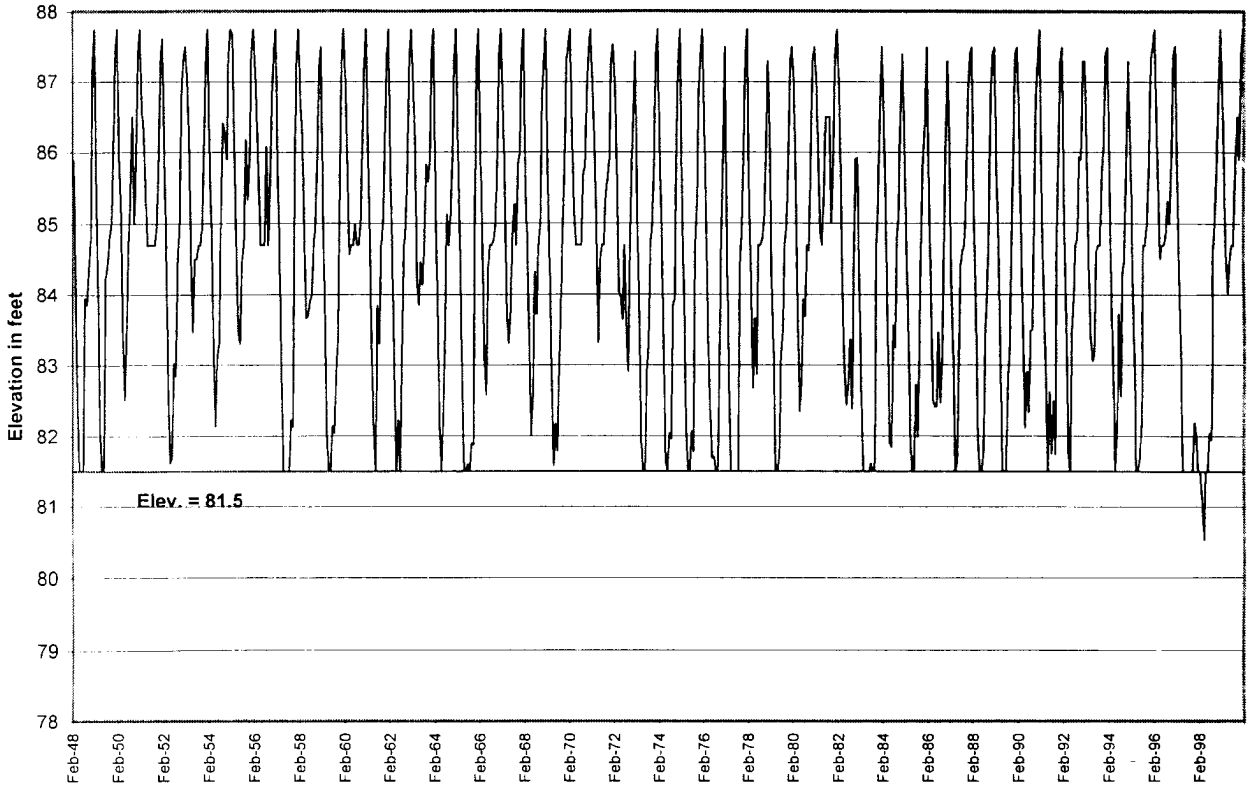

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Figure 5
Option 5: Caño Sucio 100-90 + Indio 80-40
Total Demand = 56.7 locks/day

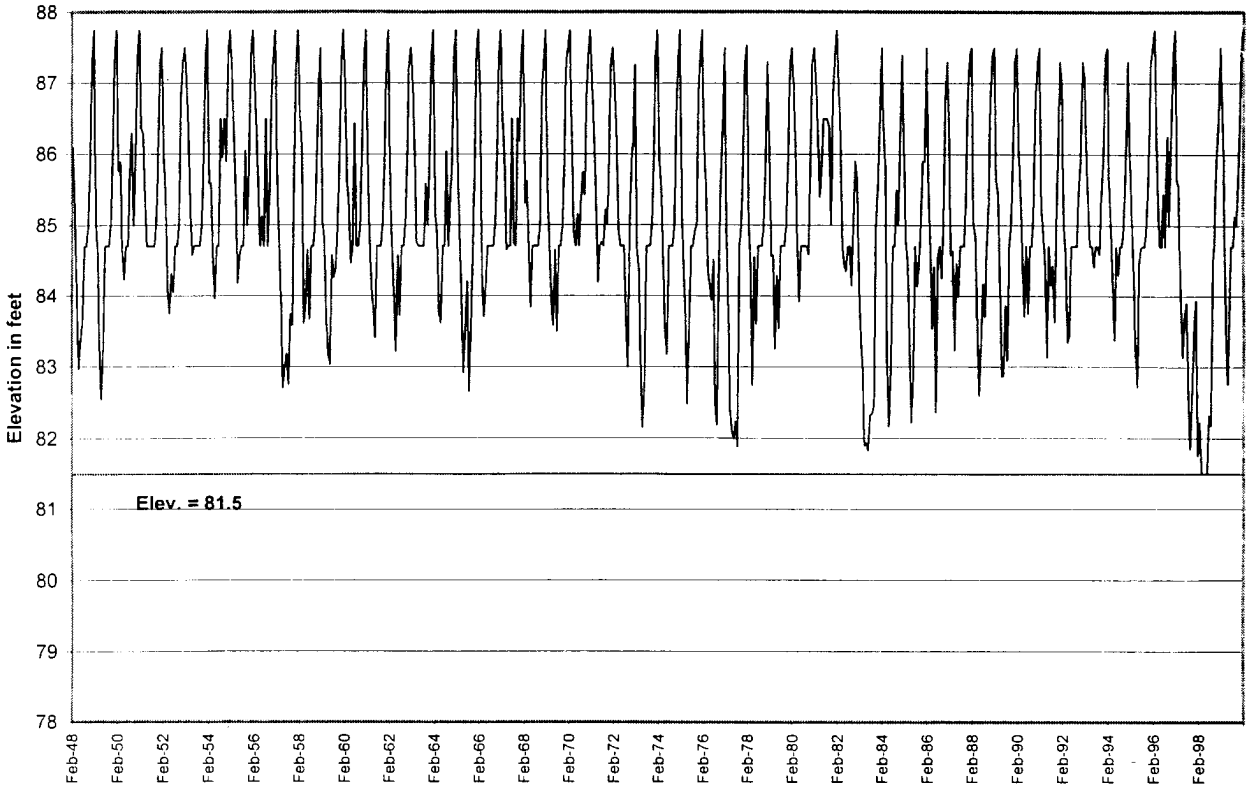

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Figure 6
Option 6: Caño Sucio 100-90 + Indio 45-40
Total Demand = 56.7 locks/day

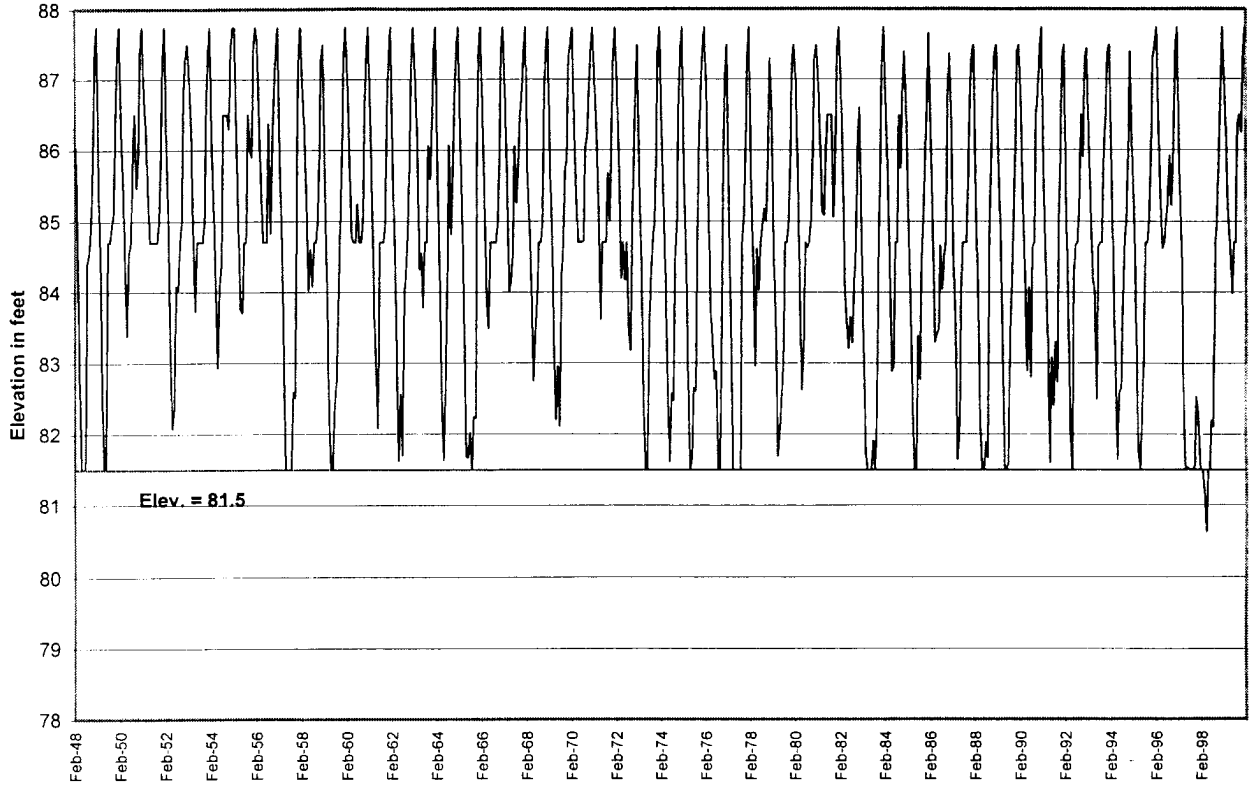

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Figure 7
Option 7: Toabre 95-50 + Indio 80-40
Total Demand = 56.7 locks/day

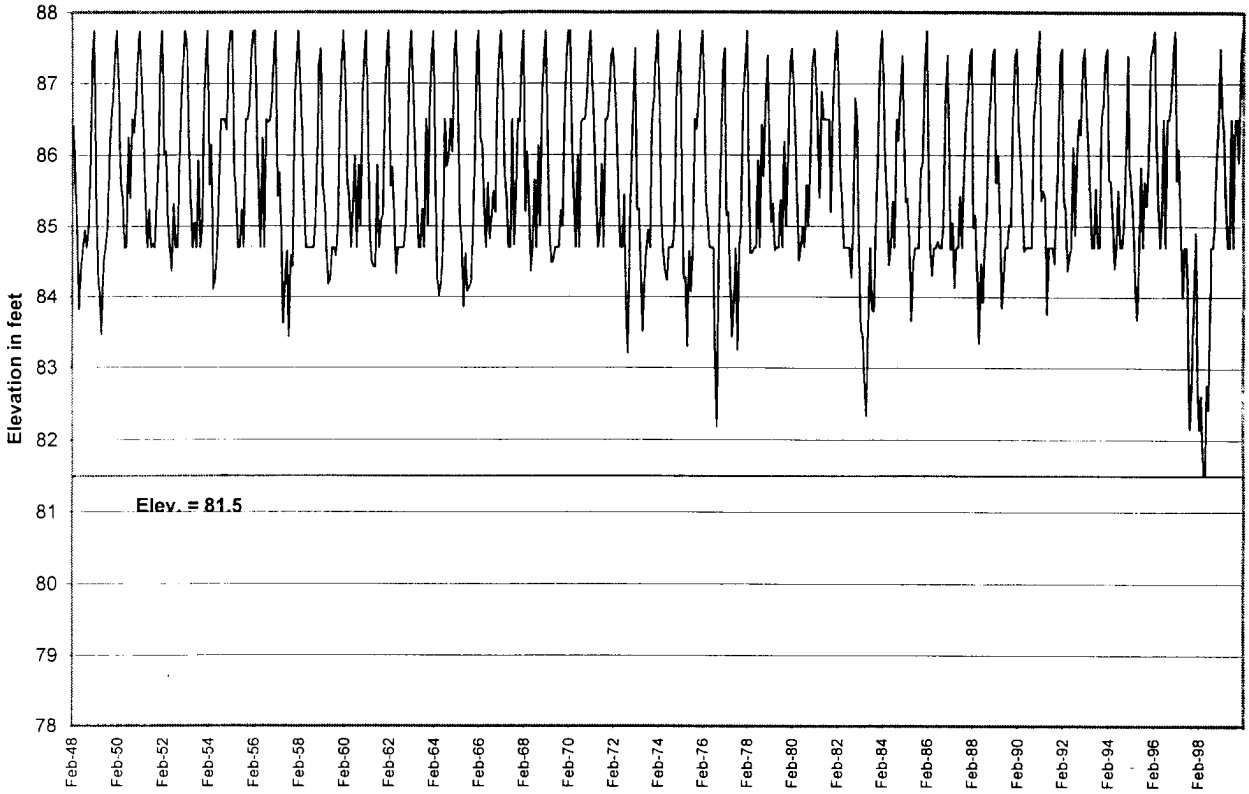

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Figure 8
Option 8: Toabre 95-50 + Indio 45-40
Total Demand = 56.7 locks/day

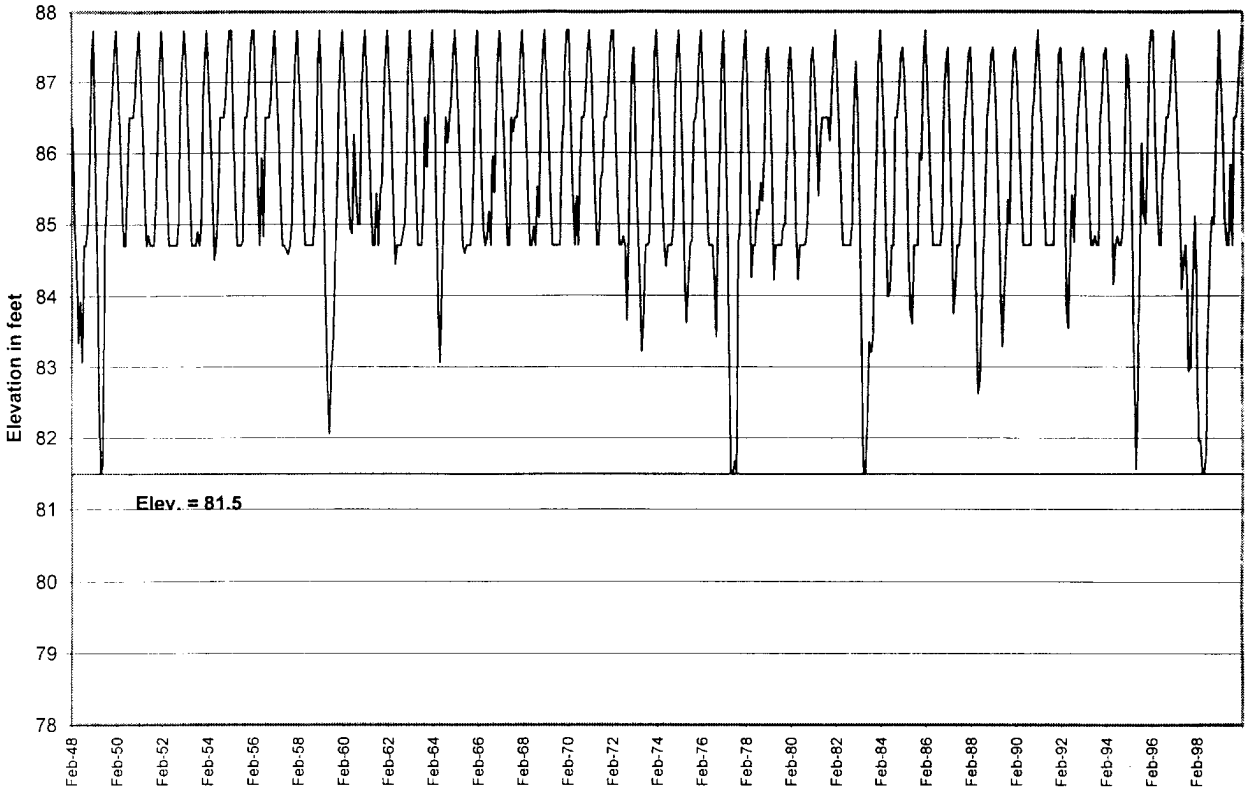

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Figure 9
Option 9: Toabre 100-90 + Caño Sucio 100-90 + Indio 80-40
Total Demand = 56.7 locks/day

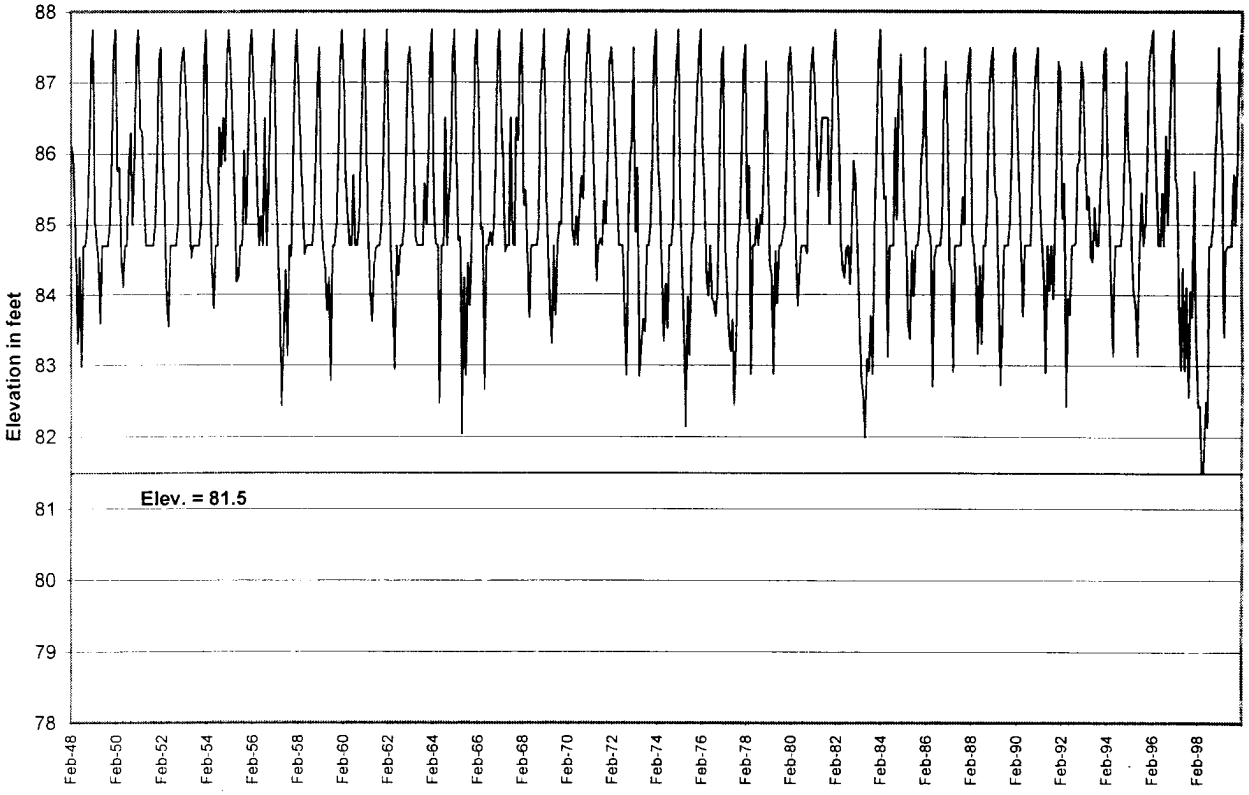

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Figure 10
Option 10: Toabre 100-90 + Caño Sucio 100-90 + Indio 45-40
Total Demand = 56.7 locks/day

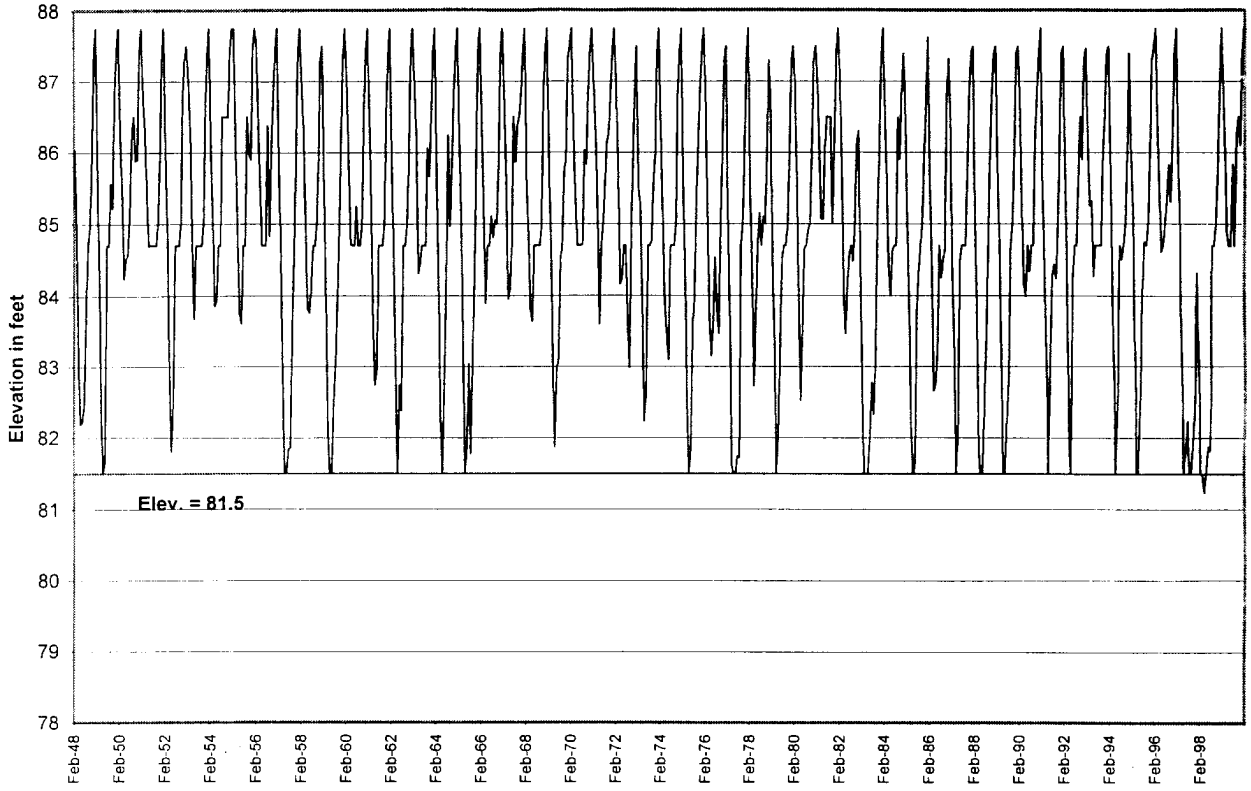

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Figure 11
Option 11: Teria
Total Demand = 56.7 locks/day

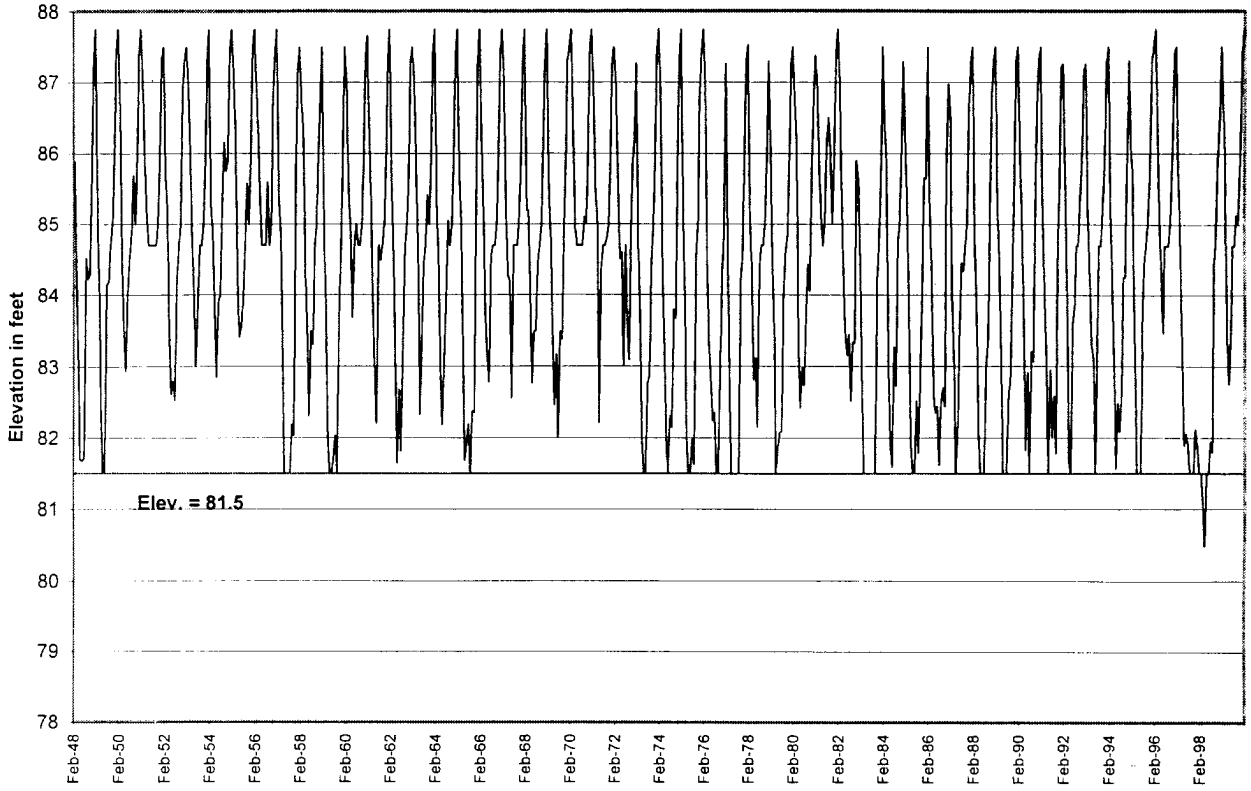

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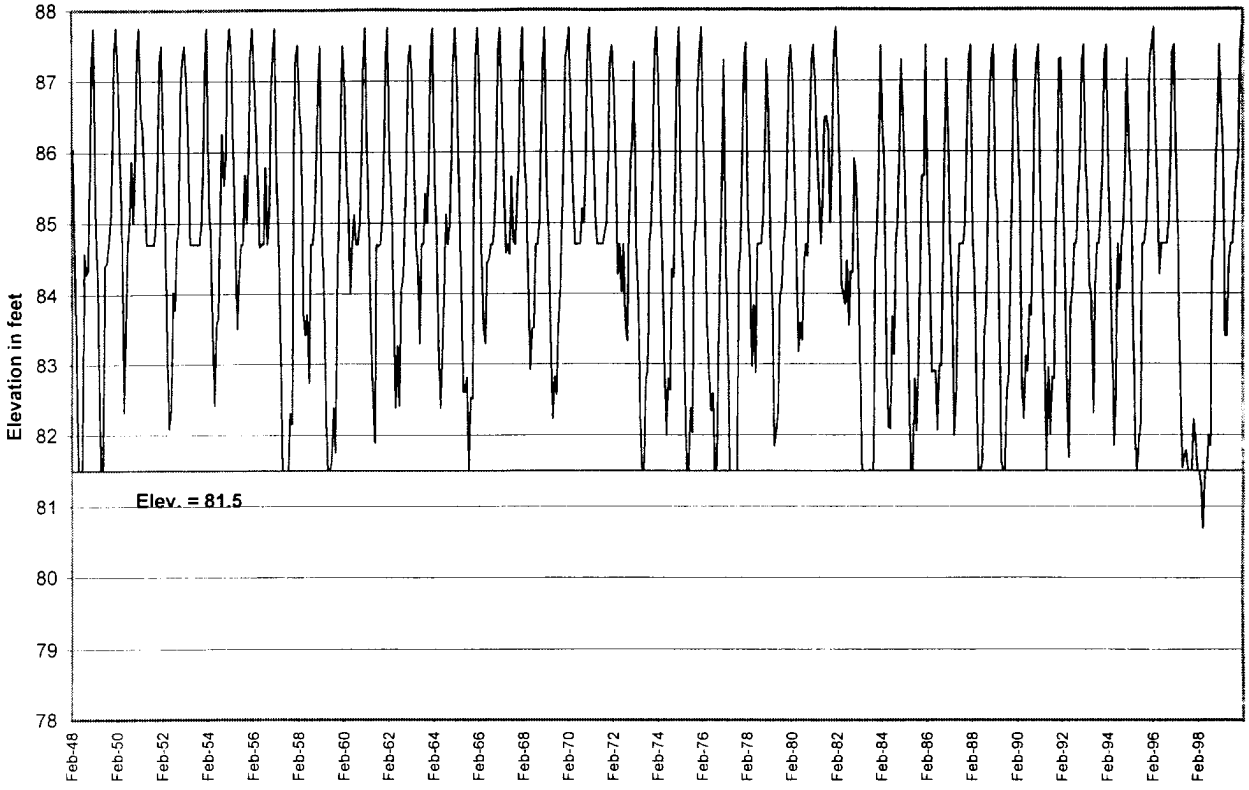
Figure 12
Option 11: Teria + Cabecera Indio
Total Demand = 56.7 locks/day



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ANNEX 3

Table No.1

Insects of Special Interes in the Indio River Watershed.

FAMILY		Ind	MA	VEE	SLE	SLE-FA	LEI	MAN	ONC	PL	TOR	CHA
Tabanidae												
	SPECIE											
	Catachlorps fulmineus	x										
	Chrysops calogaster	x										
	Chrysops melaenus	x								x		
	Chrysops nexosus	x										
	Chrysops variegatus	x										
	Dichelacera fasciata	x								x		
	Dichelacera hartmanni	x										
	Esenbeckia prasiniventris	x										
	Fifena flavipennis	x										
	Leucotabanus exaestuans	x										
	Philipotabanus magnificus	x										
	Philipotabanus nigrinubilus	x										
	Poeciloderas quadripunctatus	x										
	Stibasoma flaviventre	x										
	Tabanus albocirculus	x										
	Tabanus occidentalis	x										
	Tabanus punctipleura	x										
	Tabanus pungens	x										
	Tabanus surifer	x								x		
	Tabanus unistriatus	x										
Culicidae												
	Aedes fulvus											
	Aedes septentriatus	x										
	Aedes taeniorhynchus	x										
	Anopheles albimanus		x									
	Anopheles punctimacula	x	x									
	Anopheles seudopuntipennis	x	x									
Culicidae												
	Coquillettidia venezuelensis	x										
	Culex coronator	x										
	Culex nigripalpus				x							
	Culex vomerifer	x										
	Culex(Melanoconium) sp	x										
	Haemagogus iridicoler	x										
	Limatus assuleptus											
	Mansonia dyari			x								
	Psorophora ferox	x										
	Psorophora lineata											
	Sabethes clhropterus	x				x						
	Sabethes undosus	x										

Table No.1

Insects of Special Interes in the Indio River Watershed.

FAMILY		Ind	MA	VEE	SLE	SLE-FA	LEI	MAN	ONC	PL	TOR	CHA
Psychodidae												
	Lutzomyia adydifera	x										
	Lutzomyia camposi	x										
	Lutzomyia carpenteri	x										
	Lutzomyia gomezi	x					x					
	Lutzomyia harmanni	x										
	Lutzomyia olmeca						x					
	Lutzomyia panamensis	x					x					
	Lutzomyia sanguinaria	x					x					
	Lutzomyia shannoni	x										
	Lutzomyia trapidoi	x					x					
	Lutzomyia triramula	x										
	Lutzomyia vespertilionis	x										
	Lutzomyia vlephiletor	x					x					
Ceratopogónidos												
	Culicoides furens	x						x				
	Culicoides insignis	x										
Simuliidae												
	Simulium sanguineum	x	x					x				
	Simulium metallicum	x							x			
	Simulium mexicanum	x										
	Simulium ochraceum	x										
	Simulium quadrivittatum	x							x			
Triatominae												
	Panstrongylus geniculatus	x							x			x
	Panstrongylus humeralis	x										x
	Panstrongylus rufotuberculatus	x										x
	Rhodnius pallescens	x										x
Oestridae												
	Dermatobia hominis	x									x	

MA: Malaria

VEE: equine Venezuelan encephalitis

SLE: San Luis encephalitis

SLE/FA: encephalitis

LEI: Leishmaniasis

Source: Louis Berger, 2003.

Table No.2

List of Fishes distribuited for Hydric Systems in the Indio River Watershed

Family/Génera		Specie	SHBCL	SHBCR	SHA	SHE	Ind
Aplocheilidae							
	Rivulus	*sp.*	x		x		x
Atherinidae							
	Atherinella	*chagresi*				x	x
Characidae							
	Astyanax	*aeneus*	x		x	x	x
	Brycon	*chagrensis*	x		x	x	x
	Bryconamericus	*emperador*	x	x	x	x	x
	Compsura	*mitoptera*	x	x		x	x
	Gephyrocharax	*intermedius*	x				x
	Hyphessobrycon	*panamensis*	x	x	x		x
	Roeboides	*guatemalen*	x			x	x
Cichlidae							
	Aequidens	*coeruleopur*	x	x	x	x	x
	Vieja	*maculicauda*		x		x	x
Engraulidae							
Eleotridae							
	Eleotris	*amblyopsis*		x		x	x
	Eleotris	*pisonis*	x	x		x	x
	Gobiomorus	*dormitor*	x	x		x	x
Gobiidae							
	Awaous	*banana*	x	x			x
	Gobionellus	*sp.*		x		x	x
	Sicydium	*altum*	x	x	x	x	x
Haemulidae							
	Pomadasys	*crocro*	x	x			x
Lebiasinidae							
	Piabucina	*panamensis*	x		x		x
Loricariidae							
	Leptoancistrus	*canensis*			x		x
	Rineloricaria	*uracantha*	x				x
Mugilidae							
	Agonostomus	*monticola*	x	x	x	x	x
Pimelodidae							
	Rhamdia	*laticauda*			x		x
	Rhamdia	*quelen*			x		x
Poeciliidae							
	Brachyrhaphis	*cascajalens*	x	x		x	x
	Brachyrhaphis	*episcopi*	x				x
	Brachyrhaphis	*roswithae*	x	x	x	x	x
	Poecilia	*gillii*	x	x	x	x	x
Rhamphichthyidae							
	Brachyhypopomus	*occidentalis*	x	x	x		x
Syngnathidae							
	Pseudophallus	*mindii*				x	x
	Microphis	*brachyurus*		x		x	x
Trichomycteridae							
	Trichomycterus	*striatus*	x	x	x		x

Source: Louis Berger, 2003.

Table No. 3

Amphibians and Reptiles by Categories of Habitat, Activity and mode of Detection in the Indio River Watershed

Order /Classe	Family	Specie	Habitat Category	Micro Habitat	Period of Activity	Site of Reprod.	Mode of Detection	Indio
CLASS AMPHIBIA								
ORDER ANURA	BUFONIDAE	*Bufo coniferus*	B	Ts,Mq	N	Qu	V,A	x
		Bufo haematiticus	B	Ts,Mq	D,N	Qu	V,A	x
		Bufo marinus	AB	Ts,Ch,Mq	N	Qu	V,A	x
		Bufo typhonius	B	Ts,Mq,Ch	D	Qu	V,A	x
	CENTROLENIDAE	*Centrolene prosoblepon*	B	Aa,Mq	N	Qu	V,A	x
		Cochranella albomaculata	B	Aa, Mq	N	Qu	V,A	x
		Cochranella granulosa	B	Aa,Mq	N	Qu	V,A	x
		Cochranella spinosa	B	Aa,Mq	N	Qu	V,A	x
		Hyalinobatrachium colymbiphyllum	B	Aa,Mq	N	Qu	V,A	
		Hyalinobatrachium fleischmanni	B	Aa,Mq	N	Qu	V,A	x
		Hyalinobatrachium pulveratum	B	Aa,Mq	N	Qu	V,A	x
		Hyalinobatrachium vireovittatum	B	Aa,Mq	N	Qu	V,A	x
	DENDROBATIDAE	*Colostethus flotator*	B	Ts	D	Qu*	V,A	x
		Colostethus inguinalis	B	Ts,Mq	D	Qu*	V,A	x
		Colostethus nubicola	B	Ts	D	Qu*	V,A	x
		Colostethus pratti	B	Ts	D	Qu*	V,A	x
		Colostethus talamancae	B	Ts	D	Qu*	V,A	x
		Dendrobates minutus	B	Ts	D	Aca*,Ac*?	V,E	x
		Phyllobates lugubris	B	Ts,Mq	D	Ac*	V,A	x
	HYLIDAE	*Agalychnis callidryas*	AB	Aa,Ah,Ch	N	Po	V,A,I	x
		Gastrotheca cornuta	B	Aa, Mq	N	Ma	V,A	x
		Hyla crepitans	A	Ah,Ts,Ch	N	Po	V,A	x
		Hyla ebraccata	AB	Ah,Ch	N	Po	V,A	x
		Hyla microcephala	A	Ah,Ch	N	Po	V,A	x
		Hyla palmeri	B	Aa, Mq	N	Qu	V,A	x
		Hyla phlebodes	AB	Ah,Ch	N	Po	V,A	x
		Hyla rufitela	B	Aa,Mq	N	Po,Qu	V,A	x
		Phrynohyas venulosa	AB	Aa,Ch,Mq	N	PO	F,A	x
		Scinax boulengeri	A	Ah,Aa,Ch	N	Po	V,A	x
		Scinax rostrata	A	Ah,Aa,Ch	N	Po	V,A	x
		Scinax rubra	A	Ah, Ch	N	Po	V,A,E	x
		Smilisca phaeota	AB	Ah,Ch	N	Po	V,A	x
		Smilisca sila	B	Ah,Mq	N	Qu	V,A,E	x
	LEPTODACTYLIDAE	*Eleutherodactylus bransfordii*	B	Ts	D	Te	V	x
		Eleutherodactylus bufoniformis	B	Ts,Mq	N	Te	V	x

Table No. 3

Amphibians and Reptiles by Categories of Habitat, Activity and mode of Detection in the Indio River Watershed

Order /Classe	Family	Specie	Habitat Category	Micro Habitat	Period of Activity	Site of Reprod.	Mode of Detection	Indio
ORDER ANURA	LEPTODACTYLIDAE	*Eleutherodactylus caryophyllaceus*	B	Aa,Ts?	N	Ar	V	x
		Eleutherodactylus cerasinus	B	Ts,Aa	N	Te	V	x
		Eleutherodactylus crassidigitus	B	Ts	N	Te	V	x
		Eleutherodactylus cruentus	B	Ts,Aa	N	Te,Ar	V	x
		Eleutherodactylus diastema	AB	Aa	N	Ar	V,A	x
		Eleutherodactylus fitzingeri	B	Ts,Aa	N	Te	V,A	x
		Eleutherodactylus gaigei	B	Ts,Mq	N	Te	V	x
		Eleutherodactylus gollmeri	B	Ts	D?	Te	V	x
		Eleutherodactylus grupo *diastema*	AB	Aa	N	Ar?	V,A	x
		Eleutherodactylus megacephalus	B	Ts,Mq	D,N	Te	V	x
		Eleutherodactylus museosus	B	Aa	N	Ar?	V	x
		Eleutherodactylus pardalis	B	Aa	N	Ar?	V	x
		Eleutherodactylus punctariolus	B	Ts,Mq	N	Te	V	x
		Eleutherodactylus ridens	B	Ts,Aa	N	Te?,Ar?	V,A	x
		Eleutherodactylus taeniatus	B	Aa,Ts	N	Ar?,Te?	V,A	x
		Eleutherodactylus talamancae	B	Ts,Aa	N	Te	V	x
		Eleutherodactylus vocator (TA)	B	Ts,Aa	N	Te?,Ar?	V,A	x
		Eleutherodactylus vocator (TB)	B	Ts	D	Te?	V,A	x
		Leptodactylus insularum	A	Ts,Ch	N	Po	V,A	x
		Leptodactylus labialis	A	Ts,Ch	N,D	Po	V,A	x
		Leptodactylus melanonotus	AB	Ts,Ch,Mq	N,D	Po,Qu	V,A	x
		Leptodactylus pentadactylus	AB	Ts,Ch,Mq	N	Po,Qu	V,A	x

Table No. 3

Amphibians and Reptiles by Categories of Habitat, Activity and mode of Detection in the Indio River Watershed

Order /Classe	Family	Specie	Habitat Category	Micro Habitat	Period of Activity	Site of Reprod.	Mode of Detection	Indio
ORDER ANURA	LEPTODACTYLIDAE	*Leptodactylus poecilochilus*	AB	Ts,Ch	N	Po	V,A	x
		Physalaemus pustulosus	AB	Ts,Ch,Mq	N,D	Po,Qu	V,A	x
	MICROHYLIDAE	*Chiamocleis panamensis*						x
	RANIDAE	*Rana vaillanti*	AB	Ts,Ch,Mq	N	Po,Qu	V,A	x
		Rana warszewitschii	B	Ts,Mq	D	Qu	V,E	x
ORDER CAUDATA	PLETHODONTIDAE	*Bolitoglossa biseriata*	B	Aa	N	Te	V,E	x
		Bolitoglossa schizodactyla	B	Aa	N	Te	V	x
		Oedipina collaris	B	Ts,Mq,Tm?	N	Te	V	x
		Oedipina parvipes	B	Ts,Tm?	N?	Te	V	x
ORDER CROCODYLIA	ALLIGATORIDAE	*Caiman crocodilus*	AB	Sa	N,D	Nm	V,I	x
ORDER SQUAMATA	CORYTOPHANIDAE	*Basiliscus basiliscus*	B	Ts,Aa,Mq	D	Te	V	x
		Corytophanes cristatus	B	Aa	D	Te	V	x
	GEKKONIDAE	*Gonatodes albogularis*	ABR	Aa,Ts,Zh	D	Ed,Ar	V	x
		Hemidactylus frenatus	R	Zh	N	Ed	V,A	x
		Lepidoblepharis xanthostigma	B	Ts	D	Te	V	x
		Sphaerodactylus lineolatus						x
	GYMNOPHTHALMIDAE	*Leposoma southi*	B	Ts	D	Te	V	x
	IGUANIDAE	*Iguana iguana*	AB	Aa,Ts	D	Te	V,I	x
	POLYCHROTIDAE	*Anolis auratus*	A	Ah	D	Te	V,I	x
		Anolis capito	B	Ts	D	Te	V,T	x
		Anolis frenatus	B	Aa	D	Ar?	V,I	x
		Anolis humilis	B	Ts	D	Te	V,E	x
		Anolis limifrons	AB	Ts,Aa	D	Te	V,T	x
		Anolis lionotus	B	Ts,Mq	D	Te	V,E	x
		Anolis vittigerus	AB	Aa	D	Ar	V,E	x
	SCINCIDAE	*Mabuya unimarginata*	AR	Ts	D	Vi	V	x
	TEIIDAE	*Ameiva ameiva*	A	Ts	D	Te	V	x
		Ameiva festiva	B	Ts	D	Te	V,T	x
		Ameiva leptophrys	B	Ts	D	Te	V,T	x
SUBORDER SERPENTES	BOIDAE	*Corallus annulatus*	B	Aa	N	Vi	V	
	COLUBRIDAE	*Dryadophis melanolomus*	AB	Ts,Ah	D	Te	V	x
		Imantodes cenchoa	B	Aa	N	Ar?	V,I	x
		Leptodeira annulata	AB	Ts	N	Te	V	x
		Leptophis ahaetula	B	Aa,Ts	D	Ar	V,F	x
		Sibon nebulatus	B	Aa	N	Ar?	V	x
		Spilotes pullatus	B	Ts,Aa	D	Te,Ar?	V,I	x
		Urotheca euryzona	B	Ts	N	Te	V	x

Table No. 3

Amphibians and Reptiles by Categories of Habitat, Activity and mode of Detection in the Indio River Watershed

Order /Classe	Family	Specie	Habitat Category	Micro Habitat	Period of Activity	Site of Reprod.	Mode of Detection	Indio
SUBORDER SERPENTES	COLUBRIDAE	*Urotheca fulviceps*	B	Ts	N,D	Te	V	x
		Xenodon rabdocephalus	AB	Ts	D	Te	V	x
	ELAPIDAE	*Micrurus mipartitus*	AB	Ts,Tm	N,D	Te	E	x
		Micrurus stewarti	AB	Ts,Tm	N	Te	V	x
	VIPERIDAE	*Bothrops asper*	AB	Ts	N,D	Vi	V,E,I	x
	KINOSTERNIDAE	*Kinosternon leucostomum*	SAB	Sa	N	Nm	V,T	x

A:open area, forest
B: Forest
R: humane housing
S: Aquatic or Semiaquat.
Ac:water accumulate

Aa: Arboreal
Ah: lower vegetation
Ch: Charcas
Sa: Aquatic to semiaquatic
Aca: tree accumulation
Tm:Terrestrial mining

Tm:Terrestrial soil/fallen leaves
Zh: Inhabited zones
D:Diurnal; N:nocturne
Ar:arboreal;Ed:buildings
Ma:eggs y larvs in purse
I:informant; Nm:nest near to water

Qu;quebrada
Po:l puddles
Te:terrestrial
Vi:vivipare
A:acustic
E:specimen

F:foto
T:traps
V:visual

Source: Louis Berge, 2003.

Table No. 4

List of Amphibians and Reptiles of Special Interest in the Indio River Watershed.

Class	Family	Genera	Specie	VU	EP	END	IC	AM	CITES	PH	CO	Indio
Amphibia												
	Bufonidae	*Bufo*	*marinus*				x				x	1
	Caeciliidae	*Oscaecilia*	*ochrocephala*		x							1
	Centrolenidae	*Centrolene*	*ilex*	x			x	x				1
		Centrolene	*prosoblepon*				x					1
		Cochranella	*albomaculata*				x					1
		Cochranella	*granulosa*				x	x				1
		Cochranella	*spinosa*				x					1
		Hyalinobatrachium	*vireovittatum*	x	x		x					1
		Hyalinobatrachium	*pulveratum*	x			x					1
	Dendrobatidae	*Dendrobates*	*minutus*		x				II			1
		Phyllobates	*lugubris*									1
	Hylidae	*Gastrotheca*	*cornuta*					x				1
	Leptodactylidae	*Eleutherodactylus*	*caryophyllaceus*			x		x	II			1
		Eleutherodactylus	*cerasinus*					x				1
		Eleutherodactylus	*diastema*				x					1
		Eleutherodactylus	*gaigei*					x				1
		Eleutherodactylus	grupo *diastema*		x		x	x	II			1
		Eleutherodactylus	*museosus*		x	x						1
		Eleutherodactylus	*pardalis*	x				x				1
		Eleutherodactylus	*punctariolus*			x						1
		Eleutherodactylus	*vocator* (de tierras altas)				x					1
		Eleutherodactylus	*vocator* (de tierras bajas)				x					1
		Leptodactylus	*insularum*					x				1
		Leptodactylus	*pentadactylus*								x	1
	Plethodontidae	*Bolitoglossa*	*biseriata*	x								1
		Bolitoglossa	*schizodactyla*	x	x							1
		Oedipina	*collaris*		x							1

Table No. 4
List of Amphibians and Reptiles of Special Interest in the Indio River Watershed.

Class	Family	Genera	Specie	VU	EP	END	IC	AM	CITES	PH	CO	Indio
Amphibia	**Ranidae**	*Rana*	*vaillanti*								x	1
Reptilia	**Alligatoridae**	*Caiman*	*crocodilus*					x			x	1
	Anguidae	*Diploglossus*	*monotropis*	x								1
	Colubridae	*Leptodeira*	*annulata*					x				1
		Sibon	*argus*		x							1
		Urotheca	*euryzona*									1
		Urotheca	*fulviceps*		x		x					1
		Xenodon	*rabdocephalus*	x								1
	Corytophanidae	*Basiliscus*	*basiliscus*								x	1
	Elapidae	*Micrurus*	*stewarti*		x	x				x		1
		Micrurus	*mipartitus*							x		1
	Gekkonidae	*Hemidactylus*	*frenatus*									1
	Gymnophthalmidae	*Leposoma*	*southi*					x				1
	Iguanidae	*Iguana*	*iguana*		x				II			1
	Polychrotidae	*Anolis*	*lionotus*		x	x		x				1
		Anolis	*vittigerus*					x				1
	Teiidae	*Ameiva*	*leptophrys*					x				1
	Viperidae	*Bothrops*	*asper*							x		1

VU: Vulnerable
EP: Endangered
END: Endemic
IC:Scientific Interes
AM: Treathened
CITES II: Appendix 2 of species no listed how endangered
PH: Endangered to the man
CO: Edible

Source: Louis Berger, 2003.

Table No. 5 General list of Birds Reported in the Rio Indio River Watershed

Order	Family	Specie	AIE	AIG	Indio
Apodiformes	Apodidae	*Chaetura spinicauda*	*	*	x
		Streptoprocne zonaris	*	*	x
	Trochilidae	*Amazilia amabilis*	*		x
		Amazilia tzacatl	*	*	x
		Anthracothorax nigricollis	*	*	x
		Chalybura buffoni	*	*	x
		Chalybura urochrysia	*	*	x
		Chlorostilbon assimilis	*	*	x
		Damophila julie	*	*	x
		Eutoxeres aquila	*	*	x
		Florisuga mellivora	*	*	x
		Glaucis hirsuta	*	*	x
		Heliodoxa jacula		*	x
		Phaethornis guy	*	*	x
		Phaethornis longuemareus	*	*	x
		Phaethornis superciliosus	*	*	x
		Thalurania colombica	*	*	x
		Threnetes ruckeri	*	*	x
	Jacanidae	*Jacana jacana*	*		x
Ciconiiformes	Ardeidae	*Ardea alba*	*		x
		Bubulcus ibis	*	*	x
		Egretta caerulea	*	*	x
		Egretta thula	*		x
	Cathartidae	*Cathartes aura*	*	*	x
		Coragyps atratus	*	*	x
Columbiformes	Columbidae	*Columba livia*	*		x
		Columba nigrirostris	*	*	x
		Columba speciosa	*	*	x
		Columba subvinacea		*	x
		Columbina talpacoti	*	*	x
		Geotrygon chiriquensis		*	x
		Geotrygon montana	*	*	x
		Leptotila cassini	*	*	x
		Leptotila verreauxi	*	*	x
Coraciiformes	Alcedinidae	*Ceryle torquata*	*	*	x
	Bucconidae	*Malacoptila panamensis*	*	*	x
		Nonnula ruficapilla	*		x
		Notharchus pectoralis	*		x
		Nystalus radiatus	*	*	x
	Momotidae	*Baryphthengus martii*	*	*	x
		Electron platyrhynchum	*	*	x
		Momotus momota	*		x
	Picidae	*Campephilus melanoleucos*	*		x
		Dryocopus lineatus	*	*	x
		Melanerpes pucherani	*	*	x
		Melanerpes rubricapillus	*	*	x

Table No. 5 General list of Birds Reported in the Rio Indio River Watershed

Order	Family	Specie	AIE	AIG	Indio
Coraciiformes	Ramphastidae	*Aulacorhynchus prasinus*		*	x
		Capito maculicoronatus	*	*	x
		Pteroglossus torquatus	*	*	x
		Ramphastus sulfuratus	*	*	x
		Selenedeira spectabilis		*	x
Cuculiformes	Cuculidae	*Crotophaga ani*	*	*	x
		Crotophaga major	*	*	x
		Piaya cayana	*	*	x
		Tapera naevia	*	*	x
Falconiformes	Accipitridae	*Elanoides forficatus*	*	*	x
		Harpagus bidentatus	*	*	x
		Ictinia plumbea	*		x
		Leucopternis albicollis		*	x
		Leucopternis plumbea	*		x
		Spizaetus tyrannus	*		x
	Falconidae	*Caracara plancus*			x
		Micrastur ruficollis	*	*	x
		Milvago chimachima	*	*	x
Galliformes	Cracidae	*Chamaepetes unicolor*		*	x
		Ortalis cinereiceps	*	*	x
Gruiformes	Rallidae	*Aramides cajanea*	*	*	x
Passeriformes	Cardinalidae	*Caryothraustes poliogaster*	*		
		Cyanocompsa cyanoides	*	*	x
		Saltator albicollis		*	x
		Saltator atriceps	*	*	x
		Saltator maximus	*	*	x
		Saltator striatipectus	*	*	x
	Coerebidae	*Coereba flaveola*	*	*	x
	Corvidae	*Cyanocorax affinis*	*	*	x
	Cotingidae	*Querula purpurata*	*	*	x
	Dendrocolaptidae	*Dendrocincla fuliginosa*	*	*	x
		Glyphorynchus spirurus	*	*	x
		Sittasomus griseicapillus	*	*	
		Xiphorhynchus susurrans	*	*	x
	Emberizidae	*Arremon aurantiirostris*	*	*	x
		Arremonops conirostris	*	*	x
		Oryzoborus funereus	*	*	x
		Sporophila americana	*	*	x
		Sporophila nigricollis		*	x
		Volatinia jacarina	*	*	x
	Formicariidae	*Formicarius analis*	*	*	x
	Furnariidae	*Automolus ochrolaemus*	*	*	x
		Xenops minutus	*	*	x
		Xenops rutilans		*	x
	Hirundinidae	*Hirundo rustica*		*	x
		Pygochelidon tibialis		*	x

Table No. 5 General list of Birds Reported in the Rio Indio River Watershed

Order	Family	Specie	AIE	AIG	Indio
Passeriformes	Hirundinidae	*Stelgidopteryx ruficollis*	*	*	x
	Icteridae	*Amblycercus holosericeus*	*	*	x
		Cacicus cela	*	*	x
		Cacicus uropygialis	*	*	x
		Icterus chrysater	*	*	x
		Psarocolius wagleri	*	*	x
		Scaphidura oryzivora	*		x
	Parulidae	*Basileuterus fulvicauda*	*	*	x
		Basileuterus rufiforns	*	*	x
		Dendroica castanea	*	*	x
		Dendroica pensylvanica	*	*	x
		Dendroica petechia	*	*	x
		Geothlypis trichas			
		Mniotilta varia	*	*	x
		Oporornis agilis	*		x
		Oporornis formosus	*	*	x
		Oporornis philadelphia		*	x
		Protonotaria citrea		*	x
		Seiurus motacilla	*	*	x
		Seiurus novaboracensis	*	*	x
		Vermivora chrysoptera		*	x
		Vermivora peregrina	*	*	x
		Wilsonia citrina		*	x
	Pipridae	*Corapipo altera*	*	*	x
		Manacus vitellinus	*	*	x
		Pipra mentalis	*	*	x
	Sylviidae	*Microbates cinereiventris*	*	*	x
		Ramphocaenus melanurus	*	*	x
	Thamnophilidae	*Cercomacra nigricans*	*		x
		Cercomacra tyrannina	*	*	x
		Cymbilaimus lineatus	*	*	x
		Dysithamnus mentalis	*	*	x
		Gymnopithys leucaspis	*	*	x
		Hylophylax naevioides	*	*	x
		Microrhopias quixensis	*	*	x
		Myrmeciza exsul	*	*	x
		Myrmeciza longipes	*	*	x
		Myrmotherula axillaris	*	*	x
		Myrmotherula fulviventris	*	*	x
		Myrmotherula schisticolor		*	x
		Thamnophilus atrinucha	*	*	x
		Thamnophilus doliatus		*	x
		Taraba major	*	*	x
	Thraupidae	*Chlorophanes spiza*	*	*	x
		Cyanerpes cyaneus	*	*	x
		Dacnis cayana	*	*	x
		Euphonia anneae	*	*	x

Table No. 5 General list of Birds Reported in the Rio Indio River Watershed

Order	Family	Specie	AIE	AIG	Indio
Passeriformes	Thraupidae	*Euphonia laniirostris*	*	*	x
		Euphonia luteicapilla	*	*	x
		Habia fuscicauda	*	*	x
		Habia rubica		*	x
		Mitrospingus cassinii	*	*	x
		Piranga flava		*	x
		Piranga rubra	*	*	x
		Ramphocelus dimidiatus	*	*	x
		Ramphocelus flammigerus	*	*	x
		Tachyphonus delatrii	*	*	x
		Tachyphonus luctuosus	*	*	x
		Tangara florida		*	x
		Tangara gyrola		*	x
		Tangara inornata	*	*	x
		Tangara larvata	*	*	x
		Thraupis episcopus	*	*	x
		Thraupis palmarum	*	*	x
	Troglodytidae	*Campylorhynchus albobrunneus*	*		x
		Cyphorhinus phaeocephalus	*	*	x
		Henicorhina leucosticta	*	*	x
		Microcerculus marginatus	*	*	x
		Thryothorus fasciatoventris	*	*	x
		Thryothorus leucotis		*	x
		Thryothorus modestus	*	*	x
		Thryothorus nigricapillus	*	*	x
		Troglodytes aedon	*	*	x
	Turdidae	*Catharus fuscater*	*		
		Catharus ustulatus	*	*	x
		Turdus grayi	*	*	x
	Tyrannidae	*Attila spadiceus*	*	*	x
		Camptostoma obsoletum	*	*	x
		Capsiempis flaveola		*	x
		Cnipodectes subbrunneus	*	*	x
		Colonia colonus	*	*	x
		Contopus cinereus	*	*	x
		Contopus virens	*	*	x
		Elaenia chiriquensis		*	x
		Elaenia flavogaster	*	*	x
		Elaenia frantzii		*	x
		Empidonax flaviventris		*	x
		Empidonax traillii		*	x
		Empidonax virescens	*	*	x
		Lophotriccus pileatus		*	x
		Mionectes oleagineus	*	*	x
		Mionectes olivaceus	*	*	x
		Myiarchus crinitus	*	*	x

Table No. 5 General list of Birds Reported in the Rio Indio River Watershed

Order	Family	Specie	AIE	AIG	Indio
Passeriformes	Tyrannidae	*Myiarchus panamensis*	*		x
		Myiarchus tuberculifer		*	x
		Myiobius atricaudus	*	*	x
		Myiodynastes maculatus	*	*	x
		Myiozetetes cayanensis	*		x
		Myiozetetes similis	*	*	x
		Oncostoma olivaceum	*	*	x
		Onychorhynchus coronatus	*	*	x
		Ornithion brunneicapillum	*		x
		Pachyramphus albogriseus			x
		Pachyramphus cinnamomeus	*	*	x
		Pitangus sulphuratus	*	*	x
		Platyrinchus mystaceus	*	*	x
		Rhynchocyclus olivaceus	*	*	x
		Schiffornis turdinus		*	x
		Terenotriccus erythrurus	*	*	x
		Tityra semifasciata	*	*	x
		Todirostrum cinereum	*	*	x
		Tyrannus elatus	*	*	x
		Tyrannus melancholicus	*	*	x
		Zimmerius vilissimus	*	*	x
	Vireonidae	*Hylophilus decurtatus*	*	*	x
		Hylophilus flavipes	*	*	x
		Vireo flavifrons		*	x
		Vireo flavoviridis	*	*	x
Psittaciformes	Psittacidae	*Amazona autumnalis*	*		x
		Amazona ochrocephala	*	*	x
		Brotogeris jugularis	*	*	x
		Pionus menstruus	*	*	x
Strigiformes	Caprimulgidae	*Nyctidromus albicollis*	*	*	x
	Strigidae	*Ciccaba virgata*	*	*	x
	Nyctiibidae	*Nyctibius griseus*	*	*	x
Tinamiformes	Tinamidae	*Crypturellus soui*	*	*	x
		Tinamus major	*	*	x
Trogoniformes	Trogonidae	*Trogon aurantiventris*		*	x
		Trogon clathratus	*	*	x
		Trogon massena	*	*	x
		Trogon rufus	*	*	x
		Trogon violaceus	*		x
		Trogon viridis	*	*	x

AIE: Specific Interes Area
AIG: Interes General Area

Source: Louis Berger. 2003.

Table No.6
Species of Birds of special Interest in the Indio River Watershed.

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Indio
Apodiformes								
	Trochilidae							
	Amazilia amabilis			II				x
	Amazilia edward		V	II				x
	Amazilia tzacatl			II				x
	Anthracothorax nigricollis			II				x
	Chalybura buffoni			II				x
	Chalybura urochrysia			II	N3			x
	Chlorostilbon assimilis		V	II				x
	Damophila julie			II	N3			x
	Eutoxeres aquila			II	N3			x
	Florisuga mellivora			II				x
	Glaucis hirsuta			II				x
	Phaethornis guy			II				x
	Phaethornis longuemareus			II				x
	Phaethornis superciliosus			II				x
	Thalurania colombica			II				x
	Threnetes ruckeri			II				x
	Ardea alba			III				x
	Bubulcus ibis			III				x
	Egretta caerulea					r		x
	Cathartes aura			II		t,r(p)		x
	Coragyps atratus			II				x
Columbiformes								
	Bucconidae							
	Nonnula ruficapilla				N3			x
	Nothar chus pectoralis				N3			x
	Columbidae							
	Columba livia			III				x
	Columba nigrirostris	x						x
	Columba speciosa	x						x
	Columba subvinacea	x	V					x
	Geotrygon chiriquensis	x	V		N3			x
	Galbulidae							
	Jacamerops aurea				N3			
	Ramphastidae							
	Capito maculicoronatus		V					x
	Selenedeira spectabilis				N3			x
Falconiformes								
	Accipitridae							
	Buteo magnirostris			II				x
	Elanoides forficatus			II		t(p)		x
	Harpagus bidentatus			II				x
	Harpagus bidentatus			II				x
	Ictinia plumbea			II		i		x
	Spizaetus tyrannus			II				x
	Falconidae							
	Micrastur ruficollis			II				x
	Milvago chimachima			II				x

Table No.6
Species of Birds of special Interest in the Indio River Watershed.

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Indio
Galliformes								
	Cracidae							
	Chamaepetes unicolor	x	V		N2			x
	Ortalis cinereiceps	x			N3			x
Passeriformes								
	Cotingidae							
	Querula purpurata			II				x
	Dendrocolaptidae							
	Deconychura longicauda				N3			x
	Hirundinidae							
	Hirundo rustica					t		x
	Tachicyneta albilinea				N3			
	Icteridae							
	Icterus galbula					r		x
	Icterus spurius					r		x
	Parulidae							
	Basileuterus tristriatus				N3			
	Dendroica castanea					t,r		x
	Dendroica fusca					t,r		x
	Dendroica pensylvanica					r		x
	Dendroica petechia					t,r		x
	Geothlypis trichas					r	x	x
	Mniotilta varia					t,r		x
	Oporornis agilis					t	x	
	Oporornis formosus					r		x
	Oporornis philadelphia					t,r		x
	Vermivora peregrina					t,r		x
	Seiurus motacilla					t,r		x
	Seiurus novaboracensis					t,r		x
	Protonotaria citrea					t,r		x
	Pipridae							
	Corapipo altera				N3			x
	Sylviidae							
	Microbates cinereiventris				N3			x
	Turdidae							
	Catharus ustulatus					t,r		x
	Thamnophilidae							
	Cercomacra nigricans				N3			x
	Thraupidae							
	Dacnis venusta				N3			x
	Euphonia anneae		V					x
	Piranga rubra					t,r		x
	Tyrannidae							
	Contopus virens					t		x
	Empidonax traillii					t,r		x
	Empidonax virescens					t,r		x
	Myiarchus crinitus					r		x
	Oncostoma olivaceum		V					x
	Pachyramphus polychopterus				N2		x	x
	Vireo flavifrons					t,r		x

Table No.6

Species of Birds of special Interest in the Indio River Watershed.

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Indio
	Tyrannidae							
	Vireo flavoviridis					i		x
	Vireo olivaceus					t		x
Psittaciformes								
	Psittacidae							
	Amazona autumnalis			II				x
	Amazona ochrocephala	x	V	II	N3			x
	Brotogeris jugularis			II				x
	Pionus menstruus			II				x
Strigiformes								
	Strigidae							
	Ciccaba virgata			II				x
	Otus choliba			II				x
Tinamiformes								
	Tinamidae							
	Crypturellus soui	x						x
	Tinamus major	x						x
Trononiformes								
	Trogonidae							
	Trogon clathratus		V				x	x

V: Vulnerable

LP: Panamenian Laws

CITES: Appendices of the Convention on the International Commerce of Sspecies Threatened of Flora and Fauna.

TNC National: Species protected inside the country.

UICN National: Species protected inside the country.

N2, N3: Specie with Habitat of restringed distribution

t: Transitory species

r: Resident winter species

p: Migratory partial

i: Migratory Intertropical

Fuente: Louis Berger, 2003.

Tabla No.7
Species of Mammals Reported in the Indio River Watershed.

ORDER	FAMILY		Indio
DIDELPHIMORPHIA	DIDELPHIDAE	*Didelphis maursupialis*	PC
XENARTHRA	MYRMECOPHAGIDAE	*Tamandua mexicana*	R
	BRADYPODIDAE	*Bradypus variegatus*	PC
	DASYPODIDAE	*Dasypus novemcinctus*	C
CHIROPTERA			
	MORMOOPIDAE	*Pteronotus parnellii*	PC
	PHYLLOSTOMIDAE	*Artibeus hartii*	R
		Artibeus intermedius	R
		Artibeus jamaicensis	A,C,PC
		Artibeus lituratus	PC
		Artibeus phaeotis	PC
		Artibeus watsoni	R
		Carollia brevicauda	R
		Carollia castanea	PC,R
		Carollia perspicillata	PC,C
		Chiroderma salvini	R
		Desmodus rotundus	C
		Glossophaga commissarisi	PC,R
		Glossophaga soricina	R
		Lonchophylla robusta	R
		Phyllostomus discolor	R
		Phyllostomus hastatus	R
		Platyrrhinus helleri	PC,R
		Sturnira lilium	PC,R
		Tonatia brasiliense	R
		Tonatia silvicola	R
		Uroderma bilobatum	R
		Vampyressa pusilla	R
	MOLOSSIDAE	*Promops centralis*	R
PRIMATES	CALLITRICHIDAE	*Saguinus geoffroyi*	PC
	CEBIDAE	*Aotus lemurinus*	PC
RODENTIA	SCIURIDAE	*Sciurus variegatoides*	C
		Sciurus granatensis	C
		Microsciurus mimulus	R
	HETEROMYDAE	*Heteromys desmarestianus*	PC
	HYDROCHAERIDAE	*Hydrochaeris hydrochaeris*	R
	MURIDAE	*Oryzomys alfari*	R
		Melanomys caliginosus	R
		Rattus rattus	R
	ERETHIZONTIDAE	*Coendou rothschildi*	R
	AGOUTIDAE	*Agouti paca*	PC
	DASYPROCTIDAE	*Dasyprocta punctata*	PC
	ECHYIMIDAE	*Proechymis semispinosus*	C
CARNÍVORA			
	PROCYONIDAE	*Procyon lotor*	R
	MUSTELIDAE	*Conepatus semistriatus*	R
		Lontra longicaudis	R
	FELIDAE	*Puma concolor*	R
		Leopardus pardalis	PC
ARTIODCATYLA	TAYASSUIDAE	*Tayassu tajacu*	PC
	CERVIDAE	*Odocoileus virginianus*	R
		Mazama americana	

Source: Louis Berger, 2003.

- **R:Rare**
PC: Slightly common
C: Common
A: Abundant

Table No. 8
Species of Mammals of Special Interest in the Indio River Watershed

ORDER	FAMILY	SPECIE	Indio	EPL	CITES 1	CITES 2	EP	ISP	V	R	END
XENARTHRA											
	BRADYPODIDAE										
		Bradypus variegatus	x			x		x**			
	MYRMECOPHAGIDAE										
		Tamandua mexicana	x	x			x	x*			
	DASYPODIDAE										
		Dasypus novemcinctus	x	x					x		
CHIROPTERA											
	NOCTILIONIDAE										
		Noctilio albiventris	x								
	PHYLLOSTOMIDAE										
		Artibeus hartii	x							x	
		Chiroderma salvini	x							x	
		Desmodus rotundus	x					x***			
PRIMATES											
	CEBIDAE										
		Aotus lemurinus	x	x		x	x	x**			
	CALLITRICHIDAE										
		Saguinus geoffroyi	x	x	x		x	x**			
RODENTIA											
	ERETHIZONTIDAE										
		Coendou rothschildi	x						x		x
	AGOUTIDAE										
		Agouti paca	x	x				x			
	DASYPROCTIDAE										
		Dasyprocta punctata	x	x					x		
CARNÍVORA											
	PROCYONIDAE										
		Nasua narica	x						x		
		Procyon lotor	x	x					x		
CARNÍVORA											
	FELIDAE										
		Leopardus pardalis	x	x	x		x				
	MUSTELIDAE										
		Conepatus semistriatus	x						x		
		Lutra longicaudis	x		x		x				
ARTIODACTYLA											
	TAYASSIDAE										
		Tayassu tajacu	x						x		
	CERVIDAE										
		Odocoileus virginianus	x						x		

* Inn-keeper of the illness of chagas
** Inn-heeper of the illness of Leishmaniasis
***Bat hematophagus
EPL: Protected species by panamenian laws
CITES I y 2: Species listed in International conventions
EP: Endangered
ISP: Of importance to the public health
V: Vulnerable
R: Rare
END: Endemic

Source: Louis Berger, 2003.

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Acanthaceae													
	Blechum pyramidatum											x	x
	Justicia comata											x	x
	Odontonema tubaeforme												x
Amaranthaceae													
	Cyathula achyranthoides											x	
Amaryllidaceae													
	Pancratium littorale												x
Anacardiaceae													
	Anacardium excelsum											x	
	Anacardium occidentale											x	
	Mangifera indica											x	
	Mosquitoxylum jamaicense											x	
	Spondias mombin	Clavellín										x	
	Spondias purpurea												x
	Spondias radlkoferi												x
	Tapirira guianensis												x
Annonaceae													
	Annona montana	Guanábana de montaña									x		x
	Annona spraguei		x									x	x
	Guatteria amplifolia											x	
	Guatteria crispiflora	Negrito1										x	
	Xylopia frutescens											x	x
Apocynaceae													
	Aspidosperma spruceanum	Alcarreto colorado									x	x	x
	Couma macrocarpa	Pera de montaña									x	x	x
	Himatanthus articulataus	Calacuche									x		
	Mandevilla hirsuta											x	x
	Mandevilla villosa											x	x
	Plumeria pudica											x	
	Stemmadenia alfari	Suspiro										x	
	Stemmadenia macrophylla												x
	Tabernaemontana panamensis												x
Aquifoliaceae	*Ilex stellata*											x	
	Ilex yurumanguinis											x	

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
	Anthurium clavigerum										x		
	Anthurium friedrichsthalii											x	
	Anthurium lancifolium											x	
	Anthurium pentaphyllum										x		
	Anthurium scandens		x									x	
	Anthurium spathiphyllum											x	
	Anthurium trinerve											x	
Araceae	*Anthurium trisectum*											x	
	Anthurium trisectum												x
	Colocasia esculenta												x
	Dracontium sp.												x
	Homalomena wendlandii												x
	Philodendron inaequilaterum												x
	Philodendron radiatum												x
	Syngonium schottianum												
Araliaceae	*Dendropanax arboreus*	Harino blanco1									x	x	x
	Dendropanax latilobus	Harino blanco										x	
	Sciadodendron excelsum											x	
	Asterogyne martiana										x		
	Astrocaryum standleyanum										x		
	Attalea allenii										x		
	Attalea butyracea										x	x	
	Bactris hondurensis											x	
Arecaceae	*Chamaedorea pinnatifrons*											x	
	Euterpe precatoria	Palmito										x	
	Geonoma cuneata		x									x	
	Geonoma epetiolata											x	
	Iriartea deltoide	Palmito1											x
	Oenocarpus batatua		x									x	
	Socratea exorrhiza	Palma jira	x								x		x
	Welfia regia	Palma conga										x	x
Asclepiadaceae	*Asclepias curassavica*											x	x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Aspleniaceae													
	Asplenium auritum												x
	Asplenium maxonii										x		
	Asplenium serratum											x	x
Asteraceae													
	Austroeupatorium inulaefolium		x										x
	Clibadium grandifolium												x
	Clibadium pilonicum			x								x	
	Clibadium surinamense												x
	Elephantopus mollis											x	x
	Erechtites hieracifolia												x
	Melampodium costaricense											x	
	Mikania hookeriana												x
	Mikania micrantha											x	x
	Neurolaena lobata												x
	Rolandra fruticosa											x	x
	Schistocarpha eupatorioides												x
	Sphagneticola trilobata											x	
	Spiracantha cornifolia											x	
	Tilesia baccata											x	
	Verbesina gigantea											x	x
	Vernonanthura patens											x	x
	Wedelia calycina											x	
Begoniaceae													
	Begonia plebeja		x									x	
	Begonia urophylla												x
Bignoniaceae													
	Amphitecna sessilifolia											x	
	Jacaranda copaia											x	
	Tabebuia guayacan		x									x	
	Tabebuia rosea											x	
Bixaceae													
	Bixa orellana											x	x
Blechnaceae													
	Blechnum caudatum												x
	Blechnum occidentale											x	

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Blechnaceae	*Salpichlaena volubilis*										x	x	x
Bombacaceae													
	Ceiba pentandra											x	x
	Matisia exalata	Cacaillo		x	x							x	
	Pachira aquatica											x	
Boraginaceae													
	Cordia alliodora											x	
	Cordia lucidula	Laurel negro									x		x
	Cordia spinescens											x	x
	Heliotropium curassavicum											x	
Bromeliaceae													
	Aechmea magdalenae												x
	Guzmania calamifolia		x									x	
	Guzmania musaica		x									x	
	Ronnbergia explodens		x									x	
	Tillandsia punctulata												x
Burseraceae													
	Protium pittieri					x							x
	Trattinnickia aspera	Caraño									x		x
Calymperaceae													
	Syrrhopodon isthmi		x									x	
Caricaceae													
	Jacaratia costaricensis												x
Caryophyllaceae													
	Drymaria cordata												x
Cecropiaceae													
	Cecropia peltata												x
Celastraceae													
	Quetzalia occidentalis											x	
	Zinowiewia costaricensis							x				x	
Chlorantaceae													
	Hedyosmum bonplandianum	Palo de agua										x	
	Hirtella latifolia	Camaroncillo									x	x	
	Hirtella triandra											x	

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Chlorantaceae	*Licania arborea*	Rasca										x	
	Licania jefensis	Raspo											x
	Maranthes sp.												x
Clethraceae													
	Clethra coloradensis											x	
	Clethra lanata											x	
Clusiaceae													
	Calophyllum longifolium	María	x									x	
	Calophyllum nubicola	María			x							x	
	Chrysochlamys grandifolia											x	
	Chrysochlamys psychotriifolia										x		
	Clusia minor											x	
	Clusia uvitana												x
	Dystomovita paniculata											x	
	Garcinia intermedia	Cerillo						x				x	
	Garcinia madruno							x					x
	Marila laxiflora										x	x	x
	Symphonia globulifera	Cerillo	x								x	x	x
	Tovomita weddelliana											x	
	Tovomita longifolia	Copé									x	x	x
	Tovomita stylosa												x
	Tovomitopsis myrcioides											x	
	Vismia baccifera	Pinta mozo										x	x
	Vismia billbergiana												x
	Vismias jefensis			x									
	Vismia macrophylla												x
Combretaceae													
	Terminalia amazonia		x								x	x	x
Commelinaceae													
	Floscopa robusta												x
	Tripogandra serrulata											x	x
Connaraceae													
	Cnestidium rufescens											x	

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Convolvulaceae													
	Maripa panamensis											x	
Costaceae													
	Costus laevis												x
	Costus villosissimus											x	x
	Dimerocostus strobilaceus												x
Cucurbitaceae													
	Cayaponia glandulosa												x
	Cayaponia granatensis												x
	Cayaponia racemosa												x
	Gurania tubulosa												x
	Momordica charantia											x	
	Rytidostylis carthaginensis											x	x
Cyatheaceae													
	Alsophila cuspidata										x		
	Cyathea delgadii			x								x	
	Cyathea petiolata		x		x				x			x	
	Cyathea schiedeana												x
Cyclanthaceae													
	Carludovica drudei											x	x
	Carludovica palmata		x										x
	Cyclanthus bipartitus		x								x	x	x
Cyperaceae													
	Cyperus laxus											x	x
	Cyperus luzulae											x	x
	Cyperus tenuis											x	x
	Fimbristylis dichotoma												x
	Fimbristylis littoralis											x	
	Kyllinga pumila											x	
	Mapania assimilis										x		
	Rhynchospora argentea												x
	Rhynchospora cephalotes												x
	Rhynchospora nervosa											x	
	Rhynchospora nervosa												x
	Scleria melaleuca											x	x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Cyperaceae	*Scleria microcarpa*												x
	Torulinium odoratum											x	x
Cyrillaceae													
	Cyrilla racemiflora											x	
Davalliaceae													
	Nephrolepis exaltata												x
	Nephrolepis pendula												x
Dennstaedtiaceae													
	Hypolepis repens												x
	Pteridium caudatum												x
Dilleniaceae													
	Doliocarpus major											x	
Dioscoreaceae													
	Dioscorea standleyi					X						X	
Dryopteridaceae													
	Polybotrya caudata										x		x
Elaeocarpaceae													
	Sloanea stipitata	Carretillo										x	
Ericaceae													
	Disterigma trimerum											x	
Erythroxylaceae													
	Erythroxylum macrophyllum											x	x
Euphorbiaceae													
	Acalypha diversifolia											x	x
	Acalypha macrostachya												x
	Alchornea latifolia	Cacao de montaña									x		x
	Croton billbergianus											x	x
	Croton trinitatis											x	x
	Hura crepitans											x	
	Hyeronima alchorneoides	Vaquerillo									x	x	x
	Hyeronima oblonga	Guabo rosario										x	
	Mabea occidentalis	Cauchillo									x	x	x
	Phyllanthus acuminatus												x
	Phyllanthus urinaria											x	x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Euphorbiaceae													
	Richeria obovata											x	
Fabaceae													
	Albizzia niopoide											x	
	Andira inermis												x
	Desmodium adscendens											x	x
	Desmodium axillare											x	x
	Desmodium incanum											x	x
	Diphysa americana												x
	Erythrina fusca											x	
	Erythrina gibbosa	Cuchillo										x	
	Gliricidia sepium											x	
	Inga cocleensis		x					x					x
	Inga goldmanii												x
	Inga heterophylla	Guabo verde									x	x	x
	Inga marginata											x	
	Inga mucuna											x	
	Inga punctata											x	x
	Inga spectabilis	Guabo de montaña									x	x	x
	Inga thibaudiana											x	
	Leucaena multicapitula												
	Lonchocarpus pentaphyllus	Cuerillo									x		x
	Lonchocarpus velutinus	Cuerillo										x	
	Machaerium seemannii											x	
	Macrolobium colombianum	Guabinillo										x	
	Mimosa polydactyla		x									x	
	Mimosa pudica											x	x
	Pachyrhizus erosus											x	x
	Pterocarpus officinalis	Sangrillo									x	x	x
	Swartzia panamensis	Algarrobillo									x	x	x
	Swartzia simplex	Naranjillo prieto										x	
	Tachigali versicolor	Veraguao										x	
Flacourtiaceae													
	Banara guianensis											x	
	Casearia arborea											x	x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Flacourtiaceae													
	Casearia commersoniana	Cascarita									x		x
	Casearia sylvestris											x	
	Lacistema aggregatum												x
	Ryania speciosa											x	
Gentianaceae													
	Chelonanthus alatus												x
	Lisianthius pedunculatis												x
	Voyria tenella											x	
Gesneriaceae													
	Besleria notabilis			x									x
	Chrysothemis friedrichsthaliana			x								x	x
	Columnea kahlbreyeriana												x
	Cremosperma maculatum		x	x								x	
	Drymonia serrulata												x
	Gasteranthus acropodus			x								x	
	Nautilocalyx colombianus			x									x
Haemodoraceae													
	Xiphidium caeruleum											x	x
Heliconiaceae													
	Heliconia longiflora											x	
Hernandiaceae													
	Hernandia didymantha	Pecho de poclora									x		x
	Hernandia stenura	Aguacatillo						x				x	
Hipocastanaceae													
	Billia colombianum											x	
Hymenophyllaceae													
	Trichomanes elegans										x		
	Trichomanes pinnatum										x	x	
	Trichomanes diversifrons											x	
Icacinaceae													
	Calatola costarricensis	Jagua blanco								x		x	
	Discophora guianensis												x
Lamiaceae													
	Hyptis capitata											x	x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Lamiaceae	*Hyptis obtusiflora*											x	x
Lauraceae													
	Endlicheria sericea	Chigüilla									x	x	x
	Ocotea cernua											x	
	Phoebe brenesii											x	
Lecythidaceae													
	Eschweilera pittieri	Ollito negro									x		x
	Eschweilera panamensis	Ollito1										x	
	Eschweilera sessilis	Ollito2										x	
	Gustavia superba	Membrillo									x	x	x
Limnocharitaceae													
	Limnocharis flava												x
Loganiaceae													
	Strychnos toxifera											x	
Lomariopsidaceae													
	Bolbitis nicotianifolia										x		x
	Elaphoglossum crinitum		x									x	
	Lomariopsis vestita										x		
	Lomariopsis fendleri												x
Loranthaceae													
	Phoradendron piperoides											x	
Lycopodiaceae													
	Lycopodiella cernua											x	x
Lythraceae													
	Cuphea setosa											x	
	Cuphea calophylla												x
Magnoliaceae													
	Magnolia sororum	Baco										x	
	Talauma sp.1											x	
	Talauma sp.2											x	
	Talauma sp.3											x	
Malpighiaceae													
	Byrsonima crassifolia											x	

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
	Hampea albipetala											x	
	Hampea micrantha				x								x
	Malvaviscus arboreus		x									x	
Malvaceae	*Pavonia fruticosa*											x	
	Sida acuta											x	
	Sida rhombifolia											x	x
	Urena lobata											x	
	Wercklea ferox												x
	Wissadula excelsior												x
	Calathea allenii												x
	Calathea insignis											x	x
	Calathea lasiostachya											x	
Marantaceae	*Calathea marantifolia*												x
	Calathea micans											x	x
	Calathea nodosa												x
	Ischnosiphon arouma												x
	Stromanthe jacquinii												x
Marattiaceae													
	Danaea elliptica												x
	Aciotis caulialata												x
	Aciotis indecora											x	x
	Bellucia pentamera												x
	Clidemia capitellata											x	x
	Clidemia coloradensis										x		
	Clidemia dentata											x	x
Melastomataceae	*Clidemia discolor*											x	x
	Clidemia epiphytica												x
	Clidemia hirta											x	
	Clidemia lanuginosa										x		
	Clidemia quinquenervia											x	
	Conostegia setosa		x									x	
	Conostegia subcrustulata												x
	Ossaea laxivenula		x									x	

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Melastomataceae	*Leandra chaetodon*										x		
	Leandra granatensis											x	x
	Leandra mexicana												x
	Miconia affinis	Titicillo colorado									x		x
	Miconia argentea											x	x
	Miconia barbinervis											x	x
	Miconia curvipetiolata											x	
	Miconia gracilis												x
	Miconia ligulata											x	
	Miconia oinochrophylla.											x	
	Miconia serrulata												x
	Miconia smaragdina												x
	Miconia valeriana		x									x	
	Tribouchina wurdackii											x	
Meliaceae													
	Carapa guianensis	Bateo									x	x	x
	Cedrela odorata		x									x	
	Guarea glabra	Pica lengua									x	x	x
	Guarea grandifolia											x	
	Guarea guidonia												x
	Guarea rhophalocarpa										x		
	Trichilia glabra	Cocá1										x	
	Trichilia martiana	Cocá2										x	
Menispermaceae													
	Cissampelos pareira											x	
Metaxyaceae													
	Metaxya rostrata											x	
Monimiaceae													
	Siparuna cuspidata	Pasmo de montaña									x	x	x
	Siparuna gesnerioides												x
	Siparuna guianensis		x										x
	Siparuna pauciflora	Pasmo	x									x	x
Moraceae													
	Brosimum alicastrum	Berbá									x	x	x
	Brosimum guianensis	Cacique										x	

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Moraceae	*Brosimum rubescens*	Cocobolo									x	x	x
	Castilla elastica											x	x
	Castilla tunu												x
	Ficus insipida											x	x
	Maquira guianensis		x										x
	Naucleopsis ulei	Cocá verde									x		x
	Perebea xanthochyma											x	x
	Poulsenia amata											x	
	Trophis caucana												x
Myristicaceae													
	Compsoneura sprucei										x		
	Otoba novogranatensis		x									x	
	Virola sebifera	Miguelario colorado										x	
	Virola surinamensis		x									x	x
Myrsinaceae													
	Ardisia opegrapha												x
	Parathesis amplifolia	Saginillo	x	x								x	
Myrtaceae													
	Psidium guajava											x	x
	Psidium guineense											x	
	Syzygium jambos											x	x
	Syzygium malaccense											x	
Nyctaginaceae													
	Guapira costaricana												x
	Neea amplifolia												x
Ochnaceae													
	Cespdezia macrophylla	Membrillo de montaña										x	
	Ouratea lucens											x	
	Sauvagesia erecta											x	x
Olacaceae													
	Heisteria cyanocarpa		x									x	
	Chiariantus domingensis											x	
	Minquartia guianensis	Almendro						x			x	x	x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Onagraceae	*Ludwigia affinis*											x	x
	Ludwigia erecta											x	x
	Ludwigia hyssopifolia											x	
	Ludwigia octovalvis											x	x
Orchidaceae													
	Epidendrum sp.											x	
	Habenaria sp.											x	
Passifloraceae													
	Passiflora auriculata												x
	Passiflora biflora												x
	Passiflora vitifolia											x	
Piperaceae													
	Peperomia umbrigaudens		x									x	
	Peperomia panamensis		x									x	
	Peperomia pernambucensis		x									x	
	Piper aduncum											x	x
	Piper daguanum												x
	Piper hispidum											x	x
	Piper imperiale										x		x
	Piper leptocladum											x	x
	Piper marginatum											x	x
	Piper multiplinervium												x
	Piper nudifolium												x
	Piper peltatum											x	x
	Piper reticulatum												x
	Piper subsessilifolium												x
	Piper trigonum												x
	Peperomia urocarpoides			x									x
	Piper villiramulum												x
Poaceae													
	Andropogon bicornis											x	x
	Axonopus compressus												x
	Axonopus fissifolius											x	
	Bambusa sp.												x
	Homolepis aturensis											x	x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Poaceae	*Ichnanthus pallens*											x	x
	Ischaemum timorense												
	Ischaemum timorense										x	x	x
	Panicum laxum											x	
	Panicum mertensii												x
	Panicum pilosum											x	x
	Panicum trichoides											x	
	Pariana strigosa											x	
	Paspalum conjugatum											x	
	Pennisetum purpureum												x
	Pharus latifolius												x
Podocarpaceae													
	Podocarpus magnifolius	Pino de montaña										x	
	Podocarpus oleifolios	Pino de montaña1										x	
Polygalaceae													
	Polygala jefensis				x							x	
	Polygala paniculata												x
	Polygonum punctatum												x
Polypodiaceae													
	Campyloneurum angustifolium											x	
	Campyloneurum phyllitidis											x	
	Dicranoglossum panamense											x	
	Microgramma percussa												x
	Niphidium crassifolium												x
	Pleopeltis macrocarpa										x		
	Polypodium fraxinifolium												x
	Polypodium loriciforme												x
	Polypodium maritimum												x
	Polypodium wagneri												x
Pontederiaceae													
	Heteranthera reniformis											x	
	Pontederia rotundifolia												x
Pteridaceae													
	Adiantum decoratum												x
	Adiantum latifolium											x	x
	Adiantum lucidum											x	x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Pteridaceae	*Adiantum obliquum*											x	
	Adiantum petiolatum												x
	Adiantum villosum											x	x
	Ceratopteris pteridoides		x									x	
	Pityrogramma calomelanos												x
	Pteris lechleri											x	
Rhamnaceae													
	Gouania lupuloides												x
Rubiaceae													
	Amaioua corymbosa	Madroño alzano										x	
	Amaioua pedicellata											x	
	Borreria assurgens											x	
	Borreria latifolia											x	x
	Borreria ocymifolia											x	
	Coccocypselum hirsutum												x
	Elaeagia glossostipula											x	
	Elaeagia nitifolia	Cafecillo1										x	
	Faramea multiflora												x
	Faramea occidentalis												x
	Genipa americana											x	
	Guettarda foliacea					x							x
	Hamelia axillaris												x
	Hedyotis lancifolia												x
	Isertia haenkeana											x	x
	Manettia reclinata											x	
	Palicourea guianensis	Palo de agua									x	x	x
	Palicourea lasiorrachis		x									x	
	Pentagonia macrophylla										x	x	x
	Posoqueria latifolia											x	
	Posoqueria maxima	Fruta de vieja									x	x	x
	Psychotria acuminata											x	x
	Psychotria brachiata											x	x
	Psychotria correae	Carne de perro										x	
	Psychotria cyanococca											x	x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
	Psychotria deflexa												x
	Psychotria dichroa		x									x	
	Psychotria emetica											x	
	Psychotria graciliflora												x
	Psychotria guapilensis												x
	Psychotria horizontalis											x	
	Psychotria luxurians											x	
	Psychotria macrophylla												x
	Psychotria marginata											x	x
	Psychotria microbotrys										x		
	Psychotria officinalis											x	
Rubiaceae	*Psychotria poeppigiana*										x	x	x
	Psychotria psychotriifolia											x	
	Psychotria pubescens											x	x
	Psychotria racemosa											x	x
	Psychotria suerrensis											x	
	Psychotria tenuifolia												x
	Raritebe palicoureoides		x									x	
	Rondeletia hammeliifolia											x	
	Rudgea cornifolia												x
	Sabicea villosa											x	x
	Simira maxonii												x
	Spermacoce confusa											x	
	Warscewiczia coccinea	Pico de loro										x	x
	Citrus sinensis											x	
	Hortia colombiana	Aceituna	x								x		x
Rutaceae	*Zanthoxylum acuminatum*												x
	Zanthoxyllum melanostictum	Jumo										x	
	Zanthoxylum panamense											x	x
	Zanthoxylum setulosum											x	
	Allophylus gentry			x								x	
Sapindaceae	*Allophylus psilospermus*	Cuamo										x	
	Cupania cinerea											x	x
	Cupania rufescens											x	

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Sapindaceae	*Cupania scrobiculata*											x	
	Sapindus caudatum	Olivo										x	
	Serjania mexicana												x
	Serjania rhombea											x	
	Talisia nervosa											x	
Sapotaceae													
	Chrysophyllum argenteum											x	x
	Chrysophyllum cainito											x	
	Pouteria buenaventurensis	Maya	x					x				x	
	Pouteria congestifolia	Mamecillo										x	
	Pouteria reticulata											x	
Saxifragaceae													
	Phyllomona tenuideus											x	
Schizaeaceae													
	Lygodium venustum											x	
Scrophulariaceae													
	Lindernia crustacea											x	
	Scoparia dulcis											x	x
Selaginellaceae													
	Selaginella arthritica											x	x
	Selaginella diffusa											x	x
	Selaginella eurynota												x
	Selaginella exaltata											x	x
	Selaginella haematodes											x	x
	Selaginella huehuetenangensis												
	Selaginella silvestris											x	
Simaroubaceae													
	Quassia amara											x	
	Simarouba amara	Aceituno										x	
Smilacaceae													
	Smilax spissa											x	x
Solanaceae													
	Cestrum megalophyllum												x
	Physalis cordata											x	
	Solanum arboreum												x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Solanaceae	*Solanum circinatum*												x
	Solanum hayesii											x	x
	Solanum jamaicense												x
	Solanum lancaeifolium											x	x
	Solanum nudum												x
	Solanum rudepannum												x
	Witheringia asterotricha												x
Staphyleaceae													
	Turpinia occidentalis										x		x
Sterculiaceae													
	Byttneria aculeata												x
	Guazuma ulmifolia											x	x
	Herrania purpurea											x	x
	Melochia melissifolia												x
	Sterculia apetala	Panamá									x	x	x
	Sterculia recordiana												x
Tectariaceae													
	Ctenitis sloanei		x										x
	Cyclopeltis semicordata											x	
	Tectaria draconoptera												x
	Tectaria incisa												x
	Tectaria nicotianifolia												x
	Tectaria pilosa										x	x	x
	Tectaria rivalis												
Thelypteridaceae													
	Thelypteris hispidula											x	x
	Thelypteris nicaraguensis											x	x
Theophrastaceae								x					
	Clavija costaricana											x	
Tiliaceae													
	Apeiba aspera	Cortezo									x	x	x
	Apeiba membranaceae	Cortezo										x	
	Apeiba tibourbou												x
	Heliocarpus americanus	Majagüillo										x	
	Luehea seemannii											x	x
	Triumfetta lappula											x	-x

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Ulmaceae													
	Trema micrantha											x	
Umbelliferae													
	Hydrocotyle umbellata												x
Urticaceae													
	Boehmeria ramiflora		x									x	
	Myriocarpa longipes											x	x
	Pouzolzia obliqua												x
	Urera elata											x	x
Verbenaceae													
	Aegiphila anomala	Muñequillo								x		x	
	Aegiphila panamensis		x									x	
	Cornutia grandifolia											x	x
	Lantana camara											x	x
	Lantana maxima												x
	Lantana trifolia											x	
	Stachytarpheta jamaicensis											x	
	Vitex cooperi	Cuajao		x								x	
Violaceae													
	Hybanthus prunifolius											x	
	Rinorea squamata	Gasparillo		x								x	
	Hybanthus prunifolius											x	
Vitaceae													
	Cissus erosa												x
Vochysiaceae													
	Vochysia ferruginea	Tegle										x	x
Winteraceae													
	Drimys granadensis											x	
Zamiaceae													
	Zamia skinneri											x	
Zingiberaceae													
	Costus laevis												
	Renealmia cernua												x

VU: Vulnerable; EP: Endagered;CU: Cultivated; LR nT: Lower Risk, near threatened;DR: Restringed Distribution ;CS: Caño Sucio; IN: Indio;TB: Toabré; END: Endemic:; RA: Rare

Source: Louis Berger, 2003.

ANNEX 4-A

Total of Hectares by Type of Vegetation Cover.

HECTARES

LEGEND	RÍO INDIO	ALTO INDIO	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	**TOTAL**
Mature Forest	10,146.9	7,699.4	2787.7	1310.95	2,392.4	952.7	15,109.6	26,209.3
Pasture Landl	5,725.2	2,816.9	1314.6	267.06	334.3	5,485.8	18,787.6	29,998.6
Stubble	22,788.3	15,722.9	5300.4	1985.09	3,359.4	5,400.4	38,966.2	67,154.9
TOTAL	38,660.5	26,239.2	9,402.7	3,563.1	6,086.1	11,838.9	72,863.4	123,362.8

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE RESERVOIRS

	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
LEYEND	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50
Mature Forest	403.7	142.8	101.9	97.0	81.65	34.66	337.3	3.4	89.8	45.2	29.4
Pasture Land	1,561.6	800.9	218.0	198.2	440.4	299.3	55.1	5.4	743.2	1504.8	966.4
Stubble	2,573.2	1,150.2	531.8	489.0	854.3	426.0	432.2	102.1	521.5	3385.3	2429.4
TOTAL	**4,538.6**	**2,094.0**	**851.7**	**784.2**	**1,376.3**	**760.0**	**824.5**	**110.8**	**1,354.5**	**4,935.3**	**3,425.1**

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE CONSTRUCTION OF WAYS, QUARRIES, CAMPS, ETC.

	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ		CANTERAS Y
LEYEND	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50	PRESTAMOS
Mature Forest	11.7	11.7	11.7	11.7	0.0	0.0	4.0	5.0	3.6	5.205	5.205	150.0
Pasture Land	46.1	46.1	46.1	46.1	7.3	7.3	12.3	13.7	49.7	25.019	25.019	368.9
Stubble	51.3	51.3	51.3	51.3	1.9	1.9	27.9	46.3	31.8	49.374	49.374	321.4
TOTAL	**109.2**	**109.2**	**109.2**	**109.2**	**9.2**	**9.2**	**44.2**	**64.9**	**85.1**	**79.6**	**79.6**	**840.4**

HECTARES POTENTIALLY AFFECTED BY THE OPTIONS

LEYEND	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
MATURE FOREST	565.5	304.6	263.7	258.8	658.9	398.0	600.0	339.2	709.3	448.4	573.01	534.36
PASTURE LAND	1976.7	1216.0	633.1	613.2	2769.6	2008.9	2968.1	2207.4	4299.4	3538.7	883.93	761.89
STUBLE	2946.0	1523.0	904.5	861.7	3499.3	2076.2	5424.7	4001.7	6933.9	5510.9	1637.75	1357.89
TOTAL	**5488.1**	**3043.5**	**1,801.3**	**1,733.8**	**6,927.7**	**4,483.1**	**8,992.8**	**6,548.2**	**11,942.7**	**9,498.0**	**3,094.7**	**2,654.1**

Total of Hectares by Type of Metallic authorizations And No Metallic authorizations

HECTARES

LEYEND	RÍO INDIO	ALTO INDIO	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	**TOTAL**
Metallic authorizations	38,100.2	26,009.3	5907.8	3621.12	5,824.7	11838.910	72864.730	122,803.8
Without Information	560.5	230.0	0.0	0.00	227.6	0.0	0.0	560.5
No Metallic authorizations	0.0	0.0	0.0	0.00	0.0	0.0	0.0	
TOTAL	**38,660.7**	**26,239.2**	**5,907.8**	**3621.12**	**6,052.3**	**11,838.9**	**72864.730**	123,364.3

TOTAL OF HECTARES POTENCIALLY AFECTED BY THE RESERVOIRS

	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
LEYEND	80-40	45-40	50-40	45-40	155	130	2	Cabecera 300	100-90	100-90	95-50
Metallic authorizations	4,478.9	2,081.0	851.7	784.2	1171.7	760.0	743.5	110.0	1,354.5	4117.5	3425.1
No Metallic authorizations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Without Information	60.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	4,538.9	2,094.0	851.7	784.2	1,171.7	760.0	743.5	110.0	1,354.5	4,117.5	3,425.1

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE CONSTRUCTION OF WAYS, QUARRIES, CAMPS, ETC.

	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ		QUARRIES AND
LEYEND	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50	LOAND
Metallic authorizations	109.2	109.2	109.2	109.2	9.2	9.2	44.2	64.9	85.1	79.600	79.600	840.4
No Metallic authorizations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	109.2	109.2	109.2	109.2	9.2	9.2	44.2	64.9	85.1	79.6	79.6	840.4

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE OPTIONS

LEYEND	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
Metallic authorizations	4,478.9	2,081.0	851.7	784.2	5,833.4	3,435.5	7,904.0	5,506.1	9,950.8	7,552.9	1,503.6	1,613.6
No Metallic authorizations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Without Information	60.0	13.0	0.0	0.0	60.0	13.0	60.0	13.0	60.0	13.0	0.0	0.0
TOTAL	**4538.9**	**2094.0**	**851.7**	**784.2**	**5,893.4**	**3,448.5**	**7,964.0**	**5,519.1**	**10,010.8**	**7,565.9**	**1,503.6**	**1,613.6**

CURRENT LAND USE

ALLUVIAL DEPOSITS

DESCRIPTION	HECTAREAS
Water	15.9860
Cow land	13.5230
Lowland dense Forest slowly Disturbed	
Disturbed Forest	6.8160
Stubble	48.1690
No Data	0.6070
TOTAL	**85.1010**

AREA OF BORROWING OF MATERIALS

DESCRIPTION	HECTARES
Water	0.179
Cow land	118.393
Lowland dense Forest slowly Disturbed	8.187
Disturbed Forest	118.129
Annual Crops	5.115
Stubble	204.323
No Data	240.620
TOTAL	**694.9460**

SANDY STONE QUARRY

DESCRIPTION	HECTARES
Cow land	30.083
Disturbed Forest	10.847
Annual Crops	2.769
Stubble	15.096
TOTAL	**58.7950**

CHANNEL INDIO CABECERA

DESCRIPTION	HECTARES
Cow land	1.4130
Lowland dense Forest slowly Disturbed	0.0260
Disturbed Forest	1.3840
Stubble	3.3050
TOTAL	**6.1280**

Total of Hectares for Description of Geology

HECTARES

Symbol	GROUP	FORMATION	FORMS	LEYEND	RÍO INDIO	ALTO INDIO	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	**TOTAL**
PI/PS-Cv		Cerro Viejo	Volcanics	Basalts/andesite, Glassy amigdaloids. Post-ignimbriticsBasalts .	5,661.7	5,612.9	2,642.9	1,111.1			1,065.0	6,726.7
QPS-P		C. Picacho	Volcanics	Basalts/andesite, conglomerates, alluvions, colluvions, Shale.	243.9	243.9	232.6					243.9
QR-Aha	Aguadulce	Río Hato	Sedimentary	Conglomerate, sandstone, Shale, tuffs, no consolidate sandstone, Pomice.	1,719.6	1,686.1	10.2		476.8		5,610.7	7,330.4
TM-CATu	Cañazas	Tucué	Volcanics	Andesitas/basaltos, lavas, brechas, tobas y plugs.	23,729.3	16,321.3	5,845.5	1,783.2	5,105.6	9,042.5	52,086.3	84,858.2
TM-Yen	La Yeguada	C. El Encanto	Volcanics	Dacites, riodacites, ignimbrites, sub-intrusives,tuffs and lavas.	991.2	981.8	671.52	668.9			12,012.0	13,003.2
TMPL-VA		El Valle	Volcanics	Dacites, brech., plugs, fl. ignimbrit., pum., fine tuffs, Andesites/basalts, tuffs and fine grain sub-intrusives	528.2	528.2			503.6		413.4	941.6
TO-CAI	Caimito	Caimito	Sedimentary	Tuffaceus sandstone, tuffaceus shale, tuffs, caliza foraminífer limestone. Quebrancha member-	5,786.2	865.7				2,796.4	1,507.4	10,090.0
TPA-CHI	Chiguirí	Chiguirí	Sedimentary	Deformed shale							168.6	168.6
				TOTAL	38,660.1	26,239.9	9,402.7	3,563.1	6,086.1	11,838.9	72,863.4	123,362.4

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE RESERVOIRS
GEOLOGICAL FORMATIONS

					INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
SYMBOL	GROUP	FORMATION	FORMS	LEYEND	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50
PI/PS-Cv		Cerro Viejo	Volcanics	Basalts/andesites.glassy amigdaloids. Post-ignimbrtics Basalts.					253.326	60.70	520.47				
QPS-P		C. Picacho	Volcanics	Andesite/basalts, conglomerates, alluviums, colluvions, lodolites.	6.0				205.05	140.26					
QR-Aha	Aguadulce	Río Hato	Sedimentary	Conglomerate, Sandstone, Shale, Tuff, Unconsolidate Sandstone, Pumice.	810.4	348.6	364.5	326.2						94.6	38.3
TM-CATu	Cañazas	Tucue	Volcanics	Basalts/sandesites, lavas, breccias, Tuffs and plugs.	753.7	218.8	238.1	218.8	917.9	559.0	66.1	110.8	1,146.1	3,986.0	2,602.4
TM-Yen	La Yeguada	C. El Encanto	Volcanics	Dacitas, riodacites, ignimbrtes , sub-intrusives, Tuffss and lavas.	121.8	3.4	5.3	3.4			237.96				
TMPL-VA		El Valle	Volcanics	Dacites, brech., plugs, fl. ignimbrit., pum., to. finas. And./bas., tob. y s.intrusivos de gra. fino											
TO-CAI	Caimito	Caimito	Sedimentary	Tuffaceus sandstone, tuffaceus shale, shale, foraminife limestone. Quebrancha member - TOCAlqr.	2,846.5	1,523.2	243.8	235.9					208.4	854.742	784.4
TPA-CHI	Chiguiri	Chiguiri	Sedimentary	Deformed shale											
				TOTAL	4,538.4	2,093.9	851.7	784.2	1,376.3	760.0	824.5	110.8	1,354.5	4,935.3	3,425.1

TOTAL DE HECTAREAS POTENCIALMENTE AFECTADOS POR LAS OPCIONES

FORMACIONES GEOLOGICAS

SIMBOLO	GRUPO	FORMACION	FORMAS	LEYENDA	Opción 1	Opción 2	Opción 3	Opción 4	Opción 5	Opción 6	Opción 7	Opción 8	Opción 9	Opción 10	Opción 11	Opción 12
PI/PS-Cv		Cerro Viejo	Volcánicas	Basaltos/andesita, amigdaloides vidriosos. Basaltos Post-ignimbriticos.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	773.79	581.17
QPS-P		C. Picacho	Volcánicas	Basaltos/andesita, conglomerados, aluviones, coluviones, lodolitas.	6.0	0.0	0.0	0.0	6.0	0.0	6.0	0.0	6.0	0.0	205.05	140.26
QR-Aha	Aguadulce	Río Hato	Sedimentarias	Conglomerado, areniscas, lutitas, tobas, areniscas no consolidadas, poméz.	810.4	348.6	364.5	326.2	810.4	348.6	848.7	386.9	905.0	443.2	0.00	0.00
TM-CATu	Cañazas	Tucue	Volcánicas	Andesitas/basaltos, lavas, brechas, tobas y plugs.	753.7	218.8	238.1	218.8	1899.7	1364.9	3356.1	2821.2	5885.7	5350.9	984.06	735.99
TM-Yen	La Yeguada	C. El Encanto	Volcánicas	Dacitas, riodacitas, ignimbritas, sub-intrusivos, tobas y lavas.	121.8	3.4	5.3	3.4	121.8	3.4	121.8	3.4	121.8	3.4	237.96	237.96
TMPL-VA		El Valle	Volcánicas	Dacitas, brech., plugs, fl. ignimbrit., pum., to. finas. And./bas., tob. y s.intrusivos de gra. fino	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
TO-CAl	Caimito	Caimito	Sedimentarias	Arenisca tobácea, lutita tobácea, toba, caliza foraminífera. Miembro Quebrancha TOCAlqr.	2846.5	1523.2	243.8	235.9	3054.9	1731.6	3630.8	2307.5	3909.7	2586.4	0.00	0.00
TPA-CHl	Chiguiri	Chiguiri	Sedimentarias	Lutitas deformadas.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
				TOTAL	**4538.4**	**2093.9**	**851.7**	**784.2**	**5,892.9**	**3,448.5**	**7,963.5**	**5,519.1**	**10,828.2**	**8,383.8**	**2,200.9**	**1,695.4**

Totals by Type of Infrastructure

HECTARES

INFRASTRUCTURE	RÍO INDIO	ALTO INDIO	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	**TOTAL**
Drinkable water, Distribution, Storage, Source, Tanks of Water reservation	31	27	3	3	3	1	75	107
Sewers							4	4
Recreative area, Football camps, Baseball parks, Parks.	22	20	6	2	2		36	58
Roads	62	48				5	250	317
Cemetery	33	25	6	3	2	5	67	105
Clinics or health post	9	6	2		1	2	13	24
Dining room, School Dining rooms	9	9	1	3	2			9
Commerce/Manufacturer/Agroindustrial	49	38	9	3	12	3	165	217
School	41	32	8	2	4	8	63	112
Electrical generation							4	4
Sustainable Farms	8	8	1	1	3		6	14
Governmental structure, Regidurias, Communal Houses, House of Local Government	26	22	5	2	3	3	42	71
Church or Chapel	52	42	12	3	4	8	84	144
Stop of Buses	1	1		1			20	21
Electrical posts	32	32			32		450	482
Pozo (subterranean Water reserve)							1	1
Permanent bridges, Pedestrian Bridge, Suspension bridge	24	12	2	1	3	9	87	120
Telecommunication, Telephonic Antenna , Public Phone	6	1	1				65	71
Electrical red, Post of light	1	1			1		133	134
TOTAL	406	324	56	24	72	44	1565	2015

TOTAL OF INFRASTRUCTURES AFFECTED BY THE RESERVOIR

	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
LEYEND	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50
Drinkable water, Distribution, Storage, Source, Tanks of Water reservation	2				9		2			11	8
Sewers											
Recreative area, Football camps, Baseball parks, Parks.	6	4	2	2	10	3	2	1		7	5
Roads	15	8	6	6						5	5
Cemetery	8	4	3	3	11	1	1	1		8	4
Clinics or health post	3	1			3	2		1		2	2
Dining room, School Dining rooms					6		3	2			
Commerce/Manufacturer/Agroindustrial	16	7	1	1	24	4	3	1		7	6
School	11	3	1	1	14	4	2	1		8	8
Electrical generation										1	1
Sustainable Farms					5		1	1			
Governmental structure, Regidurias, Communal Houses, House of Local Government	9	4	1	1	10	1	2	1		3	3
Church or Chapel	15	6	2	2	19	3	3	2		7	6
Stop of Buses					1						
Electrical posts					32						
Pozo (subterranean Water reserve)											
Permanent bridges, Pedestrian Bridge, Suspension bridge	8	7	3	3	6	2	1	2	3	14	9
Telecommunication, Telephonic Antenna , Public Phone	3	2			1	1				4	3
Electrical red, Post of light					1						
TOTAL	96	46	19	19	152	21	20	13	3	77	60

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE CONSTRUCTION OF WAYS, QUARRIES, CAMPS, ETC.

	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ		QUARRIES
LEYEND	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50	AND BORROWING
Water												
Pasture												
Cultivos												
Shrubland, Stubble												
Secondary Forest												
Mature Forest												
Without Information												
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TOTAL OF INFRASTRUCTURES AFFECTED BY THE OPTIONS

LEYEND	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
Drinkable water, Distribution, Storage, Source, Tanks of Water reservation	2.0	0.0	0.0	0.0	2.0	0.0	10.0	8.0	13.0	11.0	11.00	2.00
Sewers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
Recreative area, Football camps, Baseball parks, Parks.	6.0	4.0	2.0	2.0	6.0	4.0	11.0	9.0	13.0	11.0	12.00	6.00
Roads	15.0	8.0	6.0	6.0	15.0	8.0	20.0	13.0	20.0	13.0	0.00	0.00
Cemetery	8.0	4.0	3.0	3.0	8.0	4.0	12.0	8.0	16.0	12.0	12.00	3.00
Clinics or health post	3.0	1.0	0.0	0.0	3.0	1.0	5.0	3.0	5.0	3.0	3.00	3.00
Dining room, School,Dining rooms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.00	5.00
Commerce/Manufacturer/Agroindustrial	16.0	7.0	1.0	1.0	16.0	7.0	22.0	13.0	23.0	14.0	27.00	8.00
School	11.0	3.0	1.0	1.0	11.0	3.0	19.0	11.0	19.0	11.0	16.00	7.00
Electrical generation	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.00	0.00
Sustainable Farms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.00	2.00
Governmental structure, Regidurias, Communal Houses, House of Local Government	9.0	4.0	1.0	1.0	9.0	4.0	12.0	7.0	12.0	7.0	12.00	4.00
Church or Chapel	15.0	6.0	2.0	2.0	15.0	6.0	21.0	12.0	22.0	13.0	22.00	8.00
Stop of Buses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.00
Electrical posts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.00	0.00
Pozo (subterranean Water reserve)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
Permanent bridges, Pedestrian Bridge, Suspension bridge	8.0	7.0	3.0	3.0	11.0	10.0	17.0	16.0	25.0	24.0	7.00	5.00
Telecommunication, Telephonic Antenna , Public Phone	3.0	2.0	0.0	0.0	3.0	2.0	6.0	5.0	7.0	6.0	1.00	1.00
Electrical red, Post of light	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.00
TOTAL	**96.0**	**46.0**	**19.0**	**19.0**	**99.0**	**49.0**	**156.0**	**106.0**	**176.0**	**126.0**	**172.0**	**54.0**

POPULATION

Province, District and Corregimiento	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
Coclé								22378
Antón								237
1. El Valle	237	237	0	0	237	0	0	237
La Pintada								23
3. Llano Grande	0	0	0	0	0	0	23	23
Penonomé								22118
6. Chiguirí Arriba	423	423	0	0	211	0	6691	7114
7. Pajonal	0	0	0	0	0	0	158	158
8. Río Indio	2353	633	0	0	0	1294	395	4042
9. Toabré	0	0	0	0	0	0	8930	8930
10. Tulú	0	0	0	0	0	0	1874	1874
Colón								789
Chagres								374
11. La Encantada	374	90	0	0	0	0	0	374
Donoso								415
13. Coclé del Norte	0	0	0	0	0	0	217	217
14. El Guásimo	0	0	0	0	0	198	0	198
Panamá								3680
Capira.								3680
19. Cirí de Los Sotos	631	631	408	0	0	0	0	631
20. Cirí Grande	1784	1784	663	663	588	0	0	1784
21. El Cacao	50	50	50	50				50
22. Santa Rosa	1215	1215	826	0	0	0	0	1215
	7067	5063	1947	713	1036	1492	18288	26847

TOTAL OF HOUSINGS POTENCIALLY AFECTED BY THE RESERVOIRS

Province, District and	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
Corregimiento	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50
Coclé											
Antón											
1. El Valle											
La Pintada											
3. Llano Grande											
Penonomé											
6. Chiguirí Arriba								50			
7. Pajonal											
8. Río Indio	894	549	132	132					524	193	193
9. Toabré										489	489
10. Tulú										408	408
Colón											
Chagres											
11. La Encantada	332	326	90	90							
Donoso											
13. Coclé del Norte										101	101
14. El Guásimo									78		
Panamá											
Capira.											
19. Cirí de Los Sotos	342	64	94	64	335	335					
20. Cirí Grande							382				
21. El Cacao											
22. Santa Rosa					669	183					
	1,568.0	939.0	316.0	286.0	1,004.0	518.0	382.0	50.0	602.0	1,191.0	1,191.0

TOTAL OF POPULATION POTENCIALLY AFECTED BY THE OPTIONS.

Province, District and Corregimiento	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
Coclé												
Antón												
1. El Valle												
La Pintada												
3. Llano Grande												
Penonomé												
6. Chiguirí Arriba												
7. Pajonal												
8. Río Indio	894.0	549.0	132.0	132.0	1418.0	1073.0	1087.0	742.0	1611.0	1266.0		
9. Toabré							489.0	489.0	489.0	489.0		
10. Tulú							408.0	408.0	408.0	408.0		
Colón												
Chagres												
11. La Encantada	332.0	326.0	90.0	90.0	332.0	326.0	332.0	326.0	332.0	326.0		
Donoso												
13. Coclé del Norte							101.0	101.0	101.0	101.0		
14. El Guásimo					78.0	78.0			78.0	78.0		
Panamá												
Capira.												
19. Cirí de Los Sotos	342.0	64.0	94.0	64.0	342.0	64.0	342.0	64.0	342.0	64.0	335.00	335.00
20. Cirí Grande											382.00	382.00
21. El Cacao												
22. Santa Rosa											669.00	183.00
	1568.0	939.0	316.0	286.0	2170.0	1541.0	2759.0	2130.0	3361.0	2732.0	1386.0	900.0

HOUSING

Province, District and Corregimiento	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
Coclé								4258
Antón								46
1. El Valle	46	46	0	0	46	0	0	46
La Pintada								8
2. Llano Grande	0	0	0	0	0	0	8	8
Penonomé								4204
3. Chiguirí Arriba	62	62	0	0	29	0	1134	1196
4. Pajonal	0	0	0	0	0	0	35	35
5. Río Indio	449	123	0	0	0	252	79	780
6. Toabré	0	0	0	0	0	0	1836	1836
7. Tulú	0	0	0	0	0	0	357	357
Colón								163
Chagres								84
8. La Encantada	84	19	0	0	0	0	0	84
Donoso								79
9. Coclé del Norte	0	0	0	0	0	0	38	38
10. El Guásimo	0	0	0	0	0	41	0	41
Panamá								705
Capira.								705
11. Cirí de Los Sotos	144	144	101	0	0	0	0	144
12. Cirí Grande	328	328	122	122	107	0	0	328
13. El Cacao	12	12	12	12				12
14. Santa Rosa	221	221	147	0	0	0	0	221
	1346	955	382	134	182	293	3487	5126

TOTAL OF HOUISING POTENCIALLY AFECTED BY THE RESERVOIR

Province, District and	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
Corregimiento	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50
Coclé											
Antón											
1. El Valle											
La Pintada											
3. Llano Grande											
Penonomé											
6. Chiguirí Arriba								7			
7. Pajonal											
8. Río Indio	177	109	29	29					96	39	39
9. Toabré										111	111
10. Tulú										78	78
Colón											
Chagres											
11. La Encantada	72	71	19	19							
Donoso											
13. Coclé del Norte										18	18
14. El Guásimo									15		
Panamá											
Capira.											
19. Cirí de Los Sotos	78	19	24	19	77	77					
20. Cirí Grande							69				
21. El Cacao											
22. Santa Rosa					115	28					
	327.0	199.0	72.0	67.0	192.0	105.0	69.0	7.0	111.0	246.0	246.0

TOTAL OF HOUSINGS POTENTIALLY AFFECTED BY THE OPTIONS

Province, District and Corregimiento	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
Coclé												
Antón												
1. El Valle												
La Pintada												
3. Llano Grande												
Penonomé												
6. Chiguirí Arriba												
7. Pajonal												
8. Río Indio	177.0	109.0	29.0	29.0	273.0	205.0	216.0	148.0	312.0	244.0		
9. Toabré							111.0	111.0	111.0	111.0		
10. Tulú							78.0	78.0	78.0	78.0		
Colón												
Chagres												
11. La Encantada	72.0	71.0	19.0	19.0	72.0	71.0	72.0	71.0	72.0	71.0		
Donoso												
13. Coclé del Norte							18.0	18.0	18.0	18.0		
14. El Guásimo					15.0	15.0			15.0	15.0		
Panamá												
Capira.												
19. Cirí de Los Sotos	78.0	19.0	24.0	19.0	78.0	19.0	78.0	19.0	78.0	19.0	77.00	77.00
20. Cirí Grande											69.00	69.00
21. El Cacao												
22. Santa Rosa											115.00	28.00
	327.0	199.0	72.0	67.0	438.0	310.0	573.0	445.0	684.0	556.0	261.0	174.0

POPULATION

Province, Distrcit and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
Coclé									
Antón									198
1. El Valle									198
	La Mesa	39	39			39			
	Alto De La Mesa	198	198			198			198
La Pintada									23
3. Llano Grande									23
	La Poclora							1	1
	El Espino							7	7
	La Tulua (P2)							5	5
	La Colonia							10	10
Penonomé									
6. Chiguirí Arriba									7114
	Boca De Las Minas							455	455
	Boca De Vaquilla							91	91
	Brazo Chico							32	32
	Brazo De U (P2)							75	75
	Chiguirí Arriba							912	912
	Chiguirí Centro							226	226
	Larguillo Abajo							68	68
	Larguillo Arriba							152	152
	La Vieja							128	128
	Palmilla							290	290
	Quebrada Grande							73	73
	Rio Indio Arriba (P2)							15	15
	San Miguel Arriba							398	398
	San Miguel Centro							710	710
	San Pedro (2)							593	593
	San Pedro Abajo (P1)							22	22
	Tavidal Abajo							292	292
	Tavidal Arriba							437	437
	U Arriba							177	177
	La Vaquilla							779	779
	Cerro Congoso							10	10
	Cocobari							68	68
	El Zapotal							8	8
	Larguillo Centro							164	164
	San Miguelito (Los Cajones)							71	71
	Renacimiento De U							166	166
	El Congal							39	39

Province, Distrcit and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Los Pilares (P)							24	24
	Peña Blanca							76	76
	San Miguel (P2)							12	12
	Sacramento							42	42
	Santa Ana Arriba (P)							86	86
	Barrio Unido	149	149			149			149
	El Vallecito (P2)	212	212						212
	El Limon D2	62	62			62			62
7. Pajonal									158
	Atre No.1 (P1)							43	43
	Atre Arriba							58	58
	El Desecho							51	51
	Larguillo Abajo (P)							6	6
8. Rio Indio									4042
	Alto Limon							52	52
	Boca De La Encantada (P3)							193	193
	Bajo Pifa							3	3
	Gurbe							44	44
	La Pedregosa							18	18
	U Abajo							33	33
	Los Rodeos							52	52
	Alto Del Mora	16							16
	Boca De Uracillo	92							92
	Boca Del Silencio	9							9
	Alto De Uracillo	31	31						31
	El Ladrillal De San Cristobal	27	27						27
	El Aguila	36							36
	El Barrero	2	2						2
	La Calabaza	14	14						14
	Coquillo Centro (El Coquillo)	64							64
	La Arenosa	85	85						85
	El Limon No.1 (P)	14							14
	Cabecera De Las Marias	46	46						46
	Pon La Olla	8							8
	El Silencio No.1	68							68
	El Silencio Chico (El Silencio N	21							21
	La Hormiguera	27							27
	La Mona D1	29	29						29
	La Sardina	41	41						41
	Las Canoas	27							27
	Las Marias D1	36							36

Province, Distrcit and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Las Maŕyas Arriba	107							107
	Las Potreras	40	40						40
	Las Quebradas De Uracillo	57							57
	La Tollosa D2	83							83
	Loma De La Cigarra	3							3
	Los Molejones D1	37	37						37
	Manguesal D1	3	3						3
	Palma Real	61							61
	Uracillo No.2	46							46
	Piedra Amarilla D1	16	16						16
	Quebrada El Macho	8							8
	Quebrada Jacumilla	61							61
	Quebrada La Conga	11							11
	Quebrada La Palma	25							25
	Coquillo De Uracillo (Rio Coqu	67							67
	Rio Indio (P)	27	27						27
	San Cristobal	79	79						79
	Silencito	45							45
	Tierra Buena D1	11							11
	Tres Hermanas (2)	9							9
	U Centro D2	132							132
	Uracillo No.1	20							20
	Alto Silencio	64							64
	Las Lajas D2	19							19
	El Limite	74							74
	El Vallecito (P1)	35	35						35
	La Mina	88	88						88
	La Tollosita	47							47
	Los Naranjitos	33	33						33
	Coquillo Abajo	83							83
	El Harino	17							17
	El Silencio	75							75
	El Silencio Arriba	24							24
	Pueblo Nuevo	11							11
	Silencio De Las Marias	28							28
	Uracillo Centro	61							61
	Uracillo De Las Marias	38							38
	Boca De Paso Carnal	15							15
	Los Elegidos (El Caraño O...)						84		84
	Alto Limon						52		52
	Las Palmas (Alto Riecito O...)						24		24

Province, Distrcit and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Alto De Riecito						149		149
	El Aji						12		12
	El Faldar						27		27
	El Pantano						20		20
	Cerro Miguel (N°2)						73		73
	La Pita						21		21
	Sabaneta De U (P)						74		74
	Campo Alegre						10		10
	Loma Alta						79		79
	Los Zules (Los Hules)						154		154
	Paso Carnal (Pasacarnal)						33		33
	Valle Del Platanal (Platanal)						111		111
	El Quebraon						23		23
	Riecito Abajo						42		42
	La Guinea Arriba						13		13
	La Negrita						14		14
	Las Cruces						22		22
	Las Maravillas (P)						3		3
	Los Cerritos						20		20
	Los Rastrojos						32		32
	Samaria						6		6
	La Puente						77		77
	Boquilla De La Mina						16		16
	Boquilla De Quebraon						8		8
	Cigüa						29		29
	Santa Maria (P)						44		44
	Caño Sucio (Santa Maria O...)						6		6
	Cacique (El...)						16		16
9. Toabré									8930
	Chiguirí Abajo							197	197
	La Boca De Tulu							105	105
	Caðazas N 1							68	68
	Alto De San Miguel							42	42
	Atre No.1 (P)							129	129
	Banazo Centro							69	69
	Banacito							123	123
	Banazo Arriba							14	14
	Bito							87	87
	Boca De Chiguirý							164	164
	Boca De Lura							164	164
	Boca De San Miguel							5	5

Province, Distrcit and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Boca De Tucuú							208	208
	Cacaco (Cacao)							27	27
	Cañazas Nª 2							39	39
	Cerro Chica (Chica)							20	20
	Dominica							17	17
	Higueronal							37	37
	Altos Del Coco							157	157
	El Cucharo							1	1
	El Pajal							21	21
	El Guayabo (Toabre Abajo)							95	95
	Altos De Los Darieles							31	31
	Lourdes							114	114
	La Martillada							262	262
	La Mona D2							12	12
	Las Quebradas De U (Las Quebradas)							64	64
	Las Varitas							46	46
	Brazo De U (P1)							95	95
	Los Molejones D2							42	42
	Miraflores							672	672
	El Naranjal							447	447
	Santa Ana Abajo							206	206
	Santa Ana Arriba							25	25
	Ojo De Agua							101	101
	Paso Ancho							12	12
	Paso Real							204	204
	Quebrada Culebra							19	19
	Sabana Larga							192	192
	Sabaneta De U (P1)							59	59
	Sagreja							553	553
	San Miguel (P1)							28	28
	Tambo							570	570
	Tierra Buena D2							4	4
	Toabrè							648	648
	Tucuè							259	259
	Tucuecito							200	200
	U Centro D1							42	42
	Valle De San Miguel							256	256
	Bejuco							80	80
	Boquilla De Dominica							51	51
	El Caño De San Miguel							209	209
	Cuiria O San Francisco							95	95

Province, Distrcit and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Chorrerita							70	70
	San Pedro Abajo (P2)							15	15
	San Jose							60	60
	San Pablo							79	79
	Atre Nª 2							76	76
	Boca De Guayabo							30	30
	Boca De Larguillo							21	21
	Cabecera De Quebrada La Tortuga							12	12
	Cabecera De Quebrada Los Manueles							2	2
	Cerro Venturilla							20	20
	El Pernal							3	3
	Guabal Arriba							49	49
	La Chispa							28	28
	Las Marias D2							56	56
	Los Pilares							52	52
	Monte Buena							21	21
	Quebrada El Clavo							17	17
	Quebrada El Corotu O Quebrada La Minga							32	32
	Quebrada El Tigre							5	5
	Quebrada La Tabila							22	22
	Quebrada La Vaca							23	23
	Quebrada Lajosa							21	21
	Quebrada Los Sules							17	17
	Quebrada Sardinosa							23	23
	San Miguel Nª 2							39	39
	San Miguelito							37	37
	San Pablo Abajo							38	38
	San Pablo Arriba							65	65
	El Bajito							225	225
	Cabecera De Rio Bito							7	7
	La Candelaria							378	378
10. Tulú									
	Boca De Cuiria							142	142
	La Marina							106	106
	Buena Vista							79	79
	La Tulua (P1)							158	158
	Lubre							33	33
	Lura Centro							328	328
	Lura Arriba							116	116
	Tulu Abajo							37	37
	Tulu Arriba							78	78

Province, Distrcit and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Alica							2	2
	Chicagua							22	22
	Gato Espino							22	22
	Nuevo San Pablo							93	93
	San Isidro							129	129
	Tul · Centro							278	278
	Union Santeða							40	40
	La Boca De Tulu (P)							10	10
	Nuevo Rosario							50	50
	Nuevo San Antonio							99	99
	Piedra Amarilla D2							10	10
	Agua Fria							13	13
	Los Villarretas							17	17
	Tacuma							12	12
Colón									0
Chagres									0
11. La Encantada	El Dominical	7							7
	El Lim¾N No.1 (P)	113							113
	Torno Abajo	12							12
	El Jordan	15							15
	Piedra Amarilla	22							22
	El Tornito	65							65
	Tres Hermanas (1)	6							6
	El Torno	24							24
	Quebrada Los Cedros	1							1
	Cerro Benito	1							1
	Los Frailes	53	53						53
	Cerro Hinojal	18							18
	Los Uveros (P)	37	37						37
Donoso									
13. Coclé del Norte	Cerro Verde							61	61
	Santa Elena							66	66
	La Inglesa							12	12
	La Tomasa							7	7
	Boca De La Encantada (P2)							48	48
	El Desfiladero							7	7
	Los Tres Cabos.							14	14
	Quebrada De Los Nietos							2	2
14. El Guásimo	Boquilla De Escobal						12		12
	Chorrerita						12		12
	Los Chorritos De Santa Maria						19		19

Province, Distrcit and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Cerro Miguel De Donoso						55		55
	Las Maravillas (P)						61		61
	Santa Maria (P)						5		5
	Las Cruces						12		12
	La Raspadura						22		22
Panamá									
Capira.									
19. Cirí de Los Sotos									578
	Alto Del Naranjo	32	32	32					32
	La Bonga o El Cruce (El Bong	53	53	53					
	Cerro El Clavo	17	17						17
	Los Uveros (P)	27	27						27
	Los Uveros Arriba	30	30						30
	Quebrada La Conga Arriba (Quebrada La Conga)	53	53	53					53
	Riecito Abajo	14	14						14
	Santa Rosa No.1 (P1)	30	30	30					30
	Teria No.3	35	35	8					35
	Tres Hermanas (3)	196	196	196					196
	Tres Hermanas Arriba	20	20	20					20
	El Hinojal Arriba	41	41						41
	Quebrada La Conga Abajo	37	37						37
	El Ahogado	16	16	16					16
	El Zahino	30	30						30
20. Cirí Grande	El Cedro	18	18	18	18				18
	Caracolar	57	57	57	57				57
	Rýo Indio Centro	165	165			165			165
	Jordanal (Quebrada Jordanal)	193	193			193			193
	Teria	142	142	142	142				142
	Las Claras Arriba	392	392						392
	Quebrada Aguacate	6	6	6	6				6
	Quebrada Escobal	22	22	22	22				22
	Rýo Indio De Los Chorros	141	141						141
	Teria Nacimiento (P2) (Teria A	91	91	91	91				91
	Bajo Grande (Teriacito)	64	64	64	64				64
	Rio Indio Nacimiento	39	39			39			39
	Pacorita	15	15	15	15				15
	Boca De Escobal	10	10	10	10				10
	Cerro San Andrés	24	24	24	24				24
	Ciricito Arriba (P) (...Abajo)	160	160	160	160				

Province, Distrcit and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Arenilla (Quebrada Arenilla)	111	111			111			111
	Rio Indio Cabecera	44	44			44			44
	El Ahogado	42	42	42	42				42
	Rio Indio Arriba (P1)	36	36			36			36
	Teriacito	4	4	4	4				4
	Escobalito	8	8	8	8				8
21. El Cacao	Teria Nacimiento (P1) (Teria A	50	50	50	50				50
22. Santa Rosa	Bajo Bonito	4	4						4
	Bella Vista O La Sanguijuela	128	128	128					128
	El Ahogado O El Almendro	114	114	114					114
	La Pita	45	45						45
	Las Claras Abajo	71	71						71
	Las Claras Centro	40	40						40
	Los Raudales (P)	72	72	72					72
	Nuevo Limon	55	55	55					55
	Quebrada Bonita (La Cachorra	54	54						54
	Quebrada Limon	52	52	52					52
	Riecito Abajo (P1)	144	144						144
	Riecito Arriba	43	43	43					43
	San Juan (1)	31	31						31
	Santa Rosa No.1 (P2)	131	131	131					131
	Santa Rosa No.2	231	231	231					231
		7067	5063	1947	713	1036	1492	18288	26847

HOUSING

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
Coclé									
Antón									39
1. El Valle									39
	La Mesa	7	7			7			
	Alto De La Mesa	39	39			39			39
La Pintada									8
3. Llano Grande									8
	La Poclora							1	1
	El Espino							2	2
	La Tulua (P2)							2	2
	La Colonia							3	3
Penonomé									
6. Chiguirí Arriba									1196
	Boca De Las Minas							76	76
	Boca De Vaquilla							14	14
	Brazo Chico							5	5
	Brazo De U (P2)							13	13
	Chiguirí Arriba							133	133
	Chiguirí Centro							41	41
	Larguillo Abajo							12	12
	Larguillo Arriba							25	25
	La Vieja							22	22
	Palmilla							51	51
	Quebrada Grande							13	13
	Rio Indio Arriba (P2)							3	3
	San Miguel Arriba							68	68
	San Miguel Centro							119	119
	San Pedro (2)							106	106
	San Pedro Abajo (P1)							5	5
	Tavidal Abajo							61	61
	Tavidal Arriba							71	71
	U Arriba							30	30
	La Vaquilla							120	120
	Cerro Congoso							4	4
	Cocobari							15	15
	El Zapotal							2	2
	Larguillo Centro							31	31
	San Miguelito (Los Cajones)							16	16
	Renacimiento De U							24	24
	El Congal							7	7

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Los Pilares (P)							5	5
	Peña Blanca							12	12
	San Miguel (P2)							3	3
	Sacramento							7	7
	Santa Ana Arriba (P)							20	20
	Barrio Unido	20	20			20			20
	El Vallecito (P2)	33	33						33
	El Limon D2	9	9			9			9
7. Pajonal									35
	Atre No.1 (P1)							7	7
	Atre Arriba							12	12
	El Desecho							15	15
	Larguillo Abajo (P)							1	1
8. Rio Indio									780
	Alto Limon							12	12
	Boca De La Encantada (P3)							39	39
	Bajo Pifa							1	1
	Gurbe							8	8
	La Pedregosa							3	3
	U Abajo							6	6
	Los Rodeos							10	10
	Alto Del Mora	3							3
	Boca De Uracillo	22							22
	Boca Del Silencio	3							3
	Alto De Uracillo	5	5						5
	El Ladrillal De San Cristobal	6	6						6
	El Aguila	7							7
	El Barrero	1	1						1
	La Calabaza	2	2						2
	Coquillo Centro (El Coquillo)	15							15
	La Arenosa	17	17						17
	El Limon No.1 (P)	3							3
	Cabecera De Las Marias	5	5						5
	Pon La Olla	2							2
	El Silencio No.1	12							12
	El Silencio Chico (El Silencio No.2)	3							3
	La Hormiguera	5							5
	La Mona D1	5	5						5
	La Sardina	11	11						11
	Las Canoas	5							5
	Las Manas D1	8							8

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Las Maŕyas Arriba	19							19
	Las Potreras	8	8						8
	Las Quebradas De Uracillo	10							10
	La Tollosa D2	16							16
	Loma De La Cigarra	1							1
	Los Molejones D1	6	6						6
	Manguesal D1	1	1						1
	Palma Real	10							10
	Uracillo No.2	11							11
	Piedra Amarilla D1	3	3						3
	Quebrada El Macho	2							2
	Quebrada Jacumilla	9							9
	Quebrada La Conga	2							2
	Quebrada La Palma	6							6
	Coquillo De Uracillo (Rio Coquillito)	14							14
	Rio Indio (P)	5	5						5
	San Cristobal	17	17						17
	Silencito	8							8
	Tierra Buena D1	2							2
	Tres Hermanas (2)	2							2
	U Centro D2	25							25
	Uracillo No.1	3							3
	Alto Silencio	11							11
	Las Lajas D2	3							3
	El Limite	19							19
	El Vallecito (P1)	7	7						7
	La Mina	17	17						17
	La Tollosita	8							8
	Los Naranjitos	7	7						7
	Coquillo Abajo	12							12
	El Harino	2							2
	El Silencio	12							12
	El Silencio Arriba	4							4
	Pueblo Nuevo	2							2
	Silencio De Las Marias	6							6
	Uracillo Centro	9							9
	Uracillo De Las Marias	7							7
	Boca De Paso Carnal	3							3
	Los Elegidos (El Caraño O...)						15		15
	Alto Limon						12		12
	Las Palmas (Alto Riecito O...)						5		5

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Alto De Riecito						27		27
	El Aji						3		3
	El Faldar						6		6
	El Pantano						6		6
	Cerro Miguel (N°2)						14		14
	La Pita						5		5
	Sabaneta De U (P)						17		17
	Campo Alegre						1		1
	Loma Alta						16		16
	Los Zules (Los Hules)						32		32
	Paso Carnal (Pasacarnal)						6		6
	Valle Del Platanal (Platanal)						20		20
	El Quebraon						4		4
	Riecito Abajo						8		8
	La Guinea Arriba						3		3
	La Negrita						4		4
	Las Cruces						4		4
	Las Maravillas (P)						1		1
	Los Cerritos						4		4
	Los Rastrojos						3		3
	Samaria						1		1
	La Puente						14		14
	Boquilla De La Mina						3		3
	Boquilla De Quebraon						2		2
	Cigüa						5		5
	Santa Maria (P)						7		7
	Caño Sucio (Santa Maria O...)						1		1
	Cacique (El...)						3		3
9. Toabré									1836
	Chiguirí Abajo							35	35
	La Boca De Tulu							22	22
	Caðazas N‖ 1							14	14
	Alto De San Miguel							12	12
	Atre No.1 (P)							29	29
	Banazo Centro							18	18
	Banacito							24	24
	Banazo Arriba							5	5
	Bito							21	21
	Boca De Chiguirý							37	37
	Boca De Lura							34	34
	Boca De San Miguel							1	1

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Boca De Tucuú							35	35
	Cacaco (Cacao)							12	12
	Cañazas Nª 2							7	7
	Cerro Chica (Chica)							4	4
	Dominica							5	5
	Higueronal							10	10
	Altos Del Coco							32	32
	El Cucharo							1	1
	El Pajal							9	9
	El Guayabo (Toabre Abajo)							20	20
	Altos De Los Darieles							8	8
	Lourdes							27	27
	La Martillada							66	66
	La Mona D2							2	2
	Las Quebradas De U (Las Quebradas)							13	13
	Las Varitas							8	8
	Brazo De U (P1)							20	20
	Los Molejones D2							8	8
	Miraflores							134	134
	El Naranjal							83	83
	Santa Ana Abajo							42	42
	Santa Ana Arriba							6	6
	Ojo De Agua							26	26
	Paso Ancho							4	4
	Paso Real							38	38
	Quebrada Culebra							5	5
	Sabana Larga							47	47
	Sabaneta De U (P1)							11	11
	Sagreja							106	106
	San Miguel (P1)							8	8
	Tambo							135	135
	Tierra Buena D2							1	1
	Toabrè							112	112
	Tucuè							54	54
	Tucuecito							41	41
	U Centro D1							8	8
	Valle De San Miguel							49	49
	Bejuco							16	16
	Boquilla De Dominica							10	10
	El Caño De San Miguel							28	28
	Cuiria O San Francisco							17	17

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Chorrerita							17	17
	San Pedro Abajo (P2)							5	5
	San Jose							12	12
	San Pablo							17	17
	Atre Nª 2							17	17
	Boca De Guayabo							5	5
	Boca De Larguillo							4	4
	Cabecera De Quebrada La Tortuga							3	3
	Cabecera De Quebrada Los Manueles							1	1
	Cerro Venturilla							4	4
	El Pernal							2	2
	Guabal Arriba							10	10
	La Chispa							5	5
	Las Marias D2							12	12
	Los Pilares							9	9
	Monte Buena							4	4
	Quebrada El Clavo							3	3
	Quebrada El Corotu O Quebrada La Minga							6	6
	Quebrada El Tigre							1	1
	Quebrada La Tabila							5	5
	Quebrada La Vaca							4	4
	Quebrada Lajosa							4	4
	Quebrada Los Sules							3	3
	Quebrada Sardinosa							4	4
	San Miguel Nª 2							5	5
	San Miguelito							8	8
	San Pablo Abajo							8	8
	San Pablo Arriba							15	15
	El Bajito							46	46
	Cabecera De Rio Bito							1	1
	La Candelaria							76	76
10. Tulú									
	Boca De Cuiria							23	23
	La Marina							22	22
	Buena Vista							16	16
	La Tulua (P1)							31	31
	Lubre							6	6
	Lura Centro							56	56
	Lura Arriba							23	23
	Tulu Abajo							9	9
	Tulu Arriba							16	16

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Alica							1	1
	Chicagua							3	3
	Gato Espino							4	4
	Nuevo San Pablo							20	20
	San Isidro							24	24
	Tul· Centro							50	50
	Union Santeða							10	10
	La Boca De Tulu (P)							2	2
	Nuevo Rosario							10	10
	Nuevo San Antonio							19	19
	Piedra Amarilla D2							2	2
	Agua Fria							3	3
	Los Villarretas							4	4
	Tacuma							3	3
Colón									0
Chagres									0
11. La Encantada	El Dominical	2							2
	El Lim¾N No.1 (P)	27							27
	Torno Abajo	3							3
	El Jordan	4							4
	Piedra Amarilla	5							5
	El Tornito	12							12
	Tres Hermanas (1)	1							1
	El Torno	5							5
	Quebrada Los Cedros	1							1
	Cerro Benito	1							1
	Los Frailes	9	9						9
	Cerro Hinojal	4							4
	Los Uveros (P)	10	10						10
Donoso									
13. Coclé del Norte	Cerro Verde							11	11
	Santa Elena							13	13
	La Inglesa							1	1
	La Tomasa							1	1
	Boca De La Encantada (P2)							8	8
	El Desfiladero							1	1
	Los Tres Cabos.							2	2
	Quebrada De Los Nietos							1	1
14. El Guásimo	Boquiila De Escobal						3		3
	Chorrerita						2		2
	Los Chorritos De Santa Maria						3		3

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Cerro Miguel De Donoso						13		13
	Las Maravillas (P)						12		12
	Santa Maria (P)						1		1
	Las Cruces						2		2
	La Raspadura						5		5
Panamá									
Capira.									
19. Cirí de Los Sotos									132
	Alto Del Naranjo	7	7	7					7
	La Bonga o El Cruce (El Bongo Arriba)	12	12	12					
	Cerro El Clavo	2	2						2
	Los Uveros (P)	10	10						10
	Los Uveros Arriba	8	8						8
	Quebrada La Conga Arriba (Quebrada La Conga)	12	12	12					12
	Riecito Abajo	2	2						2
	Santa Rosa No.1 (P1)	8	8	8					8
	Teria No.3	8	8	8					8
	Tres Hermanas (3)	48	48	48					48
	Tres Hermanas Arriba	4	4	4					4
	El Hinojal Arriba	7	7						7
	Quebrada La Conga Abajo	9	9						9
	El Ahogado	2	2	2					2
	El Zahino	5	5						5
20. Cirí Grande	El Cedro	3	3	3	3				3
	Caracolar	10	10	10	10				10
	Rýo Indio Centro	27	27			27			27
	Jordanal (Quebrada Jordanal)	32	32			32			32
	Teria	29	29	29	29				29
	Las Claras Arriba	70	70						70
	Quebrada Aguacate	1	1	1	1				1
	Quebrada Escobal	4	4	4	4				4
	Rýo Indio De Los Chorros	29	29						29
	Teria Nacimiento (P2) (Teria Arriba)	13	13	13	13				13
	Bajo Grande (Teriacito)	10	10	10	10				10
	Rio Indio Nacimiento	9	9			9			9
	Pacorita	3	3	3	3				3
	Boca De Escobal	2	2	2	2				2
	Cerro San Andres	4	4	4	4				4
	Ciricito Arriba (P) (...Abajo)	32	32	32	32				32

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Arenilla (Quebrada Arenilla)	20	20			20			20
	Rio Indio Cabecera	10	10			10			10
	El Ahogado	9	9	9	9				9
	Rio Indio Arriba (P1)	9	9			9			9
	Teriacito	1	1	1	1				1
	Escobalito	1	1	1	1				1
21. El Cacao	Teria Nacimiento (P1) (Teria Arriba)	12	12	12	12				12
22. Santa Rosa	Bajo Bonito	1	1						1
	Bella Vista O La Sanguijuela	22	22	22					22
	El Ahogado O El Almendro	22	22	22					22
	La Pita	10	10						10
	Las Claras Abajo	14	14						14
	Las Claras Centro	6	6						6
	Los Raudales (P)	13	13	13					13
	Nuevo Limon	12	12	12					12
	Quebrada Bonita (La Cachorra)	10	10						10
	Quebrada Limon	7	7	7					7
	Riecito Abajo (P1)	27	27						27
	Riecito Arriba	10	10	10					10
	San Juan (1)	6	6						6
	Santa Rosa No.1 (P2)	21	21	21					21
	Santa Rosa No.2	40	40	40					40
		1346	955	382	134	182	293	3487	5126

Option 1 (INDIO 80-40)

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	11	**698,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	3	**151,500**
Recreative Area			0	1900	0.50	950	**950**	6	**5,700**
Cemetery			0	1560	0.50	780	**780**	8	**6,240**
Church	129	250	32,250	200	0.50	100	**32,350**	15	**485,250**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	9	**135,450**
								E =	**1,482,640**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents	**1.00**	90,000	**90,000**
Dry seasons	**18.80**	20,000	**376,000**
Footpath	**71.80**	2,000	**143,600**
		C =	**609,600**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	**Unitary Cost**		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5,000		**5,000**	3	**15,000**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Woody (Peatonal ¿?)	**2,000**	0	**-**
Bridge of Concrete	meters	0	2,000	two ways	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	8	**12,000**
Kiosk (Traded)	m^2	20	50		**1,000**	16	**16,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**	3	**21,000**
Tank of storage	Gallon	**5000**	1		**5,000**	2	**10,000**
						I =	**74,000**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **2,166,240**

Option 2 (INDIO 45-40)

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M²**	**B/.-M²**	**S Total 1**	**M²**	**B/.-M²**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	3	**190,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	1	**50,500**
Recreative Area			0	1900	0.50	950	**950**	4	**3,800**
Cemetery			0	1560	0.50	780	**780**	4	**3,120**
Church	129	250	32,250	200	0.50	100	**32,350**	6	**194,100**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	4	**60,200**
								E =	**502,220**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents		90,000	**0**
Dry seasons	**8.70**	20,000	**174,000**
Footpath	**40.80**	2,000	**81,600**
			C = **255,600**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Units	Dimension	Unitary Cost		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5.000		**5,000**	2	**10,000**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	metros	8	250	Madera (Peatonal ¿?)	**2,000**	7	**14,000**
Bridge of Concrete	metros	0	2.000	Dos carriles	**-**	0	**-**
Woody Bridge	metros	3	500	Un carril	**1,500**	0	**-**
Kiosk (Traded)	m^2	20	50		**1,000**	7	**7,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**	0	**-**
Tank of storage	Galón	**5000**	1		**5,000**	0	**-**
						I =	**31,000**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **788,820**

Option 3: ALTO INDIO 50-40

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	1	**63,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**		**-**
Recreative Area			0	1900	0.50	950	**950**	2	**1,900**
Cemetery			0	1560	0.50	780	**780**	3	**2,340**
Church	129	250	32,250	200	0.50	100	**32,350**	2	**64,700**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	1	**15,050**
								E =	**147,490**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents		90,000	**0**
Dry seasons	**4.40**	20,000	**88,000**
Footpath	**8.40**	2,000	**16,800**
			C = **104,800**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	**Unitary Cost**		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5.000		**5,000**		**-**
Posts of light	0	-	0		**-**		**-**
Suspension bridge	meters	8	250	Madera (Peatonal ¿?)	**2,000**	3	**6,000**
Bridge of Concrete	meters	0	2.000	Dos carriles	**-**	0	**-**
Woody Bridge	meters	3	500	Un carril	**1,500**	0	**-**
Kiosk (Traded)	m^2	20	50		**1,000**	1	**1,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**	0	**-**
Tank of storage	Gallon	**5000**	1		**5,000**	0	**-**
						I =	**7,000**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **259,290**

Option 4: ALTO INDIO 45-40

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M²**	**B/.-M²**	**S Total 1**	**M²**	**B/.-M²**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	1	**63,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**		**-**
Recreative Area			0	1900	0.50	950	**950**	2	**1,900**
Cemetery			0	1560	0.50	780	**780**	3	**2,340**
Church	129	250	32,250	200	0.50	100	**32,350**	2	**64,700**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	1	**15,050**
								E =	**147,490**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents		90,000	**0**
Dry seasons	**3.60**	20,000	**72,000**
Footpath	**7.80**	2,000	**15,600**
			C = **87,600**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimensión	**Unitary Cost**		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5,000		**5,000**	0	**-**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Woody (Peatonal ¿?)	**2,000**	3	**6,000**
Bridge of Concrete	meters	0	2,000	two way	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	0	**-**
Kiosk (Traded)	m^2	20	50		**1,000**	1	**1,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**	0	**-**
Tank of storage	Gallon	**5000**	1		**5,000**	0	**-**
						I =	**7,000**

El tamaño del tanque de agua debe ser en volumen (galones)

Gran Total (E + C + I) = **242,090**

Option 5 (INDIO 80-40, CAÑO SUCIO 100-90)

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	11	**698,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	3	**151,500**
Recreative Area			0	1900	0.50	950	**950**	6	**5,700**
Cemetery			0	1560	0.50	780	**780**	8	**6,240**
Church	129	250	32,250	200	0.50	100	**32,350**	15	**485,250**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	9	**135,450**
								E =	**1,482,640**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents	**1.00**	90,000	**90,000**
Dry seasons	**18.80**	20,000	**376,000**
Footpath	**95.00**	2,000	**190,000**
		C =	**656,000**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	**Unitary Cost**		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5,000		**5,000**	3	**15,000**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Woody(Peatonal ¿?)	**2,000**	0	**-**
Bridge of Concrete	meters	0	2,000	two ways	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	11	**16,500**
Kiosk (Traded)	m^2	20	50		**1,000**	16	**16,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**	3	**21,000**
Tank of storage	Gallon	**5000**	1		**5,000**	2	**10,000**
						I =	**78,500**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **2,217,140**

Option 6: (INDIO 45-40, CAÑO SUCIO 100-90)

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	3	**190,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	1	**50,500**
Recreative Area			0	1900	0.50	950	**950**	4	**3,800**
Cemetery			0	1560	0.50	780	**780**	4	**3,120**
Church	129	250	32,250	200	0.50	100	**32,350**	6	**194,100**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	4	**60,200**
								E =	**502,220**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents		90,000	**0**
Dry seasons	**8.70**	20,000	**174,000**
Footpath	**64.00**	2,000	**128,000**
			C = **302,000**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	**Costo Unitario**		**Total por Unidad**	**Nº**	
Telephonic antenna	1	-	5,000		**5,000**	2	**10,000**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Woddy (Peatonal ¿?)	**2,000**	10	**20,000**
Bridge of Concrete	meters	0	2,000	two way	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	0	**-**
Kiosk (Traded)	m^2	20	50		**1,000**	7	**7,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**	0	**-**
Tank of storage	Gallon	**5000**	1		**5,000**	0	**-**
						I =	**37,000**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **841,220**

Option 7: (INDIO 80, TOABRÉ 95-50)

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	19	**1,206,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	5	**252,500**
Recreative Area			0	1900	0.50	950	**950**	11	**10,450**
Cemetery			0	1560	0.50	780	**780**	12	**9,360**
Church	129	250	32,250	200	0.50	100	**32,350**	21	**679,350**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	12	**180,600**
								E =	**2,338,760**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents	**1.00**	90,000	**90,000**
Dry seasons	**18.80**	20,000	**376,000**
Footpath	**127.20**	2,000	**254,400**
			C = **720,400**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	**Unitary Cost**		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5,000		**5,000**		-
Electric generation	0		2,000		**2,000**	1	**2,000**
Posts of light	meters	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Woddy (Peatonal ¿?)	**2,000**	0	**-**
Bridge of Concrete	meters	0	2,000	two ways	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	17	**25,500**
Kiosk (Traded)	m^2	20	50		**1,000**	22	**22,000**
Stop of buses	m^2	25	50		**1,250**		
Telephone box	1	-	7000		7,000	6	**42,000**
Tank of storage	Galón	**5000**	1		**5,000**	10	**50,000**
						I =	**141,500**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **3,200,660**

Option 8: (INDIO 45-40, TOABRÉ 95-50)

To introduce in these cells the quantity that corresponds to every type of building.

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	11	**698,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	3	**151,500**
Recreative Area			0	1900	0.50	950	**950**	9	**8,550**
Cemetery			0	1560	0.50	780	**780**	8	**6,240**
Church	129	250	32,250	200	0.50	100	**32,350**	12	**388,200**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	7	**105,350**
								E =	**1,358,340**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents	**0.00**	90,000	**0**
Dry seasons	**8.70**	20,000	**174,000**
Footpath	**96.20**	2,000	**192,400**
			C = **366,400**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimensión	**Unitary Cost**		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5,000		**5,000**	5	**25,000**
Electric generation			2,000		**2,000**	1	**2,000**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Wooddy (Peatonal ¿?)	**2,000**	16	**32,000**
Bridge of Concrete	meters	0	2,000	two ways	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	20	**30,000**
Kiosk (Traded)	m^2	20	50		**1,000**	13	**13,000**
Stop of buses	m^2	25	50		**1,250**		
Telephone box	1	-	7000		**7,000**	0	**-**
Tank of storage	Gallon	5000	1		**5,000**	8	**40,000**
						I =	**142,000**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **1,866,740**

Option 9: (INDIO 80-40, CAÑO SUCIO 100-90, TOABRE 100-90)

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	19	**1,206,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	5	**252,500**
Recreative Area			0	1900	0.50	950	**950**	13	**12,350**
Cemetery			0	1560	0.50	780	**780**	16	**12,480**
Church	129	250	32,250	200	0.50	100	**32,350**	22	**711,700**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	12	**180,600**
								E =	**2,376,130**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents	**1.30**	90,000	**117,000**
Dry seasons	**18.80**	20,000	**376,000**
Footpath	**176.70**	2,000	**353,400**
			C = **846,400**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	**Unitary Cost**		**Total by Unit**	Nº	
Telephonic antenna	1	-	5,000		**5,000**	3	**15,000**
Electric generation			2,000		**2,000**	1	**2,000**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Woddy (Peatonal ¿?)	**2,000**	0	**-**
Bridge of Concrete	meters	0	2,000	two way	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	25	**37,500**
Kiosk (Traded)	m^2	20	50		**1,000**	23	**23,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**	7	**49,000**
Tank of storage	Gallon	**5000**	1		**5,000**	13	**65,000**
						I =	**191,500**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **3,414,030**

Option 10: (INDIO 45-40, CAÑO SUCIO 100-90, TOABRÉ 100-90)

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	11	**698,500**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	3	**151,500**
Recreative Area			0	1900	0.50	950	**950**	11	**10,450**
Cemetery			0	1560	0.50	780	**780**	12	**9,360**
Church	129	250	32,250	200	0.50	100	**32,350**	13	**420,550**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	7	**105,350**
								E =	**1,395,710**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents		90,000	**0**
Dry seasons	**8.70**	20,000	**174,000**
Footpath	**145.70**	2,000	**291,400**
			C = **465,400**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	**Unitary Cost**		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5,000		**5,000**	6	**30,000**
Electric generation			2,000		**2,000**	1	**2,000**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Woody (Peatonal ¿?)	**2,000**	24	**48,000**
Bridge of Concrete	meters	0	2,000	two ways	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	0	**-**
Kiosk (Traded)	m^2	20	50		**1,000**	14	**14,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**		**-**
Tank of storage	Gallon	**5000**	1		**5,000**	11	**55,000**
						I =	**149,000**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **2,010,110**

Option 11: (TERIA, ALTO TERIA)

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	6	**381,000**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	2	**101,000**
Recreative Area			0	1900	0.50	950	**950**	5	**4,750**
Cemetery			0	1560	0.50	780	**780**	2	**1,560**
Church	129	250	32,250	200	0.50	100	**32,350**	6	**194,100**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	7	**105,350**
								E =	**787,760**

ITo introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents		90,000	**0**
Dry seasons		20,000	**0**
Footpath		2,000	**0**
			C = **0**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimensión	**Unitary Cost**		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5,000		**5,000**	1	**5,000**
Electric generation			2,000		**2,000**		**-**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Woody (Peatonal ¿?)	**2,000**	3	**6,000**
Bridge of Concrete	meters	0	2,000	two ways	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	0	**-**
Kiosk (Traded)	m^2	20	50		**1,000**	7	**7,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**		**-**
Tank of storage	Gallon	5000	1		**5,000**	2	**10,000**
						I =	**28,000**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **815,760**

Option 12: (TERIA, ALTO TERIA, INDIO CABECERA)

To introduce in these cells the quantity that corresponds to every type of building

	Construction			Terrain					
Buildings	**M^2**	**B/.-M^2**	**S Total 1**	**M^2**	**B/.-M^2**	**S Total 2**	**Total 1+2**	**Nº**	
School	250	250	62,500	2000	0.50	1000	**63,500**	6	**381,000**
Center of health	200	250	50,000	1000	0.50	500	**50,500**	2	**101,000**
Recreative Area			0	1900	0.50	950	**950**	5	**4,750**
Cemetery			0	1560	0.50	780	**780**	2	**1,560**
Church	129	250	32,250	200	0.50	100	**32,350**	7	**226,450**
Junta Comunal	60	250	15,000	100	0.50	50	**15,050**	7	**105,350**
								E =	**820,110**

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	**Km**	**B/.-Km**	
Permanents		90,000	**0**
Dry seasons		20,000	**0**
Footpath		2,000	**0**
		C =	**0**

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimensión	**Unitary Cost**		**Total by Unit**	**Nº**	
Telephonic antenna	1	-	5,000		**5,000**	1	**5,000**
Electric generation			2,000		**2,000**		**-**
Posts of light	0	-	0		**-**	0	**-**
Suspension bridge	meters	8	250	Woody	**2,000**	4	**8,000**
Bridge of Concrete	meters	0	2,000	two ways	**-**	0	**-**
Woody Bridge	meters	3	500	one way	**1,500**	0	**-**
Kiosk (Traded)	m^2	20	50		**1,000**	7	**7,000**
Stop of buses	m^2	25	50		**1,250**	0	**-**
Telephone box	1	-	7000		**7,000**		**-**
Tank of storage	Gallon	**5000**	1		**5,000**	2	**10,000**
						I =	**30,000**

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = **850,110**

ANNEX 4-B

Options	1	2	3	4						
Parameter	**Indio**	**Indio**	**Alto Indio**	**Alto Indio**	**Caño Sucio**	**Toabre**	**Toabre**	**Teriá**	**Alto Teriá**	**Cabecera I**
	x=80 - y=40	x=45 - y=40	x=50 - y=40	x=45 - y=40	x=100 - y=90	x = 100-y=90	x=95 - y=50	x=130-y=90	x=265-y=220	x=300-y=290
Acuenca (10^6 m^2)	381.00	381.00	262.00	262.00	111.00	727.00	727.00	94.00	35.63	60.86
Qmedio (m^3/seg)	25.80	25.80	17.70	17.70	7.50	40.80	40.80	7.41	3.35	6.44
Qs (m^3/m^2*año)	2.14	2.14	2.13	2.13	2.13	1.77	1.77	2.49	2.97	3.34
Y (10^6 m^3/año)	813.63	813.63	648.37	648.37	233.37	1,290.00	1,290.00	233.80	105.60	203.20
Vx (10^6 m^3)	1,577.00	404.00	126.60	86.40	73.00	1,131.00	850.00	285.00	245.00	20.00
Ax (10^6 m^2)	45.60	20.94	8.52	7.84	13.56	49.35	34.25	7.56	8.17	1.10
T (años)	1.94	0.50	0.20	0.13	0.31	0.88	0.66	1.22	2.32	0.10
Zx (metros)	34.58	19.29	14.86	11.02	5.38	22.92	24.82	37.70	29.99	18.18
$T^{0.75}$/3 Zx	0.016	0.010	0.007	0.007	0.026	0.013	0.010	0.010	0.021	0.003
Lpx (gr/m^2/año)	0.09	0.20	0.33	0.36	0.09	0.15	0.22	0.13	0.05	0.57
Lpx x 1.2	0.11	0.24	0.40	0.43	0.11	0.18	0.27	0.16	0.06	0.69
Lp/Zx	0.0032	0.0123	0.0266	0.0390	0.0202	0.0080	0.0107	0.0043	0.0019	0.0378
Fósforo (ug/l) (x)	0.0017	0.0024	0.0026	0.0029	0.0028	0.0024	0.0026	0.0017	0.0012	0.0022
clorofila a (ug/l)	0.15	0.23	0.25	0.28	0.27	0.23	0.25	0.14	0.09	0.20
Penetración luz (m)	-15.21	-15.14	-15.12	-15.09	-15.09	-15.14	-15.12	-15.22	-15.27	-15.16
Agotamiento Oxigeno	0.17	0.33	0.43	0.59	1.10	0.28	0.28	0.15	0.15	0.33

Options	5	6	7	8	9	10	11	12	Options		
Parameter	**CS-I (1)**	**CS-I (2)**	**T-I (1)**	**T-I (2)**	**T-CS-I (1)**	**T-CS-I (2)**	**Subbasin** Teriá	**Sub. Teriá** Cabec. Indio	**Parameter**	**Bayano** (62-50)	**Alhajuela** (77-61)
Acuenca (10^6 m^2)	381.00	381.00	381.00	381.00	381.00	381.00	94.00	94.00	Acuenca (10^6 m^2)	3,771.70	952.00
Qmedio (m^3/seg)	31.80	31.80	65.80	65.80	71.80	71.80	7.41	13.85	Qmedio (m^3/seg)	158.00	54.00
Qs (m^3/m^2*año)	2.63	2.63	5.45	5.45	5.94	5.94	2.49	4.65	Qs (m^3/m^2*año)	1.32	1.79
Y (10^6 m^3/año)	1047.00	1047.00	2103.63	2103.63	2337.00	2337.00	233.80	437.00	Y (10^6 m^3/año)	4,982.69	1,702.94
Vx (10^6 m^3)	1577.00	404.00	1577.00	404.00	1577.00	404.00	285.00	285.00	Vx (10^6 m^3)	4,787.10	765.00
Ax (10^6 m^2)	45.60	20.94	45.60	20.94	45.60	20.94	7.56	7.56	Ax (10^6 m^2)	352.90	49.00
T (años)	1.51	0.39	0.75	0.19	0.67	0.17	1.22	0.65	T (años)	0.60	0.32
Zx (metros)	34.58	19.29	34.58	19.29	34.58	19.29	37.70	37.70	Zx (metros)	13.57	15.61
$T^{0.75}$/3 Zx	0.013	0.008	0.008	0.005	0.007	0.005	0.010	0.006	$T^{0.75}$/3 Zx	0.017	0.009
Lpx (gr/m^2/año)	0.12	0.56	0.26	0.28	0.26	0.62	0.16	0.19	Lpx (gr/m^2/año)	0.11	0.33
Lp/Zx	0.0035	0.0290	0.0075	0.0145	0.0075	0.0321	0.0042	0.0050	Lp/Zx	0.0081	0.0211
Fósforo (ug/l) (x)	0.0016	0.0047	0.0020	0.0014	0.0019	0.0029	0.0016	0.0012	Fósforo (ug/l) (x)	0.0018	0.0030
Clorofila a (ug/l)	0.13	0.51	0.18	0.12	0.17	0.28	0.14	0.10	Clorofila a (ug/l)	0.16	0.29
Penetración luz (m)	-15.23	-14.86	-15.1823	-15.25	-15.20	-15.09	-15.22	-15.27	Penetración luz (m)	-15.20	-15.07
	0.16	0.47	0.18	0.25	0.17	0.36	0.15	0.13		0.39	0.45

Total load of phosphorus to the reservoir, in tons per year and in grams for m2 per year, from not punctual sources in the basin of the Indio river.

Forest Cover and Actual Use of the Soil	Reservoir Area (km^2) 80-40	Reservoir Area (km^2) 45-40	Watershed Area (km^2)	Coefficient of exportation (grams/m^2/year)	Loads (tons / year)
Urban			0.10	0.10	0.01
Agriculture			6.85	0.05	0.34
Grasslands and Stubbles			249.00	0.01	2.49
Forest			130.65	0.01	1.31
Total =	45.60	20.94	386.60		4.15
				loads of phosphorus 80-40 por m^2 =	0.09 gr/m2/year
				Load to 45-40 por m^2 =	0.20 gr/m2/year
				Loads to 40 por m^2 =	0.23 gr/m^2/year

ALTO INDIO

Forest Cover and Actual Use of the Soil	Reservoir Area (km^2) 50-40	Reservoir Area (km^2) 45-40	Watershed Area (km^2)	Coefficient of exportation (grams/m^2/year)	Loads (tons / year)
Urban			0.10	0.10	0.01
Agriculture			4.45	0.05	0.22
Grasslands and Stubbles			166.00	0.01	1.66
Forest			91.85	0.01	0.92
Total =	8.52	7.84	262.40		2.81
				loads of phosphorus 50-40 por m^2 =	0.33 gr/m^2/year
				Load to 45-40 por m^2 =	0.36 gr/m2/year

TERIA

Forest Cover and Actual Use of the Soil	Reservoir Area (km^2)		Watershed Area (km^2)	Coefficient of exportation (grams/m^2/year)	Loads (tons / year)
Urban			0.10	0.10	0.01
Agriculture			1.90	0.05	0.10
Grasslands and Stubbles			55.59	0.01	0.55
Forest			36.43	0.01	0.36
Total =	7.56		94.02		1.02
				loads of phosphorus by m^2 =	0.13 gr/m^2/year

ALTO TERIA

Forest Cover and Actual Use of the Soil	Reservoir Area (km^2)		Watershed Area (km^2)	Coefficient of exportation (grams/m^2/year)	Loads (tons / year)
Urban			0.10	0.10	0.01
Agriculture			0.24	0.05	0.01
Grasslands and Stubbles			19.55	0.01	0.20
Forest			15.74	0.01	0.16
Total =	8.17		35.63		0.38
				loads of phosphorus by m^2 =	0.05 gr/m^2/year

INDIO CABECERA

Forest Cover and Actual Use of the Soil	Reservoir Area (km^2)		Watershed Area (km^2)	Coefficient of exportation (grams/m^2/year)	Loads (tons / year)
Urban			0.10	0.10	0.01
Agriculture			0.10	0.05	0.01
Grasslands and Stubbles			46.60	0.01	0.47
Forest			14.06	0.01	0.14
Total =	1.10		60.86		0.63
				loads of phosphorus by m^2 =	0.57 gr/m^2/year

Total load of phosphorus in tons a year to the reservoir, from punctual sources in the basin of the Indio river.

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	7,641	1.57 kg/person/day	12.00
Cow	7587	17.60 kg/cattlehead/year	133.53
Pigs	933	3.23 kg/cattlehead/year	3.01
Chicken	21382	0.09 kg/person/day	1.92
		Total =	150.47
		Loads / m^2 of Watershed =	0.389

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	7,641	1.57 kg/person/day	12
Cow	7587	17.60 kg/cattlehead/year	134
Pigs	933	3.23 kg/cattlehead/year	3
Chicken	21382	0.09 kg/person/day	2
		Total =	150.47
		Loads / m^2 of Watershed =	0.573

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	1979	1.57 kg/person/day	3
Cow	1522	17.60 kg/cattlehead/year	27
Pigs	176	3.23 kg/cattlehead/year	1
Chicken	6270	0.09 kg/person/day	1
		Total =	31.03
		Loads / m2 of Watershed =	0.330

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	713	1.57 kg/person/day	1
Cow	584	17.60 kg/cattlehead/year	10
Pigs	94	3.23 kg/cattlehead/year	0
Chicken	2354	0.09 kg/person/day	0
		Total =	11.91
		Loads / m2 of Watershed =	0.334

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	1036	1.57 kg/person/day	2
Cow	750	17.60 kg/cattlehead/year	13
Pigs	122	3.23 kg/cattlehead/year	0
Chicken	3026	0.09 kg/person/day	0
		Total =	15.49
		Loads / m2 of Watershed =	0.255

ANNEX 7-A

Report on the Workshops for Consultation on the Scope and Methodology for the Environmental Evaluation of the Water Options in the Indio, Caño Sucio and Toabré Rivers in the Western Region of the Panama Canal Basin

November 12 and 13, 2003, Room 315 of the Ascanio Arosemena Center

November 26, 2003

Table of Contents

1.0 Introduction

URS Holdings, Inc. (URS) was selected by the Panama Canal Authority (ACP) for the environmental analysis of water options in the Western Panama Canal Basin. The selection and signing of URS was a competitive process (Request of Offer # SAA-158332), under the negotiated offer for best value scheme. More specifically, under this contract URS will conduct the environmental analysis of the water resources in the rivers Indio, Caño Sucio and Toabré, previously identified by the ACP.

In accordance with the terms of reference, the work plan of this consultancy includes a presentation of the scopes and methodology for the environmental identification and evaluation of the possible impacts on representative entities of the different sectors of the country, including agencies of the the public administration of the Government of Panama, as well as representatives of Civil Society. This document has been prepared with the purpose summarizing what took place during the consultation process.

The document has four sections including this introduction. Section two describes the activities developed during the consultation workshops and the organizations that participated. Section three describes the commentaries and contributions made by participants in these consultation events and section four presents the conclusions and recommendations made at the end of the consultation. Also included is an annex of the presentations made by the ACP and URS and the identification and impact evaluation mythology** document as prepared by the URS prior to the consultation.

2.0 Description of Consultations

The consultations were held during two consecutive days, November 12 and 13 of 2003, in room 315 of the Ascanio Arosemena Learning Center, which is part of the ACP facilities in building 704 in Balboa. Both events started at approximately 8:30 AM and lasted until 1:00 PM. The objectives of these events were the following:

1. To present the results of recently concluded studies on the socioeconomic and environmental characterization of the ROCC that describe existing conditions in the area of study
2. To present the characteristics of the water options contemplated for the rivers Indio, Caño Sucio and Toabré;
3. To present the scopes and methodologies proposed for the environmental evaluation of the water options in the Indio, Caño Sucio and Toabré river basins; and

4. To hear comments from participants about those scopes and methodologies that will enrich the process of environmental evaluation for the mentioned options.

2.1 Workshop Participants

Workshop participants were institutions such as the national environment authority (ANAM), the ministry of housing (MIVI), the ministry of agricultural development (MIDA), Caritas Arquidiocesana, the NGO TECNOSERVE, and the Natura Foundation. Also present were representatives of the ACP and specialists from the URS. A complete list of participants is annexed to this document.

2.2 Summary of Workshop

The workshop program began with a presentation by the ACP thanking participants and asking for their active participation in the consultation process, which is highly valued by the ACP. After the introduction came a brief description of the workshop objectives and an opportunity for the participants to introduce themselves.

After the presentation all those present were allowed to make prepared presentations. In the first presentation the ACP described a brief list of the environmental studies related to the modernization of the Panama Canal that have been done or are in progress, indicating that the workshop's purpose is to present a methodology of environmental evaluation derived from one of those studies and subsequent comments about it. Finally it was established that consultation on the environmental evaluation of the water options in the western region of the Canal basin began in September and would conclude in June, 2004.

The second presentation was given by URS team members and it described the existing conditions of the ROCC. The description was based on information generated by the characterization of the biophysics and socioeconomics in the ROCC, recently carried out by consultants of the ACP, including URS.

Then the ACP proceeded to the third presentation in which the considered water options for the Indio, Caño Sucio and Toabré rivers were briefly described. Finally in the fourth presentation, members of the URS team presented the methodology for environmental evaluations for the water options in detail. As mentioned before, those presentations are included in the Annex.

The presentations were made to two institutional groups on 2 different days. The first day there was some confusion when participants thought the evaluation was ending, rather than beginning.

This was clarified and the consultation proceeded with excellent participation from the atendees.

At the end of the presentations a fruitful discussion ensued about aspects mentioned in the presentations and about suggestions made by participating guests. Comments were documented and URS provided an email address for those who wished to send additional comments and suggestions.

3.0 Comments from Participants

The participants made excellent points during and after the presentations. These observations were documented and later analyzed by the URS team, which grouped comments by subject. Comments from the MIDA representative were also received and these are detailed in the Annex.

Classification of comments by subject was organized into the following: those related to potential socio-environmental impacts and those that refer to preventive measures, mitigation and compensation from those impacts.

3.1 Comments Relating to Possible Socio-Environmental Impacts

Comments related to the characterization and possible impacts on biophysical, socioeconomic and cultural components of the ROCC and adjacent areas are listed below:

1. A more detailed evaluation of groundwaters is suggested. Also, that hydraulic regulation should be discussed in greater detail;

2. Risks associated with extreme events and contingencies should be included in the evaluation;

3. The Panamanian biological corridor and its possible fragmentation due to water options should be considered;

4. The fact that existing conditions in the region force many peasants to live and work on the sides of main rivers should be considered;

5. The precise quantity of earth to be excavated must be clearly stated and the final disposal sites and procedures;

6. The activities and actions that take place during various stages of water optimization

reflect positive effects (water provisions for the cities of Panama and Colon, and profits from ship passage through the Canal). Also, to remind others that during the drought of 1997 and 1998 water was not rationed for human consumption, but it was rationed for ship passage through the Canal, which shows that human use has a higher priority ;

7. To point out that the Canal is losing its competitive edge, and that as State policy, it must be modernized;

8. Some organizations are undermining the work done by social groups of the ACP in the region;

9. There is community resistance to dams; there is internal ideological maneuvering. Also that there are risks due to political opportunists and certain capitalists; "The latter are buying lands".

10. People in the eastern region have approached the ACP in search of the same compensation considered for the ROCC;

11. Lessons learned from recent cases in which communities have opposed hydraulic projects such as the irrigation project in Azuero be considered;

12. It is necessary to consider the possible effects of diverted waters on the marine resources of the Atlantic. Natural erosion already adds sediment to the estuaries that sustain mangroves and corals that create biodiversity and marine fauna. Fishing could be harmed and coastal economies affected. Further consultation with the Marine Authority of Panama (Doctor Franco) and the Institute for marine investigation of the University of Panama (Dr. Hansel Villaláz, Doctor Juan B. Gomez, Doctor Humberto Garcés) is suggested.

13. Besides the water options presented, the other alternatives must be studied in the event that national referendum does not approve the master plan.

14. A review of the study of hydrological regulation due to changes in plant coverage and other land uses by Doctor Ian Calder from the University of Newcastle, Director of the Centre for Land Use and Water Resources Research, is recommended

3.2 Comments Regarding Preventive Measures, Mitigation and Compensation

Comments related to strategies of prevention, mitigation and compensation for possible impacts are listed below:

1. People who are to be relocated must agree to the relocation site, as must the "receiving" or neighboring communities;

2. The development of options must be a step for communities to improve the conditions of isolation and poverty in which they live (social justice). The neighboring communities of the La Yeguada hydroelectric facility still have no electricity. Every four years before elections promises to complete the Tres Hermanas road are made but have yet to be kept;

3. Roads must not only be built to connect civil construction sites, rather they must be extended to favor surrounding communities. These communities must be taught how to maintain the roads;

4. "Improvements" or benefits derived from pending actions are perceived by families; "People have priority over the Canal";

5. Land use regulation, like that in place for the eastern region, must be considered and proposed for the ROCC. The environmental management plan must include soil conservation;

6. Grassroots community organizations that center on economic activity and have external contacts in the region must taken into consideration;

7. Continued support must be provided for projects and efforts taking place in the area. For example, the Natura Foundation has been technically assisting in the ROCC now for three years;

8. Proposed technical assistance must serve to orient communities towards environmentally beneficial activities such as forest farming, non-traditional farming (palmito, fruit trees), new technologies and fishing, among others. Among new technologies some suggestions include pulp for paper, bioenergy and the production of wood products and crafts;

9. To formulate and develop an awareness program for peasants and dissuades them from selling their land. So far, information on the subject has been provided to peasants but

there has been no campaign to get them to agree;

10. Continue working on community awareness;

11. Rather than focusing on relocation plans, an investment plan to overcome poverty must be made;

12. If no water option is chosen, there should be a sustainable development plan for the ROCC anyway;

13. Guidelines for environmental evaluation provided by international development banks should be followed in order to qualify for funds.

4.0 Conclusion and Workshop Recommendations

The analysis of the information shared during this two-day consultation prompted worthy participation, comments and suggestions about the analysis process and environmental evaluation of the water options of the ROCC. Some key aspects derived from this consultation process are mentioned below:

1. Workshop participants had an active participation and their contributions actively helped to accomplish the workshop objectives, that is, to receive feedback about the scope and methodologies of the environmental evaluations of the water options of the ROCC and enrich them with comments and suggestions;

2. Active and relaxed participation indicates that participants felt enthusiastic and receptive towards knowing more about water options and their effects;

3. Generally speaking, participants were in agreement about the methodology of the presented environmental evaluation of water options, as indicated by an email sent by a MIDA technician. However, comments will be considered according to the needs of each case;

A written letter of thanks was sent to each participant reiterating that their suggestions will be considered and including a written report of the presentations. Follow up must be given to each delegate from each organization in such a manner that those participants return to the next activities for the advancement of this and other efforts by the ACP in the interest of a Master Plan for the Modernization of the Panama Canal.