ENVIRONMENTAL IMPACT ASSESSMENT

ADDENDA

For

ARA MACAO Resort & Marina

To be located in:

Placencia peninsula, Stann Creek District

Prepared by:

June 2006

Table of Contents

Tables

Figures

1.0 Introduction

Ara Macao Resort and Marina is located in the South Stann Creek District just north of the Placencia Peninsula and south of Riversdale Village. Placencia Village is about 18 miles south of the project site while Seine Bight is approximately 10 miles from the project. The project lies on some 628 acres of undeveloped land previously owned by Mackinnon Belize Land and Development Limited.

Ara Macao is a proposed residential and commercial project, with an important tourism component. The proposed undertaking will result in increased population growth, increased visitation to the site, and an increase in the temporary and full time labor force. The project will comprise of the construction of a marina with various slips; a 260 room hotel; various beach condominiums along the marina in concert with villa homes; a 410 ft^2 commercial center, a casino and an 18 hole golf course.

An Environmental Impact Assessment (EIA) was prepared for Ara Macao and submitted to the National Environmental Appraisal Committee (NEAC) for review and commentary. Deliberations and discussions were held in accordance to the EIA process and the NEAC determined that further information be submitted in the form of an Addendum for additional clarification.

In view of this request, the following are inserts to be included into the final EIA document for Ara Macao. This *addendum* (as requested by the NEAC – **See letter from DOE**) was prepared as a result of various revisions and deliberations with the National Environmental Appraisal Committee, the affected community, the Project Owner and EIA Preparers. The following issues were addressed:

1. A proper pump test be conducted and the report submitted
2. Identify at least three additional water quality sampling sites in the north of the Placencia Lagoon and conduct water quality tests. These tests should account for seasonal variations and additional parameters as per the Terms of Reference.
3. Agreement with the Ministry of Works in regards to the rerouting of the Placencia Road
4. Land Tenure Agreement
5. Copy of the pre-sale agreement as was stated in the correspondences with respect to the advertisement on the Internet
6. Details of the servicing to be provided for water vessels within the Marina, including liquid and solid waste management
7. Details Sand Monitoring Program
8. Bathymetrical data and alignment of the jetties and marina access channel.

Insert Letter from DOE

BELIZE
Please Quote: PRO/DEV/02/193/05 (43)
Telephone Numbers: 822-2542/822-2816
Fax No. 822-2862
E-mail: envirodept@btl.net

Department of the Environment
10/12 Ambergris Avenue
Belmopan,
Belize C.A.

May 2, 2006

Jose Garcia
P.O. Box 806
Belize City

Dear Mr. Garcia,

Kindly be informed that the National Environmental Appraisal Committee (NEAC) met on April 12, 2006 to review the Environmental Impact Assessment (EIA) for Ara Macao Resort and Marina. The NEAC, a this meeting determined that prior to making a recommendation to the Department, the following information be submitted as an Addendum to the EIA for further review:

- A proper pump test be conducted and the report submitted;
- Identify at least three additional water quality sampling sites in the north of the Placencia Lagoon and conduct water quality test. These test should take into consideration seasonal variations and thus be conducted in both the dry and the wet season. In addition to the parameters request for as per the Terms of Reference, BOD and Hydrocarbons should also be included.
- Agreement with the Ministry of Works in regards to the rerouting of the Placencia Road;
- Land tenure documents;
- Copy of a pre-sale agreement as was stated in the correspondence with respect to the advertisement on the internet;
- Details of the servicing to be provided for water vessels within the marina, including liquid and solid waste management;
- Detailed Sand Monitoring Program;
- Bathymetrical data and alignment of the jetties and marina access channel.

In addition to the above, it is required that a Public Consultation Meeting be held in Seine Bight Village on May 3, 2006. A report of the Public Consultation meeting should also be included in the EIA Addendum.

Kindly have the above matters addressed and submit thirteen copies of the EIA Addendum to the Department of the Environment for subsequent dissemination to the NEAC members. The Department shall inform you of the next NEAC meeting upon receipt of the above requested information.

Thanks for you kind attention.

Sincerely,

Martin Alegria
Chief Environmental Officer
Department of the Environment

Issue 1

- A proper pump test be conducted and the report submitted

Aquifer and pumping tests were conducted on Ara Macao property along the Placencia road approximately half mile from Riversdale Village at the top of the Placencia Peninsula (**See Technical Report overleaf**). Constant rate pumping tests began at 12:00 midday on the 5th June 5, 2006 and concluded at 12:00 midday on the 6th June 5, 2006. Recovery data was collected immediately after the pumping test and concluded 6:00 p.m. on 6th June 5, 2006. The Ara Macao wells are within the northern portions of the Savannah Groundwater Province of Belize and tap a 18.29 meters (60 ft) aquifer confined by a 9.14 (30ft) clay aquiclude that is overlain with karstic and fractured cretaceous limestones and quaternary alluvial deposits.

Aquifer test indicate that the transmissivity of the pumped aquifers is 1.541 m^2/day. The storativity of the aquifer was calculated to be1.82 * 10^{-4} and the hydraulic conductivity 3.72 * 10^{-1} m/day. Aquifer transmissivity and storativity were generated using excel spreadsheets and the Cooper-Jacob modified Thies method.

The pumped well, 1A taps a 11.5 metres (38 ft) combination brown and gray sandy confined aquifer whose thickness extends from 26.517 metres (87 ft) to 38.1 metres (125 ft) below the surface. Observation Well 1B located 33.7 metres south east of well 1A taps a 5.486 metres (18 ft) thick semi confined aquifer whose limits area at 2.44 metres (8 ft) and 7.93 metres (26 ft) below ground level. Pre-pumping test static levels in wells 1A & 1B were 1.7272 and 1.83 meters below the top of casings references. Water levels were observed in the Sagitun well field 2.3 km northwest and the Laguna well 3.1 km south west of the pumped well. Well 1A was pumped at 366 gpm for a total 11.5 hours and full recovery in well 1A was observed for 50 minutes. Drawdown of the potentiometric surface in the pumping well and observation well 1B were 2.01 metres and 1.8 metres respectively. Drawdown in the Sagitun well field was 8.9 mm. The Laguna well is not connected to the aquifer being investigated and the pumpage had no impact on this well.

Analyses of the time drawdown graphs indicate that pumping at the rate of 366 gpm for 70 days will reduce the potentiometric surface by 6.0 meter below the reference level. At this rate the potentiometric surface will remain 18.75 metres above the top of the aquifer. These analyses assume that existing wells tapping this aquifer continued to operate normally.

No hydrogeologic barriers influencing well 1A's capacity to produce Ara Macao's 210 gpm water requirement were identified. No adverse impacts are expected from the required pumpage on the water supply for the neighbouring communities. Neither short nor long term risk to the integrity of the Savannah Groundwater Province can be expected from this pumping rate.

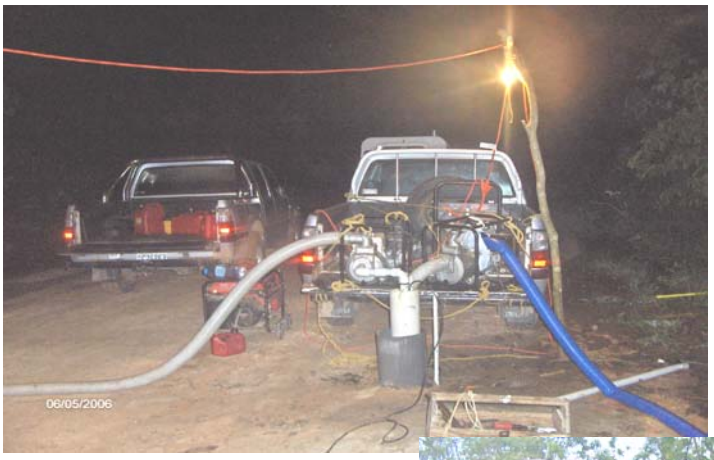
ARA MACAO AQUIFER PUMPING TESTS

Riversdale Area, Stann Creek District, Belize, Central America

TESTS CONDUCTED AND REPORTS PREPARED

FOR

Tunich-Nah Consultants & Engineering



BY: RUDOLPH S. WILLIAMS JR

June, 2006

EXECUTIVE SUMMARY

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No hydrogeologic barriers influencing well 1A's capacity to produce Ara Macao's 210 gpm water requirement were identified. No adverse impacts are expected from the required pumpage on the water supply for the neighbouring communities. Neither short nor long term risk to the integrity of the Savannah Groundwater Province can be expected from this pumping rate.

Table of Contents

I. Background

Ara Macao perforated two wells (1A & 1B) in order to investigate the feasibility of these wells to provide potable water to the project site. At a 100 % capacity, the project will have an initial demand of 324,000 gallons of potable water a day. Preliminary well rigger's report indicted that the well 1A had a flow of 200 gallons a minute.

With this in mind, a more comprehensive and detailed pumping test was carried out in order to evaluate the feasibility of the wells to suffice the entire project.

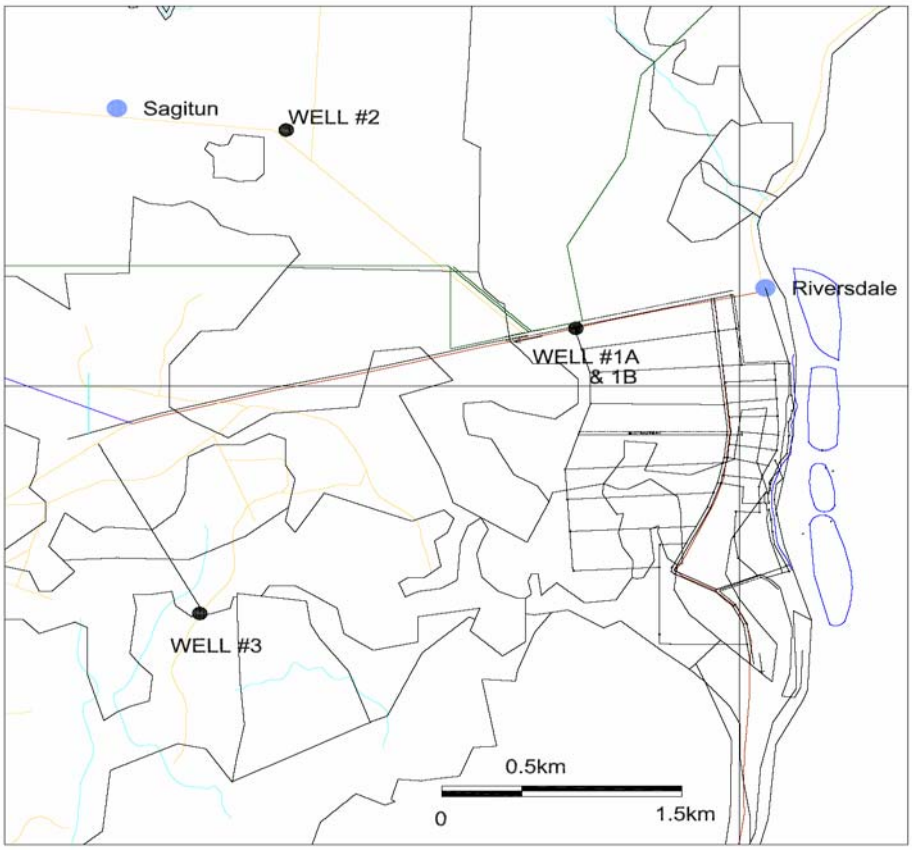
II. Purpose and goals of the Hydrogeologic Study

This aquifer and pumping test was conducted to determine the capacity of the well 1A on the northern end of the Ara Macao property near Riversdale on the northern end of the Placencia Peninsula. It was also conducted to determine the aquifer properties such as the Transmissivity and Storativity of the Savannah Groundwater Province in the region of the Ara Macao development. This study investigated the potential impact of the projected pumpage on water levels on the surrounding wells and the identification of the presence of nearby hydrogeologic barriers, specific recharge features that may influence this pumpage. Additionally, the tests assessed possible water quality changes consequent of the pumping.

III. Hydrogeologic Aspects of the Savannah Groundwater Province and Aquifer

A. Description of the Well Site and Water System

A description of the current and anticipated annual pumping demands was presented in the main Environmental Impact Assessment document. Included in that document are typical pumping schedules, frequency, duration, peak demand hours, and pumping rates of the pumped well 1A. The location and volume of water-storage facilities on and adjacent to the Ara Macao well site are also discussed in the document.



WELL LOCATION					
ID	E	N	STATIC LEVEL	WELL DEPTH	COMMENTS
WELL 1A	358980	1845417	3.55 ft	125 ft	Well to be pumped (see project well section)
WELL 1B	358989	1845388	3.9 ft	65 ft	Well to be monitored
WELL 2	357195	1846847	N/a	N/a	Three wells located in Sagitun Compound (one to be monitored)
WELL 3	356635	1843367	7.5 ft	67 ft	6 "Pvc Casing in Nova Shrimp farm (to be monitored)

Fig . 1: Well pumping and monitoring location

B. Geology & Aquifer Description

Geology

The Savannah Province extends along coastal Belize from the extreme south-eastern Belize district to extreme north-eastern Toledo District. This province extends along the eastern slopes of the Maya mountains to the coast. The aquifers in the northern portions of this

Province are confined and overlain with karstic and fractured cretaceous limestones and quaternary alluvial deposits.

Fig. 2: Geology Map of Belize

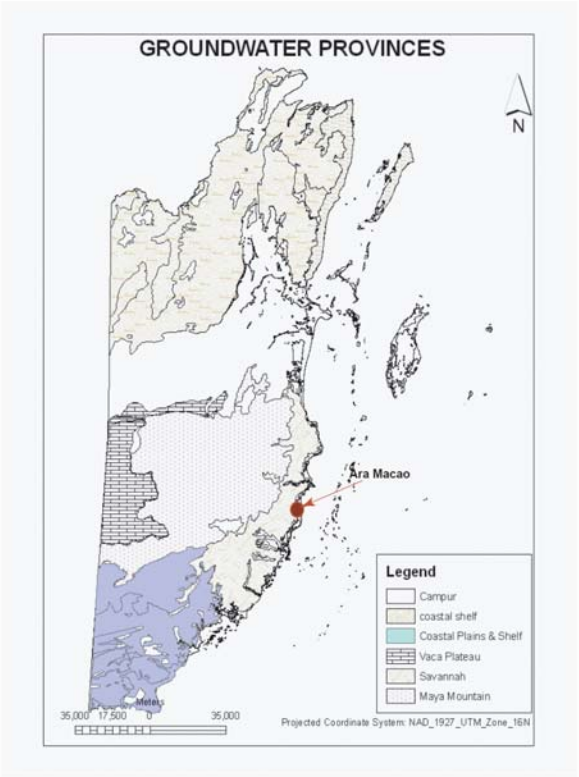


Fig 3: Groundwater Province of Belize

Savannah Groundwater Province

The Ara Macao project lies within the central coastal portions of the Savannah Province See Fig. 3. In this region of the province aquifers consist of mostly Eocene shales, claystones, marls, sandy shales, and calcareous sandstones overlain by quaternary alluvium.

Multiple aquifers exist within this province with the alluvium deposits forming the uppermost or phreatic aquifers. These phreatic aquifers found 3 to 8 metres below the surface are discontinuous and connected to rivers and streams extend westward and pinches out near the 40-metre contour. Immediate aquifer response can be expected to pumping, drought, and rainfall.

A second and lower 20 metres thick aquifer exists near 25 metres. Like the phreatic aquifers it extends westward up the slopes of the Maya mountains and pinches out near the 100 metres contour. This aquifer consists of primarily calcareous sandstone. This aquifer is confined by a clay aquiclude that pinches out westward below the 100 metre contour. It transcends the entire areal extent of the Province. The recharge is from rainfall in the vicinity of the exposed sandstone contact with the Maya Mountains. Wells tapping this Province penetrate to depths less than 65 metres with depths to water ranging from 8 to 33

metres. The potentiometric surface for this aquifer ranges from 2 to 8 metres below the surface depending on the surface features.

Lower confined aquifers near 115 meters were reported (Mr. Linares Farm Supervisor) near the Sagitun well field, however no separate corroborating information was found.

A thin freshwater lens exists along the Placencia Peninsula. This lens was overexploited and contaminated with effluents. This is not a viable source of freshwater.

C. Inventory of potential recharge and discharge locations

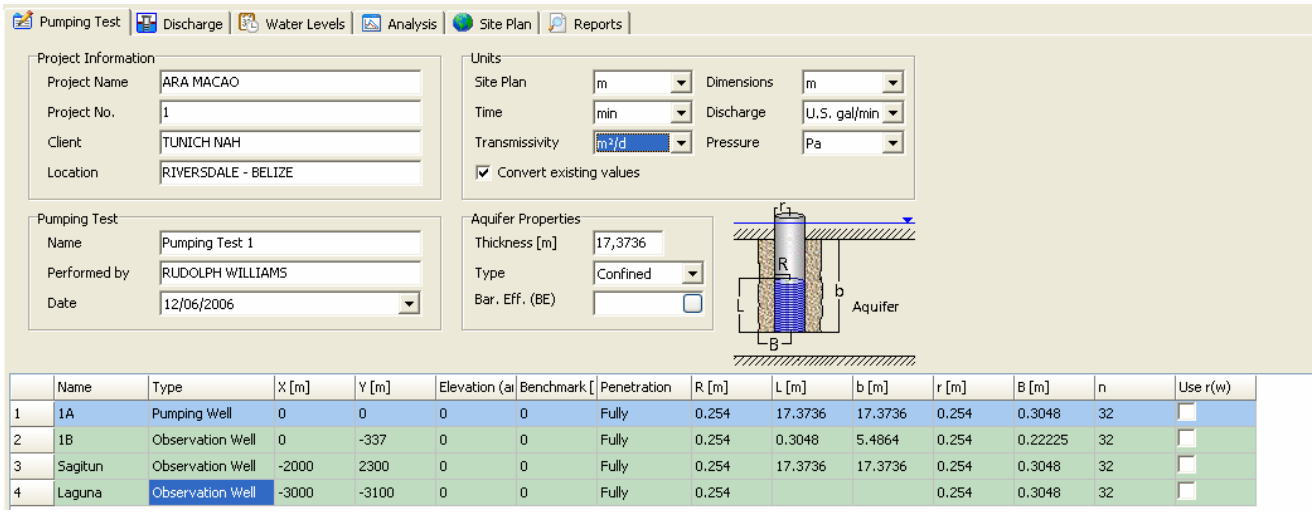
The aquifer under investigation is a confined one that has it recharge area on the slopes of the Maya mountains. Other water bodies in he area include the Placencia Lagoon and the swamps along the estuaries the empties into the same Lagoon. Wells southwest of the Ara Macao well field tap the same aquifer. This aquifer supplies the Mango Creek/Independence area, Big Creek, Placencia Village and Seine Bight. In addition this aquifer supplies many households and Resorts along he peninsula. Attempts to secure copies of the log for existing well were unsuccessful.

D. Design and Operation of Aquifer Test

Number and Location of Observation Wells

Production Well 1A

The production well, 1A, is a 0.3048 metre bore completed to a depth of 38.41 metres below ground level. A 24.834-metre 0.254-metre PVC well screen was installed throughout the full thickness (17.3736 metres) of the confined aquifer, the thickness of the aquiclude (5.7 metres), and 1.22 metres of the upper aquifer. The entire depth of the well above the confined layer was sealed with bentonite grouting to ensure that no down well flow occurs between both aquifers. The screen was packed with 32% porosity gravel.



	Name	Type	X [m]	Y [m]	Elevation (a	Benchmark [	Penetration	R [m]	L [m]	b [m]	r [m]	B [m]	n	Use r(w)
1	1A	Pumping Well	0	0	0	0	Fully	0.254	17.3736	17.3736	0.254	0.3048	32	
2	1B	Observation Well	0	-337	0	0	Fully	0.254	0.3048	5.4864	0.254	0.22225	32	
3	Sagitun	Observation Well	-2000	2300	0	0	Fully	0.254	17.3736	17.3736	0.254	0.3048	32	
4	Laguna	Observation Well	-3000	-3100	0	0	Fully	0.254			0.254	0.3048	32	

Fig 4: Well Specification

Observation Well 1B

Observation well, 1B was located 33.7 metres southwest of the production well 1A, was completed to a depth of 19.81 metres. It has a 3048 metre bore with 0.254 metre PVC casing. This well has 12.19 metres of 0.254 metre well screen of which .3048 metres is in the upper aquifer. This well is sealed with bentonite grouting from the top to a depth of 10.67 metres.

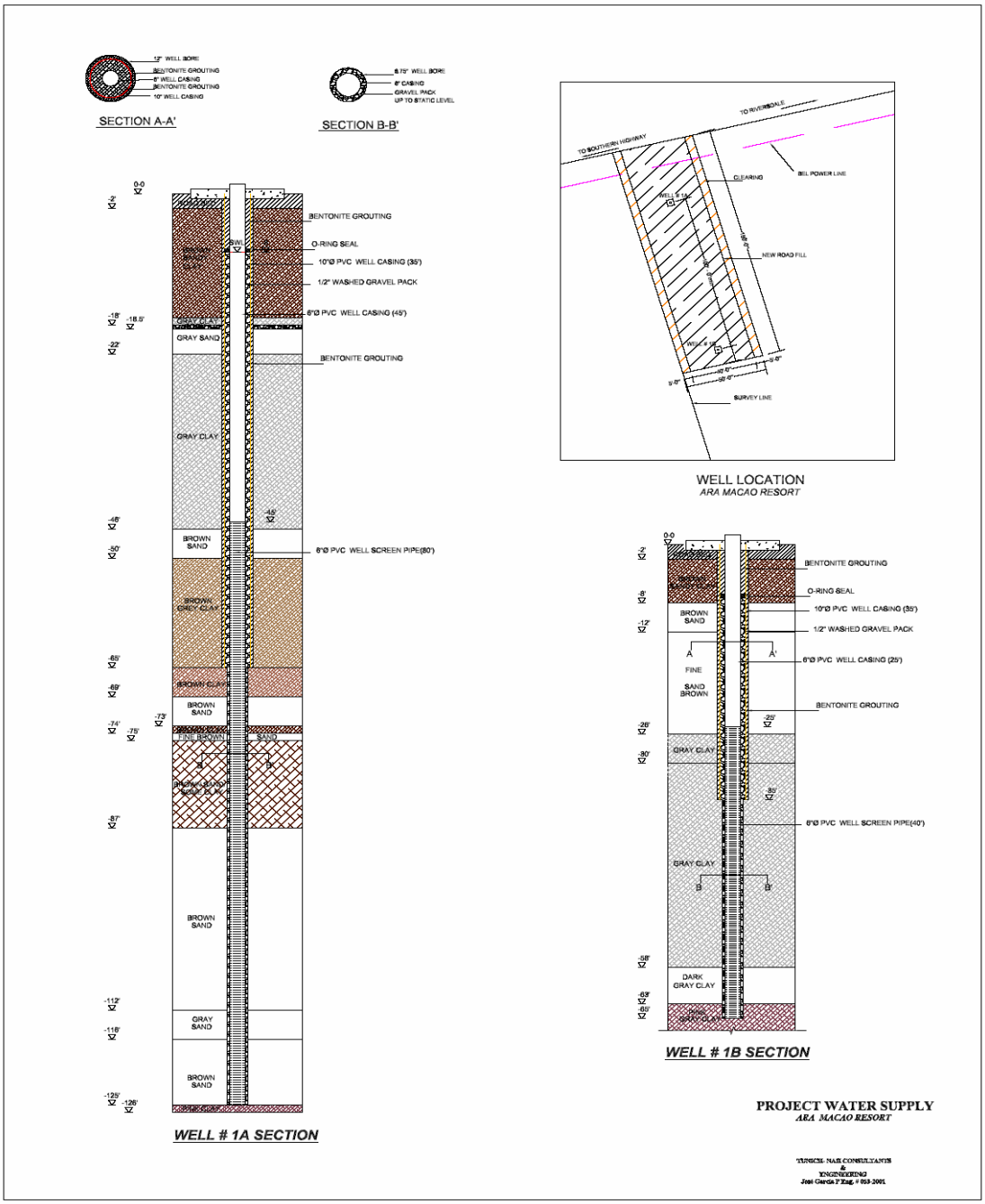


Fig. 5: Ara Macao Well Section

Sagitun Well

The Sagitun well is one of four within the Sagitun well field which is located 2300 metres northwest of the production well1A. This well was completed to depth of 48.77 metres. This well has a 0.3048 metre bore and 0.254 PVC metres casing. The 0.254 slotted PVC screen penetrates the full thickness of the aquifer (reported by Farm supervisor Mr. Linares) is at 21.34 metres below the surface.

Laguna Well

The Laguna well is 3100 metres to the south west of the production well 1A. It is located at the entrance of the abandoned Laguna Madre Shrimp Farm. This well is approximately 20.4 metres deep with a 0.3048 metre bore and a 0.254 metre PVC well casing. The length of the casing and the type and size of screen is not known.

Duration and Pumping Rate of the Aquifer Test

The pumping was conducted in production well 1A using two gasoline powered Honda model E60 capable of producing a combined rate of 600 gal min^{-1}. Pumps were started on June 05, 2006 at 6:30 p.m. and were stopped on June 06, 2006 at 5:57 a.m. when there was no significant changes in the drawdown in Well 1A.

The duration of the pumping was a total of 11 hours and 27 minutes. The average pumping rate was 366 gal min^{-1} while the maximum was 386.01 gal min^{-1} and the minimum rate was 347.14 gal min^{-1}. This rate was 43% below the pumps' ratings. The pumping rate was 74% higher than the required 209 gal min^{-1} and as such stresses the aquifer sufficiently to predict the long term response and impacts to the neighbouring wells. At 366 gal min^{-1} the volume of water pumped during the test period was 251,442 gallons.

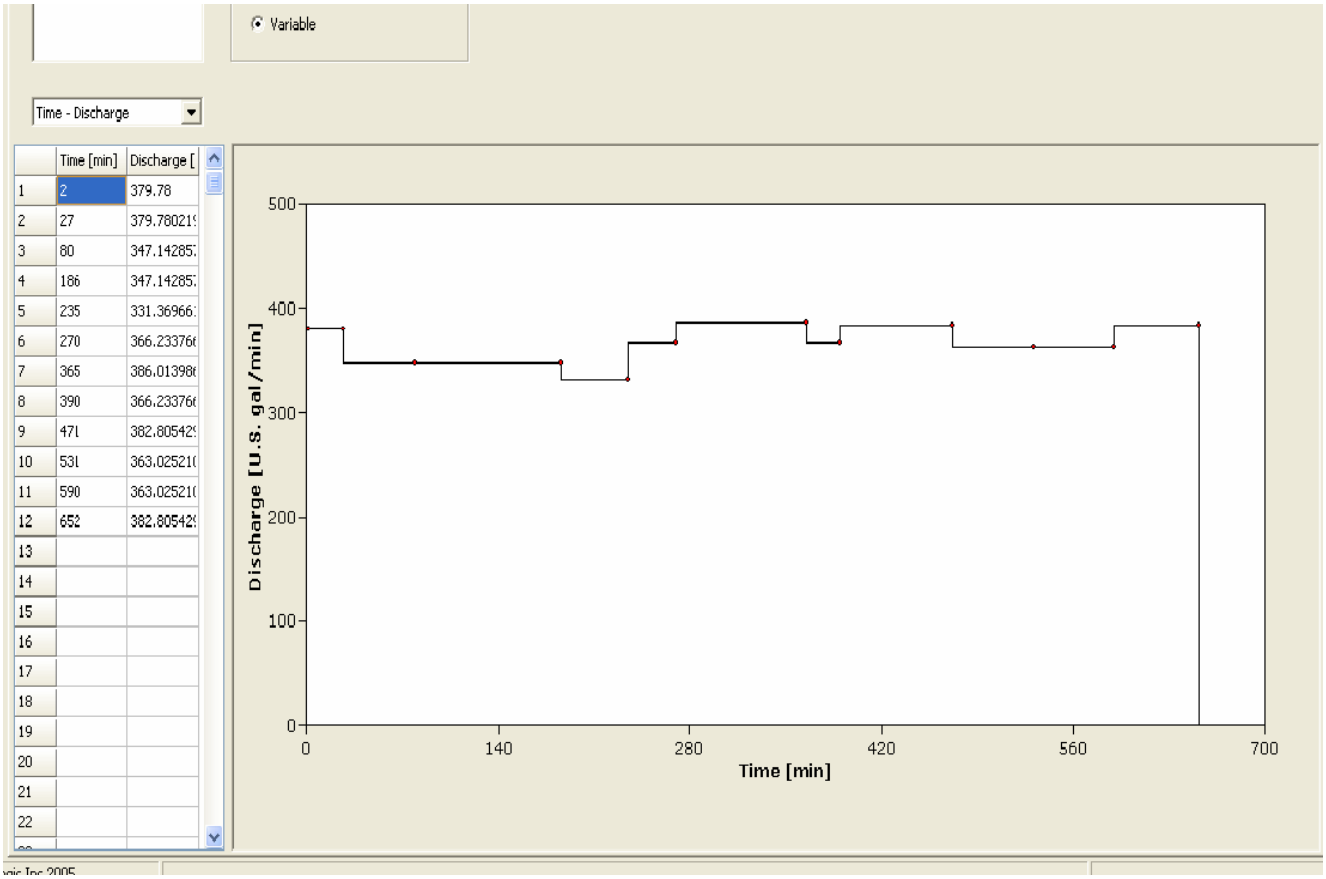


Fig 6: Discharge Results

During the aquifer test, discharge was measured from both pumps within a few minutes of each other. The container method was used to determine the pumps' discharges. A 60 gallon polyurethane tank and a stop watch we used to determine the discharges. During the 11 hours and 27 minutes 12 discharges were taken to determine the rate. Discharged water was routed toward surface drains along the Placencia access road and then to the lagoon. The pumped aquifer is confined and no aquifer recharge due to the surface discharge was expected.

	Water Solutions 1145 Cottonwick Street Belize City Belize +501-223-6544 +501-606-3578 rudolph_williams@hotmail.com	**Pumping Test:** **Discharge Data** Method: 60 gal. Container/ Stop Watch Project : Ara Macao Number: 1 Client : Tunich Nah

Location: Riverdale, Stann Creek District - BELIZE	Pumping Test: Pumping Test 1	Pumping Well:1A
Test Conducted by: Rudolph Williams Jr.		Date: 05/06/2006
Analysis performed by: Rudolph Williams Jr.	Theis	Date: 05/06/2006
Aquifer thickness: 17.37 metres	Discharge: variable, average rate 340 [U.S. gal/min]	

Clock Time	Time [s]		Volume [gal]		Time elapsed	Discharge [U.S. gal/min]	Remarks
	Pump 1	Pump 2	Pump 1	Pump 2			
6:30	32	35	112.5	102.857	00:02	215.3571	
6:57	35	13	276.923	102.857	00:27	379.7802	
7:32							Sample 1
7:50	14	40	257.143	90.00	01:20	347.1429	
9:36	14	40	257.143	90.0	03:06	347.1429	
10:25	14	48.5	257.143	74.227	03:55	331.3697	
11:16	33	14	257.143	109.091		366.2338	
12:00							Sample 2
12:35	33	13	109.091	276.923	06:05	386.014	
13:00	33	14	109.091	257.143	06:30	366.2338	
14:21	13	34	276.923	105.882	07:51	382.8054	
15:21	13	34	257.143	105.882	08:51	363.0252	
16:20	14	34	257.143	105.882		363.0252	
17:15							Sample 3
17:22	13	34	276.923	105.882	10:52	382.8054	
Average	18.42	32.88	225.36	127.22		352.58	

Table 1: Pump Discharge

Water-Level Data

Static water levels were collected for all wells prior to the commencement of the pumping test. Static water levels were collected from Wells 1A and 1B on May 26 and 30, 2006 and were identical to June 05, 2006 static water levels. All water level measurements were referenced to the top of the well casings.

During the pumping test water levels were monitored using measuring tapes and transducers and data-loggers. Transducers and data loggers were installed in Wells 1A, Sagitun, and Laguna. As a precaution against logger malfunction water levels were also monitored manually in well1A. Well 1B was monitored using measuring tape. Data loggers were configured to collect data at a one minute interval and later adjusted to meet recommendations as per Driscol (1986). Manually collected water level data was collected from wells 1A and 1B as per Driscol (1986).

Time Since pump Started (or Stopped) [min]	Time Intervals between measurements [min]
0 10	0.5 – 1
10 - 15	1
15 - 60	5
60 - 300	30
300 - 1440	60
1440 – termination of test	480 (8 hr)

Table 2: Standard schedule of monitoring pumping well as per DRISCOL

The precision of tape measured water levels were within 0.01 metres and the transducers and data-loggers were within 0.0001 metres.

A shower lasting approximately 75 minutes was experienced 7 hours into the pumping. Since the pumped aquifer is a confined one, and recharge is believed to be on the slopes of the Maya Mountains, the shower is not expected to have any influence on the water levels at time of pumping.

Drawdown of the potentiometric surface in the pumped well, 1A was 2.0129 metres. In observation well1B drawdown was 0.80 metres. Drawdown in the Sagitun and Laguna wells were 0.00892 and 0.031 metres respectively. That is the Sagitun well was drawdown was 8.9 millimetres and the Laguna well drawdown was 3 centimetres.

Water Samples

During the pumping three water samples were taken to determine if the pumping impacted the water quality. Samples were taken at the beginning, midway and at the end of the pumping. All the samples were sent to an accredited DOE laboratory. The results are indicative of fresh pristine ground water (see Annex III). The total hardness content was less than 8.0 ppm and the TSS values was less than 3.0 ppm making this water exceptional. This water is an excellent source for the project.

Recovery Data

Recovery data was collected from wells 1A and 1B using measuring tapes and in Sagitun and Laguna using transducers and data-loggers. As per Driscol (1986) recovery data in

wells 1A and 1B were collected with the same frequency as those taken during the pumping portion of the aquifer test.

Well 1A fully recovered to the initial static level within 50 minutes of shutting down the pumps. Well 1B was 93 % recovered at the termination of the pumping test. The Sagitun and Laguna wells levels were fully recovered when the data-loggers and transducers were removed 40 and 80 minutes after shutting off the pumps.

E. Analyses of Aquifer Test Data

1. Transmissivity and Storage coefficients

The transmissivity and Storativity were calculated using the Theis equation modified by Cooper and Jacob (1946). This modified non-equilibrium Theis equation assumes that t is sufficiently large and r is sufficiently small that the well function can be replaced with the logarithmic terms.

Cooper-Jacob Modified Theis Equation $$T = \frac{0.183Q}{\Delta s},$$

Where

T = coefficient of transmissivity in m 2/day
Q = pumping rate in m3/day
Δs = slope of the time drawdown between any two log cycles

Coefficient of storage is calculated using $$S = \frac{2.25Tt_0}{r^2}$$

Where

S = the storage coefficient [ ]
T = coefficient of transmissivity in m^2/day
t_o= intercept of the straight line at zero drawdown in days
r = distance I metres from the pumped well to the observation well

The Hydraulic Conductivity was determined using $$K = \frac{Q \log \frac{r_2}{r_1}}{2.73b(h_2 - h_1)}$$

Where

K = the Hydraulic Conductivity
r_1 = distance to nearest observation well
r_2 = distance to farthest observation well
b = thickness of the aquifer
h_2 = head in the farthest observation well
h_1= head in nearest observation well

Using the Cooper- Jacob equation and drawdown data from observation well **1A**.

$$T_{1A} = \frac{0.183Q}{\Delta s} = \frac{0.183 * 1994.7 \frac{m^3}{day}}{0.2368} = 1541.51 \frac{m^2}{day}$$

Storage coefficient for well 1A is

$$S_{1A} = \frac{2.25Tt_0}{r^2} = 2.25*1541.51\frac{m^2*0.002778day}{day*2300^2} = 1.821*10^{-4}$$

The Hydraulic Conductivity for well **1B**

$$K_{1B} = \frac{Q\log\frac{r_2}{r_1}}{2.73b(h_2-h_1)} = \frac{1994.7\frac{m^3}{day}*\log\left(\frac{2300}{.254}\right)}{2.73*17.3736\,m*(2.16535-1.7272)m} = 3.72*10^2\frac{m}{day}$$

Using the Cooper- Jacob equation and drawdown data from observation well **1B**.

$$T_{1B} = \frac{0.183Q}{\Delta s} = \frac{0.183*1994.7\frac{m^3}{day}}{0.196} = 1862.40\frac{m^2}{day}$$

The storativity for well **1B** is calculated using

$$S_{1B} = \frac{2.25Tt_0}{r^2} = 2.25*1730\frac{m^2*0.10417day}{day*1135.69} = 3.57*10^{-2}$$

The Hydraulic Conductivity for well **1B**

$$K_{1B} = \frac{Q\log\frac{r_2}{r_1}}{2.73b(h_2-h_1)} = \frac{1994.7\frac{m^3}{day}*\log\left(\frac{2300}{33.7}\right)}{2.73*17.3736\,m*(2.16535-1.82)m} = 2.2335*10^2\frac{m}{day}$$

The pumpage did not impact the Laguna and Sagitun wells, hence no aquifer parameters were calculated for those wells.

F. Evaluation of Potential Water-Level and Quality Impacts

The effects of pumpage from the investigated wells on the aquifer and surrounding wells must be evaluated.

1. The hydraulic conductivity for Ara Macao wells 1A an 1B have $2.2335*10^2$ an $3.57 * 10^2$ m/day coroborrate the well driller's lithology log of fine to coarse sandy aquifer. Driscol puts that aquifer type in the range of $10^{-1} – 10^4$.

2. Transmissivity for Ara Macao wells 1A and 1B were $1.541 * 10^3$ and $1.86 * 10^3$ m^2/day. Transmissivity indicates how much water will move through the aquifer. Driscol (page 211) suggests that wells with transmissivities greater than or equal to 124 m^2/day can yield adequate water for industrial, municipal or irrigation purposes.

3. Storativity indicates how much water can be removed by pumping or draining. Freeze and Cherry (page 60)suggests that storativities are greatest in confined aquifers and great head over extensive areas are required to produce substantial

yields. On page 61 Freeze and Cherry put confined aquifer storativities in the 0.005 and0.00005 range. Ara Macao well have storativities of $1.82*10^{-4}$ and $3.57*10^{-2}$ and The Ara Macao potentiometric surface near Wells 1A and 1B is 24.75 metres above the top of the aquifer.

4. The maximum measured drawdown of the potentiometric surface in well 1A was 2.01 metres and 0.8 metres in well 1B. Drawdown in the Sagitun well was 8.9 millimetres. The Laguna well showed a 7 cm drawdown 4.5 hours into the pumping and increased 9.3 cm above the previous drawdown 9.5 hours into the test. The Laguna well was completed at a depth of 20.43metres and hence it is highly probable that this well is not connected to the confined aquifer. The pumpage at well 1A had no impact on this well. It is highly probable that the Sagitun well, completed at a depth of 160 feet, tap the same aquifer that the pumped well 1A taps. The magnitude of the drawdown in the Sagitun well is negligible and may be the consequence of barometric changes in the atmosphere.

5. Extension of the time-drawdown graphs can be used to predict future water-level declines for a given time period and pumping rate. At 366 gal min^{-1} and not accounting for other pumpages the potentiometric surface in the Ara Macao well field will fall 0.8 metres in 6.9 days. At this level the surface will be still be 21.94 metres above the top of the aquifer. Furthermore, at the same rate for 70 days the potentiometric surface will fall 6 metres and remain 18.75 metres above the top of the aquifer.

6. Water quality parameters monitored and analysed for this pumping test indicate that there was no significant variation or trend during the test. Taste and visual tests indicate that the water is soft palatable, clear and without odor. The laboratory tests results confirm that the water is of excellent quality. With exception of a slight increase in chlorides and hardness there were no discernible trends in the water quality result for samples taken during the pumping.

G. Conclusion

The Ara Macao wells 1A and 1B have the capacity to provide and suffice the entire project with the required 210 gal min^{-1} and more.

Drawdown in the confined aquifer will not adversely affect other users with a 3 kilometer radius of the wells.

The production from well 1A can be increased without reducing the elevation of the potentiometric surface.

There are no hydrogeologic barriers within the radius of influence of well 1A. Pumping at the test rate will not adversely impact the excellent quality of the water.

There is limited or no recharge of the aquifer from overlying aquifers, aquicludes, streams or lagoon systems.

Recharge is via the expose aquifer near the contact surface with the Maya Mountains.

H. Recommendations

It is recommended that all well in the general area of the project, Placencia Village, Mango Creek be registered and their characteristics documented.

All well tapping this Groundwater Province should be metered.

All abandoned wells should be decommissioned to ensure no contamination of the aquifer systems.

I. Supplemental Information

Transmissivity. The rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient. Transmissivity values are given in gallon per minute through a vertical section of a aquifer one foot wide and extending the full saturated height of an aquifer under a hydraulic gradient of 1 in English Engineering system; in International System, transmissivity is given in cubic metres per day through a vertical section of a aquifer one metre wide and extending the full saturated height of an aquifer under a hydraulic gradient of 1.

Coefficient of Storage. The volume of water an aquifer releases or take into storage per unit surface area of the aquifer per unit change in head.

References

Driscol, Fletcher, 1986 Groundwater and Wells, Johnson Division, St Paul Minnesota

Kruseman & Ridder, 1983, Bulletin 11:Analysis and Evaluation of Pumping Test Data' International Institute for Land Reclamation and Improvement/ILRI.

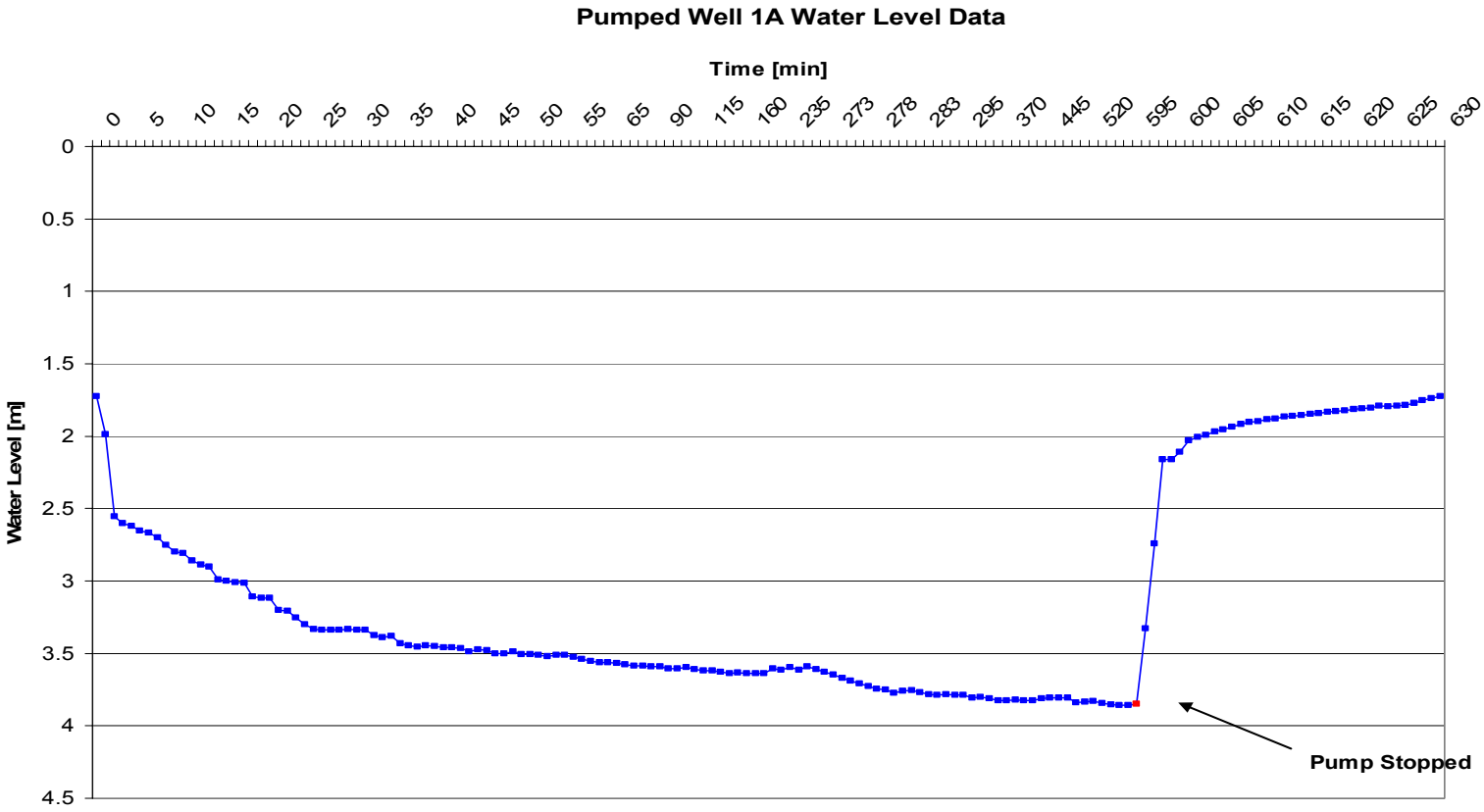
Freeze & Cherry, 1979, Groundwater, Prentice Hall, Englewood Cliffs, NJ 07632

Appendices

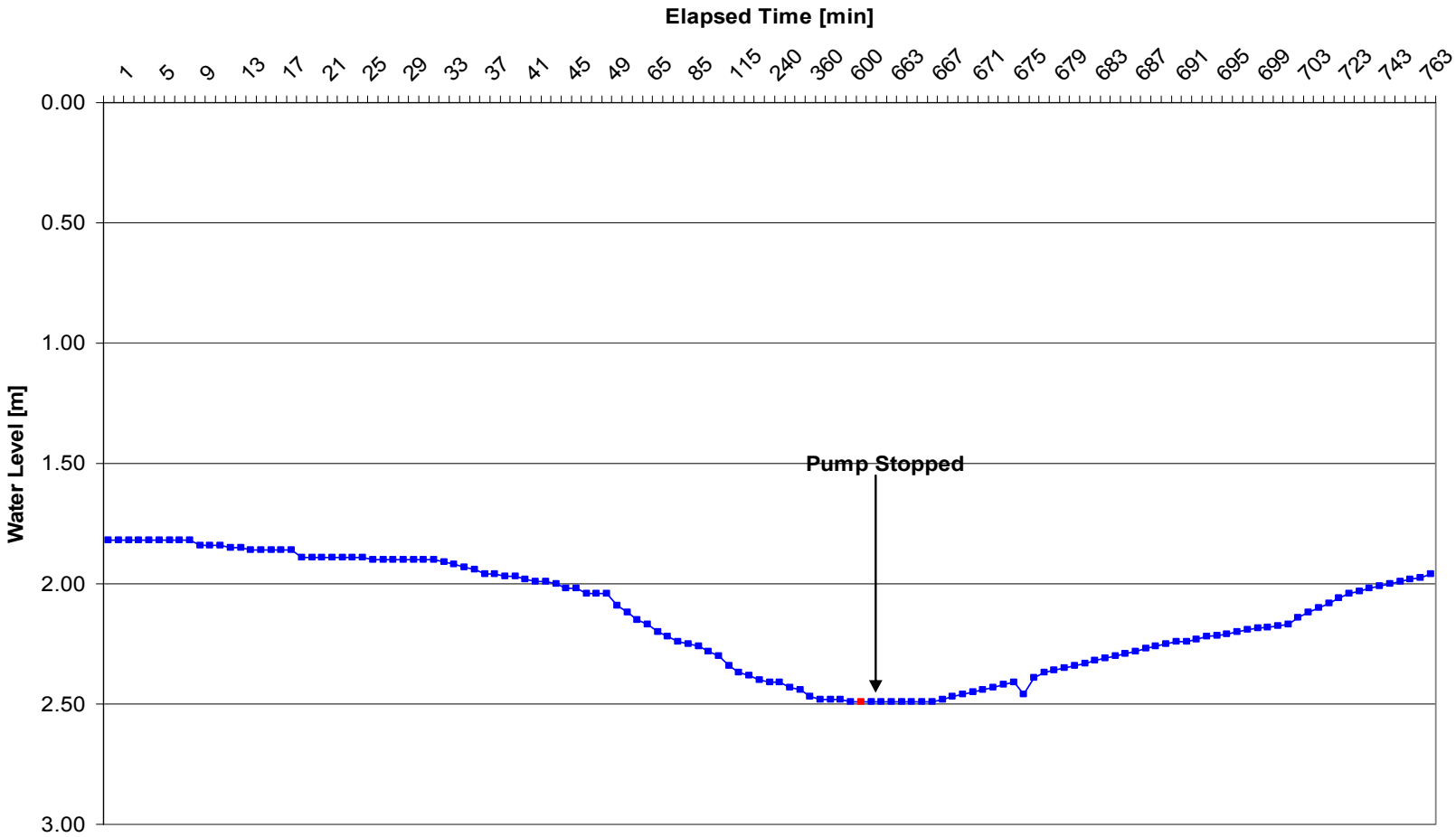
Arithmetic graphs of water levels
Semi log Graphs of the Time Drawdown data
Recovery Graphs for all wells
Tables of water levels for all wells
Recovery data for all well
Water Quality Analyses Results

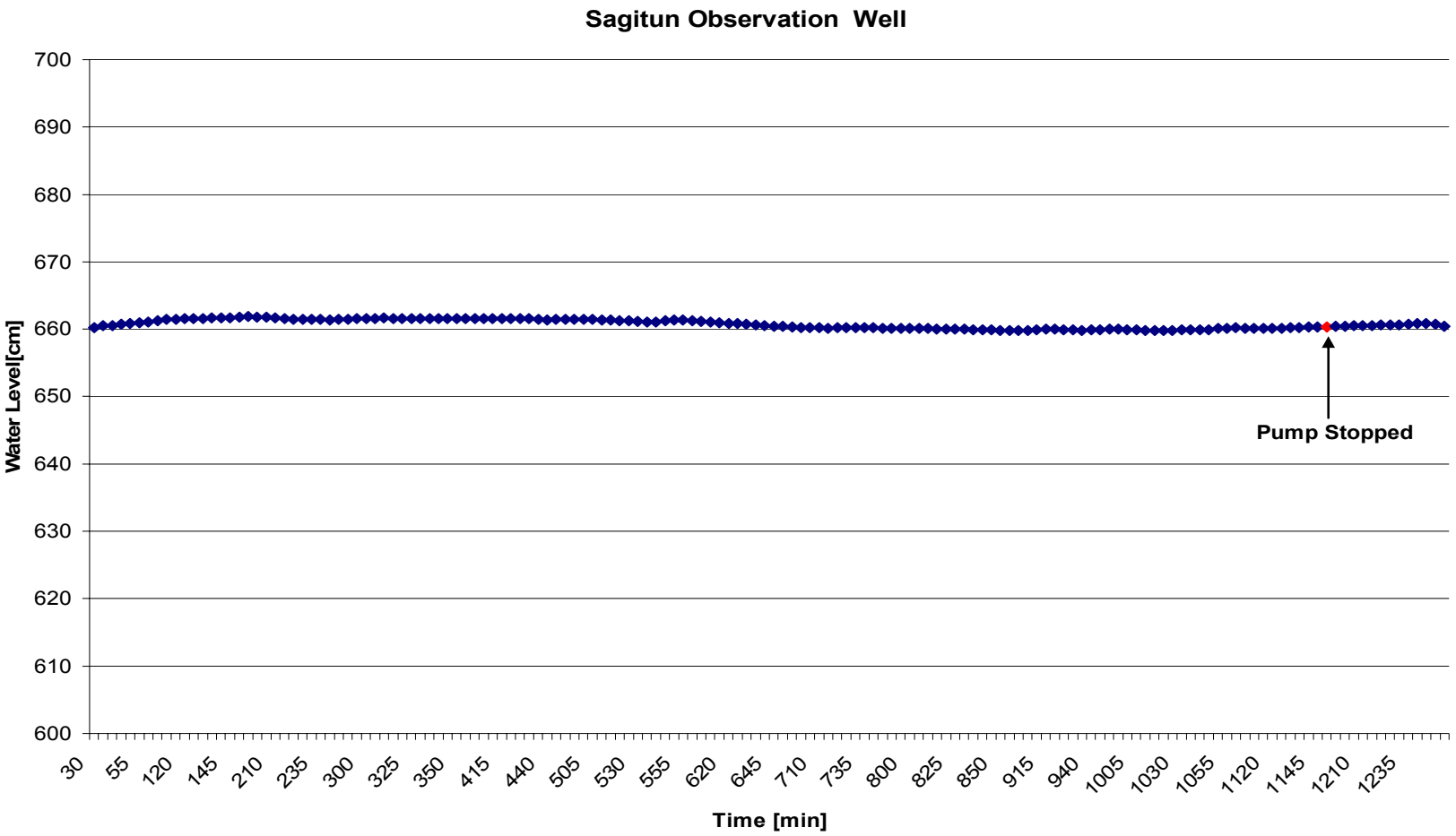
APPENDICEES

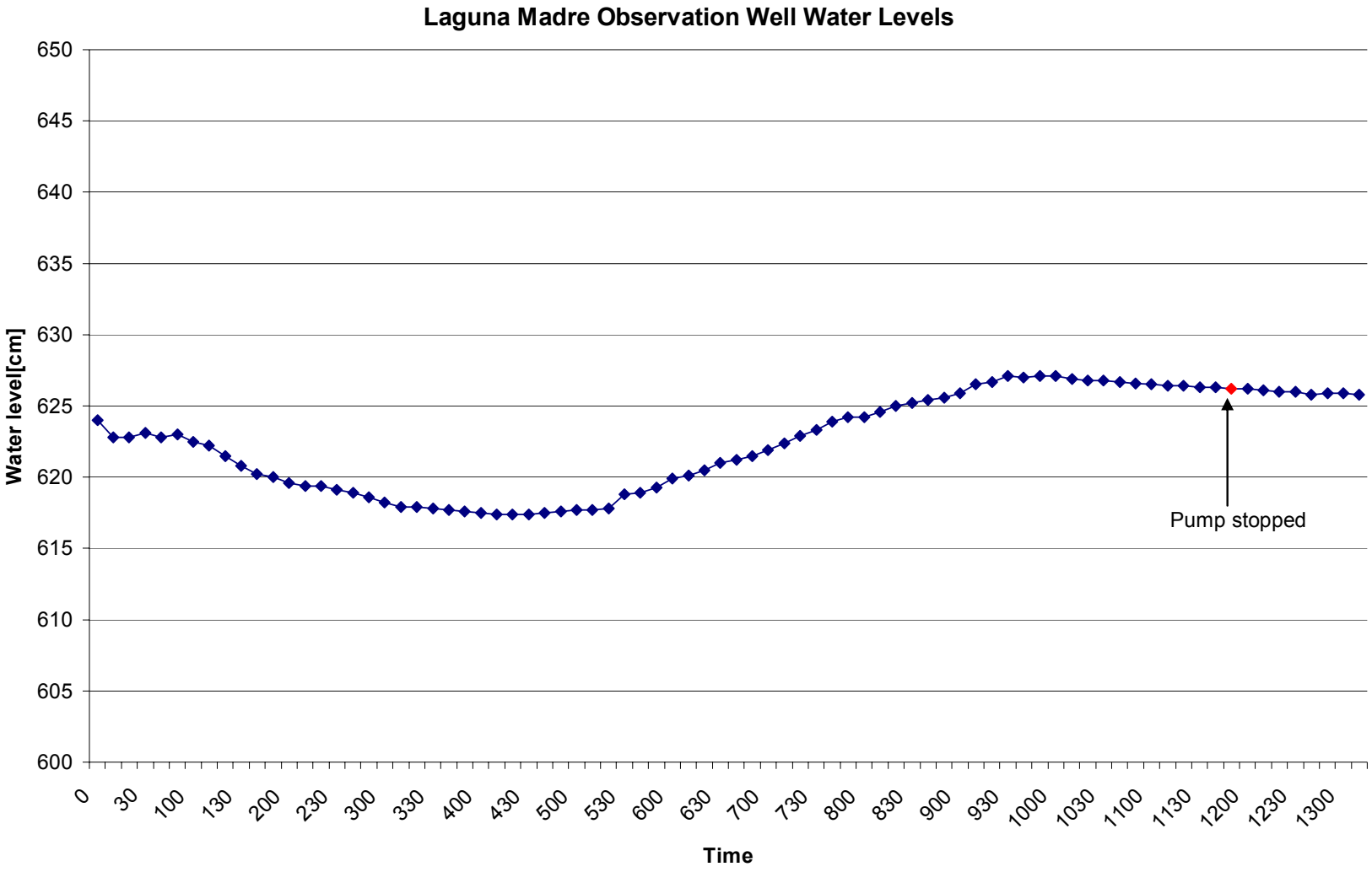
Well Pump Test

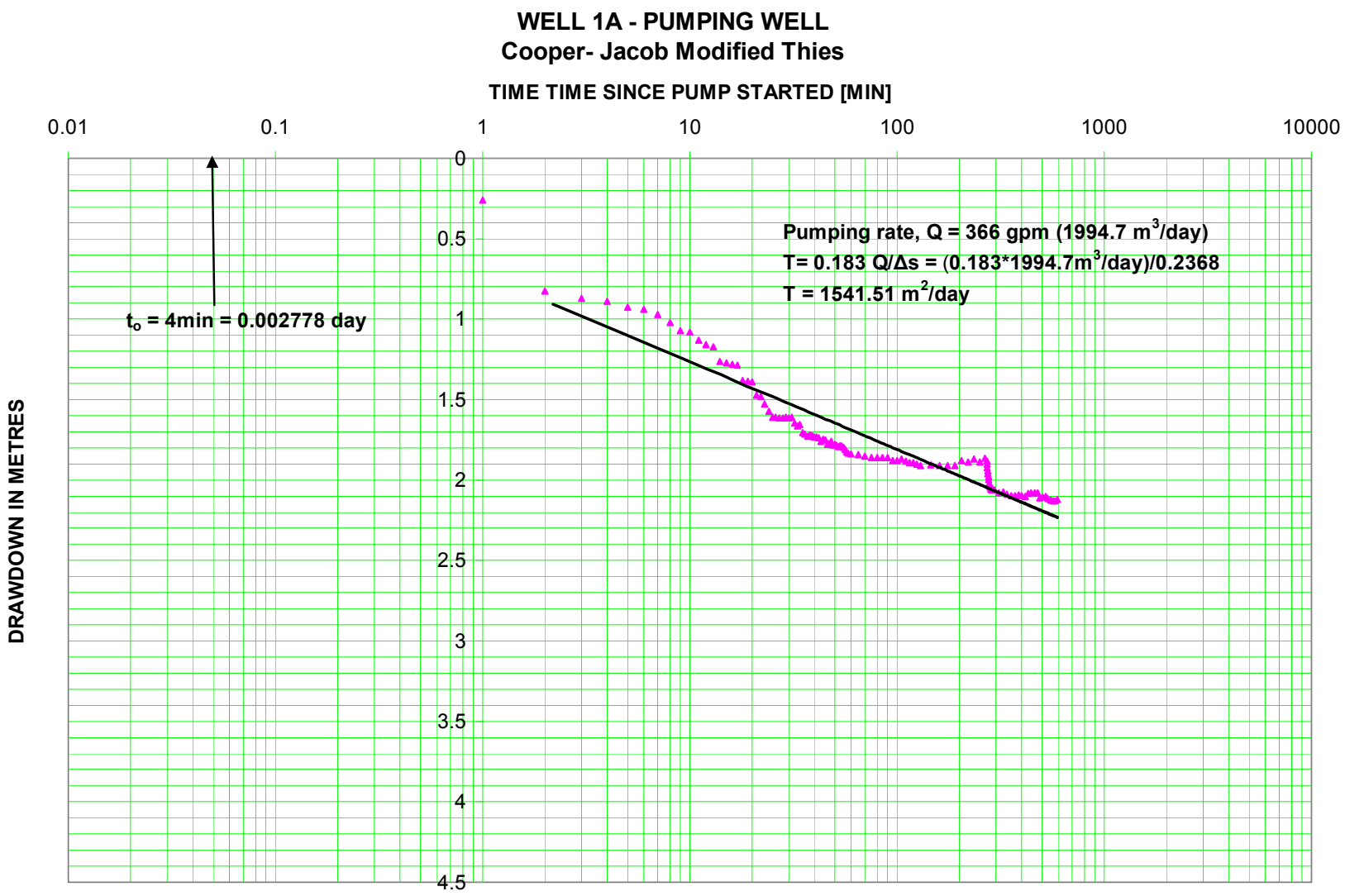

Pumped Well 1A Water Level Data
Time [min]
0 5 10 15 20 25 30 35 40 45 50 55 65 90 115 160 235 273 278 283 295 370 445 520 595 600 605 610 615 620 625 630
Water Level [m]
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5
Pump Stopped

Water Level Data for Observation Well 1B

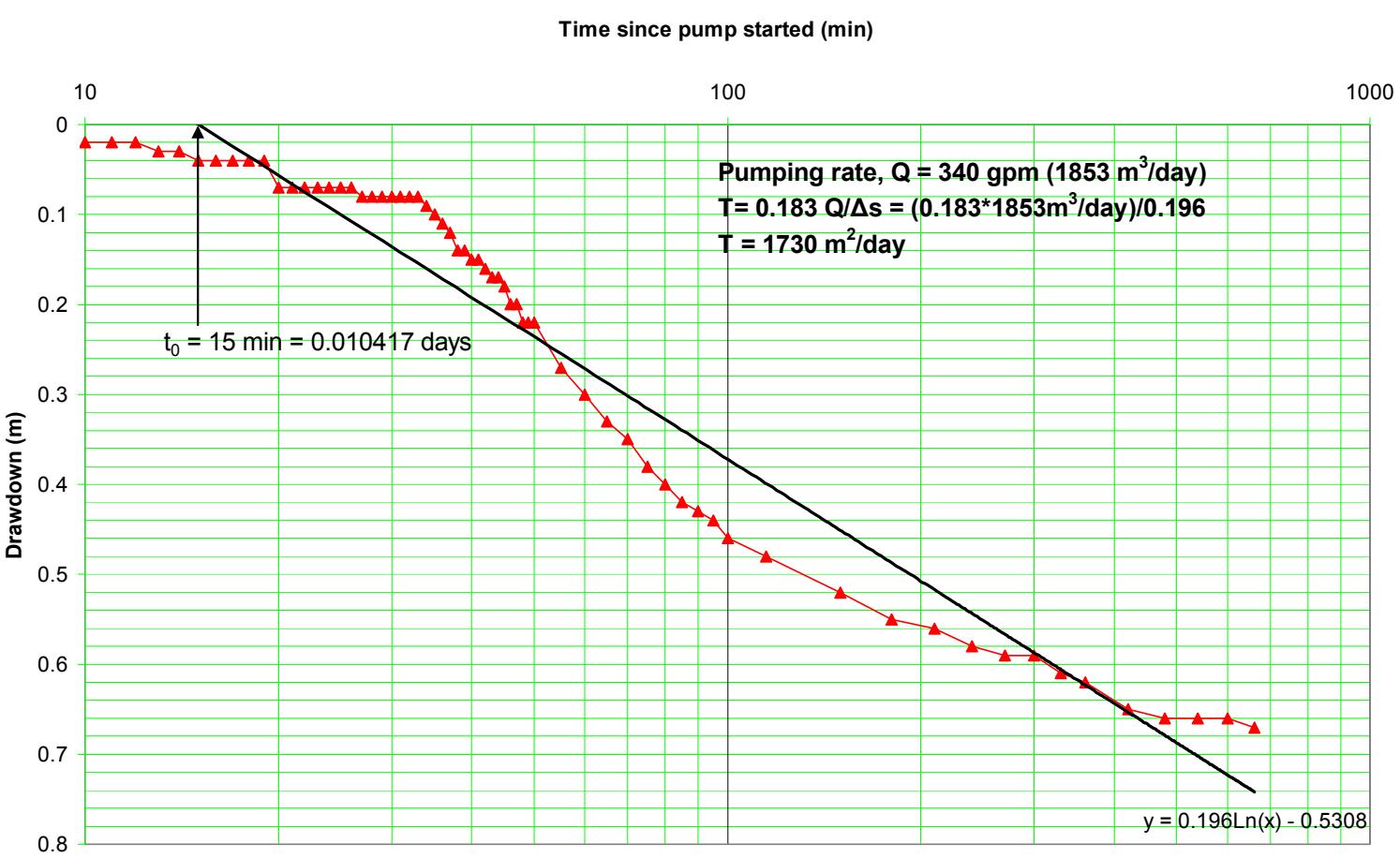


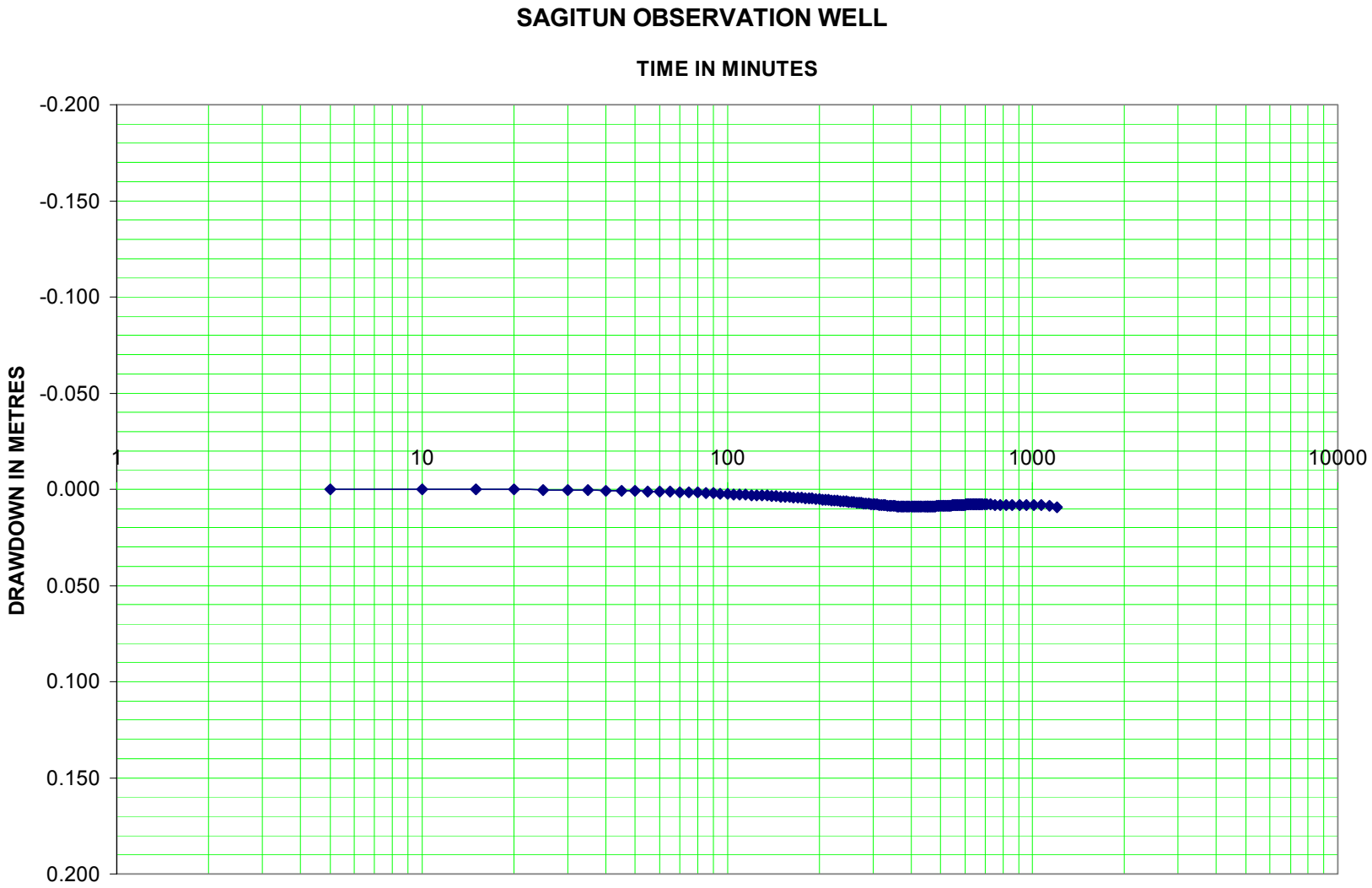

Sagitun Observation Well
Water Level[cm]
700
690
680
670
660
650
640
630
620
610
600
Pump Stopped
30
55
120
145
210
235
300
325
350
415
440
505
530
555
620
645
710
735
800
825
850
915
940
1005
1030
1055
1120
1145
1210
1235
Time [min]

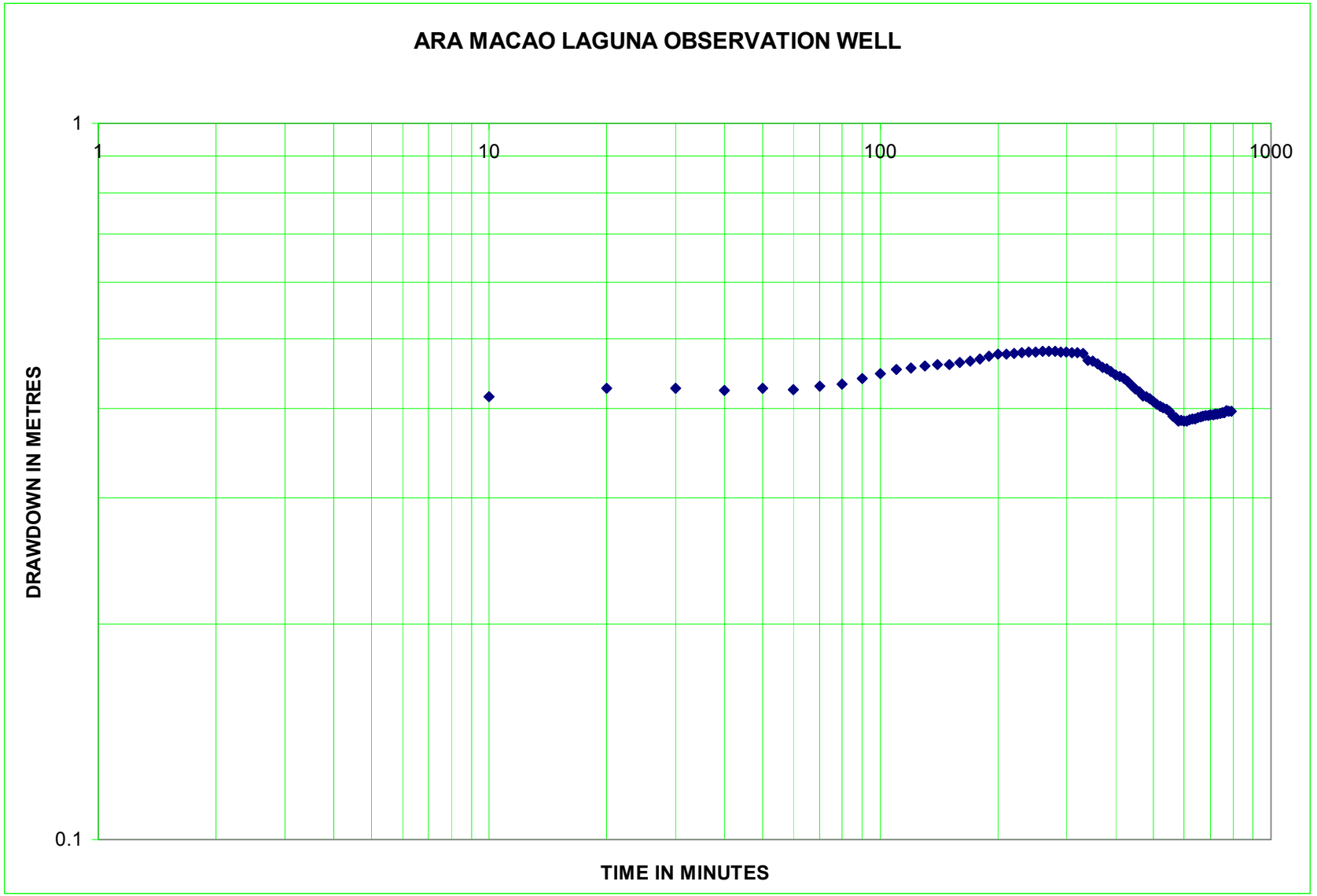

Laguna Madre Observation Well Water Levels
Water level[cm]
650
645
640
635
630
625
620
615
610
605
600
0
30
100
130
200
230
300
330
400
430
500
530
600
630
700
730
800
830
900
930
1000
1030
1100
1130
1200
1230
1300
Time
Pump stopped

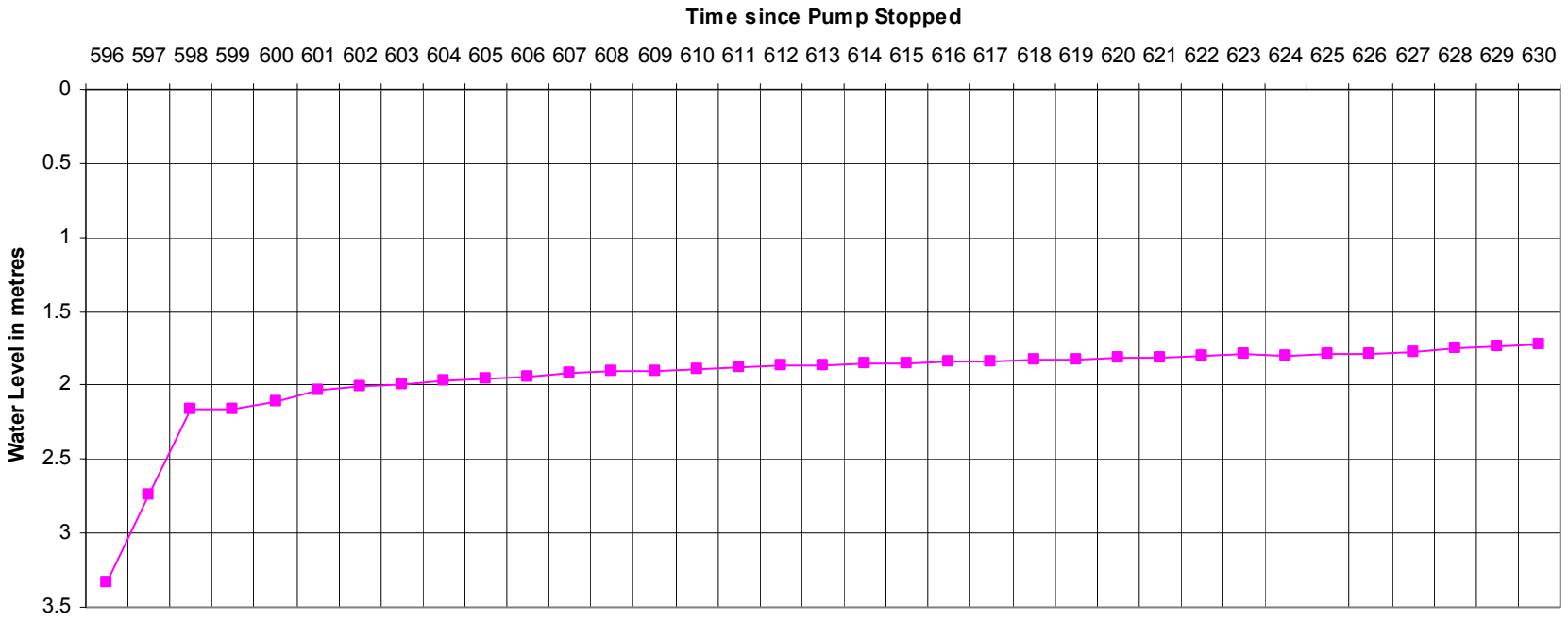

WELL 1A - PUMPING WELL
Cooper- Jacob Modified Thies
TIME TIME SINCE PUMP STARTED [MIN]
0.01
0.1
1
10
100
1000
10000
DRAWDOWN IN METRES
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
t_o = 4min = 0.002778 day
Pumping rate, Q = 366 gpm (1994.7 m^3/day)
T= 0.183 Q/Δs = (0.183*1994.7m^3/day)/0.2368
T = 1541.51 m^2/day

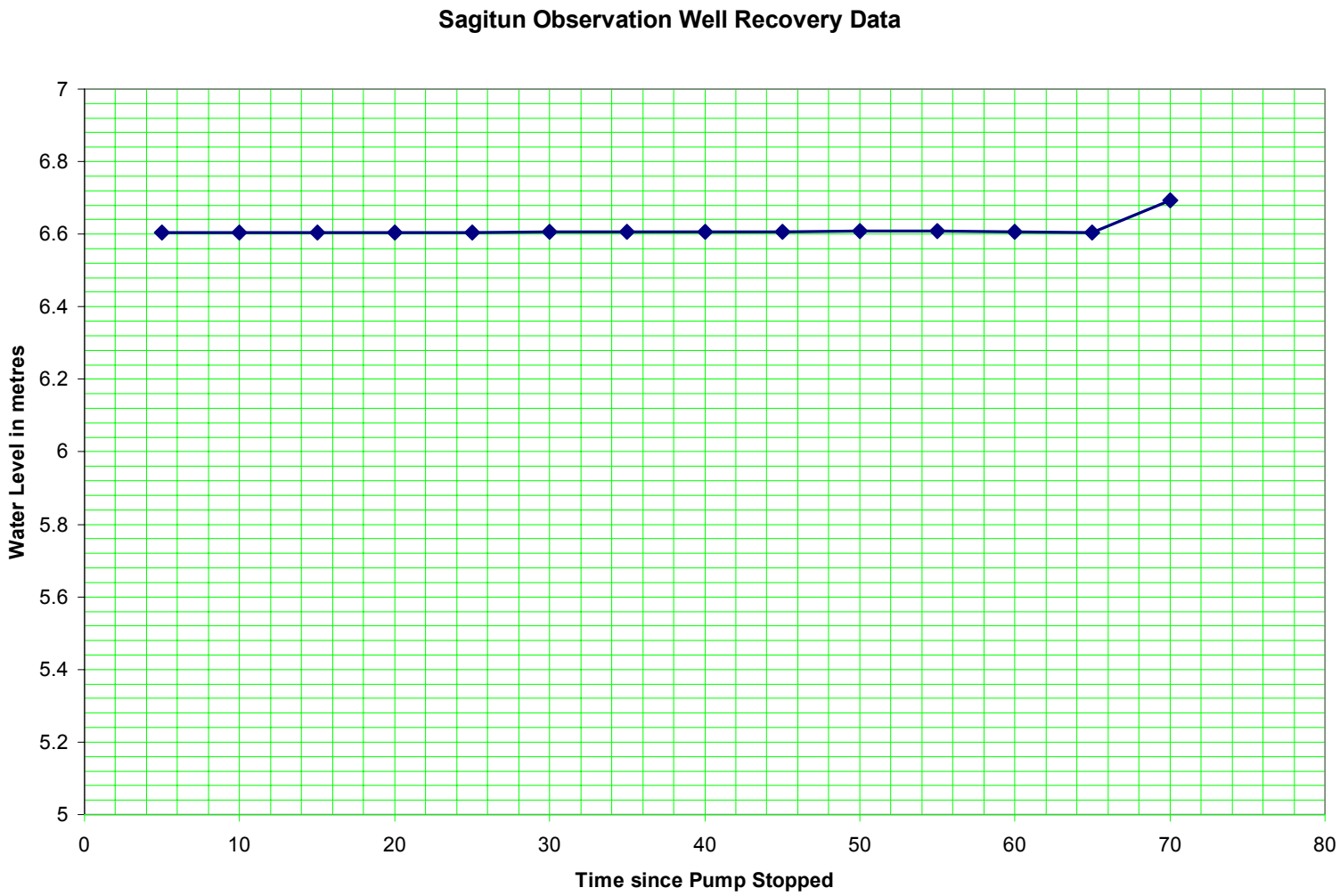
Well 1B
Cooper- Jacob Method

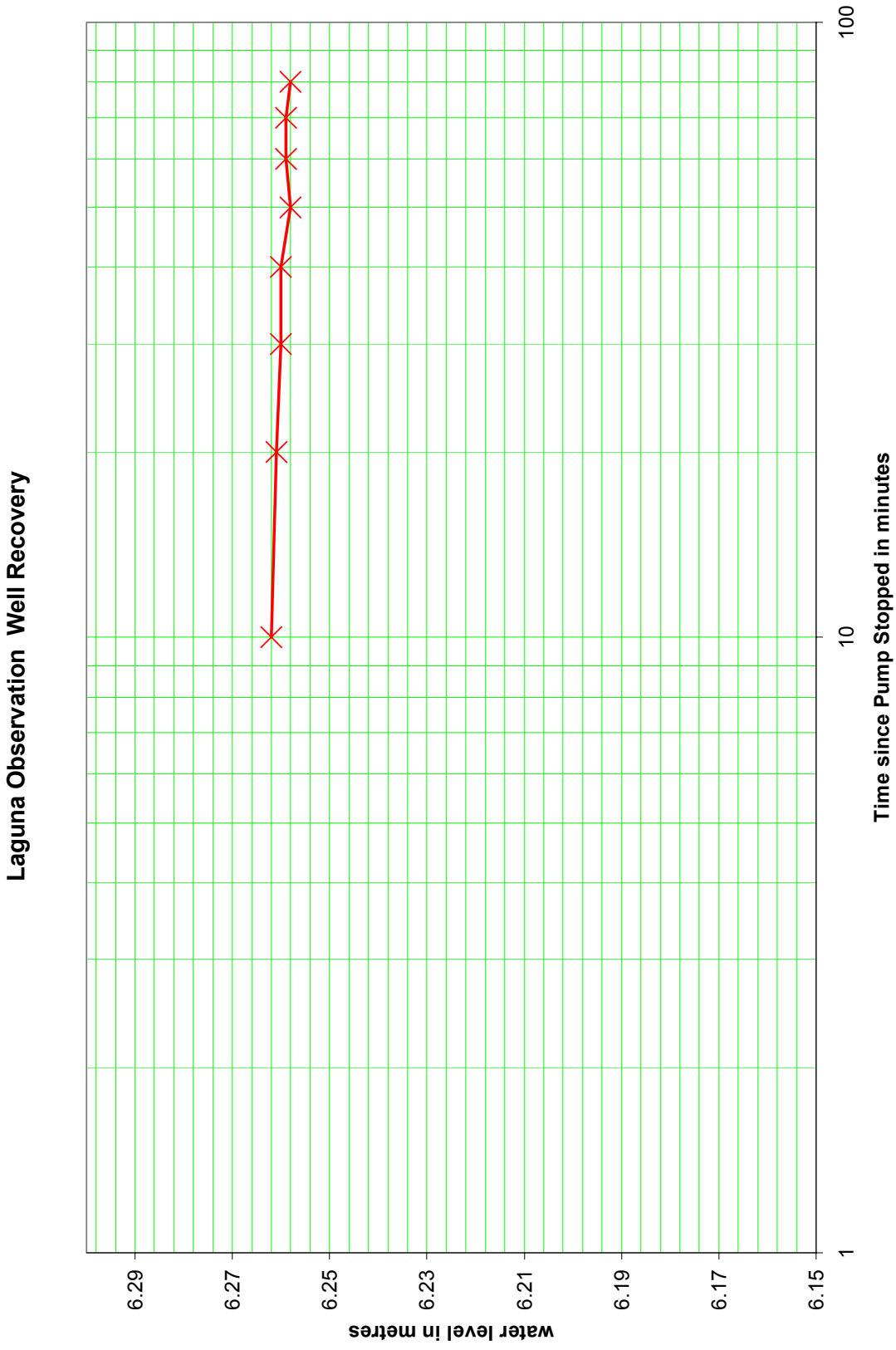



SAGITUN OBSERVATION WELL
TIME IN MINUTES
DRAWDOWN IN METRES
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
0.200
1
10
100
1000
10000


ARA MACAO LAGUNA OBSERVATION WELL
1
1
10
100
1000
0.1
DRAWDOWN IN METRES
TIME IN MINUTES


Pumped Well 1A Recovery Data
Time since Pump Stopped
596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630
Water Level in metres
0
0.5
1
1.5
2
2.5
3
3.5


Sagitun Observation Well Recovery Data
Water Level in metres
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
0
10
20
30
40
50
60
70
80
Time since Pump Stopped


Laguna Observation Well Recovery
water level in metres
6.29
6.27
6.25
6.23
6.21
6.19
6.17
6.15
1
10
100
Time since Pump Stopped in minutes

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Pumping Test - Water Level Data

Project: **Ara Macao**

Number: **1**

Client: **Tunich Nah**

Location:	**Riversdale, Stann Creek District, Belize**	Pumping Test:	**1**	Pumping well:	**1A**
Test conducted by:	**Rudolph Williams**	Test date:	**5-Jun-2006**	Discharge:	**variable, average rate 366 [u.s. gal/min]**
Observation well:	**1A**	Static water level [m]:	**1.7272**	Radial distance to PW [m]:	

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
0	1.7272	0	35	3.4302	1.703	115	3.6182	1.891
1	1.9872	0.26	36	3.4432	1.716	120	3.6202	1.893
2	2.5542	0.827	37	3.4542	1.727	125	3.6262	1.899
3	2.6002	0.873	38	3.4442	1.717	130	3.6362	1.909
4	2.6182	0.891	39	3.4502	1.723	145	3.6342	1.907
5	2.6542	0.927	40	3.4602	1.733	160	3.6382	1.911
6	2.6652	0.938	41	3.4592	1.732	175	3.6362	1.909
7	2.7	0.9728	42	3.4622	1.735	190	3.6392	1.912
8	2.75	1.0228	43	3.4862	1.759	205	3.6052	1.878
9	2.8	1.0728	44	3.4752	1.748	220	3.6162	1.889
10	2.806	1.0788	45	3.4802	1.753	235	3.5972	1.87
11	2.859	1.1318	46	3.5032	1.776	250	3.6132	1.886
12	2.887	1.1598	47	3.5012	1.774	265	3.5922	1.865
13	2.9	1.1728	48	3.4892	1.762	271	3.6112	1.884
14	2.99	1.2628	49	3.5082	1.781	272	3.6302	1.903
15	3	1.2728	50	3.5042	1.777	273	3.6492	1.922
16	3.01	1.2828	51	3.5112	1.784	274	3.6682	1.941
17	3.015	1.2878	52	3.5182	1.791	275	3.6872	1.96
18	3.109	1.3818	53	3.5122	1.785	276	3.7062	1.979
19	3.115	1.3878	54	3.5132	1.786	277	3.7252	1.998
20	3.119	1.3918	55	3.5252	1.798	278	3.7452	2.018
21	3.2	1.4728	56	3.5372	1.81	279	3.7512	2.024
22	3.208	1.4808	57	3.5512	1.824	280	3.7712	2.044
23	3.254	1.5268	58	3.5622	1.835	281	3.7612	2.034
24	3.3	1.5728	60	3.5632	1.836	282	3.7542	2.027
25	3.335	1.6078	65	3.5672	1.84	283	3.7702	2.043
26	3.337	1.6098	70	3.5782	1.851	284	3.7822	2.055
27	3.339	1.6118	75	3.5882	1.861	285	3.7882	2.061
28	3.3395	1.6123	80	3.5882	1.861	286	3.7832	2.056
29	3.335	1.6078	85	3.5892	1.862	287	3.7892	2.062
30	3.339	1.6118	90	3.5892	1.862	295	3.7872	2.06
31	3.336	1.6088	95	3.6062	1.879	310	3.8072	2.08
32	3.3752	1.648	100	3.6042	1.877	325	3.8032	2.076
33	3.3892	1.662	105	3.5952	1.868	340	3.8132	2.086
34	3.3812	1.654	110	3.6102	1.883	355	3.8232	2.096

	Water Solutions 1145 Cottonwick Street Belize City, Belize Ph. - +501-223-6544 Cell - +501-606-3578 E-mail:- rudol	**Pumping Test - Water Level Data** Project: **Ara Macao** Number: **1** Client: **Tunich Nah**

Location:	**Riversdale, Stann Creek District, Belize**	Pumping Test:	**1**	Pumping well:	**1A**
Test conducted by:	**Rudolph Williams**	Test date:	**5-Jun-2006**	Discharge:	**variable, average rate 366 [u.s. gal/min]**
Observation well:	**1A**	Static water level [m]:	**1.7272**	Radial distance to PW [m]:	

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
370	3.8232	2.096						
385	3.8212	2.094						
400	3.8242	2.097						
415	3.8272	2.1						
430	3.8102	2.083						
445	3.8082	2.081						
460	3.8042	2.077						
475	3.8072	2.08						
490	3.8372	2.11						
505	3.8322	2.105						
520	3.8302	2.103						
535	3.8432	2.116						
550	3.8532	2.126						
565	3.8562	2.129						
580	3.8562	2.129						
595	3.8462	2.119						

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Pumping Test - Water Level Data - 1B

Project: **Ara Macao**

Number: **1**

Client: **Tunich Nah**

Location:	**Riversdale, Stann Creek District, Belize**	Pumping Test:	**1**	Pumping well:	**1A**
Test conducted by:	**Rudolph Williams**	Test date:	**5-Jun-2006**	Discharge:	**variable, average rate 351.23 [u.s. gal/min**
Observation well:	**1B**	Static water level [m]:	**1.82**	Radial distance to PW [m]:	

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
1	1.82		36	1.93	0.11	480	2.48	0.66
2	1.82	0	37	1.94	0.12	540	2.48	0.66
3	1.82	0	38	1.96	0.14	600	2.48	0.66
4	1.82	0	39	1.96	0.14	660	2.49	0.67
5	1.82	0	40	1.97	0.15			
6	1.82	0	41	1.97	0.15			
7	1.82	0	42	1.98	0.16			
8	1.82	0	43	1.99	0.17			
9	1.82	0	44	1.99	0.17			
10	1.84	0.02	45	2.00	0.18			
11	1.84	0.02	46	2.02	0.2			
12	1.84	0.02	47	2.02	0.2			
13	1.85	0.03	48	2.04	0.22			
14	1.85	0.03	49	2.04	0.22			
15	1.86	0.04	50	2.04	0.22			
16	1.86	0.04	55	2.09	0.27			
17	1.86	0.04	60	2.12	0.3			
18	1.86	0.04	65	2.15	0.33			
19	1.86	0.04	70	2.17	0.35			
20	1.89	0.07	75	2.20	0.38			
21	1.89	0.07	80	2.22	0.4			
22	1.89	0.07	85	2.24	0.42			
23	1.89	0.07	90	2.25	0.43			
24	1.89	0.07	95	2.26	0.44			
25	1.89	0.07	100	2.28	0.46			
26	1.89	0.07	115	2.30	0.48			
27	1.90	0.08	150	2.34	0.52			
28	1.90	0.08	180	2.37	0.55			
29	1.90	0.08	210	2.38	0.56			
30	1.90	0.08	240	2.40	0.58			
31	1.90	0.08	270	2.41	0.59			
32	1.90	0.08	300	2.41	0.59			
33	1.90	0.08	330	2.43	0.61			
34	1.91	0.09	360	2.44	0.62			
35	1.92	0.1	420	2.47	0.65			

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Pumping Test - Water Level Data - Sagitun

Project: **Ara Macao**

Number: **1**

Client: **Tunich Nah**

Location:	**Riversdale, Stann Creek District, Belize**	Pumping Test:	**1**	Pumping well:	**1A**
Test conducted by:	**Rudolph Williams**	Test date:	**5-Jun-2006**	Discharge:	**variable, average rate 366. [u.s. gal/min]**
Observation well:	**Sagitun**	Static water level [m]:	**2.16535**	Radial distance to PW [m]:	

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
5	2.1420	0.023	180	2.1280	-0.037	355	2.1350	-0.030
10	2.1390	0.026	185	2.1280	-0.037	360	2.1350	-0.030
15	2.1390	0.026	190	2.1280	-0.037	365	2.1370	-0.028
20	2.1370	0.028	195	2.1280	-0.037	370	2.1380	-0.027
25	2.1350	0.030	200	2.1280	-0.037	375	2.1390	-0.026
30	2.1340	0.031	205	2.1280	-0.037	380	2.1400	-0.025
35	2.1330	0.032	210	2.1280	-0.037	385	2.1400	-0.025
40	2.1310	0.034	215	2.1280	-0.037	390	2.1410	-0.024
45	2.1290	0.036	220	2.1280	-0.037	395	2.1420	-0.023
50	2.1290	0.036	225	2.1280	-0.037	400	2.1420	-0.023
55	2.1280	0.037	230	2.1280	-0.037	405	2.1420	-0.023
60	2.1280	0.037	235	2.1280	-0.037	410	2.1430	-0.022
65	2.1280	0.037	240	2.1280	-0.037	415	2.1420	-0.023
70	2.1270	0.038	245	2.1280	-0.037	420	2.1420	-0.023
75	2.1270	0.038	250	2.1290	-0.036	425	2.1420	-0.023
80	2.1270	0.038	255	2.1300	-0.035	430	2.1420	-0.023
85	2.1260	0.039	260	2.1290	-0.036	435	2.1420	-0.023
90	2.1250	0.040	265	2.1290	-0.036	440	2.1430	-0.022
95	2.1260	0.039	270	2.1290	-0.036	445	2.1430	-0.022
100	2.1260	0.039	275	2.1290	-0.036	450	2.1430	-0.022
105	2.1270	0.038	280	2.1290	-0.036	455	2.1430	-0.022
110	2.1280	0.037	285	2.1300	-0.035	460	2.1430	-0.022
115	2.1290	0.036	290	2.1300	-0.035	465	2.1430	-0.022
120	2.1290	0.036	295	2.1310	-0.034	470	2.1440	-0.021
125	2.1290	0.036	300	2.1310	-0.034	475	2.1440	-0.021
130	2.1290	0.036	305	2.1320	-0.033	480	2.1440	-0.021
135	2.1300	0.035	310	2.1330	-0.032	485	2.1440	-0.021
140	2.1290	0.036	315	2.1330	-0.032	490	2.1450	-0.020
145	2.1290	0.036	320	2.1310	-0.034	495	2.1450	-0.020
150	2.1280	0.037	325	2.1300	-0.035	500	2.1450	-0.020
155	2.1280	0.037	330	2.1300	-0.035	505	2.1460	-0.019
160	2.1280	0.037	335	2.1310	-0.034	510	2.1460	-0.019
165	2.1270	0.038	340	2.1320	-0.033	515	2.1460	-0.019
170	2.1280	0.037	345	2.1330	-0.032	520	2.1460	-0.019
175	2.1280	0.037	350	2.1340	-0.031	525	2.1450	-0.020

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Pumping Test - Water Level Data - Sagitun

Project: **Ara Macao**

Number: **1**

Client: **Tunich Nah**

Location:	**Riversdale, Stann Creek District, Belize**	Pumping Test:	**1**	Pumping well:	**1A**
Test conducted by:	**Rudolph Williams**	Test date:	**5-Jun-2006**	Discharge:	**variable, average rate 366 [u.s. gal/min]**
Observation well:	**Sagitun**	Static water level [m]:	**2.16535**	Radial distance to PW [m]:	

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
530	2.1440	-0.021	710	2.1390	-0.026			
535	2.1440	-0.021	715	2.1380	-0.027			
540	2.1450	-0.020	720	2.1380	-0.027			
545	2.1450	-0.020	725	2.1380	-0.027			
550	2.1460	-0.019	730	2.1370	-0.028			
555	2.1450	-0.020	735	2.1360	-0.029			
560	2.1450	-0.020	740	2.1350	-0.030			
565	2.1440	-0.021	745	2.1370	-0.028			
570	2.1440	-0.021	750	2.1400	-0.025			
575	2.1450	-0.020						
580	2.1450	-0.020						
585	2.1460	-0.019						
590	2.1460	-0.019						
595	2.1460	-0.019						
605	2.1450	-0.020						
610	2.1450	-0.020						
615	2.1450	-0.020						
620	2.1450	-0.020						
625	2.1430	-0.022						
630	2.1430	-0.022						
635	2.1420	-0.023						
640	2.1430	-0.022						
645	2.1430	-0.022						
650	2.1430	-0.022						
655	2.1430	-0.022						
660	2.1430	-0.022						
665	2.1420	-0.023						
670	2.1420	-0.023						
675	2.1410	-0.024						
680	2.1410	-0.024						
685	2.1410	-0.024						
690	2.1400	-0.025						
695	2.1400	-0.025						
700	2.1390	-0.026						
705	2.1390	-0.026						

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Pumping Test - Water Level Data -Laguna

Project: **Ara Macao**

Number: **1**

Client: **Tunich Nah**

Location:	**Riversdale, Stann Creek District, Belize**	Pumping Test:	**1**	Pumping well:	**1A**
Test conducted by:	**Rudolph Williams**	Test date:	**5-Jun-2006**	Discharge:	**variable, average rate 366 [u.s. gal/min]**
Observation well:	**Laguna Madre**	Static water level [m]:	**1.1938**	Radial distance to PW [m]:	

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
0	6.2400	-0.012	350	6.1930	-0.041	700	6.2620	0.022
10	6.2280	-0.012	360	6.1990	-0.039			
20	6.2280	-0.009	370	6.2010	-0.035			
30	6.2310	-0.012	380	6.2050	-0.030			
40	6.2280	-0.010	390	6.2100	-0.028			
50	6.2300	-0.015	400	6.2150	-0.025			
60	6.2250	-0.018	410	6.2190	-0.021			
70	6.2220	-0.025	420	6.2240	-0.016			
80	6.2150	-0.032	430	6.2290	-0.011			
90	6.2080	-0.038	440	6.2330	-0.007			
100	6.2020	-0.040	450	6.2390	-0.001			
110	6.2000	-0.044	460	6.2422	0.0022			
120	6.1960	-0.046	470	6.2420	0.002			
130	6.1940	-0.046	480	6.2460	0.006			
140	6.1940	-0.049	490	6.2500	0.01			
150	6.1910	-0.051	500	6.2520	0.012			
160	6.1890	-0.054	510	6.2540	0.014			
170	6.1860	-0.058	520	6.2560	0.016			
180	6.1820	-0.061	530	6.2590	0.019			
190	6.1790	-0.061	540	6.2650	0.025			
200	6.1790	-0.062	550	6.2670	0.027			
210	6.1780	-0.063	560	6.2710	0.031			
220	6.1770	-0.064	570	6.2700	0.03			
230	6.1760	-0.065	580	6.2710	0.031			
240	6.1750	-0.066	590	6.2710	0.031			
250	6.1740	-0.066	600	6.2690	0.029			
260	6.1740	-0.066	610	6.2680	0.028			
270	6.1740	-0.065	620	6.2680	0.028			
280	6.1750	-0.064	630	6.2670	0.027			
290	6.1760	-0.063	640	6.2660	0.026			
300	6.1770	-0.063	650	6.2650	0.025			
310	6.1770	-0.062	660	6.2640	0.024			
320	6.1780	-0.052	670	6.2640	0.024			
330	6.1880	-0.051	680	6.2630	0.023			
340	6.1890	-0.047	690	6.2630	0.023			

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Pumping Test - Water Level Data - Recovery

Project: **Ara Macao**

Number: **1**

Client: **Tunich Nah**

Location:	**Riversdale, Stann Creek District, Belize**	Pumping Test:	**1**	Pumping well:	**1A**
Test conducted by:	**Rudolph Williams**	Test date:	**5-Jun-2006**	Discharge:	**variable, average rate 351.23 [u.s. gal/min]**
Observation well:	**1A**	Static water level [m]:	**1.7272**	Radial distance to PW [m]:	**4313.93**

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
1	3.3274							
2	2.7432							
3	2.159							
4	2.159							
5	2.1082							
6	2.032							
7	2.0066							
8	1.9939							
9	1.9685							
10	1.9558							
11	1.93675							
12	1.9177							
13	1.905							
14	1.89865							
15	1.88595							
16	1.8796							
17	1.8669							
18	1.86055							
19	1.8542							
20	1.84785							
21	1.8415							
22	1.83515							
23	1.8288							
24	1.82245							
25	1.8161							
26	1.80975							
27	1.8034							
28	1.7907							
29	1.79705							
30	1.7907							
31	1.78435							
32	1.77165							
33	1.7526							
34	1.7399							
35	1.7272							

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Pumping Test - Water Level Data
1B Recovery

Project: **Ara Macao**

Number: **1**

Client: **Tunich Nah**

Location:	**Riversdale, Stann Creek District, Belize**	Pumping Test:	**1**	Pumping well:	**1A**
Test conducted by:	**Rudolph Williams**	Test date:	**5-Jun-2006**	Discharge:	**variable, average rate 366. [u.s. gal/min]**
Observation well:	**1B**	Static water level [m]:	**1.82**	Radial distance to PW [m]:	

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
661	2.4900		696	2.215				
662	2.4900		697	2.21				
663	2.4900		698	2.2				
664	2.4900		699	2.19				
665	2.4900		700	2.185				
666	2.4900		701	2.18				
667	2.4900		702	2.175				
668	2.4900		703	2.17				
669	2.4800		708	2.14				
670	2.4700		713	2.12				
671	2.4600		718	2.1				
672	2.4500		723	2.08				
673	2.4400		728	2.06				
674	2.4300		733	2.04				
675	2.4200		738	2.03				
676	2.4100		743	2.02				
677	2.4600		748	2.01				
678	2.3900		753	2				
679	2.3700		758	1.99				
680	2.3600		763	1.98				
681	2.3500		768	1.975				
682	2.3400		773	1.96				
683	2.3300							
684	2.3200							
685	2.3100							
686	2.3000							
687	2.2900							
688	2.2800							
689	2.2700							
690	2.2600							
691	2.2500							
692	2.2400							
693	2.2400							
694	2.2300							
695	2.2200							

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Pumping Test - Water Level Data
Sagitun Recovery

Project: **Ara Macao**

Number: **1**

Client: **Tunich Nah**

Location: **Riversdale, Stann Creek District, Belize**	Pumping Test: **1**	Pumping well: **1A**
Test conducted by: **Rudolph Williams**	Test date: **5-Jun-2006**	Discharge: **variable, average rate 366. [u.s. gal/min]**
Observation well: **Sagitun**	Static water level [m]: **2.16535**	Radial distance to PW [m]:

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
635	2.1420							
640	2.1430							
645	2.1430							
650	2.1430							
655	2.1430							
660	2.1430							
665	2.1420							
670	2.1420							
675	2.1410							
680	2.1410							
685	2.1410							
690	2.1400							
695	2.1400							
700	2.1390							
705	2.1390							
710	2.1390							
715	2.1380							
720	2.1380							
725	2.1380							
730	2.1370							
735	2.1360							
740	2.1350							
745	2.1370							
750	2.1400							

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Pumping Test - Water Level Data
Laguna Recovery

Project: **Ara Macao**

Number: **1**

Client: **Tunich Nah**

Location:	**Riversdale, Stann Creek District, Belize**	Pumping Test:	**1**	Pumping well:	**1A**
Test conducted by:	**Rudolph Williams**	Test date:	**5-Jun-2006**	Discharge:	**variable, average rate 366 [u.s. gal/min]**
Observation well:	**Laguna Madre**	Static water level [m]:	**1.1938**	Radial distance to PW [m]:	

Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]	Time [min]	Water Level [m]	Drawdown [m]
710	0.0220							
730	0.0210							
760	0.0200							
800	0.0200							
850	0.0180							
910	0.0190							
980	0.0190							
1060	0.0180							

Issue 2

- Identify at least three additional water quality sampling sites in the north of the Placencia Lagoon and conduct water quality tests. These tests should account for seasonal variations and additional parameters as per the Terms of Reference.

Water Resources

Three additional water quality sampling sites have been included in the Ara Macao Water Monitoring Program. These sites are located in the middle (Sample 9), upper middle (sample 8) and northern (sample 7) portions of the Placencia Lagoon. This would bring the overall sampling sites to 9 with four of these sites in the Placencia Lagoon. Water quality tests were conducted by an accredited DOE laboratory for these sites and are exemplified in table 2.1 below (**See Attached Water Test Results**). These sites are further illustrated in figure2.1.

Table 2.1 Water Sampling Results for Ara Macao

11 May, 2006

PHYSICAL	UNIT	METHOD	RESULTS			
			Sample 2	Sample 7	Sample 8	Sample 9
CONDUCTIVITY	µs/cm	CONDUCTIVITY (probe)	**39,700**	**40,100**	**40,600**	**42,000**
pH	unit	pH/ISE meter (probe)	**7.99**	**7.65**	**7.2**	**8.2**
SALINITY	ppt	Mercuric Nitrate titration	**24.2**	**25.4**	**25**	**26.9**
TOTAL SUSPENDED SOLIDS (TSS)	ppm	Colorimeter	**21**	**25**	**23**	**21**
TEMPERATURE (IN LAB)	°C	Probe/Termometer	**23.8**	**24.7**	**24.8**	**23.9**
TOTAL DISSOLVED SOLIDS (TDS)	ppm	CONDUCTIVITY (probe)	**19,870**	**20,000**	**20,300**	**21,000**
NITROGEN, TOTAL (N)	ppm	Cadmium Reduction	**3.4**	**1.8**	**2.3**	**2.9**
DISSOLVED OXYGEN (DO)	ppm	PROBE	**3.3**	**3.8**	**3.5**	**3.5**
PHOSPHATE, TOTAL (PO_4)	ppm	PhosVer / Orthophosphate/	**0.07**	**0.33**	**0.14**	**0.14**
TOTAL HARDNESS (as $CaCO_3$)	ppm	EDTA Titration	**4,945**	**4,920**	**4,970**	**5,300**
SULPHATE (SO_4)	ppm	Sulfa Ver 4	**1,750**	**1,750**	**1,850**	**5,300**
OXYGEN DEMAND, BIOCHEMICAL (BOD_5)	mg/l	BODTRAK / 5 days Digestion		**19**	**14**	**21**
TOTAL COLIFORM	count	m-ENDO Broth (MF)	**TNTC**	**464/100ml**	**TNTC**	**TNTC**
ESCHERICHIA COLI (E.coli)	count	m-ENDO Broth (MF)	**22/100ml**	**114/100ml**	**44/100ml**	**26/100ml**
FECAL COLIFORM	count	m-FC/ROSOLIC Broth (MF)	**14/100ml**	**0/100ml**	**0/100ml**	**2/100ml**

In comparing the data, it can be noted that there is not much difference among the different sites. The physical characteristics of the sampling are consistent with pH

varying slightly among the different sites but generally being in the range of 7.5. The salinity concentrations showed minimal fluctuations between sites. The average salinity was 25 ppt for the lagoon as compared to 32 ppt for the sea. The Total dissolved solids and the total suspended solids were consistent averaging 20,292 mg/l and 22.5 mg/l respectively. These values are indicative of a more stable environment.

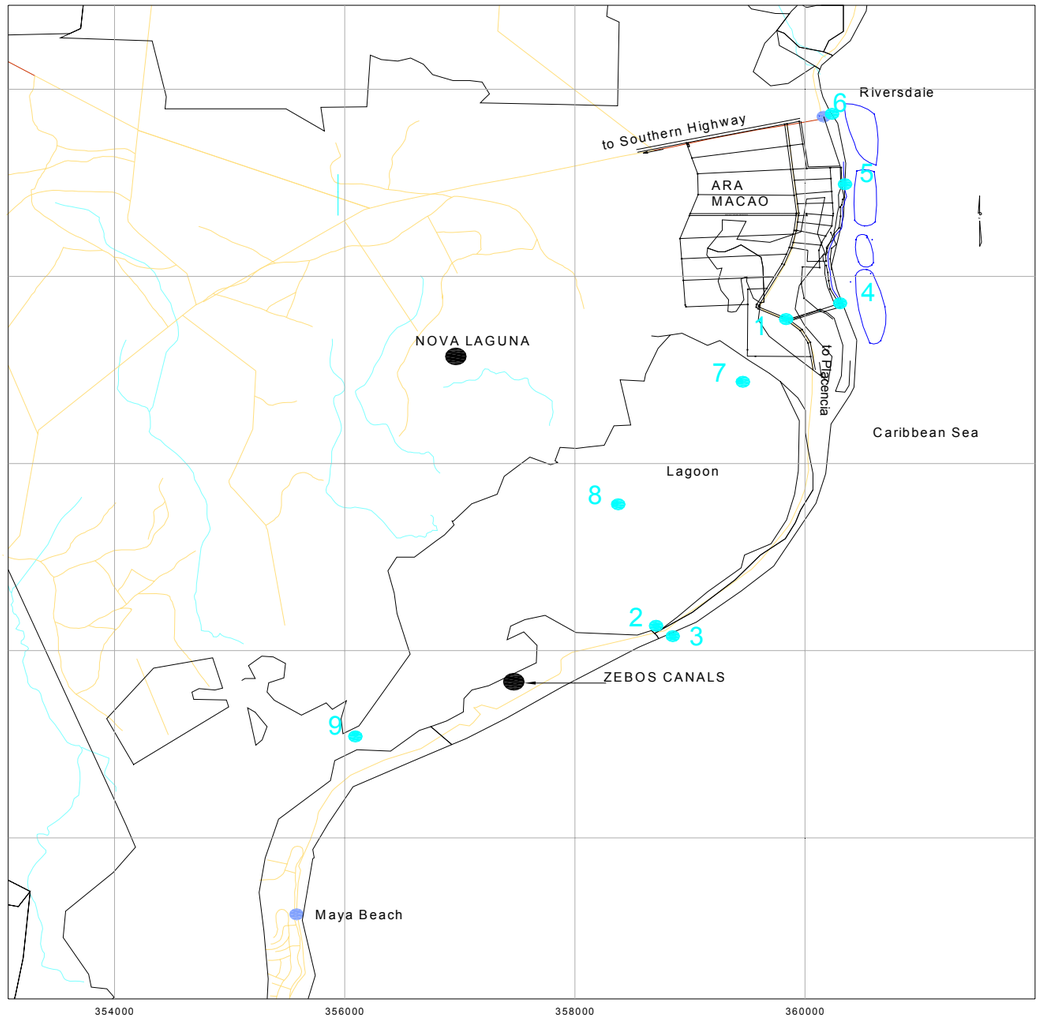
The nitrogen and phosphate levels varied from site to site, but remained generally consistent with the overall parameter fluctuations. This would put the nitrogen levels higher than in normal lagoons systems similar to the Placencia Lagoon. This nutrient increase can be attributed to the agricultural and aquaculture activities taking place around the lagoon, especially in the water shed areas of the South Stann Creek Valley. This attribute, can be exemplified by the BOD levels. Sample 9 had the highest with 21 ppm whilst sample 8 had the lowest with 18 ppm. All these are to some extent high concentrations.

In the microbiological aspects, all samples tested positive for E. Coli and two for fecal coliform. This can be attributed to the Placencia Lagoon Catchments which transport organic matter to the lagoon and the existence of faulty wastewater treatment systems and latrines along the peninsula.

In general, it can be noted that the upper portions of the lagoon experience less water circulation than the lower region as described in the CZMIA's technical report prepared by Eugene Ariola.

Literature

Ariola, E. 2003; Characteristics of a Tropical Estuarine System: The Placencia Lagoon. Technical report prepared for Coastal Zone Management Authority and Institute



Water Sample Location

ID	E	N	Location
1	359836	1843543	At road culvert
2	358747	1840240	In lagoon
3	258846	1840167	In Sea opposite sample 2
4	360305	1843713	In Sea
5	360340	1844985	In Sea
6	360235	1845737	At abandoned pier
7	359431	1842881	In Lagoon infront of project survey boundary
8	358350	1841577	Center of lagoon
9	356093	1839113	Channel entrance to lagoon

COORDINATES ARE UTM 16 NAD 27 CENTRAL

Water Sample Analysis

Date: 11 May, 2006

Inorganic Chemistry Physical	Unit	Method	Results							
			Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9
Conductivity	us/cm	CONDUCTIVITY (probe)	39,700	50,200	49,800	49,200	49,800	40,100	40'600	42,000
pH	unit	pH/ISE meter (probe)	7.99	8.15	8.3	7.67	8.23	7.65	7.2	8.2
Salinity	ppt	Mercuric Nitrate titration	24.2	32.7	31.9	31.4	31	25.4	25	26.9
Total Suspended Solids (TSS)	ppm	Colorimeter	21	28	28	22	38	25	23	21
Temperature (in Lab)	°c	Probe/Termometer	23.8	24.8	24.7	24.8	24.8	24.7	24.8	23.9
Total Dissolved Solids (TDS)	ppm	CONDUCTIVITY (probe)	19,870	25,100	24,900	24,600	24,400	20,000	20,300	21,000
Non Metals										
Nitrogen Total (N)	ppm	Cadmium Reduction / UV VIS Spectro	3.4	4.1	2.6	1.9	3	1.8	2.3	2.9
Dissolved Oxygen (DO)	ppm	Probe	3.3	4	4	3.7	3.9	3.8	3.5	3.5
Phosphorus, Total ($asPO_4$)	ppm	PhosVer/Orthophosphate/ UV Vis Spectro	0.07	0.05	0.12	0.09	0.08	0.33	0.14	0.14
Inorganic Compounds										
Total Hardness (as $CaCo_3$)	ppm	EDTA Tritation / UV VIS Spectro	4,945	6,620	6,590	5,950	5,950	4,920	4,970	5,300
Sulphate (SO_4)	ppm	Sulfa Ver 4/ UV Vis spectro	1,750	2,500	3,000	2,800	2,450	1,750	1,850	5,300
Oxygen Demand, Biochemical (BOD5)	mg/l	BODTRAK /5days Digestion				34		19	14	21
Microbiological Analysis										
Total Coliform	count	m-ENDO Broth (MF)	TNTC	38/100 ml	112/100 ml	TNTCl	CG	464/100 ml	TNTC	TNTC
Escheria Coli (E.coli)	count	m-ENDO Broth (MF)	22/100 ml	6/100 ml	14/100 ml	24/100 ml	CG	114/100 ml	44/100 ml	26/100 ml
Fecal Coliform	count	m-FC/Rosolic Broth (MF)	14/100 ml	4/100 ml	0/100 ml	0/100 ml	18/100 ml	0/100 ml	0/100 ml	2/100 ml

Legend

Water Sampling Points
Roads
Creeks & Rivers

Note: No sample was collected from # 1 location

WATER SAMPLING LOCATION
AND RESULTS
ARS MACAO , RIVERSDALE

TUNICH- NAH CONSULTANTS
&
ENGINEERING
José Garcia P Eng. # 053-2001

Fig. 2.1 Ara Macao Sampling Station

ATTN: MR. Jose Garcia

BELIZE BREWING COMPANY LIMITED

(SEA WATER)

WATER and WASTEWATER LABORATORY

Sample ID: Ara Macao project **DATE: 11 May, 2006**

INORGANIC CHEMISTRY

PHYSICAL	UNIT	METHOD						RESULTS	
			2	3	4	5	6	7	8
COLOUR, TRUE	units	Platinum - Cobalt Standard/ UV VIS Spectro							
COLOUR, APPARENT	units	Platinum - Cobalt Standard/ UV VIS Spectro							
CONDUCTIVITY	µs/cm	CONDUCTIVITY (probe)	39'700	50'200	49'800	49'200	48'900	40'100	40'600
LANG. INDEX	units	Calculated/ Titration							
OIL IN WATER	ppm								
pH	unit	pH/ISE meter (probe)	7.99	8.15	8.30	7.67	8.23	7.65	7.20
SALINITY	ppt	Mercuric Nitrate titration	24.2	32.7	31.9	31.4	31.0	25.4	25.0
SILT DENSITY INDEX (SDI)	units	Filtration							
TOTAL SUSPENDED SOLIDS (TSS)	ppm	Colorimeter	21	228	28	22	38	25	23
TEMPERATURE (IN LAB)	°C	Probe/Termometer	23.8	24.8	24.7	24.8	24.8	24.7	24.8
TOTAL DISSOLVED SOLIDS (TDS)	ppm	CONDUCTIVITY (probe)	19'870	25'100	24'900	24'600	24'400	20'000	20'300
TURBIDITY	ntu	Nephelometric -Tungsten							
METALS	**UNIT**	**METHOD**						**RESULTS**	
ALUMINUM (Al)	ppm	Aluminon/UV VIS Spectro							
BARIUM (Ba)	ppm	Turbidimetric/ UV VIS Spectro							
CALCIUM (Ca)	ppm	UV VIS Spectro/ Titration							
CHROMIUM (Cr)	ppm	1,5-Diphenylcarbohydrazide/UV VIS Spectro							
COPPER (Cu)	ppm	Bicinchoninate/ UV VIS Spectro							
IRON, TOTAL (Fe)	ppm	UV VIS Spectro							
LEAD (Pb)	ppm	Dithizone/ UV VIS Spectro							
MANGANESE (Mn)	ppm	Periodate Oxidation/UV VIS Spectro							
MAGNESIUM (Mg)	ppm	UV VIS Spectro / Titration							
MERCURY (Hg)	ppm	Cold Vapor							
SELENIUM (Se)	ppm	Diaminobenzidine/ UV VIS Spectro							
SILVER (Ag)	ppm	Colorimetric/ UV VIS Spectro							
SODIUM (Na)	ppm	Probe							
ZINC (Zn)	ppm	Zincon/ UV VIS Spectro							
NON-METALS	**UNIT**	**METHOD**						**RESULTS**	
CHLORINE, FREE (Cl)	ppm	UV VIS Spectro /DPD							
CHLORINE, TOTAL (Cl)	ppm	UV VIS Spectro/DPD							
FLUORIDE (F)	ppm	SPADNS/UV VIS Spectro							
NITRATE, TOTAL (NO_3)	ppm	Cadmium Reduction/ UV VIS Spectro	3.4	4.1	2.6	1.9	3	1.8	2.3
DISSOLVED OXYGEN (DO)	ppm	PROBE	3.3	4	4	3.7	3.9	3.8	3.5
PHOSPHATE, TOTAL (PO_4)	ppm	PhosVer / Orthophosphate/ UV VIS Spectro	0.07	0.05	0.12	0.09	0.08	0.33	0.14
INORGANIC COMPOUNDS	**UNIT**	**METHOD**						**RESULTS**	
ACIDITY (as $CaCO_3$)	ppm	Titration							
AMMONIA (NH_3)	ppm	Salicylate / Probe							
BICARBONATE (HCO_3)	ppm	Titration							
CARBON DIOIXIDE (CO_2)	ppm	Titration							
CARBONATE (CO_3)	ppt	Titration							
CHLORIDE (Cl)	ppm	Mercuric Nitrate							
CHROMATE (CrO_4)	ppm	Titration							
CYANIDE (CN)	ppm	Pyridine-Pyrazalone/ UV VIS Spectro							
TOTAL HARDNESS (as $CaCO_3$)	ppm	EDTA Titration/ UV VIS Spectro	4945	6,620	6590	5950	5,950	4,920	4,970
HYDROGEN SULFIDE (H_2S)	ppm	Titration / UV VIS Spectro							
HYPOCHLORITE (BLEACH)	ppm	Titration							
M ALKALINITY(TOTAL), (as $CaCO_3$)	ppm	Sulfuric acid titration							
TOTAL NITRATE (NO_3)	ppm	Cadmium Reduction/ UV VIS Spectro							
NITRATE NITROGEN (NO_3-N)	ppm	Cadmium Reduction/ UV VIS Spectro							
NITRITE (NO_2)	ppm	Diazotization/ UV VIS Spectro							
HYDROXIDE ALKALINITY (OH)	ppm	Titration							
OZONE (O_3)	ppm	Indigo Trisulfonate/ UV VIS Spectro							
PHENOLPHTHALEIN ALKALINITY (as CaC	ppm	Sulfuric acid titration							
PHOSPHATE (PO_4)	ppm	PhosVer / Orthophosphate/ UV VIS Spectro							
SILICA (SiO_2)	ppm	Smcomolybdate/Colometric							
SODIUM CHLORIDE (NaCl)	ppm	UV VIS Spectro / Titration							
SULFIDE (S^-)	ppm	Methylene Blue Titration							
SULFITE (SO_3)	ppm	Titration							
SULPHATE (SO_4)	ppm	Sulfa Ver 4/ UV VIS Spectro	1'750	2'500	3'000	2'800	2'450	1'750	1'850

ORGANIC CHEMISTRY

OXYGEN DEMAND, BIOCHEMICAL (BOD_5)	mg/l	BODTRAK / 5 days Digestion				34		19	14
OXYGEN DEMAND, CHEMICAL (COD)	mg/l	Reactor Digestion							
ORGANIC	1/cm	Direct method/ UV VIS Spectro							
ORGANIC CARBON, TOTAL (TOC)	ppm	Direct method/UV VIS Spectro							
TRIHALOMETHANES (THMs)	ppb	Chloroform/UV VIS Spectro							

MICROBIOLOGICAL ANALYSIS

SEE ATACHED TEST RESULTS FOR DETAILS

	UNIT	METHOD					RESULTS	
HETEROTROPHIC BACTERIA	count	R2A Agar (MF)						
TOTAL COLIFORM	count	m-COLIBLUE24 Broth (MF)	T.N.T.C.	38/100ml	112/100ml	T.N.T.C.	C.G.	464/100ml	T.N.T.C.
ESCHERICHIA COLI (E.coli)	count	m-COLIBLUE24 (MF)	22/100ml	6/100ml	14/100ml	24/100ml	C.G.	114/100ml	44/100ml
FECAL COLIFORM	count	m-FC/ROSOLIC Broth (MF)	14/100ml	4/100ml	0/100ml	0/100ml	18/100ml	0/100ml	0/100ml
ENTEROCCOCCI	count	m-EL Broth (MF)							
YEAST	count	R. B. Agar (MF)							
MOLD	count	R. B. Agar (MF)							

T.N.T.C. = Too Numerous To Count
C.G. = Confluent Growth

SIGNATURE_____

ATTN: MR. Jose Garcia

BELIZE BREWING COMPANY LIMITED

(WELL WATER)

WATER and WASTEWATER LABORATORY

Sample ID: AM2 (Well Samples) **DATE: 7th June, 2006**

INORGANIC CHEMISTRY

PHYSICAL	UNIT	METHOD	RESULTS				
			Sample 1	Initial	Midway	End	Sample 5
COLOUR, TRUE	units	Platinum - Cobalt Standard/ UV VIS Spectro					
COLOUR, APPARENT	units	Platinum - Cobalt Standard/ UV VIS Spectro					
CONDUCTIVITY	µs/cm	CONDUCTIVITY (probe)	36,800	58	56.3	55.8	40,900
LANG. INDEX	units	Calculated/ Titration					
OIL IN WATER	ppm						
pH	unit	pH/ISE meter (probe)	8.12	5.71	5.72	5.66	8.19
SALINITY	ppt	Mercuric Nitrate titration	24.5	0.017	0.017	0.018	26.8
SILT DENSITY INDEX (SDI)	units	Filtration					
TOTAL SUSPENDED SOLIDS (TSS)	ppm	Colorimeter	25	3	2	N/D	10
TEMPERATURE (IN LAB)	°C	Probe/Termometer	21.6				21.5
TOTAL DISSOLVED SOLIDS (TDS)	ppm	CONDUCTIVITY (probe)	18,420	29	28.2	27.9	20,400
TURBIDITY	ntu	Nephelometric -Tungsten					
METALS	**UNIT**	**METHOD**	**RESULTS**				
ALUMINUM (Al)	ppm	Aluminon/UV VIS Spectro					
BARIUM (Ba)	ppm	Turbidimetric/ UV VIS Spectro					
CALCIUM (Ca)	ppm	UV VIS Spectro/ Titration					
CHROMIUM (Cr)	ppm	1,5-Diphenylcarbohydrazide/UV VIS Spectro					
COPPER (Cu)	ppm	Bicinchoninate/ UV VIS Spectro					
IRON, TOTAL (Fe)	ppm	UV VIS Spectro					
LEAD (Pb)	ppm	Dithizone/ UV VIS Spectro					
MANGANESE (Mn)	ppm	Periodate Oxidation/UV VIS Spectro					
MAGNESIUM (Mg)	ppm	UV VIS Spectro / Titration					
MERCURY (Hg)	ppm	Cold Vapor					
SELENIUM (Se)	ppm	Diaminobenzidine/ UV VIS Spectro					
SILVER (Ag)	ppm	Colorimetric/ UV VIS Spectro					
SODIUM (Na)	ppm	Probe					
ZINC (Zn)	ppm	Zincon/ UV VIS Spectro					
NON-METALS	**UNIT**	**METHOD**	**RESULTS**				
CHLORINE, FREE (Cl)	ppm	UV VIS Spectro /DPD					
CHLORINE, TOTAL (Cl)	ppm	UV VIS Spectro/DPD					
FLUORIDE (F)	ppm	SPADNS/UV VIS Spectro					
NITROGEN, TOTAL (N)	ppm	Cadmium Reduction/ UV VIS Spectro					
DISSOLVED OXYGEN (DO)	ppm	PROBE					
PHOSPHATE, TOTAL (PO4)	ppm	PhosVer / Orthophosphate/ UV VIS Spectro	0.08	1.82	1.82	1.58	0.055
INORGANIC COMPOUNDS	**UNIT**	**METHOD**	**RESULTS**				
ACIDITY (as $CaCO_3$)	ppm	Titration					
AMMONIA (NH_3)	ppm	Salicylate / Probe					
BICARBONATE (HCO_3)	ppm	Titration					
CARBON DIOIXIDE (CO_2)	ppm	Titration					
CARBONATE (CO_3)	ppt	Titration					
CHLORIDE (Cl)	ppm	Mercuric Nitrate		9.9	10	10.3	
CHROMATE (CrO_4)	ppm	Titration					
CYANIDE (CN)	ppm	Pyridine-Pyrazalone/ UV VIS Spectro					
TOTAL HARDNESS (as $CaCO_3$)	ppm	EDTA Titration/ UV VIS Spectro	4,670	7.9	6.8	8.1	5,715
HYDROGEN SULFIDE (H_2S)	ppm	Titration / UV VIS Spectro					
HYPOCHLORITE (BLEACH)	ppm	Titration					
M ALKALINITY(TOTAL), (as $CaCO_3$)	ppm	Sulfuric acid titration					
TOTAL NITRATE (NO_3)	ppm	Cadmium Reduction/ UV VIS Spectro	N/D	0.09	0.06	0.08	N/D
NITRATE NITROGEN (NO_3-N)	ppm	Cadmium Reduction/ UV VIS Spectro					
NITRITE (NO_2)	ppm	Diazotization/ UV VIS Spectro					
HYDROXIDE ALKALINITY (OH)	ppm	Titration					
OZONE (O_3)	ppm	Indigo Trisulfonate/ UV VIS Spectro					
PHENOLPHTHALEIN ALKALINITY (as CaC	ppm	Sulfuric acid titration					
PHOSPHATE (PO_4)	ppm	PhosVer / Orthophosphate/ UV VIS Spectro					
SILICA (SiO_2)	ppm	Smcomolybdate/Colometric					
SODIUM CHLORIDE (NaCl)	ppm	UV VIS Spectro / Titration					
SULFIDE (S^-)	ppm	Methylene Blue Titration					
SULFITE (SO_3)	ppm	Titration					
SULPHATE (SO_4)	ppm	Sulfa Ver 4/ UV VIS Spectro	27,300	0.1	N/D	N/D	28,600

ORGANIC CHEMISTRY

OXYGEN DEMAND, BIOCHEMICAL (BOD_5)	mg/l	BODTRAK / 5 days Digestion					
OXYGEN DEMAND, CHEMICAL (COD)	mg/l	Reactor Digestion					
ORGANIC	1/cm	Direct method/ UV VIS Spectro					
ORGANIC CARBON, TOTAL (TOC)	ppm	Direct method/UV VIS Spectro					
TRIHALOMETHANES (THMs)	ppb	Chloroform/UV VIS Spectro					

MICROBIOLOGICAL ANALYSIS

SEE ATACHED TEST RESULTS FOR DETAILS

	UNIT	METHOD	RESULTS				
TOTAL BACTERIA	count	m-TGE/TTC Broth (MF)					
TOTAL COLIFORM	count	m-coliblue24 Broth (MF)	98/100 ml				94/100 ml
ESCHERICHIA COLI (E.coli)	count	m-Coliblue24 Broth (MF)	14/100 ml				22/100 ml
FECAL COLIFORM	count	m-FC/ROSOLIC Broth (MF)					
ENTEROCOCCI	count	m-EL Broth (MF)					
YEAST	count	R. B. Agar (MF)					
MOLD	count	R. B. Agar (MF)					

SIGNATURE_____

Issue 3

- Agreement with the Ministry of Works in regards to the rerouting of the Placencia Road

The Ara Macao Resort and Marina project intends to reroute a section of the Placencia Road passing through the property. The Placencia Road begins at mile 22 on the Southern Highway and travels for 23 miles down passing Riversdale, Maya Beach, Seine Bight and finally to Placencia Village. Immediately south of the project site the Placencia Peninsula begins, and because of its narrow size in some areas, it is possible to have only one road running parallel down the length of peninsula. The Placencia road is an all weather dirt road, which makes the project site accessible all year round.

As stated in the EIA for the Ara Macao Resort and Marina Project, the developer will request permission from the competent authorities for the road realignment. An agreement was entered after numerous discussions were held with the Ministry of Works and the Government of Belize.

In a letter dated 19, June 2006, an agreement was signed between the Developer of Ara Macao Resort and Marina and the Ministry of Works for permission to realign the existing road passing through the property, **(See Agreement Attached)** for the official letter. The agreement outlines the following:

1. The proposed realignment of the Placencia Road would move part of this road approximately 2,000 feet to the west side of the project.
2. The connection to the existing Placencia Road ROW on the south end of the project would be retained and the connection to the existing Riversdale Road would be made slightly west of the current intersection.
3. The present Placencia Road ROW through the project site is approximately 6,000 feet in length with a 66 foot dedicated ROW. The proposed realigned Placencia Road ROW would be approximately 11,000 feet in length on a new 66 foot ROW. The dedicated ROW would be wider at roundabouts and intersections.
4. The new ROW would be deeded to the Belize Government in exchange for the abandoned old ROW land.
5. The new realigned Placencia Road through the project is proposed as a boulevard design with at least one lane of traffic in each direction separated by a center planting median. Left and Right turning lanes or roundabouts would be provided at the several entrances to the resort facilities along the road.
6. The cost for completing the new realigned Placencia road including the resurfacing and all associated improvements on the Project will be paid entirely by the Developer.

Hon. Michael J. Espat
Minister
Government of Belize
Ministry of Works
#1 Power Lane
Belmopan
Belize Central America

RE: Ara Macao Resort & Marine
Placencia Road Realignment

Dear Mr. Espat,

Ara Macao Development Ltd. (the "Developer') respectfully requests approval from the Ministry of Works and the Government of Belize for a realignment of the Placencia Road where it passes through the proposed Ara Macao Resort and Marina property (the "Project"). The Project is located on the mainland north of the Placencia Lagoon and immediately west and south of Riversdale and Riversdale Road in the Stann Creek District. The location proposed for the new Placencia Road Right Of Way is shown on the attached site plan rendering for the Project.

The proposed realignment of the Placencia Road would move part of the road approximately 2,000 feet to the west side of the Project. The connection to the existing Placencia Road ROW on the south end of the Project would be retained and the connection to the existing Riversdale Road would be made slightly west of the current intersection. The current Placencia Road ROW through the resort site is approximately 6,000 feet in length with a 66 foot dedicated ROW. The proposed realigned Placencia Road ROW would be approximately 11,000 feet in length on a new 66 foot ROW. The dedicated ROW will be wider at round-abouts and intersections. The new ROW would be deeded to the Belize Government in exchange for the abandoned old ROW land. The new realigned Placencia Road through the Project is proposed as a boulevard design with at least one lane of traffic in each direction separated by a center planting median. Left and right turning lanes or round-abouts would be provided at the several entrances to the resort facilities along the road.

The cost for completing the new realigned Placencia Road including resurfacing and all associated improvements on the Project will be paid entirely by the Developer.

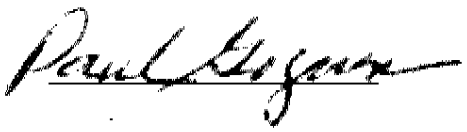
Should this plan be acceptable to the Ministry of Works and the Government of Belize, it is requested that the planned surfacing and improvements be suspended for the existing Placencia Road on the Project site for a period not exceeding one year. This section of road will be maintained by the Developer, in

its current location until the new Realigned Placencia Road is completed, using a temporary wearing surface.

Ara Macao Development Ltd. respectfully requests approval, in principle, of this plan pending final approval of the Ara Macao Resort and Marina EIA submissions and the final engineering, financial and legal documentation for the new Right of Way and Realigned Placencia Road improvements. If this outline proposal is acceptable, please acknowledge your agreement to the principles outlined above by signing where noted below. This agreement will not be fully binding on either party until the necessary approvals and agreements are fully processed and documented.

Agreed in Principle,
Date: June 19, 2006

Ara Macao Development, Ltd.



Paul Goguen
President

Agreed in Principle,
Date: June 19, 2006

Government of Belize
Ministry of Works

Hon. Michael J. Espat
Minister

Witnessed by:

Jose Garcia, P Eng.
Date: June 19, 2006

Issue 4

- Land Tenure Documents

MEMORANDUM

To: Government of Belize, Department of the Environment

From: Steven J. Thayer, Handler, Thayer & Duggan, L.L.C., Attorneys at Law

Date: June 6, 2006

Re: Ara Macao Resort & Marina

The purpose of this Memorandum is to provide a brief overview of the legal rights to develop the Property that is proposed for the development of the Ara Macao Resort & Marina near Placencia (the "Project").

Property & Title

The Property consists of all those parcels of land on the northern tip of the Placencia Peninsula in the Stann Creek District of Belize comprising approximately 582-597 acres and further shown on Exhibit A to this Memorandum. Title to the Property commences with and derives from Transfer Certificate of Title dated July 12, 2002, Volume 41, Folio 59 and Transfer Certificate of Title dated July 12, 2002, Volume 41, Folio 60, both in the name of Mackinnon Belize Land & Development Limited, as registered proprietor.

Legal Structure

The developer of the Property will be Ara Macao Development, Ltd., a newly formed Belize corporation, owned by Ara Macao Holdings, L.P., an Illinois limited partnership (99%), and IoVest Development, LLC, an Illinois limited liability company (1%). Upon the closing of the acquisition of the Property, as further discussed below, title will be transferred to a newly established Belize Trust that will be organized for the benefit of Ara Macao Holdings, L.P. to serve as the legal owner of the Property. Ownership of the land will be held in trust until such time as the Property is subdivided and transferred to future owners. The rights to develop the property will be transferred from Ara Macao Holdings, L.P., to its subsidiary, Ara Macao Development, Ltd., who will serve as the Developer of the Project. In addition to these entities, Ara Macao Resort & Marina, LLC, a Nevis limited liability company, will be established to assist with the marketing and sale of resort properties to individual buyers.

Contract Rights to Property

The rights to develop the Property derive from that certain Memorandum of Sale dated June 7, 2004 ("Contract") by and between Mackinnon Belize Land & Development Limited ("Vendor"), and IoVest Development, L.L.C. ("Purchaser"), a copy of which is attached hereto as Exhibit B. This Contract grants Ara Macao Holdings, L.P., through it's General Partner, IoVest Development, LLC, the legal rights to acquire the Property over time as payments are made against the total purchase price.

Purchase Areas – Phased Development

Pursuant to the terms of the Contract, the Property is divided into three primary Purchase Areas, Purchase Area 1, Purchase Area 2, and Purchase Area 3. Purchase Areas 2 and 3 are further subdivided into four separate Purchase Areas, including Purchase Areas 2A, 2B, 2C, 2D, 3A, 3B, 3C, and 3D (see attached Exhibits C and D). Payments under the Contract are further allocated to each designated Purchase Area such that the Purchaser may acquire the Property in one or more phases as the development of the Property proceeds. The Purchaser has currently made payments under the Contract such that Purchase Areas 1 and 2 are fully paid for and Purchase Areas 3C and 3D are yet to become due and payable.

Upon securing all necessary approvals from the Government of Belize, the Purchaser intends on closing upon all Purchase Areas which are necessary to complete the development of the initial phases of the Project, including all of Purchase Areas 1 and 2. The Purchaser will proceed with the completion of the balance of the Project in phases as set forth in the Environmental Impact Assessment Application.

Conclusion

The rights to acquire, own, develop, and market the Property derive from the underling Memorandum of Sale Agreement that was entered into on June 7, 2004, with Mackinnon Belize Land & Development Limited. Each of these underlying property rights have been further assigned and transferred to certain affiliated entities for various legal, tax, and reporting purposes. Ara Macao Development, Ltd., as the Developer of the Project, will oversee the development of the overall Project and serve as the primary agent responsible for the completion of the Project.

If you would like any further information concerning these agreements and arrangements, please feel free to contact our office.

Issue 5

- Copy of the pre-sale agreement as was stated in the correspondences with respect to the advertisement on the Internet

MEMORANDUM

To: Government of Belize, Department of the Environment

From: Steven J. Thayer, Handler, Thayer & Duggan, L.L.C., Attorneys at Law

Date: June 6, 2006

Re: Ara Macao Resort & Marina

The purpose of this Memorandum is to provide a brief overview of the rights of contract purchasers of resort properties being marketed and sold in connection with the Ara Macao Resort & Marina Project to be located near Placencia (the "Project").

Current Marketing Activities

A limited number of resort properties are currently being marketed and sold to individual buyers by Ara Macao Development, Ltd. (the "Developer"), and certain affiliates of the Developer, pursuant to the terms and conditions of a certain "Pre-Construction Incentive Pricing Purchase Agreement," a copy of which is set forth in the "Purchaser Information Package" which is attached hereto. These marketing and sale activities are ordinary and customary in many Caribbean jurisdictions and the United States as a means of securing financing for a contemplated Project.

Pursuant to the terms and conditions of the Pre-Construction Agreement, Buyers enter into contracts to purchase a resort property subject to certain inherent development risks which are set forth in the Purchaser Information Package that is provide to Buyers at the time of their purchase. The Purchaser Information Package explains the overall scope of the Project, the anticipated development schedule, the approvals necessary to complete the Project, and other inherent risks related to the Project. Among the various risk factors that is disclosed to prospective buyers is that the Project remains subject to the approval of the Government of Belize.

The purpose of the Purchaser Information Package is to provide buyers with a full and fair disclosure of the status of the Project so that they enter into contracts knowing the inherent risks related to the completion of the Project. See pages 39-41 of the Purchaser Information Package for a summary of the risk factors related to the completion of the Project.

The developer is currently offering up to 50 Units to prospective purchasers at a 20% discount from the intended purchase price of the Units to compensate buyers for taking these additional development risks. The developer will use the deposits it receives from these sales to help fund initial development costs related to the Project. In the event that the Project is not completed as contemplated the Property will be sold and the proceeds of the sale will be used to refund any deposits collected by the developer pursuant to the terms of the Pre-Construction Agreement. Paragraph 16 of the Contract grants initial buyers a general security interest in the land related to the Project until such time as their units are delivered or their money is refunded pursuant to the terms of the Pre-Construction Agreement.

Conclusion

By providing prospective purchasers with a Purchaser Information Package, the developer disclosures to buyers the inherent risks related to the acquisition of a resort property in the Project. By providing buyers with a substantial discount from the published sales prices, the developer adequately compensates buyers for taking these additional risks. The Pre-Construction Purchase Agreement further provides buyers with adequate assurances that if the Project is not competed for any reason they will likely get their deposits back from the proceeds from the sale of the Property. The marketing of resort properties under these circumstances represents a reasonable and customary means of both providing financing for the Project and offering buyers a unique investment opportunity.

If you would like any further information concerning these agreements and arrangements, please feel free to contact our office.

(See Electronic Copy for Purchaser Information Package.)

Issue 6

- Details of the servicing to be provided for water vessels within the Marina, including liquid and solid waste management

6.1 Boat Liquid Waste Management

Liquid waste from the boats will consist of liquid waste from the wastewater holding tank and any liquid waste from the boat's bilge. It is unlawful for any vessel to discharge sewage or bilge water into the sea as per the MARPOL 73/78 Convention signed between Belize and the IMO. For this purpose Ara Macao will provide the necessary facilities required for the proper disposal and treatment of the boat's bilge and wastewater for the residents and transient population. These facilities will be situated between the Harbor Master and the Hotel and vessels will first obtain permission from the Harbor Master to dock and subsequent discharge their bilge water and/or wastewater into the receiving system. This is to prohibit any vessel from dumping their waste into the marina and adjacent coastal waters.

The marina **(See Volume II; Annex IV – Marina Component of the EIA)** will have two stations for the pumping out of sewage from the boats;

1) Central Location at the Fueling Docks

In the first station there will be a boat pump out system at the fueling dock so that any boat in the marina or transient boat can pump out their sewer tank at the fueling dock when fueling their boat. The boat pump out system will consist of a Peristaltic pump system. An attendant at the fuel dock will connect a hose from a stanchion, which is connected to the pump, to the boat. The peristaltic pump will then pump the sewage through a PVC piping system underneath the dock to a manhole on land which will then gravity flow to the BESST Treatment Plant.

2) Dockside Pump out System

At the second station the marina will also have a dockside pump out system. A dockside pump out system means that the boat can be pumped out while it is in the slip. This system consists of a vacuum pump located near the entrance of the marina dockage on land or on the dock. The pump will have approved PVC piping going from a hydrant located approximately every fifty feet on the docks thru the dock system to the pump. From the discharge side of the pump there will be PVC piping to a manhole and then a gravity flow to the BESST treatment plant. A marina attendant will do the dockside pumping by connecting a hose to the dockside hydrant and to the boat allowing it to flow through the system. The system will have flex hoses at appropriate locations. Expansion joints will also be installed at appropriately, engineered locations. All marina personnel will be trained to operate the pump outs properly.

3) Bilge Pump Out

A bilge pump out system will be located at the fuelling dock near the Harbor Master. The bilge pumping system, which consists of an oil/water separator, peristaltic vacuum pump, **(See Attached Information on Bilge Water Pump)** and waste oil (hydrocarbon) accumulator, will collect and filter the bilge water. This will then be acceptable to be pumped into the BESST Treatment Plant. The free oils will be separated and collected in a primary collection vessel and then disposed by a licensed waste oil disposal company. All material hauled out by the waste oil company will be documented and kept on file.

This service will also be available to local vessels equipped with such amenities. The marina and adjacent coastal waters will have notice signs to inform all vessels of the pump out system on site and not to deter dumping any sewage or bilge water in the marina.

6.2 Wastewater Generation

It is difficult to calculate the wastewater generated by the vessels in terms of visitation frequency. Nevertheless, taken into consideration the marina design and the capacity of vessel (see figure 2.2) at any one given time the following table best describes the wastewater volume generated at 100% occupancy. This percentage, in the real world, may never surmise but is an important factor in wastewater engineering.

Table 2.2 Wastewater generated by marine vessels

Wastewater Production

Boat Length (feet)	Marina	Slips	Total Boats	Water Capacity (gals)	Water Demand (gals)	WW 70% (gals)
30	20	0	20	0	0	0
40	150	0	150	0	0	0
50	112	173	285	400	114,000	79,800
100	12	0	12	1000	12,000	8,400
Totals	**294**	**173**	**467**		**126,000**	**88,200**

It is expected that the three treatment zones (3, 4 and 5) will treat the wastewater (88,200 gallons or 333,873 liters) generated by the marine vessels. Also, note that vessels less than 30 feet were not considered due to the fact they carry no facilities as such.

6.3 International Waste Management

Solid waste from boats or international waste consist of food tainted waste and clean waste. It is unlawful for any water vessel to dispose of solid waste into the sea as per the MARPOL 73/78 Convention signed between Belize and the IMO. For the purpose of

this convention, Ara Macao Resort and Marina will provide the necessary facilities for the collection, transportation and incineration of the solid waste generated by the international water vessels.

All foreign vessels (yachts, catamarans, sailboats, houseboats etc.) will be required to obtain permission from the Harbor Master to dock and dispose of their solid waste. The Harbor Master will inform the vessel's captain to dispose of their waste whilst servicing their vessel. This is important as all vessels anchored outside the marina will be monitored.

Solid Waste will be separated into two categories, clean garbage and tainted waste (with food etc.). Disposal containers will be located on land at the entrance of each main dock. Each location will have two containers which will be clearly marked for separation process.

a) Tainted Waste: When this waste is picked up by marina personnel at each dock location it will then be stored in a larger container for incineration on site. **(See incinerator Information attached)**

b) Clean Trash: This trash will be picked up by marina personnel at each dock location and will then be stored in a larger container for disposal by a licensed contractor to landfill or incinerated on site along with the tainted waste.

Ara Macao Resort and Marina will install a low volume incinerator to incinerate all the international waste and any hazardous waste produced by the project during its operation. This incinerator will be located at the back of the project and will consist of a two chambered, diesel operated incinerator with scrubber capable of incinerating 220 lbs/day or 100 kg/day of waste.

Disposal signs and notices will be made available at the designated docks for collection and disposal. Also, a myriad of disposal signs will be placed through out the marina for the residents and guests.

6.3.1 Solid Waste Generation

Just as with the wastewater production, calculating the generated waste is complicated. This is due to the fact that marine vessels vary in length and capacity of persons on the vessels. Nevertheless, taking into consideration of the marina design and capacity of vessels (see figure 2.2), the following table illustrates the waste generated by the vessels at 100 %.

Table 2.3 International waste generated by marine vessels
Solid Waste Generation

Boat Length (feet)	Marina	Slips	Total Boats	Person/ Boat	Visiting Population	Factor 3lb/p/day
30	20	0	20	2	40	120
40	150	0	150	6	900	2,700
50	112	173	285	6	1,710	5,130
100	12	0	12	12	144	432
Totals	**294**	**173**	**467**		**2,794**	**8,382**
						4.2 tons

Literature

International Maritime Organization 2003; MARPOL Convention 73/78 Annex IV: Prevention of pollution by sewage from ships. Convention signed between Belize and the IMO.

International Maritime Organization 1988; MARPOL Convention 73/78: Annex V: Prevention of pollution by garbage from ships. Convention signed between Belize and the IMO.

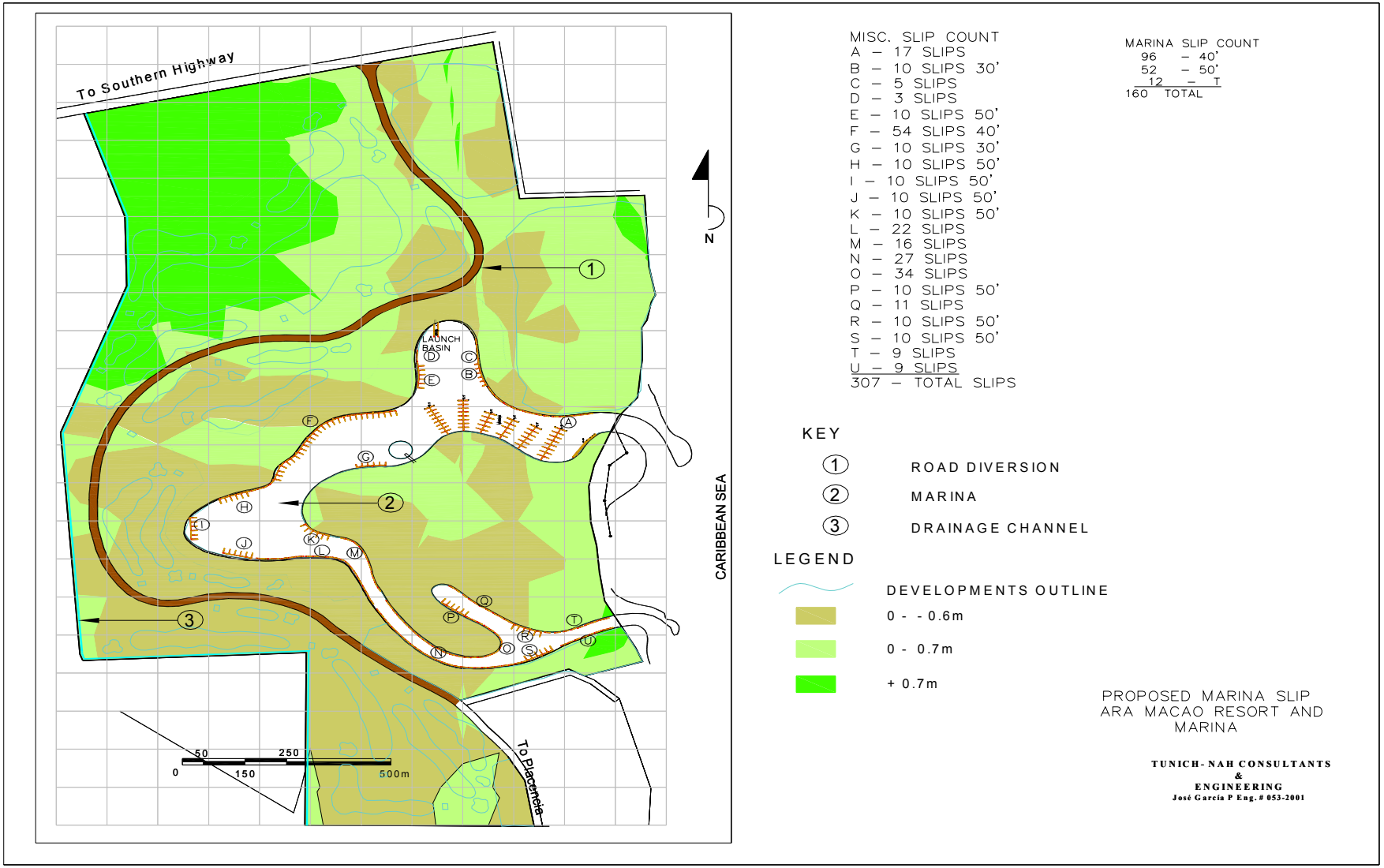


Fig. 2.2 Proposed Marina and slip design for Ara Macao

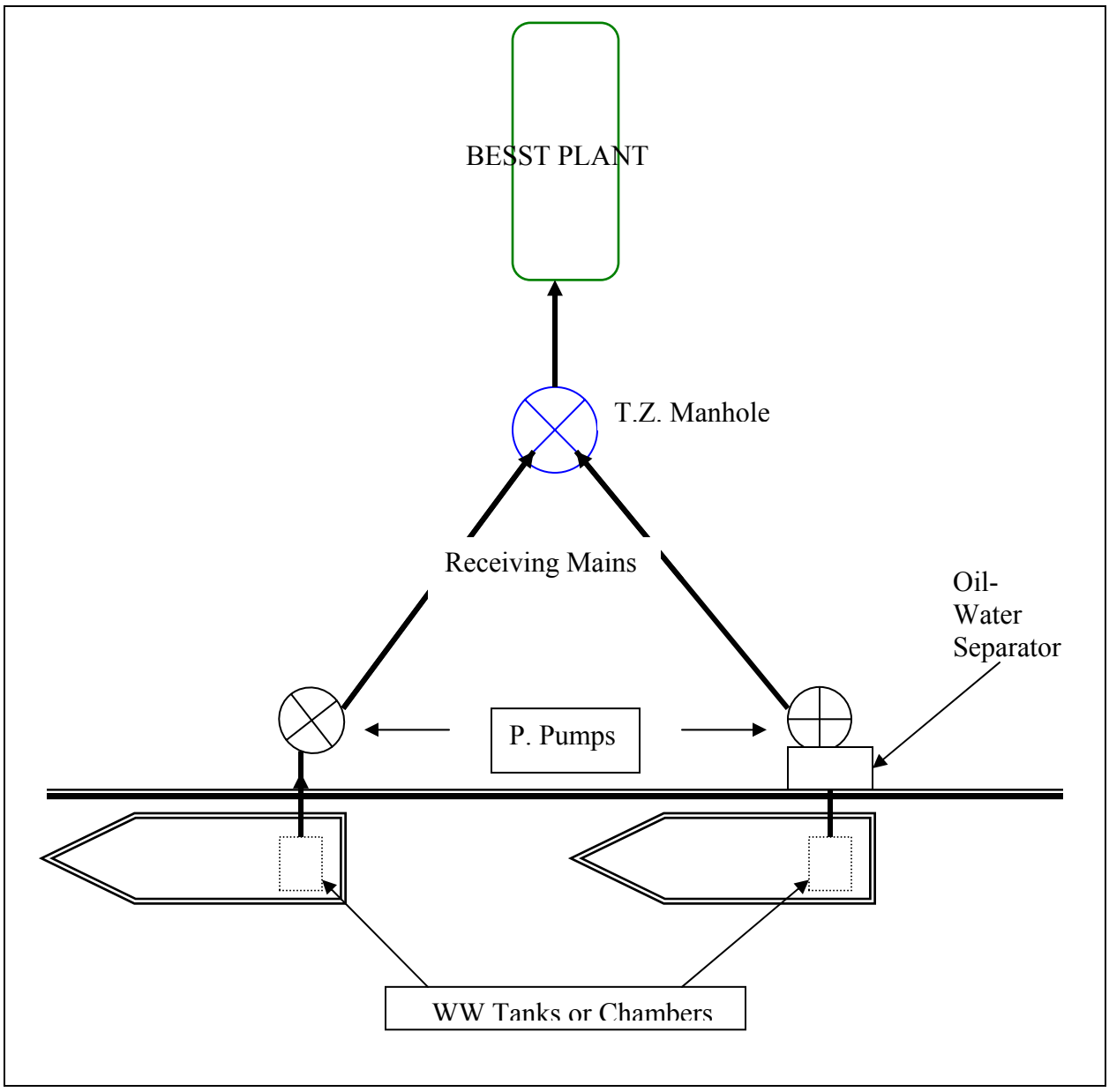


Fig 2.3 Boat wastewater and bilge water treatment sketch

BILGE WATER PUMP SYSTEM

SaniSailor

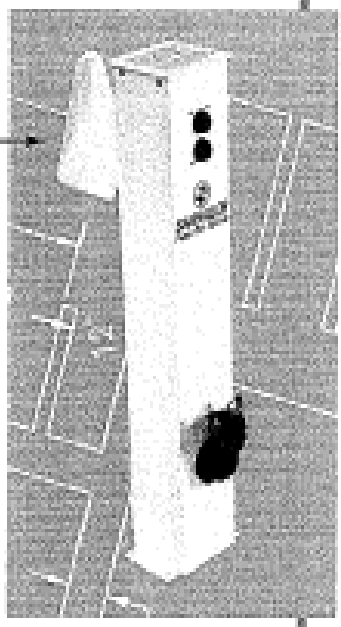
PUMPOUT SYSTEM PERIPHERALS

SaniSailor Stanchions are remote pumpout location pedestals. They may include different options such as: on-off push buttons, an hour meter, or hose rack. All stanchions include pumpout hose connection plumbing.

Stanchion with hose rack, push button on/off switch. (ST8201)

Stanchion with hose rack only. (not shown) (ST-CV200)

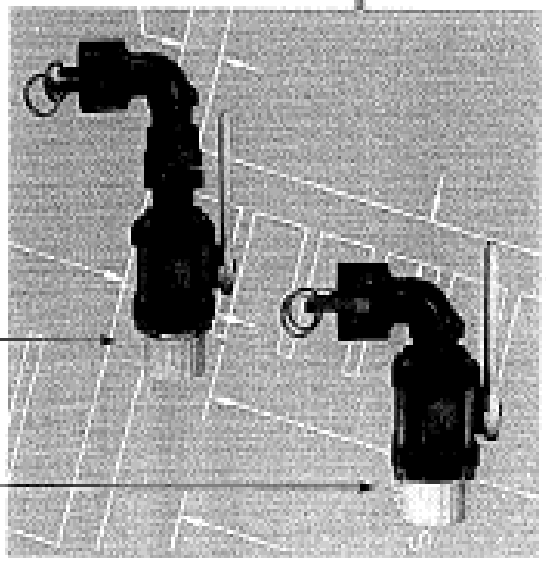
Stanchion with plumbing only. (not shown) (ST-190)



Hydrants are the low profile plumbing connections to be used at individual slips. EMP offers two types: a fixed hydrant for single slip use, or a swivel hydrant for a 360 degree pumping radius where 2, 3, or 4 slips are to be serviced fom a single hydrant.

Swivel Hydrant. (H-203)

Fixed Hydrant. (H-202)



SaniSailor

SENTINEL LINE IMITATED, NEVER DUPLICATED

With over 1500 systems in use worldwide, and a reputation for quality and reliability, SaniSailor is the most trusted name in marine pumpout systems.

The Sanisailor Sentinel Systems are designed for generating the vacuum and the lift for "point of pumpout" configurations. This means the system is typically located at the point of pumpout in the case of a single pumpout location, or within 100 ft. of a stanchion(s), when several pumpout locations are required.

The Sentinel models are stationery systems. EMP offers four Sentinel models that are designed for different applications: The Sentinel SlipMate, M300, M500, & EV405.

- Continuous vacuum.
- Capacity rate from 10 to 60 gpm.
- Suction lift to 30 ft.
- Discharge head from 65 ft. to over 300 ft. vertically.

The Sentinel SlipSide

The Sanisailor SlipSide & SlipMate (see mobile units) Pumpout models are for smaller marinas and yacht clubs where pumpouts are important but usage and volumes may be low.

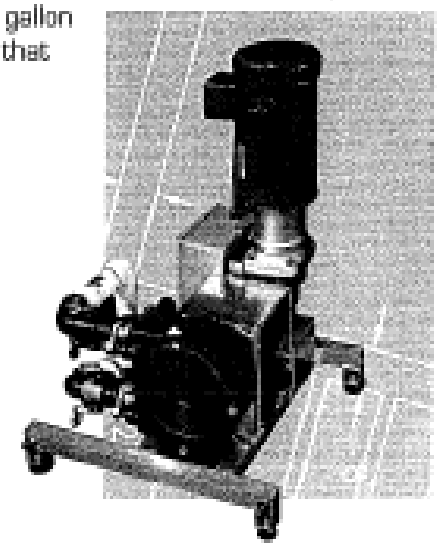
The SlipSide series includes a stationary SaniSailor Sentinel SlipSide and the mobile SaniSailor SlipMate (P30). The SlipSide models use a slightly smaller peristaltic pump compared to the rest of the Sentinel Line.

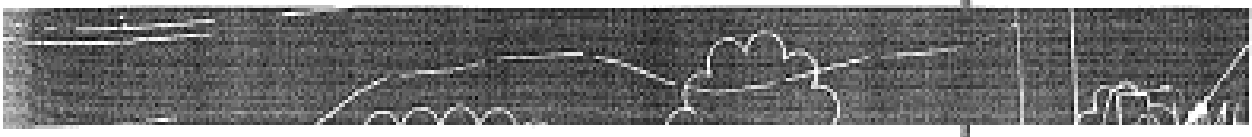
The SlipSide operates perfectly in the 10-15 gallon range and is suitable for facilities with boats that have smaller holding tanks (30 – 60 gallon).

The SlipSide is ideal where a single pumpout location is needed.

SaniSailor Sentinel SlipSide specs:

- 15gpm max peristaltic pump
- 1.5 hp TEFC motor
- all aluminim frame
- sturdy pvc cover





The Sanisailor Sentinel M300

The M300, is designed for the most standard point of pumping application. Use the M300 with one pumpout location or several in close proximity, as on a fuel dock or convenience dock. The Sentinel M300 is designed for pumping out at up to 30 gpm, where the septic system is no more than 30 ft. above the system, (i.e. no more than 30 ft. of "dynamic head" or "vertical discarge."]

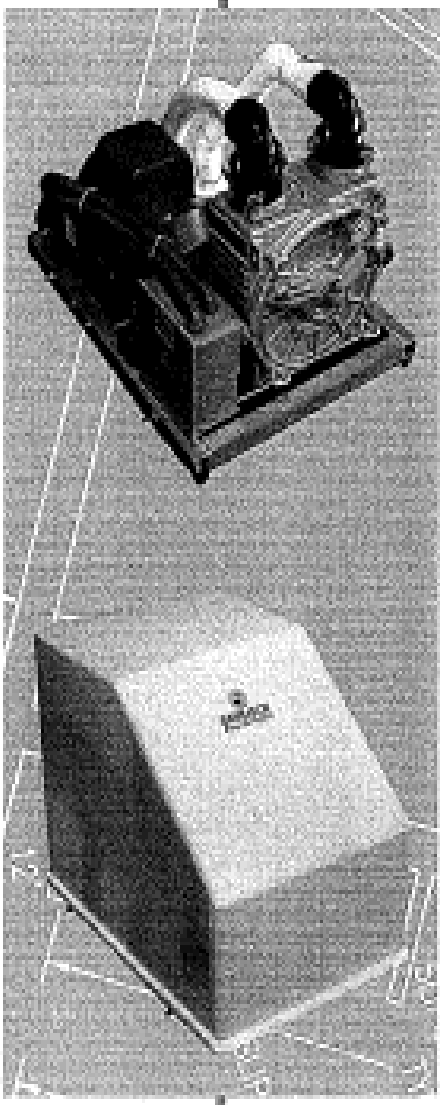
Just like all other SaniSailor pumpout systems, the Sentinel M300 pulls a high vacuum of 29 inches of mercury, over 30 ft. of water.

The Sanisailor Sentinel M500

The Sentinel M500 is essentially a turbo version of the M300. It handles a greater "vertical discharge head" or, alternatively, can offer increased flow rate.

The M500 is a good choice when the vertical discharge head is between 30 and 65 ft.

Or, where there is less than 30 ft. of vertical discharge head, the M500 will provide maximum pumpout speed (up to 60 gpm) - a real benefit for larger holding tanks.



SaniSailor M line specs:

- high capacity suction
- flow rates to 65 gpm
- compact dockside design

SaniSailor

High Vacuum Suction Hoses,

SaniSailor Hoses
Manufactured specifically for high vacuum suction applications. They are made completely made of plastic; an engineered combination of copolymer materials meeting the requirements of high flexibility and corrosion resistance.

Complete Suction Hose Assembly: 30' suction hose with cuffed ends and quick connect fittings. Plus one complete universal suction nozzle with ball valve and sight tube.
(H-301)

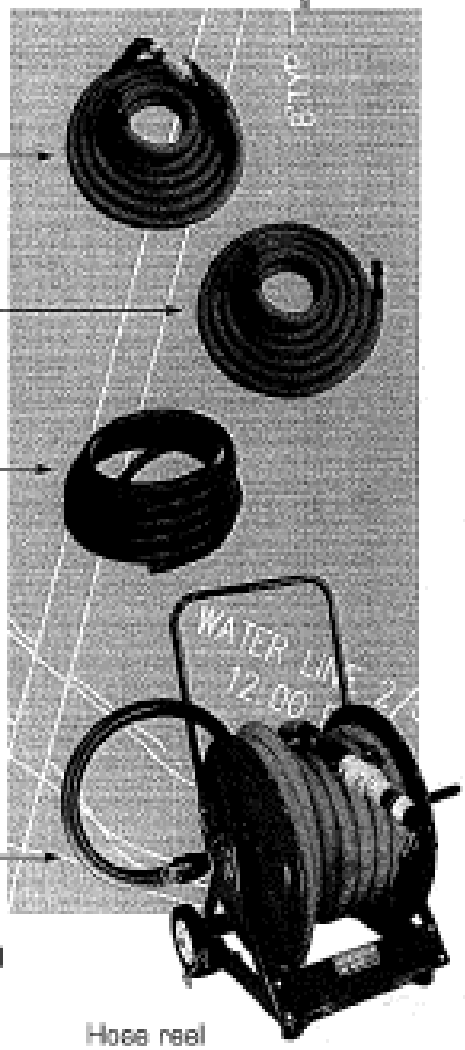
Extension Hose
30 feet of the same suction hose with cuffed ends and quick connect fittings.
(H-302)

(Call factory for non-standard lengths.)

SaniSailor PVC Flex Hose (green)
For flexible connections at gangways
(H-390)

Hose Specifications:

- fused-on leak proof cuffs at both ends.
- handles a full vacuum 29.9" hg without collapse
- excellent temperature rating -40°F to 160°F
- smooth interior wall (bore) minimizes friction for maximum pump performance



Hose Reels
Powder coated steel construction with 8 inch solid rubber tires. Handles are removable for compact storage. Rubber feet prevent hose reel from rolling forward when pulling hose out.

Standard Hose reel w/hand crank.
(H-403)

Hose reel w/rolling hose guides.
(H-404)

Hose reel w/PVC cabinet.
(H-405)

Hose Assemblies & Fittings

Connection fittings are made of glass reinforced polypropelene.

These connectors offer excellent rigidity, light weight and resistance to stress cracks and impact. They allow virtually no moisture absorption.

Nozzle Assmebly Standard
(F-302)

Heavy Duty
(F-312)

Nozzle Check valve
(F-302c)

Rubber Nozzle replacement
(F-305)

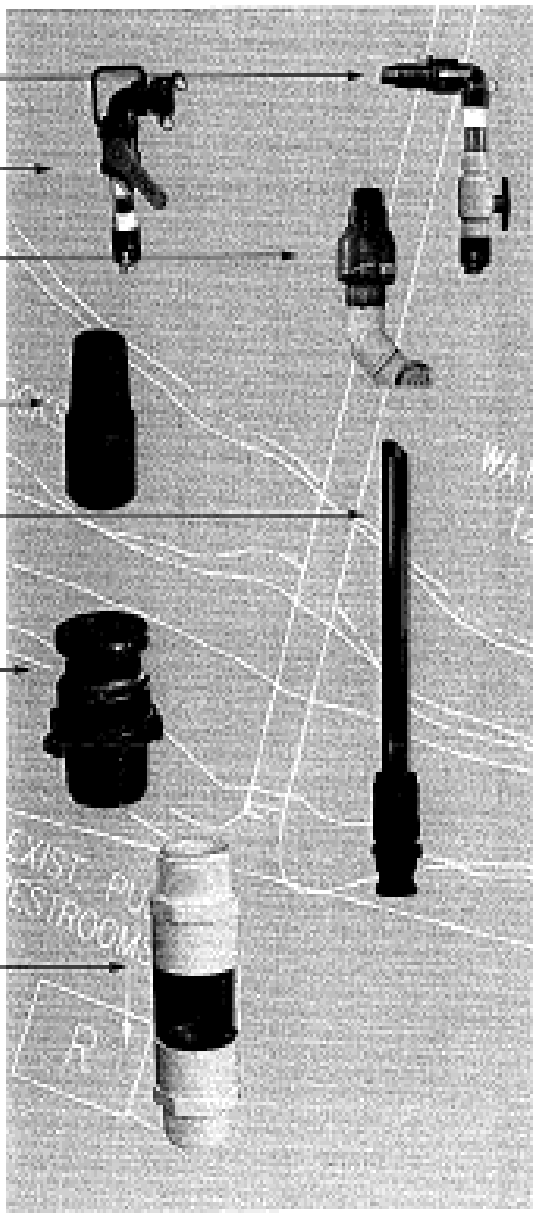
Potty Wand
(F-309)

Threaded deck fittings
1½" quick connect to 1½" thread
(F-450)

1½" quick connect to 1¼" thread
(F-425)

Set, one each
(F-401)

Sight Tube Assembly
(F-409)



INCINERATOR

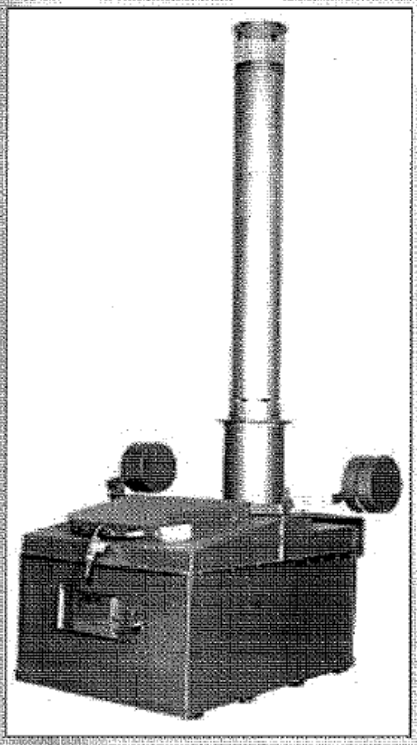
FOR

TAINTED WASTE

Inciner8 Ltd

Model A850 Waste Incinerator

Efficient, clean and durable



Standard Model A850

Features overview

- Designed for economical performance.
- Low profile for easy loading and ash removal
- Refractory lined to retain heat for efficiency
- Available with LP, Natural gas or fuel oil burner
- Optional secondary burner where needed.
- Optional secondary chamber to produce 2 second gas retention time at 850 deg C

Ease of use

- Auto ignition. No pilots to light. Set the timer and walk away.
- Single burner reduces maintenance cost.
- Built-in skid facilitates placement.

Fuel efficiency

- Rapid incineration means low fuel consumption.
- Higher burn rate than smaller models.
- Thick refractory lining in main chamber retains heat, increasing efficiency.

Quality built to last

- Heat resistant aluminized steel.
- Stainless steel stack.
- Backed by years of incineration experience.

The benefits of incineration . . .

Hygienic
Waste can be destroyed as fast as it accumulates. Nothing is left to spread disease or to attract rodents and flies.

Convenient
Fill the chamber and turn on the burner. No watching required since timer automatically shuts down burner. Alternative methods frequently require more time to manage and maintain.

Thorough
Leaves only sterile white ash and brittle bone fragments. Reduces animal carcasses to approximately 5% of sterile residue.

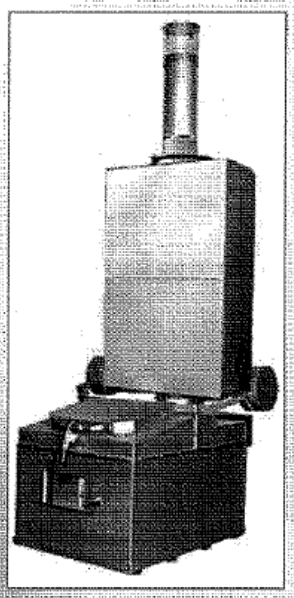
CE BS EN 746-2:1997

Inciner8 Ltd Model A850(A)

The Model A850 is the largest unit that we produce in the range of incinerators burning less than 50kg per hour. It is available in different variations, with the most popular being the UK DEFRA approved Model A850(A), which utilises a secondary chamber providing a gas retention time of 2 seconds at 850 degrees Centigrade and maintains this throughout the burn cycle. This makes the Model A850 (A) version ideal for burning animal carcasses in accordance with the animal-by-product act.

The unit is unique in that it uses a dual fired burner motor rather than two separate burner units, this not only is more efficient but provides low maintenance and fuel costs.
The unit can be preset to burn for the required time and has numerous safety cut off features.
The burners come with a unique post burn cool down system, which allows for quicker cool down before restocking.

The model A850 also includes a small front opening clean out door for quicker and safer cleanout. It also has skids to allow easy handling with a forklift.



DEFRA Approved Unit A850(A)

Specifications

CHARGING RATE - Pathological: Up to 400 kg per charge of typical pathological waste with a BTU/lb. rating of 1000. Batch loaded allowing complete burn-out in approximately 8.5 hours, cool down and ash removal before reloading.
Burn rate: Approximately 46kg/hr.
Available in Natural gas, LPG, Diesel Oil or Kerosine

Model A850

Chamber capacity - 400 kg
Chamber volume (approx.) .75 m3
Chamber size (outside)
Width 113 cm Height 114 cm Length 152 cm
Door opening 53 x 69cm
Height to door 91 cm
Height to top of stack 4.8 m
Weight - 1820 Kgs
Suggested slab size (l x w x thick) 2.4 m x 3 m x 10cm
STACK
Refractory Lined stack .6m height, 36cm diameter 14 gauge (1.90 mm) stainless steel
Stainless Steel Stack height 2.4m, 30.5 diameter, 16 gauge (1.52 mm) stainless steel
GENERAL
Electrical service Standard—115 volt, 60 HZ, 20 amp. Also available—220 volt, 50 HZ, 10 amp

Model A850(A)

Chamber capacity - 400 kg
Chamber volume (approx.) .75 m3
Chamber size (outside)
Width 113 cm Height 114 cm Length 152 cm
Door opening 53 x 69cm
Height to door 91 cm
Height to top of stack 4.8 m
Suggested slab size (l x w x thick) 2.4 m x 3 m x 10cm
Secondary Chamber Volume .80 cubic metres
2 second gas retention time at 850 deg. C
Temperature monitor. Dual fired burner available in LPG, natural gas, Diesel or kerosene.
STACK
Stainless Steel Stack height 2.4m, 30.5 diameter, 16 gauge (1.52 mm) stainless steel
GENERAL
Electrical service Standard—115 volt, 60 HZ, 20 amp. Also available—220 volt, 50 HZ, 10 amp

Dealer

Inciner 8 Ltd, Unit 9, Shakespeare House,
37-39 Shakespeare Street, Southport, PR8 5AB
Tel +44 (0) 1704548508 Fax +44 (0) 1704 542461
Email info@inciner8.com Web www.inciner8.com

Issue 7

- Details Sand Monitoring Program

Sand Monitoring Program

The sand monitoring plan for the Ara Macao Development calls for a semi-annual beach survey. The surveys will be conducted including shore-perpendicular transects along the entire site at 100m intervals and 10m intervals on the beaches immediately north of the north jetty and south of the south jetty. On the beaches adjacent to the entrance channels, transects will run from the backshore (zone unaffected by wave activity) offshore to a depth of 4m with survey points spaced 5m apart or when the profile changes by more than 0.3m. On beaches along the rest of the Ara Macao shore, transects will run from the backshore to a depth of 2m with survey points spaced 5m apart or when the profile changes by more than 0.3m.

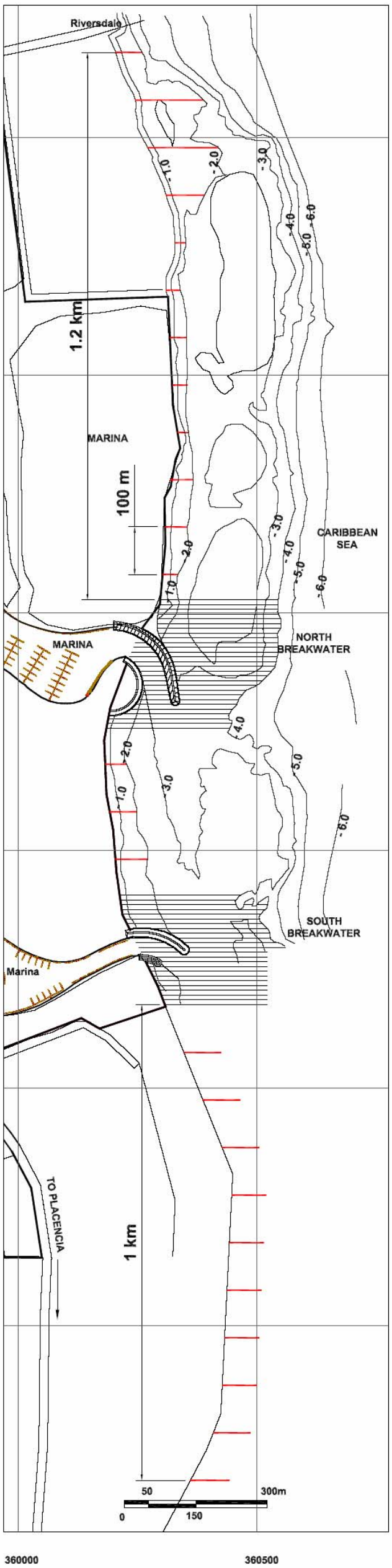
Assuming the system performs as predicted, sand will accumulate north of the north jetty and a smaller amount accumulating against the south side of the south entrance channel. To help assure no negative impact on adjacent properties, quantities of accumulated sand will be calculated, excavated and bypassed. After the first year of monitoring sediment dynamics, the survey schedule and location of transects will be re-evaluated to assure a comprehensive and efficient plan for the following year.

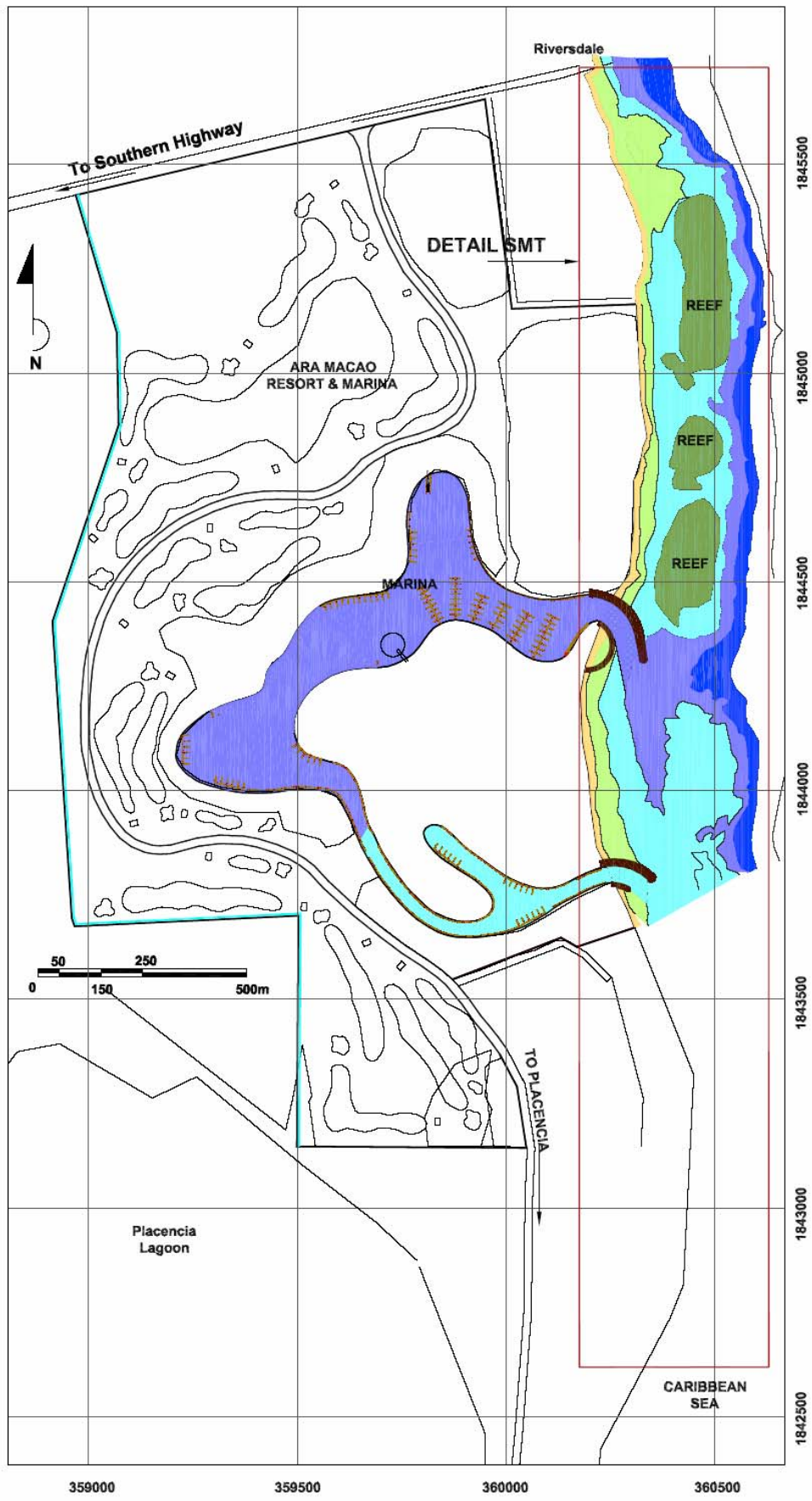
The threshold sand amount to initiate sand bypassing is 3,500 cubic meters of the net littoral drift to the south. If the beach fillet is allowed to accumulate more than 3,500 cubic meters, sand may begin to accumulate in the channel mouth and need to be dredged at a much higher cost. Therefore it is in the best interest of the development as well as the coastal neighbors to bypass the beach sand before it spills over into the marina entrance.

The marina entrance channel will be surveyed on an annual basis to measure sand trapped within the marina entrance channels. The channels will be dredged when they shoal to depths that may be hazardous to boat traffic or exceed 3,500 cubic meters of new sediment. This material will also be dredged and bypassed based on net littoral drift quantities.

REPORT IS COMPLIMENTARY TO THE MARINA COMPONENT; ANNEX IV OF THE EIA DOCUMENT

PLEASE READ ANNEX IV IN VOLUME II OF THE ARA MACAO EIA.





SAND MONITORING PLAN
ARA MACAO

LEGEND

- -4 to -5m
- -3 to -4m
- -2 to -3m
- -1 to -2m
- -0 t0 -1m

Sand Monitoring Transect at 100 m Intervals o.c. to 2 m depth

Sand Monitoring Transect at 10 m Intervals o. c. to 4 m depth

DETAIL SMT: TRANSECT LOCATION
DESIGN by Shabica & Associates, Inc

TUNICH- NAH CONSULTANTS
&
ENGINEERING
José Garcia P Eng. # 053-2001

FIG. 2.4

Ara Macao Development
Stann Creek District

EFFECTS OF LITTORAL BARRIERS ON MARINE COASTS

06/29/2006

Shabica & Associates, Inc.
Coastal Consultants
550 Frontage Road, Suite 3735
Northfield, Illinois 60093, USA
847-446-1436

Sand Management on the Stann Creek Coast of Belize

Two issues face environmental planners and coastal engineers regarding the long-term health of the shore and beaches of the Stann Creek District. These are both local and also global in impact. The first, structural interference with coastal sand transport is a site specific maintenance problem. The second, global sea level rise will require regional solutions to narrowing beaches and accelerating erosion. The Placencia Peninsula is no exception and is eroding due to the long-term rise in sea level.

Structural Impacts

The immediate concern is to assure that any structures built along the coast are not only improvements to the ecosystem but are also benign in their effects on the coastal sediment budget. The proposed structures will have no negative impact on downdrift beaches and rates of coastal erosion.

History has shown that human-made structures that protrude into the surf zone tend to trap sand on their updrift sides, causing localized erosion immediately downdrift. The more perpendicular the structure is to the shoreline and the littoral drift, the greater the amount of updrift sand entrapment. Examples in the Ara Macao area include the pier and groin in Riversdale. When the structures are first built, they tend to trap sand moving along shore, leaving a sand deficit that is mirrored in accelerated erosion immediately downdrift of the structure. Once the updrift area is filled with sand, natural bypassing occurs and the system achieves a dynamic equilibrium where there is no longer a net loss of sand.

To promote natural sand bypassing at Ara Macao, in contrast to the effects of the straight perpendicular barriers in Riversdale, the Ara Macao jetties are streamlined and curved in the same north to south direction as the littoral drift. These two design features significantly reduce updrift sand entrapment. Moreover, it is the intent of the Ara Macao Development to begin bypassing the sand before the system fills, thus avoiding the localized erosion immediately south of the project. When it is built, the proposed Ara Macao Marina breakwater will begin to trap sand in a “source beach” on its updrift side. Before the beach fills with sand and spills into the marina entrance, the sand will be trucked to the feeder beach where it can continue its way south in the littoral system.

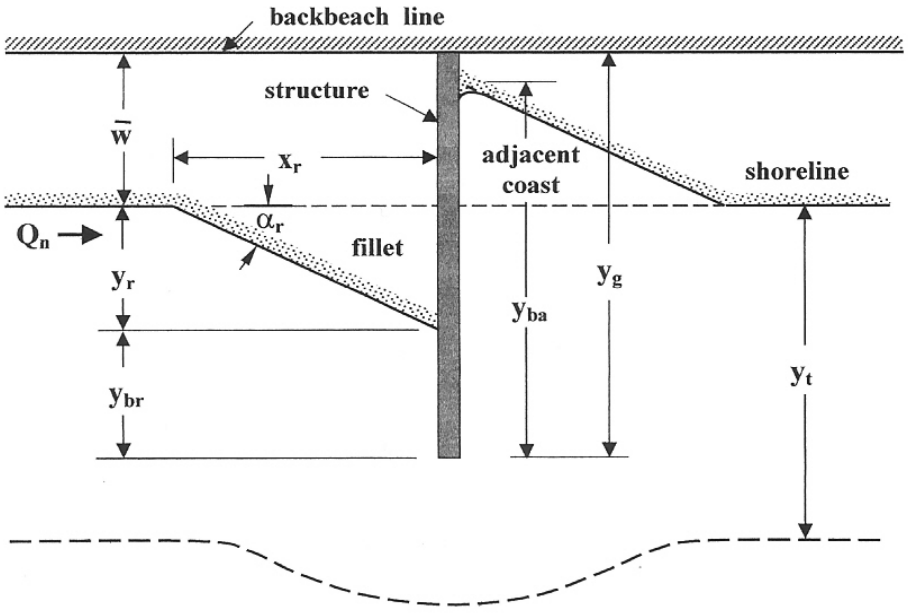
Effects of Littoral Barriers on Eroding Marine Coasts

- Erosion and accretion impacts are greatest in the immediate vicinity of the structure and not a regional effect. Examples are Riversdale Pier and Groin where erosion caused by impoundment of sand is limited to less than 250 meters south of the structures.

- Once the structure fills, natural bypassing resumes and the accelerated erosion caused by the pier and groin is arrested.

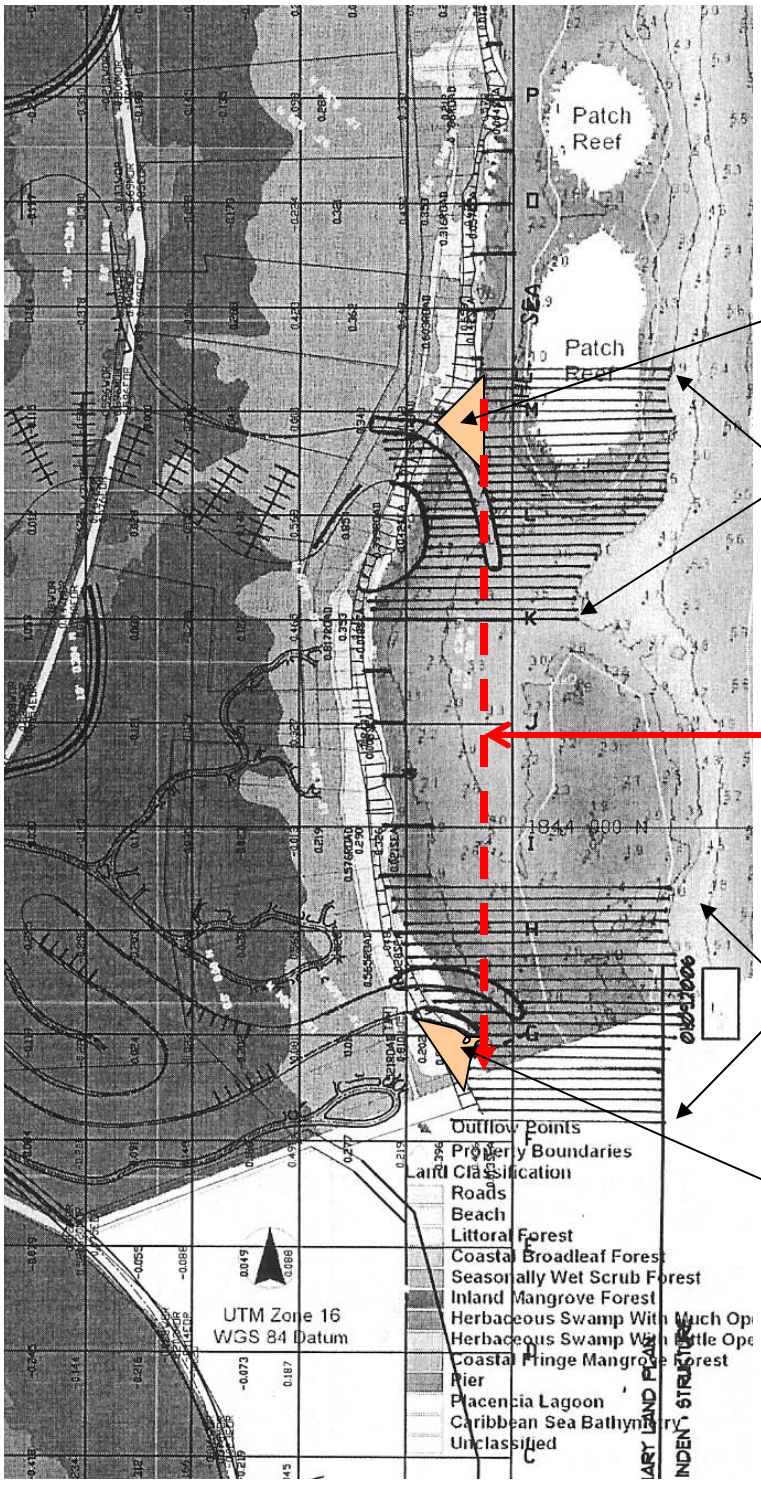
- To prevent downdrift erosion caused by a littoral barrier, sand can be artificially bypassed to the downdrift side of the structure.

- Breakwaters such as those at Ara Macao can be designed to minimize sediment entrapment through streamlined configuration.



The diagram above (Journal of Coastal Research, Issue 33, 2004, p. 270) shows the areas affected by the structure are similar in size. The amount of accumulation updrift of the structure mirrors the erosion caused by the structure downdrift. $\mathbf{Q_n}$ is the net littoral drift.

Sand Management Plan with Bypassing



Accreted Sand

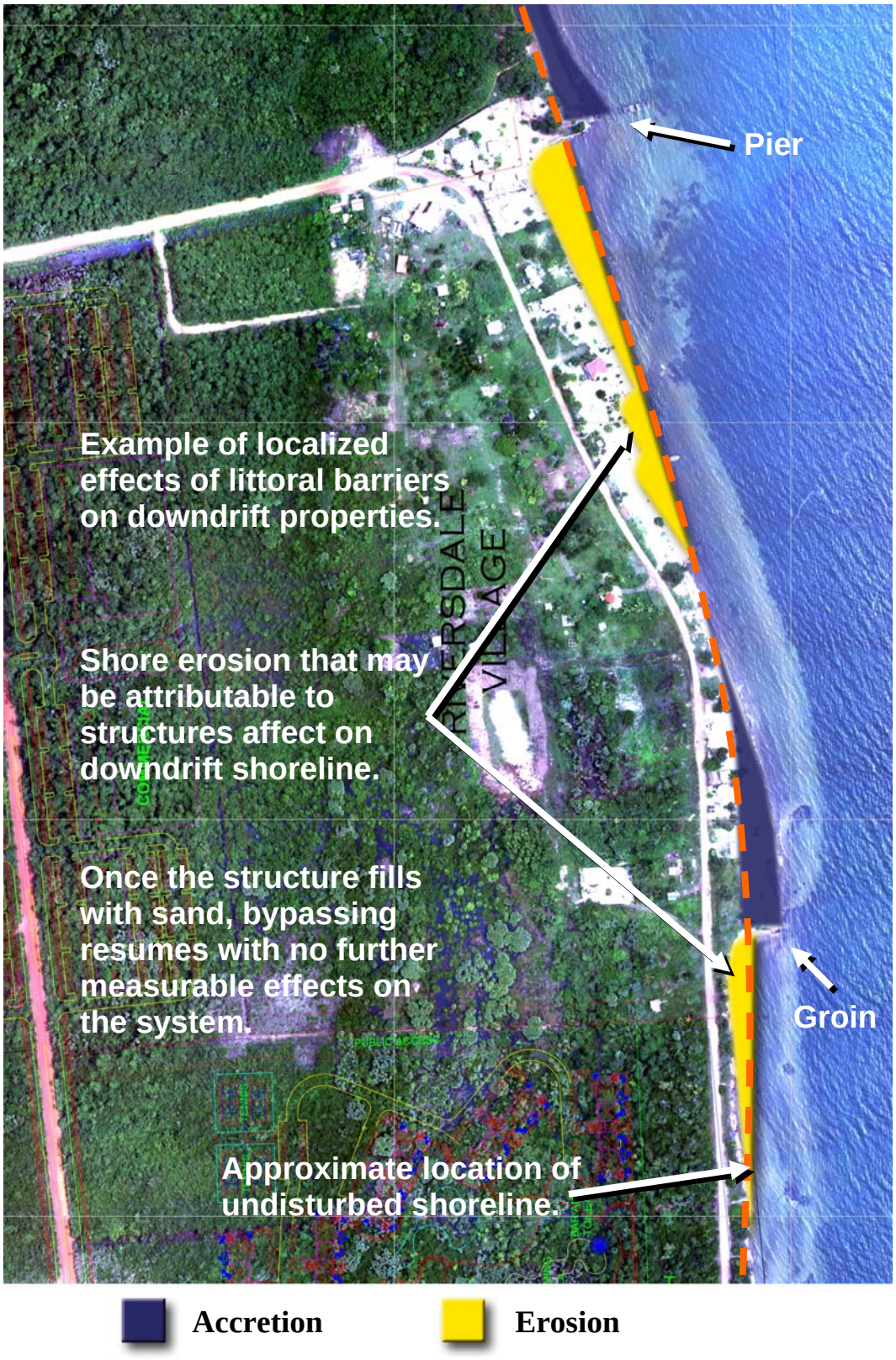
Approximate location of biannual survey profile.

Accreted sand to be trucked from updrift beach to downdrift feeder beach.

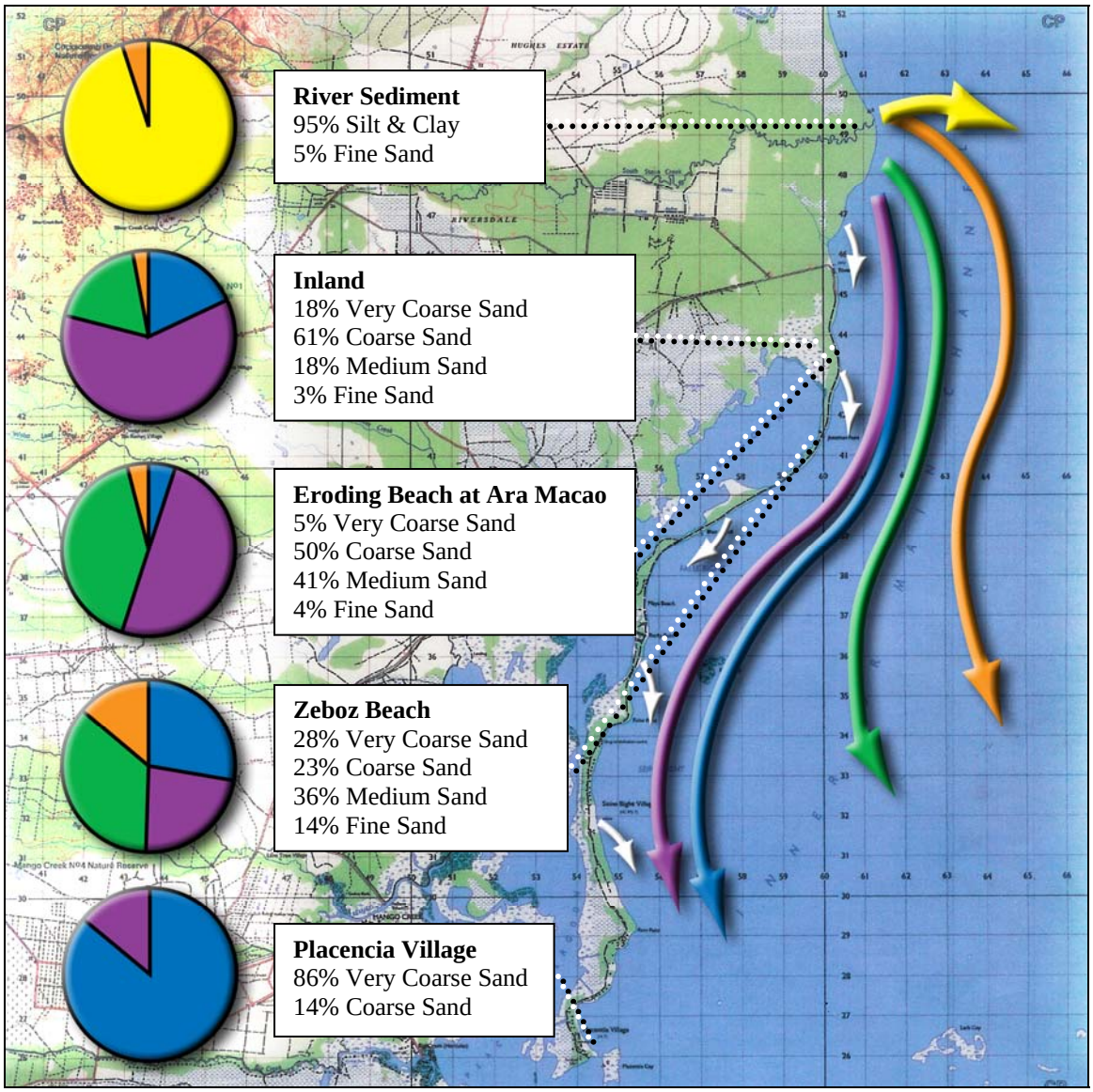
Approximate location of sand monitoring.

Feeder Beach

Littoral Barriers



Regional Sediment Balance Sheet



The Stann Creek coast is erosional. Coarse sand from eroding land (white arrows) moves along shore south to Placencia. Finer sediments are lost to deeper water.

- Very Coarse Sand
- Coarse Sand
- Medium Sand
- Fine Sand
- Silt & Clay

Ara Macao Initiatives - Improvements include:

- The design is streamlined to promote natural sand bypassing.
- As part of the initial installation, coarse sand nourishment will be placed on the beaches, therefore adding sand to the littoral stream (premitigation).
- A detailed sand monitoring plan has been drafted that will be updated as necessary to assure no negative impacts.
- The goal of this project is to enhance the natural environment and to set an example for other coastal management plans.

Long-Term Management

A larger issue for the entire Belize coast is global sea level rise causing accelerated coastal erosion.

On all sandy marine coasts, regional sand management is becoming a critical issue. In most developed resort areas where beaches are an important resource, periodic beach renourishment is a necessity. Examples include most of the beaches of Florida, North and South Carolina, Louisiana, Texas and California, USA. Alternatives like moving away or building large seawalls are considered a last resort at best.

Placencia Peninsula is no exception and is generally eroding except for the accreting sand spit in the Town of Placencia approximately 20 kilometers south of Ara Macao. Two viable shore management options are available, artificial beach nourishment and regional sand backpassing.

Artificial Beach Nourishment: The first option, bringing in new sand from inland areas is part of the Ara Macao plan. New coarse sand will be placed on Ara Macao beaches, thereby increasing the net quantity of sand in the system. An added benefit is the clearer water associated with a coarse sand beach. New sand will be added periodically, as needed.

Sand Backpassing: Backpassing is a method used in areas where coarse beach sand on a sand spit is naturally transported into deeper water where it is lost from the system. For example, sand on the west end of many Gulf coastal barrier islands off Louisiana and Florida is routinely transported to updrift beaches where it re-enters the littoral system.

To reduce erosional sand loss along the Placencia Peninsula, the sandspit growing at the south end of Placencia can be dredged and back passed updrift to the north end of the peninsula.

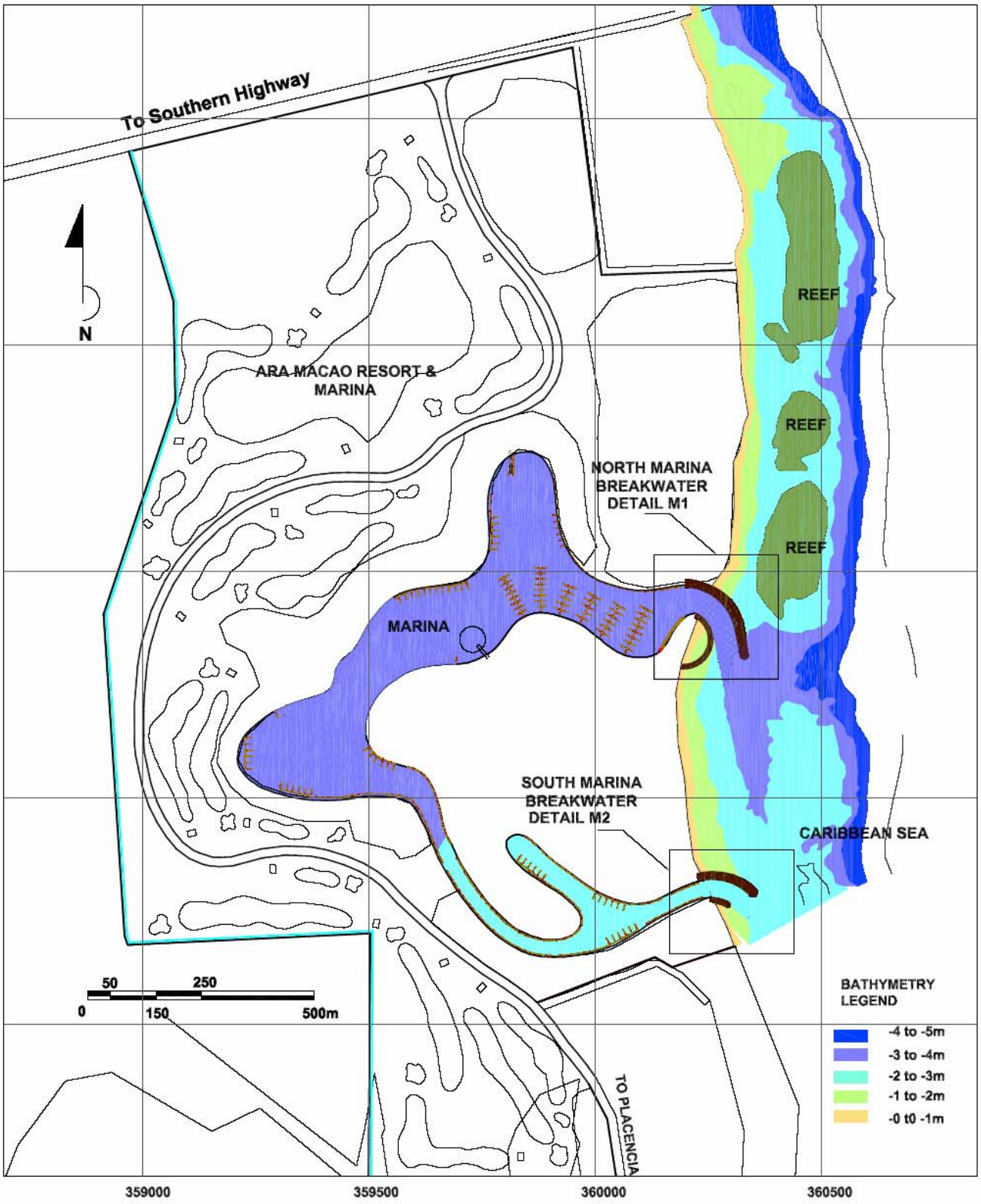
Issue 8

Bathymetrical data and alignment of the jetties and marina access channel.

The following figure 2.5 shows the bathymetry of the project area. The bathymetry shows a uniform coastal fringe of 0 – 1 meter depth, followed by a wider fringe of 1 – 2 meters depth. The 1 – 2 meters depth widens in-front of Riversdale, caused by accretion caused by the old jetty north of the village. The general area surrounding the badly damaged reef (**See Reef Balls report in CD**) has a depth of 2 – 3 meters.

Figures 2.6, 2.7, and 2.8 show the alignment of the breakwaters for the north and south entrances. They are mostly trapezoidal in design, with a layer of filter cloth at the lower level. The bottom layer is basically comprised of "as blasted or quarry run", followed by a layer of filter stone and finally the armor stone. The crests of the breakwaters are 3 meters wide.

Figure 2.9 shows the entrance channels boating routes and lighting for both the north marina entrance and south marina entrance.

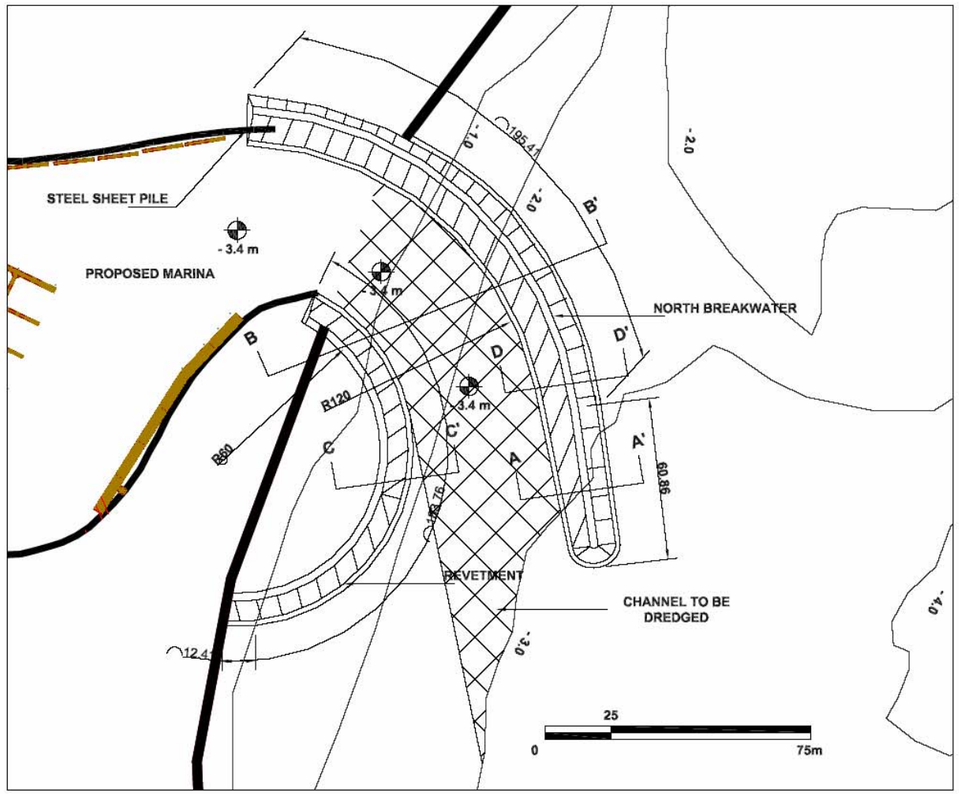


NORTH & SOUTH ENTRANCE CHANNEL BREAKWATER
ARA MACAO MARINA

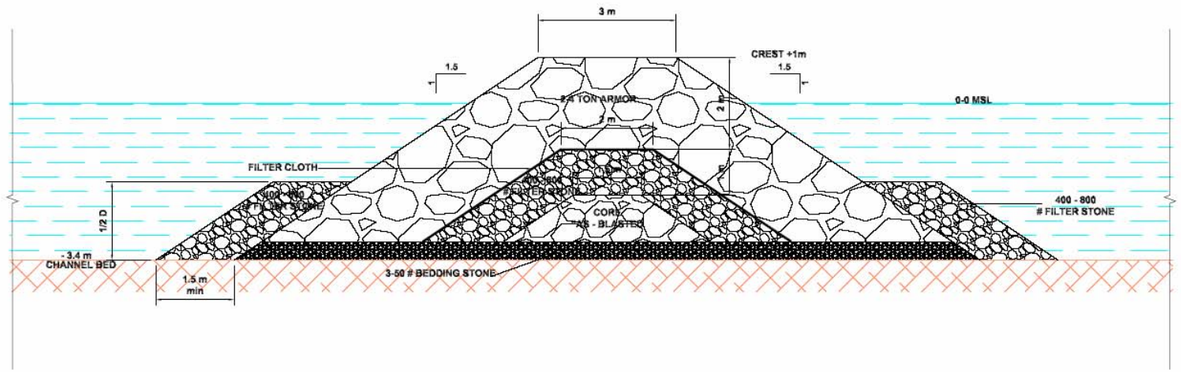
DESIGN by Shabica & Associates, Inc

TUNICH- NAH CONSULTANTS
&
ENGINEERING
José Garcia P Eng. # 053-2001

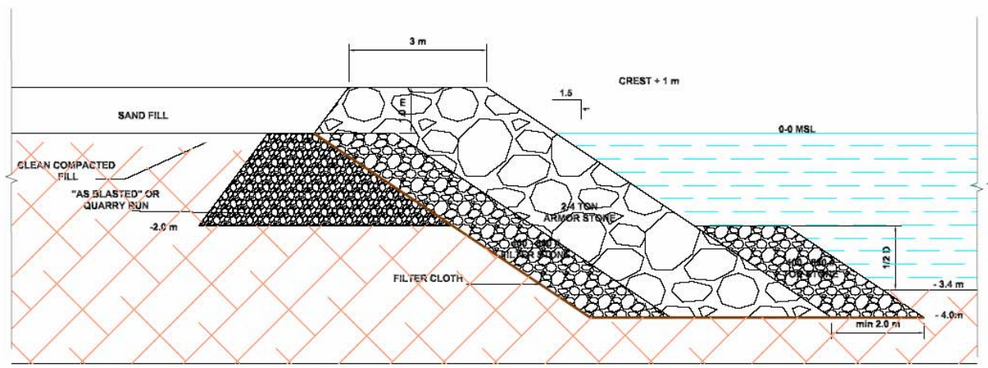
FIG. 2.5



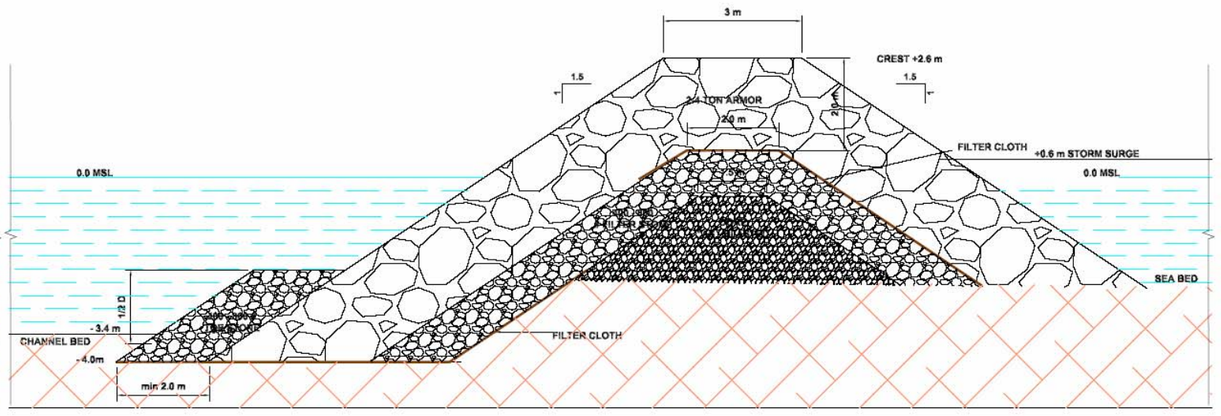
DETAIL M1: MARINA NORTH ENTRANCE CHANNEL



TYPICAL CROSS-SECTION A-A' AT SEAWARD END
ARA MACAO MARINA NORTH ENTRANCE BREAKWATER



TYPICAL CROSS-SECTION C -C'
ARA MACAO MARINA NORTH ENTRANCE REVETMENT

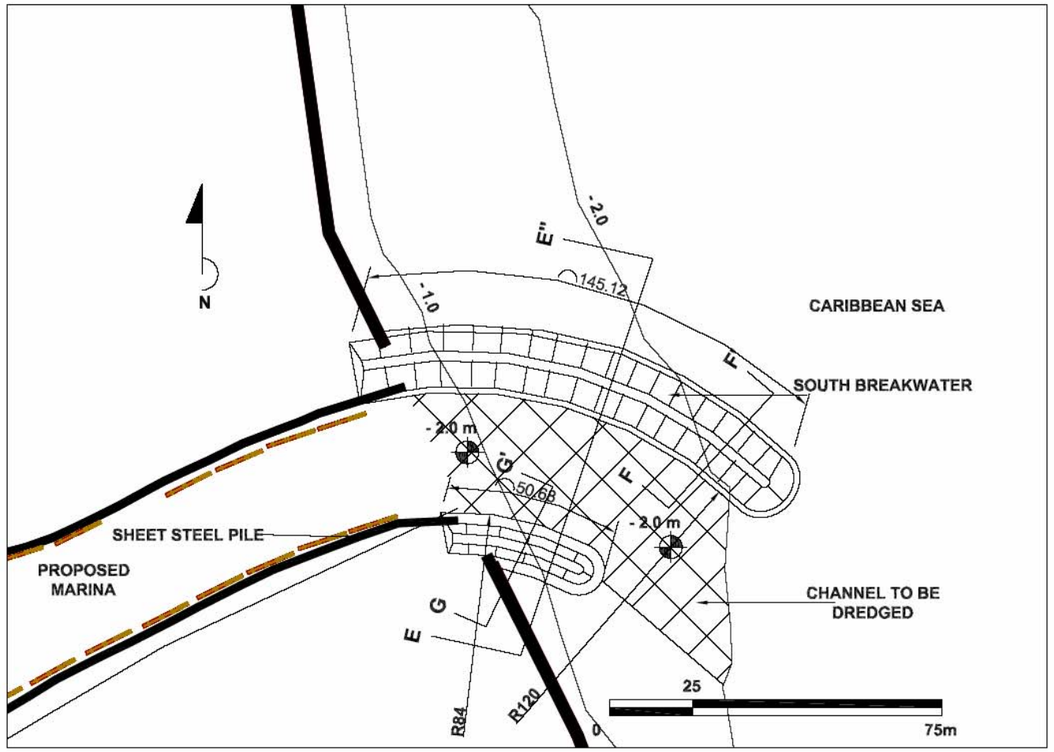


TYPICAL CROSS-SECTION D -D'
ARA MACAO MARINA NORTH ENTRANCE BREAKWATER

DESIGN by Shabica & Associates, Inc

TUNICH- NAH CONSULTANTS
&
ENGINEERING
José Garcia P Eng. # 053-2001

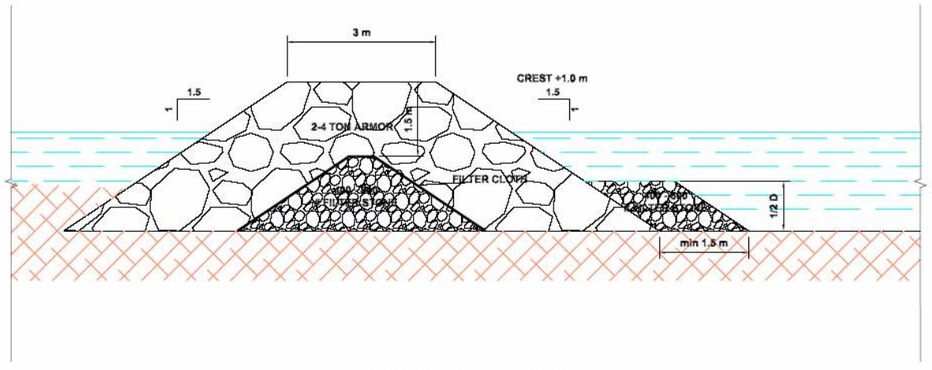
FIG. 2.6



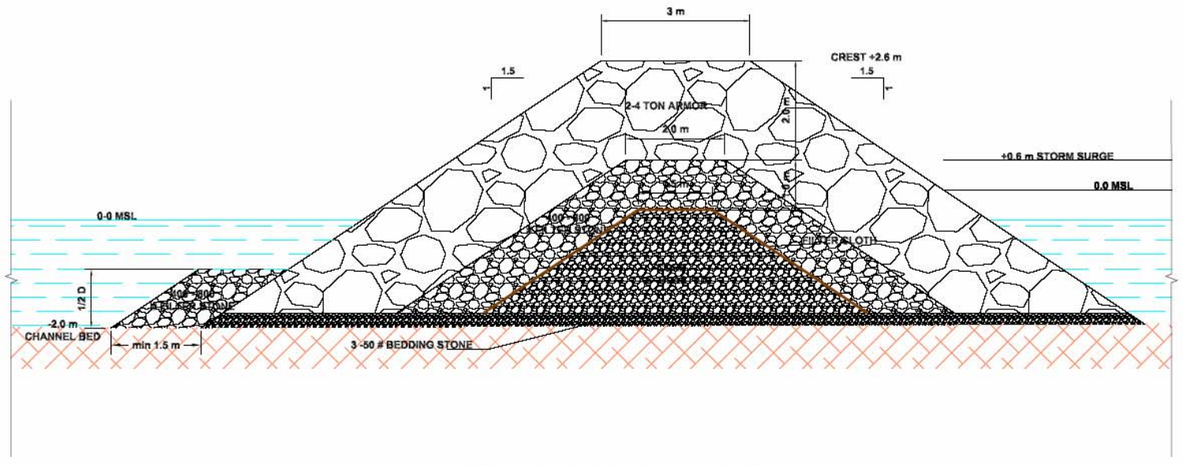
Marina Channel Excavation Materials		
Marina Channel	Depth to Channel Bed (m)	Materials (m^3)
Northern channel	-3.4	9,422
Southern Channel	-2.0	1,198
	Total	10,620

Marina Breakwater Fill Requirements		
Breakwater/Revetment	Material type	Materials (m^3)
South	as required	8,077.5
North	as required	17,482.4
	Total	25,559.9

DETAIL M2: MARINA SOUTH ENTRANCE CHANNEL



TYPICAL CROSS SECTION G- G'
ARA MACAO MARINA SOUTH ENTRANCE
BREAKWATER

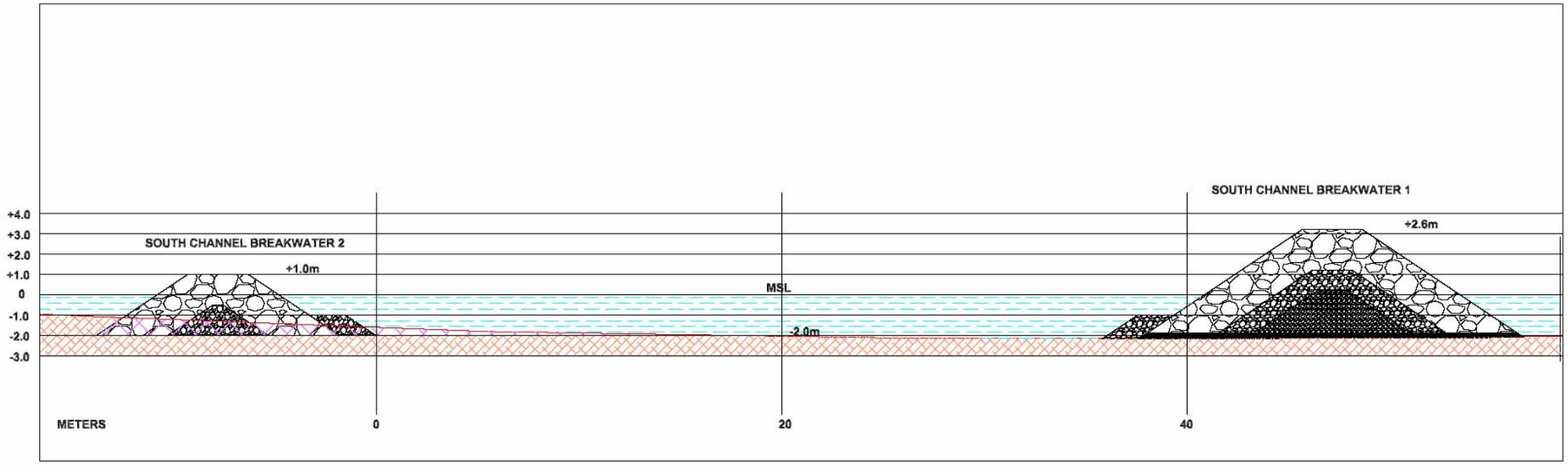


TYPICAL CROSS SECTION F- F'
ARA MACAO MARINA SOUTH ENTRANCE
BREAKWATER

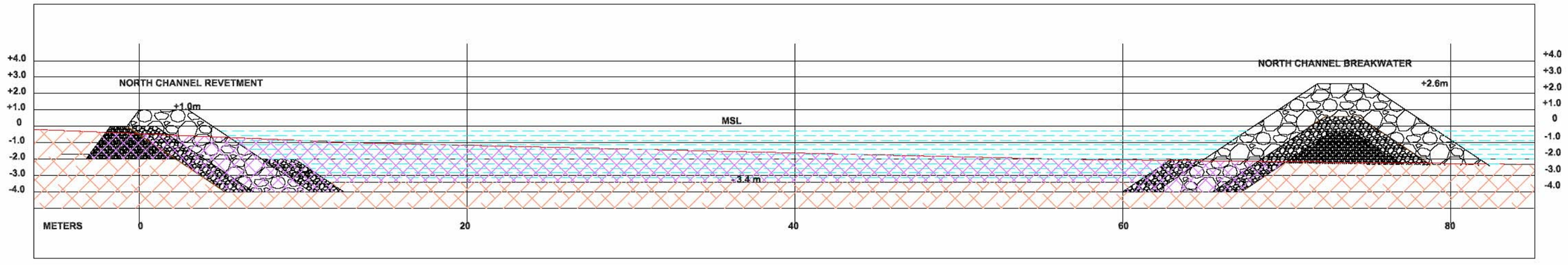
DESIGN by Shabica & Associates, Inc

TUNICH- NAH CONSULTANTS
&
ENGINEERING
José Garcia P Eng. # 053-2001

FIG. 2.7



TYPICAL CROSS-SECTION E -E'
ARA MACAO MARINA SOUTH ENTRANCE BREAKWATER 1 & 2



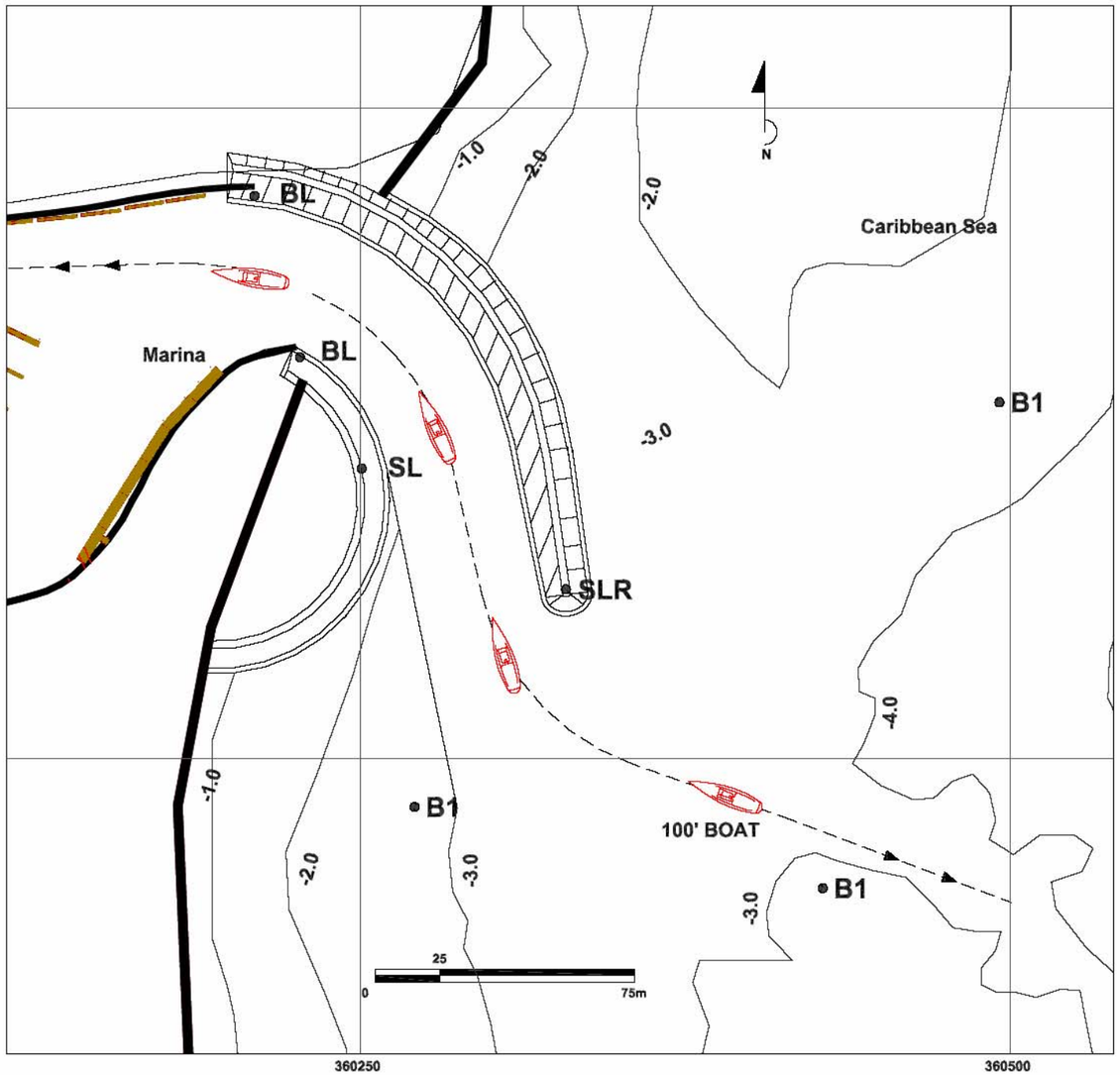
LEGEND

- EXISTING SEA BED
- MATERIALS TO BE DREDGED
- SEA BED
- SEA

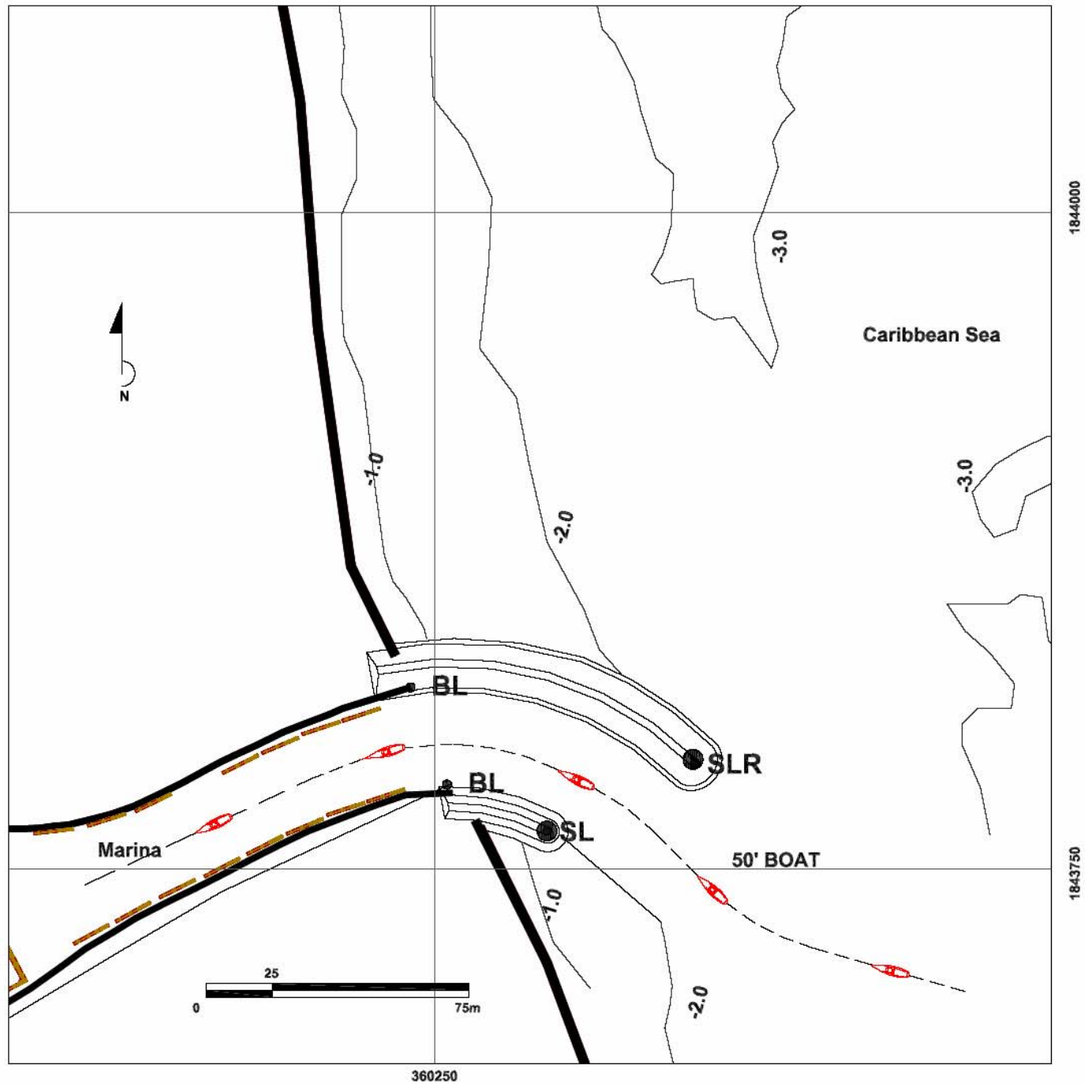
TYPICAL CROSS-SECTION B -B'
ARA MACAO MARINA NORTH ENTRANCE BREAKWATER & REVETMENT
DESIGN by Shabica & Associates, Inc

TUNICH- NAH CONSULTANTS
&
ENGINEERING
José Garcia P Reg. # 053-2001

FIG. 2.8



DETAIL M1: MARINA NORTH ENTRANCE CHANNEL
BOATING ROUTE AND LIGHTING
ARA MACAO



DETAIL M2: MARINASOUTH ENTRANCE CHANNEL
BOATING ROUTE AND LIGHTING
ARA MACAO

LEGEND

- B1 — LIGHTED BOUY
- SLR — SECTOR LIGHT AND RADAR REFLECTOR
- BL — BEACON LIGHT
- SL — SECTOR LIGHT
- BOATING ROUTE

TUNICH- NAH CONSULTANTS
&
ENGINEERING
José Garcia P Eng, # 053-2001

FIG. 2.9

Ara Macao Resort and Marina

Second Public Consultation

Ara Macao Resort and Marina

2nd Public Consultation

Seine Bight Village

May 3rd, 2006

The following includes questions and comments which arose out of the 2nd Ara Macao Public Presentation, held at the Seine. Bight Roman Catholic School, Stann Creek District. Where the speakers use Creole, however, we attempt to paraphrase the quotes in English. Head count total at the public presentation was 280; however only 177 (173+4) signed the attendance list and about 30 declined signing the list.

It must be noted that at least eight names and email addresses were not omitted as they were "not legible" during report preparation.

1) Dwight Neal, Friends of Nature

My major concern with the project is the marina, why create something out of dry land when quite easily you can use the lagoon. The marina construction proposes major modifications not only the dredging but offshore as well. I have 28 years of experience working with the marine environment in Belize. There is no way of knowing what the long term effects of this marina will be. Take for example, San Pedro, Caye Caulker, Caye Chapel, Belize City Harbor and at Monkey River; we see what happened and it will happen again due to beach erosion.

I see some fantastic models, but nobody showed the numbers from off shore Riversdale that were used in the models. I also see that no one went off shore and did current level. In the absence of that, please hold off project for now.

Another note to mention is that we have a fantastic marine shore current which runs predominantly south. No one showed me how the sand will move; what kind of beach nourishment are we going to get; how will beach nourishment be affected; how far south will this affect beach nourishment.

You need to show how the marina will benefit the people of the area; how beach erosion will not affect the area.

Answer: Well like I said, the excess sand accumulated on the breakwater will be carted and deposited on the southern breakwater to allow the natural flow to take place. We did numerous models of sand transport including worst case scenarios and with that we were able to come up with the breakwater dimensions.

2) When are we going to get a presentation by the people who want to protect the environment?

We want the facts. Why is the company already drilling? Why are the people talking that the project has already been approved?

Answer: Like it was mentioned earlier, on the NEAC there are NGO's presents, these are umbrella NGO's who represent other NGO's.

Answer: To date, a decision has not been taken by the Department of the Environment. The hearing today is part of the decision making process.

3) Mary Toy

The rogue EIA which I have right here says that this project has already been approved by the developers. Who is here from the developer?

Who is Mr. Minnitti?

Answer: Mr. Minnitti is our Director of Financial Services

4) Candy Powers.

Chapter 16 of the EIA report speaks of golf courses and the use of beach grass which is archaic; who is the designer or builder? It will take about 28 million to build an eco-friendly golf course and/or about 6 million just to design.

At Bella Maya, there will be an 18-hole golf course. You will need to bring in expertise from outside. It does not tell us how many foreigners will be employed. We will need an EIA for the golf course.

Why haven't you posted a bond if in the case you go broke?

5) Will the friendly disguised project bring cruise ships for the Casino?

Answer: The project will not bring any cruise ships, but rather yachts, catamarans and smaller vessels.

6) Sam Lopez, National Garifuna Council

Nothing in the EIA says that the people of Seine Bight Village were consulted. A project of this magnitude will need to factor in cultural entertainment. Perhaps an auditorium should be constructed and integrated as part of the development; you need to involve us from the village otherwise we will say no to this project.

Answer: The developer has no problem in constructing an auditorium. The developer would like to work as partner with all the communities. In fact the developer has donated funds into the HANS project for high school children.

7) Fred Garcia

Any kind of engineering facility out to sea will affect the beach – did you consult with a geologist for this project?

Answer: Sand transport will really not be a problem. It will not benefit the developer to block the marina sand, and that sand do not go into the channel but travel south along the beach.

8) Melvin Hulse

I read the report twice, but there is nothing in there about Maya Center, Cockscomb, Maya Beach etc. Do you know where Maya Center is?
Fifteen foot surges coming on the beach brings in the sea? about 67 acres of land and everybody knows what a hurricane can do. The EIA report says that international data claims more hurricanes each year.

Pesticides are used for specific purposes.

This is an excellent project in the wrong place. Existing marinas along the peninsula have not interfered with the integrity of the peninsula.

The project will bring in 12,000 Mexicans; with 12,000 people needing water.

What is the reason to relocate the road in valuable property? Based on study that I have for the construction of the Placencia road, the road will not be relocated. I will go on the internet and stop people from buying property at the project.

9) Harold Allen– lived in Belize for 30 years.

With the construction of the marina, will the people be able to walk along the beach?

Answer: The law states that 66 feet along the coast is public land and public access.

10) Deborah Coston

I haven't heard anything about our improvements and our benefits.

Answers: The benefits will come over time, as the project will be developed in phases.

11) Beverly Cabral

I have read through the EIA and I have difficulties in many areas. We have also consulted with outside expert and have gotten feed back from them. We would like to forward these questions and responses – to DOE and the NEAC. How does the NEAC operate?

Answers: NEAC operates by vote. We are currently going through the process.

12) Lyn Wilson

We are told that locals and residents will be discouraged or not allowed to enter into the development. Why is it in the plan?

Answer: The project will be open to everyone to enjoy the amenities.

13) There are 2 sets of people from Placencia and Seine Bight villages.

Right now there is no more land in Seine Bight; give us land across the lagoon so we can have more land for our village.

Answer: Lands for the Ara Macao project were bought from private individuals and not from the Government.

14) Peter Ciego, Concerned Citizen and President, National Garifuna Council

If you are going to build, do not build in Seine Bight; the people of Seine Bight will not be employed. We are proud of our village and we will cherish it.

15) You need to spend some money in the community so that money can filter into the Seine Bight community.

16) Manuel Martinez

The jetty - the thing to hold back the sand will bring in lobster – that is a lie. I make my living with this.

Answer: The rocks will provide more habitats for the lobster.

17) It seems to me that the project will happen – I am very familiar with golf course and marina.

Give something back to the people and the village; the Government promised us a road.

18) Sandy Johnson

What is significant about May 9th?

Answer: The date for review was extended and will be tabled back to the NEAC.

19) Why Placencia? This development will bring more criminal activity, more sanitary problems, and more diseases to the area.

Answer: This is a decision making process; health and social issues have been addressed in the EIA. NEAC will decide to approve or not to approve the project. No decision has been taken; - that is the reason why we are here. Those questions not addressed here can be sent to the Department in writing.

20) Rusty

The southeast wind builds up the south side of the Peninsula. If you put up the marina, what will happen to Seine Bight beach? We all know what happens to the beach in certain wind direction. If the channel/marina is built, we will not be able to use the beach.

21) Alfred Ramirez

I wish hurricane like Iris come back. I will ask the Government to stop the project.

Answer: No one would want to wish something like that to happen again.

22) Glenn Eiley, Placencia Village Chairman

We have never seen development of this scale. I am prepared . . . . but without the marina. Built up sand will not use trucks.

23) Lisa Thorn

Southern Belize is known for its eco-tourism.

Couldn't the Government plan for a better space; the school cannot handle this crowd.

Answer: The meeting was convened at this location.

24) What about animals, will they be transferred to another site; the animals will be displaced.

Answer: The animals will not be displaced as an area (or reserve) has been set aside within the development.

25) Justino Mendez, Independence Village Chairman

I adamantly oppose such a huge development for this peninsula.

26) Adrian Vernon

I have lived here for nine years. I have walked the beach many times and see what the sea can do to the beach. If that big erosion starts, how can the beach come back? Have you consulted with the local fishermen etc.

Answer: Local fishermen were consulted but not relevant to beach erosion. For this, the locals were interviewed. As mentioned before, I think someone brought this up earlier, a sand monitoring program will be put in place. The accumulated sand on the northern jetty would be carted away in trucks and dumped on the southern jetty so that it follows the natural pattern.

27)

We are videotaping the whole procedure. When this is over we will hand you a copy along with this document I would like to present to you and also to the NEAC and to the developer.

Answer: Ok thanks

28) Dwight Neal

While this project may be a good project, we want to see major modifications; In terms of sold waste, I see impressive photos of the dump site but what will happen to this site.

Answer: Like was mention before in the presentation, Ara Macao intends to improve the current site, which is not an adequate site at the moment as you can see, there is garbage all over the place. The project intents to improve the site and make it into an adequate land fill. This will benefit not only the project but the whole peninsula and surrounding communities.

29) We would like another meeting with the NGOs people who care for the environment; we don't want this project done.

30) Department of the Environment

There are three options to consider:

a) stop project
b) go back and make amendments and
c) go ahead as planned.

The public consultation is a decision making process by NEAC and the DOE of whom individuals are professionals.

Literature

International Maritime Organization 2003; MARPOL Convention 73/78 Annex IV: Prevention of pollution by sewage from ships. Convention signed between Belize and the IMO.

International Maritime Organization 1988; MARPOL Convention 73/78: Annex V: Prevention of pollution by garbage from ships. Convention signed between Belize and the IMO.

ARA MACAO RESORT & MARINA

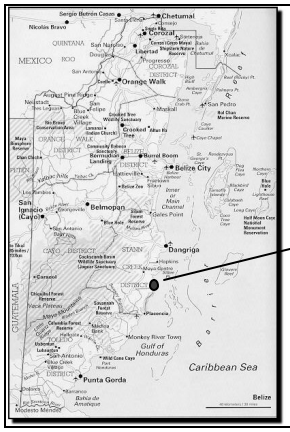
PUBLIC CONSULTATION

AGENDA

- Overview of EIA Process and Public Consultation – Facilitator - DOE
- General overview of project – Jose Garcia
- Golf Course, Chemical Use and Drainage – Mario Fernandez
- Solid Waste collection, transportation and disposal – Evaristo Avella
- Marina Component – Dr. Charles Shabica

PROJECT OVERVIEW

Jose Garcia



Project Name:

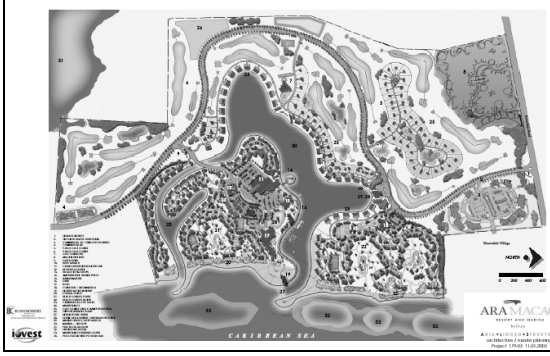
Ara Macao Resort & Marina

Project Location:

Riversdale Area,

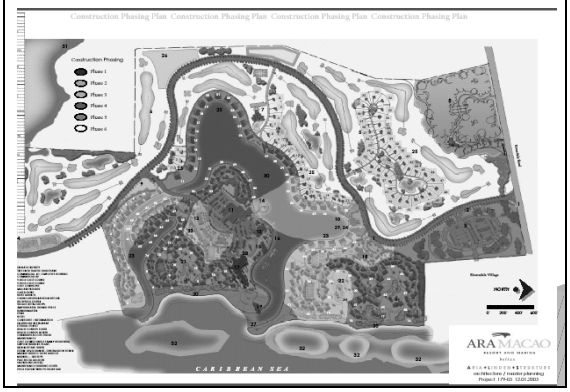
Stann Creek District

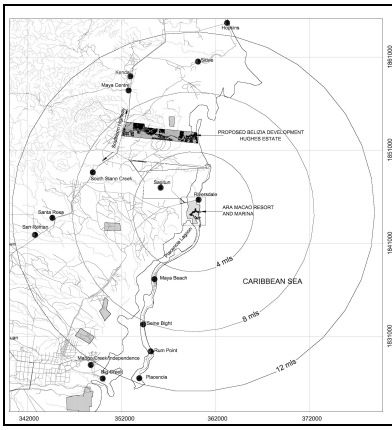
Schematic Master Plan



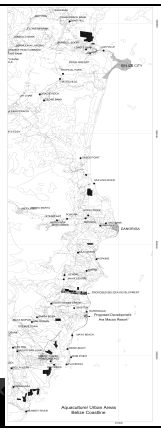
- **250 structures will be constructed.**
- **condominiums, (four levels / 458 units)**
- **villa homes, (2 levels / 296 units - two / three bdrms)**
- **260 room hotel.**
- **50 employee living quarters**
- **2 reception & activities center (south & north),**
- **bar & restaurant,**
- **harbor master's building,**
- **2 commercial areas,**
- **village retail shops,**
- **macaw preserve exhibit & lab,**
- **poolside bar,**
- **boat storage & repair area,**
- **casino and night club**
- **golf course**
- **club house**

Project Phases

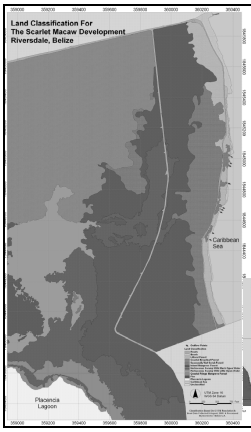




Ara Macao Project and Surrounding Communities



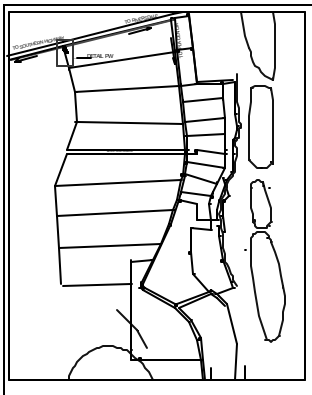
Ara Macao Project in relation to Aquaculture Farm Developments in Coastal Belize



Flora & Fauna

OCCUPANCY

Permanent	Staff / Day Clients & Intransit Visitors	Total
Condos, Villas, Clubhouses, Hotel, Golf Course Homes, Employee Housing	**Casino, Night Club, Reception, Commercial Areas, Pools, Bars, Restaurants, Maintenance**	**Premanent and Non Permanent**
5,124 (100%)	7,868 (100%)	12,992
3,587 (70%) Design Average	5,508 (70%) Design Average	9,095
2,050 (40%) National Average	3,147 (40%) National Average	5,197



Proposed Well Location
Scarlet Macaw Resort

Water Resources

Well Location

Ara Macao PROJECT
Drill Logs for Water Well # 2
Start Date: 01/17/06 End Date: 02/02/06

- 0 - 2 Road Bed
- 2 - 8 Brown Sandy Clay
- 17 - 18 Gray Clay
- 18 - 18.5 Rock
- 18.5 - 22 Gray Sand
- 22 - 46 Gray Clay
- 46 - 50 Brown Sand
- 50 - 65 Brown Gray Clay

» Set and Grouted 10 inch PVC Well Casing

- 65 - 69 Brown Clay
- 69 - 73 Brown Sand
- 73 - 74 Brown Clay with sand
- 74 - 75 Fine Brown Sand
- 75 - 87 Brown Sand plus some clay
- 87 - 112 Brown Sand
- 112 - 116 Gray Sand
- 116 - 125 Brown Sand
- 125 - 126 Pink Clay
- DOH = 126 FT.
- SWL = 8 FT.
- GPM = 200 +

» 65 FT OF 10 INCH PVC WELL CASING
» 80 FT OF SIX INCH SLOTTED PVC WELL SCREEN
» 45 FT OF SIX INCH SOLID PVC WELL CASING
» GRAVEL-PACKED SIX INCH WITH ½ IN WASHED GRAVEL

BELIZE BREWING COMPANY LIMITED
WATER and WASTEWATER LABORATORY

Sample ID: Placencia Peninsula(Ara Macao Project) DATE: 7 February, 2006

INORGANIC CHEMISTRY

PHYSICAL	UNIT	METHOD	RESULTS WELL 1	RESULTS WELL 2
COLOUR, TRUE	units	Platinum - Cobalt Standard/ UV VIS Spectro		
COLOUR, APPARENT	units	Platinum - Cobalt Standard/ UV VIS Spectro		
CONDUCTIVITY	µs/cm	CONDUCTIVITY (probe)	73.7	64.3
LANG. INDEX	units	Calculated/ Titration		
OIL IN WATER	ppm			
pH	unit	pH/ISE meter (probe)	5.65	5.83
SALINITY	ppt	Mercuric Nitrate titration	0.02	0.01
SILT DENSITY INDEX (SDI)	units	Filtration		
SUSPENDED SOLIDS (SS)	ppm	Colorimeter		
TEMPERATURE (IN LAB)	°C	Probe/Termometer		
TOTAL DISSOLVED SOLIDS (TDS)	ppm	CONDUCTIVITY (probe)	36.8	32.1
TURBIDITY	ntu	Nephelometric -Tungsten		
METALS	**UNIT**	**METHOD**		**RESULTS**
ALUMINUM (Al)	ppm	Aluminon/UV VIS Spectro		
BARIUM (Ba)	ppm	Turbidimetric/ UV VIS Spectro		
CALCIUM (Ca)	ppm	UV VIS Spectro/ Titration		
CHROMIUM (Cr)	ppm	1,5-Diphenylcarbohydrazide/UV VIS Spectro		
ZINC (Zn)	ppm	Zincon/ UV VIS Spectro		
NON-METALS	**UNIT**	**METHOD**		**RESULTS**
CHLORINE, FREE (Cl)	ppm	UV VIS Spectro /DPD		
CHLORINE, TOTAL (Cl)	ppm	UV VIS Spectro/DPD		
FLUORIDE (F)	ppm	SPADNS/UV VIS Spectro		
NITRATE, TOTAL	ppm	Cadmium Reduction/ UV VIS Spectro	N/D	N/D
DISSOLVED OXYGEN (DO)	ppm	PROBE		
PHOSPHATE, TOTAL	ppm	PhosVer / Orthophosphate/ UV VIS Spectro	0.177	0.064
INORGANIC COMPOUNDS	**UNIT**	**METHOD**		**RESULTS**
ACIDITY (as $CaCO_3$)	ppm	Titration		
AMMONIA (NH_3)	ppm	Salicylate / Probe		
BICARBONATE (HCO_3)	ppm	Titration		
CARBON DIOXIDE (CO_2)	ppm	Titration		
CARBONATE (CO_3)	ppt	Titration		
CHLORIDE (Cl)	ppm	Mercuric Nitrate	13.8	9.5
CHROMATE (CrO_4)	ppm	Titration		
CYANIDE (CN)	ppm	Pyridine-Pyrazalone/ UV VIS Spectro		
TOTAL HARDNESS (as $CaCO_3$)	ppm	EDTA Titration/ UV VIS Spectro	10.9	9.8
HYDROGEN SULFIDE (H_2S)	ppm	Titration / UV VIS Spectro		
SILICA (SiO_2)	ppm	Smcomolybdate/Colometric		
SODIUM CHLORIDE (NaCl)	ppm	UV VIS Spectro / Titration		
SULFIDE ($S^{=}$)	ppm	Methylene Blue Titration		
SULFITE (SO_3)	ppm	Titration		
SULPHATE (SO_4)	ppm	Sulfa Ver 4/ UV VIS Spectro	0.2	N/D

ORGANIC CHEMISTRY

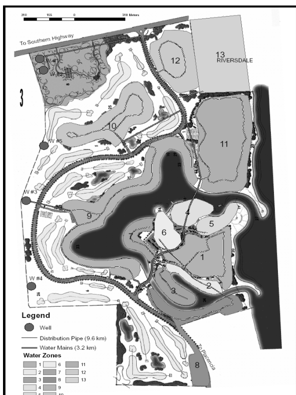
OXYGEN DEMAND, BIOCHEMICAL (BOD_5)	mg/l	BODTRAK / 5 days Digestion		
OXYGEN DEMAND, CHEMICAL (COD)	mg/l	Reactor Digestion		
ORGANIC	1/cm	Direct method/ UV VIS Spectro		
ORGANIC CARBON, TOTAL (TOC)	ppm	Direct method/UV VIS Spectro		
TRIHALOMETHANES (THMs)	ppb	Chloroform/UV VIS Spectro		

MICROBIOLOGICAL ANALYSIS *SEE ATACHED TEST RESULTS FOR DETAILS*

	UNIT	METHOD		RESULTS
HETEROTROPHIC BACTERIA	count	R2A Agar (MF)		
TOTAL COLIFORM	count	m-ENDO Broth (MF)		
ESCHERICHIA COLI (E.coli)	count	m-ENDO Broth (MF)		
FECAL COLIFORM	count	m-FC/ROSOLIC Broth (MF)		
ENTEROCOCCI	count	m-EL Broth (MF)		
YEAST	count	R. B. Agar (MF)		
MOLD	count	R. B. Agar (MF)		

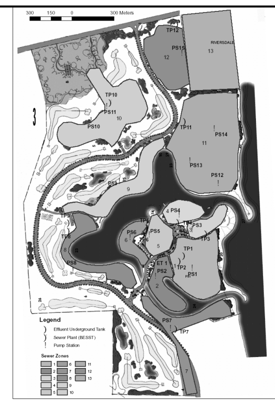
Analyst : Gustavo Izaguirre SIGNATURE___________

Water Test Results



Water Distribution Plan
Scarlet Macaw Resort
Tunich - Nah Consultants & Engineering

Water Distribution Plan



Sewerage Collection & Treatment Plan
Scarlet Macaw Resort
Tunich - Nah Consultants & Engineering

Liquid Waste

BESST- brings cutting edge technology

The Technology

BESST™ (Biologically Engineered Single Sludge Treatment) is a Patent Pending process that is a culmination of activated sludge processes dating back to the 1920's. The BESST process is the most advanced wastewater treatment process available, and is the result of almost 60 years of research, development, practical experience and testing. Combining the principals of single sludge treatment for BOD_5, TSS and nutrient removal, and sludge blanket clarification for efficient solids separation, this process places all the components into one vessel. The end result is a compact system that can be provided in either a steel package plant for smaller systems or built in place concrete systems for larger municipalities and high strength industrial waste streams. Either configuration provides an efficient, cost effective wastewater treatment plant with extremely low maintenance and operating costs. With its efficient use of mixed liquor, the BESST process requires less sludge wasting resulting in lower hauling costs for waste sludge.

The BESST process has no capacity limits, and is used in a wide range of applications. Plants serving development and municipal sectors, industrial, and food processing wastewaters, have been designed and are in highly successful operation throughout the US, Mexico, Central America and the Caribbean.

The Process

The BESST process is based on Lawrence and McCarty biological kinetics and hydraulic models dating back to the early 1900's. Utilizing the benefits of Pre-Anoxic Single Sludge activated sludge process; the BESST system uses the endogenous carbon source found in all sanitary waste to denitrify in the anoxic zone without the use of methanol or other exogenous carbon sources. The raw wastewater enters the anoxic zone first where it is mixed with nitrified Return Activated Sludge from the sludge blanket clarifier. Submersible mechanical mixers are installed in the anoxic compartment to facilitate homogeneous mixing, and increase the denitrification efficiency. From here, the mixed liquor flows in a plug flow manner to the aeration zone where fine bubble diffusers provide the oxygen required for nitrification and BOD_5 reduction.

After aeration, the mixed liquor enters the bottom of the separation compartment where solids and treated effluent are separated by a patented velocity gradient sludge blanket clarifier. The operation of the velocity gradient sludge blanket clarifier is self-regulating. As the flow enters the bottom of the clarifier, a velocity gradient is created in such a way that the bottom 2 to 3 feet of solids are kept in a completely mixed state which eliminates the need for the operator to scrape the clarifier (solids will not bulk). While the solids rise, their velocity decreases creating a sludge based, fluidized bed filter, which removes fine and colloid particles from the treated effluent. Trapping these particles increases the weight of the solids, causing them to drop to the bottom of the clarifier, where they are returned to the anoxic zone by an airlift or mechanical pump. The internal circulation loop created by this plug flow is typically set at a minimum of four (4) times the average daily flow, increasing nitirification and denitrification dramatically.

The effluent weir is equipped with a scum baffle and scum skimmer which aids in the reduction of TSS in the effluent. The efficiency of the process, and velocity gradient sludge blanket clarifier, produces effluent quality well below 10 mg/l BOD_5, <10 mg/l TSS, less than 1 mg/l ammonia, less than 10 mg/l total nitrogen (<5 mg/l TKN) and effluent phosphorous levels between 2 and 3 mg/l by "Luxury Uptake" and less than 0.5 mg/l with the use of metal salts.

BESST Waste Water Treatment Plant

Effluent Standards

PARAMETER	EFFLUENT LIMITATIONS
Temperature	33 °C
Colour	7 LU
pH	6-9
BOD5 at 20 °C	50 mg/L
Oil and grease	10 mg/L
Nitrate	3 mg/L
Phosphate	5 mg/L
Faecal Coliform	0 MPN/100 ml
TSS	50 mg/L

Domestic Effluent Profile

PARAMETER	TYPICAL RESORT WASTEWATER	DAILY RESORT LOAD
Total Suspended Solids	350 mg/L	11,907 Kg/day
Total Organic Nitrogen	15 mg/L	510 Kg/day
Free Ammonia	40 mg/L	1,361 Kg/day
BOD (5 day)	350 mg/L	11,907 Kg/day
Phosphate	10 mg/L	340 Kg/day

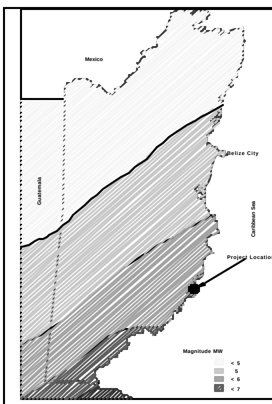
Projected Performance of BESST Treatment Plant

CONSTITUENTS	TYPICAL WASTEWATER EFFLUENT POST TREATMENT	DAILY LOAD POST TREATMENT	DAILY LOAD REDUCTION POST TREATMENT
Total Suspended Solids	10mg/L	357 Kg/day	**97 %**
Total Organic Nitrogen	5 mg/L	168 Kg/day	**67%**
Free Ammonia	1 mg/L	34Kg/day	**97.5%**
BOD (5day)	10mg/L	357 Kg/day	**97%**
Phosphate	2 mg/L	68Kg/day	**80%**

Geology

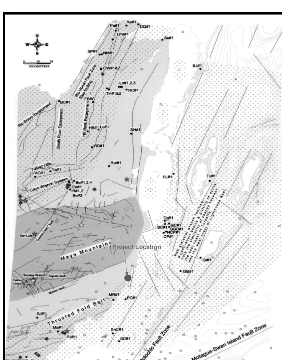
Borehole Location Plan

Soil Sample Location
Scarlet Macaw Resort



Maximum Seismic Intensity in Belize
Source: OAS Publication

Maximum Seismic Intensity in Belize



Geological Fault Location Near the Project Site
Source: Geology Map of Belize, 2003
Jean H. Cornec

Legend
Earthquake Epicenters (1990-1999) with Moment Magnitude of Mw > 3.5
Fault Lines
Formation Boundary

Geological Fault Location Map

Boring # 1
Project name: Ara Macao Resort   Date of boring: September 13, 2005

Location: Riversdale, Stann Creek District   Recorded by: Joe Petrof

Depth	Description	Remarks
0'- 0" – 4'-0"	road base material	Imported material
4'- 0"-- 12'- 0"	brown Sandy clay	
12'- 0"-- 18'- 0"	Organic silt	
18'- 0"-- 22'- 0"	course gray Sand	
22'- 0"-- 31'-0"	brown Sandy clay	
31'-0"-- 60'- 0"	brown Clay	
60'-0" – 72'- 0"	brown Clay	
72' 0'' – 73'-0"	brown course Sand	Boring terminated and sealed to avoid contamination of fresh water aquifer

Energy Generation

- Transmission lines and other infrastructure only require linking to the BEL National Grid
- Energy requirements - mainly for domestic and commercial purposes.

Energy requirement of Project.

Facility	Quantity	Unit equivalent	Yearly Energy use x(10,000 kWh)
Condos 2br	398	1	3,980,000
Condos 3br	58	1.5	870,000
Villas 2br	148	1	1,480,000
Villas 3br	148	1.5	2,220,000
Residential	59	1	590,000
Hotel	260	1	2,600,000
Casino &night club	10	1	100,000
Commercial Area Village Shops	25	1	250,000
Employee Housing	50	1	500,000
Otherfacilities*	20	1	200,000
		TOTAL	**12,790,000 kWh**
		TOTAL	**12.79MWh**

Social Factors

- Employment
  - Construction Phase – 500+ workers
  - Post construction – 2500+ workers
  - Diverse skilled personnel required in project
- Procurement of Material
- Foreign Exchange
- Transfer of Skills and Technology within the Hospitality Industry
- Improvements to local infrastructure

Tourism Component

- Hotels, Villas, Condominiums, Golf Course
- Over 250 structures will be constructed.
  - condominiums (four levels - 458 units),
  - villa homes (2 levels - 296 units),
  - 260 room hotel.

Conceptual Condo Elevations

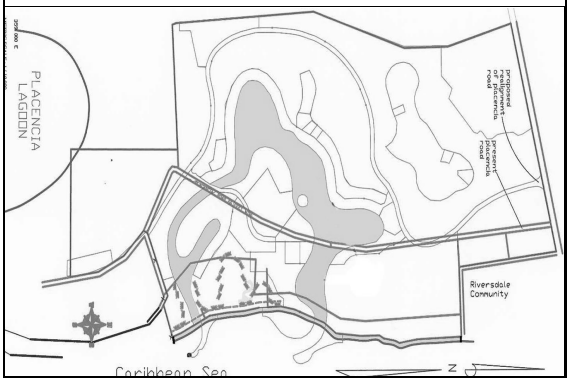
Proposed Subdivision Plan

- Residential component consists of:
  - 59 single family residential homes.
  - Lot range in sizes from 0.35 acres to 0.85 acres.

Road Transportation

- Development involves construction of approximately 5 miles of new roads,
- Section of Placencia Road passing through project site will be rerouted.
- rerouting will include approximately two miles of road
- Project will finance incremental cost of road rerouting

Proposed road re-routing



Mitigation And Monitoring Plan

Project Activity (Construction Period)	Potential Impact	Mitigation Measures
Equipment use	Noise etc.	1. Avoid sensitive areas (bird nests etc.), 2. Restrict construction period to daylight time
Vegetation Removal	Habitat loss	1. Confine to area of construction, selective clearing to leave selected trees, re-vegetation & landscaping.
Pier construction	Siltation & Sedimentation	1. Use logwood as the preferred option for material
Installation of walkways	Habitat loss	1. Confine to immediate area and keep canopy intact. 2. Avoid the use of treated lumber,
Canal dredging	Siltation sedimentation & mangrove removal	1. Dredge inland before opening outlet to lagoon 2. Minimize mangrove clearance & re-vegetate with mangroves 3. Store & use material carefully to avoid siltation 4. Use sediment curtain at exit to sea 5. Dredge during low tide and dry season
Construction (Buildings)	Noise, vegetation loss, waste generation	1. Confine work crew to work area 2. Re-vegetate work areas with grass 3. Reduce equipment use 4. Separate waste into recyclable, non recyclable & organic
Installation of equipment & appliances	Noise, loss of aesthetics	1. Avoid unnecessary use of equipment, 2. Design around landscape

Mitigation Matrix for Post Construction Period

Project Activity (Operational Period)	Potential Impact	Mitigation Measures
Solid Waste Generation	Contamination of ground and water resources	1. Implement SWMP, including the separation of batteries for recycling 2. Include solid waste educational component targeting homeowners &visitors
Liquid Waste Generation	Contamination of ground and water resources (Impact to marine organisms)	1. Installation of sewage treatment plants 2. Implement water quality monitoring program 3. Monitor and enforce recommended guidelines (gray water sys tem)
Aquatic Resources Use (Lagoon etc.)	Noise, impact to wildlife (manatees), over fishing	1. Declare no wake zone for boat movement 2. Stop all boat movement if manatee are sited 3. Reduce boat movement in the Placencia Lagoon, wherever possible
Visitation (bird watching etc.)	Noise	1. Report manatee sitings in logs
Social activity	Impact to local communities	1. Ensure employment opportunities for locals
Siltation from canal	Impact to marine environment	1. Re-vegetate with mangroves as needed 2. Dredge during calm periods & low tides

Photographs

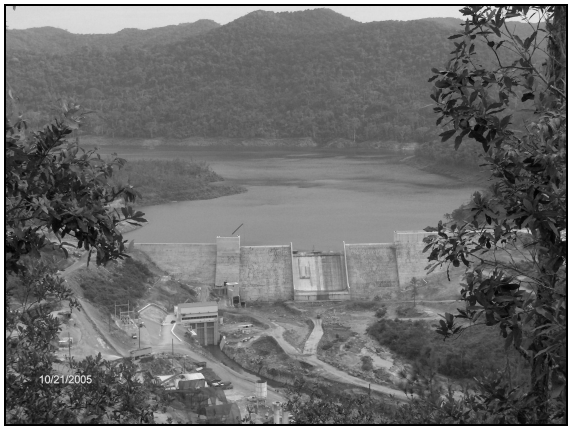

28 4:55PM


30 9:27AM


4 11:18AM

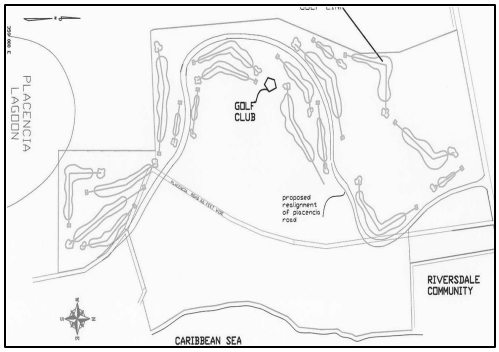

28 1:18PM


30 3:59PM



ARA MACAO

GOLF COURSE COMPONENT



PRELIMINARY GOLF COURSE DESIGN

GROUNDWATER AND SURFACE WATER QUALITY IS AFFECTED PRIMARILY BY TWO MECHANISMS*:*
LEACHING AND ***RUNOFF***

LEACHING IS THE DOWNWARD MOVEMENT OF A PESTICIDE OR FERTILIZER THROUGH THE SOIL AND POTENTIALLY INTO THE GROUNDWATER

LEACHING IS AFFECTED BY SEVERAL FACTORS:

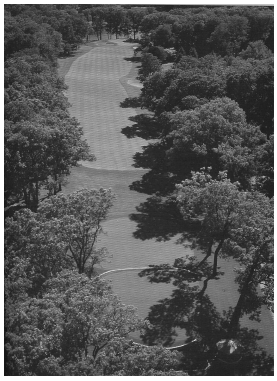
SOIL TYPE (PRODUCTS LEACH LESS IN CLAY THAN SAND)

THE DEGREE TO WHICH FERTILIZERS OR CHEMICALS BIND TO THE SOIL.

PERSISTENCE OF CHEMICALS OR FERTILIZERS IN THE SOIL.

SOLUBILITY OF THE PESTICIDE IN WATER.

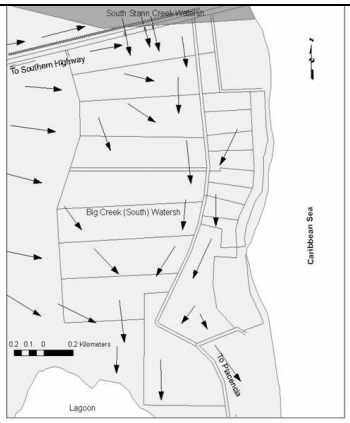
Runoff describes the movement of water across the turf and soil surface, such as what happens after a thunderstorm or heavy irrigation. If this water removes pesticides or fertilizers from the turf, then it can move these chemicals into streams, lakes, and rivers.

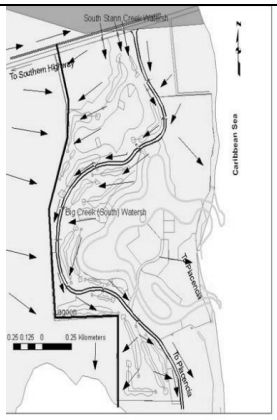


INTEGRATED TURF MANAGEMENT

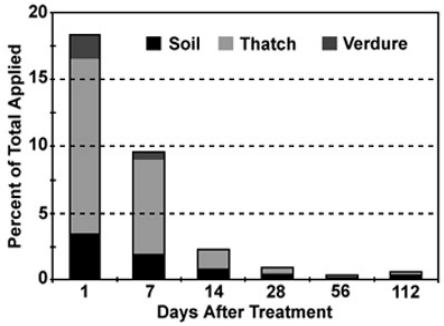
MEASURES TO MITIGATE POTENTIAL RISK TO ENVIRONMENT

- **CHEMICAL CONTROL IS ONLY ONE APPROACH USED AGAINST PESTS IN MODERN GOLF COURSE**
- **TURFGRASSES WITH PEST RESISTANCE AND TOLERANCE TO CLIMATIC STRESS**
- **PROPER AMOUNT OF SUNLIGHT AND AIR MOVEMENT REACH TURF AREA.**
- **MOWING HEIGHTS**
- **WELL-MAINTAINED EQUIPMENT**
- **SELECTION AND PROPER APPLICATION OF FERTILIZERS**
- **WATER MANAGEMENT, THROUGH CORRECT IRRIGATION AND ADEQUATE DRAINAGE**



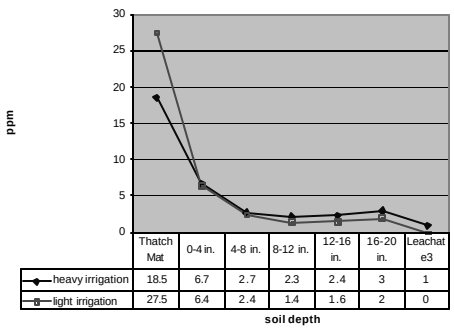


Pesticide residues on Turf/Soil (Triumph applied at 2 lbs. a i per acre)



P Concentration in soil after irrigation

Available Phosphorus Concentrations (ppm) in the Soil and Total Phosphorous in the Leachate (mg)1



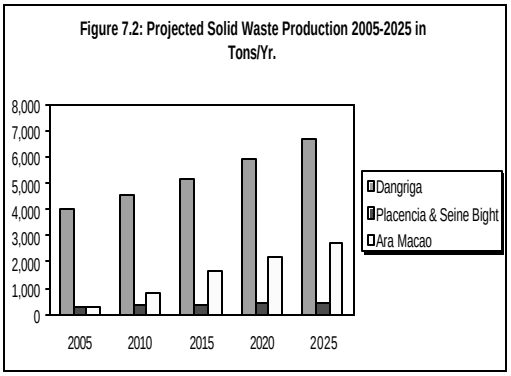
	Thatch Mat	0-4 in.	4-8 in.	8-12 in.	12-16 in.	16-20 in.	Leachate3
heavy irrigation	18.5	6.7	2.7	2.3	2.4	3	1
light irrigation	27.5	6.4	2.4	1.4	1.6	2	0

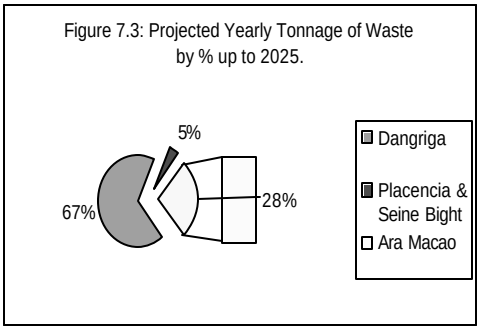
- GOLF COURSE WILL BE CONSTRUCTED DURING PHASE 5
- BASELINE DATA WILL BE AVAILABLE FOR AT LEAST 6 – 10 YEARS

ARA MACAO

SOLID WASTE MANAGEMENT

By Evaristo Avella





PROJECTED SOLID WASTE PRODUCED BY ARA MACAO

2010	821 tons/yr
2025	2737 tons/yr

SOLID WASTE PROBLEM HAS ONLY BEEN TRANSFERRED AWAY FROM THE PENINSULA BUT HAS NOT BEEN PROPERLY ADDRESSED

MARINA COMPONENT

CHARLES SHABICA, PhD

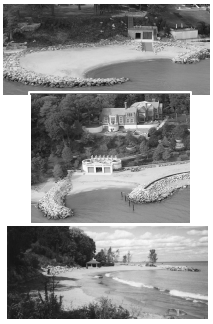
Executive Summary

Ara Macao Marina:

- 67 acre marina & canal system, Stann Creek District
- Approximately 1 mile of coast
- North of Placencia peninsula to Riversdale
  - **Shoreline stabilization with Coarse Clean Sand**
  - **Water Quality: Reduce silt, clay and organic pollutants**
  - **Stone jetties (Live Rock) will improve lobster habitat**

Shabica & Associates, Inc.

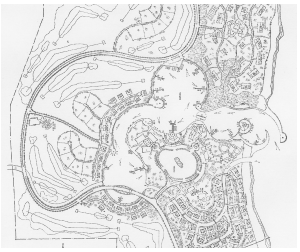
- **Shabica & Associates, Inc.** is an international coastal consulting firm. Our professional staff specializes in design, engineering, construction observation, coastal management and preservation, & research in this highly specialized field. Projects include:
  - Beach and dune restoration and enhancement
  - Shore protection
  - Marina design and coastal engineering
  - Wetlands protection & rehabilitation
  - Coastal lagoon preservation
- Winner of the 2004 Top Restored Beach Award by the American Shore & Beach Preservation Association for Sunrise Park in Lake Bluff, Illinois.



Marina – Initial Design

Large segmented marina

Rejected as testing proves inadequate circulation due to low tide range and narrow connecting channels



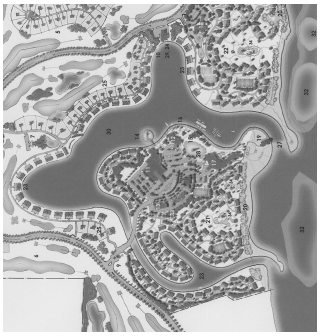
Marina – Design 2

- Large, narrow, meandering marina

Dead end segments inland did not flush adequately

Marina – Selected Design

- Plan revised for safer boat berthing.
- Fine-tuned by extensive hydraulic modelling for greatly improved circulation



Design Achievements

- Improved water quality and circulation in the marina.
- Improved water and sand quality for coastal ecosystem and neighbors
- The two entrance marina breakwaters are designed to allow for inexpensive sand bypassing to assure no negative impact on the littoral stream of sand.
- Two entrance design will allow for safe, small craft access at the south entrance, while larger vessels access the marina from the north channel.

Moffatt & Nichol

- A multi-disciplined firm that is recognized throughout the world for their role in the evolution of modern marina and small craft harbor planning and design.
- Moffatt & Nichol credentials include:

  authoring Government design manuals for waterfront developments

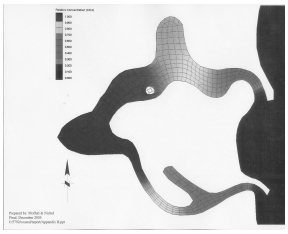
  serving as an appointed U.S. representative to multiple international committees.

Moffatt & Nichol - Modeling

- Extensive hydraulic modelling by Moffatt & Nichol Engineers

  The final plan has a water circulation residence time of 2.9 days

  Marina design guidelines call for a 4 day or less residence time



Cumulative Impacts

- Mitigation of Turbidity

  - Covering the beach and nearshore with the coarser sand will help reduce the turbidity in the water by creating a system where the breaking waves are no longer able to stir up fine sands and silts.

  - This condition is observed along Placencia Beach where sands are exclusively coarse to very coarse sands.

  - Further the sediments on land, with a component of medium and fine sand, are protected and are not being eroded into the sea.

New Habitat

Stone Jetties Will Function as Artificial Reefs "Live Rocks"

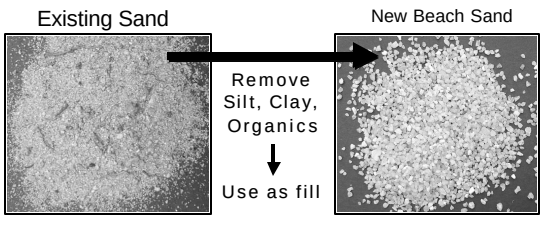
Jetties will be constructed in areas that are choked with eroding silt and clay banks.

Intended result - improvement of fish and lobster habitat.

Result: higher diversity, rocky intertidal and subtidal ecosystems.

Cumulative Impacts & Monitoring and Mitigation Plans

- Mitigation of Turbidity



Purpose for Jetties

Method of Controlling Sedimentation in Marina

A quarrystone breakwater system is designed to:

- reduce the wave state in the marina

- reduce littoral drift sedimentation in the marina entrance channel

Cumulative Impacts

- **Minimal Sand Transport**
- **Study regional wind and wave conditions, nearby piers, groins and river mouth sand bars provide an upper estimate of minimal yearly sand movement**
- **Sand quantities will vary annually depending on frequency, direction and intensity of high wave conditions in this region**
- **Over time, a sand beach will begin to grow adjacent to the marina entrance jetties**
- **In order to prevent shoaling in the channel mouths, the beaches will be monitored annually and net quantities of accreted sand will be bypassed south of the system**

Sand Monitoring

- Beaches and channels will be surveyed on a semi-annual
- After the first year, the survey schedule and location of transects will be re-evaluated to assure a comprehensive and efficient plan for the following year.

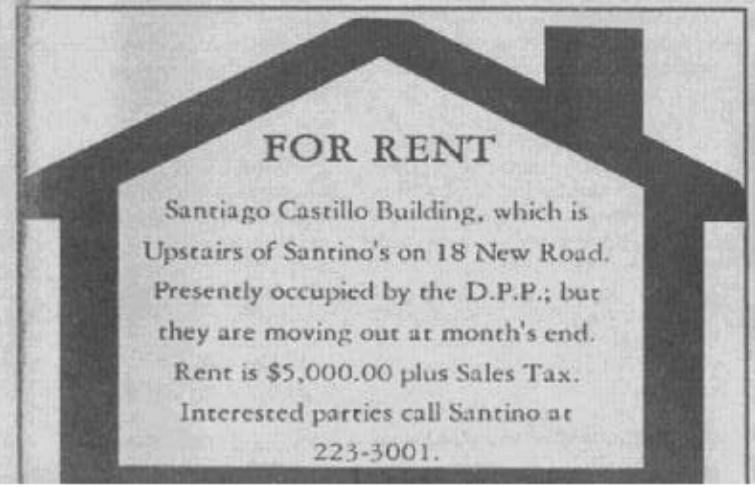
Public Notices

PUBLIC CONSULTATION NOTICE

Ara Macao Resort and Marina

The General Public is hereby advised that the Environmental Impact Assessment (EIA) for **Ara Macao Resort and Marina,** a tourism and marina project to be located in the Riversdale area, Stann Creek District, has been completed and submitted to the Department of the Environment. A Public Consultation will be conducted on Wednesday May 3rd, 2006 at 6:30 p.m. at the New Primary School in Seine Bight.

The General Public is invited to this public consultation.



Royal Caribbean plans Liberty voyages

South Florida Business Journal, April 12, 2006

Royal Caribbean has disclosed the name of its second Freedom-class ship and plans to homeport the vessel in Miami.

The Miami-based cruise line said the Liberty of the Seas reflects the same freedom of choice and experiences as her similarly titled sister ship, Freedom of the Seas, which is to enter service in June.

Liberty's debut is planned for May 2007.

Currently under construction at Aker Finnyards in Turku, Finland, Liberty of the Seas is to closely mirror her prototype, with amenities including a surfing simulator and whirlpools suspended more than 200 feet above the ocean.

The 3,600-guest Liberty of the Seas is to sail alternating seven-night eastern and western Caribbean itineraries year-round from Miami. Ports of call are to include San Juan, Puerto Rico; Philipsburg, St. Maarten; and Labadee, Haiti, in the east and Labadee; Montego Bay, Jamaica; George Town, Grand Cayman; and Cozumel, Mexico, in the west.

Liberty of the Seas is to depart Miami on Saturdays, while Freedom of the Seas sails alternating seven-night eastern and western Caribbean itineraries out of Miami, departing Sundays.

The line also said it plans short-cruising options when Navigator of the Seas returns to the United States after a summer spent overseas. The ship's four- and five-night western Caribbean itineraries are to sail from Miami.

Ports of call are to include Ocho Rios, Jamaica; George Town, Grand Cayman; Key West; Cozumel; and Belize City, Belize.

The newly lengthened Enchantment of the Seas is to sail similar western Caribbean itineraries from Fort Lauderdale and then from Tampa in the winter months of 2007.

VACANCY

Administrative Assistant

Social Security Board

DEADLINE FOR APPLICATIONS: April 28, 2006
ORGANIZATIONAL LEVEL: Above the First Class Clerk
DUTY STATION: Headquarters, Belmopan
REMUNERATION: Negotiable

CLASSIFIED ADS

Belize's best bargains are found here

Pickstock Street. Contact Regent Realty Ltd. 227 - 6286/604-5212. Our web site www.regentrealtybelize. com

FOR SALE: 2-storey concrete house and lot 100 ft. x 100 ft. situated at 10/12 Trinity Blvd., Belmopan. Total living space is 1,323 sq. ft., 3 bedrooms, 3 bathrooms. Contact 224-5643.

FOR SALE: Commercial property near Haulover Bridge. Lots in Gardenia Village. 11 acres south of Georgeville, Cayo District. 32.23 acres in Belmopan. Commercial building on Regent Street. 1.46acres Dangriga (Ecumenical Drive), Apartment Complex Fabers Road. Contact Regent Realty Ltd. 227 - 6286/ 604-5212. Our web site www.regentrealtybelize .com

FOR SALE: Land – Location! Location! Location! Industrial and commercial lots in Belmopan across from Agri-Show Grounds. Please contact 222-4013 or 610-2509 for further information.

FOR SALE: House and Lot in Corozal, 5 acres near Mile 14, Western Highway. 40 acres Freetown Sibun, 5 acres Biscayne Mile 25 and 26. Office space on Gabourel Lane. Commercial space on Albert Street. Office and apartment on Albert Street. House for rent near Haulouver Bridge.

NEEDED: Professional building supplies need a business system analyst - urgent! Please contact us at 523-3238 or 523-3184.

NOTICE: Need your septic cleaned? Call Septic Rangers at 620-2916.

NOTICE: Tenchtronics Communications has received the latest unlocking software for GSM phones. We can unlock: Motorola V3 – all versions; SL VR L7 & L6; PEBL U-6, all Vxxx series. Support latest Samsung T809; D357 T309 X495 X497; all D series. Support latest Sony K series, W series, Z series. Unlocking $50.00 – *Older phones $30.00.

VACANCY: A vacancy exists for the post of Electronics Technician/Installer for Car Audio & Video Equipment. Experience will be an asset. Interested persons should apply in writing to Manager, Tenchtronics Communications, P.O. Box 2180, Belize City.

Sugar crisis in Jamaica - Protest locks down Frome factory

by Noel Thompson, Freelance Writer

JAMAICA, Tues. Apr. 11, 2006

"An abrupt halt" as Puntarenas was eliminated in the semi-finals. Alajuela, who finished at second place in Group B, defeated Puntarenas 2-0 in the first leg and drew 1-1 in the second. more were ordered from farmers but they cannot be transported to the factory "this time," said [illegible] official abo... season for Belizean Shane Moody, and we Belizeans are proud of his accomplishments so far. Congrats Shane on a job well done.

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The General Public is invited to this public consultation.

NAME	ORGANIZATION	Tel#	EMAIL
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Alejandra Cacho J.P.	Seine Bight	523-3547	
Vuntu of Seine Bight Village			
BRUCE & STELLA MATTHEWS		606-0754	smatthews@mayaplace.com
Karl & Pamela Keck		520-4057	mvg2bz@aol.com
Kenneth + Judy Mitchell		523-8013 Cell 662-1067	
Dennis Lampela	Riversdale	509-4051	
Stephen Flax	Rivers Dale	5094050	
Lupe Lampela	"		
Ellen Faux	"		
Rockwell Ferguson	Area Representative	610-529	
Gomley M			
[illegible]			
John & Ellen Lee	Maya Beach Hotel	5208040	info@mayabeachhotel.com
BRIAN JACKSON		660-0988	BKJACKSON113
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William Sylvester	RIVERSDALE		patkarrick@AOL.COM
PAT KARRICK	RIVERSDALE		patrarrick@AOL.com
JOSE SHO			
Alberto FAUX	Riverdale	609 2671	
Macedonio Ulewe	Maya beach (Maya Centre)	661 8761	

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Kenneth + Judy Mitchell 523-8013 cell 662-1067
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Lupe Lampela "
Olga Faux "

Rockwell Ferguson Area Representative 610-5296
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[illegible]

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Carlos [illegible] Santa Familia V. 662-3887
Augusto Ack Medina Bank
[illegible] Santa Familia Village
[illegible] Santa Elena Toledo
[illegible] T 5094050
YESILA POSADAS MEDINA
Rebeca POSADAS MOLINA
Seferina Castellanos
[illegible] Riverdal
[illegible] Seine Bight 503 2051
[illegible] / Seine Bight
[illegible]
NICK CARPENTER Belize Aquaculture 521-2113
Wilfred B Cas[illegible] CNA-Seine Bight Ph 5233575
Gregory Moreira Seine Bight
JONY WILDMAN BAYSHORE MAYA BEACH 523 8019.
DEBBIE GABOR " "
CORDY FORD SEINE BIGHT.
DORRANCE YOUNT PLANTATION HOA
[illegible] 520 8076
KARL RECK 520-4057
Bruce Matthews Propowner 606-0754
John VALERIO Sieno Village
Kim CARPENTER. BELIZE AQUACULTURE 520-3021.
Mario fernandez PASCO marfer@btl.net
[illegible] CLEARWATER DRILLING
Robert A. Bush Bush/Kowert Associates 630518 6223
DOUG KOWERT BUSH KOWERT ASSC 812-339-0685
EDWARD EILEY-TREE SERVICE/LANDSCAPE INC 609-6008
Charles Shabica charles@shabica.com

Ara Macao

Third Presentation

And

Outreach Initiative

INDEPENDENCE VILLAGE

STANN CREEK DISTRICT

MAY 31, 2006

Memorandum

Date: June 23, 2006
To: National Environmental Appraisal Committee,
Attention, Martin Allegria, CEO
From: Paul Goguen
Subject: Report of Ara Macao, Third Public Consultation and Outreach Initiative

This is to report on the substance and results of a third public consultation and an outreach initiative to raise public awareness about the proposed Ara Macao project.

Overview

At the request of NEAC two previous Ara Macao public consultations were held. The first was held in Riversdale on December 14, 2005. The meeting was attended by about 100 people who were primarily Seine Bight and Riversdale residents and business people, although a few people representing Santa Familia, Santa Elena and other locations were in attendance. Although the first public consultation engendered spirited debate, questions were answered satisfactorily and no material opposition to the project arose.

A second public consultation was held in Seine Bight on May 3, 2006. This was called shortly after the NEAC reviewed the Ara Macao Final Draft EIA near the end of April. It was reasoned a second public consultation should be held because the EIA Final Draft had not been available for public review prior to the December 14 consultation and also that the Village of Placencia had not received sufficient notice of the December consultation. Approximately 200 + people, primarily from Placencia and Seine Bight, attended the second consultation. Those in attendance seemed to be dominated by a handful of well organized activists from the village of Placencia. Although the presenters provided a professional representation of the findings of the Environmental Impact Assessment, the consultation was disrupted by a few outspoken politically motivated people representing a limited point of view characterized by individual self interest. The majority of the people in attendance, when interviewed later, were found to be in favor of the project as can be seen by the significant number of signatures and support letters described below. Unfortunately, it was the inflammatory language of the activists that was reported in the media.

In response to the negative media play arising from the second public consultation, Hon. Rodwell Ferguson, Stann Creek West Area Representative, requested that Ara Macao representatives reach out and visit the many villages, businesses and organizations within the Ara Macao 12 mile zone of influence (Exhibit A) to raise public awareness of the project and explain the potential benefits of the project. It was further requested by Mr. Ferguson that the outreach initiative culminate in a third public consultation be held in Independence on May 31. Ara Macao was happy to oblige and immediately organized a campaign to get the facts of the project out to the people of Belize.

Raising Public Awareness

During the period from May 28 through the public consultation date of May 31, Paul Goguen along with other representatives of Ara Macao visited numerous persons, government agencies,

businesses and organizations throughout Belize City, Belmopan and many of the villages of Stann Creek West, including Placencia, Seine Bight, Independence, Maya Center, Dangriga, Hopkins, Silk Grass, and others. They met with several ministers of state and their staff, several influential business owners, several Belize organizations and the chairmen of several villages. During each meeting, Goguen made a PowerPoint presentation (Exhibit E) which describes the project and the potential benefits it holds for Belize and its people. In addition, he provided them with a two page letter entitled "Dear Friend" (Exhibit B) describing the facts of the project and refuting much of the misinformation which had been disseminated by the activists. Questions were asked and answered. Typically, people were pleasantly surprised by what they witnessed and commented that the facts were much more understandable and acceptable than the fiction that was being promoted by the activists and printed in the press. More importantly most all of those visited offered their support either through signed written letters or word to mouth. To date, over 800 letters of support and signatures (Exhibit F) have been received by Ara Macao. Some of the most noteworthy individuals and groups writing letters of support include:

- Raymond Ogaldez and the full council of Seine Bight Village
- Ernesto Saqui representing Maya Center and DAVCO, the District Association of Village Councils consisting of the 25 villages of Stann Creek
- Michael Polonio representing the National Garifuna Council
- James Parker representing the entire Plantation Homeowners Association
- Jose Alpuce, on behalf of the Belize Agro-Productive Sector Group representing over 10,000 growers and producers
- Zaid Flores representing the Banana Growers Association
- Harold Duncker of Aquamar Limited
- Dr. Henry Canton of Citrus Products of Belize Limited
- John Usher of Sanctuary Bay
- Aaron Loewen of A & L Construction

More letters of support are received daily. At the end of each presentation Goguen informed the people of the meeting in Independence scheduled for May 31 and invited them to attend. He noted that bus transportation and refreshments would be provided by Ara Macao.

The Public Consultation

A public notice (Exhibit C) was distributed to the eight villages within a 12 mile radius of the proposed Ara Macao project by Mr. Wayne Perriott, representative of Honorable Rodwell Ferguson. Five buses were arranged for interested villagers to be transported to the meeting. The meeting was held on May 31, 2006 at 7:00PM at the Independence Primary school.

It is estimated that between 200 and 300 people attended the meeting. Included among them were the following officials:

- Honorable Rodwell Ferguson, Stann Creek District Representative
- Ernesto Saqui, District Association of Village Councils; Chairman of Maya Center
- Mario Cho, Village Chairperson of Mayopan
- Ms. Chiec, Village Chairperson of Santa Rosa
- Patricia Harimon, Village Chairperson of San Roman
- Ms. Carmella Martinez, Village Representative from Georgetown
- Ms. Sylvia Ogaldes, Village Representative from Georgetown

- Visiano Teul, Village Chairperson from Red Bank
- Alfred Aranda, Village Chairperson from Silk Grass
- George Ramirez, Village Chairperson from Hopkins
- Ms. Zorita Andrews, Village Representative from Sittee River
- Hugh Linarez, Village Chairperson of Independence
- Percy Neal, Representative of Placencia
- Raymond Ogaldez, Chairperson of Seine Bight

The Agenda for the meeting was as follows:

- Opening Comments – Honorable Rodwell Ferguson
- Ara Macao Presentation: Paul Goguen (Exhibit E)
- Questions and Answers: Paul Goguen/Doug Kowert
- Closing Comments – Honorable Rodwell Ferguson

After closing comments were completed, the floor was open for questions. Although most of the questions revolved around employment opportunities, other questions about erosion, water quality and the lagoon were also addressed. Some of the questions raised included:

***Question**: Mrs. Beck, a local schoolteacher, asked, "Why are all of the workers coming from other countries?" **Answer**: The Earn & Learn Program and the Belize First Initiative will give first preference to Belizeans who want to work on the project.*

Question: Will the cut through the peninsula create an island and eliminate the only road off of the peninsula in the event of a hurricane? ***Answer***: The Ara Macao development will be located on the mainland, north of the peninsula, and will not be cutting through any part of the peninsula.

***Question**: Does the development have a hurricane evacuation plan? **Answer**: The Ara Macao development will have structures designed to survive a category 5 hurricane. The development has a hurricane evacuation plan.*

***Question**: Will the jetties for the marina cut off the flow of sand from the Stann Creek River and cause erosion on the beaches south of the development? **Answer**: The marina and jetties were designed by Dr. Charles Shabica, a world renowned designer of marinas. Surveys and studies of the existing conditions, along with computer modeling, were used to develop a plan that allows the littoral drift to be unimpeded and should not cause sand starvation to the south.*

***Comment**: The development will create job opportunities in the service sector only. **Response**: Job opportunities in both the construction and service industries will be created by the project, as well as opportunities for small business owners to grow and develop their own businesses. This project will create a demand for additional services and businesses in the area.*

***Question**: Will waste water be diverted into the lagoon? **Answer**: The development will build a waste water treatment facility. The BESST system will be utilized. On site, the treated water will be used to irrigate the golf course and nursery.*

At the conclusion of the meeting, attendees were asked to sign a letter in support of the project. All of the village leaders and most of the attendees signed the support letters. The support letters are attached to this report (Exhibit F).

Information, including the facts of the project, (Exhibit B) was distributed to attendees who requested them.

Overall, the third public consultation stood in stark contrast to the one held in Seine Bight. The meeting was attended by a much wider and more diverse group of people. Debate was lively and passionate but controlled. One or two people who got out of hand were escorted away by a well manned security patrol. It was clear that the people were in attendance to be informed and learn rather than to cause a public disturbance. It was also clear that the number one concern on most everyone's mind was Jobs. When we told everyone that our accounting firm, Deloitte Touch had projected that Ara Macao would generate over 2,600 permanent direct jobs and over 5,300 permanent indirect jobs they were really excited. And when we told them that they would receive first preference on jobs under our Belize First initiative and job training under our Earn & Learn program people cheered. At the end of the meeting, most everyone walked away with a positive feeling. From Ara Macao's perspective, we believed we had made many new friends and forged the foundation from which to build many new partnerships.

Epilogue

During the period immediately after the May 31 public consultation and continuing up to the present, the Ara Macao team embarked on a continuing effort to provide factual information to the people of Belize. Mr. Goguen started by placing an informative full page letter entitled Setting the Record Straight About the Ara Macao Resort and Marina (Exhibit D) in all of the significant Belize News publications including the Belize Times, the Guardian, the Amandala the Reporter and the Placencia Breeze. In addition, he granted an interview with Channel 5 and Love FM in which he responded to questions and held a press conference at the Radisson in which all of the print media were invited.

Mr. Goguen and his representatives continue to meet with influential persons and groups to tell the Ara Macao story. They have recently made presentations to The Belize Tourism Board, the BTIA, BELTRAIDE, The Central Bank of Belize and most recently the Prime Minister and certain members of his Cabinet. The response to these meetings continues to be positive.

The biggest question we receive now is, and I quote the Prime Minister... *"How soon can you get started?"*

Exhibit A
Zone of Influence

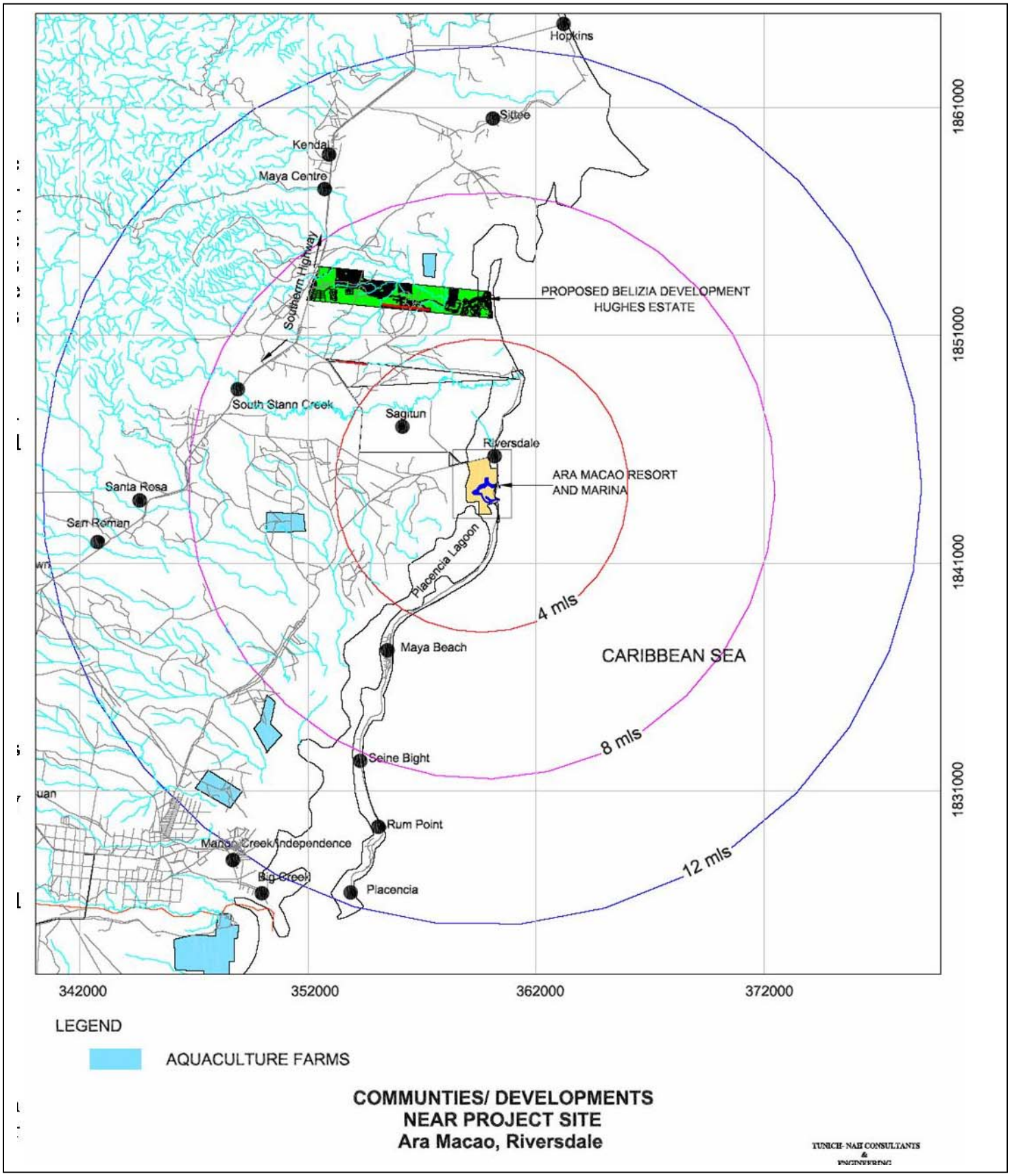

Exhibit B, Fact Letter

Dear Friend,

In recent weeks a number of exaggerated claims and misstatements of facts have been made about Ara Macao Resort and Marina. My purpose in sending you this message is to provide a true picture of this carefully planned project and the positive effects that will result from its completion. I hope that you will take a few moments to read what follows and that you will send a letter or email in support of Ara Macao Resort and Marina.

A small group of activists with no official recognition have taken information from the Environmental Impact Assessment (EIA), which was recently presented to the National Environmental Appraisal Committee (NEAC), out of context and distorted it to make a number of false and flagrant assertions. These claims suggest that the Ara Macao development will have a negative impact on the environment and economy of the Placencia Peninsula and surrounding area. Common sense demonstrates the folly of their assertions.

For example, an engineering analysis in our EIA used a *population* figure of 13,000 to calculate peak load on the Resort's water and sewage systems. According to Jose "Pepe" Garcia, a civil/sanitary engineer with Tunich-Nah Consultants & Engineering in Belize, the peak load calculations are used to identify a theoretical capacity that would be required if every living unit were occupied to maximum capacity, the casino and golf course were filled and every retail shop and commercial space was jammed with customers — all at the same time. While this is not very likely, it is prudent and common to over-engineer a project's mechanical systems to provide for a smooth and efficient operation while accounting for possible unknown factors. However, it is certainly *not* a measure of the Resort's residential population which the activists have claimed.

Here are the facts about the projected population for Ara Macao. Ara Macao will have 1,012 living units when completed. If you assume 100% occupancy with an average of three people per unit, the potential population would be about 3,036 people. However, resorts in Belize currently have an average annual occupancy level of 40%; the international standard is 60%. So, in fact, Ara Macao's resident population would range from 1,214 to 1,821. Nowhere near the exaggerated claim of 13,000! Moreover, these new residents would be absorbed into the area over a 5 year period allowing plenty of time for additional infrastructure to be put in place.

The activists have alleged that Ara Macao's marina and jetties will erode the beach south of the resort. The facts say otherwise. Erosion and accretion of Placencia beaches is primarily the result of storms and other weather systems. The prevalent southward littoral drift, which carries replenishing sand from the Stann Creek River South, has only a minor impact on Placencia beaches as will be seen in the illustration below. Also, because the jetties at Ara Macao point southward, they conform to the direction of the littoral drift and allow most of the sand to drift by. The minor impact of the littoral drift and the Ara Macao jetties is best illustrated in the following example. The Resort's award winning marine engineer, Dr. Charles Shabica has studied the shoreline and offers this worst-case scenario. If Ara Macao absorbed all the sand drifting from the north into the mouth of its marina, it would take five years to fill in (rendering the marina useless — again, not likely to happen) and the beaches to the south would lose a mere ¼ of one inch of sand!

Some have raised concerns that constructing the marina could cause the peninsula to be cut in half during a hurricane. In fact, Ara Macao is on the mainland just north of the peninsula, so it poses no such threat. As for concern about sedimentation from the excavation of the marina, the utmost care will be taken during construction. Inner walls of sheet piling will be installed first; then the marina lagoon will be dredged prior to creating the opening to the sea. When the opening is made, standard dredging curtains will be used to control sedimentation.

Ara Macao has painstakingly planned to mitigate the resort's impact on the environment. Solid waste will be handled according to international standards at the current dumpsite, which will be upgraded to a sanitary landfill. Wastewater and sanitary wastewater will be treated with a state-of-the-art Biologically Engineered Single Sludge Treatment (BESST) system that will also be available to Riverdale residents. Although, the output water from this wastewater system is almost pure enough for human consumption after post chlorination, it is projected to be recycled and used only for landscaping and other secondary water needs. This is in sharp contrast to the multitude of worn out septic systems observed up and down the Placencia Peninsula. Because these systems are filled to capacity and leaking badly, local engineers have postulated that it is very likely that every time a toilet is flushed on the Placencia Peninsula, an equivalent amount of raw sewage is displaced into the groundwater and eventually into the Placencia lagoon or Caribbean Sea. Some people won't swim off certain Placencia Beaches after they see the results of water quality tests showing dangerously high

levels of Fecal Coliform, Phosphate and other harmful compounds. It is not surprising that the Belize Department of the Environment has ordered that these systems be shut down and replaced with the new self contained systems.

The golf course will be designed to utilize recycled water for irrigation and to avoid run-off into surrounding areas. An integrated pest management system and hybrid grasses will utilize environmentally friendly fertilizers and pesticides which have been proven to absorb quickly, do their work and mitigate contamination of the environment.

As much as Ara Macao's management team is committed to minimizing environmental impact, they are also dedicated to maximizing positive economic benefits to the Placencia community and Belize. The following projections prepared by Deloitte, Belize show that Ara Macao will be a powerful engine for job creation and revenue production.

	2006/2007	**2011**
• **New Jobs**-Direct Employees	318	2,678
• **Salaries**-Direct Employee	$4,445,000	$37,485,000
• **New Jobs**-Indirect	635	5,355
• **Salaries**-Indirect	$3,810,000	$32,010,000
• **Foreign Exchange**/Construction	$48,181,568	$2,873,662
• **Foreign Exchange**/Guests and Owners	$4,036,270	$34,038,144
• **Hotel Tax**/Cumulative	$1,513,600	$12,764,304
• **Departure Tax**	$309,150	$2,607,088

In addition to jobs and income, Ara Macao will have a positive effect on infrastructure improvements. The resort's management team supports enabling legislation that will promote the creation of Tax Increment Financing districts — a means of financing vital projects such as the paving of the Placencia Road and the connecting road from Riverdale to Southern Highway. Ara Macao's fire station and fire truck will be available to serve the Placencia Peninsula and its surrounding villages.

Ara Macao is also committed to investing in the people of Belize. The resort's management team partnered with local officials to create an educational initiative called Help Assistance Needs Development Service (HANDS), which helps to provide tuition funds, school supplies, uniforms, shoes and nutrition to all Stann Creek West District schools. Another partnership, this one between Ara Macao and the Belizean national government, will establish an employment program for local residents. Known as Earn and Learn, the program will feature training and mentoring in construction trades and hospitality careers. Ara Macao is also on record supporting the unique culture of Belize including the Garifuna Nation, sports teams such as the Placencia Pirates and unique individuals such as Shane Vasquez the winner of this years national bike race.

In summary, Ara Macao is and will continue to be a responsible corporate citizen of Belize. We intend to be contributors: To support local initiatives in education and employment, to create economic growth and build infrastructure, to respect the environment and to promote Belize as the destination of choice in the Caribbean. If you agree that Ara Macao will have a positive impact on the Placencia Peninsula, Stann Creek West and the country of Belize, let your civic and government officials know. Please write a letter or send an email to show your support to:

Department of the Environment
Attention: Martin Allegria, CEO
10/12 Ambergris Avenue
Belmopan, Belize C.A.
Email: envirodept@btl.net

With a copy to:

Mr. Jose Garcia
Tunich-Na Consultants
Mile 6 Northern Highway,
Belize City, Belize C.A.
Email: pepe@btl.net

Best regards,

Paul

Paul Goguen

Exhibit C

NOTICE!!

The developers on the North end of the Placencia Peninsula, is having a consultation on Wednesday, 31st May, 2006 at 7:00 P.M. at the Center in Independence Village. Transportation will be provided from Maya Center and pass through all the villages on the route to Independence Village. All are encouraged to attend and please don't be afraid to ask questions!

Below please find schedule for picking up of persons.

LEAVE MAYA CENTER AT 6:00 P.M.

SANTA CRUZ	**6:15 P.M.**
SANTA ROSA	**6:15 P.M.**
SAN ROMAN	**6:15 P.M.**
MAYA MOPAN	**6:15 P.M.**
GEORGE TOWN	**6:15 P.M.**
RED BANK	**6:15 P.M.**
SEINE BIGHT	**6:00 P.M.**

Exhibit D

Setting the Record Straight About Ara Macao Resort and Marina

Recently a number of exaggerated claims and misstatements of facts have been made about Ara Macao Resort and Marina. Before you make up your mind, please take a moment to read the truth about this carefully planned project.

The Facts About Ara Macao's Residential Population

A small group of people with no official recognition has taken information from the Environmental Impact Assessment (EIA), which was recently presented to the National Environmental Appraisal Committee (NEAC), out of context and distorted it to make a number of false and irresponsible assertions. The whole story leads to a common sense conclusion.

- The engineering analysis in Ara Macao's EIA uses a population figure of 13,000 to calculate peak load on the resort's water and sewerage system
- According to Jose "Pepe" Garcia, a civil/sanitary engineer with Tunich-Nah Consultants & Engineering in Belize, this theoretical capacity is based on the standard industry practice of over-engineering a project's mechanical systems
- Ara Macao will have 1,012 living units when completed
- Assuming 100% occupancy with an average of 3 people per unit, the potential population would be only 3,036 people
- Resorts in Belize currently average 40% occupancy; the international standard is 60%, so Ara Macao's residential population would likely range from 1,214 to 1,821 — nowhere near the exaggerated claim of 13,000!

The Facts About Beach Erosion

Opponents have alleged that Ara Macao's marina and jetties will erode the beach south of the resort. The facts say otherwise.

- Erosion and accretion of Placencia beaches is primarily the result of storms and other weather systems
- The prevalent southward littoral drift, which carries replenishing sand south from the Stann Creek River, has only a minor impact on Placencia beaches and because the jetties at Ara Macao will point southward, they will allow most of the sand to drift by
- Dr. Charles Shabica, an internationally renowned coastal engineer, has studied the shoreline and concludes that if Ara Macao absorbed all the sand drifting from the north into the mouth of its marina (which would render the marina useless and is not likely to happen), it would take five years to fill in and the beaches to the south would lose a mere 1/4 of one inch of sand!

The Facts About Cruise Ships

There has been unfounded speculation that Ara Macao will be a port of call for cruise ships.

- Ara Macao was conceived, planned and designed to be a five-star-quality condominium resort community
- The resort's infrastructure and amenities will not support an influx of cruise ship passengers

The Facts About Marina Construction

Some critics of Ara Macao have suggested that construction of the marina could cause Placencia Peninsula to be cut in half during a hurricane and create a sedimentation problem for offshore reefs. The facts create a different picture.

- Ara Macao and its marina are actually located on the mainland just north of the peninsula and do not pose any threat to that body of land
- During marina construction, inner walls of sheet piling will be installed first and the entire marina lagoon will be excavated prior to creating the opening to the sea
- When the opening is made, standard dredging curtains will be used to control sedimentation

The Facts About Environmental Impact

While some have claimed that Ara Macao will have a detrimental effect on Placencia's beautiful environment, the facts show that the resort will actually improve the area's treatment of solid waste and wastewater.

- Solid waste will be handled according to international standards at the current dumpsite, which is slated to be upgraded to a sanitary landfill
- Wastewater and sanitary wastewater will be treated with the resort's state-of-the-art Biologically Engineered Single Sludge Treatment (BESST) system that will also be available to Riverdale residents
- The resort will not add to the problem of worn out septic tanks, which are prevalent along Placencia Peninsula
- Ara Macao's golf course will use recycled water for irrigation, implement an integrated pest management system to control insects, and mitigate the effects of run-off into surrounding areas with environmentally friendly fertilizers that are quickly absorbed

The Facts About Economic Benefits

Opponents have created a false impression that Ara Macao's presence will overwhelm Placencia and its residents. In fact, the resort will provide measurable benefits for both the community and Belize.

- The internationally recognized accounting firm Deloitte projects the creation of 318 new jobs over the next year and 2,678 new jobs by 2011
- Deloitte projects $4.4 million in annual direct employee salaries and $3.8 million in annual indirect salaries over the next year; $37.4 million in annual direct employee salaries and $32 million in annual indirect salaries by 2011 (income figures in BZ dollars)
- Hotel taxes for 2006/2007 are estimated at $1.5 million and $12.7 million by 2011 (income figures in BZ dollars)
- "Belize First" hiring policy means all qualified Belizeans will be given first preference in employment opportunities
- "Earn and Learn" program will provide training and mentoring in construction trades, hospitality careers and related industries during construction and post-construction phases
- Ara Macao's management team supports enabling legislation that will promote the creation of Tax Increment Financing districts — a means of financing vital projects such as the paving of Placencia Road and the connecting road from Riverdale to Southern Highway
- The resort's fire station and fire truck will be available to serve Placencia Peninsula and its villages

The Facts About Community Support

Ara Macao's management team is and will continue to be a responsible corporate citizen of Belize. The facts show a track record of support for our community.

- In partnership with local officials, the resort's management team helped to create an educational initiative called Help Assistance Needs Development Service (HANDS), which helps to provide tuition funds, school supplies, uniforms, shoes and nutrition to all Stann Creek West District schools
- Ara Macao supports the unique culture of the Garifuna Nation, sports teams such as the Placencia Pirates and national bicycling champion Shane Vasquez

Moving Forward Together

Ara Macao plans to be a cooperative partner in promoting Belize as the eco-destination of choice and a significant contributor to the responsible development of Belize and the Placencia community. If you agree that Ara Macao will have a positive impact, let your civic and government officials know. Please write a letter or send an email to show your support.

ARA MACAO
RESORT AND MARINA
belize
aramacao.com

Exhibit E
PowerPoint Presentation

(next Page)

ARA MACAO
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belize

Comparison of Beachfront Land Prices in Popular Caribbean destinations

Comparative Properties-Popular Caribbean and Central American Destinations

Subject Property		Map #	Acres	Ocean Footage	Price	Pr. Per Ft.
Ara Macao	Placencia Peninsula, Belize		582	5,112	$6,000,000	$ 1,174
Comparable Properties-Popular Caribbean and Central American Destinations						
Tomatoes Beach	Puerto Vallarta, Mexico	1	299	719	25,240,000	35,243
Grand Bahama Island	Bahamas	2	5.4	500	1,900,000	3,800
Bella De Ooca	Aeua Dominican Republic	3	118	320	6,000,000	18,750
Dian Point	Antigua	4	1	195	1,800,000	9,184
Mazatlan	Sinaloa, Mexico	5	670	7,920	40,500,000	5,114
Acapulco	Guerrero, Mexico	6	0.75	213	5,000,000	23,474
Long Island	Bahamas	7	10	220	1,200,000	5,455
Tulum	Quintana Roo, Mexico	8	0.35	81	550,000	6,790
Bonnie View Estates Island	Grand Cayman	9	11.22	460	5,000,000	11,111
Bodden Town Beachfront	Grand Cayman	10	6.22	1050	10,500,000	10,000
Seven Mile Beach	Grand Cayman	11	0.92	100	1,237,000	12,370
Leeward Beach Oasis	Provo, Turks and Caicos	12	9.85	515	5,000,000	9,709
Coral Gables	Provo, Turks and Caicos	13	2.05	400	1,145,341	2,866
Sandy Point	Provo, Turks and Caicos	14	12.11	1050	9,900,000	9,429
Water Cay	Turks and Caicos	15	4.14	300	2,250,000	7,500
Canoun	Quintana Roo, Mexico	16	374	2,457	38,500,000	15,670
North Andros Island	Bahamas	17	5	250	1,500,000	6,000
Punta Cana	La Altagracia, Dom. Rep.	18	2,548	14,766	371,165,000	25,136
Average Comparable Pricing						$ 12,089

Located in Stann Creek...

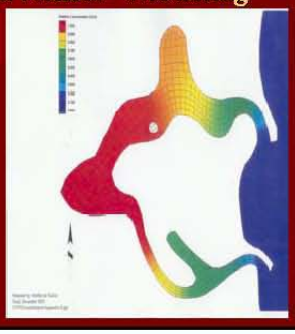
Just North of the Placencia Peninsula

The Plantation Stage II

Aerial Survey Reveals Natural Propensity for Marina Basin

Moffatt & Nichol - Modeling

- Extensive hydraulic modelling by Moffatt & Nichol Engineers
- The final plan has a water circulation residence time of 2.9 days
- Marina design guidelines call for a 4 day or less residence time



Marina – Selected Design

- Plan provides for safe boat berthing.
- Fine-tuned by extensive hydraulic modeling for greatly improved circulation

Mitigation of Turbidity

Cumulative Impacts

Mitigation of Turbidity

- - Covering the beach and near-shore with the coarser sand will help reduce the turbidity in the water by creating a system where the breaking waves are no longer able to stir up fine sands and silts.
- - This condition is observed along Placencia Beach where sands are exclusively coarse to very coarse sands.
- - Further the sediments on land, with a component of medium and fine sand, are protected and are not being eroded into the sea.

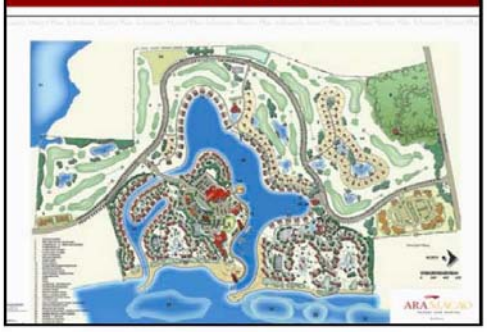
Design Achievements

- Improved water quality and circulation in the marina.
- Improved water and sand quality for coastal ecosystem and neighbors
- The two entrance marina breakwaters are designed to allow for inexpensive sand bypassing to assure no negative impact on the littoral stream of sand.
- Two entrance design will allow for safe, small craft access at the south entrance, while larger vessels access the marina from the north channel.

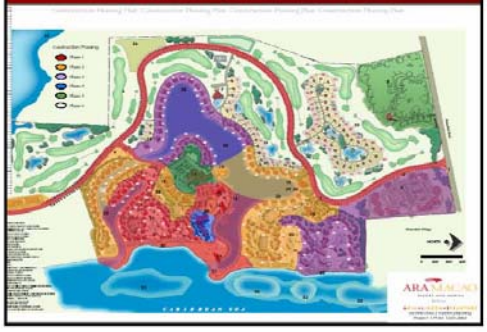
New Habitat

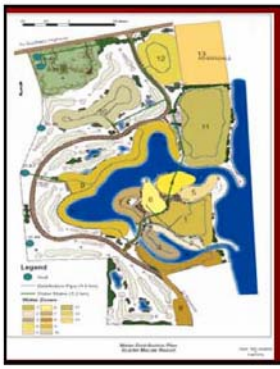
- Stone Jetties Will Function as Artificial Reefs "Live Rocks"
- Jetties will be constructed in areas that are choked with eroding silt and clay banks.
- Intended result - improvement of fish and lobster habitat.
- Result: higher diversity, rocky intertidal and subtidal ecosystems.

Schematic Master Plan



Project Phases-5 Years





Water Distribution Plan

Liquid Waste System

BESST (Biologically Engineered Single Sludge Treatment) Waste Water Treatment Plant

The next Caribbean Destination

When completed, this professionally designed purpose built residential and commercial resort will feature:

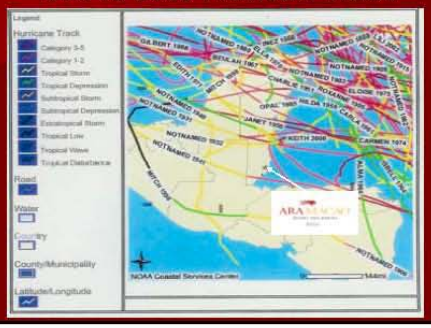
- **456 purpose built full size condominium residences** arranged in courtyard settings with lush landscaping, under-building parking, central swimming pools, 6 floor-plans ranging from 1,778 square feet to 2,801 square feet of living space all with ocean views
- **296 waterfront villas** along an inland waterway featuring private docking areas, and three large floor plans ranging from 1,876 square feet to 2,206 square feet of living space
- A **reception center** with over 47,000 square feet of lobby area, restaurant, convenience shopping and fitness center
- **260 full service luxury hotel condominium suites** with three floor plans ranging from 450 to 550 square feet of living space
- **50,000 square feet of hotel retail space** providing a full service spa, restaurant & bar, banquet and meeting facilities and retail shops
- A **full service marina** with easy access to a deep water Caribbean channel and shelter for over 300 boats up to 100 feet in length
- A **marina ocean walk** with a 5,300 square foot lighthouse bar & restaurant
- A **2,500 square harbor master building**
- An **85,000 square foot gaming casino and nightclub** fashioned to resemble an ancient Mayan Temple
- An **18 hole designer golf course** with up to 59 residential lots
- A **rainforest nature trail** anchored by a 5,000 square foot macaw breeding facility and exhibit hall
- **Three shopping areas** containing a total of 368,000 square feet of specialty shops and local services

Purpose-Built Condominium Residences

All residences will feature:

- high grade concrete and steel construction using International Building Code (IBC) construction standards finished to a category 5 wind rating with resistance to water surges up to 10 feet above grade and 13 feet above sea level
- multiple floor plans including 2 bedroom/2 bath deluxe suites, 2 bedroom/2 bath bi-level lofts and 3 bedroom/3 bath luxury penthouses with vaulted ceilings, tri-level villas with private docking
- all condominium residences will feature sea, marina or golf course views, elevator service, generously sized outside decking, enclosed parking and high end quality finishes with upgrade options

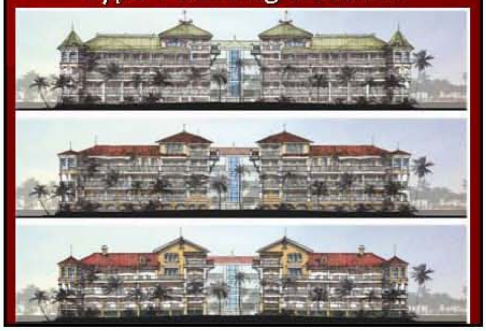
1850 to 2003 Hurricane Tracks



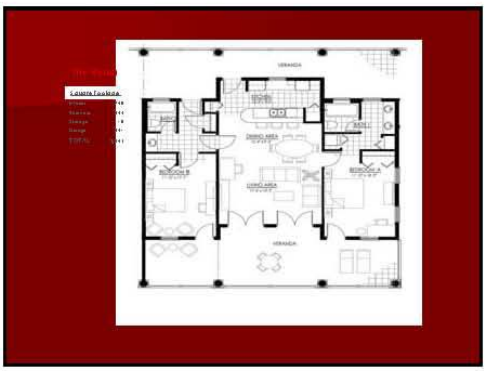
Population Figures

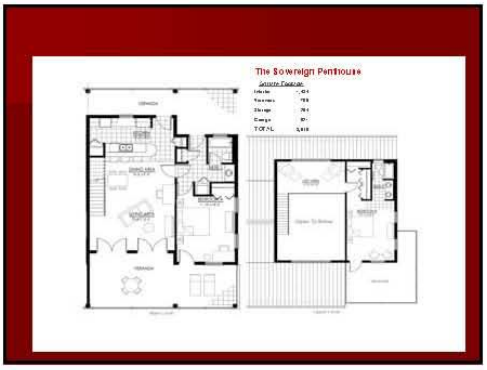
Permanent	Staff / Day Clients & In-transit Visitors	Total
Condos, Villas, Clubhouses, Hotel, Golf Course Homes, Employee Housing	**Casino, Night Club, Reception, Commercial Areas, Pools, Bars, Restaurants, Maintenance**	**Permanent and Non Permanent**
5,124 (100%)	7,868 (100%)	12,992
3,587 (70%) Design Average	5,508 (70%) Design Average	9,095
2,050 (40%) National Average	3,147 (40%) National Average	5,197

Type 1 Building Elevation



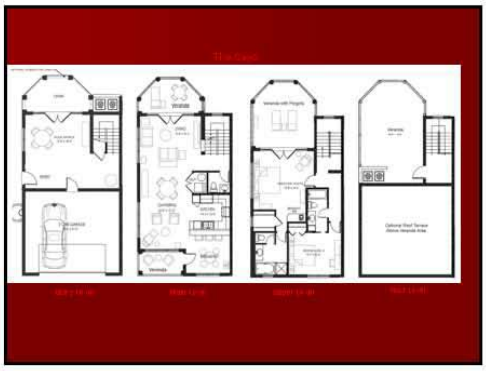
5




The Sovereign Penthouse


The Marquis Penthouse


SQUARE FOOTAGE
The Coronal
The Cayo



- Chicago based development team
- 75 year combined real estate development experience
- Over $7 Billion of residential & commercial property developed

iovest
INVESTING IN OPPORTUNITY

Earn & Learn Program

	2006/2007	2011
New Jobs-Direct Employees	*378*	*2,678*
Salaries -Direct Employee	*$4,445,000*	*$37,485,000*
New Jobs-Indirect	*635*	*5,355*
Salaries -Indirect	*$3,810,000*	*$32,010,000*

Foreign Exchange

	2006/2007	2011
Foreign Exchange/Construction	$48,181,568	$2,873,662
• **Foreign Exchange**/Guests and Owners	$4,036,270	$34,038,144
Hotel Tax/Cumulative	$1,513,600	$12,764,304
Departure Tax	$309,150	$2,607,088

Raising a Family of Scarlet Macaws

Raymond & Mindy

Preparing the Nest

Our First Baby


4 days
7 Days


10 days
8 days
18 days


41 days – Pin feathers well defined
49 days – Pin feathers are starting to shed husk layer


Time for Bed


Outdoor Time


Shower & Blow Dry

Double Trouble – New birds in the house

4 days old

Crops full – Time to play

Playing with my sibs

4 weeks old & 3 months old

It's a Family Affair

Learning to Fly

Blues Brothers

I'm All In!

It's a Birds Life

Can Billy Play

Albert wants to play

Kristi and Moses

Making New Friends

ARA MACAO
RESORT AND MARINA
belize

A Condominium Resort Community

Exhibit F
Letters and Signatures of Support

(See Folder A)

For Assistance of attendees

Also attached is CD with Electronic Version

Of names of persons Supporting the Project.