RECORD OF DECISION

COROZAL WELL SUPERFUND SITE

COROZAL, PUERTO RICO

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 2

September 2015

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Corozal Well Superfund Site
Corozal, Puerto Rico
PRN000206452

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) documents the selected remedial action for the Corozal Well Contamination Superfund Site, located in the Municipality of Corozal, Puerto Rico, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. §§ 9601-9675, as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision document explains the factual and legal basis for selecting the remedy for the Site. This decision is based on the Administrative Record file for the selection of this remedy. Refer to Appendix I of the Decision Summary for copy of the Administrative Record Index for the selection of this remedy.

The Puerto Rico Environmental Quality Board (PREQB) concurs with the selected remedy. Refer to Appendix II of the Decision Summary for a copy of the concurrence letter.

ASSESSMENT OF SITE

The United States Environmental Protection Agency (EPA), in consultation with PREQB, has determined that actual or threatened releases of hazardous substances at the Site, if not addressed, may present a current or potential threat to human health and the environment. Therefore, remediation is necessary. This determination is based on the conclusions set forth in the remedial investigation, the human health risk assessment, and the screening level ecological risk assessment.

DESCRIPTION OF THE SELECTED REMEDY

EPA, in consultation with PREQB, selects the remedy described in this document to address groundwater contamination detected at the Site. Under the selected remedy, groundwater contaminated with volatile organic compounds (VOCs) will be addressed by monitored natural attenuation and institutional controls. As a result of early response actions by EPA (described in the Decision Summary) the community well ("Santana well"), that originally led to the placement of the Corozal Well Site on EPA's National Priorities List, currently meets drinking water standards without treatment; however, because VOCs are still present in nearby monitoring wells, the selected remedy will continue to monitor the Santana well, and maintain the Granular Activated Carbon (GAC) system installed as part of the early response action, as an added level of protection.

The selected remedy Alternative 2 (Monitored Natural Attenuation and Institutional Controls) includes the following major components:

- **Monitored Natural Attenuation (MNA).** Decreasing VOC contamination trends in the aquifer, documented since 2010, are expected to continue, such that drinking water standards will be met throughout the aquifer within a reasonable time frame, conservatively estimated at 15 years. MNA requires a robust monitoring program to demonstrate that the conditions supporting natural attenuation continue to be present, and that decreasing plume trends perpetuate. Monitoring will continue until concentrations have achieved the remediation goals.
- **Monitoring of the Santana well.** The Santana well will be monitored and the existing GAC system will continue to be maintained to assure that this municipal water supply is protected.
- **Institutional Controls.** Institutional controls will assure that areas of the plume above the remediation goals are not used for drinking water purposes.

INSTITUTIONAL CONTROLS

While groundwater contamination is still present, institutional controls will be implemented to help control and limit exposure to hazardous substances in the groundwater at the Site. The types of institutional controls which will be employed for the groundwater at the Site are: 1) existing local laws that limit installation of drinking water wells without a permit; and 2) informational devices such as advisories published in newspapers, periodic letters sent to local government authorities informing them of the need to prevent well installation, and inspection of local and/or Commonwealth health department records to insure that no wells are installed that could impact the groundwater plume or result in exposure to contaminated groundwater.

DECLARATION OF STATUTORY DETERMINATIONS

STATUTORY REQUIREMENTS

The selected remedy meets the requirements for remedial actions set forth in Section 121 of CERCLA, 42 U.S.C. § 9621, because it meets the following requirements: 1) it is protective of human health and the environment; 2) it meets a level of standard of control of the hazardous substances, pollutants, and contaminants which at least attains the legally applicable or relevant and appropriate requirements under the federal and State laws; 3) and it is cost-effective.

STATUTORY PREFERENCE FOR TREATMENT

The selected remedy would not meet the statutory preference for the use of remedies that involve treatment as a principal element.

FIVE-YEAR REVIEW REQUIREMENTS

This remedy will not result in hazardous substances, pollutants, or contaminants remaining at the Corozal Well Superfund Site above levels that would allow for unlimited use and unrestricted exposure. However, because it may take more than five years to attain the remediation goals, pursuant to Section 121(c) of CERCLA, policy reviews will be conducted no less often than once every five years after the completion of construction to ensure that the remedy is, or will be, protective of human health and environment.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file located in the information repository.

- Contaminants of concern and their respective concentrations may be found in the "Site Characteristics" section.
- Potential adverse effects associated with exposure to Site contaminants may be found in the "Summary of Site Risks" section.
- A discussion of cleanup levels for chemicals of concern may be found in the "Remedial Action Objectives" section.
- A discussion of principal threat waste is contained in the "Principal Threat Waste" section of the ROD.
- Current and reasonably-anticipated future land and groundwater use assumptions are discussed in the "Current and Potential Future Land and Groundwater Uses" section.
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs are discussed in the "Description of Alternatives" section.
- Key factors that led to selecting the remedies (i.e., how the selected remedy provides the best balance of tradeoffs with respect to the NCP criteria, highlighting those criteria which are key to the decisions) may be found in the "Evaluation of Remedial Alternatives" and "Statutory Determinations" sections.

AUTHORIZING SIGNATURE

Walter E. Mugdan, Director
Emergency and Remedial Response Division
EPA - Region 2

September 29, 2015
Date

DECISION SUMMARY

COROZAL WELL SUPERFUND SITE
COROZAL, PUERTO RICO

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 2

SEPTEMBER 2015

TABLE OF CONTENTS

SITE NAME, LOCATION, AND DESCRIPTION

The Corozal Well Superfund Site (the Site) is located in the Palos Ward, a rural residential community within the mountainous region of north-central Puerto Rico (Appendix I, Figure 1). The Site straddles the border between the municipalities of Corozal and Naranjito. The Palos Ward is serviced by the Comunidad Santana Well (Santana well), a private community well that is the sole source of drinking water for a community of more than 200 people.

The Site was placed on the National Priority List of Superfund sites because of detection of tetrachloroethylene (PCE) contamination in the groundwater which is the source of potable water for a community drinking water well. This Record of Decision (ROD) addresses the groundwater of the Site.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

In November 2010, the Puerto Rico Aqueduct and Sewer Authority (PRASA), on behalf of Puerto Rico Department of Health (PRDOH), sampled the Santana well and discovered that concentrations of PCE exceeded the federal drinking water standard, the maximum contaminant level (MCL), of 5 micrograms per liter (µg/L). In response, EPA provided a temporary water supply to affected residents and undertook actions, discussed in more detail below, to modify the Santana well so that it could be reopened.

In March 2011, an analysis of the Santana well indicated that the upper zone of the well casing was probably in contact with shallow groundwater contaminated with PCE. The well was reconfigured and the upper zone of the well was sealed, isolating the well from that portion of the aquifer, as that was considered to be a likely source of the contamination. In addition, a granular activated carbon (GAC) system was added to treat water from the Santana well before distribution to residents on August 2011.

EPA added the Site to the National Priorities List on March 15, 2012.

Currently, EPA maintains the GAC system. Since 2011, the PCE concentrations in the well before treatment by the GAC system have decreased and are currently below the MCL of 5 µg/L. PCE has not been detected in either of the next nearest municipal wells, the Don Antonio (La Riviera) or Nieves-Sanchez wells. As shown on Figure 2 (Appendix I), Nieves well is upgradient of the Santana well along the unnamed stream, and the Don Antonio well is downgradient along the unnamed stream.

EPA REMEDIAL INVESTIGATION/FEASIBILITY STUDY

In October 2013, EPA commenced a fund-lead Remedial Investigation (RI) at the Site. The overall purpose of the RI was to evaluate the nature and extent of the groundwater, soil, surface water, and sediment contamination at the Site. This was assessed during the RI by collecting and analyzing surface and subsurface soil, soil gas, surface water, sediments, and groundwater samples, and then comparing analytical results to federal, commonwealth, and site-specific screening criteria. Screening criteria are values used in the RI to conservatively screen potential areas of contamination.

An RI Report was prepared by EPA to document the nature and extent of the contamination at the Site. As part of the RI, EPA also prepared a Baseline Human Health Risk Assessment

(HHRA) Report to document the current and future effects of Site contaminants on human health associated with the contamination found at the Site. EPA also conducted a Screening-level Ecological Risk Assessment (SLERA) to evaluate any potential for ecological risks from the presence of Site contaminants in surface water and sediment. A description of the HHRA and SLERA for this Site is provided in the Summary of Risk Section of this ROD.

A Feasibility Study (FS) was prepared to present and analyze cleanup alternatives suitable for the Site. The purpose of the FS was to identify, develop, screen, and evaluate a range of remedial alternatives that protect human health and the environment from potential risks and enable EPA to select a remedy for the Site. A detailed description of the cleanup alternatives evaluated for this Site is provided in the Description of Alternatives Section of this ROD.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

As part of the RI, a community involvement plan (CIP) was developed to assess any community concerns about the Site and encourage public participation. As part of the CIP and as required by Superfund regulations, EPA prepared a Proposed Plan for the Site. A Proposed Plan summarizes the remedial alternatives considered in the FS and identifies EPA's preferred alternative and the rationale for the preferred remedy. On August 12, 2015, EPA made the Proposed Plan, the RI Report, the HHRA and SLERA Reports, and the FS Report for the Site available to the public. All of these documents along with others, are included in the Administrative Record for the selection of this remedy, which has been was made available to the public at the following locations: EPA's Docket Room in New York, New York; the Library of the Felipa Sanchez Cruzado Public School in Naranjito, Puerto Rico; the Puerto Rico Environmental Quality Board (PREQB) Superfund File Room in San Juan, Puerto Rico; and EPA's Caribbean Environmental Protection Division Office in Guaynabo, Puerto Rico. A copy of the Administrative Record Index for the Site remedy is provided in Appendix II of this ROD.

A notice of the availability (Appendix III) of the Proposed Plan (Appendix IV) and supporting documentation was published in the "Primera Hora" newspaper on August 12, 2015. A public comment period was held from August 12, 2015 – September 11, 2015. In addition, a public meeting was held on August 20, 2015, at at the Library of the Felipa Sanchez Cruzado Public School in Naranjito, Puerto Rico from 6:00 pm to 8:00 pm. The purpose of the public meeting was to present the Proposed Plan to the community and provide an opportunity for the public to ask questions or give comments on the proposed remedial alternatives described in the Proposed Plan and EPA's preferred alternative. At this meeting, representatives from EPA and PREQB were present to answer questions and receive comments about the remedial alternatives for the Site and the proposed clean-up plan for the Site. A copy of the attendance sheet for this meeting can be found in Appendix VI of this ROD. Appendix VII of this ROD contains the official transcript of the public meeting. In addition, EPA's response to written comments received during the public comment period is included in the Responsiveness Summary, which is found in Appendix VII of this ROD.

SCOPE AND ROLE OF RESPONSE ACTION

EPA is addressing the cleanup of this Site by implementing a single, comprehensive remedial action to address the groundwater contamination at the Site.

SITE CHARACTERISTICS

CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) is developed to integrate all the different types of information collected during the RI, including the physical setting, the nature and extent of contamination, and the contaminant fate and transport.

PCE was likely discharged to the vadose zone composed of silty clay soil at the former source area (Appendix I, Figure 4). The high rates of tropical rainfall (greater than 75 inches per year) infiltrating through the vadose zone enhance the transport of PCE to the saturated zone. During the 1st Round (June 2014) and 2nd Round (February 2015) of the RI sampling, PCE was detected in all the shallow and deep bedrock monitoring wells (except MW-1S) and in the piezometer located between the suspected source area upslope and the Santana well, as well as in Santana well. After peaking at 120 µg/L in 2010, PCE concentrations in the Santana well have decreased and have been below the MCL of 5 µg/L since November 2013. There is little if any evidence that anaerobic biodegradation of PCE is on-going in the saprolite zone and upper fractured bedrock zone. However, PCE degradation products (Trichloroethylene (TCE) and vinyl chloride) were detected in MW-4D, in the deep bedrock, during the latest round of sampling in February 2015.

Long term water level monitoring data show the influence of semi-diurnal pumping of the Santana well in PZ-1, MW-2S, MW-4S, and MW-4D, with MW-4D showing the greatest fluctuations in response to pumping. Thus, these wells are hydraulically connected to the Santana well.

Water level data collected during the RI reveals that heads in both the shallow and deep bedrock fracture monitoring wells are lower than the water level in the stream. However, the water level in PZ-1 (in highly fractured, upper bedrock just below the saprolite zone) is slightly higher than the stream level. Groundwater from this zone is likely discharging to the stream. Where high angle fractures intersect the bedrock observed in some stretches of the stream, it is likely losing water to the bedrock. This effect is likely greater along the stream near the Santana well, where pumping in the deep bedrock is likely inducing groundwater recharge from the unnamed stream.

This fracture network and the saprolite zone provided a pathway for PCE migration to the Santana well. Pumping at the Santana well has likely induced migration of PCE from the saprolite zone into the bedrock. However, the rate of contaminant migration in the saprolite zone and shallow fracture zone to the Santana well has likely decreased since this zone was sealed off in 2011 and no longer induces as significant a hydraulic gradient in the vicinity of the well.

Contamination in fractures connected to the pumping well will likely move through the fractures with little retardation or dilution, and thus dilution and dispersion are expected to have more demonstrable effects over time on PCE concentrations in the fractures. Little if any contamination is expected to have diffused out of the fractures and into the bedrock matrix. Thus, the competent bedrock is not expected to be a significant secondary source that would maintain elevated PCE concentrations because of back diffusion over time. The hydrogeology and extent of contamination downgradient of the Santana well is unknown although expected to be minimal, as downgradient surface water and porewater concentrations were below screening criteria (see results summary below) and no VOCs were detected in a downgradient supply well, Don Antonio.

CONTAMINATION OVERVIEW

The RI identified PCE as a Site-related chemical. The fate of a chemical in the environment is a function of its physical and chemical properties and conditions at the site. The potential for environmental transport is a function of the conditions at a site, including geological and hydrogeological characteristics. The primary fate and transport aspects of the Site are summarized below.

- PCE has migrated from the ground surface into groundwater. Some of the PCE mass is retained by capillary forces in the soil pores. The concentrations of PCE observed do not indicate the presence of dense non-aqueous phase liquid (DNAPL).

- The greatest potential for the transport of PCE is through dissolution of contaminants in soil, vertical migration to groundwater, groundwater migration via advection and dispersion, and volatilization.

- Dissolved contaminants migrate primarily via advection in groundwater through the saprolite zone and fractured bedrock zones. Flux is likely greatest in the lower saprolite zone and the highly fractured upper bedrock. Some of the dissolved contamination has entered the bedrock through bedrock bedding planes and fractures via natural advection. Additionally, pumping in the Santana well has likely drawn contamination into the deeper bedrock fractures.

- PCE in soil and groundwater has migrated as vapor, as confirmed by the soil vapor sample results.

- There is limited evidence that anaerobic biodegradation of PCE is occurring at the Site.

TOPOGRAPHY AND DRAINAGE

The Site is located in an area of rugged hills in the Cedro Abajo region. Surface elevation at the Site varies between approximately 1,150 and 1,280 feet above mean sea level (amsl). The Santana well is located at approximately 1,150 feet amsl. The well is within the Rio Mavilla watershed with headwaters at approximately 1,315 feet amsl. Surface drainage from the Site flows into an unnamed stream that discharges into the Rio Mavilla and eventually into the Rio Cibuco. An intermittent stream located in the eastern portion of the Site also discharges local surface runoff into the unnamed stream.

GEOLOGY

The unconsolidated zone observed in Site soil borings is generally composed of brown silty clay near the surface, becoming more reddish yellow and brownish yellow silty clay close to the saprolite zone. The thickness of this zone varies from 2 to 17 feet across the Site. The saprolite zone is described as weathered rock with fractures and angular rock fragments (sand to gravel size) in a red to reddish brown silt and clay matrix. Saprolite zone thickness also varies considerably from 2 to 22 feet across the Site.

The Site is underlain by moderately to highly fractured Lower/Upper Cretaceous volcanic bedrock consisting of basaltic tuff. Geophysical borehole logs indicate linear features in the vicinity of the wells on Site in lengths from 330 to 660 feet, generally following steep ravines and stream valleys. One of these features is the unnamed stream. The stream likely follows a weak zone or potential fault. This likely increases the number of fractures in the bedrock, leading to a preferred flow pathway parallel to the stream.

HYDROGEOLOGY

Site hydrogeology consists of a low permeability vadose zone of silty clay soil that transitions into the saprolite zone. The transmissivity of the saprolite zone increases with depth as the weathering profile transitions from rock fragments in a silty clay matrix to cobble-sized rock fragments in a sand/gravel matrix, eventually becoming fractured volcanic bedrock. The number of bedrock fractures generally decreases with depth, although highly fractured bedrock was observed from 141 to 159 feet below ground surface (bgs) in the Santana well. These fractures act as conduits for deeper groundwater movement.

Groundwater/surface water interaction in the vicinity of the Site is complex. Figure 5 (Appendix I) shows the potentiometric map based on the water levels in the shallow bedrock wells. Base flow in the unnamed stream is likely the result of groundwater discharge from the saprolite zone, which has a water elevation higher than the adjacent stream level (at PZ-1). However, water levels in both the shallow and deep bedrock wells are lower than water levels in the adjacent unnamed stream. Where high angle fractures from these bedrock zones intercept the stream, it is expected to lose water to the bedrock. Regular pumping by the Santana well may be lowering groundwater levels in the shallow and deep bedrock and inducing infiltration of stream water into the bedrock aquifer near the Santana well area. The relationship between surface water and groundwater likely varies along the stream depending on the location of fractures connecting to the shallow and deep bedrock and the extent of the influence of Santana well pumping.

CULTURAL RESOURCES

In July 2013, a Stage 1A level Cultural Resources Survey was completed by Richard Grubb & Associates, Inc., under subcontract to EPA's RI/FS contractor, CDM Smith. The Stage 1A survey included a comprehensive documentary research and Site visit designed to identify known or potential historical, architectural, and/or archeological resources within the area of potential effects (APE), a 30-acre area between the municipalities of Corozal and Naranjito. No previously recorded archeological sites are documented within or near the APE. Heavy erosion in the area renders the survival of intact archeological resources unlikely. The APE is situated far from any historic roads or structures, indicating a low sensitivity, or probability, for historic period archeological resources. No further archeological survey was recommended.

SOURCES OF CONTAMINATION

Potential source areas were investigated by first conducting broad screening of soil gas around the Site. Soil gas results and subsequent soil sampling pointed toward a potential source area near the top of the upper reaches drainage (the intermittent stream), over 400 feet upgradient of the Santana well. The combined analytical and hydrogeological data provided evidence that

PCE was likely discharged to the surface at the suspected source area. It is not known when and how much PCE was discharged. As discussed below, no significant mass of contamination was detected in soils (the maximum PCE concentration detected was 14 micrograms per kilogram (µg/kg)) or groundwater (the maximum PCE detention was 27 µg/L). The maximum soil PCE concentration was less than the RI screening criterion, which was based on a "Soil Protective of Groundwater" standard. Thus, the data collected in the RI does not indicate the presence of a source of contamination in the soil that will continue to impact groundwater.

SUMMARY OF SOIL CONTAMINATION

Soil Gas Results

PCE was detected in 8 of the 14 passive soil gas screening samples, at concentrations ranging from 4 to 7,184 nanograms (ng)/sampler. As shown in Figure 6 (Appendix I), the majority of PCE detections in soil gas samples, and the highest concentrations, were clustered along the eastern bank of the upper reaches of the intermittent stream. The highest PCE concentration (7,184 ng/sampler) was detected in SG-03, and it was almost 60 times higher than the next highest concentration.

Soil Results

PCE was detected in only one soil boring, SB-08 (Appendix I, Figure 3), located adjacent to SG-03, which was the soil gas screening sample with the highest PCE level (Appendix I, Figure 6). The surface soil sample (0 to 2 feet bgs) collected from SB-08 contained PCE at 9.1 µg/kg. Saprolitic soils (from 5.5 to 6.5 feet bgs) collected from SB-08 contained PCE at 14 µg/kg. PCE was not detected in the deeper sample from 10.5 to 11.5 feet bgs.

Though not current practice, historically, PCE has been used to clean out residential septic systems. Septic tank soil sampling was conducted at nearby properties to assess whether septic systems were a source of PCE contamination. PCE was not detected in any of the soil samples collected adjacent to septic tanks.

These sampling results indicate that the highest PCE level in soils is located along the eastern bank of the upper reaches of the intermittent stream in both surface soils and the saprolite zone. This distribution suggests that PCE was likely disposed of onto the ground in this area and subsequently migrated downward to the saprolite zone. The relatively low concentrations (maximum of 14 µg/kg) are indicative of residual levels of PCE, suggesting that the original source of PCE has likely migrated downgradient into the saprolite zone and underlying bedrock fractures. This area is considered a former source area. The quantity and concentration levels of the original PCE source cannot be determined from current residual levels. No other potential source areas were identified.

SUMMARY OF GROUNDWATER CONTAMINATION

Groundwater in Saprolite Zone

PCE was detected in three of the seven groundwater screening samples, which were all collected in the saprolite zone. These locations are shallow (less than 18 feet bgs) and are clustered along the northern bank of the unnamed stream, downgradient of the suspected source area and upgradient of the Santana well (Appendix I, Figure 7). GWS-6 and GWS-7, the two sample locations where the results exceed the PCE criterion of 5 µg/L, are the sample locations located closest to the Santana well. Concentrations of PCE in these screening samples were 7.1 and 9.7 µg/L, respectively. PCE concentrations detected in piezometer well PZ-1, screened in the transition zone intersecting the saprolite and shallow bedrock zones, were 10 and 13 µg /L in Rounds 1 and 2, respectively.

Groundwater in Bedrock

PCE is present in the Santana well at concentrations currently below the MCL (5 µg/L) (Appendix I, Figure 8). PCE is also present in shallow bedrock groundwater at MW-3S (58 – 78 feet bgs), located on the eastern bank of the upper reaches of the intermittent stream, in the vicinity of the suspected source area. Further downgradient of this area, PCE exceeded its criterion in shallow saprolite zone groundwater screening locations near the unnamed stream, the saprolite zone/shallow bedrock piezometer well PZ-1 (10 to 13 µg /L), the shallow bedrock wells MW-4S and MW-2S (5.5 to 13 µg /L), and in deep bedrock well MW-4D (20 to 27 µg/L). The shallow bedrock wells range in depth from 61 to 79 feet bgs, and the deep wells range in depth between 140.8 and 162.2 feet bgs. Pumping drawdown and recovery data from the Santana well and long-term water level monitoring data for MW-3 and MW-4 indicate that the shallow and deep bedrock fractures beneath the stream valley are hydraulically connected to the Santana well. This fracture network provided a pathway for PCE migration that is likely enhanced by pumping at the Santana well. Figures 9 and 10 (Appendix I) show the spatial distribution and cross section of PCE detections in monitoring wells, respectively.

Arsenic marginally exceeded its screening criterion of 10 µg/L in MW-2D, at 12 µg/L. It was not detected in any other monitoring well sample and is, therefore, not considered to be Site-related.

SUMMARY OF SURFACE WATER/SEDIMENT CONTAMINATION

PCE was detected in 9 of the 12 porewater samples. PCE exceeded its screening criterion of 5 µg/L in one porewater sample, WP-05 (33 µg/L), located in the unnamed stream approximately 100 feet south of the suspected source area (Appendix I, Figure 11). PCE was not detected in the intermittent stream or the three most upstream samples in the unnamed stream, including the background sample.

PCE was detected below its screening criterion in 8 of the 15 surface water samples at concentrations ranging from 0.59 to 2.6 µg/L. These detections were co-located with the detections in pore water samples, at locations downstream of the suspected source area. The highest levels, 2.2 and 2.6 µg/L, were in the samples closest to the suspected source area. PCE was not detected in the three upstream samples in the unnamed stream, including the background sample nor in any of the samples in the intermittent stream. The PCE concentrations in the 2014 surface water samples are lower than those in surface water samples collected previously by EPA in 2010 and 2011 (Appendix I, Figure 12). The surface water sample results at the Site clearly show a decreasing trend over the years, from 2010 to 2011 and to 2014 (Appendix I, Figure 9). The decreasing surface water PCE concentrations could be attributable to a decrease in concentrations of contaminated groundwater at the Site discharging to the surface water. The decreasing trend of PCE in surface water is similar to the decreasing trend of PCE concentrations in the Santana well itself.

PCE was not detected in any sediment samples collected from the unnamed stream or the intermittent stream. Figure 12 (Appendix I) displays all surface water, pore water, and sediment sampling results.

EVALUATION OF NATURAL ATTENUATION

"Natural attenuation" refers to naturally occurring attenuation processes that may already be present in an aquifer to decrease contaminant concentrations. It can be considered as a remedial component if it can be expected to achieve site-specific remediation goals within a reasonable time frame when compared to other remedial measures. Natural attenuation processes that reduce chlorinated-VOC contaminant concentrations in groundwater include destructive (e.g., biodegradation, abiotic degradation, and chemical reactions with other subsurface constituents) and nondestructive mechanisms (e.g., volatilization, dissolution, dilution/dispersion, and adsorption/desorption).

Biodegradation is frequently a significant destructive attenuation mechanism. Chlorinated solvents, such as PCE and TCE, attenuate predominantly by reductive dechlorination under anaerobic conditions. At the Site, there is insufficient evidence to support the conclusion that biodegradation alone can be effective to address the groundwater contaminants within a reasonable timeframe. There is little evidence that biodegradation of PCE may be occurring. That evidence is limited to the presence of TCE and vinyl chloride in the bedrock, which are both PCE biodegradation byproducts. In the shallower zones and the bedrock, PCE and TCE may not be concentrated enough in the groundwater to sustain a community of dechlorinating bacteria, and conditions for complete and sustainable reductive dechlorination of these compounds does not appear to be present.

While biodegradation alone cannot be relied upon for natural attenuation, nondestructive mechanisms are present, and multiple rounds of groundwater sampling suggest a continuing downward trend in PCE and TCE concentrations. There are six lines of evidence which indicate that natural attenuation may be capable of reducing concentrations within a reasonable timeframe:

- No continuing source of contamination was found that would cause the plume to expand in the future. Thus, the plume is expected to currently be stable or shrinking.
- Dilution and dispersion are active attenuation mechanisms in the plume, enhanced by the continued pumping of the Santana well and the typically high rainfall rates in the area.
- Historical data from surface water and from the Santana well indicate that PCE concentrations in these media have decreased over time. No exceedances of surface water criteria were detected during the RI, and PCE concentrations in the Santana well have decreased from 120 µg /L in December 2010 to below the MCL (5 µg/L) since November 2013. Given these trends and the fact that no continuing source was identified, it is reasonable to expect that concentrations are also decreasing in the rest of the plume.
- A Mann-Kendall statistical analysis of the historical data from the Santana well showed a statistically significant decrease in concentrations over time. Decreasing trends were evident both before the upper zone was sealed off and afterwards.

- The highest remaining groundwater contamination levels (e.g., PCE at 27 μg/L in MW-4D) are less than one order of magnitude higher than their respective MCLs (e.g., the MCL for PCE is 5 μg/L), and are present at only a few of the monitoring wells. Based upon EPA's experience with natural attenuation at other sites, the time needed for a further reduction in concentration to meet MCLs is expected to be a reasonable time frame, estimated at between six and 15 years (as discussed in more detail in the description of Alternative 2).

- There is evidence of degradation of the PCE in MW-4D, provided by the observed reduction in PCE concentrations and an increase in TCE and vinyl chloride concentrations (not detected in the first round of sampling) during the second round of sampling.

CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

According to 2010 census figures, Corozal's population is 37,142, and the population at the Palos Ward is 3,458. Corozal covers an area of approximately 42 square miles. The primary land use in the vicinity of the Site is residential with some agricultural (plantain/banana farming) and light commercial activity. The population currently served by the Santana well is about 200 people.

SUMMARY OF SITE RISKS

As part of the RI/FS, EPA conducted a baseline risk assessment to estimate the current and future effects of contaminants on human health and the environment. A baseline risk assessment is an analysis of the potential adverse human health and ecological effects of releases of hazardous substances from a site in the absence of any actions or controls to mitigate such releases, under current and future land uses. The baseline risk assessment includes a human health risk assessment and an ecological risk assessment. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The remedial alternative that was chosen for the site addresses contamination at the site. The risks and hazards for the site was presented in the baseline risk assessment will be summarized in this section.

HUMAN HEALTH RISK ASSESSMENT

A four-step process is utilized for assessing site-related human health risks for a reasonable maximum exposure scenario: *Hazard Identification* – uses the analytical data collected to identify the contaminants of potential concern at the site for each medium, with consideration of a number of factors explained below; *Exposure Assessment* - estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways (e.g., ingesting contaminated well-water) by which humans are potentially exposed; *Toxicity Assessment* - determines the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of adverse effects (response); and *Risk Characterization* - summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site-related risks. The risk characterization also identifies contamination with concentrations which exceed acceptable levels, defined by the NCP as an excess lifetime cancer risk greater than 1×10^{-6} – 1×10^{-4}, an excess of lifetime cancer risk greater than 1×10^{-6} (i.e., point of departure) combined with site-specific circumstances, or a Hazard Index greater than 1.0; contaminants at these concentrations are considered chemicals of concern (COCs) and are typically those that will require remediation at the site. Also included in this section is a discussion of the uncertainties associated with these risks.

Hazard Identification

In this step, the chemicals of potential concern (COPCs) in each medium were identified based on such factors as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations, mobility, persistence, and bioaccumulation. The risk assessment focused on surface soil, subsurface soil, surface water, sediment and groundwater contaminants related to the Corozal Well site which may pose significant risk to human health. Analytical information that was collected to determine the nature and extent of contamination revealed the presence of volatile organic compounds (VOCs) in the groundwater at concentrations of potential concern.

A comprehensive list of all COPCs can be found in the baseline human health risk assessment (BHHRA), entitled "Revised Final Human Health Risk Assessment – Corozal Well Superfund Site" – June 2015. This document is available in the Administrative Record file. This ROD focuses on the area around the Santana well and the surrounding community of Corozal. The contaminated media, concentrations detected, and concentrations utilized to estimate potential risks and hazards for the COCs at the site are presented in Table 5. Groundwater was the only media that contained COCs.

Exposure Assessment

Consistent with Superfund policy and guidance, the BHHRA is a baseline human health risk assessment and, therefore, assumes no remediation or institutional controls to mitigate or remove hazardous substance releases. Cancer risks and noncancer hazard indices were calculated based on an estimate of the reasonable maximum exposure (RME) expected to occur under current and future conditions at the site. The RME is defined as the highest exposure that is reasonably expected to occur at a site. For those contaminants for which the risk or hazard exceeded the acceptable levels, the central tendency estimate (CTE), or the average exposure, was also evaluated.

The primary land use in the vicinity of the Site is residential with some agricultural and light commercial development. The BHHRA evaluated potential risks to populations associated with both current and potential future land use.

Exposure pathways were identified for each potentially exposed population and each potential exposure scenario for exposure to surface soil, subsurface soil, surface water, sediment, air and groundwater. Exposure pathways assessed in the BHHRA are presented in Table 6 and included current and future exposure to residents and recreators and future exposure to residents and construction workers exposed through incidental ingestion, dermal contact, and inhalation from contaminated media on the site. Typically, exposures are evaluated using a statistical estimate of the exposure point concentration, which is usually an upper-bound estimate of the average concentration for each contaminant, but in some cases may be the maximum detected concentration. A summary of the exposure point concentrations for the COCs in groundwater can be found in Table 5, while a comprehensive list of the exposure point concentrations for all COPCs can be found in the BHHRA.

Toxicity Assessment

Under current EPA guidelines, the likelihood of carcinogenic risks and noncancer hazards due to exposure to site chemicals are considered separately. Consistent with current EPA policy, it was assumed that the toxic effects of the site-related chemicals would be additive. Thus, cancer and noncancer risks associated with exposures to individual COPCs were summed to indicate the potential risks and hazards associated with mixtures of potential carcinogens and noncarcinogens, respectively.

Toxicity data for the human health risk assessment were provided by the Integrated Risk Information System (IRIS) database, the Provisional Peer Reviewed Toxicity Database (PPRTV), or another source that is identified as an appropriate reference for toxicity values consistent with EPA's directive on toxicity values. This information for the COCs is presented in Table 7 (noncancer toxicity data summary) and Table 8 (cancer toxicity data summary). Additional toxicity information for all COPCs is presented in the BHHRA.

Risk Characterization

Noncarcinogenic risks were assessed using a hazard index (HI) approach, based on a comparison of expected contaminant intakes and benchmark comparison levels of intake (reference doses, reference concentrations). Reference doses (RfDs) and reference concentrations (RfCs) are estimates of daily exposure levels for humans (including sensitive individuals) which are thought to be safe over a lifetime of exposure. The estimated intake of chemicals identified in environmental media (*e.g.*, the amount of a chemical ingested from contaminated drinking water) is compared to the RfD or the RfC to derive the hazard quotient (HQ) for the contaminant in the particular medium. The HI is obtained by adding the hazard quotients for all compounds within a particular medium that impacts a particular receptor population.

The HQ for oral and dermal exposures is calculated as below. The HQ for inhalation exposures is calculated using a similar model that incorporates the RfC, rather than the RfD.

HQ = Intake/RfD

Where: HQ = hazard quotient
Intake = estimated intake for a chemical (mg/kg-day)
RfD = reference dose (mg/kg-day)

The intake and the RfD will represent the same exposure period (i.e., chronic, subchronic, or acute).

As previously stated, the HI is calculated by summing the HQs for all chemicals for likely exposure scenarios for a specific population. An HI greater than 1.0 indicates that the potential exists for noncarcinogenic health effects to occur as a result of site-related exposures, with the potential for health effects increasing as the HI increases. When the HI calculated for all chemicals for a specific population exceeds 1.0, separate HI values are then calculated for those chemicals which are known to act on the same target organ. These discrete HI values are then compared to the acceptable limit of 1.0 to evaluate the potential for noncancer health effects on a specific target organ. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. A summary of the noncarcinogenic hazards associated with these chemicals for each exposure pathway is contained in Table 5.

It can be seen in Table 9 that the HI for noncancer effects is elevated for exposure to groundwater, due to concentrations of TCE and PCE future residents.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen, using the cancer slope factor (SF) for oral and dermal exposures and the inhalation unit risk (IUR) for inhalation exposures. Excess lifetime cancer risk for oral and dermal exposures is calculated from the following equation, while the equation for inhalation exposures uses the IUR, rather than the SF:

Risk = LADD x SF

Where: Risk = a unitless probability (1 x 10^{-6}) of an individual developing cancer
LADD = lifetime average daily dose averaged over 70 years (mg/kg-day)
SF = cancer slope factor, expressed as [1/(mg/kg-day)]

These risks are probabilities that are usually expressed in scientific notation (such as 1 x 10^{-4}). An excess lifetime cancer risk of 1 x 10^{-4} indicates that one additional incidence of cancer may occur in a population of 10,000 people who are exposed under the conditions identified in the assessment. Again, as stated in the National Contingency Plan, the point of departure is 10^{-6} and the acceptable risk range for site-related exposure is 10^{-6} to 10^{-4}.

A summary of the estimated cancer risks are presented in Table 10. The results indicated that although the cancer risks were within the acceptable risk range, the groundwater concentrations exceeded the maximum contaminant levels (MCLs) for both TCE and PCE.

Uncertainties

The procedures and inputs used to assess risks in this evaluation, as in all such assessments, are subject to a wide variety of uncertainties. In general, the main sources of uncertainty include:

- environmental data
- exposure parameter estimation
- exposure point concentrations
- toxicity values
- risk characterization

Two of the primary sources of uncertainty identified in the HHRA were associated with exposure parameters and toxicological data. Uncertainty in exposure parameters was related to many of the parameters being associated with default values since site-specific values were not available. This would provide a conservative estimate of potential risk and hazards.

Another important source of uncertainty was toxicological data. The toxicity factors used in the quantitative evaluation of potential risks and hazards were primarily selected from the Integrated Risk Information System (IRIS). For many chemicals, there is a lack of appropriate information on effects in humans (i.e., epidemiologic studies). Therefore, animal studies are generally used to develop toxicity values in human health risk assessments, which may under- or over-estimate potential risks and hazards.

More specific information concerning uncertainty in the health risks is presented in the baseline human health risk assessment report.

ECOLOGICAL RISK ASSESSMENT

A screening-level ecological risk assessment was conducted to evaluate the potential for ecological risks from the presence contaminants in soil, sediment, surface water and porewater. The SLERA focused on evaluating the potential for impacts to sensitive ecological receptors to site-related constituents of concern through exposure to soil, sediment, surface water and porewater on the Corozal site. Concentrations in the media listed above were compared to ecological screening values as an indicator of the potential for adverse effects to ecological receptors. A complete summary of all exposure scenarios can be found in the SLERA.

There is not a potential for adverse effects to ecological receptors (invertebrates, reptiles, amphibians, birds, and mammals) from exposure to contaminated soil, sediment, surface water or porewater. The screening criteria for all chemicals in all media were below the acceptable hazard index of 1. There were no COCs identified for ecological receptors.

Based on the results of the ecological risk assessment, a remedial action is not necessary to protect the ecological receptors from actual or threatened releases of hazardous substances.

RISK ASSESSMENT SUMMARY

In summary, volatile organic compounds, specifically TCE and PCE in groundwater on the site contributed to unacceptable risks and hazards to future residents as summarized in Table 1, below. Based on the results of the human health assessments, the response action selected in the Record of Decision is necessary to protect the public health or welfare of the environment from actual or threatened releases of contaminants into the environment.

Table 1. Summary of hazards and risks associated with groundwater at the Site

Receptor	Hazard Index	Cancer Risk
Residential adult – future	**-----**	**$2.0x10^{-5}$**
Residential child – future	**4**	

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards, such as applicable or relevant and appropriate requirements (ARARs), to-be-considered (TBC) guidance, and Site-specific, risk-based levels.

EPA has a preference that it will use treatment to address any principal threats posed by a site. Principal threat wastes are those source materials considered to be highly toxic or mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. Contaminated groundwater generally is not considered to be a source material. However, non-aqueous phase liquids (NAPLs) in groundwater may be viewed as source material. No principal threat waste has been identified at the Site.

The Site was placed on the National Priorities List because of the detection of PCE contamination in the groundwater that supplies a community drinking water well (the Santana well). An RI was performed, and PCE contamination was found in soil, groundwater, and surface water (including the pore water). Therefore, PCE, and its degradation products, including TCE, are considered Site-related contaminants.

Based on the sampling results at the Site, the media of concern is groundwater. When the problem was first discovered in 2010, PCE was detected in the shallow zone of the Santana well (between 50 and 100 feet bgs) at concentrations of up to 120 μg/L. As a result of an EPA removal action conducted at the Site in March 2011, the shallow zone of the Santana well was sealed off from the aquifer. Since that time, the PCE concentrations from the Santana well have been decreasing. Since November 2013, PCE concentrations have been below the MCL of 5 μg/L.

PCE was detected in multiple groundwater samples during the remedial investigation, including samples from the shallow and deep bedrock units, with the highest residual concentration of 27 μg /L found in the deep bedrock.

While surface water sampling did identify low levels of PCE, the surface water and sediments are not considered media of concern for the Site.

To protect human health and the environment, RAOs have been identified.

The RAOs for groundwater are:

- Prevent human exposure to PCE and TCE concentrations in groundwater above levels that are protective of drinking water.
- Restore the groundwater to drinking water quality.

REMEDIATION GOALS

To meet the RAOs, remediation goals were developed to aid in defining the extent of contaminated groundwater requiring remedial action. Remediation goals are chemical-specific measures for each media and/or exposure route that are expected to be protective of human health and the environment. They are derived based on comparison to ARARs, risk-based levels, and background concentrations, with consideration also given to other requirements such as analytical detection limits, guidance values, and other pertinent information. Federal MCLs (5 μg/L for PCE and 5 μg/L for TCE) are the remediation goals for the Site.

DESCRIPTION OF THE ALTERNATIVES

Section 121(b)(1) of CERCLA, 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, be cost-effective, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) of CERCLA also establishes a preference for remedial actions that employ, as a principal element, treatment to permanently and significantly reduce the volume, toxicity, mobility of the hazardous substances, pollutants, and contaminants at a site. Section 121(b)(1) of CERCLA, 42 U.S.C. § 9621(d), further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants that at least attains ARARs under federal and state laws, unless a waiver of the ARAR can be justified pursuant to Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4).

The time frames presented below for each alternative reflect only the time required to construct or implement the remedy and do not include the time required to design the remedy or procure contracts for design and construction.

The cost estimates, which are based on available information, are order-of-magnitude engineering cost estimates that are expected to be within +50 to -30 percent of the actual cost of the project.

COMMON ELEMENTS

There are several common elements (CEs) that are included in remedial alternatives 2, 3, and 4. The common elements listed below do not apply to the No Action alternative.

Pre-Design Investigation (PDI)

The nature and extent of groundwater contamination in both the saprolite zone and shallow bedrock would be fully delineated in a PDI. Design parameters would also be obtained during the PDI.

Santana Well GAC Unit Maintenance

The existing GAC unit at the Santana well would be maintained to ensure the prevention of human exposure to contaminant concentrations in groundwater above the remediation goals. The influent and effluent would typically be sampled once per month to protect human health by ensuring that the concentrations prior to distribution to the system are below MCLs. The sampling results can also assist in monitoring the groundwater concentrations, generally.

Monitored Natural Attenuation (MNA) of the Deep Bedrock

MNA for both the bedrock and shallow groundwater is considered in Alternative 2 (see description below). MNA for the deep bedrock is also a remedial component of the other active remedial Alternatives 3 and 4. In evaluating active remedies for the deep bedrock, several factors were considered in the FS, including the effect that bedrock actions may have on the functionality of the Santana well. For example, groundwater extraction in the bedrock can provide hydraulic control and contaminant removal at sites where hydrogeologic conditions support it and where pumping rates to maintain hydraulic control are sustainable. At this Site, the contaminated regions of the deep bedrock may be hydraulically connected to the Santana well. However, the deep bedrock is also not highly transmissive, and the volcanic bedrock fracture system is highly complex, such that an extraction well network is likely to draw cleaner water away from the Santana well rather than withdrawing, or even hydraulically controlling the migration, of contaminants in the deep bedrock.

Furthermore, there are few other technologies that are likely to be effective in a poorly transmissive bedrock aquifer system such as this one. The most promising technologies, such as *in-situ* treatment techniques (discussed in detail in the FS report) may be able to treat the PCE and TCE. But they also have the potential to introduce treatment chemicals that could preferentially enter the Santana well rather than reach the deep bedrock fractures where the PCE and TCE are present. On balance, EPA has concluded that the limited effectiveness of the available treatment technologies, when compared to the decreasing trends already seen across the plume, including in the deep bedrock, support a MNA approach to the deep bedrock combined with the continued operation of the existing GAC unit at the Santana well.

Institutional Controls

Institutional controls are non-engineered controls such as administrative and/or legal measures that minimize the potential for human exposure to contamination by limiting land or resource use. In this case, institutional controls would be used to restrict the future construction of groundwater extraction wells in the area until cleanup is complete.

Other than the Santana well, there no current groundwater withdrawals that would interfere or capture Site groundwater contamination. Commonwealth laws and requirements restrict well drilling and the withdrawal of groundwater within the Commonwealth by requiring new users to obtain well-drilling and use permits from the Puerto Rico Department of Natural and Environmental Resources (PRDNER). EPA would work with PRDNER to identify the area of contaminated groundwater associated with the Site as an area where no permits are to be issued. EPA would periodically update PRDNER about the scope of the contaminant plume. Furthermore, EPA would educate local municipal officials with authority over issuing building permits and making zoning/land use decisions about the presence of contaminated groundwater so that new construction applications would not unintentionally include a new potable well that could capture Site groundwater.

Five-Year Reviews

Although not part of the remedy itself, if a remedy results in contaminants remaining above levels that allow for unrestricted use and unlimited exposure, CERCLA mandates that the Site be reviewed at least once every five years. If justified by the review, additional remedial actions may be considered to remove, treat, or contain the contamination.

EPA Region 2 Clean and Green Policy

The environmental benefits of the preferred remedy may be enhanced by giving consideration, during the design, to technologies and practices that are sustainable in accordance with EPA Region 2's Clean and Green Energy Policy. This will include consideration of green remediation technologies and practices. Some examples of practices that would be applicable are those that reduce emissions of air pollutants, minimize fresh water consumption, incorporate native vegetation into re-vegetation plans, and consider beneficial reuse and/or recycling of materials, among others.

REMEDIAL ALTERNATIVES

The following alternatives were considered for the Site:

Alternative 1 – No Action

Alternative 1 is required by the NCP to provide an environmental baseline against which impacts of various other remedial alternatives can be compared. Under this alternative, no remedial activities would be initiated at the Site to address contaminated groundwater above remediation goals or otherwise mitigate the associated risks to human health from exposure to groundwater contamination.

Alternative 2 – Monitored Natural Attenuation (MNA) and Institutional Controls

This alternative would rely on all of the CEs discussed above, including but not limited to MNA to reduce contaminant concentrations remaining in the aquifer to the remediation goals, and rely on institutional controls to assure that areas of the plume where the remediation goals are exceeded are not used for drinking water purposes. Monitoring of the Santana well and maintenance of the existing GAC treatment system would continue while remediation goals are still exceeded in the aquifer upgradient of the well, so as to assure a safe drinking water supply for its users.

A long-term monitoring program for the Site would be instituted. MNA requires a robust monitoring program to demonstrate that the conditions supporting natural attenuation continue to be present and that decreasing plume trends perpetuate. Monitoring should continue until concentrations have achieved the remediation goals.

For costing purposes, it is assumed that the ten existing monitoring wells in the bedrock and five new monitoring wells installed in the saprolite zone would be used for the monitoring program. Santana well sampling activities would continue, along with the Santana GAC unit maintenance. The sample results from the Santana well monitoring would be included in the long-term monitoring program. The monitoring data collected would be evaluated and used to assess the migration and attenuation of the groundwater contamination.

To estimate the timeframe for MNA, an empirical rate of decrease of PCE concentrations in the Santana well (using what is called the "the Theil-Sen regression analysis"), using PCE data collected after the well was modified and reopened by EPA, was calculated using EPA's Groundwater Statistical Tool software and ProUCL software. This rate is considered representative of the expected attenuation in PCE concentrations in the deep bedrock at the Site, as the natural attenuation in deep bedrock is the controlling factor for the time required to reach MCLs at the Site (Appendix I, Figure 13).

The Mann-Kendall statistics indicate that there is a statistically significant decreasing trend in concentrations. Applying a calculated rate of decrease to the highest currently observed concentration in a monitoring well (27 µg/L in MW-4D) predicts that the remediation goals would be met in nine years. Given a wide range of uncertainties in this analysis, nine years was statistically translated to a range of between six and 15 years before PCE concentrations in MW-4D would reach MCLs. For cost-estimating purposes, the duration of the remedial action is estimated to be 15 years. It is assumed that samples would be collected twice per year for the first two years of the monitoring program and then annually for 13 years thereafter.

Alternative 2 would also rely on institutional controls including existing Commonwealth laws and requirements that restrict well drilling and the withdrawal of groundwater within the Commonwealth. Entities seeking to install a potable well are required to obtain well-drilling and use permits from PRDNER. EPA would work with PRDNER to identify the area of contaminated groundwater associated with the Site as an area where no permits are to be issued. EPA would periodically update PRDNER about the scope of the contaminant plume, as it is expected to diminish in size over time. Furthermore, EPA would educate local municipal officials with authority over issuing building permits and making zoning/land use decisions about the presence of contaminated groundwater, so that new construction applications would not unintentionally include a new potable well that could capture Site groundwater. EPA's local communication/education efforts would need to be renewed periodically while contaminated groundwater is still present, to remind public officials of the need to prevent new well installation. Other informational devices may also be appropriate, such as advisories published in newspapers, periodic letters sent to local government authorities informing them of the need to prevent well installation, and inspection of local and/or Commonwealth health department records to insure that no wells are installed that could impact the groundwater plume or result in exposure to contaminated groundwater.

Alternative 3 – Groundwater Extraction, Treatment, and Long-term Monitoring; and Institutional Controls

Under this alternative, all of the CEs discussed above will be implemented. In addition, the groundwater plume contaminated with PCE at levels above the remediation goals in the saprolite zone and shallow bedrock zone would be targeted for extraction, treatment, and surface water discharge to the unnamed stream. A groundwater extraction well would serve to extract contamination from the aquifer and also create a hydraulic barrier to limit contaminant migration into the bedrock, downgradient, and the surface water. Extraction and treatment would continue until the aquifer is restored. As discussed in the common elements section, MNA would be relied upon to achieve the remediation goals in the deep bedrock.

Long-term groundwater monitoring of contaminants in the saprolite zone and the competent bedrock would be performed to assess remedial action performance.

For cost-estimating purposes, a range of 10 to15 gallons per minute (gpm) of pumping from a single extraction well was estimated as necessary to efficiently achieve and maintain hydraulic control during operation. The extraction well would be screened from 10 to 30 feet bgs, in the saprolite zone layer and shallow bedrock.

The extracted groundwater would be treated *ex situ* in a groundwater treatment system, which would include GAC units in series to reduce groundwater PCE and TCE concentrations to Puerto Rico standards acceptable for surface water discharge.

For costing purposes, it was assumed that the treated groundwater would be discharged to the unnamed stream. System maintenance would include maintenance of the well, pump, and treatment process equipment. Periodic samples would be collected from various sample locations along the groundwater treatment train to verify the effectiveness of each treatment process. The lead GAC unit would be changed out when breakthrough occurs. Because of the low contaminant concentrations, GAC change-out is anticipated to be infrequent.

The operation duration of the groundwater extraction and treatment system and the time to reach remediation goals in the saprolite zone/upper fractured bedrock is estimated to be up to four years. The overall time frame for reaching the RAOs is governed by the deep bedrock, as discussed in Alternative 2.

Long-term monitoring is an essential component of an extraction system to ensure that the extraction well is effectively removing contaminants from the aquifer and hydraulically controlling the groundwater plume such that it does not migrate downgradient. A long-term monitoring program for the Site groundwater plume, surface water, and pore water would be instituted. The monitoring program as described in the Common Elements section and in Alterative 2 should continue until concentrations have attenuated to the remediation goals. The monitoring data collected would be evaluated and used to assess the migration and attenuation of the groundwater contamination and the effectiveness of the extraction system.

Institutional controls would be implemented similar to Alternative 2.

Alternative 4 – Air Sparge Curtain, Long-term Monitoring, and Institutional Controls

Under this alternative, all of the CEs discussed above will be implemented. In addition, the RAOs would be met by using an air sparge curtain to remove contamination from the saturated saprolite zone and shallow bedrock, and through natural processes (i.e., MNA) in the bedrock. The air sparge process would be used to strip PCE from the groundwater as groundwater plume passes through the sparge zone.

For cost-estimating purposes, it is assumed that the curtain would be installed upgradient of the Santana Well to prevent further migration downgradient, and that sparge points would have a 10-foot radius of influence. The density and layout of the sparge locations would be determined after the PDI.

The need for a vapor-phase treatment system should be evaluated during remedial design, but based upon FS assumptions, the mass collected by an air sparge system would be very low and potentially below detection limits in the system effluent and below air quality discharge standards. Thus, the FS assumed that collected vapors would be released directly to the atmosphere.

Long-term monitoring would be required, similar to Alternatives 2 and 3. For cost-estimating purposes, it is conservatively assumed that the air sparging system would be operated for 15 years.

The overall time frame for reaching the RAOs is governed by the deep bedrock, as discussed in Alternative 2. Institutional controls would be implemented similar to Alternative 2.

EVALUATION OF REMEDIAL ALTERNATIVES

In selecting a remedy for a site, the EPA considers the factors set forth in CERCLA Section 121, 42 U.S.C. § 9621, by conducting a detailed analysis of the remedial alternatives FS pursuant to the requirements of the NCP at 40 C.F.R. § 300.430(e)(9), the EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies*, OSWER Directive 9355.3-01, and the EPA's *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, OSWER 9200.1-23.P. The detailed analysis consists of an assessment of the individual alternatives against each of the nine evaluation criteria set forth at 40 C.F.R. § 300.430(e)(9)(iii) and a comparative analysis focusing upon the relative performance of each alternative against those criteria.

The following **“threshold”** criteria are the most important and must be satisfied by any remedial alternative in order to be eligible for selection:

1. **Overall protection of human health and the environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
2. **Compliance with ARARs** addresses whether a remedy would meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes and regulations or provide grounds for invoking a waiver. Other federal or state advisories, criteria, or guidance are “To Be Considered” (TBC). While TBCs are not required to be adhered to by the NCP, the NCP recognizes that they may be very useful in determining what is protective of a site or how to carry out certain actions or requirements.

The following **“primary balancing”** criteria are used to make comparisons and to identify the major tradeoffs between alternatives:

3. **Long-term effectiveness and permanence** refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once remediation goals have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

4. **Reduction of toxicity, mobility, or volume through treatment** is the anticipated performance of the treatment technologies, with respect to these parameters, that a remedy may employ.

5. **Short-term effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation of the remedy.

6. **Implementability** is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. **Cost** includes estimated capital, O&M, and present-worth costs.

The following **“modifying”** criteria are used in the final evaluation of the remedial alternatives after the formal comment period, and they may prompt modification of the preferred remedy that was presented in the Proposed Plan:

8. **State acceptance** indicates whether, based on its review of the RI/FS report, HHRA, and Proposed Plan, the State concurs with, opposes, or has no comments on the proposed remedy.

9. **Community acceptance** refers to the public's general response to the alternatives described in the RI/FS report, HHRA, and Proposed Plan.

Overall protection of human health and the environment

Alternative 1 (no action) is not protective of human health and the environment. Alternatives 2, 3, and 4 are expected to be protective through a combination of active treatment of the shallow groundwater zones (for Alternatives 3 and 4), MNA, institutional controls, and the continued monitoring and maintenance of the Santana well and the treatment of the water supply via the GAC system.

Compliance with Applicable or Relevant and Appropriate Requirements

Groundwater at the Site is classified as SG (which includes all groundwater as defined in Puerto Rico Water Quality Standards (PRWQS) Regulation, which indicates it is suitable for drinking water use, and is historically and currently used as a source of potable water supply. In order to accommodate any future use of Site groundwater as a source of potable water, federal drinking water standards are ARARs. Alternative 1 is not anticipated to provide for a suitable drinking water source in compliance with ARARs the period during which MCLs are exceeded in the aquifer because the Santana well monitoring and treatment systems would not be maintained. Alternatives 2, 3, and 4 are expected to achieve drinking water ARARs over the life of the remediation (conservatively estimated to be the next 15 years) and through active and passive means, address exceedances still present in the aquifer.

The PRWQS Regulation for surface water discharges, which are ARARs, will be considered for groundwater if remedial alternatives under consideration entail any discharges to waters of Puerto Rico. Alternative 3 would be expected to satisfy these regulations for water discharged from the groundwater treatment plant. Similarly, the air sparging vapor phase would be expected to satisfy air emissions requirements, to the extent required, as discussed in the description of Alternative 4.

Long-Term Effectiveness and Permanence

Alternative 1 would not be considered a permanent effective remedy because no action would be implemented to reduce the level of contamination or verify any naturally occurring reduction of contaminant concentrations. Alternative 2 provides a method to monitor and evaluate the attenuation of contaminant concentrations over time because of natural processes as well as provide GAC treatment at the Santana well, ensuring safe water. Alternatives 3 and 4 permanently and irreversibly reduce groundwater concentrations in the subsurface, at least for the shallow groundwater.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 would not monitor and evaluate the reduction of contaminant toxicity, mobility, volume through natural processes, because no remedial action would be conducted. Alternative 2 would not actively reduce toxicity and volume through treatment. Alternative 3 and 4 would reduce toxicity, mobility, and/or volume through treatment in the saprolite zone/upper fractured bedrock.

SHORT-TERM EFFECTIVENESS

With respect to the no action alternative, there would be no short-term impact to the community and environment, as no remedial action would occur. There would be some minor short-term impacts to the local community and workers in ascending order of impacts for alternatives 2, 3, and 4 because of the active remedial actions undertaken and associated construction and operation. Alternatives 2 through 4 are estimated to achieve the RAOs within approximately 15 years. While Alternative 3 offers the potential to remediate shallow groundwater in a shorter time frame, the bedrock is the determining factor for achievement of RAOs for all the active alternatives, including Alternative 3.

IMPLEMENTABILITY

No problems are anticipated for the implementation of Alternatives 1, 2 and 4, including the implementation of long-term monitoring. With regard to institutional controls, due to limited resources within the Commonwealth, PRDNER's well-permitting system may not be sufficiently robust to assure that no new drinking water wells are installed; thus, PRDNER's regulatory institutional control may need to be bolstered by periodic (e.g., annual) communication/education by EPA at the local municipal level, to remind officials of the need to prevent new uses of contaminated water.

Alternative 3 may encounter implementability problems with the Santana well, which draws water from the bedrock. Under Alternative 3, we would extract groundwater from the saprolite zone/upper fractured bedrock, which recharges the deep bedrock aquifer. Implementation of the extraction system might be problematic as it would be competing with the Santana well water supply source.

COST

The cost estimates for all four alternatives are provided below.

Groundwater Alternative	Capital Costs	Present Worth O&M Costs	Total Present Worth
1	$0	$0	$0
2	$ 43,000	$ 1,439,000	$ 1,482,000
3	$ 883,000	$ 2,097,000	$ 2,980,000
4	$ 911,000	$ 2,369,000	$ 3,280,000

COMMONWEALTH/SUPPORT AGENCY ACCEPTANCE

The Puerto Rico Environmental Quality Board concurs with the selected remedy.

COMMUNITY ACCEPTANCE

All the alternatives were made available for the community to review and comment. The preferred alternative was presented to the community in the Proposed Plan. A public comment period (August 12, 2015, to September 11, 2015) was established to allow the community to review and comment on all the alternatives and the proposed alternative. In addition, a public meeting was held on August 20, 2015. No substantive comments were received from the public during this public meeting. EPA's response to all public comments received during the comment period is presented in the Responsiveness Summary of this ROD.

PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a Site whenever practicable (40 CFR Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for the migration of contamination to groundwater, surface water, or air, or act as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present significant risk to environment human health or the environment should exposure occur.

No principal threat waste has been identified at the Site.

SELECTED REMEDY

EPA's selected remedy is Alternative 2, monitored natural attenuation and institutional controls, combined with continued monitoring of the Santana well and maintenance the existing GAC system on the Santana well. The selected remedy will continue to monitor the Santana well while remediation goals are still exceeded in groundwater. The selected remedy includes the following major components:

- **Monitored Natural Attenuation (MNA).** Decreasing VOC contamination trends in the aquifer, documented since 2010, are expected to continue, such that drinking water standards will be met throughout the aquifer within a reasonable time frame, conservatively estimated at 15 years. MNA requires a robust monitoring program to demonstrate that the conditions supporting natural attenuation continue to be present, and that decreasing plume trends perpetuate. Monitoring will continue until concentrations have achieved the remediation goals.
- **Monitoring of the Santana well.** The Santana well will be monitored and the existing GAC system will continue to be maintained to assure that this municipal water supply is protected.
- **Institutional Controls.** Institutional controls will assure that areas of the plume above the remediation goals are not used for drinking water purposes.

DETAILED DESCRIPTION OF THE SELECTED REMEDY

Alternative 2 includes the common elements (PDI, continued operation of the Santana well GAC treatment system, and institutional controls) and a long-term monitoring program.

A long-term monitoring program for the Site groundwater plume, surface water, and pore water will be instituted. The monitoring program will continue until concentrations have achieved the remediation goals. There is a lack of shallow monitoring wells in the saprolite zone, in particular in the area near the Santana well. PZ-1 is the only shallow monitoring well in the saprolite zone/upper fractured bedrock interface, and it is 200 feet upgradient of the Santana well. It is not known whether elevated PCE concentrations persist in the saprolite zone/upper fractured bedrock surrounding the Santana well or whether the PCE has migrated further downgradient. For cost-estimating purposes, it is assumed that five new monitoring wells will be installed in the saprolite zone/upper fractured bedrock zone during the PDI to define the extent of contamination. These five wells along with the ten existing wells would be monitored during the long-term monitoring program. Santana well sampling activities would continue along with implementation of the Santana well GAC treatment unit; sample results will be included in the long-term monitoring program. The monitoring data collected will be evaluated and used to assess the migration and attenuation of the groundwater contamination. Site pore water and surface water will be sampled periodically in the long-term monitoring program to track potential impacts to surface water quality.

The duration for achieving the remediation goals across the Site is likely to be dictated by the rate of attenuation in the deep bedrock, where the highest PCE concentrations were observed. The statistical analysis estimates that the remediation goals are expected to be met across the Site in a time frame of between 6 and 15 years. For cost-estimating purposes, the time required until the RAOs are met is estimated to be 15 years. It is assumed that samples will be collected twice per year for the first two years of the monitoring program and then annually for 13 years thereafter. During the design, the calculations will be reevaluated.

Institutional Controls: EPA will rely on existing Commonwealth laws and requirements that restrict well drilling and the withdrawal of groundwater within the Commonwealth. Entities seeking to install a potable well are required to obtain well-drilling and use permits from PRDNER. EPA will work with PRDNER to identify the area of contaminated groundwater associated with the Site as an area where no permits are to be issued. EPA will periodically update PRDNER about the scope of the contaminant plume, as it is expected to diminish in size over time. Furthermore, EPA will educate local municipal officials with authority over issuing building permits and making zoning/land use decisions about the presence of contaminated groundwater, so that new construction applications would not unintentionally include a new potable well that could capture Site groundwater. EPA's local communication/education efforts will need to be renewed periodically while contaminated groundwater is still present, to remind public officials of the need to prevent new well installation. At the Corozal site, this effort will be aided by the relatively steep terrain in the area of contaminated groundwater, conditions that are not conducive to development. EPA may also consider other informational devices, such as advisories published in newspapers, periodic letters sent to local government authorities informing them of the need to prevent well installation, and inspection of local and/or Commonwealth health department records to insure that no wells are installed that could impact the groundwater plume or result in exposure to contaminated groundwater.

Green Remediation: The environmental benefits of the selected remedy may be enhanced by employing design technologies and practices that are sustainable in accordance with the EPA Region 2's Clean and Green Energy Policy.[a]

RATIONALE FOR SELECTED REMEDY

The selected remedy satisfies the two threshold criteria and achieves the best combination of

[a] http://epa.gov/region2/superfund/green_remediation.

the nine criteria after a comparative analysis that focuses on the relative performance of the alternative against those criteria. This remedy was selected because it will achieve the RAOs and remediation goals in a comparable period as compared against the other active alternatives without threatening the long-term functionality of the Santana well, a sole-source of potable water for the community.

SUMMARY OF THE ESTIMATED SELECTED REMEDY COSTS

The estimated capital, O&M, and present worth costs of the components of the selected remedy are discussed in detail in the FS Report. The cost estimates, which are based on available information, are order-of-magnitude engineering cost estimates that are expected to be within +50 to -30 percent of the actual cost of the project.

The estimated capital, operation and maintenance (O&M), and present-worth cost for each component of the selected remedy and the total cost is $1,482,000. A cost estimate summary for the selected remedy is presented in Table 2 in Appendix VIII.

ESTIMATED OUTCOMES OF SELECTED REMEDY

The principal outcomes of the selected remedy are: 1) to prevent human exposure to contaminant concentration in groundwater above levels that are protective of drinking water, and 2) to remediate contaminated groundwater and restore it as a potential source of drinking water in a reasonable time period by reducing contaminant levels to the federal MCLs and Commonwealth standards.

STATUTORY DETERMINATIONS

Section 121(b)(1) of CERCLA mandates that a remedial action must be protective to human health and the environment, cost-effective, and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. Section 121(b)(1) of CERCLA also establishes a preference for remedial actions which employ treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants, or contaminants at a site. Section 121(d) of CERCLA further specifies that a remedial action must attain a degree of cleanup that satisfies ARARs under federal and state laws, unless a waiver can be justified pursuant to Section 121(d)(4) of CERCLA. For the reasons discussed below, EPA has determined that the selected remedy meets the requirements of Section 121 of CERCLA.

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will protect human health and the environment because it will assure that groundwater at the Site achieves drinking-water standards over the long term, and will address the potential for exposure to contaminated water in the short term through monitoring and maintenance of the Santana well. Institutional controls will also assist in protecting human health and the environment over both the short term by helping to control and limit exposure to hazardous substances.

COMPLIANCE WITH ARARS

There are federal drinking water standards and chemical-specific ARARs for groundwater. The selected remedy for groundwater will comply with chemical-specific, location-specific, and action-specific ARARs. Tables 3, and 4 of Appendix VIII summarized the location specific, action-specific and chemical ARARs.

COST EFFECTIVENESS

According to the NCP, a cost-effective remedy is one which has costs that are proportional to its overall effectiveness (40 CFR Section 300.430(f)(1)(ii)(D)). Overall, effectiveness is based on the evaluations of long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. EPA evaluated the "overall effectiveness" of the three alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume though treatment; and short-term effectiveness). Overall effectiveness was then compared to those alternatives' costs to determine cost-effectiveness.

Each of the alternatives underwent a detailed cost analysis. In that analysis, capital and O&M costs were estimated and used to develop present-worth costs. In the present-worth cost analysis, O&M costs were calculated for the estimated life of each alternative. The total estimated present-worth cost for implementing the selected remedy is $1,482,000.

UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT (OR RESOURCE RECOVERY) TECHNOLOGIES TO MAXIMUM EXTENT PRACTICABLE

The selected remedy provides the best balance of tradeoffs among the alternatives with respect to the balancing criteria set forth in the 40 CFR Section 300.430(f)(1)(i)(B), because it represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site.

PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy would not meet the statutory preference for the use of treatment as a principal element.

FIVE YEAR REVIEW REQUIREMENTS

Because the remedy will ultimately result in no hazardous substances, pollutants, or contaminants remaining above levels that allow for unlimited use and unrestricted exposure in groundwater, EPA anticipates that five-year reviews will not be required perpetually for the remedy. However, because it is estimated that it will take more than five years to attain remediation goals for the groundwater at the Site, five-year reviews will be conducted until the remediation goals are achieved. Pursuant to Section 121(c) of CERCLA, reviews will be conducted no less often than once every five years after the completion of construction (in this case, the installation of additional monitoring wells as part of the Site monitoring program) to ensure that the remedy is, or will be, protective of human health and environment.

DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

The Proposed Plan for the Site was released for public comment on August 12, 2015, and the public comment period ran from that date through September 11, 2015. The Proposed Plan identified the selected remedy as the Preferred Alternative for the Site.

All written and verbal comments submitted during the public comment period were reviewed by EPA. Upon review of these comments, EPA has determined that no significant changes to the remedy, as it was originally proposed in the Proposed Plan, are necessary.

Appendix I

Figures

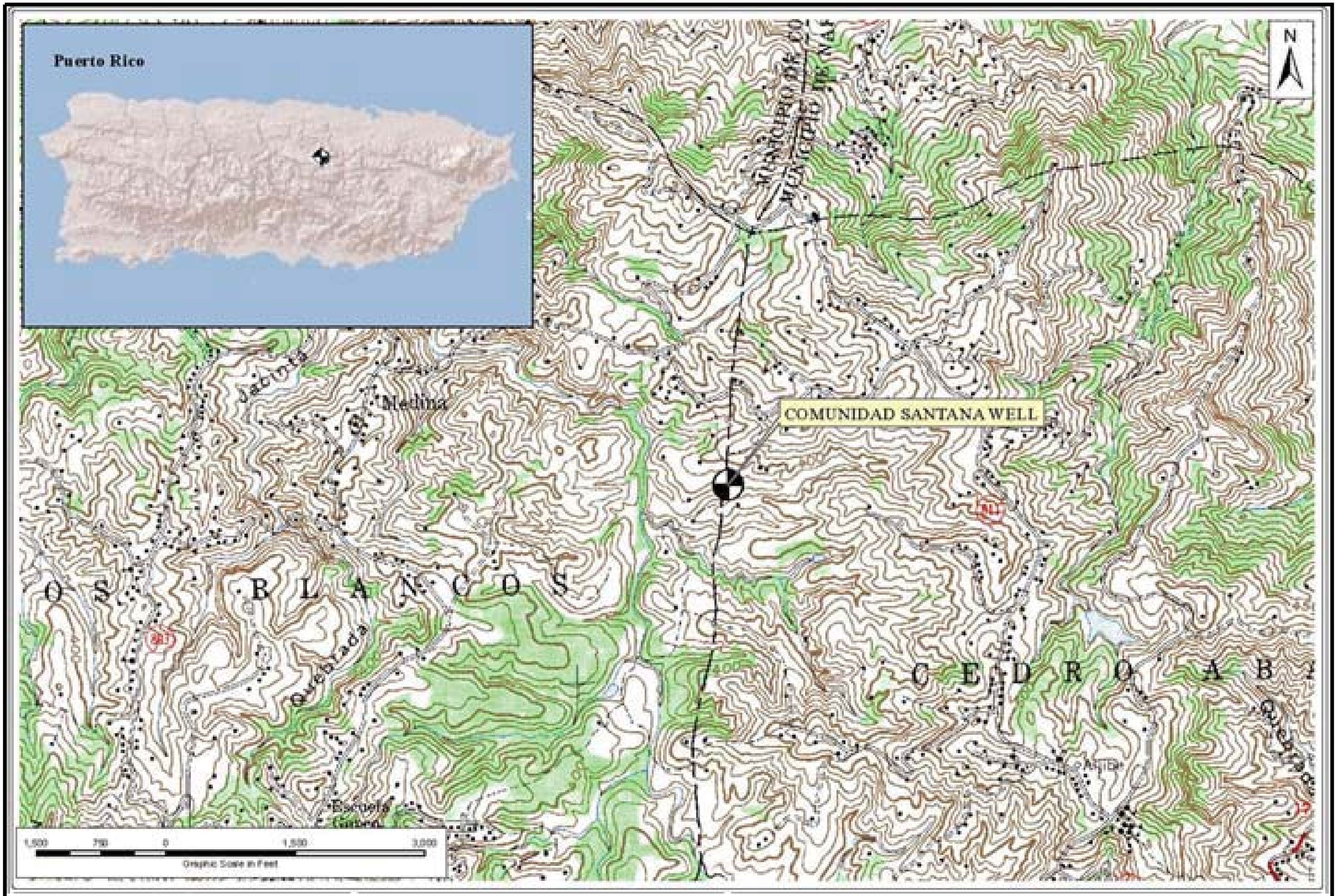


Figure 1
Site Location Map
Corozal Well Site
Corozal, Puerto Rico

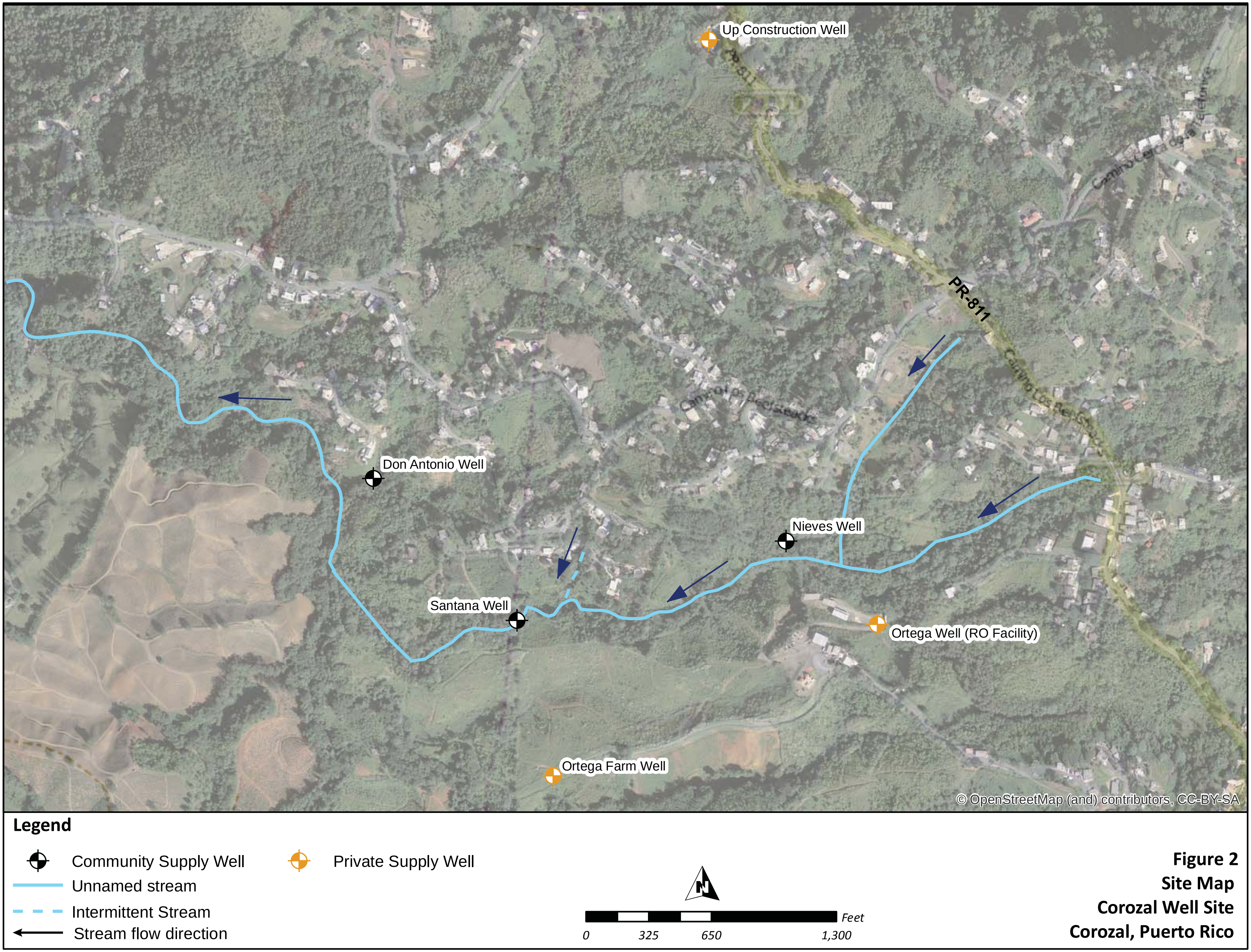
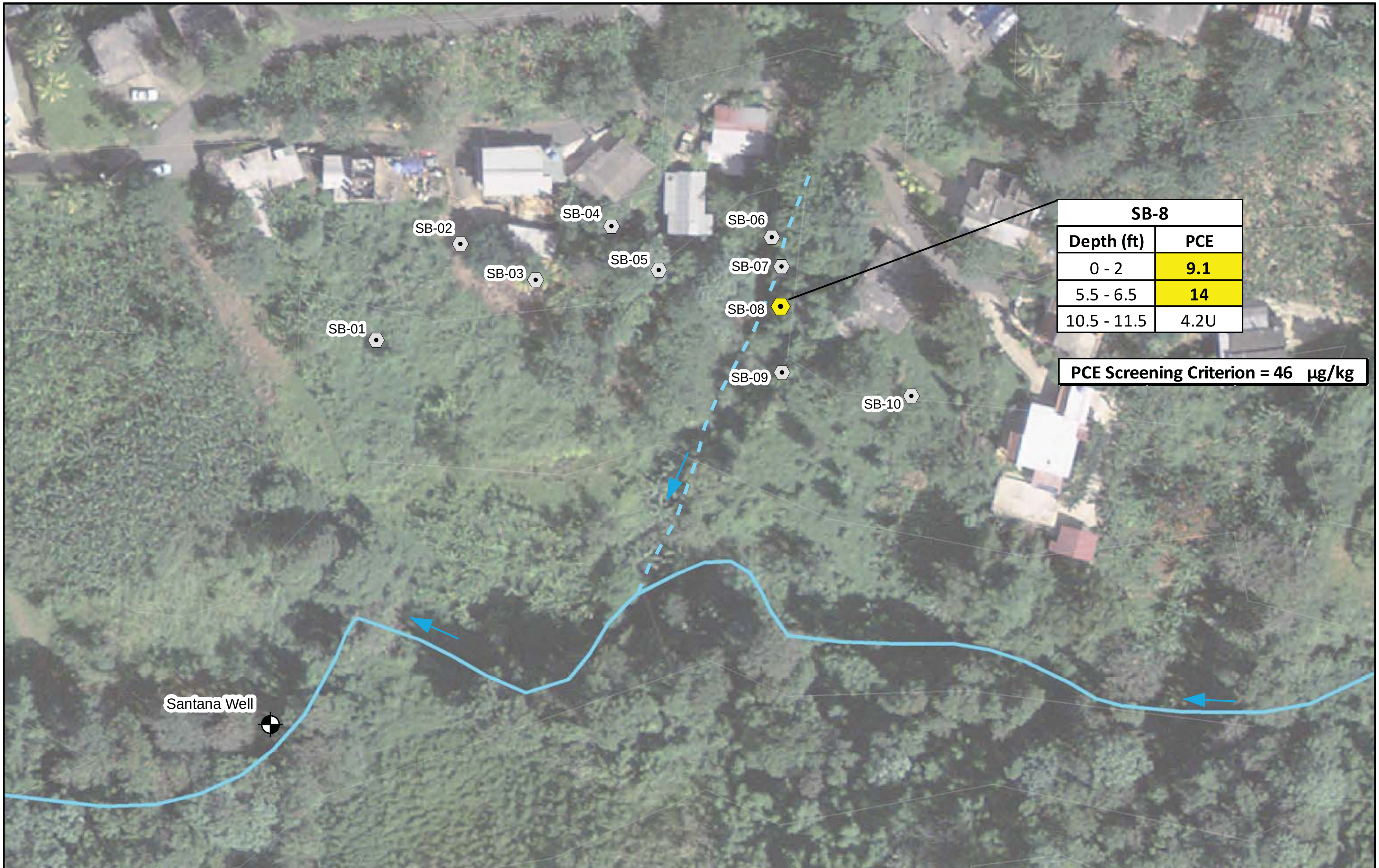


Figure 2
Site Map
Corozal Well Site
Corozal, Puerto Rico



SB-8	
Depth (ft)	PCE
0 - 2	**9.1**
5.5 - 6.5	**14**
10.5 - 11.5	4.2U

PCE Screening Criterion = 46 µg/kg

Legend

- Unnamed Stream
- Intermittent Stream
- PCE not detected
- PCE detection below screening criterion
- Flow direction

Notes:
PCE - Tetrachloroethene
All results are in micrograms per kilogram (µg/kg)
ft - feet below ground surface
U - non detect

0 37.5 75 150 Feet

Figure 3
PSA Soil Sampling PCE Results
Corozal Well Site
Corozal, Puerto Rico

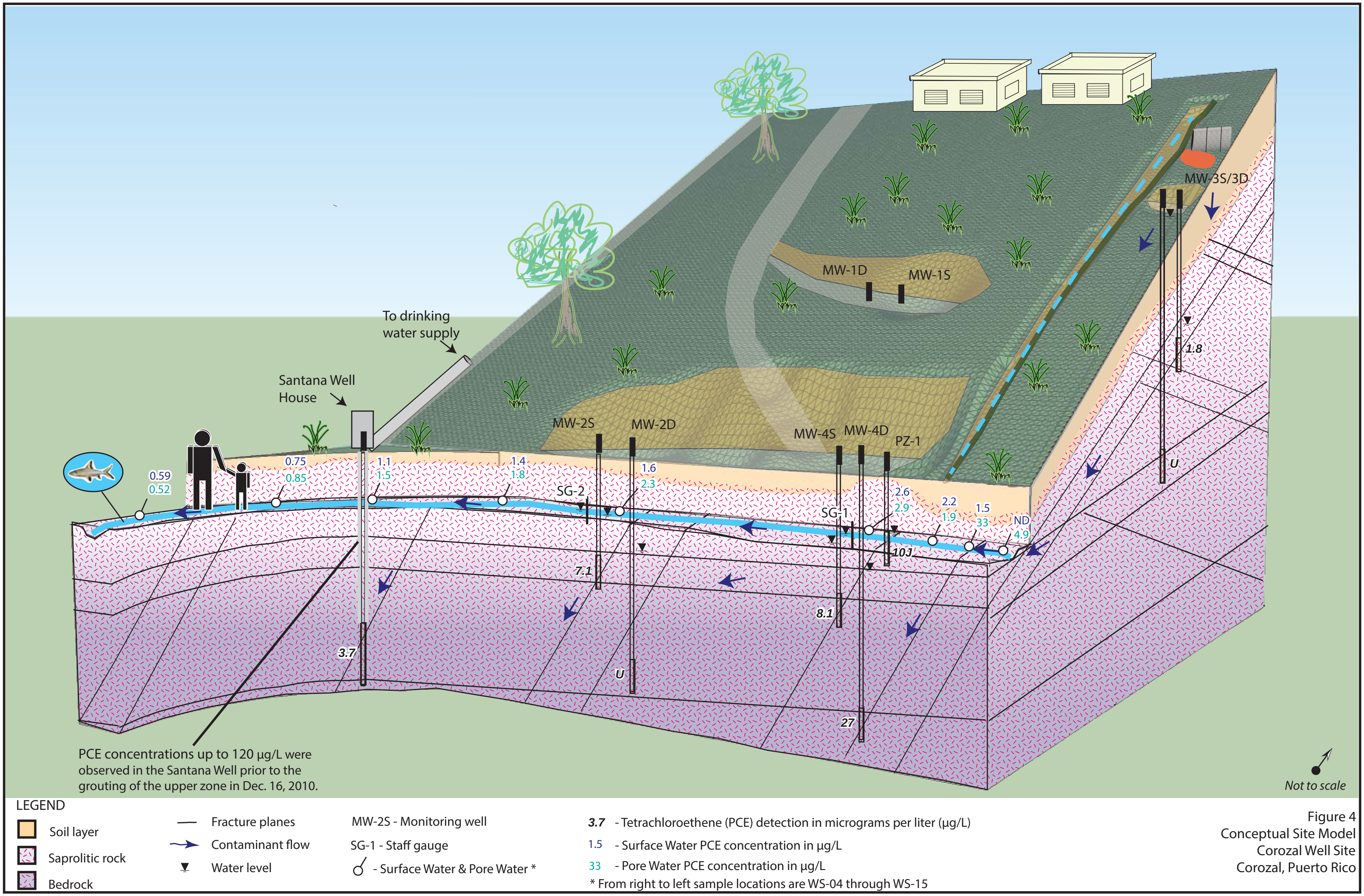
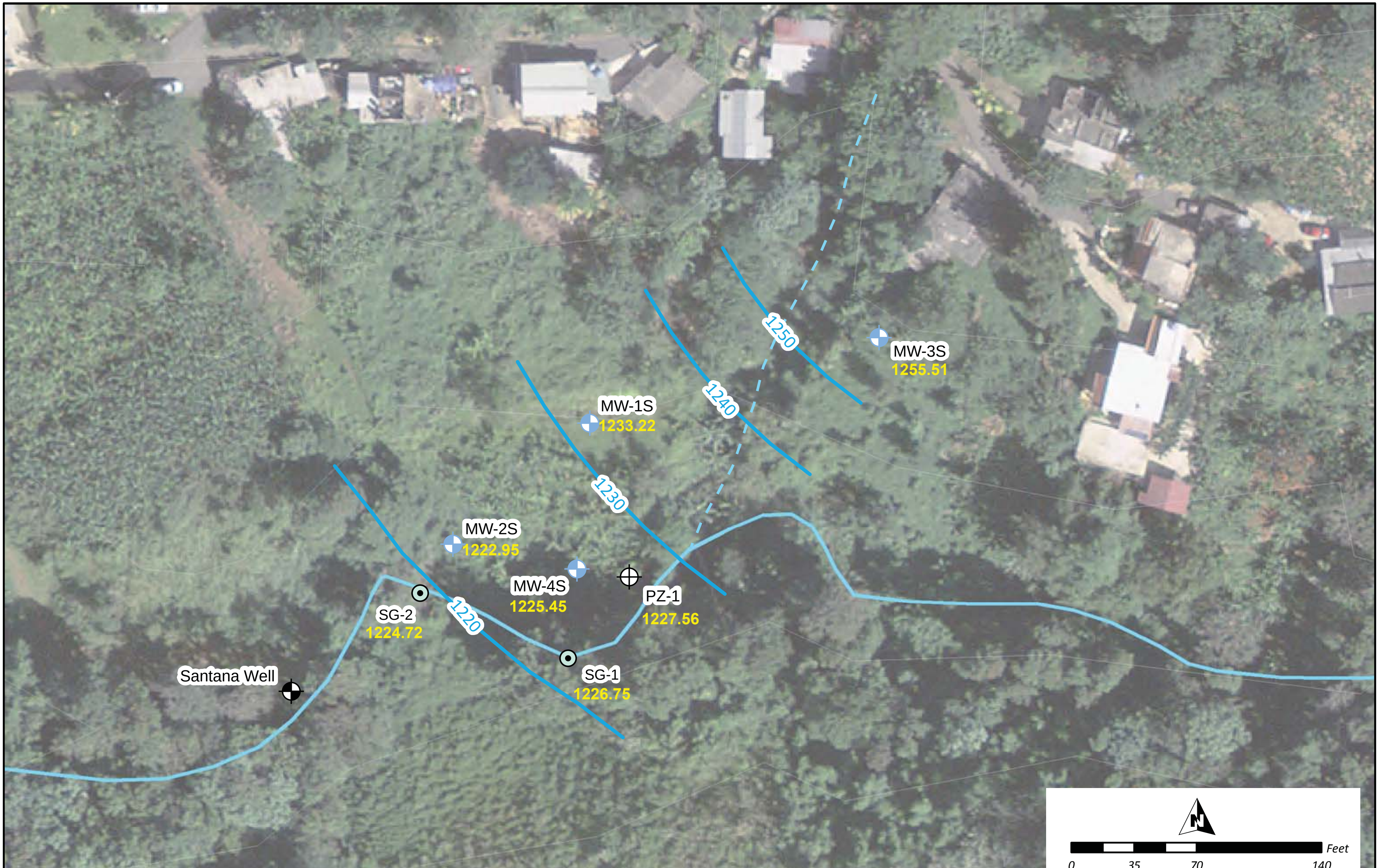


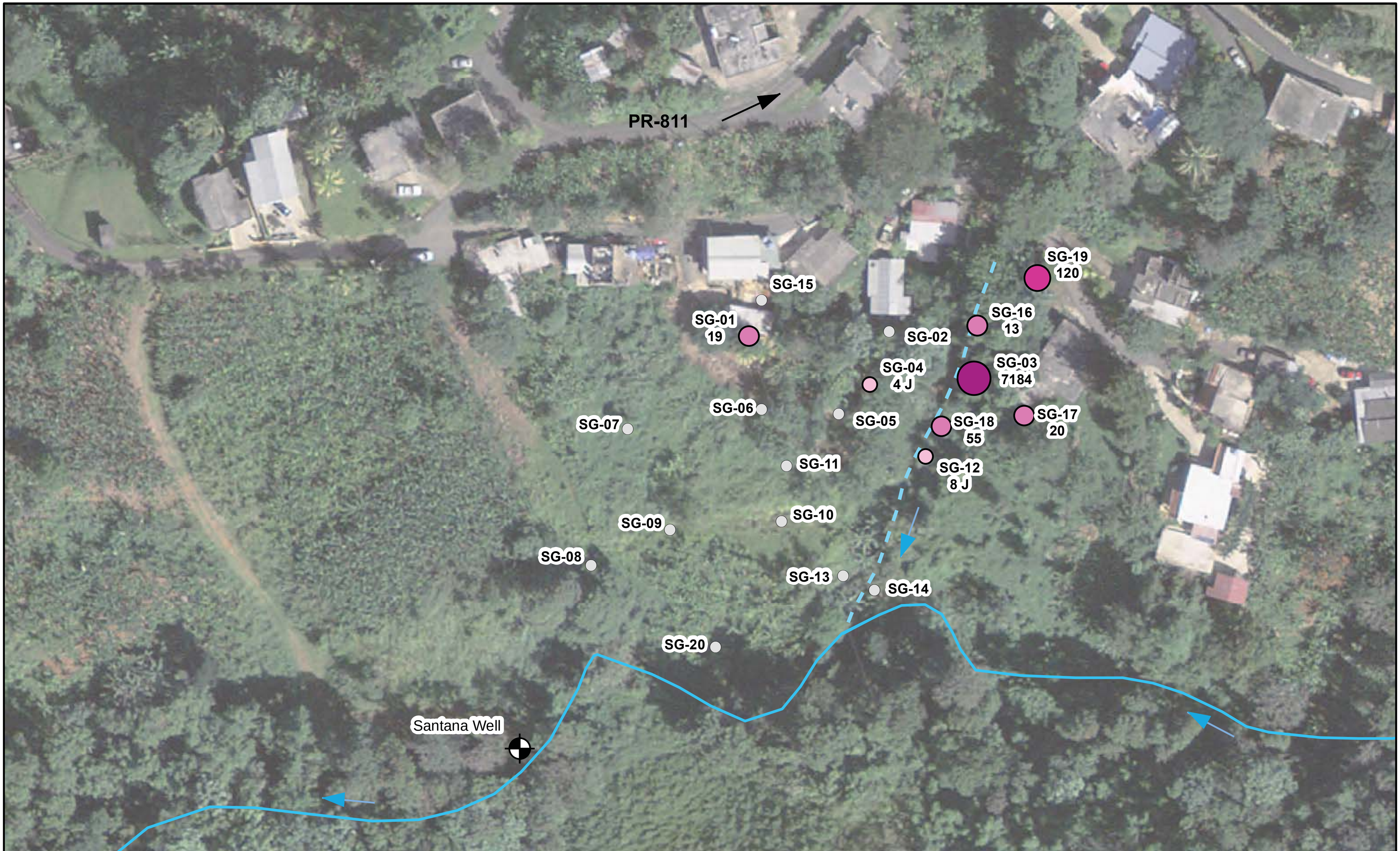
Figure 4
Conceptual Site Model
Corozal Well Site
Corozal, Puerto Rico



Legend

- Santana Well
- Deep bedrock monitoring well
- Piezometer
- Shallow bedrock monitoring well
- Unnamed stream
- Intermittent Stream
- Staff Gauge (elevation as reference only, not contoured)
- 1250 Groundwater level elevation (ft amsl)
- 1226.75 Water level elevation - 9/13/2014 (feet above mean sea level (ft amsl))

Figure 5
Shallow Bedrock Potentiometric Surface Map
Corozal Well Site
Corozal, Puerto Rico



Legend

Flow direction

Unnamed Stream

Intermittent Stream

Passive Soil Gas Sampling PCE Results (ng)

Non detect

0.1 - 10

10 - 100

100 - 1,000

1,000 - 10,000

Notes:

All results in nanograms (ng)

PCE - Tetrachloroethene

Samples were only analyzed for PCE

J - estimated result

N

Feet

0 37.5 75 150

Figure 6
Passive Soil Gas PCE Results
Corozal Well Site
Corozal, Puerto Rico

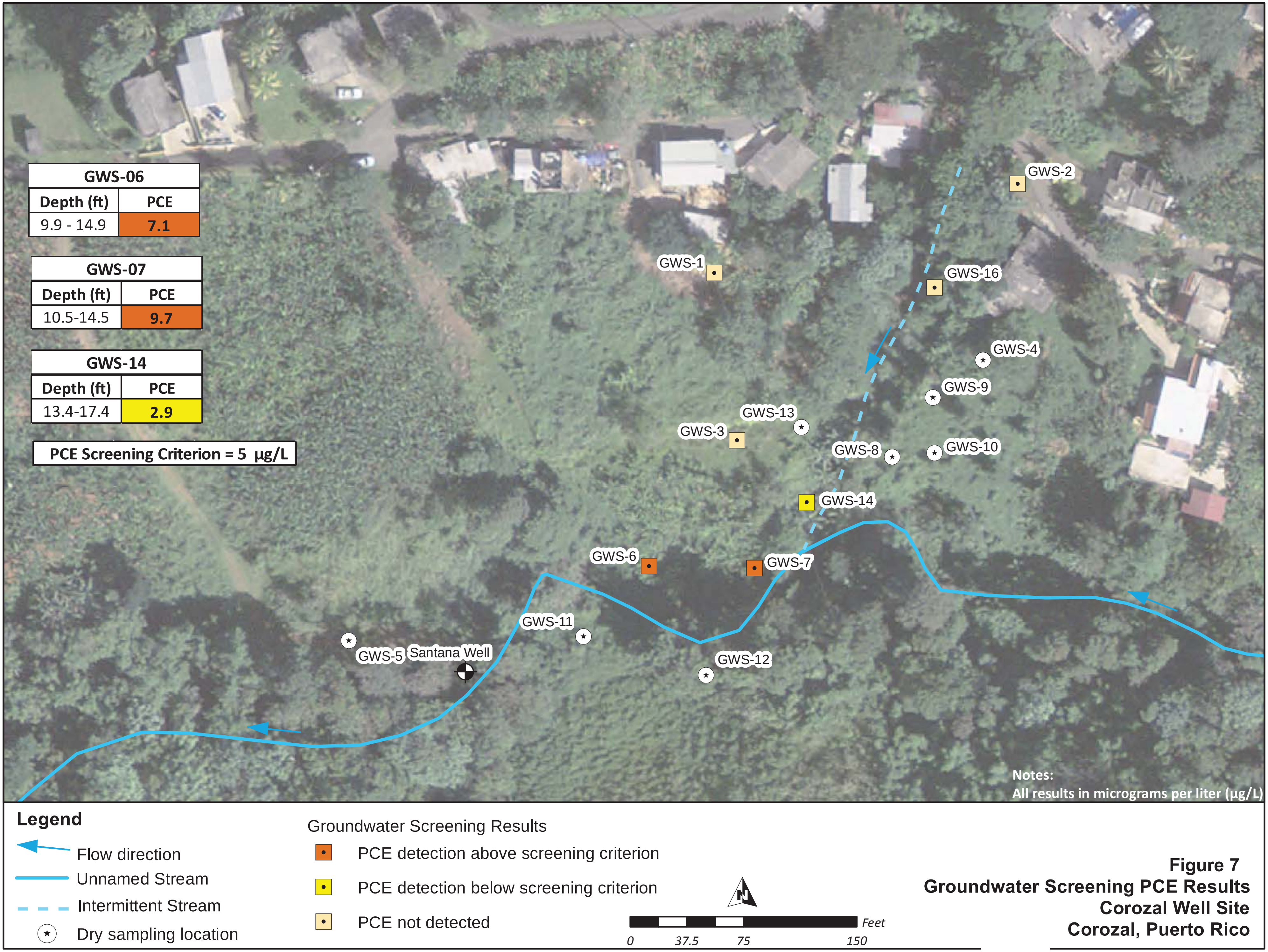


Figure 7
Groundwater Screening PCE Results
Corozal Well Site
Corozal, Puerto Rico

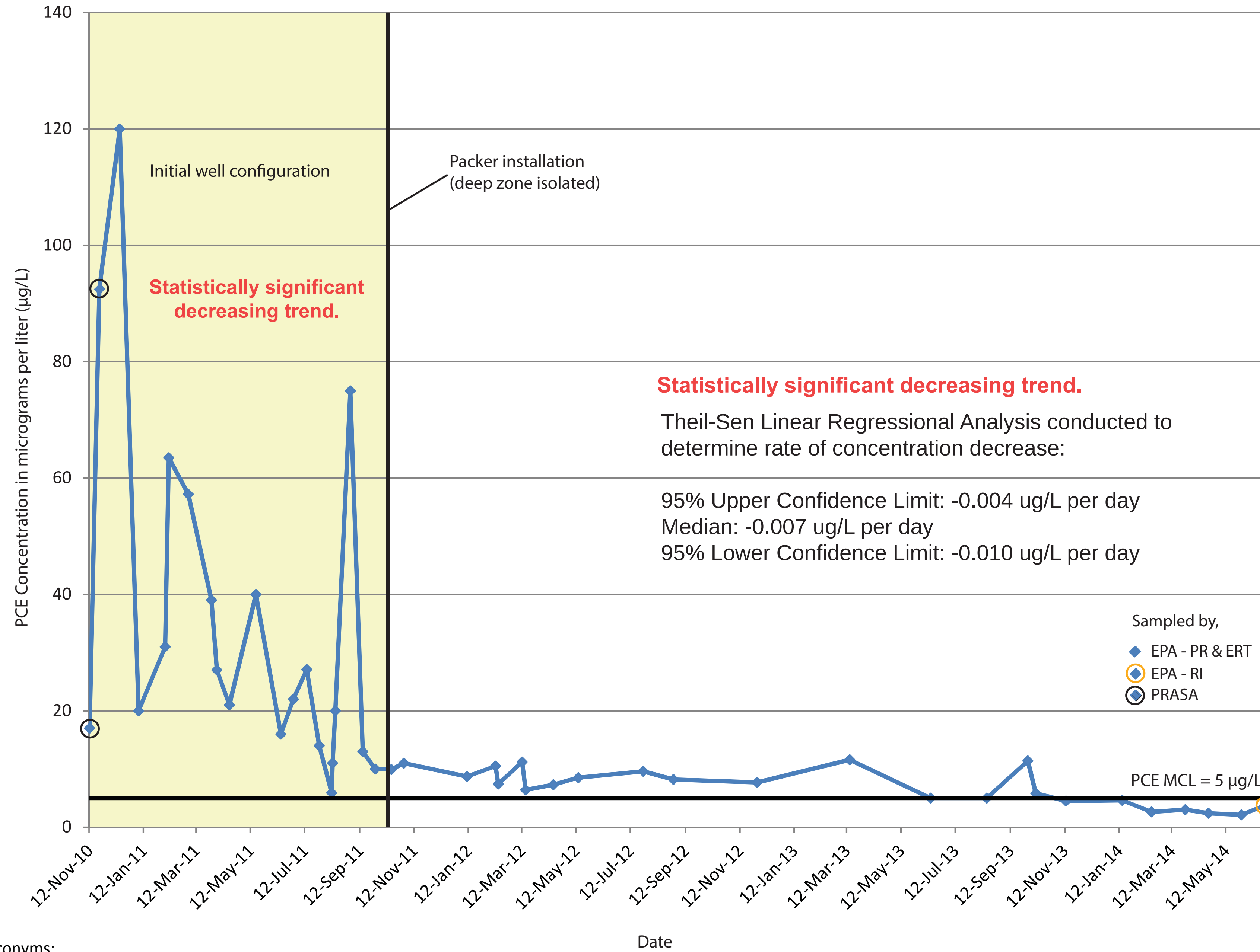


Figure 8
Santana Well Influent Data, November 2010 through June 2014
Corozal Well Site
Corozal, Puerto Rico

Acronyms;
EPA – Environmental Protection Agency
ERT – Emergency Response Team
µg/L – microgram per liter
RI – Remedial Investigation
PRASA – Puerto Rico Aqueduct and Sewer Authority

Santana Well				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	n/a	3.7	0.5 U
Round 2	GW	n/a	4.3	0.5 U

MW-1D				
Event	Matrix	Depth (ft)	PCE	PCE
Round 1	GW	115 - 135	0.11 U	0.5 U
Round 2	GW	115 - 135	0.028 J	0.5 U

MW-2S				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	40.5-60.5	7.1	0.5 U
Round 2	GW	40.5-60.5	5.5	0.25 J

MW-3S				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	58.6-78.6	1.8	0.5 U
Round 2	GW	58.6-78.6	1.5	0.5 U

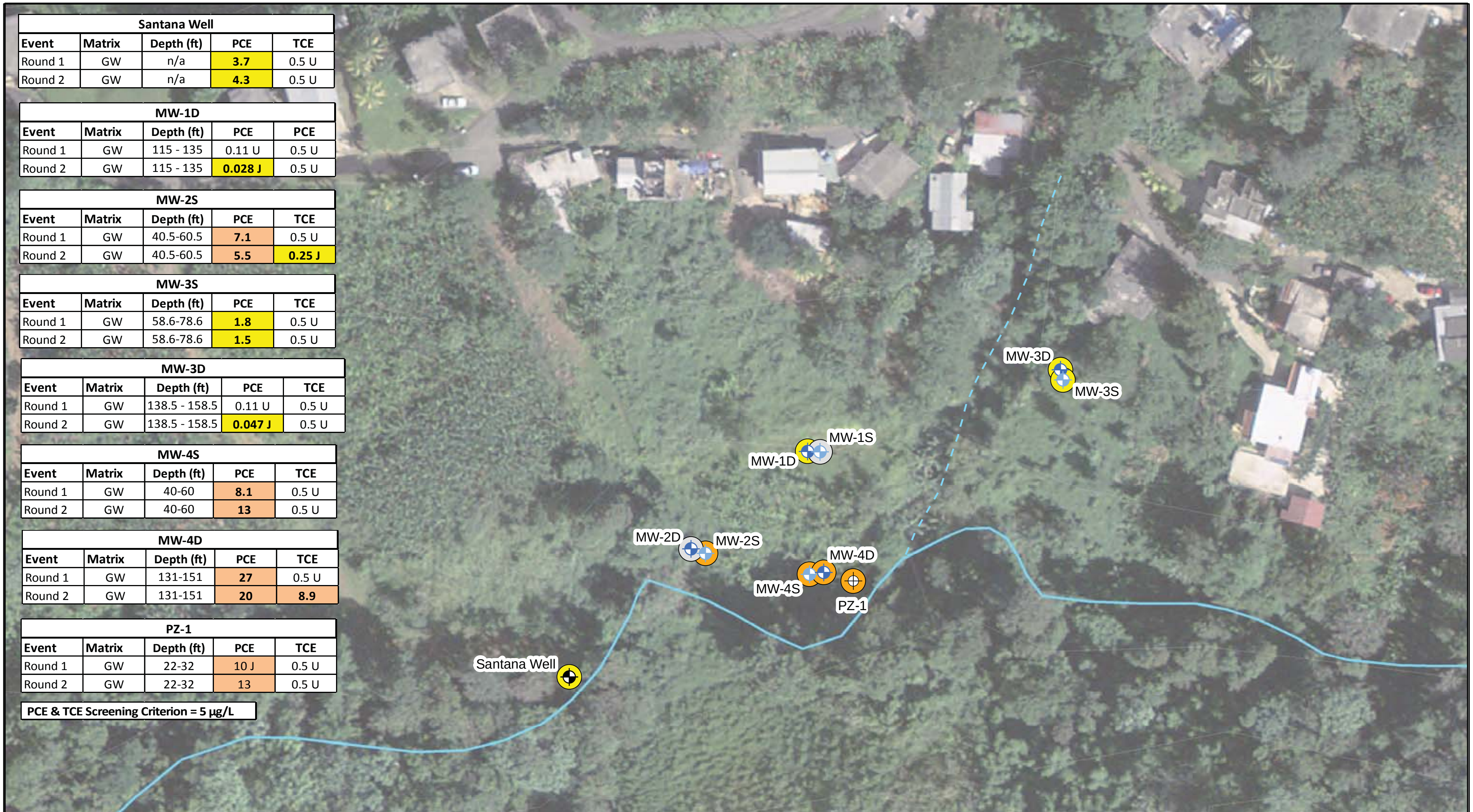
MW-3D				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	138.5 - 158.5	0.11 U	0.5 U
Round 2	GW	138.5 - 158.5	0.047 J	0.5 U

MW-4S				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	40-60	8.1	0.5 U
Round 2	GW	40-60	13	0.5 U

MW-4D				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	131-151	27	0.5 U
Round 2	GW	131-151	20	8.9

PZ-1				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	22-32	10 J	0.5 U
Round 2	GW	22-32	13	0.5 U

PCE & TCE Screening Criterion = 5 μg/L



Legend

- Santana Well
- Deep bedrock monitoring well
- Piezometer
- Shallow bedrock monitoring well
- Estimated Streambed
- Intermittent Stream
- Detection above screening criterion
- Detection below screening criterion
- Non detect

Acronyms:
MW-1S - Shallow Monitoring Well
MW-1D - Deep Monitoring Well
PCE - tetrachloroethene
TCE - trichloroethene
ug/L - micrograms per liter
ft - feet below ground surface

Feet
0 40 80 160

Figure 9
Monitoring Well PCE and TCE Results
Corozal Well Site
Corozal, Puerto Rico

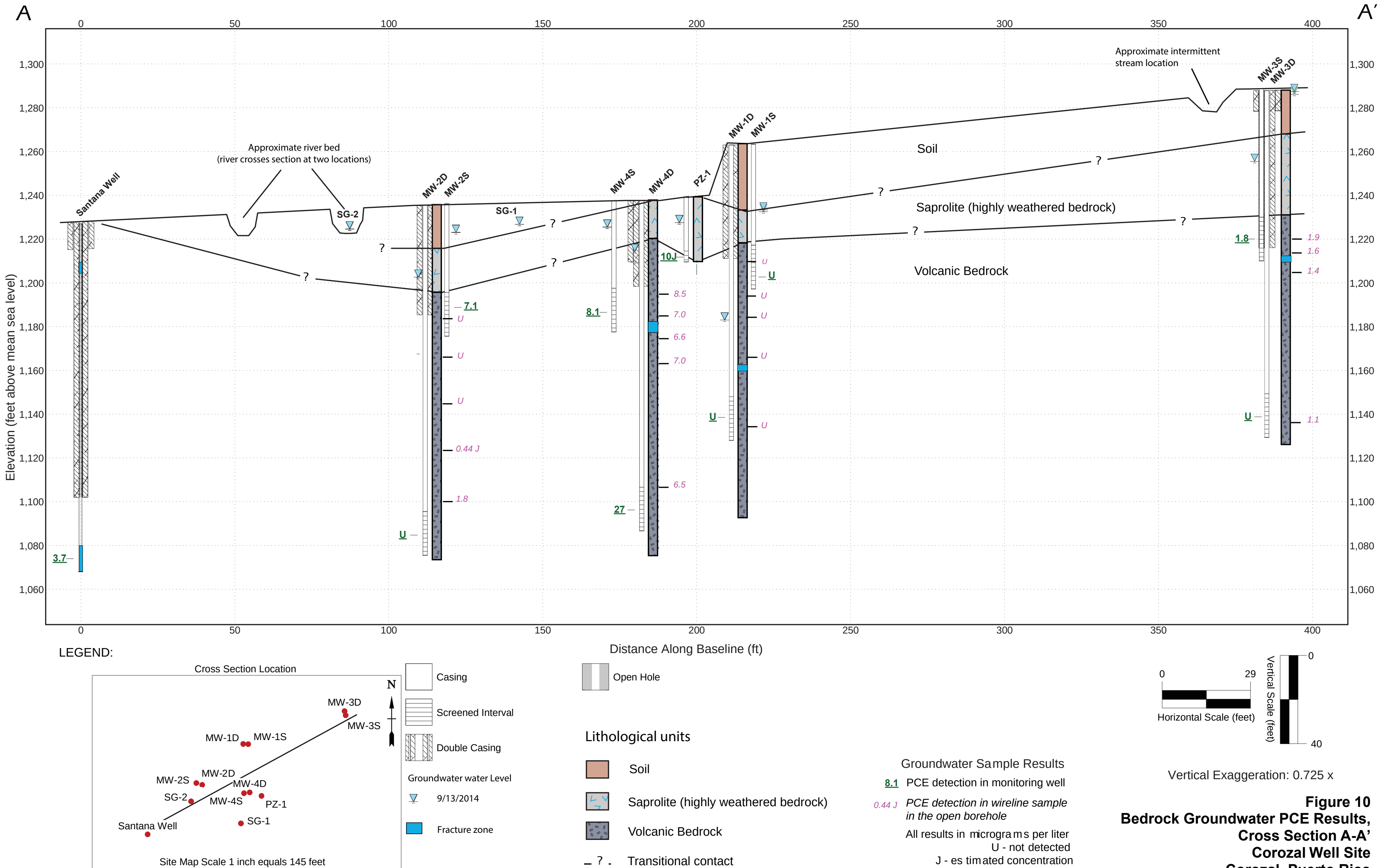


Figure 10
Bedrock Groundwater PCE Results, Cross Section A-A'
Corozal Well Site
Corozal, Puerto Rico

Screening Criterion	
Matrix	PCE
Surface water	5
Porewater	5
Sediment	468

Legend

- Surface Water (WS)
- Porewater (WP)
- Sediment (SE)

PCE detection

- Non detect
- Detection below screening criteria in either surface water or porewater samples
- Detection above screening criteria in porewater sample

0.59 - PCE detection in surface water sample
0.52 - PCE detection in porewater sample

Notes:
PCE - Tetrachloroethene
All results in micrograms per liter
No detections in sediment samples.
SW, SED & WP samples are co-located except where indicated.

- Unnamed Stream
- Intermittent Stream
- Flow direction

0 37.5 75 150 Feet

Figure 11
Surface Water, Sediment and Porewater PCE Results
Corozal Well Site
Corozal, Puerto Rico

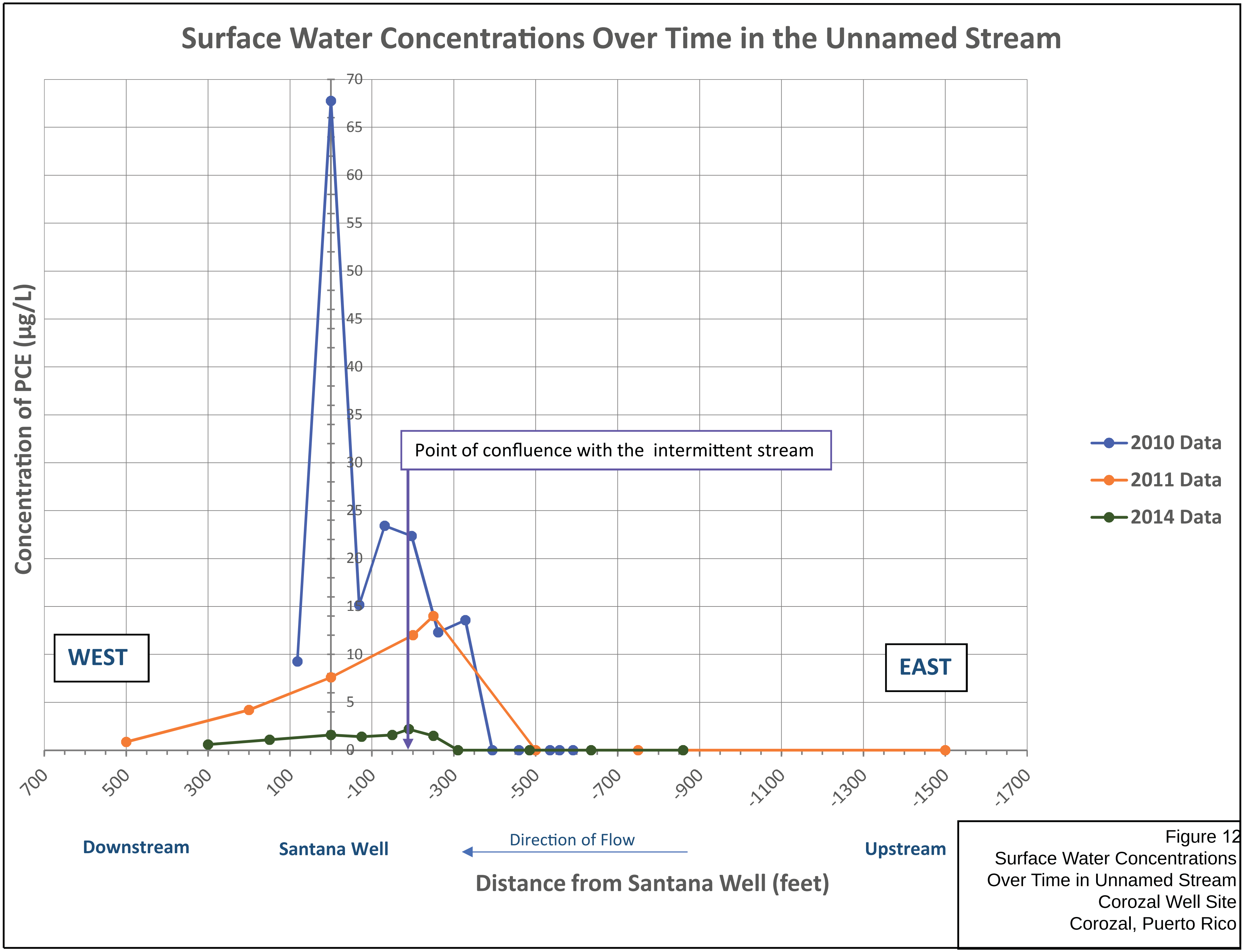


Figure 12
Surface Water Concentrations
Over Time in Unnamed Stream
Corozal Well Site
Corozal, Puerto Rico

Figure 13

Groundwater Statistics Tool
Data input worksheet

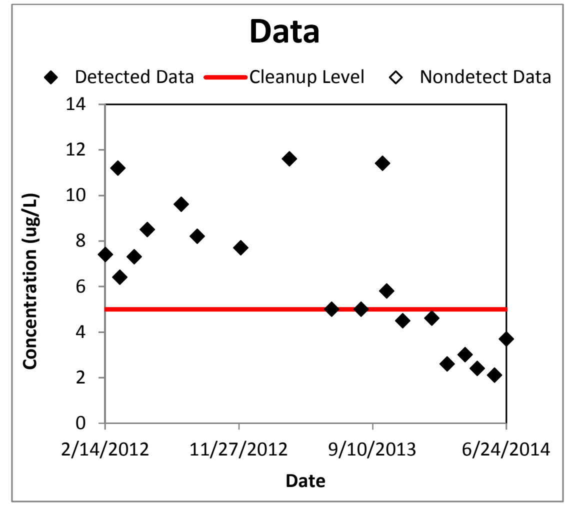
Site Name	Corozal
Operating Unit (OU)	post packering
Type of Evaluation	Attainment
Date of Evaluation	5/14/2015
Person performing analysis	KRM

Chemical of Concern	PCE
Well Name/Number	Santana well
Date Units	Date
Concentration Units	ug/L

Confidence Level Desired	95%
Cleanup Level	5
Source of cleanup level (e.g. MCL or risk-based concentration)	MCL
Risk of False Outlier Rejection	1%
Random Seed (may be left blank)	35533.74219
Significant figures to use	3

Number of data points:	20
Number of detected results:	20
Number of nondetect results:	0
Detection frequency:	1

Date (Date)	PCE Concentration (ug/L)	Data Qualifier	Detected? (Yes or No)
2/14/2012	7.4		Yes
3/12/2012	11.2		Yes
3/16/2012	6.4		Yes
4/16/2012	7.3		Yes
5/14/2012	8.5		Yes
7/26/2012	9.6		Yes
8/29/2012	8.2		Yes
12/1/2012	7.7		Yes
3/15/2013	11.6		Yes
6/14/2013	5		Yes
8/16/2013	5		Yes
10/1/2013	11.4		Yes
10/10/2013	5.8		Yes
11/13/2013	4.5		Yes
1/15/2014	4.6		Yes
2/17/2014	2.6		Yes
3/27/2014	3		Yes
4/22/2014	2.4		Yes
5/29/2014	2.1		Yes
6/24/2014	3.7		Yes



Axis Values			
Time		Concentration	
Min	Max	Min	Max
Auto	Auto	Auto	Auto

Reset Concentration Axis

Data Review		Recommendations
Are all necessary data fields entered, and in proper format?	Yes	None
Are at least 4 data points present for statistical analysis?	Yes	None
Are detection limits for nondetects ≤ maximum detected value?	Yes	None
Are all data within chart axis limits?	Yes	None

Figure 13

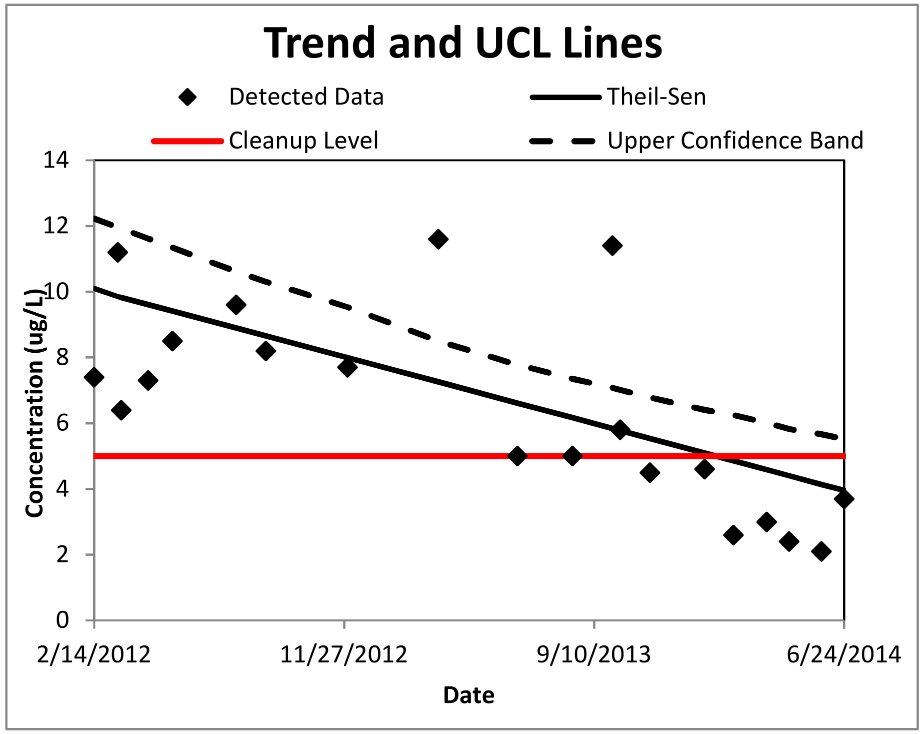
Groundwater Statistics Tool

UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Corozal
Operating Unit (OU)	post packering
Type of Evaluation	Attainment
Date of Evaluation	5/14/2015
Person performing analysis	KRM

Chemical of Concern	PCE
Well Name/Number	Santana well
Date Units	Date
Concentration Units	ug/L

Confidence Level	95%
Number of results	20
Number < cleanup level	7
Are any potential outliers present?	No
Mean of concentration	6.4
Standard deviation of concentration	3.04
t-value for UCL calculation	1.729



95% Upper Confidence Limit (UCL)	7.58
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	5.52
Trend calculation method	Theil-Sen/Mann-Kendall
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

Figure 13

Groundwater Statistics Tool

Data input worksheet

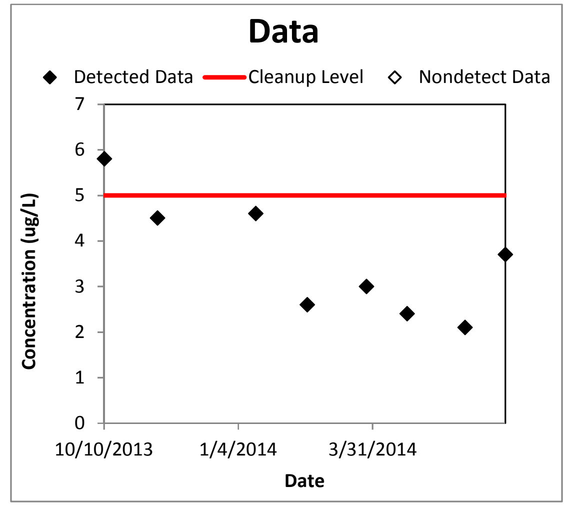
Site Name	Corozal
Operating Unit (OU)	post packering
Type of Evaluation	Attainment
Date of Evaluation	5/14/2015
Person performing analysis	KRM

Chemical of Concern	PCE
Well Name/Number	Santana well
Date Units	Date
Concentration Units	ug/L

Confidence Level Desired	95%
Cleanup Level	5
Source of cleanup level (e.g. MCL or risk-based concentration)	MCL
Risk of False Outlier Rejection	1%
Random Seed (may be left blank)	35533.74219
Significant figures to use	3

Number of data points:	8
Number of detected results:	8
Number of nondetect results:	0
Detection frequency:	1

Date (Date)	PCE Concentration (ug/L)	Data Qualifier	Detected? (Yes or No)
10/10/2013	5.8		Yes
11/13/2013	4.5		Yes
1/15/2014	4.6		Yes
2/17/2014	2.6		Yes
3/27/2014	3		Yes
4/22/2014	2.4		Yes
5/29/2014	2.1		Yes
6/24/2014	3.7		Yes



Axis Values			
Time		Concentration	
Min	Max	Min	Max
Auto	Auto	Auto	Auto

Reset Concentration Axis

Data Review		Recommendations
Are all necessary data fields entered, and in proper format?	Yes	None
Are at least 4 data points present for statistical analysis?	Yes	None
Are detection limits for nondetects ≤ maximum detected value?	Yes	None
Are all data within chart axis limits?	Yes	None

Figure 13

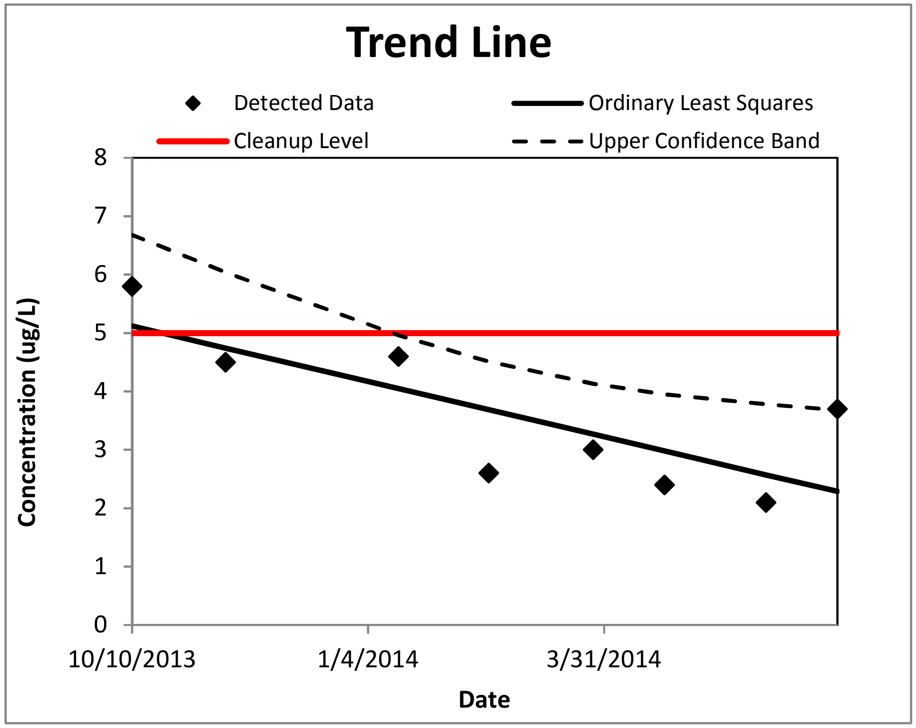
Groundwater Statistics Tool

UCL calculations and summary statistics for data sets that are normally distributed

Site Name	Corozal
Operating Unit (OU)	post packering
Type of Evaluation	Attainment
Date of Evaluation	5/14/2015
Person performing analysis	KRM

Chemical of Concern	PCE
Well Name/Number	Santana well
Date Units	Date
Concentration Units	ug/L

Confidence Level	95%
Number of results	8
Number < cleanup level	7
Are any potential outliers present?	No
Mean of concentration	3.59
Standard deviation of concentration	1.29
t-value for UCL calculation	1.895



95% Upper Confidence Limit (UCL)	4.45
Method for calculating UCL	Student's t UCL
Value of 95% Upper Confidence Band value at final sampling event	3.68
Trend calculation method	Ordinary Least Squares
Cleanup level	5
Source of cleanup level	MCL
Is the trend decreasing or statistically insignificant?	Yes

When is the concentration predicted to exceed the MCL?	Not applicable - slope is not statistically increasing
Message: None.	

APPENDIX II

Administrative Record Index

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

FINAL

08/13/2015 **REGION ID: 02**

Site Name: COROZAL WELL
CERCLIS ID: PRN000206452
OUID: 01
SSID: A265
Action:

DocID:	Doc Date:	Title:	Image Count:	Doc Type:	Addressee Name:	Addressee Organization:	Author Name:	Author Organization:
350413	08/13/2015	ADMINISTRATIVE RECORD INDEX FOR OU1 FOR THE COROZAL WELL SITE	1	[AR INDEX]	[]	[]	[,]	[US ENVIRONMENTAL PROTECTION AGENCY]
266212	01/11/2013	NEGOTIATED WORK PLAN, VOLUME I OF II FOR REMEDIAL INVESTIGATION / FEASIBILITY STUDY FOR THE COROZAL WELL SITE	106	[PLAN]	[,]	[US ENVIRONMENTAL PROTECTION AGENCY]	[,]	[CDM FEDERAL PROGRAMS CORP, CDM SMITH]
350405	03/28/2013	FINAL QUALITY ASSURANCE PROJECT PLAN FOR THE COROZAL WELL SITE	306	[PLAN]	[]	[]	[,]	[CDM SMITH]
350401	03/17/2014	FINAL COMMUNITY ENGAGEMENT PLAN FOR THE COROZAL WELL SITE	41	[PLAN]	[]	[]	[,]	[CDM SMITH]
350407	03/11/2015	FINAL SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT FOR THE COROZAL WELL SITE	44	[REPORT]	[]	[]	[,]	[CDM SMITH]
350409	06/23/2015	REVISED FINAL HUMAN HEALTH RISK ASSESSMENT FOR THE COROZAL WELL SITE	124	[REPORT]	[]	[]	[,]	[CDM SMITH]
350403	07/01/2015	FINAL FEASIBILITY STUDY REPORT FOR THE COROZAL WELL SITE	149	[REPORT]	[]	[]	[,]	[CDM SMITH]
350411	07/16/2015	FINAL REMEDIAL INVESTIGATION REPORT FOR THE COROZAL WELL SITE	422	[REPORT]	[]	[]	[,]	[CDM SMITH]
350399	08/11/2015	PROPOSED PLAN FOR THE COROZAL WELL SITE	27	[PLAN]	[]	[]	[,]	[US ENVIRONMENTAL PROTECTION AGENCY]

350413

APPENDIX III

Public Notices

AVISO PÚBLICO

AGENCIA FEDERAL DE PROTECCIÓN AMBIENTAL
PLAN PROPUESTO Y PERIODO DE COMENTARIOS
LUGAR DEL SUPERFONDO POZO DE AGUA DE COROZAL
COROZAL, PUERTO RICO

La Agencia Federal de Protección Ambiental (EPA, por sus siglas en inglés) en colaboración con la Junta de Calidad Ambiental, anuncia el comienzo de un período de treinta (30) días de comentario público sobre el Plan Propuesto para la remediación del Lugar de Superfondo conocido como Pozo de Agua de Corozal, localizado entre los municipios de Corozal y Naranjito, Puerto Rico. El Plan Propuesto describe las alternativas recomendadas y las razones para estas recomendaciones. Antes de seleccionar un remedio final, la EPA va a considerar los comentarios escritos y verbales recibidos durante este periodo de comentario público. Todos los comentarios (verbales y/o escritos) deberán ser recibidos en o antes del 11 de Septiembre de 2015. La EPA proveerá un resumen de todos los comentarios y sus respuestas en el Récord de Decisión para este Lugar.

A tales fines, EPA llevará a cabo una reunión pública el jueves, 20 de agosto de 2015, de 6:00 pm a 8:00 pm en el salón de Conferencias localizado en la Escuela Felipa Sánchez Cruzado, Barrio Cedro Abajo, Naranjito, Puerto Rico. El propósito de esta reunión es informarle a la comunidad sobre los hallazgos, conclusiones y recomendaciones de la investigación remedial realizada en el lugar. Además, se discutirá la alternativa de limpieza recomendada. Durante esta reunión pública, la EPA contestará preguntas o comentarios que los participantes tengan con relación a la investigación realizada y sobre la alternativa de limpieza recomendada.

Copias del Plan Propuesto y otros documentos relacionados al Lugar de Superfondo Pozo de Agua de Corozal están disponibles en los siguientes repositorios de información:

Escuela Felipa Sánchez Cruzado
Carretera 811 Km 5 Hm 9 Bo. Cedro Abajo
Naranjito, Puerto Rico 00719
(787) 869-4231
Horario: Lunes – Viernes 8:00am a 4:00 pm

Puerto Rico Environmental Quality Board
Emergency Response and Superfund Program
Edificio de Agencias Ambientales Cruz A. Matos
Urbanización San José Industrial Park
1375 Avenida Ponce de León
San Juan, PR 00926-2604
(787)767-8181 ext 3207
Horario: Lunes – Viernes 9:00am a 3:00 pm
Por cita

Agencia Federal de Protección Ambiental, Región 2
División de Protección Ambiental del Caribe
City View Plaza II- Suite 7000
48 RD, 165 Km. 1.2
Guaynabo, PR 00968-8069
Fax: (787) 289-7104 (787) 977-5869
Horario: Lunes.- Viernes, 9:00 a.m. a 4:30 p.m.
Por cita

U.S. Environmental Protection Agency, Región 2
290 Broadway, 18th floor
New York, New York 10007-1866
(212) 637-4308
Horario: Lunes.-Viernes, 9:00 a.m. a 3:30 p.m.
Por cita

Para más información, puede llamar a Daniel Rodríguez al (787) 741-5201. Los comentarios escritos del Plan Propuesto deben ser enviados por correo electrónico o regular a las siguientes direcciones:

Daniel Rodríguez
Gerente de Proyectos
U.S. Environmental Protection Agency, Región 2
Oficina de Campo en Vieques
PO Box 1537
Vieques, PR 00765
Fax: (787) 741-5017
Correo electrónico: rodriguez.daniel@epa.gov

Estado Libre Asociado de Puerto Rico ● Gobierno Municipal Autónomo de
TIERRA DE GIGANTES Carolina

AVISO PÚBLICO

ÁREA LOCAL DE DESARROLLO LABORAL CAROLINA

Especificaciones de Trabajo para los Programas de Jóvenes, Adultos y Trabajadores Desplazados
Año Programa 2015-2016
Ley de Oportunidades y de Innovación de la Fuerza Laboral

La Junta Local de Inversión de la Fuerza Trabajadora de Carolina, en colaboración con el Área Local de Desarrollo Laboral (ALDLC), ha preparado las Especificaciones de Trabajo para los Programas de Jóvenes, Adultos y Trabajadores Desplazados correspondientes al Año Programa 2015-2016.

A continuación, una descripción del uso de los fondos por programas y categorías:

CATEGORÍA	PROGRAMA DE JÓVENES	PROGRAMA DE ADULTOS	PROGRAMA TRABAJADORES DESPLAZADOS
ADMINISTRACIÓN	$68,380.43	$76,845.74	$34,263.51
PROGRAMA	$615,423.88	$691,611.62	$308,371.54
TOTAL	$683,804.31	$768,457.36	$342,635.05

Copia del Plan Anual, recomendaciones y Transferencias entre Programas estarán disponible para revisión en nuestras oficinas, durante 30 días a partir de la publicación de este aviso en la siguiente dirección:

Edificio Plaza San Fernando
Calle Amadeo, Esquina Bernardo García
Frente a la Plaza San Fernando de la Carolina
Carolina, PR 00986
Teléfonos (787) 752-4090 TTY: (787) 701-5586
amoe@aldlcarolina.org

Rey F. Marrero Candelario — Director Ejecutivo
Dr. José N. Lugo Montalvo — Presidente Junta Local
José Carlos Aponte Dalmau — Alcalde

Viva Carolina

Patrono – Programa con igualdad de oportunidades. Servicios auxiliares disponibles a personas con impedimentos de ser solicitados
Programa auspiciado con fondos de la Ley de Oportunidades y de Innovación de la Fuerza Laboral (WIOA por sus siglas en inglés)

Estado Libre Asociado de Puerto Rico ● Gobierno Municipal Autónomo de
TIERRA DE GIGANTES Carolina

AVISO PÚBLICO

ÁREA LOCAL DE DESARROLLO LABORAL CAROLINA

Solicitud de Propuestas

Ley de Oportunidades y de Innovación de la Fuerza Laboral

El Área Local de Desarrollo Laboral de Carolina (ALDLC) invita a proveedores de servicios, autorizados a ejercer la práctica de Contabilidad en Puerto Rico, a someter propuesta para la siguiente área:

1. Servicios de Apoyo Técnico en el Sistema MIP y Fas Gov

Se requiere experiencia previa con programas federales.

Los interesados deberán recoger las especificaciones e información general a partir del viernes, 7 de agosto de 2015, en nuestras instalaciones ubicadas en:

Edificio Plaza San Fernando
Calle Amadeo, Esquina Bernardo García
Frente a la Plaza San Fernando de la Carolina
Carolina, PR 00986
Teléfonos (787) 752-4090 TTY: (787) 701-5586
amoe@aldlcarolina.org

La fecha límite para entregar la propuesta será el viernes, 21 de agosto de 2015, hasta las 3:00 de la tarde.

Rey F. Marrero Candelario — Director Ejecutivo
Dr. José N. Lugo Montalvo — Presidente Junta Local
José Carlos Aponte Dalmau — Alcalde

Viva Carolina

Patrono / Programa con Igualdad de Oportunidad y Servicios Auxiliares a Personas con Impedimentos de ser solicitados
Programa auspiciado con fondos de la Ley de Oportunidades y de Innovación de la Fuerza Laboral (WIOA por sus siglas en Inglés)

APPENDIX IV
Proposed Plan and Fact Sheet (Spanish)

Corozal Well
Superfund Site

Corozal, Puerto Rico
August 2015

EPA Region 2

EPA ANNOUNCES PROPOSED CLEANUP PLAN

This Proposed Plan describes the remedial alternatives developed for the Corozal Well Superfund Site (the Site) in Corozal, Puerto Rico, and identifies the preferred remedy for the Site with the rationale for this preference. This document was developed by the U.S. Environmental Protection Agency (EPA), the lead agency for Site activities, in consultation with the Puerto Rico Environmental Quality Board (PREQB), the support agency. EPA is issuing this Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. § 9617(a) (CERCLA, commonly known as Superfund), and Sections 300.430(f) and 300.435(c) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The nature and extent of the contamination at the Site and the remedial alternatives summarized in this document are described in detail in the Remedial Investigation (RI) and Feasibility Study (FS) reports.

EPA's preferred remedy for the Site is Alternative 2: monitored natural attenuation and institutional controls. Actions previously taken by EPA at the municipal well have allowed the well to be reopened, and the levels measured at the well currently meet Federal drinking water standards. Because there are still exceedances in groundwater in monitoring wells nearby the municipal well, as part of the preferred remedy, the existing water treatment system would be maintained at the Site while the potential that the well could become recontaminated remains.

MARK YOUR CALENDAR

PUBLIC MEETING
August 20, 2015 at 6:00 pm
Library
Escuela Felipa Sanchez Cruzado
Carretera 811 Km 5 Hm 9 Bo. Cedro Abajo
Naranjito, Puerto Rico 00719

PUBLIC COMMENT PERIOD
August 12, 2015 – September 11, 2015

INFORMATION REPOSITORY
The administrative record file, which contains copies of the Proposed Plan and supporting documentation, is available at the following locations:

Escuela Felipa Sanchez Cruzado
Carretera 811 Km 5 Hm 9 Bo. Cedro Abajo
Naranjito, Puerto Rico 00719
(787) 869-4231
Horario: Lunes – Viernes 8:00am a 4:00 pm

U.S. Environmental Protection Agency
City View Plaza II- Suite 7000
#48 PR-165 Km. 1.2
Guaynabo, PR 00968-8069
(787) 977-5865
Hours: Monday – Friday 9:00 am to 5:00 pm
By appointment.

Puerto Rico Environmental Quality Board
Emergency Response and Superfund Program
Edificio de Agencias Ambientales Cruz A. Matos
Urbanización San José Industrial Park
1375 Avenida Ponce de León
San Juan, PR 00926-2604
(787) 767-8181 ext 3207
Hours: Monday – Friday 9:00 am to 3:00 pm
By appointment.

U.S. EPA Records Center, Region 2
290 Broadway, 18th Floor
New York, New York 10007-1866
(212) 637-4308
Hours: Monday-Friday – 9:00 am to 5:00 pm
By appointment.

EPA evaluated a number of active treatment technologies for addressing the residual groundwater contamination, along with natural attenuation. EPA concluded none of the active measures would clean up the groundwater more quickly or more comprehensively than the natural processes that are already at work within the aquifer.

COMMUNITY ROLE IN SELECTION PROCESS

EPA relies on public input to ensure that the concerns of the community are considered in selecting an appropriate remedy for each Superfund site. To this end, this Proposed Plan has been made available to the public for a 30-day public comment period, which begins with the issuance of this Proposed Plan and concludes on **September 11, 2015**.

EPA is providing information to the public regarding the investigation and cleanup of the Site through a public meeting and the public repositories, which contain the administrative record file. EPA encourages the public to gain a more comprehensive understanding of the Site and the Superfund activities that have been conducted there.

The public meeting held during the comment period is to provide information regarding the Site investigations, the alternatives considered, and the preferred remedy, as well as to receive public comments. Comments received at the public meeting, as well as written comments, will be documented in the Responsiveness Summary Section of the Record of Decision (ROD), the document that formalizes the selection of the remedy.

Written comments on this Proposed Plan should be addressed to:

Daniel Rodríguez
Remedial Project Manager
U.S. Environmental Protection Agency
Vieques Field Office
PO Box 1537
Vieques, PR 00765
Telephone: (787) 741-5201
Fax: (787) 741-5017
E-mail: rodriguez.daniel@epa.gov

SCOPE AND ROLE OF ACTION

EPA is addressing the cleanup of this Site by implementing a single, comprehensive remedial action to address the groundwater contamination at the Site.

SITE BACKGROUND

Site Description

The Site is located in the Palos Ward, a rural residential community within the mountainous region of north-central Puerto Rico (see Figure 1). The Site straddles the border between the municipalities of Corozal and Naranjito. The Palos Ward is serviced by the Comunidad Santana Well (Santana well), a private community well that is the sole source of drinking water for a community of more than 200 people.

Site History

In November 2010, the Puerto Rico Aqueduct and Sewer Authority (PRASA), on behalf of Puerto Rico Department of Health (PRDOH), sampled the Santana well and discovered that concentrations of tetrachloroethylene (PCE) exceeded the federal drinking water standard, the maximum contaminant level (MCL), of 5 micrograms per liter (µg/L). In response, EPA provided a temporary water supply to effected residents and undertook actions, discussed in more detail below, to modify the Santana well so that it could be reopened.

EPA listed the Corozal Well site on the National Priorities List (NPL) in March 2012 due to groundwater contamination.

Topography and Drainage

The Site is located in an area of rugged hills in the Cedro Abajo region. Surface elevation at the Site varies between approximately 1,150 and 1,280 feet above mean sea level (amsl). The Santana well is located at approximately 1,150 feet amsl. The well is within the Rio Mavilla watershed with headwaters at approximately 1,315 feet amsl. Surface drainage from the Site flows into an unnamed stream that discharges into the Rio Mavilla and eventually into the Rio Cibuco. An intermittent stream located in the eastern portion of the Site also discharges local surface runoff into the unnamed stream.

Geology

The unconsolidated zone observed in Site soil borings is generally composed of brown silty clay near the surface, becoming more reddish yellow and brownish yellow silty clay close to the saprolite. Thickness varies from 2 to 17 feet across the Site. The saprolite zone is described as weathered rock with fractures and angular rock fragments (sand to gravel size) in a red to reddish brown silt and clay matrix. Saprolite thickness also varies considerably from 2 to 22 feet across the Site.

The Site is underlain by moderately to highly fractured Lower/Upper Cretaceous volcanic bedrock consisting of basaltic tuff. Geophysical borehole logs indicate linear features in the vicinity of the wells on Site in lengths from 330 to 660 feet, generally following steep ravines and stream valleys. One of these features is the unnamed stream. The stream likely follows a weak zone or potential fault. This likely increases the number of fractures in the bedrock, leading to a preferred flow pathway parallel to the stream.

Hydrogeology

Site hydrogeology consists of a low permeability vadose zone of silty clay soil that transitions into saprolite. The transmissivity of the saprolite zone increases with depth as the weathering profile transitions from rock fragments in a silty clay matrix to cobble-sized rock fragments in a sand/gravel matrix, eventually becoming fractured volcanic bedrock. The number of bedrock fractures generally decreases with depth, although highly fractured bedrock was observed from 141 to 159 feet below ground surface (bgs) in the Santana well. These fractures act as conduits for deeper groundwater movement.

Groundwater/surface water interaction in the vicinity of the Site is complex. Figure 2 shows the potentiometric map based on the water levels in the shallow bedrock wells. Base flow in the unnamed stream is likely the result of groundwater discharge from the saprolite, which has a water elevation higher than the adjacent stream level (at PZ-1). However, water levels in both the shallow and deep bedrock wells are lower than water levels in the adjacent unnamed stream. Where high angle fractures from these bedrock zones intercept the stream, it is expected to lose water to the bedrock. Regular pumping by the Santana well may be lowering groundwater levels in the shallow and deep bedrock and inducing infiltration of stream water into the bedrock aquifer near the Santana well area. The relationship between surface water and groundwater likely varies along the stream depending on the location of fractures connecting to the shallow and deep bedrock and the extent of the influence of Santana well pumping.

Land Use

According to 2010 census figures, Corozal's population is 37,142 people and the population at the Palos Ward is 3,458. Corozal covers an area of approximately 42 square miles. The primary land use in the vicinity of the Site is residential with some agricultural (plantain/banana farming) and light commercial activity. The population currently served by the Santana well is about 200 people.

Ecology

Habitats throughout the Site support a number of ecological receptors and communities. The unnamed stream is a high gradient stream with a well-defined channel situated within a heavily vegetated steep-sloped valley.

Threatened, endangered, and rare species and sensitive environments are not present in the vicinity of the Site and were not observed during the site reconnaissance, although sitings of the endangered Puerto Rican parrot (*Amazona vittata vittata*) have been observed in the municipality of Corozal.

EARLY SITE INVESTIGATIONS

In November 2010, PCE was detected at levels exceeding the EPA MCL in the Santana well. In December 2010, February 2011, and March 2011, PREQB and EPA collected groundwater, surface water, and soil samples from the Site for volatile organic compound analysis. EPA also investigated three facilities located upstream of the Santana well and in the same watershed (ERC Manufacturing, RO Rental Equipment, and Up Construction Corporation). Analytical results indicate that PCE was isolated to the Santana well and an adjacent unnamed stream at levels exceeding the MCL.

In March 2011, an analysis of the Santana well indicated that the upper zone of the well casing was probably in contact with shallow groundwater contaminated with PCE. The well was reconfigured and the upper zone of the well was sealed, eliminating that as a pathway to that portion of the aquifer, as that was considered to be a likely source of the contamination. In addition, a granular activated carbon (GAC) system was added to treat water from the Santana well before distribution to residents.

Currently, EPA maintains the GAC system. Since 2011, raw water PCE concentrations have decreased and are currently below the MCL of 5 μg/L. PCE has not been detected in either of the next nearest municipal wells, the Don Antonio (La Riviera) or Nieves-Sanchez wells. As shown on Figure 3, Nieves well is upgradient of the Santana well along the unnamed stream and the Don Antonio well is downgradient along the unnamed stream.

NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination in Site media was assessed during the RI by comparing analytical results to Site-specific screening criteria. Screening criteria are values used in the RI to conservatively screen potential areas of contamination. PCE is the main contaminant that caused the temporary closure of the Santana well. PCE is also the primary contaminant detected in Site media based on the frequency and magnitude of detections. Further, it is the only contaminant that exceeded its screening criterion in Site media, with the exception of arsenic and trichloroethylene (TCE) in one monitoring well sample. For this reason, PCE is considered the primary Site-related contaminant at the Site. TCE is also considered a Site contaminant because it was detected in one Site well and because it is a daughter product of PCE.

Environmental media investigated during the RI (October 2013 to February 2015) included groundwater, soil, surface water, sediment, pore water, and soil gas. The following RI field activities were completed by media:

- Groundwater - Groundwater screening, deep bedrock borehole drilling, borehole geophysics, wireline fracture zone sampling, deep bedrock well installation, shallow bedrock well drilling and installation, piezometer and staff gauge installation, groundwater sampling, synoptic water level measurements, slug testing, long-term water level monitoring, and Santana supply well recovery tests.
- Soil - Passive soil gas screening, potential source area (PSA) surface and subsurface soil sampling, septic tank soil sampling, and surface geophysical investigations.
- Surface Water - Surface water, sediment and pore water sampling.
- Surveys - Topographic, ecological, and cultural resource surveys.

The results of the sampling events are discussed below.

Summary of Soil Contamination

PCE was detected in 8 of the 14 passive soil gas screening samples, at concentrations ranging from 4 to 7,184 nanograms (ng)/sampler. As shown in Figure 4, the majority of PCE detections in soil gas samples and the highest concentrations were clustered along the eastern bank of the upper reaches of the intermittent stream. The highest PCE concentration (7,184 ng/sampler) was detected in SG-03, and it was almost 60 times higher than the next highest concentration.

PCE was detected in only one soil boring, SB-08 (Figure 5), located adjacent to SG-03, which was the soil gas screening sample with the highest PCE level in soil gas (Figure 4). The surface soil sample collected in silty clay from 0 to 2 feet below ground surface (bgs) contained PCE at 9.1 micrograms per kilogram (µg/kg); saprolitic soils from 5.5 to 6.5 feet bgs contained PCE at 14 µg/kg. PCE was not detected in the deeper sample from 10.5 to 11.5 feet bgs. Septic tank soil sampling was conducted to assess whether septic systems were a source of PCE contamination. PCE was not detected in any of the soil samples collected adjacent to septic tanks.

These sampling results identify that the highest PCE level in soils is located along the eastern bank of the upper reaches of the intermittent stream in both surface soils and the saprolite. This distribution suggests that PCE was likely disposed of to the ground in this area and subsequently migrated downward to the saprolite. The relatively low concentrations (maximum of 14 µg/kg) are indicative of residual levels of PCE, suggesting that the original source of PCE source has likely migrated downgradient into the saprolite and underlying bedrock fractures. This area is considered a former source area; the quantity and concentration levels of the original PCE source cannot be determined from current residual levels. No other potential source areas were identified.

Summary of Groundwater Contamination

PCE was detected in three of the seven groundwater screening samples, which were all collected in the saprolite. These locations are shallow (less than 18 feet bgs) and are clustered along the northern bank of the unnamed stream, downgradient of the former source area and upgradient of the Santana well (Figure 6). GWS-6 and GWS-7, the two sample locations where the results exceeds the PCE criterion of 5 µg/L, are located closest to the Santana well. Concentrations of PCE in these screening samples were 7.1 and 9.7 µg/L, respectively. PCE concentrations detected in piezometer well PZ-1, screened in the transition zone between the saprolite and shallow bedrock, were 10 and 13 ug/L in Rounds 1 and 2, respectively.

PCE is present in the Santana well at concentrations currently below the MCL (5 µg/L) (Figure 7). PCE is also in shallow bedrock groundwater at MW-3S (58 feet bgs to 78 feet bgs), located on the eastern bank of the upper reaches of the intermittent stream, in the vicinity of the former source area. Further downgradient of this area, PCE exceeded its criterion in shallow saprolite groundwater screening locations near the unnamed stream, the saprolite/shallow bedrock piezometer well PZ-1 (10 to 13 ug/L) shallow bedrock wells MW-4S, and MW-2S (5.5 to 13 ug/L), and in deep bedrock well MW-4D (20 to 27 µg/L). The shallow bedrock wells range from 61 to 79 feet bgs and the deep wells range between 140.8 and 162.2 feet bgs. Pumping drawdown and recovery data from the Santana well and long-term water level monitoring data for MW-3 and MW-4 indicate that the shallow and deep bedrock fractures beneath the stream valley are hydraulically connected to the Santana well. This fracture network provides a pathway for PCE migration, which is likely enhanced by pumping at the Santana well. Figures 8 and 9 show the spatial distribution and cross section of PCE detections in monitoring wells, respectively.

Arsenic marginally exceeded its screening criterion of 10 µg/L in MW-2D, at 12 µg/L. It was not detected in any other monitoring well sample and is, therefore, not considered to be Site related.

Summary of Surface Water/Sediment Contamination

PCE was detected in 9 of the 12 pore water samples. PCE exceeded its screening criterion of 5 µg/L in one pore water sample, WP-05 (33 µg/L), located in the unnamed stream approximately 100 feet south of the source area (Figure 10). PCE was not detected in the intermittent stream or the three most upstream samples in the unnamed stream, including the background sample.

PCE was detected below its screening criterion in 8 of the 15 surface water samples at concentrations ranging from 0.59 to 2.6 µg/L. These detections were co-located with the detections in pore water samples, at locations downstream of the former source area. The highest levels, 2.2 and 2.6 µg/L, were in the samples closest to the former source area. PCE was not detected in the three upstream samples in the unnamed stream, including the background sample, or in any of the samples in the intermittent stream. The PCE concentrations in the 2014 surface water samples are lower than those in surface water samples collected previously by EPA in 2010 and 2011 (Figure 11). The surface water sample results at the Site clearly show a decreasing trend over the years, from 2010 to 2011 and to 2014. The decreasing surface water PCE concentrations could be attributable to a decrease in concentrations of contaminated groundwater at the Site discharging to the surface water. The decreasing trend of PCE in surface water is similar to the decreasing trend of PCE concentrations in the Santana well itself.

PCE was not detected in any sediment samples collected from the unnamed stream or the intermittent stream. Figure 10 displays all surface water, pore water and sediment sampling results.

Evaluation of Natural Attenuation

"Natural attenuation" refers to naturally occurring attenuation processes that are already present in an aquifer to decrease contaminant concentrations. It can be considered as a remedial component if it can be expected to achieve site-specific remediation goals within a reasonable time frame when compared to other remedial measures. Natural attenuation processes that reduce PCE and TCE contaminant concentrations in groundwater include destructive (e.g., biodegradation, abiotic degradation, and chemical reactions with other subsurface constituents) and nondestructive mechanisms (e.g., volatilization, dissolution, dilution/dispersion and adsorption/desorption).

Biodegradation is frequently a significant destructive attenuation mechanism. Chlorinated solvents, such as PCE and TCE, attenuate predominantly by reductive dechlorination under anaerobic conditions. At the Site, there is insufficient evidence to support the conclusion that biodegradation alone can be effective to address the groundwater contaminants within a reasonable timeframe. There is little evidence that biodegradation of PCE may be occurring. That evidence is limited to the presence of TCE and vinyl chloride in the bedrock, which are both PCE biodegradation products. In the shallower zones and the bedrock, PCE and TCE may not be concentrated enough in the groundwater to sustain a community of dechlorinating bacteria, and conditions for complete and sustainable reductive dechlorination of these compounds does not appear to be present.

While biodegradation alone cannot be relied upon for natural attenuation, nondestructive mechanisms are present, and multiple rounds of groundwater sampling suggests a continuing downward trend in PCE and TCE concentrations. There are six lines of evidence which indicate that natural attenuation may be capable of reducing concentrations within a reasonable timeframe:

- No continuing source of contamination was found that would cause the plume to expand in the future. Thus, the plume is expected to currently be either stable or shrinking.

- Dilution and dispersion are active attenuation mechanisms in the plume, enhanced by the continued pumping of the Santana well and the typically high rainfall rates in the area.

- Historical data from surface water and from the Santana well indicate that PCE concentrations in these media have decreased over time. No exceedances of surface water criteria were detected during the RI, and PCE concentrations in the Santana well have decreased from 120 ug/L in December 2010 to below MCLs since November 2013. Given these trends and since no continuing source was identified, it is reasonable to expect that concentrations are also decreasing in the surrounding plume.

- A Mann-Kendall statistical analysis of the historical data from the Santana well showed a statistically significant decrease in concentrations over time. Decreasing trends were evident both before the upper zone was cased off and afterwards.

- Observed groundwater concentrations are less than one order of magnitude higher than their respective MCLs. Based upon EPA's experience, the time needed for a reduction in concentrations falls within a reasonable time frame, based the bounds of what has been observed with natural attenuation at other sites.

- There is evidence of degradation in MW-4D provided by the observed reduction in PCE concentrations and an increase in TCE and vinyl chloride concentrations (not detected in the first round of sampling) during the second round of sampling.

SUMMARY OF SITE RISKS

The purpose of the risk assessment is to identify potential cancer risks and non-cancer health hazards at the Site assuming a scenario that no remedial action is taken. A risk assessment was performed to evaluate current and future cancer risks and non-cancer health hazards based on the results of the RI.

A screening-level ecological risk assessment was also conducted to assess the risk posed to ecological receptors as a result of Site-related contamination.

Human Health Risk Assessment

As part of the RI/FS, a baseline human health risk assessment was conducted to estimate the risks and hazards associated with the current and future effects of contaminants on human health and the environment. A baseline human health risk assessment is an analysis of the potential adverse human health effects caused by hazardous-substance exposure in the absence of any actions to control or mitigate these under current and future land uses.

A four-step human health risk assessment process was used for assessing site-related cancer risks and non-cancer health hazards. The four-step process is comprised of: Hazard Identification of Chemicals of Potential Concern (COPCs), Exposure Assessment, Toxicity Assessment, and Risk Characterization (see adjoining box "What is Risk and How is it Calculated?").

The baseline human health risk assessment began with selecting COPCs in the various media (i.e., soil, surface water, sediment, and groundwater) that could potentially cause adverse health effects in exposed populations. Groundwater was the only media that contained contaminants above screening values. The current and future land use scenarios include the following exposure pathways and populations:

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these under current- and future-land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the COPCs at the Site in various media (*i.e.*, soil, groundwater, surface water and air) are identified based on such factors as toxicity, frequency of occurrence and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants in air, water, soil, etc. identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil and ingestion of and dermal contact with contaminated groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other non-cancer health hazards, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and non-cancer health hazards.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks for all COPCs. Exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means an "one-in-ten-thousand excess cancer risk;" or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the Exposure Assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10^{-4} to 10^{-6}, corresponding to an one-in-ten-thousand to a one-in-a-million excess cancer risk. For non-cancer health effects, a "hazard index" (HI) is calculated. The key concept for a non-cancer HI is that a threshold (measured as an HI of less than or equal to 1) exists below which non-cancer health hazards are not expected to occur. The goal of protection is 10^{-6} for cancer risk and an HI of 1 for a non-cancer health hazard. Chemicals that exceed a 10^{-4} cancer risk or an HI of 1 are typically those that will require remedial action at the Site.

- Residents (adult/child): future ingestion, dermal contact, and inhalation of vapors from residential use of untreated groundwater. Current exposure was not evaluated as there is a treatment system on the contaminated well.

In this assessment, exposure point concentrations were estimated using either the maximum detected concentration of a contaminant or the 95% upper-confidence limit of the average concentration. Chronic daily intakes were calculated based on the reasonable maximum exposure (RME), which is the highest exposure reasonably anticipated to occur at the Site. The RME is intended to estimate a conservative exposure scenario that is still within the range of possible exposures. Central tendency exposure assumptions, which represent typical average exposures, were also developed. A complete summary of all exposure scenarios can be found in the baseline human health risk assessment.

Risks and hazards were evaluated for the potential future exposure to groundwater. The populations of interest included residential adults and children. The cancer risks were above the EPA acceptable ranges, primarily because of arsenic. The non-cancer hazards were above the EPA acceptable value of 1, primarily because of TCE and arsenic. Arsenic was not considered to be Site-related because of being at concentrations similar to background. Additionally, TCE and PCE were both detected at concentrations above the MCL of 5 µg/L; therefore, PCE was also identified as a COPC in the groundwater (Table 1).

Additionally, lead in groundwater was evaluated, and all detected lead concentrations were below the Puerto Rico Water Quality Standard for Class SG groundwater.

Based on the results of the human health risk assessment a remedial action is necessary to protect public health, welfare and the environment from actual or threatened releases of hazardous substances in the groundwater.

Table 1. Summary of hazards and risks associated with groundwater at the Site

Receptor	Hazard Index	Cancer Risk
Residential adult – future	-----	**$3.0x10^{-4}$**
Residential child – future	**6**	
The COPCs identified in the groundwater for the Site was TCE and PCE due to TCE (3.8) being above a hazard index of 1 and TCE and PCE being above the MCL of 5 µg/L.		

Ecological Risk Assessment

A screening-level ecological risk assessment (SLERA) was conducted to evaluate the potential for ecological risks from the presence contaminants in soil, sediment, surface water, and pore water. The SLERA focused on evaluating the potential for impacts to sensitive ecological receptors to site-related constituents of concern through exposure to soil, sediment, surface water, and pore water on the Site. Concentrations in the media listed above were compared to ecological screening values as an indicator of the potential for adverse effects to ecological receptors. A complete summary of all exposure scenarios can be found in the SLERA.

There is no a potential for adverse effects to ecological receptors (invertebrates, reptiles, amphibians, birds, and mammals) from exposure to contaminated soil, sediment, surface water or pore water. The screening criteria for all chemicals in these media were below the acceptable hazard index of 1. There were no COPCs identified for ecological receptors.

Based on the results of the ecological risk assessment, there is no unacceptable risk posed to ecological receptors by the Site conditions.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards, such as applicable or relevant and appropriate requirements (ARARs), to-be-considered (TBC) guidance, and Site-specific risk-based levels.

EPA has established expectations to use treatment to address any principal threats posed by a site. Principal threat wastes are those source materials considered to be highly toxic or mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. Contaminated groundwater generally is not considered to be a source material; however, non-aqueous phase liquids (NAPLs) in groundwater may be viewed as source material. NAPLs are hydrocarbons that exist as a separate, immiscible phase when in contact with water and/or air. NAPLs are not present in groundwater at the Site, and no principal threat waste has been identified. The Site was placed on the National Priority List of Superfund sites because of detection of PCE contamination in the groundwater that supplies a community drinking water well (the Santana well). A remedial investigation was performed, and PCE contamination was found in soil, groundwater, and surface water (including the pore water). Therefore, PCE, and its degradation products, including TCE, are considered Site-related contaminants.

Based on the sampling result at the Site, the media of concern at the Site is groundwater. PCE was detected in the shallow zone, between 50 and 100 feet bgs, of the community well (Santana well) at historical concentrations of up to 120 µg/L, in 2010. As a result of a removal action conducted at the Site in March 2011, the shallow zone of the Santana well was sealed off and since that time the PCE concentrations in groundwater from the well samples are currently below the MCL of 5 µg/L. PCE was detected in multiple groundwater samples during the remedial investigation, including samples from the shallow and deep bedrock units, with the highest residual concentration of 27 ug/L found in the deep bedrock. While surface water sampling did identify low levels PCE, the surface water and sediments are not considered media of concern for the Site.

To protect human health and the environment, RAOs have been identified.

The RAOs for groundwater are:

- Prevent human exposure to contaminant concentrations in groundwater above levels that are protective of drinking water.

REMEDIATION GOALS

To meet the RAOs, remediation goals were developed to aid in defining the extent of contaminated groundwater requiring remedial action. Remediation goals are chemical-specific measures for each media and/or exposure route that are expected to be protective of human health and the environment. They are derived based on comparison to ARARs, risk-based levels, and background concentrations, with consideration also given to other requirements such as analytical detection limits, guidance values, and other pertinent information. Federal MCLs (5 ug/L for PCE and 5 ug/L for TCE) are the remediation goals for the Site.

SUMMARY OF REMEDIAL ALTERNATIVES

CERCLA § 121(b)(1), 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, be cost-effective, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions which employ, as a principal element, treatment to permanently and significantly reduce the volume, toxicity, mobility of the hazardous substances, pollutants, and contaminants at a site. CERCLA § 121(d), 42 U.S.C. § 9621(d), further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants, which at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4).

The time frames presented below for each alternative reflect only the time required to construct or implement the remedy and do not include the time required to design the remedy, negotiate the performance of the remedy with any potentially responsible parties, or procure contracts for design and construction.

The cost estimates, which are based on available information, are order-of-magnitude engineering cost estimates that are expected to be within +50 to -30 percent of the actual cost of the project.

Common Elements

There are several common elements that are included in all active remedial alternatives. With the exception of five-year reviews, the common elements listed below do not apply to the No Action alternatives.

Pre-Design Investigation (PDI)

The nature and extent of groundwater contamination in both the saprolite and shallow bedrock would be fully delineated in a PDI. Design parameters would also be obtained during the PDI.

Santana Well GAC Unit Maintenance

The existing GAC unit at the Santana well would be maintained to ensure the prevention of human exposure to contaminant concentrations in groundwater above the remediation goals. To protect human health by ensuring that the concentrations prior to distribution are below MCLs and monitor the groundwater concentrations, the influent and effluent would typically be sampled once per month.

Monitored Natural Attenuation (MNA) of the Deep Bedrock

MNA for both the bedrock and shallower groundwater is considered in Alternative 2. MNA for the deep bedrock is also a remedial component of the other active remedial Alternatives 3 and 4. In evaluating active remedies for the deep bedrock, several factors were considered in the FS, including the effect that bedrock actions may have on the functionality of the Santana well. For example, groundwater extraction in the bedrock can provide hydraulic control and contaminant removal at sites where hydrogeologic conditions support it and where pumping rates to maintain hydraulic control are sustainable. At this Site, the contaminated regions of the deep bedrock may be hydraulically connected to the Santana well; but the deep bedrock is also not highly transmissive, and the volcanic bedrock fracture system is highly complex, such that an extraction well network is likely to draw cleaner water away from the Santana well rather than withdrawing, or even hydraulically controlling the migration of contaminants in the deep bedrock.

Furthermore, there are few other technologies that are likely to be effective in a poorly transmissive bedrock aquifer system such as this one. The most promising technologies, such as *in-situ* treatment techniques (discussed in detail in the FS report) may be able to treat the PCE and TCE. But they also have the potential to introduce treatment chemicals that could preferentially enter the Santana well rather than reach the deep bedrock fractures where the PCE and TCE reside. On balance, EPA has concluded that the limited effectiveness of the available treatment technologies, when compared to the decreasing trends already seen across the plume, including in the deep bedrock, support a MNA-only approach to the deep bedrock.

Institutional Controls

Institutional controls should restrict the future construction of groundwater extraction wells until cleanup is complete.

More information about Institutional Controls can be found at: http://www2.epa.gov/sites/production/files/documents/ic_ctzns_guide.pdf

Five-Year Reviews

Per CERCLA, alternatives resulting in contaminants remaining above levels that allow for unrestricted use and unlimited exposure require that the Site be reviewed at least once every five years. If justified by the review, additional remedial actions may be implemented to remove, treat, or contain the contamination. The Site review would include evaluation of data collected from the long-term monitoring, a Site-wide visual inspection, and a report prepared by EPA.

EPA Region 2 Clean and Green Policy

The environmental benefits of the preferred remedy may be enhanced by giving consideration, during the design, to technologies and practices that are sustainable in accordance with EPA Region 2's Clean and Green Energy Policy. This will include consideration of green remediation technologies and practices. Some examples of practices that would be applicable are those that reduce emissions of air pollutants, minimize fresh water consumption, incorporate native vegetation into revegetation plans, and consider beneficial reuse and/or recycling of materials, among others.

Remedial Alternatives

The remedial alternatives to address groundwater contamination at the Site are summarized below.

Alternative 1 – No Action

Capital Cost	$0
Present Worth O&M Cost	$0
Total Present Worth Cost	$0
Construction Time Frame	0 years
Timeframe to meet RAOs	not applicable

The No Action alternative is required to be considered pursuant to the NCP. The No Action alternative would include no action being taken and serves as a baseline for comparison of remedial alternatives.

Alternative 2 – Monitored Natural Attenuation (MNA) and Institutional Controls

Capital Cost	$43,000
Present Worth O&M Cost	$1,439,000
Total Present Worth Cost	$1,482,000
Construction Time Frame	1 year
Timeframe to meet RAOs	15 years

This alternative would rely on MNA to reduce contaminant concentrations remaining in the aquifer to the remediation goals, and would also use institutional controls (ICs) to assure that areas of the plume above the remediation goals are not used for drinking water purposes. While the remediation goals area still exceeded in areas upgradient of the Santana well, monitoring of the well and maintenance of the existing treatment system would continue, to assure a safe drinking water supply for its users.

A long-term monitoring program for the Site would be instituted. MNA requires a robust monitoring program to demonstrate that the conditions supporting natural attenuation continue to be present, and that decreasing plume trends perpetuate. Monitoring should continue until concentrations have achieved the remediation goals.

For costing purposes, it is assumed that ten existing monitoring wells in the bedrock and five new monitoring wells to be installed in the saprolite would be used for the monitoring program. Santana well sampling activities would continue, along with the Santana GAC unit maintenance; sample results would be included in the long-term monitoring program. The monitoring data collected would be evaluated and used to assess the migration and attenuation of the groundwater contamination.

To estimate the timeframe for MNA, an empirical rate of decrease of PCE concentrations in the Santana well (Theil-Sen regression analysis) after the well was modified and reopened by EPA was calculated using EPA's Groundwater Statistical Tool software and ProUCL software. This rate is considered representative of the expected attenuation in PCE concentrations in the deep bedrock at the Site, as the natural attenuation in deep bedrock is the controlling factor for the time required to reach MCLs at the Site.

The Mann-Kendall statistics indicate that there is a statistically significant decreasing trend in concentrations. Applying a calculated rate of decrease to the highest observed concentration in a monitoring well (27 µg/L in MW-4D) predicts that the remediation goals would be met in nine years. Given a wide range of uncertainties in this analysis, nine years was statistically translated to a range of between six and 15 years before PCE concentrations in MW-4D would reach MCLs. For cost-estimating purposes, the duration of the remedial action is estimated to be 15 years. It is assumed that samples would be collected twice per year for the first two years of the monitoring program and then annually for 13 years thereafter.

Alternative 3 – Groundwater Extraction, Treatment, and Long-term Monitoring; and Institutional Controls

Capital Cost	$883,000
Present Worth O&M Cost	$2,097,000
Total Present Worth	$2,980,000
Construction Time Frame	2-3 years
Timeframe to meet RAOs	15 years

Under this alternative, the groundwater plume contaminated with PCE above the remediation goals in the saprolite and shallow bedrock zone would be targeted for extraction, treatment, and surface water discharge to the unnamed stream. A groundwater extraction well would serve to extract contamination from the aquifer, and also create a hydraulic barrier to limit contaminant migration into the bedrock, downgradient, and the surface water. Extraction and treatment would continue until the aquifer is restored. As discussed in the common elements section, MNA would be relied upon to achieve the remediation goals in the deep bedrock.

Long-term groundwater monitoring of contaminants in the saprolite and the competent bedrock would be performed to assess remedial action performance.

For cost-estimating purposes, a range of 10 to15 gallons per minute (gpm) of pumping from a single extraction well was estimated as necessary to efficiently achieve and maintain hydraulic control during operation. The extraction well would be screened from 10 to 30 bgs, in the saprolite layer and shallow bedrock.

The extracted groundwater would be treated *ex-situ* in the groundwater treatment system, which would include GAC units in series to reduce groundwater PCE and TCE concentrations to Puerto Rico standards acceptable for surface water discharge.

For costing purposes, it was assumed that the treated groundwater would be discharged to the unnamed stream. System maintenance would include maintenance of the well, pump, and treatment process equipment. Periodic samples would be collected from various sample locations along the groundwater treatment train to verify the effectiveness of each treatment process. The lead GAC unit would be changed out when breakthrough occurs. Because of the low contaminant concentrations, GAC change-out would be infrequent.

The operation duration of the groundwater extraction and treatment system and the time to reach PRGs in the saprolite/upper fractured bedrock is estimated to be up to four years. The overall time frame for reaching the RAOs is governed by the deep bedrock, as discussed in Alternative 2.

Long-term monitoring is an essential component of an extraction system to ensure that the extraction well is effectively removing contaminants from the aquifer and hydraulically control the groundwater plume from moving downgradient. A long-term monitoring program for the Site groundwater plume, surface water, and pore water would be instituted. The monitoring program as described under Alterative 2 should continue until concentrations have attenuated to the remediation goals. The monitoring data collected would be evaluated and used to assess the migration and attenuation of the groundwater contamination and the effectiveness of the extraction system.

Alternative-4 – Air Sparge Curtain, Long-term Monitoring, and Institutional Controls

Capital Cost	$911,000
Present Worth O&M Cost	$2,369,000
Total Present Worth	$3,280,000
Construction Time Frame	4 Month
Timeframe to meet RAOs	15 years

Under this alternative, the RAOs would be met by using an air sparge (AS) curtain to remove contamination from the saturated saprolite and shallow bedrock, and through natural processes (MNA) in the bedrock. The AS process would be used to strip PCE from the groundwater as groundwater plume passes through the sparge zone.

For cost-estimating purposes, it is assumed that the curtain would be installed upgradient of the Santana Well to prevent further migration downgradient, and that sparge points would have a 10-foot radius of influence. The density and layout of the sparge locations would be determined after the PDI.

The need for a vapor-phase treatment system should be evaluated during remedial design, but based upon FS assumptions, the mass collected by a SVE system would be very low and potentially below detection limits in the system effluent and below air quality discharge standards. Thus, the FS assumed that collected vapors would be released directly to the atmosphere.

Long-term monitoring would be required, similar to Alternatives 2 and 3. Using the same approximate duration described under Alternative 2, it is estimated that the AS system would need to be operated for between six and fifteen years or for a shorter duration if the contamination in the saprolite/upper fractured bedrock attenuates faster than the deep bedrock zone. For cost estimating purposes, it is conservatively assumed that the air sparging system would be operated for 15 years.
The overall time frame for reaching the RAOs is governed by the deep bedrock, as discussed in Alternative 2.

EVALUATION OF REMEDIAL ALTERNATIVES

Nine criteria are used to evaluate remediation alternatives in order to select a remedy. This Proposed Plan profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are discussed below. A more detailed analysis of alternatives can be found in the FS.

A comparative analysis of these alternatives based upon the evaluation criteria noted above is presented below.

Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

Alternative 1 (no action) is not protective of human health and the environment. Alternatives 2, 3 and 4 are expected to be protective through a combination of active treatment of the shallow groundwater zones (for Alternatives 3 and 4), MNA, institutional controls (ICs) and the continued monitoring and maintenance of the Santana well and its GAC treatment system.

Compliance with ARARs

Groundwater at the Site is classified as SG (which includes all groundwater as defined in Puerto Rico Water Quality Standards (PRWQS) Regulation), suitable for drinking water use, and is historically and currently used as a source of potable water supply. In order to accommodate any future use of Site groundwater as a source of potable water supply, federal drinking water standards are relevant and appropriate requirements. Alternative 1 is not expected to provide for a suitable drinking water source complying ARARs during the period while MCLs are exceeded in the aquifer, because the Santana well monitoring and treatment systems would not be maintained. Alternatives 2, 3 and 4 are expected to achieve drinking water ARARs over the life of the remediation (conservatively estimated to be the next 15 years), and, through active and passive means, address exceedances still present in the aquifer.

The PRWQS Regulation for surface water discharges, which are ARARs, will be considered for groundwater if remedial alternatives under consideration entail any discharges to waters of Puerto Rico. Alternative 3 would be expected to satisfy these regulations for water discharged from the groundwater treatment plant. Similarly, the air sparging vapor phase would be expected to satisfy air emissions

NINE EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
Overall protection of human health and the environment determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
Compliance with ARARs evaluates whether the alternative would meet all of the applicable or relevant and appropriate requirements of federal and state environmental statutes and other requirements that pertain to the site, or provide grounds for invoking a waiver.
Long-term effectiveness and permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of toxicity, mobility, or volume through treatment is the anticipated performance of the treatment technologies an alternative may employ.
Short-term effectiveness considers the period of time needed to implement an alternative and the risks the alternative may pose to workers, residents, and the environment during implementation.
Implementability is the technical and administrative feasibility of implementing the alternative, including the availability of materials and services.
Cost includes estimated capital and annual operation and maintenance costs, as well as present-worth costs. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
Commonwealth acceptance considers whether the Commonwealth (the support agency) concurs with, opposes, or has no comments on the preferred remedy.
Community acceptance will be assessed in the ROD and refers to the public's general response to the alternatives described in the Proposed Plan and the RI/FS reports. Comments received on the Proposed Plan are an important indicator of community acceptance.

requirements, as discussed in the description of Alternative 4.

Long-Term Effectiveness and Permanence

Alternative 1 would not be considered a permanent remedy since no action would be implemented to reduce the level of contamination or verify any naturally occurring reduction of contaminant concentrations. Alternative 2 provides a method to monitor and evaluate the attenuation of contaminant concentrations over time because of natural processes. Alternatives 3 and 4 permanently and irreversibly reduce groundwater concentrations in the subsurface, at least for the shallow groundwater.

Reduction of Toxicity, Mobility, or Volume through Treatment

The No Action alternative would not monitor and evaluate the reduction of contaminant toxicity, mobility, volume through natural processes, because no remedial action would be conducted. Alternative 2 would not actively reduce toxicity and volume through treatment. Alternative 3 and 4 would reduce toxicity, mobility or volume through treatment in the saprolite/upper fractured bedrock.

Short-Term Effectiveness

With respect to the No Action alternative, there would be no short-term impact to the community and environment, as no remedial action would occur. There would be some minor short-term impacts to the local community and workers for alternatives 2, 3, and 4 because of the active remedial actions undertaken and associated construction and operation. Alternatives 2 through 4 are estimated to achieve the RAOs within approximately 15 years. While Alternative 3 offers the potential to remediate shallow groundwater in a shorter time frame, the bedrock is the determining factor for achievement of RAOs for all the active alternatives, including Alternative 3.

Implementability

No problems are anticipated for the implementation of Alternatives 1, 2 and 4, including the enforcement of long-term monitoring or institutional controls. Alternative 3 may encounter implementability problems with the Santana well, which draws water from the bedrock. Alternative 3 would extract groundwater from the saprolite/upper fractured bedrock, which recharges the deep bedrock aquifer. Implementation of the extraction system might be problematic as it would be competing with the Santana well water supply system.

Cost

The cost estimates for all four alternatives are provided below.

Groundwater Alternative	Capital Costs	Present Worth O&M Costs	Total Present Worth
1	$0	$0	$0
2	$ 43,000	$ 1,439,000	$ 1,482,000
3	$ 883,000	$ 2,097,000	$ 2,980,000
4	$ 911,000	$ 2,369,000	$ 3,280,000

Commonwealth/Support Agency Acceptance

The PREQB agrees with Alternative 2, the preferred remedy in this Proposed Plan.

Community Acceptance

Community acceptance of the preferred remedy will be evaluated after the public comment period ends and will be described in the Responsiveness Summary section of the ROD for this Site.

PREFERRED REMEDY

EPA's preferred alternative is Alternative 2, monitored natural attenuation and institutional controls. The preferred alternative would continue to monitor the Santana well while remediation goals are still exceeded in groundwater, along with maintaining the existing GAC system. Long-term monitoring and five-year reviews would also be required during that period. The estimated present-worth cost of the preferred alternative is $1,482,000.

The preferred alternative satisfies the two threshold criteria and achieves the best combination of the five balancing criteria of the comparative analysis. This alternative is preferred because it will achieve the RAOs and remediation goals in a comparable period of time to the other active alternatives without threatening the long-term functionality of the Santana well, a sole-source drinking source for the community.

BASIS FOR REMEDY PREFERENCE

The preferred alternative is believed to provide the best balance of tradeoffs among the alternatives based on the information available to EPA at this time. EPA and PREQB believe that the proposed remedy would be protective of human health and the environment, comply with ARARs, be cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The preferred remedy would not meet the statutory preference for the use of treatment as a principal element. The preferred alternative can change in response to public comment or new information.

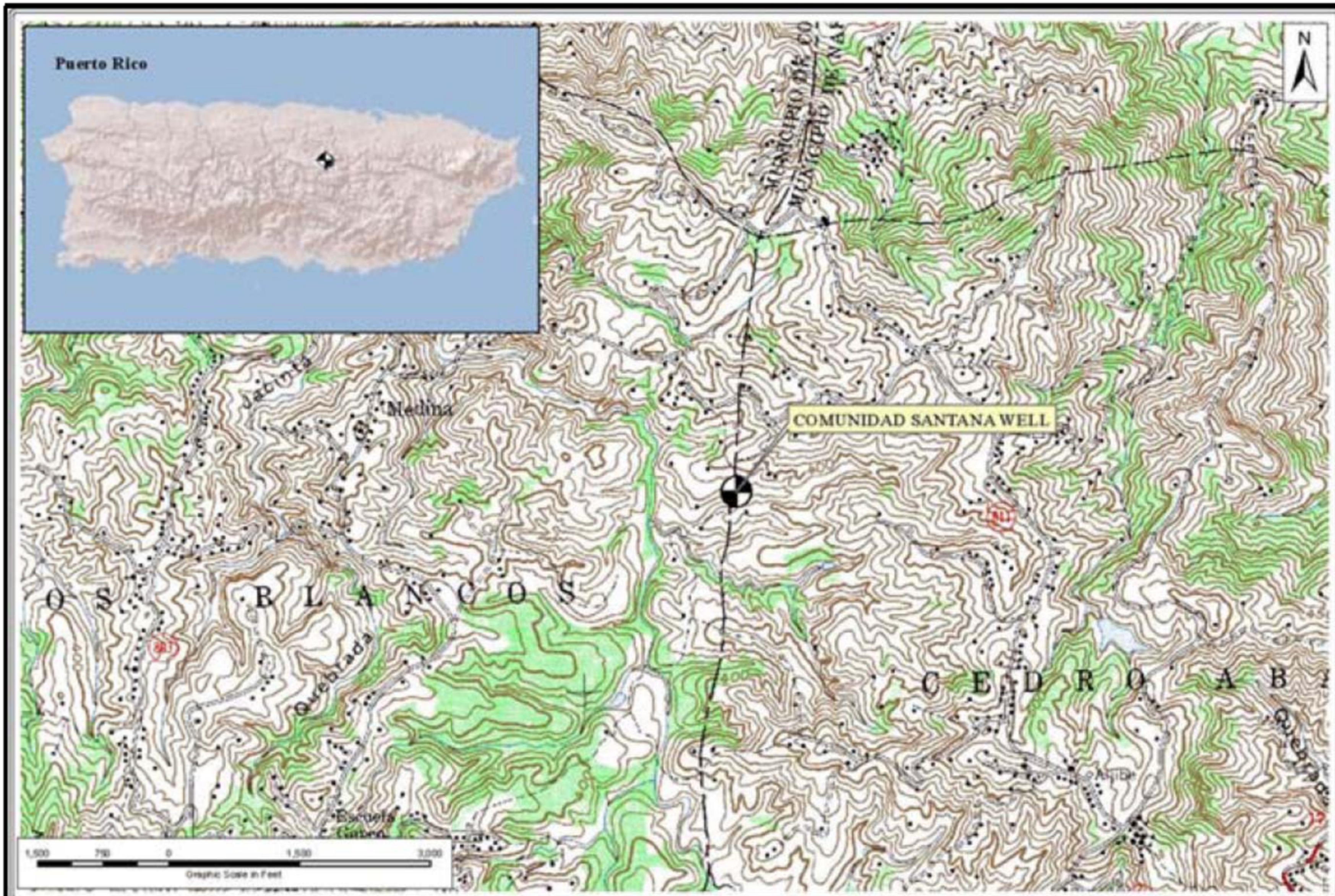


Figure 1
Site Location Map Corozal Well
Site Corozal, Puerto Rico

Legend

- Santana Well
- Deep bedrock monitoring well
- Piezometer
- Shallow bedrock monitoring well
- Unnamed stream
- Intermittent Stream
- Staff Gauge (elevation as reference only, not contoured)
- 1250 Groundwater level elevation (ft amsl)
- 1226.75 Water level elevation - 9/13/2014 (feet above mean sea level (ft amsl))

Figure 2
Shallow Bedrock Potentiometric Surface Map
Corozal Well Site
Corozal, Puerto Rico

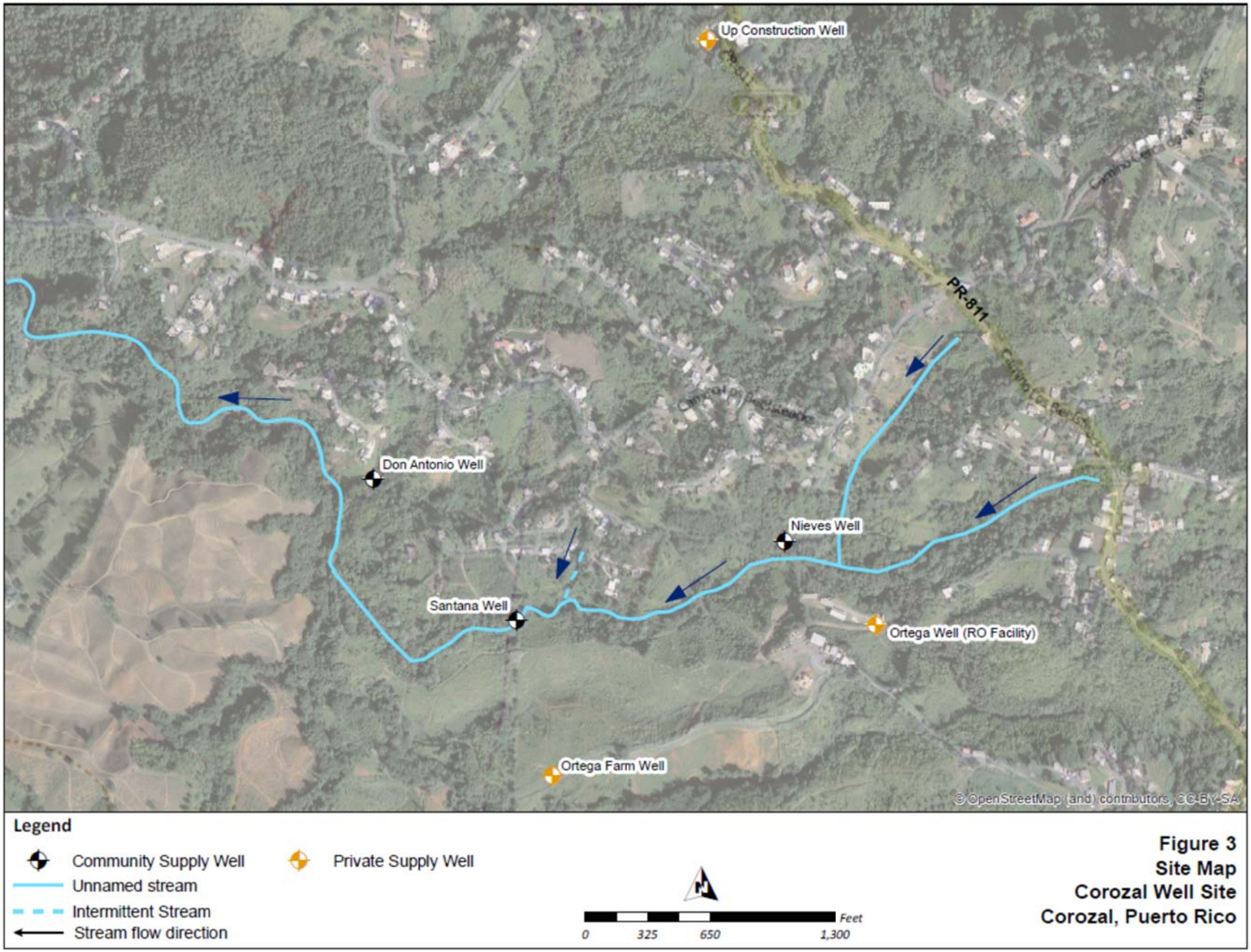


Figure 3
Site Map
Corozal Well Site
Corozal, Puerto Rico

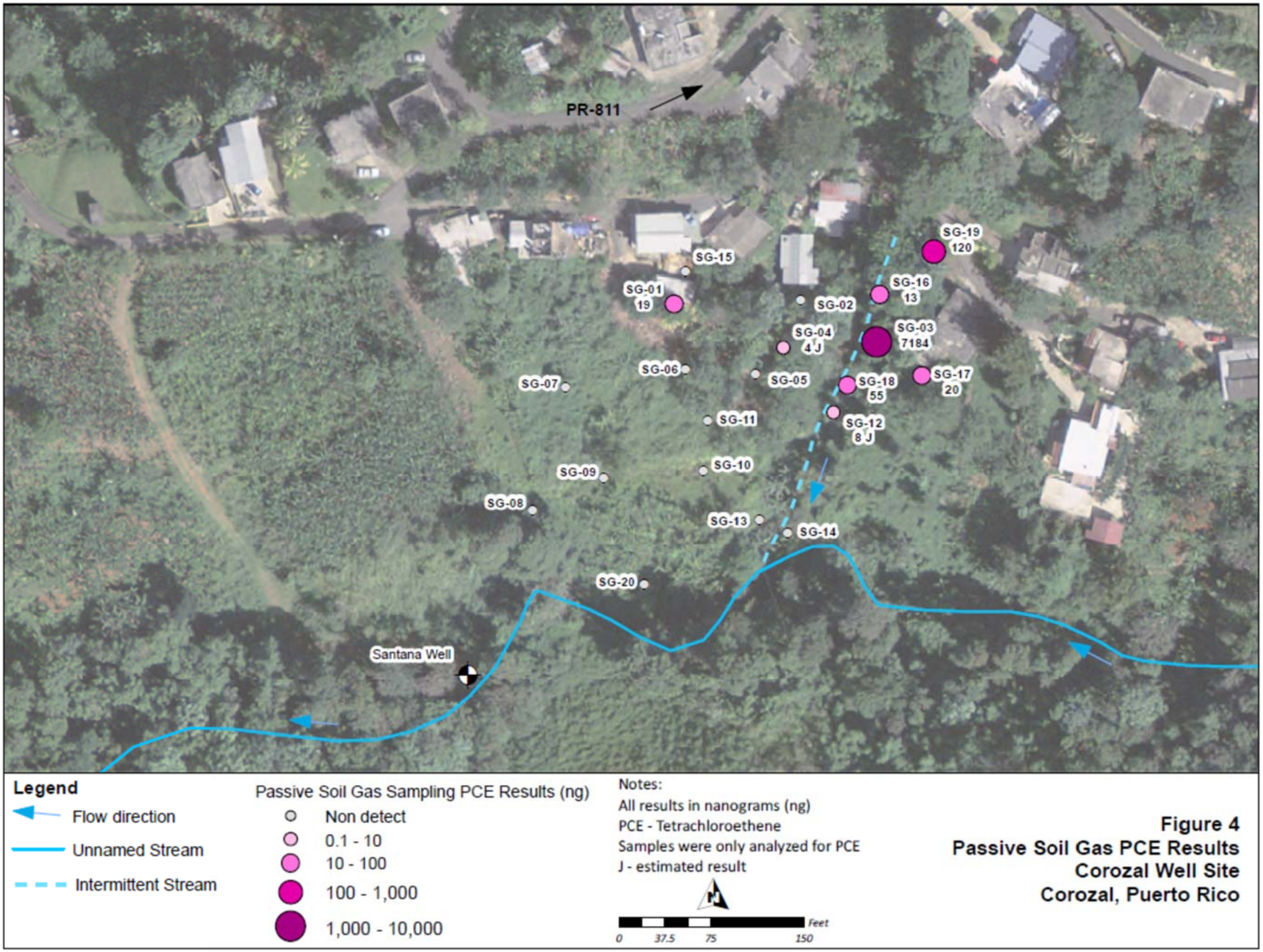


Figure 4
Passive Soil Gas PCE Results
Corozal Well Site
Corozal, Puerto Rico

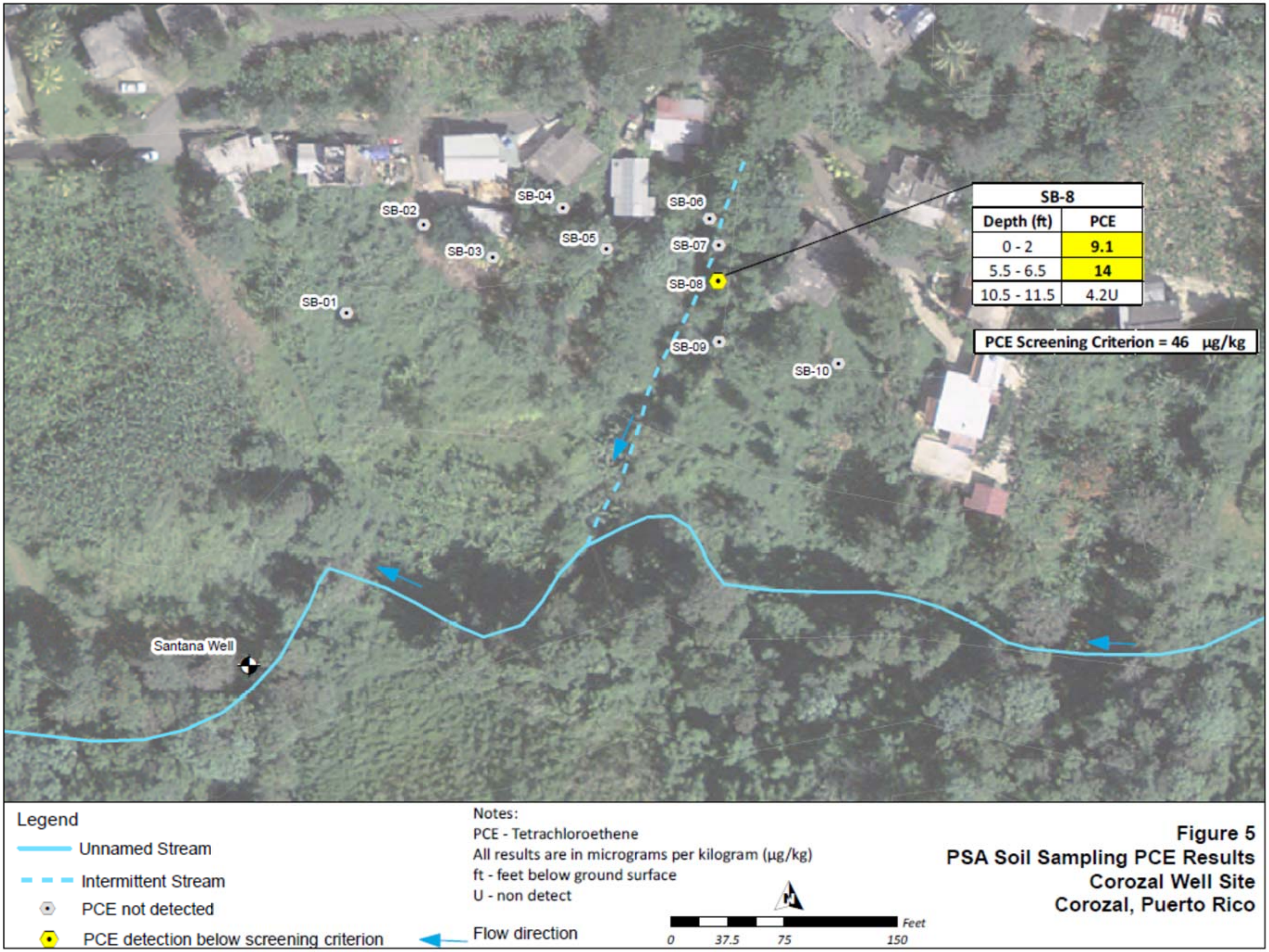


Figure 5
PSA Soil Sampling PCE Results
Corozal Well Site
Corozal, Puerto Rico

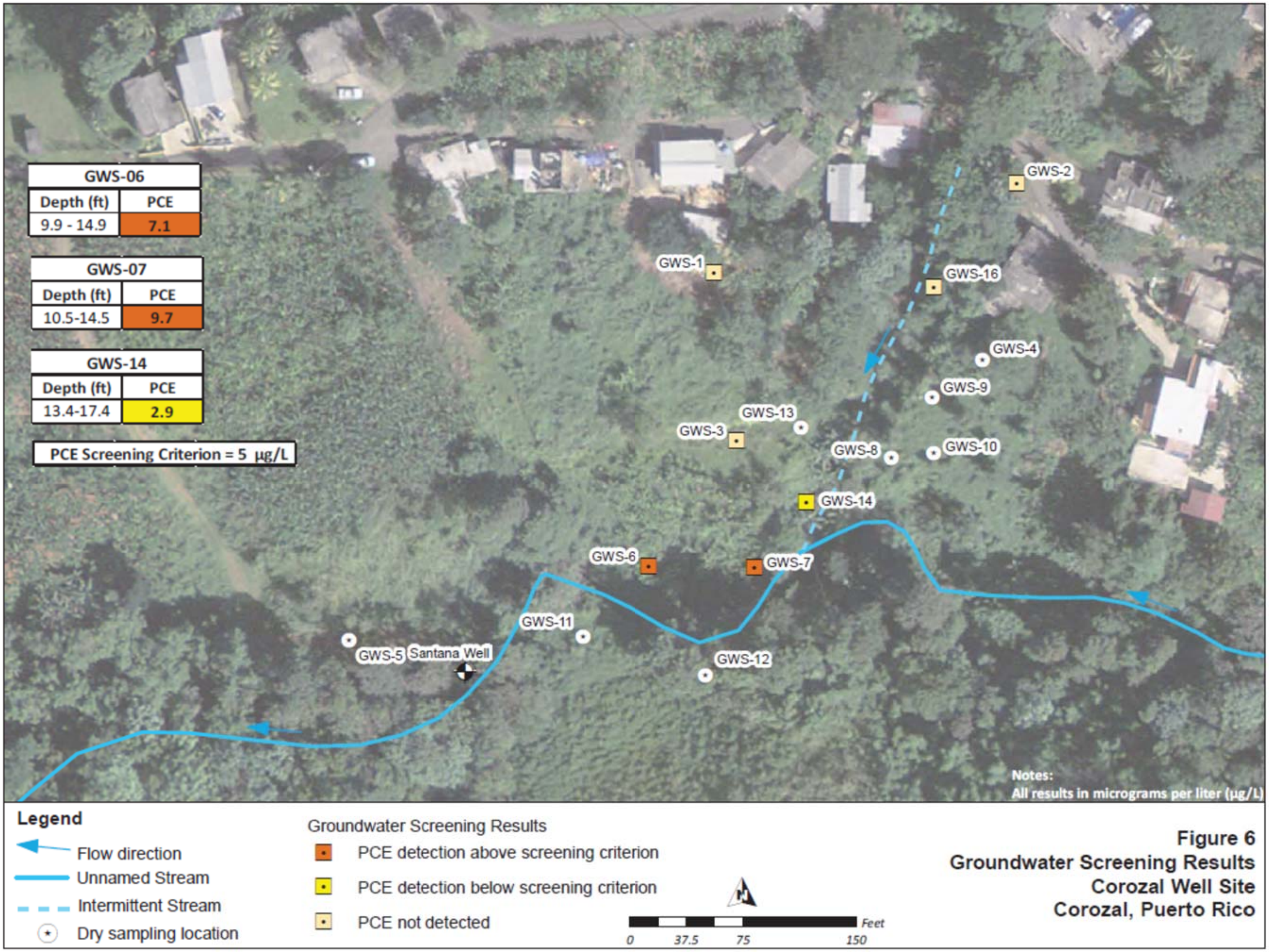
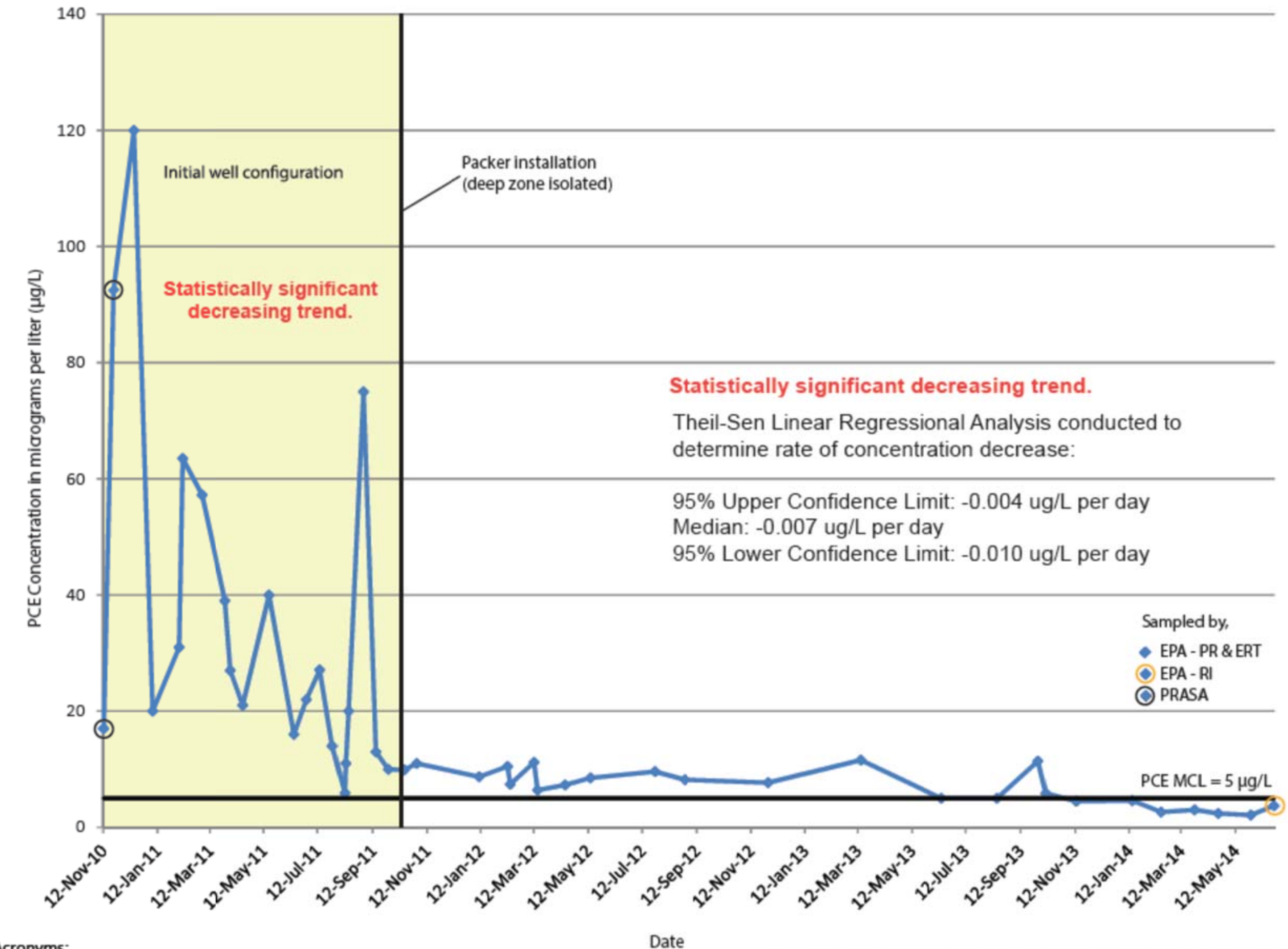


Figure 6
Groundwater Screening Results
Corozal Well Site
Corozal, Puerto Rico



Acronyms;
EPA – Environmental Protection Agency
ERT – Emergency Response Team
µg/L – microgram per liter
RI – Remedial Investigation
PRASA – Puerto Rico Aqueduct and Sewer Authority

Figure 7
Santana Well In˜uent Data, November 2010 through June 2014
Corozal Well Site
Corozal, Puerto Rico

Santana Well				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	n/a	3.7	0.5 U
Round 2	GW	n/a	4.3	0.5 U

MW-1D				
Event	Matrix	Depth (ft)	PCE	PCE
Round 1	GW	115 - 135	0.11 U	0.5 U
Round 2	GW	115 - 135	0.028 J	0.5 U

MW-2S				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	40.5-60.5	7.1	0.5 U
Round 2	GW	40.5-60.5	5.5	0.25 J

MW-3S				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	58.6-78.6	1.8	0.5 U
Round 2	GW	58.6-78.6	1.5	0.5 U

MW-3D				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	138.5 - 158.5	0.11 U	0.5 U
Round 2	GW	138.5 - 158.5	0.047 J	0.5 U

MW-4S				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	40-60	8.1	0.5 U
Round 2	GW	40-60	13	0.5 U

MW-4D				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	131-151	27	0.5 U
Round 2	GW	131-151	20	8.9

PZ-1				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	22-32	10 J	0.5 U
Round 2	GW	22-32	13	0.5 U

PCE & TCE Screening Criterion = 5 µg/L

Legend
- Santana Well
- Deep bedrock monitoring well
- Piezometer
- Shallow bedrock monitoring well
- Estimated Streambed
- Intermittent Stream
- Detection above screening criterion
- Detection below screening criterion
- Non detect

Acronyms:
MW-1S - Shallow Monitoring Well
MW-1D - Deep Monitoring Well
PCE - tetrachloroethene
TCE - trichloroethene
ug/L - micrograms per liter
ft - feet below ground surface

Feet 0 40 80 160

Figure 8
Monitoring Well PCE and TCE Results
Corozal Well Site
Corozal, Puerto Rico

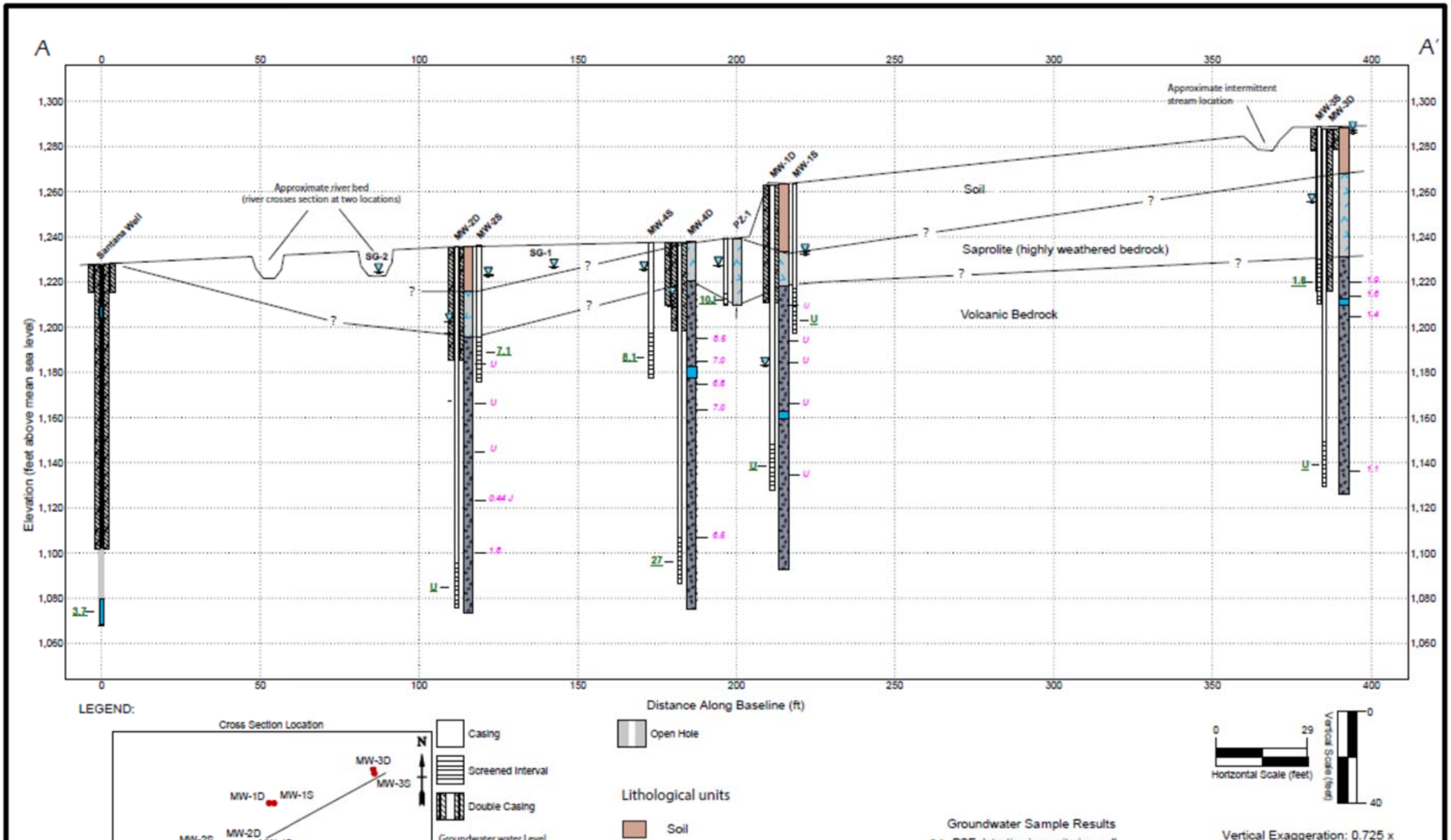


Figure 9
Bedrock Groundwater PCE Results, Cross Section A-A'
Corozal Well Site
Corozal, Puerto Rico

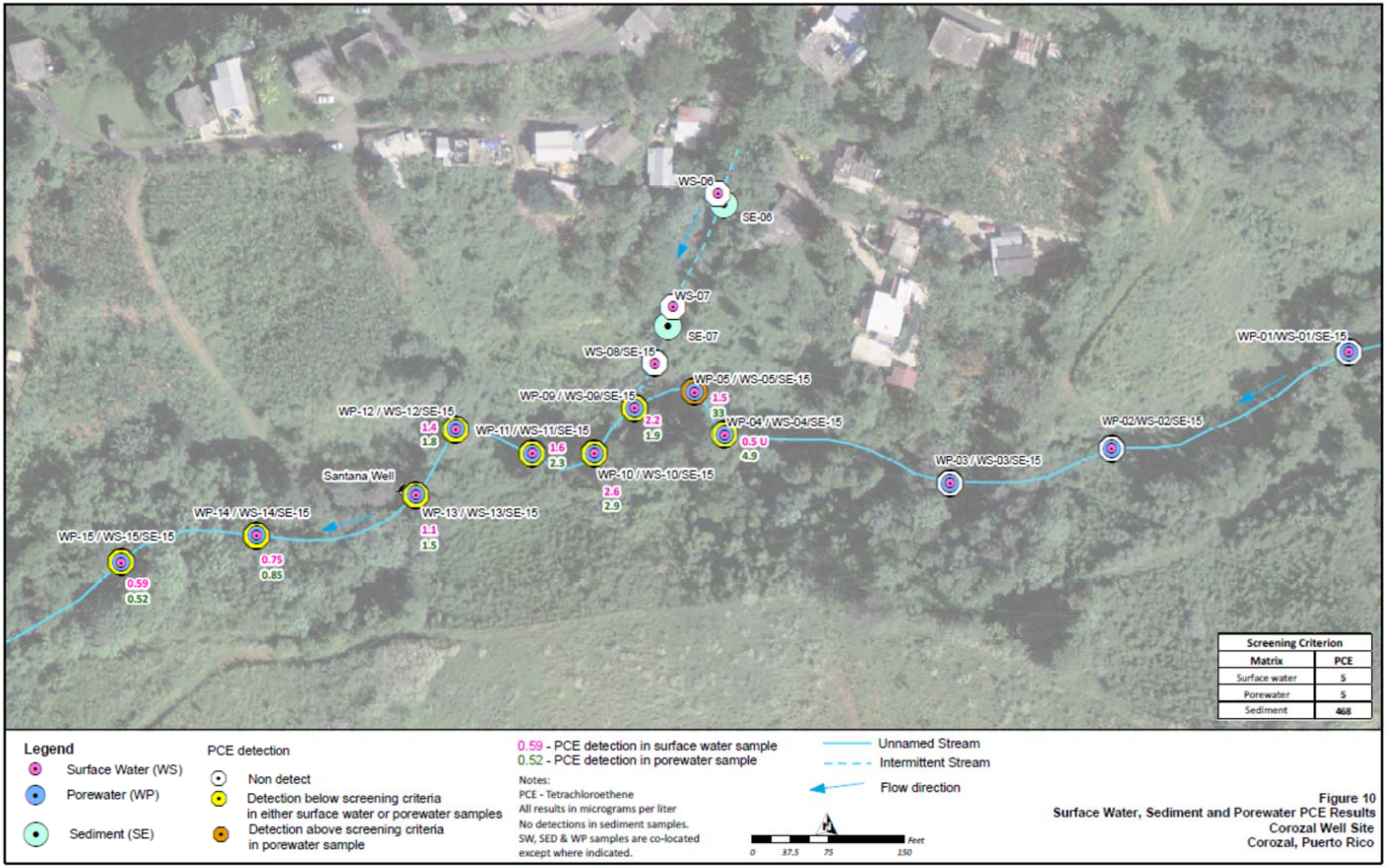


Figure 10
Surface Water, Sediment and Porewater PCE Results
Corozal Well Site
Corozal, Puerto Rico

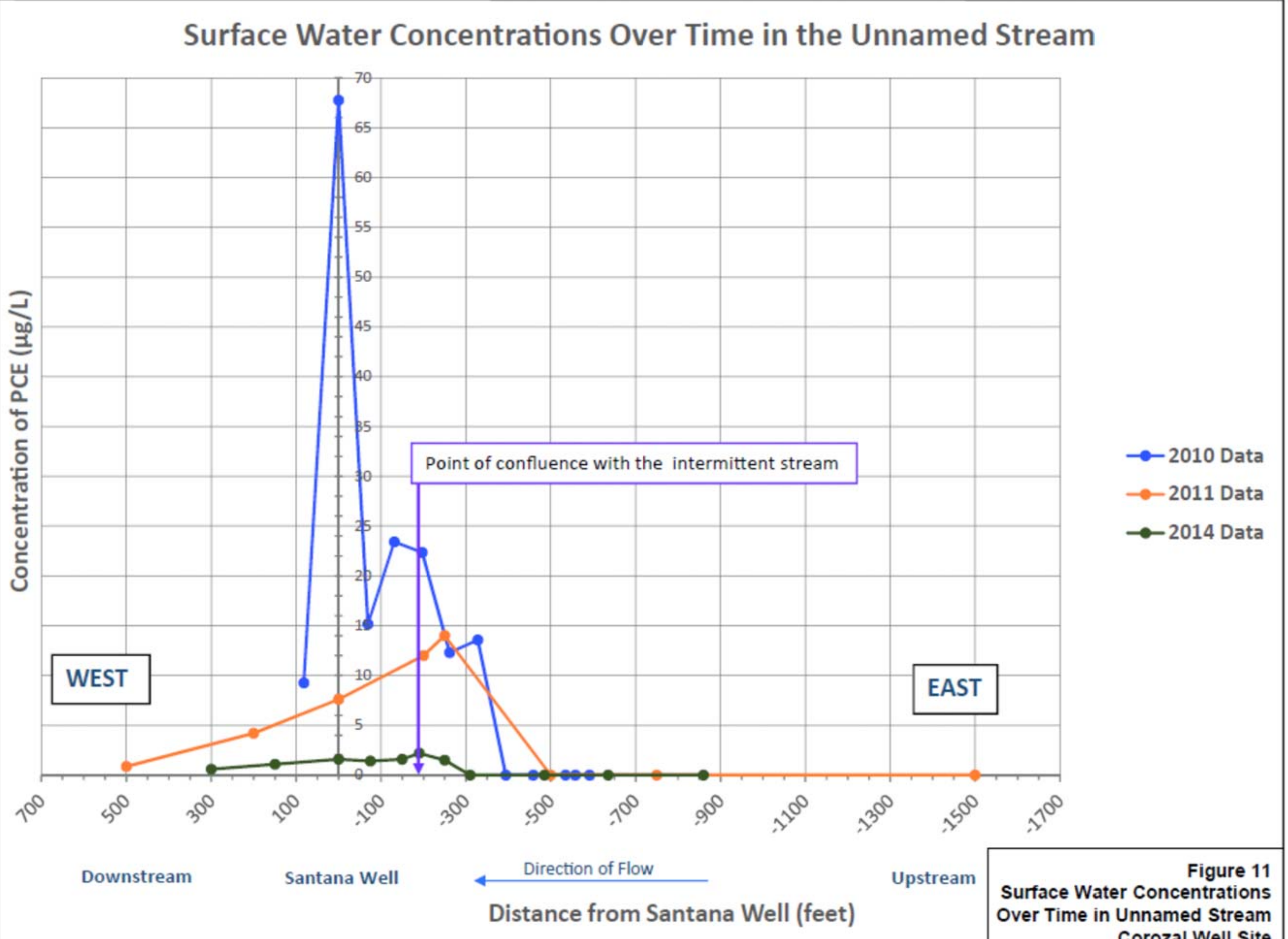


Figure 11
Surface Water Concentrations Over Time in Unnamed Stream
Corozal Well Site
Corozal, Puerto Rico

Corozal Well Superfund Site

Corozal, Puerto Rico
August 2015

EPA Region 2

United States Environmental Protection Agency

PARA OBTENER MÁS INFORMACIÓN

Participación de la Comunidad
Participación del público es esencial para el éxito del Programa de Superfondo de la EPA. Si usted tiene alguna pregunta acerca de las actividades en el lugar del Pozo de Corozal, póngase en contacto con:

Daniel Rodríguez, EPA Gerente de Proyecto de Remediación, (787) 741-5201, rodriguez.daniel@epa.gov , o Brenda Reyes, Coordinadora de Participación de la Comunidad de EPA al (787) 977-5869, reyes.brenda@epa.gov .

Superfondo
Para obtener información sobre el proceso de Superfondo, visite el sitio web de la EPA en www.epa.gov/superfund.

Repositorio de información
El repositorio de información contiene documentos relacionados con el Lugar, disponibles para la revisión del público en las siguientes ubicaciones:

Escuela Felipa Sánchez Cruzado
Carretera 811 Km 5 Hm 9 Bo. Cedro Abajo
Naranjito, Puerto Rico
Lunes a viernes de 8:00 AM a 4:00 PM

USEPA Región II
Centro de Expedientes del Superfondo
290 Broadway, piso 18
Nueva York, NY 10007-1866
Lunes a viernes de 9:00 AM a 5:00 PM
(212) 637-4308,

Agencia Federal de Protección Ambiental
División de Protección Ambiental del Caribe
City View Plaza II, Suite 7000
#48 PR-165 km 1.2
Guaynabo, Puerto Rico 00968-8069
Lunes a viernes de 9:00 AM a 4:30 PM
Brenda Reyes, (787) 977-5869

Junta de Calidad Ambiental
Programa de Respuestas de Emergencias y Superfondo
Edificio de Agencias Ambientales Cruz A. Matos
Urbanización San José Industrial Park
1375 Avenida Ponce de León
San Juan, PR 00926-2604
(787) 767-8181 ext 3207
Hours: Monday – Friday 9:00 am to 3:00 pm

Reunión Pública
Ubicación: Escuela Felipa Sánchez Cruzado
Salón de Conferencias
PR-811 Km 5.9 Bo. Cedro Abajo
Naranjito, Puerto Rico
Fecha: 20 de agosto de 2015
Hora 6:00 PM

COMUNIDAD SUPERFONDO **Hoja Informativa Lugar de Pozo de Corozal**

Corozal Well Site

Corozal, Puerto Rico
August 2015

EPA PROPONE UN REMEDIO PARA EL LUGAR DEL POZO DE COROZAL

HISTORIA Y TRASFONDO DEL LUGAR

El Lugar de Superfondo del Pozo de Corozal (el Lugar) consiste de un sistema comunal de abastecimiento de agua contaminado en el área rural residencial montañosa conocida como Barrio Palo. El Lugar se extiende hasta la frontera entre los municipios de Corozal y Naranjito (Figura 1). El Barrio Palo se suple del Pozo Comunidad Santana (pozo Santana), un pozo comunal privado que es la única fuente de agua potable para una comunidad de más de 200 personas (Figura 2).

Contaminación de Tetracloroeteno (PCE, por sus siglas en inglés) fue descubierta en el pozo Santana en noviembre de 2010 cuando la Autoridad de Acueductos y Alcantarillados (AAA) tomó muestras de agua del pozo en nombre del Departamento de Salud de Puerto Rico (DS). Basado en los resultados, el DS ordenó cerrar el pozo Santana debido a la presencia del PCE en concentraciones que excedían el nivel máximo de contaminante (MCL, por sus siglas en inglés) de 5 microgramos por litro (µg/L), según lo establece la Ley de Agua Potable Segura (SDWA, por sus siglas en inglés). El DS ordenó también que se provea una fuente alterna de agua para la población afectada. AAA, la Guardia Nacional y la Agencia Federal de Protección Ambiental (EPA, por sus siglas en inglés) proporcionaron una fuente alterna de agua para los residentes afectados por el cierre del pozo.

En febrero y marzo de 2011, EPA modificó el pozo Santana para limitar la entrada de PCE al pozo mediante la instalación de un sistema de tratamiento con carbón activado granular para remover el PCE del agua. Al completar las modificaciones al pozo y realizar pruebas del agua, el pozo Santana volvió a distribuir agua tratada a la comunidad. La EPA continúa operando el sistema de tratamiento y realizando pruebas periódicas al agua del pozo.

En marzo de 2012, EPA incluye el lugar del Pozo de Corozal en la lista de prioridades nacionales (NPL, por sus siglas en inglés) debido a la contaminación de PCE en las aguas subterráneas que suplen agua potable para los residentes del área.

INVESTIGACIÓN DE REMEDIACIÓN

De octubre de 2013 a febrero de 2015 EPA llevó a cabo una investigación de remediación (RI, por sus siglas en inglés) en el Lugar para evaluar las aguas subterráneas, suelo, aguas superficiales, sedimentos, tranques y gas del suelo. Se realizaron las siguientes actividades de campo bajo el RI:

- Aguas subterráneas – clasificación de las aguas subterráneas, perforación de pozo profundo en la roca, perforación geofísica, muestreo de zona de fractura, instalación de pozo profundo en la roca, perforación e instalación de pozo poco profundo en la roca, piezómetro e instalación de medidores, muestreo de agua subterránea, mediciones del nivel sinóptico del agua, monitoreo de agua a largo plazo y pruebas de recuperación al abasto del pozo Santana.
- Suelo - Detección pasiva de gas en suelo, muestreo de suelo superficial y sub-suelo en el área potencial de la fuente (PSA, por sus siglas en ingles), muestreo de suelo de tanque séptico e investigaciones geofísicas superficiales.
- Agua superficial – muestreo de agua superficial, sedimento y muestreo de agua de los poros.
- Encuestas - Encuestas topográficas, ecológicas y de recursos culturales.

RESUMEN DE LA CONTAMINACIÓN DEL SUELO

Para identificar las fuentes de la contaminación observadas en el pozo se llevaron a cabo pruebas de detección de gas en suelo pasivo, muestreo de suelo superficial y bajo la superficie y muestreo de suelo de tanques sépticos.

PCE se detectó en 8 de las 14 muestras tomadas para detección de gas en suelo pasivo con concentraciones que van desde 4 hasta 7,184 nanogramos (ng) / muestra. Como se muestra en la figura 3, la mayoría de las detecciones de PCE en las muestras de gas de suelo y las concentraciones más altas ocurrieron en el lado superior este de la quebrada con corriente intermitente.

Se recolectaron un total de 31 muestras de suelo de áreas potenciales de la fuente a profundidades que van desde la superficie del suelo hasta 29 pies debajo de la superficie de la tierra (bgs, por sus siglas en inglés). PCE se detectó en una muestra de suelo, SB-08 (Figura 4), situado junto a la muestra de gas de suelo con el más alto nivel de PCE. En SB-08, la muestra de suelo superficial recopilada de 0 a 2 pies bgs contenía 9.1 microgramos por kilogramo (µg/kg) de PCE; suelos de 5.5 a 6.5 pies bgs contenían 14 µg/kg de PCE.

Se tomaron muestras de suelo de tanque séptico para evaluar si los sistemas sépticos eran una fuente de contaminación del PCE. PCE no fue detectado en ninguna de las muestras recogidas adyacentes a tanques sépticos.

Los resultados del muestreo de suelo indican que los niveles más altos de PCE están a lo largo del lado superior este de la quebrada con corriente intermitente. Posiblemente el PCE fue dispuesto sobre el terreno en esta área y posteriormente migró hacia abajo a las aguas subterráneas. Las concentraciones relativamente bajas (máximo de 14 µg/kg) indican niveles residuales de PCE, sugiriendo que la fuente original del PCE probablemente ha migrado a aguas subterráneas. Ningún otro tipo de fuente potencial fue identificado.

RESUMEN DE LA CONTAMINACIÓN DEL AGUA SUBTERRÁNEA

La EPA llevó a cabo una investigación para determinar la magnitud y el alcance de la contaminación, incluyendo una clasificación del agua subterránea para identificar las ubicaciones para la instalación de pozos de monitoreo. Basado en la clasificación del agua subterránea, nueve pozos de monitoreo se instalaron para evaluar la contaminación del agua subterránea. Se instalaron pozos en roca profunda y poco profunda. Pozos en roca poco profunda van desde 61 a 79 pies bgs y los pozos profundos entre 140.8 y 162.2 pies bgs.

EPA tomó dos rondas de muestras de agua subterránea de los nueve pozos de monitoreo, el pozo Santana, dos pozos comunales cercanos y un pozo industrial.

PCE se detectó en tres de las siete muestras de clasificación las aguas subterráneas, las cuales fueron todas tomadas en una zona superior de roca conocida como *saprolite*. Estas muestras están agrupadas a lo largo de la orilla norte de la quebrada sin nombre, aguas abajo del área de la fuente y aguas arriba del pozo Santana (figura 5). Las dos muestras con resultados que excedieron el MCL de 5 µg/L para PCE son las más cercanas al pozo Santana; la concentración de PCE en estas muestras fue 7.1 y 9.7 µg/L. Las concentraciones de PCE en el pozo piezómetro PZ-1, en la zona de transición entre la *saprolite* y la roca poco profunda fueron de 10 y 13 µg/L en las rondas 1 y 2, respectivamente.

PCE está actualmente presente en el pozo Santana en concentraciones por debajo del MCL (5 µg/L) (figura 6). PCE fue detectado en aguas subterráneas de la roca poco profunda en MW-3S, situado en el lado superior este de la quebrada con corriente intermitente, cerca de la área de la fuente. Aguas abajo de esta zona, se detectó PCE por encima del MCL en aguas subterráneas poco profundas del *saprolite* cerca de una quebrada sin nombre, el pozo piezómetro poco profundo del *saprolite* PZ-1 (10 a 13 mg/L), pozos poco profundos MW-4S y MW-2S (5.5 a 13 ug/L) y en el pozo profundo MW-4 D (20 a 27 µg/L).

Datos sobre la reducción y recuperación del bombeo en el pozo Santana y datos del monitoreo del nivel de agua a largo plazo indican que las fracturas de la roca poco profunda y profunda debajo de la quebrada están conectadas hidráulicamente al pozo Santana. Esta red de fracturas proporciona una vía para la migración de PCE, que probablemente es reforzada por bombeo del pozo Santana también. Las figuras 7 y 8 muestran la distribución espacial y la sección transversal de las detecciones del PCE en los pozos de monitoreo, respectivamente.

RESUMEN DE AGUAS SUPERFICIALES, SEDIMENTOS Y CONTAMINACIÓN DEL AGUA DE PORO

Se tomaron muestras de agua superficial, sedimentos y agua de poros (agua en los espacios de los poros del lecho de la quebrada) de la quebrada con corriente intermitente y de la quebrada sin nombre que fluye aguas abajo del pozo Santana. Se detectó PCE en 9 de 12 de las muestras de agua de poro. PCE excedió su MCL de 5 µg/L en una muestra de agua de poro, WP-05 (33 µg/L), localizada en la quebrada sin nombre, aproximadamente 100 pies al sur del área de la fuente (figura 9). PCE no fue detectado en el flujo intermitente o las tres muestras aguas arriba de la quebrada sin nombre, incluyendo la muestra de trasfondo.

PCE se detectó bajo su MCL en 8 de las 15 muestras de aguas superficiales en concentraciones que van desde 0.59 a 2.6 µg/L. Los niveles más altos, 2.2 y 2.6 µg/L en las muestras más cercanas al área de la fuente. PCE no fue detectado en las tres muestras aguas arriba en la quebrada sin nombre, incluyendo la muestra de trasfondo, ni en ninguna de las muestras de la corriente intermitente.

Tabla 1. Resumen de los peligros y riesgos asociados con las aguas subterráneas en el Lugar

Receptor	Índice de riesgo	Riesgo de cáncer
Residencial adulto – futuro	-----	3.0x10-4
Residencial niño – futuro	6	
Los COPCs identificados en el agua subterránea del Lugar fueron TCE y PCE debido al TCE (3.8) estar por encima de un índice de riesgo de 1 y TCE y PCE por encima del MCL de 5 µg/L.		

Las concentraciones de PCE en las muestras de agua superficial del 2014 son menores que las de aguas superficiales tomadas por la EPA en 2010 y 2011 (Figura 10). Los resultados de las muestras de agua superficial muestran claramente una tendencia decreciente en los años 2010 al 2014. Las concentraciones decrecientes de PCE en agua superficial podrían atribuirse a una disminución en las concentraciones de las aguas subterráneas contaminadas que descargan a las aguas superficiales. La tendencia decreciente del PCE en el agua superficial es similar a la tendencia decreciente del PCE en el propio pozo Santana.

PCE no fue detectado en las muestras de sedimentos recogidas en la quebrada sin nombre o en la corriente intermitente.

EVALUACIÓN DE LA ATENUACIÓN NATURAL

"Atenuación natural" se refiere a procesos de atenuación que ocurren naturalmente y que ya están presentes en un acuífero para disminuir las concentraciones de contaminantes. Puede considerarse como un componente de remediación si puede esperarse alcanzar metas de remediación específicas para el Lugar dentro de un plazo razonable en comparación con otras medidas de remediación. Procesos de atenuación natural que reducen las concentraciones de PCE en el agua subterránea incluyen procesos destructivos como las reacciones de biodegradación y químicas y mecanismos no-destructivos como dilución, volatilización y dispersión.

En el Lugar hay poca evidencia de que biodegradación sola pueda ser eficaz para tratar los contaminantes de las aguas subterráneas en un plazo razonable. Hay cierta evidencia que la biodegradación de PCE está ocurriendo, pero las condiciones de biodegradación completa y sostenible no parecen estar presentes. Sin embargo, mecanismos no-destructivos están presentes, y múltiples rondas de muestreo de agua subterránea sugieren una continua tendencia a la baja en las concentraciones de PCE. Hay múltiples evidencias, incluyendo disminuciones significativas en el PCE con el tiempo en las aguas subterráneas y aguas superficiales, falta de una fuente continua de PCE en el suelo, dilución y dispersión apoyado por altas precipitaciones y el bombeo del pozo Santana, que indican que la atenuación natural podría ser capaz de reducir las concentraciones en un plazo razonable.

RESUMEN DE LOS RIESGOS DEL LUGAR

Una evaluación de riesgos a la salud humana (HHRA, por sus siglas en inglés) y una evaluación de riesgo ecológico por detección (SLERA, por sus siglas en inglés) fueron preparadas para evaluar los riesgos a receptores humanos y ecológicos de los contaminantes del Lugar. A continuación se resumen los resultados de las evaluaciones de riesgo.

Evaluación de Riesgos a la Salud Humana

Se llevó a cabo una HHRA de referencia para estimar los riesgos y peligros asociados con los efectos actuales y futuros de los contaminantes sobre la salud humana y el medio ambiente. Un proceso de 4 pasos para la HHRA fue utilizado para evaluar los riesgos de cáncer relacionados con el Lugar y peligros para la salud no cancerosos. El proceso de 4 pasos se compone de: identificación de riesgos de químicos de interés potencial (COPCs, por sus siglas en inglés), evaluación de la toxicidad, evaluación de la exposición y caracterización del riesgo.

COPCs que podrían potencialmente causar efectos perjudiciales a la salud en poblaciones expuestas fueron identificados en los diferentes medios (suelo, aguas superficiales, sedimentos y aguas subterráneas).   El agua subterránea fue el único medio que contenía contaminantes por encima de los valores de detección. El uso actual y futuro de la tierra incluye futura ingestión, contacto cutáneo e inhalación de vapores por el uso residencial del agua subterránea no tratada. Exposición actual no se evaluó ya que existe un sistema de tratamiento en el pozo contaminado.

Concentraciones en el punto de exposición se calcularon utilizando la máxima concentración detectada de un contaminante o el 95% del límite superior de confianza de la concentración promedio. Consumos diarios crónicos se calculan basándose en la exposición máxima razonable (RME, por sus siglas en inglés), que es la más alta exposición razonablemente anticipada para ocurrir en el Lugar. Presunciones de exposición de tendencia central, que representan exposiciones promedio típicas, también fueron desarrolladas.

Se evaluaron riesgos y peligros para la exposición potencial futura a las aguas subterráneas. Las poblaciones de interés incluyeron niños y adultos residentes. Los riesgos de cáncer estaban por encima de los rangos aceptables por EPA, principalmente debido a arsénico. Los riesgos de no-cáncer fueron por encima del valor aceptable por EPA de 1, principalmente a causa de tricloroetileno (TCE) y arsénico. Arsénico no fue considerado como relacionado con el Lugar porque las concentraciones eran similares a las de trasfondo. Además, TCE y PCE ambos fueron detectados en concentraciones superiores al MCL de 5 µg/L; por lo tanto, PCE también fue identificado como un COPC en el agua subterránea (Tabla 1).

Basado en los resultados de la HHRA, una acción de remediación es necesaria para proteger la salud pública, el bienestar y el ambiente de la exposición actual y cualquier amenaza futura a liberar sustancias peligrosas en las aguas subterráneas.

Evaluación de Riesgo Ecológico por Detección

Una SLERA fue preparada para evaluar el potencial de riesgos ecológicos de contaminantes presentes en el suelo, sedimento, agua superficial y agua de poro. La SLERA se enfocó en evaluar el potencial de impactos a receptores ecológicos sensibles de componentes de interés relacionados con el Lugar. Concentraciones promedio del Lugar fueron comparadas con valores de proyección ecológica como un indicador del potencial de efectos adversos a receptores ecológicos.

La SLERA no encontró ningún potencial de efectos adversos a los receptores ecológicos por exposición a suelos contaminados, sedimentos, aguas superficiales o agua de poro. Los criterios de detección para todos los químicos en estos medios estaban por debajo del índice de riesgo aceptable de 1. Basado en los resultados de la evaluación de riesgo ecológico, no hay ningún riesgo inaceptable a los receptores ecológicos de los contaminantes del Lugar.

OBJETIVOS DE LA ACCIÓN DE REMEDIACION

Objetivos de Acción de Remediación (RAOs, por sus siglas en inglés) son objetivos específicos para proteger la salud humana y el medio ambiente. Estos objetivos se basan en la información disponible y estándares, tales como requisitos aplicables o relevantes y apropiados (ARARs, por sus siglas en inglés), orientación a ser considerada y niveles específicos del Lugar basados en riesgo.

Para proteger la salud humana y el medio ambiente, se han identificado RAOs. El RAO para las aguas subterráneas es:

Evitar la exposición humana a las concentraciones de contaminantes en las aguas subterráneas por encima de niveles protectores del agua potable.

OBJETIVOS DE REMEDIACIÓN

Para cumplir con los RAOs, objetivos de remediación fueron desarrollados para ayudar a definir el alcance de las aguas subterráneas contaminadas que requieren medidas de remediación. Los objetivos de remediación son medidas químico-específicas para cada medio y/o exposición que se espera que sean protectores de la salud humana y el medio ambiente. Los MCL Federales (5 µg/L para PCE y 5 µg/L de TCE) son los objetivos de remediación del Lugar.

RESUMEN DE ALTERNATIVAS CORRECTIVAS

En todas las alternativas activas de remediación se incluyen varios elementos comunes. Los elementos comunes que se enumeran a continuación no se aplican a la alternativa de No Acción.

Elementos comunes

Investigación pre-diseño (PDI, por sus siglas en inglés): La naturaleza y alcance de contaminación del agua subterránea en la *saprolite* y en la roca poco profunda serán completamente delineados en una PDI. Parámetros de diseño también se obtendrían durante la PDI.

Mantenimiento de GAC en el pozo Santana: la unidad existente de GAC en el pozo Santana se debería mantener para asegurar la prevención de exposición humana a concentraciones de contaminantes en las aguas subterráneas por encima de los objetivos de remediación. El afluente y efluente serían típicamente muestreados una vez al mes para asegurarse que las concentraciones de contaminantes estén por debajo de los MCL.

Controles institucionales (IC, por sus siglas en inglés): controles institucionales deben restringir la futura construcción de pozos de extracción de agua subterránea hasta que se complete la limpieza.

Política Limpia y Verde de la EPA Región 2: los beneficios ambientales del remedio recomendado pueden mejorarse considerando, durante el diseño, tecnologías y prácticas que sean sostenibles según establecido en la Política Limpia y Verde de la EPA Región 2.

Alternativas de Remediación

Las alternativas de remediación fueron definidas combinando tecnologías de remediación aplicables y opciones de proceso para agua subterránea contaminada. A continuación se resumen las alternativas de remediación a la contaminación de aguas subterráneas del Lugar.

Alternativa 1 – No Acción

El Plan de Contingencia Nacional (NCP, por sus siglas en inglés) requiere que la alternativa de No Acción sea considerada. La alternativa de No Acción incluiría ninguna acción y sirve como base para la comparación de alternativas de remediación.

Alternativa 2 – Atenuación Natural Monitoreada (MNA, por sus siglas en inglés) y Controles Institucionales

Costo Capital	$43,000
Costo Valor Presente de O&M	$1,439,000
Costo Valor Presente Total	$1,482,000
Tiempo de Construcción	1 año
Plazo para cumplir con RAOs	15 años

Esta alternativa se basaría en la MNA para reducir las concentraciones de contaminantes en el acuífero a los objetivos de remediación y también utilizar ICs para asegurar que las áreas dentro del plumacho que estén por encima de los objetivos de remediación no se utilicen para fines de agua potable. Monitoreo del pozo Santana y mantenimiento del sistema de tratamiento existente continuaría.

Un programa de monitoreo a largo plazo para el Lugar seria instituido y continuaría hasta que las concentraciones hayan alcanzado los objetivos de remediación. Diez pozos de monitoreo existentes en la roca y cinco nuevos pozos de monitoreo se utilizarían para monitorear las aguas subterráneas. Continuarían las actividades de muestreo en el pozo Santana y los resultados se incluirían en el programa de monitoreo a largo plazo. Datos del monitoreo se utilizarían para evaluar la migración y la atenuación de la contaminación del agua subterránea.

Para estimar el tiempo de MNA, se calculó una tasa empírica de disminución de las concentraciones de PCE en el pozo Santana. Esta tasa se considera representante de la atenuación esperada en las concentraciones de PCE en la roca profunda en el Lugar, dado a que la atenuación natural en la roca profunda es el factor que controla el tiempo necesario para llegar al MCL. Teniendo en cuenta las incertidumbres en este análisis, las concentraciones de PCE alcanzarían el MCL en 6 a 15 años. Debido a esta incertidumbre, la duración de la acción de remediación se estima a 15 años.

Alternativa 3 – Extracción de Aguas Subterráneas, Tratamiento, Monitoreo a Largo Plazo y Controles Institucionales

Costo Capital	$883,000
Costo Valor Presente de O&M	$2,097,000
Costo Valor Presente Total	$2,980,000
Tiempo de Construcción	2-3 años
Plazo para cumplir con RAOs	15 años

Bajo esta alternativa, la plumacho de agua subterránea contaminada con PCE sobre los objetivos de remediación en la zona de la roca poco profunda y *saprolite* serían destinados a la extracción, tratamiento y descarga del agua superficial a la quebrada sin nombre. Un pozo de extracción de agua subterránea sería utilizado para extraer la contaminación del acuífero y también para crear una barrera hidráulica para limitar la migración del contaminante hacia la roca, aguas debajo de la fuente y hacia el agua superficial. Extracción y tratamiento continuarían hasta que se restablezca el acuífero. Según discutido en la sección de elementos comunes, MNA dependería de lograr los objetivos de remediación en la roca profunda.

Un programa de monitoreo a largo plazo de la plumacho de agua subterránea, agua superficial y agua de poro sería instituido. El programa de monitoreo descrito en la Alternativa 2 debería continuar hasta que las concentraciones hayan atenuado a los objetivos de remediación. Los datos de monitoreo recogidos serían evaluados y utilizados para evaluar la efectividad del sistema de extracción.

La duración de la operación del sistema de extracción y tratamiento del agua subterránea y el tiempo para alcanzar los PRGs en la *saprolite*/roca superior fracturada se estima hasta cuatro años. El plazo general para alcanzar los RAOs es de 15 años, gobernados por la atenuación en la roca profunda se explica en la Alternativa 2.

Alternativa 4 – Cortina de Aspersión de Aire, Monitoreo a Largo Plazo y Controles Institucionales

Costo Capital	$911,000
Costo Valor Presente de O&M	$2,369,000
Costo Valor Presente Total	$3,280,000
Tiempo Construcción	4 meses
Plazo para cumplir con RAOs	15 años

Bajo esta alternativa, los RAOs se lograrían mediante el uso de una cortina de aspersión de aire (AS, por sus siglas en inglés) para eliminar la contaminación de la *saprolite* saturada y la roca poco profunda y a través de procesos naturales (MNA) en la roca profunda. El proceso de AS se utilizaría para separar el PCE del agua subterránea al pasar el plumacho de agua subterránea a través de la zona de aspersión. Se presume que la cortina de AS sería instalada aguas arriba del pozo Santana para evitar más migración aguas abajo.

Monitoreo a largo plazo, similar al descrito en las Alternativas 2 y 3 sería necesario. Se estima que el sistema AS tendría que ser operado entre 6 y 15 años. Presumiendo conservadoramente, el sistema AS sería operado durante 15 años. El plazo general para alcanzar los RAOs está regido por la atenuación en la roca profunda, como se discutió en la Alternativa 2.

EVALUACIÓN DE ALTERNATIVAS DE REMEDIACIÓN

Nueve criterios que se especifican en el NCP se utilizan para evaluar alternativas de remediación para seleccionar un remedio. Se evalúa el desempeño relativo de cada alternativa contra los nueve criterios, observando cómo compara con las otras opciones bajo consideración. A continuación se enumeran los nueve criterios de evaluación. Un análisis detallado de alternativas de remediación contra los nueve criterios se puede encontrar en el Estudio de Viabilidad (FS, por sus siglas en inglés).

- **Protección General de la Salud Humana y el Medio Ambiente** determina si una alternativa elimina, reduce o controla las amenazas a la salud pública y el medio ambiente a través de controles institucionales, controles de ingeniería o tratamiento.
- **Cumplimiento de ARARs** evalúa si la alternativa cumple todos los requisitos aplicables o pertinentes y requisitos pertinentes de las leyes ambientales federales y estatales y otros requisitos relacionados al Lugar o proporcionan motivos para invocar una dispensa.
- **Permanencia y efectividad a largo plazo** considera la capacidad de una alternativa para mantener la protección de la salud humana y el medio ambiente a través del tiempo.
- **Reducción de la toxicidad, movilidad o volumen a través del tratamiento** es el desempeño esperado de las tecnologías de tratamiento que una alternativa podría emplear.
- **Implementabilidad** es la viabilidad técnica y administrativa de la aplicación de la alternativa, incluyendo la disponibilidad de materiales y servicios.
- **Costo** incluye capital estimado y costos de operación anual y mantenimiento, así como costos de valor presente. Costo del valor presente es el costo total de una alternativa a través del tiempo en términos del valor actual del dólar.
- **Aceptación del Estado Libre Asociado** considera si el Estado Libre Asociado (la Agencia de apoyo) concuerda con, se opone a, o no tiene comentarios sobre el remedio recomendado.
- **Aceptación de la comunidad** se evalúa en el Registro de la Decisión (ROD, por sus siglas en inglés) y se refiere a la respuesta general del público a las alternativas descritas en el Plan Propuesto y los informes de RI/FS. Comentarios recibidos al Plan Propuesto son un importante indicador de la aceptación de la comunidad.

REMEDIO RECOMENDADO

La alternativa recomendada por EPA es la Alternativa 2, atenuación natural monitoreada y controles institucionales. La alternativa preferida seguirá monitoreando el pozo Santana mientras los objetivos de remediación sean excedidos en agua subterránea, junto con el mantenimiento del sistema de tratamiento existente para el pozo Santana. Monitoreo a largo plazo y revisiones cada cinco años serían necesarios durante ese período. El costo del valor presente de la alternativa preferida es $1,482,000.

La alternativa preferida logra el mejor equilibrio entre los nueve criterios del análisis comparativo incluyendo los dos principios de proteger la salud humana y el medio ambiente y cumplimiento de ARARs. Esta alternativa es preferida porque logrará los objetivos de remediación y RAOs en un período comparable a las otras alternativas activas sin amenazar la funcionalidad a largo plazo del pozo Santana, la única fuente de agua potable para la comunidad.

La Junta de Calidad Ambiental de Puerto Rico (JCA) coincide con la Alternativa 2, la solución preferida en este Plan Propuesto.

BASE PARA EL REMEDIO DE PREFERENCIA

Se cree que la alternativa preferida proporcionará el mejor equilibrio de intercambios entre las alternativas, basado en la información disponible a la EPA en este momento. EPA y la JCA creen que el remedio propuesto protegerá la salud humana y el medio ambiente, cumplirá con los ARARs, será costo-efectivo y utiliza soluciones permanentes y tecnologías alternas de tratamiento o tecnologías de recuperación de recursos en la máxima medida posible. El remedio preferido no satisfaría la preferencia legal por el uso de tratamiento como un elemento principal. La alternativa preferida podría cambiar en respuesta al comentario público o nueva información disponible.

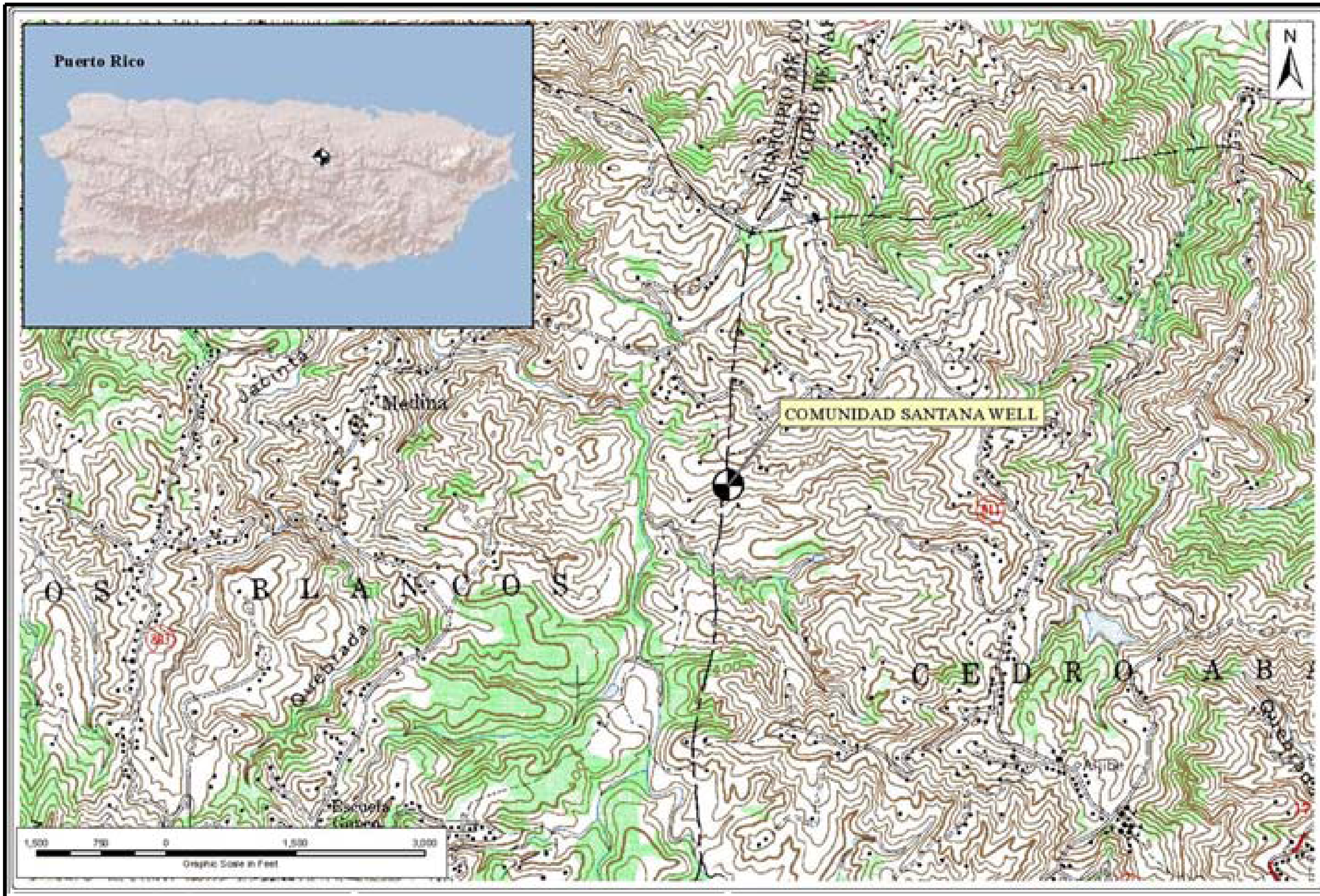
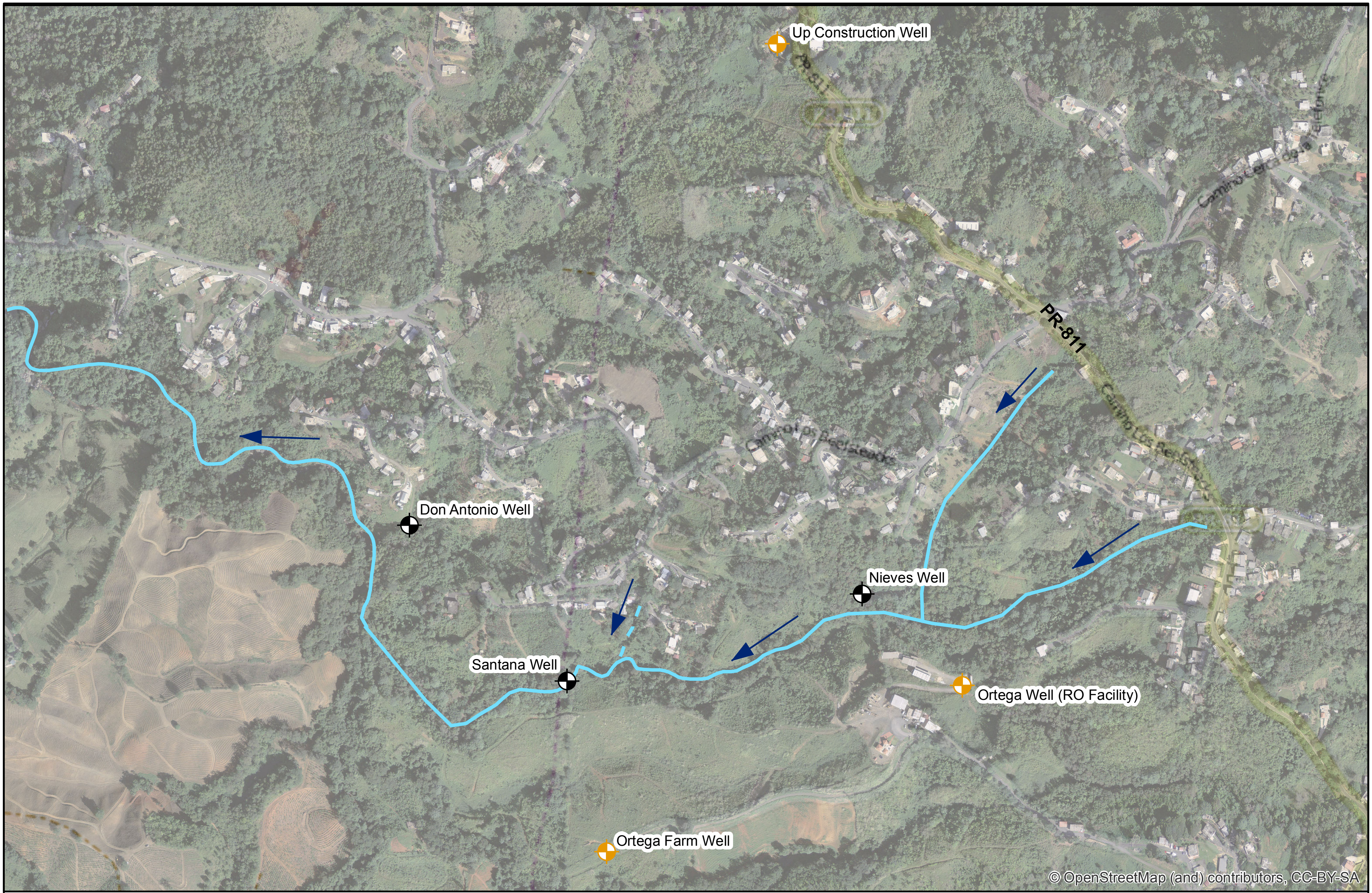


Figure 1
Site Location Map Corozal Well
Site Corozal, Puerto Rico



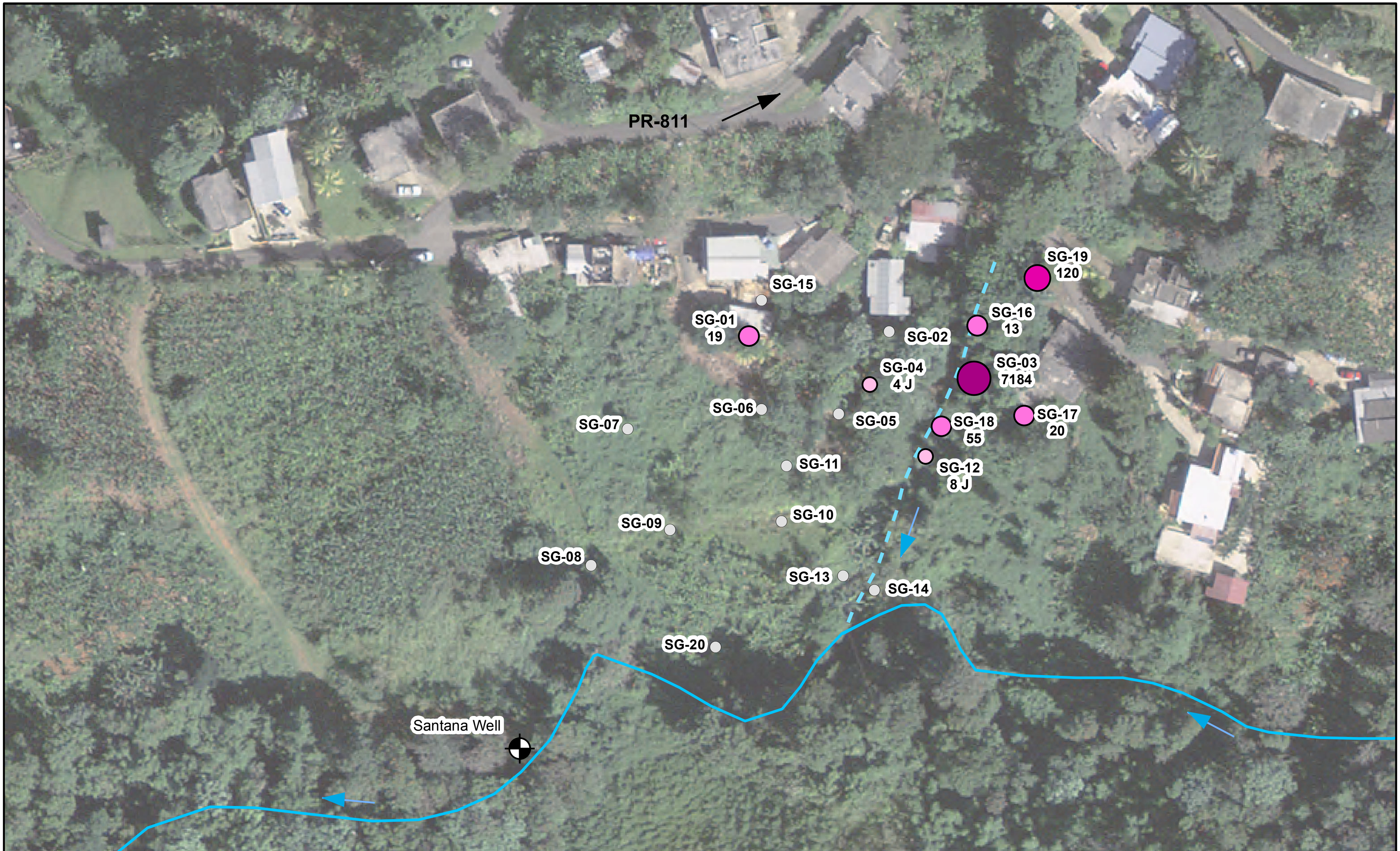
Legend

- Community Supply Well
- Private Supply Well
- Unnamed stream
- Intermittent Stream
- Stream flow direction

N

0 325 650 1,300 Feet

Figure 2
Site Map
Corozal Well Site
Corozal, Puerto Rico



Legend

- Flow direction
- Unnamed Stream
- Intermittent Stream

Passive Soil Gas Sampling PCE Results (ng)

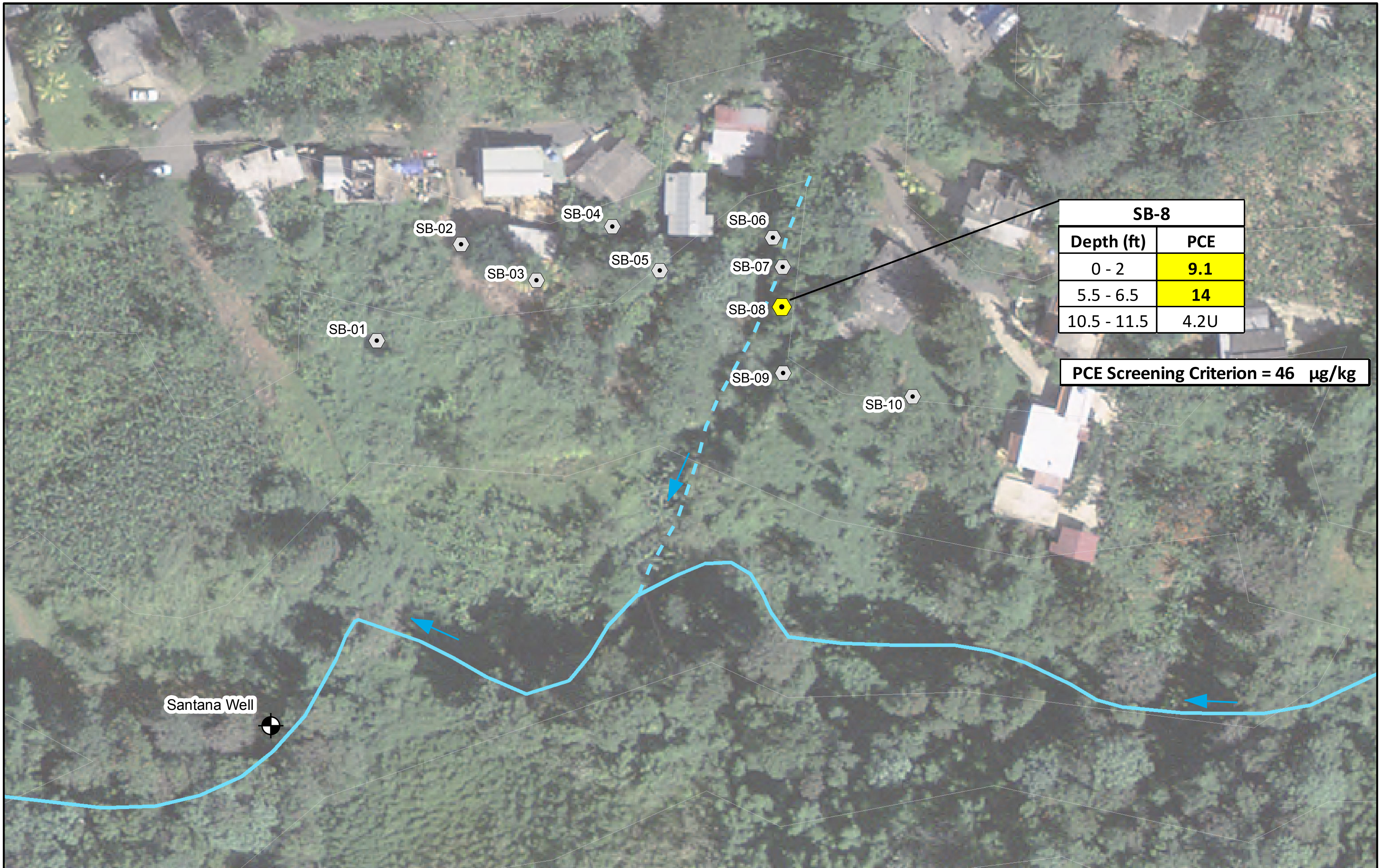
- Non detect
- 0.1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000

Notes:
All results in nanograms (ng)
PCE - Tetrachloroethene
Samples were only analyzed for PCE
J - estimated result

N

Feet
0 37.5 75 150

Figure 3
Passive Soil Gas PCE Results
Corozal Well Site
Corozal, Puerto Rico



Legend

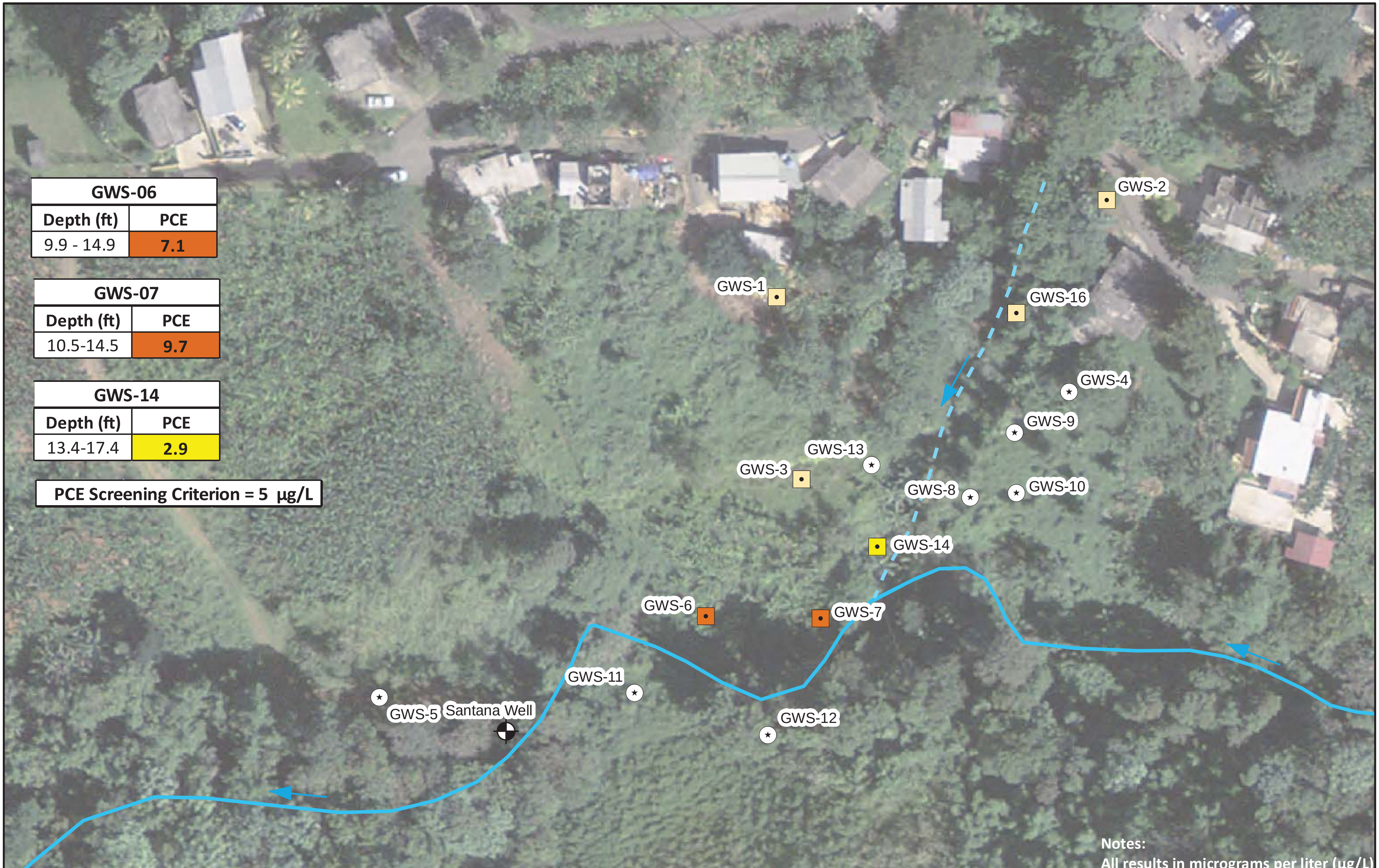
- Unnamed Stream
- Intermittent Stream
- PCE not detected
- PCE detection below screening criterion
- Flow direction

Notes:
PCE - Tetrachloroethene
All results are in micrograms per kilogram (µg/kg)
ft - feet below ground surface
U - non detect

N

0 37.5 75 150 Feet

Figure 4
PSA Soil Sampling PCE Results
Corozal Well Site
Corozal, Puerto Rico



Legend

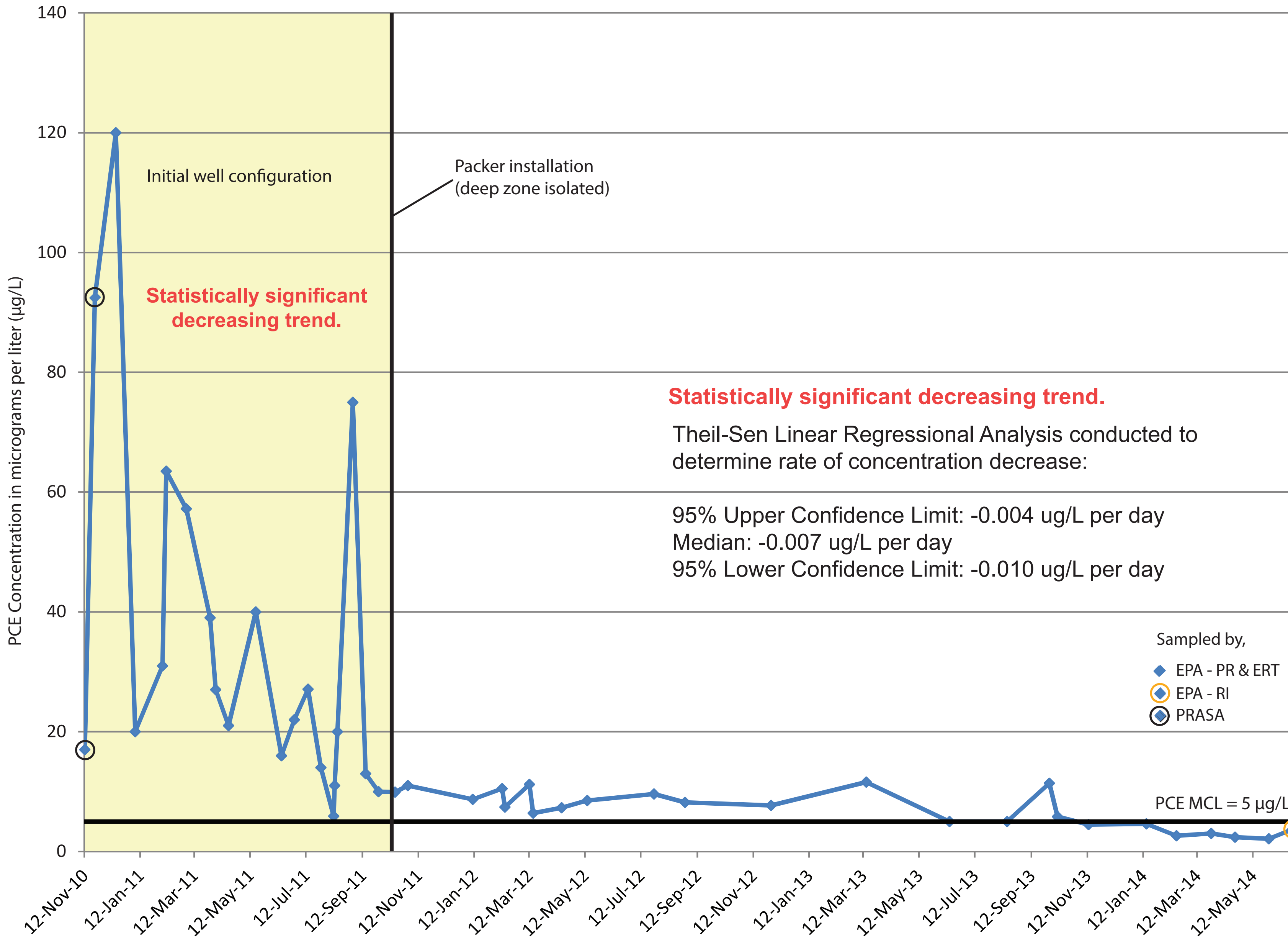
- Flow direction
- Unnamed Stream
- Intermittent Stream
- Dry sampling location

Groundwater Screening Results

- PCE detection above screening criterion
- PCE detection below screening criterion
- PCE not detected

Feet
0 37.5 75 150

Figure 5
Groundwater Screening Results
Corozal Well Site
Corozal, Puerto Rico



Acronyms;
EPA – Environmental Protection Agency
ERT – Emergency Response Team
µg/L – microgram per liter
RI – Remedial Investigation
PRASA – Puerto Rico Aqueduct and Sewer Authority

Figure 6
Santana Well In˜uent Data, November 2010 through June 2014
Corozal Well Site
Corozal, Puerto Rico

Santana Well				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	n/a	3.7	0.5 U
Round 2	GW	n/a	4.3	0.5 U

MW-1D				
Event	Matrix	Depth (ft)	PCE	PCE
Round 1	GW	115 - 135	0.11 U	0.5 U
Round 2	GW	115 - 135	0.028 J	0.5 U

MW-2S				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	40.5-60.5	7.1	0.5 U
Round 2	GW	40.5-60.5	5.5	0.25 J

MW-3S				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	58.6-78.6	1.8	0.5 U
Round 2	GW	58.6-78.6	1.5	0.5 U

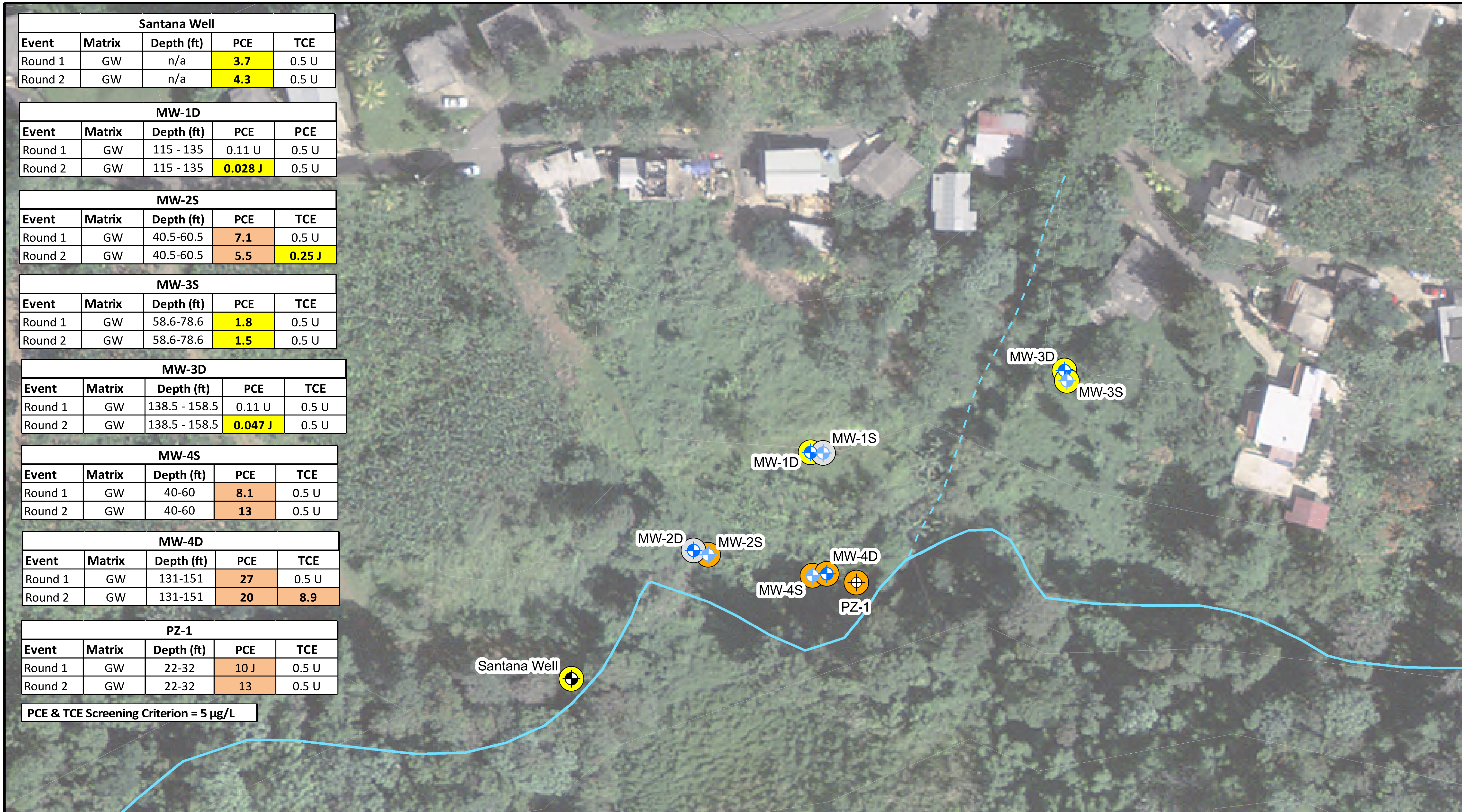
MW-3D				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	138.5 - 158.5	0.11 U	0.5 U
Round 2	GW	138.5 - 158.5	0.047 J	0.5 U

MW-4S				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	40-60	8.1	0.5 U
Round 2	GW	40-60	13	0.5 U

MW-4D				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	131-151	27	0.5 U
Round 2	GW	131-151	20	8.9

PZ-1				
Event	Matrix	Depth (ft)	PCE	TCE
Round 1	GW	22-32	10 J	0.5 U
Round 2	GW	22-32	13	0.5 U

PCE & TCE Screening Criterion = 5 µg/L



Legend

- Santana Well
- Deep bedrock monitoring well
- Piezometer
- Shallow bedrock monitoring well
- Estimated Streambed
- Intermittent Stream
- Detection above screening criterion
- Detection below screening criterion
- Non detect

Acronyms:
MW-1S - Shallow Monitoring Well
MW-1D - Deep Monitoring Well
PCE - tetrachloroethene
TCE - trichloroethene
ug/L - micrograms per liter
ft - feet below ground surface

0 40 80 160 Feet

Figure 7
Monitoring Well PCE and TCE Results
Corozal Well Site
Corozal, Puerto Rico

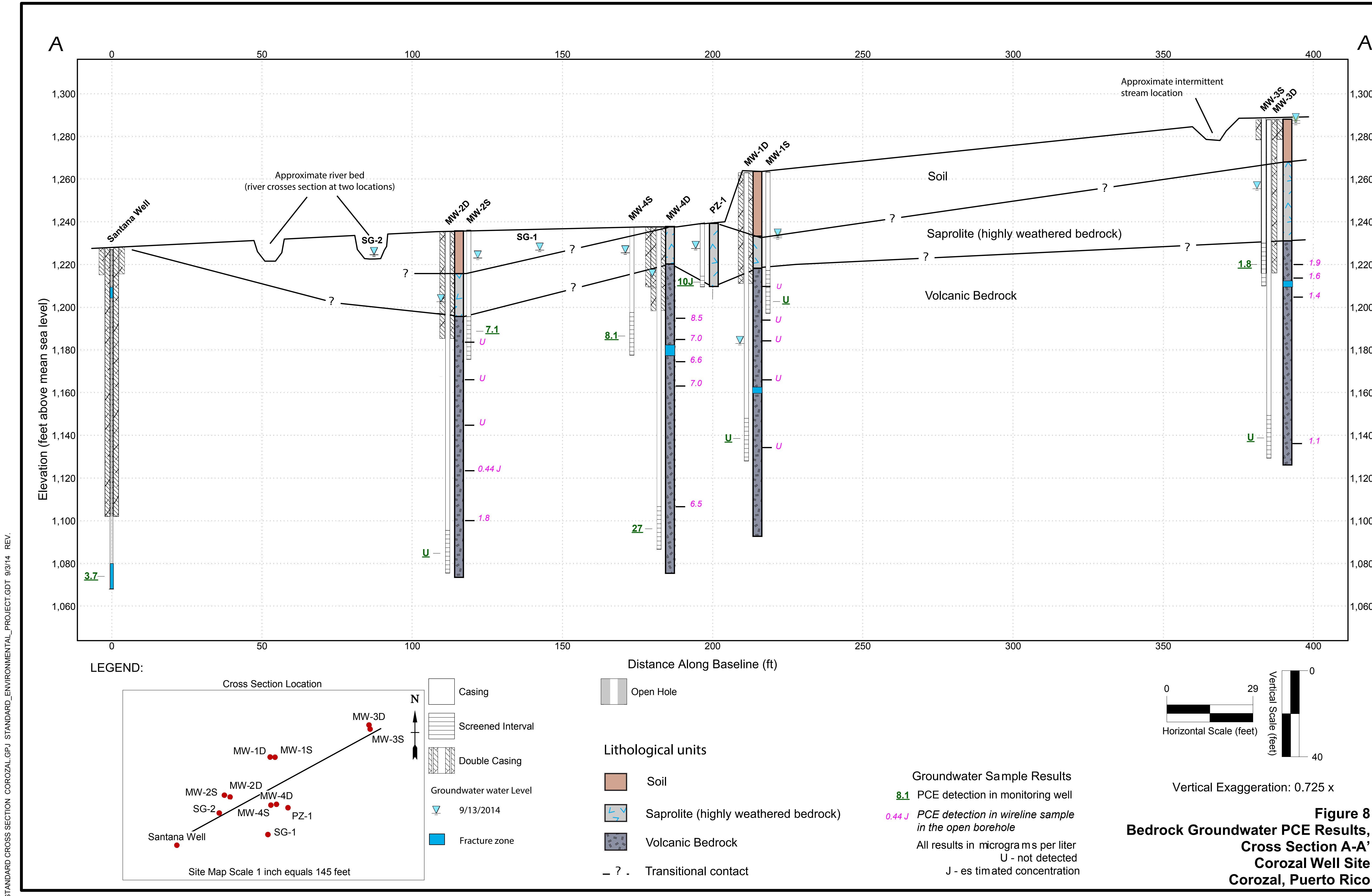
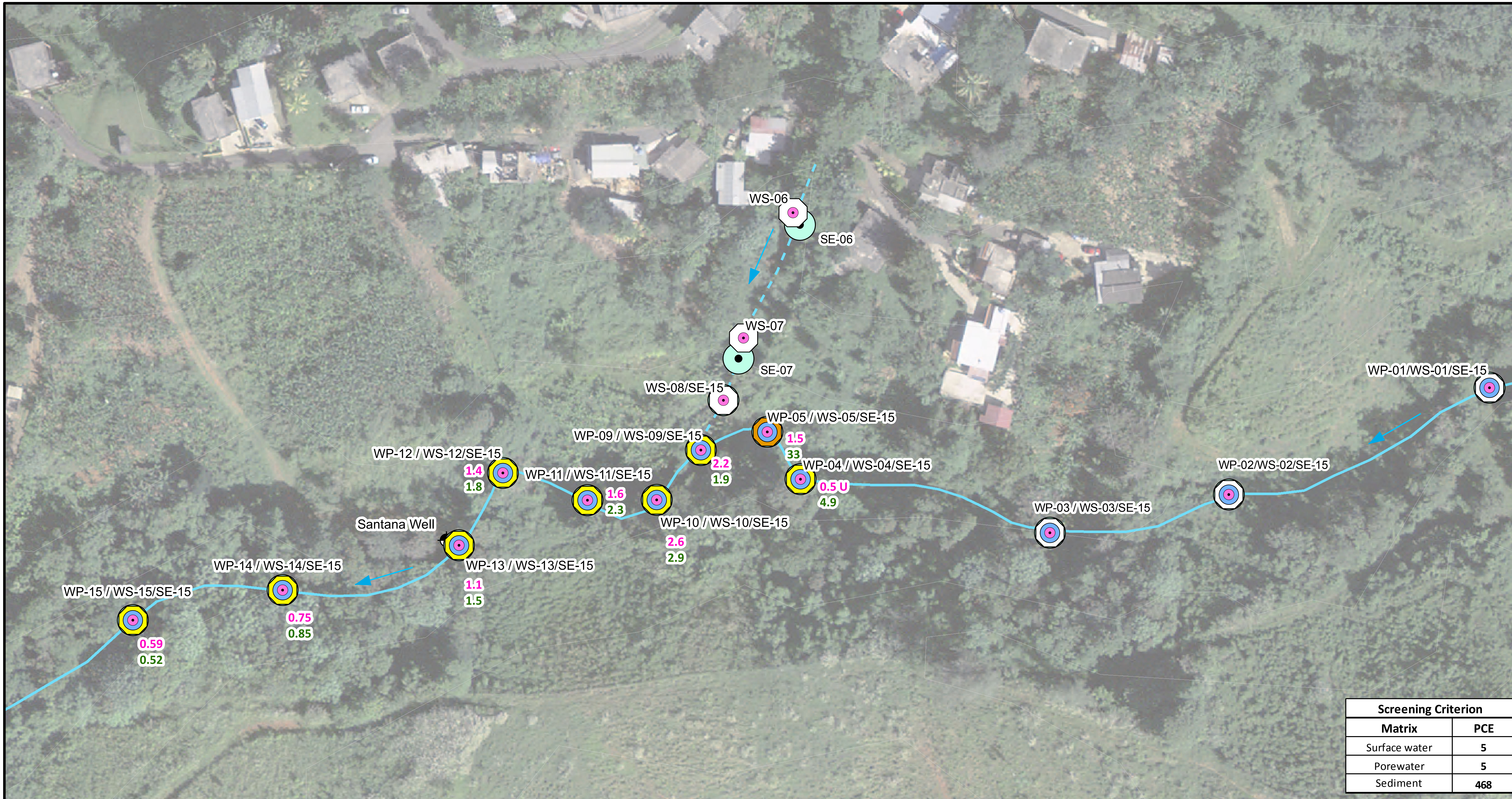


Figure 8
Bedrock Groundwater PCE Results,
Cross Section A-A’
Corozal Well Site
Corozal, Puerto Rico



Screening Criterion	
Matrix	**PCE**
Surface water	5
Porewater	5
Sediment	468

Legend

- Surface Water (WS)
- Porewater (WP)
- Sediment (SE)

PCE detection

- Non detect
- Detection below screening criteria in either surface water or porewater samples
- Detection above screening criteria in porewater sample

0.59 - PCE detection in surface water sample
0.52 - PCE detection in porewater sample

Notes:
PCE - Tetrachloroethene
All results in micrograms per liter
No detections in sediment samples.
SW, SED & WP samples are co-located except where indicated.

- Unnamed Stream
- Intermittent Stream
- Flow direction

0 37.5 75 150 Feet

Figure 9
Surface Water, Sediment and Porewater PCE Results
Corozal Well Site
Corozal, Puerto Rico

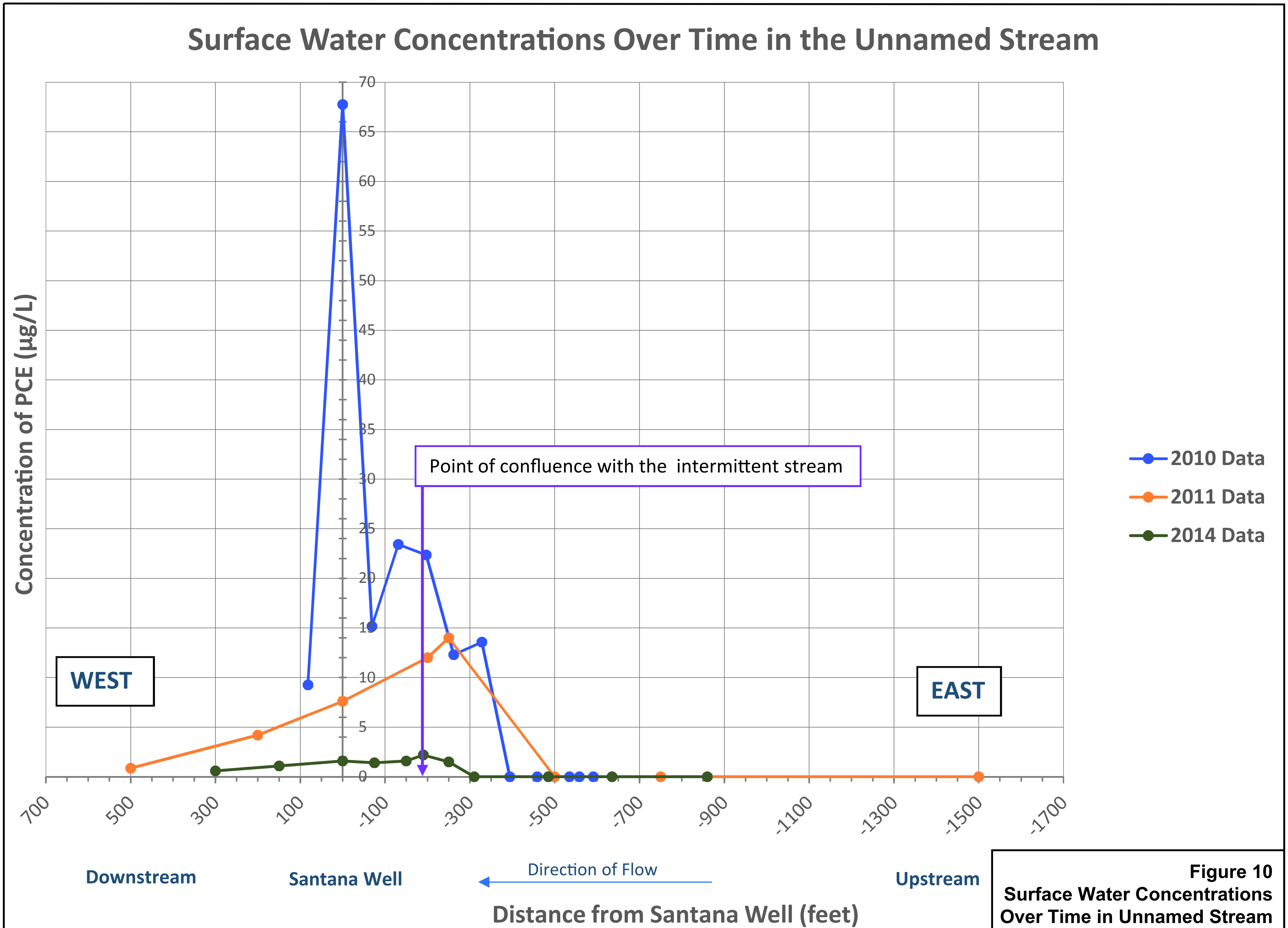


Figure 10
Surface Water Concentrations
Over Time in Unnamed Stream
Corozal Well Site
Corozal, Puerto Rico

APPENDIX V

Puerto Rico Environmental Quality Board's Concurrence Letter

COMMONWEALTH OF
PUERTO RICO
Environmental Quality Board

July 17, 2015

Mr. Daniel Rodríguez
Remedial Project Manager
U.S. Environmental Protection Agency
Vieques Field Office
P.O. BOX 1537
Vieques, P.R. 00765

RE: COROZAL GROUNDWATER CONTAMINATION SITE PROPOSED PLAN CONCURRENCE LETTER

Dear Mr. Rodríguez:

The Puerto Rico Environmental Quality Board (PREQB) has completed its review of the aforementioned document. This Proposed Plan (PP) dated July, 2015, identifies the preferred alternative to address groundwater contamination at the Corozal Groundwater Contamination Site. All PREQB's comments and concerns were addressed in a conference call held on May 6, 2015 with USEPA and CDM Smith (USEPA contractor) representatives. The preferred remedy, which is Alternative 2: Monitored Natural Attenuation and Institutional Controls, fulfills the requirement of protecting the public health and the environment from potential risk at the site. Therefore, PREQB concurs with the remedial technology selected in the PP.

If you have any questions, please feel free to contact the undersigned at (787) 767-8181 ext. 3234 or 3236 or Mr. Pascual E. Velázquez, State Remedial Project Manager assigned to this case at (787) 767-8181 ext. 3253 or by email at juanbaba@jca.pr.gov or pascualvelazquez@jca.pr.gov respectively.

Cordially,

Juan J. Babá Peebles
Manager
Superfund Program
Environmental Emergencies Response Area
Puerto Rico Environmental Quality Board

APPENDIX VI
Public Meeting Attendance Sheet

Corozal Well Site

Public Meeting – August 20, 2015 6 to 8 p.m.

Name	Address	Phone	Email
Maria M. Ortega	(b) (6) [redacted]	[redacted]	[redacted]
Maria L. Cintron	[redacted]	[redacted]	[redacted]
Raul Santana	[redacted]	[redacted]	[redacted]
Juan C. Santana	[redacted]	[redacted]	[redacted]
Juan A. Santana	[redacted]	[redacted]	[redacted]
Antonio Ortiz	[redacted]	[redacted]	[redacted]
Paswal E. Velazquez	Junta de Calidad Ambiental	787-767-8181 Ext: 3253	paswalvelazquez@jca.gobierno.pr

APPENDIX VII
Responsiveness Summary

Transcript of the Public Meeting and Written Comments

APPENDIX VII

RESPONSIVENESS SUMMARY
FOR THE
RECORD OF DECISION
COROZAL WELL SITE
COROZAL, PUERTO RICO

INTRODUCTION

This Responsiveness Summary provides a summary of citizen's comments and concerns received during the public comment period related to the Corozal Well Site (Site) Proposed Plan, and it provides the U.S. Environmental Protection Agency's (EPA's) responses to those comments and concerns. All comments summarized in this document have been considered in EPA's final decision in the selection of a groundwater remedy.

SUMMARY OF COMMUNITY RELATIONS ACTIVITIES

The 2015 Remedial Investigation (RI) and Feasibility Study (FS) reports and the Proposed Plan for the contaminated groundwater at the Site were released to the public for comment on August 12, 2015. These documents were made available to the public at information repositories maintained at the Felipe Sanchez Cruzado School, the EPA Region 2 office in Guaynabo, Puerto Rico, the Puerto Rico Environmental Quality Board (PREQB) Office in San Juan, Puerto Rico, and the EPA Region 2 Office in New York, New York. The notice of availability for the above-referenced documents was published in the Primera Hora newspaper on August 12, 2015. The public comment period ran from August 12, 2015, to September 11, 2015.

On August 20, 2015, EPA held a public meeting at the Felipe Sanchez Cruzado School to inform officials and interested residents about the Superfund process, to present the Proposed Plan for the Site, including the preferred remedial alternative, and to respond to questions and comments from the attendees. Responses to the questions and comments received at the public meeting and in writing during the public comment period are included in the Responsiveness Summary. On the basis of comments received during the public comment period, the public generally supports the selected remedy.

SUMMARY OF COMMENTS AND RESPONSES

Comments were received at the public meeting and in writing via e-mail. The transcript from the public meeting and the written comments submitted during the public comment period can be found in Appendix VII. A summary of the comments provided at the public meeting and in writing, as well as EPA's responses to them, are provided below.

Comments from the Public Meeting

Comment #1: Alternative 3 involves extracting water upgradient of the Santana well. The manager of the Santana well was concerned that extraction of groundwater could affect the supply of water available to the Santana well because the water level in the Santana well is extremely low recently due to the drought. The water at one point fluctuated between 80 and 85 feet above the pump but currently, the water level has been between 4 and 6 feet above the pump.

Response to comment #1: EPA agreed that Alternative 3, which includes extraction of groundwater, treatment at the surface, and discharge of treated effluent to the adjacent creek, could potentially impact the supply of groundwater available to the Santana public supply well. This was one of the factors that EPA considered during evaluation of the remedial alternatives and it is also one of the reasons Alternative 2 was chosen as the preferred alternative. Alternative 2 does not involve extraction of groundwater and will not impact the supply of groundwater available to the Santana well.

Comment #2: Regarding the long-term monitoring presented as part of each of the remedial alternatives, the manager of the Santana well asked if the results of the long-term monitoring would be provided to the public along with any conclusions based on the monitoring data.

Response to comment #2: EPA has established certain mandatory milestones such as five-year remedy reviews as part of the Superfund process. However, EPA can hold periodic meetings with community members to present the results of the long-term groundwater monitoring. EPA can also prepare written releases of monitoring information for the community.

Comment #3: Were the other community wells in the area sampled? If so, are there options for relocating the community supply well or finding an alternative to the well? The water levels have diminished so much that the decreased production of the well may present a long-term water supply problem.

Response to comment #3: Other wells in the area were sampled and no contamination was found. At present, the groundwater, even before it goes through the granular activated carbon treatment system at the Santana well, is in compliance with the Clean Water Act and the Department of Health criteria and has been in compliance for the last two years. The water is safe to drink. If the location of the Santana well was changed, the source of the water would be different, but the contamination at the current well would still need to be addressed. EQB indicated that if the supply well was relocated, the hydrogeology of the site could be altered by the pumping from this other supply well location, which could cause unforeseen problems. It is important for the implementation of the selected alternative that the hydrogeology remain the same.

Comment #4: Is there a chance that the La Riviera supply well will be affected in the future?

Response to comment #4: There is no contamination in the La Riviera well at present time. The groundwater contamination at the Santana well is not expected to travel to the Don Antonio (La Riviera) well. See EPA's response to Comment No. 6 below for more details.

Comment #5: One resident commented that there are very few people at the meeting from the Corozal and Naranjito communities. They asked how extensively the news of the public meeting was spread and suggested using a loudspeaker to share the information in the community as a better option. It was also suggested that EPA should send letters to home addresses because the letters might be taken more seriously.

Response to comment #5: EPA responded by detailing the variety of ways the public was notified about the proposed plan public meeting. A public notice was placed in the *Primera Hora* newspaper, a newspaper that is widely ready in the area, simultaneously with the release of the Proposed Plan. Flyers were placed around the community, in the community postbox area, in the business across from the school, and at the Felipe Sanchez Cruzado School. In the future, EPA will consider the additional resources suggested to distribute flyers and disseminate information to the community.

Written Comments Received from Public

Comment #6: A commenter asked how EPA and EQB can ensure that the contaminant plume is not migrating and not being affected by water pumpage (groundwater/aquifer drawdown) caused by the groundwater withdrawal by other wells in operation in the vicinity? In Puerto Rico, the radius of influence is not calculated for water wells (such as PRASA, DNER, etc.) nor dewatering activities. It is very important to understand that these activities apply stress to the aquifer causing a potential migration effect over contamination areas, causing the plume to migrate. Entities or individuals applying for water well permits (including wells for irrigation) or proposing dewatering activities must perform radius of influence calculations in relation to known contamination areas to minimize the possibility that the proposed action/operation will not have a negative effect and will not promote plume migration.

Response to comment #6: During the Remedial Investigation (RI), the surrounding public supply wells were sampled and found to have no contamination. The RI found that the contamination is confined to a relatively small area. Pumping of the Santana well is producing a capture zone, and PCE concentrations in the Santana well have shown a consistent decreasing trend over time and have been below the drinking water standard of 5 micrograms per liter (µg/L) since November 2013. This decreasing trend is present despite the fact that the Santana well is located less than 200 feet from the highest PCE concentration detected during the RI (27 µg/L in monitoring well MW-4D). The Santana well has been shown to be hydraulically connected to MW-4D via the bedrock fracture network. The public supply well closest to the Santana well is the Don Antonio well, which is over 1,000 feet downgradient of the Santana well. For the reasons cited above, it is unlikely that the Don Antonio well or other local supply wells (which are located upgradient or further from the contamination) will be affected by contaminant migration. However, as part of the long-term monitoring plan, additional monitoring wells will be installed and monitored on a regular basis to ensure that contaminant migration is not occurring. In addition, EPA's selected remedy includes the implementation of institutional controls to restrict future construction of groundwater extraction wells in the area until remediation goals are met.

[CERTIFIED TRANSLATION]

PUBLIC MEETING
COROZAL SUPERFUNDSITE
AUGUST 20, 2015
COROZAL, PUERTO RICO

Date: August 20, 2015
Time: 6:00pm
Place: Felipa Sánchez Cruzado School

Brenda Reyes: Ok, here we are. Good evening, my name is Brenda Reyes, US Environmental Protection Agency press and public affairs officer. Allow me to welcome you this evening and as ever our thanks to the Felipe Sanchéz Cruzado School and its Principal who has so graciously welcomed us. The last meeting was held at the Monte Choca Center, but the community requested that we hold it here because this place is more accessible to them, so here we are. The information repository is also here, the documents are here in the school, in case you want to review them as they are more accessible. Tonight I wish to cordially welcome you, because we will be discussing the Corozal Superfund Site; this public meeting is held to discuss the proposed plan. Throughout all the phases of the Superfund program EPA has to prepare like a small, a small list, and this list includes periodic meetings with the community. That is to say, you may ask to meet with us periodically, but there are some meetings that are part of the Superfund process and this is one of them. With me today is engineer Daniel Rodríguez, the Project manager, previously it was Julio Vázquez who workedforRegión2, New York, but now it is Danny. Danny is a colleague, he is working with the Vieques project, the cleanup of the former Navy Base in Vieques; with us also this evening is Pascual Velázquez, from the Environmental Quality Board, Frances (Frances Delano), Mike (Michael Valentino) and Susan (Susan Schofield) from CDM, José (José Reyes) is somewhere around there, and, in addition, we have our Region 2 risk assessor Chuck Nace, Chuck works for EPA, so I will now leave you with Danny. Please save any questions until the end of the presentation. The format we generally follow is that Daniel makes the presentation at the end of which you may ask questions. It is very important for you to identify yourself when asking questions, please state your first and last name and who you represent, or if you are residents, state I am so and so, a resident of the community. This is very important for Widy, who is making the transcript for the record. It is also very important for you to know that the public comments period ends on September 11, 2015. The comments you make today orally will be included in the record which is why we have a transcription service here today; you may also make written comments. Is there anything else? Then they're all yours.

Daniel Rodríguez: Thank you. Good evening to all, my name, formally, is Daniel Rodríguez, I am the Project manager for the Corozal well. This is the agenda for the meeting *(see slides 2 and 3: Agenda)*. We had the introductions, which Brenda already covered. Tonight we will be telling you about the Superfund remediation process. We will be presenting the results of the remedial investigation for the well area, the affected area, and we will be presenting the remedial alternatives, and what remedial alternative we are proposing for the Corozal well, or the Santana well as it is known. During the Superfund process *(see slide 4: Superfund Process)*, here we marked the sites, the places, to be evaluated, to determine the action to be taken, because we found, we detected contamination that may represent a risk to human health and the environment. It consists of two paths, two elements, once the site is determined: one is the removal actions program, which was one of the parts begun in the Corozal Project with the purpose of reducing or eliminating this contamination in the short term, and that is what the program did by modifying the well and with the granular activated carbon system placed in the area. The next element, which is for a longer term, is the remedial actions program, which is what we are involved in right now. This is part of what we will be presenting. This is more of a description of what happens *(see slide 5: Site Evaluation Phase)*. An investigation is performed, or somebody determines there is a contamination problem, the records are located, data is obtained and included in an Agency databank, site assessment begins, which is the PA/SI part, Preliminary Assessment and Site Investigation, it is assigned a number, and it is ranked, and based on this, depending on the ranking, it is included in the National Priorities List. The Corozal case was ranked and it was therefore included in the National Priorities List. During this investigative phase, this preliminary phase, it is not included in the Superfund program per se, although in some cases it takes place concurrently. This was one of such cases, a removal action to reduce the risk immediately and faster. The green section below is the part we are working on, and right now we are in the phase where we prepare the Record of Decision. During a remediation investigation that already took place we conducted a feasibility study that determined the possible remedial alternatives and we are proposing one of them, that is where we are right now. The history of the site *(see slide 6: Site History)*, I am almost sure you know more about this than I do, because you have been dealing with it longer. In 2010, at the request of the Department of Health, the Puerto Rico Aqueducts and Sewer Authority sampled the area's wells and found PCE contamination in the Santana well; PCE, in Spanish is tetrachlorethane right?

Frances Delano: Tetrachloroethylene.

Daniel Rodríguez: Ethylene? thank you. As a result of this sampling, the Department of Health gave orders that the water could not be used and water was brought in for a period, after which the removal action was implemented, which consisted of the modification of the well and the activated carbon system. This was in…that was in 2011. That system is not even receiving maintenance from the system.[sic] That is a map of the area *(see slide 7: Map)*, showing the different wells that are close to the site; I am certain you know this area well. During the remedial investigation *(see slide 8: Remedial Investigation/Feasibility Study)*, which as I've already explained is conducted to determine the nature and extent of the site contamination, in the place, and the risk such contamination represents to human health and the environment… The feasibility study evaluates the contamination cleanup options for the site and the investigation work, in this case they were done from2013, from June 2013 to February 2015, which is when the last, the last field sampling was performed; and in 2013 the work plans were prepared and the investigations of record were conducted. As part of the field work *(see slide 9: Field Work during RI)*, soil gas samples, subsoil samples and surface soil samples were collected; surface water and sediment samples were collected; a number of wells were installed, from which two rounds of samples have already been taken—this was the data gathered for decision-making—and hydrogeologic tests and monitoring of groundwater levels were performed, in a slightly longer term, and the ecologic characterization was performed.

I can barely see this map*(see slide 10: Map)*, here, those were the areas screened for the passive soil gas system and these are the contamination ranges found during this sampling; and here we can get, more or less, an idea of the focus of the soil contamination problem at that time. Here are the soil samples *(see slide 11: Map).*If I'm not mistaken this is surface soil, right?

Frances Delano: No, it is soil.

Daniel Rodríguez: Soil per se.

Frances Delano: Surface soil and subsoil.

Daniel Rodríguez: …and both in the same place. Here we can see a clearer indicator of the problem focus area, or the problem that used to exist, and these are the concentrations they found. The criterion level was 46 micrograms per kilogram and those were the concentrations found, and all the concentrations were below the criterion level, right, contamination was found but no longer at a level that constitutes a problem.

This is for surface water and sediments *(see slide 12: Map)*, it was sampled from a point upstream to further down past the well. And all the concentrations detected; well almost all, just one of them exceeded the criterion level. In this case it was 5 micrograms per liter, same as the MCL, and it was a sediment sample. Here we see the water concentration data, over time, for surface water …*(see slide 13: Surface Water Concentrations over time in the unnamed stream)*.The blue, it was the first one taken in 2010, these were the concentrations being detected; later, in 2011,samples were again taken and you can see how the surface water concentrations have decreased. In the last sample taken, in 2014, I believe it was in October, the mobilization, in October, and they were all under the 5 micrograms per liter or parts per billion criterion. These are the monitoring results for the wells installed and for other wells existing in the area *(see slide 14: Monitoring)*, in the Santana well, to be more specific. All, many of them rather, had concentrations under the five micrograms criterion, detection of five parts per billion, except in four contiguous wells, because one was closer to the surface, less deep, and one was deeper; and these are the concentrations. Almost all the wells that exceeded the criterion were very close to the criterion: 7.1, 5.5, 8.1, 10. There was one that was higher, but even so the concentrations were not exceedingly high; we are talking of 27 and 20. This is in the Santana well *(see slide 15: Santana Well Influent Data, Nov 2010-June 2014),* it shows how the concentration has changed since the problem was discovered, until May 2014. The concentration has been decreasing naturally, without receiving any type of treatment until November 12, 2013, when it fell below the criterion level. In other words, currently, because I believe the sample was taken at the end of July, on July 30 to be more precise, the concentrations were still below 5 parts per billion, I believe it was at 2.7. That is below the criterion established by the Clean Water Act for this contaminant. And this shows a collection of all the data gathered and a graphic representation of where we believe the plume may be located. Again, the concentrations are so low that it is very hard to say: here it is, because the concentrations are extremely low. But some of them exceed the criterion level; therefore, we have to address the problem.

This is the same Surface water map, right? *(see slide 16: Sampling Results from all media and areal extent of plume)*.

Frances Delano: Yes that is the same surface water map.

Daniel Rodríguez: Surface water, ok. Data was gathered as part of the process; now we have the data, what do we do with it? We conduct a risk assessment study. The risk posed by the soil contaminants associated with the site to the ecological receptors was assessed *(see slide 18: Ecologic Risk Assessment)*. No ecologic risk was found. The risk to human health—adults and children—due to groundwater exposure was assessed *(see slide 19: Human Health Risk Assessment)*. This was the only media that presented a problem, and this is why it is the media we evaluated in the risk assessment. We found there is a cancer risk from arsenic, but arsenic is not one of the chemicals of concern, because it is deemed to be background concentration, that concentration was already there and is not associated with the discharge or disposition of the chemical. It was determined there could be a non-cancer risk for arsenic and TCE, the Trichloretane, right?

Frances Delano: Trichloroethylene.

Daniel Rodríguez:…ethylene…I always get it wrong. Again, arsenic is not part of the discharge, and these are in the wells that are not being used for consumption, but it is, it is there, it is latent and that is why we decided that if we did not take remedial action for the concentrations exceeding the five parts per billion criterion it could pose a risk to human health. The proposed plan was prepared *(see slide 20: Proposed Plan)*, which is the document you have there; it identifies the removal action we propose. We are requesting public comments regarding the alternatives included in the proposed remedial action plan. The comment period, as Mrs. Brenda Reyes indicated, began on August 12 and it will end on September 11, 2015. The remedial alternative will be chosen after taking into consideration the public comments received.

The elements, we are now going to discuss the alternatives presented in the proposed plan *(see slide 22: Summary of Remedial Alternatives)*. All the alternatives have certain elements in common, these are: gathering more data during the pre-design phase when more samples will be taken to see where we are at that time, and to decide in what direction we will move. Institutional controls will not be permitted; rather, we will restrict the installation of water extraction wells in the future until the remedial action objectives are achieved, to wit, until the cleanup is completed. And the existing treatment system installed by the removal program will be operated and maintained to ensure that if, in the eventuality that the contaminant concentration migrates from the well where it is now, from the area where it is now, towards the Santana well and it is extracted, right, the system will treat it and therefore we can guarantee that it will always be below the five parts per billion criterion.

All these are common elements, except for the first alternative *(see slide 23: Remedial Alternative No.1)*. The first alternative must be considered because the Superfund Act, National Contingency Plan, requires that we use it as baseline, the No Action alternative, to do nothing. We pick up our things, we leave, it's done, there are no associated costs, no follow-up; this is it. We believe that this option is not feasible, because we have a contamination problem in the upstream wells and we must be alert to ensure the extraction well is not contaminated.

Alternative number 2*(see slide 24: Remedial Alternative No.2)*, monitored natural attenuation and institutional controls. Natural attenuation will depend … it is rather to reduce contaminant levels until the remediation objectives are achieved. It is not that an action is being implemented as such, but that we will continue monitoring efforts, ensuring in a more systematic way that these contaminants are not migrating; but rather there is a degradation of contaminants and, therefore, the concentrations will not reach the well from which you are extracting water. The historical data results of the investigations carried out give us, show us, there is a tendency for a decrease in groundwater contaminants, and we could see that in the chart, that it has been decreasing. The monitoring program would be long term for this alternative and it includes institutional controls to ensure nobody will be extracting potentially contaminated water. The cost of this remedy is close to one and one half million, one million four hundred and eighty-two thousand *(see slide 25: Remedial Alternative No. 2)*. We estimate some wells must be added to complete the monitoring program design and this would take approximately one year, and it is expected that with this remedy, to… if it is monitored, the objective would be achieved in 15 years.

The third alternative evaluated was groundwater extraction *(see slides 26and 27: Remedial Alternative No. 3)*, with treatment, long-term monitoring and institutional controls. The groundwater contamination plume in the aquifer that is close to the surface will be extracted, it will be treated, and will be discharged back into the surface water. The contaminants in the deeper aquifer will follow the alternative number 1 criterion, similar to alternative number 1I should say, which is monitoring to see if the natural attenuation process is taking place. Monitoring is the same as for option number 2, it will be long-term to determine that the contaminant decrease tendency is moving towards the objective we are trying to achieve, for it to be below the Clean Water Act criteria. Groundwater extraction can impact the production of the Santana well, this is one of the things we must consider when evaluating alternative number 3, because it can happen. The cost of this alternative is approximately three million dollars, 2,980,000 *(see slide 28: Remedial Alternative No. 3)*.Construction time is estimated to be two to three years and results are the same, in15 years.

Alternative number 4 is a more dynamic alternative *(see slide 29: Remedial Alternative No. 4)*, it consists of an air sparge curtain, long term monitoring, and institutional controls. These components will be found in all the alternatives. The air sparge curtain would be used to remove the contaminants from the deep aquifer zone; there we would be treating both the shallow and deep aquifers, both of them at the same time. The contaminants in the deeper aquifer may persist during the natural attenuation process, and as in the other alternative it will be a long-term monitoring. The cost of this alternative is estimated at 3.3 million, 3,280,000*(see slide 30: Remediation Alternative No. 4)*. It can be constructed in four months and the duration is 15 years.

All these alternatives were evaluated using the 9 criteria provided under the Superfund Act, National Contingency Plan *(see slide 31: Evaluation of Remedial Alternatives)*, which are: Overall protection of human health and the environment; Compliance with environmental law regulations or those which are applicable or relevant and appropriate; Long-term effectiveness and permanence, we don't want to implement a remedy that will produce an immediate decrease only to increase again, failing to meet objectives; Reduction of toxicity, mobility, and volume through treatment; Short-term effectiveness; Implementability; Cost; Commonwealth of Puerto Rico Agency acceptance, in this case the Environmental Quality Board; and in fact, Community acceptance of the proposed remedy. The EPA is recommending alternative number 2 as the preferred alternative *(see slide 32: EPA's Preferred Remedy)*, natural monitoring, natural attenuation, and institutional controls, which includes continuing to monitor the Santana well and operating the system, maintaining the activated carbon system, groundwater monitoring, until objectives are achieved, that is until groundwater concentration is less than the criterion established under the Clean Water Act. The Environmental Quality Board gave its concurrence; I don't know how to say it…

Frances Delano: approval.

Daniel Rodríguez: …approved this remedy, that is, it agreed with the EPA's preference for alternative number 2. Again *(see slide 33: EPA's Preferred Remedy)*, alternative number 2, it meets the conditions to protect human health and relevant and applicable laws, and it is cost effective in addition to the other parameters.

The next step*(see slide 34: Next Steps)*, we are requesting public comments about the proposed plan. Where are we now? We are going to prepare a Record of Decision that describes the chosen remedy; again, it will include the comments made by the public regarding the plan, during the proposed plan, and this is very important; September 11 is the last day for receiving comments, so if you have any comment, please send them to us, and you can send your comments, it is in the documents you received, and they are here on the screen, or to my office in the Municipality of Vieques *(see slide 35: Send Comments)*. You can reach me at these telephone numbers, and this is the electronic mail. This is what I have for you tonight. Do you have any questions? Any comment?

Frances Delano: Do you have any questions?

Daniel Rodríguez: Please give her the microphone because it must be recorded.

Frances Delano gives the microphone to the residents for the questions section.

Frances Delano: Name and question.

Raúl Santana: My name is Raúl Santana, I currently manage the Santana well. Regarding alternative number 2, you are the one practically evaluating the system I am a little concerned about the sample extraction you mentioned using the other wells that could affect our well.

Daniel Rodríguez: No, that was not alternative number 2. That can be one of the consequences in alternative number 3, because we will be extracting the water to provide surface treatment and discharge it into the creek, to the surface water. That was one of the factors we took into consideration when we performed the evaluation, and that is why one of the criteria considered for choosing alternative 2 as the preferred alternative is that this does not happen.

Raúl Santana: That this does not happen? Ok. That was my concern. Because right now, currently, the well level is extremely low...

Daniel Rodríguez: The drought…

Raúl Santana: Normally our well fluctuated between, at one point it was some 80 to 85 feet above the pump, currently we are estimating some 4 or 5, 6 feet above the pump…It could be, unfortunately, due to the lack of rain. As to the monitoring of alternative number 2, will you count on us will you provide us, at all times, the results, the data, whatever may come up regarding that?, or will you make, will all the decisions be made…?

Daniel Rodríguez: No. Once we enter the Record of Decision that the…let us say that the remedial alternative chosen for the site, or the place, is alternative number 2, we can hold periodic meetings with community members to present the results of the different samplings performed. The Agency has established certain mandatory dates and one of them is the 5 year review period, but we don't have to wait 5 years we can do it more frequently. Contractors are given time to take the samples, analyze them, prepare them, present them, and we can hold a meeting with the community to periodically present the results of these sampling efforts, if a change has been observed, if there is no change, etc. It doesn't have to be through a community meeting, we can prepare flyers, written releases that interested persons may access, whether through the Internet, or by mailing them to their residences. There are many ways for us to remain in contact with the community.

Raúl Santana: The other community wells, both the Sánchez well and the… Were they sampled too, or…?

Daniel Rodríguez: All of them.

Raúl Santana: All of them?

Daniel Rodríguez: I believe all of them were sampled.

Frances Delano: In the image, in the image in the poster there it shows a picture showing they were all sampled, that one it is at the beginning. Further, further back, the same one you have in the back *(referring to a presentation slide).*

Daniel Rodríguez: Oh, oh, ok. You mean this one?

Frances Delano: The one at the beginning, go, go further back. Those; see, it shows Antonio…

Daniel Rodríguez: Ortega, but were these wells sampled during the sampling rounds?

Frances Delano: Yes, both times.

Daniel Rodríguez: So then the answer is yes, now, we have found no contamination in it.

Raúl Santana: ¿And what is the probability, or what options for relocating our well? or finding an alternative … seeking another solution? So we can be done with this situation.

Daniel Rodríguez: That has not been considered, the…

Frances Delano: We must address the contamination.

Daniel Rodríguez: The thing is we have the contamination problem.

Raúl Santana: Ok, that is, we have to address the contamination, because it affects the area, but we as, as community, because in others, in the other wells it has not been found…

Daniel Rodríguez: Please, could you come closer to speak? Because she will get your comments to present them…

Raúl Santana: This kind of contamination has not been found in the other wells; only in our well, the Santana well. Is another alternative possible? Can the well be relocated, that does not have that, that problem, while the contamination problem is solved? I know it has to be addressed because, of course…

Daniel Rodríguez: It is clear.

Raúl Santana:…it has to be addressed, but to release us, perhaps, from this process we are dealing with as regards the water.

Daniel Rodríguez: Many times during the removal action phase, this is taken into consideration, because it is more immediate. It may be considered, but here we have the, right…

Frances Delano: The water is in compliance.

Daniel Rodríguez: On the positive side, the quality of the water you are extracting meets the conditions of the Clean Water Act, and Department of Health criteria. That is, right now, that water, with the concentrations it is showing, for the last 2 years, has no problems. But we know there is a focal point of contamination, that may, it is not certain, that may migrate towards that well, therefore we must take measures to ensure this does not happen. And that is what we are doing. Relocate it? I don't know, I would have to… present it. That will be one of the comments we will answer.

Raúl Santana: Also the well levels have diminished so much that the well may be showing signs, that in the long-term it will have a water supply problem.

Daniel Rodríguez: Yes.

Raúl Santana: That is an observation, a concern I have.

Daniel Rodríguez: Ok. Your comment was included for the record and we will address it. I don't know if this is a possibility within the remedial alternatives, because that is… you are changing the source, but in doing so you are not addressing the contamination problem. And we, right, our concern is to address the contamination problem. But the comment you have made this evening is being recorded. Yes?

Pascual Velázquez: Pascual Velázquez, from the Environmental Quality Board. Continuing with that point, we understand that with the activated carbon treatment being given to the water, concentrations have diminished to permissible concentration levels, right? That the water is safe, as you have stated, and a result, perhaps, of relocating the well a little towards the other is that the hydrogeology of the place could be altered, which is very important in the remediation to be implemented. It has been studied, we know it is so, if you drill a well close by, or if the flow is altered in any way, that could constitute another problem, or it could exacerbate the potential contamination of the site. But I understand that you have a very valid concern, and with the activated carbon, as shown in the graph Danny has back there, the Santana well, over time, the tendency is clearly to decrease and it is under control.

Daniel Rodríguez: That concentration is before it reaches the activated carbon system, that is, it is under criteria even before it reaches the system.

PascualVelázquez: Much better then. Thank you.

Frances Delano: Questions? Does anyone have a question?

Daniel Rodríguez: The gentleman?

Juan Santana: My name is Juan Santana, but I am from the La Riviera community. So you are saying that you took samples from our well and we don't have that problem. It does not exist; there is no chance that it will happen in the future?

Daniel Rodríguez: Based on the data we have, the data we gathered—let me see if I can show you a slide—I know it is for the collection area, minimized, it does not include the area where your wells are located, but this is the focal point of the contamination. Here is where the data reveals it is. That is, there is no likelihood, no possibility for them to migrate towards your wells, because the groundwater flows towards the Santana well.

Juan Santana: That is, they are to the east of us, and we are towards the west.

Daniel Rodríguez: West and north, right? Yes, you are west and south. Can you identify it there?

Frances Delano: You, which one is yours? Nieves?

Juan Santana: No, La Riviera Community.

Frances Delano: But which well is it?

Juan Santana: What?

Daniel Rodríguez: Which well is it?

Juan Santana: The La Riviera Community well!

José Reyes: The one at the end and to the right. Is it the well they call Don Antonio?

Juan Santana: No that one is Nieves, that one is Nieves Sanchéz.

José Reyes: Nieves Sánchez is below.

Juan Santana: Exactly. We should be a little further down, I think it is that one, since it says Raúl.

Frances Delano: If the well is not there it wasn’t sampled.

José Reyes: Yes it is there, it must be there. The one that says Don Antonio Well…zoom it Frances.

Daniel Rodríguez: Yes, so the gentleman can see it.

Juan Santana: That one must be ours. There is no other.

Pascual Velázquez: The one that says Don Antonio?

José Reyes: Then, how should it be called?

Juan Santana: It is called La Riviera Community, and it is identified and everything. And look here, in the letters that were sent to me.

Frances Delano: If it is not here it was not analyzed.

Raúl Santana: They say it is registered there as Don Antonio.

José Reyes: It must be this one because there is no other.

Raúl Santana: From here on down there are no other wells.

Daniel Rodríguez: I imagine then, this is the La Riviera Community well, right?

Person from the Audience – Yes.

Daniel Rodríguez: It must be that one. The wells shown here were the wells that were monitored.

Raúl Santana: There is probably a confusion with the name.

Daniel Rodríguez: With the name, exactly. The well’s identification.

Raúl Santana: With the name.

Daniel Rodríguez: Is seems that Don Antonio took them there that day and they gave it that name.

Persons from the Public: [laughter]

Raúl Santana: It should not be, but [laughter].

Daniel Rodríguez: Then, but we can correct it, clarify it, right? That that well is also known, or that the name of that well is the La Riviera Community well.

Juan Santana: La Riviera Community. And in fact we used to be one, but we split.

Daniel Rodríguez: Oh ok. It used to be one system but now there are two.

Raúl Santana: Yes, because the population grew so much, the number of residents, and we made the decision. A bunch of Santanas over there and the other Santanas over here.

Daniel Rodríguez: [laughter]

Wispering from the public.

Daniel Rodríguez: Please give the microphone to Raúl Santana so his words are recorded.

Raúl Santana: Yes, I would like to make an observation, because this situation began in 2010, I don't know if at that time they were still… Antonio.

Juan Santana: The thing is that originally, it was always called La Riviera Community.

Daniel Rodríguez: Yes.

Juan Santana: It has always been identified there as the La Riviera Community.

Daniel Rodríguez: So, it appears that the persons who gathered the data at that time, gave it that name. We have continued to use that name, right? But we can explain that this is the well that serves the La Riviera Community. The point is, it was sampled and no contamination was found. Any other comment, question, concern?

Juan Santana: I would like to make a comment, because he mentioned this to me, and also so they may be informed. The owner of the, of the land where that, that carbon system is currently located, right, he alleges that he was being paid rent for the land and that he is no longer being paid.

Daniel Rodríguez: I understand that he is being paid.

Juan Santana: that is, I mean, the reason why I am telling you, is so we can avoid that problem, would make it difficult in the future.

Raúl Santana: Regarding this issue, I spoke with Don Esteban regarding this matter. He told me that yes, that he was not being paid. I called Joel Morales, the person previously in charge of the Project, and he told me that he paying him. So much so, that he has the cancelled checks. Now the new, the new contractors that just began, NRC I believe, they have been in operation for two months, and they have not paid yet. They have not paid. I told him about this matter and he said he would deal with it. I spoke with him last week and he told me that he would deal with it.

Daniel Rodríguez: You spoke about this with Ángel Rodríguez when you spoke with him?

Raúl Santana: I spoke with Carlos Huertas.

Daniel Rodríguez: Ok, Carlos works with…

Raúl Santana: Carlos Huertas told Joel and Joel called me. I spoke with Don Esteban. Regarding these new…This week I brought the issue up again, and he said he would take steps... That is what I know, I've not been told what has been done, but at least regarding the contract with Joel, according to him he has the cancelled checks showing they were cashed.

Daniel Rodríguez: I'll state your concern.

Raúl Santana: And the new people, who are working with the monitoring levels, they have not paid yet.

Daniel Rodríguez: Ok

María L Cintrón: María L. Cintrón, I am a teacher at the Felipa Sánchez School. I am a resident of the Cedro Abajo Community, La Antena sector. At that time, when the community was notified, I worked, and I still work here in the school. And at that time it really impacted us right? because we did not know; we had been asked for the use of the school for a special program in which many members of the community participated. I learned about it, right, about the orientation, because they had left several notices on top of the school counter. As a member of the Cedro Abajo community, right, I would like to suggest…you are saying that September 11 is the last day to submit comments, and sadly I see very few people here from the Corozal and Naranjito communities. How extensively did you notify this orientation? Whether using loudspeakers, the letters you mentioned, placing them in mailboxes? Because, for example, in the Felipa Community, it was placed on the counter, but if the parents don't come to the office, well the notice will get nowhere. I understand that the most convenient, the best and most effective result, I believe, would have been to drive around with a loudspeaker, right, because I believe this is very important and something the community most know about, and provide more suggestions and comments, because, there is less than a month to go, right; and I understand, right, that there is very little time for the community to learn about this.

Brenda Reyes: Ok, to answer your question, (for the record, Brenda Reyes, press and public affairs officer) the law requires that we notify the community by means of a public notice. That notice was published in the Primera Hora newspaper, ¿on what day Frances?

Frances Delano: The 12.

Brenda Reyes: On August 12.

Frances Delano: The first day of comments.

Brenda Reyes: The first day of public comments. That is standard. That is, these are standard operations we follow in all the communities. I placed flyers in the community postbox area, wherever I found them. In addition, we left flyers, the information sheet, right, in the business across from the school; it was left here at the school, we had met here in the school; We left one there in the bulletin board; there is a small supermarket on the road where our trailer was located, we left flyers there; and we left them inside the community, just after the steaks (*biftecs*) area where there is a minimarket, and a small restaurant, we left flyers there. This is the standard method we follow. We are always willing to accept the suggestions of the community, so that perhaps we can do better the next time, right? To spread the word. However, I am complying, I complied with all the legal requirements, and made an extra effort, right, by using flyers to notify the community. It is also related to how you inform the community, I know many people work, persons that really… I am telling you this, because I have worked with many kinds… all kinds of communities throughout Puerto Rico. There are places, like in Vieques where my colleague works, where the community is very involved, and we have cases where the community simply does not go to the meetings, very few, they are very little involved with issues; however, you are here today, and all your comments will be included. I invite you to spread the word in your community, the record, right, and the documents are here. The proposed plan is here. They can come and evaluate them here and they are in the library, they can access them during library hours. Likewise, here is the sheet describing the proposed remedy, the plan, it has charts, is has everything, you can take them with you, and if you know of anybody who might be interested, you can take it to them, and distribute it in your community, we will also be leaving the information here. Is there anything else Danny?

Daniel Rodríguez: Those of you who are served, who receive the Santana well service, Do you distribute something to the, to bill people for the water? I don't know how it is done.

Raúl Santana: In our well at least, you see, unfortunately I generally prepare a newsletter when I have something important for the community, I distribute a newsletter; unfortunately this time I found out too late. Too late, and I couldn't even send a notification although I have the material to do so. The letter is prepared at least one month or three weeks in advance and it states why it is important, not that everyone will come because in the communities…but at least a representative number, half, perhaps we can get that. But we need more time.

Brenda Reyes: The proposed plan was approved barely two, two and one half weeks ago. We are, we came literally photo finish, as we say in English, we have…Frances and I have been running three Superfund cases. That is, three of my proposed plans were approved the same week, one for Manatí, one for San German and one for Corozal. We did our best within the constraints and we were organized, we had all the public notices, we had contacted the press to run them. I arrived here on Friday, literally photo finish, that is, my work was approved, that is, I understand your point of view, perhaps with a little more time, and I generally try to schedule meetings two or three weeks in advance. But the case here is that we, the EPA is nearing the end of the federal fiscal year, this was approved literally at the last minute, I had three sites in the island that had to be visited and the communities had to be notified, so we made the notifications within the work frame. The time our work allows… and remember I work from Monday to Friday, and sometimes I work from Monday to Thursday. So believe me, my colleague at CDM, Frances, and I, we have been pushing ourselves these last two weeks.

Frances Delano: But it was done simultaneously, the proposed plan was approved and the notice was placed in the newspaper.

Brenda Reyes: Yes it was notified in the newspaper, because we had everything organized and we had already prepared the notices. Danny, there were…there were documents that had to be reviewed, documents that had to be translated, documents that had to be edited, to have them. We had to deliver materials to each of the communities. And I am not making excuses, but just so you will understand how we worked these last two weeks and why it was notified last Friday. I mean, the public notice was published in the newspaper on the 12th and some people had seen it, here, they had seen the notice.

Daniel Rodríguez: The comment is very valid, and we will be using it in the future because the important thing is for the people who are being served by this well, the affected persons, right, for them to be notified. We will use the resource you have suggested to distribute flyers to these persons. If you have the addresses of these neighbors, please provide them to us and we will send the information to them and to you, we will send the information to each and every user.

Raúl Santana: That would be even more effective, perhaps if the Agency, per se, sends the newsletter, perhaps they will take it more seriously.

Daniel Rodríguez: We would appreciate it if you were to send us the address list.

Raúl Santana: I am working on it right now; I have begun to gather the postal addresses of each user. As soon as I have them, and I have the list, I will send it to you.

Daniel Rodríguez: Perfect, we will appreciate it, and in the future we will us the address list to inform all system users about the data generated, meetings held, when the final remediation plan is approved, all that. We can do it immediately so all the neighbors are informed, exactly.

María L Cintrón: Something we find very effective, at least in Cedro Abajo and in these communities is the use of loudspeakers after 6 pm, since by that time parents are back home, in their residences. I believe that if they are notified in advance, right, perhaps they could, we could get it to be …

Daniel Rodríguez: That option can also be considered.

María L Cintrón: Exactly.

Daniel Rodríguez: And we use it in many places.

María L Cintrón: …for example the school, I know the school can help with this, you provide us the flyers, because we've begun without paper, because things are difficult. You bring us the notice, the announcements and we will distribute them by group. We can paste them in the student's notebooks, because, for example I have a postbox, but it is locked, because there are other community issues also, but this means has been the most effective.

Brenda Reyes: If you can provide us, as Mr. Santana mentioned, an electronic mail this is very important, if the people in the community, some of them have electronic mail, a postal address where we can send them the materials, that is very important for me. The other thing is if you have a loudspeaker service provider that you already know someone in the community that provides that service we would be extremely grateful if you could provide us his or her name for the record, to know this person comes and visits this area. We have notified meetings this way at other times. This is why this community input is so important, this conversation, because we get to know each other little by little, right? what are the best ways to contact you. When I came here with Frances, yes we did this for the community interviews, but we were told about the flyers and not the loudspeakers, and when we asked about newspapers, the one mentioned was Primera Hora, remember?

Frances Delano: And that is where we placed the notice.

Brenda Reyes: That is where we placed the notice. Because during these interviews, that are always done in Superfund cases, we go, right, home to home, door to door and interview whoever is available, we take a sample and this sample tells me what is the newspaper the community reads most. In this case it was Primera Hora, so we spoke with Primera Hora. In some communities it is the regional newspapers, for example, El Norte, La Cordillera, but frequently in the northern area of Puerto Rico they say “oh, right, the Periódico El Norte”, right, so I publish the notice in the Periódico El Norte. There are people who prefer house to house notification, that is, right? there are different ways. You are now telling us that an effective and the preferred means of notification in this community is the use of loudspeakers.

María L Cintrón: And the flyers.

Brenda Reyes: Right, but we already knew about the flyers, and ok, I will make a note of this, and Mr. Santana, we will appreciate it if you provide us that information at a later time.

Raúl Santana: I will do my best to obtain all the addresses and send them to you, that won’t be a problem, certainly.

Daniel Rodríguez: We will be grateful.

María L Cintrón: You were saying that you will provide follow-up, right? In 5 years time, you will follow-up on this.

Daniel Rodríguez: No, the Superfund Act requires us to evaluate the remedy every 5 years to see if it is effective, whether it has to be amended, altered, or modified. These are key dates in our work.

María L Cintrón: But do you determine these dates? or is it done by people directly…?

Daniel Rodríguez: No, these dates are included in the Superfund process. Now, as regards the frequency with which we can share information with you that can be as often as when we collect samples. Once we have designed the final remedy for the site, right, we determine how often we will be collecting samples, how often we will visit the site and do field work, and when the results are ready we share them with the community and we can schedule follow-up meetings to let you know if the remedy is working, or if nothing has happened, or we have concerns, whatever the action is. We don't have to wait until the 5 years are up, that is what I am saying.

Brenda Reyes: In addition...The Superfund process is a standard process for all cases. That is, it is similar to a guideline, I do this, I do that, I do that. Every 5 years I have to perform the 5 year review. Public meetings are included in each and all parts of the process, however, separate meetings with the community, like Danny mentioned, those, we can have as often as we can meet, as often as you want us to come, I will come and speak with the school director, request the use of the school, whenever you want. We will need you to send us an email, either to Danny or myself, saying, look we want to meet, we want to discuss this with you, but within the Superfund process I have some forms that I can perhaps bring to you, or send them to you by electronic mail, there are certain standard areas, that is we will meet again regardless of whether we have already met, and we have held twenty meetings; there are certain legal requirements I must comply with. The Act, provides that list, that framework, a checklist that I must go check, check, check, right? on the list. Are there any other questions?

Daniel Rodríguez: In addition to this we have information that is maintained on an Agency Internet page, I was trying to locate it here, because I don't recall the name they gave to it, exactly, but we can also send that information to you and then you can monitor the EPA page to see…

Brenda Reyes: epa.gov/region2

Daniel Rodríguez: … that is what I wrote …but

Brenda Reyes: EPA is, our page iswww.epa.gov\region02and here you can enter Corozal Superfund site and it will take you to the page with the information. Generally all the cases are posted; we are sent some forms that we must update every so often, see if you can find it …cleanup site region 2…

Daniel Rodríguez: …looking for the page …

Brenda Reyes: …no that is the press release. Go back.

Daniel Rodríguez: … here it is …The proposed plan should be here together with the press release. Right, here it is.

Brenda Reyes: here it is …Superfundnpl. Yes it is, right, www.epa.gov\region02\superfund\npl\corozal

Here it is.

Daniel Rodríguez: Right, if you can copy it on the blackboard…Do you have any other questions, comments…?

Brenda Reyes: She is getting the chalk.

Person from the Audience: I have a… not regarding this, but I do have a concern…

Daniel Rodríguez: But it is not related to the proposed plan? Then hold on to it for a minute, let us close the meeting and we can sit down and talk, right here, ok. Thank you for participating in the public meeting this evening. Have a good night.

TRANSCRIBER CERTIFICATE

I, Aledawi Figueroa Martínez, transcriber for the Smile Again Learning Center, Corp. hereby CERTIFY:

That the above is a true and exact transcript of the recording made during the meeting held in the place and time indicated in page one of this transcript.

I also certify that I have no interest in the results of this issue and I am not related by consanguinity in any degree to the parties to same.

In Isabela, Puerto Rico, on September 1, 2015.

____

Aledawi Figueroa Martínez
Smile Again Learning Center, Corp.

CERTIFICADO DE TRADUCCIÓN AL INGLÉS **VISTA PÚBLICA: COROZAL** Yo, Mercedes Solís, traductora profesional y miembro de la *American Translators Association*, por la presente certifico que a mi mejor entender el documento anterior es una traducción fiel y exacta al inglés del texto en español, realizada a petición de la parte interesada. En San Juan, Puerto, hoy 11 de septiembre de 2015. Mercedes Solís Mercedes Solís ATABEX TRANSLATION SPECIALISTS P.O. Box 195044, San Juan, PR 00919-5044 20219	**CERTIFICATE OF TRANSLATION INTO ENGLISH** **PUBLIC HEARING: COROZAL** I, Mercedes Solís, professional translator and member of the American Translators Association, hereby certify that, to the best of my knowledge and abilities, the foregoing is a faithful rendering into English of the Spanish text, made at the request of interested party. In San Juan, Puerto Rico, today, September 11, 2015. Mercedes Solís Mercedes Solís ATABEX TRANSLATION SPECIALISTS P.O. Box 195044, San Juan, PR 00919-5044 20219

Rodriguez, Daniel

From: Rosa, David R. <drrosa@csagroup.com>
Sent: Thursday, August 13, 2015 11:47 AM
To: Rodriguez, Daniel
Subject: RE: EPA Asks Public for Comments on Plan to Protect Drinking Water in Corozal, P.R.

Importance: High

Mr. Rodríguez:

Hi. Thanks for the opportunity in providing comments. My comment is, how the EPA and EQB can ensure that the contaminant plume is not migrating and not being affected by water pumpage (groundwater / aquifer drawdown) caused by the withdrawal in the vicinity by other water well under operation?

In PR, the radius of influence is not calculated for water wells (such as PRASA, DNER, etc.) neither dewatering activities. It is very important to understand that these activities apply stress to the aquifer causing a potential migration effect over contamination areas (making the plume to migrate).

Entities or individuals applying for water well permits (including for irrigation) or proposing dewatering activities must performed radius of influence calculations in relation to known contamination areas minimizing the possibility that the proposed action / operation will not have a negative effect and will not promote plumes migration. I

https://www.broward.org/PollutionPrevention/ContaminatedSites/Documents/sopexhibitiii1209.pdf

Regards,

David R. Rosa | Environmental Discipline Manager | drrosa@csagroup.com
6100 Blue Lagoon Drive, Suite 300 | Miami, FL 33126
T: 305.461.5484 | C: 305.726.4247 F: 305.461.5434

-----Original Message-----
From: U.S. Environmental Protection Agency [mailto:noreply-subscriptions@epa.gov]
Sent: Thursday, August 13, 2015 11:00 AM
To: Rosa, David R.
Subject: EPA Asks Public for Comments on Plan to Protect Drinking Water in Corozal, P.R.

EPA Asks Public for Comments on Plan to Protect Drinking Water in Corozal, P.R.
August 20 Public Meeting Planned

Contact: Brenda Reyes, (787) 977-5869, reyes.brenda@epa.gov

(New York, N.Y. – August 13, 2015) The U.S. Environmental Protection Agency has proposed a plan to use natural processes along with the continued use of a system that EPA previously installed to treat contaminated groundwater at the Corozal Well Superfund Site in Corozal, Puerto Rico. A key step in moving forward is receiving the public's feedback on the plan.

Previously, the EPA installed a system that uses carbon to address pollutants as an initial step to address the risks posed by people drinking contaminated groundwater. Data collected since the EPA installed the system confirms that there are no levels of concern at the well. The system will remain in place as a safeguard.

"EPA was able to install this system to provide the community with water that is safe to drink—and that is of paramount importance to us," said Judith A. Enck, EPA Region 2 Administrator. "That system is working well, and EPA is proposing to continue to operate and maintain it, but we want the public to have a voice in that decision."

The EPA will hold a public meeting to explain the proposed plan on August 20, 2015 at 6:00 p.m. at the Felipa Sanchez Cruzado School, Carretera 811 Km 5 Hm 9, Bo. Cedro Abajo, Naranjito. Comments will be accepted until September 11, 2015.

The Corozal well, known locally as the Santana well, serves a small, rural population that is not connected to the Puerto Rico Aqueduct and Sewer Authority public water supply system. The Puerto Rico Department of Health sampled the well, which serves a rural area within the municipalities of Corozal and Naranjito, and found that the chemical tetrachloroethylene, known as PCE, was contaminating a source of drinking water for local residents. Exposure to PCE, a solvent commonly used in industrial processes, can have serious effects on people's health, including liver damage and an increased risk of cancer.

After discovering the contamination, the Puerto Rico Department of Health ordered the well closed. In March 2011, the EPA installed the activated carbon treatment system on the well to remove the contaminants and provide the community with water that is safe to drink. The carbon strips out the PCE as the contaminated water is drawn through it. Since 2013, data shows that the water in the well now meets drinking water standards for PCE. The EPA plans to periodically sample the groundwater to confirm that the PCE level continues to decline.

The cleanup of the well is being conducted and paid for by the EPA. The EPA has not identified the source of the groundwater contamination.
Written comments may be mailed or emailed to: Daniel Rodriguez, Remedial Project Manager U.S. Environmental Protection Agency, Vieques Field Office, PO Box 1537, Vieques, PR 00765, telephone: 787-741-5201, email: rodriguez.daniel@epa.gov.

To view the proposed plan, please visit: http://www.epa.gov/region02/superfund/npl/corozal-well-proposed-plan.pdf

Follow the EPA Region 2 on Twitter at http://twitter.com/eparegion2 and visit our Facebook page, http://facebook.com/eparegion2.

15-056

APPENDIX VIII
Tables

Table 2
Cost Summary for Selected Remedy
Monitored Natural Attenuation and Institutional Controls
Corozal Well Site
Corozal, Puerto Rico

	Description	Cost
OPERATION, MAINTENANCE, AND MONITORING COSTS		
	Work Plan Preparation	$43,000
	Annual Santana Well Maintenance Costs	$69,000
	Santana Well GAC replacement per event	$8,000
	Monitoring Costs per event	$72,000
PRESENT WORTH		
	Work Plan Preparation	$43,000
	Total Santana Well Maintenance Costs	$643,000
	Bi-annual monitoring for year 1 and 2	$270,000
	Annual Monitoring year 3 - 15	$526,000
	Total Present Worth	**$1,482,000**

Note: The project cost presented herein represents only feasibility study level, and is thus subject to change pending the results of the pre-design investigation, which is intended to collect sufficient data to assist in the development of remedial design and associated detailed cost estimate. Expected accuracy range of the cost estimate is -30% to +50%.

Table 3
Chemical-specific ARARs, Criteria, and Guidance
Corozal Well Site
Corozal, Puerto Rico

Regulatory Level	ARAR	Status	Requirement Synopsis	Feasibility Study Consideration
Federal	National Primary Drinking Water Standards (40 CFR 141)- MCLs	Relevant and Appropriate	Establishes health-based standards for public drinking water systems. Also establishes drinking water quality goals set at levels at which no adverse health effects are anticipated, with an adequate margin of safety. Groundwater at the site is currently not used as a source of drinking water.	The standards were used to develop the PRGs to accommodate any future use of site groundwater as a source of drinking water supply.
Commonwealth of Puerto Rico	Puerto Rico Water Quality Standards (PRWQS) Regulation, August 2014	See remarks under "Feasibility Study Consideration".	This regulation is to preserve, maintain and enhance the quality of the waters of Puerto Rico and regulate any discharge of any pollutant to the waters of Puerto Rico by establishing water quality standards. Water quality standards and use classifications are promulgated for the protection of the uses assigned to coastal, surface, estuarine, wetlands, and ground waters of Puerto Rico.	The PRWQS are neither applicable nor relevant or appropriate chemical-specific ARARs. These standards will be evaluated under action-specific ARARs if any remedial alternatives under consideration entail any discharges to waters of Puerto Rico.

Acronyms:

ARARs - Applicable or Relevant and Appropriate Requirements
CFR - Code of Federal Regulations
PRGs - Preliminary Remediation Goals
OSWER - Office of Solid Waste and Emergency Response
MCLs - Maximum Contaminant Levels

Table 4
Action-specific ARARs, Criteria, and Guidance
Corozal Well Site
Corozal, Puerto Rico

Regulatory Level	ARARs	Status	Requirement Synopsis	Feasibility Study Consideration
General - Site Remediation				
Federal	OSHA Recording and Reporting Occupational Injuries and Illnesses (29 CFR 1904)	Applicable	This regulation outlines the record keeping and reporting requirements for an employer under OSHA.	These regulations apply to the companies contracted to implement the remedy. All applicable requirements will be met.
Federal	OSHA Occupational Safety and Health Standards (29 CFR 1910)	Applicable	These regulations specify an 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below the 8-hour time-weighted average at these specified concentrations.
Federal	OSHA Safety and Health Regulations for Construction (29 CFR 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be on-site, and appropriate procedures will be followed during remediation activities.
Federal	RCRA Identification and Listing of Hazardous Wastes (40 CFR 261)	Applicable	This regulation describes methods for identifying hazardous wastes and lists known hazardous wastes.	This regulation is applicable to the identification of hazardous wastes that are generated, treated, stored, or disposed during remedial activities.
Federal	RCRA Standards Applicable to Generators of Hazardous Wastes (40 CFR 262)	Applicable	Describes standards applicable to generators of hazardous wastes.	Standards will be followed if any hazardous wastes are generated on-site.
Federal	RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – General Facility Standards (40 CFR 264.10–264.19)	Relevant and Appropriate	This regulation lists general facility requirements including general waste analysis, security measures, inspections, and training requirements.	Facility will be designed, constructed, and operated in accordance with this requirement. All workers will be properly trained.
Commonwealth of Puerto Rico	Regulation of the Puerto Rico Environmental Quality Board (PREQB) for the Prevention and Control of Noise Pollution	Applicable	This standard provides the standards and requirements for noise control.	This standard will be applied to any remediation activities performed at the site.
Commonwealth of Puerto Rico	Puerto Rico's Anti-degradation Policy	Applicable	Conserve, maintain and protect the designated and existing uses of the waters of Puerto Rico. The water quality necessary to protect existing uses, including threatened and endangered species shall be maintained and protected.	The requirement will be considered during the development of alternatives. The potential effects of any action will be evaluated to ensure that any endangered or threatened species and their habitat will not be affected.

Table 4
Action-specific ARARs, Criteria, and Guidance
Corozal Well Site
Corozal, Puerto Rico

Regulatory Level	ARARs	Status	Requirement Synopsis	Feasibility Study Consideration
Waste Transportation				
Federal	Department of Transportation (DOT) Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171, 172, 177 to 179)	Applicable	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting hazardous materials.	Any company contracted to transport hazardous material from the site will be required to comply with this regulation.
Federal	RCRA Standards Applicable to Transporters of Hazardous Waste (40 CFR 263)	Applicable	Establishes standards for hazardous waste transporters.	Any company contracted to transport hazardous material from the site will be required to comply with this regulation.
Waste Disposal				
Federal	RCRA Land Disposal Restrictions (40 CFR 268)	Applicable	This regulation identifies hazardous wastes restricted for land disposal and provides treatment standards for land disposal.	Hazardous wastes will be treated to meet disposal requirements.
Federal	RCRA Hazardous Waste Permit Program (40 CFR 270)	Applicable	This regulation establishes provisions covering basic EPA permitting requirements.	All permitting requirements of EPA must be complied with.
Commonwealth of Puerto Rico	PREQB Regulation for the Control of Non-Hazardous Solid Waste (November 1997)	Applicable	This regulation establishes standards for the generation, management, transportation, recovery, disposal and management of non-hazardous solid waste.	Control activities for the non-hazardous wastes must comply with the treatment and disposal standards.
Commonwealth of Puerto Rico	PREQB Regulation for the Control of Hazardous Solid Waste (September 1998)	Relevant and Appropriate	This regulation establishes standards for management and disposal of hazardous wastes.	All remedial activities must adhere to these regulations while handling hazardous waste during remedial operations.

Table 4
Action-specific ARARs, Criteria, and Guidance
Corozal Well Site
Corozal, Puerto Rico

Regulatory Level	ARARs	Status	Requirement Synopsis	Feasibility Study Consideration
Water Discharge or Subsurface Injection				
Federal	National Pollutant Discharge Elimination System (NPDES) (40 CFR 100 et seq.)	Applicable	NPDES permit requirements for point source discharges must be met, including the NPDES Best Management Practice (BMP) Program. These regulations include, but are not limited to, requirements for compliance with water quality standards, a discharge monitoring system, and records maintenance.	Project will meet NPDES permit requirements for point source discharges.
Federal	Safe Drinking Water Act – Underground Injection Control (UIC) Program (40 CFR 144, 146)	Applicable	Establish performance standards, well requirements, and permitting requirements for groundwater re-injection wells.	Project will evaluate the requirement for injection of reagent for in situ treatment.
Commonwealth of Puerto Rico	Puerto Rico Water Quality Standards (PRWQS) Regulation, March 2010	Applicable	This regulation is to preserve, maintain and enhance the quality of the waters of Puerto Rico and regulate any discharge of any pollutant to the waters of Puerto Rico by establishing water quality standards. Water quality standards and use classifications are promulgated for the protection of the uses assigned to coastal, surface, estuarine, wetlands, and ground waters of Puerto Rico.	Project will meet PRWQS requirements for point source discharges.

Table 4
Action-specific ARARs, Criteria, and Guidance
Corozal Well Site
Corozal, Puerto Rico

Regulatory Level	ARARs	Status	Requirement Synopsis	Feasibility Study Consideration
Off-Gas Management				
Federal	Clean Air Act (CAA)—National Ambient Air Quality Standards (NAAQs) (40 CFR 50)	Applicable	These provide air quality standards for particulate matter, lead, NO_2, SO_2, CO, and volatile organic matter.	During remediation and treatment, air emissions will be properly controlled and monitored to comply with these standards.
Federal	Standards of Performance for New Stationary Sources (40 CFR 60)	Applicable	Set the general requirements for air quality.	During remediation and treatment, air emissions will be properly controlled and monitored to comply with these standards.
Federal	National Emission Standards for Hazardous Air Pollutants (40 CFR 61)	Applicable	These provide air quality standards for hazardous air pollutants.	During remediation and treatment, air emissions will be properly controlled and monitored to comply with these standards.
Federal	Federal Directive - Control of Air Emissions from Superfund Air Strippers (OSWER Directive 9355.0-28)	Applicable	Provides guidance on control of air emissions from air strippers used at Superfund Sites for groundwater treatment.	During treatment, air emissions will be properly controlled and monitored to comply with these standards.
Commonwealth of Puerto Rico	PREQB Regulation for the Control of Atmospheric Pollution (1995)	Applicable	Describes requirements and procedures for obtaining air permits and certificates; rules that govern the emission of contaminants into the ambient atmosphere.	Need to meet requirements when discharging off-gas. Need to meet fugitive emissions requirements during remediation and treatment. Need to meet visible emissions requirements for motor vehicles.

Acronyms:

ARARs - Applicable or Relevant and Appropriate Requirements
OSHA - Occupational Safety and Health Administration
CFR - Code of Federal Regulations
RCRA - Resource Conservation and Recovery Act
EPA - Environmental Protection Agency
NO_2 - Nitrogen dioxide
SO_2 - Sulfur dioxide
CO - Carbon monoxide
OSWER - Office of Solid Waste and Emergency Response

TABLE 5
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Concern	Concentration Detected		Concentration Units	Frequency of Detection	Exposure Point Concentration (EPC)	EPC Units	Statistical Measure
		Min	Max					
Groundwater	Trichloroethene	0.25	8.9	ug/l	2/18	8.9	ug/l	Maximum
	Tetrachloroethene	0.028	27	ug/l	12/18	9.3	ug/l	95% KM (t) UCL

95% KM (t) UCL – 95% upper-confidence limit

Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

This table presents the chemicals of concern (COCs) and exposure point concentrations (EPCs) for each of the COCs in groundwater. The table includes the range of concentrations detected for each COC, as well as the frequency of detection (i.e., the number of times the chemical was detected in the samples collected at the site), the EPC and how it was derived.

TABLE 6. Selection of Exposure Scenarios

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis
Current/Future	Soil	Surface soil	The Corozal Well Site	Resident	Adult and Child (birth to <6 yrs)	Ing/Der/Inh	Quantitative
	Surface Water	Surface water	Unnamed Stream and Intermittent Stream	Recreational User	Adolescent (12 to < 18 yrs)	Ing/Der	Quantitative
	Sediment	Sediment	Unnamed Stream and Intermittent Stream	Recreational User	Adolescent (12 to < 18 yrs)	Ing/Der	Quantitative
Future	Soil	Surface and Subsurface soil	The Corozal Well Site	Construction Worker	Adult	Ing/Der/Inh	Quantitative
	Groundwater	Groundwater	Groundwater from Monitoring Wells and Piezometer	Resident	Adult and Child (birth to <6 yrs)	Ing/Der/Inh	Quantitative
			Groundwater from Wireline Sampling	Resident	Adult and Child (birth to <6 yrs)	Ing/Der/Inh	Qualitative
		Indoor Air	Indoor Air	Resident	Adult and Child (birth to <6 yrs)	Inh	Quantitative

Ing – Ingestion

Der – Dermal

Inh - Inhalation

Summary of Selection of Exposure Pathways

The table describes the exposure pathways that were evaluated for the risk assessment. Exposure media, exposure points, and characteristics of receptor populations are included.

TABLE 7

Non-Cancer Toxicity Data Summary

Pathway: Oral/Dermal

Chemical of Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Absorp. Efficiency (Dermal)	Adjusted RfD (Dermal)	Adj. Dermal RfD Units	Primary Target Organ	Combined Uncertainty /Modifying Factors	Sources of RfD: Target Organ	Dates of RfD:
Trichloroethene	Chronic	5E-04	mg/kg-day	1	5E-04	mg/kg-day	Heart	10 to 1000	IRIS	06/15/15
Tetrachloroethene	Chronic	6E-03	mg/kg-day	1	6E-03	mg/kg-day	CNS	1000	IRIS	03/18/15

Pathway: Inhalation

Chemical of Concern	Chronic/ Subchronic	Inhalation RfC	Inhalation RfC Units	Inhalation RfD	Inhalation RfD Units	Primary Target Organ	Combined Uncertainty /Modifying Factors	Sources of RfD: Target Organ	Dates:
Trichloroethene	Chronic	2.0E-03	mg/m^3	-----	-----	Heart	10 to 100	IRIS	06/15/15
Tetrachloroethene	Chronic	4.0E-02	mg/m^3	-----	-----	CNS	1000	IRIS	03/15/15

Key

-----: No information available
CNS – Central Nervous System
IRIS: Integrated Risk Information System, U.S. EPA

Summary of Toxicity Assessment

This table provides non-carcinogenic risk information which is relevant to the contaminants of concern in groundwater. When available, the chronic toxicity data have been used to develop oral reference doses (RfDs) and inhalation reference doses (RfDi).

TABLE 8

Cancer Toxicity Data Summary

Pathway: Oral/Dermal

Chemical of Concern	Oral Cancer Slope Factor	Units	Adjusted Cancer Slope Factor (for Dermal)	Slope Factor Units	Weight of Evidence/ Cancer Guideline Description	Source	Date
Trichloroethene	4.6E-02	$(mg/kg/day)^{-1}$	4.6E-02	$(mg/kg/day)^{-1}$	Carcinogenic to humans	IRIS	06/15/15
Tetrachloroethene	2.1E-03	$(mg/kg/day)^{-1}$	2.1E-03	$(mg/kg/day)^{-1}$	Likely to be carcinogenic to humans	IRIS	03/18/15

Pathway: Inhalation

Chemical of Concern	Unit Risk	Units	Inhalation Slope Factor	Slope Factor Units	Weight of Evidence/ Cancer Guideline Description	Source	Date
Trichloroethene	4.1E-06	$1(ug/m^3)$	-----	-----	Carcinogenic to humans	IRIS	06/15/15
Tetrachloroethene	2.69E-07	$1(ug/m^3)$	-----	-----	Likely to be carcinogenic to humans	IRIS	03/18/15

Key:

IRIS: Integrated Risk Information System. U.S. EPA
-----: No information available

Summary of Toxicity Assessment

This table provides carcinogenic risk information which is relevant to the contaminants of concern in groundwater. Toxicity data are provided for both the oral and inhalation routes of exposure.

TABLE 9

Risk Characterization Summary - Noncarcinogens

Scenario Timeframe: Future
Receptor Population: Site Resident
Receptor Age: Lifetime (Adult/child)

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Non-Carcinogenic Risk			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	Trichloroethene	Heart	0.89	0.15	**2.7**	**3.8**
			Tetrachloroethene	Liver	0.07	0.045	0.14	0.26
							Hazard Index Total=	**4**

Summary of Risk Characterization - Non-Carcinogens

The table presents hazard quotients (HQs) for each route of exposure and the hazard index (sum of hazard quotients) for exposure to groundwater containing site-related chemicals. The Risk Assessment Guidance for Superfund states that, generally, a hazard index (HI) greater than 1 indicates the potential for adverse non-cancer effects.

TABLE 10

Risk Characterization Summary - Carcinogens

Scenario Timeframe: Future
Receptor Population: Site Resident
Receptor Age: Lifetime (Adult/child)

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	Trichloroethene	7E-06	1E-06	2E-05	2E-05
			Tetrachloroethene	3E-07	1E-07	7E-07	1E-06
						Total Risk =	2E-05

Summary of Risk Characterization – Carcinogens

The table presents site-related cancer risks for groundwater exposure. As stated in the National Contingency Plan, the point of departure is 10^{-6} and the acceptable risk range for site-related exposure is 10^{-6} to 10^{-4}. Although the cancer risk fell within the acceptable risk range, the concentration of trichloroethene and tetrachloroethene in groundwater exceeds the maximum contaminant level (MCL) for both chemicals, indicating an unacceptable risk from exposure to groundwater.