April 2009

127 FERC ¶ 61,044
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: Jon Wellinghoff, Chairman;
Suedeen G. Kelly, Marc Spitzer,
and Philip D. Moeller.

EcoEléctrica, L.P. Docket No. CP95-35-001

ORDER AMENDING AUTHORIZATION UNDER SECTION 3
OF THE NATURAL GAS ACT

(Issued April 16, 2009)

1. On March 5, 2008, EcoEléctrica, L.P. (EcoEléctrica) filed an application to amend its previous authorizations under section 3 of the Natural Gas Act (NGA), issued by the Commission on May 15, 1996 (May 1996 Order), for the siting, construction, and operation of liquefied natural gas (LNG) facilities for the importation of natural gas into the Commonwealth of Puerto Rico (Puerto Rico).[1] EcoEléctrica seeks Commission approval of its Terminal Modification Project (project), which would install two additional vertical shell and tube heat exchange vaporizers at the EcoEléctrica LNG terminal in order to deliver a greater volume of natural gas to Puerto Rico Electric Power Authority's (Power Authority) Aguirre Combined Cycle Power Plant. During the course of reviewing EcoEléctrica's application a great deal of additional information was sought and provided that was necessary to complete Commission staff's environmental review of EcoEléctrica's proposal.[2] For the reasons discussed herein, we will approve the requested modifications to EcoEléctrica's previous authorizations under section 3 of the NGA, subject to the conditions discussed herein.

I. Background

2. In the May 1996 Order, the Commission authorized EcoEléctrica to site, construct, and operate LNG import terminal facilities, including: (1) a marine terminal with a

[1] *EcoEléctrica, L.P.*, 75 FERC ¶ 61,157 (1996).

[2] EcoEléctrica responded to four Commission staff environmental information requests. The responses and supplements were filed on April 24, 2008, May 30, 2008, July 18, 2008, August 5, 2008, September 5, 2008, September 29, 2008, October 8, 2008, and November 13, 2008.

1,800-foot pier for unloading LNG tankers; (2) two 1-million-barrel LNG storage tanks;[3] (3) an LNG vaporization system;[4] and (4) various control systems, piping, and other ancillary equipment. The Commission found that EcoEléctrica's LNG terminal would provide an environmentally acceptable alternative to oil in meeting the increasing electric demands of Puerto Rico. In view of these considerations, the Commission found that the LNG terminal would not be inconsistent with the public interest.[5]

3. In conjunction with the LNG import terminal, EcoEléctrica also constructed: (1) a 461-megawatt electric cogeneration facility that uses vaporized LNG as a fuel source for power generation; (2) a desalination facility capable of producing up to 4 million gallons of fresh water per day; (3) other facilities necessary for the operation of the cogeneration facility, including a 2.3-mile, 230-kilovolt transmission line connecting the plant substation to an existing Power Authority substation and a gas line to serve the cogeneration facility; and (4) a gas line to serve the Power Authority's Costa Sur power plant.[6] The section 3 authorization granted in the May 1996 Order did not cover any of these facilities.

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[3] EcoEléctrica has only built one of the two LNG storage tanks approved in the May 1996 Order. EcoEléctrica has not commenced construction of the second storage tank or related facilities. Environmental Condition No. 11 of the May 1996 Order specified that "EcoEléctrica shall commence construction on its LNG facilities within 3 years of the date of this Order, or file a motion to extend the deadline, with the specific reasons why additional time is necessary." As noted, to date, over 12 years from issuance of the May 1996 Order, EcoEléctrica has not constructed the second authorized storage tank or four of the six authorized vaporizers. Nor did it ever file for an extension of time to construct these facilities. Therefore, the authorizations with respect to those facilities issued by the May 1996 Order have lapsed. Accordingly, should EcoEléctrica seek to build another LNG storage tank, or other related facilities, it must obtain prior Commission authorization.

[4] The May 1996 Order authorized EcoEléctrica to install up to six vaporizers (consisting of two vertical shell and tube heat exchanger vaporizers and four open rack vaporizers) in conjunction with the two approved LNG storage tanks. Since EcoEléctrica only constructed one LNG storage tank, it only installed two vaporizers. As stated above, if EcoEléctrica seeks to build another LNG storage tank, or other related facilities, it must at such time seek Commission authorization.

[5] *EcoEléctrica, L.P.*, 75 FERC at 61,515 and 61,518.

[6] The Power Authority's Costa Sur Power Plant was never converted to natural gas firing. Consequently, the pipeline intended to serve the plant was never constructed.

II. Proposal

4. In the instant proceeding, EcoEléctrica requests authority under section 3 of the NGA to construct two additional vertical shell and tube heat exchanger vaporizers within EcoEléctrica's existing 36-acre LNG facility site. EcoEléctrica also proposes to install other facilities associated with the vaporizers including: (1) one fixed speed, in-tank LNG sendout pump; (2) three seawater heat exchangers; (3) three water/glycol circulation pumps; (4) one water/glycol expansion tank at 1,800 gallons; (5) one seawater supply pump at 6,000 gallons per minute (gpm); and (6) three seawater circulation pumps.

5. The proposed modifications to EcoEléctrica's existing LNG terminal facilities would enable it to supply natural gas to the Power Authority's Aguirre Combined Cycle Power Plant (Aguirre electric plant), in Aguirre, Puerto Rico, once the plant's conversion from fuel oil to natural gas is completed. EcoEléctrica proposed to interconnect its existing 1.2-mile, 24-inch send-out pipeline, which extends to the fenceline of its 36-acre LNG terminal site, with a Power Authority pipeline that would carry the regasified LNG to its Aguirre electric plant.[7]

6. EcoEléctrica's proposed LNG terminal modifications would enable it to increase its regasified LNG send-out capacity by an additional 77.4 (average) to 93 (peak) million standard cubic feet per day (MMscf/day), resulting in a total send-out capacity of approximately 186 MMscf/day. The existing LNG storage tank has sufficient volume capacity to accommodate this additional send out. EcoEléctrica confirms that no new compressors, liquid nitrogen storage, or pipelines will be required to implement the planned increase in send out.

7. EcoEléctrica states there would be no net increase in the amount of water withdrawn or discharged as a result of the modifications. The proposed vaporization facilities would use a closed-loop vaporization system that draws heat as a side stream from the same volume of water as EcoEléctrica currently withdraws for its existing LNG facilities.

8. EcoEléctrica asserts that to accommodate the increased send out of vaporized LNG, a total of two LNG vessels per month would call at the EcoEléctrica LNG terminal;

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[7] The Power Authority began constructing a 42-mile-long, natural gas pipeline from the Aguirre electric plant in 2008. This pipeline will tap into EcoEléctrica's existing 1.2-mile long send-out pipeline. The Power Authority will own and operate the 42-mile long pipeline currently under construction. The Power Authority's new pipeline underwent separate environmental analyses conducted by the U.S. Army Corp of Engineers (Army Corp) and the Puerto Rico Environmental Quality Control Board.

this would be an increase of one LNG vessel per month over the historic level of traffic. EcoEléctrica consulted with the U.S. Coast Guard (Coast Guard), which expressed no objection to the increased frequency of LNG vessel deliveries related to EcoEléctrica's proposal.

9. EcoEléctrica states that the proposed modifications were designed, and would be constructed and operated according to U. S. Department of Transportation safety standards.[8] All construction activities would occur within the fenceline of the LNG terminal site. EcoEléctrica plans to place the facilities in service by the end of 2009.

III. Notice and Interventions

10. Public notice of EcoEléctrica's application was published in the *Federal Register* on March 24, 2008 (73 Fed. Reg. 15,511). Motions to intervene were due on or before April 8, 2008. Timely, unopposed motions to intervene were filed by Shell NA LNG LLC and Distrigas of Massachusetts LLC.[9] No comments or protests were filed regarding the application.

IV. Discussion

11. Because the proposed LNG terminal facilities will be used to import gas from foreign countries, the siting, construction and operation of the facilities require approval by the Commission under section 3 of the NGA.[10]

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[8] 49 C.F.R. Part 193 (2008).

[9] Timely, unopposed motions to intervene are granted by operation of Rule 214 of the Commission's Rules of Practice and Procedure. 18 C.F.R. § 385.214 (2008).

[10] The regulatory functions of section 3 of the NGA were transferred to the Secretary of the U. S. Department of Energy (DOE) in 1977 pursuant to section 301(b) of the Department of Energy Organization Act (Pub. L. No. 95-91, 42 U.S.C. §§ 7101 *et seq.*). In reference to regulating the imports or exports of natural gas, the DOE Secretary has delegated to the Commission the authority to approve or disapprove the construction and operation of particular facilities, the site at which facilities shall be located and, with respect to natural gas that involves the construction of new domestic facilities, the place of entry or exit for exports. *See* DOE Delegation Order No. 00-044A.00 (2006), FERC Stats. & Regs. ¶ 9920 (reissuing, effective May 16, 2006, authorities contained in previous delegation orders). In addition, section 3(e)(1) of the NGA, as amended by section 311(c) of the Energy Policy Act of 2005 (EPAct 2005), Pub. L. 109-58, 119 Stat. 594, provides that the Commission has exclusive authority to approve or deny applications for the construction or operation of LNG terminals. DOE (continued)

12. The Commission's authority over facilities constructed and operated under section 3 of the NGA includes the authority to apply terms and conditions as necessary and appropriate to ensure that the proposed construction and siting is in the public interest.[11] Section 3 provides that the Commission "shall issue such order on application" if it finds that the proposal "will not be inconsistent with the public interest."[12]

13. The Commission previously authorized EcoEléctrica to install six vaporizers on its LNG facility. Currently, only two vaporizers have been installed. The two proposed vaporizers are of the same type and function as two of those initially authorized and installed. Although the proposed modifications will increase EcoEléctrica's send-out capacity from 93 MMscf/day to 186 MMcsf/day, the send-out capacity will remain below the import capacity of 130 billion cubic feet (Bcf) per year currently authorized by DOE's Office of Fossil Energy (DOE/FE).[13] The proposed project will not change the authorized level of expansion capacity or the deliverability of the terminal.[14]

14. To achieve a greater send-out capacity, EcoEléctrica will need to increase the incoming volumes of LNG. This will be accomplished by increasing vessel traffic to 24 LNG vessels per year, from the historic level of 12 LNG vessels per year. However, we note that EcoEléctrica's original October 1994 application, as well as the Coast Guard's 1996 letter of recommendation, contemplated a much higher amount of vessel traffic (up to 60 LNG vessel unloadings per year), than what would result from the

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has retained authority to act on applications for authority to import or export natural gas. Such applications must be submitted to DOE's Office of Fossil Energy. The Commission does not authorize the importation of the commodity itself.

[11] *See* section 3(e)(3)(A) of the NGA, as enacted by section 311(c) of EPAct 2005. *See also Distragas Corporation v. FPC*, 495 F.2d 1057, 1063-64, *cert. denied*, 419 U.S. 834 (1974); *Dynegy LNG Production Terminal, L.P.*, 97 FERC ¶ 61,231 (2001).

[12] 15 U.S.C. § 717b(a) (2006).

[13] *EcoEléctrica, L.P.*, 75 FERC at 61,516. *See* DOE/FE Order No. 1042 (April 19, 1995) (granting EcoEléctrica authority to import 130 Bcf of LNG per year for a 40-year term).

[14] Since there will be no impact on Puerto Rico or local safety concerns, the pre-filing procedures for review of LNG terminals established in Order No. 665 are not implicated by the addition of vaporizers requested herein. *See Regulations Implementing Energy Policy Act of 2005, Pre-Filing Procedures for Review of LNG Terminals and Other Natural Gas Facilities*, Order No. 665, FERC Stats. & Regs. ¶ 31,195 (2005).

proposed project. In reviewing EcoEléctrica's current proposal, the Commission's staff has consulted with the Coast Guard and the U.S. Fish and Wildlife Service. Neither of these agencies have expressed any concerns with the increase in LNG vessel traffic that will result from approval of EcoEléctrica's proposal. The Commission finds that the additional LNG vessels calling on the LNG facility would not have an adverse impact on public interest or the environment.

15. EcoEléctrica's LNG terminal was the first, and remains the only, source of natural gas in Puerto Rico. EcoEléctrica's proposed project will enable it to deliver natural gas to the Power Authority's Aguirre plant, replacing No. 2 distillate oil as the plant's fuel for generating electricity. The increase in natural gas supply is an environmentally acceptable alternative to oil in meeting the anticipated increases in electric demand of Puerto Rico.

16. The instant proposal will not have an impact on landowners, since all of the construction is taking place within EcoEléctrica's existing LNG terminal site. Currently, all of the regasified LNG sent out from EcoEléctrica's LNG terminal is used as fuel at its own facilities. Thus, EcoEléctrica has no existing customers that might be adversely affected by the costs or risks of recovery of those costs from the proposed modifications. Therefore, we find that, subject to the conditions imposed in this Order, EcoEléctrica's proposal is not inconsistent with the public interest.

V. Environmental Assessment

17. On June 11, 2008, the Commission issued a *Notice of Intent to Prepare an Environmental Assessment for the proposed EcoEléctrica Terminal Modification Project and Request for Comments on Environmental Issues* (NOI). The notice was published in the *Federal Register* on June 18, 2008 (73 Fed. Reg. 34,720). The NOI was sent to affected landowners; federal, state/commonwealth, and local government agencies; elected officials; environmental and public interest groups; and local libraries and newspapers. No comments were received in response to our NOI.

18. Like the authorizations granted in the original Order, Commission staff's conclusions and recommendations in its 1996 environmental impact statement are out-of-date. As a result, the environmental staff was not able to rely on its environmental impact statement to the extent that EcoEléctrica contemplated, and materials which EcoEléctrica had not prepared at the time its application was filed were needed for staff to complete its environmental review. In the end, EcoEléctrica was required to file a substantial amount of new and updated information and mitigation plans.

19. To satisfy the requirements of the National Environmental Policy Act (NEPA), our staff prepared an environment assessment (EA) which was distributed for public comment and placed in the record on February 13, 2009. Issuance of the EA was published in the *Federal Register* on February 23, 2009 (74 Fed. Reg. 8,079). The

analysis in the EA addressed: geology; soils; water resources and wetlands; vegetation; fisheries and wildlife (including threatened and endangered species); essential fish habitat; land use, recreation and visual resources; cultural resources; air quality and noise; safety; socioeconomics; cumulative impacts; and alternatives. The public comment period ended on March 16, 2009. No comments were received.

20. In a letter dated March 6, 2009, the U.S. Fish and Wildlife Service (FWS) concurred with the determination presented in our staff's Biological Assessment, that the project was not likely to adversely affect the brown pelican or the Antillean manatee. Because our consultation with the FWS is complete, we have modified the EA's recommendation that the Director of the Office of Energy Projects withholds authorization for the commencement of construction until the staff completes its consultation with the National Oceanic and Atmospheric Administration National Marine Fisheries Service.

21. Any state/commonwealth or local permits issued with respect to the jurisdictional facilities authorized herein must be consistent with the conditions of this certificate. The Commission encourages cooperation between regulated entities and local authorities. However, this does not mean that state/commonwealth and local agencies, through application of state/commonwealth or local laws, may prohibit or unreasonably delay the construction of facilities approved by this Commission.[15]

22. Based on the discussion in the EA, we conclude that if constructed in accordance with EcoEléctrica's application and supplements and the conditions imposed herein, approval of this proposal would not constitute a major federal action significantly affecting the quality of the human environment.

VI. <u>Conclusion</u>

23. For the reasons set forth herein, and subject to the conditions set forth below in the Appendix, we find that EcoEléctrica's proposed modifications are not inconsistent with the public interest under section 3 of the NGA. Thus, we grant the requested authorization to EcoEléctrica.

24. At a hearing held on April 16, 2009, the Commission on its own motion received and made part of the record all evidence, including the application and exhibits thereto,

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[15] *See, e.g.*, *Schneidewind v. ANR Pipeline Co.*, 485 U.S. 293 (1988); *National Fuel Gas Supply v. Public Service Commission*, 894 F.2d 571 (2d Cir. 1990); and *Iroquois Gas Transmission System, L.P., et al.*, 52 FERC ¶ 61,091 (1990) and 59 FERC ¶ 61,094 (1992).

submitted in support of the authorization sought herein, and upon consideration of the record,

The Commission orders:

(A) EcoEléctrica's authorization under section 3 of the NGA, issued May 15, 1996, for its approved LNG terminal is amended as more fully described in EcoEléctrica's application and as conditioned herein.

(B) Except as provided herein, the authorization issued May 15, 1996, remains unchanged and EcoEléctrica must comply with all of the conditions applicable to the LNG terminal set forth in the Appendix to the May 15, 1996 Order.

(C) EcoEléctrica shall notify the Commission's environmental staff by telephone, e-mail, and/or facsimile of any environmental noncompliance identified by other federal, state/commonwealth, or local agencies on the same day that such agency notifies EcoEléctrica. EcoEléctrica shall file written confirmation of such notification with the Secretary of the Commission within 24 hours.

By the Commission.

(SEAL)

Kimberly D. Bose,
Secretary.

Appendix

Environmental Conditions for EcoEléctrica's LNG Terminal Modification Project Docket No. CP95-35-001

As recommended in the Environmental Assessment, this authorization includes the following conditions:

1. EcoEléctrica, L.P. (EcoEléctrica) shall follow the construction procedures and mitigation measures described in its application and supplements, including responses to staff data requests, and as identified in the Environmental Assessment (EA), unless modified by the order. EcoEléctrica must:

    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary of the Commission (Secretary);
    b. justify each modification relative to site-specific conditions;
    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and
    d. receive approval in writing from the Director of the Office of Energy Projects (OEP) before using that modification.

2. The Director of OEP has delegated authority to take all steps necessary to ensure the protection of life, health, property, and all environmental resources during construction and operation of the project. This authority shall include:

    a. stop-work authority and authority to cease operation; and
    b. the design and implementation of any additional measures deemed necessary to assure continued compliance with the intent of the conditions of the Commission order.

3. **Prior to construction**, EcoEléctrica shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, environmental inspectors, and contractor personnel will be informed of the environmental inspector's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs before becoming involved with construction and restoration activities.

4. **Within 60 days of the acceptance of this certificate and before construction** begins, EcoEléctrica shall file an initial Implementation Plan with the Secretary for review and written approval by the Director of OEP. EcoEléctrica must file revisions to the plan as schedules change. The plan shall identify:

a. how EcoEléctrica will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EA, and required by this Order;

b. how EcoEléctrica will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;

c. the number of environmental inspectors assigned to the project, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;

d. company personnel, including environmental inspectors and contractors, who will receive copies of the appropriate material;

e. the training and instructions EcoEléctrica will give to all personnel involved with construction and restoration (initial and refresher training as the project progresses and personnel change;

f. the company personnel (if known) and specific portion of EcoEléctrica's organization having responsibility for compliance;

g. the procedures (including use of contract penalties) EcoEléctrica will follow if noncompliance occurs; and

h. for each discrete facility, a Gantt or PERT chart (or similar project scheduling diagram), and dates for:

(1) the completion of all required surveys and reports;
(2) the mitigation training of onsite personnel;
(3) the start of construction; and
(4) the start and completion of restoration.

5. Beginning with the filing of its initial Implementation Plan, EcoEléctrica shall file updated status reports with the Secretary on a monthly basis until all construction and restoration activities are complete. On request, these status reports will also be provided to other federal and state/commonwealth agencies with permitting responsibilities. Status reports shall include:

a. an update on EcoEléctrica's efforts to obtain the necessary federal authorizations;

b. the construction status of the project and work planned for the following reporting period;

c. a listing of all problems encountered and each instance of noncompliance observed by the environmental inspector during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state/commonwealth, or local agencies);

d. a description of the corrective actions implemented in response to all instances of noncompliance, and their cost;
e. the effectiveness of all corrective actions implemented;
f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the order, and the measures taken to satisfy their concerns; and
g. copies of any correspondence received by EcoEléctrica from other federal, state/commonwealth, or local permitting agencies concerning instances of noncompliance, and EcoEléctrica's response.

6. EcoEléctrica must receive written authorization from the Director of OEP **before commencing service** from the project. Such authorization will only be granted following a determination that rehabilitation and restoration of the areas disturbed by the project are proceeding satisfactorily.

7. EcoEléctrica **shall not begin construction** until the FERC staff completes any necessary consultation with the National Oceanic and Atmospheric Administration National Marine Fisheries Service and EcoEléctrica requests and receives written notification from the Director of OEP that construction and/or use of mitigation (including implementation of conservation measures) may begin.

The following measures shall apply to the EcoEléctrica Terminal Modification Project design and construction details. Information pertaining to these specific recommendations shall be filed with the Secretary for review and approval by the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; or prior to commencement of service as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, should be submitted as critical energy infrastructure information (CEII) pursuant to 18 C.F.R. § 388.112. *See Critical Energy Infrastructure Information*, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. ¶ 31,228 (2006). Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements would be subject to public disclosure. This information should be submitted a minimum of 30 days before approval to proceed is required.

8. Complete plan drawings and a list of the hazard detection equipment shall be filed **prior to initial site preparation**. The list shall include the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings shall clearly show the location of all detection equipment.

9. Complete plan drawings and a list of the fixed and wheeled dry-chemical, fire extinguishing, and other hazard control equipment shall be filed **prior to initial site preparation**. The list shall include the equipment tag number, type, size, equipment covered, and automatic and manual remote signals initiating discharge of the units. Plan drawings shall clearly show the planned location of all fixed and wheeled extinguishers.

10. Facility plans showing the proposed location of, and area covered by, each monitor, hydrant, deluge system, hose, and sprinkler, as well as piping and instrumentation diagrams, of the firewater system shall be filed **prior to initial site preparation**.

11. The **final design** of the fixed and wheeled dry-chemical, fire extinguishing, and other hazard control equipment shall identify manufacturer and model.

12. The **final design** shall specify that dual temperature elements and transmitters are provided for low temperature alarm and shutdown at the discharge of each vaporizer.

13. The **final design** shall include a check valve between the LNG vaporizer discharge shutoff valve and the discharge manual isolation valve for all existing and proposed vaporizers.

14. The **final design** shall specify that for LNG and natural gas service, branch piping and piping nipples less than 2 inches are to be no less than schedule 160.

15. The **final design** shall include details of the shutdown logic, including cause and effect matrices for alarms and shutdowns.

16. The **final design** shall include details of the air gaps to be installed downstream of all seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that: shall continuously monitor for the presence of a flammable fluid; shall alarm the hazardous condition; and shall shut down the appropriate systems.

17. The **final design** shall include a hazard and operability review of the completed design. A copy of the review and a list of the recommendations shall be filed with the Secretary.

18. The **final design** shall provide up-to-date Piping & Instrument Diagrams (P&IDs) including a description of the instrumentation and control philosophy, type of instrumentation (pneumatic, electronic), use of computer technology, and control

room display and operation. Drawings and all information should be clearly legible on 11- by 17-inch paper and the piping legend and symbology shall be in accordance with accepted practice. All drawings shall be filed in black and white. The following information shall be included on the P&IDs:

a. equipment tag number, name, size, duty, capacity and design conditions;
b. piping with line number, piping class specification, size and insulation;
c. LNG tank pipe penetration size or nozzle schedule;
d. piping specification breaks and insulation limits;
e. isolation flanges, blinds and insulating flanges;
f. valve type, in accordance with the piping legend symbol;
g. all control valves numbered;
h. all valve operator types and valve fail position;
i. instrumentation numbered;
j. control loops including software connections;
k. alarm and shutdown set points;
l. shutdown interlocks;
m. relief valves numbered, with set point;
n. relief valve inlet and outlet piping size;
o. car-sealed valves and blinds;
p. equipment insulation;
q. drawing revision number and date;
r. all manual valves numbered, including check, vent, drain, and car-sealed valves; and
s. alarm and shutdown set points.

19. The **final design** shall specify that all hazard detection equipment include redundancy, fault detection, and fault alarm monitoring.

20. All valves including drain, vent, main, and car-sealed valves shall be tagged in the field during construction and **prior to commissioning**.

21. A tabulated list of the proposed hand-held fire extinguishers shall be filed **prior to commissioning**. The information shall include a list with the equipment number, type, size, number, and location. Plan drawings shall include the type, size, and number of all hand-held fire extinguishers.

22. Updated Operation and Maintenance procedures and manuals, as well as safety procedure manuals, shall be filed **prior to commissioning**.

23. FERC staff shall be notified of any proposed revisions to the security plan and physical security of the facility **prior to commencement of service**.

24. Progress on construction of the LNG terminal modifications shall be reported in monthly reports filed with the Secretary. Details shall include a summary of activities, projected schedule for completion, problems encountered and remedial actions taken. Problems of significant magnitude shall be reported to the FERC **within 24 hours**.

In addition, the following measures should apply throughout the life of the facility:

25. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, EcoEléctrica shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted.

26. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporization quantities, boil-off/flash gas, etc.), and plant modifications including future plans and progress thereof. Abnormalities shall include, but not be limited to: unloading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, vapor or liquid releases, fires involving natural gas and/or from other sources, negative pressure (vacuum) within a storage tank and higher-than-predicted boiloff rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports should be submitted **within 45 days** after each period ending **June 30 and December 31**. In addition to the above items, a section entitled "Significant plant modifications proposed for the next 12 months (dates)" also shall be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.

27. In the event the temperature of any region of any secondary containment becomes less than the minimum specified operating temperature for the material, the

Commission shall be notified **within 24 hours** and procedures for corrective action should be specified.

28. Significant non-scheduled events, including safety-related incidents (i.e., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security related incidents (i.e., attempts to enter site, suspicious activities) shall be reported to the FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to the Commission staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable LNG-related incidents include:

a. fire;
b. explosion;
c. estimated property damage of $50,000 or more;
d. death or personal injury necessitating in-patient hospitalization;
e. free flow of LNG that results in pooling;
f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes gas or LNG;
g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes gas or LNG;
h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes gas or LNG to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;
i. a leak in an LNG facility that contains or processes gas or LNG that constitutes an emergency;
j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;
k. any condition that could lead to a hazard and cause a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility;
l. safety-related incidents to LNG vessels occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the Commission staff would determine the need for an on-site inspection by the Commission staff, and the timing of an initial incident report (normally within 10 days) and follow-up reports.

29. EcoEléctrica shall develop an updated Emergency Response Plan (ERP) (including evacuation) and coordinate procedures with the Coast Guard, state/commonwealth, county, and local emergency planning groups; fire departments; state/commonwealth and local law enforcement; and appropriate federal agencies. This plan shall include at a minimum:

a. designated contacts with state/commonwealth and local emergency response agencies;
b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;
c. procedures for notifying residents and recreational users within areas of potential hazard;
d. evacuation routes/methods for residents and other public use areas that are within any transient hazard areas along the route of the LNG vessel transit;
e. locations of permanent sirens and other warning devices; and
f. an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices.

The ERP shall be filed with the Secretary for review and written approval by the Director of OEP **prior to initial site preparation**. EcoEléctrica shall notify the FERC staff of all planning meetings in advance and shall report progress on the development of its ERP at **3-month intervals**.

30. The ERP shall include a Cost-Sharing Plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state/commonwealth and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. The

Cost-Sharing Plan shall be filed with the Secretary for review and written approval by the Director of OEP **prior to initial site preparation.**

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.

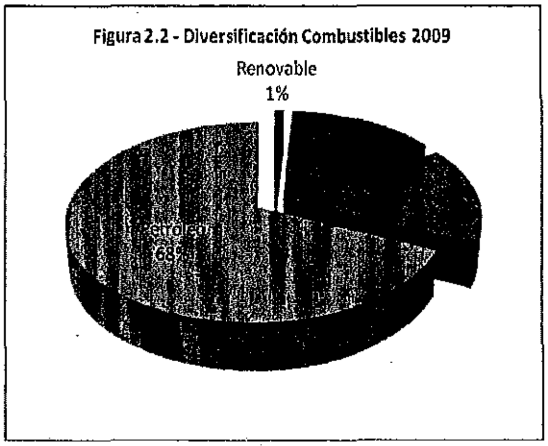
Recognizing that the Puerto Rican economy is directly related to the stability of PREPA, it is important for the company to comply with its strategic development plans and maintain a fixed cost structure that avoids sudden peak variations in the cost of the fuel purchased. Complying with these plans 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.

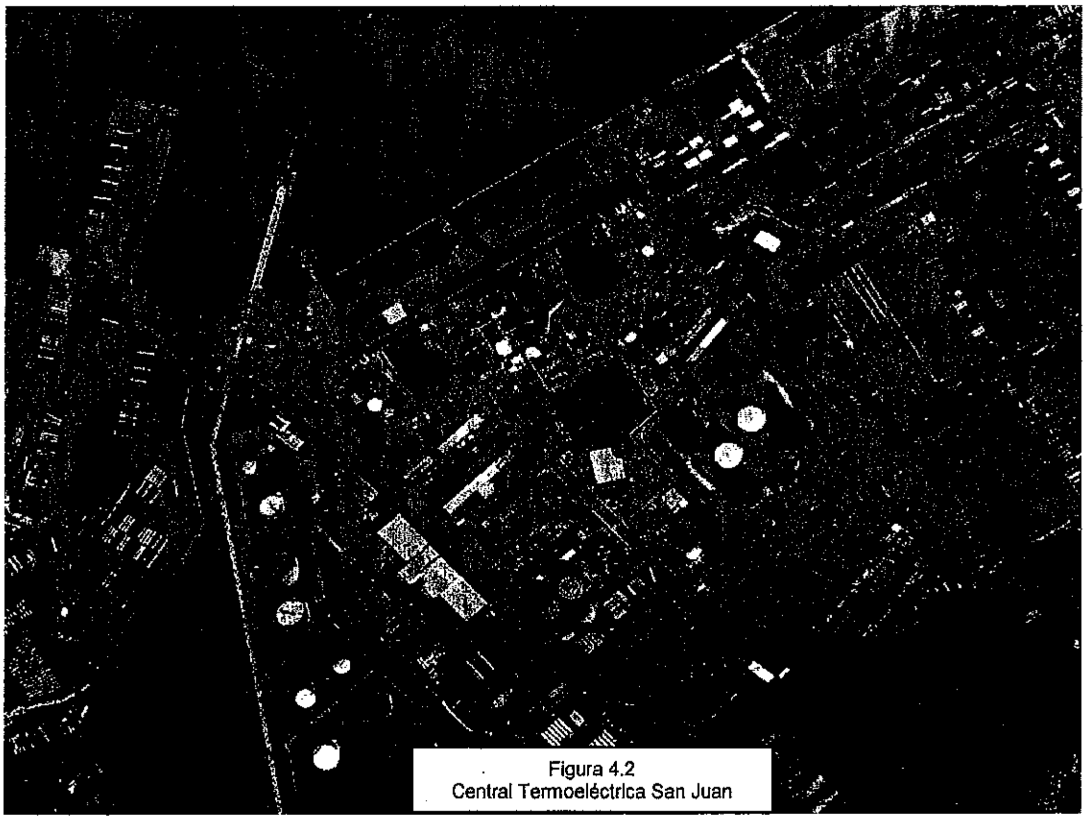


Figura 4.2
Central Termoeléctrica San Juan

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.

- o 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

- o 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.

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

- o 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.

- o 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).

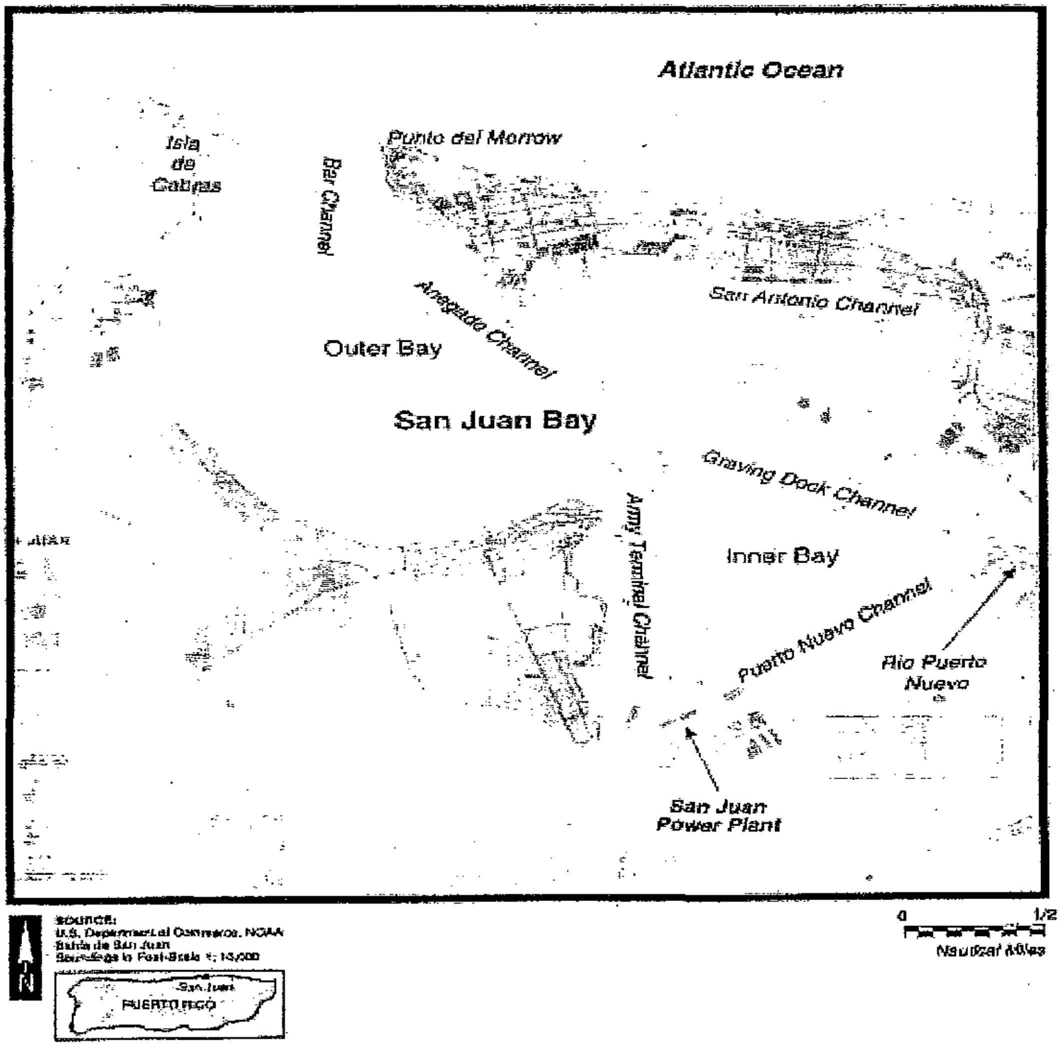


FIGURE 4.3
Approximate Location of San Juan Power Plant
and San Juan Bay Shipping Channels

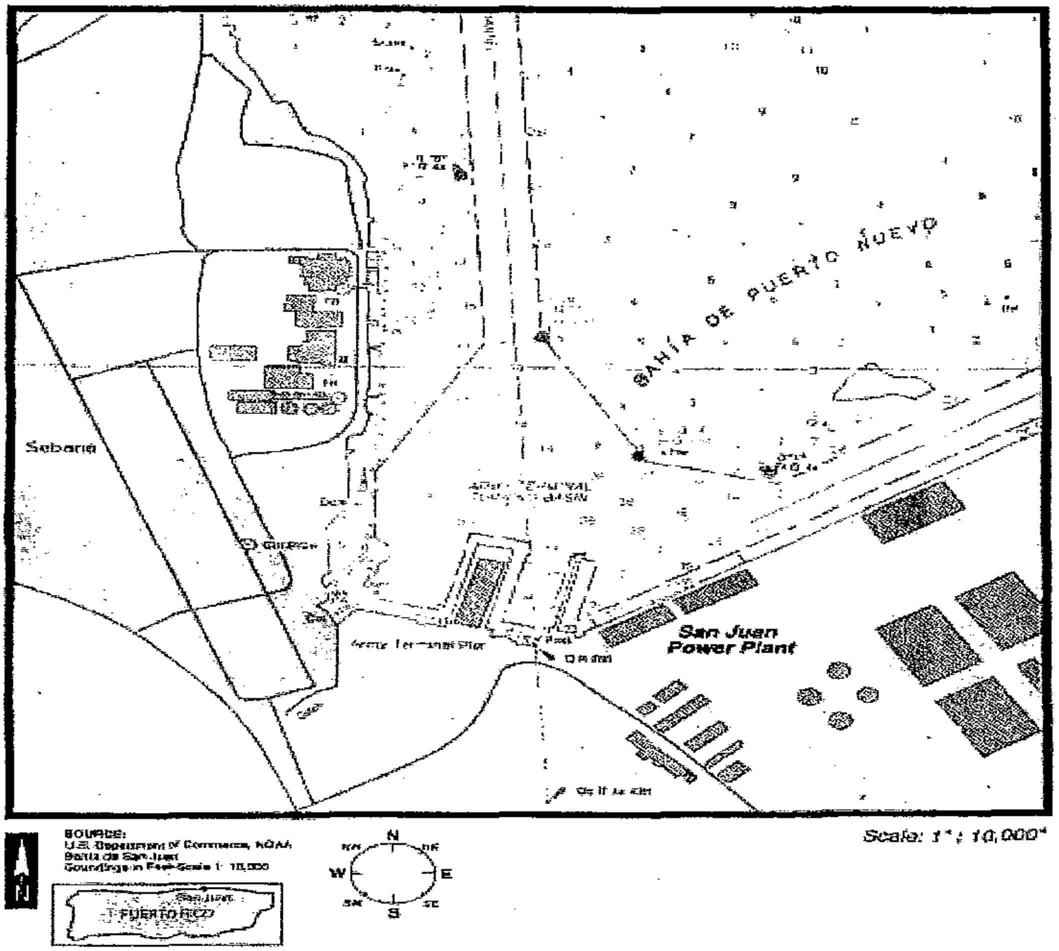


FIGURE 4.4

Bathymetry of Bahia de P r 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,

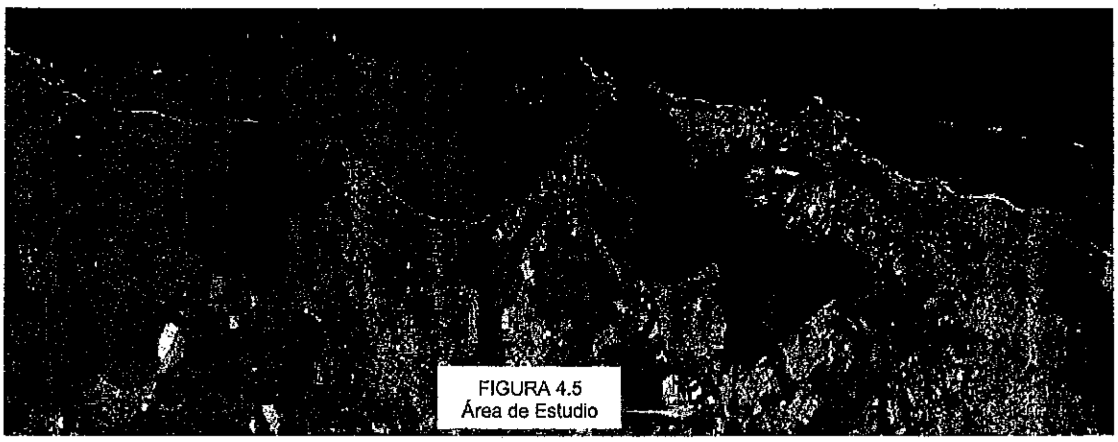


FIGURA 4.5
Área de Estudio

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

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.

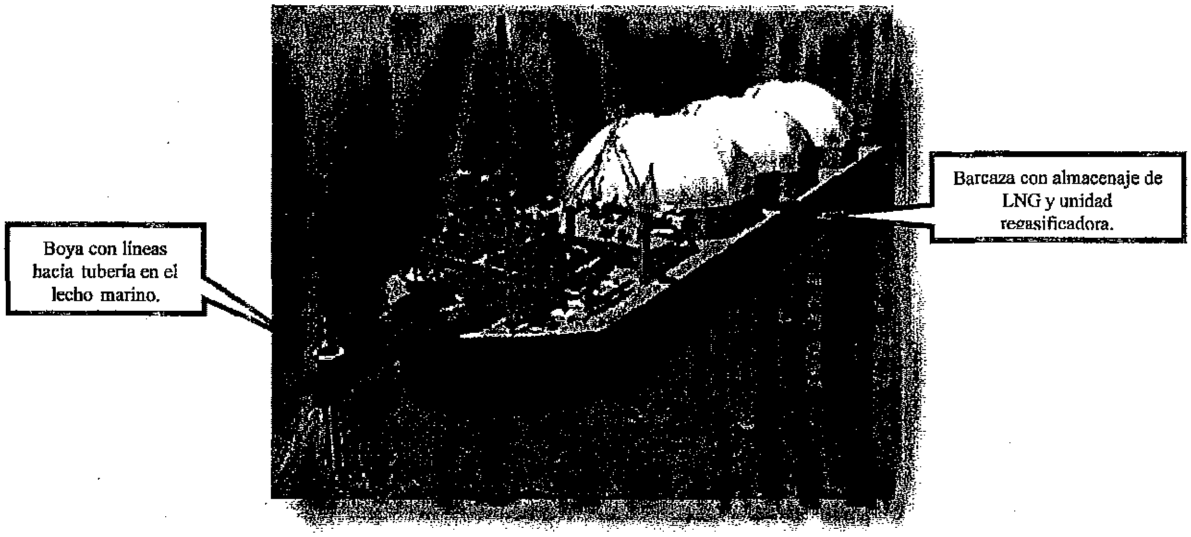
This reality would turn the alternative of constructing an importation terminal into a medium-term project, which would not satisfy our need for an immediate project to bring about the transition from petroleum to renewable sources of energy. The construction cost of the existing terminal was over $570 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 m².

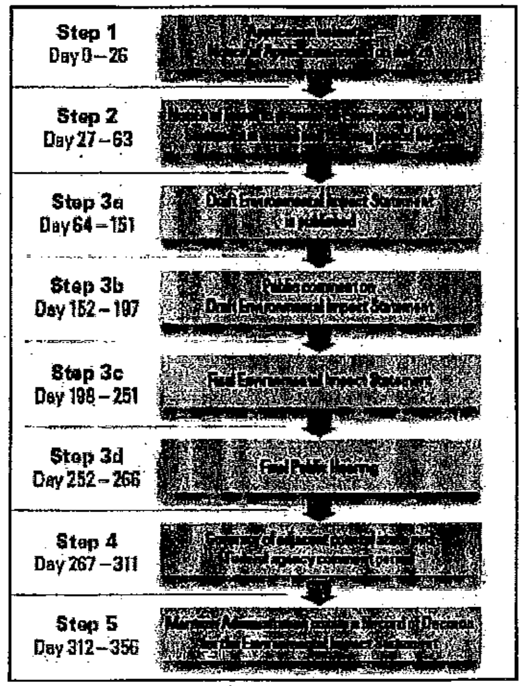


The construction, installation and operation of these tankers and buoys systems are regulated by two leading agencies: the Maritime Administration (MARAD), ascribed to the Federal Department of Transportation, and the US Coast Guard, under their Deepwater Ports Standards division. Other federal agencies 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.

[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

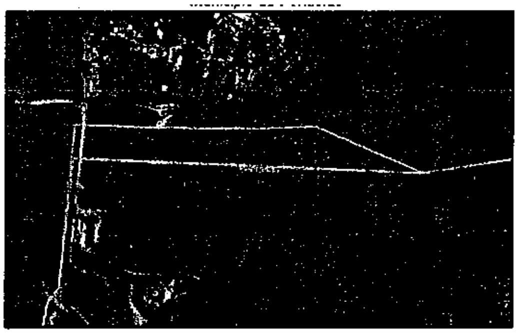
The development of the selected alignment evolved to incorporate necessary changes due to different reasons: impact the communities in the least, avoid or minimize environmental impacts, economic factors, and factors associated to the construction. In the determination of the variations, the main emphasis 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

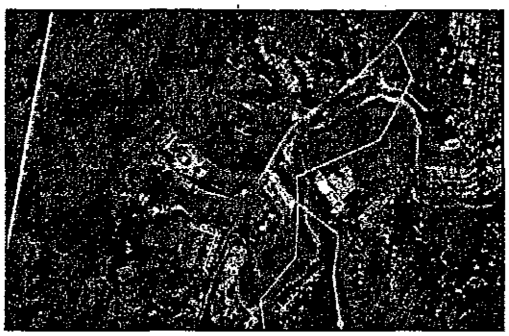


Initially, the alignment was some 300 feet from this community. We made the decision to move the line away some 300 feet to the south, because there was space available. In addition, this change did not affect other communities. Finally, the present alignment is at a distance of some 600 feet away from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

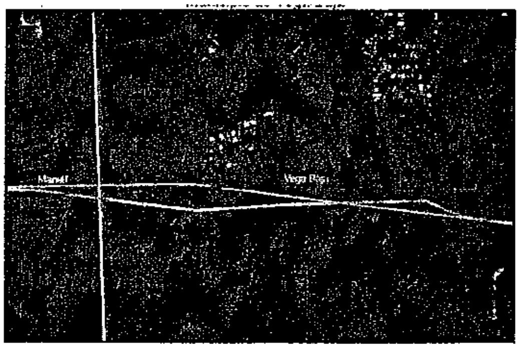
4.5.2.1.4. Variation at Urbanización Jardines de Mónaco, Manatí

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

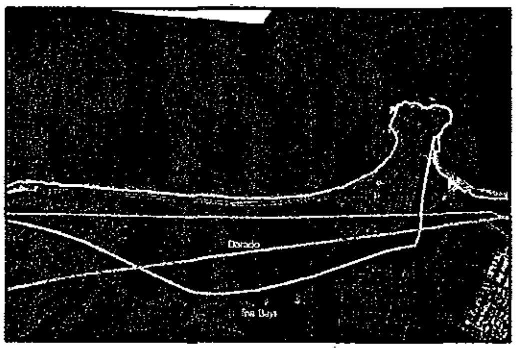


Initially, the alignment affected the Bethel Sector. Several residences would be within 150 feet of this alignment. By incorporating this variation, we were able to move the alignment more than 300 feet away.

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

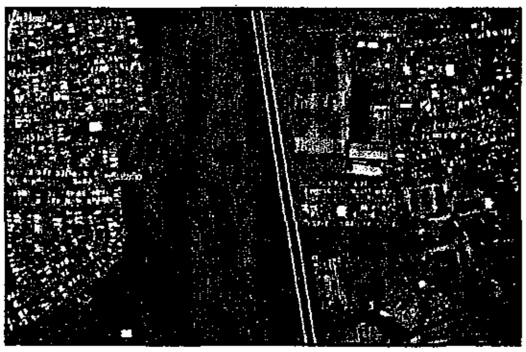


Initially, the alignment affected the Mameyal Playa Sector. Several residences in this sector were within 150 feet of this alignment. By incorporating this variation, we were able to move the alignment to more than 300 feet away.

4.5.2.1.9. Variation at Levittown Communities, Toa Baja

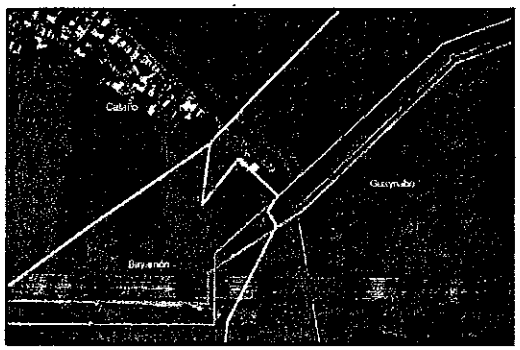
Initially, the alignment affected several urbanizations in the Levittown area. Several residences in these communities would be within 150 feet of this alignment. By incorporating this variation, we were able to move the alignment to more than 500 feet away.

4.5.2.1.10. Variation at Villa Aurora Urbanization, Cataño



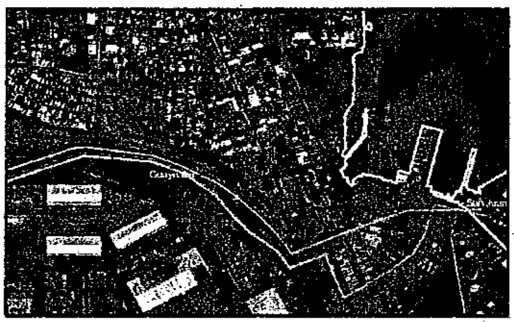
Initially, the alignment affected this urbanization. Twelve residences of this sector would be within 150 feet of this alignment. By incorporating this variation we were able to keep these residences more than 200 feet away.

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.

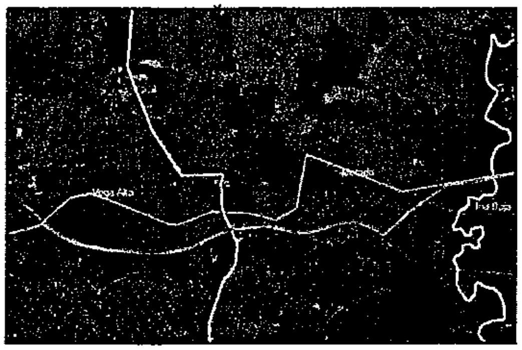
4.5.2.1.12. Variation at Miraderos de Sabana Walk-ups and the Sabana Ward, Guaynabo



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

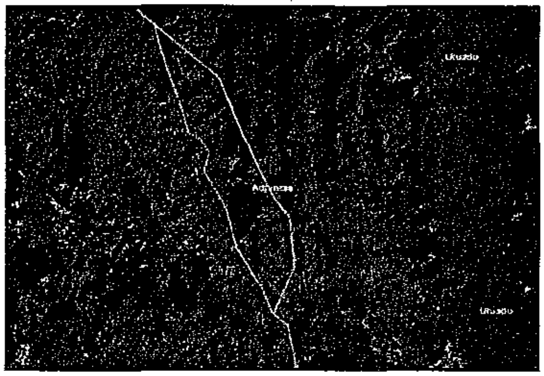
4.5.2.2.1. Variation at PR-22, in the Municipalities of Vega Alta and Dorado



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.

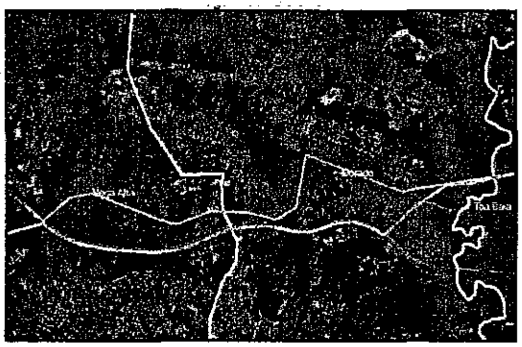
4.5.2.3. Variations to minimize environmental impacts

4.5.2.3.1. Variation in Bosque del Pueblo, Adjuntas



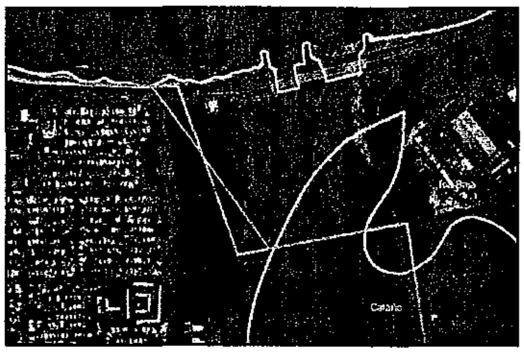
Initially, the alignment crossed a small area of Bosque del Pueblo in the Municipality of Adjuntas. To avoid this impact the alignment was located farther to the west.

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



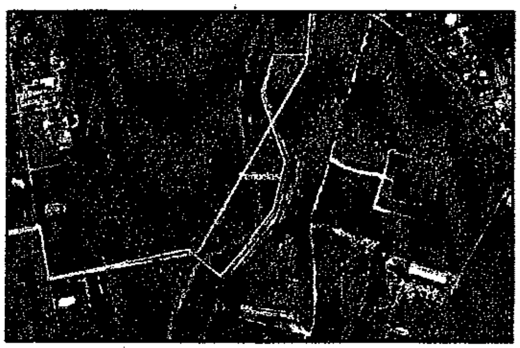
Initially, the alignment impacted the structure of historic value directly. By incorporating this variation we were able to move the alignment out of this area and thus avoid the impact.

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

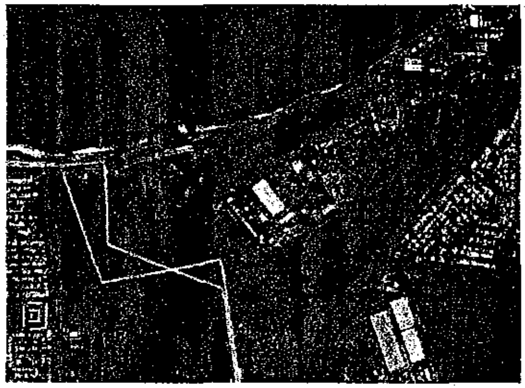


Initially, the alignment crossed the Tallaboa River in two sections at a 90° angle. To use the HDD method, it was decided to reduce this angle because 90° angles are not recommended for this method.

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

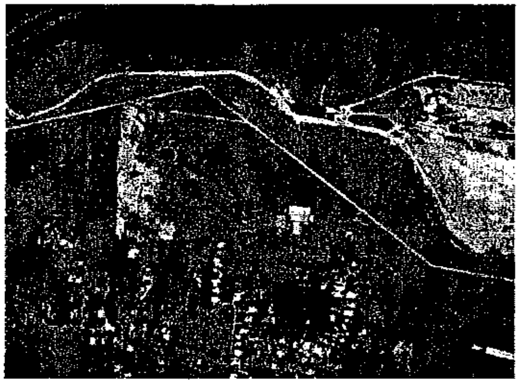


To address recommendations from the UPR, and to move away from the historical archaeological area of the shrine in the Municipality of Toa Baja.

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

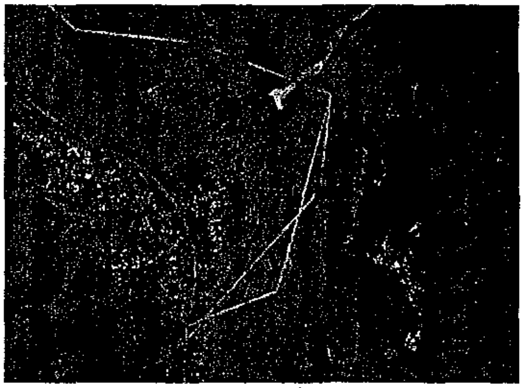
To avoid impacting mangrove areas in the Punta Salinas sector of the Municipality of Toa Baja.

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.

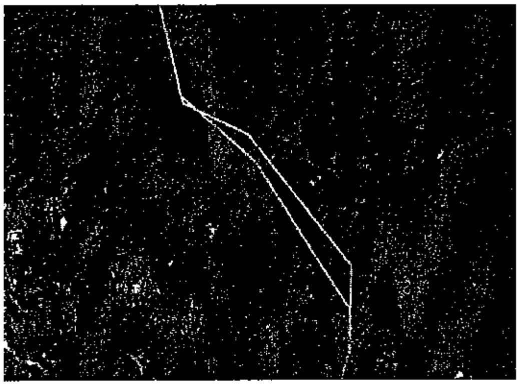
4.5.3.5. Changes to keep the alignment away from communities and future projects

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.

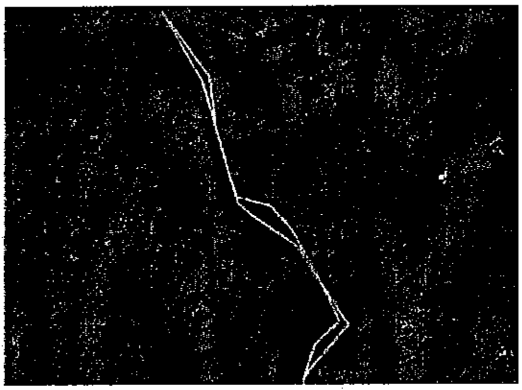
To move away from a future development in the Municipality of Vega Baja that already has approved permits from the Planning Board.

4.5.3.6. Changes for construction reasons

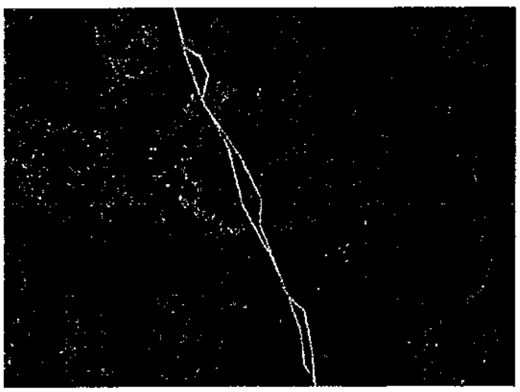
The following changes to the alignment respond to construction factors due to the steepness of the topography in the center of the island in the mountainous area or to difficulties in the use of the HDD technology.



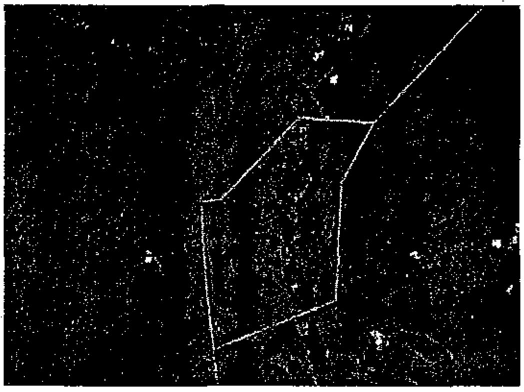
Municipality of Peñuelas



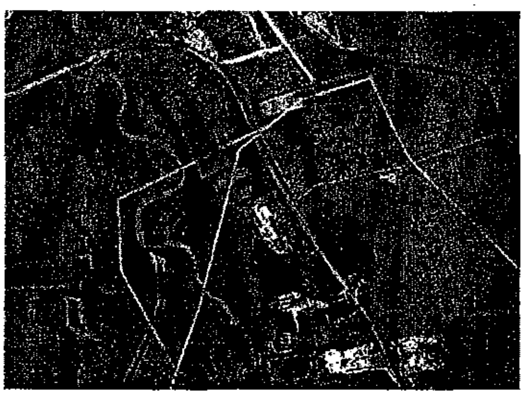
Municipality of Peñuelas



Municipality of Adjuntas



Municipality of Utuado



Municipality of Arecibo

Capítulo 5. DESCRIPCIÓN DEL PROYECTO

5.1 Introducción

La Autoridad de Energía Eléctrica (AEE) tiene a su cargo el diseño y construcción del Proyecto Vía Verde. El mismo es un proyecto de interés público para Puerto Rico y atiende la emergencia en cuanto a la infraestructura de generación de energía eléctrica que decretó el Honorable Luis G. Fortuño Burset, en la Orden Ejecutiva OE-2010-034, al amparo de la Ley 76 de 5 de mayo de 2000. Además, es esencial para cumplir con el compromiso de su programa de trabajo de disminuir el costo de la energía eléctrica y para fortalecer la economía de Puerto Rico.

Vía Verde de Puerto Rico proveerá un sistema de transporte de gas natural desde la EcoEléctrica en Peñuelas, hasta las centrales Cambalache, Palo Seco y San Juan de la AEE. Para esto, la AEE propone construir unas 90 millas de tubería de acero de 24 pulgadas de diámetro, para transportar el gas natural. El uso del gas natural proveerá mayor eficiencia a las operaciones de la AEE y ayudará a manejar los costos energéticos. Además, reducirá la dependencia del petróleo y el impacto ambiental de contaminantes atmosféricos. La duración del proyecto es de unos nueve a doce meses, lo que permitirá una pronta respuesta a la crisis energética que confronta el país.

La tubería será soterrada y cruzará por los municipios de Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manatí, Vega Alta, Vega Baja, Dorado, Toa Baja, Cataño, Bayamón y Guaynabo. Se impactarán tierras privadas y públicas, de uso comercial, industrial y agrícola. La tubería y los demás materiales de construcción se ordenarán a compañías de los Estados Unidos e internacionales y se recibirán por el Puerto de Las Américas, en Ponce y la Zona Portuaria de San Juan. Aledaño al puerto, se establecerá un centro de operaciones para almacenar materiales, equipo y reunir a los empleados diariamente para asignar tareas (ver Sección 5.4, Centros de Operaciones). Otros centros de operaciones se establecerán en Utuado, cercano a la milla 23.8 de la alineación; en Arecibo, cercano a la Central Cambalache; en Vega Alta, cercano a la milla 71 de la alineación; y en Toa Baja en las instalaciones de la AEE en la PR-165 (conocido como el CASE).

El proyecto tendrá un costo total de $447,000,000. Esta suma incluye las partidas por concepto de diseño, compra, acarreo y entrega de materiales, construcción, pago de patentes e impuestos, adquisición de terrenos, estudios y permisos. El costo para la conversión a gas natural de las unidades se estima que será entre $50 a $70 millones.

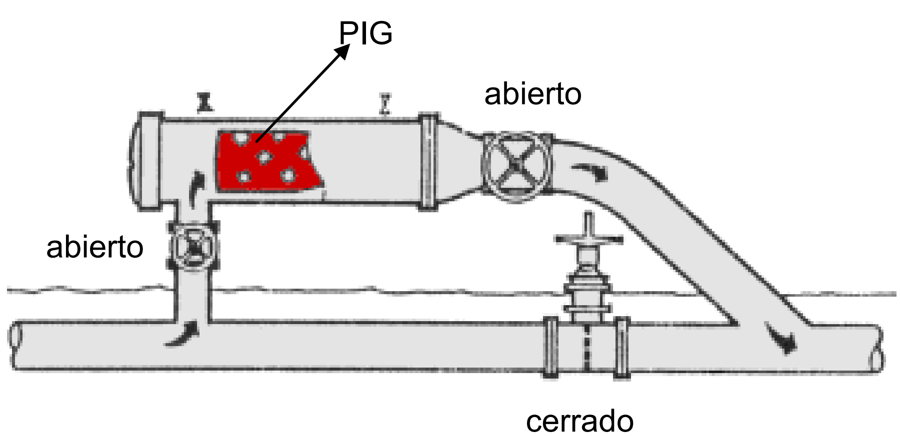
El diseño de la tubería y sus equipos auxiliares se hará de acuerdo a las leyes, reglamentos y guías aplicables. Además, se tomarán en consideración para dicho diseño las características especiales de los suelos, la topografía, la geología, la actividad sísmica, el ambiente, entre otras, de manera que el diseño final sea el adecuado para cualquier situación o condición que se encuentre a lo largo de la alineación.

En cumplimiento con los requisitos de la Ley Núm. 109 de 28 de junio de 1962, Ley de Servicio Público de Puerto Rico, y con el Reglamento para la Creación y Funcionamiento del Centro de Excavaciones y Demoliciones, Reglamento 7245, antes de comenzar las excavaciones se coordinará con la Comisión de Servicio Público (CSP) o con la Oficina de Gerencia de Permisos, según sea aplicable, para que la Autoridad de Acueductos y Alcantarillados (AAA), la *Puerto Rico Telephone Company* (PRTC) y cualquier otra agencia o empresa con infraestructura soterrada, marque la localización de dicha infraestructura en las áreas donde pueda afectarse, especialmente en los tramos paralelos a la PR-10 y PR-22. De acuerdo al Código de Reglamentaciones Federales, Título 49, Parte 192, Sección 325 (49 CFR 192.325), *Underground Clearance*, la distancia entre la tubería y otra infraestructura soterrada debe ser no menor de 12 pulgadas. La práctica de la industria en Estados Unidos es mantener una distancia igual al diámetro de la tubería. Para nuestro proyecto se utilizará una distancia mínima de 24 pulgadas, donde esto no pueda cumplirse se utilizará el mínimo de 12 pulgadas requeridas por el reglamento.

Como parte del proyecto, se instalarán 4 metros de flujo de gas: en Peñuelas, cercano a la terminal de EcoEléctrica (*Receipt Meter Station)*; en la Central Cambalache (*Delivery Meter Station*); en la Central Palo Seco (*Delivery Meter Station*); y otro en la Central San Juan (*Delivery Meter Station*). La estación del metro de recibo tendrá instalado un cromatógrafo de gas, analizador infrarrojo y analizador de humedad. Las estaciones de los metros de despacho tendrán cromatógrafo de gas, analizador infrarrojo, analizador de humedad, filtro/separador, control de flujo y calentador de gas. Además, las estaciones de los metros incluirán una estructura de 10' x 12' para la computadora de flujo de gas.

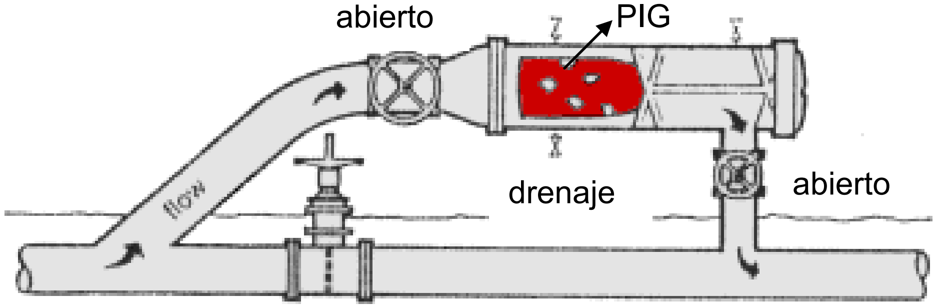
La tubería incluirá un *bidirectional PIG launcher/receiver* (Figura 5-1) en la estación de metro de flujo en la EcoEléctrica; un *PIG receiver* (Figura 5-2) en la estación del metro de flujo de gas en la Central San Juan; y se proveerán conexiones para una unidad portátil de *PIG launcher/receiver* en la Central Palo Seco. La unidad será portátil en Palo Seco debido a que hay restricciones de espacio, por lo que se instalará mientras se use y el resto del tiempo se almacenará en un lugar adecuado para ese uso. El *PIG* consiste en una herramienta, tipo robot, que se inserta dentro de la tubería y recorre la misma para realizar inspecciones, identificar y documentar defectos y anomalías, y realizar limpiezas del interior de la tubería.

Figura 5-1



Método convencional de impulsar el PIG

Figura 5-2



Método convencional de recibir el PIG

Además, habrá válvulas en la tubería que se utilizarán para aislar segmentos en caso de inspecciones, reparaciones o emergencias. El número y la localización de las válvulas se determinarán durante el diseño, dependiendo de la clase por localización (ver Sección 5.6.3 para la definición de cada Clase). De acuerdo al 49 CFR 172.179, *Transmission line valves,* las válvulas se localizan de la siguiente manera:

- **Clase 1** – cada punto de la tubería en esta clase no estará a más de 10 millas de distancia de una válvula; la distancia entre las válvulas será igual o menor a 20 millas.

- **Clase 2** – cada punto de la tubería en esta clase no estará a más de 7.5 millas de distancia de una válvula; la distancia entre las válvulas será igual o menor a 15 millas.

- **Clase 3 –** cada punto de la tubería en esta clase no estará a más de 4.0 millas de distancia de una válvula; la distancia entre las válvulas será igual o menor a 8 millas.

- **Clase 4** – cada punto de la tubería en esta clase no estará a más de 2.5 millas de distancia de una válvula; la distancia entre las válvulas será igual o menor a 5 millas.

En el Anejo 5.1, *Class Location Study*, se incluye la Clase por Localización que se asignó a todos los tramos de la alineación. En el Anejo 5.2, *Valve Location Calculations*, se muestra la localización de las estaciones de válvulas.

La presión de entrada del gas a la tubería será de 650 psi. En las diferentes centrales que se abastecerán de gas natural mediante Vía Verde, se instalará equipo permanente para reducir esta presión a alrededor de 400 psi, antes de que entre a las turbinas de combustión. Todos los equipos que se instalen como parte del proyecto tendrán la capacidad de operar a una presión máxima de 1,450 psi, a una temperatura máxima de 120° F.

5.2 Gas Natural

El gas natural es un combustible fósil no derivado del petróleo y se forma cuando materia orgánica (restos de plantas y animales) es comprimida bajo la tierra a presiones altas por tiempos de escala geológica. La presión, combinada con altas temperaturas, produce petróleo y gas natural. En ocasiones, el gas natural se encuentra en depósitos de petróleo que están de 1 a 2 millas bajo la corteza terrestre. Esto se conoce como gas asociado. Cuando el yacimiento es exclusivamente gas natural, se denomina yacimiento no asociado. El gas también se denomina rico o pobre dependiendo de la cantidad de hidrocarburos pesados que puedan extraerse del mismo y que tienen valor comercial.

El gas natural es una mezcla de hidrocarburos. Su composición varía de acuerdo a la formación o reserva de donde se extrae, pero su componente principal siempre es el metano (CH_4). También contiene etano, propano, butano, dióxido de carbono, oxígeno, nitrógeno, compuestos de azufre y helio. No tiene color ni olor y es más liviano que el aire. Su gravedad específica fluctúa entre 0.55 y 0.64. La gravedad específica del aire es 1.00. Su límite de explosividad es de 3 a 17%. Esto quiere decir que la mezcla de aire y gas natural tiene que estar entre 3% gas natural y 97% aire (límite menor) y 17% gas natural y 83% aire (límite mayor) para que haya combustión. Fuera de estos límites, el gas natural se mantiene estable.

Como no tiene olor, para poder detectar un escape del gas, la práctica en la industria es añadir un odorante. Usualmente se usa como odorante el etilmercaptano. Este compuesto tiene un olor muy peculiar a huevo podrido y sólo una ínfima cantidad del compuesto se percibe por la mayor parte de las personas. Los odorantes del gas natural utilizan el método de absorción. Mediante este método se agrega el odorante en las tuberías de gas natural con flujos de hasta ocho millones de pies cúbicos estándar por hora (basado en un índice de absorción de 0.5 libras de odorante por mmscf de gas natural.

El ASTM D6273 - 08 describe el método estándar de la prueba para la intensidad del olor del gas natural. El Código de Regulaciones Federales 49 CFR parte 192.625 indica que: "Un gas combustible en una línea de distribución debe contener un odorante de modo que posea una concentración en el aire de una quinta parte del límite explosivo inferior y que el gas sea fácilmente perceptible por una persona con un sentido del olor normal". Este reglamento menciona además que "cada operador conducirá el muestreo periódico de gases combustibles para asegurar una concentración apropiada de odorante de acuerdo con esta sección." Además, un número de estados de la nación Americana han decretado legislación que requiere que el gas natural sea con odorante de modo que sea perceptible en concentraciones de una quinta parte de su límite explosivo inferior. Es la responsabilidad de las personas que usan estos métodos de prueba desarrollar y mantener el equipo, los procedimientos y el funcionamiento adecuado para asegurar la seguridad pública y el cumplimiento con todas las regulaciones vigentes. Se incluye la Hoja de Datos de

Seguridad del Mercaptano y una vista de una estación típica de inyección de odorante en el Anejo 5.3.

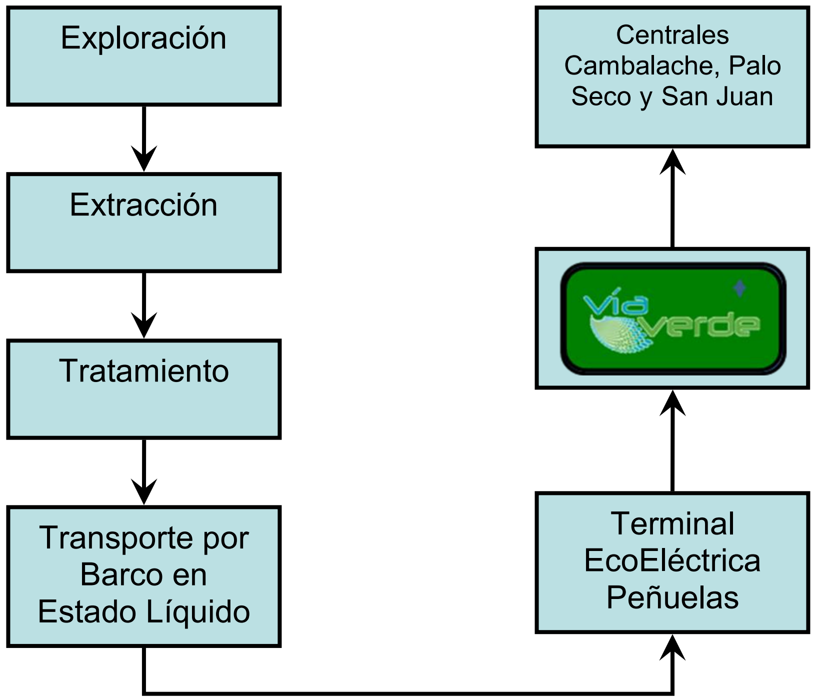
Compuestos de azufre son contaminantes comunes en el gas natural y se remueven antes de utilizarlo. El gas natural que contiene una cantidad significativa de impurezas de azufre se denomina gas natural amargo; dulce, si la cantidad de impurezas es baja. El gas natural que se utiliza por compañías de transmisión tiene que cumplir con requisitos para preservar la integridad de la tubería. Entre estos requisitos están: contenido de agua, punto de condensación de hidrógeno, valor calórico y contenido de compuestos de azufre. El control de estos parámetros ayuda a controlar la corrosión interna de la tubería.

La cantidad de energía que produce la combustión de gas natural se mide en Unidades Térmicas Británicas (BTU). El valor del gas natural se determina por su potencial energético que se mide en BTU's. Un BTU representa la cantidad de energía que se requiere para elevar un grado *Fahrenheit* la temperatura de una libra de agua. Un pie cúbico de gas natural produce un promedio de 1,000 BTU, aunque puede fluctuar entre 500 y 1,500 BTU.

El gas natural es un componente vital del suministro mundial de energía. Es la fuente de energía fósil que ha tenido más auge desde los años 70 y representa actualmente la quinta parte del consumo energético mundial. El gas natural se considera uno de los combustibles fósiles más limpios y mejores para el ambiente. Su ventaja ambiental, en comparación con el carbón o con el petróleo, es que las emisiones de dióxido de azufre son ínfimas y que los niveles de óxido nitroso y dióxido de carbono son menores. Una mayor utilización de esta fuente de energía permitirá disminuir considerablemente los impactos negativos sobre el ambiente, tales como: lluvia ácida y el calentamiento global.

La industria de gas natural se compone de tres segmentos: producción (exploración, extracción, tratamiento), transmisión y distribución. En Puerto Rico no hay producción de gas natural. Vía Verde de Puerto Rico representa el segmento de transmisión, ya que recibe el gas natural regasificado de la terminal de EcoEléctrica para transportarlo directamente a las centrales Cambalache, Palo Seco y San Juan. En Puerto Rico, el gas natural se utiliza en su totalidad para la producción de electricidad (EcoEléctrica y, posteriormente, las centrales de la AEE). Sin embargo, éste tiene otros usos domésticos (enseres: lavadoras, secadoras, calentadores de agua), comerciales e industriales (equipos médicos, maquinaria industrial, aire acondicionado, refrigeración, enseres de restaurantes, incineración y reciclaje, entre otros). También se utiliza en vehículos de motor. Se estima que hay 1.5 millones de vehículos en todo el mundo que utilizan gas natural como combustible.

GAS NATURAL



5.3 Descripción General de la Alineación

A continuación se presenta una descripción general de los lugares por donde cruzará la línea. En el Anejo 3.1, *Fotos Aéreas con Alineación Ilustrada*, se muestra la alineación del proyecto. Las fotos aéreas que se incluyen en esta sección no están a escala y sólo tienen una función ilustrativa. Las mismas muestran la alineación en color verde y los límites municipales en color azul.

Milla 0 – 8, Foto 5.1

La alineación propuesta para el proyecto comienza en el Municipio de Peñuelas, cercano a los predios de EcoEléctrica, hacia el oeste de la PR-337 del Barrio Tallaboa Poniente. Esta es la milla 0.0, el lugar propuesto para la estación del metro de recibo. De ahí, la alineación se dirige hacia el norte, paralela a la PR-337 hasta la milla 0.2. La alineación cruza la PR-337 y el canal de *Union Carbide,* sigue en dirección este y cruza el río Tallaboa. Continúa dirigiéndose al norte, cruza la PR-127, pasa el área industrial y se acerca a la PR-385. Cerca de la milla 2.35, la alineación cruza la PR-2 y sigue hacia el norte hasta la milla 2.7. Aquí se dirige hacia el este y cruza la PR-385, donde comienza su ascenso hacia el área montañosa de Tallaboa. De aquí, la línea sigue rumbo al este hasta llegar al vertedero BFI, el cual bordea. En la milla 5.16, la alineación se dirige hacia el norte. De aquí la alineación sigue hacia el norte hasta llegar al oeste de la Comunidad Monte Santo.

Milla 8 – 13, Foto 5.2

La alineación continúa su rumbo hacia el norte y pasa al este de las comunidades de Villa Esmeralda, Tallaboa II y La Moca, donde cruza la PR-132. Cercano a la milla 8.1 se acerca al límite municipal entre Peñuelas y Ponce. En ese punto cruza la PR-520. De ahí se dirige al noroeste y luego de la milla 8.3, se dirige hacia el norte y pasa entre las comunidades Calvache y Brisas del Monte. Entre las millas 9.78 y 10.29, cruza las carreteras PR-3391 y PR-391. Continúa hacia el norte hasta alcanzar la milla 11.8, hacia el oeste del Sector Belleza. Continúa hacia el norte, hacia el Municipio de Adjuntas.

Milla 13 – 20, Foto 5.3

La alineación entra a Adjuntas en la milla 13.17, por el Barrio Saltillo. A 159 metros al oeste de la colindancia con el Barrio Portugués, intercepta la PR-516 en las millas 13.32 y 13.39. La alineación continúa en dirección noreste hasta que, cercano a la milla 13.56, entra al Barrio Portugués. De ahí continúa hacia el noreste hasta llegar a la PR-10, la cual intercepta en la milla 14.88. Sigue hacia el norte donde intercepta la PR-143. Entra en el Barrio Vegas Arriba en la milla 15.3 e intercepta la PR-521 en la milla 16.07. Continúa con dirección noroeste, pasa al lado este del Sector Las Antenas, hasta llegar al Barrio Vegas Abajo en la milla 17.20. El proyecto continúa hacia el norte y entra en el Barrio Pellejas en la milla 18.57. La trayectoria de la línea atraviesa la PR-524 y sigue paralela al lado este de la PR-523, hasta llegar a la colindancia del Barrio Arenas del Municipio de Utuado en la milla 20.20.

Milla 20 – 29, Foto 5.4

La alineación continúa su trayectoria interceptando el río Pellejas, en la milla 20.52. El proyecto continúa su trayectoria hacia el norte paralelo a la PR-10 y al río Grande de Arecibo. Intercepta un ramal de la PR-5523, continúa hacia el norte atravesando el Séctor Tomás Colón en la milla 21.6 hasta pasar por detrás de la Universidad de Puerto Rico. Aquí cambia su trayectoria hacia el noroeste hasta entrar al Barrio Pueblo donde cruza la PR-123. Entra al Barrio Salto Arriba, cerca a la milla 23.6, de donde procede hacia el norte hasta cruzar la PR-10. De ahí sigue al noreste por la servidumbre de la PR-10. La alineación continúa por campo abierto hacia el noreste y cruza el Barrio Sabana Grande. Continúa hacia el norte interceptando la PR-10 en la milla 28.57 y transcurre paralela a ésta. Luego atraviesa el Barrio Caníaco hasta llegar a la colindancia del Municipio de Arecibo.

Milla 29 – 35, Foto 5.5

En la milla 29.05 la trayectoria del proyecto sigue hacia el norte, entrando al Municipio de Arecibo. El proyecto sigue paralelo al noroeste de la PR-10. En la milla 29.7 la alineación pasa hacia el oeste del Sector Cuerpo de Paz en el Barrio Rio Arriba de Arecibo. Luego, sigue en dirección hacia el noroeste, por la servidumbre de la PR-10 y cruza el Barrio Hato Viejo en la milla 31.45. Llega al Barrio Carreras, en la milla 33.87 y pasa colindando con el Barrio Hato Viejo en la milla 35.26.

Milla 35 – 46, Foto 5.6

En la milla 35.10, la línea cambia de dirección hacia el noreste atravesando el Sector La Pica y continúa hacia el noreste por el Barrio Carreras. En la milla 36.06, la alineación cambia de dirección hacia el oeste entrando así al Barrio Hato Viejo a la altura de la milla 36.2. En la milla 36.95 la alineación cambia en dirección norte y va paralelo a la PR-10 en el Barrio Tanamá. Luego continúa subiendo hasta pasar por el este de la Comunidad Villa Ángela en la milla 38.9. En la milla 39.4 la alineación atraviesa la PR-22 y continúa subiendo hacia el noreste paralelo al río Grande de Arecibo hasta la milla 40.66. En la milla 40.68 atraviesa el río Grande de Arecibo, entrando al Barrio Cambalache. La alineación continúa hacia el este hasta atravesar la PR-2 a la altura de la milla 40.94. En la milla 41.38 la alineación cambia en dirección sur cercano a la Comunidad Monte Grande. En la milla 42.23 la alineación cambia de dirección hacia el este, y entra al Barrio Santana de Arecibo en la milla 42.54. En la milla 44.9, la alineación pasa por el norte del Sector El Palmar. En la milla 45.0 la alineación entra en el Barrio Factor; y cambia su dirección hacia el norte en la milla 45.55. En la milla 45.76, la alineación sigue en dirección este por el Sector Factor II; y bordea por el norte al Sector Villa Garrochales en la milla 46.8. En la milla 47.5 llega a la colindancia del Barrio Garrochales. La alineación continúa en dirección este cercano a los sectores La Sabana y El Alto en las millas 48.8 y 49.0, respectivamente, hasta llegar a la colindancia del Municipio de Barceloneta.

Milla 46 – 54, Foto 5.7

La alineación continúa al sur del Caño Tiburones hasta la milla 50.06. En ese punto entra al Municipio de Barceloneta y cruza por campo abierto por terrenos de la Autoridad de Tierras. Entre la milla 50 a la 52 se proveerá una toma de gas para dar servicio al área industrial de Barceloneta, en consideración a la petición que realizara la Compañía de Fomento Industrial (PRIDCO, en inglés). Pasa al norte del dique que protege a este municipio, hasta la milla 52.54 donde comienza una trayectoria hacia el sureste, cruza la PR-684 y entra al Municipio de Manatí.

Milla 54-63, Foto 5.8

En la milla 53.7 la alineación cruza la PR-616, continúa hacia el sur cruzando la PR-22 a la altura de la milla 54.37 y sigue por campo abierto por el valle del río Manatí, el cual cruza en repetidas ocasiones. Cruza la PR-6685, después la PR-149 y pasa al sur de la Urbanización Jardines de Mónaco. Continúa hacia el este por campo abierto, al sur del Sector Sábana Seca y la Barriada El Polvorín. Cercano a la milla 63 la alineación pasa al norte del Sector Palo Alto y entra al Municipio de Vega Baja.

Milla 63 – 71, Foto 5.9

Desde la milla 61.5 hasta la 62.3, la alineación bordea los sembradíos de piña. Luego pasa al sur de los sectores Bethel, Panaini y Amadeo. Además, cruza la PR-137 y la PR-155. Luego, pasa al sur de la Urbanización Villa Pinares, cruza la PR-674 y continúa hacia el noreste. Luego, bordea el Sector El Indio, desde donde cambia a una trayectoria hacia el sureste. Cercano a la milla 69, la alineación pasa al sur de la Comunidad Carmelita y al sur de la PR-2, pero al norte de la PR-22.

Milla 71 – 77, Foto 5.10

En la milla 69.65 entra al Municipio de Vega Alta cercano al bosque de Vega. En la milla 71.2 la alineación se ubicará en la servidumbre de la PR-22, al sur de la misma, donde pasará cerca de los sectores Maysonet, Martell, Los Dávila y Cotto Martell y al norte del bosque Dorado. De ahí continúa hacia el noreste y pasa cercano a la Urbanización San Nicolás. Cercano a la milla 75.8, cruza la PR-693 y luego el río La Plata.

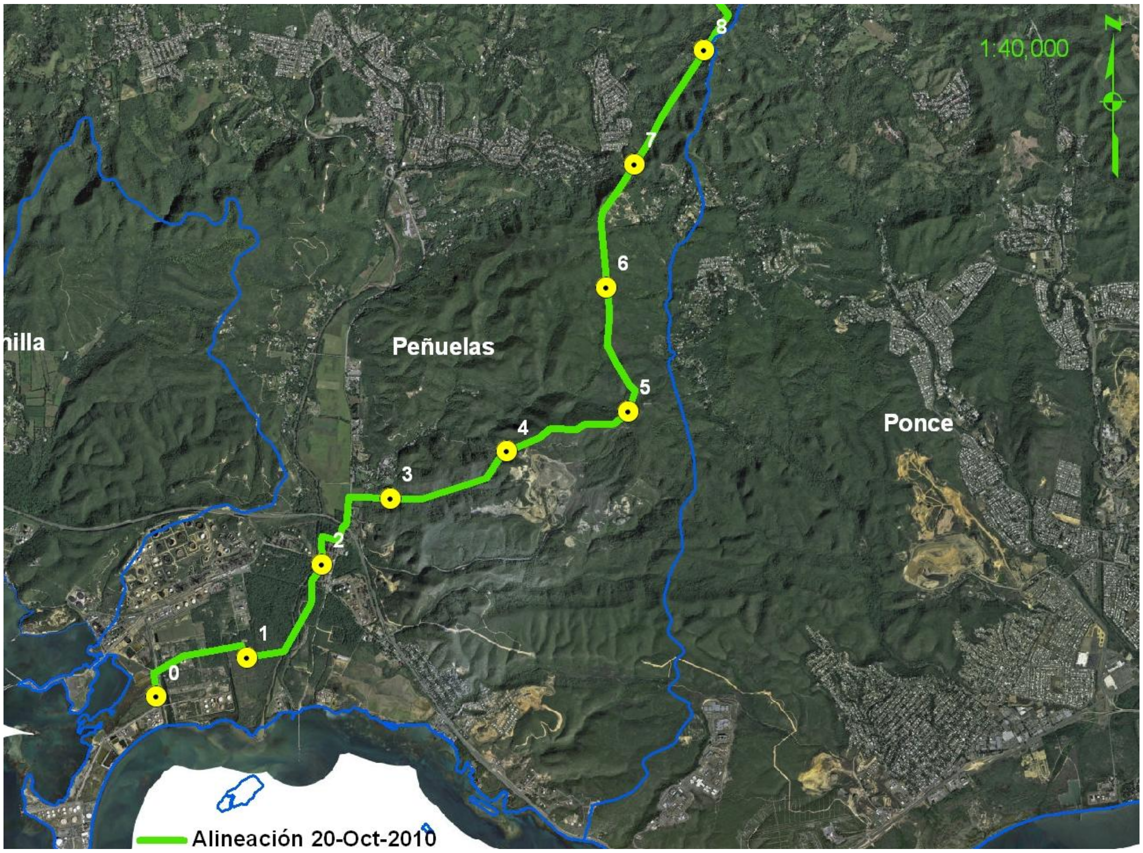
Milla 77 – 85, Foto 5.11

Después de la milla 76.3, la alineación entra al Municipio de Toa Baja y continúa hacia el noreste, cruza la PR-165 y pasa al este del pueblo de Toa Baja y al este de Toa Ville. Desde la milla 78 sigue por campo abierto hasta alcanzar la costa norte de Toa Baja y bordea el área de Levittown por la servidumbre norte de la PR-165. En la milla 84 la alineación sale de Toa Baja. Este tramo se cruzará mediante la tecnología de HDD, la cual permitirá ubicar la tubería a una profundidad entre 50 a 60 pies. A esta profundidad los suelos están más compactados, lo que evitará el riesgo de daños a la tubería en caso de un evento de licuación de los terrenos.

Milla 85 – 92, Foto 5.12

Cercano a la milla 84.2 cruza el río de Bayamón y se bifurca en dos segmentos: uno que va hasta la Central Palo Seco con el propósito de suplir gas natural para la operación de esta central y pasa al sur de los terrenos de la AEE donde está el CASE; el otro segmento continúa hacia el sur, por el este del canal del río Bayamón y pasa al oeste de la Urbanización Villa Aurora del Municipio de Cataño. Sigue hacia el sur hasta encontrar la PR-22, la cual cruza y sigue por su servidumbre al lado sur de la misma. Desde la milla 86, la alineación sigue por la servidumbre del lado sur de la PR-22. Entre la milla 86 a la 87 se proveerá una toma de gas para dar servicio al área industrial de Bayamón, en consideración a la petición que realizara la Compañía de Fomento Industrial (PRIDCO, en inglés). Frente a las instalaciones de CAPECO, cruza la PR-22 nuevamente, esta vez hacia el norte. Pasa hacia el norte de la urbanización industrial y cercana a la Urbanización Las Vegas y la Barriada Puente Blanco. Cercano a su milla 89.04, la alineación cruza la PR-165 cercano a la cárcel federal y de ahí entra a la Central San Juan, con el propósito de suplir gas natural para la operación de esta central.

Foto 5.1



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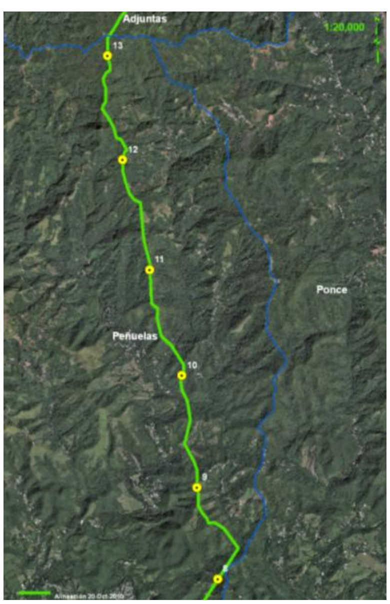

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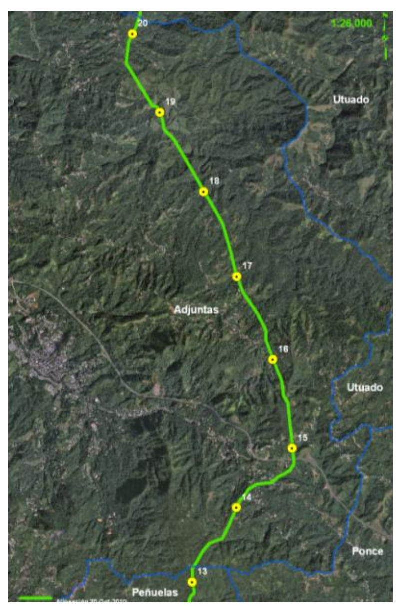

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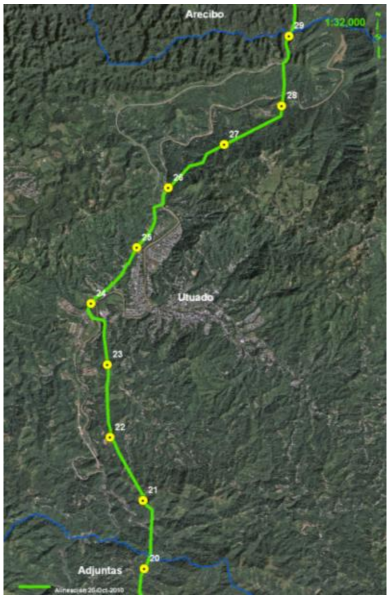

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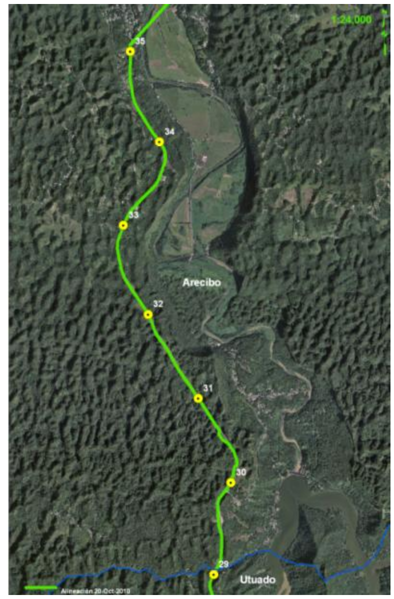

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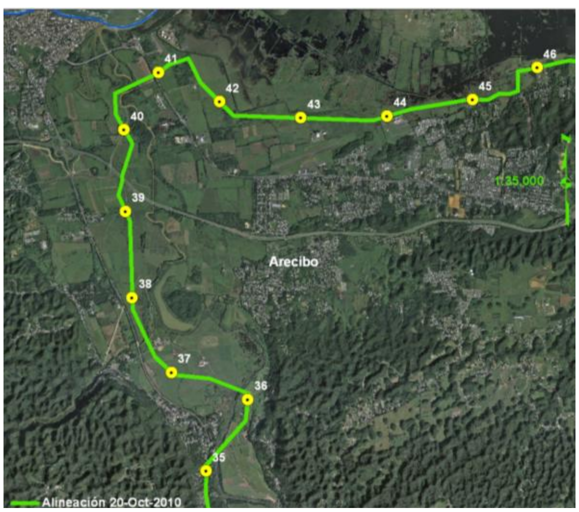

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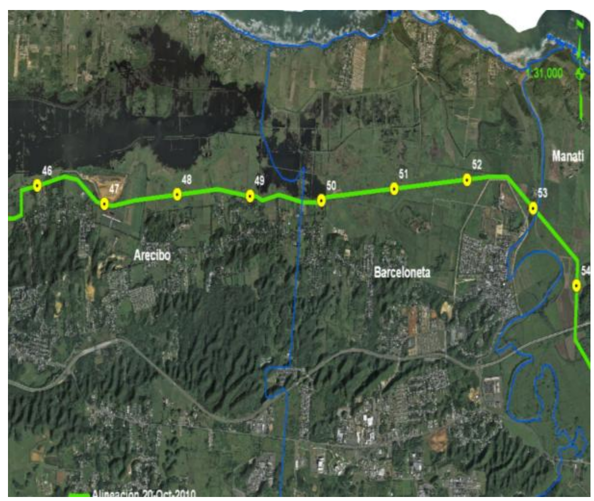

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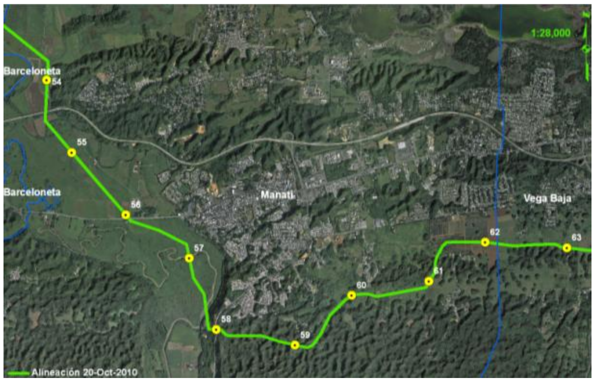

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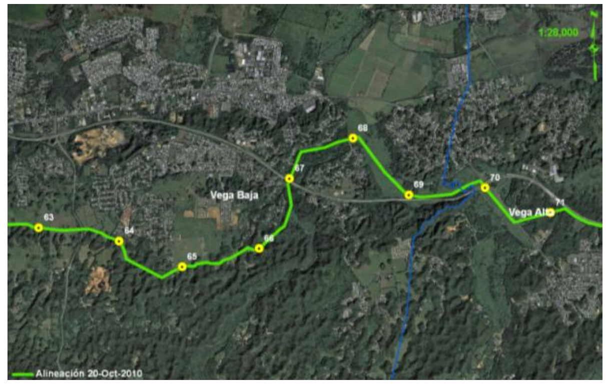
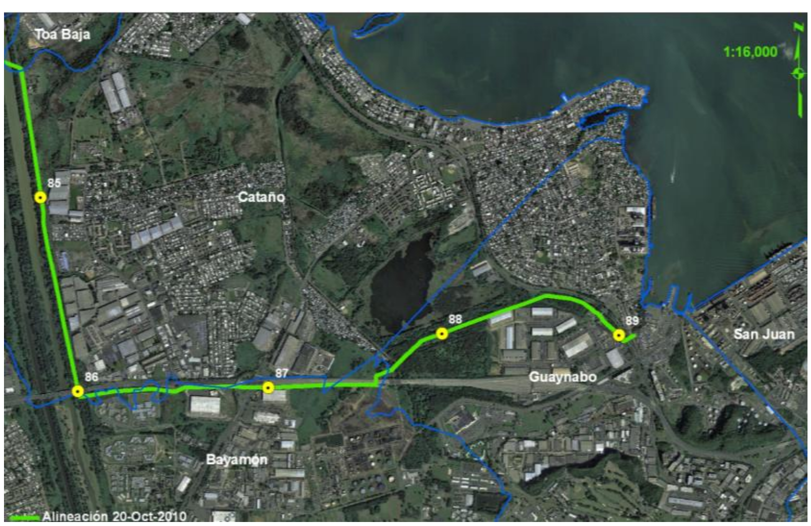


Foto 5.10

Foto 5.11

Foto 5.12



5.4 Centros de Operaciones

El Proyecto necesitará varios espacios de terreno donde se establecerán los centros de operaciones. Preliminarmente, la AEE contempla usar varios terrenos: en Ponce, próximo a las facilidades del Puerto de Las Américas; Utuado, Operaciones Técnicas AEE; Arecibo, Central Cambalache; y Toa Baja, predios del Almacén de Palo Seco AEE. Todos excepto el de Ponce, estarán en terrenos que albergan instalaciones de la AEE y tendrán un área promedio de 30,000 metros cuadrados. Estos locales ya están impactados por actividad industrial, por lo que no representan un impacto al ambiente. Su uso será de carácter temporero mientras se construye el proyecto.

Todos los locales son de topografía llana y están muy cerca del proyecto. Dos de ellos están sumamente cercanos a las áreas de desembarque de los materiales y equipos del proyecto. Los terrenos se seleccionaron por las siguientes razones:

- Localización estratégica con relación a la alineación propuesta.
- Rápido acceso a diferentes puntos del proyecto a través de carreteras principales.
- Disponibilidad de espacio requerido por el proyecto.
- Área destinada para uso industrial (uso compatible para nuestro proyecto).
- Proximidad a zonas portuarias.
- Rápida movilización de los materiales y equipos; retraso mínimo de las actividades rutinarias.

Los mismos albergarán, de forma temporal y durante la etapa de construcción, las oficinas de los ingenieros residentes de la AEE, los contratistas y subcontratistas. En estas oficinas se planificará, desarrollará, coordinará y se implantará la logística para las actividades de trabajo diario, programados o de emergencia.

También servirá como base para el recibo, almacenamiento, inventario y despacho de materiales y equipos para el proyecto, tales como: tuberías de acero con longitudes entre 40 a 80 pies, registros, válvulas, equipos sanitarios portátiles, tuberías “PVC”, cables, madera, varillas, cemento, bombas, generadores de emergencias, maquinaria para soldadura, herramientas de trabajo, equipos de seguridad, vehículos de transporte livianos, transporte de plataforma, equipo de barrenado horizontal, camiones para acarreo, excavadoras, rolo vibratorio, *“backhoe loaders”*.

Previo al comienzo del proyecto, habrá actividades de limpieza de los terrenos y remoción de la vegetación existente para algunas secciones de los predios. De ser necesario, habrá movimiento de tierra para la nivelación del mismo. Se implantará un Plan de Control de Erosión y Sedimentación y un Plan para Control de Emisiones de Polvo Fugitivo. Como parte de esto, se instalará *silt fence* y pacas de heno de acuerdo a los patrones de drenaje del área; se prepararán las entradas y se establecerá un área de lavado de gomas. Además, se implantará un plan de asperjación para controlar el particulado.

El área de los centros de operaciones se dividirá en diferentes secciones para atender las necesidades de contratistas, subcontratistas, ingenieros residentes e inspectores. Se ubicará un centro de mando para el contratista principal, oficinas para los subcontratistas, oficinas para inspectores e ingenieros, baños, despacho de materiales y equipos, centro de apoyo para la construcción, almacenamiento de materiales, estacionamiento de vehículos livianos y pesados, área de almuerzo, entre otros, y según sea necesario.

Otras actividades que se realizarán, según sea necesario, para la preparación de los centros de operaciones son:

- Excavación de trincheras para el drenaje de las aguas.
- Excavación y relleno temporal del terreno para las facilidades de estacionamiento o almacenamiento de materiales. Las aguas de escorrentía se redirigirán para reducir estancamiento.
- Instalación de verja eslabonada. La acción evitará el hurto de materiales, el acceso de personas no relacionadas con el proyecto y evitará accidentes.
- El centro de operaciones contará con oficiales de seguridad para la vigilancia de los materiales, equipos y seguridad del personal. Sólo se permitirá acceso a la instalación al personal autorizado y agencias reguladoras municipales, estatales y federales.

De ser necesario, se utilizarán áreas dentro del solar para almacenar material selecto para relleno. Estos montículos estarán cubiertos.

Luego de que termine la construcción del proyecto, los centros de operaciones cesarán sus actividades; se removerán todos los equipos y el terreno se acondicionará a su estado original y se entregará a su dueño.

5.5 Seguridad Personal

Para la construcción del proyecto, se contratará a una compañía especializada en la construcción de gasoductos. El contratista será responsable de someter un plan de trabajo que incluya los aspectos de salud y seguridad que se implantarán durante la construcción. La AEE evaluará el plan y se asegurará de que incluya los siguientes aspectos, según el Código de Regulaciones Federales, Título 29, *Labor*, Parte 1910, *Occupational Safety and Health Standards* y Parte 1926, *Safety and Health Regulations for Construction:*

- Adiestramiento básico de reglas de seguridad a todos los empleados del proyecto.
- Situaciones peligrosas; cómo reconocerlas y manejarlas o evitarlas.
- Construcción de trincheras y medidas que se tomarán para evitar que colapsen. Medidas que se tomarán en trincheras llenas de agua.
- Exposición a tráfico (uso de chalecos reflectores, etc.)

- Exposición a cargas (tubería) que puedan caer sobre los empleados (*falling loads*).
- Uso de alarmas de reversa en vehículos.
- Uso de protectores (*stop logs*, barricadas, señales mecánicas y de mano) para evitar que los equipos que transitan cerca de las trincheras caigan dentro de las mismas.
- Caídas
- Equipo de seguridad por clasificación de trabajo
- Inspección de áreas de trabajo
- Limpieza
- Baños
- Agua potable
- Primeros auxilios
- Identificación de servicios médicos por municipio.
- Exposición a ruidos
- Disposición de desperdicios sanitarios
- Procedimiento para informe e investigación de accidentes.
- Control de acceso a área de trabajo.
- Protección de trincheras en caso de que permanezcan abiertas de un día para otro.
- Copia Hojas de Datos de Seguridad de Materiales (MSDS, por sus siglas en inglés)
- Lista de personal especializado y copia de certificaciones o licencias vigentes.

5.6 Etapas de Construcción

La construcción del proyecto se realizará por tramos y seguirá una secuencia específica (tipo línea de producción). Por lo general, la brigada que limpia y nivela la servidumbre comienza sus labores una semana antes de que los demás grupos se movilicen. Luego de esto, los agrimensores cotejan los marcadores y remplazan los que se hayan removido. Tan pronto terminan los agrimensores, se trae la tubería y se acomoda a lo largo del tramo limpio; luego, se comienzan a excavar las trincheras. Cuando se termina el tramo de excavación, los soldadores comienzan a soldar y llega la maquinaria que acomodará la tubería dentro de la trinchera, se cubre la tubería y se realiza la prueba hidrostática. Si la tubería pasa la prueba hidrostática, se comienza la restauración de la servidumbre. El proceso se repite hasta que termina la construcción de las 92 millas de tubería.

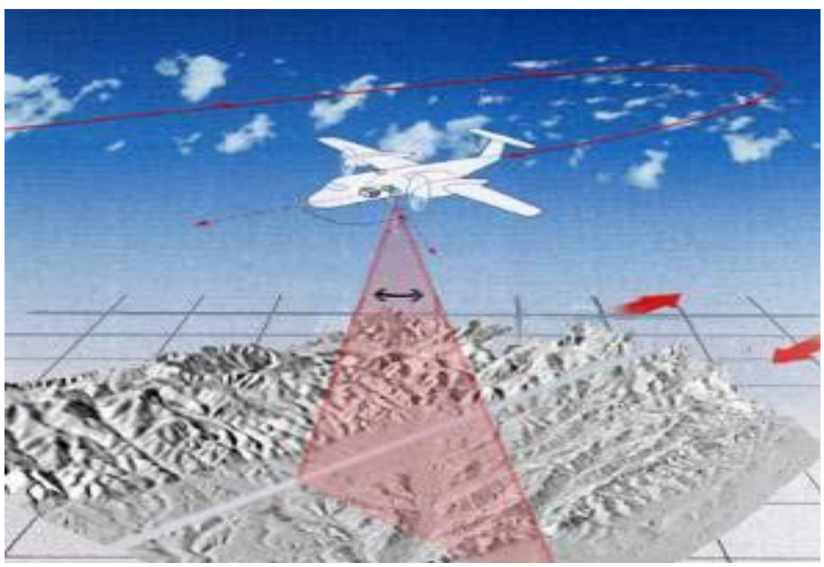
A continuación se describe cada etapa de la construcción. La determinación de alineación preliminar, identificación de dueños, agrimensura I y estudios ambientales ya se realizaron.

5.6.1 Identificación de dueños, agrimensura y estudios ambientales

Luego que se escogió la alineación preliminar, se identificaron los dueños de los terrenos y se comenzó el proceso de visitar a cada uno de ellos. Se les explicó el proyecto y se solicitó permiso de acceso a su propiedad, para realizar la agrimensura y los estudios ambientales pertinentes. Para esto, se contrató a la compañía *New Star Acquisitions*.

Los dueños firmaron un acuerdo para otorgar permiso. Se le proveyó copia de estos acuerdos a los agrimensores y una carta de presentación firmada por un representante de la AEE. Los agrimensores también participaron en una charla informativa sobre el proyecto.

En la primera etapa de la agrimensura se utilizó la tecnología aérea de ***Light Detection and Ranging*** (LIDAR). Esta etapa tomó casi cuarenta y cinco días y con la misma se trazó el centro de la línea por donde cruzará la tubería.



Uso de la Tecnología LIDAR
(*Light Detection and Ranging*)

Los estudios ambientales se comenzaron con las coordenadas de la alineación preliminar, las cuales se obtuvieron por medio de vuelos de reconocimiento en helicópteros de la AEE. Los estudios ambientales que se comenzaron fueron: delineación de humedales, flora y fauna y arqueológico.

5.6.2 Limpieza de Servidumbre

Figura 5-3
Servidumbre preparada para construcción

Aunque no existe reglamentación, federal ni estatal, que establezca una distancia de despejo respecto a edificaciones, la AEE establecerá una servidumbre que será de 150 pies a lo largo de toda la alineación. Esta servidumbre se conocerá como servidumbre de mantenimiento y podrá reducirse o aumentarse en aquellas áreas que haya limitaciones de espacio o situaciones particulares. No obstante, dentro de esos 150 pies se mantendrá libre de vegetación de raíces profundas y de cualquier edificación una servidumbre de operación de 50 pies. El remanente de la servidumbre de mantenimiento podrá reforestarse de forma natural o por medio de algún plan de mitigación, según coordinado con las agencias concernidas. Además, en la servidumbre de mantenimiento se permitirá el uso y disfrute de la misma por su titular, sujeto a que éste tramite y obtenga la autorización de la AEE para conducir las actividades que se desarrollarán dentro de dicha servidumbre.

La servidumbre de construcción será de 100 pies en áreas llanas. En áreas montañosas y donde se realice barreno horizontal directo, la misma varía entre 100 y 300 pies. Esto es servidumbre temporal. La servidumbre permanente será de 50 pies (25 pies a cada lado del centro de la tubería), pero la misma puede ser reducida en ciertas áreas en las que existan limitaciones de espacio.

Una vez se adquieran los terrenos que se identificaron para la construcción y se hagan las coordinaciones necesarias con los dueños para el uso de servidumbre temporal, se utilizará maquinaria pesada para limpiar y nivelar. Se estima que se impactarán 1,191.3 acres. De estos terrenos se removerán verjas, árboles, arbustos, maleza, piedras y todo obstáculo que impida el libre movimiento de la maquinaria que se utilizará para transportar la tubería, construir las trincheras y acomodar la tubería. El terreno que se remueva se almacenará para utilizarlo en la etapa de restauración. El *top soil* se almacenará separado del subsuelo. Ambos terrenos se cubrirán para evitar que la lluvia y el viento los dispersen. Durante esta etapa se colocarán mallas protectoras (*silt fence*) y pacas de heno para evitar la sedimentación en cuerpos de agua. La siguiente tabla contiene la información sobre la longitud del proyecto en cada municipio, y los acres de servidumbre de construcción:

Municipio	Longitud		Servidumbre Construcción	
	millas	kilómetros	acres	cuerdas
Peñuelas	14.2	22.9	172	177.3
Adjuntas	7.0	11.3	84.0	86.6
Utuado	8.9	14.3	107.9	111.2
Arecibo	20.8	33.0	248.6	256.3
Barceloneta	3.3	5.5	39.5	40.7
Manatí	9.2	14.8	111.5	114.9
Vega Baja	7.5	12.1	90.9	93.7
Vega Alta	3.6	5.8	43.6	44.9
Dorado	5.0	8.0	60.6	62.5
Toa Baja	6.9	11.1	81.5	84.0
Cataño	2.4	3.8	29.1	30.0
Bayamón	1.4	2.3	17.0	17.5
Guaynabo	1.9	3.1	23.0	23.7
TOTAL	**92.1**	**148.2**	**1,139.3**	**1,179**

Además, se requerirá un área de 32 acres como área adicional para el proyecto. Ésta se consignará para situaciones especiales y particulares necesarias para este tipo de construcción como, pero sin limitarse a: centros de operación, terreno preparatorio para los HDD, accesos adicionales, terrenos adicionales para maniobrar maquinaria en pendientes, etc. Para la limpieza de la servidumbre de construcción se estima que se removerán unos 688,507 metros cúbicos de terreno.

5.6.3 Validación de la agrimensura

Luego de la agrimensura mediante LIDAR, los agrimensores cotejarán que todos los puntos del centro de línea estén correctos. Entonces, se marcarán las áreas.

5.6.4 Distribución de tubería

Figura 5-4
Transportación de Tubería

Figura 5-5
Distribución de tubería

Una vez se limpie la servidumbre y se cotejen los marcadores, la tubería se trae del área de almacenaje y se coloca a lo largo del área que se utilizará para excavar la trinchera. Esto facilita el proceso de soldadura y acomodo. Las secciones de tubería son de 40 pies de largo. La tubería es específica a la localización y se coloca de acuerdo al plan de diseño. Las especificaciones de grosor y revestimiento varían de acuerdo a variaciones en densidad poblacional, topografía, cruces de cuerpos de agua y carreteras. Durante la evaluación de datos se identificaron las siguientes clasificaciones y el número de millas que cubre cada clasificación.

Definición de clasificación de acuerdo al 49 CFR 192.5:

Clase 1 – 10 edificios o menos
Clase 2 – más de 10 edificios, pero menos de 46
Clase 3 – más de 46 edificios o a 100 yardas de áreas de uso común (parques, teatros al aire libre, etc.)

Vía Verde de Puerto Rico Clasificación de Tubería para Distribución			
Clasificación	**Factor de Diseño**	**Espesor de la Tubería (pulg.)**	**Millas**
Clase 1	0.72	0.199	49.5%
Clase 2 y 3	0.50	0.286	50.5%

5.6.5 Construcción de Trincheras

Figura 5-6
Excavación de Trinchera

En áreas planas, se utilizará maquinaria especializada para la construcción de trincheras (*wheel ditcher*). Esto evitará que los empleados tengan que entrar a dichas trincheras. En otras áreas se utilizará maquinaria con brazo mecánico. Las trincheras serán de 5 a 6 pies de profundidad y de 4 a 5 pies de ancho. La cubierta mínima sobre el tope de la tubería será de 3 pies, ya que se requiere que la distancia entre la tubería y las paredes de la trinchera sea 12 pulgadas a cada lado de la misma. La cubierta mínima sobre la del tope de la tubería será de 3 pies.

El terreno que se remueva de las trincheras se cernirá y se almacenará a lo largo de la misma. El propósito de cernirlo es remover pedazos de rocas grandes que pueden dañar el revestimiento. El material excavado se utilizará para cubrir la tubería. De haber un sobrante de este material, el mismo se dispondrá en un vertedero autorizado.

La trinchera se excava con paredes anguladas para evitar que colapsen durante los trabajos. Donde sea necesario, se instalará tabla estacado para reforzar las paredes mientras se trabaja. Para la excavación de la trinchera se estima que se removerán 450,000 metros cúbicos de terreno.

5.6.6 Perforación (*Bore*), Barreno Horizontal Directo (HDD), *y* Trinchera Abierta (*open cut*)

Los cruces de carreteras se harán utilizando el método de perforación (*boring*) por debajo de la carretera. En las áreas de cruces de carreteras la servidumbre de construcción sobrepasará los 100 pies que se utilizarán en las excavaciones normales. La tubería se instalará a un mínimo de 4 pies debajo de la carretera. Estos tramos de tubería están diseñados para tolerar los pesos asociados a la carretera y los vehículos que transitan por la misma.

Figura 5-7
Cruce de carretera

Durante la agrimensura se identificaron sesenta de carreteras estatales y caminos que se cruzarán por el método de perforación (*bore*). En el Anejo 5.4 muestra los cortes típicos que se harán en las carreteras y caminos. La siguiente tabla presenta las carreteras que se cruzarán con la alineación del proyecto y el *Mile Post* correspondiente a cada cruce:

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 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

Carretera	MP Entrada	MP Salida
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
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

Para cruzar algunos cuerpos de agua, se utilizará barreno horizontal directo. En estas áreas, la servidumbre de construcción será de 100 a 200 pies en la entrada y la salida de la tubería. Entre ellas están la PR-2 y la PR-22. Para cruces de cuerpos de agua, el barreno horizontal directo se considera como un método de cruce "seco" porque no interfiere con el flujo del cuerpo de agua, ya que la perforación se hace por debajo del lecho del cuerpo de agua. El método tiene tres etapas. Éstas incluyen: (1) hacer una perforación piloto con trayectoria arqueada, (2) agrandar la perforación piloto con una serie de barrenos de mayor tamaño para acomodar la tubería de 24 pulgadas, y (3) halar la tubería por la perforación hasta alcanzar el otro lado del cuerpo de agua.

Figura 5-8
Técnica de Barreno Horizontal Directo

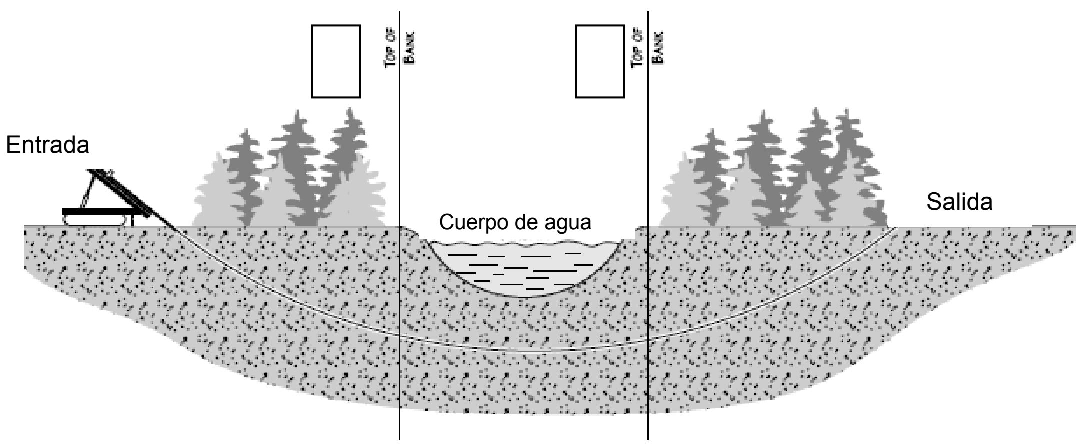


Figura 5-9
Ilustración Barreno Horizontal Directo

La perforación piloto establece la posición final de la tubería. El barreno se dirige hacia el lecho del cuerpo de agua a un ángulo, hasta que se alcanza la profundidad deseada. Luego, se barrena horizontalmente la distancia necesaria para cruzar el cuerpo de agua y se cambia la dirección hacia la superficie. El barreno se maneja colocando dos cables aislados en la superficie. En la parte posterior del barreno se instala una sonda que detecta la corriente que fluye por los cables. De esta manera, el barreno puede resurgir en la posición correcta al otro lado del cuerpo de agua.

Durante el barrenado, se utiliza una mezcla de bentonita y agua para lubricar el barreno, mantener la perforación y remover residuos del barreno. Bentonita es el nombre comercial de arcillas no tóxicas mezcladas con partículas de piedra. Aunque el método de barreno horizontal directo es la mejor forma de evitar impactos a cuerpos de agua, existe la remota posibilidad de un escape de bentonita. Esto es más común durante la perforación piloto, cuando la bentonita busca la alineación de menor resistencia, la cual puede ser una fractura en el lecho marino.

Un escape de bentonita usualmente se detecta cuando hay pérdida de circulación del líquido de barrenado y/o se observa bentonita en la superficie. Una de las funciones de la bentonita es sellar la perforación para mantener la presión en la misma (*downhole pressure*). Si hay un escape, hay una reducción en la cantidad de bentonita que se recircula. (Ver Capítulo 6, Sección 6.14)

Durante el barrenado se añadirá un tinte (uranina) a la bentonita, ya que escapes pequeños son difíciles de detectar debido a la turbidez del agua y a la gravedad específica de la bentonita. Si se detecta un escape, se apagará la bomba de fluido, lo cual detendrá inmediatamente el flujo de bentonita. Se asignará un inspector para corroborar el cumplimiento en los cuerpos de agua que requieran cruce por HDD.

Durante la agrimensura, se identificaron 10 cuerpos de agua que se cruzarán por HDD: 1 canal, 8 ríos, algunos de los cuales se cruzarán varias veces, 1 humedal. También se cruzará el área costera de la playa de Levittown por HDD. El resto de los cruces de cuerpos de agua se realizarán por trinchera abierta. La trinchera abierta se puede realizar mediante dos métodos distintos: “*dam and pump*” o “*Flume pipe*”. Esto quiere decir que la trinchera se excava mientras el cuerpo de agua sigue fluyendo. La mayoría de los cuerpos de agua que se cruzarán utilizando estas técnicas son quebradas pequeñas y zanjones secos. Se identificaron 204 cruces de cuerpos de agua. De éstos, 17 se harán mediante HDD. Los demás se harán por trinchera abierta, “*dam and pump*” o “*Flume pipe*”. Esta información se incluye en la siguiente tabla. En el Anejo 5.5 se muestran Diagramas de Cruces Típicos de Cuerpos de Agua.

Autoridad de Energía Eléctrica
Proyecto Vía Verde
Cuerpos de Agua y Tipo de Cruce

T1- Barreno Horizontal Directo T2- Flume pipe, Dam and Pump T3- Trinchera abierta

ID	Cuerpo de Agua	Tipo de cruce	Pueblo
C1	Canal	T3	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

ID	Cuerpo de Agua	Tipo de cruce	Pueblo
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	Río 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

ID	Cuerpo de Agua	Tipo de cruce	Pueblo
C66	Río Grande de Manatí	T1	Manati
C67	Creek	T3	Manati
C68	Creek	T3	Manati
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	Rio Cibuco	T2	Vega Alta
C81	Quebrada sin nombre	T3	Vega Alta
C82	Ditch	T3	Dorado
C83	Rio 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	Rio 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	Wetland	Arecibo

ID	Cuerpo de Agua	Tipo de cruce	Pueblo
	herbaceous		
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 herbaceous	Wetland	Arecibo
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	Wetland	Manatí

ID	Cuerpo de Agua	Tipo de cruce	Pueblo
	herbaceous		
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

ID	Cuerpo de Agua	Tipo de cruce	Pueblo
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

Además de los cruces de cuerpos de agua, se utilizará trinchera abierta para cruzar los caminos de tierra y asfaltados.

5.6.7 Soldadura y doblez

Figura 5-10
Máquina para doblar tubería

Una vez se coloca la tubería con las especificaciones correctas, se doblan las secciones necesarias de acuerdo a la topografía del terreno. Para esto, se utiliza una maquinaria para doblar tubería que ejerce presión hidráulica y crea un doblez suave y controlado. Todos los dobleces se hacen siguiendo los parámetros establecidos en el 49 CFR 192.313, *Bends and elbows*, para asegurar la integridad de la tubería. En ocasiones, los dobleces se determinan previo a la construcción de la tubería y se prefabrican en talleres especializados.

Para soldar las diferentes secciones de tubería, éstas se colocan sobre soportes temporales, se limpian los extremos cuidadosamente y se alinean. Luego, se sueldan utilizando el método *manual submerged arc welding.*

Figura 5-11
Soldadura

Todos los procedimientos de soldadura se rigen por el CFR, Título 49, Parte 192, Subparte E, *Welding of Steel in Pipelines* y por el *American Petroleum Institute* Standard 1104, *Welding of Pipelines and Related Facilities.* Como parte del primer nivel de control de calidad, los soldadores se cualifican antes de que comience el proyecto. Cada soldador debe completar varias soldaduras utilizando el mismo tipo de tubería que se utilizará en el proyecto. Cada soldadura se evalúa con métodos destructivos, midiendo la fuerza que se necesita para romperla.

Figura 5-12
Aplicación de revestimiento

Una vez comienza el proyecto, las soldaduras se cotejarán con métodos no destructivos para detectar fallas. Éstos incluyen inspección visual por un supervisor experimentado y rayos X. Los técnicos de rayos X toman las lecturas en el campo y procesan las películas en un cuarto oscuro portátil. Si se detectan fallas, la soldadura se repara o se corta y se hace una nueva soldadura.

El 49 CFR 192. 243, *Non Destructive Testing*, requiere que se hagan rayos X a un 10% de las soldaduras en localizaciones Clase 1, para localizaciones Clase 2, un 15% y 100% para localizaciones Clase 3 y 4. No obstante, la AEE realizará pruebas no destructivas por medio de rayos X al 100% de las soldaduras.

Luego de que se suelda y se inspeccionan las soldaduras, se cubren los extremos con un revestimiento protector. La tubería trae un revestimiento protector de fábrica, pero los extremos se dejan sin proteger para que éste no interfiera con la soldadura.

5.6.8 Acomodo y Relleno de Trinchera

Figura 5-13
Acomodo de Tubería

Figura 5-14
Acomodo de Tubería

Una vez la soldadura pasa inspección, se vuelve a inspeccionar el revestimiento de la tubería y se procede a levantar la misma con maquinaria especializada (*sidebooms*) y a acomodarla dentro de la trinchera.

El terreno cernido de partícula fina se utiliza primero para cubrir la tubería y evitar daños en el revestimiento. Luego, se añade el restante del terreno y piedras pequeñas, seguidas por el *top soil*.

Figura 5-15
Relleno de trinchera

En general, la tubería tendrá una cubierta mínima de 36 pulgadas. En áreas agrícolas la cubierta será de 48 pulgadas. La cubierta mínima en carreteras es de 4 pies, a menos que se requiera cubierta adicional en algunas de ellas.

5.6.9 Prueba Hidrostática

El Departamento de Transportación Federal (49 CFR 192.505, *Strength Test Requirements for Steel Pipeline)* requiere que se realice una prueba hidrostática en toda tubería nueva. El propósito de la prueba hidrostática es detectar cualquier defecto que amenace la habilidad de la tubería de tolerar la presión máxima de operación para la cual se diseñó, o para determinar que no existen defectos que comprometan la integridad de la misma. Una vez se coloca la tubería en la trinchera y se cubre, se llena de agua y se aplica una presión superior a la presión de operación por al menos ocho horas (la prueba se puede realizar en toda la tubería o dividir la misma en secciones).

La prueba ayuda a localizar áreas en la tubería que no pueden tolerar presiones elevadas y por consiguiente fallan. Cuando esto ocurre, hay una disminución súbita en la presión y se detecta agua en la servidumbre. Estos defectos se reparan, si es posible, o la sección completa de tubería se remplaza y se repite la prueba.

Para realizar la prueba se utilizará agua de pozo. Estos pozos pertenecen a la AEE, Central Costar Sur, bajo una franquicia del Departamento de Recursos Naturales y Ambientales.

5.6.10 Restauración de servidumbre

Figura 5-16
Servidumbre restaurada

La restauración comienza tan pronto se determina que el segmento de tubería que se probó pasa la prueba hidrostática. Se tomará video antes de la construcción y éste se utilizará como guía para la restauración. La mayor parte de las parcelas tienen áreas verdes de vegetación silvestre. Los terrenos agrícolas podrán utilizarse para la siembra, siempre y cuando no se siembren cultivos con raíces profundas y se mantengan los marcadores de línea en su lugar. La AEE será responsable por la pérdida de cultivos en el área de construcción.

En el caso de humedales, la AEE propone mitigación "on site", ya que es difícil conseguir terrenos con las características necesarias para una mitigación exitosa. Se seguirán las recomendaciones del Cuerpo de Ingenieros una vez evalúen el informe de delineación de humedales y el impacto del proyecto sobre los mismos.

Donde haya cruces de carreteras por el método de trinchera abierta, se seguirán las recomendaciones de la Autoridad de Carreteras con respecto al tipo de material que debe utilizarse para la reparación y los procedimientos que deben seguirse para control de tránsito.

5.6.11 Marcadores

Durante la restauración, se instalan marcadores que indican la localización aproximada de la tubería. Éstos indicarán el nombre y número de teléfono del operador. Además, se instalarán marcadores que pueden detectarse durante el patrullaje aéreo.

5.7 Construcción en Humedales y Mangles

Las técnicas de construcción para minimizar el impacto a humedales dependerán de las condiciones del terreno; si el mismo está o no saturado de agua. Se tratará en lo posible de construir durante épocas secas o de poca lluvia.

5.7.1 Construcción en áreas no saturadas

La construcción será similar a la construcción en terrenos elevados (no humedales). Si el terreno es lo suficientemente firme, se utilizará el mismo equipo y procedimiento de trinchera abierta para cruzar el humedal.

De ser necesario y del terreno soportar el peso de la maquinaria, se colocarán mantas de vigas de madera "timber mats" o "timber rip-raps". Los "timber mats" son troncos de árboles unidos y amarrados con un tamaño específico, los cuales forman una superficie plana y amplia que distribuye el peso de los equipos sobre el área. Esta técnica evita que el equipo se hunda dentro del humedal (ver Fig. 5-17) y evita disturbios del terreno y turbidez excesiva en el agua.

La capa orgánica o corteza terrestre de la trinchera se extraerá, almacenará y separará del subsuelo para reutilizarla como relleno en la misma y evitar traer relleno ajeno o no afín con el terreno existente.

5.7.2 Construcción en áreas saturadas o inundadas

Bajo estas condiciones, la tubería se suelda fuera del área del humedal, lo que evita cualquier contaminación producto de la soldadura.

Para excavar y luego rellenar la trinchera, se utilizan grúas tipo “backhoe”, las cuales se sostienen dentro del humedal por medio de mantas de vigas de madera “timber mats” o “timber rip-raps”.

La tubería se instala por medio de la técnica de empuje y tirado donde se lleva a través del humedal mediante boyas de flotación, empujando y tirando a través de la trinchera cubierta de agua. Después de colocada en la posición correcta, se remueven las boyas y la tubería se hunde a su lugar. La mayor parte de las tuberías instaladas en humedales saturados tienen un revestimiento de concreto o se equipan con pesas para mantenerlas en posición una vez se instalen en la trinchera.

Durante la excavación de la trinchera, se creará una pendiente de unos 45 grados en las paredes para prevenir el colapso de terreno dentro del mismo.

Figura 5-17
Uso de “timber mats” sobre humedales

5.8 Construcción en Áreas Propensas a Terremotos

Existen gasoductos en áreas propensas a terremotos tales como California y Alaska. Sin duda alguna, Alaska es una de las zonas con mayor incidencia de terremotos intensos en todo el mundo, con 50 a 100 temblores diarios, los que incluyen un promedio de uno anual sobre magnitud 7 y uno sobre magnitud 8 al menos cada 13 años.[1] No obstante, Alaska es uno de los mayores productores de petróleo y de gas natural de Norte América. Por los pasados 30 años, Alaska exportó hacia Canadá y los Estados Unidos su producción de petróleo a través de un oleoducto que cruza el área de mayor actividad sísmica en su región. Al momento de su construcción, su diseño consideró el riesgo de terremotos. Este diseño se probó el 3 de noviembre de 2002, cuando la Falla de Denali se desplazó unos 5.5 metros (18 pies) de forma lateral y más de 1 metro (3 pies) de forma vertical, justo debajo del *Trans-Alaska Pipeline* durante un terremoto de magnitud 7.9 sin que se rompiera el oleoducto ni se derramara ni una gota de petróleo. Hoy día se construye en la misma zona el Gasoducto de Denali, el cual incluye factores de diseño como contingencias a la ocurrencia de un terremoto de gran magnitud.

Entre el 1 de enero de 2000 y el 29 de abril de 2010, ocurrieron 75 movimientos telúricos entre los municipios de Peñuelas, Adjuntas, Utuado y Arecibo. El de mayor intensidad fue de una magnitud de 3.0, de acuerdo a la escala basada en la duración del sismo utilizando la formula de Bataille y von Hillebrandt (1993), que utiliza la red sísmica de Puerto Rico en su página de internet. Entre el 1 de enero de 2000 y el 29 de abril de 2010, ocurrieron 33 movimientos telúricos o sismos entre los municipios de Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, Cataño, Guaynabo y Bayamón. El de mayor intensidad fue de una magnitud de 3.9, de acuerdo a la escala basada en la duración del sismo utilizando la formula de Bataille y von Hillebrandt (1993). De estos datos se puede apreciar que la actividad sísmica en Puerto Rico es mucho menor que la de Alaska. Además, de acuerdo al estudio geológico incluido en el Apéndice 3.3, *Overview of the Geology of the Proposed Vía Verde Natural Gas Pipeline*, *Peñuelas to San Juan*, *Puerto Rico,* las fallas geológicas que se encuentran en la zona del proyecto están consideradas como inactivas. A pesar de esto, Vía Verde se diseñará y construirá con especificaciones similares a las que se toman en lugares como California y Alaska para asegurar la integridad de la tubería durante terremotos. Entre los criterios que se incorporarán al diseño de Vía Verde se encuentran los siguientes: la alineación relativa de la tubería respecto a la falla para disminuir el impacto de un deslizamiento de dicha falla; soterrar la tubería en una trinchera ancha, con pendientes laterales largas y rellenas con arena compactada para permitir la deformación de la tubería durante un evento sísmico; incluir suficientes dobleces en el diseño de la tubería para garantizar su flexibilidad; los resultados de los estudios geotécnicos que se realizarán para evaluar las propiedades de los suelos. Estas medidas garantizarán la integridad y operación continua de Vía Verde. (Ver Anejo 5.6, Especificaciones para Construcción en Áreas Propensas a Terremotos)

Además, la AEE se propone utilizar un sistema de Aviso Temprano de Terremoto (*Earthquake Early Warning System*, EEWS). Este sistema provee aviso previo sobre la intensidad estimada y el tiempo estimado de llegada de la onda sísmica principal. Estos estimados se basan en el análisis inmediato del foco y magnitud del evento que utiliza datos de la onda sísmica que se observan por los sismógrafos cercanos al epicentro. Estos sistemas se usan con éxito en lugares como Japón y California. El sistema se hará en coordinación con la Red Sísmica. El mismo proveerá señales

[1] *http://www.geotimes.org/nov06/feature_GasPipeline.html, 26 de agosto de 2010*

avanzadas al sistema inteligente de supervisión de Vía Verde (SCADA, ver página 5-60), lo que a su vez permitirá que se active de forma remota el sistema de aisladoras y purga de la tubería para evitar un incendio en caso de la rotura de la misma. Enfatizamos que la rotura de la tubería será poco probable debido a que en el diseño de la misma se tomaron en consideración las fallas geológicas y el historial sísmico de la región. Sin embargo, se añade el EEWS con la intención de que existan sistemas de resguardo para garantizar la operación segura de Vía Verde aún bajo condiciones extremas.

Construcción en la Zona Cárstica

A pesar de que se hicieron esfuerzos para evitar el paso por la zona cárstica, donde se pueden encontrar mogotes, sumideros o cuevas en roca porosa o suelos erosionados por el agua, una pequeña parte del proyecto cruzará algunas porciones de dicha zona.

Entre las áreas de mogote cercanas al área del proyecto, se identifican las siguientes, por las que la alineación del proyecto cruza áreas con fisiografía de zona cárstica en las millas:

- 3.0 a la 5.8 y de la milla 6.4 a la 6.7 en el Municipio de Peñuelas, para un total de 3.1 millas en este municipio. No obstante, ninguna de esas millas está indentificada como área cárstica protegida.

- 28.5 hasta la 29.1 en el Municipio de Utuado, para un total de 0.6 millas, todas identificadas como área cárstica protegida. No obstante, este tramo ya se impactó por la construcción de la PR-10 y Vía Verde se construirá dentro de la servidumbre ya impactada de dicha vía pública.

- 29.1 a la milla 35.3 en el Municipio de Arecibo, para un total de 6.2 millas, de las cuales 5.5 están identificadas como área cárstica protegida. No obstante, este tramo ya se impactó por la construcción de la PR-10 y Vía Verde se construirá dentro de la servidumbre ya impactada de dicha vía pública.

- 57.8 hasta la milla 62.1 en el Municipio de Manatí, para un total de 4.3 millas en este municipio, de las cuales 2.0 están identificadas como área cárstica protegida.

- 62.1 a la milla 66.9 en el Municipio de Vega Baja, para un total de 4.8 millas en este municipio, de las que 3.0 están identificadas como área cárstica protegida.

- 70.7 a la milla 73.3 en el Municipio de Vega Alta, para un total de 2.6 en este municipio, de las que sólo 0.6 están identificadas como área cárstica protegida. En este municipio unas 1.8 millas, de las mencionadas 2.6 millas, discurren por la servidumbre de la PR-22. Esta área ya se impactó durante la construcción de dicha vía pública.

- 73.3 a la milla 74.5 en el Municipio de Dorado, para un total de 1.2 millas en este municipio, de las que ninguna está identificada como área cárstica protegida.

El total de área cárstica protegida que no ha sido previamente impactada que será afectada por Vía Verde es de 5.6 millas, para un área de 2,475.65 kilómetros cuadrados.

La zona cárstica es hábitat para especies únicas de plantas y animales, por lo que se tomarán todas las medidas posibles para evitar el impacto a especies protegidas y se mitigará en el caso de especies no protegidas. Para asegurar que ninguna especie protegida sea perturbada, habrá un biólogo en el proyecto en todo momento cuando se construya en la zona cárstica. Este biólogo, que será empleado del DRNA, evaluará el área cuidadosamente antes de introducir personal o equipos de construcción a la misma.

El proceso de construcción se llevará a cabo de manera que sólo equipos livianos entren a la zona cárstica para minimizar las posibilidades de daño a la misma. Se establecerán controles de erosión y sedimentación adecuados para el área para proteger las zonas circundantes y evitar que el sedimento alcance las aguas subterráneas. Los centros de operación o espacios auxiliares a la construcción se ubicarán fuera de la zona cárstica, y la instalación de la tubería se hará mediante proceso de halar para minimizar la presencia de equipo pesado en la zona. El material de relleno será adecuado para permitir la capacidad hidráulica del suelo. Se sembrará vegetación en el área circundante a la servidumbre permanente de 50 pies. Dicha vegetación se hará con yerbas y árboles nativos, y se hará inmediatamente después de haber cubierto las trincheras.

Durante la fase de operación, las áreas del proyecto que estén en la zona cárstica serán inspeccionadas como parte del programa de patrullaje a la alineación. No obstante, también se prestará especial atención a las condiciones del suelo de manera que se pueda corregir cualquier erosión que se pueda observar o detectar.

5.9 Uso de Explosivos

De acuerdo a los estudios que se realizaron para el diseño **no** será necesario el uso de explosivos para la construcción de este proyecto. No obstante, si en el proceso de construcción se identificara algún área en el cual el uso de explosivos sea indispensable para completar el proyecto, entonces se procederá a obtener todo permiso requerido para esa actividad, de acuerdo a las leyes y reglamentos aplicables al uso de estos materiales peligrosos. El uso de los mismos se hará sólo por personal especializado y en cumplimiento con dichas leyes y reglamentos. Se mantendrán y rendirán todos los documentos e informes requeridos. Entre los reglamentos aplicables están el 29 CFR 1926 Subparte U y el 49 CFR 100 – 180. De ser necesario, el trabajo de uso de explosivos se llevará a cabo por personal experto en esta materia y luego de haber evaluado el área en que se usará. Este personal experto deberá contar con los permisos requeridos por la Policía de Puerto Rico, la Comisión de Servicio Público.

5.10 Proyecto Conversión Unidades a Gas Natural Asociadas a Vía Verde

Las unidades a ser convertidas a gas natural deberán modificarse para que las mismas puedan quemar gas natural, combustibles derivados de petróleo o una combinación de ambos. El flujo de gas natural que necesitará cada una de las centrales se presenta en la tabla que aparece a continuación:

Central	Flujo Mínimo / Máximo (MMSCFD)
Cambalache	5.5/61
San Juan	1.1/180
Palo Seco	1.1/84

5.10.1 Modificaciones a las Unidades 3 y 4 de la Central Palo Seco:

La Central Palo Seco consta de cuatro unidades, denominadas 1, 2, 3 y 4. Todas estas unidades están habilitadas para utilizar Bunker C (Fuel Oil No. 6). Como parte de este proyecto, se propone la modificación de las unidades 3 y 4 para cambiar e instalar varios componentes para que las turbinas puedan quemar gas natural. Basándose en el análisis realizado para estas unidades, los siguientes equipos y modificaciones son las más importantes:

a. Sistema suplido gas natural a calderas - Estación reductora de presión

Description:
High pressure transmitter with switch (Q2), upstream of (J), as 2003
Low pressure transmitter with switch (R2), as 2003, voting
Automated isolation valve, 16" flanged carbon steel (T, not shown)
PRV, flanged carbon steel (J1A and J1B), inlet 450-600 psig, outlet 300 psig
PRV, flanged carbon steel (J2B and J2B), inlet 300 psig, outlet 180 psig
PRV, flanged carbon steel (J1C), inlet 450-650 psig, outlet 300 psig
PRV, flanged carbon steel (J2C), inlet 300 psig, outlets 180 psig
Pressure relief valve, flanged carbon steel, set at ~200 psig (K)
Pressure transmitter, downstream of (J)
Pressure gauges with isolation valves (S)

- Aire comprimido para instrumentación/control de válvulas

- Calentador de gas con vapor auxiliar
- Detectores de gas
- Alumbrado *explosion proof* o *intrinsically safe*
- Sistema de purga con N_2
- Filtros
- Fibra Óptica para sistema de comunicación de señales de control
- Señales integradas al Boiler Management System (BMS)

b. Modificación en Calderas

- Instalación nuevos quemadores *low* NOx

Description:
Tilting gas nozzle
Tilting oil nozzle with swirler and flexible pipe
Nozzle attachment kits (pins, retainers, fasteners)
Nozzle socket
Nozzle tilt linkage
Gas wafer with mounting hardware
Gas manifold and internal piping assembly
Gas stainless steel flexible house 6" diameter
Gas pressure gauge with root valve

- Detectores de flama

Description:
iScan flame detector with quartz fiberoptic extension (FOX)
signal cable, quick disconnect fitting, junction box
Redundant power supply sufficient for 24 scanners

- Modificación en *windbox* para cambios en patrón flujo de aire
- Sistemas de válvulas de control para cada quemador

Description:
Manuel isolation valve, flanged carbon steel
Safety shutoff valve, flanged carbon steel, pneumatic, fail closed, Position switches
Vent valve, flanged carbon steel, pneumatic, fail opened, position switches
Air filter / regulator
Pressure gauge with root valve
Flexible corrugated metal house, flanged stainless steel

- Detectores de gas
- Señales integradas al BMS
- Metro de flujo individual

5.10.2 Central San Juan: Unidades 7, 8, 9 y 10

a. Sistema suplido gas natural a calderas

- Estación reductora de presión

Description:
High pressure transmitter with switch (Q2), upstream of (J), as 2003
Low pressure transmitter with switch (R2), as 2003, voting
Automated isolation valve, 16" flanged carbon steel (T, not shown)
PRV, flanged carbon steel (J1A and J1B), inlet 450-600 psig, outlet 300 psig
PRV, flanged carbon steel (J2B and J2B), inlet 300 psig, outlet 180 psig
PRV, flanged carbon steel (J1C), inlet 450-650 psig, outlet 300 psig
PRV, flanged carbon steel (J2C), inlet 300 psig, outlets 180 psig
Pressure relief valve, flanged carbon steel, set at ~200 psig (K)
Pressure transmitter, downstream of (J)
Pressure gauges with isolation valves (S)

- Aire comprimido para instrumentación/control de válvulas
- Calentador de gas con vapor auxiliar
- Detectores de gas
- Filtros
- Sistema de purga con N_2
- Alumbrado *explosion proof o intrinsically safe*
- Fibra Óptica para sistema comunicación de señales de control
- Señales integradas al BMS

b. Modificación en Calderas

- Instalación nuevos quemadores low NOx

Description:
Tilting gas nozzle
Tilting oil nozzle with swirler and flexible pipe
Nozzle attachment kits (pins, retainers, fasteners)
Nozzle socket
Nozzle tilt linkage

Gas wafer with mounting hardware
Gas manifold and internal piping assembly
Gas stainless steel flexible house 6" diameter
Gas pressure gauge with root valve

- Detectores de flama

Description:
iScan flame detector with quartz fiberoptic extension (FOX)
signal cable, quick disconnect fitting, junction box
Redundant power supply sufficient for 24 scanners

- Modificación en *windbox* para cambios en patrón flujo de aire
- Sistemas de válvulas de control para cada quemador

Description:
Manual isolation valve, flanged carbon steel
Safety shutoff valve, flanged carbon steel, pneumatic, fail closed, position switches
Vent valve, flanged carbon steel, pneumatic, fail opened, position switches
Air filter / regulator
Pressure gauge with root valve
Flexible corrugated metal house, flanged stainless steel

- Detectores de gas
- Señales integradas al BMS
- Metro de flujo individual

5.10.3 Central San Juan: Ciclo Combinado 5 y 6

- Sistema suplido gas natural a turbinas
- Aire comprimido para instrumentación/control de válvulas
- Calentador de gas con vapor auxiliar
- Filtros
- Detectores de gas
- Sistema de purga con N_2
- Alumbrado *explosion proof* o *intrinsically safe*
- Fibra Óptica para sistema de comunicación de señales de control
- Señales integradas al control de turbinas
- Modificación en turbinas
- Nuevo sistema de boquillas combustible dual
- Sistema de ignición
- Tubería para inyección de vapor

- *Manifold* para gas y diesel
- Modificación al sistema de bombas de diesel
- Válvula aislación sistema diesel
- *Fuel oil control valve rack*
- Filtros para combustible gas
- Detectores de gas
- Metro de flujo individual
- Sistema control de presión gas, reguladoras
- Sistema de purga con aire
- Válvulas control de flujo e instrumentación

5.10.4 Central Cambalache: Unidades 1,2 y 3

a. Sistema suplido gas natural a calderas

- Aire comprimido para instrumentación/control de válvulas
- Calentador de gas con vapor auxiliar
- Filtros
- Detectores de gas
- Sistema de purga con N_2
- Alumbrado *explosion proof* o *intrinsically safe*
- Fibra Óptica para sistema de comunicación de señales de control
- Señales integradas al BMS

b. Modificación en Turbinas

- Nuevo sistema de quemador para combustible dual
- Sistema de ignición dual
- Tubería para inyección de vapor
- *Manifold* para gas y diesel
- Modificación al sistema de bombas de diesel
- Válvula aislación sistema diesel
- *Fuel oil control valve rack*
- Filtros para combustible gas
- Detectores de gas
- Metro de flujo individual
- Sistema control de presión de gas, reguladoras
- Sistema de purga con aire
- Válvulas control de flujo e instrumentación

5.11 Análisis de Riesgos y Medidas de Seguridad

La transportación de gas natural para uso industrial y doméstico se puede realizar mediante tuberías o mediante cilindros del gas comprimido unidos a un vehículo de arrastre. No obstante, para suplir el alto volumen de gas natural requerido para la operación de nuestras centrales, el único mecanismo viable y el más seguro es el uso de tuberías. En los países que tienen reservas de gas natural, éste se transporta por tubería hasta las terminales de proceso, luego se envía por tubería a los consumidores. En los países que no tienen reservas de gas natural, como Puerto Rico, el gas natural se recibe por barco en forma líquida.

En Estados Unidos, el gas natural se descubrió en el 1626, pero no fue hasta el 1859 cuando se construyó una tubería de 2 pulgadas de diámetro y 5 ½ millas de largo para transportar gas natural. Esto comprobó que se podía transportar el gas por tubería, pero aún así, el gas que se descubría se dejaba escapar por falta de una infraestructura adecuada y segura. Después de la Segunda Guerra Mundial, avances en metalurgia, y el desarrollo de nuevas técnicas de soldadura y fabricación de tubería, hicieron posible la construcción de tuberías más seguras y confiables. Esto facilitó la construcción de miles de millas de tuberías para transportar el gas natural.

Nuevos avances en metalurgia, pruebas de integridad y la participación del gobierno federal para implantar reglamentos de diseño, operación y mantenimiento de tuberías mejoraron sustancialmente el récord de seguridad de los gasoductos. Para atender los aspectos de seguridad de los gasoductos, también se creó la Oficina de Seguridad de Tuberías (*Office of Pipeline Safety*), la cual se encarga de realizar inspecciones, implantar reglamentos, fomentar la investigación, emitir órdenes de cumplimiento, aplicar penalidades civiles y criminales y educar al público, entre otras funciones.

En el 2002, se estableció el *Pipeline Safety Improvement Act*, la cual estableció una alianza entre el Departamento de Transportación Federal, el Departamento de Energía y el Instituto Nacional de Estándares y Tecnología, para realizar investigaciones, hacer demostraciones y estandarizar procedimientos que garanticen la integridad de tuberías. Los esfuerzos de investigación y desarrollo se enfocan principalmente en las siguientes áreas:

1. Desarrollo de tecnologías nuevas para la detección de escapes y prevención de daños.
2. Mejorar las tecnologías de operación, monitoreo y control de tuberías.
3. Mejorar los materiales de construcción.

La construcción de gasoductos tiene un fundamento sólido de seguridad. El Vía Verde de Puerto Rico utilizará los métodos y materiales más avanzados que existen en el mercado actual y se regirá por los códigos del Departamento de Transportación Federal.

A continuación se discuten aspectos de seguridad, tales como: información pública, equipo adecuado, mantenimiento, monitoreo y calificación de empleados; los cuales se destacan como parte importante de la seguridad del proyecto. Estos aspectos se trabajan en conjunto para hacer de éste un proyecto viable y seguro para la salud, la seguridad y la propiedad del público en general.

5.11.1 Análisis de riesgos

Según las estadísticas del *Office of Pipeline Safety (OPS)*, las causas para incidentes y accidentes en las tuberías de gas natural, en orden de probabilidad de ocurrencia, son:

1. Corrosión

   - Externa
   - Interna

2. Daños por Excavación

   - Por operador
   - Por terceros

3. Falla del Material

   - Rotura de una línea afectada anteriormente
   - Vandalismo
   - Falla en el cuerpo de la tubería
   - Falla en componentes de la tubería, tales como: juntas, soldadura, roscas, uniones, etc.
   - Falla en sellos o empaquetadura de bombas

4. Daño por la Acción de Fuerzas Naturales

   - Movimiento de tierra, tales como: temblores o terremotos
   - Impacto por descarga eléctrica de rayos
   - Lluvias intensas/inundaciones
   - Cambios intensos en la temperatura del ambiente

5. Error Humano

   - Fuego o explosiones externas
   - Daños causados por otros equipos ajenos a excavaciones, tales como: impactos por carros o camiones
   - Operación incorrecta

6. Misceláneas/Desconocidas

De acuerdo a las causas mencionadas, se identifican los riesgos relacionados a la operación de tuberías de transmisión para gas natural. La siguiente Tabla incluye estos riesgos y las medidas preventivas para evitar o minimizar cada uno de los mismos. No obstante, antes de comenzar la construcción y operación de Vía Verde, el personal concernido de la AEE y sus contratistas participará en un ***Hazard and Operability Analysis*** **(HAZOP)**. Este HAZOP es una técnica estructurada en la que un grupo multidisciplinario realiza un estudio sistemático de los procesos relacionados con la operación de Vía Verde, de manera que al usar guías descubre como desvíos del diseño propuesto, de los procesos o del mantenimiento pueden ocurrir en los equipos, en las acciones o materiales y si las consecuencias de estas desviaciones pueden resultar en un peligro. Así se pueden identificar riesgos y se hacen recomendaciones para enmendar el diseño y los procedimientos asociados a la operación del sistema para mejorar la seguridad del mismo.

RIESGOS RELACIONADOS A LA OPERACIÓN DE LÍNEAS DE TRANSMISIÓN DE GAS NATURAL Y LAS MEDIDAS PREVENTIVAS PARA MINIMIZARLOS

RIESGO	MEDIDAS PREVENTIVAS	SECCIONES EN LAS QUE SE DESCRIBEN LAS MEDIDAS
Corrosión interna	• Selección de las especificaciones del material con el que se construirá la tubería. • Medidas para el control de la corrosión. • Inspecciones utilizando un PIG	Ver secciones c y d que aparecen a continuación
Corrosión externa	• Selección de las especificaciones del material con el que se construirá la tubería. • Medidas para el control de la corrosión. • Control de excavaciones que causan daños menores a la tubería.	Ver secciones c, d y h
Daños por excavación por operador	• Asegurarse de la calificación del operador. • Observar las precauciones para excavaciones. • Cotejo de marcadores de la tubería.	Ver secciones a, a, h, i, k y l

RIESGO	MEDIDAS PREVENTIVAS	SECCIONES EN LAS QUE SE DESCRIBEN LAS MEDIDAS
Daños por excavación por terceros	• Observar las precauciones para excavaciones. • Asegurarse de que existen los marcadores de la tubería. • Mantener educado al público sobre la localización de la tubería mediante un Programa de Información. • Realizar patrullaje. • Tipo de la tubería de acuerdo a la clase por localización.	Ver secciones a, b, h, k, l y m
Falla del material por rotura de una línea afectada anteriormente	• Realizar inspecciones y mantenimiento. • Prevención de daños por excavaciones	Ver secciones j, a, h, k y l
Falla del material por vandalismo	• Realizar inspecciones y mantenimiento • Programa de Información • Patrullaje y marcadores	Ver secciones j, a, h, k y l
Falla del material por falla en componentes de la tubería, tales como: juntas, soldadura, roscas, uniones, etc.	• Selección de las especificaciones de los demás componentes del material con el que se construirá el proyecto. • Realizar inspecciones y mantenimiento. • Asegurar la calidad de las soldaduras. • Prueba hidrostática. • Mantener presión óptima de operación mediante equipo de control de presión.	Ver secciones c, e, f, g y j
Falla del material por falla en sellos o empaquetadura de bombas	• Selección de las especificaciones de los demás componentes del material con el que se construirá el proyecto. • Realizar inspecciones y mantenimiento.	Ver secciones c y j

RIESGO	MEDIDAS PREVENTIVAS	SECCIONES EN LAS QUE SE DESCRIBEN LAS MEDIDAS
Daño por movimiento de tierra, tales como: temblores o terremotos	• Tomar en consideración el estudio geológico al diseñar la tubería. El estudio concluye que la falla geológica del área está inactiva. • Para áreas donde existe la posibilidad de terremotos se utiliza mayor grosor de la tubería, las válvulas aisladoras se colocan a menor distancia la una de la otra y se utilizan juntas de expansión.	Ver el informe del estudio geológico y las secciones c y e
Daño por impacto por descarga eléctrica de rayos	• Para el diseño de la tubería, en las áreas en que la misma quede expuesta a este riesgo, se tomarán en consideración los datos estadísticos de descargas eléctricas por rayos que tiene la AEE.	Ver las secciones c y e
Daño por lluvias intensas o inundaciones	• Se tomará en consideración la clasificación de zona inundable establecida por la Junta de Planificación y los proyectos de control de inundaciones para el diseño de la tubería.	Ver secciones c y e.
Error humano que cause fuego o explosiones cercanas a la tubería	• Prevención de daños a las líneas mediante Programa de Información, patrullaje y marcadores.	Ver secciones j, a, h, k y l
Error humano que cause daños por mal uso de otros equipos ajenos a excavaciones, tales como: impactos por carros o camiones	• Prevención de daños a las líneas mediante Programa de Información, patrullaje y marcadores.	Ver secciones j, a, h, k y l
Error humano por operación incorrecta	• Asegurarse de la calificación del operador.	Ver sección i

5.11.2 Medidas preventivas

a. Programa de información

Uno de los factores más importantes del Vía Verde es la seguridad. Mantener el público informado es vital para el éxito del proyecto. Es importante que el público se sienta confiado porque tiene conocimiento de los controles que se establecen, desde que se selecciona la alineación hasta que comienza la operación del proyecto. También es importante que estén educados con respecto a las acciones que pueden tomar para contribuir a mantener el proyecto operando de una manera segura. Para esto, la AEE implantará un plan de información pública en dos fases.

La primera fase se implantará antes y durante la construcción. Esta fase ya comenzó con visitas a los alcaldes de los trece municipios por donde cruza la alineación y a las agencias que tienen inherencia en el proyecto. El proyecto también se presentará en foros profesionales como el Colegio de Ingenieros, Cámara de Comercio, Asambleas Legislativas, etc. Se notificará con anticipación a los colindantes sobre las fechas en que se construirá en su área.

Antes de presentar el proyecto a las comunidades, se identificarán los líderes comunitarios y ambientalistas para organizar las reuniones informativas y el material se presentará de acuerdo a las características demográficas de las comunidades. Las charlas tienen como propósito:

1. Llevar información clara, concisa y correcta.
2. Conocer y responder a las preocupaciones de la comunidad.
3. Establecer un punto de contacto entre la comunidad y la AEE.

Además de las charlas, se utilizarán las emisoras de radio y periódicos locales y regionales para divulgar información.

La segunda fase del programa de información se llevará a cabo durante la operación del proyecto. Para esto, se desarrollará un plan escrito de información pública siguiendo las guías del Código de Regulaciones Federales, Título 49, Parte 192, Subparte L, *Operations*, Sección 616, *Public Awareness* y el *American Petroleum Institute, Public Awareness, Recommended Practice 1162* y de las disposiciones aplicables de la Ley de Planificación para Emergencias y Derecho a Saber de la Comunidad (*EPCRA*, en inglés).

El Plan estará dirigido a la siguiente audiencia:

1. Público – residentes y lugares donde se congregan personas tales como: negocios, escuelas, hospitales, prisiones, iglesias y otros lugares; donde la gente se congrega y que están cercanos a la servidumbre del peoyecto.
2. Personal municipal y estatal encargado de respuesta a emergencias.
3. Gobierno municipal.

4. Personal de la industria de construcción.

Este Plan de Información Pública tiene como metas:

1. Concienciar a las personas de la proximidad de una tubería de gas natural en su vecindario.
2. Informar riesgos asociados con escapes.
3. Informar las actividades del operador para prevenir accidentes.
4. Asesorar al público sobre cómo reconocer y responder a una emergencia relacionada con la tubería.
5. Asesorar al público sobre cómo pueden ayudar a prevenir accidentes reportando excavaciones, construcciones ilegales y actividad sospechosa en la servidumbre del proyecto.
6. Informar al público sobre cómo comunicarse con el operador para preguntas y comentarios con respecto a la seguridad de la tubería.

El programa de educación pública es proactivo. Los residentes en áreas cercanas al proyecto pueden llamar a los números que se establecerán para información pública. Se realizará una reunión anual con los residentes y otra con el personal de respuesta a emergencias y oficiales municipales.

b. Clase por localización

Los aspectos de seguridad se atienden desde que se comienza la evaluación preliminar de alineaciones. Una vez se determina la alineación final del proyecto y se estudia en detalle cada tramo, se establecen diferentes tipos de clasificaciones, de acuerdo a la localización, y según el Código de Regulaciones Federales, Título 49, Subparte A, Sección 192.5, *Class Location*. Esto quiere decir que los tramos de tubería se fabricarán con especificaciones diferentes, de acuerdo a la densidad poblacional. Los tramos que se utilizarán para cruces de carreteras o cuerpos de agua también tienen especificaciones diferentes en términos de grosor y revestimiento.

A continuación se definen las diferentes clasificaciones según el 49 CFR, 192.5:

Definición de una Unidad de Clase por Localización - área que se extiende 220 yardas (200 metros) a ambos lados del centro de línea de cualquier milla continua de tubería. (Cada unidad de vivienda en edificios multifamiliares se considera como un edificio separado.)

Clase por Localización 1

- Área a una distancia de la costa (*offshore*)
- Cualquier localización que tenga diez edificios o menos que sean ocupados por humanos.

Clase por Localización 2

- Localización que tiene más de diez edificios, pero menos de cuarenta y seis designados para ocupación humana.

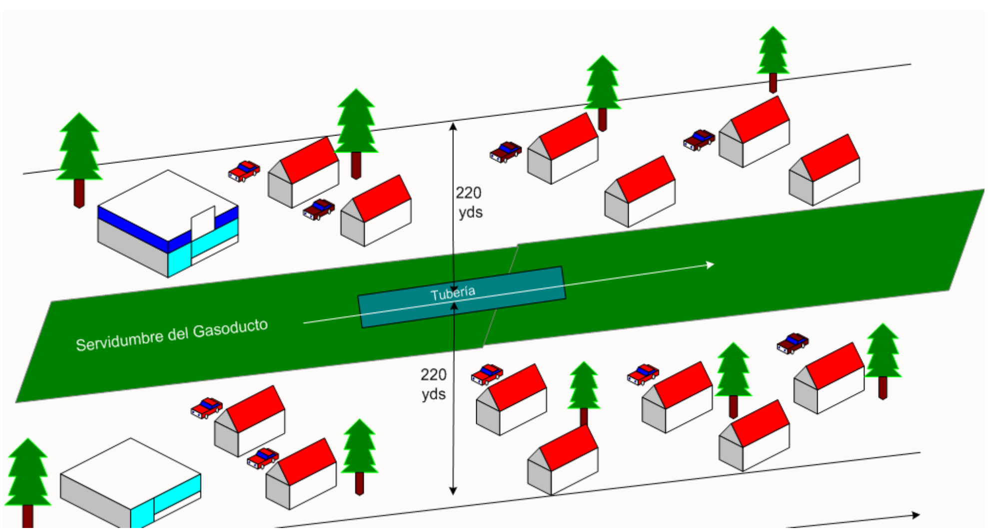
Clase por Localización 3

- Localización que tiene cuarenta y seis edificios o más designados para ocupación humana.

- Área donde la tubería está a 100 yardas (91 metros) de un edificio o de un área pequeña al aire libre que está bien definida (área de juego para niños, área recreativa, teatro al aire libre, u otro lugar donde se reúne público) y está ocupado por 20 personas o más, al menos 5 días a la semana por 10 semanas en cualquier período de 12 meses (los días y las semanas no tienen que ser consecutivos).

Clase por Localización 4

- Localización donde existen edificios de cuatro pisos o más.



Ejemplo de cómo se Calcula la Clase por Localización

Cambios de Clase por Localización

En ocasiones, la clase de algunos segmentos puede variar luego de que se instala la tubería, debido a que la densidad poblacional del área aumenta. Cuando esto ocurre, el Código de Regulaciones Federales, Título 49, Parte 192, Sección 609 *Change In*

Class Location: Required Study (49 CFR 192.609) requiere que se realice un estudio para determinar lo siguiente:

- Clasificación actual del segmento (clase 1, 2, 3, 4).
- El diseño, construcción y los procedimientos que se utilizaron para realizar las pruebas en la tubería y una comparación de esos procedimientos con los que requiere el cambio de clasificación.
- Condición física del segmento.
- Historial de operación y mantenimiento del segmento.
- Presión máxima de operación actual.
- El área específica afectada por el aumento poblacional y barreras físicas u otros factores que limitarían el crecimiento poblacional.
- *Hoop stress* - esfuerzo (*stress*) que actúa sobre la circunferencia de la tubería y es causado por la presión interna empujando contra la pared de la misma. A medida que la presión dentro de la tubería aumenta, este esfuerzo debe ser capaz de actuar contra esta presión para contenerla.
- *Yield strength* - nivel de esfuerzo (*stress*) donde el material comienza a deformarse permanentemente.

De acuerdo al 49 CFR 192.611, si el *hoop stress* que corresponde a la presión máxima de operación del segmento no corresponde al cambio de clasificación y el segmento está en condición satisfactoria, la presión máxima de operación permitida debe confirmarse o revisarse de acuerdo a uno de estos requisitos:

- Si el segmento se probó (prueba hidrostática) por no menos de 8 horas, la presión máxima de operación permitida es 0.8 veces la presión de prueba en localización Clase 2; 0.677 veces la presión de prueba en localización Clase 3; 0.555 veces la presión de prueba en localización Clase 4.
- La presión máxima de operación permitida debe reducirse para que el *hoop stress* correspondiente no sea mayor al permitido para segmentos nuevos de tubería en la localización existente.
- El segmento debe probarse de acuerdo a los requisitos del 49 CFR 192, Subparte J, *Test Requirements*, y la presión máxima de operación se establece de acuerdo a los siguientes criterios:
    - La presión máxima de operación permitida, luego de la prueba de recualificación, es 0.8 veces la presión de prueba en localización

Clase 2; 0.677 veces la presión de prueba en localización Clase 3; 0.555 veces la presión de prueba en localización Clase 4.

- El *hoop stress* correspondiente no puede exceder 72% del *yield strength* de la tubería en localización Clase 2; 60% del *yield strength* en localización Clase 3; ó 50% del *yield strength* en localización Clase 4.

- La presión máxima de operación confirmada o revisada no puede exceder la presión máxima permitida antes de la confirmación o revisión.

- Confirmación o revisión de la presión máxima permitida de acuerdo a los parámetros de esta subparte no releva al operador de aplicar lo establecido en el 49 CFR 192.553, *General Requirements* y 49 CFR 192.555, *Uprating to Pressures that Will Produce a Hoop Stress of 30% or more of SMYS (Specified Maximum Yield Strength) in Steel Pipelines.*

- La confirmación o revisión de la presión máxima de operación permitida tiene que completarse en veinticuatro meses del cambio de clasificación del segmento.

c. Especificaciones de la tubería

La tubería es el equipo más importante de este proyecto. El largo de vida de la tubería de Vía Verde es cincuenta años. La misma se diseñará utilizando los factores de diseño del 49 CFR 192.105, *Design Formula for Steel Pipe* y 49 CFR 192.111, 107, 113 y 115, *Design Factor for Steel Pipe, Yield Strength for Steel Pipe, Longitudinal Joint Factor for Steel Pipe y Temperature Derating Factor for Steel Pipe*. Todos los aspectos de diseño se incorporarán en una orden de compra y se contratará una compañía especializada en fabricación de tubería para transporte de gas natural, siguiendo el estándar 5L del *American Petroleum Institute* (API 5L) (ver Anejo 5.7, Especificaciones de la Tubería).

Una vez la compañía recibe la orden de compra, se asigna la fecha de comienzo de fabricación. Los representantes de la AEE pueden ir en cualquier momento a inspeccionar el proceso de fabricación. La AEE contratará un inspector para que evalúe el proceso de fabricación de principio a fin, por el tiempo que dure el mismo. Además, una vez que termina el proceso de fabricación, la compañía certificará que la tubería cumple con los requisitos del estándar API 5L y presentará todos los resultados de los análisis que se realizaron en la tubería. Entre las pruebas que se realizarán en la tubería están: análisis químico, pruebas de impacto, dureza, hidrostática y soldadura.

d. Control de corrosión

La corrosión es un factor importante que puede comprometer la integridad de la tubería. Para manejar este factor, se le aplicará un revestimiento externo a la tubería y tendrá protección catódica.

Para aplicar el revestimiento, la superficie de la tubería se limpia para remover aceites y grasas y se realiza una limpieza a presión con un abrasivo. Este método se utiliza para remover moho y otras impurezas. Luego de esto, la tubería se calienta pasándola por un campo magnético con corriente alterna de alta frecuencia y se le aplica el revestimiento (*epoxy*) en forma de polvo suspendido. Este polvo se adhiere a la superficie de la tubería, se derrite y forma una capa protectora sumamente resistente y duradera. Este revestimiento se conoce como *Fusion Bonded Epoxy* (FBE). A la tubería que se utilizará para atravesar cuerpos de agua y carreteras, se le aplicará un segundo revestimiento, *Tough Coat* sobre el FBE, para protegerlo cuando la tubería se hale de un lado a otro.

La protección catódica se instalará según el 49 CFR 192.463, *External Corrosion Control: Cathodic Protection*. En este tipo de protección se utilizan rectificadores para mantener un voltaje de -0.85 voltios, aproximadamente, en la tubería. Esto previene la corrosión de la tubería. La tubería se evaluará una vez al año, sin exceder quince meses, para asegurarse de que la protección catódica cumple con los requisitos establecidos en el 49 CFR 192.43. Para monitorear el voltaje, se instalarán estaciones de monitoreo, según el 49 CFR 192.469, *External Corrosion Control, Test Stations,* para cotejar el funcionamiento de los rectificadores. Los rectificadores se inspeccionarán seis veces al año. Los intervalos de inspección no deben exceder 2 ½ meses.

Durante la operación, el interior de la tubería se inspecciona utilizando un PIG. Esto es una herramienta que recorre el largo de la tubería y utiliza métodos no destructivos para identificar y documentar defectos y anomalías en la tubería.

e. Soldadura

Se estima que EcoEléctrica enviará el gas natural a una presión de 650 libras por pulgada cuadrada (psi). La tubería se diseñará para tolerar esta presión. La soldadura de las diferentes secciones también tolerará esta presión. Para controlar la calidad de la soldadura, la primera etapa es la selección de los soldadores. Éstos se cualifican antes de que comience el proyecto. Los soldadores deben completar una serie de soldaduras utilizando el mismo tipo de tubería y soldadura que se utilizará en el proyecto. Cada soldadura se evalúa midiendo la fuerza que se necesita para romperla (método destructivo).

Aunque la reglamentación no lo requiere, la práctica de la industria en Estados Unidos es asignarles un número de identificación a los soldadores que cualifican para el trabajo. Este número debe aparecer al lado de cada soldadura que realizan en el proyecto. De esta manera, si se detectan irregularidades en la soldadura durante la prueba de rayos X, o ésta falla durante la prueba hidrostática, se identifica inmediatamente al soldador y se remueve del trabajo. Antes de volver a trabajar en el proyecto, éste tiene que pasar las pruebas requeridas nuevamente. La AEE requerirá número de identificación para todos los soldadores que trabajen en Vía Verde.

La segunda etapa para establecer control de calidad es el uso de inspección visual y de rayos X para detectar fallas en la soldadura. La inspección visual la realiza un inspector con experiencia específica en el tipo de soldadura. Los técnicos de rayos X toman las lecturas en el campo y procesan las películas en un cuarto oscuro portátil. Si se detectan fallas, la soldadura se repara o se corta y se hace una nueva soldadura.

El 49 CFR 192. 243, *Non Destructive Testing*, requiere que se hagan pruebas de rayos X a un 10% de las soldaduras en localizaciones Clase 1, 15% para las localizaciones Clase 2 y 100% para localizaciones Clase 3 y 4. Luego de que se suelda y se inspeccionan las soldaduras, se cubren los extremos con un revestimiento protector. La tubería trae un revestimiento protector de fábrica, pero los extremos se dejan sin proteger para que el revestimiento no interfiera con la soldadura.

f. Prueba hidrostática

Cuando se termina la soldadura, la tubería se coloca en la trinchera y se cubre con tierra antes de realizar la prueba hidrostática. El propósito de la prueba es detectar cualquier defecto que amenace la habilidad de la tubería de tolerar la presión máxima de operación para la cual se diseñó, o para determinar que no existen defectos que comprometan la integridad de la misma. Esto incluye defectos en la soldadura.

La prueba hidrostática se puede realizar en toda la tubería o la misma se puede dividir en tramos. Esto lo determina el contratista de acuerdo a la cantidad de agua disponible y a la topografía del terreno. Una vez se coloca la tubería en la trinchera y se cubre, se llena de agua y se aplica una presión de prueba superior a la presión de operación permitida (MAOP). La presión de prueba es 1.1 veces la MAOP en espacios abiertos, 1.25 veces la MAOP en localizaciones Clase 2 y 1.5 veces la MAOP en localizaciones Clase 3. Esta presión se deja estabilizar por 8 horas. La prueba ayuda a localizar áreas en la tubería (incluye la soldadura) que no pueden tolerar presiones elevadas y por consiguiente fallan.

g. Equipos de Control de Presión, Válvulas Aisladoras

Debido a la importancia de prevenir accidentes por exceso de presión en las tuberías, se establecieron estándares nacionales que requieren que las tuberías incluyan equipo de monitoreo y protección contra presiones elevadas. Además, es necesario instalar válvulas para aislar tramos de la tubería en caso de accidentes o para realizar inspecciones o reparaciones.

Ejemplos de controles para la presión son:

- La presión del gas que sale de EcoEléctrica es 650 psi y la controla la presión de la bomba de gas natural líquido de EcoEléctrica.
- En los metros de flujo de gas habrá válvulas para controlar la presión de entrada a las turbinas.

- No se utilizarán válvulas aliviadoras de presión, ya que la presión máxima de operación de los equipos que se instalarán es mayor a la presión de salida de EcoEléctrica.
- Las válvulas aisladoras se colocarán en intervalos según lo requiere la reglamentación de DOT aplicable, en función de la Clase por Localización. En caso de emergencias, o para realizar reparaciones, las válvulas se cierran para aislar el tramo afectado del resto de la tubería.

h. Precauciones para Excavaciones

Uno de los mayores riesgos a la integridad de la tubería de gas natural es daño accidental a la tubería o al revestimiento por actividades de excavación. Los daños pueden ser causados por actividades, tales como: mantenimiento de carreteras, construcción general y actividades agrícolas. Aunque la AEE va a instalar marcadores de línea, éstos no enseñan la localización precisa de la tubería (sólo la localización general), ya que ésta no sigue una línea recta.

Las excavaciones pueden causar daño al revestimiento externo de la tubería, lo cual acelera el proceso de corrosión, y también pueden averiar la tubería y provocar situaciones que amenazan la vida y la propiedad.

Antes de excavar, toda persona debe comunicarse a la CSP o a la Oficina de Gerencia de Permisos, según sea aplicable, y ésta a su vez se comunica con el operador para que éste marque la alineación correcta de la tubería. Además, la AEE trabajará en conjunto con los municipios para establecer un mecanismo de control de excavaciones en áreas donde puedan afectar la tubería. Una vez se marque la alineación de la tubería, la AEE asignará un inspector para que esté presente por la duración de la excavación.

Si la tubería se avería durante una excavación, el personal debe abandonar el área inmediatamente. En coordinación con el inspector, se notificará al operador y los oficiales de respuestas a emergencias y hasta donde sea posible, se informará a otros y se mantendrá el tráfico y las personas fuera del área (contrario a la dirección del viento).

Cualquier contacto con la tubería durante una excavación, aunque no haya evidencia visible de daños, o sólo se causen pequeños rasguños, debe informarse al operador para que éste pueda hacer la inspección necesaria y tomar las acciones correspondientes y documentar el incidente. Daños superficiales que no se atienden pueden causar un problema de corrosión externa.

i. Calificación del operador

En ocasiones, acciones incorrectas del operador (error humano) pueden resultar en fallas en la tubería que ocasionan accidentes serios. Las investigaciones de este tipo de accidente por el *National Transportation Safety Board* resultaron en recomendaciones para la calificación formal del personal que realiza tareas que se relacionan con la seguridad de la tubería.

Como consecuencia de estas recomendaciones, el *OPS* publicó el *Operator Qualification Rule*, el 27 de agosto de 1999. Esta regla requiere que el operador establezca un programa formal de calificación de personal.

El programa de calificación de operadores requiere que el personal encargado de tareas relacionadas con la seguridad tenga el conocimiento y las destrezas necesarias para realizar su trabajo apropiadamente, y que puedan reconocer y reaccionar adecuadamente ante condiciones de operación que están fuera de los parámetros establecidos y que pueden resultar en accidentes. Este requisito también aplica a personal contratado por el operador. Además, se requiere que el personal de operación cumpla con las disposiciones del Reglamento del Programa de Pruebas para la Detección de Sustancias Controladas en Funcionarios y Empleados de la AEE.

Para asegurarse de que el operador cumple con estos requisitos de ley, el *OPS* desarrolló una serie de protocolos de inspección para uso de inspectores federales y estatales. Todos los inspectores tienen que adiestrarse y pasar pruebas de los protocolos y el proceso de inspección. Las inspecciones se realizan en el Programa de Calificación de Empleados (escrito) del operador, y en la implantación de este programa en el campo. Los resultados de la inspección se envían a un banco de datos.

El programa de calificación de personal se realizará según el 49 CFR 192.805, *Qualification Program.* Como Vía Verde es una tubería nueva y la AEE es un operador nuevo, tiene que comenzar con el plan de calificación antes de que la tubería comience a operar. Se contratará a una firma especializada para que desarrolle el plan escrito y califique a los empleados, según el reglamento. En términos generales, el programa debe ser escrito y discutir los siguientes parámetros:

- Identificar las tareas cubiertas por el plan.
- Proveer adiestramiento apropiado para asegurarse que los empleados que realizan las tareas cubiertas tienen el conocimiento y las destrezas necesarias para realizarlas de manera que aseguren una operación segura de la tubería.
- Asegurarse, por la evaluación, de que los empleados que realizan las tareas cubiertas están debidamente calificados.
- Permite que un empleado que no está calificado de acuerdo al reglamento, realice una tarea cubierta, si es observado por personal calificado.
- Evaluar un empleado, si el operador entiende que el desempeño de éste contribuyó a un accidente.
- Evaluar al empleado calificado, si el operador entiende que éste ya no está calificado para realizar la tarea.
- Comunicar cambios que afectan las tareas cubiertas a los empleados que realizan las tareas.

- Identificar las tareas cubiertas y el intervalo de evaluación de los empleados que las realizan.

El operador debe mantener documentación según el 49 CFR 192.807, *Recordkeeping*, para demostrar cumplimiento con el plan escrito. Esta documentación debe incluir lo siguiente:

- Identificar personal calificado.
- Identificar tareas cubiertas que el empleado esté calificado para realizar.
- Fecha de calificación/recalificación.
- Método de calificación - examen oral, escrito, desempeño, simulación, adiestramiento en el trabajo y otros.

j. Distancias de Despejo de la Tubería

La reglamentación de seguridad que aplica a las tuberías de transmisión de gas natural, tanto federal como estatal, no dispone requisitos mínimos de distancia entre la tubería y edificios ocupados o viviendas. No obstante, Vía Verde guardará una distancia de 150 pies a cada lado del centro de la alineación, respecto a residencias. En esta zona no se permitirá la construcción de nuevas estructuras. De esta manera se asegura que exista una distancia mínima de 150 pies entre cualquier residencia y el centro de la tubería. Esta distancia de despejo de 150 pies se seleccionó de acuerdo al estudio de Mark J. Stephens sobre *A Model for Sizing High Consequence Areas Associated with Natural Gas Pipelines* (Octubre de 2000)[2]. Este estudio desarrolla la fórmula que luego fue adoptada por la reglamentación federal para calcular el concepto del *Potential Impact Radius* (PIR). Este PIR se usa para identificar áreas de alta consecuencia. Las áreas de alta consecuencia son aquellas donde una falla de la tubería pudiera tener consecuencias para la propiedad y la vida. No obstante, Stephens, al utilizar datos de accidentes para validar su fórmula, concluye que la fórmula da un resultado conservador, ya que el radio calculado es siempre mayor al daño observado realmente. De este modo se ejecuta un mantenimiento más agresivo a los tramos de la tubería que caen dentro de las áreas de alta consecuencia y se preparan planes de emergencia que salvaguardan la seguridad de las personas dentro de esas áreas. En el caso de Vía Verde el PIR viene a ser de 422 pies. No obstante, de acuerdo a la validación que el autor hace de la fórmula que propone, las consecuencias graves o fatales que pueden ocurrir en caso de una falla para una tubería similar a Vía Verde alcanzan los primeros 150 pies. Es por esto que, a pesar de que la reglamentación no dispone requisitos mínimos de distancia entre la tubería y edificios ocupados y viviendas, la AEE adoptó el criterio de mantener una distancia de despejo de 150 pies.

Estas distancias de despejo son distintas a la servidumbre del proyecto (150 pies). Sólo la servidumbre de construcción y la de operación serán las impactadas con el proceso de construcción. La distancia restante hasta estas residencias dentro de los

[2] Marx Stephens

150 pies del centro de la tubería no será impactada por la construcción ni la operación de Vía Verde. Las tuberías soterradas deben tener distancias de despejo, relativo a otros equipos soterrados que no formen parte del sistema de transmisión de gas natural, de un mínimo de 12 pulgadas (49 CFR 192.325). En este proyecto se mantendrán distancias mínimas de despejo de 24 pulgadas, aproximadamente, respecto a otros equipos soterrados.

k. Inspección y mantenimiento

Vía Verde es una tubería de transmisión de gas natural. Según el 49 CFR 192.905, todo operador de tuberías de transmisión de gas natural tiene que identificar las Áreas de Alta Consecuencia (AAC). Para todo tramo de tubería que se encuentre dentro de AAC, el operador tiene que desarrollar e implementar un **Programa para el Manejo de la Integridad de la Tubería** que contenga todos los elementos descritos en el 49 CFR 192.911 y que a la misma vez, discuta los riesgos específicos para cada tramo de la tubería.

Los elementos que formarán parte del **Programa para el Manejo de la Integridad de la Tubería,** que se encuentran reglamentados por el 49 CFR 192 y el ASME/ANSIB31.85, son:

(a) Identificación de las AAC, de acuerdo a §192.905. Esta sección define las AAC de la siguiente manera:

- Localización de clase 3 y 4.
- Cualquier área en Localización de Clase 1 ó 2 donde el radio de impacto potencial es mayor de 660 pies (200 metros) y el área dentro del círculo de impacto potencial tiene 20 edificios o más para ocupación humana.
- Cualquier área en Localización de Clase 1 ó 2 donde el círculo de impacto potencial contiene un sitio identificado (*identified site*).

Sitio identificado - Se define de la siguiente manera según el 49 CFR 192.903:

- Un área al aire libre o una estructura que es ocupada por personas al menos 50 días en cualquier período de 12 meses. Los días no tienen que ser consecutivos. Ejemplos son: playas, áreas de juego de niños, facilidades recreativas, áreas de acampar, teatros al aire libre, estadios, facilidades religiosas.
- Un edificio ocupado por 20 personas o más al menos 5 días a la semana por 10 semanas en cualquier periodo de 12 meses. Los días de la semana no tienen que ser consecutivos. Ejemplos son: facilidades religiosas, edificios de oficinas, centros comunitarios, tiendas.
- Una facilidad ocupada por personas que están confinadas, o tienen problemas de movilidad o son difíciles de desalojar. Ejemplos son: hospitales, prisiones, escuelas, casas de jubilados.

De acuerdo al estudio de Clases por Localización se encontró que 44.13 millas son Clase 1, 17.19 millas son Clase 2 y 27.78 millas son Clase 3. Vía Verde no tiene áreas de Clase 4. Por lo tanto, Vía Verde sólo tiene 27.78 millas que caen bajo la clasificación de AAC, salvo la presencia de algún sitio identificado en áreas con Clase 1 ó 2 en el Anejo 5.1 *Class Location Study Report*.

(b) Desarrollar un plan para un estudio base, que cumpla con los requisitos del 49 CFR 192.919 y 49 CFR 192.921. Esto incluye lo siguiente:

- Identificación de riesgos potenciales para cada tramo de tubería y la información que respalda esa evaluación. Estos riesgos se considerarán en la redacción del Plan de Respuestas a Emergencias.
- Señalar los métodos seleccionados para evaluar la integridad de la tubería, incluyendo una explicación de por qué se seleccionó el método, y cómo el mismo se relaciona a los riesgos del tramo.
- Un itinerario para completar la evaluación de integridad para cada tramo de la tubería.

La evaluación se hará por métodos de inspección interna, de prueba de presión, evaluación directa de riesgos, tales como corrosión o mediante otro método que el operador sea capaz de demostrar que será igualmente efectivo para determinar la integridad de la tubería. En el caso de tuberías de instalación reciente, como lo será Vía Verde, el operador tiene hasta diez años desde la fecha de instalación para completar el estudio base o, en la alternativa, puede realizar una prueba hidrostática a la tubería, antes de ponerla en operación. A Vía Verde se le hará la prueba hidrostática antes de comenzar la operación.

(c) Identificación de los riesgos específicos de cada tramo de tubería, para establecer prioridades en cuanto a los tramos de tubería que ameriten mayores medidas de mitigación.

(d) Un plan de evaluación directa de la tubería de acuerdo al riesgo identificado para el tramo.

(e) Medidas de mitigación de los riesgos identificados.

(f) Un proceso de evaluación continua de acuerdo a la §192.937.

(g) Forma en que se mantendrá la documentación, de acuerdo a la §192.947.

(h) Un proceso para manejo de cambios, según el ASME/ANSI B31.8S, sección 11.

(i) Un proceso de confiabilidad de calidad, según el ASME/ANSI B31.8S, sección 12.

(j) Un plan de comunicación que incluya los elementos del ASME/ANSI B31.8S, sección 10, y que incluya procedimientos para atender preocupaciones señaladas por la *OPS* y por la CSP.

(k) Procedimientos que aseguren que las evaluaciones de integridad se realizan de una forma segura para el ambiente y en cumplimiento con los reglamentos ambientales aplicables.

(l) Un proceso para la identificación y evaluación de nuevas Áreas de Alta Consecuencia (AAC).

La AEE contratará personal con experiencia para evaluar las AAC y redactar el Plan.

Además, se preparará un Plan de Inspección y Mantenimiento que cubrirá la tubería, metros de flujo, válvulas y otros equipos. La inspección de los equipos se realizará según las recomendaciones del manufacturero. Copias de este Plan se mantendrán en cada una de las centrales a las que llegue el gas natural y en la terminal de EcoEléctrica.

El Plan incluirá información relevante sobre la tubería como:

- Localización (municipios y millas que cubre)
- Tipo
- Tamaño (diámetro interno)
- Edad
- Manufacturero
- Método de construcción
- Condición de la tubería
- Tipo de material que transporta
- Volumen que transporta
- Presión máxima de operación
- Condiciones climáticas, sísmicas y geológicas, y características de los suelos en la alineación de la tubería.
- Densidad poblacional y características demográficas en la alineación de la tubería. Incluye proyección de crecimiento.

Además, se mantendrá expediente de las siguientes actividades, según el 49 CFR 192.709, *Recordkeeping:*

- Día, localización y descripción de cada reparación realizada a la tubería (por tramo). Este expediente se mantendrá por el tiempo que la tubería esté en servicio.

- Día, localización y descripción de cada reparación que se haga a otras partes del sistema. Esta información debe mantenerse por cinco años, según el reglamento, pero la AEE la mantendrá por el tiempo que la tubería esté en servicio.

- Récord de patrullajes, inspecciones y pruebas. Esta información debe mantenerse por cinco años, según el reglamento, pero la AEE la mantendrá por el tiempo que la tubería esté en servicio.

l. Patrullaje

La AEE establecerá un programa de patrullaje para observar condiciones en la servidumbre que puedan afectar la integridad de la tubería. Esto incluye actividades de excavación, construcción y de siembra. También se observará para evidencia de escapes. La frecuencia del patrullaje se determina de acuerdo al tamaño de la tubería, presión de operación, topografía, condiciones del tiempo y otros factores de relevancia. La frecuencia no será menor a lo establecido en el 49 CFR, Parte 192, Subparte M, Sección 705, *Transmission Lines: Patrolling*. A continuación se muestran los intervalos recomendados:

Vía Verde de Puerto Rico Intervalo Máximo entre Patrullajes		
Clase por Localización	**En Cruces de Autopistas y Trenes**	**En Todo Otro Lugar**
1 & 2	7 ½ meses; pero al menos 2 veces al año	15 meses; pero al menos una vez al año
3	4 ½ meses; pero al menos 4 veces al año	7 ½ meses; pero al menos 2 veces al año
4	4 ½ meses; pero al menos 4 veces al año	4 ½ meses; pero al menos 4 veces al año

Los métodos de patrullaje que utilizará la AEE serán: caminar, guiar y vuelos en helicóptero.

m. Marcadores

Una vez se construya la línea, se colocarán marcadores a través del trayecto de 92 millas para alertar al público sobre la presencia de la misma. El 49 CFR, Parte 192, Subparte M, Sección 707, *Line Markers for Mains and Transmission Lines*, establece que se colocarán marcadores de la siguiente manera:

- Tubería soterrada en cruces de carreteras o trenes – sobre la tubería o lo más cerca posible.
- Cuando sea necesario para reducir la posibilidad de interferencia o con daño a la tubería.
- Aviso – el aviso “Peligro Gas Natural” con el nombre del operador, su número de teléfono y el aviso de que toda excavación tendrá que ser coordinada con el

811, aparecerá en los marcadores de línea. Éstos se harán en inglés y español.

5.11.3 Planes de respuestas a emergencias

La reglamentación federal, que se adoptó en Puerto Rico por la Comisión de Servicio Público, requiere que todo operador de un gasoducto establezca los procedimientos para minimizar los riesgos que surjan durante una emergencia con una tubería de gas (49 CFR 192.615). Entre las posibles emergencias se considerarán aquellas causadas por eventos sísmicos. Este plan deberá estar totalmente implantado y coordinado con las agencias para el manejo de emergencias antes de comenzar la operación del proyecto. El plan debe incluir, como mínimo, lo siguiente: el protocolo para recibir y procesar notificaciones que requieran atención inmediata por el operador; establecer y mantener los medios de comunicación efectivos entre el operador y las agencias para el manejo de emergencias; protocolo para la inmediata respuesta a distintos tipos de notificaciones, tales como escapes de gas, fuegos o explosiones cercanos a la tubería o desastres naturales; disponibilidad de personal, equipos, herramientas y materiales necesarios para responder a una emergencia; acciones dirigidas a proteger primero a las personas y luego a la propiedad; protocolo para cierre y bloqueo de la sección de la tubería que confronta una situación de emergencia; notificación a las agencias para el manejo de emergencias; cómo reponer el servicio de manera segura después de controlada la emergencia; protocolo para la investigación de la causa de la emergencia.

La AEE solicitó los comentarios de las agencias relacionadas al manejo de emergencias que pueden surgir por el uso de tuberías de gas natural. A estos efectos recibió comentarios del Cuerpo de Bomberos, de la Policía, de la Comisión de Servicio Público, Departamento de la Vivienda, Departamento de la Familia, Departamento de Salud y de la Agencia Estatal para el Manejo de Emergencias y Administración de Desastres, entre otras. Una vez se cuente con el diseño final de Vía Verde, la AEE comenzará a desarrollar el Plan de Emergencias en coordinación con las agencias antes mencionadas.

5.11.4 Datos de seguridad del gas natural

El gas natural no es tóxico, pero es un asfixiante simple. En áreas confinadas, el gas natural desplaza el oxígeno y no hay un suministro adecuado de oxígeno a los pulmones. Esto producirá mareos, respiración profunda debido a la necesidad de aire, posibles náuseas e inconsciencia si no se aleja la persona del área afectada. El metano no está clasificado como cancerígeno o potencialmente cancerígeno por NTP, IARC u OSHA Subparte Z.

En caso de sobre exposición al gas natural, se requiere atención médica inmediata en todos los casos. En caso de escapes, el personal de respuesta y de rescate debe tener el equipo de protección respiratoria adecuado; respirador auto contenido (SCBA), y deben tener los adiestramientos requeridos por ley (*HAZWOPER – Hazardous Waste Operations and Emergency Response* – 29 CFR 1910.120). Las personas que estén conscientes deben trasladarse a un área sin contaminación e inhalar oxígeno suplementario, si está disponible. Las personas inconscientes deben trasladarse a un área sin contaminación. Si no está respirando, dar resucitación boca a boca y oxígeno suplementario. El tratamiento posterior debe ser sintomático y de apoyo.

El gas natural forma mezclas explosivas o inflamables con la mayoría de los agentes oxidantes (oxígeno, cloro, flúor, etc.) y es inflamable en aire sólo entre un 5% y 15% de concentración. Sin embargo, el gas natural es más liviano que el aire, por lo que en áreas abiertas y con ventilación natural se escapa rápidamente a la atmósfera, haciendo difícil que alcance la concentración requerida para que se incendie en presencia de una chispa o llama. Aún cuando la tubería es soterrada, el gas penetra el terreno y escapa a la atmósfera. A pesar de que algunos terrenos pueden presentar características de poca permeabilidad, debido a la naturaleza de la molécula del gas metano, que es una molécula pequeña del orden de picometros, por lo que aún bajo ese tipo de terreno las moléculas encontrarán la forma de disiparse hacia la atmósfera.

Cuando ocurre un incendio, se cierra la fuente de gas y se aísla el segmento de tubería cerrando la válvula aisladora. El cierre de estas válvulas se hace de manera remota y automática, una vez los detectores de presión y de flujo de masa registran algún cambio que sea indicativo de un escape en algún punto de la tubería. Todo este proceso está controlado de forma remota por un nuevo e independiente sistema de SCADA (*Supervisory Control and Data Acquisition),* que estará localizado en Monacillos y con un segundo centro redundante en Costa Sur. Desde una distancia segura, se utiliza agua para enfriar las tuberías y equipos adyacentes hasta que el fuego sea extinguido. Este trabajo lo realiza el Cuerpo de Bomberos. Tanto el modo de responder el Cuerpo de Bomberos, como otras medidas necesarias para responder a una emergencia con Vía Verde, estarán incluidas en el Plan de Respuestas a Emergencias que por requisito de ley debe estar listo e implantado antes de comenzar la operación del sistema. Este plan incluye los equipos y adiestramientos que son requeridos para todo el personal que participará en la respuesta a la emergencia.

La respuesta a un escape incluye el desalojo de todo el personal del área afectada, incrementar la ventilación en el área de la fuga (si es espacio confinado). Se debe usar un explosímetro calibrado para monitorear la concentración del gas. El personal de respuesta a emergencias debe utilizar equipo de protección apropiado (equipo de protección autónomo y ropa resistente al fuego). Nunca se debe entrar a un área donde la concentración del gas sea mayor al 1%, lo que es el 20% del límite inferior de inflamabilidad (5%). Estos datos aplican mayormente en áreas confinadas. Cualquier escape de gas de Vía Verde se disipará directamente a la atmósfera. (Ver *Material Safety Data Sheet* que se incluye a continuación.)

MATERIAL SAFETY DATA SHEET - NATURAL GAS

1. SUPPLIER

ATCO Gas 10035 – 105 Street Edmonton, Alberta T5J 2V6 1-800-511-3447 (toll-free) for information	**Emergency Telephone : (24 –hr)** CANUTEC: 1-613-996-6666 (Call Collect)

2. PRODUCT IDENTIFICATION

Manufacturer	Not applicable (natural gas is a naturally occurring product)
Trade Name	Natural Gas
Chemical Name	Methane
Synonyms	Natural Gas/high Methane content
Chemical Family	Alkanes
Molecular Formula	CH_4 (Methane)
Product Use	Natural Gas is used primarily for space and water heating and for industrial processing applications
Method of Transport	Pipeline (under pressure) or high pressure cylinders attached to mobile vehicles

Transportation of Dangerous Goods Regulations

UN 1971; Class 2.1	**Shipping Name and Description: METHANE, COMPRESSED**
WHMIS Classification	**Compressed Gas (Class A)** **Flammable Gas (Class B1)**

3. HAZARDOUS COMPONENTS (See Note, Section 11)

Components	**% by Volume**	**Occupational Exposure Information**
Methane	95	Asphyxiant if breathed in place of air (refer to Section 6)
Ethane & Heavier Hydrocarbons	2	Asphyxiant if breathed in place of air (refer to Section 6)
Nitrogen	2	Asphyxiant if breathed in place of air (refer to Section 6)
Carbon Dioxide	1	Asphyxiant if breathed in place of air (refer to Section 6)
Sulphur Compounds	Trace amounts (varies in odourized gas)	

4. PHYSICAL DATA (See Note, Section 11)

Appearance and Odour	Colourless gas at room temperature and pressure Odourless unless odourized with Mercaptan (skunky smell)
Boiling Point (degrees Celsius)	-161.5°C (as Methane)
Vapour Pressure	Gaseous state at normal conditions
Freezing Point	-182.5°C
Percent Volatile (by volume)	100%
Vapour Density in Air (gaseous specific gravity)	0.584 to 0.610
Solubility in Water	0.0022% (as Methane)
Evaporation Rate	N/A

5. FIRE AND EXPLOSION HAZARD DATA (See Note, Section 11)

Flammability	In the presence of oxygen
Flammability Limits (percent in air)	4% - 14%
Fire Extinguishing Media	Dry Chemical (most effective) or carbon dioxide (CO_2) or Halon
Ignition Temperature	Approximately 630°C (varies with temperature pressure and oxygen concentration)
OR	
Auto Ignition Temperature in Air	Range 482°C - 649°C
Special Fire Fighting Procedures	Control release by limiting or shutting off source utilizing pipeline control valves Evacuate area Keep up wind of fire
Unusual Fire and Explosion Hazards	Could be potentially hazardous if uncontrolled in a confined space

NOTE: Natural Gas is lighter than air and will dissipate to atmosphere. Natural Gas **without sufficient** or **with too much** air will not burn or explode. A hazard from re-ignition or explosion exists if the flame is extinguished without stopping the flow of gas and/or cooling surroundings and eliminating ignition sources. Water spray can be used to cool the surroundings.

6. HEALTH HAZARD DATA

Effects of Overexposure	Acts as an asphyxiant by displacing oxygen in the air Displacement of air by the gas may lead to shortness of breath, unconsciousness, and death from hypoxemia. Incomplete combustion may produce carbon monoxide and aldehydes.
Emergency and First Aid Procedures	Do not enter a contaminated area unless properly protected (refer to Section 9) Stop flow of gas Move victim to uncontaminated area Supply fresh air, oxygen Perform artificial respiration if necessary Contact a physician

7. REACTIVITY DATA

Stability	Natural Gas/Methane is stable
Conditions to Avoid	Uncontrolled explosive mixtures Open flame and spark source Strong oxidants
Incompatibility	Natural Gas readily mixes with air when released and creates a combustible atmosphere. Some other strong oxidizing agents with which it can burn or explode in confined areas are: chlorine, bromine pentafluoride, oxygen difluoride and nitrogen trifluoride. It will ignite spontaneously when mixed with chlorine dioxide.
Hazardous Polymerization	May not occur
Hazardous Decomposition Products	CO_2, trace amounts of oxides of sulphur and nitrogen (SO_2 and NO_X) CO if starved of oxygen during combustion

8. SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Gas Leak/Line Break Occurs	Evacuate area Contact office emergency number for repair procedures Shut off source of ignition such as flame or electrical spark Shut off source of gas supply Increase ventilation Minor leaks can be detected with a soap solution applied at suspected leak points **NEVER USE AN OPEN FLAME TO DETECT LEAKS**
Suggested Disposal Method	Contact office emergency number

9. SPECIAL PROTECTION INFORMATION

Respiratory Protection	Positive pressure, self contained breathing apparatus (SCBA) or supplied air breathing apparatus (SABA) complete with egress unit, for emergency use Adequate ventilation required Adequate venting of possible combustion products required
Other Protective Equipment	CSA/ANSI Safety Equipment must be available and worn as required to protect ears, feet, hands, head, remaining body area

10. SPECIAL PRECAUTIONS

Precautions to be Taken	Avoid personal body contact (skin/eye contact, etc.) with high pressure gas stream
Other Precautions	Avoid all possible sources of accidental ignition (i.e., static electricity or any other explosive source) Test for hazardous concentrations prior to entering meter stations

11. PREPARATION DATE OF MSDS (September 24, 2008)

Prepared by: The Health and Safety Section of ATCO Gas
For further information or MSDS update requests, please contact Health and Safety at (780) 420-7953.

NOTE: The physical and hazard data provided is specific to the typical natural gas composition that has been provided. As a naturally occurring product, natural gas samples may have compositions that vary slightly from the typical composition. If required, the exact gas sample composition can be determined by gas chromatography analysis. For more information, contact ATCO Gas, Gas Specification Management at (403) 245-7591.

MATERIAL SAFETY DATA SHEET

SECTION I: PRODUCT IDENTIFICATION

NORTHWEST NATURAL GAS COMPANY
220 N.W. 2ND AVENUE
PORTLAND, OR 97209-3991

PRODUCT NAME: **NATURAL GAS**
MSDS DATE: November 7, 2002

EMERGENCY (24-HOUR) PHONE: [503]-226-4211, Ext. 4513.
CHIEF CHEMIST (GENERAL INFO, 8-5, Mon-Fri): Same, Ext. 4729.

TRADE NAME: Natural gas.

SYNONYMS: Pipeline gas, natural gas - dry.

SHIPPING NAME:
- [DOT] Flammable gas, UN1971 (if liquefied, UN1972).
- [ICC] Flammable gas, RED LABEL, limit 300 lb.
- [IATA] Flammable gas, RED LABEL.
  - CARGO: Limit 140 KG.
  - PASSENGER: NOT ACCEPTABLE.

NFPA RATING (Health-Flammability-Reactivity): 1 - 4 - 0 [GAS]. 3 - 4 - 0 [LIQUID].

CHEMICAL FAMILY: Paraffin (saturated) hydrocarbons and inert gases.

CHEMICAL FORMULA: Not applicable. Product is a mixture.

CHEMICAL ABSTRACTS SERVICE (CAS)#: 68410-63-9

SECTION II: COMPONENTS AND HAZARDS

COMPONENT	FORMULA	CAS NO.	VOL% (TYP.)	TLV (PPM)	DOT#
Methane	CH_4	74-82-8	93.5	N/A	UN1971
Ethane	C_2H_6	74-84-0	3.8	N/A	UN1035
Propane	C_3H_8	74-98-6	1.0	1,000	UN1978
i-Butane	C_4H_{10}	75-28-5	0.1	N/A	UN1969
n-Butane	C_4H_{10}	106-97-8	0.1	800	UN1011
i-Pentane	C_5H_{12}	78-78-4	<0.1	350	UN1265
n-Pentane	C_5H_{12}	109-66-0	< 0.1	600	UN1265
n-Hexane	C_6H_{14}	110-54-3	< 0.1	50	UN1208
Carbon Dioxide	CO_2	124-38-9	0.3	10,000 [OSHA]	UN1013
Nitrogen	N_2	7727-37-9	1.2	N/A	UN1066
t-Butyl Mercaptan	$C_4H_{10}S$	75-66-1	< 30 ppm	N/A	UN2347
Methyl Ethyl Sulfide	C_2H_6S	624-89-5	< 3 ppm	40,250	UN1993
Hydrogen Sulfide	H_2S	7783-06-4	< 5 ppm	10	UN1053

AQUATIC TOXICITY: Not applicable. Natural gas and LNG have low water-solubility.

SECTION III: PHYSICAL DATA

FREEZING POINT (760 mm Hg):		-182.6°C (-296.7°F)
BOILING POINT (760 mm Hg):		-161.5°C (-258.7°F)
GAS SPECIFIC GRAVITY	(air = 1.000):	0.55 - 0.64
LIQUID SPECIFIC GRAVITY	(H_2O = 1.000):	0.42 - 0.46
GAS DENSITY:	[varies slightly w. composition]	0.044 lb/cf
VAPOR PRESSURE:	Gaseous at 60°F, 1 atmosphere.	
SOLUBILITY IN WATER:	Less than 3.5 vol%. LIQUID pH: Not Applicable (not water-based)	
EVAPORATION RATE:	Normally a gas. Liquefied natural gas (LNG) evaporates much faster than diethyl ether.	

APPEARANCE AND ODOR:
GAS is extremely flammable, with no color, odor, or taste. If trace amounts of sulfur compounds are added as odorant, the gas has a characteristic garlic/rotten-egg/skunk odor.
LIQUID is clear, colorless, odorless, cryogenic (super-cold) and extremely flammable.

SECTION IV: FIRE AND EXPLOSION DATA

FLASH POINT	-306°F (-188°C)
AUTOIGNITION TEMPERATURE:	1,004°F (540°C)
FLAMMABLE LIMITS IN AIR:	[LEL] 4.8 vol% [UEL] 15.0 vol%
EXTINGUISHING MEDIA:	Class B: [Dry chemical, "Halon", CO_2].

SPECIAL FIREFIGHTING PROCEDURES: Remove unnecessary personnel. Fire crews should have supplied-air respirators. Try to remove ignition sources. Use non-sparking tools to shut off the gas. Let the fire burn itself out to stop a flammable mix from forming when the flame is extinguished. Natural gas is lighter than air and will vent upward. If the gas cannot be shut off, let it burn and cool the surrounding area with water fog. If natural gas is compressed in cylinders, use water fog to cool them. If LNG has spilled, dike the liquid using non-sparking tools and disperse the vapors with water fog. Keep leaking natural gas, LNG or its vapors out of sewers or other enclosed spaces.

UNUSUAL FIRE/EXPLOSION HAZARD: Extremely flammable. <u>NO SMOKING</u> where natural gas is in use. Keep public away in case of leak/spill. Notify local gas utility (see Section I) immediately, plus local fire department as needed.

SECTION V: HEALTH HAZARD INFORMATION

MIXTURE TLV: Not established by OSHA or ACGIH.

EFFECTS OF ACUTE OVEREXPOSURE:

INHALATION: At high pressures and high concentrations, may cause cardiac sensitization. At high concentrations and in enclosed areas, may displace sufficient oxygen to cause dizziness, headache, lack of muscular coordination, diminished mental alertness, cyanosis, narcosis, dyspnea, or death by asphyxiation.

SKIN CONTACT: Not toxic, non-irritating. At high pressure, gas may be injected under skin, causing pain, possible tissue damage or embolism. Contact with LNG may cause immediate, severe frostbite.

SKIN ABSORPTION: Unlikely: natural gas is lighter than air.

EYE CONTACT: Not toxic, non-irritating. Pressurized gas or an LNG splash may cause physical damage to unprotected eyes.

SWALLOWING: Unlikely exposure route for gaseous or liquid products.

EFFECTS OF CHRONIC EXPOSURE: None.

NOTE TO PHYSICIAN: See "Natural Gas and Its Physiological Action", in *California and Western Medicine*, V. **47**, #1. Light hydrocarbons (methane through butanes) are simple asphyxiants that displace O_2. CO_2 has health effects above 0.5 vol%. Nitrogen is inert.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Respiratory conditions such as emphysema may be aggravated by long exposure to high concentrations.

CARCINOGENS: None by NTP, IARC, or ACGIH.

SECTION VI: FIRST AID PROCEDURES

EYE: If physical damage occurs due to high-pressure gas release or an LNG splash, cover BOTH eyes with loose, bulky, sterile dressing and obtain immediate medical treatment.

SKIN: If gas is injected under skin, treat patient for shock and seek immediate medical treatment. If LNG has splashed skin, remove victim from contact, flush affected area with lukewarm water. Apply a loose, sterile, bulky dressing. Get immediate medical help.

INHALATION: Remove victim to fresh air quickly. Restore or support breathing as needed. Use mouth-to-mouth resuscitation or CPR as needed if asphyxiation has occurred. If available, have a trained person administer oxygen. Seek medical help immediately.

SECTION VII: REACTIVITY

STABILITY: Stable when contained and not exposed to oxidizers or heat.

CONDITIONS CAUSING INSTABILITY: Fire or other heat sources, frictional sparks, electrical arcing may cause ignition. Reacts explosively with Cl_2, BF_5, OF_2, NF_3, and ClO_2. On contact with liquid oxygen (LOX) or liquid fluorine (LF_2), LNG will explode.

TENDENCY TO POLYMERIZE: None.

CORROSIVENESS: None.

HAZARDOUS DECOMPOSITION PRODUCTS: CO, CO_2, partially-oxidized combustion products of hydrocarbons (aldehydes, acids, "soot").

SECTION VIII: DISPOSAL/LEAK PROCEDURE

If leak is from a gas line, notify appropriate safety personnel. Evacuate the area. Provide explosion-proof ventilation. Use non-sparking tools to shut off the gas flow ahead of the leak. If the leak is on the Gas Company side of the gas meter, call Northwest Natural Gas immediately at 503-226-4211, Ext.4513.

If leak is on a compressed-natural-gas cylinder, cautiously remove the cylinder to an isolated outside area or to an explosion-proof hood. Vent the gas at a slow, controlled rate. When empty, tag the defective cylinder and return it to the supplier.

If leak is from an LNG container, put on proper protective clothing and dike the liquid with dirt or other nonflammable absorbent. Use water fog to disperse the vapor cloud. Keep LNG or its vapors out of sewers or other enclosed spaces.

SECTION IX: SPECIAL PRECAUTIONS

Flame-retardant clothing, including leather or cotton gauntlet gloves, must be worn in any situation where pressurized natural gas or LNG vapors may ignite accidentally.

Wear goggles or a faceshield when working with any pressurized gases or LNG.

Use an explosion-proof oxygen [O_2] tester, NOT a combustible-gas detector, to check the atmosphere of any area that may be deficient in oxygen. If the oxygen reading is below 19%, use a SUPPLIED-AIR RESPIRATOR with a properly fitting face mask. Use the same type of respirator in trenches over four feet deep when a gas-air mix exists below the gas line. Using only a cartridge respirator in low-oxygen conditions may lead to asphyxiation.

Ground all equipment and houselines used in natural gas service to prevent the buildup of static and possible sparks. Where feasible, use non-sparking tools to work on and around natural gas lines and equipment.

Natural gas may be present in mains, services, houselines, or customers' equipment at pressures ranging from less than 1 psi to over 720 psi. Open and close gas valves slowly to avoid pressure surges that might cause personal injury or damage equipment.

Provide sufficient local exhaust to prevent gas buildup to 20% of LEL. Pressure-test natural gas houselines with inert gas before putting them into service for the first time, and again when taking them permanently out of service.

At least 48 hours prior to excavating in an area where gas lines are known or suspected to be, call Northwest Natural Gas [503-226-4211, Ext. 4513] for location and marking at the site. NOTE: Many communities have a one-call service that alerts all underground utilities (gas, power, telephone, TV cable, water, or sewer) to mark their lines. Check your telephone book for the local number.

If a gas line is damaged, IMMEDIATELY report the incident to Northwest Natural Gas [503-226-4211, Ext. 4513]. If the gas line is broken, evacuate the area and also call the local fire department. If a gas line has been bent or pulled out of alignment, other gas lines in the vicinity may have been damaged even if the pulled line looks intact.

If only the gas line's coating is damaged, it must still be inspected and properly repaired by the gas company before reburial, to prevent corrosion and possible leakage.

SECTION X: OTHER

ADDITIONAL REGULATORY CONCERNS:

CPSC: None
FDA: None
SARA: Title III, Sections 302, 304, 311, 312, and 313.
TSCA: None
USDA: None
OTHER FEDERAL: Department of Transportation, Office of Pipeline Safety, CFR Title 49, Parts191-192, with all revisions.
OTHER STATE: None in either Oregon or Washington.

DISCLAIMER: The data contained in this MSDS are believed to be accurate, but are not so warranted, whether or not they originated at Northwest Natural Gas Company. Recipients of this MSDS are advised to confirm ahead of time that the data are current and suitable to their needs.

SIGNED:______________________________ TITLE: CHIEF CHEMIST
(W. T. Amies)

DATE: 11/07/02

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.

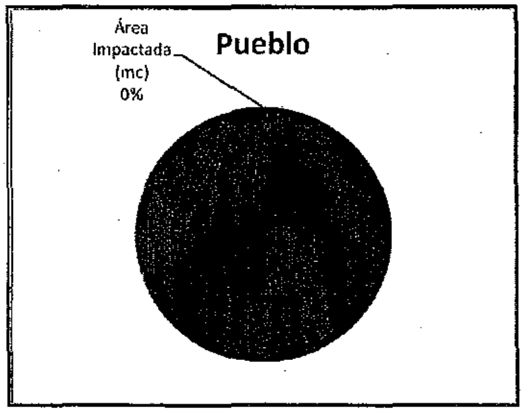
- Areas near the project's site will be reforested in a proportion of 3:1 per affected individual. This will be done in coordination with the concerned agencies and in strict compliance with the applicable regulations. In terms of its location, the mitigation will be of two kinds: *in situ* and by acquisition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

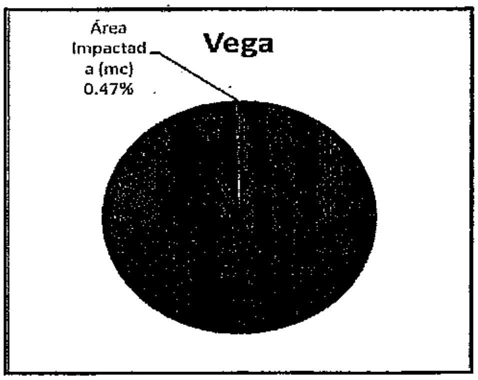
To avoid causing an impact on these forests, the design of the alignment was varied in such a manner that:

- 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.

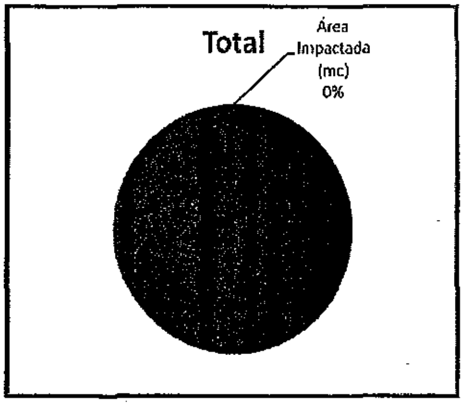
- Bosque Vega is the only forest that will receive a direct impact with this project. This reserve is fragmented in six portions. Vía Verde will impact one of them. However, the impact will be minimal. The total area of this forest is 1.85 square miles (4,791,480 square meters). The portion that will 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.

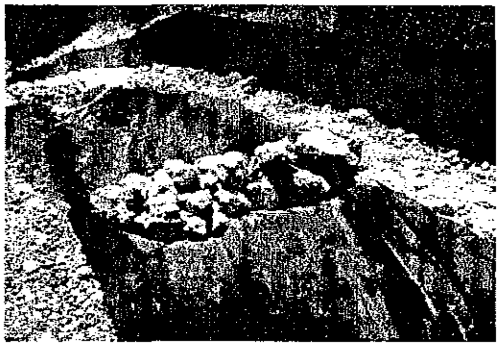
- The bodies of water that could be affected by the construction will be identified to protect them.

- 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

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.

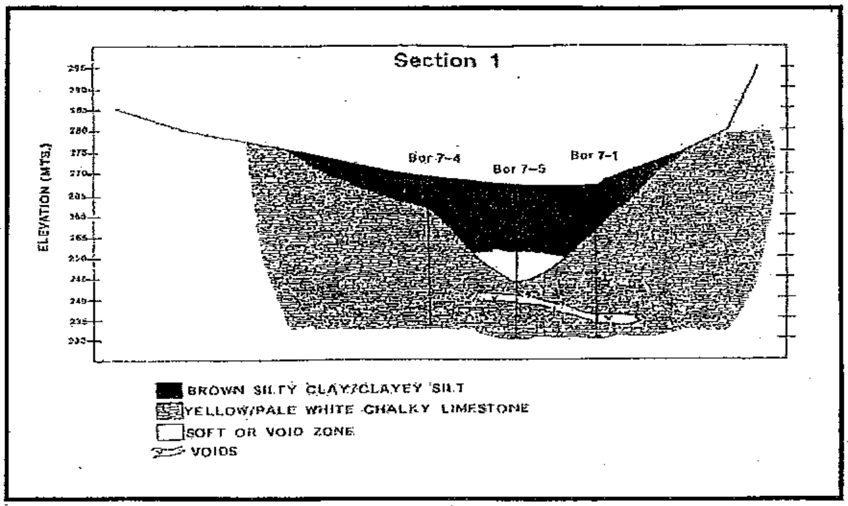


Figure 1 - Example of the interpretation of a sinkhole with geotechnics and geophysics.
1983 to 1990. (Rodríguez & Vázquez - 1999)

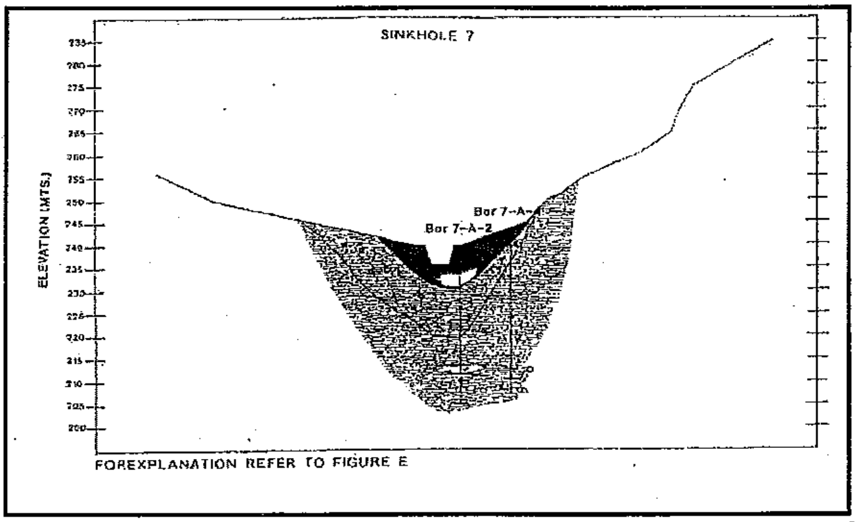


Figure 2 - Example of the interpretation of a sinkhole with geotechnics and geophysics.
1983 to 1990 (Rodríguez & Vázquez - 1999)

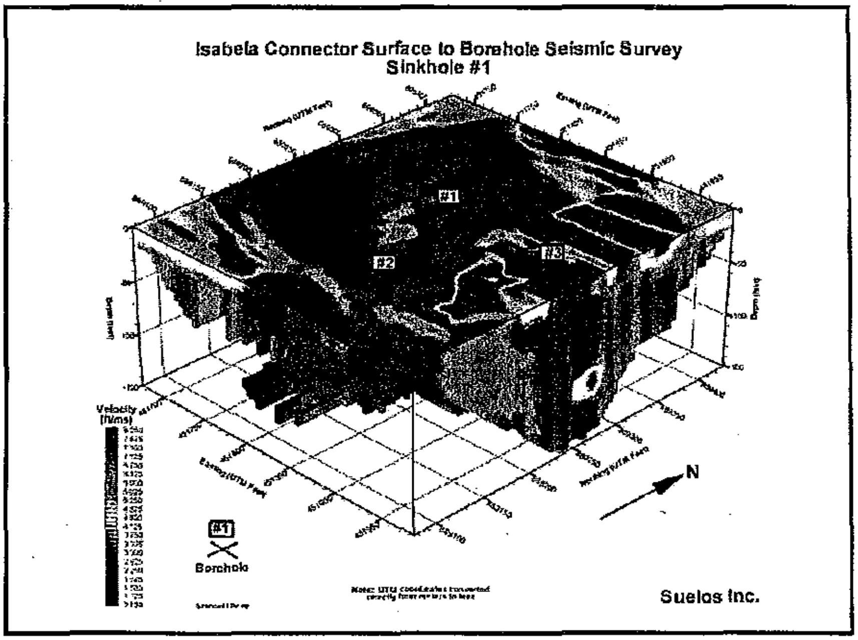


Figure 3 - Example of the interpretation of a sinkhole with geotechnics and geophysics. 2005

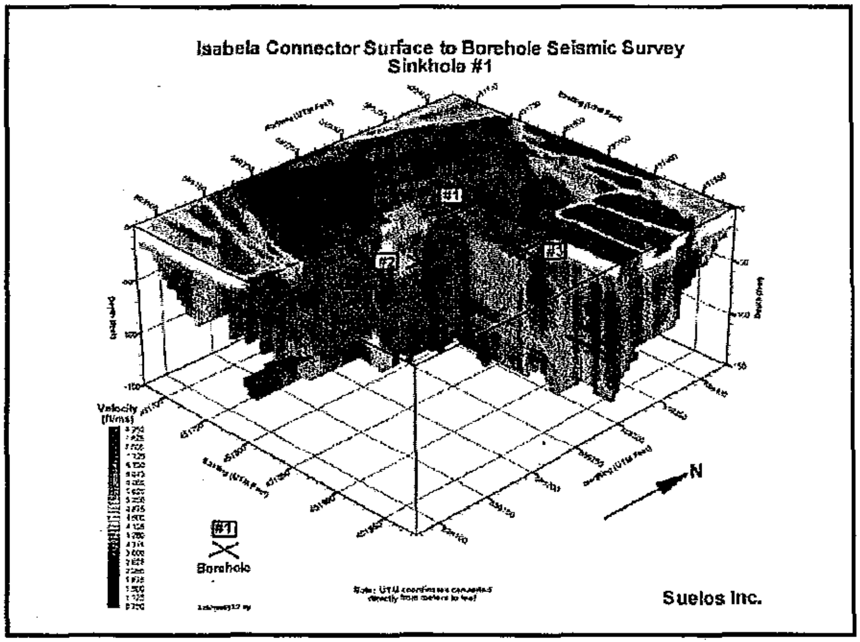


Figure 4 - Example of the interpretation of a sinkhole with geotechnics and geophysics. 2005

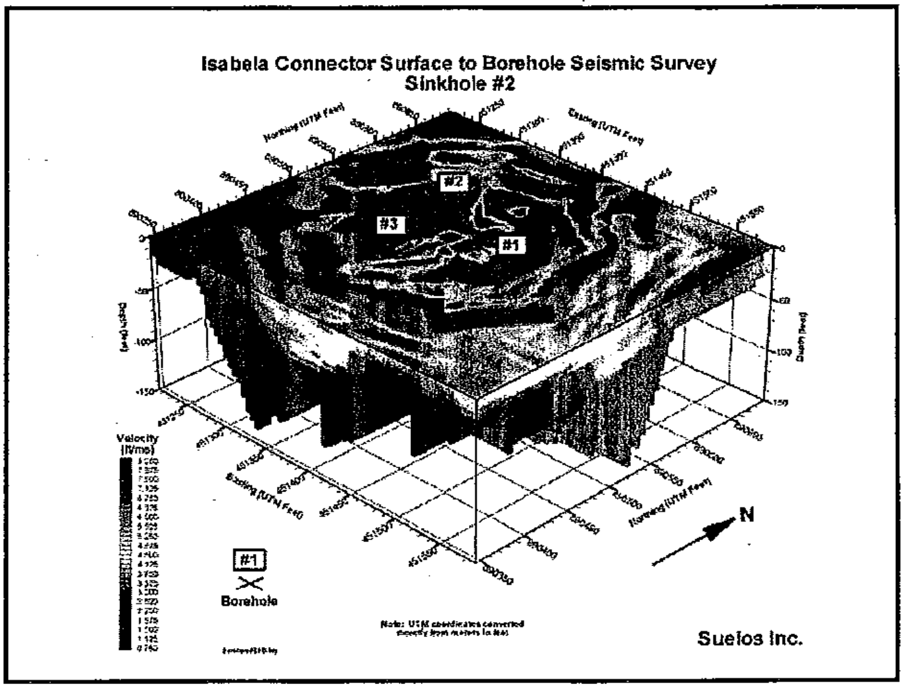


Figure 5 - Example of the interpretation of a sinkhole with geotechnics and geophysics. 2005

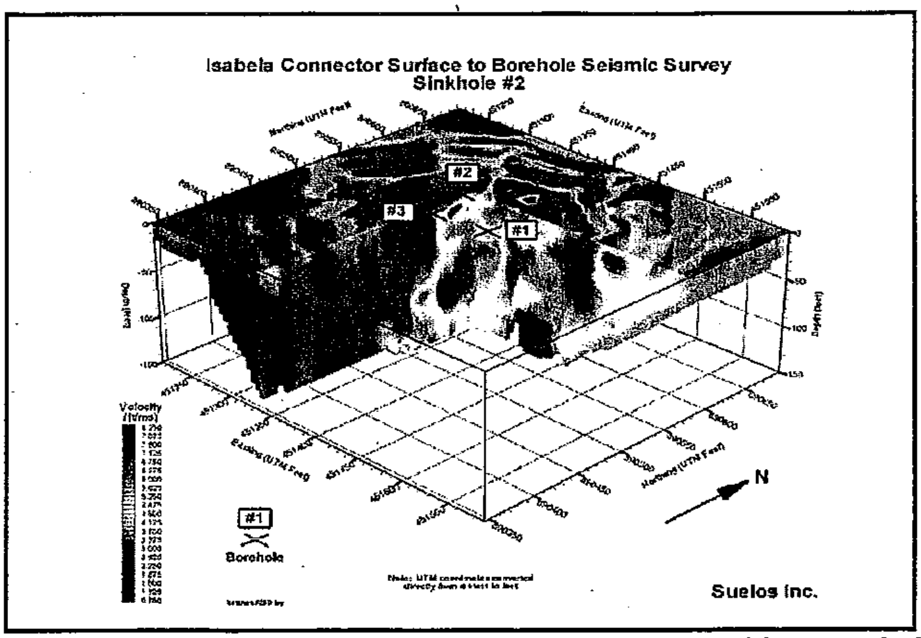


Figure 6 - Example of the interpretation of a sinkhole with geotechnics and geophysics. 2005

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.

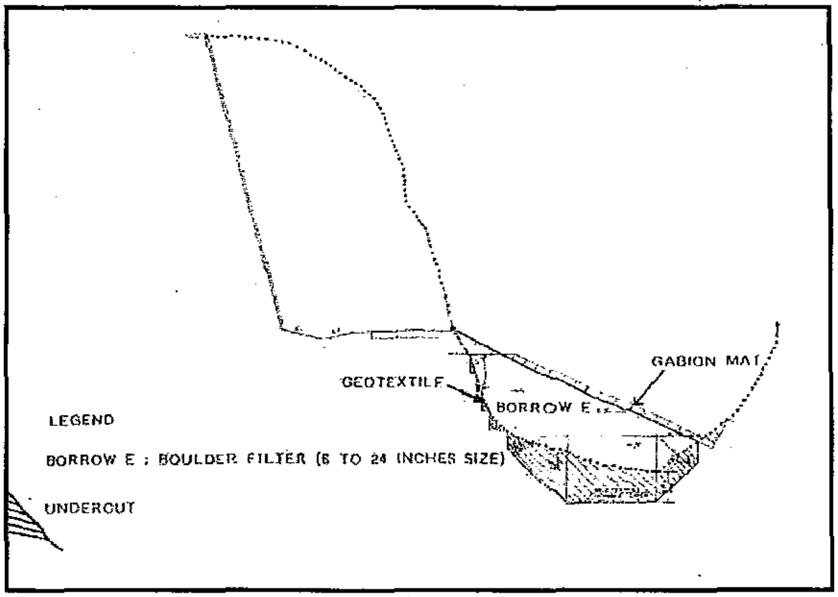


Figure 7 - Remediation by habilitation of sinkholes with inverted filter. (Rodríguez & Vázquez 1999)

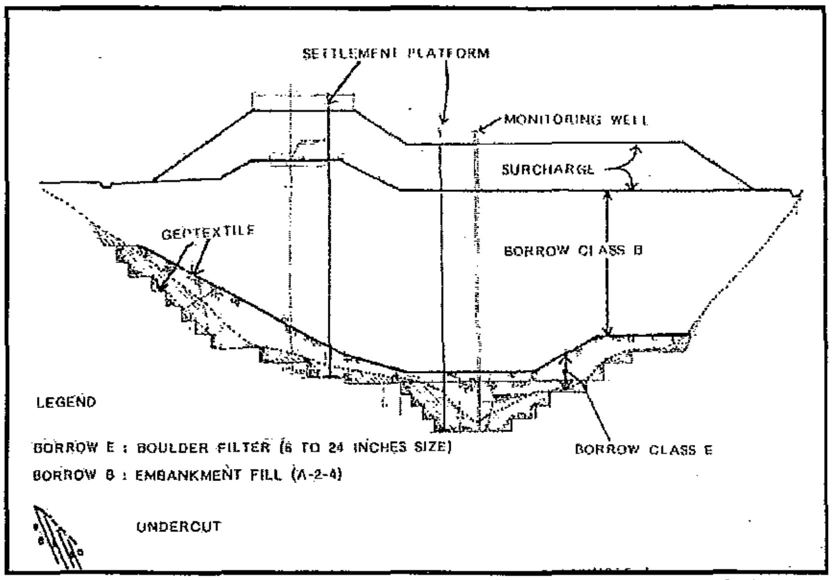


Figure 8 - Remediation by habilitation of sinkholes with inverted filter. (Rodríguez & Vázquez 1999)

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

4 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	Río 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 / Río 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	Manati
W71	Palustrine-man altered herbaceous	Wetland	Manati
W72	Palustrine herbaceous	Wetland	Manati
W74	Palustrine herbaceous	Wetland	Manati
W76	Palustrine herbaceous	Wetland	Manati
W77	Palustrine-man altered herbaceous	Wetland	Manati
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 Vía 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 Vehiculo	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		SJCC5 & 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**

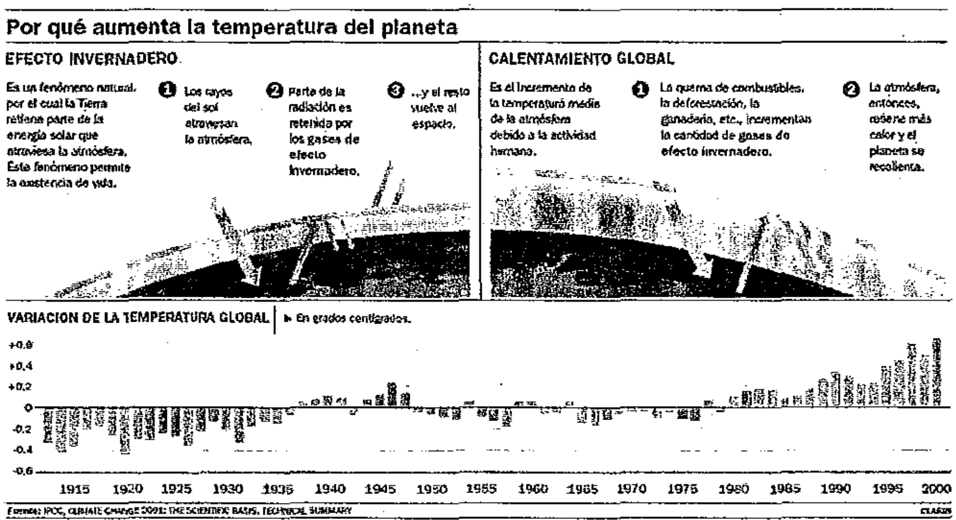
The RCCA was amended recently to re-designate the Guaynabo PM10 No Achievement Area, as a Maintenance Area through a 24-Hour National Environmental Air Quality Maintenance Standard for particulate matter (PM_{10}) for the Municipality of Guaynabo. According to the preliminary calculations, the conversion 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.

Via 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
Acenaphthylene	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	Berylium	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 generated; it is odorless, nontoxic, and has very low level contaminant levels; it requires no environmental cleanup for spills; and there are no procurement problems.

Vía Verde Description:

The Puerto Rico Power Electric Authority (PREPA) proposes the construction of a carbon steel pipeline with the following Specifications:

- API 5L, grade X70,
- Schedule from 0.375 to 0.500 inches, depending in its classification,
- Twenty Four (24) inches in diameter,
- Fusion Bonded Epoxy of, at least, 14 Mils for corrosion protection,
- Cathodic Protection by impressed current for an additional corrosion protection,
- Meets the standards and regulations set for by entities such as: DOT 40 CFR 192, ASME B31.8, ASTM, ANSI, NACE, NFPA, API, OSHA, and the Puerto Rico Public Service Commission,

The transmission pipeline will be used for transferring natural gas from EcoEléctrica, in Peñuelas where the Liquefied Natural Gas storage tank is located, to PREPA's generating plants at Arecibo (Cambalache), Toa Baja (Palo Seco), and San Juan (San Juan). The pipeline will be underground and it will be approximately 92 miles long. The pipeline will require a Maintenance Right of Way (ROW) of 150 feet wide. Out of these 150 feet, the construction process will only impact 100 feet. After construction is finished, 50 out of the 100 feet will be restored to its original state, and only 50 feet will remain as a permanent operational ROW, which will be kept free of deeply rooted vegetation. Total Impacted Area: 1,107.4 acres, approximately, and an additional 32 acres for special situations such as water body crossings. The pipeline will go across 13 municipalities and 48 wards. The municipalities are: Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, Cataño, Bayamón, and Guaynabo. The estimated cost of the project is approximately $447 millions (design, material acquisition, shipping and delivery, construction, state and local rights and taxes, land acquisition, field studies, environmental documents and permits). An additional $50 to $70 million will be required for the conversion of generating units for the use of natural gas. The direct temporary employments are estimated to be between 1,000 y 1,200 and the indirect temporary employments between 4,000 to 4,500.

PREPA has submitted the Preliminary Environmental Impact Statement (P-EIS) to the Environmental Quality Board (EQB) for review and Public Hearings and will adopt any comments or recommendations that are legally binding.

ALTERNATIVES ANALYSIS

Background

Section 404(b)(1) of the Clean Water Act prohibits the discharge of dredged or fill material into waters of the United States unless the proposed discharge is the least environmentally damaging practicable alternative capable of achieving the project purpose. Alternative routes for the pipeline and to the pipeline were evaluated pursuant to 40 CFR 230.10. The National Environmental Policy Act (NEPA) and implementing regulations at 40 CFR 1502.14, together with the Commonwealth Policy Act, require a range of reasonable alternatives including the no action alternative be evaluated. Under these laws and regulations, the no action alternative and action alternatives that meet the project purpose and need of the preferred alternative are considered to be reasonable alternatives. Under the aforementioned laws, these alternatives do not need to be available to the applicant. Though the Corps will evaluate these alternatives, the alternatives selected should be available to the applicant at the time of the permit decision.

The Government of Puerto Rico's 1993 Energy Policy acknowledged the island's high dependency on oil, which at the time was 99%, and the high environmental cost this caused. The policy directs the Puerto Rico Electric Power Authority (PREPA) diversification of fuel sources for power generation to reduce the volatility of oil prices and overall power generation costs and to introduce environmental criteria for the selection of new power plants. Following is a detailed discussion of alternatives to the proposed Via Verde project that meet the project purpose and need. Each alternative discussed addresses logistics, technology, cost and environmental consequences and is followed by a statement indicating whether or not we consider the alternative to be practicable. Among alternatives considered were: the construction of a natural gas import terminal on the north coast of the island, three tanker and buoys systems (Deepwater Port) for receipt of natural gas at Palo Seco, San Juan and Cambalache plants, and several terrestrial alignments for a natural gas pipeline system. The alternative of no action was also analyzed.

EVALUATION CRITERIA

To evaluate the data on each of the alternatives discussed, a set of criteria was defined and rated. Also, weight was given to each criterion according to its importance. Each alternative will be discussed separately and at the end, a table will be presented where the criteria is applied and the rating is multiplied by the weight to obtain a numerical value for each alternative. The alternative with the highest value is deemed the best alternative for construction.

Criteria used for site evaluation

Criterion number	Criterion	Consideration
1	Land Use	Avoid land targeted for high density developments. Favorable land uses considered to be public, commercial, agricultural, industrial
2	Bodies of water	Reduce number, complexity and width of crossings
3	Forests and nature reserves	Avoid or minimized to the maximum extent possible impact to known sites
4	Endangered species	Avoid or minimize to the maximum extent possible impact to the species and their habitat
5	Architectural and Archaeological findings	Avoid or minimized to the maximum extent possible impact to known sites
6	Road crossings	Reduce number of road crossings
7	Zoning	Favorable zoning designations: non residential, public, industrial, agricultural, commercial and non-zoned.
8	Topography	Seek route with smallest number of abrupt topographic changes
9	Community	Maximize safety to residents, avoid or minimize number of dwellings directly impacted by the project (expropriation)
10	Pipeline length	Reduce pipeline length to minimize impacts. Place pipeline parallel to or along existing linear disturbances (ROW's)
11	Impacts to jurisdictional areas	Avoid or minimized to the maximum extent possible, impact to jurisdictional areas
12	Pipeline security	Ideally the pipeline is located on private property where public access is limited. The pipeline is ideally suited to rural land uses unlikely to be targeted for high density

Criterion number	Criterion	Consideration
		uses.
13	Impact on transportation or traffic	Avoid or minimize to the maximum extent possible, impact to transportation and terrestrial or maritime traffic
14	Water Quality	Avoid or minimize to the maximum extent possible, impact to water quality, especially permanent effects
15	Aquatic resources	Avoid or minimize to the maximum extent possible, impact to aquatic resources
16	Cost	Develop project that is within the company's financial possibilities
17	Noise impact to communities and species	Minimize noise impact during construction and operation
18	Essential fish habitat	Avoid or minimize impact to this resource
19	Corals	Avoid or minimize impact to this resource
20	Ease of access	The location needs to provide safe access for routine maintenance and integrity monitoring.
21	Exclusion zone	Project location must comply with regulatory requirements on exclusion zones. A special exclusion zone could also be defined by the owner to avoid impact to certain resources.

Rating assigned to each criterion

Criterion number	Criterion	Comment	Condition	Rating
1	Land Use	Per cent of the project in land favorable to construction	0-10	5
			11-100	10
2	Bodies of water	Number of points were the project intercepts a body of water	0-25 crossings	10
			25-100	5
3	Forests and nature reserves	Per cent of the project in forest and nature reserves	0-10	10
			11-20	5

Criterion number	Criterion	Comment	Condition	Rating
4	Endangered species	Per cent of project in areas where these species are found	0-5	10
			5-10	5
5	Architectural and Archaeological findings	Number of sites impacted by the project	0-5	10
			5-10	5
6	Road crossings	Number of crossings	0-40	10
			41-100	5
7	Zoning	Per cent of the project in favorable zoning	0-20	5
			21-100	10
8	Topography	Number of abrupt topographic changes	0-60	10
			60-100	5
9	Community	Number of residences impacted by expropriation	0-15	10
			16-100	5
10	Pipeline length	Covers less miles from point A to point B	Less than 50 miles	10
			More than 50 miles	5
11	Impacts to jurisdictional areas	Percentage of project in jurisdictional areas	0-20	10
			21-50	5
12	Pipeline security	Percentage of auxiliary equipment exposed and accessible to public	0-5	10
			6-10	5
13	Impact on transportation or traffic	Has potential to affect land or marine traffic	Minimum or no impact	10
			Significant	5
14	Water Quality	Turbidity Sedimentation	Permanent	5
			Temporary	10
15	Aquatic resources	General impact to species	Permanent	5
			Temporary	10
16	Cost	Cost efficient	Less than 1 billion	10
			Greater than 1 billion	5
17	Noise impact to communities and species	Produces noise during construction or operation that impacts quality of life or harasses species	Yes	5
			No	10
18	Essential fish habitat	Per cent of the project in	Less or equal to 5	10

Criterion number	Criterion	Comment	Condition	Rating
		designated areas	Greater than 5	5
19	Corals	Per cent of the project in designated areas	Less or equal to 5	10
			Greater than 5	5
20	Ease of access	Safe access for maintenance and inspections	Yes	10
			No	5
21	Exclusion zone	Project location complies with regulatory requirements on exclusion zones	Yes	10
			No	5

Weight assigned to each criterion

1. Important 2. Mid importance 3. More important

Criterion number	Criterion	Weight
1	Land Use	3
2	Bodies of water	2
3	Forests and nature reserves	2
4	Endangered species	3
5	Architectural and Archaeological findings	2
6	Road crossings	2
7	Zoning	3
8	Topography	2
9	Community	3
10	Pipeline length	2
11	Impacts to jurisdictional areas	3
12	Pipeline security	3
13	Impacts on transportation or traffic	3
14	Water quality	3
15	Aquatic resources	3
16	Cost	3
17	Noise impact on communities an species	2
18	Essential fish habitat	2
19	Corals	2
20	Ease of access	2

Criterion number	Criterion	Weight
21	Exclusion zone	3

DESCRIPTION OF ALTERNATIVES CONSIDERED

No Action

The alternative of no action, although considered, was found not feasible given the transcendence, importance; and public welfare pursued by the project.

Preliminary environmental impacts and direct/indirect impacts associated with construction of a natural gas pipeline are considered. If the project is not built the following impacts would be avoided:

- Impacts from moving earth that could result in erosion and sedimentation in bodies of water
- Temporary increases in noise levels
- Impacts to forest reserves
- Temporary impacts to wetlands and other bodies of surface water
- Impacts to farmland
- Temporary impacts to infrastructure such as waterlines, buildings and (possible) phone lines
- Temporary impacts to traffic and roads, i.e. detours
- Potential impacts to archaeological sites
- Acquisition of land by expropriation

However, if the project is built most of these impacts, if not avoided completely, could be minimized and mitigated using engineering design options and support from agencies and municipalities the project would cross through.

No action is not indicative of no impact, since with this alternative PREPA will be forced to continue to produce electricity by burning petroleum products that generate greater amount of pollutants emitted to the air. While some of these emissions can be controlled by using technology that requires, in many cases, an investment of millions of dollars, modern emission reduction highlights that the emissions of these derivatives of petroleum would be greater if related to the burning of natural gas. In addition, maintenance of petroleum burning units has to take place more frequently and with higher costs to guarantee optimal operation. Continuing to burn petroleum derivatives has other implications, such as an increased frequency of deliveries of these fuels to our ports which increases erosion of the seabed and the likelihood of spills. The continued use of fuels derived from petroleum increases the cost of electricity, which negatively impacts the Puerto Rican economy and results in a lower quality of life for its citizens. Finally, liquid fuels expose PREPA to fluctuations in the market value creating instability in the costs of energy production and invoices. Recognizing that the Puerto Rico economy is directly linked to PREPA's stability, it is important for the company to meet its strategic development plans and maintain a fixed cost structure to avoid sudden peaks of variations in the cost of purchased fuel. Compliance with this plan demonstrates vision, stability and commitment to customers, the ability to assess complex situations of world character and the ability to develop strategies to minimize adverse impacts making it easier to expand options to obtain fuels in the future.

After evaluating local and global dynamics, PREPA developed a strategic plan to guide future development of the company and Puerto Rico. This plan includes the following parameters:

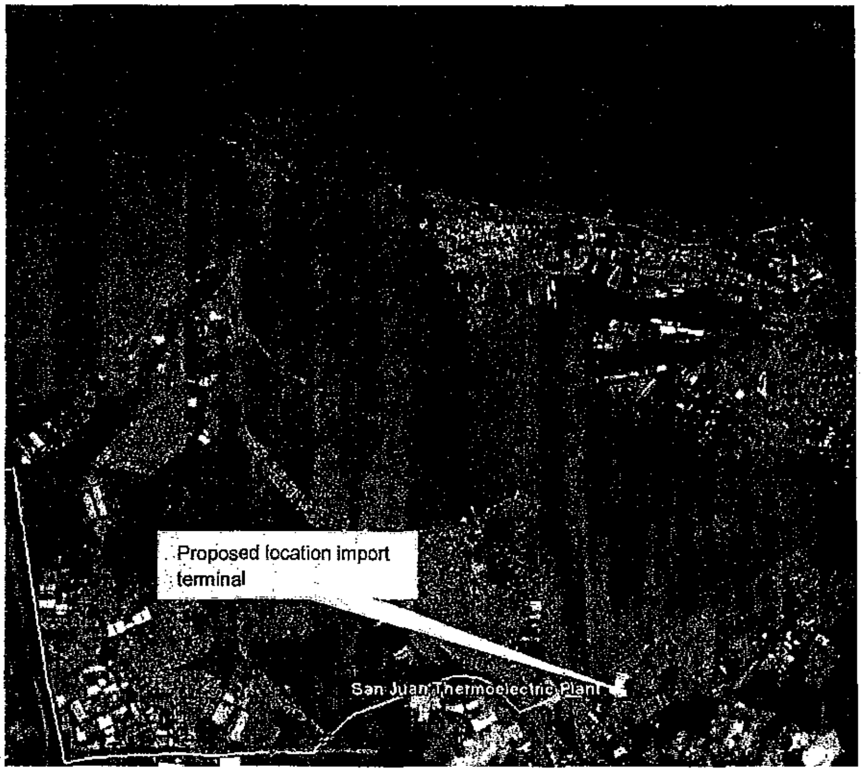
- Diversification of energy sources
- Reduction in costs
- Geographic diversification of generating electricity
- Environmental considerations
- Expansion of electrical generation
- Diversification of revenue

The Via Verde project is part of the plan to diversify fuels which can make PREPA better. In addition, there are important environmental considerations to help AEE to more effectively manage their energy costs. A significant percent of Puerto Rico's generated electrical power depends on oil. At the moment, AEE uses only No. 2 fuel (light distillate) and No. 6 (bunker C) its generator units and it buys electricity, in turn, from the AES co-generators in the municipality of Guayama (coal) and EcoElectrica in the municipality of Penuelas (natural gas). With the introduction of the co-generators AEE began to buy electricity generated from NG or coal but internally AEE still depends exclusively on oil.

PREPA aims to reduce its dependence on the use of oil, which currently is approximately 68%, to approximately 12% by 2014. To do this PREPA must identify alternative fuels that can meet their customers demand for power. Lack of action would only aggravate the current dependence on oil, and at a time of seizure or high global demand, Puerto Rico would have no viable alternatives to generate electricity. In addition, no action exposes PREPA to sudden changes in the cost of oil which reduces the economic capacity of PREPA and, consequently, the Puerto Rican economy. It is important to highlight that PREPA is limited by regulations to the type of fuel it can burn. The greatest limitation is the amount of sulfur contained in fuel. Low sulfur fuel is more expensive than fuel with higher sulfur content. If there are shortages in this type of fuel, or if PREPA cannot set contracts with the suppliers, there are only two options left: reduce the production of electricity, which is not feasible, or burn a cheaper fuel with higher sulfur content in violation of established environmental permits, with subsequent exposure to fines and sanctions from regulatory agencies. The use of natural gas significantly decreases emissions of pollutants to the environment. No action means PREPA must expend significant capital to reduce emissions that result from burning oil and to maintain their units, instead of using that capital to develop a more efficient system that uses cleaner fuel with lower maintenance costs.
The No Action Alternative would not meet the project purpose and will not be considered further.

Construction of a Liquefied Natural Gas Import Terminal

Currently Puerto Rico has the EcoElectrica Cogeneradora in the municipality of Peñuelas, to receive LNG (and meet PREPA's needs). Still, the alternative of building a new terminal closer to PREPA's power facilities was evaluated in consideration of environmental impacts potentially associated with the construction of a delivery pipeline from the EcoElectrica terminal. A location between the three power plants on the northern coast selected to convert to Natural Gas (NG) was identified next to the Central Thermoelectric San Juan (CTSJ) unit. Currently, an existing pier has infrastructure to transport diesel and Bunker C Fuel to two of the three plants, San Juan and Palo Seco.



A new LNG import terminal must be able to receive, download, and store up to 3.0 Bcf/d (3 trillion cubic feet) of liquid natural gas imported by sea. In addition, facilities to gasify and handle the natural gas would also need to be built. The construction of the terminal would result in an environmental impact associated with the different stages of the construction and operation, which include:

- Build, repair, or expand (depending on the case), a pier for receipt of liquid natural gas.
- Increase in the transit of ships.
- Construction of a tank for liquid natural gas storage and gasification - this plant would require an area of approximately 25 acres.
- Constructing navigation channels to support transit tankers, which would mean dredging and disposing dredged material.

Selecting a place to construct a terminal to receive liquid natural gas requires a deep port to minimize the environmental impacts associated with the development and operation of the terminal. In addition, a relatively low population density area with industrial development is necessary.

Three (3) criteria were used to determine whether building close to PREPA's installation import terminal was a viable alternative. These were: 1) specific factors at the workplace, 2) maritime operations and, 3) environmental issues.

1. **Factors specific to the workplace**

Availability of land

A suitable location must have enough space available to accommodate the proposed installation and all safety components required by the Federal Department of transportation regulations (49 CFR part 193), the U.S. Coast Guard (33 CFR part 127) and the National Fire Protection Association (NFPA). In addition, a site must comply with the regulatory distance required between structures used to gasify LNG and the LNG storage tank. Facilities would need to occupy an area of approximately 25 acres. Structures would include, among other components, a dual containment tank 167 feet in height and diameter with the ability to store 1,000,000 barrels of liquid natural gas at a temperature of minus 260 degrees Fahrenheit and a pressure of 2.0269 psig; vaporization or gasification systems to gasify liquid natural gas, and pipes to transport the natural gas to the power stations. Other factors to be considered would include activities outside and adjacent to the terminal and the distance or separation needed between the terminal to occupied areas of activity and/or populated areas (49 CFR parts 193.2055, 193.2057 and/or populated areas.

Availability of a coastal area

A site must have an available maritime quay with facilities for tankers 950 feet long, with PIP cubic meters capacity, and a minimum 40-foot boat anchor area. The criteria used to assess whether a port or dock has the capacity for this type of project are the depth of greater than 40 feet, navigation channels with extension airway passage (greater than 180 feet) and proximity to equipment to conduct storage and gasification of liquid natural gas. The quay must be approximately 30 feet wide by 1,700 long and have, among others: teams to tie up the tanker to the dock; a boat platform with two levels at the end (a 40-foot wide by 100 long lower level and 20 wide and 100 long upper level); and a emergency spill collection system.

Disposal of dredged material

Any area under consideration must include the requirement to dredge to create a proper shipping channel for the maritime tanker traffic to deliver the liquid natural gas; also a site must be identified for dredged material generated during construction and future maintenance operations required for the channel.

2. Maritime Operations

<u>Increase in ships</u>

The transit of tanker ships is subject to more restrictions than general maritime traffic. Federal regulations and restrictions could affect other shipping and increase the risk of affecting other users of the navigation channel.

<u>Access to the navigation channel</u>

The quicker a tanker vessel can arrive at the terminal, unload and return to sea, the more economic the operation is. A shorter channel would reduce possible adverse effects on traffic for other ships from marine transit restrictions. Yaw (amplitude and proximity) area: a typical liquid natural gas tanker ship would require a dock with a minimum turning diameter of 1,200 feet and 40 feet of depth.

3. Environmental issues

<u>Environmental consequences</u>

Minimizing environmental impact by using places previously impacted, including the place for dock, and areas zoned for this type of use.

<u>Compatibility with the region</u>

The place must be compatible with future developments on adjacent properties.

According to the rating system described above, the import terminal is favorable based on the following criteria:

1. The land to be used for the project is compatible with the uses defined in the criteria (commercial, industrial, public, agricultural).
2. Bodies of water- the number of water bodies to be crossed are reduced, since the length of pipe between Peñuelas and Arecibo is eliminated with this option.
3. Forests and Reserves- the percentage of forests and reserves is considerably reduced because the length of pipe between Peñuelas and Arecibo is eliminated
4. Architectural and Archaeological findings- no findings anticipated in the marine portion of the project. There are no findings in the land portion from San Juan to Arecibo.
5. Road crossings- the number of road crossings is reduced since the length of pipe from Peñuelas to Arecibo is eliminated.
6. Zoning- the zoning in the project area is compatible with the zoning designated in the criteria: non residential, public, industrial, agricultural, commercial and non-zoned.

7. Topography- the number of abrupt topographic changes is significantly reduced since the length of pipe from Peñuelas to Arecibo is eliminated.
8. Community- the number of residences expropriated is reduced.
9. Pipe length- the length of pipe needed is reduced.
10. Pipeline security – the pipe is still underground.
11. Noise impact – the noise levels will be compatible with the noise levels in the area.

The import terminal proved disadvantageous based on the following criteria:

1. Endangered species- to bring the natural gas tanker to the selected location, the navigation channel must be dredged and a disposal site identified. The Estuary of the Bay of San Juan (EBSJ) is composed of several bodies of water. The EBSJ provides food and shelter to eight species of fauna and 17 species of flora in danger of extinction, such as the Antillean Manatee and several species of turtles, including the hawksbill and leatherback; 160 species of birds, such as the Brown Pelican and the Heron; 19 species of reptiles and amphibians, such as the coquí and Puerto Rican boa; 124 species of fish, Tarpon and bass; and 300 species of wetland plants are found on EBSJ.

2. Impact to jurisdictional areas- the San Juan Bay is considered waters of the United States. In addition to this, a disposal site for the dredged material must be identified. A deep water disposal site would also fall under the jurisdiction of the USACE.
3. Cost – the estimated cost to build an import terminal is approximately $1.2-$1.5 billion, above the government's financial capability at the moment.
4. Impact to transportation and traffic- the dredging operation to prepare the navigation channel and the gas natural tankers entering the area would have a significant impact on the maritime traffic of San Juan Bay. Also, there would an increase in maritime traffic due to the LNG ships entering the area. The transit of tanker ships is subject to more restrictions than general maritime traffic. Federal regulations and restrictions could affect other shipping and increase the risk of affecting other users of the navigation channel. One example of an effect would be the increase in maritime traffic restrictions which make it difficult, if not impossible, for others to use the navigation channels simultaneously with LNG tankers
5. Water quality and aquatic resources- Dredging operations would degrade the quality of the receiving waters due to suspended fine sediments. Effects from the turbidity plume

could occur daily during working hours and up to two (2) hours after the discharge of dredged material is completed. This would affect water quality and, consequently, water quality parameters required by environmental permits governing the CTSJ, especially turbidity, sedimentation and suspended solids.

6. Essential fish habitat – There are no identified essential fish habitats in the San Juan Bay.

7. Ease of access – the quicker a tanker vessel can arrive at the terminal, unload and return to sea, the more economic and safe is the operation. In order to reach the unloading pier, the LNG tanker must use three channels, Bar, Anegado and Army Terminal, until it reaches the pier at Puerto Nuevo Bay. A shorter channel would reduce possible adverse effects on traffic for other ships from marine transit restrictions.

8. Corals- the entire north coast of Puerto Rico is designated critical habitat for elkhorn and staghorn coral. Species specific studies would have to be performed to determine the status of the species, if dredging is needed in designated areas.
9. Exclusion zone- the regulations establish an exclusion zone of 1-2 mile radius for the storage tank needed to store the LNG. This exclusion zone limitation could not be met.

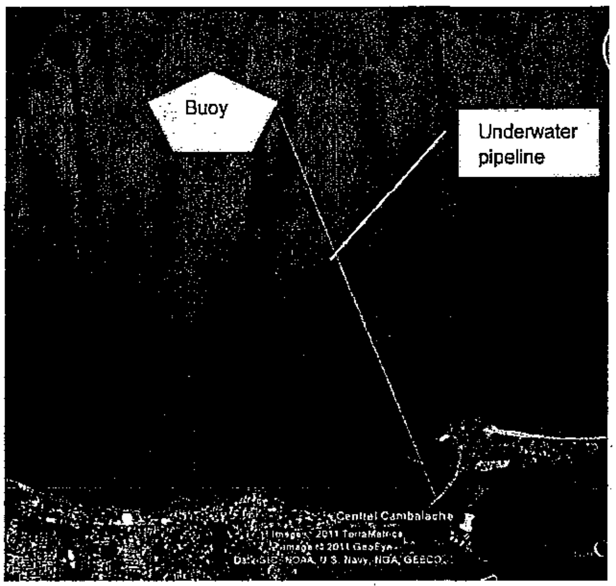
Construction of a system of buoys and tankers (Deep water Port) in San Juan, Palo Seco and Arecibo

As one of the alternatives to the project, the installation and operation of tankers and a buoy for the receipt, storage and regasification to transport natural gas to each area in the north central system was considered. The buoy would be located 5km from the coast in Palo Seco and Arecibo. In San Juan, the buoy will be located 8 km offshore. The infrastructure needed is:

- one submerged turret loading buoy that connects to the vessel and serves as both a mooring for the vessel and a conduit for the discharge of natural gas
- chains, wire rope, and anchors used to secure the buoy to the seabed
- a flexible riser designed to connect the buoy to a seabed pipeline end manifold (PLEM) – allowing tie-in to a subsea pipeline

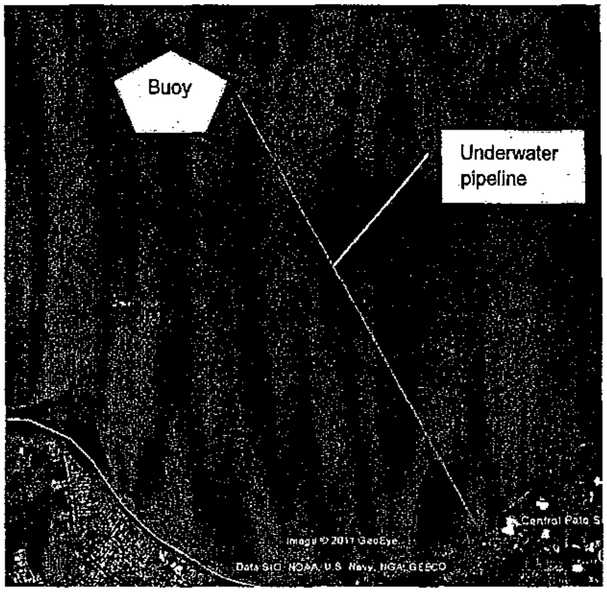
- a subsea PLEM that incorporates necessary control instrumentation and related valving; and,
- an interconnecting subsea pipeline to tie into downstream delivery infrastructure.

The delivery tanker will have a regasification system. This tanker will dock at the buoy which keeps afloat lines connecting the tanker to a pipeline on the seabed. This pipeline will transport compressed gas to a receiving terminal near the central power unit.



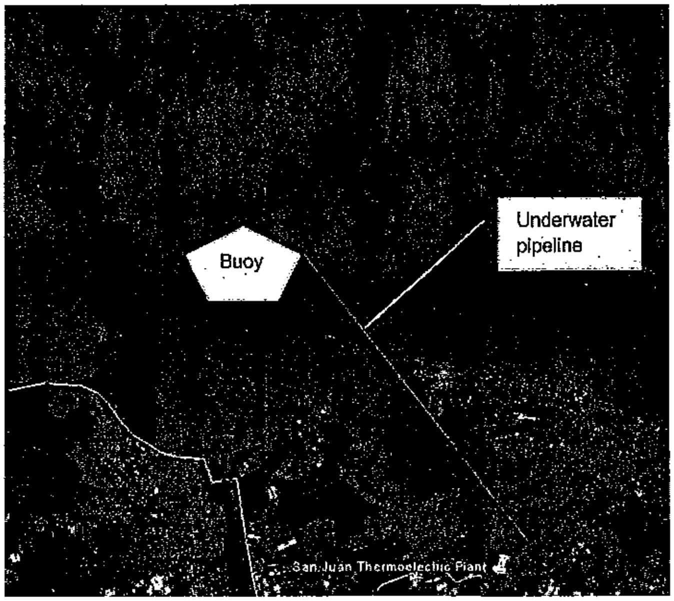
Proposed location LNG receiving buoy

Cambalache, Arecibo



Proposed location LNG receiving buoy

Palo Seco, Toa Baja



Proposed location LNG receiving buoy
San Juan

According to the ranking system described above, the buoy and barge system is favorable based on the following criteria:

1. Forests and Reserves- no forests and reserves are affected by this alternative
2. Architectural and Archaeological findings- no findings anticipated in the marine portion of the project, but required studies will be performed.
3. Road crossings- no road crossings
4. Topography- it is assumed that the seabed in the area is flat, but a bathymetric study will be performed
5. Community- no residences will be expropriated due to the projects construction.
6. Pipe length- the length of pipe needed is reduced
7. Pipeline security – the pipe is still underground

The import terminal proved disadvantageous based on the following criteria:

1. Bodies of water- although only one body of water is affected by the project, there are no alternatives to avoid its impact. Directional drilling is not an option in this case. The pipe to transport the gas must be buried in a trench of approximately 3 ft deep and 4 ft wide

for a length of ocean between 5-8 miles, per buoy. Also, there will be impact on the sea floor during the installation of the anchors and other equipment related to the buoys.

2. Endangered species- a number of endangered species of sea turtles, whales and others could be affected by the project's construction.

3. Impact to jurisdictional areas- waters affected by the project in San Juan, Palo Seco and Arecibo are jurisdictional.

4. Cost – The AEE would request a private company with expertise in the design, construction, and operating system of a Deepwater Port. This could cost AEE between $70 and $80 million per year, subject to signing a contract with that company for a period of not less than 20 years. At the end of the 20 year period the total cost would be approximately $1.6 billion dollars, per buoy system.

5. Impact to transportation and traffic- As in other cases, the Coast Guard may impose safety zones restrictions extending at least 500 meters in all directions from the buoy to protect vessels and mariners from potential safety hazards associated with the construction of the deepwater port facilities, and to protect the port's infrastructure. All vessels will be prohibited from entering into, remaining or moving within the safety zone.

6. Water quality and aquatic resources- The primary physical impact of construction on water quality would occur as a direct or indirect result of the sediment plume that will be created from setting the buoy anchors, installing the flowlines, and temporarily laying the mooring chain on the seafloor. Although temporary, plumes resulting from disturbance to the seafloor would be exposed to currents with the potential to carry them into the surrounding environment and strip nutrients and/or contaminants from the sediments and release them to the water column. The extent and duration of the turbidity plumes would be based on the strength of the currents at the location of the specific activity. Sediment re-suspension could release sediment bound contaminants, but this is an assumption that need to be validated by chemical analysis of the sediments.

Withdrawal of ballast and cooling water at the port as the regasification vessel unloads cargo (approximately 1 million gallons per day) could potentially entrain zooplankton and ichthyoplankton that serve as prey for other species.

7. Noise impact - During port operations, sound will be generated by the regasification of the LNG aboard the regasification vessel and the use of thrusters by vessels maneuvering and maintaining position at the port. Another potential sound source would be sound generated from large construction-type dynamic positioning (DP) vessels used for a major repair of the subsea pipeline or unloading facility. Of these potential operations and maintenance/repair sound sources, thruster use for DP is the most significant. The National Marine Fisheries Service recognizes three kinds of sound: continuous, intermittent (or transient), and pulsive. The project will not cause pulsive noise activities. Rather, the sound sources of potential concern will be continuous and intermittent sound sources, including underwater sound generated by regasification/offloading (continuous) and dynamic positioning of vessels (regasification and large repair vessels) using thrusters (intermittent). Both continuous and intermittent sound sources are subject to the National Marine Fisheries Service's 120 dB re 1μPa threshold for determining levels of underwater sound that may result in the disturbance of marine mammals. Potential effects of noise on marine mammals include masking, disturbance (behavioral), hearing impairment (temporary threshold shift [TTS] and permanent threshold shift [PTS]), and non-auditory physiological effects.

8. Essential fish habitat - Withdrawal of ballast and cooling water at the port as the regasification vessel unloads cargo (approximately 1 million gallons per day) could potentially entrain plankton and fish larvae .

9. Ease of access – although the delivery tankers will have easy access to the buoys, on shore personnel will have to travel 5-8 miles in case emergency situations arise.

10. Corals- the entire north coast of Puerto Rico is designated critical habitat for elkhorn and staghorn coral. Species specific studies would have to be performed to determine the status of the species. The species could be affected by trenching done to install the underwater pipeline.

11. The land to be used for the project is not compatible with the uses defined in the criteria (commercial, industrial, public, agricultural).

12. Exclusion zone- the Coast Guard will determine the exclusion zone during construction and operation of the project

13. Zoning- the zoning in the project area is not compatible with the zoning designated in the criteria: non residential, public, industrial, agricultural, commercial and non-zoned

Construction of a Natural Gas Pipeline (Terrestrial routes)

The purpose of this analysis is to select the best terrestrial route for a pipeline to deliver natural gas from the Ecoelectrica facility in Peñuelas to the Cambalache, Palo Seco and San Juan plants. Other works and studies contracted by PREPA were used during the Alternative Routes Selection effort. Part of the study conducted by *Power Technologies Corporation (PTC)* in 2006 was used for this analysis *(Corridor and Alternative Routes Selection Study).* The PTC study was inclusive since it took into consideration the entire island. Corridors were evaluated every 1,000 meters and used the following criteria for such evaluation; topography, land use, existing corridors, and sensitive areas. Options were refined with other factors such as: individual residences, minor topographic variations, sensitive habitats identified during field visits, and methodology of construction in areas of greatest difficulty, such as: steep slopes, bridges and densely populated areas. Finally, the study selected multiple routes to bring natural gas to various points of the island. These included the PREPA facilities at Arecibo, San Juan and Palo Seco, which are the focal points of this Via Verde project.

The study carried out by PTC identified two viable alignments to transport natural gas from EcoElectrica to Central Cambalache and two segments from San Juan to Cambalache.

Ecoelectrica to Cambalache Segments

1. Alignment South to North "A"

Starting at EcoElectrica, take a Northeast route overland to Ponce and then follow the State Road 10 road easement. The route follows State Road 10 through Adjuntas and Utuado. At Utuado the pipeline moves away from but parallel to the State Road 10 corridor until it reaches Arecibo. At Arecibo the route follows Northern plains until it reaches Central Cambalache. This route runs a total of 45.1 miles and the study labeled this alignment *"Overland".*

2. Alignment South to North "B"

Starting at EcoElectrica, take one of two options to get to State Road 10. The first is to follow the right-of-way of the southern gas pipeline to Ponce and the second option is to take the State Road 10 right-of-way from Guayanilla. Both go to the west of Ponce where the pipeline route follows the State Road 10 right-of-way State Road 10 until it reaches Central Cambalache. This route runs a total of 36.8 miles and the study labeled this alignment *"DOT Route".* The study also identified two viable alignments for the proposed natural gas pipeline, from Central Cambalache to San Juan and Palo Seco.

San Juan to Cambalache Segments (East to West)

3. Alignment East to West "A" (Include drawing)

From San Juan, in Levittown, take a path west and cross the Municipalities,of Toa Baja, Dorado, Vega Alta, Vega Baja, Manati and Barceloneta to Arecibo. This route runs a total of 44.6 miles. The study labeled this alignment *"Overland Corridor".*

4. Alignment East to West "B"

Ruta B

From Cataño, follow the PR-22 right-of-way to Arecibo. This route crosses the Municipalities of Toa Baja, Dorado, Vega Alta, Vega Baja, Manati and Barceloneta. This route would necessitate an investigation to determine if the pipeline would interfere with the right-of-way of the Superacueducto (Super Aqueduct). This alignment runs a total of 45.6 miles and the study called this alignment *"DOT Corridor"*.

5. Alignment "C" segments

Ruta C

A third alignment, which was not contemplated in any of the previous studies contracted by PREPA, was also considered for the Via Verde project that ran near both of the other two alternative routes but avoided more residential areas. In summary, three (3) routes were considered for the pipeline corridor from EcoElectrica to Arecibo and then from Arecibo to San Juan. These were: alignment South-North A (SNA), alignment South-North B (SNB), alignment South-North C (SNC); alignment West-East A (OEA), West-East B (OEB), West-East C (OEC).

Evaluation criteria for terrestrial route comparison

The following environmental criteria were used to evaluate the six alignment segments and determine which segments met the criteria as explained below:

- **Use of land** - The different uses of land were analyzed in each alignment. A route was defined as favorable for pipeline construction if existing land use was currently used for public, industrial, agricultural and commercial applications. A route was defined as not favorable for construction if land was currently in residential use and/or environmentally-sensitive. The percentage of the alignment with favorable uses and then the percentage not favorable were compared to obtain a final value. The route which had the largest value received the positive (+) value.

- **Impacted water bodies** - The number of crossings of bodies of water increases the difficulty to construct the pipeline. Crossing a large body of water would need special construction methods to avoid adverse impacts. These construction methods increase the cost of the project. All bodies of water which were intercepted by an alignment were counted. The route with the fewest water body crossings received a positive (+) value.
- **Forests or nature reserves** - Forests and nature reserves were areas considered important public resources due to their high ecological value. For selection of a positive (+) value the criteria considered avoidance or minimization of impacts to these areas. The percentage of forested/nature reserves impacted was measured against the total length of each route alternative. The route with the smallest percentage of forests and nature reserves received the positive (+) value.
- **Endanqered Species** - This criterion measured the extent of the alignment alternative that was considered protected habitat and/or had listed species present. The route alternative with the smallest percentage of impact in protected habitat received the positive (+) value.
- **Archaeoloqical sites** - All identified architectural and archaeological sites that would be intercepted by an alignment alternative were marked. The route with the fewest sites received the positive (+) value.
- **Highway crossings** - Road crossings increase the difficulty of pipeline construction since special construction methods are needed to avoid affecting the integrity of the infrastructure and vehicle congestion. All roads intercepted by an alignment alternative were identified. The route with the fewest road crossings received the positive (+) value.
- **Zoning** - The different zonings were identified for each alignment alternative. Favorable zonings were considered to be non residential, public, industrial, agricultural, commercial and non-zoned. Not favorable was considered to be areas zoned residential, or areas identified as forests, historical sites and conservation lands. We measured the extent of alignment with terrain for favorable zoning against not-favorable zoning to obtain a final value. The route which had the largest value (favorable vs. not-favorable) received the positive (+) value.

- **Topography** - Puerto Rico has a variety of topographical areas within its limited geographical scope. The Cordillera Central area is characterized by its rugged topography. We analyzed different levels and steepness of topography and types of soils within each alignment. Abrupt changes in the topographic levels were marked. The route which had the smallest number of abrupt topographic changes received the positive (+) value.
- **Residential areas** - Due to its limited geography and high population density, Puerto Rico has abundant residential areas, especially in the coastal plains. Distance from Residential Areas, as part of the general public safety factors was considered to be a very important factor in identifying the best, practicable alternative. For this reason, greater weight was given in the project planning criterion to minimize the number of homes in the vicinity of an alignment. Any residence which would be within 150 feet from the center of an alignment was identified and counted. The route with the fewest number of residences received the positive (++) value.

To determine the best terrestrial alternative, the three (3) segment alternatives for the South-North section were compared to each other based on the results obtained once the criteria was applied. The three (3) segment alternatives for the East- West section were also compared. The route option with the least impact to each criterion received a positive value (+). Then the total number of positive values for each route alternative was added and tabulated. The route option with the largest number of criteria in its favor was selected. The analysis is summarized in the Table 1.

Table 1: Route Selection Matrix for Terrestrial Route

Criteria	South North A		South North B		South North C		West East A		West East B		West East C	
Use of land	3.09		8.68		14.35	+	1.32		14.38		18.89	+
Bodies of water	23		25		20	+	15		12	+	13	
Forests or nature reserves	1.39	+	2.50		3.04		0.59		0.03	+	2.79	
Endangered Species	6.49		11.69		6.01	+	7.03		1.53	+	10.43	
Architectural and archaeological findings	1		0	+	0	+	0	+	0	+	0	+
Highway crossings	40		28		21	+	64		47		30	+
Zoning	24.21		30.61		33.41	+	4.28		0.44		32.42	+
Topography	86		78		59	+	15		12	+	13	
Residences	17		2	+	2	++	29		22		1	++
Total Positive criteria		1		3		9		1		5		6

Of the three south-north segments, the South-North C (SNC) segment was the most favorable with nine positive points, while South-North B had three positive points and South-North A only one positive point. Minimal direct impact to residential areas also favored segment SNC.

Of the three west-east (east-west) segments, the West East C (OEC) segment was the most favorable with six positive points while, West-East B had five positive points and West-East A only one positive point. Again, direct impact to residences strongly supported segment OEC since only one residence would be directly impacted while the other two segments potentially directly impact over twenty residences each.

Based on this analysis, together, segment South North C and segment West East C were selected as the best option for a pipeline route.

EVALUATION OF ALTERNATIVES USING RATING AND WEIGHT – Table 2

	Terrestrial Route			Buoys			Import Terminal		
Criteria	Rating	Weight	Total	Rating	Weight	Total	Rating	Weight	Total
Land use	10	3	30	5	3	15	10	3	30
Bodies of water	5	2	10	5	2	10	10	2	20
Forests and nature reserves	5	2	10	10	2	20	10	2	20
Endangered species	5	3	15	5	3	15	5	3	15
Architectural and archaeological findings	10	2	20	10	2	20	10	2	20
Road crossings	5	2	10	10	2	20	10	2	20
Zoning	10	3	30	10	3	30	10	3	30
Topography	5	2	10	10	2	20	10	2	20
Community	10	3	30	10	3	30	10	3	30
Pipe length	5	2	10	5	2	10	10	2	20
Impact to jurisdictional areas	5	3	15	5	3	15	5	3	15
Pipe security	10	3	30	10	3	30	10	3	30
Impact on transportation and traffic	10	2	20	5	2	10	5	2	10
Water quality	10	3	30	5	3	15	5	3	15
Aquatic Resources	10	3	30	5	5	25	5	5	25
Cost	10	3	30	10	3	30	5	3	15
Noise impact	10	2	20	5	2	10	10	2	20
Essential fish habitat	10	2	20	10	2	20	5	2	10
Ease of access	10	2	20	5	2	10	5	2	10
Corals	10	2	20	5	2	10	5	2	10
TOTAL			**410**			365			385

CONCLUSIONS

1. The alternative of building a terminal at or near the CTSJ is not feasible, nor practicable, when comparing potential environmental impacts associated with the construction of a natural gas pipeline to service AEE's power stations. It must be considered that the process of constructing and operating an LNG import terminal is complex. Permits and endorsements are regulated by the Federal Energy Regulatory Commission (FERC). In comparison, the EcoElectrica studies and permit process to construct an import terminal and start of the operation took between 7 to 10 years. This timeline would not satisfy AEE's need to begin a project to facilitate the transition from oil to a renewable source of energy. The cost of the existing EcoElectrica terminal fluctuated around $570 million in 1995. Considering inflation, the construction of a similar terminal today would be too onerous as it would be beyond $1 billion. As a project of the Government of Puerto Rico, it would require funding through bond issues, limiting savings on electrical bills.

   Although an area of maritime use, the CTSJ (as well as the other two stations in the northern area) does not comply with depth criteria or the anchor capacity for the necessary tankers. This alternative lacks a dredged material disposal area and necessary dredging activity would adversely impact the benthic community in the area. Maritime traffic would be highly compromised by the existence of only one entrance channel to San Juan Bay. It is believed that locating a receiving terminal here would adversely impact the local economy, as well as the tourism industry.

2. The system of mono buoy and tanker would cost approximately $70 to $80 million per year. The plants (Cambalache, Palo Seco and San Juan) have a small footprint and do not have space to locate the terminal facility to receive the CNG. The period of time required to put the system into operation, in compliance with all applicable federal and State legislation is estimated between 5 to 8 years. Although this project is not viable at this time, PREPA will continue to study this possibility since multiple projects using two buoys a natural gas without compression have been constructed in the US Mainland and are operating successfully.

3. Although the terrestrial route is not without impacts, it is the best alternative to deliver natural gas to PREPA's plants in northern Puerto Rico. Impacts to human and other resources can be avoided, minimized or mitigated. There is extensive knowledge about the resources affected by the project and PREPA will work following the regulatory agencies recommendations and strict construction codes.

ELECTRIC POWER AUTHORITY
Puerto Rico's Via Verde Project
Preliminary Environmental Impact Statement (DIA-P)

Summary

This project is one of the tools needed to address the emergency regarding the infrastructure for generating electric power decreed by the Hon. Luis G. Fortuño Burset in Executive Order OE-2010-034, under Law 76 of May 5, 2000. In addition, it is essential to comply with the commitment of his work program aimed to reduce the energy cost and to strengthen Puerto Rico's economy.

What is proposed is the construction of a 24" diameter steel pipeline to transport natural gas from the facilities of EcoEléctrica to the Cambalache, San Juan and Palo Seco Power Plants. The pipeline will be underground, it extends for some 92 miles and it will run through the municipalities of Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, Cataño, Bayamón and Guaynabo. The works will include clearing the right of way, excavation of trenches and installation and testing of the pipeline. In addition, they include modifications to units of the Cambalache, Palo Seco and San Juan power plants to enable them to burn natural gas as well as liquid fuels. The estimated cost of the project will be $447,000,000 dollars which includes the cost of design, purchase, conveyance of and delivery of materials, construction, payment of municipal licenses and taxes, if applicable, purchase of land, studies and permits. The cost for the conversion of the units to natural gas is estimated to be between $50 to $70 million dollars. Approximately between 1,000 and 1,200 temporary direct and 4,000 to 5,000 indirect jobs will be generated.

A. Project Rationale

Currently, 99% of the electricity generated by the Electric Power Authority (Autoridad de Energía Eléctrica or AEE, in Spanish) is obtained from petroleum. The excessive and unpredictable increase in the cost of liquid fuels makes us less competitive in a global economy. To control and reduce the high cost of electricity the AEE's Governing Board approved a General Strategic Plan for the Development and Expansion of Generating Capacity. This Plan established, as a quicker, more viable and environmentally safe alternative, that generating capacity would be added using natural gas as the main fuel, as part of the strategy to diversify fuel that would allow us to reduce the operating costs and to maintain sustained environmental compliance.

The main reasons for this determination are the following: in Puerto Rico there already is a Liquefied Natural Gas Terminal; the historical and projected price of natural gas is lower than the distillate fuels and it will be cheaper than residual No. 6 fuel oil; reduces the maintenance cost of the units, which are prepared, or can be modified, for its use; the technology is developed and tested; and there exist confirmed reserves of natural gas in different parts of the world. The use of natural gas for the production of electric energy increased during the last three years in the United States thanks to the implementation of an intensive domestic policy to promote the extraction of this fuel from non-conventional sources. This action was reflected in the international markets as a reduction in the price of the fuel, which permits Puerto Rico to buy this product at low and favorable prices.

In addition, when analyzing Puerto Rico's economic situation, and its relation with the sudden changes in the cost of liquid fossil fuels, it was concluded that Puerto Rico's economy is not viable, unless its vulnerability to the shocks of crude oil markets is reduced dramatically.[1] This reduction is achieved by diversifying the sources for generating electricity through the use of natural gas, as a transition to the effective use of renewable sources of energy in the future. The direct result will be the strengthening of our economy and, at the same time, the improvement of the environment, as demonstrated by the interpretation made by economists of the Environmental Kuznet's Curve.

Most of the electricity is produced in the south of Puerto Rico, but it is consumed in greater quantities in the north. Hence, the need for a geographical diversification with respect to the generation of electricity. With the construction of the Via Verde project, the AEE will be able to increase generation in the north and to improve the electrical system reliability.. This will give the AEE greater flexibility to choose the parameters to work on the point and with the fuel that will permit the most efficient and economical generation of electricity and with a lesser generation costs and impact on the environment.

On the face of the economic crisis confronting Puerto Rico, the AEE amended its Fuel Diversification Plan to accelerate the transition, through the use of natural gas, to the effective use of renewable energy sources. In the measure in which the use of natural gas cheapens the cost of electric energy and drives the country's economic recovery we will be in position to promote the development and establishment of generation from renewable energy sources. With this in sight the AEE signed several contracts to receive and acquire from private cogenerators a total of 295 MW in renewable energy projects and it is considering proposals to receive and acquire an additional 207 MW. In addition, internally the AEE is studying the viability of renewable solar thermal energy which would generate 50 MW.

B. Description of the Environment

A description of the environment in the zones through which the project will pass is

1 Comments in reaction to the conference titled "Transition to an Energy Use and Production Structure that will Permit Efficiency and Growth at a Sustainable Rate" by Gerrit Jan Schaeffer, drafted by Dr. Elías R. Gutierrez, February 19, 2010.

discussed in Chapter 3. The project consists of the construction and installation of a natural gas transportation system through the municipalities of Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, Cataño, Bayamón and Guaynabo. The same will have a longitude of 92 miles approximately and will require a maintenance right of way of 150' on each side of the pipeline. The construction will impact, within the right of way and throughout its length, a width of 100' (30.48 m) for the construction within which will be created a 50' (15.24 m) operational right of way and the remaining 50' in width will be restored to its original state once construction activities are completed. The total area impacted by the project will be 1,113.8 acres approximately. An additional area of 32 acres will be required for special and particular situations necessary in this type of construction.

The 48 wards (barrios) through which the pipeline will cross are: in Peñuelas, the wards of Tallaboa Poniente, Encarnación, Tallaboa Saliente, Tallaboa Alta and Rucio; in Adjuntas the wards of Saltillo, Portugués, Vegas Arriba, Vegas Abajo and Pellejas; in Utuado, the wards of Arenas, Salto Arriba, Pueblo, Salto Abajo, Rio Abajo, Caguana and Caníaco; In Arecibo, the wards of Río Arriba, Hato Viejo, Carreras, Tanamá, Cambalache, Santana, Factor and Garrochales; in Barceloneta, the wards of Garrochales and Palmas Altas, in Manatí, the wards of Tierras Nuevas Poniente, Bajura Afuera, Río Arriba Poniente, Río Arriba Saliente and Coto Sur; in Vega Baja, the wards of Pugnado Afuera, Río Abajo and Almirante Norte; in Vega Alta, the wards of Bajura, Sabana and Espinosa; in Dorado, the wards of Higuillar, Maguayo and Mameyal; in Toa Baja, the wards of Media Luna, Candelaria, Sabana Seca and Palo Seco; in Cataño, the Palmas ward; in Bayamón the Juan Sánchez ward and in Guaynabo the Juan Sánchez ward.

The environmental document presents a general description of the different environmental aspects characteristic of each one of the municipalities through which the Via Verde pipeline will cross. In addition, the AEE has contracted Asesores Ambientales y Educativos (AAE) to conduct the project's environmental studies. They, in turn, contracted diverse firms to realize the same. The firms contracted were the following: for the flora and fauna study the firm of Coll, Rivera Environmental; for the geology study, the firm of Geo Cim, Inc; for the Jurisdictional Determination, Coll Rivera Environmental; for the archeological study Phase 1A, archeologists Marisol Rodríguez Miranda and Carlos Ayes Suárez. These studies are part of the appendixes that are presented together with the environmental document.

The most relevant aspects regarding the environment are summarized as follows:

- Flora and fauna

For purposes of the flora and fauna, the study area was divided into five sub-areas: subtropical dry forest, subtropical wet forest plains, mogotes of the subtropical wet forest, subtropical wet forest, and lower-montano subtropical wet forest.

For the subtropical dry forest, the total plant species found was 164, divided into 57 families, and the total animal species found was 65 divided into 33 families. Of these, the critical species of flora, regulated and in danger of extinction, according to the Department of Natural and Environmental Resources (DNER) were: palo de vaca (pigeon-berry), jayajabico (soldierwood), guayacán blanco (Hollywood lignumvitae), *Passiflora bilobata* Jussieu, palo de violeta (violet tree) and jusillo (*Henriettea squamulosum*). The species of fauna were: pato quijada colorada (White-cheeked Pintail or Bahama Duck), guabairo (Puerto Rican Whip-Poor-Will, *Caprimulgus vociferous noctitherus*), paloma perdiz áurea (Key West Quail Dove), calandria (Puerto Rican Black-Cowled Oriole) and bien-te-veo (Puerto Rican Vireo).

For the subtropical wet forest plains the plant species was 353, divided into 86 families, and the total animal species was 90, divided into 47 families. Of these, the critical flora species, regulated and in danger of extinction, according to the DNER were: higüerillo (white fiddlewood), cedro hembra (Spanish cedar), ceiba (Silk-cotton tree) and avispillo (Jamaica ocotea). The species of fauna were: culebra corredora (Puerto Rican Racer Snake), paloma cabeciblanca (White-crowned Pigeon), boa de Puerto Rico (Puerto Rican Boa), buruquena (Freshwater Crab), calandria (Puerto Rican Black-Cowled Oriole) and the bien-te-veo (Puerto Rican Vireo).

For the area of subtropical wet forest mogotes the total species of plants was 424, divided into 91 families and the total species of animals was 86, divided into 41 families. Of these, the critical species of flora, regulated and in danger of extinction, according to the DNER were: palo de vaca (pigeon-berry), doncella (*Brysonima coriacea*), ceiba (Silk-cotton tree), almez (*Celtis australis*), ortegón (*Coccoloba swartzii*), palma plateada (Tyre palm), jayajabico (soldierwood), palma de lluvia (Llume palm), corcho blanco (Water Mampoo), *Hyperbaena domingensis*, lebisa (*Licaria triandra*), *Maytenus ponceana*, *Passiflora Murucuja L.*, palo de violeta (Violet Tree), *Pristimera caribaea*, almendrón (Florida poisontree), palma de sombrero (Puerto Rico Palmetto), ortiga (*Urera baccifera*), *Zamia amblyphyllidia*. The species of fauna were: culebra corredora (Puerto Rican Racer snake), boa de Puerto Rico (Puerto Rican Boa), calandria (Puerto Rican Black-Cowled Oriole) and the bien-te-veo (Puerto Rican Vireo).

For the area of the subtropical wet forest the total species of plants was 363, divided into 94 families, and the total species of fauna was 64, divided into 28 families. Of these, the critical species of flora, regulated and in danger of extinction, according to the DNER were: culantrillo, higüerillo (white fiddlewood), doncella (*Brysonima coriacea*), cedro hembra (Spanish-cedar), ceiba (Silk-cotton tree), plateado (*Exostema ellipticum*), *Hibiscus trilobus*, palo de peo (*Lasianthus lanceolatus*), laurel (*Jamaica ocotea*), almendrón (Florida poisontree), yagrumillo (*Schefflera gleasonii*) and ortiga (*Urera baccifera*). The species of fauna were: culebra corredora (Puerto Rican Racer Snake), calandria (Puerto Rican Black-Cowled Oriole) and bien-te-veo (Puerto Rican Vireo).

For the area of lower-montano subtropical wet forest the total of plant species was 86, divided into 41 families and the total animal species was 20, divided into 12 families. Of these, the critical flora species, regulated and in danger of extinction, according to the DRNA was cedro macho (*Hyeronima clusioides*). The fauna species was the bien-te-veo (Puerto Rican Vireo).

Although according to the consultation made with the United States Fish and Wildlife Service (F&WS), the project could affect habitat adequate to several species, none of these species was detected during the field work, with the exception of the guabairo (Puerto Rican Nightjar).

- Geology

According to the study of the geology, the area through which the project will cross is very diverse and it encompasses close to 90 million years of Puerto Rico's geological history. The geological report indicates that the alignment crosses two geological faults that cross in the general direction of east to west in the Juana Diaz outcropping, both of the normal type. These, like the other geological faults that cross the alignment, are considered inactive. The alignment enters the layer of rocks from the Eocene (40 to 55 million years ago) which is comprised in the Great Southern Puerto Rico Fault Zone. The layer, some 4.5 km wide, extends until the margin of the Utuado Pluton, an extensive mass of intrusive rock that is also within the alignment. Also, along a 14 km stretch, the alignment crosses two of the types of topographical zones that characterize the Karst Zone; which are not necessarily part of the protected Karst Zone, according to the DNER.

The report concludes with a discussion of the limitations that the alignment's geology can present to the Via Verde project. , It indicates that none of them present a major impact to the project, since all of them are addressed with the geologic and geotechnical study that is the basis for the design and construction which minimizes or eliminates their possible impacts.

- Natural systems

The project will cross through a great variety of natural and artificial systems characteristic to the island. The most significants natural and artificial systems within a distance of 400 mt or less of the proposed project alignments were considered in the document.

Next to the project are five bays (the Tallaboa Bay in the Municipality of Peñuelas, the Guayanilla Bay in the Municipality of Guayanilla, the Toa Bay in the Municipality of Toa Baja, the San Juan Bay and the Puerto Nuevo Bay); one cove (Boca Vieja in the Sabana Seca ward of the Municipality of Toa Baja); three estuaries (the estuary of the Tallaboa Bay, the Cocal River estuary, and the San Juan Bay estuary); one beach (Punta Salinas Beach); three forests (Bosque del Pueblo, Rio Abajo Forest and Vega Forest); two quarries (in the municipalities of Peñuelas and Utuado); two salt mines (in the Tallaboa Poniente ward of the Municipality of Peñuelas); four marsh areas (freshwater marsh in the Santana ward and the Caño Tiburones marsh, both in the Municipality of Arecibo; San Pedro marsh in the Sabana Seca ward of the Municipality of Toa Baja, and Las Cucharillas marsh between the municipalities of Guaynabo, Toa Baja and, for the most part, Cataño); 31 acquifer areas (two each in the municipalities of Peñuelas, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja and Cataño; three in the Municipality of Adjuntas; five in each of the municipalities of Utuado and Arecibo; and one each in the municipalities of Bayamón and Guaynabo); three springs in the Municipality of Arecibo; 18 canals (three in the Municipality of Peñuelas, seven in the Municipality of Arecibo, three in the Municipality of Manatí, one in the Municipality of Vega Baja, one in the Municipality of Dorado, two in the Municipality of Cataño, and one in the Municipality of Guaynabo); six lakes and lagoons (one artificial body of water in the Tallaboa Alta ward of the Municipality of Peñuelas; the Adjuntas lake, in the Juan Gonzalez ward; the Pellejas lake in the Pellejas ward, and the Garzas lake between the Garzas and Saltillo wards; the Matrullas lagoon in the Palo Seco ward of the Municipality of Toa Baja; and Secreta lagoon in the Palmas ward of the Municipality of Cataño); six cave systems (five in the Municipality of Arecibo and one in the Municipality of Vega Baja); a 3.91 lineal-mile crossing in the Carst Belt Region in the Municipality of Manatí; 156 drinking water wells and sampling stations; 117 creeks; 13 rivers (the Tallaboa river in the Municipality of Peñuelas; the Corcho river in the Portugués ward of the Municipality of Adjuntas; the Pellejas river in the Vegas Abajo ward of the Municipality of Adjuntas; the Rio Grande de Arecibo in the Pellejas ward of the Municipality of Adjuntas, and in the Carreras, Hato Viejo and Tanamá wards of the Municipality of Arecibo; the Caguanita river in the Caguana ward of the Municipality of Utuado; the Caguanas river in the Caguanas ward of the Municipality of Utuado; the Tanamá river in the Tanamá ward of the Municipality of Arecibo; the Rio Grande de Manatí in the Palmas Altas, Bajura Afuera and Rio Arriba Poniente wards of the Municipality of Manatí; the Cibuco river in the Municipality of Vega Baja; the La Plata river in the Municipality of Dorado; the Cocal river in the Sabana Seca ward of the Municipality of Toa Baja; the Hondo river in the Palmas ward of the Municipality of Cataño; the Bayamón river in the Palmas ward of the Municipality of Cataño); four natural reserves (Tiburones Canal Natural Reserve, Hacienda La Esperanza Nature Reserve, El Indio Natural Reserve and the Las Cucharillas Marsh Nature Reserve); 128 sinkholes (3 in the Municipality of Utuado, 64 in the Municipality of Arecibo, 47 in the Municipality of Manatí, 9 in the Municipality of Vega Baja, 2 in the Municipality of Guaynabo and one each in the municipalities of Dorado, Toa Baja and Cataño - the alignment will cross over 21 of which 14 had already been impacted by PR-10).

It is stressed that the project will not impact or affect coral reefs, cays, dunes, cisterns, dams, reservoirs, drinking water intakes or irrigation systems because none are in areas near the project.

- Determination of Jurisdiction

The determination of jurisdiction study concluded that of the 2,988,833.3 m² (738.6

acres) of wetlands under the jurisdiction of the United States Corps of Engineers delimited for this project, the project's construction right of way will cover some 369.3 acres.

The delimited wetlands are classified in the following categories: palustrine forested, palustrine herbaceous, palustrine herbaceous in agricultural use in the past or in the present, estuarine forested, estuarine forested canals and estuarine salt marshes. Approximately 2.0 acres of palustrine forested wetlands were delimited; 310.1 acres of palustrine herbaceous wetlands; 397.8 acres of palustrine herbaceous wetlands in agricultural use in the past or in t he present; 23.6 acres of estuarine forested wetlands; 1.2 acres of estuarine forested canals; and 3.9 acres of estuarine salt marsh wetlands.

• Soil Classifications

The project is distributed in 419 plots of which 84.8% belong to the private sector and 15.2% to the public sector. The different types of use of the soils through which the alignment will cross were distributed approximately in the following manner: industrial area, 3.1%; public and recreational area, 2.8%; transportation area, 0.3%; commercial area, 0.1%; residential area, 1.0%; agricultural area, 56.2%; forest area, 35.3%; and hydrographic-hydrological area, 1.3%.

Of the 92 miles the project encompasses, 4.3% will be in a zone classified as having a 0.2% annual probability of risk of flooding, 0.43% will be in a zone classified as A (areas with a 1% annual probability of flooding and a 26% probability of flooding within 30 years), 38.9% will be in a zone classified as AE (areas with a 1% annual probability of flooding and a 26% probability of flooding within the next 30 years), 3.8% will be in a zone classified as VE (area with an annual probability of flooding equal to, or greater than 1% and a 26% probability of flooding within 30 years) and 54.5% will be in a zone classified as X (area with an annual probability of flooding of less than 1%).

• Highway crossings

Sixty three (63) state highway crossings are identified as intercepted by the project's alignment. These are indicated in Addendum 1, Highway Crossings.

• Proximity to the communities and quiet zones

The sectors or communities close to the project's alignment, approximately 400 meters or less from them, and each municipality's quiet zones closest to the project were determined. The findings are gathered in Addendum 2, Distance to the Communities and Quiet Zones.

• Archaeological and architectural findings and cultural and historic sites

The Phase 1A study identified the already known archaeological resources and established the basis for discovering additional resources in the project's area. The following findings are worth highlighting:

In the Municipality of Peñuelas - vestiges of the railroad line and the Loyola Hacienda in the Tallaboa Poniente ward; a small shell heap with pottery and conch shell fragments from the chicoid taino period in the Encarnación ward; the Dolores and Coto Haciendas in the Rucio ward.

In the Municipality of Utuado: an archeological find near the cemetery and the river crossing.

In the Municipality of Arecibo: archaeological residues inside a cave with habitation remains and several in the Rio Arriba ward; archaeological finds in Refugio Salmón and in the Ventana cave, in the Hato Viejo ward; residues, a cave or rockshelter, petroglyphs and pictographs and historical material were found in Matos Cave in the Carreras ward.

In the Municipality of Barceloneta, in the Palmas Altas ward there are vestiges of the railroad line that intercept the alignment at mile 53.25. The Phase 1A Archaeological Study recommends a 1B Phase, with the exclusion of the mountainous areas and the Tiburones Marsh zone, for the whole area the project will traverse in this municipality.

In the Municipality of Manatí: two architectural structures, the Truss Bridge and Central Monserrate sugarcane mill.

In the Municipality of Vega Baja: an architectural structure, Hacienda Monserrate; the study recommends going ahead with Phase 1B in the Paso del Indio area.

In the Municipality of Vega Alta: architectural structure, a bridge; the Abra de los Perros Cave is considered an area of archaeological findings.

In the Municipality of Dorado: Casa Hernandez or the residence of Mrs. Antonia Ramírez; abundant dispersed materials were found of the Taíno/Colonial period of the late 19th Century; material on the surface of the Taíno, subtaíno, late saladoid and colonial period in Punta Corozo; a multi-component site with Taíno and late 19th century colonial period in the Mameyal ward.

In the Municipality of Toa Baja: Santa Elena dairy farm; fragments of 19th century historical ceramic dispersed on the surface; ruins of the Our Lady of Candelaria shrine in the ancient Hacienda El Plantaje, in the Sabana Seca ward of Toa Baja; an archaeological site under the gravel topping in the posterior part of land belonging to the Electric Power Authority, in the Palo Seco ward.

In the Municipality of Cataño: Hacienda Palmas in the Palmas ward.

C. Study of Alternatives and selection of the alignment

Chapter 4 analyzes in detail the alternatives considered for the execution of this project. The following were considered among such alternatives: land alignments for a natural gas pipeline; the use of a system of barges and buoys to receive, re-gasify, store and provide natural gas; the construction of a liquified natural gas receiving and re-gasification terminal. In addition the utilization of renewable energie options technicaly and commercially proven and the No Action alternative were also considered.

- No Action

The No Action alternative was found to be not feasible given the transcendence, importance and public well-being sought by the project. It was considered that, although this alternative would avoid the impact related to the construction, installation and operation of a pipeline to transport natural gas, such impact can be minimized and mitigated. This alternative is not indicative of no impact, since it forces the continued burning of petroleum derived products which generate a greater amount of pollutinon and emissions into the air and at higher costs than the burning of natural gas, which would make the service of electric power more expensive and it would negatively impact Puerto Rico's economy.

The No Action option would not permit maintaining a structure of fixed costs that would avoid the abrupt peak changes in the cost of the fuel acquired. This can only be avoided by reducing the dependence on the use of petroleum and expensive fossil fuels. In addition, the limitations of the federal and state permits on the type of fuel that can be burned would lead us to one of two options: to cease generating electricity, which is not viable, or burn a cheaper fuel with higher sulfur content than that contained in said permits, which would expose us to fines and sanctions.

- Liquified natural gas receiving terminal in the San Juan Power Plant

Even though Puerto Rico has an Liquefied Natural Gas (LNG) Terminal with the capacity to supply our needs, at the EcoElectrica Cogenerator facility, the alternative of constructing a new LNG terminal near the San Juan Thermoelectric Plant was considered because it would be near an existing dock for the receipt of fossil fuel. Three criteria were used determine whether this was a viable alternative: specific site factors, maritime operations, and environmental issues.

The analysis of these criteria leads us to the conclusion that this was not a viable alternative for the following reasons: we would need to dredge the navigational canal and the turning basin; the dredged material would present the problem of securing an adequate disposal location; the dredging and disposal operations would produce a high concentration of sediments, which would impact the benthic area and the water quality even more; maritime traffic would be adversely affected and as a consequence our economy and tourism because the San Juan Bay is the backbone of our tourist economy; the increase in maritime traffic would affect marine life in the area; there would be an increase in the temperature of the Puerto Nuevo Bay waters, which would have a cumulative effect on the benthic community of the bay, water quality would be affected and, in consequence, the water quality parameters required in the environmental permits which govern the power plant; due to space limitations in the power plant and in areas near it, we would be unable to comply with the regulations that determine the space that must exist between the different elements within the terminal and the establishment of an exclusion zone or distance from populated areas; the environmental impact associated with the construction of the pipelines to transport natural gas in the North of the island would not be eliminated; the process of studies and permits together with the construction and commencement of the operation could take from 7 to 10 years, it would not satisfy our need for an immediate project to propitiate the transition from petroleum to renewable sources of energy; the project would be too onerous because it would surpass $1,000 million.

• Systems of barges and buoys

The installation of a system of barges and monobuoy for the receipt, storage, re-gasification and transport of the natural gas was considered as one of the alternatives. The AEE evaluated the viability of the construction of these systems in three areas: San Juan, Toa Baja and Arecibo. The criteria considered in such evaluation were: costs, space, time to have it operational, permits, safety, environmental justice, past experiences in Puerto Rico and the United States.

The process for the design, construction and operation of the barges and buoy system would have an approximate cost for each power plant of between 70 and 80 million dollars yearly, subject to the signing of a contract with the company in charge of the process for a term of not less than 20 years. At the end of the 20 years the cost would be some 1.6 billion dollars for each power plant. The time period required to start the operation of the system would be between 5 and 8 years. In addition, an analysis for each power plant demonstrated that it is not a viable alternative in the short term.

The San Juan Power Plant does not have space available to locate the receiving terminal; the pipeline to the power plant would run through an area of intense maritime traffic; there are low-income communities near the project that would be affected; the proximity of CAPECO would influence the community's perception of the project.

The Palo Seco Power Plant does not have space to locate the receiving terminal; the permits process is complicated and costly; there are low-income communities near the project that would be affected, the proximity to CAPECO would influence the community's perception of the project.

The Cambalache Power Plant does not have space available to locate the receiving terminal; the permits process is complicated and costly; there are low-income communities near the project that would be affected.

The foregoing ruled out the construction of a system of barges and monobuoy for the receipt, storage, re-gasification and transport of natural gas within the time frame required for the action under consideration. Consequently, the supply of natural gas to this power plant will have to be through a gas transport pipeline, inevitably.

- Natural gas pipeline

In this analysis, some components of the study owned by the AEE and conducted under contract by *Power Technologies Corporation* (PTC) in 2006, titled: *Corridor and Alternative Routes Selection Study*. The two alignments suggested in the PTC study to carry natural gas from EcoEléctrica to Cambalache Power Plant were analyzed, together with a third alignment not considered in the study. The same was done with the alignments suggested in the study for the transport of natural gas from Cambalache Power Plant to the metropolitan area power plants, Palo Seco and San Juan.

For the selection of the alignment with the greater potential for development, the three alignments for each stretch were compared and the alignment that obtained the greater number of positive criteria in its favor was selected. Eight criteria were used to compare each stretch: land use; bodies of water impacted; miles of forest or natural reserves impacted; endangered species; archaeological findings; highway crossings; zoning or soil calification and nearby residences. For each criterion, a positive (+) value was assigned to the most favored stretch, except for the criterion of nearby residences, which was assigned a value of two (++) positives since one of the primary goals of the project is to be as far away as possible from communities or inhabited areas.

The matrix created would indicate which alignment would have the greater potential for development for each stretch. The alignment selected for the project would be the union of the two favored segments. Necessary variances were incorporated into this selected alignment due to different reasons: minimal impact to the communities, avoiding or minimizing the environmental impacts, economic factors and factors associated to the construction. The total number of variances incorporated were 18, broken as follows: 12 variances to keep far away from communities; three variances to avoid or minimize environmental impacts; one variance for economic factors; and two variances for construction reasons. The incorporation of these variances resulted in the alignment presented in this environmental document.

D. Project Description

Via Verde will provide a natural gas transport system from EcoEléctrica in Peñuelas to the AEE's Cambalache, Palo Seco and San Juan power plants through some 92 miles of 24" diameter, underground steel pipeline.

The pipeline and the other construction materials will be ordered from companies outside of Puerto Rico and will be received by the Port of the Américas and the San

Juan Port Zone. Six operation centers will be established located adjacent to each port, plus in the areas of Utuado, Arecibo, Vega Alta and Toa Baja. Their locations are already impacted by industrial activity and their use will be temporary in nature while the project is under construction. They will serve as bases for the receipt, storage, inventory and dispatch of materials and equipment for the project.

The project will have a cost of $447,000,000 dollars. This sum includes the items of design, purchase, hauling and delivery of materials, construction, payment of licenses and taxes, land acquisitions, studies and permits. The cost of the conversion to natural gas of the units is estimated at between 50 and 70 million dollars.

Before the excavation begins there will be coordination with the Public Service Commission or with the Permit Office (Oficina de Gerencia de Permisos), as applicable, so that the agencies or companies with underground infrastructure mark the location of said infrastructure. Whenever possible, a minimum distance of 24" from other underground infrastructure will be maintained.

Four gas flow meters with their respective equipment, one bidirectional PIG launcher/receiver and one PIG receiver will be installed, and connections will be provided for a portable PIG launcher/receiver unit. The latter are to carry out inspections, measurements and cleaning inside the pipeline. In addition, isolation or security block valves will be installed to isolate segments in case of inspections, repairs or emergencies, the number and location of which will be determined by the class and location.

The equipment will have the capacity to operate at maximum pressure and temperature of 1,450 psi and 120°F, but the entry pressure will be 650 psi and it will be reduced to 400 psi before it enters the combustion turbines.

- Natural Gas

Natural gas is a fossil fuel formed by organic matter underground at high pressure for geological-scale times. It is a mixture of hydrocarbons whose principal component is methane (CH_4). It is colorless and odorless and it is lighter than air; it's specific gravity fluctuates between 0.55 and 0.64; its explosive limit is 3-17%, outside of these limits there is no combustion. Natural gas is non-toxic, but it is a simple asphyxiant if it displaces oxygen, which could produce dizziness, deep breathing or, due to the need for air, nausea and unconsciousness in case of overexposure, which would require immediate medical attention. It is not classified as carcinogen or potentially carcinogen.

To address leakages the emergency response and rescue personnel must use a self-contained respirator (SCBA) and fire-resistant clothing, and they must have the training required by Law (29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*). All personnel must be evacuated from the affected area and if it is in a confined space, the area ventilation is to be increased.

One cubic foot of natural gas produces an average of 1,000 BTU. It represents one fifth of the world's energy consumption. It is one of the cleanest fossil fuels and better for the environment because the sulfur dioxide emissions are minimal and those of nitrous oxide and carbon dioxide are less than those of other fossil fuels. The natural gas industry is comprised of three segments: production, transmission and distribution. In Puerto Rico it is used in its entirety for the generation of electricity although natural gas has other domestic, commercial, industrial and transportation uses.

- Personal safety

The construction project will be contracted out. The contractor will be responsible for submitting a work plan which includes the health and safety aspects established in the Code of Federal Regulations, Title 29, *Labor*, Part 1910, *Occupational Safety and Health Standards* and Part 1926, *Safety and Health Regulations for Construction.*

- Construction stages

The construction will be done by segments and it will follow a specific sequence (production line style). Each construction stage will be described below.

  - Identification of owners, Surveying l and Environmental Studies

The *New Star Acquisitions* company was hired for this stage. They identified the land owners; they were asked for an access permit to carry out the land surveying and the pertinent environmental studies and one was signed. In the first stage of the surveying the LIDAR aerial technology was used; with the alignment's coordinates the environmental studies were started.

  - Clearance of the right of way

Once the land comprising the right of way has been acquired, heavy machinery will be used to clear and level. Although the construction right of way will be 100' in flat areas, on mountainous areas and in places where the horizontal directional drilling is made, it may range from 100 to 300 feet. It is estimated that 1,113.8 acres will be impacted and 687,760 cubic meters of soil will be removed. The soil removed will be stored to be used later in the restoration stage. The necessary measures will be taken to minimize sedimentation of the water bodies.

  - Land surveying

The center points of the line will be checked and marked. Then the pipeline (in 40-foot long spreads) is laid throughout the alignment.

o Trench Construction

Specialized machinery will be used for the construction of the trenches (*wheel ditcher)* or machinery with a mechanical arm, depending on the conditions of the area. The trenches will be 5 to 6 feet deep and 4 to 5 feet wide, so as to allow a 3-foot cap over the pipeline. The removed soil will be sifted and stored alongside the trench to cover the same later. The remainder will be disposed of in an authorized landfill. It is estimated that 494,206 cubic meters of soil will be removed.

The highway crossings will be made by boring and the pipeline will be at a minimum of 4 feet under the same highway. (See addendum 1, Highway Crossings). These segments will be designed to tolerate the weights associated to the highway and the vehicles that pass through it. The crossings of bodies of water and of some highways will be made by horizontal directional drilling (HDD). This is a "dry" crossing method because it does not interfere with the flow of the body of water, and it is made underneath the bed of the body of water. A dye will be added to detect small bentonite leaks. Ten bodies of water were identified that will be crossed by HDD. In addition, 66 crossings of bodies of water were identified to be crossed by open trench. Addendum 3, Crossings of Bodies of Water, contains the bodies of water and the coordinates where the project will cross.

o Welding and bending

Once the pipeline is positioned, the necessary bending is made to couple it to the ground with machinery that exerts hydraulic pressure. Then it is laid on supports, the ends are cleaned, lined up and welded using the manual submerged arc welding method. The welded seams will be checked with non-destructive methods; if any flaw is detected, the weld is repaired or it is cut off and a new weld is made. Lastly, the ends are covered with a protective coating. Next a second inspection of the pipeline protective coating is made.

o Lowering and backfill of the trench

The pipeline is lifted using specialized machinery (sidebooms) and it is lowered into the trench. Fine-particle sifted soil is used first to back-fill the trench to prevent damage to the protective coating. Then the remainder of the soil and small stones are deposited on the excavated trench and finally the top soil is placed within the construction area. In total the minimum cover will be 36 inches and 48 inches in agricultural areas. The recommendations of the Highways Authority with respect to the backfill material to be used will be followed in crossings of highways, roadways and roads where the open trench method was used.

o Hydrostatic testing

In compliance with 49 CFR 192.505, *Strength test requirements for steel pipeline*, hydrostatic testing will be conducted on the totality of the pipeline. The pressure will be higher than the operating pressure for at least eight hours.

o Pipeline right of way restoration

After passing the hydrostatic test, the right of way will be restored. Of the 100 feet width of the construction right of way, 50 will be restored to their original state; the remaining 50 feet will be a permanent or operations right of way, which will be restored only with wild vegetation or lawn without deep roots. In agricultural lands it may be used to plant crops that don't have deep roots. On wetlands, mitigation will be carried out "on site".

• Construction in special areas

o Wetlands and mangrove areas

In non-saturated areas the same equipment and procedure of open trench will be used. In saturated areas, the pipeline is welded outside the wetland area; the excavation and backfill of the trench is made with backhoes; the pipeline is installed by the push and pull method through flotation buoys; the buoys are removed and the pipeline is sunk by its cement coating or using weights.

To prevent the equipment from sinking or to avoid disturbing the soil or excessive turbidity of the water, timber mats or timber rip-raps will be placed. The organic cover extracted will be stored and used as backfill.

o Earthquake prone areas

Via Verde will be designed and constructed with similar specifications to those used in places with a higher incidence of intense earthquakes, like California and Alaska. The following measures will be incorporated to the design to guarantee the integrity and continuous operation of Via Verde: the relative alignment of the pipeline relative to the faults to diminish the impact of a slip in such fault; burying the pipeline in a wide trench, with long lateral slopes filled with compacted sand to allow for the deformation of the pipeline during a seismic event; including enough bends in the design of the pipeline to guarantee its flexibility; the results of the geotechnical studies that will be conducted to evaluate the properties of the soil.

o Karst zone areas

During the construction there will be a resident biologist at all times to evaluate the area carefully. Only light equipment will enter to minimize the possibility of harm. Adequate erosion and sedimentation controls will be established. There will not be any operation centers or auxiliary spaces of the construction in this zone. The pipeline will be installed through the pulling method to minimize the heavy equipment. The backfill will be adequate to permit the hydraulic capacity of the soil. Once the trench is covered, vegetation will be immediately planted in the area surrounding the permanent right of way. The pipeline patrolling program during the operation will give special attention to the soil to detect any erosion.

o Use of explosives

The use of explosives will not be necessary. Nevertheless, if any area were identified in which the use of explosives is indispensable, it will be made only by specialized personnel and in compliance with the applicable laws and regulations.

• Conversion of Units to natural gas

The units that will use natural gas for the production of energy will be: Units 1, 2 and 3 of the Cambalache Power Station; Units 3 and 4 of the Palo Seco Power Station; Units 7, 8, 9,10 and Combined Cycle Units 5 and 6 of the San Juan Power Station. The units will be modified so they can burn natural gas, Bunker C or a combination of both. The minimum and maximum flow of natural gas each power station will need, respectively, will be: 5.5 and 61, 1.1 and 84, 1.1 and 180 MMSCFD. The systems that will require modifications, among others, will be: modifications to boilers and their gas supply system and modifications to turbines.

• Risk analysis and safety measures

The safety aspects of the gas pipelines are addressed by the Office of Pipeline Safety (OPS). It is in charge of carrying out inspections, establish regulations, promote research, issue compliance orders, apply civil and criminal penalties and educate the public, among other functions. The Pipeline Safety Improvement Act established an alliance between the Federal Department of Transportation, the Energy Department and the National Institute of Standards and Technology, to conduct research, make demonstrations and standardize procedures that guarantee the integrity of pipelines. Via Verde of Puerto Rico will be governed by the codes of the Federal Department of Transportation.

According to the OPS, the causes of incidents and accidents in the natural gas pipelines are, in order of probability of occurrence: corrosion, excavations, failure of the construction materials, action of the forces of nature, human error and unknown or miscellaneous causes. The OPS established preventive measures to minimize each one of these risks.

o Information program

One of the most important factors of Via Verde is safety, for which reason keeping the public informed is vital to the success of the project. The AEE established a public information plan in two phases.

The first one already commenced and it covers the periods of time before and during the construction. We continue to present the project to the mayors and their legislative assemblies, to agencies with inherence in the project, professional forums and to the general communities. The presentations have the purpose of: conveying clear, concise and correct information; know and respond to the communities' concerns; and establish a point of contact between the community and the AEE. In addition, the different means of communication are used to convey the information.

The second phase will be during the operation of the project. A written Public Information Plan will be developed in accordance with 49 CFR 192.616, Public Awareness, and the American Petroleum Institute, Public Awareness, Recommended Practice 1162.

o Class location

The different specifications for the manufacture of the pipeline are established in 49 CFR 192.5, Class Location, in accordance with its location or the population density. The regulated specifications that will depend on the classification are, among others: thickness of the pipeline, distance between valves, operating pressure, frequency of inspections and tests. The class unit by location extends to 220 yards (200 meters) on both sides of the line center of any continuous mile of pipeline. There are four classes defined in the following way: Class 1- area near the coast or which contains 10 or less buildings designated for human occupation; Class 2 - area which contains more than 10 but less than 46 buildings; Class 3 - area that contains more than 46 buildings or where the pipeline is within 100 yards of a well defined place (building, children's play area, recreational area, open air theater, or where the public congregates) and is occupied by 20 or more persons, at least 5 days in the week for 10 weeks in any 12 month period (the days and weeks don't need to be consecutive); Class 4 - area where there are four storey buildings or taller.

The classification of the class unit by location may vary by the increase in the population density after the pipeline is installed and in use. The federal regulation establishes that a study must be made to determine, among other things, the hoop stress and the yield strength. This study will determine whether there will be a need to vary the operational pressure so as to adapt to the new class by location. The applicable regulation is 49 CFR 192, sections 609, Change in Class Location: Required Study, 611, 553, General Requirements, and 555, Up rating to Pressures that Will Produce a Hoop Stress of 30% or more of SMYS (Specified Maximum Yield Strength) in Steel Pipelines.

o Pipeline specifications

The life span of the Via Verde pipeline is fifty years. The same will be designed in accordance with federal regulation 49 CFR 192, sections 105, Design Formula for Steel Pipe and 111, 107, 113 and 115, Design Factor for Steel Pipe, Yield Strength for Steel Pipe, Longitudinal Joint Factor for Steel Pipe and Temperature De-rating Factor for Steel Pipe, and standard 5L of the American Petroleum Institute (API 5L). Among the tests to be conducted on the pipeline are: chemical analysis, impact, hardness, hydrostatic and weld tests.

- Corrosion control

A Fusion Bonded Epoxy (FBE) external coating will be applied to the pipeline. A second coating, Tough Coat, will be applied over the FBE to the part of the pipeline that passes through bodies of water and under highways for protection when the pipeline is pulled from one side to the other. In addition, the pipeline will have cathodic protection to prevent corrosion. The pipeline will be evaluated annually to insure the functioning of the cathodic protection and the voltage will be monitored by monitoring stations that will check the functioning of the rectifiers. All the parameters of the federal regulations will be followed: 49 CFR 192, sections 463, External Corrosion Control: Cathodic Protection, 469, External Corrosion Control, Test Stations. During the operation, a PIG (pipeline inspection gauge) will also be used, a tool that runs the length of the pipeline and uses non-destructive methods to identify and document defects and anomalies in the same.

- Welding

Welders will be qualified before the project starts; and all of them must pass the tests required for this type of welds. The destructive method will be used for the qualification of the pipeline welds. It consists in evaluating the weld measuring the force needed to break it. Approved welders will be assigned an identification number that must be placed on every welding job s/he performs. If any irregularities are detected in the weld during the X-ray test or the hydrostatic test, the welder will be removed from the job immediately and the weld will either be repaired, or it will be cut off and a new weld will be made. The weld inspections will be visual, by an inspector with specific expertise in the type of weld, and through X-rays. The welds will be covered with a protective coating. The applicable regulation is 49 CFR 192, section 243, Non-destructive Testing.

- Hydrostatic test

Once the pipeline has been lowered into the trench and covered, it is filled with water and a test pressure greater than the maximum allowable operating pressure (MAOP) is applied. The test pressure is 1.1 times the MAOP in open spaces, 1.25 times in Class 2 locations and 1.5 times in Class 3 locations. The pressure applied is stabilized for 8 hours. The test helps locate areas in the pipeline (including the welds) that cannot tolerate elevated pressures and which therefore fail.

o Pressure control equipment, isolation valves

To prevent accidents caused by excessive pressure, monitoring and protection equipment to guard from harm caused by elevated pressures will be installed. In addition, valves will be installed that will isolate sections of the pipeline in case of emergency or to perform inspections and repairs. These will be placed by intervals as required by regulation, as a function of the Class by Location.

o Precautions for excavations

The greatest risks to the integrity of the pipeline are excavation activities whereby any contact with the pipeline must be informed to the operator for the corresponding actions. Before excavating, every person must communicate with the Public Service Commission, or the Permits Office (OGP), as applicable. They will communicate with the operator who will mark the pipeline's alignment. Work will be done in conjunction with the municipalities to establish an excavation control mechanism. An inspector will be assigned to be present during the excavation.

o Operator qualification

The OPS requires that the operator and personnel hired by him takes part in a formal personnel qualification program (Operator Qualification Rule, August 27, 1999), which must be in writing. This plan must start before the pipeline begins to operate. The personnel qualification program is governed by 49 CFR 192.805, Qualification Program, and it must be documented in accordance with 49 CFR 192.807, Recordkeeping, to demonstrate compliance with the written plan. The OPS established an inspection protocol for use by federal and state inspectors. In addition, the operation personnel must comply with the Regulations of the Testing Program to Detect Controlled Substances in Officers and Employees of the AEE.

o Clearance distance from the pipeline

The regulation, for the purpose of protecting the underground pipeline, requires that it keep a distance of 12 inches from other underground equipment and infrastructure (49 CFR 192.325). Nevertheless, whenever possible a distance of 24 inches will be kept. The regulation does not provide distance requirements between the pipeline and buildings or dwellings.

o Inspection and maintenance

A Pipeline Integrity Management Program will be developed and established pursuant to 49 CFR 192.911, which will discuss the specific risks for each high consequence area (HCA, or AAC for *Area de Alta Consecuencia* in Spanish) identified in accordance with 49 CFR 192.905. In addition, an Inspection and Maintenance Program will be prepared that will cover the pipeline, flow meters, valves and other equipment. Copies of these will be kept in our Power Plants and in EcoEléctrica. In addition, pursuant to 49 CFR 192.709, Recordkeeping, a file will be kept for everything related to the repairs, patrolling, inspections and tests.

- Patrolling

The AEE will establish a patrolling program to observe evidences of leakage and conditions in the right of way that may affect the integrity of the pipeline. The patrolling methods will be: walk through, drive through or helicopter flights. The frequency of patrolling is established in 49 CFR 192.705, Transmission Lines: Patrolling, and it depends on the class by location.

- Markers

Once the line is constructed, markers will be placed throughout its length. The places, reasons and information the markers must have are regulated in 49 CFR 192.707, Line Markers for Mains and Transmission Lines.

E. Impacts

Every possible effort was made to avoid areas or habitats of ecological value and to avoid significant impacts. In places where it is unavoidable, measures will be taken to minimize the negative effects and mitigate the impact caused.

- Deforestation and soil movement

It is estimated that 1,113.8 acres of land will be impacted. All the trees and vegetation will be removed from that area. The movement of soil for the project's construction is 1,181,966 cubic meters, approximately. The impact caused by these activities will be soil erosion, sedimentation of bodies of water, emission of fugitive dust, possible reduction in the soil's absorption capacity due to compaction, increase in the potential for the introduction of invasive species and reduction of available habitat for fauna.

- Emissions of fugitive dust

The following measures will be taken to minimize these impacts: a construction permit will be requested for fugitive dust emission sources; a Notice of Intent will be filed and a Storm Water Pollution Prevention Plan will be prepared; sprinkler trucks will be used to sprinkle the areas; dump trucks will use tarps.

- Erosion and sedimentation

To minimize the impact the following measures will be taken: the work area will be demarcated to avoid removal from outside the area; an Erosion and Sedimentation Control Plan will be prepared; a Notice of Intent will be filed and a Storm Water

Pollution Prevention Plan will be prepared; the soil will be stored adjacent to the trenches or be reused as backfill (the remainder will be disposed of in an authorized landfill); the soil will be compacted; and the removed vegetable cover and trees will by mechanically shredded and reused as wood chips; in areas of marked slopes, terraces will be built and covered with wood chips.

- Karst Zone

The protected karst zone in Puerto Rico covers some 151 square miles. Vía Verde will cross over some 3.91 linear miles, or 0.08 square miles of these, which is equivalent to **0.05%** of the protected karst zone. During the construction there will be a resident biologist available at all times to evaluate the area carefully. Only light equipment will enter the zone to minimize the probability of damage, for that reason the installation of the pipeline within said area will be using the push and pull method. Adequate erosion and sedimentation controls will be established. There will be no operation centers or auxiliary spaces to the construction in this zone. The backfill will be adequate to allow the soil's hydraulic capacity. Once the trench is covered, vegetation will be planted immediately in the area surrounding the permanent right of way. The pipeline patrolling program during the operation will pay special attention to the soil to detect any erosion.

- Agriculture

The potential impacts on agricultural land will include: crop losses, interference with agricultural drainage, loss of top soil, soil compacting and impact to irrigation systems. Once the construction is finished, the use of the soil will continue as before, including planting as long as it doesn't include trees whose roots may interfere with the pipeline.

The following measures were evaluated to minimize or mitigate the impacts and the viable ones will be implemented: the time of less impact to agriculture will be established; when the soils are used continually for cultivation damages will be indemnified; topsoil will be separated and stored for reuse; erosion control measures will be implemented; the surface soil will be de-compacted to facilitate planting and water absorption; the construction works will be coordinated with landowners and lessees to avoid as much as possible damages to irrigation systems and cattle movement; there will be indemnification for crop losses.

- Deforestation

Loss of vegetation will be inevitable. Therefore the following measures will be taken: the right of way will be delimitated to avoid damage in other areas; the soil will be restored to its original state and only the permanent right of way will be kept free of deep-rooted vegetation; a mitigation plan will be devised for cases in which the loss of species with ecological value cannot be avoided; reforestation will be in a 3:1 ratio.

o Forests

The original alignment crossed through three forests: Bosque del Pueblo, Rio Abajo Forest and De La Vega Forest, which together comprise 10,515.85 square miles of forest. To prevent impacting those, the alignment was varied so as to avoid Bosque del Pueblo totally, the Rio Abajo Forest will not be impacted because the existing, already impacted RoW of PR-10 will be used. The only forest to be impacted will be De La Vega Forest. Its total area is 1.85 square miles and only 0.0086 square miles of it will be impacted temporarily, that is 0.47%. Once the construction is finished, 0.0043 square miles will be restored, whereby the permanent impact will be 0.235%. The impact to the total area of the three forests will be 0.0086 square miles or 0.000082%.

• Wetlands

Thirty-three percent (33%) of the alignment will cross through wetlands. The impact will be reflected on soil disturbances, which will increase the turbidity of the water, there will be temporal and permanent loss of vegetation and impact to resident and migratory species. To minimize the impact on wetlands the following measures will be taken: to avoid the accumulation and putrefaction of the removed vegetable cover, it will be removed outside of the area and disposed of as non-hazardous solid waste; the right of way will be delimited to avoid impact outside of this area; erosion and sedimentation control measures will be established; vehicles with leaks will not be allowed; special wetland construction techniques will be used; loss of vegetation will be mitigated on site; a Mitigation Plan will be prepared in coordination with the concerned agencies.

• Mangroves

This resource will not be impacted since measures have already been taken to avoid the same: the alignment was varied in the four mangrove areas so as to avoid crossing over the same or construction techniques will be used that will not impact them (HDD).

• Surface water bodies

Seventy-eight (78) bodies of water through which the project will cross were identified. The small ones will be crossed by open trench. The impacts include turbidity, sedimentation, diminution of dissolved oxygen, mortality of aquatic fauna and flora. The impact will be mitigated by reducing the construction time: bodies of water fewer than 10 feet wide will be crossed in 24 hours or less; from 10 to 100 feet wide, in 48 hours.

The more voluminous bodies of water will be crossed with HDD. Geotechnical studies will be made and construction plans specific for the site will be developed. The release of bentonite may affect the turbidity, diminish dissolved oxygen and affect the respiration of aquatic organisms. To avoid it a dye will be added to detect leaks and, should one occur, the flow of bentonite will be immediately stopped and the pertinent

Agencies will be notified. Another impact is the size of the construction right of way which will be 150 to 300 feet on both sides of the body of water. Erosion and sedimentation control measures will be established.

• Groundwater and aquifers

Thirty-one (31) aquifers were identified; the possibility of polluting groundwater is remote. To avoid oil and fuel spills a Spill Control Plan will be established.

• Water consumption

The hydrostatic test entails the greater water consumption (7 million gallons) whereby, to eliminate the impact on the public distribution system and the bodies of water, the water will be obtained from the wells for which the AEE has a water franchise. Bottled water from local suppliers will be used for consumption by employees. A local supplier will be hired to sprinkle the ground. He will be responsible for supplying the truck and the water.

• Water wells

Of 156 wells within a radius of 460 meters from the alignment, only five are inside the project's operation right of way. These will be identified in the project's drawings, their location will be marked on the ground to avoid impacting them and any breaks that may occur due to the construction will be repaired.

• Transportation and traffic

Barges will be used for the maritime transport of materials and machinery to the Port of the Americas and the San Juan port zone. To minimize the impact to maritime transport the following measures will be taken: all the requirements established by the receiving ports, the Ports Authority and Federal Customs will be complied with; a logistics plan will be submitted for endorsement by the pertinent authorities.

The roadways will be used as access to transport personnel, equipment, vehicles (light and heavy) and materials to the different project areas. Roads will be crossed using the open trench method or drilling. These roads are indicated in Addendum 1, Highway crossings. To minimize the impact to the integrity of the roadways and the interruption of, or increase in traffic the following measures will be taken: car pooling by employees will be encouraged; a Traffic Management Plan will be submitted to the Transportation and Highways Authority (in Spanish Autoridad de Carreteras y Transportación or ACT); if necessary and in coordination with the ACT and the local Police, detours will be established; the trenches will not be left uncovered.

• Archaeological finds and cultural and historic places

Three rock shelters with the presence of petroglyphs, possible farming terraces, remainders of two railroad bridges and the remainders of two haciendas were located. An archaeological study was conducted, Phase 1A which indicated the most important findings: Tallaboa Site, Salto Arriba Site, Bridges, Hacienda La Teresa, Hacienda Las Lisas, rock shelters, farming terraces, Paso del Indio, Punta Corozo, Dorado 15, Toa Baja 18, Hacienda La Candelaria, Warehouse 5. The recommendations the Institute of Puerto Rican Culture and other concerned agencies see fit to provide will be followed.

- Noise

Via Verde is a lineal project and the construction will move along day by day, therefore the noise will not be concentrated in any specific area. The noise levels of the machinery and the vehicles to be used are comparable to those established by the Environmental Quality Board's (in Spanish Junta de Calidad Ambiental or JCA) Noise Pollution Control Regulation. The following measures will be taken to minimize the effects of noise in populated areas: the work will be circumscribed to the time schedule established by the Regulation; the vehicles and machinery will have noise control equipment; inasmuch as possible, the newest equipment found will be used; the machinery will be turned off when not in use.

- Spills

In general, spills occur by human error: poor handling of the products, lack of maintenance of the equipment, and lack of adequate knowledge of the functioning and operation of the machinery. If spill occur, they will not be of a significant magnitude, because small quantities of the products will be used. The most significative event would be the total spill of a fuel truck, 2,500 gallons of diesel fuel.

The following measures will be established to avoid spills or minimize the impact of the same: a Spill Control Plan and a Spill Prevention, Control and Mitigation Plan for the use of bentonite will be prepared; Personnel will be trained (in: handling of chemicals; situations that might cause spills; how to avoid or minimize the impact; how to respond to a spill and who to inform; the correct functioning and operation of machinery); vehicles will have a Spill Kit; spills in water will be cleaned using absorbent pads and in case of spills on the ground, the contaminated soil will be removed; the collected material will be deposited in containers, identified, full RCRA tests will be conducted and it will be disposed of in an authorized place; vehicles with leaks will not be allowed in the work area; no chemicals will be stored outside the operation centers.

- Wastes

It is estimated that non-toxic solid wastes will be generated in amounts greater than 100 cubic yards weekly, approximately. This could increase the amount of waste received at the landfills because this waste will be collected and transported to the nearby landfills approved by the JCA. The impact will be minimized by reusing part of the soil to backfill the trenches and restore the right of way, only the surplus soil will be disposed of in an authorized landfill. The vegetable cover and trees removed will be mechanically shredded and used as wood chips for erosion control in slopes. Measures will be established for the control of erosion and sedimentation. Handling of chemical products will be delegated on experienced personnel and it will be separated from the other waste to be disposed of in accordance with the pertinent regulations after being characterized with a Full RCRA analysis.

The following measures will be implemented to minimize the impact caused by used water: the water used in the hydrostatic test will be discharged in our power plants with a permit from NPDES and in coordination with the EPA; the contractor who provides the portable toilets will be in charge of providing maintenance and for disposing of the waste and for handling any spills, all in accordance with the regulations of the Department of labor and Human Resources.

• Socioeconomic impact

The project represents a temporary benefit for the local economy. Among the benefits are: the taxes paid to the municipalities if applicable; employment opportunities (between 1,000 and 1,200 temporary direct jobs and some 4,000 to 4,500 indirect jobs); and an increase in sales and the use of services (hotels, motels, restaurants, gas stations, fast food and articles of prime necessity businesses, hauling trucks, sprinkler trucks, heavy equipment, rental of cars, trailers, portable toilets, purchase of lumber, gravel and bottled water, among others).

The project's construction will not have a disproportionate environmental impact on any socioeconomic group and whatever impact there is will be of short duration because the construction is not stationary. Free access to communities and residences will be ensured; the work area will be delimited; special work areas will be located outside the quiet zone; the necessary measures to control fugitive dust, noise and increased traffic will be complied with. A public information program to educate the community prior to the construction will be established and will continue during the same.

One of the most important impacts will be the establishment of the maintenance right of way which encompasses 150 feet of the pipeline. Within this were located approximately 102 structures or residences. The properties will be appraised and the owners will be compensated (fair market value) for the appraised value. The general use of the soil will not be altered, however, the construction of buildings or structures or the planting of trees or vegetation with deep roots will not be permitted in the operation right of way (a width of 50 feet throughout the length of the pipeline).

• Protected, threatened or endangered species

The presence of the listed species was not detected during the field work, with the exception of the guabairo (Puerto Rican Nightjar, *Caprimulgus vociferus noctitherus*).

This species will be protected by the implementation of a protocol for its protection and conservation and by constructing the project outside of its nesting season. All permanent loss of habitat for the guabairo will be mitigated in accordance with a plan approved by the DNER and the United States Fish and Wildlife Service.

Regarding the species of fauna designated as vulnerable, the Puerto Rican boa and the white-cheeked pintail or Bahama duck were sighted. The Puerto Rican boa will be protected by the implementation of a protocol for its protection and conservation during the construction phase. The white-cheeked pintail prefers lagoons or ponds, which are not under the project's impact footprint. Other species such as the falcón de sierra (Puerto Rican Sharp-Shinned Hawk, *Accipiter striatus venator*), the guaraguaíto (Puerto Rican Broad-Winged Hawk, *Buteo platypterus brunnescens)* and the Puerto Rican Parrot (Puerto Rican Amazon, *Amazona vittata vittata)*, should not be impacted as long as areas with characteristics similar to their habitat are not disturbed, especially during their mating and nesting seasons.

The species of flora designated as critical can be identified with some conspicuous method (printed marking ribbon, or "DO NOT CUT flagging tape") and thus avoid impacting them. If there is the possibility of impacting them, they will be transplanted to an adequate place, by personnel qualified for this practice.

- Air quality impact

The change to natural gas represents a substantial reduction in criteria pollutants air emissions. The percentage of reduction of criteria pollutants in pounds per year for each power plant, calculated according to the formulas of the Air Pollutants Emission Factors (AP 42), will be the following: 75.79% for the Palo Seco Power Plant, 69.30% for the San Juan Power Plant, and 66.75% for the Cambalache Power Plant. The only individual criteria pollutant that would see a slight increase in the percentage of emissions (6.04%) would be the Volatile Organic Compounds (VOC) in the Palo Seco Power Plant. In compliance with federal regulations, a Prevention of Significant Deterioration (PSD) permit will be obtained for this power plant.

The change to natural gas will also result in a significant reduction (between 25% and 30%) in carbon dioxide emissions. An increase in the concentration of carbon dioxide in the atmosphere results in an increase in global temperatures or global warming.

- Environmental monitoring program

As part of the efforts to avoid or minimize the impacts of the construction, the project will have an Environmental Coordinator who will be in charge of the project's environmental impact issues.

- Cumulative impact

The cumulative impact is the total effect on the environment resulting from a series of past, present or future actions of independent or common origin. No cumulative impact on mangroves and wetlands is expected.

There may be constructions going on in certain project areas which coincide with Vía Verde and contribute to increase the fugitive dust in the air. The cumulative effects on the air quality due to the operation of the units are contemplated in the current permits and those that will be obtained for the changes due to the use of natural gas. The cumulative impact of pollutant emissions will be a positive one, since there will be a reduction in the emissions of criteria pollutants and carbon dioxide.

The project's impact on traffic will be added to the impact due to private and public vehicles from other projects developed in the area. The cumulative impact will be temporary in each municipality.

During the project's construction there will be an increase in the demand for bottled water and water used for sprinkling which will be added to the demand from other construction projects and the demand from the general population. This will be temporary for the duration of the construction.

The impact to agricultural areas in certain areas is unavoidable and in those the project's impact will be added to the impact of past and future agricultural activities.

There will be a temporary noise increase during the construction that will be added to the noise impact of public and private vehicles and other construction equipment located in the area. Although the noise generated by the project will not be concentrated in one specific zone because the construction area will change daily, it will be temporary.

F. Socioeconomic study

Chapter 7 includes a socioeconomic study to determine whether the impact the proposed action will have is one of fair treatment for all groups of persons. To prepare this analysis data from the 2000 Census were used, which were obtained from the information supplied by the Puerto Rico Planning Board, Census Office.

The policy for the implementation of Environmental Justice in Region 2 of the Federal Environmental Protection Agency (EPA), established that a homogeneous population such as Puerto Rico's is identified in its totality as a minority, wherefore an analysis by ethnic groups is not applicable and must be substituted by an analysis of socioeconomic groups and other factors (United States EPA Region 2 Draft Interim Policy on Identifying EJ Areas, June, 1999).

As the population of Puerto Rico is homogeneous, identified in its totality as a minority, we proceeded to measure the impact the project would have on other factors beyond ethnicity. Among the factors considered were: geographical distribution, racial groups and socioeconomic groups. The socioeconomic factors considered were: gender, age, income, education, employment and housing. The condition for Puerto Rico was established for each one of the factors and it was compared with that of the 13 Municipalities where the construction will be made. From there, it was compared with the 48 specific wards through which it will cross, for the purpose of detecting if any of these areas would be disproportionally affected in any of the factors under consideration.

The following findings were made:

- Geographic distribution - The construction will be made in wards of diverse population density; fluctuating between 5.1 and 2,334.9 inhabitants per square kilometer. Even so, it does not represent a disproportionate burden because it will not require complete sectors or areas of a community to be moved or evicted. The mobilization or eviction of tenants or property owners of existing properties will be isolated. Ninety-one (91) structures or residences were observed within the maintenance right of way, which could be the equivalent of the relocation or compensation of some 263 persons. Addendum 5, Persons within the Maintenance Right of Way, gives an idea of the quantity of persons, by ward and municipality, which could be affected.

- Race - Homogeneity in the distribution of races was observed throughout the project's alignment, and a proportional relation is kept when the wards, the municipality and the island are compared. Only the Palo Seco community in the Palo Seco Ward of the Municipality of Toa Baja represents the black race, in percentage, in a greater proportion than that found in the other wards and municipalities. For this community, the analysis revealed that it is at a considerable distance from the project's area whereby it will not be adversely impacted. There will not be any expropriation of residences or land belonging to this group.

- Gender - The general pattern for Puerto Rico was maintained. The difference in the population by gender in the wards directly associated to the project, compared to that of the municipalities or with the totality of the island of Puerto Rico, is not significant wherefore the project will not have a disproportionate impact on any group in terms of gender.

- Age - The project will not have a disproportionate environmental impact on any group on account of age, or on the services or housing they require. The 18-65 years group will benefit temporarily, because close to 1,200 direct jobs will be created during the construction of the project and services will be used which will benefit these groups and create hundreds of indirect jobs.

- Income - Neither the median and per capita and family income, nor the poverty index will vary as a consequence of the project's construction and operation. The only impact will be on the working class, because close to 1,200 direct jobs will be created in the region, in addition to the indirect jobs, which will represent an increase in income. This increase, although positive, will be temporary, because the construction works will last approximately eleven months.

- Education - The population in areas where the project will be developed is in an average level similar to the rest of Puerto Rico. The schooling or education level attained by the population through which the pipeline will cross will not vary as a consequence of the project's construction and operation and there will not be any disproportionate impact on any group based on the classification of education.

- Employment - The project will not affect the employment and unemployment rates in Puerto Rico directly or indirectly. Nor will it affect the distribution of occupations of employed persons or of the classes of workers. The project's impact on the area will be a temporary increase in the labor force due to the direct and indirect jobs contemplated during the construction.

- Housing - The project will not affect the present housing availability in these municipalities during its construction or operation, because the majority of the land through which the pipeline will cross will not be residential but mostly in agricultural and industrial use, and part of the alignment will pass through government-owned land. In addition, there are housing developments in progress in the thirteen municipalities, which will increase the quantity of housing units in these areas, wherefore the project will not compromise the need for expansion in the housing area. As previously indicated, only 91 structures or residences were found within the maintenance right of way, which represented 0.08, 0.03 and 0.01% of the residences when compared with the total number of residences in the 48 wards through which the construction will be made, the 13 municipalities and the totality of the island, respectively.

We note that no group, based on the different classifications, will receive a disproportionate negative environmental impact on account of the project. Even so, the AEE will take the necessary measures to maintain the communities adjacent to the project and the population of the municipalities, informed of the project's scope, its impacts and benefits. This will be through a public education program developed by the AEE, which will comply with all the applicable state and federal regulations.

As part of this education program, the AEE will be in charge of preparing and distributing all the necessary informative materials and will schedule meetings with the communities and other interested groups. In addition, the AEE is in communication with, and has presented the project to the mayors of the municipalities where the construction will be made and to the agencies called upon to ensure that projects of this magnitude do not create disproportionate burdens on particular groups.

G. Agencies consulted

Chapter 8 lists the municipalities and agencies consulted, state and federal, and to whom the Preliminary Environmental Impact Statement (in Spanish, Declaración de Impacto Ambiental Preliminar, or DIA-P) will be circulated. Addendum 4, Meetings with Agencies, summarizes the meetings held with them. The agencies to whom the document will be circulated are the following: Puerto Rico Aqueducts and Sewers Authority, Department of Transportation and Highways Authority, Public Lands Authority, Land Management Administration, Public Service Commission, Department of Natural and Environmental Resources, Institute of Puerto Rican Culture, Environmental Quality Board, Planning Board, Fire Department, Ports Authority, State's Historical Preservation Office, United States Corps of Engineers, US Fish and Wildlife Service, Environmental Protection Agency, National Marine Fisheries Service, Federal Highway Authority, and the Municipalities of Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, Cataño, Bayamón and Guaynabo.

EcoEléctrica

A better environment with natural gas

LNG Import Terminal
Peñuelas, Puerto Rico

SEMI-ANNUAL OPERATIONAL REPORT
FOR THE PERIOD OF
January 1st to June 30th, 2010

DOCKET NO. CP95-35-000
DATE: July 19th, 2010

Eng. Oscar Cedeño
LNG Terminal Manager

OPERATIONAL REPORT

1 LNG TERMINAL PERFORMANCE SUMMARY

During the reporting period from January 1st to June 30th, 2010, EcoElectrica maintained an excellent Safety, Environmental & Operational record of compliance. A total of six (6) LNG cargos were successfully offloaded at the LNG Terminal, representing a total energy value of 11,705,215 MMBtu.

During this reporting period, all LNG cargoes received at EcoElectrica were imported from Atlantic LNG in Trinidad. No significant Perlite contamination has been observed from the LNG Tank. The LNG tank monthly cold spot inspections were completed without any abnormal conditions reported.

On January 28th the US Coast Guard performed their annual compliance inspection related to Security and the LNG Terminal; no deficiencies were noted.

On Tuesday February 2nd, 2010 the 2009 Semi annual report of the LNG Terminal; was sent to the Commission covering the operational period of July 1st to December 31st, 2009.

On February 12th the LNG Vaporizers 102-A and 102-B were isolated for maintenance and existing block valves 1LNG-V-0516 and 1LNG-V-0519 were replaced with new valves. During this maintenance process the LNG Vaporizer 102-A was internally cleaned by recirculation of Kerosene on the heat exchanger gas side. During this scheduled Terminal maintenance three new block valves were installed at the LNG tank top related to the LNG Sendout Pump 101A. The replaced valves were: 1LNG-V-0290, 1LNG-V-0221 and 1LNG-V-0223 at the pump discharge pipelines. These new

Vanessa Valves were installed as an improvement for the pump maintenance. These valves has a better seal on the close position providing the opportunity to remove the pump from well without the need to shut down the Terminal. The new installed valves are the same design and didn't require any change in the operation or logic system.

On March 10th, as part of the scheduled LNG Terminal maintenance outage, the annual inspection of the Terminal ESD push button stations and the tests on each of the eleven LNG ESD actuators were performed by the Electrical & Instrumentation Maintenance Department. No deficiencies were noted and all test results were documented for record.

During this reporting period the Maritime Security (MARSEC) was maintained at Level 1 for all maritime operations.

During this reporting period a significant amount of work has been performed on the Terminal to complete the Corrosion Control Program. The LNG pipelines located on the trestle pipe rack were cleaned and BOG Blowers and Compressors paint touch-up work was completed.

During this reporting period the LNG Boil Off Gas Blowers and Compressors operated normally without significant events to be reported.

1.1 LNG Deliveries Summary:

DATE RECEIVED	SHIP	MMBtu OFFLOADED	Origin
January 26th , 2010	Matthew	2,668,528	Trinidad
March 18th, 2010	Matthew	2,715,453	Trinidad
April 22nd ,2010	Matthew	2,688,350	Trinidad
May 21st,2010	Matthew	447,652	Trinidad
May 29th,2010	Neptune	2,737,146	Trinidad
June 8th,2010	Neptune	448,086	Trinidad

Total energy in cargoes received during the reporting period was for 11,705,215 MMBtu.

2 LNG TERMINAL OPERATING CONDITIONS

2.1 Rollover

No rollover or conditions for possible rollover were observed. The LNG Tank has continually been re-circulated from bottom to top through the pier unloading line.

2.2 Geysering

No pressure change was observed to indicate Geysering.

2.3 Cold Spots

Monitoring of the LNG tank foundation temperatures has not shown any abnormal variation. Monthly visual inspections of the LNG tank exterior surface have not indicated any cold spots in the outer shell.

2.4 LNG Tank Vibration

No vibration detected.

2.5 Cryogenic Piping Vibration

No cryogenic piping vibrations have been observed.

2.6 Storage Tank Settlement

On March 19th, 2010, the EcoElectrica surveying contractor, Victor E. Rivera Associates collected data on the elevations for the 16 equally spaced survey monitoring points around the LNG Tank. The survey data was submitted to URS for geotechnical analysis and report. The URS report performed on May 18th, 2010, indicates that the West LNG tank continues to perform adequately with respect to the settlement specified by the tank designer.

2.7 LNG Terminal Incidents

No LNG incident has occurred at the Terminal during this reporting period.

2.8 Flaring events

From February 13th to 24th, the LNG Terminal was shut down for equipment maintenance; during this period of time the LNG storage tank pressure was maintained inside normal parameters by flaring the tank boil off gas excess pressure.

2.9 Non-Scheduled Maintenance or Repair

No unscheduled maintenance or repair has occurred at the Terminal during this reporting period.

3 Health and Safety

EcoEléctrica received the ISO 14001 and OHSAS 18001 certificates from ERM - CVS. With this achievement Ecoelectrica becomes the first LNG Terminal in the US receiving those environmental, health and safety international standards certifications.

Ecoelectrica completed the Facility Security Officer (FSO) training for Operations Shift Supervisors and security guards.

Incident 10-24 – Operations were trying to start the Flare several times and the piping overheated and burned the piping insulation. The fire was extinguished with portable fire extinguishers. Nobody resulted injured. The Flare was ignited later and the insulation replaced.

Incident 10 - 43 – We experience a near miss incident when a contractor employee accidentally damaged the LNG Terminal DCS LAN FO while cutting the cable trays for replacement. The employee was cutting with an electric band saw the old metal cable tray. Communication fiber optic cable resulted damaged. Nobody was injured.

3.1 Fire

No LNG related fires were experienced during the reporting period.

3.2 LNG Release

No LNG releases occurred at the LNG Terminal during this reporting period.

4 Environmental

4.1 The U.S. Coast Guard performed its regular inspections on each of the two (2) ships offloaded during this reporting period and no deficiencies were reported.

5 Project Status

5.1 Installation of additional Hazard Detectors

During the scheduled Terminal maintenance EcoElectrica, LP. installed four (4) additional flame detectors; two in the BOG Compressors building and two in the LNG-MCC to increase coverage of detection of the actual system. (Attached updated P&ID's)

5.2 LNG Terminal Expansion

In accordance with the April 16, 2009 Order Amending Authorization under Section 3 of the Natural Gas Act related to the Terminal Modification Project, EcoEléctrica filed its Initial Implementation Plan on June 15, 2009. On November 2, 2009 Mr. Miguel A. Cordero Lopez of the Puerto Rico Electric Power Authority (PREPA) filed a letter with the Commission outlining revisions to PREPA's Capacity Expansion Plan in consideration of key environmental and fuel diversification goals of the Government of Puerto Rico's Public Energy Policy Plan. In its letter, PREPA describes a change in the destination of natural gas from the Aguirre Combined Cycle Power Plant to a new Gas Combined Cycle power facility that will be constructed in the vicinity of the existing PREPA owned South Coast Steam Power Plant. The change in destination will not result in any changes to the design of the EcoEléctrica LNG terminal modification project as approved by the Commission in the Order. Additionally, no changes are required to the Implementation Plan.

6 Future Projects under Evaluation

6.1 Second LNG Storage Tank

The construction of the second LNG Storage Tank to supply Natural Gas Fuel to the Commonwealth remains one of EcoElectrica's considerations for a future expansion of the LNG Terminal.

7 Contact Person List

POSITION	NAME	TELEPHONE
General Manager - Operations	Carlos Reyes	787-836-2740, ext. 232 787-487-6002 (cellular)
LNG Terminal Manager	Oscar Cedeño	787-928-1009, ext 292 787-487-6042 (cellular) 787-835-0201 (home)
Operations Manager	Adolfo Antompietri	787-836-2740, ext. 236 787-487-6038 (cellular)
Health & Safety Manager	Pedro I. Martínez	787-836-2740, ext. 235 787-487-6043 (cellular)
Mechanical Maint. Manager	Wilbert de la Paz	787-836-2740, ext. 294 787-487-6011 (cellular)
Engineering, Electric, I&C Manager	Gaspar Bibiloni	787-836-2740, ext. 294 787-487-6010 (cellular)
Water Treatment Supervisor	José L. Rivera	787-836-2740, ext. 244 787-487-6038 (cellular) 787-264-0632 (home)
Shift Supervisor	José A. Santiago	787-836-2740, ext. 244 787-267-4925 (home)
Shift Supervisor	Alexis Díaz	787-836-2740, ext. 244 787-267-8372 (home)
Shift Supervisor	Davis Rivera	787-836-2740, ext. 244
Shift Supervisor	Luis Cruz	787-836-2740, ext. 244

Shift Supervisor	Angel Rosado	787-836-2740, ext. 244
EcoEléctrica	Main Gate	787-836-2740, ext. 247
LNG Terminal	LNG Control Room	787-836-2740, ext. 289

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Boqueron Field Office
Carr. 301, KM 5.1, Bo. Corozo
P.O. Box 491
Boqueron, PR 00622

JUN 30 2010

Mr. Yousev García
Director
Asesores Ambientales y Educativos, Inc.
PMB 145
130 Winston Churchill Avenue
San Juan, Puerto Rico 00926-6018

Re: Via Verde Project (Gasoducto del Sur)
LP-012

Dear Mr. García:

This is in reply to your letter dated June 15, 2010, requesting technical assistance in form of a list of federally listed species and designated critical habitat along the proposed alignment of the Via Verde Project, previously known as Gasoducto del Sur. Our technical assistance is preliminary since the only information provided consists of a reference map of the pipeline route in Google Earth format. The information does not provide detailed description of the project and the areas needed for access roads during construction, transit areas for vehicles, storage areas, construction facilities, among other components associated to infrastructure projects.

Based on the provided alignment, suitable habitat for the following federally-listed species may be affected.

Dry limestone hills from Guayanilla to Ponce:

1) *Ottoschulzia rhodoxylon* (palo de rosa)
2) *Trichilia triacantha* (bariaco)
3) *Buxus valhii* (diablito de tres cuernos)
4) *Eugenia woodburyana*
5) *Catesbaea melanocarpa*
6) *Cordia rupicola*
7) *Mitracarpus maxwelliae*
8) *Mitracarpus polycladus*
9) *Caprimulgus noctitherus* (guabairo)

Central Mountain Range (Volcanic):

1) *Thelypteris inabonensis*
2) *Thelypteris yaucoensis*
3) *Thelypteris verecunda*

4) *Juglans jamaicensis* (nogal)
5) *Polystichum calderoense*
6) *Accipiter striatus venator* (falcon de sierra)
7) *Buteo platypterus brunnescens* (guaraguaito)

Moist limestone (Río Abajo Forest and PR 10)

1) *Cordia bellonis*
2) *Ottoschulzia rhodoxylon* (palo de rosa)
3) *Daphnopsis helleriana*
4) *Solanum drymophilum* (erubia)
5) *Pleodendron macranthum* (chupacallos)
6) *Myrcia paganii*
7) *Shoepfia arenaria*
8) *Tectarea estremerana*
9) *Auerodendron pauciflorum*
10) *Buteo platypterus brunnescens* (guaraguaito)
11) *Amazona vittatta vittatta* (cotorra puertorriqueña)

Northern Limestone Hills

1) *Ottoschulzia rhodoxylon* (palo de rosa)
2) *Buxus vahlii* (diablito de tres cuernos)
3) *Banara vanderbiltii*
4) *Cordia bellonis*
5) *Daphnopsis helleriana*
6) *Solanum drymophilum* (erubia)
7) *Myrcia paganii*
8) *Shoepfia arenaria*
9) *Tectarea estremerana*
10) *Auerodendron pauciflorum*
11) *Zanthoxylun thomasianum*
12) *Accipiter striatus venator* (falcon de sierra)
13) *Buteo platypterus brunnescens* (guaraguaito)

Northern Wetlands and White Sands

1) *Stahlia monosperma* (cobana negra)
2) *Chamaecrista glandulosa*

We recommend surveys be conducted by qualified and experienced personnel along the proposed route and adjacent areas. It was our experience with the Gasoducto del Sur that surveys were limited to the footprint of the project, resulting on additional surveys during construction since additional access roads were needed for construction purposes. In addition, when individuals or populations of federally listed species were found, alternative routes to avoid impacts to the individuals / populations were evaluated and surveyed. This approach of limiting the surveys to the footprint of the project resulted in duplication of efforts and delays.

In your letter, you also requested information regarding surveys methodologies for the species. The Service has not developed surveys methodologies for listed species for consultation purposes. However, we recommend the applicant uses the best information available, species expert' opinion, and scientific literature to develop such methodologies. Once the methodologies are developed, the applicant should consult with the Service for review. Based on our experience in previous projects, we do not recommend the establishment of transects to survey listed plants. We recommend that the project area be systematically surveyed by qualified and experienced personnel to search for the listed plant species. Also it was our experience in one of the site visits to the area for the proposed access roads for the Gasoducto del Sur that biologists conducting surveys using transect lines did not detect one additional listed species that we detected during our visit. Regarding the guabairo, we recommend contracting qualified and experienced personnel to identify suitable habitat within the project area and to conduct surveys with playback recordings (playing the recording for 2 minutes and listening for a minimum of 3 minutes) during the appropriate time and date frames (three hours before sunset and three hours after sunset, monthly from March to early July which is the peak of the nesting season). The surveys for the falcón de sierra and guaraguaito should be conducted from November to March following survey methodologists established in Lerandi-Román (2006) and Hengstenberg and Vilella (2004).

Threatened and endangered species and their habitats are protected by both federal and Commonwealth laws and regulations. At the Federal level, the species are protected by the Endangered Species Act of 1973 as amended. Section 7 of the Endangered Species Act requires that Federal agencies ensure the actions permitted, funded, or carried out by that agency will not adversely modify and/or will not jeopardize the continued existence of threatened and endangered species. Section 9 of the Endangered Species Act prohibits take of an endangered species. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Under Section 10 of the Endangered Species Act, the Service can provide incidental take permits (ITPs) pending to permit issuance criteria are met and a Habitat Conservation Plan (HCP) is completed.

With the information available to us at the present time, we cannot determine the extent of involvement by other Federal agencies with permitting responsibilities for the proposed project nor do we know the extent of the potential impact to protected species. Therefore, we cannot determine if an incidental take permit under Section 10 of the Endangered Species Act is required.

In addition to threatened and endangered species, the Service would like to review the alternative analysis for the proposed project and the possible direct and indirect effects to resources under our jurisdiction such as migratory birds, riparian and wetland resources, and forested habitats.

Our comments are issued as technical assistance as per your request in accordance with the Fish and Wildlife Coordination Act (47 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and in accordance with the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

If you have any questions, please contact Marelisa Rivera, Assistant Field Supervisor for the Caribbean Ecological Services Field Office at 787-851-7297 extension 206.

Sincerely yours,

Edwin Muñiz

Edwin E. Muñiz
Field Supervisor
Caribbean Ecological Services Field Office

Mtr
Cc: BCPeabody Consulting, PA

Literature Citations:

Hengstenberg, D.W. and F.J. Vilella. 2004. Reproductive biology, abundance, and movement patterns of the Puerto Rican broad-winged hawk in a limestone forest of Puerto Rico. Final report submitted to the U.S. Geological Survey under Cooperative Agreement No. 14-45-009-1543-59.

Llerandi-Román, I.C. 2006. Red-tailed hawk home range, habitat use, and activity patterns in north central Puerto Rico. MS Thesis, Mississippi State University, Mississippi, 173 pp.

GOBIERNO DE PUERTO RICO
LA FORTALEZA
SAN JUAN, PUERTO RICO

Boletín Administrativo Núm. OE-2010-034

ORDEN EJECUTIVA DEL GOBERNADOR DE PUERTO RICO PARA ACTIVAR LAS DISPOSICIONES DE LA LEY NÚM. 76 DE 5 DE MAYO DE 2000

POR CUANTO: Puerto Rico enfrenta una crisis energética. Nuestra infraestructura actual de generación de energía eléctrica depende de combustibles derivados del petróleo para generar aproximadamente setenta por ciento (70%) de nuestra electricidad. Esta dependencia excesiva atenta contra la vida, la salud y la seguridad de todos los puertorriqueños.

POR CUANTO: Los precios de combustibles derivados del petróleo han subido dramáticamente en los últimos años y están sujetos a un alto grado de volatilidad. Nuestra dependencia en estos combustibles resulta en un costo de energía aproximadamente dos veces mayor al costo promedio en el resto de los Estados Unidos. Este costo tan alto afecta significativamente la calidad de vida de todos los puertorriqueños. Nos obliga a usar recursos para el pago de energía que podrían utilizarse para invertir en educación, salud, vivienda y otras áreas de necesidad.

POR CUANTO: Esta dependencia también afecta adversamente nuestro medio ambiente. La emisión de gases producto de combustibles derivados del petróleo contribuye marcadamente a la contaminación del aire y al efecto de invernadero con todas sus consecuencias. Los efectos contaminantes de estas emisiones no se limitan al ambiente sino que también repercuten sobre la salud de todos los puertorriqueños.

POR CUANTO: La dependencia en combustibles derivados del petróleo también expone a Puerto Rico a los efectos de cambios inesperados y súbitos en el ámbito internacional que puedan afectar el precio y la disponibilidad del petróleo. Esta vulnerabilidad representa una amenaza a nuestra seguridad. No podemos esperar a la próxima crisis internacional para tomar acción.

POR CUANTO: Puerto Rico necesita urgentemente cambiar y renovar su infraestructura de generación de energía para reducir nuestra dependencia en combustibles derivados del petróleo. Esta infraestructura es antigua y tiene que ser modernizada y diversificada para permitir el uso de fuentes alternas a las derivadas de petróleo.

POR CUANTO: Es una prioridad estatal promover el desarrollo de nueva infraestructura de generación energética que use fuentes alternas a los combustibles derivados de petróleo, como el gas natural, así como fuentes de energía renovable sostenible o energía renovable alterna que incluyen, entre otras, energía eólica, energía solar, biomasa, marina e hídrica, para lograr una reducción y estabilización de los costos energéticos, el mejoramiento de la calidad ambiental y la salud pública, y una situación estable de seguridad.

POR CUANTO: La Ley Núm. 76 de 5 de mayo de 2000 ("Ley Núm. 76") provee para la activación de un proceso expedito para la realización de obras y proyectos necesarios para enfrentar situaciones críticas en la infraestructura física de prestación de servicios esenciales para la ciudadanía y situaciones que pongan en riesgo la vida, salud y seguridad de la población.

POR TANTO: YO, LUIS G. FORTUÑO, Gobernador de Puerto Rico, en virtud de los poderes que me confieren la Constitución y las leyes de Puerto Rico, por la presente decreto y ordeno lo siguiente:

SECCIÓN 1ra. Declaro una emergencia en cuanto a la infraestructura de generación de energía eléctrica de Puerto Rico y ordeno la utilización de un proceso expedito, al amparo de la Ley Núm. 76, para el desarrollo de proyectos que fomenten una nueva infraestructura de generación energética que use fuentes alternas a los combustibles derivados de petróleo, fuentes de energía renovable sostenible y de energía renovable alterna en Puerto Rico (los "Proyectos de Energía"). Los Proyectos de Energía incluyen, pero no se limitan, a proyectos nuevos de generación y conversiones a gas natural, y proyectos de energía renovable sostenible y de energía renovable alterna tales como energía eólica, energía solar, biomasa, marina e hídrica.

SECCIÓN 2da. Todas las agencias afectadas por esta Orden Ejecutiva deberán seguir el procedimiento expedito al momento de otorgar los pertinentes permisos, consultas, endosos, comentarios, recomendaciones y certificaciones para Proyectos de Energía en todo Puerto Rico.

SECCIÓN 3ra. Se crea el Sub-comité Interagencial de Cumplimiento Ambiental por Vía Acelerada (el "Sub-comité"), a tenor con lo dispuesto en el Artículo 4 de la Ley Núm. 76, el cual estará encargado de evaluar los documentos ambientales presentados para cualquier proyecto al amparo de esta Orden Ejecutiva. El Sub-comité estará compuesto por un funcionario de la Junta de Calidad Ambiental, la Junta de Planificación, el Departamento de Recursos Naturales y Ambientales y cualquier otro funcionario que el Gobernador designe.

SECCIÓN 4ta. El Presidente de la Junta de Planificación, el Presidente de la Junta de Calidad Ambiental, el Secretario del Departamento de Recursos Naturales y Ambientales y el director o secretario de cualquier otra agencia concernida deberán adoptar aquellas medidas transitorias y tomar las decisiones necesarias para cumplir con esta Orden Ejecutiva.

SECCIÓN 5ta. DEFINICIÓN DEL TÉRMINO AGENCIA. Para fines de esta Orden Ejecutiva, el término "agencia" se refiere a toda agencia, instrumentalidad, oficina o dependencia de la Rama Ejecutiva del Gobierno de Puerto Rico, incluyendo las corporaciones públicas, independientemente de su nombre.

SECCIÓN 6ta. <u>NO CREACIÓN DE DERECHOS EXIGIBLES</u>. Esta Orden Ejecutiva no tiene como propósito el crear derechos sustantivos o procesales a favor de terceros, exigibles ante foros judiciales, administrativos o de cualquier otra índole, contra el Gobierno de Puerto Rico o sus agencias, sus oficiales, empleados o cualquiera otra persona.

SECCIÓN 7ma. <u>SEPARABILIDAD</u>. Las disposiciones de esta Orden Ejecutiva son independientes y separadas unas de otras y si un tribunal con jurisdicción y competencia declarase inconstitucional, nula o inválida cualquier parte, sección, disposición u oración de esta Orden Ejecutiva, la determinación a tales efectos no afectará la validez de las disposiciones restantes, las cuales permanecerán en pleno vigor.

SECCIÓN 8va. <u>VIGENCIA</u>. Esta Orden Ejecutiva entrará en vigor inmediatamente.

SECCIÓN 9na. <u>PUBLICACIÓN</u>. Esta Orden Ejecutiva debe ser presentada inmediatamente en el Departamento de Estado y se ordena su más amplia publicación.

EN TESTIMONIO DE LO CUAL, expido la presente Orden Ejecutiva bajo mi firma y hago estampar el gran sello del Gobierno de Puerto Rico, en Ponce, Puerto Rico, hoy 19 de julio de 2010.

LUIS G. FORTUÑO
GOBERNADOR

Promulgada de conformidad con la Ley, hoy 19 de julio de 2010.

LCDA. VANESSA VIERA RABELO
SECRETARIA DE ESTADO INTERINA

United States Department of the Interior

Fish and Wildlife Service
Arizona Ecological Services Office
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 242-0210 Fax: (602) 242-2513

In Reply Refer to:
AESO/SE
22410-2009-F-0191

July 30, 2010

Mr. Ron Fowler
Project Manager, Arizona Section
Department of the Army
Los Angeles District, Corps of Engineers
Arizona-Nevada Area Office
3636 North Central Avenue, Suite 760
Phoenix, Arizona 85012-1936

RE: San Francisco River Natural Gas Line Replacement and Bank Protection Project (SPL-2008-109-RWF)

Dear Mr. Fowler:

Thank you for your request for formal consultation with the U.S. Fish and Wildlife Service (FWS) pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (Act). Your request was dated March 23, 2009, and was received by us on March 27, 2009. At issue are impacts that may result from the proposed Department of the Army authorization for the El Paso Natural Gas Company (EPNG) to replace and lower the elevation of three natural gas lines and to construct approximately 300 linear feet of bank stabilization in the San Francisco River near Clifton, Greenlee County, Arizona. The proposed action will adversely affect the threatened loach minnow (*Tiaroga cobitis*) and its critical habitat.

This biological opinion is based on information provided in the: (1) the SWCA Environmental Consultants' (SWCA) April 2010 *Biological Assessment of Impacts to Loach Minnow from the proposed EPNG San Francisco River Crossing Project, Greenlee County, Arizona* (Revised BA) transmitted with your April 29, 2010, letter; (2) the January 2009 *Biological Assessment of Impacts to Loach Minnow from the Proposed EPNG Line No. 2083 Replacement Project, Greenlee County, Arizona* (Initial BA) transmitted with your March 23, 2009, letter; (3) fish survey data submitted by SWCA Environmental Consultants (SWCA 2008); (4) proceedings of various meetings and electronic mail exchanges between our respective staffs and representatives of EPNG, SWCA, and the Federal Energy Regulatory Commission (FERC); and (5) various published and unpublished sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the species of concern, and its effects, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file at this office.

Also note that this biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service* (No. 03-35279) to complete our analyses with respect to critical habitat.

Consultation History

May and June 2005: Staff from the El Paso Natural Gas Company (EPNG) and their consulting biologists, SWCA, Inc. (SWCA), made the initial contact and began meeting with our respective staffs regarding emergency repositioning work to be performed on the 2083 line under the San Francisco River. These discussions eventually included proposed pipeline integrity work on the 2006 and 2007 lines.

June 2007 through January 2009: EPNG and our respective staffs continued discussions of the proposed action, with particular attention directed to avoiding and minimizing permanent impacts to the aquatic environment.

January 22, 2009: We received your January 20, 2009, letter requesting our concurrence with your determination that the proposed action (see Description of the Proposed Action section, below) was not likely to adversely affect the threatened loach minnow or the species' critical habitat.

March 16, 2009: My staff informed your staff via electronic mail that we could not concur with your effects determination. Your staff as well as EPNG indicated that formal interagency consultation would be initiated. We transmitted a letter reiterating our nonconcurrence on March 19, 2009 (File number 22410-2009-I-0191), and began discussions regarding completing the formal consultation. We were also made aware of FERC's eventual involvement in permitting the proposed action.

March 27, 2009: We received your March 23, 2009 letter transmitting a BA and requesting formal consultation on the proposed action's effect to the loach minnow and the species' critical habitat.

June 24, 2009: Our respective staffs as well as representatives of EPNG discussed the eventual transition of the lead Federal agency to FERC. My staff also requested that a survey and monitoring plan be prepared prior to completion of formal consultation.

September 10, 2009: Your staff transmitted EPNG's *Preconstruction Survey, Environmental Inspection and Post Construction Monitoring Plan* to us via electronic mail.

November 25, 2009: We transmitted a draft biological opinion to you.

December 2, 2009: Our respective staffs as well as representatives of EPNG discussed modifications to the proposed action to accommodate the pre-excavation installation of piezometer-based observation and test wells and the potential for the resulting ground water elevation data to alter the remainder of the proposed action. Your staff also provided initial verbal comments on the draft biological opinion.

April 30, 2010: We received your April 29, 2010, letter transmitting the Revised BA

July 15, 2010: Your staff transmitted an electronic mail message stating that there were no comments on our November 25, 2009, draft biological opinion.

BIOLOGICAL OPINION

Description of the Proposed Action

Complete descriptions of the proposed action are contained in the Initial and Revised BAs, and are incorporated herein via reference. The proposed action is the replacement of three natural gas pipeline segments (2083, 2006, and 2007) beneath the San Francisco River. Excavation will occur in a 640-foot long by 175-foot wide (2.57-acre) corridor within the floodplain and active channel of the river. The river would be temporarily diverted around the trenching activities with a temporary, water-filled dam. Temporary workspace and upland staging areas (4.46 acres) will be situated on both the east and west sides of the river. Temporary workspace will also occupy 10.15 acres of land within the 100-year return interval floodplain. Permanent disturbance will be limited to 0.30 acres of bank stabilization and piezometric monitoring devices.

Proposed conservation measures include: (1) scheduling the 58-day construction period during October and November, the low-flow season and outside of the loach minnow's breeding season; (2) implementation of FERC's *Wetland and Waterbody Construction and Mitigation Procedures* and *Upland Erosion Control, Revegetation, and Maintenance Plan* (see Pages 7-9 in the Revised BA for specific measures); (3) implementation of the September 10, 2009, *Preconstruction Survey, Environmental Inspection and Post Construction Monitoring Plan* (see Appendix C of the Revised BA); (4) development of site-specific Stormwater Pollution Prevention (SWPPP) and Waste Management (WMP) plans to contain construction materials and remediate inadvertent spills; (5) site restoration and recontouring; (6) implementation of post-construction monitoring to assess the geomorphic consequences of the bank protection; and (7) revegetation with native plant species.

Status of the Species

Loach minnow was listed as a threatened species on October 28, 1986 (FWS 1986). Critical habitat was designated on March 21, 2007 (FWS 2007a), but is currently being reconsidered as a result of litigation. Furthermore, a five-year review and recovery plan revision were also initiated in 2007 (FWS 2007b).

Loach minnow is a small fish from the minnow family Cyprinidae. Loach minnow are olivaceous in color, and highly blotched with darker spots. Whitish spots are present at the front and back edges of the dorsal fin, and on the dorsal and ventral edges of the caudal fin. A black spot is usually present at the base of the caudal fin. Breeding males have bright red-orange coloration at the bases of the paired fins and on the adjacent body, on the base of the caudal lobe, and often on the abdomen. Breeding females are usually yellowish on the fins and lower body (Minckley 1973, FWS 1991).

Loach minnow are endemic to the Gila River basin of Arizona and New Mexico within the United States, and Sonora, Mexico, where they were recorded only in the Rio San Pedro. Historically, loach minnow in Arizona

were found in the Salt River mainstem near and above the Phoenix area, the White River, East Fork White River, Verde River, Gila River, San Pedro River, Aravaipa Creek, San Francisco River, Blue River, and Eagle Creek, as well as some tributaries of these streams. In New Mexico, loach minnow historically occupied the Gila River including its West, Middle, and east Forks, the San Francisco River, the Tularosa River, and Dry Blue Creek (Minckley 1973, Minckley 1985).

Loach minnow are bottom-dwelling inhabitants of shallow, swift water over gravel, cobble, and rubble substrates (Rinne 1989, Propst and Bestgen 1991). Loach minnow use the spaces between, and in the lee of, larger substrate for resting and spawning (Propst *et al.* 1988, Rinne 1989). The loach minnow is rare or absent from habitats where fine sediments fill the interstitial spaces (Propst and Bestgen 1991). Some studies have indicated that the presence of filamentous algae may be an important component of loach minnow habitat (Barber and Minckley 1966). Loach minnow feeds exclusively on aquatic insects (Schreiber 1978, Abarca 1987). Loach minnow live two to three years with reproduction occurring primarily in the second summer of life (Minckley 1973, Sublette *et al.* 1990). Spawning occurs March through May (Britt 1982, Propst *et al.* 1988); however, under certain circumstances loach minnow also spawn in the autumn (Vives and Minckley 1990). The eggs of loach minnow are attached to the underside of a rock that forms the roof of a small cavity in the substrate on the downstream side. Limited data indicate that the male loach minnow may guard the nest during incubation (Propst *et al.* 1988, Vives and Minckley 1990).

The limited taxonomic and genetic data available for loach minnow indicate there are substantial differences in morphology and genetic makeup between remnant loach minnow populations. Tibbets (1993) concluded that results from mitochondrial DNA (mtDNA) and allozyme surveys indicate variation for loach minnow follows drainage patterns, suggesting little gene flow among rivers. The levels of divergence present in the data set indicated that populations within rivers are unique, and represent evolutionarily independent lineages. The main difference between the mtDNA and allozyme data was that mtDNA suggest that the San Francisco/Blue and Gila groups of loach minnow are separate, while the allozyme data places the Gila group within the San Francisco/Blue group. Tibbets (1993) concluded that the level of divergence in both allozyme and mtDNA data indicated that all three main populations (Aravaipa Creek, Blue/San Francisco Rivers, and Gila River) were historically isolated and represent evolutionarily distinct lineages.

Critical Habitat

Critical habitat for loach minnow includes approximately 522 river miles in Arizona and New Mexico, organized into four complexes. The four complexes are: the Black River complex in Apache and Greenlee counties, Arizona; the Middle Gila/Lower San Pedro/Aravaipa Creek River complex in Pinal and Graham counties, Arizona; the San Francisco and Blue Rivers complex in Greenlee County, Arizona, and Catron County, New Mexico; and the Upper Gila River Complex in Catron, Grant, and Hidalgo counties, New Mexico.

The critical habitat designation listed primary constituent elements (PCE) that are essential for the conservation of loach minnow. The PCEs are summarized below:

1. Permanent, flowing, water with no or minimal pollutant levels.

2. Sand, gravel, and cobble substrates with low or moderate amounts of fine sediment and substrate embeddedness. Suitable levels of embeddedness are generally maintained by a natural, unregulated hydrograph that allows for periodic flooding or, if flows are modified or regulated, a hydrograph that allows for adequate river functions, such as flows capable of transporting sediments.

3. Streams that have low gradients, water temperatures (between 35-85o Fahrenheit), pool, riffle, run, and backwater components, and an abundant aquatic insect food base.

4. Habitat devoid of nonnative fish species detrimental to loach minnow or habitat in which detrimental nonnative fish species are at levels which allow persistence of loach minnow.

5. Areas within perennial, interrupted stream courses which are periodically dewatered but that serve as connective corridors between occupied or seasonally occupied habitat and through which the species may move when the habitat is wetted.

The appropriate and desirable level of these factors may vary seasonally and is highly influenced by site-specific circumstances. Therefore, assessment of the presence/absence, level, or value of the constituent elements must include consideration of the season of concern and the characteristics of the specific location. The PCEs are not independent of each other and must be assessed holistically, as a functioning system, rather than individually. In addition, the constituent elements need to be assessed in relation to larger habitat factors, such as watershed, floodplain, and streambank conditions, stream channel geomorphology, riparian vegetation, hydrologic patterns, and overall aquatic faunal community structure.

Abundance, Distribution, and Taxonomy

The status of loach minnow is declining rangewide. Loach minnow currently exist in approximately 419 miles of streams, which represents only 15 to 20 percent of their historical range. In occupied areas, loach minnow may be common to very rare. Loach minnow are common only in Aravaipa Creek, the Blue River, and limited portions of the San Francisco, upper Gila, and Tularosa rivers in New Mexico (FWS 2000).

Although it is currently listed as threatened, the FWS determined in 1994 that a petition to uplist the species to endangered status is warranted (FWS 1994). The FWS confirmed this decision in 2000 (FWS 2000). A reclassification proposal is pending.

Past Consultations

Actions that may adversely affect the species can include road crossing construction and maintenance, livestock grazing, water withdrawals, contaminants, recreational activities, and nonnative aquatic species. Our information indicates that, approximately 275 consultations have been completed or are underway for actions affecting loach minnow, often in conjunction with the threatened spikedace (*Meda fulgida*). The majority of these opinions concerned the effects of grazing, roads and bridges, or agency planning. Additional consultations dealt with timber harvest, fire, flooding, recreation, realty, animal stocking, water development, recovery (including loach minnow reintroduction efforts), and water quality issues.

Adverse effects to loach minnow have occurred due to these projects and many of these consultations have required reasonable and prudent measures to minimize effects to species. Only one of these projects (USDA Forest Service Application of Fire Retardants on National Forest System Lands) resulted in a biological opinion that the proposed action would likely jeopardize the continued existence of the loach minnow. Overall, the species is still declining. Additional reintroduction alternatives are being investigated.

Environmental Baseline

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

The action area consists of the site where the No. 2083, 2006, and 2007 lines will be replaced, which includes approximately 10.15 acres of temporary disturbance to floodplains and a permanent loss of 0.30 acre of habitat to riprap, as well as downstream reaches of habitat (in this case, one meander length) that may be affected by increased sedimentation and altered fluvial function.

Loach minnow could occur in the middle to lower reaches of the San Francisco River. Recent surveys in the Clifton area have failed to collect loach minnow, but survey efforts have been irregular and limited in scope. Loach minnow were collected from the San Francisco River and the Blue River between 1980 and 1999 (Paroz and Propst 2007), and the AGFD shows several occurrence records upstream of the project area on the San Francisco River and the Blue River, the closest being approximately 7 river miles upstream (Arizona Game and Fish Department 2002). Montgomery (1985) detected loach minnow as close as approximately 4 river miles upstream of the project limits, while more recently, in 1995, loach minnow were detected along the San Francisco River at the Apache-Sitgreaves National Forests boundary (Knowles 1995), approximately 9 river miles upstream of the project area. Both surveys also detected non-native fish, including common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), and flathead catfish (*Pylodictus olivaris*) (Knowles 1995, Montgomery 1985).

Fish surveys were conducted within and adjacent to the gas line action area during October of 2007 (SWCA 2008); loach minnow was not among the species detected. These surveys did, however, detect numerous competitive and predatory nonnative fishes, both of which would be expected to limit the potential for loach minnow to persist in the action area. The nearest record of loach minnow to the EPNG gas line project site is approximately 10 river miles upstream, and was recorded in 1984. Loach minnow are benthic and may not be readily detected when low in abundance but given the presence of large numbers of predatory nonnative fishes detected during the October 2007 survey, the species is likely to be immeasurably rare in the project area.

Fish surveys were conducted by SWCA Environmental Consultants (SWCA 2008) at four sites near the U.S. Highway 191 Bridge over the San Francisco River, situated approximately one river mile upstream from the EPNG gas line action area. Using dip nets and a backpack electrofishing unit, bridge-area surveyors caught a total of 208 fish: two native desert suckers (*Pantosteus clarki*) and 206 non-natives. The non-native fishes were dominated by 166 red shiners (*Notropis lutrensis*), but also included 18 channel catfish, three common carp, 13 flathead catfish, and six fathead minnows (*Pimephales promelas*). Another fish survey of the Highway 191 bridge area was conducted on April 10, 2009, by a qualified and permitted biologist (Thomas C. Ashbeck, EcoPlan) to determine fish species composition within the area of potential effects. Ashbeck's surveys, including 14 seine pulls and several dip nets, were conducted in all stream habitat types present in the bridge area, including riffles, pools, runs, and beneath cutbanks. Surveys failed to detect native fish, but detected over 250 red shiners.

Although loach minnow were not detected in recent surveys, finding fish when they occur at low densities is very difficult, and there are examples of native fish going undetected for years only to have them appear again in some subsequent survey (Marsh *et al.* 2003). Based on these surveys and their proximity to the gas line project area, loach minnow are likely extirpated or occur in very low densities in the action area. Occurrence in the action area is likely to change over time because the species is found with regularity upstream of the project site.

The San Francisco River within the action area is habitat for the loach minnow, including perennial flows with a moderate to swift current velocity over turbulent, rocky riffles with gravel or cobble substrates. The designation of this area of the San Francisco River as critical habitat, including the presence of one or more of the PCEs essential to the conservation of loach minnow (e.g., sufficient flow velocities and appropriate gradients, substrates, depths, and habitat types), indicates general habitat suitability. However, the presence of a high-density population of non-native fish, as indicated by previous surveys, dramatically reduces the ability of the area to support loach minnow for extended periods. The distribution of the loach minnow in the San Francisco River likely fluctuates over time depending upon water levels, flooding, and other factors that affect populations of non-native fishes or may move loach minnow downstream onto BLM, State, and private lands for short periods of time.

The action area is also entirely situated within critical habitat for loach minnow. There are 126.5 miles of critical habitat designated along the San Francisco River, 235 miles within Complex 4, and 522.2 miles throughout the range. The critical habitat in the action area exhibits the aforementioned PCEs (see Status of the Species section, above) except that it is possesses nonnative fish species detrimental to loach minnow..

We have completed one section 7 consultation (BLM grazing program; File No. 02-21-96-F-0160) that includes the action area for this consultation. The aquatic environment in the action area is subject to the indirect effects from within the watershed, including livestock grazing, mining, and runoff from urban areas, roads, and trails. The action area is also occupied by non-native fishes that prey upon and/or compete with loach minnow.

Effects of the Proposed Action

Loach minnow are not known to occur in the action area at present, but it is situated within critical habitat for the species. The proposed action will thus have no impacts to individuals of the species.

Implementation of the proposed action, however, will result in measurable effects to loach minnow critical habitat via the placement of approximately 0.30 acre of riprap and temporary disturbance of 10.15 acres of streambed and floodplain. These effects to critical habitat will not measurably reduce the ability for the critical habitat to contribute to the recovery of the loach minnow at either the critical habitat unit (126.5 miles of the San Francisco River) or rangewide (522.2 miles in Arizona and New Mexico) scales.

PCE 1 pertains to the presence of permanent, flowing, water with no or minimal pollutant levels. PCE 2 pertains to maintenance of appropriate substrates and particle size distributions, and maintenance of a hydrograph that allows for adequate river functions. PCE 3 pertains to streams gradient; water temperature; pool, riffle, run, and backwater components; and an abundant aquatic insect food base. The proposed action will not alter the flood or base flow hydrographs of the San Francisco River, and the implementation of the proposed FERC procedures, SWPPP, and WMP will minimize the entry of sediment, construction materials, and waste into the aquatic environment. There will be residual and permanent effects to substrates and fluvial function from the placement of 0.30 acre of riprap but, as stated above, the small scale of these impacts is unlikely to preclude or reverse the role of the San Francisco River's reach of critical habitat in recovering the species.

PCE 4 includes maintaining habitat devoid of nonnative fish species detrimental to loach minnow or habitat in which detrimental nonnative fish species are at levels which allow persistence of loach minnow. The proposed action will have no effect on nonnative fish abundance or distribution. PCE 5 addresses the need to maintain connective corridors between occupied or seasonally occupied habitat and through which the species may move when the habitat is wetted. The proposed action includes a short term (58-day maximum) diversion of the San Francisco River, but this effect will be temporary. The proposed action's lack of appreciable effects to these PCEs is also unlikely to preclude or reverse the role of the San Francisco River's reach of critical habitat in recovering the species.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The action area is surrounded by private lands and thus, many of the effects of activities conducted on those lands are cumulative. The primary cumulative effects occurring within the action area are runoff from the impervious areas of the adjacent wastewater treatment plant (escape of untreated effluent is not anticipated), Highway 191, and buildings and associated structures and parking areas.

Conclusion

After reviewing the current status of the loach minnow, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the action, as proposed, is neither likely to jeopardize the continued existence of the loach minnow, nor likely to destroy or adversely modify designated critical habitat for the species. We present these conclusions for the following reasons:

- Loach minnow were not detected during fish surveys conducted in October of 2007 (SWCA 2008). Loach minnow are benthic and may not be readily detected when low in abundance; but, given the presence of large numbers of predatory nonnative fishes, the species is likely to be immeasurably rare in the project area.
- The implementation of the proposed FERC procedures, SWPPP, and WMP will minimize the entry of sediment, construction materials, and waste into the aquatic environment.
- Placement of the line segments to deeper than the anticipated scour depth will minimize the potential for exposure and future emergency excavation for replacement.
- The brevity (58 days) and scheduling of construction during the non-breeding season (October-November) will minimize the effects of sedimentation to loach minnow habitat in downstream reaches, and will allow sediments to be washed from the site prior to the next breeding season.
- The permanent placement of approximately 0.30 acre of riprap and temporary disturbance of 10.15 acres of floodplains within and adjacent to loach minnow critical habitat will affect PCEs 1, 2, and 3. PCEs 4 and 5 will not be appreciably affected. The proposed action's total suite of effects are unlikely to affect recovery of the species, as the areal extent, though measurable, is small relative to the amount of critical habitat at the San Francisco River Unit scale (126.5 miles) and rangewide (522.2 miles).

INCIDENTAL TAKE STATEMENT

As demonstrated in the preceding narrative, loach minnow are likely present, but in numbers that render detection difficult. The species is thus unlikely to be directly or indirectly affected by implementation of the replacement of the 2083, 2006, and 2007 gas lines or the subsequent placement of riprap at the site. We therefore do not anticipate that implementation of the proposed action will result in the incidental take of any loach minnow.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

- The U.S. Army Corps of engineers or its likely Federal action agency successor, the Federal Energy Regulatory Commission, should assist in the implementation of the Loach Minnow Recovery Plan.

For us to be kept informed of actions minimizing or avoiding adverse effects benefiting listed species or their habitat, we request notification of the implementation of any conservation recommendations.

Reporting Requirements/Disposition of Dead or Injured Listed Animals

Upon finding a dead or injured threatened or endangered animal, initial notification must be made to the FWS's Division of Law Enforcement, 2450 West Broadway, Mesa, Arizona (480-967-7900) within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph, and any other pertinent information. Care must be taken in handling injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible condition. If feasible, the remains of intact specimens of listed animal species shall be submitted as soon as possible to the nearest FWS or Arizona Game and Fish Department office, educational, or research institutions (e.g., University of Arizona in Tucson) holding appropriate state and Federal permits.

Arrangements regarding proper disposition of potential museum specimens shall be made with the institution before implementation of the action. A qualified biologist should transport injured animals to a qualified veterinarian. Should any treated listed animal survive, the FWS should be contacted regarding the final disposition of the animal.

REINITIATION AND CLOSING STATEMENT

This concludes formal consultation on the proposed San Francisco River natural gas line replacement and bank protection project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may adversely affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to a listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by this action.

We appreciate the U.S. Army Corps of Engineers' and Federal Energy Regulatory Commission's efforts to identify and minimize effects to listed species from this project. For further information please contact Jason Douglas (520) 670-6150, (x226) or Sherry Barrett (520) 670-6150, (x223). Please refer to the consultation number, 22410-F-2009-0191 in future correspondence concerning this project.

Sincerely,

Sherry Barrett

for Steven L. Spangle
Field Supervisor

cc (hard copy):
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Assistant Field Supervisor, U.S. Fish and Wildlife Service, Tucson, Arizona
Fish and Wildlife Service, Tucson, Arizona (Attn: Jason Douglas)

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Federal Energy Regulatory Commission (Attn: Joanne Wacholder), Washington, DC
Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, Arizona
Regional Supervisor, Arizona Game and Fish Department, Tucson, Arizona
El Paso Natural Gas (Attn: Amy Moore), El Paso, Texas

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US Army Corps of Engineers

DRNA

FEDERAL AND COMMONWEALTH JOINT PERMIT APPLICATION FOR WATER RESOURCE ALTERATIONS IN WATERS, INCLUDING WETLANDS, OF PUERTO RICO

Via Verde

Autoridad de Energía Eléctrica

Brillando hacia el futuro

Via Verde NG Pipeline

August 2010

Modified
November 2010

Government of Puerto Rico
Office of the Governor
Planning Board

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1. Permit Application and General Information

1.1. Executive Summary

The Via Verde project involves the construction and installation a 24-inch diameter steel natural gas (NG) pipeline for approximately 92 miles from the EcoEléctrica LNG Terminal in Peñuelas north to the Cambalache Termoeléctricas Authority Central electric power plant (PES) in Arecibo, then east to the Palo Seco facility in Toa Baja and the San Juan facility in San Juan. The pipeline will be embedded (buried) for its entire length and will pass through the municipalities of Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manati, Vega Alta, Vega Baja, Dorado, Toa Baja, Cataño, Bayamón, and Guaynabo. The pipeline route will encompass both private and public lands which include commercial, industrial, and agricultural land uses. The pipeline will be an industrial application, serving only PREPA, and as such will require fewer laterals, metering stations, compressor stations, and access points than a public NG pipeline. This has resulted in significantly fewer impacts, limited right-of-way sizing, and the ability to locate the pipeline outside of population centers and sensitive environmental areas.

An environmental impact document - Declaraciòn de Impacto Ambiental (DIA) - has been prepared by PREPA to meet the requirements of the Commonwealth of Puerto Rico and a biological evaluation document has been prepared to assist in consultations with the U.S. Fish and Wildlife Service (USFWS) with respect to Section 7 of the Endangered Species Act. Both documents have been included as part of the Department of the Army (DA) / Puerto Rico USACE Joint Permit Application prepared for the proposed project. These documents have been prepared to:

- clarify whether and what listed, proposed, and candidate species or designated or proposed critical habitats may be in the action area;
- determine what effect the action may have on these species or critical habitats;
- explain the ways the project has been modified to reduce or remove adverse effects to the species or critical habitats;
- determine the need to enter into formal consultation for listed species or designated critical habitats, or conference for proposed species or proposed critical habitats; and

  document the design modifications and actions to be undertaken to benefit the species.

The Via Verde Pipeline project has been designed to be the least impacting practicable alternative. Environmental impacts have been avoided and minimized to the greatest extent possible and through these efforts the project qualifies for review and authorization under a series U.S. Army Corps of Engineers' (USACE) Nationwide Permits. Four principal Nationwide Permits will be utilized: 1) NWP 12- Utility Line Activities; 2) NWP 18- Minor Discharges; 3) NWP 33- Temporary Construction, Access and Dewatering, and 4) NWP 38- Cleanup of Hazardous and Toxic Waste.

Although there is no Federal or State regulation to establish a distance of clearance from buildings, AEE will establish 150 feet of servitude in any alignment, for purposes of maintenance and upkeep. The easement will be known as "bonded maintenance" and may be reduced or increased in those areas that have space limitations, or particular situations. However, inside of this 150 foot area, a bonded operation of 50 feet will remain free of any building and deep-rooted vegetation. The remaining 100 feet of the easement under the maintenance servitude will revegetate naturally or through some mitigation plan as coordinated with concerned agencies. Maintenance servitude allows use and enjoyment by a proprietor, subject to processing and authorization obtained from AEE to conduct activities that would be developed within the servitude area. The construction and installation of the pipeline will require this initial construction right-of way (ROW) approximately 150 feet wide and the permanently maintained ROW of 50 feet post construction. The total project area encompasses 1,113.8 acres (92 miles X 100 foot ROW).

1.2. COE Permit Application

Under separate Cover as "Attachment A".

1.3. Project Purpose

1.3.1. Basic Purpose (water dependent)

The Authoridad de Energía Eléctrica (AEE), also known as the Puerto Rico Electric Power Authority (PREPA), produces, transmits and distributes the majority of the electric power used in Puerto Rico. Based on the power produced, it is one of the major public electric utility corporations in the United States. As a public corporation, it is the mission of PREPA to provide electric energy services to customers in the most efficient, cost-effective manner possible while maintaining a sustained compliance with local and federal environmental regulations. To achieve these goals, PREPA proposes to convert existing electrical power generation facilities from oil based fuels to natural gas (NG). The governor of Puerto Rico, the Honorable Luis G. Fortuño, is committed to this project and realizes its implementation will provide one of the tools necessary to meet the commitment of his Government to lower the cost of electrical energy and strengthen the Puerto Rican economy.

The proposed NG Pipeline System will put PREPA on the forefront and clearly aligned with the Department of Energy's edict to decrease the United States' dependence on foreign oil. At the same time, conversion to NG will achieve a 64% reduction in air pollutants released to the environment. Construction of the Via Verde (Greenway project) pipeline will enable PREPA to increase needed power generation in the northern regions of Puerto Rico, improve electric system reliability, reduce operation costs by using cheaper fuel, and maintain a sustained compliance with local and federal environmental regulations. More importantly, the PREPA Strategic Plan reaffirms the public policy of using renewable energy and alternative fuels to the maximum extent possible where their commercial application is technically and economically viable.

The project's basic purpose is to economically construct a pipeline to deliver natural gas to three existing power facilities operated by PREPA.

1.3.2. Overall Project Purpose Description (less damaging alternatives)

Puerto Rico depends almost entirely on petroleum to fuel the plants that produce the island's electricity. In 1992, groups in the Mayaguez area concerned by environmental impacts defeated a project developed by the private company, Cogentrix, to produce electricity using cheap and widely available coal, and sell steam as a byproduct. Both proponents of the plant and the electric authority predicted chronic shortages and black outs by the turn of the century. These predictions have turned out to be true.

Moreover, the environmental impact of the oil-dependent generating plants combined with the instability of the world oil market has brought the energy crises to Puerto Rico. Energy costs per kilowatt hour for electricity which are roughly triple that of the average for the continental United States (9.75 cents per kilowatt hour US vs. 21.63 cents per kilowatt hour Puerto Rico (References: http://www.eia.doe.gov/electricity/epm/table5_6_b.html). The strategic plan approved by PREPA Board of Directors, directs a reduction in dependence on oil used to produce electricity to below 50% by the year 2014. To comply, PREPA has turned to natural gas and proposes to construct a natural gas pipeline to connect the existing Eco Eléctrica NG import terminal and transfer facility located at the Municipality of Peñuelas north to the Municipality of Arecibo, then east to PREPA's Palo Seco and San Juan Steam Power plants.

Since its inception, PREPA has largely depended on fuels derived from petroleum to generate electric power. A small portion of electricity is generated with hydropower. The uncontrolled and unpredictable increase in the cost of petroleum fuel has increased the cost of electricity in Puerto Rico and greatly affected the industry and trade of the country. We must also emphasize that Puerto Rico is governed by the Federal Clean Air Act, which requires substantial changes in the percent contaminants in order to protect public health and the environment. The cost for these fuels also affects the cost of power production.

In July 2002, through resolution 3024, PREPA adopted a Strategic Plan for development and expansion to control the high cost of electricity and meet requirements under the Clean Air Act. This plan includes the following parameters:

- Diversification of fuels
- Cost reduction
- Geographic diversification of power generation
- Environmental considerations
- Expansion of generation plan
- Diversification of income

To comply with these parameters, the plan required, among other things, increased generating capacity in western Puerto Rico using natural gas as a primary fuel. In addition, the plan contemplated the construction of a gas pipeline from Cambalache at Arecibo, the industrial area of Barceloneta, to the Palo Seco and San Juan stations. Due to a reduction in demand for electricity, the project to increase capacity in the West has been delayed, but the PREPA decided it is still important to diversify fuels used in the Central Cambalache, Palo Seco and San Juan facilities. At the same time, it is important to reduce operating costs and maintain environmental compliance.

The Via Verde project will increase generation in the north area, improve the reliability of the electrical system, reduce the cost of operation by using cheaper fuel, and continue to comply with local and federal environmental regulations. The pipeline will allow PREPA to be flexible and choose parameters to achieve the most efficient and economical electricity generation for its customers.

The project's overall purpose is to reduce PREPA's dependence on oil for the production of electricity by converting electrical power generation facilities along the north coast of Puerto Rico from oil based fuels to natural gas (NG) in the most economical and practical method possible and using available infrastructure wherever possible.

1.4. Project Description

Construct and install a 24-inch diameter steel natural gas pipeline approximately 92 miles from the EcoEléctrica LNG Terminal in Peñuelas north to the Cambalache Termoeléctricas Authority Central Combined Cycle Power Plant (CCPP) in Arecibo, then east to the Palo Seco facility in Toa Baja and the San Juan facility in San Juan. The pipeline will be embedded (buried) for its entire length and will pass through the Municipalities of Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manati, Vega Alta, Vega Baja, Dorado, Toa Baja, Cataño, Bayamón, and Guaynabo. The pipeline route will encompass both private and public lands which include commercial, industrial, and agricultural land uses. Construction and installation of the pipeline will require an initial construction right-of way (ROW) 150 feet wide and a permanently maintained ROW of 50 feet post construction.

The total project area encompasses 1,113.8 acres (92 miles X 100 foot ROW); 369.3 acres of which are jurisdictional Waters of the United States. The project will not result in any permanent wetland impacts and all disturbed wetlands will be restored to pre-construction grades, stabilized, and re-vegetated. The project qualifies for review and authorization under the U.S. Army Corps of Engineers' (USACE) Nationwide Permits.

1.5. Nationwide Permit Request, List of NWP's

The Via Verde Pipeline project has been designed to be the least impacting practicable alternative. Environmental impacts have been avoided and minimized to the greatest extent possible.

In accordance with the US Army Corps of Engineers' federal regulations, linear projects that cross multiple waterways are eligible for consideration under Nationwide Permit review. Thirty-one (31) tentative "projects" have been proposed along the pipeline route. The pipeline is designed so that each "project" (defined by a project boundary) will use, at most, a combination of four Nationwide Permits (NWP): 1) NWP 12- Utility Line Activities; 2) NWP 18- Minor Discharges; 3) NWP 33- Temporary Construction, Access and Dewatering; and 4) NWP 38- Cleanup of Hazardous and Toxic Waste. The map series in Appendix B breaks the pipeline route into 96 maps where temporary impacts will occur to Waters of the U.S. The maps identify each water body crossing and wetland area. Table 1 (below) in this section lists the NWP authorizations requested for each of the separate projects. Table 1 also identifies water body crossings, i.e. C-1, and wetland areas, i.e. W-4, that fall within each of these tentative project areas. Below is a summary of the four Nationwide Permits and their national and regional conditions. Additionally, an analysis is provided for each NWP detailing how the proposed Via Verde Pipeline Project meets these conditions.

Nationwide Permit 12: Utility Line Activities

NWP 12 Conditions: Activities required for construction, maintenance, repair, and removal of utility lines and associated facilities in waters of the United States, provided the activity does not result in the permanent loss of greater than 1/2 acre of waters of the Unites States.

Material resulting from the trench excavation may be temporarily side-cast into waters of the United States for no more than three months.

In the Commonwealth of Puerto Rico and U.S. Virgin Islands, Nationwide Permit 12 is excluded from use in forested wetlands, submerged aquatic vegetation, tidal wetlands, and/or coral assemblages.

Pre-Construction Notification (PCN) in the Commonwealth of Puerto Rico and U.S. Virgin Islands shall be made using the Puerto Rico Joint Permit Application (JPA), and the JPA form must clearly indicate that it is a Nationwide permit PCN (COE).

Project Descriptions: As a result of the regional conditions, only freshwater wetlands (Palustrine Herbaceous Wetland, PEM)[1] and freshwater intermittent or perennial surface waters

[1] USFWS Deepwater Classification

(Riverine, Lower and Upper Perennial, and Intermittent; R2, R3, R4)[2] will be temporarily impacted. Forested wetlands and tidal wetlands will not be impacted.

To comply with the national and regional conditions, only temporary impacts will occur with trenching of the pipeline and clearing activities in the ROW. Clearing activities will only involve cutting or removal of vegetation above the ground, such as mowing, rotary cutting, and chain-sawing, so dredge material associated with incidental fallback is not discharged. Mechanized equipment with front blades such as bulldozers will NOT be used to clear the right-of-way for the pipeline in wetland areas. Materials and soils excavated during the installation/trenching of the pipeline will be temporarily side-cast for a period not to exceed three months. Excess materials and soils will be placed in self-contained upland disposal sites. All affected wetland areas will be restored to pre-construction conditions and will be allowed to naturally recruit native vegetation.

<u>Nationwide Permit 18: Minor Discharges</u>

NWP 18 Conditions: Minor discharges of dredged or fill material into all waters of the United States, provided the activity meets the following criteria: (a) The quantity of discharged material and the volume of area excavated do not exceed 25 cubic yards below the plane of the ordinary high water mark or the high tide line; (b) The discharge will not cause the loss of more than 1/10 acre of waters of the United States; and (c) The discharge is not placed for the purpose of a stream diversion.

In the Commonwealth of Puerto Rico and U.S. Virgin Islands, Nationwide Permit 18 is excluded from use in forested wetlands, submerged aquatic vegetation, tidal wetlands, and/or coral assemblages.

PCN in the Commonwealth of Puerto Rico and U.S. Virgin Islands shall be made using the Puerto Rico Joint Permit Application (JPA), and the JPA form must clearly indicate that it is a Nationwide permit PCN (COE).

Project Descriptions: This Nationwide Permit will be utilized to authorize any unexpected minor discharge that may occur that would result in permanent discharge.

<u>Nationwide Permit 33: Temporary Construction, Access, and Dewatering</u>

[2] Ibid

NWP 33 Conditions: Temporary structures, work and discharges, including cofferdams, necessary for construction activities or access fills or dewatering of construction sites, provided the associated primary activity is authorized by the Corps of Engineers or the U.S. Coast Guard. Appropriate measures must be taken to maintain near normal downstream flows and to minimize flooding. Following completion of construction, temporary fill must be entirely removed to upland areas, dredged material must be returned to its original location, and the affected areas must be restored to pre-construction elevations. The affected areas must also be re-vegetated, as appropriate.

In the Commonwealth of Puerto Rico and U.S. Virgin Islands, Nationwide Permit 33 is excluded from use in forested wetlands, submerged aquatic vegetation, tidal wetlands, and/or coral assemblages.

PCN in the Commonwealth of Puerto Rico and U.S. Virgin Islands shall be made using the Puerto Rico Joint Permit Application (JPA), and the JPA form must clearly indicate that it is a Nationwide permit PCN (COE).

Project Descriptions: Temporary construction activities associated with the installation of the pipeline, such as Horizontal Directional Drilling (HDD) sites located in wetlands, that may impact Palustrine non-forested wetlands and Riverine intermittent and perennial surface waters would be authorized through Nationwide Permit 33.

Nationwide Permit 38: Cleanup of Hazardous and Toxic Waste

NWP 38 Conditions: Specific activities required to effect the containment, stabilization, or removal of hazardous or toxic waste materials that are performed, ordered, or sponsored by a government agency with established legal or regulatory authority.

PCN in the Commonwealth of Puerto Rico and U.S. Virgin Islands shall be made using the Puerto Rico Joint Permit Application (JPA), and the JPA form must clearly indicate that it is a Nationwide permit PCN (COE).

Project Descriptions: In the unlikely event an unexpected release of drilling mud, i.e. a Frac-out, should occur during HDD operation, we are requesting authorization to clean-up any such materials from waters of the U.S. utilizing NWP-38. All necessary precautionary measures will be in place to prevent Frac-outs and a Frac-Out Plan (Appendix I) has been prepared to ensure proper response to any such event.

Table 1: Nationwide Permit Requests

Project	ID	NWP Requests
1	C-1	12, 18, 33, 38
	C-2	12, 18, 33, 38
	C-3	12, 18, 33
	C-4	12, 18, 33
	W-1	12, 18, 33
	W-2	12, 18, 33
	W-3	12, 18, 33
	W-4	12, 18, 33
	W-5	12, 18, 33
	W-6	12, 18, 33, 38
	W-7	12, 18, 33, 38
	W-8	12, 18, 33
2	C-5	12, 18, 33, 38
	W-10	12, 18, 33
	W-9	12, 18, 33
3	C-6	12, 18, 33
	C-7	12, 18, 33
4	C-8	12, 18, 33
5	C-10	12, 18, 33
	C-11	12, 18, 33
	C-9	12, 18, 33
6	C-12	12, 18, 33
7	C-13	12, 18, 33
	C-14	12, 18, 33
	C-15	12, 18, 33
8	C-16	12, 18, 33
	C-17	12, 18, 33
9	C-18	12, 18, 33
	C-19	12, 18, 33
	C-20	12, 18, 33
	W-11	12, 18, 33
10	C-21	12, 18, 33
	C-22	12, 18, 33
11	C-23	12, 18, 33
	C-24	12, 18, 33
	C-25	12, 18, 33
12	C-26	12, 18, 33, 38
	C-27	12, 18, 33
	C-28	12, 18, 33

Project	ID	NWP Requests
	C-29	12, 18, 33
	C-30	12, 18, 33
	W-12	12, 18, 33, 38
	W-13	12, 18, 33, 38
13	C-31	12, 18, 33, 38
	C-32	12, 18, 33
	W-14	12, 18, 33, 38
14	C-33	12, 18, 33
	C-34	12, 18, 33, 38
	W-15	12, 18, 33, 38
15	C-35	12, 18, 33
16	C-36	12, 18, 33, 38
	C-37	12, 18, 33, 38
	C-38	12, 18, 33
	C-39	12, 18, 33, 38
	C-40	12, 18, 33
	W-16	12, 18, 33, 38
	W-17	12, 18, 33
	W-18	12, 18, 33, 38
	W-19	12, 18, 33
	W-20	12, 18, 33
	W-21	12, 18, 33
	W-22	12, 18, 33
	W-23	12, 18, 33, 38
	W-24	12, 18, 33
	W-25	12, 18, 33
	W-26	12, 18, 33
	W-27	12, 18, 33
17	C-41	12, 18, 33
	C-42	12, 18, 33
	C-43	12, 18, 33, 38
	W-28	12, 18, 33
	W-29	12, 18, 33
	W-30	12, 18, 33
	W-31	12, 18, 33, 38
	W-32	12, 18, 33
	W-33	12, 18, 33
18	C-44	12, 18, 33
	C-45	12, 18, 33
	C-46	12, 18, 33

Project	ID	NWP Requests
	C-47	12, 18, 33
	W-34	12, 18, 33
	W-35	12, 18, 33
	W-36	12, 18, 33
	W-37	12, 18, 33
	W-38	12, 18, 33
	W-39	12, 18, 33
	W-40	12, 18, 33
19	C-48	12, 18, 33
	C-49	12, 18, 33
	C-50	12, 18, 33
	C-51	12, 18, 33
	W-40	12, 18, 33
	W-41	12, 18, 33
	W-42	12, 18, 33
	W-43	12, 18, 33
	W-44	12, 18, 33
	W-45	12, 18, 33
20	C-52	12, 18, 33
	C-53	12, 18, 33
	C-54	12, 18, 33
	C-55	12, 18, 33
	C-56	12, 18, 33
	C-57	12, 18, 33
	C-58	12, 18, 33
	C-59	12, 18, 33
	C-60	12, 18, 33
	C-61	12, 18, 33
	W-45	12, 18, 33
	W-46	12, 18, 33
	W-47	12, 18, 33
	W-48	12, 18, 33
	W-49	12, 18, 33
	W-50	12, 18, 33
	W-51	12, 18, 33
	W-52	12, 18, 33
	W-53	12, 18, 33
	W-54	12, 18, 33
	W-55	12, 18, 33
	W-56	12, 18, 33

Project	ID	NWP Requests
	W-57	12, 18, 33
21	C-62	12, 18, 33
	C-63	12, 18, 33
	W-57	12, 18, 33
	W-58	12, 18, 33
	W-59	12, 18, 33
	W-60	12, 18, 33
22	C-64	12, 18, 33
	C-65	12, 18, 33
	C-66	12, 18, 33, 38
	C-67	12, 18, 33
	C-68	12, 18, 33
	C-69	12, 18, 33
	C-70	12, 18, 33
	C-71	12, 18, 33
	C-72	12, 18, 33, 38
	C-73	12, 18, 33, 38
	W-61	12, 18, 33
	W-62	12, 18, 33
	W-63	12, 18, 33, 38
	W-64	12, 18, 33
	W-65	12, 18, 33
	W-66	12, 18, 33
	W-67	12, 18, 33
	W-68	12, 18, 33
	W-69	12, 18, 33
	W-70	12, 18, 33
	W-71	12, 18, 33
	W-72	12, 18, 33
	W-73	12, 18, 33, 38
	W-74	12, 18, 33
	W-75	12, 18, 33, 38
	W-76	12, 18, 33
	W-77	12, 18, 33
23	C-74	12, 18, 33
	W-78	12, 18, 33
24	C-75	12, 18, 33
	C-76	12, 18, 33
	C-77	12, 18, 33
	C-78	12, 18, 33

Project	ID	NWP Requests
	C-79	12, 18, 33
	W-79	12, 18, 33
	W-80	12, 18, 33
	W-81	12, 18, 33
	W-82	12, 18, 33
	W-83	12, 18, 33
	W-84	12, 18, 33
	W-85	12, 18, 33
25	C-80	12, 18, 33
	C-81	12, 18, 33
	W-86	12, 18, 33
	W-87	12, 18, 33
	W-88	12, 18, 33
	W-89	12, 18, 33
	W-90	12, 18, 33
	W-91	12, 18, 33
26	C-82	12, 18, 33
	W-92	12, 18, 33
	W-93	12, 18, 33
27	C-83	12, 18, 33
	C-84	12, 18, 33
	C-85	12, 18, 33
	C-86	12, 18, 33
	C-87	12, 18, 33
	C-88	12, 18, 33
	C-89	12, 18, 33, 38
	W-100	12, 18, 33
	W-101	12, 18, 33
	W-94	12, 18, 33
	W-95	12, 18, 33
	W-96	12, 18, 33
	W-97	12, 18, 33
	W-98	12, 18, 33
	W-99	12, 18, 33
28	C-90	12, 18, 33, 38
	C-91	12, 18, 33
	C-92	12, 18, 33, 38
	C-93	12, 18, 33, 38
	C-94	12, 18, 33, 38
	W-102	12, 18, 33, 38

Project	ID	NWP Requests
	W-103	12, 18, 33, 38
	W-104	12, 18, 33, 38
	W-105	12, 18, 33
	W-106	12, 18, 33, 38
	W-107	12, 18, 33, 38
	W-108	12, 18, 33, 38
	W-109	12, 18, 33, 38
	W-110	12, 18, 33, 38
	W-111	12, 18, 33, 38
29	C-95	12, 18, 33, 38
	C-96	12, 18, 33, 38
	C-97	12, 18, 33
	W-112	12, 18, 33
	W-113	12, 18, 33
	W-114	12, 18, 33, 38
	W-115	12, 18, 33, 38
	W-116	12, 18, 33
30	W-116	12, 18, 33
	W-117	12, 18, 33
	W-118	12, 18, 33
	W-119	12, 18, 33
31	C-100	12, 18, 33
	C-98	12, 18, 33
	C-99	12, 18, 33
	W-119	12, 18, 33
	W-120	12, 18, 33
	W-121	12, 18, 33
	W-122	12, 18, 33
	W-123	12, 18, 33
	W-124	12, 18, 33
	W-125	12, 18, 33
	W-126	12, 18, 33
	W-127	12, 18, 33
	W-128	12, 18, 33
	W-129	12, 18, 33
	W-130	12, 18, 33
	W-131	12, 18, 33
	W-132	12, 18, 33
	W-133	12, 18, 33
	W-134	N/A

Project	ID	NWP Requests
	W-135	N/A
	W-136	N/A

1.6. ROW, Property Owner Information, Adjacent Owners

Please see Appendix E for the ROW list of property owners and adjacent owners.

1.7. Alternative Analysis

Section 404(b)(1) of the Clean Water Act prohibits the discharge of dredged or fill material into waters of the United States unless the proposed discharge is the least environmentally damaging practicable alternative capable of achieving the project purpose. Alternative routes for the pipeline were evaluated pursuant to 40 CFR 230.10. The National Environmental Policy Act (NEPA) and implementing regulations at 40 CFR 1502.14, together with the Commonwealth Policy Act, require a range of reasonable alternatives including the no action alternative be evaluated. Under these laws and regulations, the no action alternative and action alternatives that meet the project purpose and need of the preferred alternative are considered to be reasonable alternatives. Under the aforementioned laws, these alternatives do not need to be available to the applicant. Though the Corps will evaluate these alternatives, the alternatives selected should be available to the applicant at the time of the permit decision.

The Government of Puerto Rico's 1993 Energy Policy acknowledged the island's high dependency on oil, which at the time was 99%, and the high environmental cost this caused. The policy directs diversification of fuel sources for power generation to reduce the volatility of oil prices and overall power generation costs and to introduce environmental criteria for the selection of new power plants. Following is a detailed discussion of alternatives to the proposed Via Verde project that meet the project purpose and need. Each alternative discussed addresses logistics, technology, cost and environmental consequences and is followed by a statement indicating whether or not we consider the alternative to be practicable. Among alternatives considered were: the construction of a terminal receipt for NG on the north coast of the island, barge and buoys (Deepwater Port) for receipt of NG, storage and re-gasification of NG, and several terrestrial alignments for a natural gas pipeline system. The alternative of no action was also analyzed.

1.7.1. No Action Alternative.

The alternative of no action, although considered, was found not feasible given transcendence, importance, and public welfare that pursue the project.

Preliminary environmental impacts and direct/indirect impacts associated with construction of the pipeline natural gas are considered. If the project is not built the following impacts would be avoided:

- Impacts from moving earth that could result in erosion and sedimentation in bodies of water
- Temporary increases in noise levels
- Impacts to forest reserves
- Temporary impacts to wetlands and other bodies of surface water
- Impacts to farmland
- Temporary impacts to infrastructure such as waterlines, buildings and (possible) phone lines
- Temporary impacts to traffic and roads, i.e. detours
- Potential impacts to archaeological sites
- Acquisition of land by expropriation

However, if the project is built most of these impacts, if not avoided completely, could be minimized and mitigated using engineering design options and support from agencies and municipalities the project would cross through.

No action is not indicative of no impact, since with this alternative AEE will be forced to continue to produce electricity by burning petroleum products that generate greater amount of pollutants emitted to the air. While some of these emissions can be controlled by using technology that requires, in many cases, an investment of millions of dollars, modern emission reduction highlights that the emissions of these derivatives of petroleum would be greater if related to the burning of natural gas. In addition, maintenance of petroleum burning units has to take place more frequently and with higher costs to guarantee optimal operation. Continuing to burn petroleum derivatives has other implications, such as an increased frequency of deliveries of these fuels to our ports which increases erosion of the seabed and the likelihood of spills. The continued use of fuels derived from petroleum increases the cost of electricity, which negatively impacts the Puerto Rican economy and results in a lower quality of life for its citizens. Finally, liquid fuels expose AEE to fluctuations in the market value creating instability in the costs of energy production and invoices. Recognizing that the Puerto Rico economy is directly linked to the stability of the AEE, it is important for the company to meet its strategic development plans and maintain a fixed cost structure to avoid sudden peaks of variations in the cost of purchased fuel. Compliance with this plan demonstrates vision, stability and commitment to customers, the ability to assess complex situations of world character and the ability to develop strategies to minimize adverse impacts making it easier to expand options to obtain fuels in the future.

After evaluating local and global dynamics, AEE developed a strategic plan to guide future development of the company and Puerto Rico. This plan includes the following parameters:

- Diversification of energy sources
- Reduction in costs
- Geographic diversification of generating electricity
- Environmental considerations
- Expansion of electrical generation
- Diversification of revenue

The Via Verde project is part of the plan to diversify fuels which can make AEE better. In addition, there are important environmental considerations to help AEE to more effectively manage their energy costs.

A significant percent of Puerto Rico's generated electrical power depends on oil. At the moment, AEE uses only No. 2 fuel (light distillate) and No. 6 (bunker C) its generator units and it buys electricity, in turn, from the AES co-generators in the municipality of Guayama (coal) and EcoEléctrica in the municipality of Peñuelas (natural gas). With the introduction of the co-generators AEE began to buy electricity generated from NG or coal but internally AEE still depends exclusively on oil.

The AEE aims to reduce its dependence on the use of oil, which currently is approximately 68%, to approximately 12% by 2014. To do this AEE must identify alternative fuels that can meet their customers demand for power. Lack of action would only aggravate the current dependence on oil, and at a time of seizure or high global demand, Puerto Rico would have no viable alternatives to generate electricity. In addition, no action exposes AEE to sudden changes in the cost of oil which reduces the economic capacity of AEE and, consequently, the Puerto Rican economy. It is important to highlight that AEE is limited by regulations to the type of fuel it can burn. The greatest limitation is the amount of sulphur contained in fuel. Low sulphur fuel is more expensive than fuel with higher sulphur content. If there are shortages in this type of fuel or if AEE cannot set contracts with the suppliers, there are only two options left: reduce the production of electricity, which is not feasible, or burn a cheaper fuel with higher sulphur content in violation of established environmental permits, with subsequent exposure to fines and sanctions from regulatory agencies. The use of natural gas significantly decreases emissions of pollutants to the environment. No action means AEE must expend significant capital to reduce emissions that result from burning oil and to maintain their units, instead of using that capital to develop a more efficient system that uses cleaner fuel with lower maintenance costs.

The No Action Alternative would not meet the project purpose and will not be considered further.

1.7.2. Constructing a New Terminal to Receive Natural Gas (NG) in Central San Juan Alternative

Currently Puerto Rico has the EcoEléctrica Cogeneradora in the municipality of Peñuelas, to receive LNG (and meet AEE needs). Still, the alternative of building a new terminal closer to AEE power facilities was evaluated in consideration of environmental impacts potentially associated with the construction of a delivery pipeline from the EcoElectrica terminal. A location between the three power plants on the northern coast selected to convert to Natural Gas (NG) was identified next to the Central Thermoelectric San Juan (CTSJ) unit. Currently, an existing pier has infrastructure to transport diesel and Bunker C Fuel to two of the three plants, San Juan and Palo Seco.

A new NG import terminal must be able to receive, download, and store up to 3.0 Bcf/d (3 trillion cubic feet) of liquid natural gas imported by sea. In addition, facilities to gasify and handle the natural gas would also need to be built. The construction of the terminal would result in an environmental impact associated with the different stages of the construction and operation, which include:

- Build, repair, or expand (depending on the case), a pier for receipt of liquid natural gas.
- Increase in the transit of ships.
- Construction of a tank for liquid natural gas storage and gasification - this plant would require an area of approximately 25 acres.
- Constructing navigation channels to support transit tankers, which would mean dredging and disposing dredged material.

Selecting a place to construct a terminal to receive liquid natural gas requires a deep port to minimize the environmental impacts associated with the development and operation of the terminal. In addition, a relatively low population density area with industrial development is necessary.

Three (3) criteria were used to determine whether building close to AEE's installation import terminal was a viable alternative.. These were: 1) specific factors at the workplace, 2) maritime operations and, 3) environmental issues.

1) Factors specific to the workplace

Availability of Land: a suitable location must have enough space available to accommodate the proposed installation and all safety components required by the Federal Department of transportation regulations (49 CFR part 193), the U.S. Coast Guard (33 CFR part 127) and the National Fire Protection Association (NFPA). In addition, a site must comply with the regulatory distance required between structures used to gasify LNG and the LNG storage tank. Facilities would need to occupy an area of approximately 25 acres. Structures would include, among other components, a dual containment tank 167 feet in height and diameter with the ability to store 1,000,000 barrels of liquid natural gas at a temperature of minus 260 degrees Fahrenheit and a pressure of 2.0269 psig; vaporization or gasification systems to gasify liquid natural gas, and pipes to transport the natural gas to the power stations. Other factors to be considered would include activities outside and adjacent to the terminal and the distance or separation that you must have between the terminal to occupied areas of activity and/or populated areas (49 CFR parts 193.2055, 193.2057 and 193.2059).

Availability of Coastal Area: a site must have an available maritime quay with facilities for tankers 950 feet long, with PIP cubic meters capacity, and a minimum 40-foot boat anchor area. The criteria used to assess whether a port or dock has the capacity for this type of project are the depth of greater than 40 feet, navigation channels with extension airway passage (greater than 180 feet) and proximity to equipment to conduct storage and gasification of liquid natural gas. The quay must be approximately 30 feet wide by 1,700 long and have, among others: teams to tie up the tanker to the dock; a boat platform with two levels at the end (a 40-foot wide by 100 long lower level and 20 wide and 100 long upper level); and a emergency spill collection system.

Disposal of Dredge Material: any area under consideration must include the requirement to dredge to create a proper shipping channel for the maritime tanker traffic to deliver the liquid natural gas; also a site must be identified for dredged material generated during construction and future maintenance operations required for the channel. Infrastructure: a new import terminal will require adequate infrastructure that includes a source of reliable energy and roads where appropriate, to meet emergencies.

2) Maritime operations

Increase in ships: the transit of tanker ships is subject to more restrictions than general maritime traffic. Federal regulations and restrictions could affect other shipping and increase the risk of affecting other users of the navigation channel.

Access to the navigation channel: the quicker a tanker vessel can arrive at the terminal, unload and return to sea, the more economic the operation is. A shorter channel would reduce possible adverse effects on traffic for other ships from marine transit restrictions. Yaw (amplitude and proximity) area: a typical liquid natural gas tanker ship would require a dock with a minimum turning diameter of 1,200 feet and 40 feet of depth.

3) Environmental issues

Environmental consequences: minimizing environmental impact by using places previously impacted, including the place for dock, and areas zoned for this type of use.

Compatibility with the region: the place must be compatible with future developments on adjacent properties.

Zoning and land use: one of the objectives of the project is to avoid or minimize adverse impacts to the environment due to development. A place must be located within an area acceptable for industrial development to help confine any environmental impact to previously industrialized areas.

Distance to populated areas: the place is labeled depending on of its distance from populated areas or residences. Avoiding populated areas is necessary to comply with the criterion of the THOD (49 CFR 193.2055, 193.2057 and 193.2059), which governs the establishment of an exclusion zone, and any location or area where a terminal cannot be built due to population density. Respecting the distance set in this exclusion zone and minimizing negative public perception about security issues would be difficult with a new liquid natural gas terminal.

The tankers commonly used for transporting liquid natural gas have a capacity ranging from 125,000 to 140,000 cubic meters. Larger boats range from 950 to 1,000 feet long, with a typical draft of 38 to 40 feet. Ensuring that liquid natural gas tankers can arrive without difficulty requires an additional depth of two (2) feet under the keel. This requires tankers maritime access with a wharf and dock yaw in bodies of water that are at least 40 feet deep.

The CTSJ site consists of 32.85 acres. Fossil fuels are received from the pier located on the west side, in the port area of San Juan. This quay is located in the Puerto Nuevo channel east of the Army Terminal. This maritime area was prepared for the navigation of vessels delivering fuel, among others. Currently, barges giving service to AEE unload fuel at the dock on the Puerto Nuevo navigation channel.

According to the bathymetric maps, the current service area has a depth of more than 30 feet. The maximum depth at the Army Terminal is, at only one point, 40 feet. Most of the depths range between 35 and 37 feet. This dock is connected to the channel at the Army Terminal, which leads to the Anegado Channel. This joins the Bar Channel that serves as access to all maritime vessels entering the San Juan Bay.

To prepare the area for receipt of tanker ships the navigation channels would need to be dredged to a depth 40 feet deep and have a minimum width of 300 feet. The disposal of resultant dredged material could present a problem because of the need to identify an appropriate place for the material so it does not result in an adverse environmental impact. Puerto Rico currently does not have approved upland dredged disposal sites with the capacity to receive or process the amount of material that would be generated from a project of this magnitude. In addition, it has been shown that most upland disposal sites for dredged material are not suitable workplaces for subsequent industrial or commercial development.

The disposal of dredge material could be offshore, in an approved ocean disposal site. This also has several disadvantages. The area would need to be large enough so the amount of material to be discharged would not have an unacceptable adverse impact on the benthic community area. It would also need to be capable of receiving those materials produced from future maintenance dredging operations that would be required to avoid interruption to the delivery of liquid natural gas.

Dredging operations would degrade the quality of the receiving waters due to suspended fine sediments. Effects from the turbidity plume could occur daily during working hours and up to two (2) hours after the discharge of dredged material is completed. This would affect water quality and, consequently, water quality parameters required by environmental permits governing the CTSJ, especially turbidity, sedimentation and suspended solids.

The docks and ports on the Bay of San Juan annually receive 80% of the products imported into Puerto Rico and they play a crucial role in the process of exporting products of all kinds. The Port of San Juan Bay receives an average of 700 cruise ships annually, with 1.3 million tourists visiting San Juan. Thousands of fishermen use the waterway every year, with an average of 350,000 pounds of fresh fish caught from fishing activities. All marine traffic uses the San Juan Bay through the Bar and Anegado channels. In addition, much imported products arriving in the Bay reach the Army Terminal Pier. It is estimated a liquid natural gas import terminal would increase maritime traffic in the area of the Bay of San Juan at the rate of 25 to 60 visits annually, based on the size of the vessels that deliver liquid natural gas. Tanker ships would use the three channels, until they reach the pier at Puerto Nuevo Bay. This represents an increase in marine traffic which would disproportionately affect economy and tourism. One example of an effect would be the increase in maritime traffic restrictions which make it difficult, if not impossible, for others to use the navigation channels simultaneously with LNG tankers.

The Estuary of the Bay of San Juan (EBSJ) is composed of several bodies of water. The EBSJ provides food and shelter to eight species of fauna and 17 species of flora in danger of extinction, such as the Antillean Manatee and several species of turtles, including the hawksbill and tinglar; 160 species of birds, such as the Brown Pelican and the Heron; 19 species of reptiles and amphibians, such as the coquí and boa of Puerto Rico; 124 species of fish, Tarpon and bass; and 300 species of wetland plants are found on EBSJ.

The body of water closest to the CTSJ is Puerto Nuevo Bay, which is part of the Bay of San Juan. Close to Army Terminal dock are communities of macroalgae. Patches of *Gracilaria sp.* are present and, in smaller quantities, *Entermorpha sp.* Associated with these macroalgae is a rich population of invertebrates, which include: tube worms (*Onuphia Sp.*), blue crabs (*Callinectes sp.*) and several bivalves (*Corbula* and *Diplodonta*). There is no evidence of coral reefs in the area of the CTSJ. Slightly farther away from the CTSJ, the area of the Bridge of the Constitution and the entrance to the Martin Peña channel (all part of the EBSJ), are neighboring areas designated as critical coastal areas for wildlife. Mega-invertebrates found here include: *Callinectes sp.*, *Micropanope sp.* and pink shrimp (*Penaeus duorarum*). Although studies of fish in the vicinity of the CTSJ have not been made, it is reasonable to expect them to be found in the Bay of San Juan. Among the fish in the Bay of San Juan are: tarpons (*Megalops atlantica*), *Elops saurus*, *Eleotris Pisonis*, hardhead catfish (*Ariopsis felis*) and gafftopsail catfish (*Bargre marinus*).

Studies that cover the coast running from Punta Las Marias to Punta Boca Juana (mouth of the River plate), which includes the San Juan Bay, reference threatened and endangered species, such as: green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*), West Indian Manatee (*Trichechus manatus*), and the brown pelican (*Pelecanus occidentalis*) - recently relisted as a threatened species. These turtles and the manatee have not been sighted in the lagoons, canals or bays in the vicinity of the CTSJ, although the brown pelican is known to be in the vicinity of the CTSJ.

The alternative of building a terminal at or near the CTSJ is not feasible, nor practicable, when comparing potential environmental impacts associated with the construction of a natural gas pipeline to service AEE's power stations. It must be considered that the process of constructing and operating an LNG import terminal is complex. Permits and endorsements are regulated by the Federal Energy Regulatory Commission (FERC). In comparison, the EcoEléctrica studies and permit process to construct an import terminal and start of the operation took between 7 to 10 years. This timeline would not satisfy AEE's need to begin a project to facilitate the transition from oil to a renewable source of energy. The cost of the existing EcoEléctrica terminal fluctuated around $570 million in 1995. Considering inflation, the construction of a similar terminal today would be too onerous as it would be beyond the $1 billion. As a project of the

Government of Puerto Rico, it would require funding through bond issues, limiting savings on electrical bills.

The construction of a terminal import within or close to holdings of the CTSJ as an alternative is not feasible when comparing the physical status of the area with the physical conditions required for this type of terminal. Adverse environmental impacts from such an alternative are expected to be significant. Evaluating the criteria applied to this project concluded deficiencies exist that result in little benefit and make this alternative not practicable. Although an area of maritime use, the CTSJ (as well as the other two stations in the northern area) does not comply with depth criteria or the anchor capacity for the necessary tankers. This alternative lacks a dredged material disposal area and necessary dredging activity would adversely impact the benthic community in the area. Maritime traffic would be highly compromised by existence of only one entrance channel to San Juan Bay. It is believed locating a receiving terminal here would adversely impact the local economy, as well as the tourism industry.

1.7.3. Constructing a System(s) of Barges and Buoy (Deepwater Port) Alternative

As one of the alternatives to the project, the installation and operation of barges and a mono buoy for the receipt, storage and regasification to transport natural gas to each area in the north central system was considered.

This barge and buoy system, which is also known as a Deepwater Port, would involve the construction of a terminal to receive compressed natural gas (CNG) in the vicinity of each of the plants. This terminal would receive gas from a station located outdoors, 5 km off the coast, where a barge is docked to bring the LNG from the point of export (an LNG tanker). The barge will have a regasification system docked to a buoy which keeps afloat lines connecting the barge to pipelines that will be on the seabed. These pipelines will transport compressed gas to a receiving terminal near the central power unit. Terminals that receive methane require a minimum area of approximately 2,500 square meters.

Construction, installation and operation of these systems of barges and buoys are regulated by two leading agencies: the Maritime Administration (MARAD), attached to the Federal Department of Transportation, and the US Coast Guard under its Deepwater Ports Standards Division. Other federal agencies that have 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, U.S.

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 Materials Safety Administration (PHMSA), US Army Corps of Engineers (USACE), US Fish and Wildlife Service (FWS), and the White House Energy streamline Task Force. Commonwealth agencies with jurisdiction are: Office of the Governor, Department of Natural Resources and Environment (DRNA), Instituto de Cultura Puertorriqueña (ICP), State Historic Preservation Office (SHPO), Port Authority, Commission on Public Service (CSPs), Board of Environmental Quality (JCA), Board of Urban Planning (JPU) and the Authority of Electrical Energy (AEE).

The AEE would request a private company with expertise in the design, construction, and operating system of a Deepwater Port. This could cost AEE between $70 and $80 million per year, subject to signing a contract with that company for a period of not less than 20 years. At the end of the 20 year period the total cost would be approximately $1.6 billion dollars.

The process of obtaining permits for the construction and operation of these systems begins by filing an application to the MARAD. MARAD was delegated the authority to grant licenses for the construction and operation of systems of barges by the Secretary of Transportation under the Deepwater Port Act, as amended in 2002. Federal Regulation 33 CFR Parts 148, 149 and 150 govern the process of request for license for the construction and operation of these systems.

The license application process begins with a phase of pre-request, during which the applicant discusses the project with the concerned agencies, at both federal and State levels. The application is filed and MARAD has 356 days to issue a Record of Decision (ROD). After the publication of the ROD, the applicant must have its fully operational facility granted the license by MARAD. This process usually takes between two to four years.

Concurrent with the proceedings before the MARAD, the applicant must comply with the requirements of the National Environmental Policy Act (NEPA). During this 240 day period a declaration of environmental impact occurs, involving the other agencies. At the same time, permissions and endorsements are managed at the State level. The Environmental impact Declaration generated under the NEPA process can also be used to satisfy the requirement of the law on State environmental public policy.

One of the most important aspects that MARAD considers to grant the license is the applicant's financial ability to build and operate the system of barges and buoys. Furthermore, the applicant must have the financial ability to pay a deposit which is sufficient to cover the cost of the complete removal of the system, once it is finished or the license is revoked.

In addition, the applicant must demonstrate whether the barges and buoys system is of national interest and is consistent with federal public policies on national security, energy sufficiency and environmental quality, among others. The system should not interfere with international navigation and other reasonable use of the high seas, as defined in the treaties, conventions or customary international law. The authorization of the Governor is required at the State level.

The public has to be kept informed throughout the process through the Federal Register and the publication of all documents related to the Federal Docket Management system: www.regulations.gov. In addition, under NEPA processes, as well as government processes, there is a provision for holding public hearings which ensures public participation.

The AEE assessed the feasibility of the construction of a Deepwater Port system in three areas of San Juan, Toa Baja and Arecibo. The criteria considered in this evaluation were: cost, space, time required for the operation, permissions, security, environmental justice, past experience in Puerto Rico and U.S. experiences.

1.7.3.1. Analysis for Central San Juan

The annual cost per lease would be approximately $70 to $80 million. The plant does not have the space necessary to locate the terminal facility to receive the CNG. The period of time required to put the system into operation, in compliance with all applicable federal and State legislation is estimated between 5 to 8 years. The permissions process is complicated and expensive. Installing a pipe on the seabed toward the central area of San Juan, as a national and international port with intense maritime traffic, would raise issues of safety with Homeland Security. In the central San Juan area there are low-income communities close to the project, which would be affected. After an analysis of environmental impacts the project would not be favored. The Central San Juan area is in the vicinity of CAPECO where on November 23, 2009, a catastrophic explosion affected nearby communities. For all the above, a Deepwater Port was discarded as a construction option.

1.7.3.2. Analysis for Central Palo Seco in Toa Baja

The annual cost per lease would be approximately $70 to $80 million. The plant does not have space to locate the terminal facility to receive the CNG. The period of time required to put the system into operation, in compliance with all applicable federal and State legislation is estimated between 5 to 8 years. The permissions process is a complicated and expensive. In the Central Palo Seco area there are low-income communities close to the project, which would be affected. After an analysis of environmental impacts the project would not be favored. Central Palo Seco is in the vicinity of CAPECO where on November 23, 2009, a catastrophic explosion affected nearby communities. For all the above, a Deepwater Port was discarded as a construction option.

1.7.3.3. Analysis for Central Cambalache at Arecibo

The annual cost per lease would be approximately $70 to $80 million. The plant does not have space to locate the receiving CNG terminal. The period of time required to put the system into operation, in compliance with all applicable federal and State legislation is estimated between 5 to 8 years. The permissions process is a complicated and expensive. In the Central Palo Seco area there are low-income communities close to the project, which would be affected. After an analysis of environmental impacts the project would not be favored.

In summary, it was determined that, when compared with other alternatives considered for this project, the option of constructing Deepwater Ports was neither feasible nor practical when considering cost, technology and long-term operation.

1.7.4. Natural Gas Pipeline Corridor Alternatives

The purpose of this analysis is to select a best route for the Vía Verde project. Various alternatives for the implementation of this project were assessed. The various alternatives considered different terrestrial alignments for a natural gas pipeline. Other works and studies contracted by PREPA were used during the Alternative Routes Selection effort. Part of the study conducted by *Power Technologies Corporation* (PTC) in 2006 was used for this analysis (*Corridor and Alternative Routes Selection Study)*. The PTC study was inclusive since it took into consideration the entire island. Corridors were evaluated every 1,000 meters and used the following criteria for such evaluation; topography, land use, existing corridors, and sensitive areas. Options were refined with other factors such as: individual residences, minor topographic variations, sensitive habitats that were identified during field visits, and methodology of construction in areas of greatest difficulty, such as: steep slopes, bridges and densely populated areas. Finally, the study selected multiple routes to bring natural gas to various points of the island. These included the PREPA facilities at Arecibo, San Juan and Palo Seco, which are the focal points of this Vía Verde project.

The study carried out by PREPA identified two viable alignments to transport natural gas from EcoEléctrica to Central Cambalache:

1.7.4.1. Alignment South to North "A"

Starting at EcoEléctrica, take a Northeast route overland to Ponce and then follow the State Road 10 road easement. The route follows State Road 10 through Adjuntas and Utuado. At Utuado the pipeline moves away from but parallel to the State Road 10 corridor until it reaches Arecibo. At Arecibo the route follows Northern plains until it reaches Central Cambalache. This route runs a total of 45.1 miles and the study labeled this alignment "*Overland*".

1.7.4.2. Alignment South to North "B"

Starting at EcoEléctrica, take one of two options to get to State Road 10. The first is to follow the right-of-way of the southern gas pipeline to Ponce and the second option is to take the State Road 10 right-of-way from Guayanilla. Both go to the west of Ponce where the pipeline route follows the State Road 10 right-of-way State Road 10 until it reaches Central Cambalache. This route runs a total of 36.8 miles and the study labeled this alignment "*DOT Route*".

The study also identified two viable alignments for the proposed natural gas pipeline, from Central Cambalache to San Juan and Palo Seco.

1.7.4.3. Alignment West to East "A"

From San Juan, in Levittown, take a path west and cross the Municipalities of Toa Baja, Dorado, Vega Alta, Vega Baja, Manati and Barceloneta to Arecibo. This route runs a total of 44.6 miles. The study labeled this alignment "*Overland Corridor*".

1.7.4.4. Alignment West to East "B"

From Cataño, follow the PR-22 right-of-way to Arecibo. This route crosses the Municipalities of Toa Baja, Dorado, Vega Alta, Vega Baja, Manati and Barceloneta. This route would necessitate an investigation to determine if the pipeline would interfere with the right-of-way of the

Superacueducto (Super Aqueduct). This alignment runs a total of 45.6 miles and the study called this alignment "*DOT Corridor*".

1.7.4.5. Alignment "C"

A third alignment, which was not contemplated in any of the previous studies contracted by PREPA, was also considered for the Via Verde project that ran near both of the other two alternative routes but avoided more residential areas.

In summary, three (3) routes were considered for the pipeline corridor from EcoEléctrica to Arecibo and then from Arecibo to San Juan. These were: alignment South-North A (SNA), alignment South-North B (SNB), alignment South-North C (SNC); alignment West-East A (OEA), West-East B (OEB), West-East C (OEC).

The following environmental criteria were used to evaluate the six alignment segments:

- Use of land
- Impacted water bodies
- Forests or nature reserves
- Endangered Species
- Archaeological sites
- Highway crossings
- Zoning
- Topography
- Distances from residential areas

1.7.5. Criteria were assessed in the following manner:

Use of land - The different uses of land were analyzed in each alignment. A route was defined as favorable for pipeline construction if existing land use was currently used for public, industrial, agricultural and commercial applications. A route was defined as not favorable for construction if land was currently in residential use and/or environmentally-sensitive. The percentage of the alignment with favorable uses and then the percentage not favorable were compared to obtain a final value. The route which had the largest value received the positive (+) value.

Impacted water bodies - The number of crossings of bodies of water increases the difficulty to construct the pipeline. Crossing a large body of water would need special construction methods to avoid adverse impacts. These construction methods increase the cost of the project. All bodies of water which were intercepted by an alignment were counted. The route with the fewest water body crossings received a positive (+) value.

Forests or nature reserves - Forests and nature reserves were areas considered important public resources due to their high ecological value. For selection of a positive (+) value the criteria considered avoidance or minimization of impacts to these areas. The percentage of forested/nature reserves impacted was measured against the total length of each route alternative. The route with the smallest percentage of forests and nature reserves received the positive (+) value.

Endangered Species - This criterion measured the extent of the alignment alternative that was considered protected habitat and/or had listed species present. The route alternative with the smallest percentage of impact in protected habitat received the positive (+) value.

Archaeological sites - All identified architectural and archaeological sites that would be intercepted by an alignment alternative were marked. The route with the fewest sites received the positive (+) value.

Highway crossings - Road crossings increase the difficulty of pipeline construction since special construction methods are needed to avoid affecting the integrity of the infrastructure and vehicle congestion. All roads intercepted by an alignment alternative were identified. The route with the fewest road crossings received the positive (+) value.

Zoning - The different zonings were identified for each alignment alternative. Favorable zonings were considered to be non residential, public, industrial, agricultural, commercial and non-zoned. Not favorable was considered to be areas zoned residential, or areas identified as forests, historical sites and conservation lands. We measured the extent of alignment with terrain for favorable zoning against not-favorable zoning to obtain a final value. The route which had the largest value (favorable vs. not-favorable) received the positive (+) value.

Topography - Puerto Rico has a variety of topographical areas within its limited geographical scope. The Cordillera Central area is characterized by its rugged topography. We analyzed different levels and steepness of topography and types of soils within each alignment. Abrupt changes in the topographic levels were marked. The route which had the smallest number of abrupt topographic changes received the positive (+) value.

Residential areas - Due to its limited geography and high population density, Puerto Rico has abundant residential areas, especially in the coastal plains. Distance from Residential Areas, as part of the general public safety factors was considered to be a very important factor in identifying the best, practicable alternative. For this reason, greater weight was given in the project planning criterion to minimize the number of homes in the vicinity of an alignment. Any residence which would be within 150 feet from the center of an alignment was identified and counted. The route with the fewest number of residences received the positive (++) value.

We compared the three (3) alternatives for the South-North section of the proposed pipeline corridor and three (3) alternatives to the West-East section of the proposed corridor. To do this, the percent of each route or the number of times that the route would affect environmental criterion assessed on an individual basis was compared. The route option with the least impact to each criterion was evaluated and received a positive value (+). Then the total number of positive values for each route alternative were tabulated. The route option with the largest number of criteria in its favor was selected. The analysis is summarized in the Table 2.

After reviewing the matrix with the chosen environmental criteria, the South-North C (SNC) path was the most favorable with nine positive points while path B had three points and path A only one point. Minimal direct impacts to residential areas also favored route SNC. For the section of the pipeline corridor from Central Cambalache at Arecibo to the power plants at Palo Seco in Toa Baja and Central San Juan, the best route is West East C (OEC) with six total points while route B had five points and route A only one point. Again, direct impacts to residences strongly support route OEC since only one residence would be directly impacted while the other two routes potentially directly impact over twenty residences each.

Table 2: Route Selection Matrix

Criteria	South North A		South North B		South North C		West East A		West East B		West East C	
Use of land	3.09		8.68		14.35	+	1.32		14.38		18.89	+
Bodies of water	23		25		20	+	15		12	+	13	
Forests or nature reserves	1.39	+	2.50		3.04		0.59		0.03	+	2.79	
Endangered Species	6.49		11.69		6.01	+	7.03		1.53	+	10.43	
Architectural and archaeological findings	1		0	+	0	+	0	+	0	+	0	+
Highway crossings	40		28		21	+	64		47		30	+
Zoning	24.21		30.61		33.41	+	4.28		0.44		32.42	+
Topography	86		78		59	+	15		12	+	13	
Residences	17		2	++	2	++	29		22		1	++
Total Positive criteria		1		3		9		1		5		6

1.8. Avoidance and Minimization

To be the least impacting alternative, the Via Verde pipeline has incorporated all feasible avoidance and minimization techniques. Avoidance and minimization techniques were employed for both the natural and human environment. Much of the avoidance and minimization occurred during the alternatives analysis stage; however, the techniques discussed below were utilized during final siting of the pipeline alignment. Many more of the minimization and avoidance techniques will be used during construction.

During alignment of the pipeline route, every attempt was made to avoid and/or minimize impacts to human environment, including noise impacts, and community cohesion. Impacts to parks, historic site, schools, cemeteries, and other human environment resources were avoided and/or minimized.

Additionally, attempts were made to minimize impacts to the natural environment. Wherever possible, the pipeline alignment will cross natural environmental resources at the narrowest point, which minimizes natural environment fragmentation.

During construction, Best Management Practices (BMP) will be used. Most importantly, all impacts to wetlands and surface water will be temporary.

Table 3: Summary of Proposed Avoidance and Minimization Measures

Area of Concern	Protection Measures
Geology and Soils	• Using construction best management practices (BMP's)
Water Quality and Resources	• Using BMP's to minimize the impacts of construction activities to water quality
Wetlands and Floodplains	• Using BMP's to minimize erosion and sedimentation to wetlands • restoring temporarily impacted wetlands to pre-existing conditions immediately following pipe installation • Assess and restoring river and stream banks to preconstruction conditions • Restoration efforts will be completed by the contractor immediately following construction activities reducing the temporal functional loss of habitat, and allowing native vegetation to reestablish. • Contractor will segregate and preserve native soils during trenching and the top soil will be restored on-site to conserve the native seed source. • Utilizing HDD when possible to avoid impacts to sensitive habitats
Aquatic Biology	• Maintaining fish passage in rivers and streams throughout construction

Terrestrial Wildlife	• Construction timing will reduce potential disturbance of identified threatened and endangered species • Minimize the areas of disturbance to only those that are necessary, dispose of excavated invasive and noxious weeds to prevent reestablishment, minimize areas of soil exposed to reduce dust that can bury native plans, maintain clean work areas with proper litter control and sanitation to prevent wildlife attraction, dispose of human refuse in containers that can be sealed and protected from wildlife • Species specific impact minimization plans have been prepared for the Puerto Rican Boa and Puerto Rican Nightjar
Vegetation	• Use BMP's to eliminate or minimize effects of erosion, sedimentation and accidental fuel or oil take leaks (Please see Sediment and Erosion Control Plans—Appendix G, and Spill Plans-- Appendix I). • Avoiding impacts to threatened or endangered plants through a replanting procedure
Cultural and Historic Resources	• During construction, identified archeological resources would be avoided to the extent practicable • Contractor will follow all guidance provided by SHPO

1.8.1. Impact Minimization for the Puerto Rican Boa (*Epicrates inornatus*)

Puerto Rican conservation measures proposed for the Puerto Rican boa include educating staff, project studies, pre-construction surveys, and relocation of individuals to protected areas. Conservation measures are as follows:

(1) All construction personnel will be required to attend instructive meetings related to the Puerto Rican boa. Information to be presented at these meetings will include a description of the species, protection measures, penalties for harassing boas, and relocation and capture procedures described below.

(2) During the clearing in the construction right-of-way, two biologists will carry out daily field surveys to detect the presence of Puerto Rican boas in each area of construction and before starting work. Heavy equipment will be checked to see if any boa climbed into it

overnight. Daily changes to work plans shall be considered when planning for surveys. The field survey will take place from 5:00 a.m. to 7:30 a.m., prior to operating heavy machinery.

(3) In the event an individual is detected, the Protocol below to capture and relocate boas will be followed. If construction staff discovers a snake in the workspace, all machinery within 50 feet around the snake shall cease and the Resident Engineer will be notified. An authorized biologist will capture the snake for relocation in accordance with the Protocol that follows. Construction activities can continue once the snake has been removed.

(4) Any captured snake will be relocated to Guajataca or Río Abajo forest, or other public land in an area similar to the capture area Habitat.

(5) Monthly reports will be prepared, summarizing the results of surveys and any capture and relocation activities. These reports will be provided to the USFWS and the Department of Natural Resources and the Environment (DRNA).

Capture and Relocation Protocol for the Puerto Rico Boa

Project biologists are responsible for implementing these procedures in the event a snake is found within the limits of the established ROW during construction. At least one resident biologist will be present during all working hours. The following steps will be taken in the event a snake is observed:

(a) workers up to 50 feet away will stop their work.

(b) a person will keep watch on the snake while another notifies the project engineer and/or biologist.

(c) the project biologist will capture the snake with a snake rod or other appropriate instrument designed not to inflict any damage to the snake. The snake will be placed in a bag or box in a cool, dark place on land waiting for transportation to an approved relocation project.

(d) if the snake is positively identified as a Puerto Rican boa, it will be transported to and released in the forests of Guajataca or Rio Abajo or any other public land in an area with habitat similar to the area where captured. All other species of snake will be released within the established construction ROW at the end of the work day: outside of the limits of existing and/or future construction.

(e) the project biologist who releases a snake will be responsible for ensuring that an incident report is completed and properly filed. This report shall contain the following information:

(1) Exact location of the snake when observed and the circumstances of the observation.

(2) The order and the procedures followed after the observation time.

(3) Personnel involved in every step of the procedure.

(4) The snake's condition at the time of observation and its condition when it is released.

(5) Species of snake, if known.

(6) The time and location where the Snake is released.

(7) Any photograph of the snake that has been taken.

(f) the report shall be signed by the project biologist and included in the monthly report submitted to the USFWS and the DRNA.

(g) in the event an observed snake cannot be captured, work within 50 feet from the snake can only resume once it has left the construction right-of-way.

(h) in the event a dead snake is discovered inside of the construction right-of-way, its body will be placed in a sealed plastic bag and placed on ice or in a freezer until it is positively identified. If the Snake is identified as a Puerto Rican boa, the body will remain frozen and the USFWS and DRNA notified for instructions.

1.8.2. Impact Minimization for the Puerto Rican Nightjar (*Caprimulgus noctitherus*)

To avoid impacts to Puerto Rican nightjars from construction activities,, commencement of any clearing of vegetation required for construction within or adjacent to mature dry forest within nightjar habitat, will occur outside of the April-June nightjar nesting season. However, in emergency situations, if vegetation needs to be cleared during the nesting season, experienced and qualified biologists will survey the area proposed for clearing for night jar nests before any clearing activity is conducted. The designated Fish & Wildlife Service office in Cabo Rojo Puerto Rico will be first notified by phone about any of those potential incidents, followed by a written report describing the emergency situation and the precautions implemented to avoid any disturbance to the Puerto Rican nightjar. In the event nests are found, the nests will be avoided by reducing or relocating the right-of way, or by delaying the activity until the nightjars fledge their young.

1.8.3. Impact Minimization for the Puerto Rico Toad (*Bufo lemur*) and Baker's worm lizard (*Amphisbaena bakeri*)

The Puerto Rican crested or Concho toad (*Bufo lemur*) is very difficult to detect due to their small size and secret habits. However due to the potential for occurrence of this species in the project corridor right-of-way, the following conservation measures will be implemented: (1) during the initial establishment and clearing of the construction right-of-way, two biologists will conduct daily sampling for detecting the concho toad and the blind Baker or Baker's Worm Lizard (*Amphisbaena bakeri*) in every area of construction before the work. These monitoring activities will be carried out daily, concurrent with the monitoring required for the Puerto Rican boa. Monitoring will be focused on cover areas (cracks in rocks and trees species) that are regularly used by these species. All monitoring events will be incorporated into and will be carried out in coordination with the work plan of the contractor; daily changes to these work plans shall be considered in planning the work. Monitoring events will be carried out between 5:00 a.m. and 7: 30 a.m. on days when major equipment will be in operation within the limits of the construction right-of way. When a species is detected, established capture and relocation protocols (similar to those identified for the boa) will implemented. Data regarding all species identified within the ROW, captured and/or relocated will be incorporated into the daily environmental monitoring logs. All collections, relocations and data transmissions will be coordinated with the appropriate local, state, and federal regulatory agencies.

1.8.4. Impact Minimization for Vegetation

Unless limited by the size (e.g. large trees), all species of plants listed as threatened or endangered found inside the limits of the construction right-of-way to be impacted will be relocated. Potential relocation sites include the Guajataca Forest Reserve (DRNA), Río Abajo Forest Reserve – Utuado (DRNA), and the Combalache Forest Reserve – Arecibo (DNRA); all sites could ensure long-term protection. The area chosen for the transplantation of individual plants will be selected in coordination with the USFWS (for species listed by the federal Government) and/or the DRNA; with concurrent permission from the Manager/Owner of the forest or place where sowing or transplants will occur. The characteristics of the premises where transplants (soils, geology, associated vegetation, etc.) are carried out shall be similar to the affected location. Relocation methodology could include transplantation, spreading seeds and/or division by vegetative methods. Seeds and cuttings may be taken of all individuals affected to the maximum extent possible. Propagation of seeds and cuttings may be more appropriate for woody species since transplantation of these species often results in limited success.

To avoid any delay in relocation efforts, PREPA will negotiate a Service Contract with the DRNA to allow their technicians to undertake the relocation of any endangered plant. This approach will ensure required protocols are implemented through the use of qualified technicians accepted by both the DRNA and the U.S. Fish & Wildlife Service office. The three preserve areas identified include representative vegetative assemblages which are similar to those found within the pipeline route. Other public properties may also be available which afford suitable critical habitat, land management, and long term protection. In areas where comprehensive flora studies have not been conducted; the applicant will have a qualified professional botanist perform vegetation surveys prior to beginning work within the 150-foot wide corridor. This activity will be conducted as part of the aforementioned Service Contract negotiated between PREPA and the DRNA. The recommended purpose of these studies would be to identify and mark all plants listed by the federal Government and the State for relocation. After these studies, the project owner shall provide the details of the species specific relocation procedures to be undertaken to the USFWS (for species listed by the federal Government) or the DRNA (for species listed by the State Government) for review and approval. The procedures to be utilized will be those accepted and developed by botanical professionals or horticulturists. Methodology of relocation for transplants of trees will be prepared by a professional arborist certified by the International Society of Arboriculture and shall comply with ANSI 300 "Transplanting Standards" (parameters of transplants). Once the relocation procedures are completed, funding will be provided to the DRNA for the long-term maintenance of the population relocation plant monitoring.

1.9. Regulatory Agency Meetings/Correspondence

Regulatory Meetings with USACE and FWS

Table 4: Pre-application Meetings with Regulatory Agencies

Date	Agency	Attendees
June 6, 2010	USFWS, Boqueron Office	Edwin Muniz, Marelisa Rivera
June 8, 2010	USACE, Jacksonville Office	Mike Holley, Donnie Kinnard
June 28, 2010	USACE, Antilles Office	Edgar Garcia, Sindulfo Castillo
August 2, 2010	USACE, Jacksonville Office	Mike Holley, Bev Lawrence, Donnie Kinnard
August 5, 2010	USACE, Antilles Office	Edgar Garcia, Sindulfo Castillo

2. Environmental

2.1. Description of Project Area: Action Area (Uplands, Wetlands, Critical Habitat)

The Via Verde Project covers a vast array of lands through the following Municipalities: Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manati, Vega Baja, Vega Alta, Dorado, Toa Baja, Cataño, Bayamón, and Guaynabo. A description of the Action Area in these Municipalities can be found in Chapter 3 of the Via Verde Project, Declaracion de Impacto Ambiental (Appendix D).

2.2. Describe Physical geography attributes (Topography, Soils, Condition, Trend)

The description of the physical attributes of the Via Verde Project Corridor is found in Coll Environmental Jurisdictional Wetland Report under Project Route Description; found in the PREPA, Via Verde Project, Declaraciòn de Impacto Ambientales (Appendix D).

2.3. Describe Biological Attributes (Habitat Types, Natural Communities, Existing Management Activities, Maps)

A description of the biological attributes of the Via Verde Project Corridor can be found in the Coll Environmental Flora and Fauna Report (Informe Flora y Fauna Via Verde) under Descricion del Area de Estudio; found in the PREPA, Via Verde Project, Declaraciòn de Impacto Ambientales (Appendix D).

2.4. Wetlands

The extent of Waters of the U.S. that are subject to regulatory jurisdiction under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act of 1899 for the Project was determined by Jorge Coll (Coll Environmental). The methodology employed for this delineation followed the 1987 Corps of Engineers Wetland Delineation Manual and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Caribbean Islands Region (the Caribbean supplement). In areas where differences between the Manual and the Caribbean supplement occurred, the Caribbean supplement took precedence. There were areas where determination was difficult, due to past or recent change in land use, or other reasons. In those cases, determination was based on the best information available, interpreted in light of professional experience and knowledge of the ecology of wetlands in the area, as stated in the Caribbean supplement. The field work necessary for this jurisdictional determination (JD) was performed from May to July 2010 and the study area included 100 feet to each side of the centerline of the pipeline route.

This preliminary jurisdictional determination was performed in three phases. Phase 1 of the study was a screening level analysis to identify those areas within the site, constituting jurisdictional wetlands under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act. The screening analysis was performed using Geographical Information Systems (GIS). The data gathered from this phase provided specific and important information on the location of potential wetland sites. This phase also included a preliminary site visit to validate the data that were obtained during the GIS analysis. It also helped in providing a better understanding of the wetland condition and location to develop a fieldwork plan.

Phase II of the study included the delineation field visits to delineate the extent of the jurisdictional wetlands on the site. Each delineation visit included the sampling, collection, and description of the site's hydrology, soils, and dominant vegetation around representative sampling locations on established transects. A total of 224 sampling points were established as part of the Phase 2 evaluation. The following tasks were carried out during Phase 2:

- Establishment of the sampling transects;
- Visual inspection of the site and identification of landscape features;
- Identification of plant communities;

- Selection of a representative area within each plant community to dig a soil pit;
- Identification of dominant plant species from the various strata;
- Characterization of the soil properties and colors in the soil pit;
- Description of the hydrology around and within the soil pit;
- Photographic documentation of the site, soil pits or vegetation;
- Collection of soil and plant samples for future reference;
- Geographic Positioning System (GPS) documentation of sampling points; and
- Wetland delineation and documentation of wetland limits.

Phase 3 of the study comprised the final analysis of the data gathered during the delineation visits and the development of a final report. The Coll Environmental Wetlands and U.S. Waters Jurisdictional Determination Study – Via Verde Pipeline Project, Puerto Rico (Wetland JD report) has been included in the PREPA, Via Verde Project, Declaraciòn de Impacto Ambientales (Appendix D) of this Joint Permit Application.

Within the north segment of the Project route (Guaynabo to north Arecibo), the majority of the delineated areas were herbaceous wetlands with some river, creek and channel crossings also present.

The delineated areas within the north to south segment of the project (southern Arecibo to northern Peñuelas) included mostly river, creek and channel crossings. Topography played an important role in the wetland/U.S. Waters ratio.

Delineated wetlands were classified under the following categories:

> Palustrine Herbaceous Wetlands - These were Palustrine wetlands dominated by herbaceous species, with no apparent recent anthropogenic use. Many displayed obvious impacts from past human disturbance, but present conditions are somewhat stable and undisturbed. Approximately 306.94 acres of these wetlands were delineated.
>
> Palustrine Herbaceous Wetlands under Present or Recent Agricultural Use - These are Palustrine wetlands that are currently, or have been recently under anthropogenic use. Most of these wetlands show characteristics of some agricultural use, such as cattle

grazing, pasture management (for hay, for example), pineapple or other commercial agricultural crops. Approximately 390.18 acres of these wetlands were delineated.

Estuarine Forested Wetland - These are forested wetlands mainly dominated by mangrove trees. These wetland areas were classified as estuarine based upon the type of dominant vegetation (halophytes). Some of them are relicts of former, larger systems that are encroached by infrastructure, urban, commercial or industrial development. Approximately 27.04 acres of these wetlands were delineated.

Estuarine Forested Canal - This wetland type was limited to a manmade estuarine forested canal located at the southwest Peñuelas end of the pipeline route. The canal is colonized mostly by black mangroves (Avicennia germinans (L.)). This delineated wetland area comprised approximately 1.46 acres.

Estuarine Salt Flat - These wetlands are also located at the Peñuelas end of the route. These wetlands are salt flats dominated by dwarf black mangrove trees. Approximately 1.14 acres of this wetland type were delineated.

Approximately 726.67 acres of jurisdictional wetlands, and 59 U.S. Waters were identified and delineated during environmental field surveys within the 200 foot wide review corridor along the approximately 92 mile project route. Appendix A, Figure 6 contained in the Coll Environmental Wetland JD Report (found in the PREPA, Via Verde Project, Declaraciòn de Impacto Ambientales (Appendix D) identifies these Wetlands and U.S. Jurisdictional waters. The report also identifies dominant plant species, their respective indicator species, and other wetland details for each wetland identified in the report.

Location of Wetlands/Waters of the U.S. along route

A total of 158 waters of the US were identified within the project right-of-way. The total area of waters of the US is 369.3 acres within the 150-foot right-of-way.

2.4.1. Wetland/Water of the US Impact Summary

The project has been carefully designed to meet the regional and general conditions of Nationwide Permits 12, 18, 33 and 38. All grubbing and clearing activities in wetlands will involve only the cutting or removing of vegetation above the ground, such as mowing, rotary cutting, and chain sawing, where the activity would not disturb the root system nor involve mechanized pushing, dragging, or other similar activities that redeposit any excavated soil material. The contractor will utilize work pads (timber mats or "corduroy roads") and/or equipment with wide balloon tires designed to operate in hydric soil conditions for all pipe excavation and installation within wetlands. The proposed "footprint" for the purpose of nationwide permit 12 would be limited to the area of the trenching activity and the area where excavated soil is temporarily placed before it is deposited back into the trench. There will be 0.0-acre of permanent fill impact and this acreage falls within the nationwide permit condition limit. Under nationwide permit 33 temporary work pads of fill material will be constructed for horizontal directional drilling sites located in wetland areas. The entry pad will be approximately 100-feet by 250- feet and the exit pad will be 100-feet by 150-feet for a total of 40,000 square feet. The temporary work pads will be removed immediately after the HDD operation is completed. If temporary access roads are required to reach and construct these work pads, these roads will also be immediately removed after the HDD operation is completed.

For the purposes of computing temporary impacts for this permit application, the following terms and parameters were used:

Total Wetland Area – equals the sum total of all jurisdictional wetlands/waters that have been identified within the 150 foot wide project right of way corridor.

Total Temporary Wetland Impact Area – equals the width of the trench plus any additional area required for temporary trench spoil/top soil storage times (X) the length of the wetland crossing. Trench widths for this project will range from 4 to 28 feet depending on the type of excavator used (backhoe, wheel trencher) and the side slope required. A total of width of 50-feet has been allocated for computing temporary impacts to wetlands.

Total Temporary Impact Area for Water Body Crossings – equals the total length of the crossing times (X) the 150 foot wide project right of way corridor.

Total Temporary Impact Area for HDD Wetland Crossings – equals the total area required for the footprint of the entry and exit staging areas unless the staging is entirely in the uplands. This amount has been computed using a fixed value equal to 40,000 square feet per work pad. Both entry and exit areas will be matted. No impacts will be required to the watercourse. Construction drawing Details 1 and 15 illustrate the proposed HDD.

Table 5: Temporary Impacts to Waters of the U.S.

ID	Waterbody Name or Type	Length (Linear Foot)	Temporary Impact (Acre)
C-1	Mangrove Canal	155	0.00
C-2	Channel	65	0.00
C-3	Canal	10	0.02
C-4	Canal	10	0.02
C-5	RIO TALLABOA RIVER	122	0.00
C-6	UNNAMED CREEK	10	0.02
C-7	UNNAMED CREEK	10	0.02
C-8	UNNAMED CREEK	10	0.02
C-9	UNNAMED CREEK	44	0.10
C-10	UNNAMED CREEK	10	0.02
C-11	UNNAMED CREEK	10	0.02
C-12	UNNAMED CREEK	10	0.02
C-13	UNNAMED CREEK	10	0.02
C-14	UNNAMED CREEK	10	0.02
C-15	UNNAMED CREEK	10	0.02
C-16	UNNAMED CREEK	10	0.02
C-17	UNNAMED CREEK	10	0.02
C-18	UNNAMED CREEK	10	0.02
C-19	UNNAMED CREEK	10	0.02
C-20	RIO PELLEJAS RIVER	102.1	0.23
C-21	UNNAMED CREEK	10	0.02
C-22	UNNAMED CREEK	10	0.02
C-23	ARENAS CREEK	10	0.02
C-24	ARENAS CREEK	10	0.02
C-25	ARENAS CREEK	10	0.02
C-26	RIO GRANDE DE ARECIBO RIVER	423.7	0.00
C-27	UNNAMED CREEK	10	0.02
C-28	UNNAMED CREEK	10	0.02
C-29	UNNAMED CREEK	10	0.02
C-30	UNNAMED CREEK	10	0.02
C-31	RIO GRANDE DE ARECIBO RIVER	175.2	0.00
C-32	UNNAMED CREEK	10	0.02
C-33	UNNAMED CREEK	10	0.02
C-34	RIO GRANDE DE ARECIBO RIVER	114.5	0.00
C-35	JOBOS CREEK	10	0.02
C-36	RIO GRANDE DE ARECIBO RIVER	305.4	0.00
C-37	RIO GRANDE DE ARECIBO RIVER	417.9	0.00

ID	Waterbody Name or Type	Length (Linear Foot)	Temporary Impact (Acre)
C-38	UNNAMED CREEK	30.5	0.07
C-39	RIO TANAMA RIVER	111.5	0.00
C-40	Ditch	See W-25	See W-25
C-41	PERDOMO CHANNEL	39.6	0.09
C-42	Ditch	See W-29	See W-29
C-43	RIO GRANDE DE ARECIBO RIVER	133.4	0.00
C-44	Ditch	See W-34	See W-34
C-45	Ditch	See W-36	See W-36
C-46	Ditch	See W-39	See W-39
C-47	Ditch	10	0.02
C-48	Ditch	See W-40	See W-40
C-49	Ditch	See W-40	See W-40
C-50	Ditch	10	0.02
C-51	Ditch	10	0.02
C-52	Ditch	See W-46	See W-46
C-53	Ditch	See W-50	See W-50
C-54	Ditch	See W-50	See W-50
C-55	Ditch	See W-52	See W-52
C-56	Ditch	See W-54	See W-54
C-57	Ditch	See W-56	See W-56
C-58	Ditch	See W-57	See W-57
C-59	Ditch	See W-57	See W-57
C-60	Ditch	See W-57	See W-57
C-61	Ditch	See W-57	See W-57
C-62	Ditch	See W-57	See W-57
C-63	Canal	73.0	0.17
C-64	Ditch	See W-61	See W-61
C-65	Ditch	See W-61	See W-61
C-66	RIO GRANDE DE MANATI RIVER	218.6	0.00
C-67	Creek	See W-65	See W-65
C-68	Creek	See W-65	See W-65
C-69	CANO DE LOS NACHOS	65.4	0.15
C-70	Ditch	See W-69	See W-69
C-71	Ditch	See W-70	See W-70
C-72	RIO GRANDE DE MANATI RIVER	145.6	0.00
C-73	RIO GRANDE DE MANATI RIVER	350.1	0.00
C-74	RIO INDIO RIVER	39.7	0.09
C-75	RIO INDIO RIVER	56.3	0.13

ID	Waterbody Name or Type	Length (Linear Foot)	Temporary Impact (Acre)
C-76	RIO INDIO RIVER	76	0.17
C-77	RIO INDIO RIVER	56.4	0.13
C-78	UNNAMED CREEK	96.3	0.22
C-79	RIO INDIO RIVER	67.7	0.16
C-80	RIO CIBUCO RIVER	47.1	0.11
C-81	UNNAMED CREEK	10	0.02
C-82	Ditch	See W-93	See W-93
C-83	RIO LA PLATA RIVER	140.1	0.00
C-84	Ditch	See W-97	See W-97
C-85	Ditch	See W-98	See W-98
C-86	Ditch	See W-99	See W-99
C-87	Ditch	See W-100	See W-100
C-88	Ditch	See W-100	See W-100
C-89	RIO COCAL RIVER	25.3	0.06
C-90	RIO COCAL RIVER	877.3	0.00
C-91	Creek	See W-105	See W-105
C-92	Canal/Rio Cocal	611.3	0.00
C-93	RIO COCAL RIVER	2611.9	0.00
C-94	RIO COCAL RIVER	811.1	0.00
C-95	RIO BAYAMON RIVER	229.4	0.00
C-96	RIO BAYAMON RIVER	346.6	0.00
C-97	Ditch	10	0.02
C-98	DIEGO CREEK	See W-119	See W-119
C-99	LAS LAJAS CREEK	See W-120	See W-120
C-100	SANTA CATALINA CREEK	32.5	0.07

Table 6: Temporary Impacts to Wetlands

ID	Wetland Type	Length (Linear Feet)	Temporary Impact (acre)
W-1	Estuarine- Saltflat, Mangrove	12.30	0.01
W-2	Estuarine- Saltflat, Mangrove	No Impact	0.00
W-3	Estuarine- Saltflat, Mangrove	No Impact	0.00
W-4	Estuarine- Saltflat, Mangrove	478.79	0.55
W-5	Mangrove Canal	No Impact	0.00
W-6	Mangrove Canal	See C-1	See C-1
W-7	Canals	See C-2	See C-2

ID	Wetland Type	Length (Linear Feet)	Temporary Impact (acre)
W-8	Canals	See C-3	See C-3
W-9	Canals	See C-3	See C-3
W-10	Palustrine- Man-Altered Herbaceous	479.47	0.55
W-11	Canals	See C-20	See C-20
W-12	Canals	See C-26	See C-26
W-13	Palustrine- Herbaceous	See C-26	See C-26
W-14	Canals	See C-31	See C-31
W-15	Canals	See C-34	See C-34
W-16	Canals	See C-36	See C-36
W-17	Palustrine- Herbaceous	3,327.38	3.82
W-18	Canals	See C-37	See C-37
W-19	Palustrine- Man-Altered Herbaceous	3,266.48	3.75
W-20	Canals	See C-38	See C-38
W-21	Palustrine- Man-Altered Herbaceous	2,755.68	3.16
W-22	Palustrine- Man-Altered Herbaceous	855.67	0.98
W-23	Canals	See C-39	See C-39
W-24	Palustrine- Man-Altered Herbaceous	8,516.42	9.78
W-25	Canals	29.30	0.03
W-26	Palustrine- Man-Altered Herbaceous	1,525.95	1.75
W-27	Canals	79.98	0.09
W-28	Canals	See C-41	See C-41
W-29	Canals	33.98	0.04
W-30	Palustrine- Herbaceous	1,347.03	1.55
W-31	Canals	See C-43	See C-43
W-32	Palustrine- Herbaceous	632.43	0.73
W-33	Palustrine- Herbaceous	714.92	0.82
W-34	Palustrine- Man-Altered Herbaceous	3,792.28	4.35
W-35	Palustrine- Man-Altered Herbaceous	4,230.47	4.86
W-36	Canals	66.95	0.08
W-37	Palustrine- Man-Altered Herbaceous	1,750.97	2.01
W-38	Palustrine- Man-Altered Herbaceous	1,007.69	1.16
W-39	Palustrine- Herbaceous	4,267.40	4.90
W-40	Palustrine- Herbaceous	9,641.34	11.07
W-41	Palustrine- Herbaceous	359.10	0.41
W-42	Palustrine- Herbaceous	1,511.99	1.74
W-43	Palustrine- Herbaceous	453.93	0.52
W-44	Palustrine- Man-Altered Herbaceous	211.90	0.24
W-45	Palustrine- Man-Altered Herbaceous	10,156.56	11.66

ID	Wetland Type	Length (Linear Feet)	Temporary Impact (acre)
W-46	Palustrine- Man-Altered Herbaceous	1,425.56	1.64
W-47	Palustrine- Man-Altered Herbaceous	300.32	0.34
W-48	Palustrine- Man-Altered Herbaceous	339.37	0.39
W-49	Palustrine- Herbaceous	21.35	0.02
W-50	Palustrine- Herbaceous	444.01	0.51
W-51	Palustrine- Herbaceous	No Impact	0.00
W-52	Palustrine- Herbaceous	1,670.09	1.92
W-53	Palustrine- Herbaceous	141.95	0.16
W-54	Palustrine- Herbaceous	101.63	0.12
W-55	Palustrine- Man-Altered Herbaceous	588.44	0.68
W-56	Palustrine- Herbaceous	182.90	0.21
W-57	Palustrine- Herbaceous	8,127.68	9.33
W-58	Palustrine- Herbaceous	2,663.84	3.06
W-59	Canals	See C-63	See C-63
W-60	Palustrine- Herbaceous	73.80	0.08
W-61	Palustrine- Man-Altered Herbaceous	2,469.28	2.83
W-62	Palustrine- Herbaceous	880.99	1.01
W-63	Canals	See C-66	See C-66
W-64	Palustrine- Herbaceous	3,265.17	3.75
W-65	Palustrine- Man-Altered Herbaceous	2,483.51	2.85
W-66	Palustrine- Man-Altered Herbaceous	904.40	1.04
W-67	Palustrine- Man-Altered Herbaceous	729.84	0.84
W-68	Canals	See C-69	See C-69
W-69	Palustrine- Man-Altered Herbaceous	2,867.11	3.29
W-70	Palustrine- Man-Altered Herbaceous	4,941.97	5.67
W-71	Palustrine- Man-Altered Herbaceous	2,344.56	2.69
W-72	Palustrine- Herbaceous	2,785.85	3.20
W-73	Canals	See C-72	See C-72
W-74	Palustrine- Herbaceous	3,938.84	4.52
W-75	Canals	See C-73	See C-73
W-76	Palustrine- Herbaceous	76.16	0.09
W-77	Palustrine- Man-Altered Herbaceous	No Impact	0.00
W-78	Canals	See C-74	See C-74
W-79	Canals	See C-75	See C-75
W-80	Canals	See C-76	See C-76
W-81	Canals	No Impact	0.00
W-82	Palustrine- Herbaceous	876.33	1.01
W-83	Palustrine- Herbaceous	1,261.28	1.45

ID	Wetland Type	Length (Linear Feet)	Temporary Impact (acre)
W-84	Canals	See C-79	See C-79
W-85	Palustrine- Herbaceous	7,420.03	8.52
W-86	Canals	See C-80	See C-80
W-87	Palustrine- Herbaceous	776.65	0.89
W-88	Palustrine- Herbaceous	779.93	0.90
W-89	Palustrine- Man-Altered Herbaceous	2,410.57	2.77
W-90	Palustrine- Man-Altered Herbaceous	524.45	0.60
W-91	Palustrine- Herbaceous	637.47	0.73
W-92	Palustrine- Man-Altered Herbaceous	2,326.72	2.67
W-93	Palustrine- Man-Altered Herbaceous	1,382.65	1.59
W-94	Palustrine- Man-Altered Herbaceous	61.18	0.07
W-95	Palustrine- Man-Altered Herbaceous	2,921.95	3.35
W-96	Canals	See C-83	See C-83
W-97	Palustrine- Man-Altered Herbaceous	897.44	1.03
W-98	Palustrine- Man-Altered Herbaceous	1,602.12	1.84
W-99	Palustrine- Man-Altered Herbaceous	6,908.46	7.93
W-100	Palustrine- Man-Altered Herbaceous	8,454.44	9.70
W-101	Canals	25.23	0.03
W-102	Estuarine- Forested	See C-90	See C-90
W-103	Estuarine- Forested	See C-90	See C-90
W-104	Canals	See C-90	See C-90
W-105	Palustrine- Man-Altered Herbaceous	3,316.79	3.81
W-106	Estuarine- Forested	See C-92	See C-92
W-107	Canals	See C-93	See C-93
W-108	Estuarine- Forested	See C-93	See C-93
W-109	Canals	See C-94	See C-94
W-110	Estuarine- Forested	See C-94	See C-94
W-111	Palustrine- Forested	770	0.00
W-112	Canals	163.15	0.19
W-113	Palustrine- Herbaceous	574.78	0.66
W-114	Canals	See C-95	See C-95
W-115	Canals	See C-96	See C-96
W-116	Palustrine- Herbaceous	800.09	0.92
W-117	Palustrine- Herbaceous	7,005.42	8.04
W-118	Palustrine- Herbaceous	877.68	1.01
W-119	Palustrine- Herbaceous	327.61	0.38
W-120	Palustrine- Herbaceous	474.47	0.54
W-121	Canals	See C-100	See C-100

ID	Wetland Type	Length (Linear Feet)	Temporary Impact (acre)
W-122	Canals	No Impact	0.00
W-123	Palustrine- Herbaceous	No Impact	0.00
W-124	Estuarine- Forested	No Impact	0.00
W-125	Estuarine- Forested	No Impact	0.00
W-126	Estuarine- Forested	No Impact	0.00
W-127	Estuarine- Forested	No Impact	0.00
W-128	Canals	No Impact	0.00
W-129	Estuarine- Forested	No Impact	0.00
W-130	Palustrine- Herbaceous	No Impact	0.00
W-131	Palustrine- Herbaceous	No Impact	0.00
W-132	Palustrine- Herbaceous	585.10	0.67
W-133	Palustrine- Herbaceous	No Impact	0.00
W-134	Canals	No Impact	0.00
W-135	Canals	No Impact	0.00
W-136	Canals	No Impact	0.00

2.4.2. Analysis of Wetland Impacts

The project has been carefully designed to comply with the requirements of the national and regional conditions of NWP 12, NWP 33 and NWP 38. No fill impacts will occur in forested or tidal wetlands. Additionally, there will be no net loss of waters of the U.S.

There are approximately 143.92 acres of temporary wetland impacts. There are approximately 7.84 acres of temporary impacts associated with streams, rivers, creeks, and other surface waters. The total temporary impacts associated with the Via Verde pipeline is 151.76 acres.

2.4.3. Wetland Mitigation

As compensation for construction of the pipeline the applicant will incur the costs of horizontal directional drilling under all medium to large waterbodies, i.e. any rivers and embayments, to avoid a discharge of dredged or fill material into waters of the U.S. Furthermore, the applicant has designed the construction of the pipeline to incorporate the use of vertical wall trenching whenever possible during placement of the pipe, to minimize the width of excavation and impacts in wetlands. If vertical trenching construction method is not practicable, standard ditch excavation with sloped walls will be utilized. Regardless of the method used, the project has been designed to avoid permanent impact and ALL wetland impacts will be temporary in nature. There will be NO dredged or fill material placed permanently in waters of the U.S. All excess fill or dredged material will be removed and preconstruction wetland elevations will be re-established. Wetland organic topsoil will be separated during trench excavation and stockpiled in a separate area. This material will be used so that the top 6- inches of wetlands restored after the pipe is placed will be 100% organic material. All stream embankments where trenching occurs will be restored and covered with matting to prevent erosion until local wetland plant communities are reestablished.

Clearing activities in waters of the U.S. will not incorporate mechanized equipment and mats will be used wherever possible to avoid the need for temporary fill. In situations where temporary roads are needed to construct HDD work pads in wetland areas, these roads and the work pads will be immediately removed after the HDD operation is completed at each crossing. Wetland conditions will be immediately reestablished at each crossing as the project moves forward.

The US Army Corps of Engineers may make a determination that some type of additional compensatory mitigation is required to offset the minimal temporal impacts that will occur as the pipeline is constructed. If this occurs, the applicant is prepared to identify upland areas along the edges of existing wetland sites that will be crossed where the uplands can be lowered in elevation (scraped down) and additional herbaceous wetland habitat can be established on an agreed upon acreage ratio. Given the temporary nature of impacts expected to occur from construction, the applicant expects any such mitigation required by the Corps to be at or below 0.01 acres of compensatory mitigation per 1 acre of temporary wetland impacts.

2.5. Biological Evaluation

A Biological Evaluation has been completed for the Via Verde Pipeline, found in Appendix C.

3. SHPO

The PREPA Via Verde Pipeline project has been reviewed with respect to potential impacts to properties listed, or eligible for listing, in the National Register of Historic Places in accordance with the requirements of the National Historic Preservation Act (NHPA). Assistance regarding information on the location of, or potential for, the presence of historic resources, including but not limited to archeological sites and historic properties, has been sought from the State Historic Preservation Officer (SHPO) and the National Register of Historic Places in accordance with the requirements set forth in 33 CFR 330.4(g)). The efforts conducted to date include: background research, consultation, oral history interviews, review of prior field investigation, and field surveys.

A Phase 1A archeological research study was conducted over the project area in June 2010. The study was conducted by state certified archeologists Marisol Rodriguez Miranda and Carlos Ayez Suarez. Additional research and field evaluations were conducted by archeologists Rosa Martinez Montero and Federico Freytes. The study methodology included the following objectives:

1. Identify the presence of archaeological resources known within the pipeline corridor and/or within the periphery of the study area;
2. Evaluate the possibility of discovering additional archaeological resources within the limits or on the periphery of the study area;
3. Define any impacts to known or potential archeological resources that lie within or in the periphery of the project corridor; and
4. Offer duly endorsed recommendations for additional studies which may be required to identify sites and/or to make recommendations to minimize impacts to archaeological areas that could be affected by the installation and propose alternatives for preservation of the same.

A detailed written report which documents the historical research of all records available and a preliminary inspection of the pipeline corridor route has been included in the PREPA, Via Verde Project, Declaraciòn de Impacto Ambientales (Appendix D).

Based on the information submitted, and these efforts, the applicant respectfully requests that the district engineer determine whether the proposed activity has the potential to cause an effect on the historic properties pursuant to 36 CFR §800.3(a)) or that consultation under Section 106 of the NHPA has been completed. It is understood that the district engineer will notify the prospective permittee within 45 days of receipt of the aforementioned supporting materials whether NHPA Section 106 consultation is required.

4. Construction Details

4.1. General Construction Methods

Construction activities associated with the Project would include installing pipelines; conducting Horizontal Directional Drilling (HDD); building temporary access roads, temporary pipe storage yards, and construction wareyards; and installing four (4) metering stations.

To the extent practicable, construction would generally be conducted six days a week (Monday through Saturday), 10 hours per day during daylight hours. However, in some cases, various construction crews would work on Sundays and before and/or after daylight hours; for example, if an HDD pullback is in process, it is prudent to complete the pullback. Similarly, timing restrictions may be associated with crossing a water body that may require work outside of daylight hours.

4.1.1 General Pipeline Construction

The build-out of the 24-inch-diameter natural gas pipeline is proposed to be done in an approximately one-year period. Construction is scheduled to begin as soon as possible after receipt of all regulatory approvals, with a pipeline in-service date of January 2012.

Installation of the mainline and laterals would employ conventional overland construction techniques. In general, a 150-foot-wide construction ROW would be needed for the construction of the proposed mainline and laterals. Pipeline construction would be typical of other pipeline projects in terms of schedule, equipment used, mode of operation, length of time the equipment is in use, and amount of equipment used simultaneously. Construction equipment would be operated on an as-needed basis, mostly during daylight hours, and would be maintained to manufacturers' specifications to reduce potential noise impacts.

As is typical of a pipeline construction scenario, the construction spreads are proposed to proceed along the pipeline ROW in one continuous operation beginning at the Eco Electrica LNG Terminal in Penuelas (Mile Post 0). Each spread (pipeline layout) would involve the completion of various activities, including ROW clearing and grading; trenching; pipeline stringing, bending, welding, joint coating, and lowering-in; backfilling; compaction of backfill; and cleanup. As the spread moves along, construction at any single point along the pipeline from initial surveying and clearing to backfilling and finish grading, would be in accordance with the time frames established in Nationwide Permit 12. Pipeline construction would cause temporary increases in ambient noise levels in the immediate vicinity of the construction sites. Onsite construction noise would occur mainly from heavy-duty construction equipment, e.g., trucks, backhoes, excavators, loaders, cranes, and drill rigs.

4.1.1.1 Horizontal Directional Drilling

HDD will be used to cross large or sensitive waterbodies, environmentally sensitive areas, and/or major transportation corridors. HDD is proposed for the natural gas transmission pipeline crossings at certain water body and highway locations.

4.1.1.2 Temporary Access Road Construction

Construction phases would consist of ROW clearing, access road construction, and ROW restoration. Construction phases generally would be performed sequentially along the ROW such that any disturbance created by the activities in any one area would be short-term.

4.1.1.3 Temporary Pipe Storage Yards and Construction Wareyards

Construction wareyards and pipe storage yards would be used to stage equipment and materials and to locate temporary trailers used for jobsite office space. The associated temporary increase in traffic volume and activity at these sites may result in a minor noise impact in the Project area. Efforts will be made to locate these facilities in disturbed uplands outside of populated areas.

4.1.1.4 NG Metering Station Construction

Construction of the metering stations would involve clearing and grading, placement of fill, and excavation for foundations for the unit packages, ancillary equipment, piping, and structures. Construction of the metering stations is planned to commence after receipt of regulatory approvals, and would last about nine months. A completion year of 2011 is anticipated for all required metering stations. The locations of the metering stations are at or adjacent to the EcoElectrica, Cambilache, Palo Seco, and San Juan facilities. Noise associated with construction of the metering stations will be temporary and it is expected to occur during the daylight hours.

4.1.1.5 Trench Dewatering

During the course of construction activities, the open pipeline trench will, on occasion, accumulate water, either from groundwater intrusion or precipitation. The trench may be periodically dewatered, as necessary to prevent sedimentation of perennial waterbodies or rivers and allow for proper construction. Generally, a pump will be placed alongside the trench with an intake hose suspended into the water-filled trench. In areas with a very high water table and soils prone to sloughing, a well point system may have to be installed. Water may be pumped from the trench into vegetated upland areas within the ROW to prevent sediment-laden water from flowing directly into any water body. All dewatering areas will include suitable temporary turbidity and erosion controls. If adequately vegetated areas are too far removed from the dewatering site, the water may be discharged into straw bale or sediment fence containment areas, or into sediment bags.

The Contractor shall preserve as much vegetation as possible along the water body banks while allowing for safe equipment operation. Clearing and grubbing for temporary vehicle access and equipment crossings shall be carefully controlled to minimize sediment entering the water body from the construction right-of-way. Clearing and grading shall be performed on both sides of the water body prior to initiating any trenching work. All trees shall be felled away from watercourses.

Plant debris or soil inadvertently deposited within the high water mark of waterbodies shall be promptly removed in a manner that minimizes disturbance of the water body bed and bank. Excess floatable debris shall be removed above the high water mark from areas immediately above crossings.

Vegetation adjacent to waterbodies where HDD or boring methods will be installed or utilized, shall not be disturbed except by hand clearing as necessary for drilling operations.

4.1.1.6 Grading

The construction right-of-way in uplands adjacent to a water body shall be graded so that soil is pushed away from the water body rather than towards it when possible. To minimize disturbance to woody riparian vegetation within extra workspaces adjacent to the construction right-of-way at water body crossings, the Contractor shall minimize grading and grubbing of water body banks. Grubbing shall be limited to the ditch line plus an appropriate width to accommodate the safe installation of vehicle access and the crossing to the extent practicable.

4.1.1.7 Temporary Erosion and Sediment Control

The Contractor shall install sediment barriers across the entire construction right-of-way at all flowing water body crossings. The Contractor shall install sediment barriers immediately after initial disturbance of the water body or adjacent upland. Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench) until replaced by permanent erosion controls or restoration of adjacent upland areas is complete.

Where waterbodies are adjacent to the construction right-of-way, the Contractor shall install sediment barriers along the edge of the construction right-of-way as necessary to contain spoil and sediment within the construction right-of-way as delineated in the Sediment and Erosions Plan to be developed for this project.

4.1.1.8 Trenching

The following requirements apply to all water body crossings except those being installed by the non-flowing open cut crossing method. All equipment and materials shall be on site before trenching in the active channel of all minor waterbodies containing state designated fisheries, and in intermediate and major waterbodies. All activities shall proceed in an orderly manner without delays until the trench is backfilled and the stream banks stabilized. The Contractor shall not begin in-stream activity until the in-stream pipe section is complete and ready to be installed in the water body. The Contractor shall use trench plugs at the end of the excavated trench to prevent the diversion of water into upland portions of the pipeline trench and to keep any accumulated upland trench water out of the water body. Trench plugs must be of sufficient size to withstand upslope water pressure.

The Contractor shall conduct as many in-stream activities as possible from the banks of the waterbodies. The Contractor shall limit the use of equipment operating in waterbodies to that needed to construct each crossing.

The Contractor shall place all spoil from minor and intermediate water body crossings, and upland spoil from major water body crossings in the construction right-of-way at least 10 feet from the water's edge or in additional extra work areas. No trench spoil, including spoil from the portion of the trench across the stream channel, shall be stored within a water body unless the crossing cannot be reasonably completed without doing so.

The Contractor shall install and maintain sediment barriers around spoil piles to prevent the flow of spoil into the water body. Spoil removed during ditching shall be used to backfill the trench usually with a backhoe, clamshell or a dragline working from the water body bank. Sand, gravel, rock shield, or fill padding shall be placed around the pipe where rock is present in the channel bottom.

4.1.1.9 Pipe Installation

The following requirements apply to all water body crossings except those being installed by the non-flowing open cut crossing method. A "free stress" pipe profile shall be used at all minor, intermediate, and major waterbodies with gradually sloping stream banks. The "box bend" pipe profile shall be used for intermittent and major waterbodies with steep stream banks. The trench shall be closely inspected to confirm that the specified cover and that adequate bottom support can be achieved, and shall require construction inspection and on-site approval prior to the pipe being installed. Such inspections shall be performed by visual inspection and/or measurement by PREPA and/or by its designated construction manager. In rock trench, the ditch shall be adequately padded with clean granular material to provide continuous support for the pipe. The pipe shall be pulled into position or lowered into the trench and shall, where necessary, be held down by weights, as-built recorded and backfilled immediately to prevent the pipe from floating.

The Contractor shall provide sufficient approved lifting equipment to perform the pipe installation in a safe and efficient manner. As the coated pipe is lowered in, it shall be prevented from swinging or rubbing against the sides of the trench. Only properly manufactured slings, belts and cradles suitable for handling coated pipe shall be used. All pipes shall be inspected for coating flaws and/or damage as it is being lowered into the trench. Any damage to the pipe and/or coating shall be repaired.

4.1.1.10 Backfilling

The following requirements apply to all water body crossings except those being installed by the non-flowing open cut crossing method. Trench spoil excavated from waterbodies shall be used to backfill the trench across waterbodies. After lowering-in has been completed, but before backfilling, the line shall be re-inspected to ensure that no skids, brush, stumps, trees, boulders or other debris is in the trench. If discovered, such materials or debris shall be removed from the trench prior to backfilling.

For each major water body crossed, the Contractor shall install a trench breaker at the base of slopes near the water body unless otherwise directed by PREPA based on site specific conditions. The base of slopes at intermittent waterbodies shall be assessed on-site and trench breakers installed only where necessary. Slurred muck or debris shall not be used for backfill. At locations where the excavated native material is not acceptable for backfill or must be supplemented, the Contractor shall provide granular material approved by PREPA.

If specified in the Construction Drawings, the top of the backfill in the stream shall be armored with rock riprap or bio-stabilization materials as appropriate.

4.1.1.11 Stabilization and Restoration of Stream Banks and Slopes

The stream bank contour shall be re-established. All debris shall be removed from the streambed and banks. Stream banks shall be stabilized and temporary sediment barriers shall be installed within 24 hours of completing the crossing if practicable. Approach slopes shall be graded to an acceptable slope for the particular soil type and surface run off controlled by installation of permanent slope breakers. Where considered necessary, the integrity of the slope breakers shall be ensured by lining with erosion control blankets. Immediately following reconstruction of the stream banks, the Contractor shall install seed and flexible channel liners on water body banks.

If the original stream bank is excessively steep and unstable and/or flow conditions are severe or if specified on the Construction Drawings, the banks shall be stabilized with rock riprap, gabions, stabilizing cribs, or bio-stabilization measures to protect backfill prior to reestablishing vegetation. Stream bank riprap structures, if required, shall consist of a layer of stone, underlain with approved filter fabric or a gravel filter blanket. Riprap shall extend from the stabilized streambed to the top of the stream bank, where practicable, native rock shall be utilized.

4.1.1.12 Increased Traffic for Supplies, Materials, and Work Crews

The temporary increase in traffic volume associated with the Project would likely result in a minor noise impact in the Project area. This component of construction noise would come mainly from vehicles traveling to the staging areas and from a wide range of truck trips for delivery and recovery materials at the work sites along the pipeline ROW. The procedures for bringing personnel, materials, and equipment to each work site would vary along the alignment. Truck trips would also be required to deliver heavy construction equipment, pipe, aggregate, and other materials.

4.2 Wetland and Water body Crossings Types and Construction Methods

The construction methods and Best Management Practices (BMPs) utilized for a particular water body crossing will be compatible with the environmental sensitivity of the water body and the type of bottom or bank sediments. These detailed plans will be used by the construction contractor to reduce potential impacts associated with construction.

The extent of potential construction impacts to water resources depends on various factors: water body type, water body bank and sediment bed composition/grain-size distribution, and the method of construction. Features, such as water body width, bottom composition, special water body classifications, the presence of any federally listed species, and/or sensitive fishery resources, have been considered when determining the appropriate construction crossing method. The subsections below provide detailed descriptions of each crossing method.

Construction methods pertinent to water body crossings are presented below. Selection of the most appropriate method at each crossing shall be identified on the project drawings but may be amended or changed based on site specific conditions (i.e., environmental sensitivity of the water body, depth and rate of flow, subsurface soil conditions, site specific construction considerations, and the expected time and duration of construction) at the time of crossing. Table 7 details the crossing locations, crossing types, and method proposed. Each water body crossing shall be accomplished using one of the following construction methods (found in Appendix F):

- Non-flowing Open Cut Crossing Method - Sheet 2 of 7 (identical to Wetland Crossings)
- Flowing Open Cut Crossing Method – Minor or Intermediate Water body - Sheet 5, 6 of 7
- Flowing Open Cut Crossing – Dry Flume Method - Sheet 5 of 7 ?
- Flowing Open Cut Crossing – Dry Dam and Pump Method - Sheet 6, 7 of 7
- Horizontal Directional Drill Crossing - Sheet 1 of 7, and Detail 15
- Wetland Crossing - Sheet 2 of 7

For purposes of this project, water body crossings have been split into three groupings; labeled Type 1, Type 2, and Type 3. Crossing types have been defined based upon the width of the water body at water's edge or the type of wetland community to be crossed. Table 7 provides details for each identified project crossing. A brief description of each crossing type is included below.

4.2.1 Type 1 Crossing

Type 1 Crossing – Major Water body and associated wetlands: Includes major rivers and waterways wider than 100 feet at water's edge at the time of construction or Forested Wetlands where impacts are prohibited under NWP regional conditions. All Type 1 Crossings will be completed via horizontal direction drilling (HDD). HDD crossings will include both land based and wetland based points of entry and exits. Details of a typical HDD have been included with the design details (see Appendix F). Eighteen (18) crossings involving Type 1 waterbodies were identified. These 18 crossings incorporate twenty (20) separate waterways (some with associated wetlands on one or both banks) and one (1) independent Forested Wetland system (W-111). Table 7 identifies the waterbodies along the propose pipeline corridor and their "types". Those with a "C" designation are linear surface systems with open water and incised channels, i.e. streams, ditches, etc. Those with a "W" are vegetated wetlands contiguous to surface waterbodies or wetlands located separately in the landscape.

4.2.1.1 Construction Methods for Type 1 Crossing

The Horizontal Directional Drilling (HDD) method, which avoids disturbances to the streambed and banks, is more complex than other methods. Use of HDD is very limited and is dependent on the crossing length, burial depth, subsurface conditions, sediment composition, bank conditions, and access. This method requires large additional temporary workspace (ATWS) for drilling equipment and pipeline assembly. The natural gas pipeline will be located a minimum of 5-feet below a streambed/channel bottom or 5-feet below the maximum design dredge depth for any Federal projects. Sheet 1 and Detail 15 (Appendix F) illustrate a typical cross-section of this construction technique.

HDD consists of drilling a tunnel under the water body with multiple passes. The first pass (coming from the "drill side") of the drill is usually one-half the diameter of the pipe. During this first pass, the hole is charged with bentonite drilling mud to avoid a collapse or cave-in of the hole. Once this first drill has reached the opposite side of the water body, the original drill head is removed and a larger diameter drill head is installed. One or more reaming passes through the hole, with drill heads of increasing diameter, are performed until the hole is large enough for the pipeline segment to be pulled back through it. The pipeline segment would be assembled on the opposite side, or "laydown side", and after the final ream pass is completed the pipeline segment would be pulled back through the tunnel to complete the HDD crossing.

HDD water body crossings for the Project's preferred corridor are preliminarily proposed at 18 locations. All proposed HDD crossings are subject to verification based on engineering and geologic review during post-certification.

Where stipulated, the horizontal directional drill method as shown on Detail 15 (Appendix F) shall be utilized for designated major and sensitive water body crossings. The Contractor shall construct each directional drill water body crossing in accordance with a Site Specific Plan as shown in the Construction Drawings.

Drilling fluids and additives utilized during implementation of a directional drill shall be non-toxic to the aquatic environment. A Frac-out contingency plan has been prepared and is available for review in Appendix I. The plan shall include instructions for monitoring during the directional drill and mitigation in the event that there is a release of drilling fluids. Additionally, the water body shall be monitored downstream by the Contractor for any signs of drilling fluid.

The Contractor shall dispose of all drill cuttings and drilling mud at a landfill site. Disposal options will be limited to hauling all drilling cuts and drilling mud to a licensed landfill, or other site identified by PREPA.

4.2.2 Type 2 Crossing

Type 2 Crossing – Intermediate Water body: Includes open surface water bodies (minor rivers and streams) greater than 10 feet wide to less than 100 feet wide at water's edge at the time of construction. Type 2 crossings will be completed using either the flumed crossing and/or dam and pump method. Seven (7) intermediate water body crossings were identified along the approximately 92 mile project length.

4.2.2.1 Construction Methods for Type 2 Crossings: Flume-Pipe Method

Flume-Pipe Crossing.

The flume-pipe crossing method (flowing open-cut method) may be used for minor waterbodies (TYPE 2 crossings - typically less than 75 feet wide). Prior to any excavation, a flume pipe(s) of sufficient size would be placed into the water body across its entire width. Dams would then be erected at the upstream and downstream portions of the flume to divert water through the flume. Any water left in the crossing would be pumped out to the downstream side. Once the water body has been diverted and the crossing is dry, a land-based backhoe or similar type of equipment would be used to excavate a trench under the flume and across the water body. The excavated material would be temporarily stored and then used to backfill the trench once the pipeline segment has been placed. The flume pipes and associated dams would be removed once the pipeline segment is installed. Restoration of the water body crossing would then be completed. Sheet 5 of 7 shows a typical view of this water body crossing method.

This method will typically be limited to waterbodies with flows (including anticipated flood stages) that can be transported by a maximum of three 36-inch-diameter flume pipes (approximately 40 cubic feet per second or less) and in waterbodies that are relatively free of large rocks and bedrock at the trench line. This method will not be used at larger crossings, high flow velocities, or deeper waterbodies.

Where required, the Contractor shall utilize the Flowing Open Cut Crossing – Dry Flume Method as shown on Sheet 5 of 7 with the following "dry ditch" techniques:

• flume pipe shall be installed in water body prior to any trenching;

• sand bag or sand bag and plastic sheeting diversion structure or equivalent shall be used to develop an effective seal and to divert stream flow through the flume pipe (some modifications to the stream bottom may be required to achieve an effective seal);

• flume pipe(s) shall be aligned to prevent bank erosion and streambed scour;

• flume pipe shall not be removed during trenching, pipe laying, or backfilling activities, or initial streambed restoration efforts; and

• all flume pipes and dams that are not also part of the equipment bridge shall be removed as soon as final cleanup of the stream bed and bank is complete

4.2.2.2 Construction Methods for Type 2 Crossing: Dam and Pump Crossing

Dam and Pump Crossing. The dam and pump method (flowing open-cut crossing) may be used for smaller waterbodies with low flows, and meandering channels. As shown on Sheet 6 of 7, in this method, dams would be placed across the water body both upstream and downstream of the crossing. Water upstream of the crossing would be pumped through hoses downstream. This method is limited by the pump capacity since the pumps must convey the stream flow during construction activities. Pumps would be sized to be greater than the anticipated stream flow at the water body crossing. Intake screens would be placed to prevent entrainment of fish or other debris into the pumps. Once the water has been successfully diverted, the trench would be excavated and the pipeline installed. BMPs such as silt fence or fences would be used to contain spoil materials and prevent downstream sedimentation from upland areas. Prior to backfilling and removal of the dams, the trench would be dewatered using BMPs to prevent erosion and sedimentation. Upon installation of the pipeline, the trench would be backfilled and re-stabilized. The dams would then be removed and the water body returned to its natural condition.

Where specified in the construction drawings, the Contractor shall utilize the Flowing Open Cut Crossing – Dry Dam and Pump Method as shown on Sheet 6 of 7. The dam and pump crossing method shall meet the following performance criteria:

- sufficient pumps shall be used to maintain 1.5 times the flow present in the stream at the time of construction;
- at least one back up pump must be available on site;
- dams shall be constructed with materials that prevent sediment and other pollutants from entering the water body (e.g., sandbags or clean gravel with plastic liner);
- screen pump intakes shall be installed;
- streambed scour shall be prevented at pump discharge; and dam and pumps shall be monitored to ensure proper operation throughout the water body crossing.

4.2.3 Type 3 Crossing

Type 3 Crossings – Minor Water body: Includes waterbodies less than or equal to 10 feet wide at the water's edge at the time of construction. These waterbodies typically include intermittent streams, expanded agricultural ditches, and braided streams. Type 3 crossings will be completed using the open cut method. Seventy-three (73) of these minor water body crossing were identified along project corridor.

Open-Cut Method. The open-cut method is expected to be used for most minor (Type 3) water body crossings. In-stream trenching and filling operations for this type of crossing will be constructed within 24 hours for streams less than 10 feet in width and within 48 hours for crossings greater than 10 feet, unless site-specific conditions dictate otherwise or unforeseen conditions arise.

This construction method involves installing the pipeline in the water. Depending on the water body size, the trench would be excavated with land-based or amphibious equipment. The entire pipeline segment would be placed in the trench using draglines to pull it across the water body. Sheet 4 of 7 shows a typical cross-section of the open-cut method. The pipe would be buried at a minimum of 5 feet beneath the bed of the water body.

Spoils would be placed upland from the water body bank edge. BMPs such as silt fence and/or straw bales would be installed to reduce the potential for sediment to flow off the construction ROW or back into the water body. Once the pipeline is installed, the trench would be backfilled in the water. Based on field conditions, trench plugs may be placed on either side of the crossing so that the water body does not divert into the upland trench and to keep accumulated water in the upland trench from flowing into the water body.

4.2.4 Wetland Crossing

Pipeline construction across wetlands will be similar to typical conventional upland cross-country construction procedures, with several modifications and limitations to reduce the potential for pipeline construction to affect wetland hydrology and soil structure. Whenever possible, the width of construction right-of-way through wetlands will be minimized. Additional temporary workspace areas where required will be placed on the upland sides of wetlands to stage construction, fabricate the pipeline, and store materials. In addition to the surface water crossings, i.e. rivers, streams, ditches, etc., ninety (90) additional wetland crossings were identified along the project length where the pipeline will be placed in a trench. These wetland areas vary in size (acres) but will all be crossed using the open ditch method with only temporary impacts to waters of the U.S.

Construction equipment working in wetlands will be limited to that essential for right-of-way clearing, excavating the trench, fabricating and installing the pipeline, backfilling the trench, and restoring the right-of-way. In areas where there is no reasonable access to the right-of-way except through wetlands, non-essential equipment will be allowed to travel through wetlands only if the ground is firm enough or has been stabilized to avoid rutting. Wooden mats will be the preferred method to preclude rutting. Any fill used for temporary access will comply with the terms and conditions of Nationwide Permit 12, with all fill areas being completely removed and restored to pre-construction grades. Otherwise, non-essential equipment will be allowed to travel through wetlands only once.

Clearing of vegetation in wetlands will be limited to herbaceous vegetation and shrubs, which will be cut flush with the surface of the ground and removed from the wetland. To avoid excessive disruption of wetland soils and the native seed and rootstock within the wetland soils, grading, topsoil segregation, and excavation will be limited to the area immediately over the trench line. Topsoil segregation over the trench line will be utilized to minimize natural vegetation recruitment time and to insure that pre/post wetland soil profiles are comparable.

During clearing, sediment barriers, such as silt fence and staked straw bales, will be installed and maintained adjacent to wetlands and within additional temporary workspace areas as necessary to minimize the potential for sediment runoff. Sediment barriers will be installed across the full width of the construction right-of-way at the base of slopes adjacent to wetland boundaries. Silt fence and/or straw bales installed across the working side of the right-of-way will be removed during the day when vehicle traffic is present and will be replaced each night. Sediment barriers will also be installed within wetlands along the edge of the right-of-way, where necessary, to minimize the potential for sediment to run off the construction right-of-way and into wetland areas outside the work area. If temporary trench dewatering is necessary in wetlands, silt-laden trench water will be discharged into an energy dissipation/sediment filtration device, such as a geotextile filter bag or straw bale structure, to minimize the potential for erosion and sedimentation.

The method of pipeline construction used in wetlands will depend largely on the stability of the soils at the time of construction. If wetland soils are not excessively saturated at the time of construction and can support construction equipment on equipment mats, timber riprap, or straw mats, construction will occur in a manner similar to conventional upland cross-country construction techniques and will utilize a wheel trencher to minimize the initial impact area, excavated trench width, and area to be restored.

Where wetland soils are saturated and/or inundated, the pipeline may be installed using the push-pull technique. The push-pull technique will involve stringing and welding the pipeline outside of the wetland and excavating and backfilling the trench using a backhoe supported by equipment mats or timber riprap. The prefabricated pipeline will be installed in the wetland by equipping it with buoys and pushing or pulling it across the water-filled trench. After the pipeline is floated into place, the floats will be removed and the pipeline will sink into place. Most pipe installed in saturated wetlands will be coated with concrete or equipped with set-on weights to provide negative buoyancy.

Because little or no grading will occur in wetlands, restoration of contours will be accomplished during backfilling. Prior to backfilling, trench breakers will be installed where necessary to prevent the subsurface drainage of water from wetlands. Where topsoil has been segregated from subsoil, the subsoil will be backfilled first, followed by the topsoil. Topsoil will be replaced to the original ground level leaving no crown over the trench line. In some areas where wetlands overlie rocky soils, the pipe will be padded with rock-free soil or sand before backfilling with native bedrock and soil. Equipment mats, timber riprap, gravel fill, geotextile fabric, and/or straw mats will be removed from wetlands following backfilling.

Table 7: Wetland and WoUS Crossing Type

ID	Water body Name or Type	Crossing
C-1	Canal	Type 3
C-2	Channel	Type 1
C-3	Canal	Type 3
C-4	Canal	Type 3
C-5	RIO TALLABOA RIVER	Type 1
C-6	UNNAMED CREEK	Type 3
C-7	UNNAMED CREEK	Type 3
C-8	UNNAMED CREEK	Type 3
C-9	UNNAMED CREEK	Type 3
C-10	UNNAMED CREEK	Type 3
C-11	UNNAMED CREEK	Type 3
C-12	UNNAMED CREEK	Type 3
C-13	UNNAMED CREEK	Type 3
C-14	UNNAMED CREEK	Type 3
C-15	UNNAMED CREEK	Type 3

ID	Water body Name or Type	Crossing
C-16	UNNAMED CREEK	Type 3
C-17	UNNAMED CREEK	Type 3
C-18	UNNAMED CREEK	Type 3
C-19	UNNAMED CREEK	Type 3
C-20	RIO PELLEJAS RIVER	Type 2
C-21	UNNAMED CREEK	Type 3
C-22	UNNAMED CREEK	Type 3
C-23	ARENAS CREEK	Type 3
C-24	ARENAS CREEK	Type 3
C-25	ARENAS CREEK	Type 3
C-26	RIO GRANDE DE ARECIBO RIVER	Type 1
C-27	UNNAMED CREEK	Type 3
C-28	UNNAMED CREEK	Type 3
C-29	UNNAMED CREEK	Type 3
C-30	UNNAMED CREEK	Type 3
C-31	RIO GRANDE DE ARECIBO RIVER	Type 1
C-32	UNNAMED CREEK	Type 3
C-33	UNNAMED CREEK	Type 3
C-34	RIO GRANDE DE ARECIBO RIVER	Type 1
C-35	JOBOS CREEK	Type 3
C-36	RIO GRANDE DE ARECIBO RIVER	Type 1
C-37	RIO GRANDE DE ARECIBO RIVER	Type 1
C-38	UNNAMED CREEK	Type 3
C-39	RIO TANAMA RIVER	Type 1
C-40	Ditch	Type 3
C-41	PERDOMO CHANNEL	Type 3
C-42	Ditch	Type 3
C-43	RIO GRANDE DE ARECIBO RIVER	Type 1
C-44	Ditch	Type 3
C-45	Ditch	Type 3
C-46	Ditch	Type 3
C-47	Ditch	Type 3
C-48	Ditch	Type 3
C-49	Ditch	Type 3
C-50	Ditch	Type 3
C-51	Ditch	Type 3
C-52	Ditch	Type 3
C-53	Ditch	Type 3
C-54	Ditch	Type 3
C-55	Ditch	Type 3
C-56	Ditch	Type 3
C-57	Ditch	Type 3
C-58	Ditch	Type 3

ID	Water body Name or Type	Crossing
C-59	Ditch	Type 3
C-60	Ditch	Type 3
C-61	Ditch	Type 3
C-62	Ditch	Type 3
C-63	Canal	Type 3
C-64	Ditch	Type 3
C-65	Ditch	Type 3
C-66	RIO GRANDE DE MANATI RIVER	Type 1
C-67	Creek	Type 3
C-68	Creek	Type 3
C-69	CANO DE LOS NACHOS	Type 3
C-70	Ditch	Type 3
C-71	Ditch	Type 3
C-72	RIO GRANDE DE MANATI RIVER	Type 1
C-73	RIO GRANDE DE MANATI RIVER	Type 1
C-74	RIO INDIO RIVER	Type 2
C-75	RIO INDIO RIVER	Type 2
C-76	RIO INDIO RIVER	Type 2
C-77	RIO INDIO RIVER	Type 2
C-78	UNNAMED CREEK	Type 3
C-79	RIO INDIO RIVER	Type 2
C-80	RIO CIBUCO RIVER	Type 2
C-81	UNNAMED CREEK	Type 3
C-82	Ditch	Type 3
C-83	RIO LA PLATA RIVER	Type 1
C-84	Ditch	Type 3
C-85	Ditch	Type 3
C-86	Ditch	Type 3
C-87	Ditch	Type 3
C-88	Ditch	Type 3
C-89	RIO COCAL RIVER	Type 3
C-90	RIO COCAL RIVER	Type 1
C-91	Creek	Type 3
C-92	Canal/Rio Cocal	Type 1
C-93	RIO COCAL RIVER	Type 1
C-94	RIO COCAL RIVER	Type 1
C-95	RIO BAYAMON RIVER	Type 1
C-96	RIO BAYAMON RIVER	Type 1
C-97	Ditch	Type 3
C-98	DIEGO CREEK	Type 3
C-99	LAS LAJAS CREEK	Type 3
C-100	SANTA CATALINA CREEK	Type 3
W-1	Estuarine- Saltflat, Mangrove	No Impact

ID	Water body Name or Type	Crossing
W-2	Estuarine- Saltflat, Mangrove	No Impact
W-3	Estuarine- Saltflat, Mangrove	No Impact
W-4	Estuarine- Saltflat, Mangrove	No Impact
W-5	Mangrove Canal	No Impact
W-6	Mangrove Canal	Type 1
W-7	Canals	Type 1
W-8	Canals	Type 3
W-9	Canals	Type 3
W-10	Palustrine- Man-Altered Herbaceous	Wetland
W-11	Canals	Type 2
W-12	Canals	Type 1
W-13	Palustrine- Herbaceous	Type 1
W-14	Canals	Type 1
W-15	Canals	Type 1
W-16	Canals	Type 1
W-17	Palustrine- Herbaceous	Wetland
W-18	Canals	Type 1
W-19	Palustrine- Man-Altered Herbaceous	Wetland
W-20	Canals	Type 3
W-21	Palustrine- Man-Altered Herbaceous	Wetland
W-22	Palustrine- Man-Altered Herbaceous	Wetland
W-23	Canals	Type 1
W-24	Palustrine- Man-Altered Herbaceous	Wetland
W-25	Canals	Wetland
W-26	Palustrine- Man-Altered Herbaceous	Wetland
W-27	Canals	Wetland
W-28	Canals	Type 3
W-29	Canals	Wetland
W-30	Palustrine- Herbaceous	Wetland
W-31	Canals	Type 1
W-32	Palustrine- Herbaceous	Wetland
W-33	Palustrine- Herbaceous	Wetland
W-34	Palustrine- Man-Altered Herbaceous	Wetland
W-35	Palustrine- Man-Altered Herbaceous	Wetland
W-36	Canals	Wetland
W-37	Palustrine- Man-Altered Herbaceous	Wetland
W-38	Palustrine- Man-Altered Herbaceous	Wetland
W-39	Palustrine- Herbaceous	Wetland
W-40	Palustrine- Herbaceous	Wetland
W-41	Palustrine- Herbaceous	Wetland
W-42	Palustrine- Herbaceous	Wetland
W-43	Palustrine- Herbaceous	Wetland
W-44	Palustrine- Man-Altered Herbaceous	Wetland

ID	Water body Name or Type	Crossing
W-45	Palustrine- Man-Altered Herbaceous	Wetland
W-46	Palustrine- Man-Altered Herbaceous	Wetland
W-47	Palustrine- Man-Altered Herbaceous	Wetland
W-48	Palustrine- Man-Altered Herbaceous	Wetland
W-49	Palustrine- Herbaceous	Wetland
W-50	Palustrine- Herbaceous	Wetland
W-51	Palustrine- Herbaceous	Wetland
W-52	Palustrine- Herbaceous	Wetland
W-53	Palustrine- Herbaceous	Wetland
W-54	Palustrine- Herbaceous	Wetland
W-55	Palustrine- Man-Altered Herbaceous	Wetland
W-56	Palustrine- Herbaceous	Wetland
W-57	Palustrine- Herbaceous	Wetland
W-58	Palustrine- Herbaceous	Wetland
W-59	Canals	Type 3
W-60	Palustrine- Herbaceous	Wetland
W-61	Palustrine- Man-Altered Herbaceous	Wetland
W-62	Palustrine- Herbaceous	Wetland
W-63	Canals	Type 1
W-64	Palustrine- Herbaceous	Wetland
W-65	Palustrine- Man-Altered Herbaceous	Wetland
W-66	Palustrine- Man-Altered Herbaceous	Wetland
W-67	Palustrine- Man-Altered Herbaceous	Wetland
W-68	Canals	Type 3
W-69	Palustrine- Man-Altered Herbaceous	Wetland
W-70	Palustrine- Man-Altered Herbaceous	Wetland
W-71	Palustrine- Man-Altered Herbaceous	Wetland
W-72	Palustrine- Herbaceous	Wetland
W-73	Canals	Type 1
W-74	Palustrine- Herbaceous	Wetland
W-75	Canals	Type 1
W-76	Palustrine- Herbaceous	Wetland
W-77	Palustrine- Man-Altered Herbaceous	Wetland
W-78	Canals	Type 2
W-79	Canals	Type 2
W-80	Canals	Type 2
W-81	Canals	Wetland
W-82	Palustrine- Herbaceous	Wetland
W-83	Palustrine- Herbaceous	Wetland
W-84	Canals	Type 2
W-85	Palustrine- Herbaceous	Wetland
W-86	Canals	Type 2
W-87	Palustrine- Herbaceous	Wetland

ID	Water body Name or Type	Crossing
W-88	Palustrine- Herbaceous	Wetland
W-89	Palustrine- Man-Altered Herbaceous	Wetland
W-90	Palustrine- Man-Altered Herbaceous	Wetland
W-91	Palustrine- Herbaceous	Wetland
W-92	Palustrine- Man-Altered Herbaceous	Wetland
W-93	Palustrine- Man-Altered Herbaceous	Wetland
W-94	Palustrine- Man-Altered Herbaceous	Wetland
W-95	Palustrine- Man-Altered Herbaceous	Wetland
W-96	Canals	Type 3
W-97	Palustrine- Man-Altered Herbaceous	Wetland
W-98	Palustrine- Man-Altered Herbaceous	Wetland
W-99	Palustrine- Man-Altered Herbaceous	Wetland
W-100	Palustrine- Man-Altered Herbaceous	Wetland
W-101	Canals	Wetland
W-102	Estuarine- Forested	Type 1
W-103	Estuarine- Forested	Type 1
W-104	Canals	Type 1
W-105	Palustrine- Man-Altered Herbaceous	Wetland
W-106	Estuarine- Forested	Type 1
W-107	Canals	Type 1
W-108	Estuarine- Forested	Type 1
W-109	Canals	Type 1
W-110	Estuarine- Forested	Type 1
W-111	Palustrine- Forested	Type 1
W-112	Canals	Wetland
W-113	Palustrine- Herbaceous	Wetland
W-114	Canals	Type 1
W-115	Canals	Type 1
W-116	Palustrine- Herbaceous	Wetland
W-117	Palustrine- Herbaceous	Wetland
W-118	Palustrine- Herbaceous	Wetland
W-119	Palustrine- Herbaceous	Wetland
W-120	Palustrine- Herbaceous	Wetland
W-121	Canals	Type 3
W-122	Canals	Wetland
W-123	Palustrine- Herbaceous	Wetland
W-124	Estuarine- Forested	Wetland
W-125	Estuarine- Forested	Wetland
W-126	Estuarine- Forested	Wetland
W-127	Estuarine- Forested	Wetland
W-128	Canals	Wetland
W-129	Estuarine- Forested	Wetland
W-130	Palustrine- Herbaceous	Wetland