



APENDICE N

Estudio de Alternativas para Abasto de Aguas de Procesos

Octubre 2010

Declaración de Impacto Ambiental – Preliminar

Planta de Generación de Energía Renovable
y Recuperación de Recursos

BARRIO CAMBALACHE DE ARECIBO

EnergyAnswers
Arecibo

Alternatives for Water Sources

Preliminary Environmental Impact Statement Renewable Power Generation and Resources Recovery Facility

CAMBALACHE - ARECIBO



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LIST OF ACRONYMS

Ave.	Average
BOD	Biochemical Oxygen Demand
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
gpm	Gallons per minute
HP	Horsepower
M	Meters
MGD	Million gallons per day
NPDES	National Pollutant Discharge Elimination System
O&M	Operation & Maintenance
PRASA	Puerto Rico Aqueduct and Sewer Authority
TSS	Total Suspended Solids
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1 EXECUTIVE SUMMARY

Energy Answers International has the intention of constructing a Renewable Power Generation and Resources Recovery Facility at Cambalache Ward in the Municipality of Arecibo, Puerto Rico. The proposed Renewable Power Generation and Resources Recovery Facility has specific water needs for its different processes. This study intends to analyze the feasibility of available water sources necessary for the cooling process of the Renewable Power Generation and Resources Recovery Facility. Considering the proposed project location and the cooling process water quality requirements, the following water sources were identified and analyzed:

- Alternative 1 – Puerto Rico Aqueduct and Sewer Authority (PRASA) water main;
- Alternative 2 – Groundwater;
- Alternative 3 – Surface water;
- Alternative 4 – Brackish water from Caño Tiburones; and
- Alternative 5 – Reclaimed water from Arecibo Waste Water Treatment Plant (WWTP).

Once-through seawater, another possible alternative, will require the construction of off-shore intake, pump station, discharge structures and lines. This is a high capital cost, extensive operation and maintenance, and difficult permitting alternative; therefore this alternative was not included in this study.

This Study also analyzes each of the sources in terms of reliability, infrastructure needs, environmental issues, and capital, operation, and maintenance costs.

In order to evaluate and select the preferred alternative, the following information was considered:

- Cooling Process demand for the Renewable Power Generation and Resources Recovery Facility is 1.8 Million Gallons per Day (MGD). Boilers (deionized water) and other operations demand accounts for an additional 0.30 MGD.
- The use of brackish cooling towers at the proposed Renewable Power Generation and Resources Recovery Facility is considered under the Caño Tiburones brackish water alternative.

- In order to use the Arecibo WWTP primary effluent, additional treatment must be provided to achieve secondary level water quality.
- Use of brackish water for boilers operation shall be explored. A specific characterization is recommended to verify the salinity of the raw water source.
- The production of deionized water, from high salinity brackish or reclaimed water will require expensive treatment costs. In such case, potable water from PRASA shall be used as the source for this purpose.

This study recommends to further develop the use of brackish water from Caño Tiburones (Alternative 4) since it is the most feasible and reliable alternative to fulfill the Renewable Power Generation and Resources Recovery Facility needs. It is recommended to perform detailed characterization of the source to properly address any seasonal variations in its composition. Also, it will be necessary to negotiate with DNER in order to obtain the water franchise and the permission for construction of the necessary infrastructure at El Vigía Pump Station facilities.

2 WATER REQUIREMENTS

2.1 WATER NEEDS

As informed by Energy Answers International, the proposed Renewable Power Generation and Resources Recovery Facility will need 2.1 MGD for all of its processes. This demand includes need for potable and deionized water, which accounts for 0.3 MGD, and 1.8 MGD for cooling process. This report will only study different sources for the cooling process water.

3 ALTERNATIVES CONSIDERED

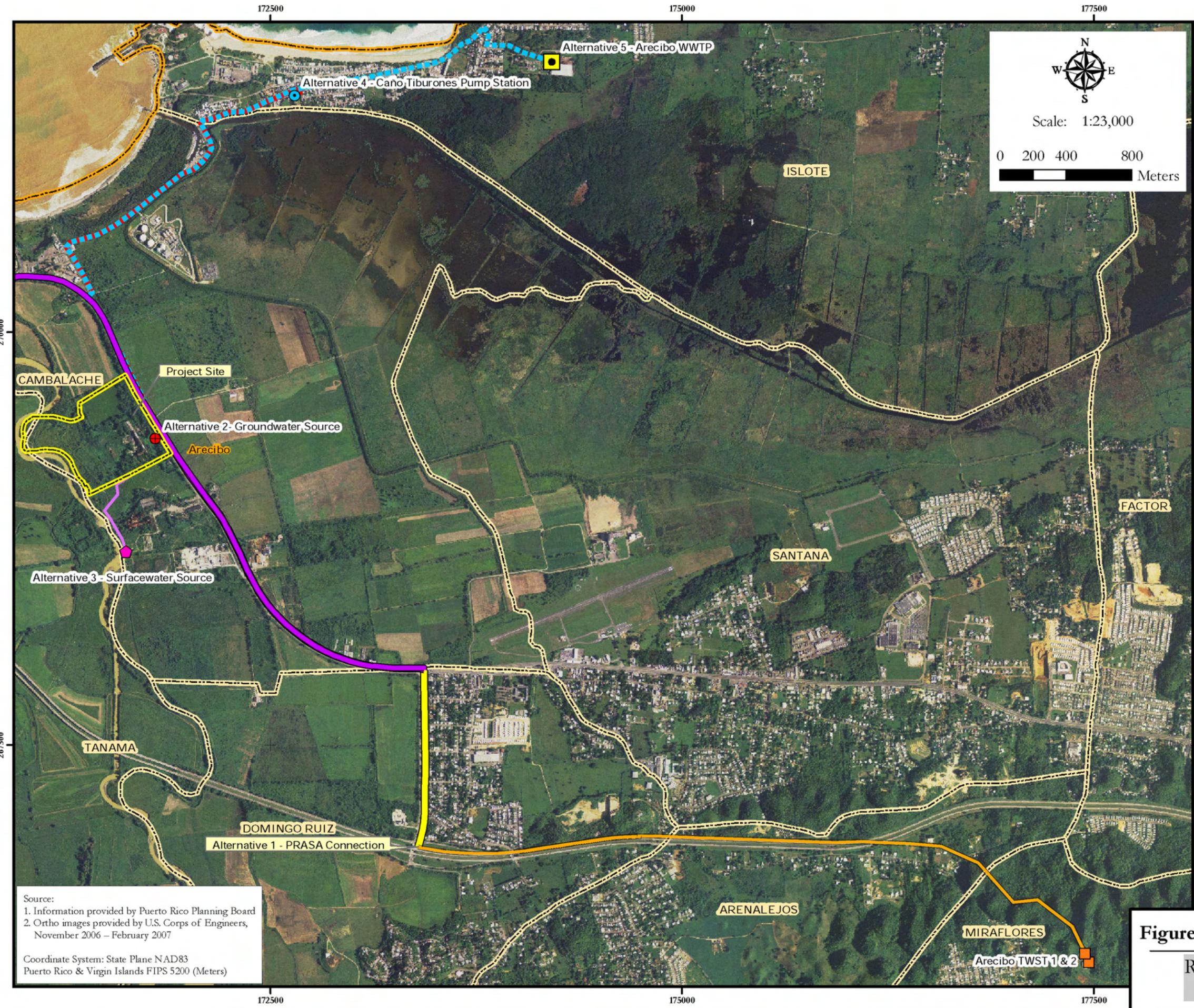
This feasibility study evaluates five alternatives to supply 1.8 MGD for the cooling towers process at the Renewable Power Generation and Resources Recovery Facility proposed by Energy Answers. These alternatives consist in five different types of water sources evaluated in terms of reliability, infrastructure needs, environmental issues, and capital, operation, and maintenance costs. The evaluated alternatives are:

- Alternative 1 – PRASA’s water main
- Alternative 2 – Groundwater
- Alternative 3 – Surface water
- Alternative 4 – Brackish water from Caño Tiburones
- Alternative 5 – Reclaimed water from Arecibo WWTP

Figure 3-1 presents the location of each alternative water source.

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Meters

- Legend:**
- █ Alternative 1 - PRASA Connection
 - Alternative 2- Groundwater Source
 - ◆ Alternative 3 - Surfacewater Source
 - Alternative 4 - Caño Tiburones Pump Station
 - Alternative 5 - Arecibo WWTP

- WaterLines**
- Diameter, Status
- 36", Existing
 - 16", Existing
 - 12", Existing

- Distances**
- - - - Arecibo WWTP
 - Surfacewater Source
 - Pump Station
 - Municipal Limit²
 - Ward Limit²
 - Project Limit



Source:

1. Information provided by Puerto Rico Planning Board
2. Ortho images provided by U.S. Corps of Engineers, November 2006 – February 2007

Coordinate System: State Plane NAD83
Puerto Rico & Virgin Islands FIPS 5200 (Meters)

Figure 3-1: Site and Alternatives Location
Renewable Power Generation and Resources Recovery Facility

3.1 ALTERNATIVE 1 – PRASA’S WATER MAIN

This alternative proposes to obtain potable water from PRASA’s distribution system connecting a new transmission line from the project site to the existing 36” pipeline at the intersection of Domingo Ruiz Avenue with Highway PR-22.

The projected site for the Renewable Power Generation and Resources Recovery Facility is located within PRASA’s Miraflores and Superaqueduct Service Area. This service area is supplied by Dr. Santiago Vázquez WTP (Superaqueduct) and three wells. The water is distributed from the plant to the service area by Arecibo Treated Water Storage Tanks (TWST) which are part of the seven TWST that distribute most of the annual average of 98 MGD produced at the plant. Arecibo TWST distributes an estimated annual average of 4.74 MGD and consists of two main tanks, and a distribution system with a 1,200 gpm pump station and a gravity distribution system. The service area also received about 1 MGD from three wells: Santana II, Santana III and Pérez Mayol for a total estimated average of 5.74 MGD of potable water within the service area.

Puerto Rico Department of Natural and Environmental Resources (DNER) “Plan de Aguas de Puerto Rico” estimate an average daily demand of 5.76 MGD currently served by PRASA within the Miraflores and Superaqueduct Service Area. Superaqueduct performance targets expect to increase Arecibo TWST production to produce a surplus of about 0.40 mgd after 2010, which could supply the potable water requirement for the WTE plant. However, this increase will not be enough to satisfy an additional 1.8 MGD of process water demand. For these reasons this study will not be further evaluated.

3.2 ALTERNATIVE 2 – GROUNDWATER

Alternative 2 consists of extracting water from aquifers at the project area. Previous studies have reported three (3) main hydrogeologic units of groundwater at the project vicinity: (1) a shallow water system comprised of alluvial deposits; (2) a limestone unconfined system contained within the Aymamón and Aguada Limestone; and (3) a confined aquifer contained within the Montebello and Lares Limestone.

On February 2000, Gregory L. Morris and Associates (GLMA) prepared a pump test report for a 240-foot well drilled at the proposed site. Groundwater quality was also monitored on the study. The report concluded that the well can produce a yield of 1.0 MGD without significant drawdown in the aquifer. Quality analysis showed Total Dissolved Solids (TDS) values over 15,000 mg/L, which indicates the presence of brackish water in the aquifer.

Based on the pumping test results of the GMLA report, it is concluded that this source will not produce the required 1.8 MGD cooling process water needs on a daily basis.. **Appendix 1** presents water quality data for a monitoring well drilled at the aquifer. These results were part of the study, *Informe final, Programa de Monitoreo del Estuario de Río Grande de Arecibo*, performed by PRASA at Río Grande de Arecibo estuary in 1998.

3.3 ALTERNATIVE 3 – SURFACE WATER

This alternative consists of obtaining surface water from Río Grande de Arecibo, which is located west of the proposed site. Global Fibers, a former paper mill at the site, conveyed surface water from the river for their process water needs. Global Fibers ceased operations in 1996 and their DNER water franchise expired. The river intake structure was abandoned.

In 2000, the Santiago Vazquez WTP, which is located upstream the proposed site, started operation. This WTP has its intake located at a Regulation Lake, which is fed from the Dos Bocas – Caonillas Reservoir System at the Río Grande de Arecibo. DNER “Plan de Aguas de Puerto Rico” (Appendix A, Table 4) sets the safe yield of the Dos Bocas – Caonillas System in

102 MGD, from which 100 MGD are actually compromised for the Santiago Vazquez WTP intake extraction.

PRASA, as part of the effort to obtain the increase of the water franchise to 100 MGD, was required to perform a 4-year study of the Río Grande de Arecibo estuary. The study, mentioned in Section 3.2, required the installation of surface water monitoring stations and monitoring wells.

It is concluded that Río Grande de Arecibo safe yield is practically compromised, and government and federal agencies permits will be difficult to obtain. For this reason, this alternative will be no longer evaluated.

3.4 ALTERNATIVE 4 – WATER FROM CAÑO TIBURONES

This alternative consists on obtaining water from Caño Tiburones estuary. Caño Tiburones extends eastward from the Rio Grande de Arecibo to the Río Grande de Manatí as a western boundary and covers approximately 7,000 acres. In 1998, the Government of Puerto Rico designated 3,428 acres of the Caño Tiburones as a natural reserve to protect the island’s largest wetland and its animal and flora species.

El Vigía Pump Station was constructed in 1949 to provide drainage for water and control water levels at the Caño Tiburones. Daily brackish water pumping of 100 MGD has been informed by DNER personnel. The Pump Station consists in an intake structure, screening, and two (2) 80,000 gpm pumps. The use of brackish cooling towers at the proposed Renewable Power Generation and Resources Recovery Facility is considered under this alternative.

3.4.1 Reliability

Water balances for the Caño Tiburones for normal rainfall periods (Zack and Class-Cacho, USGS, Water Resources Investigation Report 83-4071, 1984) estimates an average brackish water discharge of 106 MGD from El Vigía Pump Station into the ocean. A summary of this water balance is presented on

Table 3-1. It is important to notice that PRASA has envisioned the construction of a Reverse Osmosis Treatment Plant (10 to 25 MGD capacity) to treat brackish water from the Caño

Tiburones. Even if this project is developed, brackish water will be available to meet Renewable Power Generation and Resources Recovery Facility water needs.

Table 3-1 Caño Tiburones Water Balance (Zack and Class-Cacho, 1984)

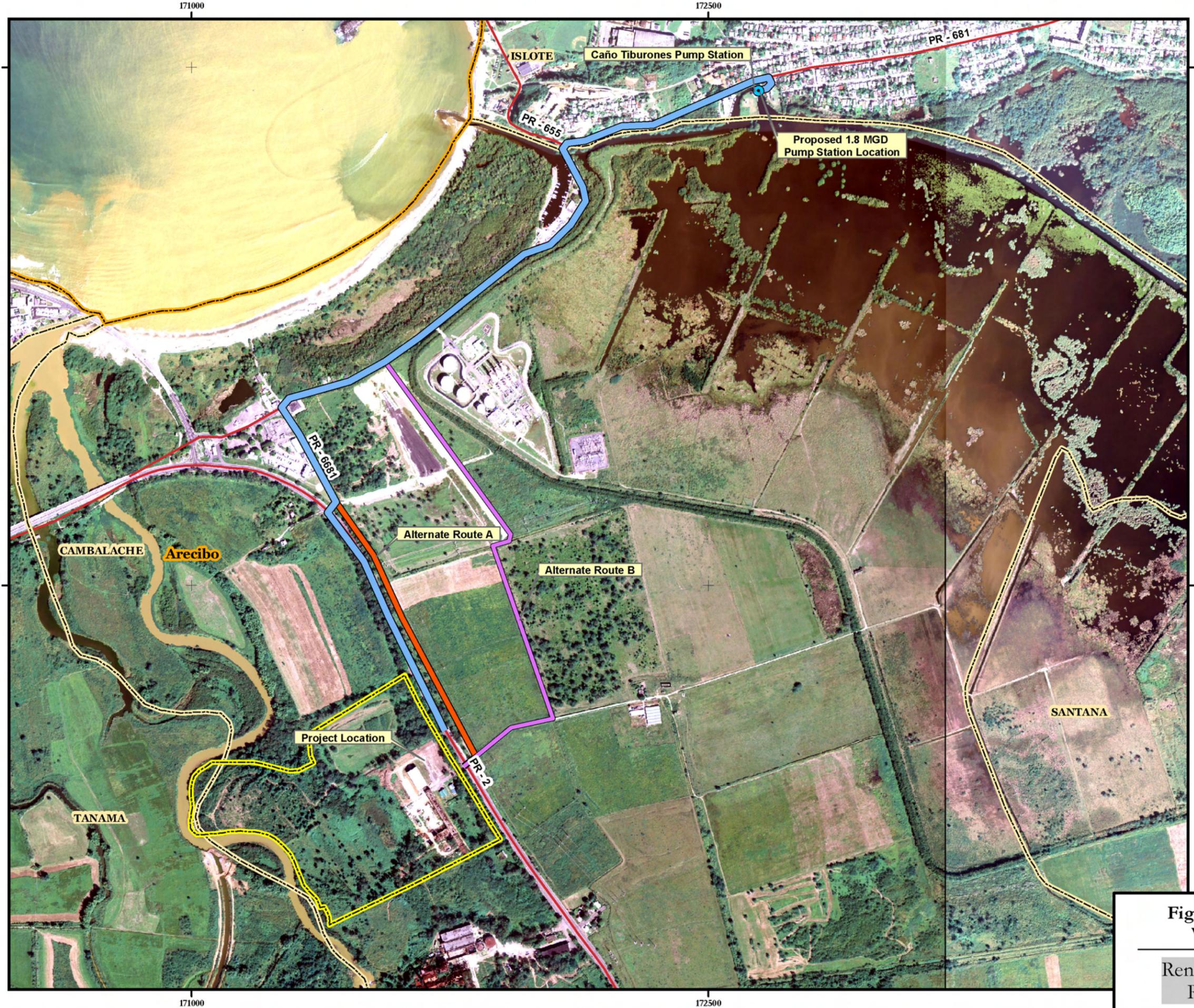
Caño Tiburones Water Sources In	Total Inflow (MGD)	Caño Tiburones Water Sources Out	Total Outflow (MGD)
Ocean	36	Evapotranspiration	18
Aymamon Limestone Aquifer	44	El Vigía Pump Station	106
Río Grande de Arecibo	10	Unaccounted	2
Direct Rainfall	24		
Direct Runoff	12		
Total Water In	126	Total Water Out	126

3.4.2 Infrastructure

Under this alternative, a 1250 gpm pump station and transmission line is required. The pump station shall include a new intake structure with screening, and a wet pit. Pumping should be provided by three (3) pumps. All three pumps shall be rated at 1250 gpm (2 pumps alternating, one stand by) and a total dynamic head (TDH) of 55 ft. Raw water shall be transferred by means of a 3.4 kilometers, 14-inch ductile iron line. The pump station shall include an emergency generator to provide reliability during possible power shortages. **Figure 3-2** shows the proposed pump station location and the transmission line alignment from El Vigía Pump Station to the proposed Renewable Power Generation and Resources Recovery Facility site.

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Legend:

-  Caño Tiburones Pump Station
-  Proposed 14" Force Line to Caño Tiburones Pump Station
-  Alternate Route A to Caño Tiburones Pump Station
-  Alternate Route B to Caño Tiburones Pump Station
-  Roads¹
-  Project Limit
-  Municipal Limit²
-  Ward Limit²

Source:
 1. Puerto Rico Highway and Transportation Authority (ACT by its acronym in Spanish), June 2006
 2. Information provided by Puerto Rico Planning Board
 3. Ortho images provided by U.S. Corps of Engineers, November 2006 – February 2007

Coordinate System: State Plane NAD83
 Puerto Rico & Virgin Islands FIPS 5200 (Meters)



Figure 3-2: Alternative 4 Brackish Water from Caño Tiburones

Renewable Power Generation and Resources Recovery Facility