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February 24, 2011

Mr. Edgar Garcia
Regulatory Project Manager
Antilles Regulatory Section
US Army Corps of Engineers
400 Fernández Juncos Avenue
San Juan, Puerto Rico 00901-3299

Re: Additional information requested for Via Verde project
SAJ 2010-02881 IP-EWG

Dear Mr. Garcia:

To facilitate the evaluation of the data and responses previously provided in our letter of January 28, 2011, supplemental data and information are being presented. Specifically, where we previously referenced the Final Environmental Impact Statement, approved in November 2010, we are providing information to address the issues raised in your December 22, 2010 letter, and at the interagency project delivery team (PDT) meeting held on February 1, 2011.

Project Impacts:

Many actions have been taken, both in the preliminary planning for the project, and more recently, in adjustments to the proposed alignment and construction techniques, to minimize or avoid impacts. In addition to the information provided in our January 28, 2011 letter, these efforts aimed to avoid project impacts include the following:

- As previously discussed, the alignment entails a 150 feet easement, that includes 50 feet of the permanent operational Right of Way (RoW), a 50 feet construction RoW, as well as 50 additional feet of the maintenance RoW. Notwithstanding that, **when traversing near towns and communities**, every effort has been made to locate the pipeline alignment to avoid populated areas. Where this is not possible, the Puerto Rico Energy Power Authority (PREPA) will allow a 150-foot clearance distance from the actual pipeline location to any residential building, to provide as much setback as reasonable.

- After due consultation with the PR Planning Board, the proposed project was also rerouted **to avoid some commercial developments, as well as future residential areas** that had completed the required Planning Board process but construction has not been initiated yet. The alignment was altered to avoid both of those cases.

- In early designs, the pipeline originally crossed three forests (Bosque del Pueblo, Rio Abajo Forest and Forest De La Vega). To avoid impact to these forests, the design of the alignment was varied as follows:

    a) **El Bosque del Pueblo State Forest** was completely avoided by moving the original alignment more to the west and outside the boundary.

b) **In the Rio Abajo State Forest,** no impact will occur because the pipeline alignment will use the existing PR-10 easement in that area. This forest was previously fragmented by the construction of PR-10. The Via Verde project proposes to use 8.4 miles of this road right-of-way to avoid further fragmentation of the forest, as well as to prevent additional impact to the karst area at said location.

c) **State Forest De La Vega** is the only forest the project will directly impact. However, the impact will be minimal (only 0.0086 square mile will be directly impacted). This 0.0086 square mile corresponds to a length of 0.43 mile of pipe located within the forest, by the 100 feet width of the initial construction area. This constitutes only 0.47% of the forest to be temporarily impacted. Minimizing fragmentation is an important factor to promote biodiversity. To mitigate this minor impact, PREPA intends to acquire land adjoining several sections in Forest De La Vega in order to connect isolated parts to further minimize fragmentation within this state forest. These lands will be devoted to conservation. The whole process will be done in coordination with DNER.

- **In the case of wetlands**, the impact is a temporary one, and will occur during installation of the pipeline. As proposed, the project does not involve any permanent impact to wetlands, so there is minimal, if any, cumulative impact in association with other actions. To further minimize wetland impacts the following measures will be taken:
  - Limit construction to a right-of-way of 50-feet.
  - Demarcate the easement to restrict the removal of vegetation and avoid impacts to the wetland outside of this area.
  - Implement control measures to prevent erosion and sedimentation or minimize sediment transport to other areas of the wetland.
  - No vehicles are allowed to leak oil or other liquids to pollute the wetland. If a leak occurs during construction, spill kits will be used to clean and remove material to a control workspace.

The project crosses north and northwest of San Pedro Swamp (Municipality of Toa Baja), where it is associated with the mouth of the Cocal River and in forested wetland areas of Punta Salinas. In these sections the pipeline will be installed utilizing Horizontal Directional Drilling (HDD) and cross at depths (over 60 Feet) well below the root zone of trees. The savanna areas of this swamp, which could be affected by pipeline construction, are (or have recently been) used for commercial planting of grass. It must be pointed out that Via Verde project was originally and is still designed and planned to comply with established USACE Nationwide Permits associated with the construction work covered under Section 404 of the Clean Water Act. The characteristics of this particular project are a clear indication of the limited impact of the pipeline to the bodies of water, mangroves, and wetlands located within the designated alignment.

Roads will be crossed by the pipeline project utilizing the cross boring technique to avoid impact to infrastructure and public transit. The pipeline will be installed at least 4 feet below the road, or as required by the Highway Authority, both state and federal, as applicable. These sections of the pipeline are designed to withstand the weights associated with road vehicles passing over it.

To minimize impact incidental to the effect of deforestation and temporary removal of topsoil, PREPA will implement a Plan for the Control of Erosion and Sedimentation (CES) and a Storm Water Pollution Prevention Plan (SWPPP) in compliance with Environmental Quality Board (EQB) regulations and regulations of the US Environmental Protection Agency promulgated for this purpose.

Changing the route of the proposed alignment in the Mogote Area of Manati to avoid impacts to the Mogotes. If any particular Mogote cannot be avoided by routing the pipeline around it, the pipeline will utilize the push/pull bore method (not HDD) to tunnel underneath the landscape.

Secondary Impacts:

The entire 92 mile length of the Via Verde project will be located underground, so secondary impacts are expected to be minimal. **Within the aquatic resource the pipeline trenches will be excavated 4-6 feet deep** and this will not adversely impact groundwater resources and aquifers. **There will be no permanent fill and no maintenance roads constructed** in waters of the U.S. **No secondary impact is expected to occur to surface sheet flow and/or ground water flow.**

Gas pipes could contaminate groundwater if the natural gas used during operation of the project contained dense contaminants (liquid natural gas) and there was a break in the bottom of the pipe where they can escape. Also contamination could occur where compressor stations are located to boost the gas flow. **It is important to mention that the gas to be used in the Via Verde project will <u>not</u> have the type of contaminant that is condensed (by specification), or have compressor stations.**

Open trench impacts include increased turbidity, sedimentation downstream from crossings, and direct impact to sessile wildlife and aquatic flora. To minimize any impact that potential erosion and sedimentation from land may have on the aquatic environment PREPA has taken the following measures:

- **An Erosion and Sedimentation Control Plan (CES) was developed** and will be submitted to the Environmental Quality Board for approval. This Plan will identify the construction easement to avoid impacting other areas; will identify water bodies that may be affected by construction to protect them; and will identify drainage patterns to a body of water and locate areas where control measures such as bales of hay and strainers will be installed. Also, a CES Plan inspector will oversee the development of the project, and will report its findings to the EQB.

- **Submit a Notice of Intent to the US Environmental Protection Agency (EPA) and prepared a Storm Water Pollution Prevention Plan (SWPPP).** This Plan will be finalized using the EPA guidance, Developing a Stormwater Pollution Prevention Plan: A Guide for Construction Operators and staff that accompanies it.

- **PREPA will present written notification to the EQB on the initiation of activities.** Such notice shall be not later than five (5) business days following the commencement of any activity defined in the CES Plan.

- **In those areas where steep gradients are encountered, slope stabilization (terraces) will be utilized** to reduce runoff velocity and minimize erosion. Geotextiles will also be installed in these areas to prevent rain or wind erosion.

- **Sediment traps** will be installed at points of discharge throughout the construction site to contain runoff. These traps will incorporate a catchment area with rocks of different sizes placed to control the discharge velocity of runoff.

- **Silt fence** will be installed along with rectangular hay bales along the perimeter of the 100-foot construction easement to contain any sediment and avoid transport to adjacent areas.

- **Hay bales** will be used to protect existing storm drains in impervious surfaces, where applicable, and will be kept in good conditions.

Another secondary impact would be effects to water quality from leakage of oils and other fluids from machinery. Although the possibility of groundwater contamination is considered remote, oil and fuel spills that are not addressed promptly could contaminate the water. To avoid this possibility, PREPA will implement a Spill Control Plan Environmental Coordinator project. This Plan will be prepared following the guidelines of the Code of Regulations Federal Regulations, Title 40, Protection of the Environment, Part 112, Oil Pollution Prevention. The plan will be submitted to EPA and the Environmental Quality Board (EQB) for evaluation. Each Operations Center will have a copy of the Plan. The Environmental Coordinator will provide briefings at each Center.

During construction, the resident engineer will be responsible for ensuring implementation of control measures in coordination with Environmental Coordinator. PREPA will do everything possible to ensure no vehicles are allowed to leak oil or other liquids that may affect water quality. If a vehicle develops leaks during the work, spill kits will be used to collect any leaks and the vehicle will be removed.

Secondary (temporal) impacts will also be mitigated by reducing construction time. PREPA will apply standards that require surface crossings of water bodies less than 10 feet wide to be completed in 24 hours or less. Water bodies of 10-100 feet wide will be crossed in 48 hours or less. These crossing will use one of the three "open" cut methods outlined in Appendix F of the Joint Permit Application. After installation of the pipeline, topographic contours will be returned to conditions that existed prior to construction to avoid affecting the hydrology and natural cycles or patterns of movement of water in the surface streams or ditches.

Finally, to reduce any secondary impacts to air quality water trucks will be used to spray the areas of construction. This includes the construction easement, any mounds of soil and all Centers of Operations. This will keep soil moist and minimize the amount of dust that might be dispersed. In addition, haul trucks will be required to use tarps to prevent dust emissions during transport of material on roadways. The tarps will be in good condition and shall properly tied to prevent loosening and the wind from moving it.

In addition to the information provided above, the translation of Chapter #6 of the State Environmental Impact Statement that covers impacts minimization has been included as Attachment #1.

Alternatives Analysis:

PREPA recently completed an extended Alternative Analysis aimed to address EPA concerns and guidelines as presented on December 22, 2010 letter. Attachment # 2 includes said Alternative Analysis.

Alternative Fuels:

Attachment # 3 included a translation of Chapter # 4 of the State Environmental Impact Statement that covers the subject mentioned above.

Compensatory Mitigation:

In our previous letter we explained why an extensive compensatory mitigation plan was not submitted up front with the permit application. Since there will be no permanent fill of waters of the U.S., and secondary impacts to these same wetlands is expected to be minimal due to the size of the pipe and its method of placement, **temporal impacts to the aquatic resource is the remaining impact that may require compensation.**

PREPA is prepared to immediately work with the Corps to identify an appropriate goal for aquatic resource "lift" to offset temporal "loss". In terms of location, mitigation could be two types: 1) in situ enhancement or creation and, 2) land acquisition, preferably adjacent and identical or similar in ecological value. PREPA is ready to propose mitigation "on site", since it is difficult to get land with the characteristics necessary for successful mitigation.

As discussed at the PDT meeting on February 1, 2011, as the pipe is put in place the contractor will move forward and "walk" the construction along the corridor. As the pipeline trench is backfilled with the wetland hydric soil and topsoil, the wetland will be returned to its preconstruction topography. The vegetation in the areas of wetlands to be impacted with open trench will be allowed to immediately restore naturally. In wetlands that are active agricultural areas, landowners will be allowed to continue planting crops that do not have deep roots. In the rest of the project corridor, i.e. uplands, reforestation will occur naturally or through mitigation plans coordinated with Department of Natural and Environmental Resources (DNER), except for the growth of deep-rooted trees within the 50 foot construction easement (25 feet on either side of the pipe whenever possible.) A mitigation plan to include reforestation at a rate of 3:1 for trees to be removed is already required by the DNER and has been agreed to by PREPA. This mitigation plan will provide habitat compensation by acquiring land, reforestation of public areas or any combination the DNER deems necessary.

One mitigation opportunity PREPA is prepared to execute exists at the herbaceous Caño Tiburones wetland reserve, which has been significantly impacted by agricultural activities in the past. The dominating herbaceous species in this wetland is cattail (*Typha domingensis*), identified as an unwanted invasive species by federal agencies.

The method of installing the pipeline in this areas will allow replacing the cattail vegetation that existed before the construction with a desirable aquatic species.

Cultural Resource Concerns:

Efforts are being undertaken by PREPA to complete the translation of the Archaeological Study 1A as requested by the USACE during the meeting held on February 1, 2011. Translation efforts are around 70% complete and final document will be presented before the USACE in the forthcoming week.

In the mean time, PREPA's consultants periodically meet with State Historic and Preservation Office (SHPO) in an effort to secure all data available to ensure that all data has been included in the efforts being undertaken by our consultants. In a meeting held at SHPO on February 23, 2011, an agreement was reached to have additional meetings between PREPA's consultants and SHPO personnel to discuss the progress being made in the implementation of the Phase 1B study initiated during the month of January 2011. These meetings will be also geared to address any particular information concerns that needed to be addressed as part of the consultation process performed by the USACE.

HDD Crossing Information:

At the PDT meeting the Corps, US Fish and Wildlife Service and National Marine Fisheries Service requested information on the proposed HDD crossing locations to include length of each crossing and depth the pipe would be placed at beneath the waterway being crossed. The following information is provided for the HDD crossing sites still proposed (due to site limitations three previous sites will no longer utilize the HDD construction method):

Number	Waterway	"C" No.	Length of HDD Crossing Entry to Exit	Depth of Pipe Under Waterway
1	Matilde River	C1	1,417 ft	-50 ft
2	Unnamed Canal	C3	1,100 ft	-58 ft
3	Rio Tallaboa	C5	1,298 ft	-58 ft
4	Grande de Arecibo	C34	1,185 ft	-40 ft
5	Grande de Arecibo	C36	1,850 ft	-60 ft
6	Grande de Arecibo	C37	1,200 ft	-45 ft
7	Rio Tanama	C39	1,360 ft	-65 ft
8	Grande de Arecibo	C43	1,838 ft	-55 ft
9	Rio Manati	C66	1,230 ft	-40 ft
10	Rio Manati	C72	1,200 ft	-48 ft
11	Rio Manati	C73	1,910 ft	-40 ft
12	Rio Indio	C74	1,387 ft	-41 ft
13	Rio Indio	C75	1,150 ft	-47 ft
14	Rio Indio	C79	1,145 ft	-40 ft
15	Rio de la Plata	C83	1,600 ft	-48 ft
16	Mangrove Slough	C90	1,300 ft	-50 ft
17	Rio Cocal mangroves	C93	4,531 ft	-55 ft
18	Uplands at Punta Salina	NA	3,588 ft	-50 ft

19	Shoreline at Levittown	NA	4,495 ft	-55 ft
20	Shoreline at Levittown	NA	3,782 ft	-55 ft
21	Rio Hondo/Rio Bayamon	C95	1,831 ft	-80 ft

*NOTE: The "C" numbers show the crossing location as identified in Table 5 in the Joint Permit Application (JPA) and on the Impact Maps in Appendix B of the JPA

The pipe depth at each HDD crossing (none less than 40 feet) **will ensure no channel bed erosion will affect the pipe (and vice versa).** This technology will enable a "dry crossing" well below the river bed. These sections of the project will be built so the drilling begins at a safe distance from a waterway channel and extends below the bed at an appropriate depth, which was determined by subsurface exploration with geotechnical borings. In addition to the eighteen waterway crossings, three locations (18-20) are proposed to minimize the potential for liquefaction and coastal erosion. At these locations the pipe will be installed by HDD at depths of 50 feet or more, which protect the pipe from the action of the waves. For this reason, no impact will occur to the dunes and the coastline at Levittown.

Another approach aimed to reduce and minimize impact associated with the HDD are the use of temporary construction workpads. For these workpads, a 200 X 200 foot area will be used on both sides of the body of water at the entry and exit points of the pipeline. Once the HDD crossing is completed, these workpads will be immediately removed and preconstruction site conditions restored. At 14 of the 18 HDD waterway crossing locations the temporary workpads will be located in Palustrine Wetlands (previously disturbed by ranching or framing activities). None of the workpads are located in forested wetland habitat. More detailed information on these workpads will be provided soon.

As indicated previously, PREPA is committed to address any and all concerns presented by the US Army Corps of Engineers (USACE). In the event additional information related with the Joint Permit Application is needed by the Corps, please do not hesitate to contact us at 503-781-7930 at your earliest convenience.

Cordially Yours,

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cc. Mr. Osvaldo Collazo (CoE)
Eng. Francisco E. López (PREPA)
Via Verde Project File

Chapter 4. STUDY OF ALTERNATIVES AND SELECTION OF THE ALIGNMENT

The different alternatives evaluated for the execution of this project are discussed in this chapter. Among said alternatives the construction of a liquefied natural gas receiving terminal in the north of the island, the installation of tankers and buoys systems for the receipt, storage and regasification of liquefied natural gas and several terrestrial alignments for a natural gas pipeline were considered. Also analyzed were the alternative of using renewable energy sources technically available in the commercial sphere and the No Action alternative.

4.1 No Action

The No Action alternative, although considered, was found to be unfeasible due to the transcendence, importance and public well-being pursued by the project.

In Chapter 6, Impacts and Mitigation, of this Preliminary Environmental Impact Statement (DIA-P), the direct and indirect impacts associated to the construction of the natural gas pipeline are considered. If the project is not constructed, the following impacts are averted:

- The impact of the movement of earth which can produce soil erosion and sedimentation of bodies of water
- Temporary increase in noise levels
- Limited impact to forest reserves
- Temporary impact to wetlands, mangroves and other surface water bodies
- Temporary impact to agricultural land
- Temporary impact to water, highways and (possibly) telephone infrastructure
- Temporary traffic increase and readjustment
- Potential impact to archaeological sites
- Acquisition of land by expropriation

Most of these impacts, in case the selected alternative is constructed, although they cannot be avoided due to the project's construction specifications, can be minimized and mitigated with engineering measures and sedimentation and erosion control measures, supervision and the support of agencies and municipalities, among other measures.

No Action is not indicative of no impact, because faced with the No Action alternative PREPA will have to continue the production of electric energy by burning petroleum products that generate a greater amount of air polluting emissions. The use of natural gas represents a significant reduction in the criteria pollutant emissions and others such as carbon dioxide. This reduction of emissions, acquires greater importance if we consider that the new regulation of the Environmental Protection Agency (EPA), which

will become effective in 2020, requires an additional and compulsory reduction in the quantity of emissions of certain air pollutants. To achieve said reduction, PREPA would be forced to install emission control equipment, such as Electrostatic Precipitators (ESP) or Multiple Bag Collectors (Baghouses for the removal of particulate matter), catalytic converters (for the removal of nitrogen oxide, NOx), and Scrubbers (for the removal of sulphur dioxide, SO_2). This kind of equipment is very costly, which would require a great capital investment, and would result in an increase in the cost of the kilowatt/hour. In addition, this kind of equipment requires a lot of space, which would represent a difficulty to PREPA, because some of our power plants do not have the space necessary for its installation. The conversion of our units to use natural gas will have the impact of reducing emissions to the levels required by this new regulation, without the need to install this equipment, which requires an estimated capital investment cost of $200 million dollars, and at the same time providing a more economical fuel for the generation of electricity.

In addition, it is emphasized that the maintenance related to units that burn petroleum derivatives must be made frequently and with higher costs to insure the optimal functioning of the same. Continuing to burn petroleum derivatives has other implications, such as a greater frequency of deliveries of said fuels in our ports, which increases the erosion of the seabed and the probability of spills. The continued use of petroleum-derived fuels increases the cost of the electric energy service, which in its stead impacts negatively the Puerto Rican economy and results in a lower quality of life for its citizens. Of no less importance is the fact that the use of these fuels exposes PREPA to market value fluctuations, which creates instability in energy production costs and in the electric bills. All of the above, together with the impact of the new federal environmental regulations projected for 2020, force PREPA to establish a definite strategy to avoid a dislocation of the electrical system as a result of the installation of additional control equipment required by the EPA.

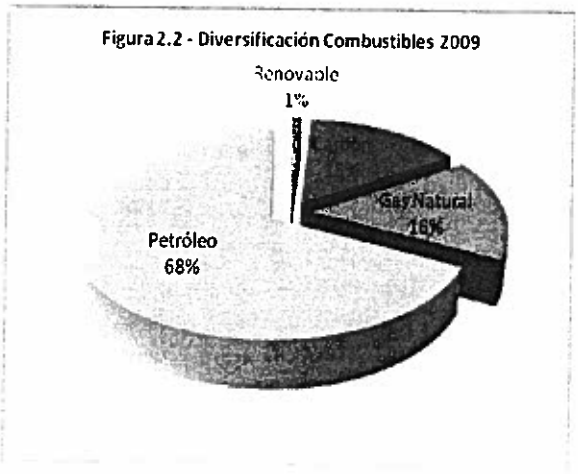
Recognizing that the Puerto Rican economy is directly related to the stability of PREPA, it is important for the company to comply with its strategic development plans and maintain a fixed cost structure that avoids sudden peak variations in the cost of the fuel purchased. Complying with these plans attests PREPA's vision, stability and commitment to its clients. In addition, it demonstrates the company's ability to evaluate complex global situations and develop strategies to diminish their impact, which facilitates broadening the fuel use options in the future.

After evaluating the local and global dynamic, PREPA developed a Strategic Corporate Plan 2009-2012. This Plan includes the following parameters, among others:

- Adding alternative energy sources to reduce the cost of fuel
- Protecting the environment
- Collaborating with all efforts to improve the quality of life in the Puerto Rican society

The construction of Via Verde is the largest fuel diversification project PREPA will be able to make in these times. This diversification guides PREPA to establish the actions required to comply with the new federal environmental regulations in a structured manner. Together with the above, there are important environmental considerations that will help PREPA to manage its energy costs effectively.

As shown in Figure 4.1, Puerto Rico depends on petroleum in a significant percent. At this moment, PREPA uses only No. 2 fuel oil (light distillate) and No. 6 (Bunker C) in its generating units and, at the same time, purchases the electricity produced in the AES co-generator in the Municipality of Guayama (coal) and EcoEléctica in the Municipality of Peñuelas (natural gas). With the introduction of the co-generators, we began to purchase electricity generated without the use of petroleum, but internally, PREPA still depends exclusively on it.



PREPA's goal is to reduce its dependence on the use of petroleum, which at present is 68%, approximately, for which reason the plan is to reduce it to close to 12% by 2014. For this, PREPA has to take action and identify alternative fuels that can supply the capacity its clients demand. Lack of action would only worsen the dependence on petroleum, and in times of embargo or high world demand, our island would not have viable alternatives to generate electricity. In addition, the No Action alternative leaves a latent impression that PREPA is affected by sudden changes in the cost of petroleum, which diminishes the agency's economic capacity and, in consequence, Puerto Rico's economy.

It is important to underscore that PREPA is limited by federal and state permits on the type of fuel it can burn in its units. The greater limitation is in the percentage of sulfur the fuel contains. This fuel is more expensive than fuel with higher sulfur percentages. If there is a scarcity of this type of fuel or if it is not possible to enter into purchase contracts with the suppliers, PREPA has two options: to cease generating electricity, which is not viable, or burn a cheaper fuel with a higher sulfur percentage than that established in the environmental permits and be exposed to fines and sanctions from the regulatory agencies.

The use of natural gas significantly reduces the atmospheric emissions of pollutants to the environment. No Action means that PREPA will maintain an investment of capital to reduce its emissions from petroleum, and will provide maintenance to its units instead of using that capital to develop a more efficient system that uses a cleaner fuel.

4.2. Liquefied Natural Gas Receiving Terminal in the San Juan Power Station

There are millions of miles of pipelines to transport natural gas throughout the world and over 1,500,00 of these are in the United States. This Nation has eight liquefied natural gas receiving terminals servicing it. Puerto Rico has one of these importation terminals, the EcoEléctrica Co-generator in the Municipality of Peñuelas, which has the capacity to supply our needs. Even so, the alternative of constructing an importation terminal near one of our installations with the purpose of eliminating part of the environmental impact associated with the construction of trenches for the natural gas pipelines was considered. Among the three power plants in the North area where the use of natural gas to generate electricity is contemplated, the San Juan Steam Plant (SJSP) was selected because it is the only one next to an existing fossil fuel receiving dock (see: Figure 4.2, San Juan Thermoelectric Power Plant). The dock has the infrastructure to transport diesel and Bunker C to two power plants, San Juan and Palo Seco. The other power plants don't have appropriate infrastructure next to the power plant.

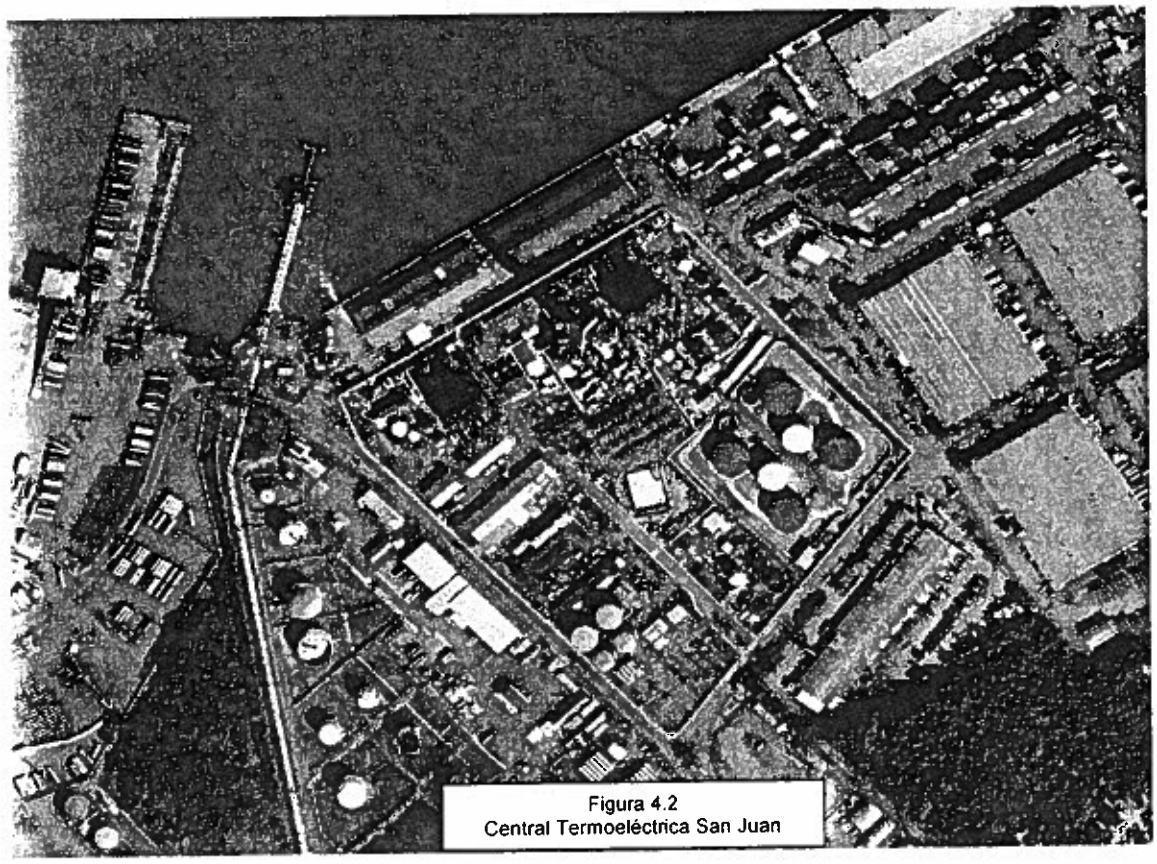


Figura 4.2
Central Termoeléctrica San Juan

When we use by way of example the importation terminal existing in Puerto Rico, the

terminal to be constructed must possess the capacity to receive, unload and store an approximate maximum amount of 160,000 cubic meters of liquid natural gas imported over the high seas; in addition to installations to gasify and handle the same. The construction of such terminal would imply an environmental impact associated with the different stages of the construction and operation of the same, among which would be included:

- Constructing, repairing or expanding, as the case may be, a dock for the receipt of liquid natural gas.
- Increase in the traffic of ships, which has an impact on the ships that supply us with the products we import, as well as on the tourism cruisers that use San Juan Bay regularly.
- Construction of a storage tank for liquid natural gas and a gasification plant. This would occupy an area of approximately 25 acres, in addition to an exclusion zone in accordance with the regulations in effect.
- Conditioning the navigation channels to support the transit of tankers, which would imply dredging and disposing of the dredged material.

The selection of a place for the construction of a natural gas receiving and regasification terminal requires the existence of deep ports to minimize the environmental impact associated with the development and operation of such terminal and the existence of areas of low population density suitable for an industrial development.

Three criteria were used to determine whether constructing an importation terminal near our installation was a viable alternative: location-specific factors, maritime operations and environmental issues.

- Location-specific factors
  - Availability of the land area: the location must have sufficient space available to accommodate the proposed installation and all the safety components required by the regulations of the Federal Department of Transportation (49 CFR Part 193), the United States Coast Guard (33 CFR Part 127) and the National Fire Protection Association (NFPA, NFPA 59A); in addition it must comply with the regulatory distance between the gasification plant and the liquid natural gas storage tank. The land facilities would occupy an area of approximately 25 acres (101,173 m^3). They would include, among other components: a double containment tank 167 feet tall and 269 feet in diameter, with a storage capacity of 1,000,000 barrels (160,000 cubic meters) of liquid natural gas at a temperature of -260°F and pressure of 2.0 psig; vaporization or gasification systems to

gasify the liquid natural gas so it can be transported to the turbines in the power plants. Other factors to consider associated with the location are the activities, external and adjacent to the terminal, and the distance or separation the terminal must observe to these areas of activity and to densely populated areas (49 CFR Parts 193.2055, 193.2057 and 193.2059).

- Availability of coastal area: the location must have available an area of maritime dock with anchoring facilities for tankers 950 feet long, 140,000 cubic meters capacity and minimum draft of 40 feet. The criteria used to evaluate whether a port or dock has the capacity for this type of project are the depth of the navigation channels (over 40 feet), the extension of the obstacle clearance height (greater than 180 feet) and its proximity to the liquid natural gas storage and gasification terminal. The dock must be approximately 30 feet wide by 1,700 feet long and possess, among others, equipment to secure the tanker to the dock, a two-level platform at the end, 40 feet wide by 100 feet long in the lower level and 20 feet wide by 76 feet long on the upper level, and a spill collection basin in case of emergencies.

- Dredged material disposal site: an area must be located for the disposal of the material to be dredged to create an appropriate navigational channel that will permit an increase in maritime traffic and the receipt of tankers with liquid natural gas and to dispose of the material generated by the routine maintenance dredging required for the appropriate flow of ships.

- Infrastructure: the importation terminal will require an adequate infrastructure that includes a reliable source of energy and appropriate highways or roads, especially for emergency response; as well as an access for tankers for the receipt of construction materials.

• Maritime operations

- Increase in the traffic of ships: the transit of tanker ships is subject to more restrictive federal regulations than general maritime traffic, which could influence the traffic of other ships and increase the risk of affecting other users of the navigation channel.

- Access to the navigation channel: the sooner a tanker can arrive at the terminal, unload, and return to sea, the better the economy of the area will be. In addition, a shorter channel would diminish the effect in traffic for other ships due to the maritime traffic restrictions on tanker ships. This is achieved with the availability of a navigation channel next to the storage and gasification terminal and with sufficient depth, width and obstacle

clearance height for the operation of a typical tanker ship, which would be in the rank of 950 feet long by 150 feet wide and which would require a minimum depth of 40 feet in the navigation channel and an obstacle clearance height of 180 feet.

- Turning area (amplitude and proximity): a typical liquefied natural gas tanker ship would require a turning basin with a minimum diameter of 1,200 feet and a depth greater than 40 feet.

- Environmental issues

  - Environmental consequences: minimize the environmental impact by using sites within a previously impacted area, including the site for the dock and areas zoned for that use.

  - Compatibility with regional plans: the location must be compatible with the future development of the adjacent properties.

  - Zoning and land use: one of the goals of the project is to avoid or minimize adverse impacts on the environment due to development. The site must be located within an area zoned for industrial development to help confine any environmental impact in previously industrialized areas.

  - Distance to populated areas: the location would be catalogued depending on its distance from populated areas or residences. Avoiding populated areas will help towards ensuring compliance with the location criteria of the DOT (49 CFR 193.2055, 193.2057 and 193.2059), which regulates in regard to the establishment of an exclusion zone, or an area where a terminal cannot be constructed due to population density. Respect for the distance established in this exclusion zone minimizes the negative public perception of safety issues normally associated with liquid natural gas terminals.

The tanker ships commonly used to transport liquid natural gas have a capacity ranging from 125,000 m^3 to 140,000 m^3. The longer ships range from 950 to 1,000 feet in length, with a typical draft of 38 to 40 feet. To insure that liquid natural gas tanker ships don't run aground easily or frequently, an additional depth of 2 feet under keel clearance is required. This implies that tanker ships require a maritime access and a docking and turning basin area in bodies of water with depths of more than 40 feet.

The SJ consists of 32.85 acres (132,941 m^3). It receives fossil fuel from the dock located to the west of it, in the San Juan port zone. Said dock is located on the Puerto Nuevo navigation channel, east of the Army Terminal dock (see Figures 4.2 and 4.3). This maritime area was prepared for the navigation of fuel vessels, among others. Currently, the tankers that service PREPA unload the fuel at the dock on the Puerto

Nuevo navigation channel.

According to the bathymetric charts, the anchorage area for the tankers that serve PREPA has a depth of little more than 30 feet. The maximum depth of the Army Terminal turning basin is, in just one point, of 40 feet, fluctuating mostly between 35 and 37 feet. This basin connects with the Army Terminal channel which is the one that reaches the Anegado Channel. This last one joins the channel that serves as the entrance for every ocean-going vessel to the San Juan bay, the Bay Channel (see Figures 4.3 and 4.4).

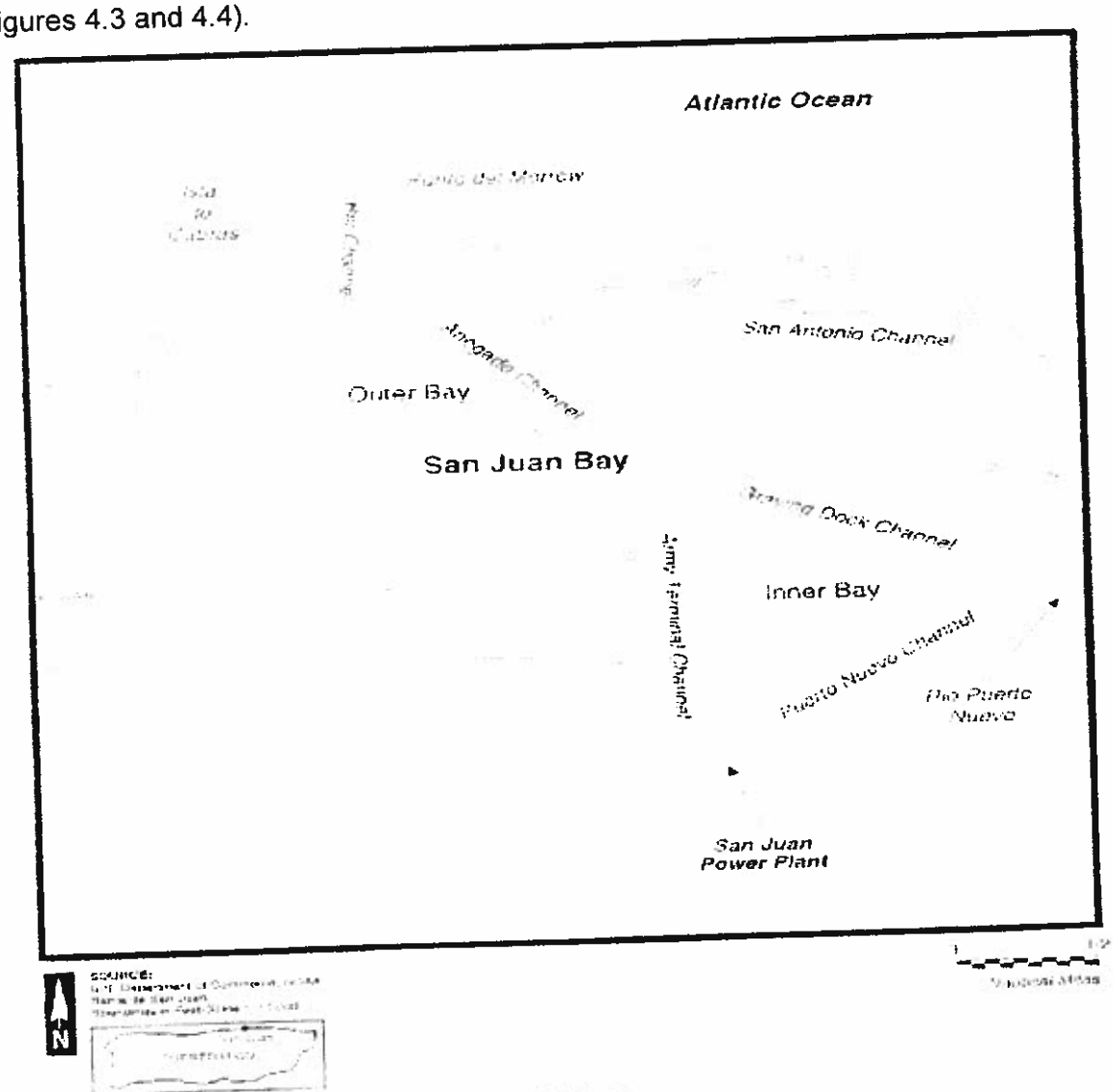
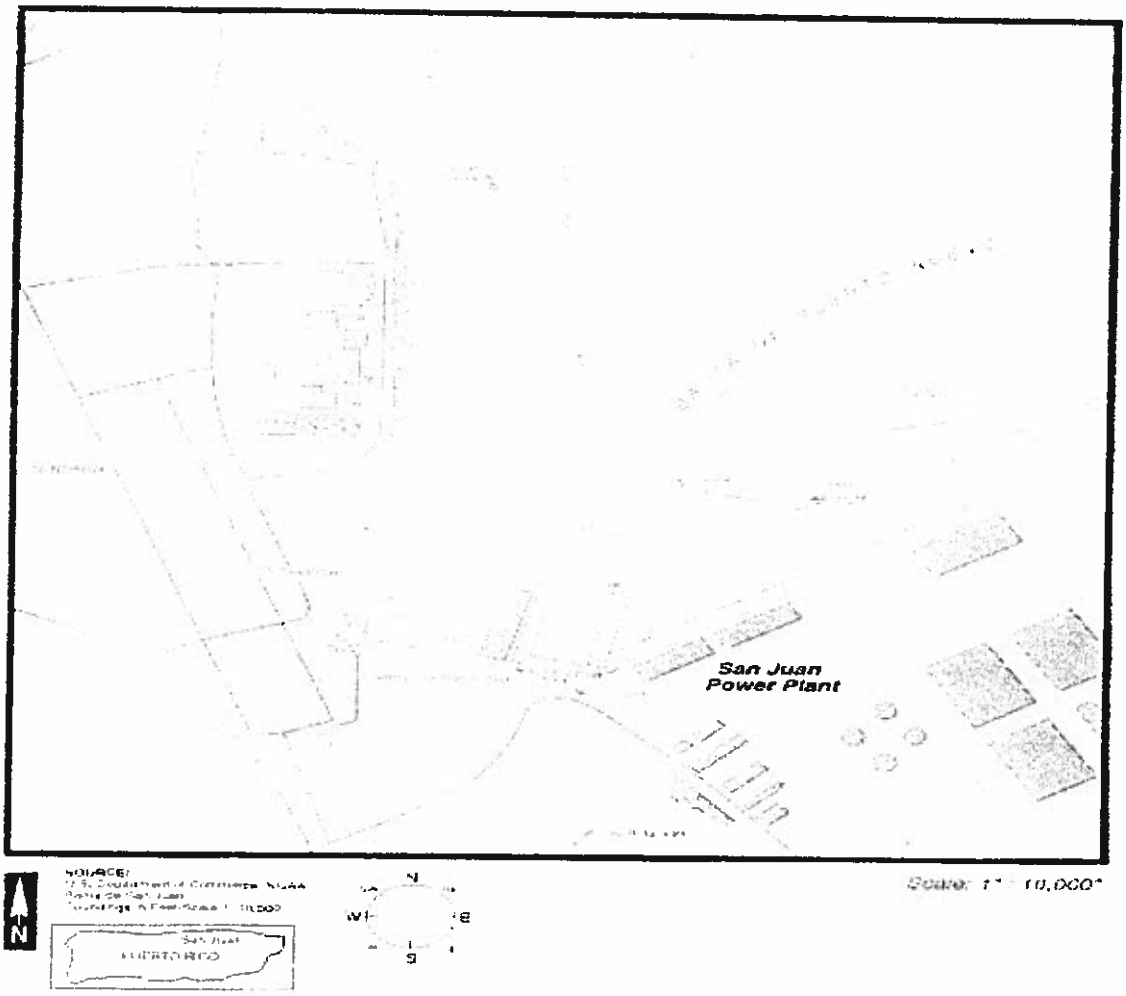


FIGURE 4.3
Approximate Location of San Juan Power Plant
and San Juan Bay Shipping Channels



Bathymetry of Bahia de P[illegible] FIGURE 4.1 [illegible] San Juan Power Plant

To prepare the maritime area to receive tanker ships, the navigation channels and the existing turning basin would have to be dredged to reach a depth of 40 feet and for the navigation channels to reach a minimum width of 300 feet. The disposal of this dredged material would present the problem of finding an adequate site for its disposal in a way that would not represent a harmful impact on the environment. At present, Puerto Rico does not have land sites with the capacity to receive or process the amount of material that would be generated during dredging of such magnitude. Historically, it has been demonstrated that the majority of land sites for disposal of dredged material are not appropriate for industrial or commercial development, which would disable the area for future uses and development.

The disposal of the dredged material would have to be offshore, in an ocean disposal site. This presents several inconveniences. The area would have to be sufficiently large so the amount of material to be disposed of does not have an adverse impact on the area's benthic community or the impact is minimal. In addition, it should have the capacity to receive material from the routine maintenance dredging necessary to avoid interrupting the continuous flow of receipt of liquid natural gas. The initial effect of the disposal operations would be a high concentration of sediments near the surface (due to the suspended sediments). Carried by the ocean currents, this material would not necessarily reach the bottom of the ocean disposal site, for which reason the benthic area impacted would be larger than the estimated. It is underscored that the use of this disposal option is highly limited, because at present there isn't an approved ocean dumping area near the San Juan bay.

The dredging operations would produce a degradation of water quality due to the fine suspended sediments, since the dredging activities would take months. The turbidity plume would affect daily during working hours and up to two hours after the same, before the sedimentation of suspended material. This would affect the water quality and, consequently, the parameters of water quality required in the environmental permits which govern the SJSP, especially the turbidity, sedimentation and suspended solids.

The docks and ports of San Juan Bay receive annually 80% of the products imported into Puerto Rico and they play a crucial part in the export process of all kinds of products. The Port of San Juan Bay is number 17 by size in the world. Over 1.3 million tourists visit in cruise ships. It receives an average of 700 cruise ships annually. Over one thousand fishermen use the system every year, with an average catch of 350,000 pounds of fresh fish.[1] All the maritime traffic in the bay uses the Bay and Anegado common channels. In addition, the majority of the imported goods cargos that arrive in this bay, arrive at the Army Terminal dock, so they use the channel to reach that dock. It is estimated that a liquid natural gas importation terminal would increase maritime traffic in the San Juan Bay area at the rate of 25 to 60 crossings yearly, depending on the size of the liquid natural gas tankers used. The tankers would have to use these three channels until they reach the discharge point of the liquid natural gas in the dock of the Puerto Nuevo Channel. This represents an increase in maritime traffic that would affect our economy and tourism disproportionally, for diverse reasons. Among these reasons are: the high security restrictions on maritime traffic, which preclude other users from using the navigation channels or the dock simultaneously with the tanker ships.

The San Juan Bay Estuary (EBSJ) is composed of several bodies of water. Of these, one of the most important is the San Juan Bay. The EBSJ offers food and shelter to: 8 animal and 17 plant species in danger of extinction such as the West Indian Manatee

[1] http://www.estuario.org/

(Trichechus manatus) and several species of marine turtles, among them the hawksbill turtle *(Eretmochelys imbricata)* and the leatherback turtle *(Dermochelys coriacea)*; 160 species of bird, such as the brown pelican *(Pelecanus occidentalis)* and the great egret *(Egretta alba egretta)*; 19 species of reptiles and amphibians, such as the coqui frog (*Eleutherodactylus coqui*) and the Puerto Rican boa *(Epicrates inornatus)*; 124 species of fish, such as the tarpon *(Megalops atlanticus)* and the snook *(Centropomus undecimalis)*; 300 species of wetland plants. The estuarine system sustains resident and migratory species and also external species that exit through one of the system's three outlets to the ocean.[2]

The body of water nearest to the SJSP is the Puerto Nuevo Bay, which is part of the San Juan Bay. An area of microalgae exists near the turning basin for vessels in the Army Terminal dock. The existence at that location of mats of *Gracilaria Sp.*, and, in lesser quantities, of *Enteromorpha sp.*, were reported. Associated with these microalgae, the presence of an abundant population of invertebrates was reported, among which are: tube worm *(Onuphia sp.)*, blue crab *(Callinectes sp.)* and some classes of bivalves (*Corbula contracta* and *Diplodonta semiaspera*). There is no evidence of coral reefs in the SJSP area.

The area of the Constitution Bridge and the entrance to the Martin Peña Canal, which are part of the EBSJ, were designated as costal Critical Wildlife Areas. The same are near the shores of the SJSP. However, there is no mangrove growth in the vicinity of the power plant.

Among the mega invertebrates are: *Callinectes sp.*, *Micropanope sp.*, and the pink shrimp (*Pemaeus duorarum*). Although no fish studies have been conducted in the vicinity of the SJSP, it is reasonable to expect that the same are those found in the San Juan Bay. Among the fish found in this bay are: tarpon (*Megalops atlantica*), guppy (*Lebistes reticulatus*), *Lepomis macrochirus*, *Elops saurus*, *Eleotris pisonis* and *Ictalurus punctatus*. No species of vertebrate wildlife, protected or endangered, are perceived near the SJSP.

However, in studies that cover the coastline from Punta Las Marías to Punta Boca Juana (the mouth of the La Plata River), which includes the San Juan Bay (see Figure 4.5), threatened and endangered species were seen, such as: green turtle *(Chelonia mydas)*, hawksbill turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*), West Indian Manatee *(Trichechus manatus)*, the brown pelican (Pelecanus occidentalis) -recently removed from the endangered species list- and an as yet unidentified school of dolphins. These turtles and manatees were not seen in the lagoons, canals or the bays that were in the study area or near the SJSP, although the brown pelican was seen near this power plant.[3]

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[2] http://www.estuario.org/

[3] Section 316(a) and (b), Demonstration, San Juan Power Plant; ENSR; July,

FIGURA 4.5
Área de Estudio

It is anticipated that an importation terminal, in combination with the existing SJSP system, will cause an impact on the water temperature in the Puerto Nuevo Bay, the body receiving the cooling and discharge waters of the power plant. The temperature of the discharged waters of the importation terminal would exceed the water's ambient temperatures, especially during the winter and spring months. This would produce a warming of the waters adjacent to the discharge structure during these months.

In addition, the extraction of marine water for the importation terminal's cooling system, added to the present extraction of the SJSP, would have a cumulative effect on the benthic community of the Puerto Nuevo Bay and, in consequence, the San Juan Bay, especially on the community of microalgae. It is to be expected that a loss of these would have an impact on the local populations of invertebrates and fish, added to the impact that the already mentioned turbidity and sedimentation associated with dredging would have on these species. Also, the rise in the discharge temperature would affect water quality and, consequently, the water quality parameters required in the environmental permits which govern the SJSP, specifically temperature.

The installation of the components of an importation terminal in the SJSP area would occupy a surface area of 25 acres, approximately. The SJSP covers 32.85 acres and does not have any free space (see Figure 4.1). The space is totally occupied by its diverse systems, among which are included: generating units, service and fuel reserve tanks, plants to demineralize and treat water, water storage tanks, cooling towers, buildings for warehouses, offices and laboratories. An importation terminal must comply with the regulations that regulate, among other things, the spaces that must be kept between the different elements inside the terminal (such as the distance between the liquid natural gas storage tank and the vaporizers) and the space that must be kept between the terminal itself and populated areas (exclusion zone). This, in compliance

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1997.

with regulations 49 CFR 193, 33 CFR 127 and NFPA 59A. Locating the different elements of the importation terminal in the areas around the SJSP, outside of it, would not comply with these standards, not only because of how distant they would be from each other, but also because there isn't enough free and available space in the surroundings. Also the exclusion zone required by regulations would be unavailable, because the SJSP is located in one of the most densely populated areas of Puerto Rico.

The alternative of constructing an importation terminal in or near the SJSP is not a viable one to comply with the purpose of eliminating the environmental impact associated with the construction of trenches for the natural gas pipeline. Even if the construction of the importation terminal were to materialize, it would be necessary to carry natural gas to the other power plants in the north area, Palo Seco and Cambalache. This would have to be by the construction and installation of a pipeline to transport natural gas. The construction, installation and operation of said terminal does not exclude the environmental impact the construction and installation of a pipeline to transport natural gas would bring.

In addition to the environmental factors, costs and space limitations for the construction of an importation terminal in or near the SJSP, we have to consider that the process of construction and operation of a natural gas importation terminal is complex. Obtaining the permits and endorsements for the same are regulated by the Federal Energy Regulatory Commission (FERC). Taking by comparison the importation terminal existing in Puerto Rico, EcoEléctrica, the process of studies and permits together with the construction and beginning of operations can take between 6 and 7 years. The previously featured data of the time to obtain the permits and the construction of these facilities are supported by information obtained from projects recently developed in the United States, which are described in the table illustrated below:

Evaluated Area	Information Collection Time	Permits Approval Time	Construction Time	Average Total Time
Gulf	1 year	1.5 years	3 years	5.5 years
East	1 year	2-3 years	3 years	6 to 7 years
West	1 year	2-3 years	3 years	6 to 7 years

Through this observation, PREPA doesn't pretend to circumvent the permit processes before the federal agencies. The purpose of evaluating the times it takes to establish this type of project is to identify an option that could respond to the energy infrastructure crisis in an opportune and diligent manner.

This reality would turn the alternative of constructing an importation terminal into a

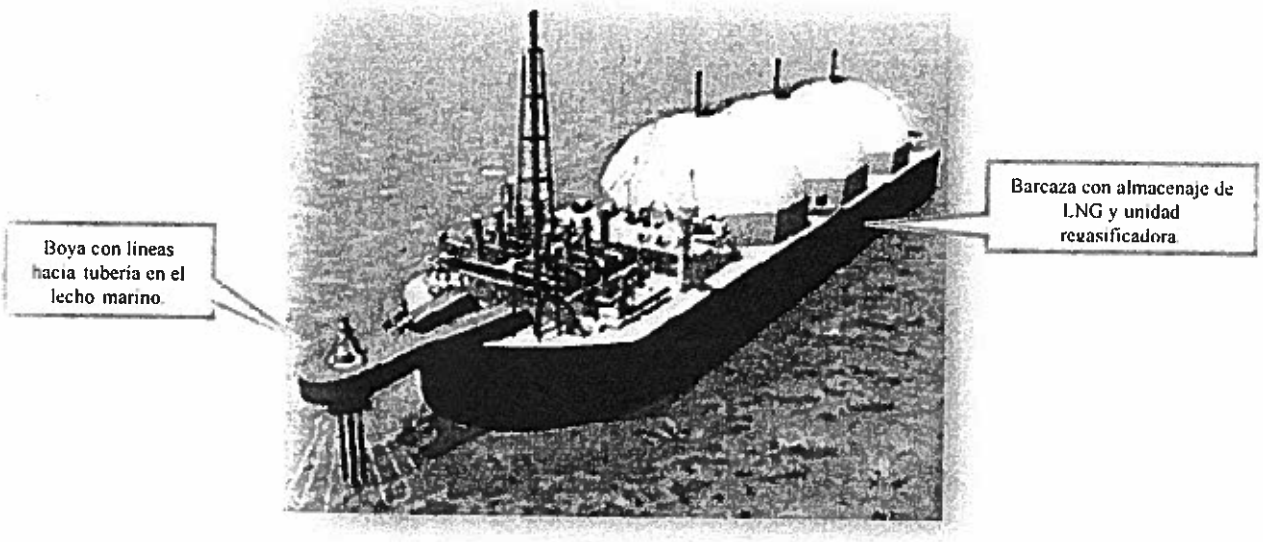
medium-term project, which would not satisfy our need for an immediate project to bring about the transition from petroleum to renewable sources of energy. The construction cost of the existing terminal was over $570 million in 1995 dollars. When we consider the cost of the present dollar and add the cost, as we indicated before, of the construction of a pipeline to transport natural gas which would connect the power plants of the north of the island, the project would be too onerous because it would surpass a billion dollars. Being a project of the Government of Puerto Rico, it would have to be financed through bond issues, which limits the savings in the electric energy bills.

The construction of an importation terminal inside or near the grounds of the SJSP as an alternative is not viable when the physical situation of the area is compared with the physical conditions required by this type of terminal. In addition, the environmental consequences in the area would be adverse and above all the time required to complete the approval of permits, as well as the construction time, would not permit a response to the energy infrastructure crisis in the least possible time. When the evaluation criteria were applied to this project, together with the previously described data, deficiencies were found that make it little or not viable at all. Although there is a maritime dock area, as opposed to the other power plants in the north area, it does not comply with the depth requirements or with the capacity for the anchorage of tanker ships of this kind. Were this alternative to materialize, there is no area for the disposal of dredged material and the dredging activity would be adverse to the area's benthic system and it would affect the water quality parameters the SJSP must comply with. Maritime traffic would be highly compromised because there is only one entrance channel to the San Juan Bay (Bay Channel) and the Anegado Channel is the only passageway to the tankers' discharge area. This would greatly affect the local economy, as well as the tourism industry.

4.3 Tankers and Buoys System

PREPA considered the installation and operation of a system of tankers and monobuoy for the receipt, storage, regasification and transport of natural gas to each one of the north area power plants as one of the alternatives to the project.

These systems of tankers and buoy, known as Deepwater Ports, suppose the construction of a receiving terminal for compressed natural gas (CNG) in the vicinity of each one of the power plants. This terminal would receive the gas from a station located some 5 km offshore, in which a tanker bringing the natural gas from its exportation point would anchor and couple. Said tanker would have a regasification unit that would couple to a buoy that holds and keeps afloat the connection lines from the tanker to the pipeline lying on the ocean floor and will transport the compressed gas to the receiving terminal near the power plant. The CNG receiving terminals require a minimum area of 2,500 m^2.



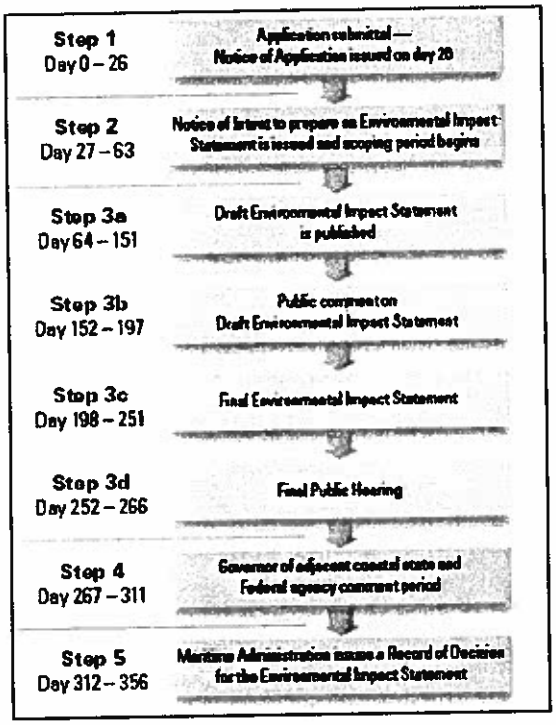
The construction, installation and operation of these tankers and buoys systems are regulated by two leading agencies: the Maritime Administration (MARAD), ascribed to the Federal Department of Transportation, and the US Coast Guard, under their Deepwater Ports Standards division. Other federal agencies with jurisdiction over the construction, installation and operation of these systems are: Advisory Council on Historic Preservation (ACHP), Council on Environmental Quality (CEQ), Department of Energy (DOE), Department of State, Environmental Protection Agency (EPA), Federal Energy Regulatory Commission (FERC), Minerals Management Service (MMS), National Marine Fisheries Service (NMFS), Department of Commerce under its National Oceanographic and Atmospheric Administration (NOAA), Pipeline and Hazardous Material Safety Administration (PHMSA), US Army Corps of Engineers (USACE), US Fish and Wildlife Service (FWS), and the White House Energy Streamlining Task Force. At the state level the agencies with jurisdiction are: Office of the Governor, Department of Natural and Environmental Resources (DRNA), Puerto Rican Culture Institute (ICP), State Historic Preservation Office (SHPO), Ports Authority, Public Service Commission (CSP), Environmental Quality Board (JCA), Urban Planning Board (JPU) and the Electric Power Authority (AEE).

PREPA would request a private company experienced in the matter, to design, construct and operate the tankers and buoy system. This would have an approximate annual cost to PREPA of 70 to 80 million dollars, subject to signing a contract with said company for a term of not less than 20 years. At the end of the 20 years, the total cost would be some 1.6 billion dollars.

The process to obtain the permits for the construction and operation of these systems begins by filing an application with the MARAD. The authority to grant licenses for the construction and operation of the tanker systems which was conferred on the Federal

Secretary of Transportation under the Deepwater Port Act, as amended, was delegated on this office in 2002. The temporary regulation 33 CFR, Parts 148, 149 and 150, which govern the license application process for the construction and operation of these systems, arises under this law.

The license application process starts with a pre-application phase during which the applicant discusses the project with the concerned agencies, both at the state and federal levels. Then the application is filed and a 356-day term is activated within which the MARAD has to issue a Record of Decision (ROD), in accordance with what is set forth in the diagram on the right, taken from MARAD's internet web page.[4]



After the publication of the ROD, the applicant must have its installation completely operational before the MARAD grants the license. This process usually takes from two to four years.

In parallel form to the process before the MARAD, the applicant must comply with the requirements of the National Environmental Policy Act (NEPA), which usually takes some 240 days from the moment in which the application notification is issued. During this 240-day period, other agencies intervene and the Environmental Impact Statement is produced. Also in parallel form the permits and endorsements from the state sphere are procured. The Environmental Impact Statement generated under the NEPA process, as well as the data and studies which supplement the same, can be used also to satisfy the requirements of the state's Environmental Public Policy Act.

Given that the ownership of the system will be in private hands, one of the most important aspects MARAD considers before issuing the required license is the applicant's financial capacity to construct and operate the tankers and buoys system under consideration. Moreover, the private applicant must have the financial capacity to post a bond sufficient to cover the expenses of the complete removal of the system, once the license expires or is revoked.

In addition, the private applicant must prove that the tankers and mono-buoy system is in the national interest and that it is consistent with the federal public policies on national security, energy independence and environmental quality, among others.

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[4] http://www.marad.dot.gov/ (March, 2010)

Neither can the system interfere with international navigation and other reasonable uses of the high seas, as defined in treaties, agreements or in the customary international law. At the state level the authorization of the governor of the state adjacent to the project is required.

The public must be kept informed of the whole process by means of the Federal Register and through the publication of all the related documents in the Federal Docket Management System: www.regulations.gov. In addition, processes under NEPA, as well as the state processes, provide for holding public hearings through which citizen participation is assured, similar to the processes established by the Environmental Quality Board in the applicable regulations (which are designed as what is denominated as a "NEPA- like process").

The environmental impacts of this alternative are similar to those analyzed for the previous alternative. Despite not having to dredge to permit accommodating the great draft of the tankers, a submarine line would have to be built from the buoy to the CNG tank and that would have an impact on an ecologically sensitive area such as the San Juan Bay and its estuary, or in the north coast areas which are considered as critical habitat for five species of coral in danger of extinction, such as the acropora.

PREPA evaluated the viability of the construction of these systems in three areas: San Juan, Toa Baja and Arecibo. The criteria considered in said evaluation were environmental impact, costs, space, time to start operations, permits, security, environmental justice, and past experiences in Puerto Rico and in the United States.

4.3.1 System Analysis for the San Juan Power Plant

The annual rental cost would be some $70 to $80 million dollars. The power plant does not have available space to locate the CNG receiving terminal. It is estimated that the time required to make the system operational, in compliance with all the applicable state and federal legislation, will be between 5 and 8 years. The permit process is complicated and costly, which together with the area's physical limitations, limits keeping this alternative as a viable one to respond to the energy infrastructure crisis. The pipeline on the ocean floor to the area of the San Juan Power Plant would run through an area of intense maritime traffic, which would raise safety and Homeland Security issues, this being a national and international port. There are low-income communities near the project which could be affected, for which reason in an environmental justice analysis the project would probably not be favored. The San Juan Power Plant is in the vicinity of CAPECO where there was an explosion on October 23 of 2009 that affected the nearby communities, which is still very recent in their memories and could support the opposition's position, even if it is an allegation lacking in merit. The project would entail impacts on San Juan Bay and its estuary. For all the reasons set forth above, the construction of the system for the San Juan Power Plant within the time frame required for the action under consideration was discarded. As a consequence, the supply of natural gas to this power plant will have to be

unavoidably through a natural gas pipeline.

4.3.2. System Analysis for the Palo Seco Power Plant in Toa Baja

The annual rental cost would be some $70 to $80 million dollars. The power plant does not have available space to locate the CNG receiving terminal. It is estimated that the time required to make the system operational, in compliance with all the applicable state and federal legislation, will be between 5 and 8 years. The permits process is complicated and costly. In the area of the Palo Seco Power Plant there are low-income communities near the project which could be affected, for which reason in an environmental justice analysis the project would probably not be favored. The Palo Seco Power Plant is in the vicinity of CAPECO where there was an explosion on October 23, 2009 that affected the nearby communities, a situation that is still very recent in their memories and could support the opposition's position, even if it is an allegation lacking in merit. Another aspect which must be taken in consideration during the analysis of this option is the fact that the energy of the Atlantic Ocean is significant, which possibly would require specialized construction techniques for the mono-buoy system in said area. The construction of this alternative would have an environmental impact on the Boca Vieja Bay. For all the reasons set forth above, the construction of the system for the Palo Viejo Power Plant within the time frame required for the action under consideration was discarded. As a consequence, the supply of natural gas to this power plant will have to be unavoidably through a natural gas pipeline.

4.3.3. System Analysis for the Cambalache Power Plant in Arecibo

The annual rental cost would be some $70 to $80 million dollars. The power plant does not have available space to locate the CNG receiving terminal. It is estimated that the time required to make the system operational, in compliance with all the applicable state and federal legislation, would be 5 to 8 years. The permits process is complicated and costly. There are low-income communities near the project that could be affected, for which reason in an environmental justice analysis the project would probably not be favored. Another factor that must be taken in consideration during the analysis of this option is the fact that the energy of the Atlantic Ocean is significant, which would probably require specialized construction techniques for the mono-buoy system in said area. As a point of reference, at present the delivery of fuel to the Cambalache facility owned by PREPA is affected by marine conditions an average of 3 to 4 months a year, this supports the facts and concerns previously expressed. For all the reasons set forth above, the construction of the system for the Cambalache Power Plant within the time frame required for the action under consideration was discarded. As a consequence, the supply of natural gas to this power plant will have to be inevitably through a natural gas pipeline.

4.4 Use of Renewable Energy

The structured integration of renewable energy sources, intermittent in nature, to electrically isolated, low-inertia systems, such as the one in Puerto Rico, requires specialized and scientific studies to evaluate its impact on the levels of stability and reliability of the electric grid. This is so because this type of system permits a maximum limit of interconnected sources of intermittent energy before its stability and reliability are affected. The Electric Power Research Institute (EPRI), recognized world-wide for its experience in the development of advanced studies in the analysis of power systems, completed a highly specialized study of this kind for PREPA in August, 2009.

One of the main objectives of the EPRI study is to provide PREPA with guidelines and technical recommendations that would allow us to integrate, in an orderly, structured, responsible and scientific manner, intermittent renewable energy sources into the electric grid, considering the critical aspects of safety and stability inherent to the operation and the dynamic nature of electrically isolated and low-inertia power systems. The following conclusions were reached based on the scientific studies of power system analysis conducted by PREPA and EPRI teams in charge of planning in the company:

a) At present, the proposed renewable energy projects of an intermittent nature submitted for our consideration could present challenges in what has to do with the maximum penetration limits considered in the EPRI study. This, in view that the reserve requirements in rotation and control considered by EPRI are significantly higher than the actual operational requirements, for which reason the equivalent penetration limits studied by EPRI are considerably lower than the penetration levels under consideration at PREPA.

b) Because of this, and in order to safeguard the electric system's stability and reliability, we must evaluate the integration into the electric grid of additional projects of renewable energy sources of an intermittent nature, regardless of their location in the electric system, until the additional studies recommended by EPRI are conducted.

c) The required studies must consider the present projections of demand for electric power, the corresponding dispatch schemes, the integration of solar parks, the location of the renewable energy projects under contract and the fuel conversion plans, among other aspects. An update of the pending studies must be complemented with the acquisition of specialized analysis tools for high level power systems and with the pertinent technical training. In this manner we guarantee that the study areas of PREPA's power systems can provide continuity to the evaluations required to transform our electric grid in harmony with Our Strategic Corporate Plan 2009 - 2012 and with Law 82 of 2010.

d) Establish, on the basis of scientific criteria for the analysis of power systems, a strategic plan for the structured integration of renewable energy sources of an intermittent nature, that do not place the stability and reliability of Puerto Rico's electric system at risk. We must establish inviolable limits and percentages of geographical penetration, which must be safeguarded in a consistent manner for the well-being and socioeconomic development of Puerto Rico.

In addition, PREPA prepared the following table in which the generating capacity from some renewable sources that could be acquired is compared with what would be invested in the installation of generating infrastructure for Via Verde, $450 MM.

Comparative Generation Table

Technology Considered	Computation Base	Equivalent Generation	Capacity Factor	Adjusted Generation	Generation with Via Verde	Estimated Time for Permits and Construction
Photovoltaic Panels	$6/Watt	75 MW	32%	24 MW	1,542 MW	1-2 years
Wind Turbines	$2/Watt	225 MW	38%	86 MW	1,542 MW	1-2 years
Solar Heaters	$2/Watt	225 MW	32%	72 MW	1,542 MW	1-2 years

When considering the data in the previous table, we conclude that the use of renewable energy technologies exhibits higher costs than those obtained by generating electricity with Vía Verde. In view of this technological reality, PREPA proposes the use of the Vía Verde infrastructure as an orderly and effective transition to the integration of these renewable technologies. This will achieve furthering the island's economic development which will in its stead permit investment in new renewable technologies. In this way, Vía Verde will spare Puerto Rico from committing the tactical error Spain committed by fomenting the construction of wind turbine projects and technologies by means of the approval of credit and economic incentives. This action led Spain to not having the capacity to repay those credits, which affected the viability of the Spanish economy.

In accordance with the previous cost analysis and the recommendations made on the basis of the EPRI study, we conclude that the use of these technologies in Puerto Rico's base generation of electricity is not cost effective and does not permit an immediate response to the energy infrastructure crisis. At the same time, this

compromises the island's economy and affects the quality of life and the well-being of the citizenry in general.

Although the technologies to use renewable energy sources represent zero emissions of air pollutants, the installation and operation of these is not exempt of adverse environmental impact. In fact, projects of this type presented in the island generated great controversies and concerns related to the environmental impact (deforestation of extensive areas, impacts on the flora and fauna, impact to critical habitats, loss of agricultural lands, among others).

4.5. Natural Gas Pipeline

The principal reasons which sustain this determination are:

1. There is a liquefied natural gas receiving terminal in Puerto Rico at EcoEléctrica, which is located in the Municipality of Peñuelas, which avoids the investment required to construct a terminal. This is one of eight importation terminals for this product in the whole United States. In addition, there are some six export terminals, also in the United States. In fact, there is one in Alaska, a state with a high incidence of seismic activity.

2. The historic and projected price of natural gas, according to data published by the Federal Energy Office, is lower than light distilled (No. 2), which is the most expensive fuel used by PREPA. In addition, the projection indicates that natural gas will be cheaper than residual No. 6, which historically had a price similar to, or lower than natural gas in the past.

3. The maintenance cost of the units is reduced because natural gas is a cleaner fuel, as shown below:

ESTIMATED SAVINGS ON GENERARTING UNITS MAINTENANCE USING NATURAL GAS

I. COMBUSTION TURBINES (DIESEL FUEL)

A. CAMBALACHE PLANT: Three Units of 83 MW ea

Fuel	Maintenance Frequency	Inspection Intervals	Cost	Amount of Inspections in 10 Years	Cost of Inspections in 10 Years
Diesel	18.000 hrs	40 months	$9.750.000	3	$29.250.000
Natural Gas	24.000 hrs	60 months	$10.050.000	2	$20.100.000

Approximate Savings on Maintenance is $27.450.000 in 10 years (30%). Se mejora la

confiabilidad.

B. UNITS 5 AND 6 OF THE COMBINED CYCLE - SAN JUAN: Two Units of 148MW ea

De acuerdo al manufacturero, el ahorro aproximado en mantenimiento es de 30%. Los intervalos de mantenimiento se alargan por un factor de 1.3 veces. Se mejora la confiabilidad.

II. STEAM TURBINES (BUNKER C FUEL)

A. PALO SECO STEAM PLANT: Two Units of 216MW ea

Fuel	Environmental Maintenance Frequency	Environmental Maintenance Cost	Auxiliary Steam for Fuel Heating	Fuel Used for Auxiliary Steam for Fuel Heating in 24 hrs	Annual Cost Fuel Used for Auxiliary Steam for Fuel Heating in 24 hrs
Bunker C	18 months	$1MM	3,900#/hr	102,123 barriles	$788,440
Natural Gas	Not Necessary	$0	0	0	0

Approximate Savings on Environmental Savings: $2MM each 18 months

B. SAN JUAN STEAM PLANT: Four Units of 100MW ea

Fuel	Environmental Maintenance Frequency	Environmental Maintenance Cost	Auxiliary Steam for Fuel Heating	Fuel Used for Auxiliary Steam for Fuel Heating in 24 hrs	Annual Cost Fuel Used for Auxiliary Steam for Fuel Heating in 24 hrs
Bunker C	18 months	$1MM	1,950#/hr	51,061 barrels	$394,220
Natural Gas	Not Necessary	$0	0	0	0

Approximate Savings on Environmental Savings: $4MM each18 months

4. The existing units are prepared, or can be modified to use natural gas as their principal fuel without affecting their generating capacity.

5. Natural gas is a cleaner fuel. Its use will help PREPA maintain sustained compliance with environmental regulations to protect the environment. In addition, it will help achieve the greatest and most significant reduction of

fuel emissions in our island's history and will allow the agency to comply with the new emissions criteria promulgated by the EPA for the year 2020. (See Section 6.18)

6. The technology to generate energy with natural gas is well-developed and tested worldwide. At the end of Chapter 2 we present data that demonstrate the use of natural gas in the United States, the number of pipelines and the terminals for natural gas. Also, we present a table from which we conclude that close to 25% of electricity generation in the United States is based on natural gas.

7. There are proven reserves in different parts of the world. The federal Department of Energy's (DOE) internet page has the most up-to-date information on the availability of the world's natural gas reserves in their electronic address, as recovered on October 21, 2010: http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=3&pid=3&aid=6. The data included there show that there are natural gas reserves in all parts of the world that at present amount to some 6,609,346 trillion cubic feet. They also show that there are gas providers as close to Puerto Rico as Trinidad and Tobago. PREPA, through the processes provided by law and by its regulations, will seek to purchase natural gas from the providers available in the market in such a way that its cost is the most economical, always in compliance with its quality specifications.

For this analysis we used some components of PREPA's property study made under contract by Power Technologies Corporation (PTC) in 2006, *Corridor and Alternative Routes Selection Study*.

The PTC study was comprehensive, since it took in consideration the whole island. One thousand (1,000) meter corridors were evaluated and the following criteria were used for said evaluation: topography, land use, existing corridors and the sensitive areas. With these parameters, 4-km-long segments were generated for analysis under the criteria of existing rights of way or land routes outside the existing rights of way.

Then, 100-meter corridors were created to be used as route alternatives, which were associated with different values and different weights of limiting factors. The route alternatives associated with the least limiting factors were analyzed by experts familiar with the route selection criteria for this kind of project. Restriction maps were created in the final round of analysis, which were used to identify different corridor options. Then, the corridor options were refined with other factors such as: individual residences, minor topographic variations, sensitive habitats identified during the field visits, construction methodology in areas of greater difficulty, such as: steep slopes, bridges and densely populated areas.

Finally, PTC identified for PREPA several routes to carry natural gas to different points

in the island. Among these are our installations in Arecibo, San Juan and Palo Seco, which are Vía Verde's focal points.

This study suggested two alignments to transport the natural gas from EcoEléctrica to the Cambalache Power Plant:

- **South-North Alignment A**

Starting at EcoEléctrica, with a northeast route cross-country until the Municipality of Ponce and then through the right of way of PR-10, continuing through the Municipality of Adjuntas and the Municipality of Utuado. In the Municipality of Utuado the trajectory veers away from the PR-10 corridor, but continues parallel to it until it reaches the Municipality of Arecibo. In said municipality it runs through the northern plains until it reaches the Cambalache Power Plant. This alignment traverses a total of 45.1 miles. This alignment was denominated the I-10 Overland alignment.

- **South-North Alignment B**

Starting at EcoEléctrica, and taking one of two options to reach PR-10. One of the options is the right of way projected for the Southern Gas Pipeline from the Municipality of Ponce; the other is to take the PR-10 right of way from the Municipality of Guayanilla, through the Municipality of Peñuelas. Both options reach the west of the Municipality of Ponce, from where they enter the PR-10 right of way until the Municipality of Arecibo and connect with the Cambalache Power Plant. This alignment traverses a total of 36.8 miles. The study called this alignment DOT Route.

In addition, the study suggested two viable alignments to transport the natural gas from Cambalache to the San Juan and Palo Seco Power Plants:

- **West-East Alignment A**

From the Municipality of San Juan, through Levittown, it takes a trajectory to the west and crosses the municipalities of Toa Baja, Dorado, Vega Alta, Vega Baja, Manatí and Barceloneta until it reaches the Municipality of Arecibo. This alignment traverses a total of 44.6 miles. The study called this alignment the Overland Corridor.

- **West-East Alignment B**

From the Municipality of Cataño, it occupies PR-22's right of way until it reaches the Municipality of Arecibo. The same crosses the municipalities of Toa Baja, Dorado, Vega Alta, Vega Baja, Manatí and Barceloneta. The study mentions that they will have to investigate whether this alignment interferes with the Superaqueduct's right of way. This alignment traverses a total of 45.6 miles. The study called this alignment the DOT Corridor.

For our analysis, in addition to the previously mentioned alignments, a third alignment was included for both sections that were not contemplated in the PTC study. Thus, a total of three alignments were studied for each section. The alignments considered were: South-North Alignment A (SNA), South-North Alignment B (SNB), South-North Alignment C (SNC), West-East Alignment A (OEA), West-East Alignment B (OEB) and West-East Alignment C (OEC).

Among the previously mentioned segments, the best alternative was selected for each one of the sections. When both selected sections were joined, we obtained the terrestrial alignment with the greater development potential.

4.5.1. Terrestrial Alignments

4.5.1.1. Selection of alignment with the greater development potential

The purpose of this stage of our analysis is to select a final alignment for Vía Verde. The two alignments suggested in the PTC study in the EcoEléctrica to Cambalache section and the two alignments in the section from Cambalache to the Palo Seco and San Juan power stations were selected. In addition, a third alternative was analyzed for both sections that was not contemplated in the PTC study.

The environmental criteria listed below were selected for the evaluation of these six segments of alignment. In Addendum 4.1, Criteria Maps, you will find a map with the illustration of each criterion.

- Land use
- Bodies of water impacted
- Miles of forest or nature reserves impacted
- Endangered species
- Archaeological finds
- Highway crossings
- Zoning or ratings
- Nearby residences

The source of information used, mostly, was the GIS technology database, which offers environmental information in a computerized manner. Each environmental criterion was evaluated as follows:

- **Land use**

An analysis was made of the different kinds of land use throughout the alignment. Non-residential, public, industrial, agricultural and commercial uses were defined as land uses favorable to the construction. Land for residential use and environmentally sensitive lands were defined as land uses unfavorable to the construction. The

extension of the alignment that ran through land for all the uses was measured and then the extension of the uses unfavorable for the construction was deducted from the favorable uses and a final value was obtained. A positive (+) value was assigned to the alignment that obtained the highest value.

- **Bodies of water**

Crossings of bodies of water increase the difficulty in the pipeline's construction because to be able to cross a body of water special construction methods will have to be implemented to avoid adverse impacts to them. This increases the cost of the projects. All the bodies of water intercepted by the construction were counted. A positive (+) value was assigned to the alignment with the least number of intercepted bodies of water.

- **Forests or nature reserves**

The forests and nature reserves are protected areas for their high ecological value. One of the criteria considered for the selection of the Vía Verde alignment is to avoid or minimize, as much as possible, impact on these areas. The extension of the alignment that crossed through the different forests or reserves was measured. A positive (+) value was assigned to the alignment that crossed through less areas of forests and reserves.

- **Endangered species**

In Puerto Rico there are several species of fauna and flora listed as protected or endangered. The habitats for such species are highly protected by state and federal regulations. One of the criteria considered for the selection of the Vía Verde alignment is to avoid or minimize as much as possible the impact to these habitats. The extension of the alignment that crossed through the protected habitats was measured. A positive (+) value was assigned to the alignment that crossed the least protected habitats.

- **Archaeological and architectural finds**

Areas with archaeological and architectural finds are protected due to their historic, social and cultural value. They are protected by state and federal laws. All the archaeological and architectural finds which would be intercepted by the alignment were counted. A positive (+) value was assigned to the alignment with the least finds.

- **Highway crossings**

Highway crossings increase the difficulty in the construction of the pipeline because to cross them, special construction methods must be implemented. This is so as to not affect the integrity of the infrastructure and vehicular congestions, which increases the

cost of the project. All the highways that would be intercepted by the alignment were counted. A positive (+) value was assigned to the alignment that ran through less crossings.

- **Zoning**

An analysis was made of the different land zonings or ratings along the alignment. Non-residential, public, industrial, agricultural, commercial and not zoned lands were defined as favorable to the construction. Residential, forested, conservation zones and historical sites were defined as land zones unfavorable to the construction. The extension of the alignment that ran through land of all zones was measured and then the extension that ran through zones unfavorable to the construction was subtracted from the favorable zoning and a final value was obtained. A positive (+) value was assigned to the alignment with the highest value.

- **Residences**

Due to its limited geographic extension, its high population density and its topography, Puerto Rico has abundant residential conglomerates, especially on its coastal plains. In addition, opposition to a similar project was conceived in the past due to a mistaken perception by the citizenry that the transport of natural gas is an unsafe operation. By the statistics of accidents with natural gas transmission lines, according to the National Transportation Safety Board (NTSB), that perception is not true. Nevertheless, to promote greater trust in the project, this criterion was incorporated in the alignment's selection process. For that reason, the criterion with greater weight in the project's planning was minimizing the number of residences in the vicinity of the alignment. The residences intercepted by the alignment were counted. A positive (++) value was assigned to the alignment with less residences.

4.5.1.2 Matrix for alignment selection

In this stage three alternatives were compared for the south-north section and three alternatives for the west-east section. For this we compared the percentage of each alignment or the number of times the alignment would affect the environmental criterion being evaluated, according to each case. A (+) was awarded to the alignment that would least impact each criterion. Then the amount of (+) each alignment had in its favor was added and the alignment with the most criteria in its favor was selected. The analysis is summarized in the matrix in Addendum 4.2, Matrix for Alignment Selection.

4.5.1.3. Selected alignment

After developing and analyzing the matrix for the environmental criteria considered, we found that the South-North C alignment was the most favorable. It obtained nine positive points, while the South-North B alignment obtained three positive points and the South-North A alignment obtained only one positive point. Also, the criterion of

impact to residences in the South-North C alignment obtained the highest positive value of the three possible alignments for this section.

For the West-East section the analysis of the matrix revealed that the best alignment is West-East C. It obtained six positive points, while the West-East B alignment obtained five positive points and the West-East A alignment only received one positive point. Also, the criterion of impact to residences in the West-East C alignment obtained the highest positive value of the three possible alignments for this section.

By joining the alignments with the most positive value for each section, we obtained the terrestrial alignment with the greater development potential. That is the alignment about which the environmental evaluation presented in this DIA-P was made.

4.5.2. Variations to the selected alignment

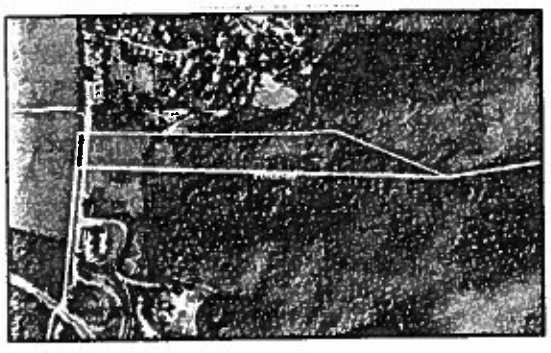
The development of the selected alignment evolved to incorporate necessary changes due to different reasons: impact the communities in the least, avoid or minimize environmental impacts, economic factors, and factors associated to the construction. In the determination of the variations, the main emphasis was on finding the shortest viable alignment in terms of construction which would have the least environmental impact and, principally, to be as far away from the communities as possible. The variations we show below led to the alignment presented in this document, Vía Verde. The illustrations of the variations that appear below contain the original alignment in orange and the varied alignment in green.

4.5.2.1. Variations to avoid communities

The criterion that carried the most weight in planning the project was to minimize the number of residences in the vicinity of the alignment. During the planning of the project we found that the initial alignment selected in the study of alternatives ran near certain communities. For that reason, we determined to displace the alignment inasmuch as possible so that no communities would be affected for a distance of 150 feet on both sides of the alignment.

The following variations were made to avoid impacting the communities.

4.5.2.1.1. Variation at Seboruco Community, Peñuelas



Initially, the alignment was some 300 feet from this community. We made the decision to move the line away some 300 feet to the south, because there was space available. In addition, this change did not affect other communities. Finally, the present alignment is at a distance of some 600 feet away from

this community.

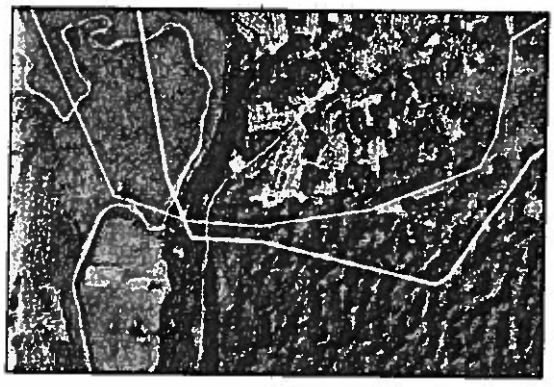
4.5.2.1.2. Variation at Urbanización Monte Santo, Peñuelas

Initially, the alignment ran on the east side of Urbanización Monte Santo. With this alignment, four residences were less than 150 feet away from the alignment. By making this change, it was reduced to only one residence.

4.5.2.1.3. Variation at Universidad de la Montaña, Utuado

Initially, the alignment impacted land belonging to Universidad de La Montaña. By incorporating this variation, the alignment diminishes the impact to these lands and now it is more than 800 feet away from the university's buildings.

4.5.2.1.4. Variation at Urbanización Jardines de Mónaco, Manatí

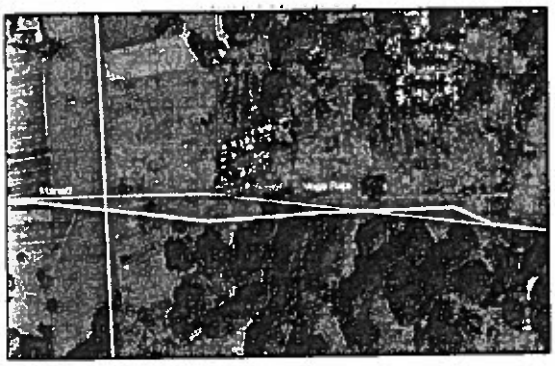


The alignment was some 400 feet away from this urbanization and affected several residences in the nearby communities. It was decided to move the line away an additional 400 feet because there was space available. In addition, this change benefitted the adjacent houses which were within a distance of 150 feet from the project. Finally, the present alignment is some 800 feet away from the Jardines de Mónaco communities.

4.5.2.1.5. Variation at La Grúa Sector and El Polvorín Ward, Manatí

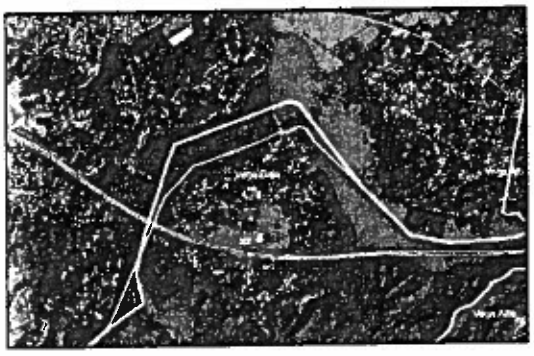
Initially, the alignment impacted the La Grúa Sector, cutting directly across it. Nine residences would be affected. By making this change we were able to avoid this community and at present it is more than 3,000 feet away.

4.5.2.1.6. Variation at Bethel Sector, Pugnado Afuera Ward, Vega Baja



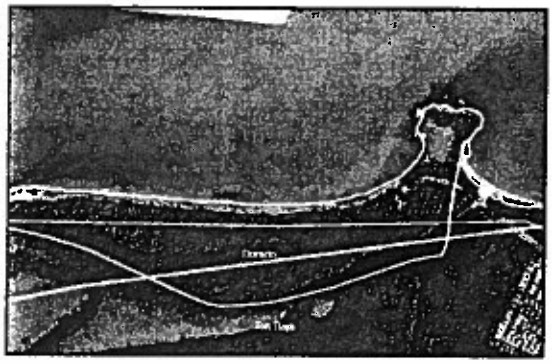
Initially, the alignment affected the Bethel Sector. Several residences would be within 150 feet of this alignment. By incorporating this variation, we were able to move the alignment more than 300 feet away.

4.5.2.1.7. Variation at El Indio Sector, Almirante Norte Ward, Vega Baja



Initially, the alignment impacted more than ten residences in the El Indio Sector. By making this change, we were able to avoid impacting these residences. We were able to move the proposed alignment more than 300 feet away from this community.

4.5.2.1.8. Variation at Mameyal Playa Community, Toa Baja



Initially, the alignment affected the Mameyal Playa Sector. Several residences in this sector were within 150 feet of this alignment. By incorporating this variation, we were able to move the alignment to more than 300 feet away.

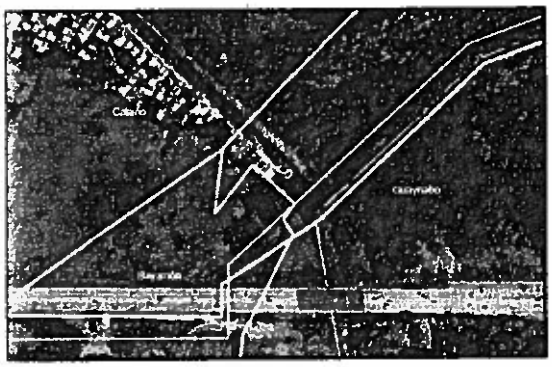
4.5.2.1.9. Variation at Levittown Communities, Toa Baja

Initially, the alignment affected several urbanizations in the Levittown area. Several residences in these communities would be within 150 feet of this alignment. By incorporating this variation, we were able to move the alignment to more than 500 feet away.

4.5.2.1.10. Variation at Villa Aurora Urbanization, Cataño

Initially, the alignment affected this urbanization. Twelve residences of this sector would be within 150 feet of this alignment. By incorporating this variation we were able to keep these residences more than 200 feet away.

4.5.2.1.11. Variation at Puente Blanco Community, Cataño-Guaynabo



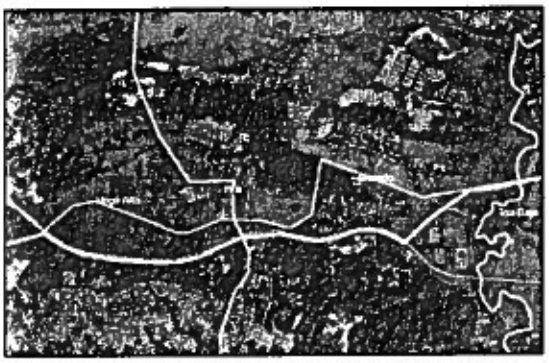
Initially, the alignment affected the Puente Blanco community, Several residences in this sector would be within 150 feet of this alignment. By incorporating this variation we were able to keep these residences more than 150 feet away.

4.5.2.1.12. Variation at Miraderos de Sabana Walk-ups and the Sabana Ward, Guaynabo

Initially, the alignment affected the Sabana Sector and the Miraderos de Sabana Walk-ups. These would be within 150 feet of this alignment. By incorporating this variation we were able to keep the Walk-ups more than 200 feet away and the Sabana Sector residences more than 250 feet away.

4.5.2.2. Variations to minimize the project's economic impacts

4.5.2.2.1. Variation at PR-22, in the Municipalities of Vega Alta and Dorado



Initially, the alignment impacted 5 miles of private lands in the municipalities of Vega Alta and Dorado, which would represent a high cost in the acquisition of the right of way for this alignment. By incorporating this variation, we were able to use the Highways Authority right of way in PR-22, resulting in substantial savings in the project's cost.

4.5.2.3. Variations to minimize environmental impacts

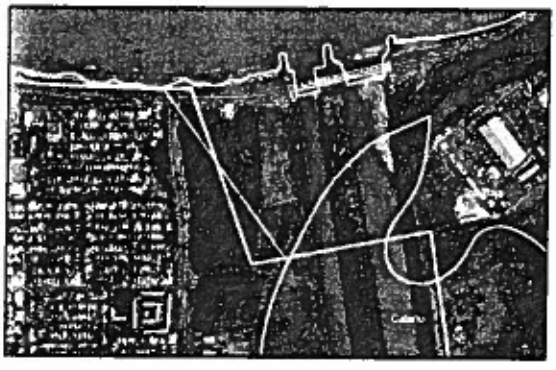
4.5.2.3.1. Variation in Bosque del Pueblo, Adjuntas

Initially, the alignment crossed a small area of Bosque del Pueblo in the Municipality of Adjuntas. To avoid this impact the alignment was located farther to the west.

4.5.2.3.2. Variation in PR-22 in the Municipalities of Vega Alta and Dorado

Initially, the alignment impacted the north portion of the La Vega forest in the Municipalities of Vega Alta and Dorado. By incorporating this variation the impact to this resource was diminished by 30%.

4.5.2.3.3. Variation at La Candelaria Shrine, Toa Baja



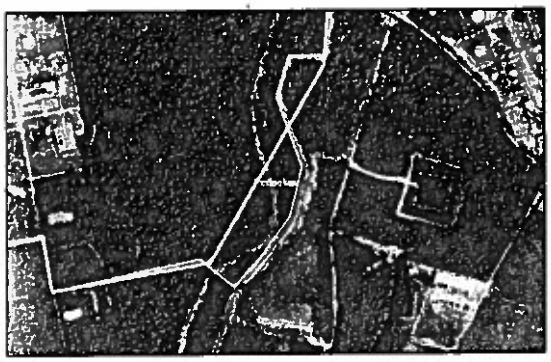
Initially, the alignment impacted the structure of historic value directly. By incorporating this variation we were able to move the alignment out of this area and thus avoid the impact.

4.5.2.4. Variations due to construction reasons

4.5.2.4.1. Variation at the EcoEléctrica Canal, Peñuelas

Initially, the alignment crossed the discharge canal at a 90° angle. To use the HDD method, it was decided to reduce this angle because 90° angles are not recommended for this method.

4.5.2.4.2. Variation at the Tallaboa River, Peñuelas

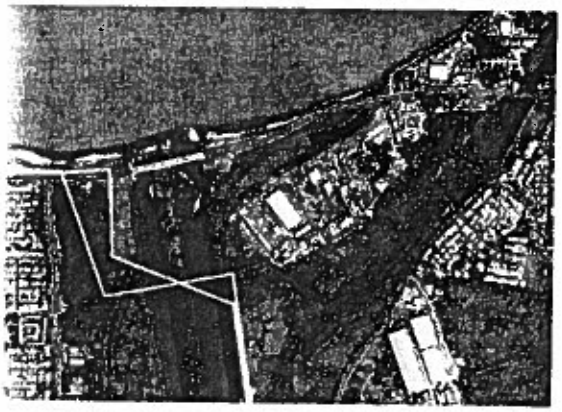


Initially, the alignment crossed the Tallaboa River in two sections at a 90° angle. To use the HDD method, it was decided to reduce this angle because 90° angles are not recommended for this method.

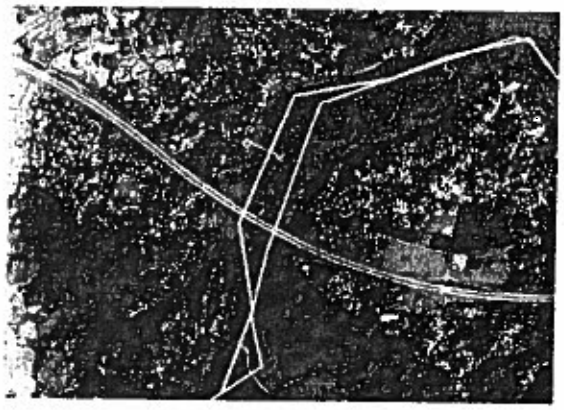
4.5.3. Changes to the Proposed Alignment

After collecting the comments of the diverse agencies and the general public to the DIA-P Draft, the changes to the proposed alignment were incorporated to address said comments and recommendations. These changes respond to various reasons, among which there are: environmental considerations, keeping it away from existing communities and future developments. Other changes respond to construction reasons.

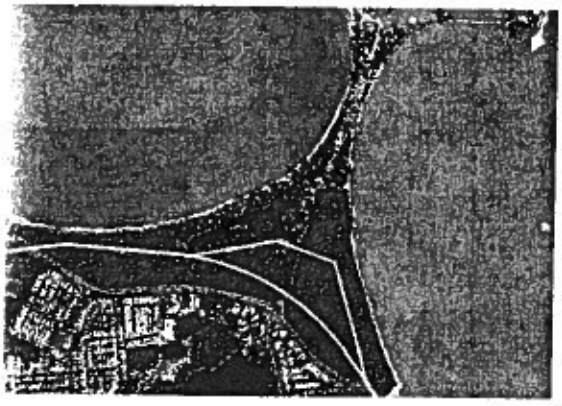
4.5.3.4. Changes for environmental considerations



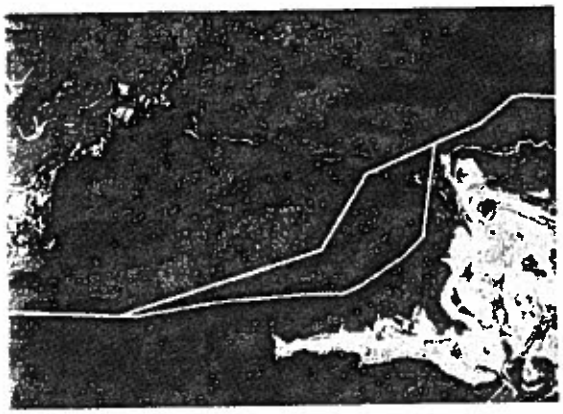
To address recommendations from the UPR, and to move away from the historical archaeological area of the shrine in the Municipality of Toa Baja.



With this change the number of times the alignment crosses the El Indio River in the Municipality of Vega Baja is reduced.

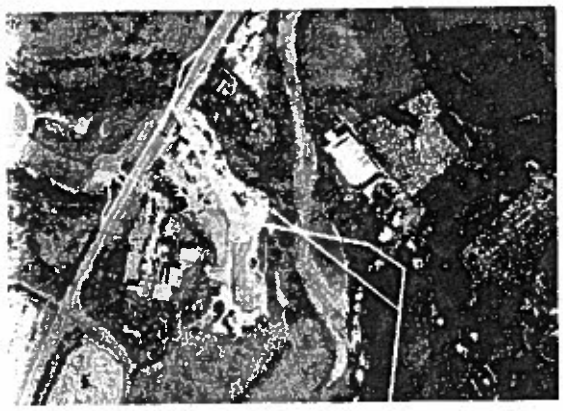


To avoid impacting mangrove areas in the Punta Salinas sector of the Municipality of Toa Baja.



To move away from the area of the industrial landfill located in the Municipality of Peñuelas.

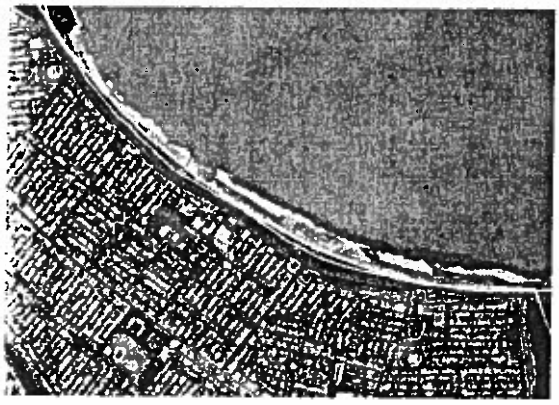
To move away from the lagoon of lixiviates on the municipal landfill in the Municipality of Arecibo.



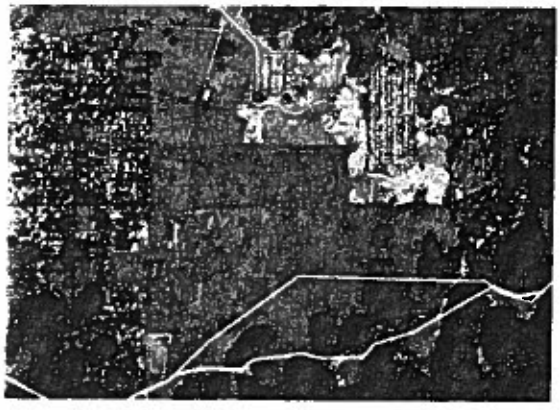
To facilitate the crossing of the Arecibo River at the height of the Municipality of Utuado using the HDD technique so as to avoid impacting this body of water.

To facilitate the crossing of the Arecibo River at the height of the Municipality of Arecibo using the HDD technique so as to avoid impacting this body of water.

4.5.3.5. Changes to keep the alignment away from communities and future projects



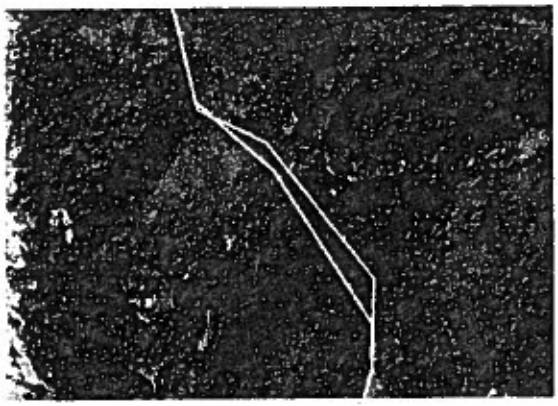
In the vicinity of Urbanización Levittown in the Municipality of Toa Baja, the alignment will be at a depth of 60 feet and the HDD technique will be used to cross the area which will prevent the impact associated with open trench excavations.



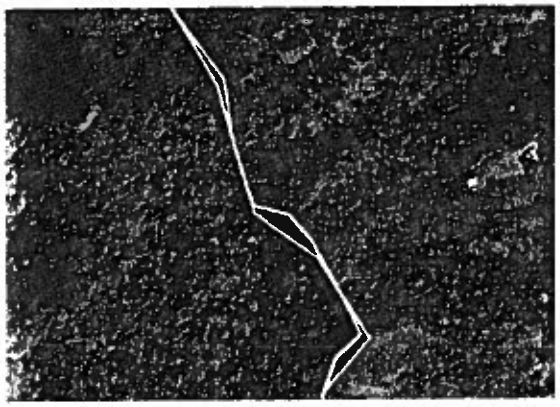
To move away from a future development in the Municipality of Vega Baja that already has approved permits from the Planning Board.

4.5.3.6. Changes for construction reasons

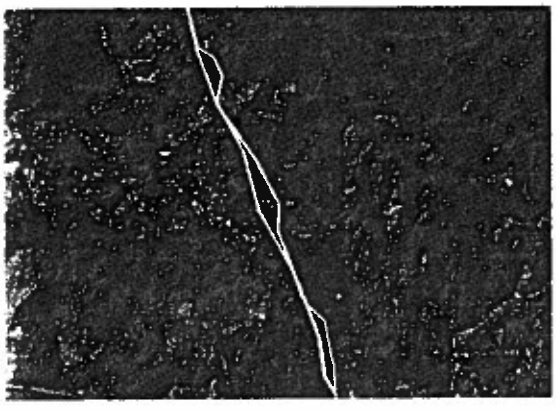
The following changes to the alignment respond to construction factors due to the steepness of the topography in the center of the island in the mountainous area or to difficulties in the use of the HDD technology.



Municipality of Peñuelas



Municipality of Peñuelas



Municipality of Adjuntas

Municipality of Utuado

Municipality of Arecibo

6. IMPACTS

The impacts of this project may be direct, indirect or cumulative. Next we evaluate these impacts on the different resources that could be affected by the project. The cumulative impact will only be analyzed for those sensitive or critical resources. The cumulative impact could result from the combination of different effects the project could have on the same ecosystem or from the combination of different projects in the same space and time frame.[1] Thus, the absence of other projects (past, concurrent or future) is not the only source of cumulative impacts that could result from the implementation of Vía Verde.

The construction of Vía Verde will have impacts on the environment. The project is a lineal excavation that covers 92 miles and affects some 1,191.3 acres of land, most of these temporarily.

During the studies phase we tried as much as possible to avoid areas of ecological value, and to avoid significant impacts. For this we consulted with the regulatory agencies to receive their recommendations before the proposed alignment was determined.

In cases where the impact is unavoidable, the impact will be analyzed and measures designed to minimize the negative effects that could develop will be established. The impacts, although they may have been minimized, will be mitigated, in accordance with the recommendations of the experts that participated in the project's study phase and in coordination with the regulatory agencies. In other cases, and due to the project's nature, the impact cannot be avoided or minimized. In those cases the magnitude of mitigation will be greater and will require a more sophisticated design.

Next we will discuss the project's impacts and the measures that will be implemented to avoid, minimize and mitigate the same.

6.1. Avoided Impacts

6.1.1. Communities

One of the criteria with more weight in the planning of the project was minimizing the number of residences in the vicinity of the alignment. During the planning phase we found that the alignment selected initially in the study of alternatives was close to certain communities. For that reason it was determined to establish a right of way in such a manner that communities would not be affected within a distance of 150 feet

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Consideration of Cumulative Impacts in EPA Review of NEPA Documents, U.S. Environmental Protection Agency, Office of Federal Activities (2252A), EPA 315-R-99-002/May 1999.

from the alignment. Among the communities that were avoided are: Seboruco in Peñuelas, Jardines de Mónaco and Sector La Grúa in Manatí, Sector Bethel and El Indio in Vega Baja, Mameyal Playa Community in Toa Baja, Urbanización Villa Aurora and Puente Blanco Community in Cataño, Miraderos de Sabana Walk Ups and Sector Sabana in Guaynabo.

6.1.2. Areas of Ecological Value

The impact to Bosque del Pueblo Reserve and several parcels dedicated to perpetual conservation in Adjuntas was avoided due to their high ecological value.

6.1.3. Bodies of Water, Mangroves and Woody Wetlands

The impact to several canals, rivers and all the mangroves and woody wetlands was avoided through the use of the dry crossing technology known as Horizontal Direct Drilling (HDD). Among these bodies of water that will be crossed with HDD are: two canals, one forested wetland and the Tallaboa River in Peñuelas; three canals, one herbaceous palustrine wetland and Río Grande de Arecibo in Utuado; one flood control project, four canals, Río Grande de Arecibo and the Tanamá river in Arecibo; three canals and the Río Grande de Manatí in Manatí; Río Indio in Vega Alta; two wetlands (estuarine forested and palustrine forested), one flood control project, La Plata River and Cocal River in Toa Baja; two canals, two estuarine forested wetlands and the Cocal River in Dorado; one flood control project, two canals and the Bayamón River in Cataño.

6.1.4. Structures of Cultural Value

Direct impact to the La Candelaria Shrine in Toa Baja was avoided.

6.1.5. Infrastructure

The highways and roads in the following table will be crossed with the boring technique to avoid impact on the infrastructure an on traffic.

Carretera	MP Entrada	MP Salida
PR-127	3.09	3.11
Camino sin Nombre	3.34	3.36
PR-2	3.68	3.72
PR-385	3.92	3.94
PR-132	8.25	8.27
PR-520	9.53	9.55
PR-391	10.50	10.52
PR-391	11.11	11.13
PR-123	15.66	15.68

Carretera	MP Entrada	MP Salida
Carretera Portugués	15.89	15.91
PR-143	16.41	15.91
Carretera Valdes	17.52	17.53
Camino sin Nombre	19.36	19.38
PR-524	20.76	20.78
Camino sin Nombre	22.72	22.74
Camino sin Nombre	22.99	23.01
Camino sin Nombre	23.49	23.51
PR-10	25.35	25.37
PR-111	25.84	25.86
PR-10	27.25	27.27
PR-123	29.80	29.82
PR-10	30.09	30.11
PR-621	30.59	30.61
Camino sin Nombre	34.69	34.71
Camino sin Nombre	35.86	35.88
PR-22	40.93	40.97
PR-2	42.18	42.22
Camino sin Nombre	47.05	47.07
PR-681	53.09	53.11
PR-616	54.96	54.98
PR-616	55.45	55.47
PR-22	55.65	56.62
PR-2	57.32	57.36
PR-149	59.26	59.28
PR-672	62.67	62.69
PR-137	64.76	64.77
Calle Mario López	66.11	66.13
Calle Rogue Cancel	66.21	66.23
PR-674	67.12	67.14
PR-22	68.24	68.28
PR-160	69.18	69.19
PR-676	71.02	71.04
PR-22	71.20	71.24
PR-690	71.69	71.70
PR-2	71.80	71.82
Elevados	74.21	74.23
PR-694/Rampas	74.68	74.72
PR-6659	75.92	75.94
PR-22/Superacueducto	76.15	76.21
PR-694	76.77	76.78

Carretera	MP Entrada	MP Salida
PR-693	77.07	77.09
PR-854	77.72	77.73
PR-165	78.39	78.41
PR-867	79.35	79.37
Boulevard de Levittown	83.10	83.11
PR-165	84.92	84.94
PR-22	87.34	87.38
PR-22	88.88	88.93
PR-24	90.18	90.22
PR-165	90.33	90.38

6.1.6. Future Projects

Proposed projects with consultations approved by the Planning Board were identified, according to that same agency's database. The original alignment impacted two of these projects (a commercial project in Vega Alta-Dorado and a residential project in Vega Baja). Said alignment was modified to avoid the same.

6.2. Impacts by Deforestation

One of the project's first impacts will be reflected in the vegetation due to the clearing and leveling of the right-of-way phase. A 100 feet wide construction area will be needed. In crossings of bodies of water and highways the right-of-way could be from 100 to 300 feet wide. It is estimated that 1,191.3 acres of land will be impacted, most of them (approximately 66%) temporarily. With the exception of protected species or habitat of interest for conservation, all the trees and vegetation in this area will be removed. This impact is not avoidable due to the project's construction specifications. Vegetation in wetland areas that is impacted with open trenches will be allowed to be restored in natural form or by mitigation in a proportion of 3:1, as required. In agricultural areas, planting of crops that don't have deep roots will be permitted. In the rest of the project reforestation will be allowed to take place in natural form or through mitigation plans coordinated with the Department of Natural and Environmental Resources (DRNA), except for the growth of trees with deep roots within the 50-foot operation right-of-way (25 feet on each side of the pipeline, whenever possible). The mitigation plans required by DRNA include reforestation in a 3:1 proportion of the trees removed.

To determine the impact of Vía Verde on areas covered by arborescent vegetation, we took the following in consideration:

- Nearly 21% of the route will traverse through highway rights-of-way (i.e.: Highways PR-10 and PR-22) and places impacted by previous activities

(i.e.: CAPECO right-of-way in Guaynabo and Union Carbide in Peñuelas);

- Two point three percent (2.3%) of the route is on woody wetlands that will not be impacted because the HDD method will be used (that is, a curved subterranean perforation well below the root systems);
- Four percent (4%) of the alignment runs through land populated by bushes (mainly leucaena, sp) of early ecological succession; and
- Fifty-three percent (53%) of the proposed alignment will run through flat land, floodplains and agricultural lands free of arborescent vegetation.

This leaves us with a total of 20% of the proposed alignment (that is 20% of 92 miles = 18 miles) that is covered with arborescent vegetation. To obtain the amount in *cuerdas* (a unit of land area of approximately 3,930 square meters or 0.971 acres) of the area that will be impacted, we multiply 18 miles times 30 meters wide (temporary construction right-of-way) which makes a total of 221 *cuerdas*. If we take in consideration that of the 30 meters of construction right-of-way, 15 meters will be reforested, we can conclude that half of the impact on areas of arborescent vegetation will be temporary and that the permanent impact will be on some 110.5 *cuerdas*. Said impact will be compensated at a ratio of three to one through the acquisition of land, reforestation of public areas or any combination of measures the DRNA deems necessary.

Finally, we propose to reforest the construction right-of-way temporarily impacted with native species that provide habitat to the fauna species of the impacted region. The Péndula (*Cytharexylum fructicosulum*) and the Úcar (*Bucida buceras*) are examples of species that provide food to wildlife (birds) and that will be taken in consideration in the planting and reforestation plan that will be made even though the AEE is exempt from compliance with Planning Regulation No. 25 (Puerto Rico Tree Cutting, Pruning and Forestation Regulation) in its rights-of-way.

The measures that will be taken to minimize the loss of vegetation are discussed below:

- The construction area will be clearly defined to avoid damage in other zones.

- Inasmuch as possible, the land will be restored to its original state. Although the AEE will acquire a 150 foot wide right-of-way, it will only keep free of deep roots a width of 50 feet (operation right-of-way).

- The AEE, in coordination with the regulatory agencies, will try to avoid the loss of species of ecological value. However, if such loss is unavoidable, a mitigation plan will be designed for those cases in which it is not possible to replant in the operation right-of-way.

- Areas near the project's site will be reforested in a proportion of 3:1 per affected individual. This will be done in coordination with the concerned agencies and in strict compliance with the applicable regulations. In terms of its location, the

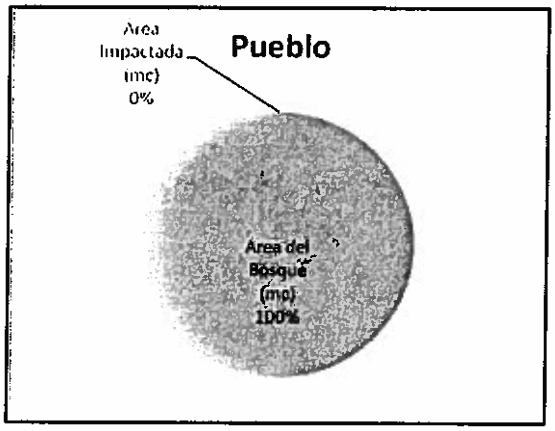
mitigation will be of two kinds: *in situ* and by acquisition of land, preferably contiguous and of equal or similar ecological value to the impacted site. In like manner, in terms of its type, the mitigation will be made in kind or with different species that bring about an improvement of the ecosystem, for example, using trees that provide more food for birds, which will be selected in coordination with the DRNA.

6.2.1. Forests

Puerto Rico has several forests, some of which are near the project. The original alignment selected crossed through three forests: Bosque del Pueblo, Bosque Río Abajo and Bosque Vega.

To avoid causing an impact on these forests, the design of the alignment was varied in such a manner that:

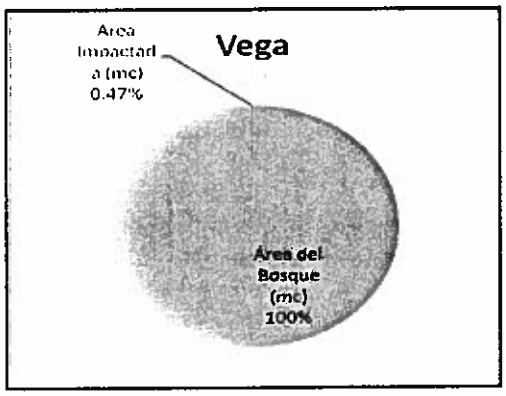
- Bosque del Pueblo was totally avoided by moving the original alignment further to the west and away from it. The total area of this forest is 1.61 square miles (4,169,880 square meters).



- Bosque Río Abajo will not be impacted because Vía Verde will use the existing and already impacted right-of-way of PR-10 in that zone. The total area of this forest is 8.90 square miles (25,050,900 square meters). This forest was fragmented by the construction of PR-10. Vía Verde uses 8.4 miles (13.52 kilometers) of this highway's right-of-way, it avoids further fragmentation of the forest, and does not add to the impacts such as mortality of organisms, the movement of species and the introduction of invasive species.

- Bosque Vega is the only forest that will receive a direct impact with this project. This reserve is fragmented in six portions. Vía Verde will impact one of them. However, the impact will be minimal. The total area of this

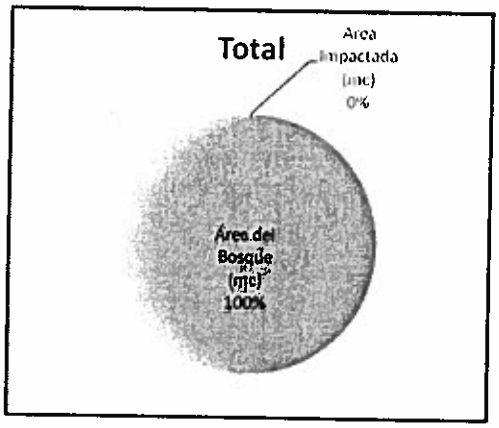
forest is 1.85 square miles (4,791,480 square meters). The portion that will be impacted is 0.46 square miles (1,191,390 square meters). Of these, only 0.0086 square miles (22,274 square meters) will be impacted. These 0.0086 square miles (22,274 square meters) correspond to a length of 0.43 miles (0.69 kilometers) of pipeline that lie in the forest, times the 100 feet width (30.5 meters) of the construction area. This constitutes only 0.47% of the forest that will be impacted temporarily. Of the 100 feet (30.5 meters) of the construction area, 50 feet (15.25 meters) will be reforested, and only 50 (15.25 meters) will be maintained as an operation right-of-way, for which reason the permanent impact is even less and it corresponds to 0.0043 square miles (11,137 square meters) or 0.235%. According to the study titled: *Incorporating Biodiversity Considerations Into Environmental Impact Analysis Under the National Environmental Policy Act*[2], minimizing fragmentation is an important factor in promoting biodiversity. Large areas are better in promoting biodiversity than small areas and connected portions are better than isolated portions. Vega Forest is fragmented into six small portions, of which one will be impacted by Vía Verde. To mitigate that impact on one of these portions, the AEE proposes acquiring land contiguous to some of the portions to connect two isolated portions. This reduces the genetic isolation of the individual species, promotes the natural flow of species, energy, water and nutrients critical to the survival of the ecosystem and improves its ability to tolerate changes. The growth of trees native to this area will be promoted or it will be reforested with arboreal species that improve the ecosystem by providing better sources of food. These land will be dedicated to conservation. This whole process will be conducted in coordination with the DRNA.



- The total area of forests near the project is 12.36 square miles. The total area to be impacted by the project is 0.0086 square miles, or 0.07%. This

[2] Published by the Council on Environmental Quality, 1993.

percentage is graphically imperceptible.



6.3 Impact on Wetlands and Mangroves

Of the 1,191.3 total acres (4,821,070 square meters the project will occupy, 1,494, 416.65 square meters or 369.3 acres of wetlands were identified and delimited over which the U.S. Army Corps of Engineers has jurisdiction. (See Section 3.5.4 of this document). This means that 33% of the alignment will cross over wetland areas. The greater portion of these wetlands is located in the north segment of the alignment, from Arecibo to Guaynabo.

The Project's route in Caño Tiburones will traverse areas of herbaceous wetland, which have been significantly impacted in the past. Herbaceous species predominate in this wetland, identified as invasive species undesired by the federal agencies (for example, *Typha domingensis*). The gas pipeline installation method in these areas will permit that, once the installation is completed, the vegetation that existed before the construction will be substituted by desired species.

The project crosses on the north and northwest side of San Pedro Marsh (Municipality of Toa Baja), where it is associated with the mouth of the Cocal River. In this section the gas pipeline will be installed beneath the root zone of the mangrove trees found in the north of it. The herbaceous areas of this marsh which could be affected by the pipeline construction, are (or have recently been) used for commercial lawn planting.

The project crosses outside the Natural Reserve of the Las Cucharillas Marsh. There will be no filling over the wetlands. The 50 feet wide operation right-of-way allows for the colonization and development of herbaceous and arbustive species, although not of trees, for which reason it is expected that the vegetation adjacent to the operation right-of-way will recolonize this strip after the Project's construction phase. As proposed, the Project will not include the removal of trees in the wetlands. On the occasions in which the rout runs in arboreal wetland areas, the installation of the gas pipeline will be made under the root zone of the trees, using an HDD system. In this manner, once the gas

pipeline is installed, the topographic contours will be returned to conditions that existed before the construction to avoid affecting the hydrology and the natural nutrient movement cycles or patterns.

In the case of wetlands the impact is temporary, during the installation of the pipeline that transports natural gas. As proposed, the Project does not entail permanent impact in the wetlands, so it is not related to cumulative impacts that result from other actions.

The pipeline's installation in the forested areas of Punta Salinas will be made mostly with HDD, which crosses under the trees' root zones. In the other forested areas, which are not in wetlands, where the installation of the pipeline will not be by HDD, the open trench method will be used. The mitigation plan for the Project's impacts will include the necessary measures to compensate for the loss of forest.

It is important to state that the impact on the wetlands will have a temporary effect only during the construction process, because immediately after the pipeline has been installed, the original conditions will be restored. No permanent impact is expected that will be detrimental to the wetlands. Because the nature of wetlands is complex, it is necessary to establish first the subject of the impact, which can be the vegetation, the hydrology, or the soil of the wetland, or the group of species developing in it. The following discussion is in regard to the possible impact to the hydrology of the wetlands due to the installation of the 24-inch diameter pipeline and the anchoring structures necessary to prevent flotation. Wetlands are nourished mainly from direct rainfall, from surface runoff and from the underlying underground water.

Direct rainfall, although it is easy to quantify with the help of a pluviometer, is generally the lesser contributor to the wetland in relation to the water runoff and the subterranean contribution. The amount of water feeding the wetland from the surface runoff and the underground water is a function of the rainfall and the catchment area. Most of the wetlands receive the surface runoff in the form of laminar surface water flow, emerging water courses, man-made ditches, ravines and rivers. The rainfall percolating underground maintains the hydraulic gradient of the underground water that determines the wetland. It is important to mention that wetlands lose water in quantities similar to the direct rainfall, as its area exposed to sunlight is on the one hand, and by plant transpiration on the other. In relation to direct rainfall, the project does not interfere with rain falling on the wetland, all the areas are exposed to rainfall without alteration of the natural condition. The surface runoff will not be impacted either by the installation of the pipeline. Almost all the project is underground, so there will not be any structures on the terrestrial surface that will have the potential to interfere with the surface runoff. Therefore, the inflow of water to the wetlands from surface runoff will not suffer alterations detrimental to the wetlands' hydrology. Although minimally, the flow of underground water feeding the wetlands could be affected by the installation of the pipeline. Appropriate mitigation measures are envisioned for this possibility.

The project's impact on the wetlands area will be reflected in soil disturbances, which

will increase water turbidity, there will be temporary loss of vegetation, and impact to migratory and resident species.

The aquatic species will be impacted by the increase in water turbidity, which diminishes the amount of dissolved oxygen. Although the species can move to other areas of the wetland, it is presumed that there will be some mortality in the excavation area, an impact that is not considered significative. The migratory bird species will be temporarily impacted because the noise of the machinery and the activity of the workmen will keep them away from the area of the project, but they will be able to move to very broad neighboring areas (such as Caño Tiburones and forested land on 41% of the island) and use other areas for rest, food and mating.

On the other hand, the use of motor vehicles could impact the wetland if there are spills of oil or other liquids.

The following measures will be taken to minimize impacts on the wetland:

- Clearing the right-of-way will require the removal of the vegetable cover (including trees) throughout the length of the area at a width of 100 feet. This vegetation will be removed from the area to prevent accumulation and putrefaction. It will be disposed of as non-hazardous solid waste.

- The right-of-way will be demarcated to restrict the removal of vegetation and avoid impact to the wetland outside of this area.

- Erosion and sedimentation control measures will be placed to avoid or minimize entrainment of sediment to other areas of the wetland.

- Vehicles leaking of oil or other liquids that could pollute the wetland will not be permitted. If any spills were to occur during the construction, spill kits will be used to clean the material and the equipment will be removed from the work area.

- Special techniques for construction in wetlands will be used (see Project Description, Construction in Wetlands and Mangroves)

To mitigate the impacts where it is not possible to minimize,

- The AEE proposes to mitigate for the loss of vegetation on site after conducting the hydrostatic test.

- A Mitigation Plan will be prepared and the recommendations of the concerned agencies will be followed.

6.3.1. Forested Wetlands (Mangroves)

The construction area for the project is 100 feet wide. An area 200 feet wide was covered for the flora and fauna studies. Within these 200 feet, an throughout the 92 miles of the alignment, four mangrove areas were found, two in Peñuelas, one in Toa Baja and another one in Guaynabo. Mangrove areas are important to prevent coastline erosion (the protection depends on the tree density), as habitat, nesting sites, recycling nutrients and food for marine organisms. They also filter water and maintain the quality and clarity of the same. Neither the alignment, nor the construction area will impact on this resource because measures have been taken to avoid it. To those effects the alignment was varied in the four mangrove areas so it would not run over the same.

6.4. Impacts Caused by Soil Movement

The movement of soil for the construction of the project is approximately 1,181,966 cubic meters. The major impact of activities that involve deforestation and soil movement is soil erosion and the subsequent sedimentation in the bodies of water. The soil that reaches the bodies of water can degrade water quality by an increase in turbidity, entrainment of pollutants and reduction of the amount of dissolved oxygen, which can interfere with the respiration of aquatic organisms. To minimize this impact incidental to the impact caused by deforestation and removal of the vegetable cover, the AEE will establish an Erosion and Sedimentation Control Plan (CES Plan) and a Stormwater Pollution Prevention Plan (SWPPP), in compliance with the regulations the Environmental Quality Board (JCA) and the EPA have promulgated to those effects. (See Section 6.1.2). The CES Plan is an indispensable requirement for the General Consolidated Permit that will be obtained for the construction of Vía Verde, once we have the certification of compliance with Article 4.B.3. of the Environmental Public Policy Act, Law No. 416 of September 22, 2004 (Law 416).

The movement of soil also generates emissions of fugitive dust that reduce visibility in the atmosphere, transports pollutants and could exacerbate respiratory conditions in susceptible persons. To those effects the AEE will adopt adequate controls to control fugitive dust in compliance with the regulation the Environmental Quality Board (JCA) promulgated to those effects. (See Section 6.1.1). These controls are indispensable requirements for the General Consolidated Permit that will be obtained for the construction of Vía Verde, once we have the certification of compliance with Article 4.B.3. of the Environmental Public Policy Act, Law No. 416 of September 22, 2004 (Law 416).

Although the necessary measures for the control of fugitive dust will be established, there may be a cumulative impact, because it is impossible to eliminate the emissions completely. In certain areas of the project there may be constructions that coincide with the construction of Vía Verde and contribute to increase fugitive dust in the air.

In agricultural areas the movement of soil can cause adverse impacts on agriculture, if there is poor management of the nutrient-rich top soil. There is also soil compaction

due to the traffic of heavy machinery, which could reduce the soil's absorption capacity.

The removal of vegetation increases the potential for the introduction and establishment of invasive species and reduces the habitat available to fauna.

Next we discuss the general measures that will be taken to minimize the impacts of soil movement. The specific measures will be presented with the request of the General Consolidated Permit.

6.4.1. Fugitive dust emissions

The construction of Vía Verde will cause the emission of fugitive dust in all the stages of the project: clearing and leveling of the right-of-way, excavation of trenches and restoration. There will also be emissions during the preparation and operation of the project's Operations Center and the additional work areas. In addition, there could be emissions due to the transport of surplus soil to the landfills.

The following measures will be established to minimize these impacts:

- We will request a construction permit for source of fugitive dust from the Environmental Quality Board.

- We will file a Notice of Intent before the Federal Environmental Protection Agency and we will prepare a Stormwater Pollution Prevention Plan (SWPPP). This SWPPP will be prepared using the EPA guide, Developing a Stormwater Pollution Prevention Plan: A guide for Construction Operators and the accompanying template. This Plan includes the following sections: Site Evaluation and Planning, Best Management Practices to control erosion and sediments, Best Management Practices to control refuse, Best Management Practices for post-construction controls, Inspections, Registration and Record Keeping, Training and Final Stabilization.

- Water sprinkler trucks will be used to sprinkle the construction areas. This includes the right-of-way, soil mounds and Operations Center. This way the soil is kept moist and the amount of fugitive dust dispersed is minimized.

- It will be required that haul trucks use covers to avoid the emission of fugitive dust during the transport of material over the roadways. The covers will be in good conditions and they will be appropriately secured to avoid their coming loose and being moved from their place by the wind.

The following measures will be taken to minimize the impact that soil erosion and sedimentation will have on bodies of water:

- An erosion and Sedimentation Control Plan (CES Plan) will be prepared and filed with the Environmental Quality Board for approval. This Plan will identify the drainage patterns and the areas where control measures such as hay bales and filtering mesh will be installed.

- A Notice of Intent will be filed before the Federal Environmental Protection Agency and a Stormwater Pollution Prevention Plan will be prepared. This Plan will be prepared using the EPA guide, Developing a Stormwater Pollution Prevention Plan: A Guide for Construction Operators and the accompanying template. This Plan includes the following sections: Site Evaluation and Planning, Best Management Practices for erosion and sediment control, (slope stabilization, sediment traps, rip-rap, geotextile mesh fabric, curbs and gutters, velocity dissipation devises); Best Management Practices for post-construction controls; Inspections; Registration and Record Keeping; Training and Final Stabilization.

- The AEE will file a written notice of commencement of activities with the JCA. This notification will be made no later than the fifth (5) working day following the commencement of any activity contemplated in the CES Plan.

- The AEE will file with the JCA progress reports of the implementation of the CES Plan and the development of its activities. The progress reports will be submitted to the Environmental Quality Board monthly, starting with the commencement of the implementation of the CES Plan. Said reports will be prepared and certified by an inspector in accordance with the Regulations for the Certification of Drawings and Documents before the Environmental Quality Board. The Environmental Quality Board may require the filing of reports in different periods than those specified, if they deem it necessary in their judgment.

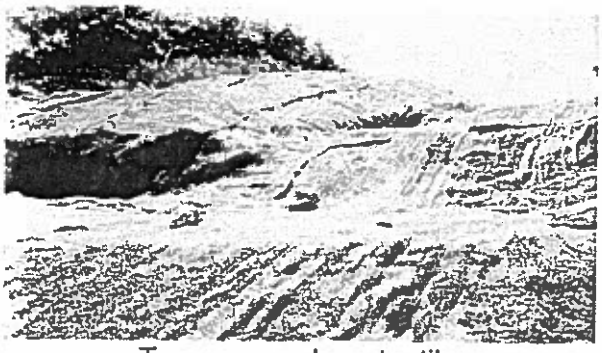
The Erosion and Sedimentation Control Plan

- The construction right-of-way will be delimited to avoid impact to other areas.

- The bodies of water that could be affected by the construction will be identified to protect them.

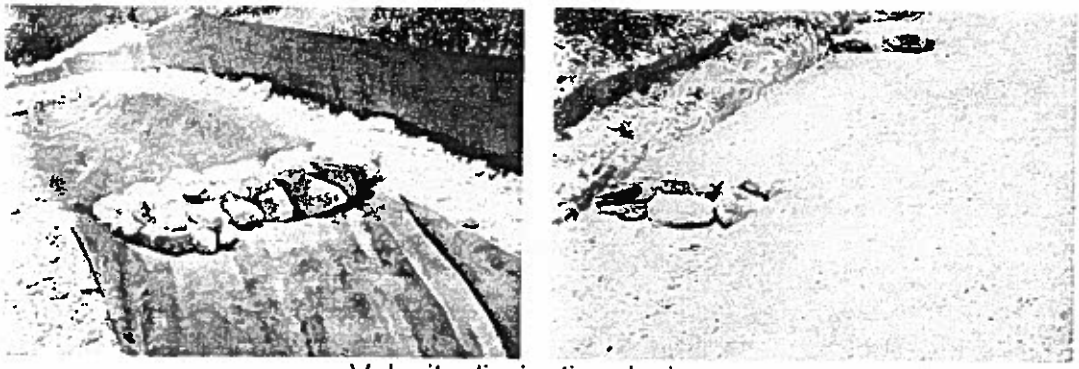
- Drainage patterns to the body of water will be identified.

- Slope stabilization (terraces) to reduce the velocity of runoff water and minimize erosion. Geotextile fabric will be installed to prevent erosion by rain or wind.



Terraces and geotextile

- Velocity dissipation devices will be installed to help minimize the erosion. These structures are constructed with gravel, rocks, sandbags, treated lumber or hay bales.



Velocity dissipation devices

- Protective blankets made of straw, jute, wood or other plant fibers will be used. This control method is used in areas with a high potential for erosion, such as steep slopes and canals, to protect the soil from the impact of rain and erosive runoffs while facilitating the growth of vegetation.

- The soil mounds accumulated when clearing the right-of-way will be covered with geotextile and a silt fence and hay bales will be placed around them. This material will be stored adjacent to the trenches and, as soon as the pipeline is laid, it will be reused to fill the same. The remainder will be carried to an authorized landfill.

- Longitudinal and transversal furrows and velocity dissipation devices will be constructed to redirect the water and reduce its velocity in mountainous areas.

Longitudinal/transversal furrows and velocity dissipation devices

- Rip rap of large boulders will be installed to protect the soil from erosion in areas of greater runoffs.

- Sediment traps will be installed at runoff discharge points in the construction area. To construct the trap a catchment area will be prepared and rocks of different sizes will be placed in it to control the runoff discharge.

Sediment Trap

- Geotextile will be installed as a separator between the soil and the rip raps to maintain a solid base.

- The vegetable cover removed during the right-of-way clearing and leveling stage will be mechanically shredded and reused as wood chips for erosion control in slopes, as allowed by Law 70 of September 18, 1992, Puerto Rico Solid Wastes Reduction and Recycling Act, as amended. The machinery to be used for shredding is a Morbark wood grinder and it will be placed near the work areas in the construction right-of-way. The shredded material will be stored at the work site and it will be covered with tarpaulin and hay bales will be placed around the mound to prevent it from dispersing in case of rain or wind. It will be used in near the areas where it was shredded to implement erosion control, together with other measures.

- A silt fence will be installed together with rectangular hay bales in the perimeter of the right-of-way to contain the entrainment of sediments.

- Tire washing stations will be constructed to avoid the transport of sediments to the public roadways.

Tire washing station

- Entries to Operation Centers will be stabilized.

- Hay bales will be used to protect storm drains, where applicable.

- An Inspection Program will be established to insure that the measures that are installed are functioning adequately. Deteriorated measures will be replaced or reconditioned. Inspections will be made weekly and after rain events.

With the implementation of all these measures and others, which are identified as necessary by the project's Environmental Coordinator at the moment of construction, it is estimated that the impact to bodies of water will be minimal.

6.5. Impact on the Karst Zone and other Geologically Vulnerable Zones

Although efforts were made to avoid crossing through the Karst zone, where you find sinkholes or caves in porous rock or soils eroded by water, a small part of the project will cross through some portions of said zone. The protected Karst zone in Puerto Rico is some 151 square miles according to the shapefile of this resource for the ArcGIS ArcMap 9.2 software program, of the Department of Natural Resources (August, 2010). Of these total of square miles, Vía Verde will cross through some 0.08 square miles. This is equivalent to a construction area 100 feet wide, along a swathe 3.91 miles long in the Karst zone. In percentage terms, Vía Verde will cross through 0.05% of the Karst zone protected in Puerto Rico.

The Karst zone is a habitat for unique plant and animal species, so all possible measures will be taken to avoid impact to protected species and in the case of non-

protected species there will be mitigation. To ensure that no protected species is disturbed, there will be a biologist in the project at all times during construction in the Karst zone. This biologist will carefully evaluate the area before the introduction of personnel or construction equipment in the same and will adopt measures to avoid and minimize impacts on the Karst physiography, such as the relocation of species, realignment of the pipeline and drilling through the mogotes, instead of making a cut across them.

The construction process will be carried out so that only light, Bobcat-type equipment enter the Karst zone to minimize the possibilities of damage to the same. Erosion and sedimentation controls adequate to the area will be established to protect the surrounding areas and prevent the sediment from reaching underground water. This Plan will be filed at the moment of requesting the Consolidated General Permit and it will comply with what is set forth in Section 6.1.2. The operation centers or auxiliary construction spaces will be located outside of the Karst zone and the installation of the pipeline will be made using the pulling method to minimize the presence of heavy equipment in the zone. The backfill material will be adequate to permit the soil's hydraulic capacity, since the same material removed will be used to refill the trenches. In case additional material is required, the same will be selected in accordance with the geotechnical studies of the area. These studies will be completed before finalizing the design of the project. Vegetation will be planted in the area surrounding the 50-foot operation right-of-way. Said vegetation will consist of native grasses and trees and it will be made immediately after having covered the trenches in a 3:1 proportion.

During the operation phase, the project areas in the Karst zone will be inspected, as part of the pipeline patrolling program. Nevertheless, special attention will also be given to the soil conditions so that any erosion that can be observed or detected is corrected. In addition, through the observance of the previously mentioned control measures, no deterioration to the mogotes will be caused, so the hydraulic function of the Karst zone will not be affected.

Vía Verde will traverse through geologically vulnerable areas with geologic limitations. According to the geologic information that has been evaluated for the project these geologic limitations do not represent major challenges or problems to the project. This is so because the same can be addressed during the design and construction stages.

To be able to address the geologic limitations, what is most important is to identify them, evaluate their location with regard to the project and know their characteristics. This is the essential information for planning the project, because it determines the subsequent studies that must be carried out before completing the design and during the construction. The geological limitations can be addressed in two ways at the design stage: either they are avoided by realigning the pipeline in those sections that could be impacted by some geologic condition or process, or engineering measures are provided to minimize or eliminate the geologic risk. Once these risks have been addressed during the design stage and the construction stage has commenced, they are observed

and the geologic and geotechnical information is documented. This has a double purpose: confirming that the conditions of the subsoil coincide with those on which the design was based, particularly in sections that require engineering controls, and it facilitates a rapid response to any finding of unfavorable conditions of the subsoil during this stage.

The geologic limitations that are being evaluated, and which were commented during the Public hearings at the JCA are:

1. Slide-prone soils[3]; several sections, which include the Cordillera Central, run through terrain whose geology and topography make them susceptible to slides.

2. Sinkholes - two sections of the alignment cross parts of Puerto Rico's Northern Karst Zone.

3. Liquefaction - a section in the south coast and one in the north cross through young soils (in geologic terms) which are saturated by the watertable. These include sandy soils of little compaction that are susceptible to liquefaction during a strong earthquake.

4. Geologic faults - the alignment crosses the Great Southwestern Puerto Rico Fault Zone.

5. Soft soils - along the section that runs south of Caño Tiburones and locally in alluvial valleys and costal plains of the route.

6. Erosion - The alignment crosses 10 named rivers and many secondary stream beds that are subject to erosion during rising waters. Likewise, the costal sections could be exposed to marine erosion, particularly considering the rise in the ocean level that started at the end of the last glacial period and which is compounded by global warming.

The potential impact of these limitations is variable and is described in the following paragraphs, together with a general discussion of available measures to minimize or eliminate its possible effects.

Slides

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3 To the effects of this document, the term 'slide' refers to all downslope movements of masses of soil, rocks and/or a mixture of both. A variety of types of slides occur in Puerto Rico which are distinguished by the velocity of the movement and by the manner in which the affected terrain is displaced, for example: falls, rolls, flows or translational movements.

The presence of deep residual soils, highly fractured rocks and a multitude of moderate to severe slopes are favorable conditions for the occurrence of gravitational movements, for which reasons slides are ubiquitous throughout the Cordillera Central, since it is the principal agent of geomorphic evolution in the region. For this reason any construction project in this area must take in consideration, in a greater or lesser degree, the potential for slides.

The greatest danger slides present to Vía Verde is a break in the pipeline due to the supporting ground giving way, and sliding, flowing or collapsing downhill. Since the pipeline will be buried at a depth of 4 feet at the minimum, which protects it from material that could fall from above, the impact of a slide occurring at a higher elevation of the alignment would tend to be limited to the pipeline access and maintenance works. At the same time, the project does not require the construction of significative cuts and once completed, it does not create a condition of increase in the susceptibility to slides, except in the measure the trench could affect the infiltration of water into the subsoil, a situation that is addressed through its design and construction. In fact, the pipeline weights less than the soil it displaces, so that contrary to most construction works, it does not produce an increase of the loads on the subsoil.

Soon to commence is a study of photointerpretation and field recognition to evaluate the potential for slides along the route of Vía Verde. This entails the identification of old slides, some of which could continue to be active or could reactivate, and sections whose geology and topography indicate the potential of instability if the project proceeds without adequate controls. The study will cover the following sections: the crossing of Seboruco Hills, the ridges and hills of the piedmont south of the Cordillera, and the mountains of the Cordillera between Peñuelas and Utuado. Also to be evaluated are three short stretches where the alignment crosses one of the limestone cliffs that form the banks of the Grande de Arecibo and Manatí rivers and Río Indio in Vega Baja.

In case any stretches were to be found on old slides or in terrain with potential for instability, we will proceed to evaluate the options of realigning the route or implement engineering measures to stabilize the soil. One variant of the realignment is to deepen the line with Horizontal Directional Drilling (HDD) to cross beneath the unstable soil. There will be cases in which the final decision will require additional geological evaluations and detailed geotechnical studies, which would in turn provide the criteria to implement the HDD option or to design stabilization measures. Regarding the latter, they seek to improve the balance between the forces that resist the movement of a mass of soil and/or rock and the forces that induce it to move. There is extensive literature on the diverse techniques and structures to achieve this improvement, many of which have already been applied in Puerto Rico. The decision on realignment and the stabilization works to be used will depend on the geologic and geotechnical characteristics particular to each section of interest.

Sinkholes

The Geotechnical, Geological and Geophysical Engineering techniques allow us to study sinkholes in depth and in consequence to make recommendations, be it for highways or rights-of-way (AAA or AEE). In this manner it is possible to design these projects so that the flow into the sinkhole is never blocked. Therefore, the soil where the sinkhole is located is never compacted or covered, rather it is habilitated to continue receiving stormwater runoff.

Usually the term 'compact' is used as a synonym for refilling with processed allochtonous material, which in typical cutting and filling projects has relatively low permeabilities. The case at hand is not a typical cut and fill project. The sinkhole is habilitated with filters designed to permit the flow of water whenever the project requires it.

Techniques in geotechnical, geologic engineering and geophysics allow us to model the sinkholes in two and three dimensions. This permits us to evaluate and analyze the sediments naturally accumulated in the bottom of the sinkholes and the limestone rocks underlying the sinkhole, which are at the same time the walls of the sinkhole.

Studies made during the 80's, 90's and 2000 decades have contributed to our knowledge of the formation and the hydraulic mechanics of sinkholes. This includes the detection of cavities in the sediments and cavities in the limestone rocks.

Regarding the publication "Karst Formation in Puerto Rico, a Vital Resource", the three problems they mention (differential compaction, suffusion and cavity collapse) have been considered in projects already made in Puerto Rico during the past 30 years (i.e.: PR-10 between Arecibo and Utuado) and will be considered in the Vía Verde project.

Hydrology and hydraulics techniques, added to water injection tests in water injection wells, all of it monitored by water flow and amount of precipitation gauges at different periods of recurrence, has allowed us (since the 1980's) to establish: a)the sinkhole's filtration capacity, and b)the filtration capacity of the same sinkhole after habilitating it with filters designed to permit (and not restrict) the flow of water into them.

This type of design is a multidisciplinary one in which Geotechnical Engineering is combined with the design of pipelines, highways, hydrology-hydraulics of each sinkhole, Geophysics (including surface seismic refraction, seismic refraction inside a drill-hole (Vertical Seismic Profiling, Down-hole Seismic Refractions, Cross-Hole Seismic Refraction)), electrical conductivity and resistivity, magnetism studies, micro-gravity studies, radar, dye tests between sinkholes, and studies of fractures in the Karst at a regional level (Fracture Analysis Using Remote Sensing Techniques).

Figures 1 and 2 show an example of projects designed and constructed in Puerto Rico. These studies were conducted during the 80's and 90's, with what was known as "State

of the Art". **Figures 3,4,5, and 6** show interpretations made with the same methods, but now with new techniques that allow us to visualize the sinkhole in three dimensions.

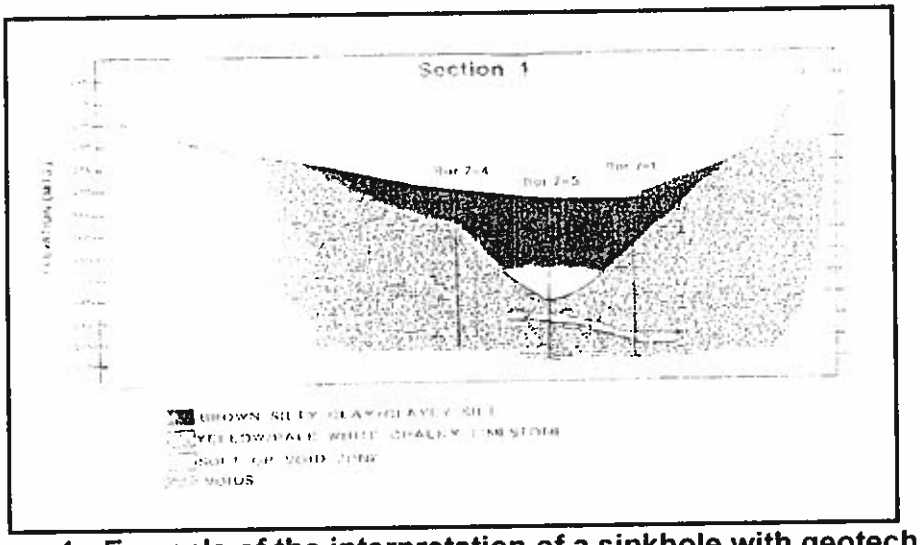

Figure 1 - Example of the interpretation of a sinkhole with geotechnics and geophysics.
1983 to 1990. (Rodríguez & Vázquez - 1999)

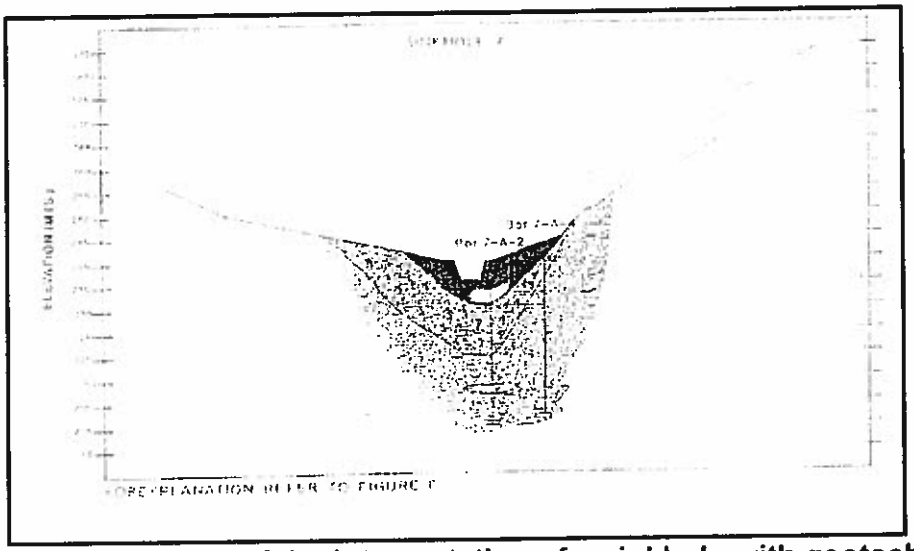

Figure 2 - Example of the interpretation of a sinkhole with geotechnics and geophysics.
1983 to 1990 (Rodríguez & Vázquez - 1999)

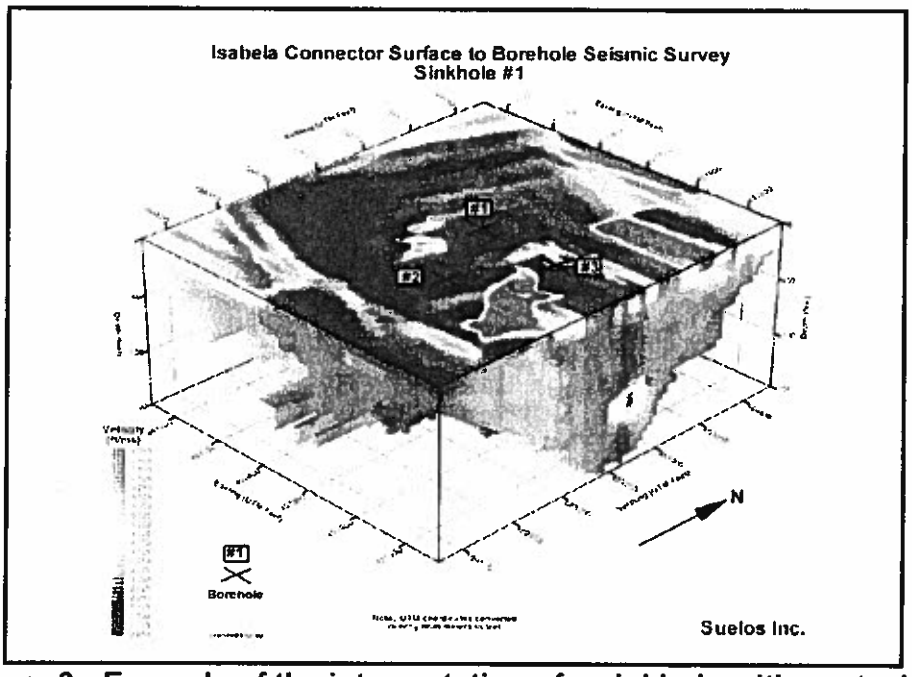

Figure 3 - Example of the interpretation of a sinkhole with geotechnics and geophysics. 2005

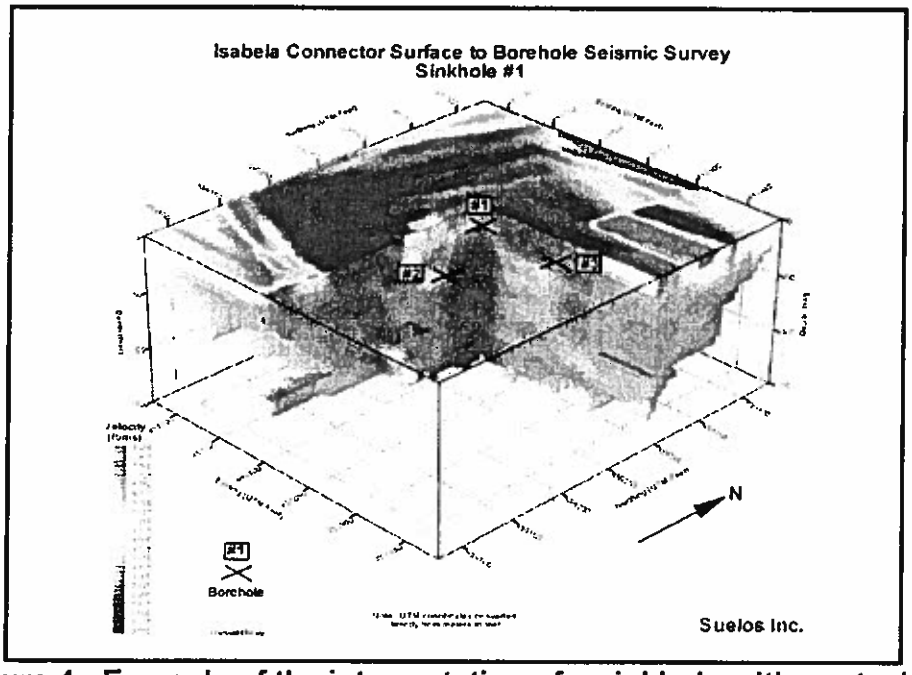

Figure 4 - Example of the interpretation of a sinkhole with geotechnics and geophysics. 2005

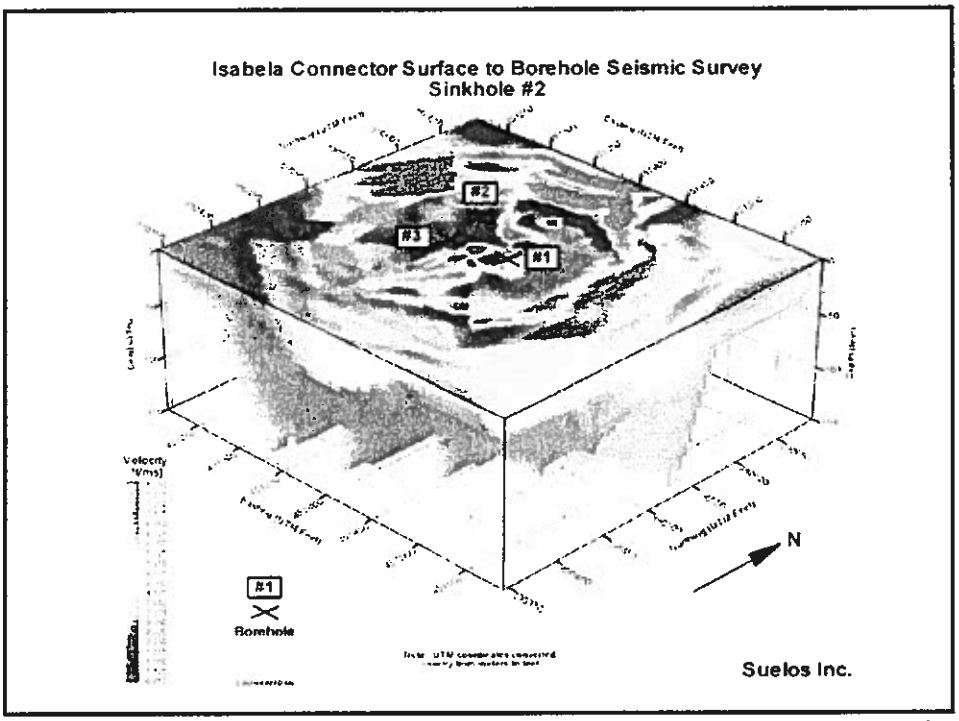

Figure 5 - Example of the interpretation of a sinkhole with geotechnics and geophysics. 2005

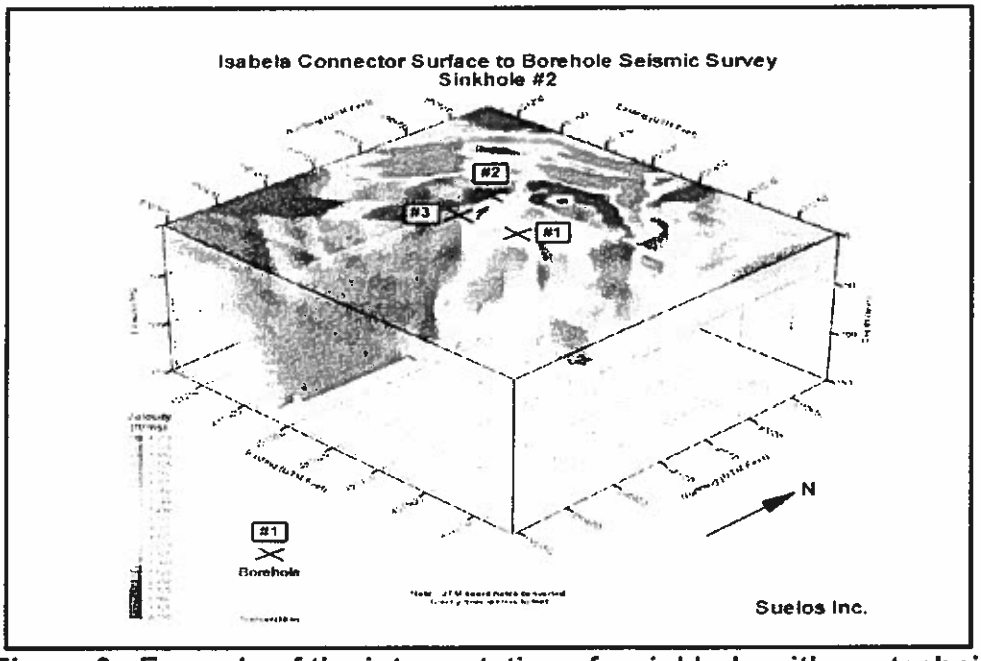

Figure 6 - Example of the interpretation of a sinkhole with geotechnics and geophysics. 2005

Figures 7 and 8 show sections of recommendations for said sinkholes. The objective was to issue the free flow of stormwater runoff using inverted filters and instrumentation to monitor the behavior of the filter during the construction of a highway.

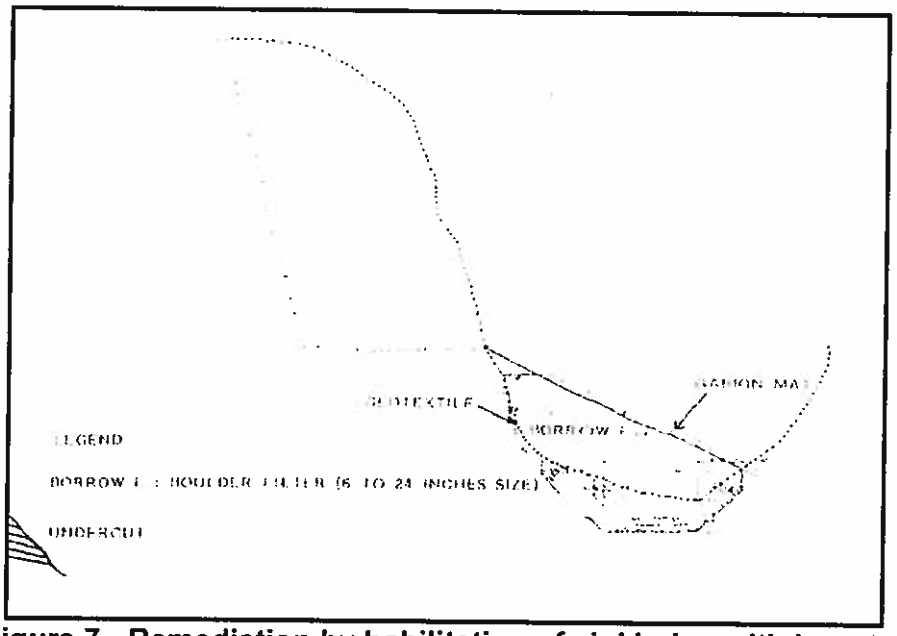

Figure 7 - Remediation by habilitation of sinkholes with inverted filter. (Rodríguez & Vázquez 1999)

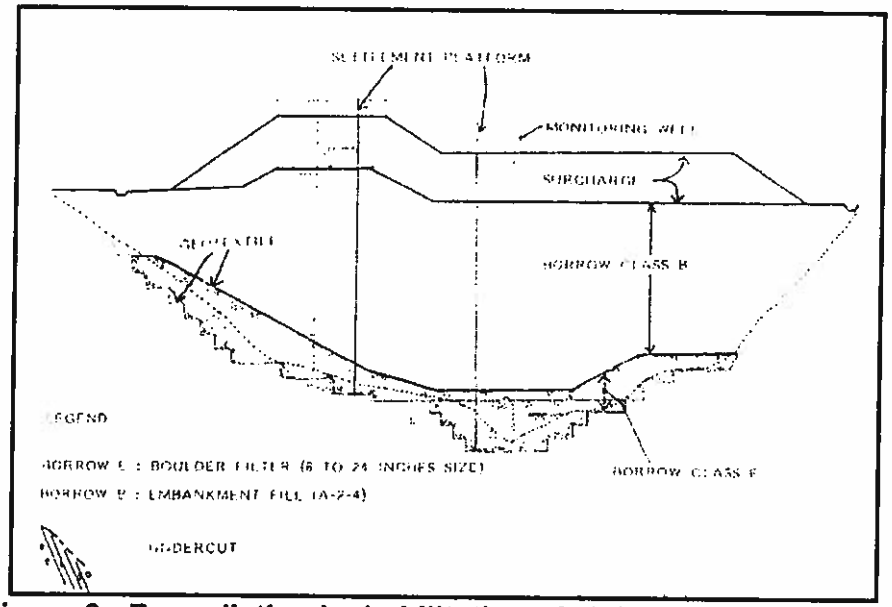

Figure 8 - Remediation by habilitation of sinkholes with inverted filter. (Rodríguez & Vázquez 1999)

These are some of several alternatives that will be evaluated to optimize the installation of the pipeline and reduce to a minimum the impacts on sinkholes.

The Vía Verde project does not compare with PR-10 between Arecibo and Utuado in the magnitude of Vía Verde. While earth movements of great magnitude were made in PR-10 to accommodate the highway and the embankments, in the case of Vía Verde the construction is for the installation of a 24-inch diameter pipeline. The habilitation of sinkholes would be considerably much less than that of a highway like PR-10 or the Isabela Connector (where 5 sinkholes adjacent to the already constructed and operating Connector were habilitated).

Another alternative to be evaluated is moving the alignment around the edges of the mogotes. Also, the use of the HDD installation method can be combined with a layer of filter. In that way we can explore the alternative of drilling through the walls of t he sinkhole at a minimal elevation which would allow us to install a minimum of filters.

The alternative selected after all the required studies mentioned before will be evaluated including the technical and the economical aspects.

The route presently is located over large part of the Karst platform in the north of Puerto Rico from where it crosses PR-10 near the Dos Bocas Reservoir. From then on, it will be located along the highway's right-of-way. The highway and the right-of-way were treated during the 90's during the construction of PR-10 between Arecibo and Utuado, through the habilitation of 12 active sinkholes. These 12 active sinkholes were treated and habilitated as in the examples shown in **Figures 1 thru 4**.

There will be no negative effect in the already constructed treatment of these 12 sinkholes. In those portions in which it crosses over the filter treatment, the pipeline's effect on the sinkholes' filtering capacity will be practically negligible. This effect can be calculated and balanced over the capacities for which they were originally designed.

The project will not affect the mitigation measures taken for the construction of PR-10 in what concerns the Karst zone. Geotechnical and geophysical studies will be conducted to avoid impacting sinkholes or aquifers, or the integrity of the project. Projects of the magnitude of PR-10 were constructed under the full-time supervision of geotechnical engineers, geologists and biologists. Vía Verde will also have that type of full-time supervision on the critical zones.

Liquefaction

The stretch of Vía Verde that runs from the EcoEléctrica terminal to the Tallaboa River valley in Peñuelas and that extends from the area known as El Cocal to the Bayamón River in Toa Baja, traverse over land that contains sandy soils susceptible to become liquefied during a strong earthquake. Liquefaction is a phenomenon that occurs mostly in fine loose sands (poorly compacted) that are saturated, that is, that have the spaces

between the grains (voids) full of water. What happens is that during the earthquake, the grains of sand tend to be compacted and rearranged. The collapse of the soil compresses the water present in the voids, which not being able to drain quickly, exerts an opposite pressure against the grains. Where this pressure is equated to the weight of the grains, the sand loses all frictional resistance and behaves like a fluid. The greatest danger this represents to Vía Verde is the dislocation of sections of the pipeline in stretches in which the soil surrounding it liquefies, or if it sinks or slides over a deeper deposit of liquefied sand.

In the Levittown Coast stretch, the pipeline will be installed through the HDD technology. This will permit locating it at depths greater than 50 to 60 feet. Soil at these depths exhibits greater compaction, therefore they are more stable and not prone to liquefaction. In this way, the risk of a possible liquefaction of the costal soils affecting the pipeline's stability is eliminated.

Geological Faults

Between Peñuelas and Adjuntas, the route crosses the Great Southwestern Puerto Rico Fault Zone, one of the principal structural features of the geology of the Island. Comments have been raised about the possible activity that the faults comprising this system, and the impact they could have on the pipeline, both in the sense of some fault breaking the ground surface and/or producing an earthquake near the pipeline.

The concept of the activity of geological faults is one of which there is no precise definition. On the contrary, there are multiple definitions, many of which are codified in regulations and protocols of governmental entities. Most of them are based on the following criteria:

1. That there is historical and/or geological evidence of a break along the fault in recent times, for which different entities specify different periods, such as the Holocene Epoch (the past 10,000 to 20,000 years) or the Quaternary Period (the past 2 million years, which includes the Holocene). The geological evidence can be of several types, including Holocene or Quaternary soil or rock that has faulted, and a range of geomorphic traits produced by movements along the faults, such as fault scarps, lineal valleys and river or coastal terraces, among others.
2. Seismic information of adequate precision that relates the seismic activity with the fault in question.
3. That the fault has a structural relationship to another fault that complies with one of the previous criteria.

It is instructive to look at the time some regulators use in the definition of activity. The Federal Government's Nuclear Regulatory Commission uses the past 500,000 years as the evaluation criteria for the construction of nuclear power plants, structures on which

the impact of a fault movement could be catastrophic. The U.S. Army Corps of Engineers uses a term of 35,000 years for the construction of dams, another type of structure whose stability is critical for thousands of citizens. On the other hand, the State of California stipulates a term of 11,000 years (Holocene) as a zoning element. The construction of most structures for dwelling or extended use by humans is prohibited within a 30-meter strip of any active fault, but the construction of other types of structures is not restricted as long as they are designed and constructed with the necessary provisions to insure the safety of citizens.

The Great Southwestern Puerto Rico Fault Zone consists of a series of geologic faults generally oriented from southeast to northwest that were identified by the Federal Geologic Service (USGS) in the 60's and 70's when the region's geologic quadrangle maps were prepared.[4] The maps illustrate the traces of the faults with thick lines whose continuity indicates the reliability of the location shown: a continuous line represents a fault located with a fair amount of certainty, a broken line indicates an approximate location and a dotted line, which means that the presence of a fault is inferred, which fault is presumed to be buried by soil or rocks of lesser age and cannot be observed directly. Throughout the Great Southwestern Fault Zone, the continuous and broken lines occur in rocks that date from the Cretaceous to the Miocene, that is, rocks that were formed more than 5 million years ago. Where the trace crosses alluvial sediments of the Quaternary period (which comprises the past 2 million years), the faults are identified with dotted lines. This indicates that the faults have not impacted the recent sediments. Nor is there geomorphic or seismological evidence that points to some recent activity, for which reason the faults are considered as inactive or incapable of seismic movement. Nevertheless, and to ensure the safety of the people, the AEE will evaluate and document the geology of the excavation in the stretches that cross the charted faults to confirm their inactivity.

On a related matter, the evaluation of the seismicity of the Vía Verde route in relation with the pipeline's seismic-resistant design, has been questioned. Regarding this, the pipeline will be designed and constructed in accordance with the requirements of the Puerto Rico Construction Code and the applicable state and federal rules. It bears pointing out that typically, the cases of damage to underground pipelines that have occurred during earthquakes are due to some type of flaw in the soil in which they are

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One of the comments made during the Public Hearings questions the validity of the geologic maps because they were prepared 50 to 60 years ago. Although they suffer changes related to meteorization or possible erosion or sedimentation, the soils and rocks present in a place are generally the same as those that were there 50 or 60 years ago, unless the site had been impacted by a major event such as a great landslide or a break and displacement along a geologic fault, events we know have not occurred since the maps were made (we could also include human activities related to the excavation and fill as possible agents of change). On the other hand, the USGS maps are official documents used for planning processes by the concerned state and federal governmental entities.

buried, for example, landslides, liquefaction, settling, or break of a geologic fault, problems that are addressed with the previously mentioned studies.

Soft Soils

As mentioned before, the weight of the pipeline and its contents is less than that of the soil removed to place it in. This nulls the settling problem characteristic of soft soils, therefore the presence of weak soils is more a construction than a design problem, particularly in relation to the movement of construction equipment and the project's personnel.

Erosion

There are 3 aspects to the erosion problem that are being evaluated. The first one is the potential of erosion that could undermine the pipeline at river crossings. The preliminary design of Vía Verde provides that the pipeline will pass under the bed of all the rivers and major ravines of the route, for which reason it is understood that the erosion of the channel and riverbed that could occur in those bodies of water will not have an impact on it. These sections of the project will be constructed using the HDD technique in which the drilling begins at a safe distance from the channel and runs under the riverbed at an adequate depth, which is determined through a subsoil exploration program with geotechnical drilling, an activity that is being currently undertaken.

The second aspect is the potential of erosion by the action of the waves in the stretch that runs near the Atlantic Ocean coastline. This is the stretch between El Cocal and the Bayamón River in Toa Baja. Soon will commence a photogrammetry evaluation that will evaluate the stability of these stretches of coastline during the past 70 to 80 years in terms of erosion and sedimentation, and it will serve as the basis to determine the need to implement protection measures against erosion caused by ocean waves. It bears mentioning that these stretches are generally the same in which the presence of liquefiable soils was identified, and that to minimize the potential of liquefaction and costal erosion, the pipeline will be installed by HDD at depths of 50 feet or more, which will protect the pipeline from the action of the waves. For this reason, Vía Verde will not affect the dunes or the coastline, therefore, during the construction and operation phases there will be no impact in the Levittown Coast stretch.

Finally, and certainly the AEE's greatest concern, is the potential of erosion in soils exposed by stormwater runoffs during the project's construction phase and subsequently in the long term. This will be addressed through the incorporation of strict short and long-term control measures in the design and the specifications for the project's construction, and a meticulous inspection of the functioning of these during and after the construction.

6.6 Impacts on Agriculture

In Peñuelas there will be a small impact on the Peñuelas, Guayanilla and Yauco Agricultural Reserve. This Reserve has a total area of 2,019,917 square meters and the temporary impact area will be 18,636 square meters, which equals 0.9% of the total Reserve area. In addition, once the project is completed in that area, agricultural activities will be able to continue in the same. The farmer will be indemnified by the AEE for the temporary damages. In addition, there is a farm where improved pasture is cultivated, the same is owned by Lucas Pérez Valdivieso and is divided in two parcels: 387-000-002-44 and 363-056-212-02.

Fifteen farms were identified in Adjuntas in which coffee is mostly cultivated and other crops such as citrus. The information of those farms is included below:

Cadaster Number	Titleholder	Crops
291-000-001-039	Charles H. Morgan	Not in use
291-000-001-038	Jose E. Carrillo Norat	Not in use
290-000-005-048	Unknown	Coffee
267-000-006-27	Jorge Ballester	Coffee
267-000-006-035	Sucn. Ramon Gonzalez Sotomayor	Coffee (the cultivated area is not affected)
267-000-006-59	Francisco López Atienza	Coffee
267-000-006-56	Unknown	Coffee
267-000-006-27	Unknown	Coffee
267-000-006-35	Unknown	Coffee
267-000-006-56	Unknown	Coffee (The cultivated area is not affected)
266-050-147-02	Unknown	Coffee
266-000-005-71	Unknown	Coffee
266-000-005-16	Unknown	Coffee
266-000-005-17	Unknown	Coffee
240-000-009-39	Luis Juan Ramos Santiago (Hacienda Central Pellejas)	Improved pastures

Ten farms were identified in the Municipality of Utuado in which coffee is mostly cultivated and other crops such as citrus. The information on these farms is included below:

Cadaster Number	Titleholder	Crops
214-000-004-14	Luis Juan Ramos Santiago (Hacienda Central Pellejas)	Improved pastures
214-000-009-34	Sucn. Juan Avila Rivera	Plantains
214-000-009-15	Juan Reyes Rivera	Coffee
214-000-009-25	Unknown	Plantains and coffee
214-000-009-16	Sucn. Juan Avila Rivera	Coffee
214-000-009-01	Unknown	Citrus, coffee and plantains
214-000-003-70	Sucn. Juan Avila Rivera	Citrus, coffee and plantains
214-000-003-48	Juan C. Cortes Lugo	Plantains
214-000-003-51	Juan C. Cortes Lugo	Plantains
214-000-003-23	Unknown	Plantains

Among the farms in Utuado, inside Hacienda Central Pellejas, there is a parcel with the FWS designation as a perpetual conservation easement and with approved permits for agro-touristic developments.

In the north of the island the farms identified belong to the Lands Authority (AT). These farms are identified in the following table:

Farm	Town	Use
Las Mercedes	Arecibo	Pastures for cutting
San Francisco	Arecibo	Pastures for cutting, milk cattle, government, natural reserve
Santa Bárbara	Arecibo	Pastures for cutting
Monte Grande	Arecibo	Pastures for cutting, autodrome, milk cattle, improved pastures
Tiburones Liza	Arecibo	Natural reserve, pastures for cutting
Garrochales	Arecibo	Landfill, pastures, natural reserve
Mendoza	Barceloneta	Sludge injection, pastures for cutting
Higuerito	Barceloneta	Pastures for cutting, cattle ranching, sludge injection
La Luisa	Manatí	Hay pastures, milk cattle
Sucn Vázquez Escobar	Vega Baja and Manatí	Pineapple farms

Carmen	Vega Alta	Transmission towers, forests
La Julia	Dorado	Agro-touristic park
Constancia	Toa Baja	Lawn planting, ornamental plants

Part of these farms are used for agriculture. Mostly they are planted with pasture for cutting and animal feed. The farms are also leased for activities such as: installation of transmission towers, autodrome, sludge injection and cattle ranching.

No pineapple groves were observed in the area of Barceloneta. These crops were found between miles 61.4 and 63.4, between the Municipalities of Manatí and Vega Baja. The same will be impacted with the 100-feet construction right-of-way. There will be coordination to construct in a season in which the impact is minimized. In case the impact is unavoidable, the AEE will indemnify farmers for their losses.

The Toa Valley in Toa Baja is catalogued as specially protected rustic soils with conservation of resources. Vía Verde is compatible with this category because it will only present a temporary impact and after the construction the indicated uses can continue in effect.

The potential impacts on agricultural lands will include: Loss of crops, interference with agricultural drainage, loss of topsoil, soil compaction and impact to irrigation systems. Most of the impacts will be temporary, others will be permanent. The AEE will acquire a 150-foot wide right-of-way. Once construction ends, the lands can be used for planting again. The planting of trees whose roots could interfere with the pipeline will not be permitted.

The AEE will consult with the AT to determine the crops planting and harvesting seasons and establish the date when there would be less impact on agriculture. According to data from the AT, most of the crops are pastures and they are planted and harvested year-round. In all lands in active cultivation, the farmer affected will be indemnified for his damages. The AEE will pay for the damages caused by crop losses. The owner will be explained of the procedure he must follow to file his claim. Once the project's construction is completed, the farmers will be able to use the operations right-of-way to continue their crops, as long as they are short-rooted, such as vegetables, legumes and grasses.

As a measure to minimize the impact to sections of agricultural lands, the surface portion of the soil, or topsoil (the first 12 inches in depth) from the rest of the soil, and it will be stored to reuse it during the restoration stage. While this soil is stored, for a period no longer than a week under normal conditions, it will be covered with tarpaulin or natural covers to protect its quality and composition. Erosion control measures will also be implemented to avoid loss of nutrients in the soil and the surface terrain will be

decompacted to facilitate planting and water absorption. (See Section 6.4.2). Before starting the works in agricultural fields, the AEE will consult with the Department of Agriculture to obtain their recommendations with respect to the additional mitigation measures that should be implemented in each type of activity.

Control measures to protect alluvial aquifers that will be discussed in Sections 6.4 and 6.5 will be implemented. In addition there will be coordination with expert personnel from the Federal Department of Agriculture to obtain their recommendations for the protection of these aquifers.

The AEE will coordinate with the owners or lessees of the agricultural lands so they will identify the location of the irrigation systems, if any, and to provide copies of the available drawings, if available. In addition, there will be coordination with the owners of farms dedicated to agribusiness, to know the details of the cattle's movement patterns. Temporary bridges will be created over the trenches to permit the passage of animals, if the owner so requires. Otherwise, the work area will be cordoned off to prevent access to it by the animals. The owners or lessees will be notified, and coordination will be had with them to provide entry to the farm for the construction works.

Regarding the cumulative impact on agriculture, many of the agricultural areas have been impacted by earth movement activities for many years. The movement of earth can accelerate the erosion of the soil and the loss of topsoil and nutrients. This can result in low production and the excessive use of fertilizers to compensate for the lost resources. Notwithstanding, the impact of Vía Verde, although unavoidable in these areas, is temporary. The quality of the topsoil should not be affected because it will be relocated from where it was removed, after being protected while the construction is carried out, so Vía Verde will not contribute significantly as regards cumulative impact.

6.7 Impacts on Superficial Bodies of Water

The possible impacts on bodies of water are: sedimentation, pollution due to spills, increase in turbidity, mortality of species, reduction of dissolved oxygen. Control measures to minimize these impacts that will be identified later will be implemented. In the event of a break in the pipeline in which the gas has to cross through a body of water before escaping to the atmosphere, the amount of gas that will dissolve in the water will be minute because the solubility of methane in water is 0.0022%. However, if the body of water is in movement, the gas will go quickly into the atmosphere due to the aeration process.

Two-hundred four (204) bodies of water through which the project will cross have been identified. This includes rivers, ravines, canals and a wetland. Some of these bodies of water will be crossed by open trench. When crossing by open trench, the trench is excavated while the body of water continues to flow through the 'dam and pump' method. This is the quickest method to cross small bodies of water.

Higher-volume bodies of water, such as rivers, will be crossed with the horizontal direct drilling method (HDD). HDD is considered a 'dry' crossing method because it does not interfere with the flow of water. This information is presented in the following table:

Bodies of Water and Type of Crossing

T1-Horizontal Direct Drilling T2-Flume pipe, Dam and Pump T3- Open Trench

ID	Body of Water	Type of Crossing	Town
ID	Cuerpo de Agua	Tipo de cruce	Pueblo
C1	Canal	T1	Peñuelas
C2	Canal	T1	Peñuelas
C4	Canal	T3	Peñuelas
C5	Río Tallaboa	T1	Peñuelas
C6	Quebrada sin nombre	T3	Peñuelas
C7	Quebrada sin nombre	T3	Peñuelas
C8	Quebrada sin nombre	T3	Peñuelas
C9	Quebrada sin nombre	T3	Peñuelas
C10	Quebrada sin nombre	T3	Peñuelas
C11	Quebrada sin nombre	T3	Peñuelas
C12	Quebrada sin nombre	T3	Adjuntas
C13	Quebrada sin nombre	T3	Adjuntas
C14	Quebrada sin nombre	T3	Adjuntas
C15	Quebrada sin nombre	T3	Adjuntas
C16	Quebrada sin nombre	T3	Adjuntas
C17	Quebrada sin nombre	T3	Adjuntas
C18	Quebrada sin nombre	T3	Adjuntas
C19	Quebrada sin nombre	T3	Adjuntas
C20	Río Pellejas	T2	Utuado
C21	Quebrada sin nombre	T3	Utuado
C22	Quebrada sin nombre	T3	Utuado
C23	Quebrada Arenas	T3	Utuado
C24	Quebrada Arenas	T3	Utuado
C25	Quebrada Arenas	T3	Utuado
C26	Río Grande de Arecibo	T1	Utuado
C27	Quebrada sin nombre	T3	Utuado
C28	Quebrada sin nombre	T3	Utuado
C29	Quebrada sin nombre	T3	Utuado
C30	Quebrada sin nombre	T3	Utuado
C31	Río Grande de Arecibo	T1	Utuado
C32	Quebrada sin nombre	T3	Utuado
C33	Quebrada sin nombre	T3	Utuado
C34	Río Grande de Arecibo	T1	Utuado
C35	Quebrada Jobos	T3	Utuado
C38	Quebrada sin nombre	T3	Arecibo
C39	Río Tanama	T1	Arecibo

C40	Ditch	T3	Arecibo
C41	Canal Perdomo	T3	Arecibo
C42	Ditch	T3	Arecibo
C43	Rio Grande de Arecibo	T1	Arecibo
C44	Ditch	T3	Arecibo
C45	Ditch	T3	Arecibo
C46	Ditch	T3	Arecibo
C47	Ditch	T3	Arecibo
C48	Ditch	T3	Arecibo
C49	Ditch	T3	Arecibo
C50	Ditch	T3	Arecibo
C51	Ditch	T3	Arecibo
C52	Ditch	T3	Arecibo
C53	Ditch	T3	Arecibo
C54	Ditch	T3	Arecibo
C55	Ditch	T3	Barceloneta
C56	Ditch	T3	Barceloneta
C57	Ditch	T3	Barceloneta
C58	Ditch	T3	Barceloneta
C59	Ditch	T3	Barceloneta
C60	Ditch	T3	Barceloneta
C61	Ditch	T3	Barceloneta
C62	Ditch	T3	Barceloneta
C63	Ditch	T3	Barceloneta
C64	Ditch	T3	Barceloneta
C65	Ditch	T3	Barceloneta
C66	Río Grande de Manatí	T1	Manatí
C67	Creek	T3	Manatí
C68	Creek	T3	Manatí
C69	Caño de los Nachos	T3	Manatí
C70	Ditch	T3	Manatí
C71	Ditch	T3	Manatí
C72	Río Grande de Manatí	T1	Manatí
C73	Río Grande de Manatí	T1	Manatí
C74	Río Indio	T1	Vega Baja
C75	Río Indio	T1	Vega Baja
C76	Río Indio	T1	Vega Baja
C78	Quebrada sin nombre	T3	Vega Baja
C80	Río Cibuco	T2	Vega Alta
C81	Quebrada sin nombre	T3	Vega Alta
C82	Ditch	T3	Dorado
C83	Río de la Plata	T1	Toa Baja
C84	Ditch	T3	Toa Baja
C85	Ditch	T3	Toa Baja
C86	Ditch	T3	Toa Baja
C87	Ditch	T3	Toa Baja
C88	Ditch	T3	Dorado
C89	Río Cocal	T3	Dorado

C90	Rio Cocal	T1	Toa Baja
C91	Quebrada sin nombre	T3	Toa Baja
C95	Río Hondo / Rio Bayamón	T1	Cataño
C97	Ditch	T3	Toa Baja
C98	Quebrada Diego	T3	Bayamón
C99	Quebrada Las Lajas	T3	Guaynabo
C100	Quebrada Santa Catalina	T3	Guaynabo
W1	Estuarine-Salt Flat- Mangle	No impacto	Peñuelas
W2	Estuarine-Salt Flat- Mangle	No impacto	Peñuelas
W3	Estuarine-Salt Flat- Mangle	No impacto	Peñuelas
W4	Estuarine-Salt Flat- Mangle	No impacto	Peñuelas
W5	Canal,Mangle	No impacto	Peñuelas
W8	Canal	T3	Peñuelas
W9	Canal	T3	Peñuelas
W10	Palustrine-Man Altered,Herbaceous	Humedal	Peñuelas
W11	Canals	T2	Utuado
W17	Palustrine-Herbaceous	Wetland	Arecibo
W19	Palustrine- man altered herbaceous	Wetland	Arecibo
W20	Canal	T3	Arecibo
W21	Palustrine, man altered herbaceous	Wetland	Arecibo
W22	Palustrine, man altered herbaceous	Wetland	Arecibo
W24	Palustrine- man altered herbaceous	Wetland	Arecibo
W25	Canals	Wetland	Arecibo
W26	Palustrine- man altered herbaceous	Wetland	Arecibo
W27	Canals	Wetland	Arecibo
W28	Canals	T3	Arecibo
W29	Canals	Wetland	Arecibo
W30	Palustrine herbaceous	Wetland	Arecibo
W32	Palustrine herbaceous	Wetland	Arecibo
W33	Palustrine herbaceous	Wetland	Arecibo
W34	Palustrine, man altered herbaceous	Wetland	Arecibo
W35	Palustrine- man altered herbaceous	Wetland	Arecibo
W36	Canals	Wetland	Arecibo
W37	Palustrine-man altered herbaceous	Wetland	Arecibo
W38	Palustrine-man altered herbaceous	Wetland	Arecibo
W39	Palustrine herbaceous	Wetland	Arecibo
W40	Palustrine herbaceous	Wetland	Arecibo
W41	Palustrine herbaceous	Wetland	Arecibo
W42	Palustrine herbaceous	Wetland	Arecibo
W43	Palustrine herbaceous	Wetland	Arecibo
W44	Palustrine-man altered	Wetland	Arecibo

	herbaceous		
W45	Palustrine-man altered herbaceous	Wetland	Arecibo
W46	Palustrine-man altered herbaceous	Wetland	Arecibo
W47	Palustrine-man altered herbaceous	Wetland	Arecibo
W48	Palustrine-man altered herbaceous	Wetland	Arecibo
W49	Palustrine herbaceous	Wetland	Arecibo
W50	Palustrine herbaceous	Wetland	Arecibo
W51	Palustrine herbaceous	Wetland	Arecibo
W52	Palustrine herbaceous	Wetland	Barceloneta
W53	Palustrine herbaceous	Wetland	Barceloneta
W54	Palustrine herbaceous	Wetland	Barceloneta
W55	Palustrine-man altered herbaceous	Wetland	Barceloneta
W56	Palustrine herbaceous	Wetland	Barceloneta
W57	Palustrine herbaceous	Wetland	Barceloneta
W58	Palustrine herbaceous	Wetland	Barceloneta
W59	Canals	T3	Barceloneta
W60	Palustrine herbaceous	Wetland	Manatí
W61	Palustrine, man altered herbaceous	Wetland	Manatí
W62	Palustrine herbaceous	Wetland	Manatí
W64	Palustrine-herbaceous	Wetland	Manatí
W65	Palustrine, man altered herbaceous	Wetland	Manatí
W66	Palustrine-man altered herbaceous	Wetland	Manatí
W67	Palustrine-man altered herbaceous	Wetland	Manatí
W68	Canals	Type 3	Manatí
W69	Palustrine,man altered herbaceous	Wetland	Manatí
W70	Palustrine-man altered herbaceous	Wetland	Manatí
W71	Palustrine-man altered herbaceous	Wetland	Manatí
W72	Palustrine herbaceous	Wetland	Manatí
W74	Palustrine herbaceous	Wetland	Manatí
W76	Palustrine herbaceous	Wetland	Manatí
W77	Palustrine-man altered herbaceous	Wetland	Manatí
W78	Canal	T2	Vega Baja
W79	Canal	T2	Vega Baja
W80	Canal	T2	Vega Baja
W81	Canal	Wetland	Vega Baja
W82	Palustrine-herbaceous	Wetland	Vega Baja
W83	Palustrine-herbaceous	Wetland	Vega Baja
W84	Canal	T2	Vega Alta
W85	Palustrine-herbaceous	Wetland	Vega Baja

W86	Canal	T2	Vega Alta
W87	Palustrine herbaceous	Wetland	Vega Alta
W88	Palustrine herbaceous	Wetland	Vega Alta
W89	Palustrine-man altered herbaceous	Wetland	Vega Alta
W90	Palustrine-man altered herbaceous	Wetland	Vega Alta
W91	Palustrine herbaceous	Wetland	Vega Alta
W92	Palustrine-man altered herbaceous	Wetland	Dorado
W93	Palustrine-man altered herbaceous	Wetland	Dorado
W94	Palustrine-man altered herbaceous	Wetland	Dorado
W95	Palustrine-man altered herbaceous	Wetland	Dorado
W96	Canal	T3	Toa Baja
W97	Palustrine-man altered herbaceous	Wetland	Toa Baja
W98	Palustrine-man altered herbaceous	Wetland	Toa Baja
W99	Palustrine-man altered herbaceous	Wetland	Toa Baja
W100	Palustrine-man altered herbaceous	Wetland	Toa Baja
W101	Canal	Wetland	Dorado
W103	Estuarine Forested	T1	Toa Baja
W105	Palustrine herbaceous	Wetland	Toa Baja
W112	Canal	Wetland	Toa Baja
W113	Palustrine herbaceous	Wetland	Toa Baja
W116	Palustrineherbaceous	Wetland	Toa Baja
W117	Palustrine herbaceous	Wetland	Cataño
W118	Palustrine herbaceous	Wetland	Bayamón/Cataño
W119	Palustrine herbaceous	Wetland	Bayamón
W120	Palustrine herbaceous	Wetland	Guaynabo
W121	Canal	T3	Guaynabo
W122	Canal	Wetland	Guaynabo
W123	Palustrine herbaceous	Wetland	Guaynabo
W124	Estuarine forested	Wetland	Guaynabo
W125	Estuarine forested	Wetland	Guaynabo
W126	Estuarine forested	Wetland	Guaynabo
W127	Estuarine forested	Wetland	Guaynabo
W128	Canal	Wetland	Guaynabo
W129	Estuarine forested	Wetland	Guaynabo
W130	Palustrine herbaceous	Wetland	Guaynabo
W131	Palustrine herbaceous	Wetland	Guaynabo
W132	Palustrine herbaceous	Wetland	Guaynabo
W133	Palustrine herbaceous	Wetland	Guaynabo
W134	Canal	No impacto	Guaynabo
W135	Canal	No impacto	Guaynabo
W137	Canal	No impacto	Guaynabo

Throughout almost its entire course of 92 miles, the pipeline will be installed at least 3 feet under the terrestrial surface and at least 6 feet under the river beds and ravines. No permanent effect on the bodies of water is anticipated. However, a temporary effect during the construction process in the crossing of river ravines is anticipated, which will be appropriately controlled.

Two types of crossings are anticipated: open trench and Horizontal Direct Drilling (HDD). The first type, open trench, will be used in the stormwater runoff courses and the ravines; and the second will be used to cross the rivers.

In regard to the open trenches, the excavation through water beds entails impact, particularly by the suspension of solids and by disturbances in the materials of the bed. For the crossing work, the watercourse will be diverted to a temporary course that allows the excavation of the water bed and carry out the installation. Once the installation is complete, the water bed will be stabilized with materials compatible with the original bed. Then the water will be redirected in its natural course, and the site of the temporary course will be restored to its original form. The mitigation of the impacts will be carried out through erosion and sedimentation control measures. CES plans will be designed in harmony with the Stormwater Pollution Prevention Plans (SWPPP) required by the Environmental Protection Agency (EPA).

As to the HDD, the rivers will not suffer any impact on their river beds, because this technology permits making a "dry crossing" by passing well below the river bed. The drilling equipment will drill the ground below the river bed and install the pipeline without affecting the river bed. The incorporation of the 24-inch pipeline in the areas classified as aquifers may be done in two ways: first, that the pipeline is installed over the water table, and second, that the pipeline is installed below the aquifer's water table. A third way in which it could be done is when the pipeline is partially submerged in the water table as a result of the fluctuations in the aquifer's level due to the variation in the annual rainfall cycle.

When it is installed over the water table, the pipeline will not cause any alteration in the aquifer's recharge. Aquifer recharge areas begin on the flanks of the central mountain range, upstream of the aquifers *per se.* However, in those cases where the aquifer also recharges on site, there will be an insignificant effect on the direct recharge which will correspond to the diameter and length of the pipeline, since the water that has to infiltrate to the subsoil at the site of the trench will be delayed in its course because it will have to flow around the pipeline.

In those places where the pipeline must be installed below the water table, the impact will also be negligible due to the extremely low migration velocities that are normal in aquifers. However, for a more detailed evaluation it is necessary to determine the direction of the flow lines and the thickness of the aquifer. In case the flow lines are parallel or they have a minimal deviation angle with respect to the axis of the pipeline, the impact of the pipeline on the movement of subterranean water will be negligible (the

one that corresponds to the area of the 24-inch diameter pipeline, that is 3.14 square feet).

In case the flow lines are perpendicular to the axis of the pipeline or they have an incidence angle of more than 45 degrees, the flow lines will encounter an obstruction in their course and the aquifer's transmissibility will be diminished. Nevertheless, this reduction in transmissibility will be imperceptible, again due to the extremely low migration velocities. However, in those areas that during the design phase are identified as compromised to a reduction of transmissibility, transmissibility compensation measures will be employed, as for example, the installation of pockets of granular material (river sand) as backfill of t he trenches in short and localized stretches sufficient to compensate the transmissibility.

Additionally, the determination of the aquifer's thickness is important, especially when the flow lines are perpendicular to the axis of the pipeline. If the thickness of the saturated aquifer is only a few feet, the impact of the two-foot diameter pipeline will be significative in terms of flow per unit of area. In this case, the compensation of transmissibility will be essential. For these reasons, in those aquifers whose thickness is of a few feet, the preferred measure will be avoiding the same. However, if it were unavoidable, studies will be made to determine the aquifer's transmissibility and the form of compensation of transmissibility will be designed with the results of said studies.

The pipeline that is installed below the water table will stand in the course of the flow of subterranean waters. However, since the velocity of the water is close to zero, the impact will be imperceptible. The hydrology of the wetland will not be affected in practice. However, in the particular case in which the pipeline runs perpendicular to the flow of subterranean water and that the wetland's aquifer is thin, structures will be installed that compensate the reduction of transmissibility, or the installation of the pipeline will run deeper. The compensation structures, when necessary, will consist of high-transmissibility granular material installed around the pipeline in localized areas. The granular material will be covered with a synthetic filter fabric.

6.7.1. Crossing by open trench

The crossings that will be made by open trench are crossings of small, perennial and intermittent ravines, ditches and drainage and irrigation canals. Some of these bodies of water are dry or of a minimal flow.

The impacts in open trench include an increase in turbidity, sedimentation downstream of the crossing, reduction of dissolved oxygen, mortality of aquatic fauna and flora. In addition to this, there could be impact to the water quality caused by leaks of oil and other fluids in the machinery.

The impact will be mitigated by reducing the time of construction. In the United States, the Federal Energy Regulatory Agency requires that crossings of bodies of water less

than 10 feet wide are crossed in 24 hours or less and bodies of water from 10 to 100 feet wide in 48 hours. These are the standards that will apply to this project.

No vehicles leaking oil or other liquids that could pollute the waters will be allowed. If the vehicle develops leaks during the work, spill kits will be used to collect any leakage and the vehicle will be removed from the site.

6.7.2. Horizontal direct drilling (HDD)

A successful crossing with this method avoids impacts on the bodies of water because it does not interfere with the flow, the water quality or with the aquatic fauna and flora. The AEE is experienced in the use of t his technique in projects like underground electric lines and the submarine cable of Isleta Marina.

During the drilling, a mixture of bentonite and water is used to lubricate the drill, maintain perforation and remove residues from the drill. Bentonite is the commercial name of non-toxic clays formed from volcanic ash. The United States is the world's leading producer of Bentonite. The best quality bentonite is found in Ft. Benton, Wyoming. It is acquired commercially in 50 - 100 pound bags, similar to cement. To prepare it, the bentonite is mixed with water (Eg: 50 lbs. For each 300 gallons of water, maintain a pH of 8-9) to form a slurry that acts as a cooling fluid for the drill and the probe, and as a lubricant for the drill head. The mixture is prepared in a tank and then transferred to a mud pit at the entrance and exit of the drill. Other mud pits will be needed to store the mud and to dry the used mud for later reuse. These mud pits will be covered with impermeable liners. In addition, hay bales and a silt fence will be installed around them.

Bentonite does not require special storage procedures. It can be stored in open air covered with plastic tarpaulin, or in a covered building to protect it from the rain.

The principal impact of the drilling procedure could be the inadvertent release of bentonite. Bentonite could escape through unidentified fractures in the material underlying the river bed, in the area of the mud pits, or along the course of the perforation due to unfavorable ground conditions. The HDD crossings could fail for various reasons, including the inability to close the pilot hole, inability to maintain a stable open hole or inability to pull the pipeline through the perforation. To avoid these faults, an adequate design will be developed, specific to the area, the correct equipment and specialized personnel to operate it will be used. If any of the parts of the drilling has problems and it cannot be finished, the design engineers will study the geotechnical data to identify the cause. If necessary, other geotechnical studies will be made, or the location of the crossing will be changed.

Although bentonite is composed of naturally-occurring, non-toxic materials, its deposit in bodies of water affect the turbidity, diminishes the quantity of dissolved oxygen and affects the respiration of aquatic organisms. A bentonite escape is usually detected

when there is a loss of circulation of drilling liquid, a loss of pressure and/or bentonite is detected on the surface of the body of water. One of the functions of bentonite is to seal the perforation to maintain the downhole pressure. If there is an escape there is a change of pressure and a reduction in the amount of bentonite recirculated. A bentonite escape does not require the evacuation of nearby residences. The remaining bentonite after the drilling is done is left to dry in the mud pits and later will be disposed of in accordance with the applicable regulations.

During the drilling, a dye will be added (uranine), that will help detect any escapes to the surface. If an escape is detected, the fluid's pump will be turned off, which will immediately stop the flow of bentonite. An inspector will be assigned, whose function will be to observe the body of water during the drilling. This inspector will keep in contact with the team in charge of the drilling and will instruct them to stop the process if bentonite is observed (mixed with uranine) on the surface. In addition, he will document all his observations from the beginning of the drilling to the end. Drilling could last 2-3 days, but it all depends on the depth, the distance to the other shore and the design in general. Each crossing by HDD is designed individually, based on geotechnical studies of the site. The team of workers in charge of the HDD crossings are specialists in this type of crossing. This is the only work they will perform for the project.

We enclose the Material Safety Data Sheet (MSDS) for Bentonite. It indicates that bentonite is an irritant to the eyes and the respiratory tract if inhaled (dust). It can also irritate the skin. In case of contact with the eyes, the eyes must be irrigated with water for 15 minutes. In contact with the skin, it must be washed off with soap and water. In case of inhalation, the person must be removed outdoors (in case of exposure to bentonite in an enclosed area).

In addition, we enclose the MSDS for uranine. Like uranine in its solid (powder) form it causes irritation to the eyes and if inhaled. According to the MSDS, the chemicals contained in uranine are not listed in the TSCA lists, Significant New Rule, Chemical Test Rules, Health and Safety Reporting List, CERCLA Hazardous Substances, SARA Section 302, Extremely Hazardous Substances. Uranine does not contain air pollutants, it does not affect the ozone layer. Neither does it contain pollutants listed as water pollutants.

Also enclosed is a Responses to Bentonite Escapes Plan where the HDD process and the control measures to be implemented in case of an escape are described in more detail.

Even though they are technically viable, HDD crossings can fail for various reasons, including inability to complete the pilot hole, inability to maintain a stable open hole, or inability to pull the pipeline through the perforation.

To prevent the technique from failing, geotechnical studies will be conducted and

construction plans specific to the site will be developed during the crossing's design stage.

The principal impact that could occur is the inadvertent release of bentonite. Bentonite could escape through unidentified fractures in the material underlaying the river bed, in the area of the mud pits, or along the course of the perforation due to unfavorable ground conditions. Although bentonite is composed of naturally-occurring non-toxic materials, its deposit in bodies of water affects the turbidity, diminishes the quantity of dissolved oxygen and affects the respiration of aquatic organisms.

Another impact associated to the HDD is the size of the construction area. In normal construction, this right-of-way will be 100 feet. For the HDD a construction area of 100-300 feet on both sides of the body of water will be used.

Erosion and sedimentation control measures will be implemented in the construction area during the crossing, in order to minimize the sedimentation of the body of water during rain events.

To minimize the impact in case of bentonite escapes, a dye will be added to the bentonite, because small escapes are difficult to detect due t o the water turbidity and to bentonite's specific gravity. If an escape is detected, the fluid pump will be turned off, which will immediately stop the flow of bentonite and the pertinent Agencies will be notified. An inspector will be assigned to corroborate compliance.

Vehicles with leaks of oil or other liquids that could pollute the waters will not be permitted. If the vehicle develops leaks during the works, a spill kit will be used to pick up any leakage and the vehicle will be removed from the site.

Once the crossing is finished, all the soil that was removed in the right-of-way will be reused to restore the same. If necessary, additional backfill will be used.

6.8 Impacts to Subterranean Waters and Aquifers

Thirty-one (31) aquifers were identified in an area of within 400 meters from the project along the course of the alignment.

Trenches 4-6 feet deep will be excavated for the project and this does not represent an impact to resources of subterranean waters or aquifers. The gas pipelines can pollute subterranean waters if the natural gas used during the operation of the project contains pollutants that condense (natural gas liquids) and there is a break in the inferior part of the pipeline through which they can escape. In addition, there can be pollution where there are compressor stations to propel the gas. It is important to mention that the gas to be used in Via Verde will not have the kind of pollutant that condenses (by specification), nor will it have compressor stations.

Escapes of natural gas rise to the atmosphere because it is lighter than air. In case of an escape in the pipeline, the effects will be visible in the vegetation of the right-of-way, because it will wither and dry.

Although it is considered that the possibility of pollution of subterranean waters is remote, spills of oil and fuel that are not addressed quickly could pollute the waters. To prevent that possibility, a Spills Control Plan will be implemented. The project's Environmental Coordinator will be in charge of compliance with the parameters established in the Plan. This Plan will be prepared following the guidelines of the Code of Federal Regulations, Title 40, Protection of the Environment, Part 112, Oil Pollution Prevention. The same will be filed with the EPA for evaluation. This Plan will have a section where the Operation Centers and the factors specific to each one of them will be discussed. Each Operations Center will have a copy of the Plan. The Environmental Coordinator will offer informative talks at each Center. During construction, the resident engineer will be responsible for ensuring the implementation of the control measures, in coordination with the Environmental Coordinator.

6.9 Impacts on Flood-prone Zones

The possibility of impact on the flood levels by some actions emerging from the installation of the pipeline is anticipated, but at the same time structural measures destined to mitigate this possible impact are established so that the flood levels are not increased by the pipeline construction actions.

The project opens the possibility that surplus of the excavation to install the 24-inch diameter pipeline will be deposited temporarily in zones regulated as flood-prone. In relation to this, Regulation No. 13 of Flood-prone Zones of the Puerto Rico Planning Board has specific requirements for each Zone.

Zone A is an area that has not been studied. FEMA does not have a detailed study and the maps do not have base flood levels. The flood levels in this area should not be increased; unless there is a Hydrologic and Hydraulic (H/H) study that justifies the landfill action. Zone AE is an area that has a detailed study. There are two sub-zones in this Zone: the floodplain and the floodway. In the floodplain, which is the area outside the floodway, landfill can be deposited without the need of an H/H study. However, landfill in the floodway is not permitted; unless an H/H study demonstrates that the flood levels are not increased by the landfill action. Zone VE is similar to Zone AE. The difference is that in this zone the floods originate from cyclonic waves. Depositing landfill in the floodplain of this zone is permitted, not so in the floodway; unless there is an H/H study that demonstrates that the land fill action does not produce an increase of flood levels. Zone X is a zone with a 0.2% probability of occurrence (500 year rainfall), there is no restriction on the deposit of landfill. Following from the above is that in the floodplain of Zones AE and VE and in Zone X landfill can be deposited without an Hydrologic and Hydraulic study. But it is not permitted to deposit landfill in the floodways of Zones AE and VE unless an H/H study demonstrates that the flood

levels will not be increased.

The construction of the pipeline through flood-prone zones will only have the possibility of temporary impacts. The surplus materials from the excavation can have temporary effects on the flood levels if they are deposited in the floodway. This situation would have to be accidental in character, of a fortuitous flood event, which would not permit the removal of said surplus materials before its occurrence. Even despite this possibility, the temporary effects will be minimal because the volume of surplus material will be only that corresponding to the material not yet transported to its place of final disposal during the work day. Permanent effects in the flood levels are not foreseen because all the surplus from the excavation will be transported to deposit sites outside the floodway.
The surplus material from the excavation will be deposited along the installation of the pipeline in the floodplains of Zone AE, Zone VE and Zone X. The material will be dispersed within the pipeline's right-of-way. The surplus of the excavation in the floodway of Zones AE and VE, in general, will be transported and deposited in authorized places outside the floodway.

6.10 Impacts on the Infrastructure

The infrastructure services for the Municipalities through which the pipeline crosses will not be affected or significantly compromised by the project. Nonetheless, regarding other underground infrastructure in the project area, there will be compliance with Regulation 7245 of the Public Service Commission, Regulation for the Creation and Operation of the Excavations and Demolitions Coordination Center, before commencing the construction of the project. Through the coordination required to be made with the owners of other infrastructures in this Regulation, plans will be developed to avoid damage to said infrastructures and plans will be agreed in response to any emergency that could arise in case of unexpected damage to the same. Each owner of infrastructures in the area of the project will have an Inspector present at the moment of the excavation, as required in the Regulation.

6.10.1. Impact on AAA Infrastructure

The project will cross through several aqueduct lines and several sewer systems. (See Section 3.8.1.) Before carrying out the excavations in the vicinity of those underground aqueduct and sewer systems mentioned below, the constructors of Vía Verde will coordinate said excavations with the owners of these underground structures, through the Public Service Commission or the new Permit Management Office, as applicable. In case of finding unidentified infrastructure, the construction will be detained until the owner of such infrastructure has been identified or a permit to proceed is obtained from the Public Service Commission.

6.10.1.1. Water Consumption

The consumption of water during the construction is estimated at 10,344,000 gallons. This consumption will be during or due to: the hydrostatic testing of the pipeline, drinking water supply for consumption by the employees, sprinkling the project's area to prevent the emission of fugitive dust and for sanitary use by the employees.

To verify the pipeline's integrity prior to its operation, it is required to conduct hydrostatic tests. This is done to ensure that the system is capable to withstand the operating pressure for which it was designed.

This test entails the greatest water consumption of the whole project. The contractor will conduct the test by stretches to reduce the amount of water needed. The decision of the length of the stretches is made by the contractor, based on his professional experience and in the topography of the route. To the effect of calculating the water consumption, a stretch length of 12 miles will be used. The total consumption will be 5,700,000 gallons. The water will be transferred from stretch to stretch until it arrives at the San Juan Thermoelectric Power Plant, where it will be discharged in the NPDES 001 discharge.

This test entails the greatest consumption of water of the whole project. The contractor will decide how to carry out the test, according to the water supply. The pipeline can be tested all at once or divided in sections. It is estimated that 7 million gallons of water will be needed to perform the test in a single day (8 hours).

The following alternatives to obtain the necessary supply were considered:

- The alternative of obtaining the water from the rivers adjacent to the project was evaluated, but it was discarded to avoid impacts on the water quality and to the fauna and flora.

- The construction of wells for this event was evaluated, but it was discarded because it represented an inefficient use of the resource.

- Because the AAA's drinking water system will be used for other phases of the project, its use was discarded so as to not overload it.

- The use of existing wells for which the AEE has a use franchise was evaluated. There is a system of wells under franchise RO-13-08-01-FI-70311. Said franchise permits a total extraction of 5.122 MGD. The decision was for this option to eliminate the impact on the public distribution system and the bodies of water.

- After this test is concluded, the water will be discharged in the NPDES 001 discharge of the San Juan Thermoelectric Power Plant. The Power Plant's NPDES discharge permit has a Certificate of Water Quality from the Environmental Quality Board. It is important to mention that the water for the

test is clean water extracted from wells. There will be coordination with the Federal Environmental Protection Agency (EPA) to obtain a temporary discharge permit. There will be compliance with all the sampling and analysis conditions established by the EPA.

During construction, it is necessary to provide drinking water to the worker brigades of the different phases of the project. It is estimated that the maximum water consumption will be 1,200 gallons daily. The project's duration is estimated at 9 months and work will proceed 7 days a week. The drinking water consumption will be approximately 324,000 gallons.

No water from t he AAA will be used for this purpose. Bottled water will be provided which will be purchased from local providers. The contractor will identify the local suppliers and arrangements will be made prior to the commencement of construction that will allow them to absorb the increased demand. The temporary increase in demand will have a positive impact on local business. The project's operation does not require the use of drinking water.

Water will be used to sprinkle the project's construction areas and minimize the emissions of fugitive dust to the atmosphere. Tanker trucks with a capacity of 2,000 gallons, equipped for this purpose, will be used to sprinkle. A maximum daily consumption of 16,000 gallons is estimated for this area. This means a maximum 4,320,000 gallons during the whole project.

A local supplier will be contracted to sprinkle the soil. He will be responsible for providing the truck and the water.

6.10.1.2. Wells

One hundred fifty-six (156) wells were identified within a radius of 460 meters from the alignment proposed for the project. Only six of these are within the project's operation right-of-way. (See Section 3.5.9.)

Water Wells				
ID	**Well's Name**	**Municipality**	**Ward**	**Distance/ meters**
018	Valdivieso #01	Peñuelas	Tallaboa Poniente	10
019	USGS	Peñuelas	Tallaboa Poniente	10
020	Valdivieso #02	Peñuelas	Tallaboa Poniente	8
087	Concora Factor	Arecibo	Factor	15
131	Maguayo #02	Dorado	Higuillar	10

132	Maguayo #03	Dorado	Maguayo	10

Of these wells, those identified as 018, 020, 087, 131, and 132 are drinking water wells; well 019 is for sampling.

The following measures will be taken to avoid or minimize impacts on the station and the wells:

- They will be identified in the project's final drawings for the knowledge of the construction personnel.
- If the wells are encountered during the clearing of the right-of-way, their location will be marked to avoid impacting them.
- There will be coordination with the owners of these wells to interrupt their operation and protect them during construction.
- Any break that could occur due to the construction will be repaired.

6.11 Impacts on Transportation and Traffic

6.11.1. Maritime transportation

The pipeline segments that will form the project and their components will be purchased out of Puerto Rico, because their manufacture is specialized. The machinery required for the project's construction process is also specialized and specifically designed for the activities of excavation, laying of the pipeline and drilling, among others. Barges will be used for the maritime transport of the materials and machinery to the Port of the Americas in Ponce and the San Juan port zone. The materials received will be carried by land transportation to the operation centers in Ponce and Toa Baja where the same will be stored. The following measures will be taken to minimize the impact the receipt, debarkation, dispatch and transportation of the machinery, pipe segments and other equipment to the operation centers could have:

- There will be compliance with all the requirements established by the different receipt ports, the Ports Authority and Federal Customs prior to the receipt of the shipment.
- The contractor will develop a logistics plan for the proposed activity, which will be presented to the pertinent authorities for comments and endorsement. The plan will include the following aspects: details of the shipping port, maritime travel itinerary, number of barges, frequency of trips, inventory of equipment, classified and identified containers, time for unloading the equipment, identification of areas for the temporary storage

in the port, maximum allowable residence time for materials in the port, travel itinerary and mobilization of materials out of the port, among others. Among the benefits derived from implementing the plan are:

- Expediting the inventory inspection and review process by the Ports Authority and Federal Customs.
- Avoid penalties for delays or residence time of the barge in the port.
- Avoid delays in the port's activities
- More efficient and speedy movement of equipment.

6.11.2. Ground transportation and traffic

The Vía Verde project comprises a length of 92 miles, approximately. The roadways will be used as access to transport personnel, equipment, vehicles (light and heavy) and materials to the different areas of the project. The main highways will be: PR-337, PR-127, PR-2, PR-385, PR-132, PR-520, PR-391, PR-123, PR-10, PR-143, PR-521, PR-524, PR-111, PR-621, PR-22, PR-681, PR-684, PR-616, PR-149, PR-672, PR-137, PR-155, PR-674, PR-160, PR-676, PR-690, PR-694, PR-693, PR-165, PR-5 and PR-28. Most of these highways are catalogued as having several lanes in both directions, wide and passable.

During the construction stage there will be an increase in light and heavy traffic, especially in areas near the operation centers. This increase may cause traffic congestion and inconveniences to the population.

Small and local roads will be crossed with the open trench method and this will cause short periods of traffic delays.

The following measures will be taken to minimize the project's impact on the integrity of the public roads and on the interruption or increase in traffic:

- A Traffic Management Plan will be prepared and submitted to the Highways and Transportation Authority for their approval. The most important elements of this Plan are: Identifying traffic flow patterns, identifying alternate routes and emergency accesses, traffic control at intersections, pedestrian control, accesses for impaired persons, coordination with law and order agencies to implement the Plan. All the traffic control signs and signals will be in compliance with the requirements of applicable regulations.

  Different traffic control methods are presented in Addendum 6.1, Typical MOT Diagrams.

- Unpaved roads will be crossed with the open trench method. This method

will require the temporary closure of traffic and detours will be established. This will be coordinated with the ACT and the local police and it will be referred to in the Traffic Management Plan. The contractor will be in charge of establishing measures such as the installation of warning signs to ensure safety and minimize the obstruction of traffic. If necessary, steel plates will be used to cover the trenches if the crossing works take more than a day.

6.12 Impacts on Archaeological Sites and Cultural and Historic Places

Part of the information below was obtained from the ArcGIS 9 ArcMap 9.2 (ArcView Geographical Information System) software programs, with the Planning Board's database for the years 2004 to 2009. In addition, the AEE contracted Environmental and Educational Consultants (in Spanish Asesores Ambientales y Educativos (AAE)) to conduct the project's environmental studies, who in turn contracted archaeologists Marisol Rodríguez Miranda and Carlos Ayes Suárez to carry out the Phase 1A study. Said study identified the known archaeologic resources and established the base to discover additional resources in the area of the project. A copy of Phase IA Study is in Appendix 5. According to the results of the Phase IA Study, Phase 1B studies will be conducted where necessary. After evaluating the results of the Phase IB study, the areas where Phase II and Phase III studies will be conducted will be identified. An inventory of properties with architectural value will be made and a Structures Protection Plan will be prepared, if necessary. In case an archaeologically sensitive area is found, that had not previously been identified at the moment of movement earth, the recommendations of the archaeologist that will be contracted to those ends will be followed.

As a result of the surface survey, three rock shelters with petroglyphs were found located in the impact zone of the proposed project. The presence of possible agricultural terraces associated with pre-Columbian cultures was also detected.

In addition, the remains of two railroad bridges and two haciendas were found. Archaeologist María López Cruz prepared the evaluation sheets for these remains. To facilitate the evaluation to be made of these data by the Institute of Puerto Rican Culture (ICP), the official sheets of said Agency were used. They correspond to the Cambalache Bridge, Hacienda Teresa, Hacienda Las Lisas in Arecibo and remains associated to Hacienda Plazuela in Barceloneta.

Isolated finds of colonial material were detected all along the alignment in the North area from Cambalache Sugar Cane Mill to the Plantaje Shrine. These finds constitute an indicator of areas with greater possibilities of finding activity related to the agricultural history of the whole north zone. It is possible that these materials are associated to the habitation areas created due to the activities of the haciendas and to the subsequent population movements they generate.

The most important finds in the area to be occupied by the alignment right-of-way are indicated next: Tallaboa Site, for which a Phase IB study is recommended; Puentes, for which protection is recommended through the placement of cement and orange mesh barriers; Hacienda La Teresa, for which a Phase IB study is recommended; Hacienda Las Lisas, for which a Phase IB study is recommended; Paso del Indio, which although widely studied, there are no studies of the area where the pipeline will be located, for which reason a Phase IB study is recommended; Dorado 15, which has not been delimited, for which a Phase II is recommended; Hacienda La Candelaria, for which there is a recommendation to enter into a mitigation process that includes architectonic documentation and archaeological excavation; Warehouse 5, for which the liberation of the area is recommended, because the same has been widely studied, and to enter into a mitigation process for the site.

In case resources are impacted and the route cannot be changed, the Authority will carry out Phase III studies. In addition, it will file the request for services and file a project before the Historic Buildings Heritage Program for its evaluation and recommendations. Visits to sensitive areas will be coordinated, as required by the agency to conduct their own evaluation. In addition, a protocol will be developed to protect resources of this kind that lie near the construction of the project.

6.13 Noise Impacts

The location, magnitude and frequency of the environmental noise can vary considerably over the course of the day. The basic units used by the JCA to measure acceptable noise levels are the decibels dB(A). The acceptable noise limit is different for daytime and nighttime hours. The JCA's Noise Pollution Control Regulation establishes the maximum permissible levels for the different receptor zones in the day and at night. In addition, it establishes the maximum permissible for motor vehicles measured at a distance of 50 feet, stationary or in motion. This information is shown in the following tables:

Noise Emission Levels in dB(A)

Noise level exceeded by 10% of the measurement period (L10)

Fuente Emisora	Zonas Receptoras							
	Zona I (Res)		Zona II (Com)		Zona III (Indus.)		Zona IV (Tranq)	
	Diurno	Nocturno	Diurno	Nocturno	Diurno	Nocturno	Diurno	Nocturno
Zona I (Res)	60	50	65	55	70	60	50	45
Zona II (Com)	65	50	70	60	75	65	50	45
Zona III (Indus.)	65	50	70	65	75	75	50	45

Maximum permissible levels for motor vehicles in public roads measured at a distance of 50 feet

Tipo de Vehículo	35 MIH o Menos	Sobre 35 M/H	Estacionado (Motor Encendido)
Vehículos de Motor de 10,000 lbs. o más (peso bruto)	86 db (A)	90 db (A)	88 db (A)
Motocicletas (cualesquiera)	80 db (A)	84 db (A)	88 db (A)
Otros (cualesquiera otro o combinación)	76 db (A)	80 db (A)	88 db (A)

The magnitude of a noise impact depends, generally, of the type of construction activity, the noise levels generated by the equipment and machinery, the duration of each phase of construction, and the distance between the noise source and the receptor. Vía Verde is a lineal project and the construction will move day to day. This means that the noise will not be concentrated in one specific area.

The noise levels for the heavy machinery to be used in the construction are itemized in the following table:

Equipo	Nivel de Ruido (dbA) a 50 pies
Bulldozer	85
Backhoe para excavar	80
Backhoe para rellenar	85
Sideboom	85
Niveladores	85
Camión	88
Wheel ditcher	80

The noise levels of the machinery to be used for the construction are comparable to those established by the Regulation. In the majority of cases the equipments will be operated in isolated areas outside the 50 feet of impact to the receptor. Although the Regulation establishes an exception for the prohibition of the sound emission limits during the installation of essential public services, the following measures will be taken to minimize the effects of noise on populated areas:

- The construction woks will be circumscribed to the day schedule established by the Regulation.
- No vehicles or machinery without noise control equipment or with

defective equipment will be allowed.

- Inasmuch as possible, the newest equipment to be found will be used. Although there is a factory-established noise limit for construction equipment, older equipments emit more noise due to wear and tear. The friction between the parts increases the noise level.

- The machinery will be turned off when not in use.

- The construction of this project will be divided in four segments and the accesses to each work area will be located in a manner that they are not within 50 feet of residences or quiet zones.

6.14 Impacts caused by Spills

The possibility of spills always exists when working with chemical products, and equipment and machinery that use oils or other fluids to operate adequately. The key is prevention through an information program to employees and an aggressive maintenance program of the equipment used.

Generally, spills occur by human error. Among the principal causes are poor handling of the products, lack of maintenance of the equipments, and lack of adequate knowledge about the functioning and operation of the machinery.

The spills in this project, if they occur, will not be of a significative magnitude, since in the majority of cases small amounts of the products will be used (paints, oils, epoxy, etc.). The following equipments and materials are possible sources of spills: heavy machinery, light vehicles, emergency electricity generators, paints, coatings and clays (bentonite). Spills of these products or of the liquids in the equipment can impact water quality and the soil.

The following measures will be implemented to avoid spills or minimize the impact of the same, if they occur:

- The contractor's Environmental Coordinator will prepare a Spills Control Plan. This Plan will be prepared following the guidelines of the Code of Federal Regulations, Title 40, Protection of the Environment, Part 112, Oil Pollution Prevention. The same will be filed with the EPA for evaluation. This Plan will have a section where the Operation Centers will be discussed, together with the factors specific to each one. Each Operation Center will have a copy of the Plan. A section on the handling of chemical products will be included.
- Prior to the commencement of the project, the Coordinator will meet with the employees (including subcontractors) to discuss the handling of oils and chemicals, and the situations that could cause spills and how to avoid

or minimize the impact of t he same. In addition, they will be told how to respond to a spill and who to inform, according to their place of work. The resident engineer in the different operation centers will be responsible for ensuring the implementation of the control measures, in coordination with the Environmental Coordinator.

- The oils and other chemical products needed for the project, which are purchased by t he principal contractor, will be stored in the designated warehouse area of the operation centers. Small containers will be stored in metal shelves, bentonite will be stored on wood pallets. Other products in 20 to 55 gallon containers will be stored on wood pallets.

- We will make sure that the assigned employees know the correct functioning and operation of the machinery.

6.14.1. Spills on the Soil

- The contractor's Environmental Coordinator will prepare a Spills Control Plan. This Plan will be prepared following the guidelines of the Code of Federal Regulations, Title 40, Protection of the Environment, Part 112, Oil Pollution Prevention. The same will be filed with the EPA for evaluation. This Plan will have a section where the Operations Centers and the factors specific to each one will be discussed. Each Operation Center will have a copy of the Plan. A section on handling chemical products will be included.

- All the project's vehicles will have a Spill Kit.

- Small spills of oil or other liquids will be cleaned with absorbent material and the contaminated soil will be removed.

- The soil will be placed in containers and identified appropriately. Full RCRA tests will be conducted before disposal in an authorized site.

- No vehicles with leaks will be permitted in the work area, nor will it be permitted to store chemical products out of the operation centers.

6.14.2 Spills in Water

- The contractor's Environmental Coordinator will prepare a Spill Control Plan. This Plan will be prepared following the guidelines of the Code of Federal Regulations, Title 40, Protection of the Environment, Part 112, Oil Pollution Prevention. The same will be filed with the EPA for evaluation. This Plan will have a section where the Operations Centers and the factors specific to each one will be discussed. Each Operations Center will have a copy of the Plan. A section on handling chemical products will

be included.

- A Plan on spills specific to the HDD process using bentonite will be prepared. (See Addendum 6.2, Spill Prevention and Contingency Plan for Drilling Mud Use).

- Oil leaks in water, if they occur, will come from the use of heavy machinery in crossings by open trench through ravines or wetlands. These will be cleaned with absorbent pads and the waste will be collected in containers for disposal.

- No vehicles with fuel or lubricant leaks will be permitted in the work area.

In case of a spill, the Environmental Coordinator will prepare a report that includes the following information:

- Physical and mailing address.
- The installation's telephone numbers.
- Day and time the spill occurred.
- Type of material spilled.
- Estimated amount of spilled material.
- Source of the spill.
- Description of the affected site.
- Cause of the spill.
- Damages caused by the spill.
- Actions taken to mitigate the effects of the spill.
- Indicate whether it was necessary to evacuate personnel or residents.
- Name of persons and/or organizations notified of the spill.

The Coordinator will have the emergency telephone numbers of the concerned agencies and will be responsible for communicating the incident to such agencies. In addition, he will attend to the inspections of these agencies and will see to it that the additional measures recommended by such agencies are implemented.

6.15 Impacts Caused by Hazardous and Non-hazardous Solid Wastes

During the construction works, **non-hazardous** solid wastes, common to this type of project will be generated. These consist mostly of debris of wood, sand, rock, paper, soil, plastic, asphalt, metal, cement and vegetable cover.

The total wastes estimated for this project is greater than 100 cubic yards weekly, approximately. The contractor will pick up and transport these wastes to a nearby landfill approved by the JCA. In addition, there will be waste generated by portable toilets, paints, used oil, etc.

The impact of these wastes will be concentrated mostly in the landfills because there will be an increase in the amount of wastes they will receive during the construction of the project. This impact will be minimized by reusing part of the soil to backfill the trenches and restore the right-of-way and recycling all recyclable material, such as used oil.

Poor handling of hazardous or non-hazardous wastes can contribute to water and soil pollution.

The following measures will be taken to minimize the impacts from waste generation:

6.15.1. Non-hazardous solid wastes

- The material removed during the right-of-way clearing and leveling phase, such as **leftover** soil, rocks and debris, will be placed in hauling trucks and disposed of in places that require fill and are authorized to receive it or in an approved landfill. The trucks will use covers to minimize the emission of fugitive dust.

- The vegetable cover removed during the right-of-way clearing and leveling phase, will be mechanically shredded and reused as wood chips for the control of erosion in slopes, as allowed by Law 70 of September 18, 1992, Puerto Rico Solid Waste Reduction and Recycling Act, as amended and Regulation No. 6825, better known as the Recycling Regulation. The shredding will be carried out with a Morbark top grinder near the site where it is generated, where the resulting material will also be used.
- The material removed during the excavation of the trenches will be stored to be reused during the restoration stage. This includes subsoil and topsoil. It will be stored within the construction right-of-way and all the erosion and sedimentation measures discussed in this Document and those included in the CES Plan to be presented together with the application for the General Consolidated Permit will be taken.

- The erosion and sedimentation control measures discussed in this document and those which are included in the CES Plan that will be filed together with the application for the General Consolidated Permit will be implemented in the soil storage areas.

- The reuse of the soil to backfill the trenches and restore the rights-of-way reduces the project's impact on landfills and fill soil quarries and it maintains the integrity of the soil characteristics in the area.

- In case any surplus soil is left over, the same will be donated to a landfill site or authorized sanitary landfill.

- Wastes generated by the employees will be collected in plastic bags and placed

in containers to be later disposed of in approved landfills.

- A company will be contracted to provide portable toilet services. The same will be responsible for the transportation and disposal of the wastes. In addition it will be responsible for addressing nay kind of spill of this kind of waste.

6.15.2. Hazardous Wastes

- The only hazardous chemical products to be used during the construction will be epoxy-based products, oils and lubricants. Inasmuch as possible, this type of waste will be minimized. Used oils and lubricants will be recycled and the epoxy-based products will be used to the maximum and any surplus will be stored for future use.

- Handling of chemical products such as epoxy, paints and other materials will be delegated on experienced personnel. This type of waste will be separated from the other construction wastes.

- Chemical product wastes will be disposed of in conformity with the contents of the Material Safety Data Sheet (MSDS) and applicable regulations. The project's Environmental Coordinator will carry out all the hazardous or toxic waste disposal activities.

- Prior to the disposal of solid wastes presumed to be hazardous but not yet identified, the residues will be analyzed (full RCRA) to identify whether they are hazardous or toxic.

6.15.3. Used waters

The generation of used waters will originate, for the most part, from the hydrostatic tests to verify the pipeline's integrity. In addition, there will be a fraction of sanitary residues generated by the employees.

Although the hydrostatic test water is clean water, an adequate place is required for its disposal. It is estimated that 10 million gallons of water will be needed for the test. Poor management of that amount of water and uncontrolled disposal techniques could result in soil erosion.

Poor handling and disposal of sanitary wastes could impact water quality and pollute the soil.

The following measures will be implemented to minimize the impact of used waters:

6.15.3.1. Hydrostatic tests

After the test is performed, the water will be discharged in discharge point NPDES 001 of the San Juan Thermoelectric Power Plant. There will be coordination with the Federal Environmental Protection Agency (EPA) to obtain the temporary discharge permit. All the sampling and analysis conditions established by the EPA will be complied with.

6.15.3.2. Sanitary residues

Portable toilets will be provided for use by personnel hired during the construction. In this way the inadequate disposal of biological pollutants in the areas near t he project will be avoided. The contractor that provides the portable toilets will be responsible for the disposal of the wastes and for providing maintenance of such toilets at least once weekly, in accordance with the applicable regulations of the Department of Labor and Human Resources. In addition, he will be responsible for addressing any spill of this waste. This will be done in coordination with the project's Environmental Coordinator.

6.16. Socioeconomic Impacts

The socioeconomic aspect of the Municipalities where the project will be constructed will be impacted temporarily. The impact is positive for the economy, because the local labor force and the services of local businesses will be used.

In addition, there will be temporary impacts that will cause inconveniences to the citizens. Those impacts are discussed next.

6.16.1. Economy

The project represents a temporary benefit to the local economy. Among the benefits directly related to the project are: increase in taxes paid to the Municipalities due to the construction, increase in employment opportunities and an increase in sales, among others. This increase in local sales will be beneficial to the municipalities because they will receive the recently established tax on purchases.

Puerto Rico has hotels and hostels that will house workers coming from the United States who will be staying for nine months. Together with the inns, the restaurants, gas stations, fast food businesses and convenience stores will benefit from the daily consumption by these and the local workers.

During the construction stage, between 1,000 and 1,200 direct temporary jobs will be created, approximately. Hiring local workers will have a temporary positive impact on the municipal economy. In addition, there will be contracting of local businesses and industries, such as: hauling trucks, sprinkling trucks, heavy equipment, leased cars, trailers, portable toilets, purchases of lumber, gravel and bottled water, among others. In addition, it is estimated that the project will generate some 4,000 to 4,500 indirect jobs.

6.16.2. Community

In Chapter 7, Socioeconomic Study, it was determined that the project's construction will not have a disproportionate environmental impact on any group.

The increase in traffic, noise and fugitive dust are factors that will impact the communities adjacent to the construction. There will also be an impact to other residents who use the public roads and to visitors, but to a lesser degree. It is important to underscore that, by the nature of the project, the impact is short-lived. The project's construction is not stationary. The same will move from one place to another in lineal form, day to day. Residents adjacent to the construction will be notified in advance of the dates construction will be carried out in their area.

The impacts caused by an increase in traffic, fugitive dust and noise cannot be avoided, but the following measures will be implemented to minimize them: free access to communities and residences will be ensured; the work area will be delimited; specialized work areas, such as the operations centers, will be located outside of the quiet zones. In addition, there will be compliance with the measures indicated in sections 6.4.1, 6.11.2 and 6.13 (Fugitive dust, Traffic and Transportation, and Noise, respectively).

The AEE will implement a public information program to educate the community. It will begin prior to the construction and will continue during the same. This will include the use of radio and the local and regional newspapers to disseminate information.

6.16.3. Impacts to public services and facilities

The construction of Vía Verde will cause temporary and minor impacts on the public services of police, firefighters and medical services. This impact will not be significative because, prior to the construction works, there will be coordination with the corresponding Agencies to ensure effective response in case of an emergency.

There will be coordination with state and municipal police to maintain order and control traffic in some areas. Their services will not be necessary in agricultural or barren areas, which represent the majority of the land that will be used.

The Health Centers of each municipality will be identified to transport to them any employee that could suffer an accident. The companies that will be evaluated for the construction of the project must have an impeccable safety record and no major accidents are expected. The existing system has adequate capacity to address any minor accident.

There will be coordination with emergency management agencies, such as the Fire Department, to handle emergencies.

6.16.4. Land Acquisition

One of the most important impacts will be the acquisition of land to establish the project's right-of-way. Although there are no federal or state regulations that establish a clearance distance with respect to buildings, the AEE will establish a 150-foot right-of-way along the length of the alignment for conservation and maintenance purposes. This right-of-way will be known as the maintenance right-of-way and it may be increased or reduced in those areas where there are space limitations or particular situations. It was calculated that within this maintenance right-of-way there were approximately 102 structures or residences.

The AEE will acquire the land by expropriation in the operation right-of-way and, if necessary, will extend the acquisition of land within all the maintenance right-of-way. The latter will be in the minority of cases. In public interest projects, the AEE is empowered by law to expropriate the land needed for a right-of-way. No more land than necessary will be expropriated. The AEE will appraise the properties and the owners will be compensated (fair market value) for the assessed value.

The project's construction will not alter the general use of the land. However, there will be specific limitations in the operation right-of-way. In agricultural areas, the owner will be able to use the area of the operation right-of-way for light agriculture, planting lawn or any other activity that does not interfere with the operation of the pipeline. The construction of buildings or structures and planting of trees or vegetation with deep roots will not be permitted.

6.17 Impacts on flora and fauna

The construction of the Project will necessitate clearing some 100-foot wide sections in forest areas. The greater impact will be during the construction process. In the operational phase there will be no impact in most of the areas, because there is no noise, no impermeabilization of the soil and no discharges of substances such as oil and fuel. At the end of construction, a 50-foot wide operation right-of-way will be maintained. This means that after construction, vegetation will be permitted to exist adjacent to the 50-foot wide operation right-of-way. To reduce the edge effect, the mitigation plan will contemplate the restoration of the remaining 50 feet that were cleared for the construction phase with the species that were present in that section of the forest before the construction and which exist in the contiguous forest.

The indirect impacts on the habitats are mostly related to the clearance of the existing vegetation during the construction. When deforestation occurs an edge effect is created and invading species can colonize the deforested area. Among these there are exotic and native species. These species can eliminate native species by depredation, genetic modification and transmission of diseases. To minimize this impact, part of the right-of-way will be reforested, except for the part corresponding to the 50-foot wide

operation right-of-way, which will remain free of deep-rooted vegetation.

This 50-foot wide strip will be restored naturally with herbaceous and arbustive vegetation between the two forest sub-units. Although this does not comply with the environmental requirements and conditions of all the species that could be affected, because it is not possible to reforest using trees, a natural strip is provided that serves as a connection to several species. On the forest margins or edges, the trees that will be planted as part of the mitigation plan will be the same native species with broad crowns that are found in that type of habitat. This will create a bridge between both sub-units and will provide a connection to those species that inhabit the highest forest stratum.

Vía Verde will require patrolling the 50-foot operation right-of-way, for that reason the AEE proposes that every six months a biologist patrols the right-of-way in forest areas of ecological value that are prone to the edge effect. This biologist will identify the invading species or the conditions affecting those areas and will propose control methods. In addition, these areas could serve as study platforms for universities. In this way the proliferation of undesired species will be controlled and the impact caused by the edge effect and the fragmentation in these areas will be minimized. The loss of habitat will be compensated through a mitigation plan that considers the characteristics and processes intrinsic to the habitat affected by the Project.

By mitigating compensating for the lost habitat area, the AEE proposes to mitigate in areas contiguous to the affected area, whenever possible. In this manner the proportion of perimeter to area of such zone can be maintained stable.

Recognized among the habitats that will be affected are the loss of habitat of the Guabairo (*Caprimulgus noctitherus*), Vahl's boxwood (*Buxus Vahlii*) and of other species. To determine the presence of the habitat of the listed species, studies specific to these species and their habitat were conducted. These studies will be complemented with additional field studies, as was coordinated with the FWS. In addition, the Project contemplates the preparation of a mitigation plan designed to compensate for the loss of habitat of the listed species found (if any) during said study.

As part of the work plan agreed with the FWS, a study will be made to determine the presence of the Coquí Llanero (*Eleutherodactylus juanariveroi*) in the Project's route, near the area of Punta Salinas in Toa Baja. This will provide important information to avoid its impact in case the presence of this species is determined in the area of the Project.

The fauna and flora study conducted for the Project produced a broad inventory of the species present along its route. The results found, with regards to the species observed allow us to specify the type of natural community, what type of habitat and the general conditions existing in the sampling site. The results also included data on the tree cover by type of forest, which allows us to establish an estimate of the maturity of

the forested areas sampled. In addition, the dominant species were included, of flora as well as of fauna, by area sampled. Data such as the abundance or density index of species were not part of the study's design.

With regard to errors in common and scientific names, we must indicate that we used recent published scientific references. Common names vary from region to region and even from town to town.

Other species that could be impacted are bats. There are 13 species of bats in Puerto Rico, divided into 5 families. Of these only 12 have been observed in bat roosts in the municipalities crossed by the Project's route. Although 12 species are found in the municipalities, only four species of bat could be affected by the construction of the project. These species are: *Artibeus jamaicensis* (Common Fruit Bat), *Erophylla sezekorni* (Buffy Flower Bat), *Monophyllus redmani* (Leach's Single Leaf Bat, Puerto Rican Long-tongued Bat) of the Phyllostomidae family and *Eptesicus fuscus* (Big Brown Bat) of the Vespertilionidae family. These four species use the Vega State Forest in the Municipalities of Vega Alta and Vega Baja to roost. In addition, the Common Fruit Bat can be found in Matos cave located on PR-10, in Utuado. These species that could be affected by the project nest in caves, whether warm or cold. Since the project does not contemplate the installation of pipeline in cave areas, these species are at lower risk of losing their roosting areas. The mitigation and compensation plan for the impacts caused by the Project will include the necessary measures for the protection of these species, considering the vegetation that produces fruits for frugivorous species. This plan will be developed in coordination with the DRNA.

The Project does not impact the habitat of the White-crowned Pigeon (*Columba leucocephala*) in the Municipality of Toa Baja, since no type of forest, mogotes or mangroves will be impacted in this municipality. Areas in other municipalities that could be habitat for this species will be impacted. However, such species was not seen during the field studies.

Regarding the impact on trees, an inventory will be conducted in compliance with the Planting, Pruning and Forestation Regulation (Regulation #25) of the Planning Board (JP) and the Department of Natural and Environmental Resources (DRNA), which includes the corresponding mitigation. In the study, 31 species of critical flora were identified, as designated by the DRNA (see Chapter 3). The mitigation and compensation plan for the impacts caused by the Project will include the necessary measures for the protection of these species.

The biological diversity along the project route is documented in the flora and fauna study conducted for it. Biodiversity could be affected more by indirect impacts than by the direct impact. The instantaneous (direct) effect of the Project's construction phase is the removal of species from the space they occupy at present. However, individuals of the same species remain in the adjacent, not-cleared areas. There could be indirect impacts on biodiversity by the secondary effects of fragmentation in the short and

middle terms. That is why it is important to establish the mitigation and management measures (like the previously mentioned ones) to avoid or reduce the edge effect that could promote the colonization of undesired species that have an effect on the native biodiversity.

6.17.1. Protected, threatened or endangered species

According to the consultation with the United States Fish and Wildlife Service (USF&WS), the Project could affect adequate habitat for the species listed in Section 3.2.2.15. During the field work for this study, none of the species was detected, with the exception of the guabairo. The methodology used, which consisted of walks through stretches of different longitudes and the transects to determine the occurrence of species, the forests' basal areas and the tree density by hectare, did not detect the presence of these species listed at the federal level.

The project's alignment crosses through different areas with characteristics and elements similar to the environments where these species inhabit, according to the life zone in which they are. With regard to plants, although the same were not detected, if any of those existed in the project's alignment its impact could be avoided as describe below for plants designated as critical at the state level.

With regard to the Puerto Rican Sharp-shinned Hawk (*Accipiter striatus venator*), the Guaraguaíto (*Buteo platypterus brunnesens*), the Puerto Rican Parrot (*Amazona vittata*) and the Guabairo (*Caprimulgus noctitherus*), construction impacts to areas similar to their respective habitats will be avoided, especially during their mating and nesting seasons.
It bears mentioning that the species listed for PR-10 and the Río Abajo area of the Subtropical Wet Forest should not be impacted, because the Project's alignment in that zone crosses through the right-of-way of highway PR-10.

The guabairo will be protected with the implementation of a protocol for its protection and conservation during the construction phase. Also, the impact on the guabairo will be minimized by constructing the project outside of this species' nesting season. On the other hand, the guabairo has limited distribution. Nevertheless, recent studies of this species (Vilella, 2009) have demonstrated that it has a broader distribution than previously reported. That is why the protection of adjacent areas, or areas near where the guabairo exists, constitutes one of the most important measures to increase its distribution and population.

Although the only endangered species (federal designation) found in the study area was the guabairo, several species designated as critical at the state level were found. These are listed in Section 3.2.2.14.

The species of flora designated as critical can be identified with some conspicuous method (printed ribbon marker or "DO NOT CUT" flagging tape) and thus avoid

impacting them. If there is a possibility of impacting these individuals, the same will be transplanted to an adequate place, by personnel qualified for that practice. These species are designated as critical for different reasons: for folkloric importance or for being indicator species of habitats of greater importance.

The species of flora in the wetlands of the north are mostly herbaceous. Cobana Negra (*Sthalia monosperma*) is sometimes found associated with mangroves. The mangroves in the project's alignment are present in the areas of Cucharillas (Guaynabo/Cataño), Río Cocal (Toa Baja/Dorado) and in Peñuelas. However, it wasn't found there. Although this species could be in herbaceous areas adjacent to mangroves, these areas will not be impacted due to the construction method the project will use in these areas.

The white or siliceous sands through which the Project's alignment will cross are already impacted. These were found in the area of Arecibo, west of the sanitary landfill. These areas have been used for the extraction of this material, for cattle grazing and for yard maintenance in some residences. The presence of *Chamaecrista glandulosa* was not detected, although the area was walked through more than once.

With regard to the fauna species, the guabairo *(Caprimulgus nochtiterus*) is designated as endangered, and the Puerto Rican Boa (*Epicrates inornatus*) and the White-cheeked Pintail *(Anas bahamensis*), as vulnerable. The white-cheeked pintail was seen flying over the project's alignment in Peñuelas. These prefer lagoons or ponds, which are not under the impact footprint of the Project.

The Puerto Rican boa will be protected by the implementation of a protocol for its protection and conservation during the construction phase. In the case of the Puerto Rican boa, its distribution is very broad and it includes most of the island.

All permanent loss of habitat of the guabairo will be mitigated in a 10:1 ratio, in coordination with the Department of Natural Resources and United States Fish & Wildlife Service. The mitigation will be made in accordance with a plan to those effects that will have the approval of both agencies before its implementation.

Cumulative Impact on the Habitat of the Guabairo

According to NOAA's Environmental Sensitivity Index Map, the guabairo is present in the mountainous zone of Peñuelas, north of PR-2. The study of flora and fauna conducted for the Vía Verde project confirmed the presence of the species in Peñuelas' Tallaboa Saliente ward. The study that was conducted for the construction of Gasoducto del Sur (Southern Gas Pipeline), confirmed the presence in the Encarnación ward. There is also presence of the guabairo in the mountainous area of Ponce, in the Canas ward, which borders Peñuelas' Encarnación ward. In Peñuelas, the guabairo's habitat was impacted in the past by the construction of an industrial landfill, the clearing of part of the construction right-of-way of Gasoducto del Sur and the clearing of areas

for the construction of houses and businesses. In addition, it is under pressure from future developments.

In Ponce the habitat was impacted in the past by the construction of PR-2, the Ponce Correctional Center (Las Cucharas), and the clearing of the right-of-way for the construction of Gasoducto del Sur. In addition, it is also under pressure from future developments. There are two future housing developments, one of them with construction permit from the Municipality of Ponce. In this estate the land is completely segmented by roads.

All these projects have contributed to diminish and fragment the habitat of the species. The survival of the guabairo depends on the presence of forested areas because it nests on the ground and avoids areas with no vegetation. Although according to Vilella and Zwank, 1987, the guabairo also can exist in lands that have suffered some type of impact.

Vía Verde is a future project that will add on to the past, present and future impact of the species, since it will add to the fragmentation and reduction of the same caused by the mentioned projects. However, since there will be no human habitation in the area of the right-of-way, there will be some degree of natural restoration of the same that could foster the presence in its surroundings.

It is important to mention, that far as is known, only the construction of PR-2 by the Highways Authority, and the clearing of part of the right-of-way for Gasoducto del Sur by the AEE, were the only ones that considered the impact on the guabairo's habitat and prepared mitigation plans. The AC (Highways Authority) bought lands with guabairo habitat in another area of Peñuelas, and the AEE promised to transfer $5 million dollars to the DRNA for the purchase of land with guabairo habitat. The AEE transferred $1.5 million dollars and the DRNA is in the process of purchasing. The AEE will continue transferring funds as the DRNA supplies yearly reports with the status of the acquisition.

For the Vía Verde project, the AEE will continue to contribute to the purchase of land of high value that are guabairo habitat. These lands will be transferred to the DRNA for perpetual conservation. These lands will be acquired contiguous to the existing habitat of this species, so as to mitigate the fragmentation to said habitat by maintaining the ratio of perimeter to area of the zone. The mitigation will be in situ or in contiguous areas, in a 10:1 ratio, by acquiring land in the north portion of the hills that constitute guabairo habitat.

6.18 Impact on Air Quality

Air quality can be impacted by the modification of the units, whether in regard to the criteria pollutants, dangerous and others included in the Prevention of Significant Deterioration (PSD) program, the fugitive dust and the emission sources that will be

used during the construction phase.

6.18.1. Description of Criteria Pollutants and their Effect on Health and the Environment

The so-called criteria pollutants are those for which limits have been established to protect human health and well-being. There are two categories of health effects as a function of exposure time to the pollutants: acute and chronic. Acute effects affect specific organs immediately, such as those related to breathing and the eyes. Chronic effects are those that will present themselves after a long exposure (years) to the pollutants. Damages to human health vary with the intensity and duration of exposure to the pollutants and with the populations' health level. Specific population groups are more sensitive to pollution than others, such as children, senior citizens and persons with cardiopulmonary and respiratory diseases.

Next, the impacts produced by each pollutant on health and the ecology are summarized:

- **Sulphur dioxide (SO_2)**

Sulphur dioxide belongs to the sulphur oxides family (SO_x). These are colorless gases created by burning sulphur and they tend to dissolve easily in water. The primary source of SO_x is burning fossil fuels, containing sulphur in their composition.

Exposure to SO_2 produces acute or chronic irritation and inflammation of conjunctival and respiratory mucous membranes. SO2 can be transformed into other products, such as fine sulphate (SO_4) particles and sulphuric acid fog (H_2SO_4). It has been found that under a combination of particles and SO_4, health risk tends to increase with an increase in morbidity and mortality of chronic heart and respiratory patients. In asthmatic individuals it could produce bronchial constriction.

- **Nitrogen dioxide (NO_2)**

Nitrogen dioxide (NO_2), together with suspended particles are responsible for the reddish-brown layer frequently seen over many urban areas. This gas belongs to the nitrogen oxides (NO_x). These are a group of highly reactive gases that contain different amounts of oxygen and nitrogen, like nitric oxide (NO) and nitrogen dioxide.

Nitrogen oxides are formed when a fuel is burned at high temperatures and/or when it contains nitrogen compounds. The principal sources of NO_x are motor vehicles, electric generation plants and other industrial, commercial and residential sources that burn fuel. NOx can also be formed naturally, by bacterial decomposition of organic nitrates, forest and grassland fires and, to a lesser degree in electric storms.

The progressive increase in exposure to NO_2 can produce olfactory perception

problems, respiratory distress, acute respiratory pain and pulmonary edema.

- **Particulate Matter (PM)**

It forms a complex mixture of solid and liquid materials suspended in the air that can vary significantly in size, shape and composition, depending fundamentally on its origin. The size of the particulate matter varies from 0.005 to 100 microns (10-6) in aerodynamic diameter, that is, from a few atoms to the thickness of a human hair.

The particles are formed by natural processes like plant pollination and forest fires and by sources like burning fossil fuels to fertilizing agricultural fields. The particles can be directly emitted from the source, as primary particles and they can form secondary particles when some atmospheric gases react, such as: nitrogen oxides, sulphur oxides, ammonia, organic compounds, etc.

Some fifteen years ago their study and environmental regulation were centered on the total suspended particles (TSP), which are smaller than 100 μm in aerodynamic diameter. Subsequently, the attention centered on particles smaller than 10 μm, and until a few years ago, on fine and ultra-fine particles, that is, smaller than 2.5 and 1 μm, respectively. Thus, the so-called PM 10 can be divided, by their size, in coarse, fine and ultra-fine, with the coarse fraction comprised of particles whose aerodynamic diameter is between 2.5 and 10 μm (PM 2.5-10); the fine fraction includes particles with an aerodynamic diameter smaller than 2.5 μm (PM2.5), and, finally, the ultra-fine fraction includes particles smaller than 1 μm.

The smaller the particles, they can penetrate directly inside the lungs with possible toxic effects due to their inherent physical-chemical characteristics. In several studies, conducted in the United States and Europe, it has been found that prolonged exposure to fine particles originating in combustion is an important environmental risk factor in cases of mortality from cardiopulmonary disease and lung cancer.

- **Lead (Pb)**

Lead is a metal that was frequently used to manufacture water pipes, food containers, paints and gasoline. The primary source of air pollution from lead has been the use of leaded fuels in automobiles.

Because lead is not consumed in the combustion process it is emitted as particulate matter. Lead is a toxic pollutant for humans, its difficult removal from the body makes it accumulate in several organs and it may damage the central nervous system. Acute intoxication causes symptoms such as diarrhoea, vomit, colic, convulsions and head aches. Its elimination from the body is possible with medical treatment, although the damage caused principally to the nervous system is not reversible. Children with high levels of lead in their blood exhibit disorders in their social behavior and a limited mental development with irreversible neuro-behavioral effects.

- **Ozone (O_3)**

Ozone is a colorless gas compound, it has the capacity to oxidate materials. Ozone is a secondary pollutant formed through the chemical reaction of nitrogen dioxide (NO_2) and volatile organic compounds (VOC) in sunlight.

Ozone can cause pulmonary inflammation, depression of the immunologic system against pulmonary infections, acute changes in the pulmonary function, structure and metabolism and systemic effects in soft organs like the liver.

6.18.2 Preliminary Estimate of Criteria Pollutant Emissions

The proposed action provides for the change to natural gas in the Cambalache, Palo Seco and San Juan power plants. This change represents a substantial reduction in the emissions of criteria pollutants into the air (those regulated by federal and local regulations). A **preliminary** estimate of emissions was prepared to determine the applicability of a PSD permit and Rule 201 of the Regulation for the Control of Air Pollution (RCCA) of the JCA. For this computation, the estimate of emissions resulting from burning natural gas was based on emission factors AP-42 of the EPA and operation at 100% was presumed. The mission values will be reviewed once the contracts for the design and conversion of the generating units are granted. During this process the manufacturer's emission factors will be obtained, which are more precise.

Acid and fluoride aerosol pollutants are included in these estimates. In addition, an estimate of CO2e emissions was included. The estimate of the CO2e emissions is based on the maximum emission potential for each power plant. Below are some tables that contain the preliminary applicability analysis of PSD and Rule 201.

Preliminary PSD Analysis for Palo Seco Units 3 & 4 **Fuel S, %** 1.5						
Pollutants	**Existing Allowable Emissions (One Unit)* (ton/yr)**	**Existing Allowable Emissions Units 3 & 4 (ton/yr)**	**Projected NG Emissions (ton/yr)****	**Increment Netting (ton/yr)**	**PSD Significant Emission Rate (ton/yr)**	**PSD, Yes or No**
PM	979.00	1,958.00	32	-1,925.8	25	No
PM10	118.00	236.00	129	-107.3	15	No
SO2	13,554.00	27,108.00	10	-27,097.8	40	No
H2SO4	602.80	1,205.60	16	-1,190.0	7	No
Nox	2,417.00	4,834.00	4,740	-94.3	40	No
CO	288.00	576.00	1,422	845.9	100	Yes
VOC	44.00	88.00	93	5.1	40	No
Pb	0.24	0.48	0	-0.5	0.6	No
Fluoride	2.16	4.32	-	-	3	-

*Existing Allowable Emissions as Stated in TV Permit Application
**Emissions Factors from AP-42

Preliminary PSD Analysis for San Juan Units 7, 8, 9, 10 & San Juan Combined Cicle Units 5 & 6									
Pollutants	SJ 7, 8, 9, & 10		SJCCS & 6		*Total Emissions NG Conversion (ton/yr)*	PSD Significant Emission Rate (ton/yr)	*Existing Allowable Emissions****	Increment Netting	PSD Applicability
	Natural Gas Emission Factors* ($lb/10^6$ scf)	Emissions NG Conversion (ton/yr)	Natural Gas Emission Factors ($lb/10^6$ scf)	Emissions NG Conversion (ton/yr)					
PM	1.90	32.87	1.94	28.19	*61.07*	25	*2,946.22*	-2,885.15	No
PM_{10}	7.60	131.49	6.73	97.94	*229.43*	15	*1,430.51*	-1,201.08	No
SO_2**	0.60	10.38	3.47	50.45	*60.84*	40	*7,619.76*	-7,558.92	No
H_2SO_4	0.92	15.90	5.31	77.26	*93.15*	7	*1,592.26*	-1,499.11	No
NOx	280.00	4,844.52	326.40	4,748.62	*9,593.14*	40	*6,739.20*	2,853.94	Yes
CO	84.00	1,453.36	83.64	1,216.83	*2,670.19*	100	*1,654.73*	1,015.46	Yes
VOC	5.50	95.16	2.14	31.16	*126.32*	40	*190.70*	-64.38	No
Pb	n/a	n/a	n/a	n/a	*n/a*	0.6	*3.54*	-	-
Fluoride	No info	No info	No info	No info	*No info*	3	-	-	-

*Emission Factors from AP-42

**AP-42 Table 3.1-2a

*** Existing Allowable Emissions Stated in TV Permit

Preliminary PSD Analysis Cambalache 1, 2 & 3						
Pollutants	Emission Factors ($lb/10^6$ scf)*	Emissions NG Conversion (ton/yr)	PSD Significant Emission Rate (ton/yr)	Baseline Actual Emisisons (ton/yr)	Increment Netting	PSD Applicability
	Cambalache 1,2 & 3					
PM	1.94	21.15	25	113.90	-92.76	No
PM_{10}	6.73	73.46	15	290.45	-216.99	No
SO_2	3.47	37.84	40	780.23	-742.39	No
H_2SO_4	5.31	57.94	7	182.24	-124.30	No
NOx	326.40	3561.47	40	120.28	3,441.18	Yes
CO	83.64	912.63	100	207.75	704.87	Yes
VOC	2.14	23.37	40	71.80	-48.43	No

Pb	n/a	n/a	0.6	0.12		n/a
Fluoride	No info	No info	3	-		No info

*Emission Factors from AP-42

When the increments are greater than the PSD values, the proposed action could have a significant impact on air quality. These are:

Pollutant	**Rate of Emission (tpa)**
Carbon monoxide	100
Nitrogen oxides	40
Sulphur dioxide	40
Particulate Matter	25
Ozone	40 (of volatile organic compounds)
Lead	0.6
PM10	15

The analysis and measures needed to minimize this possible impact will be determined under the PSD regulation and the Puerto Rico Air Pollution Control Regulation, of the Environmental Quality Board (JCA). These regulations will require the significant impact analysis by mathematic modeling of atmospheric dispersion, applying the regulatory provisions for new emission sources (New Source Performance Standard), emission control measures, visibility analysis and environmental justice. The regulatory provisions determined under these regulations will become federally enforceable conditions under the Title V federal and state permit system.

The **preliminary** emission estimates indicate that there can be applicability for Rule 201 of the RCCA (Location Approval) and PSD due to the pollution emissions of NO_x and CO in the San Juan and Cambalache power stations and of CO in Palo Seco power plant. The formal exercise of applicability or no applicability of this regulation will be performed once the formal permit application process begins. This will be done when the Environmental Compliance Certification is obtained (Article 4B3 of the Environmental Public Policy Act).

The required emission control measures will be implemented according to the determinations of the applicability or no applicability analysis for Rule 201 of the RCCA (Location Approval), as well as for PSD. Each power plant will be evaluated individually

to determine if control equipment is necessary and what will be the control required in accordance with the Best Available Control Technology (BACT).

- **PM_{10} Maintenance Area in Guaynabo**

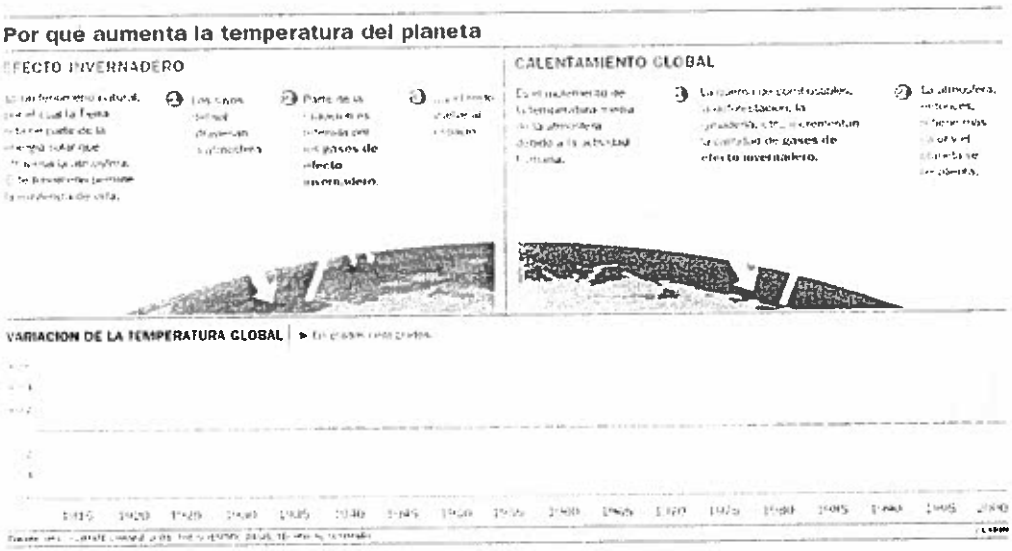
The RCCA was amended recently to re-designate the Guaynabo PM10 No Achievement Area, as a Maintenance Area through a 24-Hour National Environmental Air Quality Maintenance Standard for particulate matter (PM_{10}) for the Municipality of Guaynabo. According to the preliminary calculations, the conversion of the Palo Seco and San Juan generating units will have the effect of reducing the PM10 emissions in the Guaynabo Area by about 85%. This because the almost insignificant sulphur content of natural gas, which is a precursor of the PM_{10} pollutant.

- **Carbon dioxide**

It is important to highlight that, although the preliminary estimate indicates that Rule 201 and the PSD could apply, there is a significant reduction in the criteria pollutant emissions. In addition, Vía Verde will result in a significative reduction (between 29% and 59%) in carbon dioxide (CO_2) emissions.

Carbon Dioxide Equivalent (CO2e)				
Power Plant	Fuel Oil (Tons/yr)	Natural Gas (Tons/yr)	Diference (Tons/yr)	Reduction %
Palo Seco	2868,150.7	2022,146.4	846,004.3	29%
San Juan	4281,122.4	1738,194.4	2542,928.0	59%
Cambalache	1857,413.0	1303,468.8	553,944.2	30%

This gas is a product of combustion that has the capacity to retaining the heat the sun radiates on the planet. It is postulated that human activity causes an increase in the concentration of carbon dioxide in the atmosphere, which in turn results in an increase in global temperature. This phenomenon is denominated global warming. Global warming can have negative environmental impacts, such as droughts, wildfires, more intense storms, heat waves, glacier melting, considerable increase in sea levels, changes in ecosystems, coral bleaching, costal erosion and air quality deterioration, among others.



Throughout the world efforts are directed at controlling emissions of carbon dioxide. In fact several legislative projects were presented in Puerto Rico for the control of global warming, some of which are now law. However some of these laws became dead letter, due to the impossibility of enforcement.

Vía Verde provides a tool to assert the legislative intent regarding Puerto Rico's contributions to the control of global warming and anticipates federal environmental laws and regulations in the process of publication, by diminishing emissions of this gas.

- **Hazardous Pollutants**

The estimate of hazardous pollutant emissions for each power plant is included in the following table:

Future Potential HAP's Emissions
100% Natural Gas / 0% Fuel Oil Scenario

Pollutants	Emissions From Units 3 and 4 Palo Seco Power Plant	Emissions From Units 7, 8, 9 and 10 San Juan Power Plant	Pollutants	Emissions From Units 1, 2, & 3 Cambalache Power Plant	Emissions From Units 5 and 6 San Juan Power Plant
1,1,1-Trichloroethane			1,3 - Butadiene	0.00	0.01
1,4-Dichlorobenzene	0.02	0.02	Acetaldehyde	0.45	0.59
Acenaphthene	0.00	0.00	Acrolein	0.07	0.09
Acenaphtylene	0.00	0.00	Benzene	0.13	0.18
Anthracene	0.00	0.00	Ethylbenzene	0.36	0.47
Benzo(a)anthracene	0.00	0.00	Formaldehyde	7.90	10.54
Benzene	0.04	0.04	Naphthalene	0.01	0.02
Benzo(b,k)fluoranthene	0.00	0.00	PAH	0.02	0.03
Benzo(e)pyrene	0.00	0.00	Propylene Oxide	0.32	0.43
Benzo(g,h,i)perylene	0.00	0.00	Toluene	1.45	1.93
Dibenzo(a,h)anthracene	0.00	0.00	Xylenes	0.71	0.95
Ethylbenzene	0.00	0.00	Arsenic	0.00	0.00
Fluoranthene	0.00	0.00	Beryllium	0.00	0.00
Fluorene	0.00	0.00	Cadmium	0.00	0.00
Formaldehyde	1.27	1.30	Chromium	0.00	0.00
Indeno(1,2,3-cd)pyrene	0.00	0.00	Lead	0.00	0.00
Naphthalene/PAHs	0.01	0.01	Manganese	0.00	0.00
n-Hexane	30.47	31.14	Mercury	0.00	0.00
Phenanathrene	0.00	0.00	Nickel	0.00	0.00
Pyrene	0.00	0.00	Selenium	0.00	0.00
Toluene	0.06	0.06			
Xylene	0.00	0.00			
Arsenic	0.00	0.00			
Antimony	0.00	0.00			
Beryllium	0.00	0.00			
Cadmium	0.02	0.02			
Chromium	0.02	0.02			
Chromium VI	0.00	0.00			
Cobalt	0.00	0.00			
Lead	0.00	0.00			
Manganese	0.01	0.01			
Mercury	0.00	0.00			
Nickel	0.04	0.04			
Phosphorous	0.00	0.00			
Selenium	0.00	0.00			
Organic Total	31.86	32.57	Organic Total	11.43	15.25
Metallic Total	0.09	0.10	Metallic Total	0.00	0.00
Total HAPs	31.96	32.66	Total HAPs	11.43	15.25

The estimate is based on the maximum emission potential for each power plant. The federal regulation establishes that, an emission source is a major one, in hazardous pollutant emissions, if it has the capacity to emit 10 tons/yr of an individual pollutant or 25 tons/yr in the combination of said pollutants (CAPs). Depending on the emission source, combustion turbines or steam boilers, the corresponding NESHAP (National Emission Standard for Hazardous Air Pollutants) emission standard will be applied, as required by regulation.

For combustion turbines (Cambalache Power Station and Combined Cycle Turbines units 5 and 6 of San Juan Power Station), applies NESHAP for Construction Turbines 40 CFR Part 63, Sub-part YYYY of March 4, 2004, which establishes a limit of emission for the pollutant formaldehyde.

As for the boilers of the San Juan and Palo Seco Power Plants, at present the Environmental Protection Agency is collecting information to establish some emission standards for this type of source by March, 2011 (Air Toxics Standards for Utilities - Utility NESHAP).

Regarding the cumulative affects on air quality due to the operation of the units in the power plants that will use natural gas, the present permits system the Power Plants now have considers each one as a sole Emission Source. Therefore, the cumulative effects are contemplated in the permits in affect, and also in the permits that will be obtained for the changes related to the use of natural gas. The processing of the

corresponding permits will consider the applicability of NSPS, NSR regulations and the Puerto Rico Air Pollution Control Regulation, for the totality of emissions in each one of the power plants individually.

It is important to highlight that the cumulative impact from pollutant emissions will be positive because there will be a reduction of up to 64% in criteria pollutants (over 129,000,000 pounds annually) and up to 30% in carbon dioxide.

- **How the proposed action is in harmony or conflicts with the specific terms and goals of the plans in effect regarding the use of land, applicable public policies and controls of the area to be affected**

The public policy applicable to the activity under study is the following:

- Constitution of Puerto Rico
- Goals and public policy of the Puerto Rico Land Use Plan (JP 1995)
- Law 111 of 1985 (For the Protection of Caves, Caverns and Sinkholes)
- Law 292 of 1999 (For the Protection of the Karst Physiography of Puerto Rico)

We discuss next the concurrence of the proposed action with the applicable public policy:

6.19.1. Constitution of Puerto Rico

The Constitution of Puerto Rico provides in Article VI, Section 19 that: "The public policy of the Commonwealth of Puerto Rico will be the most effective conservation of its natural resources, as well as the greater development and use of the same for the general benefit of the community."

It is clear that this is balancing language between the protection of natural resource and their social and economic use. It's about no part of the relationship becoming exclusive of the other, but rather integrate in the most harmonious way possible; in other words, not to underutilize or overuse the country's natural resources. As discussed in this DIA-P, the proposed action pursues a balance between conservation and environmental protection, as well as the social and economic use of the natural resources. The construction of the proposed action will only impact temporarily a minimal portion of the country's physiography. Such impact will be temporary, because after the project is constructed, the strip of ground will reforest in a natural and assisted form, so there will be no net loss of wildlife habitat. At the end of several years the environmental impact will be nil and negligible when compared with the social and economic benefits such an important infrastructure will bring.

6.19.2. Goals and Public Policy Of Land Use in Puerto Rico

The document Goals and Public Policy of the Land Use Plan establishes among its general goals the following: "To direct the planning process towards the achievement of an integral, sustainable development ensuring the judicious use of the land resource and fostering the conservation of our natural resources for the enjoyment and benefit of present and future generations."

An integral, sustainable development is the balance between economic development and the conservation of natural resources with the goal of achieving a better quality of life. As discussed in this DIA-P, the proposed action is an economic activity that does not compromise the island's natural resources permanently. In this DIA we discuss in quantitative form the temporary impact that will happen in the areas under study. It is clear that such impact will be a temporary one and that the benefits of the action in the short, medium and long term will be essential to favor Puerto Rico's economic situation.

In addition, the project is not incompatible with the municipal land use plans. In fact, said project is contemplated in the Municipality of Arecibo's Land Use Plan.

6.19.3. Law 111 of 1985 (For the Protection of Caves, Caverns and Sinkholes)

Law 111 was adopted with the purpose of protecting the caves, caverns and sinkholes. As discussed in the DIA-P, in the region under study enclosures of caverns and sinkholes were identified, so this law applies. To prevent any effect on these systems, the AEE will carry out a series of studies on the nature of such systems to identify potential effects of the extraction activity and the possible use of explosives. Through the study of potential effects of extraction, we will determine the distances the construction must keep so as to not affect the physical stability of caves and sinkholes. Therefore we conclude that it is possible to carry out the construction without undermining the goal of conservation of the caverns and sinkholes.

6.19.4. Law 292 of 1999 (For the Protection of the Karst Physiography of Puerto Rico

Law 292 broadened the intent of Law 111 to other physiographic conditions found in the Karst zone. In its main statement it establishes the following: "To protect, conserve and prohibit the destruction of the Karst physiography, its natural formations and natural materials, such as fauna, flora, soils, rocks and minerals; to prevent the transportation and sale of natural materials **without the corresponding permit..."** (emphasis provided).

Notice that the law establishes the condition of a permit in order to carry out activities in the Karst zone. Although the DRNA has not developed a system of special permits for this zone, through the earth crust permits carrying out activities in is authorized. In the case at hand, the proponent will handle the permit to extract earth crust for the installation of the proposed infrastructure. Through this permit the DRNA will authorize

the action in an orderly fashion in this important zone. To achieve this, the proponent will avoid, minimize and compensate the potential impacts, as discussed in this DIA-P.

6.20. Change of land use through zoning

The proposed action does not contemplate prohibiting changes in land use through zoning. The action proposes that there are no changes in the use of land in the area it occupies; that is to say, the action seeks that the agricultural uses as well as the undeveloped areas covered with arborescent vegetation and wetlands remain that way, because in that way human populations are kept away from the alignment. Only one restriction will be established through the constitution of an operation right-of-way in favor of the AEE, in which the planting of deep-rooted trees or the construction of any structures will not be permitted.

6.21. Justification of the proposed use of resources

At present, the land proposed to construct the action are used mostly for agriculture and areas free of anthropogenic developments. A portion of the land sustains vegetation and wildlife. However, a significative portion of the premises have been recently modified in their topography and vegetable cover (for example, the highways rights-of-way). All these zones have varied functional values as wildlife habitats.

No significative economic use will be modified as part of the proposed action. The agricultural uses will return back to normal once the proposed infrastructure is installed. Likewise will happen with the wildlife, once the right-of-way is restored. In the short term, the action on the green zones will mean the temporary loss in both cases. The reforestation of the zones that remain inactive will contribute to reduce the impact on flora and fauna in the premises.

In the short, medium and long terms, the proposed action will have a positive impact on the economy of the regions where it is proposed (investment in construction) and of the island in general.

6.22. Justification of resource commitment

The irreversible commitments of the proposed action will be the temporary modification of floor space and the consumption of non-renewable resources such as fuel for the construction equipment. The impacts regarding water consumption and the occupation of a space of habitat for wildlife are considered temporary and renewable. However, the environmental and natural benefits derived from t he action include the improvement of wetlands and wildlife habitats through the mitigation plans, the protection of air quality due to the significative reduction (more than 50%) in emanations in the AEE's power plants and the reduction and stabilization of the cost of electricity in Puerto Rico.

6.23. Environmental monitoring program

As part of the efforts to avoid or minimize the impacts of the construction, the project will have an Environmental Coordinator that will be in charge of the project's environmental impact matters. Among his functions will be:

- Offering talks to employees about the project's environmental impact and how they can help minimize it.
- Supervising and ensuring compliance with all the protection measures required in the permits, certificates, or other authorization documents.
- Coordinate responses to environmental incidents.
- Document incidents and corrective actions and attend to visits from regulatory agencies.

INTRODUCTION

PREPA's Strategic Plan and the Government's Energy Reform are geared to reduce the cost of electricity for end users in Puerto Rico. A number of factors contribute to the high cost of electricity in Puerto Rico. These factors are as follows:

1. The current heavy reliance on oil-derived fuels for the generation of electricity is a major factor in the high cost of electricity.
   - Most of PREPA's electricity requirements are provided using residual fuel in its steam plants.
2. PREPA is an isolated system without interconnections and must maintain greater generating capacity reserve margins to maintain its system reliability than otherwise would be necessary, with the corresponding higher capital, operating and maintenance costs.
3. Most of PREPA's generating capacity is located on the Southern part of the island and many of these units are among PREPA's oldest, least efficient, units with high operating costs and emissions.

PREPA's total generating capacity is 5,840 MW. It self generates approximately 70% of its electrical capacity and purchases the remainder from two co-generators. The Vía Verde project will be an energy complex with two primary components: (i) a 92 miles pipeline to transport the natural gas from Peñuelas to the PREPA´s generating plants at Arecibo (Cambalache), Toa Baja (Palo Seco), and San Juan (San Juan) located in the north coast of the island and (ii) the conversion of the existing boilers to a co-firing combustion system at these locations. The project will provide generation capacity to the grid Puerto Rico Electric Power Authority by 2012, and will be an important component of the Puerto Rico's gas infrastructure. As a separate project, Via Verde could also provide natural gas to facilitate the conversion of the 820-MW South Coast Power Plant, which is currently burning liquid fuel (bunker-C).

Environmental Benefits

The project was designed to comply with the Puerto Rico's environmental controls and regulations, especially on air emissions, ambient air quality, wastewater effluent, ambient water quality, and noise. Given the management measures, monitoring by the best available technology, and commitments for the project, including the environmental regulations set by the Environmental Quality Board, the project's impacts on the environment will be manageable. The project will ensure that it meets the Environmental Protection Agency's standards and regulations. This project is indispensable to reduce the air pollution resulting from the use of fuel oil #6 in Puerto Rico.

In view of the move towards cleaner energy sources and the need to diversify the Puerto Rico's energy supply mix, natural gas was considered for the project. Natural Gas meets environmental regulations through the use of proven state-of-the-art low emissions and environmental control technologies. LNG was a superior alternative since it is the cleanest burning fuel, with least emissions per kilowatt-hour of electricity