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Region 2 RAC2
Remedial Action Contract

Final Remedial Investigation Report

Cidra Groundwater Contamination Site

Remedial Invesigation/Feasibility Study

Cidra, Puerto Rico

June 28, 2013

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CDM Smith

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Acronyms

atm-m^3/mol	atmosphere-cubic meters per mole
APE	area of potential effects
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CCC	Cidra Convention Center
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CLP	Contract Laboratory Program
CMC	Cidra Metal Caskets
CNS	central nervous system
COPC	contaminant of potential concern
CSM	conceptual site model
CTE	central tendency exposure
^{o}F	degrees Fahrenheit
DCA	dichloroethane
DCE	dichloroethene
DESA	Division of Environmental Science and Assessment
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DPT	direct-push technology
DUR	data usability report
EPA	United States Environmental Protection Agency
ESI	Expanded Site Inspection
ESL	ecological screening level
ESSO	ESSO Gas Station/Machine Shop
FCR	field change request
f_{oc}	fraction of organic carbon
ft	feet
GIS	geographic information system
g/cm^3	gram per cubic millimeter
gpd	gallon per day
gpm	gallon per minute
GSA	Geological Society of America
HHRA	human health risk assessment
HI	hazard index
HRS	Hazard Ranking System

IDC	International Dry Cleaners
IDW	investigation derived waste
K_d	soil-water partition coefficient
K_{oc}	organic carbon partition coefficient
K_{ow}	octanol-water partition coefficient
L/kg	liter per kilogram
MCL	maximum contaminant level
mg/kg	milligram per kilogram
mg/L	milligram per liter
mL/g	milliliter per gram
mm Hg	millimeters of pressure
MNA	monitored natural attenuation
msl	mean sea level
NAS	National Academy of Science
NOAA	National Oceanographic and Atmospheric Administration
NPL	National Priorities List
NRCS	Natural Resources Conservation Service
ORP	oxidation reduction potential
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PID	photoionization detector
PRASA	Puerto Rico Aqueduct and Sewer Authority
PRDOH	Puerto Rico Department of Health
PRDNER	Puerto Rico Department of Natural and Environmental Resources
ppb	parts per billion
Q	discharge
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
RAC	Remedial Action Contract
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RME	reasonable maximum exposure
s	drawdown
SAT	Site Assessment Team
SIM	selective ion monitoring
SLERA	screening level ecological risk assessment
SMW	saprolite monitoring well
SQL	sample quantitation limit
SSL	soil screening level
SVOC	semi-volatile organic compound
TAL	Target Analyte List

TBC	to be considered
TCA	tetrachloroethane
TCE	trichloroethene
TCL	Target Compound List
TDS	total dissolved solids
TGP	Tech Group de Puerto Rico
the site	Cidra Groundwater Contamination Site
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TSS	total suspended solids
µg/kg	microgram per kilogram
µg/L	microgram per liter
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Survey
UV	ultraviolet
VOC	volatile organic compound
VISL	vapor intrusion screening level
WA	work assignment
ZEN	Zenith Laboratories Caribe, Inc.

Executive Summary

CDM Federal Programs Corporation (CDM Smith) received Work Assignment (WA) 168-RICO-02WE for the Cidra Groundwater Contamination Site (the site or Cidra site) located in Cidra, Puerto Rico, under the Response Action Contract, Contract No. 68-W-98-210 for the United States Environmental Protection Agency (EPA), Region 2. This WA was continued under the EPA Region 2 Remedial Action Contract (RAC), Contract No. EP-W-09-002, as WA 004-RICO-02WE. The objective of this WA is to perform a Remedial Investigation/Feasibility Study (RI/FS), a human health risk assessment (HHRA), and a screening level ecological risk assessment (SLERA) for the site.

Purpose of Report

The overall purpose of the RI is to identify potential source areas through soil and groundwater investigations, define the hydrogeologic framework, evaluate the nature and extent of groundwater, soil, surface water, and sediment contamination, and develop appropriate remedial alternatives for the identified contamination. This report details activities and results from field investigations conducted at the site.

Site Description

The municipality of Cidra is located in the central-eastern section of Puerto Rico in the northern foothills of the Cordillera Central Mountain Range. The Cidra site consists of a plume of groundwater contaminated with chlorinated volatile organic compounds (VOCs) in an industrial area of Cidra.

The aquifer of concern at Cidra is the Pre-Robles volcanic bedrock that underlies the area. The closed and active public water supply wells are finished in this aquifer at total depths ranging from 110 to 705 feet below the ground surface (bgs). In total, there are 15 active drinking water wells located within 4 miles of the site, serving a total population of 8,838 people.

Site History

The Puerto Rico Department of Health (PRDOH) ordered four Puerto Rico Aqueduct and Sewer Authority (PRASA) public supply wells in Cidra to be closed due to tetrachloroethene (PCE) contamination; 1,1-dichloroethene (1,1-DCE) and trichloroethene (TCE) were also detected in these wells.

- Cidra Well #3 (Planta Alcantarillado), serving 112 people, closed in February 1999
- Cidra Well #4 (Calle Padilla Final), serving 177 people, closed in March 1996
- Cidra Well #6 (Calle Baldorioty), serving 207 people, closed in August 2000 (EPA 2003b)
- Cidra Well #8 (Frente Cementerio), not in service at the time of closure in October 1996

Previous Investigations

Prior to listing the site on the National Priorities List (NPL), the source(s) of contamination in the wells were unknown, and several investigations were conducted to identify potential source areas. These investigations are summarized below.

EPA Pre-CERCLIS Screening Report, October 2000

In October 2000, EPA completed a Screening Report prior to listing the site in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS). In support of the evaluation, EPA personnel conducted file searches, interviews, and field reconnaissance surveys at 31 sites in the area. Twenty-one sites were recommended for entry into CERCLIS.

EPA Expanded Site Inspection/Remedial Investigation, 2002

In June 2002, EPA's Region 2 Site Assessment Team (SAT) collected groundwater samples from the closed municipal supply wells and from 20 other active and inactive wells in Cidra. PCE was detected in the closed wells at concentrations ranging from 0.64 to 12 micrograms per liter (µg/L). PCE was also detected in two industrial/potable supply wells (IVAX No.1 and No.2) and three industrial wells (Glaxo Smith Kline No.1 and No.2 and Millipore - Cidra). The Glaxo Smith Kline wells and Millipore-Cidra industrial wells are located east of Lago de Cidra and are likely not associated with the VOC source that has impacted the closed public supply wells. Related chlorinated solvents, including 1,1-DCE; 1,1-dichloroethane (1,1-DCA); cis-1,2-dichloroethene (cis-1,2-DCE); carbon tetrachloride; and TCE, were also detected in groundwater samples. Maximum contaminant levels (MCLs) for PCE (5 µg/L) and 1,1-DCE (7 µg/L) were exceeded; however, the exceedances did not occur in active drinking water wells.

The groundwater samples were also analyzed for semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and inorganic parameters. There were no detections of SVOCs, pesticides, or PCBs above laboratory quantitation levels. Inorganic parameters were not detected above MCLs in the groundwater samples, except thallium, which was reported at estimated concentrations above the MCL (2 µg/L) in three samples. Thallium is not known to be associated with the Cidra groundwater plume.

EPA Potential Source Area Investigation, 2003

In January and February 2003, EPA Region 2 SAT investigated 12 industrial sites in the Cidra area, to determine if they could be potential sources of contamination of the groundwater plume. Eleven of the sites are listed in EPA's CERCLIS Hazardous Waste Sites database, and one site is listed in the Archived Sites database.

Site Name	CERCLIS Number
International Dry Cleaners (IDC)	PRN000204340
Shellfoam Products (Shellfoam) (archived)	PRD987377264
SmithKlein Beecham Pharmaceuticals, Inc.	PRD090023250
Tech Group de Puerto Rico, Inc. (TGP)	PRN000204348
Zenith Laboratories Caribe, Inc. (ZEN)	PRD987377702
Excellent Laundry	PRN000204338
Creative Medical Corp.	PRN000204336
CMM Laundry	PRN000204330
Cidra Metal Caskets (CMC)	PRN000204335
Ramallo/Cidra Convention Center (CCC)	PRN000204333
CCL Label de Puerto Rico	PRN000204329
Caribbean Manufacturing Co.	PRN000204331

Field screening results indicated the presence of PCE, TCE, and trans-1,2-dichloroethene (trans-1,2-DCE) in soils collected from the IDC site from depths of two to seven feet bgs, at concentrations ranging from approximately 7 to 255 parts per billion (ppb). Other VOC detections included vinyl chloride in a sample from the Ramallo/CCC site and 1,1,2,2-tetrachloroethane (1,1,2,2-TCA) in a sample from the TGP site, both at concentrations less than 3 ppb. The field-screening data also indicated the presence of other VOCs in soil samples from some sites, mostly at concentrations below 1 ppb, and chloroform in a groundwater sample collected from the TGP site.

SAT used the screening results, particularly the PCE readings mentioned above, to select samples for VOC analysis through the Contract Laboratory Program (CLP).

The CLP analytical results confirmed the presence of PCE and other VOCs in soil at the IDC site. The PCE, TCE, and cis-1,2-DCE detections exceeded EPA's generic migration-to-groundwater Soil Screening Levels (SSLs).

No detections were found in soil samples from the seven remaining facilities, and EPA recommended no further action (EPA 2003b).

SAT also collected two sediment samples from drainage channels at the Cidra Industrial Park. VOCs were not detected in the drainage channel samples. SAT also collected surface water and sediment samples from five locations in Lago de Cidra to evaluate the potential connection between the lake and the groundwater plume. Field-screening and CLP analytical results indicated that no VOCs were detected in the lake water and sediment samples.

Current Conditions

Currently the Cidra site is comprised of the VOC plume area, which includes the four closed PRASA public supply wells. Cidra obtains water from Lago de Cidra and other supply wells in the area.

Study Area Investigations

Due to the lack of existing hydrogeological data and the lack of a defined source of contamination, a staged field investigation was planned to effectively use data collected during the initial stage to focus and refine data collection activities in the following stages. This section describes the activities conducted during the Stage 1, Stage 2, and Stage 2a field investigations.

Stage 1 - July 2007 through January 2009

- Initial supply well sampling (Initial Round)
- Industrial facilities source area investigation (at Esso Gas Station/LM Auto Parts [ESSO], CCL Label, IVAX, Pepsi, Ramallo/Cidra Convention Center [CCC], Shellfoam, ENCO, and DJ Manufacturing facilities)
- Former dry cleaners source area investigation (at International Dry Cleaners [IDC], Don Quixote Pizza, Coffee Shop, and Ramoncito facilities)
- Borehole drilling and coring
- Borehole geophysical logging
- Packer sampling and packer testing
- Installation of six multiport monitoring wells in the bedrock zone
- Groundwater elevation measurement
- Multiport monitoring well and supply well sampling in the bedrock zone

Stage 2 - April to July 2010

- Source area soil investigation
- Installation of seven monitoring wells in the saprolite zone
- Groundwater elevation measurement
- Multiport and saprolite monitoring well and supply well sampling

Stage 2a - April to September 2012

- Installation of four additional monitoring wells in the saprolite zone
- Groundwater elevation measurement
- Monitoring well sampling (saprolite wells only)
- Stream gauge installation and measurement
- Surface water and sediment sampling
- Sub-slab and indoor vapor sampling

Site-Specific Geology

Three strata are encountered at the site: the Quaternary-age terrace deposits composed of silt and clay, a saprolite layer (decomposed bedrock), and the underlying Cretaceous-age Pre-Robles volcanic rocks. The units are described below.

- **Quaternary Upper Silty Clay** – This unconsolidated overburden unit consists of reddish-brown silty clay grading to gray and brown silty clay. The depth to the bottom of the silty clay unit varies from 55 feet bgs to 105 feet bgs, at which point the saprolite layer is encountered. Some evidence of dark brown to black-stained, remnant high angle fracture structures or lineations was observed in the silty clay at boring locations throughout the site. White to yellowish white very small crystals with a powdery appearance were observed in some of these lineations. These lineations were generally about four inches long and one-half inch in thickness and occurred at depths greater than 10 feet bgs and as deep as 70 feet bgs.

- **Saprolite Zone** – The saprolite is the result of chemical weathering of the underlying volcanic rocks. The material is a hard, wet, brown to light brown, sandy to silty clay with abundant dark brown to brown, angular to very angular, mafic rock fragments with fine-grained texture. The saprolite crumbles easily under light pressure. Where present, the unit ranges in thickness from 45 feet to 60 feet. The contact between the saprolite and underlying bedrock ranged from 109 to 156 feet bgs. At four locations, the depth ranged from 121 to 132 feet bgs.

- **Pre-Robles Volcanic Rock (Formation J)** - The core of the region is comprised of Cretaceous to Early Tertiary volcanic rocks of the Pre-Robles Formation (Formation J). The rocks are estimated to be a maximum of approximately 2,700 meters thick and consist mostly of massive volcanic breccia, although lava flows and flow breccia occur throughout and are more common at the base and top of the unit. Massive to poorly stratified tuffs are interlayered with the volcanic breccia. Locally, volcanic conglomerates outcrop periodically (Pease and Briggs 1960).

Key structural features in the vicinity of the Cidra site include the Arroyata Fault, located 0.25 mile to the south of the commercial area and adjacent to the industrial park. The fault is weathered and has been hydrothermally altered across much of the area to the south of Cidra. Displacement along it is uncertain, but is generally strike-slip with a minor oblique component (reverse to the east of Cidra). Cidra is on the footwall side of the projected trace of the fault. A number of smaller faults branch from the Arroyata fault. Bedding planes are also prominent in the area, with dips at 15 to 34 degrees to the west. Bedding planes are assumed to be the contacts between the successive deposits of volcanic lava flows, ash-falls, and pyroclastic flows (Pease and Briggs 1960).

Site-Specific Hydrogeology

The Cidra site encompasses a small plateau where the commercial center is located, a drainage area to the south of town where the closed municipal wells are located, and a valley below the Cidra Industrial Park. The site is immediately underlain by the Quaternary silty clays, which overlie the fractured Cretaceous-age Pre-Robles volcanic bedrock, the major aquifer beneath the site. The saprolite zone lies between the silty clays and the bedrock. The hydrogeology of these units is described below.

Hydrogeology of the Upper Silty Clay - Silts and clays have low permeabilities, which tend to hinder groundwater flow through the overburden to the groundwater table. However, the fractures and lineations observed in the silty clays may provide secondary permeability that enhances groundwater flow to the underlying units.

Hydrogeology of the Saprolite Unit - The saprolite zone below the silty clay was observed during Stage 2 well installation to be a major water-bearing unit; the saprolite stores water and provides recharge to the underlying bedrock aquifer. This unit is semi-confined by the overlying silty clay soils, as evidenced by rising water level conditions in drilling rods upon reaching this zone. During Stage 2 well installation activities, very little water was encountered while drilling through the silty clay unit. Once the saprolite unit and groundwater were encountered, water levels rose approximately 20 to 54 feet. Once in this unit, groundwater flows downward and laterally to the west/southwest and enters fractures at the top of the volcanic bedrock.

Hydrogeology of the Pre-Robles Volcanic Rock - Groundwater flow in the bedrock is complicated by fractures and bedding planes and by the site location relative to the two major river basins. The porosity of the bedrock is only two to three percent, but joints and fractures can enhance groundwater flow considerably. Bedding planes in the bedrock act as individual aquifers, separated by aquitards consisting of relatively low permeability bedrock, where less fracturing is present. Across the majority of the site, groundwater encounters bedding planes in the bedrock aquifer and flows laterally along strike (to the south) and then downdip (to the west). The resulting overall groundwater flow is to the west/southwest, toward Rio Arroyata, located south and west of the site.

In the IVAX area, which is closer to the Arroyata Fault, bedding planes and fractures strike northwest/southeast, indicating a groundwater divide somewhere on the IVAX facility. Based on the different strike and dip orientations in this area, groundwater in the bedrock flows to the southeast, toward an unnamed stream southeast of IVAX.

Aquifer tests were not performed as part of the RI; however, well yields in the fractured volcanic rock in the Cidra vicinity are generally from 5 to 10 gallons per minute (gpm) or less (Miller et al. 1997).

Ecological Characterization

The site is located within an ecological zone of Puerto Rico characterized by moist-lowland forest, and consists of the densely populated Cidra commercial district consisting of stores, private residences, municipal buildings and the town plaza. Another dominant land feature, a large cemetery, is also present. Topographic gradients and surface water drainage at the site are to the south/southwest toward the Rio Arroyata and the unnamed stream that drains the area surrounding the Cidra cemetery.

The portion of the Rio Arroyata included in the ecological reconnaissance can be characterized as a low/moderate gradient stream comprised of various riffle/run/pool sequences no more than three to five feet in width, with depth ranging from a few inches to over a foot in pooled reaches. Stream banks are relatively steep. Debris piles and eroded banks within bends suggest moderate to high flow during precipitation events. Substrate varies from coarse sand/fine gravel to coarse gravel and cobble within riffle and run areas; coarse sand comprises the majority of substrate found in deeper pools as

these are associated with depositional areas along bends. Along the right bank downstream of the Route 171 bridge, several groundwater seeps were observed.

In general, vegetative communities and available habitats are indicative of disturbed conditions as evidenced by former dilapidated structures and foundations, miscellaneous refuse, surrounding development, and the presence of native and non-native species. Tree canopy cover ranges from 85 to 100 percent within the immediate stream corridor of the Rio Arroyata and drainage swales. With the exception of areas characterized by monotypical stands of bamboo, understory is dense and consists of various woody and herbaceous vegetative species. Other than physical disturbances, no impacts that may potentially be related to site contamination are present.

Various wildlife was observed during the ecological reconnaissance, including several bird species, large terrestrial snails, lizards, frogs, and fish species.

Information regarding threatened and endangered species and ecologically sensitive environments that may exist at or in the vicinity of the site was requested from the EPA and Puerto Rico Department of Natural and Environmental Resources (PRDNER).

The EPA reported that a review of United States Fish and Wildlife Service (USFWS) records indicate that two federally-listed species may be found within the municipality of Cidra. Neither species was encountered during the site visit.

The PRDNER reported that a review of their records for the site and surrounding area indicated no known occurrences of listed rare, threatened, and/or endangered species.

Meteorology

The climate for Cidra, Puerto Rico is classified as tropical humid and is moderated by the nearly constant trade winds that originate in the northeast and its location in the foothills of the Cordillera Central Mountain Range. The average annual temperature for the Cidra area is 72.7° F. Precipitation data from 1981 to 2010 recorded at the Cidra 1 E rainfall station shows an average annual precipitation of 64.90 inches (NOAA website).

Demographics, Land Use, and Hazardous Waste Sites

The Cidra site is located just south of the main commercial district of the Cidra Municipality in central eastern Puerto Rico. The Cidra Municipality is comprised of 36.5 square miles with a population of 43,480 and a population density of 1,200 people per square mile (2010 U.S. Census). Land use for the Cidra site area includes forest (34 percent), agriculture/rural (49 percent), and urban (16 percent) (Ramos-Gines 1997). The land use in the vicinity of the site is primarily residential, commercial, manufacturing, and agricultural.

Wells located within a four mile radius of the site that draw water from the Pre-Robles volcanic rock aquifer serve a population of approximately 8,838 (EPA 2003b). No other NPL sites are located in Cidra; however, 13 sites are listed in EPA's CERCLIS Public Access Database.

Nature and Extent of Contamination

The nature and extent of contamination in site media was assessed by comparing results to the site-specific screening criteria. Site-related contaminants for all media include PCE, TCE, cis-1,2 DCE, 1,1-DCE, and vinyl chloride.

Summary of Soil Contamination

- Site-related VOCs were detected in soil samples at IDC, Ramallo/CCC, CCL Label, ENCO, DJ Manufacturing Don Quixote, and ESSO. The majority of exceedances and the highest levels were found in soils at IDC and Ramallo/CCC; these two properties are considered sources of groundwater contamination at the site.
- No VOCs were detected at the Coffee Shop or Ramoncito. A few VOCs were detected at IVAX, Pepsi, and Shellfoam, but at levels below screening criteria; none were site-related VOCs.
- The main source of contamination in the southern area of the site is at Ramallo/CCC with the highest levels of site-related contaminants found in shallow soils in the southeastern portion of the facility in RMSB-18 (PCE at 3,300,000 micrograms per kilogram (µg/kg) and TCE at 2700J µg/kg (0-2 feet bgs)).
- The highest levels of site-related contaminants in the northern drainage area were found at IDC (PCE at 1,700,000 µg/kg (4-8 feet bgs) and TCE at 39,000 µg/kg (4-6 feet bgs); contaminant levels generally decrease with depth.

Summary of Groundwater Contamination

- No exceedances were found in any of the wells downgradient of IDC in the northern area.
- The groundwater contamination in the southern area originates at the Ramallo/CCC facility and extends southwest toward the Rio Arroyata.
- Overall, the highest levels of site-related contaminants in groundwater were detected in the saprolite wells located at and downgradient of Ramallo/CCC: SMW-10 (62-72 feet bgs) had a PCE concentration of 1,700 µg/L and a TCE concentration of 31 µg/L, and SMW-1 (48-58 feet bgs) had a PCE concentration of 680 µg/L and a TCE concentration of 14 µg/L.
- Multiport well MPW-5 (located adjacent to Cidra 8) had the highest levels and the most PCE exceedances in bedrock, with a maximum of 120 µg/L at 260-274 feet bgs. TCE follows a similar pattern, with the highest concentration of 5.3 µg/L at 302-324 feet bgs.

Summary of Surface Water/Sediment Contamination

- The Rio Arroyata is hydraulically connected to groundwater in the saprolite zone; the groundwater PCE plume in the saprolite extends to the Rio Arroyata, although it is unknown whether it extends under and southwest of the river.
- Contaminant levels in surface water were below screening criteria, and less than in the nearby saprolite wells.

Summary of Vapor Intrusion Contamination

- PCE and TCE were present in subslab soil vapor at concentrations several orders of magnitude higher than their respective screening levels at both the IDC and Ramallo/CCC source areas. PCE was also detected in subslab soil vapor samples in ENCO, CCL Label, Former 579 Store, and Praxedes Public Housing, indicating that PCE vapor has migrated in the subsurface to buildings closely proximal to the source areas.

- PCE, TCE, and cis-1,2-DCE vapors have migrated from subsurface into indoor air at the IDC, Former 579 Store, Ramallo/CCC, and Praxedes Public Housing properties. However, there are no indoor air screening level exceedances for these site-related contaminants. TCE was also detected in ambient air samples, suggesting that non-site related sources may have contributed to TCE found in indoor air.

Conceptual Site Model

Two main sources of contamination were identified in soils, one at IDC and one at Ramallo/CCC. Both properties are located upgradient of documented groundwater contamination at the site.

At the IDC, PCE levels in soil were as high as 1,700,000 µg/kg; the highest levels were concentrated in the top 12 feet in the southeastern corner in an alley. However, samples as deep as 60 feet bgs in other areas still exceeded the screening criterion.

At Ramallo/CCC, the highest level of PCE, 3,300,000 µg/kg, was found in the top two feet along the eastern side of the site. Screening criteria exceedances were found as deep as 72 feet bgs.

Ramallo/CCC Area

- Contaminants were likely discharged directly to the ground at the Ramallo/CCC source area, and migrated downward with precipitation through lineations in the overburden, drawing dissolved contamination deeper into the soils. Along these flow paths, contamination diffuses into the surrounding low permeability clay matrix. Contamination then migrated into the groundwater aquifer in the underlying saprolite.

- PCE contamination moves southwest with groundwater flow in the saprolite, as evidenced by PCE levels in SMW-10 and SMW-1 (1,700 µg/L and 680 µg/L, respectively). The saprolite layer contains the highest levels of PCE in groundwater at the site, and recharges the underlying bedrock aquifer. Figure 4-11 shows the general orientation of the PCE contaminant plume in the saprolite zone, which extends horizontally to the Rio Arroyata.

- Contamination enters bedrock bedding planes and fractures just upgradient of MPW-1, as evidenced by PCE in shallow bedrock in this well. Contamination spreads along strike (primarily to the south), and downdip (west). MPW-5 and Cidra 8 are along this contaminant migration pathway, and exhibit contamination at deeper depths.

International Dry Cleaner Area

Contaminant transport at IDC is slightly different than at Ramallo/CCC.

- Contaminants were likely discharged directly to the ground at the IDC. The majority of the surface in the vicinity of the IDC is overlain by buildings and roads, which prohibit the majority of precipitation from infiltrating into the overburden. As a result, the bulk of precipitation drains via overland flow toward the northern drainage area. The remainder migrates downward through the overburden in unpaved areas and in areas where contaminants were discharged, resulting in the accumulation of dissolved contamination in the infiltrating water. Infiltration into the soil is possibly enhanced by lineations. Along the infiltration pathways, contamination diffuses into the surrounding low permeability clay matrix. Contaminant transport to the depth of groundwater through this unit may be hindered in this area, as compared to Ramallo, due to greater overburden thickness in this area (approximately 30 feet thicker) and gradation to finer-grained soils with depth.
- Low-levels of contamination eventually reach the saprolite zone and migrate to the top of bedrock.
- Once in bedding planes and fractures, contamination spreads along strike and moves down dip. The overall flow direction is to the southwest toward MPW-2, MPW-3, MPW-4, and Cidra 3, resulting in the low levels of PCE in these wells.

Surface Water /Sediment

Groundwater contamination migrating in the saprolite zone from Ramallo/CCC discharges to the Rio Arroyata via seeps. Contaminant levels in the surface water, which are below screening criteria, are highest in areas adjacent to nearby saprolite wells, and generally decrease downstream.

Fate and Transport Summary

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 the site, including geological and hydrogeological characteristics. The primary fate and transport aspects of the site are summarized below.

- PCE and its degradation daughter products have migrated from the ground surface through the unconsolidated zone and into groundwater. Some of the PCE mass is likely retained by capillary forces in the pores of soil, which are mainly present in the shallow intervals at the Ramallo/CCC and IDC source areas.
- The greatest potential for the transport of the chlorinated VOCs is through continuous dissolution of contaminants in soil to groundwater, groundwater migration, and volatilization.
- Dissolved contaminants move with the groundwater flow in the saprolite toward the southwest and eventually discharge into the Rio Arroyata. Dissolved contaminants in the saprolite enter the shallow bedrock groundwater through bedrock bedding planes and fractures.

- Chlorinated VOCs in soil and groundwater may migrate as vapor. Vapor intrusion is a potential concern for occupied buildings at the site, although the initial vapor intrusion testing in buildings at or near the two source areas indicated that no indoor vapors exceeded EPA vapor criteria.
- Based on an evaluation of monitored natural attenuation (MNA) there is limited evidence that anaerobic biodegradation of chlorinated VOCs is occurring at the site. However, TCE and cis-1,2-DCE are present in the source area and downgradient monitoring wells in both the saprolite and bedrock groundwater. TCE is most likely produced as a degradation product of PCE and cis-1,2-DCE as a daughter product of TCE. There is very little vinyl chloride in groundwater, indicating an incomplete dechlorination process.

Summary of Risk Assessments

HHRA

The HHRA divided the site into four exposure areas. The total hazard indices (HIs) for all current and future receptors, except current receptors at Exposure Area 2 (IDC) and future trespassers at Exposure Area 1 (Ramoncito, Don Quixote Pizza, Coffee Shop, and ESSO) under the reasonable maximum exposure (RME) scenario, are above EPA's threshold of unity (1). The current and future workers at Exposure Areas 3 and 4, the current and future recreational users and the future construction workers have noncancer HIs exceeding EPA's threshold under the RME scenario for the kidney and respiratory system due to exposure to vanadium in soil. Under the central tendency exposure (CTE) scenario, the total HIs are at or below EPA's threshold. The future residents have noncancer HIs exceeding EPA's threshold under the RME scenario for the cardiovascular system, central nervous system (CNS), developmental, heart, immune system, kidney, liver, lung, nervous system, respiratory system, skin, and thyroid due to exposure to PCE, 1,1,2-trichloroethane, TCE, arsenic, cobalt, and vanadium. Under the CTE scenario, the total HIs are still above EPA's threshold. The potential health hazards to cardiovascular system, CNS, development, kidney, liver, lung, nervous system, respiratory system, and skin are due to exposure to arsenic, PCE, and vanadium in soil and groundwater. Risks associated with arsenic and vanadium are most likely overestimated.

Future residents may potentially be exposed to volatile contaminants of potential concern (COPCs) via inhalation of vapor emanating from groundwater into enclosed structures via vapor intrusion and into ambient air via vaporization.

SLERA

A SLERA was conducted to evaluate the potential for risk to ecological receptors from exposure to site media. The SLERA evaluated the potential for risk from exposure to chemicals through direct contact with site sediment and surface water via one assessment endpoint aimed at the protection of aquatic receptors utilizing the Rio Arroyata. PCE was detected in one sediment sample from the Rio Arroyata, and cis-1,2-DCE, PCE, and TCE were detected in surface water samples. However, all concentrations were orders of magnitude below their respective ecological screening levels (ESLs), and therefore, the site poses no site-related risk to ecological receptors. The SLERA indicated potential risk from exposure to several metals. In general, concentrations of these metals in background samples were either higher than, or similar to the maximum concentrations of metals detected in site sediment and

surface water. The concentrations of metals detected are most likely reflective of natural conditions, or non site-related sources.

Conclusions

Based on the soil data, the RI identified the IDC and Ramallo/CCC properties as sources of contamination at the site. Site-related contaminants PCE, TCE, and cis-1,2-DCE were found at levels above screening criteria in soils at both facilities; 1,1-DCE and vinyl chloride were found at levels exdeeded screening criteria at Ramallo/CCC. Ramallo/CCC is located upgradient of groundwater contamination exceeding screening levels, whereas the levels in groundwater downgradient of IDC are below screening criteria. The two source areas differ with respect to migration of site-related contaminants, as described below.

International Dry Cleaners Source Area

- Site-related contaminants exceed soil screening criteria in several soil samples at IDC. The highest levels of site-related contaminants at IDC are concentrated in the top 12 feet of soil in an alley located along the southeast corner of the property: 1,700,000 µg/kg of PCE, 39,000 µg/kg of TCE, and 29,000J µg/kg of cis-1,2-DCE. The vertical extent of contamination in this area is not defined due to depth limitations of hand auger sampling methods. In areas that were accessible to the direct push technology (DPT) rig, and deeper samples were collected (as deep as 60 feet bgs), contaminant levels were several orders of magnitude lower, although many still exceeded soil screening criteria.

- Lineations, such as those observed in soils at IDC, generally tend to enhance transport of contaminants through the soil to the underlying groundwater. However, the bulk of soil contamination at IDC does not appear to have migrated to downgradient wells, as evidenced by the fact that site-related contaminants in wells downgradient of IDC do not exceed groundwater screening criteria. Possible reasons for this are outlined below.

  - The majority of the surface in the vicinity of IDC is overlain by buildings and roads, which prohibit the majority of precipitation from infiltrating into overburden soil. As a result, the bulk of precipitation drains via overland flow toward the northern drainage area, with a limited amount available to migrate vertically through the overburden.

  - Any vertical migration is further hindered by the underlying soil thickness (over 100 feet thick) and its tendency to grade to finer material with depth.

Ramallo Source Area

- Site-related contaminants exceed soil screening criteria in several soil samples at Ramallo/CCC. The highest levels of site-related contaminants at Ramallo/CCC are concentrated in the top 8 feet in a boring located in the northeastern corner of the property: 3,300,000 µg/kg of PCE, 2,700J µg/kg of TCE, 41,000 µg/kg of cis-1,2-DCE, 120 µg/kg of 1,1-DCE, and 2,000 µg/kg of vinyl chloride. The vertical extent of contamination in the northern and eastern areas of the property is not fully defined, as evidenced by screening criteria exceedances in the bottom of several borings in these areas; soil contamination extends to depths of 72 feet bgs in some borings.

- Levels of site-related contaminants exceed screening criteria in several bedrock and saprolite wells in the vicinity of Ramallo/CCC. The highest level of groundwater contamination (1,700 µg/L of PCE) occurs in SMW-10 located on the Ramallo/CCC property; this well is screened from 62 to 72 feet bgs, the bottom of which extends into the underlying saprolite zone. The saprolite thickness ranges from 45 to 60 feet; groundwater is semi-confined under the overlying soils. Once in the saprolite zone, contaminants move southwest with groundwater, as described below.
    - Some of the contaminated groundwater then enters the bedrock aquifer via fractures and bedding planes at the base of the saprolite zone. Contaminants then migrate with groundwater flow in the bedrock: to the north-northeast and south along strike, and to the west along bedding planes. Cidra-8 and MPW-5, which are in this flow path, contain the highest levels of contaminants in the bedrock; PCE exceedances in MPW-5 range from 11 to 120 µg/L, and up to 85 µg/L in Cidra-8.
    - Still other contaminated groundwater continues to flow southwest in the saprolite zone toward the Rio Arroyata. Based on the hydrologic connection between groundwater and the Rio Arroyata, observed seeps along the river, and the presence of low levels (below screening criteria) of site-related contaminants in surface water, contaminated groundwater is discharging to the Rio Arroyata. Although contaminated groundwater from the saprolite zone has reached the river, it is unknown whether the plume has migrated under the river.

The vertical extent of groundwater contamination has not been defined in the saprolite or bedrock aquifers, given that saprolite wells are completed in the top of the saprolite zone, and given that contamination exists at levels above screening criteria in the bottom of bedrock multiport wells MPW-5 and MPW-6.

Although the vertical extent of contamination has not been defined in some areas, contamination has been characterized to the extent needed to complete the RI/FS and risk assessments. Additional characterization may be necessary during the pre-design stage.

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Section 1

Introduction

CDM Federal Programs Corporation (CDM Smith) received Work Assignment (WA) 168-RICO-02WE for the Cidra Groundwater Contamination Site (the site or Cidra site) located in Cidra, Puerto Rico, under the Response Action Contract, Contract No. 68-W-98-210 for the United States Environmental Protection Agency (EPA), Region 2. This WA was continued under the EPA Region 2 Remedial Action Contract (RAC), Contract No. EP-W-09-002, as WA 004-RICO-02WE. The objective of this WA is to perform a Remedial Investigation/Feasibility Study (RI/FS), a human health risk assessment (HHRA), and a screening level ecological risk assessment (SLERA) for the site.

1.1 Purpose of Report

The overall purpose of the RI is to identify potential source areas through soil and groundwater investigations, define the hydrogeologic framework, evaluate the nature and extent of groundwater, soil, surface water, and sediment contamination, and develop appropriate remedial alternatives for the identified contamination. Due to the lack of existing hydrogeological data and the lack of a defined source of contamination, a staged field investigation was planned to effectively use data collected during the initial stage to focus and refine data collection activities in following stages. The Stage 1 field investigation was completed in January 2009, and was detailed in the Stage 1 Technical Memorandum Report, dated April 15, 2009 (CDM Smith 2009). The Stage 2 field investigation was completed from April to July 2010, and detailed in the Stage 2 Technical Memorandum Report, dated April 11, 2011 (CDM Smith 2011). Recommended additional work, designated as the Stage 2a field investigation, was completed in June 2012. This report details activities and results from all field investigations conducted at the site.

1.2 Site Description

The Cidra site consists of a plume of groundwater contaminated with chlorinated volatile organic compounds (VOCs) in an industrial area of Cidra. Figure 1-1 is a site location map and Figure 1-2 is a site map. The Puerto Rico Department of Health (PRDOH) ordered the following four Puerto Rico Aqueduct and Sewer Authority (PRASA) public supply wells in Cidra to be closed due to tetrachloroethene (PCE) contamination. 1,1-Dichloroethene (1,1-DCE) and trichloroethene (TCE) were also detected in these wells.

- Cidra Well #3 (Planta Alcantarillado), serving 112 people, closed in February 1999
- Cidra Well #4 (Calle Padilla Final), serving 177 people, closed in March 1996
- Cidra Well #6 (Calle Baldorioty), serving 207 people, closed in August 2000 (EPA 2003a)
- Cidra Well #8 (Frente Cementerio), not in service at the time of closure in October 1996

The aquifer of concern at the Cidra site is the Pre-Robles volcanic bedrock that underlies the area. The closed and active wells are finished in this aquifer at total depths ranging from 110 to 705 feet below

the ground surface (bgs). In total, there are 15 active drinking water wells located within 4 miles of the site, serving a total population of 8,838 people (EPA 2003b).

1.3 Site History and Previous Investigations

Prior to listing the site on the National Priorities List (NPL), the source(s) of contamination in the wells were unknown, and several investigations were conducted to identify potential source areas. These investigations, summarized below, are described in the Expanded Site Inspection/Remedial Investigation Report (ESI) package prepared by Weston Solutions, Inc. (EPA 2003a).

EPA Pre-CERCLIS Screening Report, October 2000

In October 2000, EPA completed a Screening Report prior to listing the site in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS). This report identified sites in Cidra for further evaluation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In support of the evaluation, EPA personnel conducted file searches, interviews, and field reconnaissance surveys at 31 sites in the area. Twenty-one sites were recommended for entry into CERCLIS (EPA 2000).

EPA Expanded Site Inspection/Remedial Investigation, 2003

In June 2002, EPA's Region 2 Site Assessment Team (SAT) collected groundwater samples from the closed municipal supply wells and from 20 other active and inactive wells in Cidra. PCE was detected in the closed wells at concentrations ranging from 0.64 to 12 micrograms per liter (µg/L). PCE was also detected in two industrial/potable supply wells (IVAX No.1 and No.2) and three industrial wells (Glaxo Smith Kline No.1 and No.2 and Millipore - Cidra). The Glaxo Smith Kline wells and Millipore-Cidra industrial wells are located east of Lago de Cidra and are likely not associated with the VOC source that has impacted the closed public supply wells. Related chlorinated solvents, including 1,1-DCE; 1,1-dichloroethane (1,1-DCA); cis-1,2-dichloroethene (cis-1,2-DCE); carbon tetrachloride; and TCE, were also detected in groundwater samples (see Appendix A for sample results). Maximum contaminant levels (MCLs) for PCE (5 µg/L) and 1,1-DCE (7 µg/L) were exceeded; however, the exceedances did not occur in active drinking water wells. Other VOCs were also detected, in most cases at estimated concentrations below the sample quantitation limits (SQLs) (EPA 2003a).

The groundwater samples were also analyzed for semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and inorganic parameters. There were no detections of SVOCs, pesticides, or PCBs above laboratory quantitation levels. Inorganic parameters were not detected above MCLs in the groundwater samples, except thallium, which was reported at estimated concentrations above the MCL (2 µg/L) in three samples. Thallium is not known to be associated with the Cidra groundwater plume. The VOCs found in each well during the 2002 sampling round by EPA are presented in Appendix A.

EPA Potential Source Area Investigation, 2003

In January and February 2003, EPA Region 2 SAT investigated 12 industrial sites in the Cidra area to determine if they could be potential sources of contamination of the groundwater plume. See Figures 1-3 and 1-4 for the locations of the sites investigated by SAT. Eleven of the sites are listed in EPA's CERCLIS Hazardous Waste Sites database, and one site is listed in the Archived Sites database.

Site Name	CERCLIS Number
International Dry Cleaners (IDC)	PRN000204340
Shellfoam Products (Shellfoam) (archived)	PRD987377264
SmithKlein Beecham Pharmaceuticals, Inc.	PRD090023250
Tech Group de Puerto Rico, Inc. (TGP)	PRN000204348
Zenith Laboratories Caribe, Inc. (ZEN)	PRD987377702
Excellent Laundry	PRN000204338
Creative Medical Corp.	PRN000204336
CMM Laundry	PRN000204330
Cidra Metal Caskets (CMC)	PRN000204335
Ramallo/Cidra Convention Center (CCC)	PRN000204333
CCL Label de Puerto Rico	PRN000204329
Caribbean Manufacturing Co.	PRN000204331

SAT used direct-push technology (DPT) to advance soil borings to depths just above the water table (approximately 40 to 60 feet bgs), and soil cores were retrieved from each borehole at 5-foot intervals. A groundwater sample was also collected with DPT at the TGP site. The soil and groundwater samples were field-screened for VOCs with the HAPSITE® Headspace Sampling System. Figures showing the soil boring locations at each facility are presented in Appendix A.

The HAPSITE® field screening results indicated the presence of PCE, TCE, and trans-1,2-dichloroethene (trans-1,2-DCE) in soils collected from the IDC site from depths of 2 to 7 feet bgs, at concentrations ranging from approximately 7 to 255 parts per billion (ppb). Other VOC detections included vinyl chloride in a sample from the Ramallo/CCC site and 1,1,2,2-tetrachloroethane (1,1,2,2-TCA) in a sample from the TGP site, both at concentrations less than 3 ppb. The field-screening data also indicated the presence of other VOCs in soil samples from some sites, mostly at concentrations below 1 ppb, and chloroform in the groundwater sample collected from the TGP site.

SAT used the screening results, particularly the PCE readings mentioned above, to select samples for VOC analysis through the Contract Laboratory Program (CLP). At sites where there were no detections, the CLP samples represented each borehole location from every five-foot interval to refusal.

The CLP analytical results confirmed the presence of PCE and other VOCs in soil at approximately 4 feet bgs at the IDC site, as follows: PCE at 11,000 micrograms per kilogram (µg/kg); TCE at 2,800 µg/kg; and cis-1,2-DCE at 5,100 µg/kg. These same VOCs were also detected in samples from 7 feet bgs, but at lower concentrations, and cis-1,2-DCE was detected from the 2 feet bgs sample at 6,700 µg/kg. The PCE, TCE, and cis-1,2-DCE detections exceeded EPA's generic migration-to-groundwater Soil Screening Levels (SSL). The only other significant concentrations were 1,1-DCE above the generic SSL in a soil sample from the ZEN site, and an estimated concentration for 2-butanone in a sample from the Caribbean Manufacturing Co. The CLP results also confirmed the presence of chloroform in the groundwater sample from the TGP site.

No detections were found in soil samples from the seven remaining facilities and EPA recommended no further action (EPA 2003b).

SAT collected two sediment samples from drainage channels at the Cidra Industrial Park. VOCs were not detected in the drainage channel samples. SAT also collected surface water and sediment samples from five locations in Lago de Cidra to evaluate the potential connection between the lake and the groundwater plume. Field-screening and CLP analytical results indicated that no VOCs were detected in the lake water and sediment samples.

1.4 Current Site Conditions

Currently the Cidra site includes the VOC plume area, which includes the four PRASA public supply wells. The public supply wells remain closed; Cidra obtains water from Lago de Cidra and other supply wells in the area. The IVAX/Zenith plant is currently inactive; water is drawn from the supply wells on an as-needed basis for basic maintenance.

1.5 Report Organization

The RI Report is organized as shown below.

Executive Summary - provides a synopsis of the investigations conducted and their results.

Section 1 Introduction - presents the regulatory framework for performing the RI and summarizes the objectives of the RI. The section provides an overview of the study area and site, including summaries of previous investigations. The organization of the remainder of the report is presented.

Section 2 Study Area Investigations - describes the methodology and sampling rationale for the various investigations that were conducted for the RI.

Section 3 Physical Characteristics of the Study Area - briefly describes the physical attributes of the study area, including surface topography, surface water hydrology, geology, hydrogeology, and meteorology. Sections on demography, land use, and ecology describe the potential populations and habitats for human and ecological receptors.

Section 4 Nature and Extent of Contamination - lists the screening criteria against which site data were assessed to determine the extent of contamination in soil, groundwater, sediment, and surface water, and describes the type and extent of contamination determined to be present.

Section 5 Contaminant Fate and Transport - evaluates the persistence and mobility in the environment of the contaminants identified as related to the site and summarizes the fate and transport mechanisms that apply to the site. A conceptual site model (CSM), which presents potential receptors and discusses the interaction between site conditions and detected contamination, is included in this section.

Section 6 Risk Assessment Summary - summarizes the results of the HHRA and the SLERA.

Section 7 Conclusions and Recommendations- presents the conclusions of the RI and recommends future actions.

Section 8 References.

Section 2

Study Area Investigations

This section describes the activities conducted during the Stage 1, Stage 2, and Stage 2a field investigations. All sampling, decontamination, and investigation derived waste (IDW) handling activities were conducted in accordance with the Final RI/FS Work Plan, Volume I (CDM Smith 2006) and the Final Quality Assurance Project Plan (QAPP) (CDM Smith 2007), the Final QAPP Addendum dated March 18, 2010 (CDM Smith 2010a), and the Final QAPP Addendum 2 – Stage 2a Vapor Intrusion Investigation, dated September 7, 2012 (CDM Smith 2012), except where amended by field change requests (FCRs). FCRs are provided in Appendix B.

The activities conducted during the various field investigations are summarized below.

Stage 1 - July 2007 through January 2009

- Initial supply well sampling (Initial Round)
- Industrial facilities source area investigation
- Former dry cleaners source area investigation
- Borehole drilling and coring
- Borehole geophysical logging
- Packer sampling and packer testing
- Multiport monitoring well installation in the bedrock zone
- Groundwater elevation measurement
- Monitoring well (bedrock) and supply well sampling

Stage 2 - April to July 2010

- Source area soil investigation
- Monitoring well installation in the saprolite zone
- Groundwater elevation measurement
- Monitoring well (bedrock and saprolite) and supply well sampling

Stage 2a - April to September 2012

- Additional monitoring well installation in the saprolite zone
- Groundwater elevation measurement
- Monitoring well sampling (saprolite wells only)

- Stream gauge installation and measurement
- Surface water and sediment sampling
- Sub-slab and indoor vapor sampling

2.1 Source Area Investigation

The overall objective of the source area soil investigation was to characterize the surface and subsurface soils at potential source area facilities in the vicinity of the Cidra site. The facilities included four former dry cleaners and eight industrial facilities listed below and shown on Figure 1-2.

Former Dry Cleaners

- IDC
- Former Dry Cleaner (currently Don Quixote Pizza)
- Former Dry Cleaner (currently a Coffee Shop)
- Former Dry Cleaner (currently Ramoncito)

Industrial Facilities

- ESSO Gas Station/LM Auto Parts (ESSO)
- CCL Label
- IVAX Facility
- Pepsi Facility
- Ramallo/CCC
- Shellfoam
- ENCO
- DJ Manufacturing

2.1.1 Former Dry Cleaners Source Area Investigations

2.1.1.1 Stage 1 Soil Borings

During Stage 1, ten soil borings were advanced at the four former dry cleaning facilities located in the Cidra commercial district, as follows: coffee shop (CSSB-01 and CSSB-02), Don Quixote Pizza (DQSB-01 through DQSB-03), Ramoncito (RCTSB-01 and RTCSB-02), and the former IDC (IDCSB-01, IDCSB-03, and IDCSB-04). Soil boring locations at the former dry cleaner facilities are shown on Figure 2-1a. Samples from two borings at IDC (IDCSB-02 and IDCSB-05) were not collected due to lack of sample recovery. The direct push technology (DPT) rig was not able to access the borings at any of the former dry cleaners, and therefore soil samples were collected using a hand auger. Each soil sample was screened for VOCs with a photoionization detector (PID) and logged for lithology. FCR-1 described the sampling technique change to use a high density polyethylene syringe device to collect VOC samples.

Soil samples were shipped to CLP laboratories for analysis of full Target Compound List (TCL) and Target Analyte List (TAL) parameters, with select samples also sent to EPA's Division of Environmental Science and Assessment (DESA) laboratory for analysis of pH, total organic carbon (TOC), and grain size distribution. Table 2-1 summarizes the surface and subsurface soil samples collected from the soil borings at the former dry cleaner facilities.

2.1.1.2 Stage 2 Soil Borings

Based on the results from the Stage 1 soil boring samples, IDC was identified for further investigation. Ten additional soil borings were advanced at IDC during Stage 2 (IDCSB-05 through IDCSB-14); Stage 2 boring locations are also shown on Figure 2-1a. Access restrictions inside the building and in the narrow alleyway prevented the use of DPT drilling methods; hand augers were used in areas not accessible by the DPT rig, resulting in shallower borings. Soil borings were planned to be advanced to 72 feet bgs; however, refusal at many of the locations resulted in shallower borings, as shown in Table 2-1. Each soil sample was screened for VOCs with a PID and logged for lithology.

Soil samples were analyzed through the CLP for TCL VOCs, with select samples also analyzed by a subcontract laboratory for TOC, pH, and grain size, as shown in Table 2-1. Soil boring logs are presented in Appendix C.

2.1.2 Industrial Facilities Source Area Investigations

2.1.2.1 Stage 1 Soil Borings

A total of 64 soil borings were advanced at 6 of the industrial facilities during Stage 1, as listed below. Soil boring locations on these facilities, with the exception of ESSO Gas Station, are shown on Figure 2-1b; soil borings at the ESSO Gas Station and adjacent machine shop are shown on Figure 2-1c. FCR-5 reduced the number of borings at ESSO/machine shop from 20 to 14; FCR-7 added Shellfoam borings. DPT drilling methods were used for all but one boring (CCSB-07 located at CCL Label), which was collected with a hand auger because it was not accessible by the DPT rig.

- Shellfoam (SHSB-01 through SHSB 10)
- IVAX (IVSB-01 through IVSB-10)
- Pepsi (PESB-01 through PESB-10)
- ESSO (ESSB-01 through ESSB-14)
- CCL Label (CCSB-01 through CCSB-10)
- Ramallo/CCC (RMSB-01 through RMSB-10)

At each DPT sampling location, 4-foot soil cores were collected continuously from the surface to 12 feet bgs and then every 20 feet from 20 feet bgs to the top of the bedrock, or refusal. The field geologist screened each 4-foot core for VOCs using a PID, logged the samples for lithology, and noted any observations regarding potential contamination, and then selected the intervals for laboratory analysis based on these readings and observations.

Surface and subsurface soil samples were analyzed through the CLP for full TCL/TAL parameters, with select samples also sent to EPA's DESA laboratory for analysis of pH, TOC, and grain size, as shown in Table 2-2. Soil boring logs are presented in Appendix C.

2.1.2.2 Stage 2 Soil Borings

Based on the results of the Stage 1 soil boring samples, Ramallo/CCC, CCL Label, and ESSO were identified for further investigation. Two additional industrial facilities - ENCO and DJ Manufacturing – were also identified for investigation based on a Work Plan Letter dated March 4, 2010 (CDM Smith 2010b). The Field Change Documents are included in Appendix B. A total of 35 borings were advanced at these facilities, as summarized below.

- Ramallo/CCC (RMSB-11 through RMSB-23)
- CCL Label (CCSB-11 through CCSB-18)
- ESSO (ESSB-15 through ESSB-16)
- ENCO (ENSB-1 through ENSB-7)
- DJ Manufacturing (DJSB-1 through DJSB-5)

Stage 2 soil boring locations on these facilities, with the exception of the ESSO Gas Station, are shown on Figure 2-1b; soil borings at the ESSO Gas Station are shown on Figure 2-1c.

At each DPT sampling location, 4-foot soil cores were collected continuously from the surface to 12 feet bgs and then every 12 feet from 20 feet bgs to the top of the bedrock, or refusal. DPT drilling methods were used where accessible and hand augers were used in areas not accessible by the DPT rig. Soil borings were planned to be advanced to 72 feet bgs; however, refusal at many of the locations resulted in shallower borings, as shown in Table 2-2. The field geologist screened each 4-foot core for VOCs using a PID, logged the samples for lithology, noted any observations regarding potential contamination, and then selected the intervals for laboratory analysis based on these readings and observations.

Soil samples were analyzed through the CLP for TCL VOCs, with select samples also analyzed by a subcontract laboratory for TOC, pH, and grain size, as shown in Table 2-2. Soil boring logs are presented in Appendix C.

2.2 Groundwater Investigation

2.2.1 Stage 1 Groundwater Investigation Activities

The Stage 1 hydrogeological investigation was performed to identify potential source areas and to define the nature and extent of groundwater contamination. Specifically, it focused on investigation activities in the vicinity of the affected municipal wells. The primary objectives included assessment of the condition and sampling of existing wells to confirm existing data, initial definition of the contaminant distribution in the vicinity of the affected wells, collection of hydrogeologic and geologic data to support subsequent stages of the investigation, and identification of contaminant sources.

2.2.1.1 Existing Well Evaluation and Sampling

The objectives of the existing well evaluation and sampling program were to assess the condition of the inactive public supply wells and to obtain current contaminant levels to obtain preliminary data on the vertical distribution of groundwater contamination. Groundwater samples were collected from the four inactive public supply wells (Cidra #3, Cidra #4, Cidra #6, and Cidra #8) and 12 industrial wells in the vicinity of the site (IVAX # 1, IVAX # 2, the former IVAX Well, Pepsi, Villa Carmen, Rabanal, Mylan, Ciba Vision 1, Ciba Vision 2, Caribbean Refrescos, Zapera, and Peligrin 1). Figure 2-2 shows well locations and Table 2-3 is a summary of samples. At the time, all the industrial wells were active except for the former IVAX supply well.

Assessment of the public supply wells included removing the pumps and piping (where present) and viewing the condition of the well with a downhole televiewer. FCR-3 included video logging and sampling of the former IVAX supply well; however, video logging was not possible due to inaccessibility of the well. The on-site geologist noted the depth and condition of the casing and screen (if present), the condition of the open hole portion of the well, and the depth of the well. The televiewer run in each well was recorded for more detailed evaluation. Observations regarding construction of the Cidra supply wells are summarized below.

Well ID	Diameter	Casing Depth	Open Hole Interval (Bedrock)
Cidra #3	10 inches	0-42 feet bgs	42-124 feet bgs
Cidra #4	undetermined	0-68 feet bgs	68-188 feet bgs
Cidra #6	16 inches	0-161 feet bgs	161-189 feet bgs
Cidra #8	undetermined	0-97 feet bgs	97-276 feet bgs

Three groundwater samples were collected from each of the four inactive public supply wells (Cidra #3, Cidra #4, Cidra #6, and Cidra #8) and the former IVAX supply well using a submersible pump and the low-flow sampling method. At each well, samples were collected near the top of the groundwater table, approximately midway between the groundwater table and the bottom, and near the bottom of the well (see Table 2-3 for sampling intervals). Turbidity, pH, temperature, conductivity, and dissolved oxygen were monitored during sampling. Samples were collected after all parameters stabilized (within 10 percent for successive measurements).

The remaining industrial wells contained in-well pumps, and samples were collected directly from valves close to the well head. The water lines were purged prior to sampling.

The industrial and inactive public supply well samples were analyzed through the CLP for TCL trace-level VOCs, SVOCs, pesticides/PCBs, and TAL metals.

2.2.1.2 Bedrock Borehole Drilling

This section describes the Stage 1 borehole drilling and coring activities. The primary objectives of the Stage 1 borehole drilling and coring were to collect lithologic and stratigraphic data to refine the hydrogeologic model, to advance a borehole for subsequent packer sampling and testing, and for subsequent multiport well installation and sampling.

Six boreholes were advanced in the vicinity of the affected municipal wells – MPW-1 through MPW-6. MPW-2 was advanced adjacent to Cidra Well #4; MPW-3 was advanced adjacent to Cidra Well #3, MPW-5 was advanced adjacent to Cidra Well #8; and MPW-6 was advanced adjacent to the abandoned IVAX well. MPW-1 and MPW-4 were relocated based on the results of the existing well sampling data, as described in FCR-6 (Appendix B). Figure 2-2 shows locations. Five boreholes were drilled using the air rotary drilling method and one borehole was cored using standard rock coring methods. The Final QAPP specified air rotary drilling of three boreholes and rock coring of three boreholes. This change was discussed with and approved by EPA and is documented in FCR-2 (Appendix B). Additional changes in the borehole drilling program, including increasing the borehole diameter from 4 to 6 inches and decreasing the rock core diameter from 4⅞ inches to 2⅞ inches, are documented in FCR-2 (Appendix B).

Bedrock Drilling and Coring

MPW-5 was advanced using rock coring to obtain data to verify downhole geophysical logging data. Initially, the unconsolidated soil portion of the borehole was advanced using 8-inch diameter air rotary; however, due to borehole collapse in the overburden portion of the borehole, a 12-inch borehole was advanced through the collapsed portion, and a 10-inch steel casing was installed to hold the borehole open. Eight-inch air rotary drilling then resumed and a 6-inch carbon steel casing was installed into competent bedrock. Changes in the casing diameter are documented in FCR-4 (Appendix B). Upon installation of the outer steel casing, an NQ (2⅞-inch diameter) rock coring bit was used to advance a nominal 3-inch diameter borehole to depth, and the on-site geologist logged the rock core lithology. The borehole diameter was then reamed to 6 inches.

The remaining five boreholes were advanced using the air rotary drilling method. Borehole collapse in MPW-2 and MPW-4 required a second 10-inch diameter outer casing, as described above for MPW-5; these changes were also documented in FCRs -2 and -4. A 6-inch diameter carbon steel casing was installed through the overburden material, and into competent bedrock. Upon installation of the 6-inch diameter steel casing, a 6-inch diameter borehole was advanced through the bedrock using air rotary with direct circulation drilling method

The bedrock boreholes were continuously developed during drilling to remove fines and drilling fragments from the borehole, to clear borehole fractures, and to ensure that the boreholes were clean and properly prepared for subsequent packer sampling, downhole logging, and installation multiport monitoring wells. When completed, temporary FLUTe ™ liners were installed in all of the bedrock boreholes to prevent intra-borehole flow and cross contamination among different fracture zones within the borehole.

Borehole Geophysical Logging

Borehole geophysical logging was performed in the six bedrock boreholes to define lithology and stratigraphy, including the location and orientation of fractures and bedding planes; identify groundwater flow within the well including water entry and exit points; and to provide a basis for selection of packer sampling intervals and multiport monitoring well port depths.

The following suite of borehole logs was run for the purposes indicated.

- Fluid resistivity and temperature (one tool). Data from these logs indicate borehole fluid entry/exit points.
- Natural gamma. Data is correlated with rock cores to define stratigraphy.
- Optical and acoustic televiewer. Data shows borehole wall lithology, strike and dip of fractures and bedding planes.
- Mechanical caliper. Data shows borehole wall condition, useful for deciding where to locate packers for sampling or multiport well ports.
- Vertical Flow - Static (Heat Pulse) and Pumped (Heat Pulse) (one tool, 2 runs). Data shows fluid entry and exit points and flow rates.

Downhole geophysical logging was performed by EarthData, Inc, a geophysical subcontractor to CDM Smith; and overseen by the CDM Smith hydrogeologist. The geophysical data were provided to CDM Smith in electronic format and were analyzed and evaluated to support selection of subsequent packer sampling intervals and multiport monitoring zones. See Appendix D for geophysical logs.

Packer Sampling and Testing

Packer sampling was performed in the six boreholes to provide discrete-depth, screening-level groundwater data to support selection of multiport monitoring well monitoring intervals. Prior to packer sampling, CDM Smith analyzed the downhole geophysical logging data and discussed packer sampling intervals with the EPA Hydrogeologist. Table 2-4a summarizes the intervals and rationale for the packer sampling and testing activity.

Packer samples were collected from anywhere from five to nine intervals in the multiport well boreholes, as listed in Table 2-4b. A straddle packer system 10 feet in length was used to isolate selected sample intervals. Pressure transducers were used to monitor water levels above, between, and below the packer system before, during, and after pumping. After checking the quality of the packer seal, a pump was used to remove water from the isolated interval at a constant rate, while water level changes were monitored using transducers. Packer sampling began at the bottom of the borehole and proceeded upward. The packer assembly was not removed between successive samples within the same borehole. The entire packer assembly including the pump was decontaminated between boreholes and new tubing was used at each borehole. Water quality parameters such as pH, temperature, conductivity, and dissolved oxygen were monitored prior to sample collection. Packer samples were analyzed through the CLP for 24-hour turnaround time trace-level VOCs.

After completion of packer testing, the temporary FLUTe ™ liner was placed in the borehole to prevent intra-borehole flow.

Packer testing was performed in conjunction with the packer sampling program at three of the six boreholes drilled for multiport well installation. Three intervals from MPW-4, MPW-5, and MPW-6 were selected for the packer testing, which involved isolating 10-foot intervals within each borehole using a straddle packer system. The system allowed the testing to target specific fracture zones. Water

pumped from the well during packer testing was contained and transported to a central storage tank for subsequent characterization, transport, and disposal by Seacoast, Inc., a CDM Smith subcontractor.

Each test consisted of pumping an isolated zone at two specific discharge rates and measuring drawdown in the zone. To determine if the packers were set properly, drawdown was also measured in the zones above and below the straddle packers. This also allowed an observation to be made on the interconnectivity of fractures inside and outside of the isolated zone. The drawdown and discharge information was used to calculate estimates of transmissivity for each zone. A summary of specific capacity and estimated transmissivity for each interval is included on Table 2-4b.

Empirical methods were used to estimate the hydraulic properties of each fracture zone using the discharge and drawdown data generated from the packer testing. Specific capacity, a measure of the yield of a well per unit of drawdown, was calculated for each zone using the formula below.

Specific Capacity = Q/s

Where:
Specific Capacity = gallons per minute per foot of drawdown
Q = Discharge (gallons per minute)
s = Drawdown (feet)

To estimate transmissivity from the packer testing data, an empirical formula which relates the specific capacity to transmissivity was utilized. In lieu of using a curve matching technique to estimate hydraulic properties, this technique was selected based on the spacing of drawdown data and the limitations of using data generated from a pumped well for curve matching techniques. The formula used is described further in Driscoll (1986):

Specific Capacity (Q/s) = T / 2000

Where:
T = Transmissivity (gallons per day per foot [gpd/foot])

An overall estimate of transmissivity for each zone was calculated by averaging the transmissivity values calculated during the two steps of pumping at each zone. Specific capacity and transmissivity data are discussed in Section 3.

2.2.1.3 Monitoring Well Installation

Six FLUTe ™ system multiport monitoring wells were installed in the bedrock boreholes in December 2008. The multiport well systems contained four to seven ports, based on results from the packer sampling and downhole geophysical logs. Port intervals were reviewed and approved by EPA prior to installation. Table 2-5a summarizes the rationale for choosing the port intervals for each multiport well, and Table 2-5b summarizes the multiport monitoring well construction details. Multiport monitoring well locations are shown on Figure 2-2.

Just prior to installing the multiport system in MPW-6, the blank liner was found to be ripped, and there was concern that the multiport well could rip as well. FCR-8 describes the decision to perform downhole video logging in the well to determine if fracturing in the same area would damage the

multiport system. No impediments were found, and the multiport system was installed in MPW-6. Subsequent to installation, during Stage 2 the multiport well was found to be damaged and a conventional well was installed in the MPW-6 borehole (see Section 2.2.2.1).

2.2.1.4 Stage 1 Groundwater Sampling and Synoptic Water Level Measurements

One round of groundwater samples was collected from the six multiport monitoring wells installed during Stage 1, as shown in Table 2-6. Groundwater samples were collected from the multiport monitoring wells using the FLUTe ™ gas-drive sampling system previously installed in the boreholes. Sampling was performed in accordance with the manufacturer's (FLUTe ™ Systems, Inc) sampling procedures. The FLUTe ™ system was purged twice prior to collection of the samples and water quality parameters were monitored for stability. Parameters stabilized after two purges and the sample was collected on the third purge.

Groundwater samples were analyzed through the CLP for TCL trace-level VOCs, SVOCs, pesticides/PCBs, and TAL inorganics. To support evaluation of natural attenuation of VOCs in groundwater, samples were analyzed by EPA's DESA laboratory for the following parameters: chloride, methane, ethane, ethene, nitrate/nitrite, sulfate, sulfide, and TOC; ferrous iron measurements were made in the field. Samples were also analyzed by DESA for water quality parameters; total suspended solids (TSS), total dissolved solids (TDS), alkalinity, ammonia, hardness, and total Kjeldahl nitrogen (TKN). Dissolved oxygen (DO), oxidation-reduction potential (ORP) (as Eh), turbidity, temperature, and conductivity measurements were taken in the field using flow-through cells.

CDM Smith collected a round of water level measurements from each port in the multiport monitoring wells. Water level elevations are presented and discussed in Section 3.4.4.

2.2.2 Stage 2 Groundwater Investigation Activities

Stage 2 groundwater investigation activities were conducted to address data gaps identified from Stage 1. Stage 2 activities included well installation in the saprolite zone, synoptic water level measurements, and a round of groundwater sampling.

2.2.2.1 Saprolite Monitoring Well Installation

A total of seven monitoring wells (SMW-1, SMW-2, SMW-3, SMW-5, SMW-9, SMW-10, and SMW-12) were installed in the saprolite zone using hollow stem auger drilling methods. It should be noted that the saprolite wells were screened in the top of the unit, where groundwater was first encountered. Groundwater was not encountered in the overlying silty clay unit, which acts as a semi-confining unit above the saprolite. See Section 3.4.4 for more information on the site-specific hydrogeology of these units.

Locations are shown on Figure 2-2, and well construction details are summarized in Table 2-7. Well and completion materials were installed through the augers as they were withdrawn. All wells were developed following installation. The coordinates and elevations (ground surface and top of inner casing) were measured for the newly-installed saprolite monitoring wells.

Field changes to the monitoring well installation program are summarized below.

- The planned background well (SMW-11) was not installed due to the lack of water in upgradient areas. A total of four borings were advanced northeast of Ramallo/CCC (three in the Praxedes public housing complex and one at the Pinero School); however, no water was encountered.
- Due to damage in the FLUTe ™ multiport well assembly at MPW-6, the well was converted to a conventional well, screened from 236 – 246 feet bgs, upon discussion and approval from EPA. The details of this change are documented in a letter to EPA, which is presented as Appendix E.

2.2.2.2 Stage 2 Groundwater Sampling and Synoptic Water Level Measurements

One round (Stage 2) of groundwater samples was collected from the seven newly-installed saprolite monitoring wells, the converted MPW-6 well, five multiport monitoring wells installed during Stage 1, and the four inactive supply wells. Figure 2-2 shows the well locations, and Table 2-8 summarizes the groundwater samples and analyses. Multiport monitoring well samples were collected in the same manner as in Stage 1. The supply wells, saprolite wells, and the converted MPW-6 well were purged and sampled with a submersible pump, using low-flow sampling methods. Water quality parameters (DO, ORP, turbidity, temperature, and conductivity) were measured during purging and samples were collected upon stabilization of the parameter measurements. Groundwater sampling sheets are presented in Appendix F.

Groundwater samples were analyzed through the CLP for TCL VOCs and by DESA for TAL metals (including cyanide and mercury) and wet chemistry parameters, as summarized on Table 2-8. DO, ORP, turbidity, temperature, and conductivity measurements were taken in the field using flow-through cells.

CDM Smith collected a round of synoptic water level measurements on August 3, 2010 in conjunction with the groundwater sampling round. CDM Smith measured the groundwater elevations at the multiport wells, the saprolite monitoring wells, closed public supply wells, and the IVAX well. Groundwater depth measurements were taken for each port in the multiport monitoring wells. A water level meter was used to measure water levels in the multiport wells, saprolite monitoring wells, the closed Cidra supply wells, and the IVAX well. A supplemental round of water levels was collected from saprolite monitoring wells on October 20, 2010 due to anomalies noted in the August 3, 2010 measurements, as discussed in Section 3.3.4. Multiport monitoring well water level elevations are presented and discussed in Section 3.4.4.

2.2.3 Stage 2a Groundwater Investigation Activities

Four additional monitoring wells were installed in the saprolite zone during Stage 2a; groundwater samples and a round of synoptic water level measurements were also collected.

2.2.3.1 Saprolite Monitoring Well Installation

Four additional monitoring wells (SMW-4, SMW-6, SMW-7, and SMW-8) were installed in the saprolite zone to address data gaps regarding the extent of the plume in the saprolite zone (see Figure 2-2 for locations). The wells were installed using the hollow stem auger drilling method. Well completion materials were installed through the augers as they were withdrawn from the borehole. Well

construction details are summarized in Table 2-8; well construction logs are presented in Appendix C. All wells were developed using pump and surge methods, following installation.

2.2.3.2 Stage 2a Groundwater Sampling and Synoptic Water Level Measurements

The four new saprolite monitoring wells were the only wells sampled during the Stage 2a groundwater sampling event. The wells were purged and sampled with a submersible pump, using low-flow sampling methods. Water quality parameters were measured during purging and samples were collected upon stabilization of the parameter measurements. Groundwater sampling sheets are presented in Appendix F.

Groundwater samples were analyzed through the CLP for TCL trace level VOCs only. Table 2-9 summarizes the samples collected during Stage 2a.

CDM Smith collected a round of synoptic water level measurements from all multi-port wells, saprolite wells, supply wells, and the IVAX well, in the same manner as previous measurement rounds.

2.3 Surface Water and Sediment Sampling

CDM Smith collected 10 co-located surface water and sediment samples during Stage 2a to determine if contaminants have migrated through the groundwater to surface water and sediments in the Rio Arroyata, located downgradient of the site. Figure 2-3 shows the surface water and sediment sampling locations. Table 2-10 provides a summary of the surface water and sediment samples. Samples were strategically located in areas where groundwater was expected to discharge into the river. Stream gauges were also installed and water level measurements were recorded during the Stage 2a synoptic water level measurement event, just prior to surface water and sediment sampling. It is likely that the river was a “gaining” water body at the time, based on the following: 1) samples were collected during the rainy season and 2) synoptic groundwater levels in SMW-6, SMW-7, and SMW-8 were higher than those in the adjacent stream gauges. Section 3.4.4 presents further information regarding the groundwater to surface water evaluation.

One surface water sample (SW-1) and one sediment sample (SD-1) were collected upstream of the site area to represent background conditions. Sampling began at the most downstream location and proceeded upstream. The two most downgradient samples (SD-9 and SD-10) were collected at, and downgradient of, the confluence with the unnamed stream that drains the area surrounding the Cidra cemetery. Surface water samples were collected mid-stream directly into sample containers submerged below the stream surface. Surface water samples were analyzed for TCL VOCs and TAL inorganics through the CLP; samples were also analyzed for methane, ethane, ethene, nitrate, nitrite, sulfate, sulfide, alkalinity, ammonia, chloride, TOC, TDS, and TKN through DESA. Sediment samples were collected from 0 to 6 inches below the surface of the streambed using decontaminated stainless steel trowels. Sediment samples were analyzed for TCL VOCs and TAL inorganics through the CLP, and for grain size, pH, and TOC by DESA.

2.4 Vapor Intrusion Field Investigation

CDM Smith conducted a vapor intrusion investigation during Stage 2a. The investigation was completed in accordance with the Final RI/FS QAPP, Revised Addendum No. 2, Stage 2a Vapor Intrusion Investigation, dated September 7, 2012.

Two co-located indoor air and sub-slab soil vapor samples were collected at and adjacent to the IDC building source area (Figure 2-4). Samples were collected at the center of the buildings. One ambient air sample was collected upwind of this source area. Samples were analyzed for VOCs and were collected in accordance with EPA Method TO-15, second edition 1999 and per the approach described in the September 2012 Vapor Intrusion QAPP Addendum. Access to the building immediately adjacent to the IDC source are was not available so samples were collected at the next building, 50 feet to the south of the IDC source area.

Eight co-located indoor air and sub-slab soil vapor samples were collected at and adjacent to the Ramallo/CCC source area (Figure 2-5). Samples were collected at Ramallo/CCC, CCL Label, ENCO, and the Praxedes Public Housing. Two co-located samples were collected at the center of each building and at the portion of each building closest to the Ramallo/CCC source area. Samples were analyzed for VOCs and were collected in accordance with EPA Method TO-15, second edition 1999 and per the approach described in the September 2012 Vapor Intrusion QAPP Addendum. Access to apartments in the public housing was difficult so one sample was collected in a semi-enclosed laundry room of one apartment and the other in the public housing management office. Two ambient air samples were collected upwind of the Ramallo/CCC source area.

2.5 Ecological Characterization

An ecological reconnaissance was performed at the site on November 3, 2009 in accordance with the CDM Final Work Plan (CDM 2009). The field effort focused on areas which exhibited, at a minimum, marginal habitat suitable for supporting populations or ecological communities that may potentially be exposed to site-related contaminants via groundwater discharge. These areas consisted of aquatic and riparian habitats associated with the Rio Arroyta, a tributary of Rio de la Plata, and two drainage areas which form the Rio Arroyata. Information regarding habitats and biota observed is discussed in this section. Observations from the ecological reconnaissance are presented in Section 3.7.

2.6 Control of Investigation-Derived Waste

CDM Smith procured the services of Seacoast Environmental, an IDW subcontractor, to characterize, transport, and dispose of all IDW generated during the course of the RI. Waste soil, rock fragments, and fluids generated during drilling and soil sampling activities were transferred to 20-cubic yard roll-off containers located at the staging area. Wastewater derived from borehole drilling and coring, well development and purging, and decontamination were bulked and stored in 6,500-gallon tanks prior to disposal. The IDW subcontractor sampled all soil and wastewater to determine Resource Conservation and Recovery Act (RCRA) characteristics for disposal. All soil and wastewater generated during the investigation were determined to be non-hazardous and were properly disposed by the IDW subcontractor.

2.7 Cultural Resources Survey

CDM Smith's cultural resources subcontractor, Richard Grubb & Associates, conducted a Stage IA cultural resources survey for the Site to assess the archaeological sensitivity of the area of potential effects (APE); the APE consists of approximately 144 acres in the Municipality of Cidra. The Stage IA Cultural Resources Survey Report is provided as Appendix I. The survey concluded that portions of the APE possess high and moderate sensitivity for archaeological resources; specific conclusions of the survey are presented below.

Historic evidence indicates that the Cidra Municipal Cemetery was established in the APE at least by the 1880s. Grave markers at the western end of the cemetery appear to exhibit evidence of having been relocated during expansions to the cemetery. The precise boundaries of nineteenth century cemeteries are often not accurately depicted in historic records, and associated historic burials are often identified outside recorded cemetery limits. Areas near this cemetery are assessed to possess a high sensitivity for historic burials.

Elsewhere, in the western and southern portion of the APE, zones of high and moderate sensitivity for archaeological resources have been delineated on the basis of cartographic evidence, field reconnaissance, and the review of geoprobe soil boring logs. Other portions of the APE possess extensive evidence of disturbance associated with previous earthmoving activities and are assessed to possess low sensitivity for the survival of intact archaeological resources. However, parking lots and yard areas within the northern portion of the low sensitivity zone and along Route 171 may possess potential for deep historic features. These may include wells or privies associated with nineteenth century structures as depicted on historic maps of these areas. A Stage 1B cultural resources survey was recommended if subsurface remedial activities are conducted in areas of high sensitivity for archaeological resources.

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Section 3

Physical Characteristics of the Study Area

3.1 Topography

The municipality of Cidra is located in the central-eastern section of Puerto Rico in the northern foothills of the Cordillera Central Mountain Range (Figure 3-1). The Cidra commercial district is approximately 1,400 feet above mean sea level (msl). The Cidra Industrial Park, which is slightly south of the commercial district, is approximately 1,345 feet above msl. Between and slightly west of these two areas is the Cidra cemetery. Topography generally slopes south from the commercial district to a narrow southwest-trending valley and unnamed stream. In the vicinity of the industrial park, topography slopes southwest toward the Rio Arroyata. The unnamed stream drains the area surrounding the Cidra cemetery, and flows into the Rio Arroyata southwest of the site; at this point, the Rio Arroyata forms the topographic low at approximately 1,310 feet above msl.

3.2 Surface Water and Drainage

The commercial center of the Cidra municipality is situated at the surface water drainage divide between Rio de la Plata and Rio de Bayamon drainage basins (Figure 3-2). Both the Rio de la Plata and Rio de Bayamon are major rivers that flow north to the Atlantic Ocean, approximately 20 miles north of the site. Several drainages (e.g., valleys) are present throughout the municipality and discharge either southwest into the Rio de la Plata or northeast into the Rio de Bayamon drainage basins.

In general, most of the surface water drainage from the site flows south and west across the site toward the unnamed stream and the Rio Arroyata, a tributary of Rio de la Plata. Areas to the north and east of the site drain into Lago de Cidra located 0.5 mile east of the site, which is part of the Rio de Bayamon drainage basin. This lake is a manmade reservoir and is a popular fishing destination. A surface water intake, located approximately 2.2 miles downstream of Lago de Cidra, serves approximately 20,148 people. The water is also used for watering commercial livestock. The site is located outside of the 500-year flood boundary.

3.3 Soils

The majority of the soils across the area investigated during the RI are classified by the U. S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) as non-irrigated urban land mixed with approximately 25 percent Vega Alta Complex (Uv), shown on Figure 3-3. The Vega Alta soils are fine-textured, iron-rich coastal plain sediments that are located on the toeslopes of terraces. They are typically well-drained soils with a high available water capacity. In undisturbed sequences, the top eight inches of these soils are a clayey loam, and beneath that is clay (USDA 2012).

The DJ Manufacturing, IVAX, and Pepsi, and the majority of the Shellfoam, Ramallo/Cidra Convention Center, ENCO properties are situated on the Daguey Clay (DaD) (Figure 3-3). The Daguey Clay is characterized by NRCS as a very fine kaolinitic, isohyperthermic Inceptic Hapludox (USDA 2012). According to the University of Idaho, these soils are a type of Oxisol that are formed from highly

weathered tuff breccia parent material. The soils are typically very low in nutrients and have a high phosphorus-fixing capacity. They are well drained, and are generally suitable for agricultural use, provided they are supplemented with appropriate nutrients. They typically consist of a mixture of kaolinite and iron oxide (hematite), which makes them stable and fairly resistant to soil erosion and runoff (University of Idaho, soils.cals.uidaho.edu). This soil occurs on mountainous slopes and ridges across Cidra. The NRCS classifies the soil as being well-drained and having a high available water capacity. The top six feet are described as being predominantly clay, and beneath the clay is clayey loam (USDA 2012).

The Juncos Clay occurs in the southern portion of Cidra (Figure 3-3). The Juncos Clay is classified by the NRCS as a fine smectitic isohyperthermic Chromic Hapludert, a type of humid climate Vertisol (USDA 2012). The soil has a high shrink-swell capacity due to the type of clay it contains, which formed from the weathering of pyroclastic parent material (University of Idaho, soils.cals.uidaho.edu). The soil occurs on hillslopes (toeslopes) and is comprised of approximately four feet of clay overlying competent bedrock. It is moderately well drained but has a low available water capacity and low permeability (USDA 2012).

3.4 Geology and Hydrogeology

3.4.1 Regional Geology

Puerto Rico is part of the Greater Antilles island chain in the Caribbean. The area has been shaped by volcanism, uplift from the collision of the Caribbean Tectonic Plate with the North American Tectonic Plate, and erosion. During the Early Cretaceous Period, plate convergence and subduction initiated volcanic island arc magmatism. Orogenesis then caused the obduction of oceanic crust (serpentized peridotite) onto the young Antillean arc. The arc eventually collided with the Burke Caribbean oceanic plateau. The original volcanoes of the Caribbean arc became concentrated in the northern portion of the plate boundary via left-lateral faulting, which eventually isolated them from the subduction zone altogether (GSA 1998).

While most of the magmatism of the Greater Antilles island chain occurred during the Cretaceous Period, volcanism continued into the Late Eocene, thus creating one of the oldest, best preserved volcanic island arc sequences in the world today. Subsequent to island arc volcanism was the deposition of carbonate and terrigenous sediments from weathering. This created massive sedimentary platform deposits (GSA 1998).

Tectonism continues regionally today as a result of the easterly motion of the Caribbean plate relative to the North American plate and the resultant rotation of the Puerto Rico and Virgin Islands platform. Tectonically speaking, the Puerto Rico trench off the north shore of the island and its associated sub-basin are extremely complex. The region is experiencing oceanic crust underthrusting and extensional basins are separating the Puerto Rico-Virgin Islands arc terrane from its neighboring Hispaniola and Lesser Antilles arc terranes (GSA 1998).

The volcanic core of Puerto Rico is divided into three major geographic provinces. Cidra is located within the Central Volcanic Province, which is bound to the north by the left-lateral strike-slip Cerro Mula fault and contains numerous major strike-slip faults that parallel the Cerro Mula fault. The

volcanoclastic strata are derived from subaerial volcanism that occurred on an elevated ocean floor. Intense strike-slip faulting complicated the deposition of the volcanic facies. Additionally, the strata are broadly warped by the east-trending Puerto Rico Anticlinorium (GSA 1998).

3.4.2 Regional Hydrogeology

Groundwater generally occurs in the fractured, consolidated volcanic rocks, with precipitation serving as the primary source of groundwater recharge. Precipitation percolates through the ground to the water table, and then moves in the consolidated rock through joints and fractures. The bedrock has little primary porosity (only two to three percent) but fractures can enhance groundwater flow considerably.

Bedrock yields are generally small to moderate, and depend on the type of bedrock, type of overlying unconsolidated deposits, and bedrock joints, fractures, and faults. Well yields in the fractured volcanic rock in the Cidra vicinity are generally from 5 to 10 gallons per minute (gpm) or less (Miller et al. 1997). The highest yields in the Cidra area are usually in wells located in valleys and the lowest yields in wells in the higher hills. The most productive wells in the bedrock are located in valleys where joints, fractures, and other openings are numerous and where recharge to bedrock is facilitated by topography and more permeable overlying unconsolidated deposits.

3.4.3 Site-Specific Geology

The geology of the site and the immediate vicinity is illustrated on the USGS Comerio Quadrangle geologic outcrop map (Pease and Briggs 1960) shown in Figure 3-4. The three strata encountered at the site are the Quaternary-age terrace deposits composed of silt and clay, a saprolite layer (decomposed bedrock), and the underlying Cretaceous-age Pre-Robles volcanic rocks. The units are described below.

- **Quaternary Upper Silty Clay** – This unconsolidated overburden unit consists of reddish-brown silty clay grading to gray and brown silty clay. The depth to the bottom of the silty clay unit varies from 55 feet bgs at SMW-1 to 105 feet bgs at SMW-2; generally, the silty clay layer is thicker in the northern area by IDC than in the southern area by Ramallo/CCC. Some evidence of dark brown to black-stained, remnant high angle fracture structures or lineations was observed in the silty clay at boring locations throughout the site. White to yellowish white very small crystals with a powdery appearance were observed in some of these lineations. These lineations were generally about four inches long and one-half inch in thickness and occurred at depths greater than 10 feet bgs and as deep as 70 feet bgs.

- **Saprolite Zone** – The saprolite is the result of chemical weathering of the underlying volcanic rocks. The material is a hard, wet, brown to light brown, sandy to silty clay with abundant dark brown to brown, angular to very angular, mafic rock fragments with fine-grained texture. The saprolite crumbles easily under light pressure. Where present, the unit ranges in thickness from 45 feet at MPW-2 and MPW-3 to 60 feet at MPW-1. The contact between the saprolite and underlying bedrock ranged from 109 to 156 feet bgs. At four locations, the depth ranged from 121 to 132 feet bgs.

- **Pre-Robles Volcanic Rock (Formation J)** - The core of the region is comprised of Cretaceous to Early Tertiary volcanic rocks of the Pre-Robles Formation (Formation J), which are the oldest rocks exposed in the Comerio geologic quadrangle. The rocks are estimated to be a maximum of approximately 2,700 meters thick and consist mostly of massive volcanic breccia, although lava flows and flow breccia occur throughout and are more common at the base and top of the unit. Massive to poorly stratified tuffs are interlayered with the volcanic breccia. Locally, volcanic conglomerates outcrop periodically (Pease and Briggs 1960).

  The lower rocks of the Pre-Robles unit are comprised of dacite, feldspathic andesite, and pyroxene andesite. The middle rocks are comprised of feldspathic andesite and pyroxene andesite. The upper Pre-Robles rocks are predominantly pyroxene andesites. The upper and middle parts of the Pre-Robles rocks were described by Glover (1971) as coarse near-vent pyroclastic breccias, deposited in a marine environment while the lower part of the sequence was described as near- and distant-vent submarine ash-fall and pyroclastic flow deposits. Supply wells and the multiport monitoring wells are completed in this unit, and well logs describe it as blue, brown, or black volcanic rock. A rock core collected at MPW-5 from 123 to 328 feet bgs revealed the volcanoclastic rocks consist of well-defined dark bluish-gray to dark gray to dark reddish-brown clasts in a green fine-grained matrix with inclusions of light greenish gray and white crystals. Some 1/8-inch to 1/4-inch thick veins (possibly quartz) and 45-degree angle fractures (198 to 199 feet) were observed in the core. Evidence of metamorphism was observed at 202 feet. The rock core log for MPW-5 is provided in Appendix C.

Key structural features in the vicinity of the Cidra site include the Arroyata Fault, located 0.25 mile to the south of the commercial area and adjacent to the industrial park (Figure 3-4). The fault is weathered and has been hydrothermally altered across much of the area to the south of Cidra. Displacement along it is uncertain, but is generally strike-slip with a minor oblique component (reverse to the east of Cidra). Cidra is on the footwall side of the projected trace of the fault. A number of smaller faults branch from the Arroyata fault. Bedding planes are also prominent in the area, with dips at 15 to 34 degrees to the west. Bedding planes are assumed to be the contacts between the successive deposits of volcanic lava flows, ash-falls, and pyroclastic flows (Pease and Briggs 1960).

Bedrock Fractures and Bedding Plane Orientation

The bedrock underlying the site has an average north-northeast strike, but individual strike measurements in the area range from N12W to N23E). Beds dip to the west, and range from 15 to 34 degrees. In the south, closer to the Arroyata Fault, the strike is more to the north-northwest. Features close to the fault provide evidence that the rocks have been shifted by fault movement.

Strike and dip data from the Comerio Quadrangle geologic map (Figure 3-4) were reviewed. To the west of the site, the strikes of all but one feature range from N13E to N55E. Dips range from 15 to 34 degrees to the west or northwest. One feature measured closest to the north side of the fault strikes northwest and dips 26 degrees to the south. Data from this feature are not included in the average bedding strike and dip; rather, they serve to illustrate how rocks close to the fault have been affected by fault movement (Pease and Briggs 1960).

To the east of the site, strike ranges from N12W to N23E. Dips range from 15 to 27 degrees to the west. One feature located just north of the Arroyata Fault strikes N69W and dips 25 degrees north. Data from this feature were not used to assess bedding plane strike and dip but do provide a second illustration of how proximity to the fault affects bedding orientation.

Optical and acoustic televiewer borehole geophysical data collected during the RI were processed to evaluate the orientation of features encountered during logging of the bedrock multiport monitoring wells, MPW-1 through MPW-6. Rockworks software was used to project the geophysical data onto Schmidt stereonets (equal area), shown in Figure 3-5. The planes are represented as poles on the stereonets. It is assumed that most of the features encountered in the boreholes are fractures (due to their high angle dips), as compared to the bedding plane strike and dip data from the Comerio geologic map. Relatively low angle features such as the bedding planes shown on the geologic map were not observed in the borehole logs, possibly due to weathering.

In monitoring wells MPW-1 through MPW-5, an orthogonal fracture set strikes to the northeast and dips to the northwest and southeast (see Figure 3-5). This pattern occurs most frequently in monitoring well MPW-2 and least frequently in monitoring well MPW-4. A secondary fracture set strikes to the northwest and dips to the northeast in this group of wells. This pattern occurs most frequently in monitoring well MPW-4 and least frequently in monitoring well MPW-3. In contrast, in monitoring well MPW-6, an orthogonal fracture set strikes to the northwest and dips to the northeast and southwest. In MPW-6, a secondary orthogonal fracture set strikes northeast and dips to the northwest and southeast.

Figure 3-6 shows the rose diagrams that were prepared with fracture strike data from each borehole. The rose diagrams for MPW-1 through MPW-5 show that the fractures strike to the north-northeast and northeast, like the bedding plane features discussed above. The general strike of the features at each location is as follows:

Location	Strike
MPW-1	N20E
MPW-2	N41E
MPW-3	N37E
MPW-4	N26E
MPW-5	N44E
MPW-6	N65W

The orientation of the fractures at MPW-6 is at a right angle to the features observed in the other wells. This is consistent with the strike of the bedding, as depicted on the Comerio geologic map (Figure 3-4), just east of the well and close to the Arroyata fault. MPW-6 is near the projected, buried trace of the Arroyata fault. The sharp change in the orientation of the fractures observed at MPW-6 is probably due to deformation caused by motion along the fault or the presence of another unmapped fault that may extend northward from the Arroyata fault between SMW-1/MPW-1 and MPW-6.

Geologic Cross Sections

Three geologic cross sections (A-A', B-B', and C-C') were created to illustrate site-specific lithology in select areas. A cross section location map is presented as Figure 3-7. Cross sections D-D' and E-E' are discussed in Section 4.

Geologic cross section A-A' (Figure 3-8a) is oriented perpendicular to strike and parallel to dip, running from CIDRA-8 southeast through the Shellfoam, DJ Manufacturing, and IVAX Properties to MPW-6. It includes three wells screened in the saprolite zone and five wells screened in the volcanic bedrock (two multiport wells, MPW-6, a Cidra supply well, and the former IVAX well). As described above, an unmapped fault extending north from the Arroyata fault is presumed to exist somewhere between SMW-1/MPW-1 and MPW-6. The top of the volcanic bedrock northwest of this unmapped fault is generally flat, with bedding planes dipping approximately 34 degrees to the west/northwest. The overlying saprolite zone is approximately 50 feet thick northwest of the unmapped fault; it was not observed at MPW-6, indicating that it was likely displaced by the fault. The overburden in this section ranges from approximately 40 feet thick at SMW-4 to 70 feet thick at MPW-6.

Geologic cross section B-B' (Figure 3-8b) is oriented roughly southwest/northeast from SMW-6 to the Ramallo/Cidra Convention Center property, oblique to strike and dip. It includes four wells screened in the saprolite zone and one multiport well screened in the volcanic bedrock. The top of the bedrock was observed only in the multiport well; it is assumed to be relatively flat. As in A-A', bedding planes dip 34 degrees to the west/northwest but are shown at varying apparent dips to account for the changing azimuth of the cross section. The overlying saprolite zone is approximately 60 feet thick at MPW-1, where the entire thickness of the unit was observed. The overburden in this section ranges from approximately 30 feet thick at SMW-6 to 75 feet thick at SMW-10. It becomes increasingly clay-rich to the northeast and into the Ramallo source area, where the dominant soil type changes from clayey sand at SMW-1, sandy clay at SMW-10, and mostly clay in the Ramallo soil borings. Remnant high-angle fractures or lineations were prevalent in the Ramallo soil borings; these fractures or lineations may enhance downward groundwater flow in the mostly clays soils.

Similarly to cross section B-B', geologic cross section C-C' (Figure 3-8c) is oriented roughly southwest/northeast, oblique to strike and dip. It runs from the IDC property to Cidra 3, and contains one well screened in the saprolite zone and four wells screened in the volcanic bedrock (two multiport wells and two Cidra supply wells). The top of the volcanic bedrock is relatively flat with bedding planes dipping 15 degrees to the west/northwest, but shown with an apparent dip of 10 degrees. The overlying saprolite zone varies from approximately 50 feet thick at MPW-3 to 40 feet thick at MPW-2. The overburden in this cross section thickens from approximately 65 feet thick at MPW-3 to over 100 feet thick at the IDC source area. Overburden soil at the source area is mostly clay, which becomes tighter with depth.

3.4.4 Site-Specific Hydrogeology

The Cidra site encompasses a small plateau where the commercial center is located, a drainage area to the south of town where the closed municipal wells are located, and a valley below the Cidra Industrial Park. The site is immediately underlain by the Quaternary silty clays, which overlie the

fractured Cretaceous-age Pre-Robles volcanic bedrock, the major aquifer beneath the site. The saprolite zone lies between the silty clays and the bedrock. The hydrogeology of these units is described below.

Hydrogeology of the Upper Silty Clay - Silts and clays have low permeabilities, and tend to hinder groundwater flow. Very little groundwater was encountered in the silty clay unit, which acts as a semi-confining unit overlying the saprolite unit below. The silty clay is not completely impermeable; fractures and lineations were observed in the silty clay unit, which may provide secondary permeability that allows surface water to flow to the underlying units.

Hydrogeology of the Saprolite Unit –The saprolite zone was observed during Stage 2 well installation to be a major water-bearing unit; the saprolite stores water and provides recharge to the underlying bedrock aquifer. This unit is semi-confined by the overlying silty clay soils, causing the groundwater to be under pressure. This was observed during drilling at SMW-1, SMW-2, SMW-5, and SMW-10, as water levels rose 20 to 54 feet into the drilling rods upon reaching this zone (see Figures 3-8a, 3-8b, and 3-8c). Once in this unit, groundwater flows downward and laterally to the west/southwest and enters fractures at the top of the volcanic bedrock.

Hydrogeology of the Pre-Robles Volcanic Rock - Groundwater flow in the bedrock is complicated by fractures and bedding planes and by the site location relative to the two major river basins. The porosity of the bedrock is only two to three percent, but joints and fractures can enhance groundwater flow considerably. Bedding planes in the bedrock act as individual aquifers, separated by aquitards consisting of relatively low permeability bedrock, where less fracturing is present. Across the majority of the site (west of IVAX), groundwater encounters bedding planes in the bedrock aquifer and flows laterally along strike (to the south) and then downdip (to the west). The resulting overall groundwater flow is to the west/southwest, toward the Rio Arroyata.

East of the site, in the IVAX area, which is closer to the Arroyata Fault, bedding planes and fractures strike northwest/southeast, indicating a groundwater divide somewhere on the IVAX facility. Based on the different strike and dip orientations in this area, groundwater in the bedrock flows to the southeast, toward an unnamed stream southeast of IVAX.

Aquifer tests were not performed as part of the RI; however, well yields in the fractured volcanic rock in the Cidra vicinity are generally from 5 to 10 gpm or less (Miller et al. 1997).

Specific Capacity and Transmissivity Data

The transmissivity of intervals in the bedrock was estimated from specific capacity data collected during packer testing at MPW-4, MPW-5, and MPW-6. Three intervals were tested in each well and the results are listed on Table 2-4b. The specific capacity values range from 0.03 to 3.1 gpm/foot (ft) of drawdown. Transmissivity estimates ranged from 8 to 817 ft^2/day. Three intervals were tested at well MPW-4: 140 feet to 150 feet, 162 feet to 172 feet, and 208 feet to 224 feet. The corresponding specific capacity values were 0.18, 2.09, and 0.99 gpm/ft of drawdown. These data were compared to the borehole geophysical data for this well. Taken together, these data indicate that the zone from 140 feet to 150 feet is a minor water bearing zone while the intervals from 162 feet to 172 feet and 208 feet to 224 feet are significant water bearing intervals.

Three intervals were tested at MPW-5: 134 feet to 144 feet, 185 feet to 195 feet, and 265 feet to 275 feet. The corresponding specific capacity values were 0.84, 0.05, and 1.62 gpm/ft of drawdown. These data were compared to the borehole geophysical data for this well. Taken together these data indicate that the zone from 185 feet to 195 feet is a not a significant water bearing zone while the intervals from 134 feet to 144 feet and 265 feet to 275 feet are significant water bearing intervals.

Three intervals were tested at well MPW-6: 104 feet to 114 feet, 214 feet to 224 feet, and 294 feet to 304 feet. The corresponding specific capacity values were 0.03, 3.06, and 1.11 gpm/ft of drawdown. These data were compared to the borehole geophysical data for this well. Taken together these data indicate that the zone from 104 feet to 114 feet is a not a significant water bearing zone, the interval from 214 feet to 224 feet is a significant water bearing zone, and that the interval from 294 feet to 304 feet is a minor water bearing zone.

Groundwater Flow and Potentiometric Surface Maps

Potentiometric surface maps were created from water level elevation data in saprolite and bedrock wells to illustrate the flow regime. Water levels and elevations for the three rounds of saprolite and bedrock wells are presented on Tables 3-1 and 3-2, respectively. Figures 3-9a and 3-10a illustrate groundwater flow in the saprolite wells during Stage 2 and 2a, respectively. Groundwater flows west, from higher water level elevations in SMW-9 and SMW-10 (on the CCL Label and Ramallo/Cidra Convention Center properties), toward SMW-5 and SMW-1, respectively, which have lower water elevations. The groundwater then flows to the southwest toward SMW-8, SMW-7, and SMW-6. In the north, flow is to the southwest, from SMW-2 toward SMW-3.

Groundwater flow in the bedrock unit is illustrated in Figures 3-9b and 3-10b. West of IVAX, overall flow is to the southwest, toward Rio Arroyata to the south and west. This follows the pattern of flow from higher to lower water level elevations (from MPW-2 to MPW-4 to MPW-3, and from MPW-1 toward MPW-5). Although MPW-5 is slightly side-gradient of MWP-1 in the downdip direction, it is generally along strike. Vertical gradients between the saprolite and bedrock units are downward; vertical gradients in the bedrock wells yielded no clear trends within wells or across the stages of investigation. This is most likely due to the high degree of heterogeneity of fractures and pathways within the bedrock.

Groundwater to Surface Water Evaluation

The potentiometric water levels at SG-1 and SG-2 in the Rio Arroyata are approximately 8 to 15 feet lower than in the adjacent saprolite monitoring wells SMW-6 and SMW-8, indicating that groundwater would tend to discharge to the river through seeps along the river bank or directly to the river. These levels are shown on Figure 3-10a. No seeps were observed during the surface water/sediment sampling event; water levels were high due to recent rain events, and so any seeps may have been below the water level in the stream. However, several groundwater seeps were observed during the ecological characterization reconnaissance, along the banks of the Rio Arroyata downstream of Route 171.

3.5 Meteorology

The climate for Cidra, Puerto Rico is classified as tropical humid and is moderated by the nearly constant trade winds that originate in the northeast and its location in the foothills of the Cordillera Central Mountain Range. The average annual temperature for the Cidra area is 72.7 degrees Fahrenheit (° F). Precipitation data from 1981 to 2010 recorded at the Cidra 1 E rainfall station shows an average annual precipitation of 64.90 inches as reported on the National Oceanic and Atmospheric Administration (NOAA) website - http://www.srh.noaa.gov/sju/?n=climo_cidra#1e.

3.6 Population and Land Use

The Cidra site is located just south of the main commercial district of the Cidra Municipality in central eastern Puerto Rico. The Cidra Municipality is comprised of 36.5 square miles with a population of 43,480 and a population density of 1,200 people per square mile (2010 U.S. Census). Land use for the Cidra site area includes forest (34 percent), agriculture/rural (49 percent), and urban (16 percent) (Ramos-Gines 1997). The land use in the vicinity of the site is primarily residential, commercial, manufacturing, and agricultural.

Wells located within a 4-mile radius of the site that draw water from the Pre-Robles volcanic rock aquifer serve a population of approximately 8,838 (EPA 2003b).

No National Priority List (NPL) sites are located in the vicinity of the Cidra site. However, twelve sites in vicinity of the Cidra site are listed in EPA's CERCLIS Public Access Database, and one site is listed in the Archived Sites database. These thirteen sites are listed below:

- Caribbean Manufacturing Co.
- CCL Label de Puerto Rico
- Cidra Cable Site
- Cidra Metallic Caskets
- CMM Laundry
- International Dry Cleaners
- Knogo Caribe, Inc.
- Millipore Cidra Inc.
- Mylan Pharmaceutical Corp.
- SmithKline Beecham Pharmaceuticals Inc.
- Tech Group de Puerto Rico Inc.
- Wesley-Jessen Corp.
- Zenith Laboratories Caribe Inc.

3.7 Ecological Characterization

Observations from the ecological reconnaissance are discussed below.

3.7.1 Habitat and Biota

The site is located within an ecological zone of Puerto Rico characterized by moist-lowland forest, and consists of the densely populated Cidra commercial district which includes stores, private residences, municipal buildings, and the town plaza. Another dominant land feature, a large cemetery, is also

present. Topographic gradients and surface water drainage at the site is to the south/southwest toward the Rio Arroyata and the unnamed stream that drains the area surrounding the Cidra cemetery.

The portion of the Rio Arroyata included in the ecological reconnaissance can be characterized as a low/moderate gradient stream comprised of various riffle/run/pool sequences no more than three to five feet in width, with depth ranging from a few inches to over a foot in pooled reaches. Stream banks are relatively steep. Debris piles and eroded banks within bends suggest moderate to high flow during precipitation events. Substrate varies from coarse sand/fine gravel to coarse gravel and cobble within riffle and run areas; coarse sand comprises the majority of substrate found in deeper pools as these are associated with depositional areas along bends. Along the right bank downstream of the Route 171 bridge, several groundwater seeps were observed.

Vegetative communities and areas where ecological receptors may potentially be exposed within the study area are limited due to development. Where intact, vegetative communities consist mostly of riparian forest found along the Rio Arroyata and drainage ditches. The lateral extent of riparian habitats varies; however, all are minimal, continuing in most cases approximately 30 to 50 feet and abruptly ending due to encroaching development and roads.

In general, vegetative communities and available habitats are indicative of disturbed conditions as evidenced by former dilapidated structures and foundations, miscellaneous refuse, surrounding development, and the presence of non-native species such as African tulip tree (*Spathodea campanulata*), grapefruit (*Citrus ×paradisi*), black mimosa (*Mimosa pigra*), and dense stands of bamboo (*Bambusa* spp.); however, native tree species such as American muskwood (*Guarea guidonia*) are present. Tree canopy cover ranges from 85 to 100 percent within the immediate stream corridor of the Rio Arroyata and drainage swales. With the exception of areas characterized by monotypical stands of bamboo, understory is dense and consists of various woody and herbaceous vegetative species. These species include buzzy lizzy (*Impatiens walleriana*), umbrella plant (*Cyperus involucratus*), arrowhead vine (*Syngonium auritum*), elephant ear (*Colocasia* spp.), flamingo flower (*Anthurium* spp.), and several species of philodendron (*Philodendrin* spp.). Other than physical disturbances, no impacts that may potentially be related to site contamination are present.

Various wildlife was observed during the ecological reconnaissance. Bird species included bananaquit (*Coereba flaveola*), rock dove (*Columba livia*), zenaida dove (*Zenaida aurita*), domestic chicken (*Gallus gallus domesticus*), and various unidentified song birds. Several large terrestrial snails (Order Gastropoda) were noted clinging to vegetation. Herpetofauna observed included species of lizards commonly known as anoles (Family Polychrotidae) and coqui frog (*Eleutherodactylus* spp.). Finally, several small fish which appeared to be guppy (*Poecilia reticulata*) were noted within the Rio Arroyata; however, this was not verified as none were captured for positive identification.

3.7.2 Threatened, Endangered and Rare Species, and Sensitive Environments

Information regarding threatened and endangered species and ecologically sensitive environments that may exist at or in the vicinity of the site was requested from the EPA and Puerto Rico Department of Natural and Environmental Resources (PRDNER). Letters received from both agencies are presented in Appendix I.

3.7.2.1 Federally-Listed Species

The EPA reported that a review of United States Fish and Wildlife Service (USFWS) records indicate that two federally-listed species, the Puerto Rico boa (*Boa puertorriquena*) and the Puerto Rican Plain pigeon (*Paloma sabanera*), may be found within the municipality of Cidra. Neither species was encountered during the site visit.

3.7.2.2 Puerto Rico-Listed Species

The PRDNER reported that a review of their records for the site and surrounding area indicated no known occurrences of listed rare, threatened, and/or endangered species.

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Section 4

Nature and Extent of Contamination

This section presents sample results and analytical methods used to evaluate contamination at the site. Section 4.1 describes the approach for selecting site-specific contaminants, screening criteria, and data presentation. Section 4.2 presents the results of the soil, groundwater, surface water, and sediment samples, focusing on exceedances of site-specific screening criteria. Section 4.3 presents an interpretation of the data and an overall evaluation of site-related contamination.

4.1 Approach to the Evaluation of Contamination

The characterization of site conditions emphasizes the spatial distribution of site-related contaminants in site soil, groundwater, surface water, and sediment. All analytical data were reviewed to ensure that they meet the project requirements for representativeness, completeness, precision, and accuracy. Data Usability Reports, which include summaries of data quality assurance/quality control (QA/QC) measures, were prepared for samples collected during each stage of the field investigation and are provided in Appendix J. Based on the results of the Data Usability Assessments, the data are suitable for use in the RI, FS, and risk assessments. DQO goals for completeness, comparability, and representativeness established during project planning were mainly achieved. Data that did not meet quality control (QC) criteria were appropriately qualified during data validation as "J" estimated and usable, "UJ" usable but non-detect, or as "R" rejected and not usable. All data reported herein are usable as reported with the data validation qualifiers added except for rejected data, which were not used for project decisions. A summary of each Data Usability Report is presented below.

Stage 1 Data Usability Summary

All 1,4-dioxane results were rejected for poor response factors, and are not available. Thirteen pesticide results were rejected for the large percent difference of the results between gas chromatograph (GC) columns used in the analyses. A small portion (0.5 percent) of the VOC data collected were rejected due to exceedance of surrogates, internal standards, and calibration criteria, especially rejection of 1,4-dioxane due to poor response factors. Pesticide and PCB data were rejected due to differences in the results from different columns, surrogate recovery, and laboratory control sample (LCS) failures. Ninety-nine percent of the RI/FS data are suitable for their intended use. The ninety percent completeness goal for usable data was met.

Stage 2 Data Usability Summary

In general, the majority of the data is usable for project decisions. Currently, 316 sample results, or 1.7 percent of the entire data set, were rejected due to poor 1,4-dioxane response and high moisture content in one sample. The ninety percent completeness goal for usable data was met.

Stage 2a Data Usability Summary

Approximately 43 percent of the metal results were rejected, primarily due to failure of laboratory duplicate and inductively coupled plasma (ICP) serial dilution criteria; most of these rejected data were in sediment sample results. However, metals are not site-related contaminants. The percentages

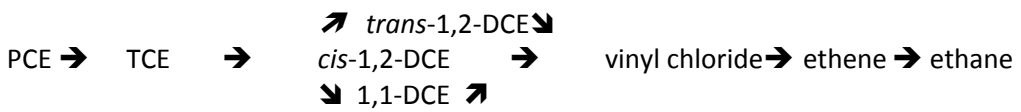
of valid Stage 2a data are: groundwater 98.92 percent, surface water 99.49 percent, and sediments 89.40 percent. The ninety percent completeness goal for usable data was met.

4.1.1 Selection of Site-Related Contaminants

The discussions of analytical results and the evaluation of contamination focus on the site-specific VOCs: PCE, TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride. These five VOCs were detected the most frequently and at the highest levels in source area soil samples and other affected media including groundwater, surface water, and sediment. The rationale for focusing on these five compounds as representative of site-related contamination is summarized below.

- PCE was the main contaminant that caused the closure of the Cidra public supply wells. It was found in all site media most frequently in soil and groundwater, and in the surface water and sediment samples from Rio Arroyata. PCE levels in IDC and Ramallo/CCC soils were as high as 1,700,000 µg/kg and 3,300,000 µg/kg, respectively. These levels are more than 36,000 times the PCE soil screening criterion.

- TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride are all daughter products of the reductive dechlorination of PCE; TCE degrades to either 1,2-DCE (with the cis-isomer more prevalent than the trans-isomer) or 1,1-DCE (EPA 1998a). The overall reductive dechlorination degradation chain for PCE is shown below.



- TCE was also found in the Cidra public supply wells when they were closed. During the RI, TCE was frequently detected in soils, especially at IDC and Ramallo/CCC; elevated levels were found at more than 1,000 times its screening criterion.

- 1,1-DCE was also historically found in the Cidra public supply wells. 1,1-DCE was primarily found in groundwater samples during the RI.

- cis-1,2-DCE was frequently detected in soil and groundwater samples during the RI. At IDC and Ramallo/CCC, cis-1,2-DCE was found at levels approximately 1,000 times and 100 times its screening criterion, respectively.

- Vinyl chloride was primarily detected in soil samples at IDC and Ramallo/CCC during the RI, at levels more than 100 times its screening criterion.

For the reasons cited above, PCE, TCE, cis-1,2-DCE, 1,1-DCE and vinyl chloride are considered to be representative of VOC contamination in groundwater and source areas at the Cidra site. For discussion purposes in this RI, these five VOCs will be referred to as “site-related contaminants”.

Although all detected contaminants were subject to the media-specific screening process, they are not all discussed in detail in the text. The major focus of analytical results discussions is on the nature and

extent of the five site-related contaminants. Other organic and inorganic contaminants that exceeded screening criteria are discussed briefly.

It should be noted that two metals exceeding screening criteria were found to result in significant risk in the HHRA – arsenic in groundwater and vanadium in soil and groundwater; however, these metals not considered site-related contaminants for the reasons outlined below.

- Arsenic was not a Cidra supply well contaminant and was not detected in any of the soil samples from Ramallo/CCC or IDC. The most likely explanation for the levels of arsenic in the first round of groundwater samples is that they are remnants from the blank FLUTe ™ liners placed in the boreholes to prevent cross contamination between fracture zones. At the time the FLUTe ™ liners were purchased for Cidra (2008), arsenic was used as a fungicide in the FLUTe ™ liner urethane coating to resist mildew.

- Based on research by FLUTe ™, arsenic may leach into the water, although it is typically removed with standard well development procedures. CDM Smith performed the standard purging of the multiport wells prior to the first groundwater sampling round. However, arsenic was still detected in multiport wells during the Stage 1 groundwater sampling round; except for one port, arsenic was not detected during the Stage 2 groundwater sampling round (Tables 4-19a and 4-20a).

- Vanadium levels were consistent in soils and groundwater throughout the site and thus were not indicative of potential source areas. In addition, elevated vanadium levels generally do not correlate well with the elevated site-related contaminants in any of the soil samples (Tables 4-5 through 4-17) or the groundwater samples (Tables 4-17 and 4-19 through 4-21). Therefore, it is highly likely that vanadium is a naturally occurring analyte related to the volcanic geology in the area.

A complete set of analytical data, showing all contaminants detected in site samples, is provided in Appendix K.

4.1.2 Selection of Site–Specific Screening Criteria

As a first step in the evaluation of the nature and extent of contamination at the site, screening criteria were selected to evaluate contaminants detected in site soil, groundwater, surface water, and sediment. Whenever possible, established regulatory criteria, known as chemical-specific applicable or relevant and appropriate requirements (ARARs), were used for the screening criteria values. In the absence of ARARs, guidance values known as "to be considered" (TBC) were used.

The screening criteria, which were reviewed and approved by EPA, are summarized in a series of Table 4-1s (soil), Table 4-2s (groundwater), Table 4-3s (surface water), and Table 4-4s (sediment).

4.1.3 Data Presentation

The analytical results from the RI were entered into the site database for evaluation purposes. The data were exported to a geographic information system (GIS) and geological evaluation and

visualization software for analysis and graphical presentation. All data presented in this section are in units consistent with the data appendices, as follows: organic soil and sediment data are presented in µg/kg; inorganic soil and sediment data are presented in mg/kg, and all groundwater and surface water data (both organic and inorganic) are presented in µg/L.

Exceedance tables were prepared to summarize contaminants that exceeded screening criteria, and statistics tables were prepared to summarize the contaminant information such as concentration ranges, detection frequencies, and the number of exceedances in the various media. Box maps were prepared to summarize results for site-related contaminants. These tables and figures are referenced in this section where appropriate.

4.1.4 Background Samples

Background samples were collected of sediment and surface water to evaluate upstream conditions in areas not impacted by site contamination. Results from background samples provide an additional perspective for the spatial evaluation of contaminants in site media. Background groundwater samples are not available since the upgradient monitoring well could not be installed, as discussed in Section 2.2.2.1.

4.2 Analytical Results

Results of site-related contaminants and exceedances of other contaminants in soil, groundwater, surface water, and sediment are discussed in the following sections. A discussion of the overall nature and extent of contamination is presented in Section 4.3.

4.2.1 Soil Analytical Results

Site-related VOCs were detected in soil samples at IDC, Ramallo/CCC, CCL Label, ENCO, DJ Manufacturing Don Quixote, and ESSO. The majority of exceedances and the highest levels were found in soils at IDC and Ramallo/CCC.

No VOCs were detected at the Coffee Shop or Ramoncito. A few VOCs were detected at IVAX, Pepsi, and Shellfoam, but at levels below screening criteria; none were site-related VOCs.

4.2.1.1 International Dry Cleaners

PCE, TCE, cis-1,2-DCE, and vinyl chloride were detected in soil samples from IDC. As shown in Figure 4-1, site-related VOCs exceeded criteria in the majority of borings, although the highest levels were located in a narrow alley along the southeastern border of the property. Screening criteria exceedances are summarized in Table 4-5a; sample statistics are summarized in Table 4-5b. As noted in Section 2.1.1.2, the Stage 2 IDC soil borings were planned to be advanced to 72 feet bgs; however, refusal at many of the locations resulted in shallower borings.

PCE was detected in 42 of the 50 samples, and exceeded its criterion of 46 µg/kg in 38 of those samples. Concentrations ranged from 0.89 J to 1,700,000 µg/kg, with the highest level in IDCSB-14-B. TCE was detected in 41 of the 50 samples; 28 exceeded its criterion of 36 µg/kg. Concentrations ranged from 0.89 J to 39,000 µg/kg, with the highest level in IDCSB-03-B. Cis-1,2-DCE was detected in 43 of the samples; 25 exceeded its criterion of 420 µg/kg. Concentrations ranged from 2.9 J to 29,000

J µg/kg, with the highest level in IDCSB-14-B. Vinyl chloride was detected in 16 samples, and exceeded its criterion of 13.8 µg/kg in 14 samples. Concentrations ranged from 5.8 J to 1,200 µg/kg, with the highest level in IDCSB-06-B.

Non-site related contaminants also exceeded screening criteria, as summarized below.

- Six SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and naphthalene)
- One pesticide (dieldrin)
- Seven metals (aluminum, arsenic, chromium, cobalt, iron, manganese, and vanadium)

4.2.1.2 Ramallo/Cidra Convention Center

All five site-related VOCs were detected in soil samples from Ramallo/CCC. As shown in Figure 4-2, site-related VOCs exceeded criteria in several borings. The highest levels were found in shallow soils in RMSB-18, located along the eastern border of the facility, however, several borings in an open paved area at the northeast corner of the facility also contained high levels. Some samples exceeded the screening criteria in the bottom-most sample, indicating that contamination extends deeper into the soil. Screening criteria exceedances are summarized in Table 4-6a; sample statistics are summarized in Table 4-6b.

PCE was detected in 94 of the 125 samples, and exceeded its criterion of 46 µg/kg in 45 samples. Concentrations ranged from 0.66 J to 3,300,000 µg/kg, with the highest level in RMSB-18-A. TCE was detected in 51 of the 125 samples; 9 exceeded its criterion of 36 µg/kg. Concentrations ranged from 0.82 J to 2,700 J µg/kg, with the highest level in RMSB-18-A. Cis-1,2-DCE was detected in 56 of the samples; 8 exceeded its criterion of 420 µg/kg. Concentrations ranged from 0.51 J to 41,000 µg/kg, with the highest level in RMSB-18-B. 1,1 DCE was detected in 3 of the samples; 2 exceeded its criterion of 50 µg/kg. Concentrations ranged from 26 to 120 µg/kg, with the highest level in RMSB-18-C. Vinyl chloride was detected in 8 samples, and exceeded its criterion of 13.8 µg/kg in 6 samples. Concentrations ranged from 8.2 to 2,000 µg/kg, with the highest level in RMSB-18-B.

Non-site related contaminants also exceeded screening criteria, as summarized below.

- Two VOCs (1,1-DCA and 1,4-dioxane)
- Ten metals (aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, manganese, nickel, and vanadium)

4.2.1.3 CCL Label

PCE, TCE, and cis-1,2-DCE were detected in soil samples from CCL Label, which is located on the west side of Ramallo/CCC. As shown in Figure 4-3, there were only two exceedances of the screening criteria. The highest levels of PCE, the only site-related VOC that exceeded screening criteria, were detected in deep soils in the southeastern corner of the property, on the border with Ramallo/CCC. PCE contamination may extend deeper in CCSB-01 and CCSB-18. Screening criteria exceedances are summarized in Table 4-7a; sample statistics are summarized in Table 4-7b.

PCE was detected in 14 of the 93 samples, and exceeded its criterion of 46 µg/kg in 2 samples. Concentrations ranged from 0.61 J to 110 µg/kg, with the highest level in CCSB-01-D. TCE was detected in 9 of the 93 samples, all at levels below its criterion of 36 µg/kg; concentrations ranged from 0.67 J to 20 µg/kg, with the highest level in CCSB-18-H. Cis-1,2-DCE was detected in 12 of the samples, all at levels below its criterion of 420 µg/kg. Concentrations ranged from 0.56 J to 180 µg/kg, with the highest level in CCSB-18-H.

Non-site related contaminants also exceeded screening criteria, as summarized below.

- One PCB (Aroclor-1268)
- Nine metals (aluminum, arsenic, chromium, cobalt, copper, manganese, mercury, nickel, and vanadium)

4.2.1.4 ENCO

PCE, TCE, cis-1,2-DCE, and vinyl chloride were detected in soil samples from ENCO, which is located on the east side of Ramallo/CCC (see Figure 4-4). The highest levels were found in two borings along the western edge of the property, on the border with Ramallo/CCC. Screening criteria exceedances are summarized in Table 4-8a; sample statistics are summarized in Table 4-8b.

PCE was detected in 16 of the 35 samples; none exceeded its criterion of 46 µg/kg. Concentrations ranged from 0.54 J to 28 µg/kg, with the highest level in ENSB-07-G. TCE was detected in two samples and cis-1,2-DCE in one sample, all at levels below their criteria. TCE levels ranged from 0.64 J to 1.1 J µg/kg, with the higher level in ENSB-07-B. Cis-1,2-DCE was detected in ENSB-05-B at 0.83 J µg/kg. Vinyl chloride was detected just above its criterion of 13.8 µg/kg in one sample, ENSB-05-C, at 16 J µg/kg.

No other contaminants exceeded screening criteria at ENCO.

4.2.1.5 DJ Manufacturing

PCE was the only site-related VOC detected at DJ Manufacturing, located south of ENCO and Ramallo/CCC (see Figure 4-5). It was detected in 1 of the 25 samples, DJSB-01-A, at 0.48 J µg/kg (below its criterion). Table 4-9 summarizes sample statistics.

No non-site-related contaminants exceeded screening criteria at DJ Manufacturing.

4.2.1.6 ESSO

PCE and TCE were detected at levels below screening criteria at ESSO, as shown on Figure 4-6. PCE was detected in 2 of the 63 samples, at 3.6 J and 8.9 J µg/kg; the higher level was found in ESSB-04-A. TCE was detected in one sample, ESSB-07-B, at 1.1 J µg/kg. Results are summarized in Table 4-10a; sample statistics are summarized in Table 4-10b.

Several non-site-related contaminants exceeded screening criteria, as summarized below.

- Eight VOCs (1,1,2-trichloroethane, benzene, toluene, ethylbenzene, m,p-xylene, o-xylene, isopropylbenzene, and methyl tert butyl ether [MTBE]). These VOCs are likely related to gasoline leaks rather than site-related contamination from sources in the area.

- Three SVOCs (2-methylnaphthalene, benzo(a)pyrene, and naphthalene)
- One pesticide (dieldrin)
- Eight metals (aluminum, arsenic, chromium, cobalt, copper, iron, manganese, and vanadium)

4.2.1.7 Don Quixote Pizza

Cis-1,2-DCE was the only site-related contaminant detected at Don Quixote Pizza, a former dry cleaners (see Figure 4-7). It was detected in only one sample, DQSB-03-A at 0.87 J µg/kg (below its screening criterion). Results are summarized in Table 4-11a; sample statistics are summarized in Table 4-11b.

The non-site-related contaminants that exceeded screening criteria are summarized below.

- Seven metals (aluminum, arsenic, chromium, cobalt, iron, manganese, and vanadium)

4.2.1.8 Shellfoam, IVAX, and Pepsi

No site-related VOCs were detected at Shellfoam, IVAX, or Pepsi; however, several other contaminants did exceed screening criteria, as described below. Shellfoam, IVAX, and Pepsi property locations are shown on Figure 2-1b.

Shellfoam

Several SVOCs, pesticides, and metals exceeded criteria, as listed below. Screening criteria exceedances are summarized in Table 4-12a; sample statistics are summarized in Table 4-12b.

- Six SVOCs (2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, n-nitrosodiphenylamine, and naphthalene)
- Three pesticides (aldrin, alpha-BHC, and beta-BHC)
- Seven metals (aluminum, arsenic, chromium, cobalt, iron, manganese, and vanadium)

IVAX

SVOCs and metals exceeded criteria, as listed below. Screening criteria exceedances are summarized in Table 4-13a; sample statistics are summarized in Table 4-13b.

- Two SVOCs (benzo(a)pyrene and dibenz(a,h)anthracene)
- Eight metals (aluminum, arsenic, chromium, cobalt, iron, manganese, thallium, and vanadium)

Pepsi

Only metals exceeded criteria at Pepsi, as listed below. Screening criteria exceedances are summarized in Table 4-14a; sample statistics are summarized in Table 4-14b.

- Eight metals (aluminum, arsenic, chromium, cobalt, copper, iron, manganese, and vanadium)

4.2.1.9 Ramoncito and the Coffee Shop

No site-related VOCs were detected at Ramoncito or the Coffee Shop, two facilities located in the northern area by IDC. However, several other contaminants did exceed screening criteria, as described below.

Ramoncito

One SVOC and several metals exceeded criteria, as listed below. Screening criteria exceedances are summarized in Table 4-15a; sample statistics are summarized in Table 4-15b.

- One SVOC (benzo(a)pyrene)
- Six metals (aluminum, arsenic, chromium, iron, manganese, and vanadium)

Coffee Shop

Only metals exceeded criteria, as listed below. Screening criteria exceedances are summarized in Table 4-16a; sample statistics are summarized in Table 4-16b.

- Six metals (arsenic, chromium, cobalt, iron, manganese, and vanadium)

4.2.2 Groundwater Analytical Results

This section summarizes the analytical results from the initial existing supply well sampling event, packer samples, and the three rounds of groundwater sampling conducted for the RI (Stage 1, Stage 2, Stage 2a). Figure 4-8 summarizes the results of the site-related contaminants detected during the initial supply well sampling event, and Figure 4-9 summarizes the results detected during three sampling events.

4.2.2.1 Initial Existing Supply Well Results

PCE, TCE, cis-1,2-DCE and 1,1-DCE were detected in samples from the existing bedrock supply wells during the initial sampling event, as shown in Figure 4-8. The highest levels were mostly found in Cidra 8, located approximately 400 feet west of Ramallo/CCC. Screening criteria exceedances are summarized in Table 4-17a; sample statistics are summarized in Table 4-17b.

PCE was detected in 13 of the 26 groundwater samples, and exceeded its criterion of 5 µg/L in three of the samples. Concentrations ranged from 0.4 J to 120 µg/L, with the highest level in Cidra 8. TCE was detected in 3 of the 26 samples, at levels below or equal to its criterion of 5 µg/L. Concentrations ranged from 4.6 to 5 µg/L, with the highest level in Cidra 8, at approximately 230 feet bgs. Cis-1,2-DCE was detected in three of the samples, all at levels below its criterion of 70 µg/L. Concentrations ranged from 15 to 17 µg/L, with the highest level in Cidra 8, at approximately 230 feet bgs. 1,1-DCE was detected in eight samples, and exceeded its criterion of 7 µg/L in four samples. Concentrations ranged from 2.5 to 56 µg/L, with the highest level in the former IVAX supply well, at approximately 175 feet bgs.

Non-site-related VOCs and metals exceeded criteria during the initial supply well sampling event, as listed below.

- Two VOCs (1,1-DCA and chloroform)
- Seven metals (cobalt, iron, lead, manganese, mercury, vanadium, and zinc).

4.2.2.2 Bedrock Boring Packer Sample Results

The packer samples collected in the multiport well bedrock boreholes were only analyzed for VOCs; results were used to design the multiport monitoring wells. PCE, TCE, cis-1,2-DCE, and 1,1-DCE were detected in the packer samples collected in the multiport well bedrock borings. The highest levels of PCE, TCE, and cis-1,2-DCE were found in the boring for MPW-5; the highest 1,1-DCE levels were found in the boring for MPW-6. PCE was detected in all but 1 of the 42 packer samples, and exceeded its criterion of 5 µg/L in 10 samples. Concentrations ranged from 0.12 J to 92 µg/L, with the highest level in the MPW-5 boring at approximately 313 feet bgs. TCE was detected in 31 of the 42 samples, all at levels below its screening criterion of 5 µg/L; concentrations ranged from 0.11 J to 3.9 µg/L, with the highest level in the MPW-5 boring at approximately 313 feet bgs. Cis-1,2-DCE was detected in 27 of the 42 samples, at levels below its criterion of 70 µg/L; concentrations ranged from 0.084 J to 14 µg/L, with the highest level in the boring for MPW-5, at approximately 313 feet bgs. 1,1-DCE was detected in 10 of the 42 samples, with 4 exceeding its criterion of 7 µg/L; concentrations ranged from 0.73 to 12 J µg/L, with the highest level in the boring for MPW-6, at approximately 177 feet bgs. Screening criteria exceedances are summarized in Table 4-18a; sample statistics are summarized in Table 4-18b.

4.2.2.3 Stage 1 Monitoring/Supply Well Results

The Stage 1 groundwater sampling event included only the six bedrock multiport monitoring wells. PCE, TCE, cis-1,2-DCE, and 1,1-DCE were detected (Figure 4-9). Similar to the packer sample results, the highest levels were in MPW-5 and the former IVAX supply well. PCE was detected in 25 of the 33 samples, and exceeded its criterion of 5 µg/L in 5 samples. Concentrations ranged from 0.11 J to 56 µg/L, with the highest level in MPW-5 port 5 (202-212 feet bgs). TCE was detected in 12 of the 33 samples, all at levels below its screening criterion of 5 µg/L; concentrations ranged from 0.1 J to 1.7 µg/L, with the highest level in MPW-5 port 5 (202-212 feet bgs). Cis-1,2-DCE was detected in 12 of the 33 samples, at levels below its criterion of 70 µg/L; concentrations ranged from 0.13 J to 9.5 µg/L, with the highest level in MPW-5 port 6 (277-287 feet bgs). 1,1-DCE was detected in 13 of the 33 samples, and exceeded its criterion of 7 µg/L in one sample, MPW-6 port 4 (215-225 feet bgs). Screening criteria exceedances are summarized in Table 4-19a; sample statistics are summarized in Table 4-19b.

PCBs and metals exceeded criteria during the Stage 1 groundwater sampling event, as listed below.

- Two PCBs (Aroclor-1016 and Aroclor-1260)
- Four metals (arsenic, manganese, mercury, and vanadium).

4.2.2.4 Stage 2 Monitoring/Supply Well Results

The Stage 2 groundwater sampling event included the four inactive supply wells, the six bedrock multiport monitoring wells, and seven saprolite monitoring wells. PCE, TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride were detected during Stage 2; the highest levels were generally found in wells completed in the saprolite zone (Figure 4-9). PCE was detected in 34 of the 40 samples, and exceeded its criterion of 5 µg/L in 9 samples. Concentrations ranged from 0.13 J to 1,700 µg/L, with the highest

level in SMW-10 (62-72 feet bgs), located on the Ramallo/CCC property. TCE was detected in 15 of the 40 samples, and exceeded its screening criterion of 5 µg/L in 4 samples. Concentrations ranged from 0.084 J to 31 µg/L, with the highest level in SMW-10 (62-72 feet bgs). Cis-1,2-DCE was detected in 18 of the 40 samples, and exceeded its criterion of 70 µg/L in 1 sample. Concentrations ranged from 0.06 J to 74 µg/L, with the highest level in SMW-9 (82-92 feet bgs), located at CCL Label, adjacent to Ramallo/CCC. 1,1-DCE was detected in 4 of the 40 samples, and exceeded its criterion of 7 µg/L in 3 samples. Concentrations ranged from 3.6 J to 39 J µg/L, with the highest level in IVAX 2 (interval unknown); this well is located east of the groundwater divide. Vinyl chloride was detected at SMW-9 (82-92 feet bgs) at a concentration of 0.17 J µg/L, which is below its screening criterion of 0.25 µg/L. Screening criteria exceedances are summarized in Table 4-20a; sample statistics are summarized in Table 4-20b.

Non-site-related VOCs and metals exceeded criteria during the Stage 2 groundwater sampling event, as listed below.

- Two VOCs (1,1-DCA and MTBE)
- Six metals (aluminum, arsenic, iron, manganese, mercury, and vanadium).

4.2.2.5 Stage 2a Monitoring Well Results

The Stage 2a groundwater sampling event included only the four saprolite monitoring wells installed during this stage. PCE, TCE, and cis-1,2-DCE were detected during Stage 2a (Figure 4-9); the highest levels were found in SMW-6 (39-49 feet bgs), located approximately 1,400 feet downgradient of Ramallo/CCC. PCE was detected in all four samples, and exceeded its criterion of 5 µg/L in two samples; concentrations ranged from 0.01 J to 70 µg/L. TCE was detected in two of the four samples, with neither exceeding its screening criterion of 5 µg/L; concentrations ranged from 1.6 to 2.3 µg/L. Cis-1,2-DCE was detected in two of the four samples, at levels below its criterion of 70 µg/L; concentrations ranged from 3.1 to 6.6 µg/L. Screening criteria exceedances are summarized in Table 4-21a; sample statistics are summarized in Table 4-21b.

One non-site-related VOC and metals exceeded criteria during the Stage 2 groundwater sampling event, as listed below.

- One VOC (2-hexanone)
- Six metals (aluminum, cobalt, iron, manganese, mercury, and vanadium)

4.2.3 Surface Water and Sediment Analytical Results

Ten co-located surface water and sediment samples were collected from the Rio Arroyata to determine if contaminated ground water is discharging, or has discharged in the past, and impacted the river environment.

4.2.3.1 Surface Water Results

PCE, TCE, and cis-1,2-DCE were found at levels below screening criteria in samples collected from the Rio Arroyata. PCE was detected in SW-5 through SW-10, with the highest levels in SW-6 (4 µg/L), SW-7

(4.6 µg/L) and SW-8 (4.1 µg/L). These locations are bounded by lower concentrations in SW-5 (2 µg/L), SW-9 (1.8 µg/L) and SW-10 (2.1 µg/L). TCE was detected in SW-7 at a concentration of 0.25 J µg/L, which is below its screening criterion of 5 µg/L. Cis-1,2 DCE was also detected in samples SW-5 (0.27 µg/L), SW-6 (0.58 µg/L) and SW-7 (0.65 µg/L). No site-related contaminants were detected in surface water samples SW-1 (up gradient sample), SW-2, SW-3, or SW-4. Figure 4-10 illustrates the site-related contaminants detected in surface water samples. Table 4-22a summarizes exceedances of the surface water screening criteria and sample statistics are summarized in Table 4-22b.

One non-site-related metal (antimony) was detected above its screening criterion.

4.2.3.2 Sediment Results

PCE was detected below its screening criteria in one downstream sediment sample, SD-9 (1.9 µg/kg), located at the junction of the Rio Arroyata and an unnamed stream running southeast from downtown Cidra. This unnamed stream drains runoff from the downtown area and Cidra Industrial Park, and overflow from the sanitary sewer pump station. No site-related contaminants were found in any of the other sediment samples. Figure 4-10 illustrates the site-related contaminants detected in sediment samples. Table 4-23a summarizes exceedances of the sediment screening criteria and sample statistics are summarized in Table 4-23b.

Ten non-site-related metals (aluminum, arsenic, chromium, cobalt, copper, iron, manganese, mercury, nickel, and vanadium) were detected above screening criteria.

4.2.4 Vapor Intrusion Analytical Results

Results of the air samples were compared with screening levels based on the EPA Vapor Intrusion Screening Levels (VISLs) dated November 2012 (EPA 2012b). Based on current and future anticipated land uses, air samples from IDC, the Former 579 Store, and the Praxedes Public Housing were evaluated using residential screening levels. Air samples collected from Ramallo/CCC, CCL Label, and ENCO were evaluated using industrial/commercial screening levels. Ambient air results were screened against residential screening levels.

Analytical results for the five site-related contaminants (1,1-DCE, cis-1,2-DCE, PCE, TCE, and vinyl chloride) are summarized in Tables 4-24a to 4-24c. Complete summary tables are presented in Appendix K. Results from the subslab soil vapor, indoor air, and ambient air samples are summarized below.

4.2.4.1 International Dry Cleaners Area

Subslab soil vapor and indoor air samples were collected from two locations in this area: IDC and the Former 579 Store. One ambient air sample was collected at an upwind location. Table 4-24c summarizes analytical results for the five site-related contaminants.

Subslab Soil Vapor

PCE, TCE, and cis-1,2-DCE were detected in subslab soil vapor samples. At the IDC source area, PCE was detected at 9,400 micrograms per cubic meter (µg/m^3), above its screening level of 94 µg/m^3. PCE concentrations decreased with distance from the source area; for example, the sample from the Former 579 Store contained PCE at 20 µg/m^3, which was below the screening level. TCE was detected

520 µg/m^3 at IDC, above its screening level of 4.3 µg/m$^{3;}$; it was not detected at the Former 579 Store. cis-1,2-DCE was detected at 89 µg/m^3 at IDC (no screening level is available); it was not detected at the Former 579 Store.

Three non-site related VOCs exceeded their respective screening levels in subslab soil vapor: 1,4-dichlorobenzene, chloroform, and naphthalene (Table 4-24b).

Indoor Air and Ambient Air

PCE, TCE, and cis-1,2-DCE were detected in indoor air samples at both IDC and the Former 579 Store. PCE was detected at 4.8 µg/m^3 and 0.18 µg/m^3, below the screening level of 9.4 µg/m^3. TCE was detected at 0.2 µg/m^3 and 0.14 µg/m^3, below the screening level of 0.43 µg/m^3. cis-1,2-DCE was detected at concentrations of 0.13 and 0.21 µg/m^3(there is no screening level for cis-1,2-DCE).

TCE was the only site-related contaminant in ambient air sample AA-01. The TCE concentration in this sample (0.62 µg/m^3) exceeded its screening level (0.43 µg/m^3); it was detected below its criteria in samples from IDC (0.2 µg/m^3) and the Former 579 Store (0.14 µg/m^3) (Tables 4-24c).

Four non-site-related VOCs exceeded indoor air screening levels at IDC and the Former 579 Store: benzene, carbon tetrachloride, chloroform, and ethylbenzene). The lack of vertical concentration gradient from subsurface to indoor air for benzene, carbon tetrachloride, and ethylbenzene indicates that these VOCs are not related to vapor intrusion, but rather from indoor sources and background levels

4.2.4.2 Ramallo/Convention Center Area

Subslab soil vapor and indoor air samples were collected from two locations at each of the four properties in this area: Ramallo/CCC, ENCO, CCL Label, and Praxedes Public Housing. Two ambient air samples were collected at upwind locations.

Subslab Soil Vapor

PCE and TCE were detected in subslab soil vapor samples (Tables 4-24a and 4-24b). PCE exceeded its screening level (472 µg/ m^3) at the Ramallo/CCC source area. The highest PCE concentration of 2,200,000 µg/m^3 was found in sample VI-07, which was located immediately adjacent to the highest PCE concentrations found in soils below the Ramallo/CCC building slab. Sample VI-8, collected from the center of the Ramallo/CCC building, contained PCE at 63,000 µg/m^3.

PCE vapor has migrated laterally in the subsurface from the Ramallo/CCC source area toward other buildings in the vicinity; however, no screening criteria exceedances were noted in other buildings. Concentrations of PCE outside of the Ramallo property decreased with distance from the source area. Samples VI-09 (ENCO), VI-03 (Praxedes Public Housing), and VI-05 (CCL Label), located approximately 100 feet southeast and north of VI-07 and 200 feet west of VI-07, contained PCE at 220 µg/m^3, 38 µg/m^3, and 49 µg/m^3, respectively. The samples collected further away from the Ramallo/CCC source area contained PCE at 8.8 and 26 µg/m^3.

TCE was only detected in one subslab soil sample (3.6 µg/m^3) from CCL Label, below its screening level of 30 µg/m^3. Due to elevated PCE concentrations, the two subslab soil vapor samples from

Ramallo/CCC were diluted, resulting in higher TCE reporting limits that were 2 to 80 times the screening level (75 µg/m^{3}and 2,300 µg/m^3).

Four non-site related VOCs exceeded their respective screening levels in subslab soil vapor: 1,1,2,2-tetrachloroethane, 1,4-dichlorobenzene , chloroform, and naphthalene.

Indoor Air and Ambient Air

PCE, TCE, and cis-1,2-DCE were detected below screening criteria in indoor air samples from the Ramallo/CCC source area and nearby buildings (Tables 4-24a and 4-24b). At the Ramallo/CCC source area, PCE was detected at 31 µg/m^3 and 9.3 µg/m^3. TCE was detected at 0.69 and 0.13 µg/m^3. cis-1,2-DCE was detected at 0.13 µg/m^{3}and 0.16 µg/m^3.

Outside of the Ramallo/CCC source area, PCE, TCE, and cis-1,2-DCE were detected in indoor air samples from the Praxedes Public Housing. PCE was detected at 1.1 µg/m^3 and 0.21 µg/m^3. TCE was detected at 0.22 µg/m^3. cis-1,2-DCE was detected at 0.093 µg/m^3. No site-related contaminants were detected in indoor air at CCL Label and ENCO.

TCE was the only site-related contaminant detected in ambient air samples (Table 4-24c). It was detected in AA-03 at 0.21 µg/m^3, similar to concentrations found in indoor air at the Praxedes Public Housing (0.22 µg/m^3 at AI-04) and the center of the Ramallo/CCC building (0.13 µg/m^3 at AI-08).

Six non-site-related VOCs exceeded indoor air screening criteria at the Praxedes Public Housing complex: benzene, carbon tetrachloride, chloroform, 1,2-dichloroethane, 1,4-dichlorobenzene, and ethylbenzene. Five non-site-related VOCs exceeded industrial/commercial indoor air screening criteria: benzene, 1,2-dichloropropane, 1,4-dichlorobenzene, ethylbenzene, and 1,1,2,2-tetrachloroethane.

4.3 Evaluation of Contamination

4.3.1. Soil Contamination and Source Areas

The main source of contamination in the southern area of the site is at Ramallo/CCC, specifically in the southeastern side of the facility, where PCE levels in soil were as high as 3,300,000 µg/kg. PCE was detected in all soil borings, and exceeded screening criteria in nine of the borings. The highest levels of site-related contaminants were found in shallow soils in the southeastern portion of the facility in RMSB-18 as follows: PCE at 3,300,000 µg/kg (0-4 feet bgs), TCE at 2,700 µg/kg (0-2 feet bgs), cis-1,2-DCE at 41,000 µg/kg (4-8 feet bgs), and 1,1-DCE at 120 µg/kg (8-12 feet bgs), and vinyl chloride at 2,000 µg/kg (4-8 feet bgs). Site-related contaminants were detected below screening criteria at CCL Label, ENCO, or DJ Manufacturing, in borings bordering the Ramallo property; these detections are likely a result of proximity to the source area at Ramallo. These properties are not considered sources of groundwater contamination for the site.

The highest levels of site-related contaminants in the northern drainage area were found at IDC, the main source of contamination in the northern area of the site. PCE levels in soils in the southeastern portion of the facility were as high as 1,700,000 µg/kg, TCE as high as 39,000 µg/kg, cis-1,2-DCE as high as 29,000 J µg/kg, and vinyl chloride as high as 1,200 µg/kg; these levels were all found from 4-8 feet bgs in samples located in the southwestern corner of the property. Several samples at the bottom of

borings (i.e., from 48-60 feet bgs) also exhibited exceedances of screening criteria, indicating that soil contamination may extend to deeper depths. As noted in Sections 2.1.1.2 and 4.2.1.1, deeper depths were not reached due to refusal and limited access. However, contaminant levels generally decrease with depth, and soils become much tighter in the deeper soil zones. None of the other former dry cleaner properties in the northern area had site-related contaminants at levels above screening criteria (Ramoncito, Don Quixote Pizza, and the Coffee Shop). The ESSO gas station also did not have any site-related contaminants above screening criteria.

4.3.2 Groundwater Contamination

As precipitation infiltrates contaminated overburden soils, the contamination dissolves into the groundwater, which allows the contamination to spread through the aquifer from a contaminated source zone located above the water table.

Site-related contaminants exceeded screening criteria only in wells in the southern portion of the site (i.e., in the areas of Ramallo/CCC, CCL Label, and Shellfoam). No exceedances of screening criteria were found in any of the wells in the northern drainage area (north of CCL Label). The lack of groundwater contamination in this area may be due to the fact that the majority of the surface in the vicinity of IDC is overlain by buildings and roads, which prohibit the majority of precipitation from infiltrating into the overburden. As a result, the bulk of precipitation drains via overland flow toward the northern drainage area. The remaining precipitation migrates through the overburden in unpaved areas and areas where contaminants were discharged (in the narrow side alley). Along the infiltration pathways, contamination diffuses into the surrounding low permeability clay matrix. Contaminant transport to the depth of groundwater through this unit may be hindered in this area, as compared to Ramallo, due to greater overburden thickness in this area (approximately 30 feet thicker) and gradation to finer-grained soils with depth, which may explain why only trace levels of site-related contaminants were found downgradient of IDC.

The groundwater contamination in the southern area originates from the contaminated soil underlying the Ramallo/CCC facility. As surface overland flow and precipitation infiltrates through the silty clay soil, contaminants dissolve into the water as it migrates downward to the groundwater in the saprolite zone. Overall, the highest levels of site-related contaminants in groundwater were detected in the saprolite wells located at and downgradient of Ramallo/CCC (SMW-10 and SMW-1, respectively). Figure 4-11 illustrates the PCE plume in the saprolite zone. As shown in this figure, the PCE plume extends to the Rio Arroyata, as evidenced by levels exceeding screening criterion in saprolite wells SMW-6 and SMW-7 and levels below the screening criterion in Rio Arroyata surface water samples SW-5 and SW-6. Lower levels (below screening criteria) were also found side gradient of Ramallo/CCC (SMW-9) and in SMW-4), which may indicate that the plume is relatively narrow in that area.

In the bedrock, site-related contaminants exceeded screening criteria in MPW-1, located adjacent to SMW-1, and MPW-5, located east of Ramallo/CCC near the closed supply well Cidra 8. MPW-5 had the highest levels and the most PCE exceedances in the five deepest ports, with a maximum of 120 µg/L in port 5 (260-274 feet bgs) (Figure 4-9).

On the IVAX facility located southeast of Ramallo/CCC, 1,1-DCE exceeded screening criteria in MPW-6 and IVAX-2, and PCE, TCE, and cis-1,2-DCE were detected below screening criteria in all three wells on the IVAX facility. These wells are located east of the groundwater divide and therefore not considered downgradient of contaminated source areas. Two possible reasons may account for the presence of site-related contaminants in this area: pumping at the IVAX wells may have been great enough to induce contaminated groundwater flow across the groundwater divide, or the 1,1-DCE could have migrated from an unknown source unrelated to the site. The IVAX facility is closer to the Arroyata Fault, where bedding planes strike northwest/southeast; groundwater and contaminant flow is to the northwest/southeast along strike, and downdip to the southeast.

4.3.3 Surface Water and Sediment Contamination

Groundwater in the saprolite zone is hydraulically connected to the Rio Arroyata. The potentiometric water level surface at SMW-6 was approximately eight feet higher than the elevation of the Rio Arroyata, indicating that groundwater would discharge to the river through seeps along the river bank or directly to the river. Although none were observed during the surface water and sediment sampling event, several groundwater seeps were observed along the banks of the Rio Arroyata downstream of Route 171.

The edge of the contaminant plume has reached the Rio Arroyata, located approximately 1,500 feet southwest of Ramallo/CCC, as evidenced by the presence of low levels of site-related contaminants in surface water downstream of the contaminated saprolite monitoring wells. Contaminant levels in surface water were lower than in the nearby saprolite wells; the tendency of VOCs to volatize from surface water and to be diluted within the river may explain the lower concentrations in surface water samples. No site-related contaminants upgradient/upstream of these wells were detected. This is illustrated in Figure 4-11.

4.3.4 Contaminant Cross Sections

Contaminant levels were added to cross sections to illustrate contaminant distribution. See Figure 3-7 for the cross section location map.

Cross Section A-A'

Cross section A-A' (Figure 4-12a) includes IVAX in the east and extends west through the DJ Manufacturing and Shellfoam properties, to the cluster of Cidra-8, MPW-5, and SMW-5. A-A' includes data from the former IVAX well, MPW-6, SMW-1/MPW-1, SMW-4, Cidra-8/MPW-5, and SMW-5, along with PCE contaminant contours in the saprolite zone. This cross section shows the unique situation near the IVAX property. A normal fault, possibly associated with the Arroyata Fault south of the site, is inferred to be present between MPW-1 and MPW-6. A fault in this area would explain the significant shift in fracture orientation and bedding plane strike and dip, and would also explain the absence of the saprolite zone in MPW-6. This also supports the assumption that groundwater flows to the southeast in this area. PCE, TCE, and 1,1-DCE were detected in wells on the IVAX property. PCE concentrations were 0.82 µg/L in the converted well MPW-6 (255 feet deep) and 1.6 µg/L in the former IVAX well. TCE was detected in the former IVAX well at a concentration of 0.084J µg/L, while 1,1-DCE was detected at MPW-6, with a concentration of 17J µg/L and at IVAX-2 (unknown depth, not

posted on A-A') with a concentration of 39J µg/L. As stated in Section 4.3.2, site-related contaminants could have migrated across the groundwater divide as a result of pumping at the IVAX wells.

West of the fault lies the SMW-1/MPW-1 cluster, SMW-4, Cidra-8, and the SMW-5/MPW-5 cluster. As shown on the cross section location map (Figure 3-7), SMW-1/MPW-1 lie at the intersection of A-A' and B-B', and are therefore included on both cross sections. PCE was detected in SMW-1/MPW-1 at concentrations of 680 µg/L (in saprolite) and up to 12 µg/L (in the top of bedrock). This contamination is likely migrated with groundwater flow approximately 250 feet southwest from the source area at Ramallo/CCC. Once in the bedrock, PCE-contaminated groundwater moves along strike and downdip. To the northwest, PCE levels in SMW-4 were 3.6J µg/L and in SMW-5 were non-detect, whereas they were 85 µg/L in Cidra-8, and ranged from 8.5 to 120 µg/L in deeper ports in MPW-5. PCE was detected in the deepest port (302-324 feet bgs) at 86 µg/L, indicating that contamination likely extends deeper in the bedrock at this location. Due to the pattern of groundwater flow, contamination would be expected to migrate from shallower zones in SMW-1/MPW-1 to deeper fractures in MPW-5 and Cidra-8, which are along strike and downdip.

Cross Section B-B'

Cross section B-B' (Figure 4-12b) runs from the Ramallo/CCC property southwest along the northwestern edge of the Shellfoam property to Rio Arroyata. B-B' includes soil data from the Ramallo/CCC source area, groundwater data from SMW-10, SMW-1/MPW-1, SMW-4, and SMW-6, and surface water data from SW-6, along with PCE contaminant contours in the saprolite zone.

PCE-contaminated soil is present at the Ramallo/Cidra Convention Center property, from the surface (3,300,000 µg/kg) to just above the saprolite zone (1,300 µg/kg at 72 feet bgs). PCE-contaminated groundwater occurs just downgradient (southwest) of this source area, in saprolite well SMW-10, at 1,700 µg/L. Moving further downgradient/southwest from SMW-10, the cross section shows the saprolite well SMW-1 with its adjacent multiport well MPW-1, as well as SMW-4. The PCE level in SMW-4 (3.6 J µg/L) is lower than in SMW-1 (680 µg/L) which is in turn lower than at SMW-10. The highest level of PCE in MPW-1 (12 µg/L) occurs at the top of bedrock in port 6 from 121-129 feet bgs. Levels in deeper ports generally decrease with depth and are below the screening criterion. From SMW-1/MPW-1, PCE-contaminated groundwater continues southwest to SMW-6, where levels are higher than at SMW-4. Surface water sample (SW-6) located in the Rio Arroyata yielded a PCE concentration of 4J µg/L and a 1,1-DCE concentration of 0.58 µg/L. This is likely related to groundwater contamination discharging to the river.

Cross Section C-C'

Cross section C-C' (Figure 4-12c) runs parallel to overall groundwater flow, from the IDC property, southwest toward the unnamed stream that flows into Rio Arroyata. C-C' includes soil boring data from the IDC source area, and groundwater data from SMW-2, MPW-2/Cidra 4, and MPW-3/Cidra 3.

As shown on cross section C-C', PCE-contaminated soil is present at the IDC property from the surface (1,700,000 µg/kg) to the deepest boring at 60 feet bgs (170 µg/kg). Borings were not able to be advanced deeper due to rig refusal, indicating that deeper soils are tighter. Tighter clays would tend to slow the downward migration of contamination. Due to lack of room for a DPT rig, soil borings in the most contaminated area were not able to be advanced deeper than 12 feet bgs. The vertical extent of

PCE in unsaturated zone soil has not been determined, and therefore, elevated levels of PCE are assumed to occur at depths below 12 feet bgs in this area.

PCE was not detected in SMW-2, located south/southwest of IDC property. Due to limited access, this well is more side-gradient than downgradient from the source area. As a result, this well may not have captured PCE migrating through the saprolite zone. Bedrock wells further southwest (MPW-2, Cidra-04, MPW-3, and Cidra-03) only had levels below screening criteria. The highest PCE concentration in these wells was 2.8 µg/L in MPW-3 port 3.

Based on drilling at SMW-2, the silty clay overburden in this area is approximately 30 feet thicker than at the Ramallo/CCC, and becomes more fine-grained and tighter at depth. These conditions may hinder the downward migration of contaminants to the saprolite zone, and would explain lower-than-expected PCE levels in the saprolite, multiport, and Cidra supply wells.

Cross Section D-D'

Cross section D-D' (Figure 4-12d) is generally perpendicular to overall groundwater flow, and crosses a branch of the unnamed stream located downgradient of IDC. D-D' includes groundwater data from MPW-4 and MPW-3/Cidra 03 to the west and saprolite well SMW-3 and SMW-12 to the east. No site-related contaminants were detected in the two saprolite wells, SMW-12 and SMW-3. PCE was detected at concentrations below its screening criterion in MPW-3 and MPW-4, at maximum levels of 2.8 µg/L and 2 µg/L, respectively. There was little variability in PCE levels from various ports in these wells. Cidra 03, located near MPW-3, also had a low level of PCE (1.4 µg/L).

Cross Section E-E'

Cross section E-E' (Figure 4-12e) includes data from multiport wells MPW-2 to the north/northeast, Cidra 04, SMW-3, and MPW-4 to the south/southwest, and is oriented sub-parallel to strike. As stated previously, samples from MPW-4 detected low levels of PCE, with a maximum of 2 µg/L. PCE levels in MPW-2 were even lower, with a maximum of 0.68 µg/L; the bottom port was non-detect. PCE was not detected in SMW-3 or Cidra-04.

4.3.5 Vapor Intrusion Contamination

PCE and TCE were present in subslab soil vapor at concentrations several orders of magnitude higher than their respective screening levels at both the IDC and Ramallo/CCC source areas. PCE was also detected in subslab soil vapor samples in ENCO, CCL Label, the Former 579 Store, and Praxedes Public Housing, indicating that PCE vapor has migrated in the subsurface to buildings closely proximal to the source areas.

PCE, TCE, and cis-1,2-DCE vapors have migrated from the subsurface into indoor air at the IDC, the Former 579 Store, Ramallo/CCC, and Praxedes Public Housing properties. However, there are no indoor air screening level exceedances for these site-related contaminants at any locations. TCE was also detected in ambient air samples, suggesting that non-site related sources may have contributed to TCE found in indoor air.

Several non-site-related VOCs (benzene, carbon tetrachloride, chloroform, 1,2-dichloroethane, 1,4-dichlorobenzene, 1,2-dichloropropane, ethylbenzene, and 1,1,2,2-tetrachloroethane) were also

detected at levels above their respective screening levels in indoor air. The presence, concentrations, and distribution of these VOCs in the subsurface, within buildings, and ambient air indicate that the VOC exceedances were mostly attributable to indoor sources and background levels rather than vapor intrusion.

Section 5

Fate and Transport

This section examines the chemical and physical processes that affect the fate and transport of site-related chlorinated VOCs in soil and groundwater at the site. An understanding of the fate and transport of contaminants aids the evaluation of potential current and future exposure risks and with the evaluation of remedial technologies in the FS. This section provides the following:

- A summary of the site-related contaminants
- A summary of the relevant physical-chemical properties and mobility of the site-related contaminants
- A discussion of processes that affect the fate of site-related contaminants in the environment
- A discussion of processes that affect transport potential of site-related contaminants
- A summary of the fate and transport evaluation
- A presentation of the CSM

5.1 Site-Related Contaminants

The primary site-related contaminants identified at the site include chlorinated VOCs: TCE, PCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride. The rationale for selecting these as site-related contaminants is presented in Section 4.

5.2 Chemical and Physical Properties of Site-Related Contaminants

To predict the fate, persistence, and potential transport of the chlorinated VOCs detected in soil and groundwater, it is necessary to identify which contaminants are likely to migrate or degrade. These processes depend on a given chemical's physical and chemical properties and the properties of the media through which it migrates. Table 5-1 presents the chemical and physical properties of these contaminants.

Specific Density

The specific density is the ratio between the density of the actual component and the density of water. The density is measured as dry mass per volume (gram per cubic millimeter [g/cm^3]). The density of a contaminant predicts its ability to float on water. Chlorinated VOCs, except vinyl chloride, are denser than water and are considered dense non-aqueous phase liquid (DNAPL). Thus, they can move downward through the water table under the force of gravity and penetrate hundreds of feet into the saturated zone.

Solubility

The solubility of a chemical is defined as the upper limit of its dissolved concentration in water at a specified temperature. Concentrations in excess of a chemical's solubility may indicate sorption onto soils, a co-solvent effect, or the presence of a DNAPL. As shown in Table 5-1, solubilities of chlorinated VOCs range from low for PCE (206 milligrams per liter [mg/L]), moderate for TCE (1,280 mg/L) and 1,1-DCE (2,420 mg/L), to relatively high for cis-1,2-DCE (6,410 mg/L) and vinyl chloride (8,800 mg/L) (EPA 2012b).

Because of their low solubilities, the rate of dissolution of PCE and TCE from soil is likely to be low. However, their higher density and low viscosity allow them to migrate downward into aquifers. Once in groundwater, their solubilities are sufficiently high to cause significant aqueous-phase contamination, but also sufficiently low to result in persistent sources (Johnson and Pankow 1992). No DNAPLs have been observed in groundwater at the site.

Soil Saturation Limit

The soil saturation limit is the contaminant concentration at which soil pore air and pore water are saturated with the chemical and the adsorptive limits of the soil particles have been reached. Above this concentration, the contaminant may be present in free phase. Free phase PCE product is suspected to be present in the shallow subsurface soils beneath the IDC and Ramallo/CCC properties, as the highest detected PCE concentrations in soil (1,700 mg/kg at IDCSB-14 and 3,300 mg/kg at RMSSB-18) were more than one order of magnitude above the soil saturation limit (166 mg/kg).

Vapor Pressure

Vapor pressure is the pressure exerted by a chemical vapor, at any given temperature, in equilibrium with its solid or liquid form. It is used to calculate the rate of volatilization of a pure substance from a surface or to estimate a Henry's Law constant for chemicals with low water solubility. The higher the vapor pressure, the more likely a chemical is to exist in a gaseous state. At the site, site-related VOCs have relatively moderate to high vapor pressure, ranging from 19 (PCE) to 2,980 (vinyl chloride) millimeters (mm) of mercury (Hg), which indicates that these VOCs will evaporate rapidly from surface soil and water.

Henry's Law Constant

Henry's Law constant provides a measure of the extent of chemical partitioning between air and water at equilibrium. The higher the Henry's Law constant, the more likely a chemical is to volatilize. Henry's Law constants for site-related VOCs range from 0.0041 (cis-1,2-DCE) to 0.028 (vinyl chloride) atmosphere-cubic meters per mole (atm-m^3/mol), which indicates they will volatilize from water.

Organic Carbon Partition Coefficient

The organic carbon partition coefficient (K_{oc}) provides a measure of the extent of chemical partitioning between organic carbon and water at equilibrium. The higher the K_{oc}, the more likely a chemical is to bind to soil or sediment rather than to remain dissolved in water. The range of K_{oc} for site site-related VOCs is from 22 milliliters per gram (mL/g) (vinyl chloride) to 95 mL/g (PCE), which indicates that these VOCs are unlikely to bind to soil.

Soil-Water Partition Coefficient

The soil-water partition coefficient (K_d) provides a soil or sediment-specific measure of the extent of chemical partitioning between soil/sediment and water, adjusted for dependence upon organic carbon. The K_d is normalized using the fraction of organic carbon (f_{oc}) of the soil/sediment as shown in the following formula:

$$K_d = K_{oc} \times f_{oc}$$

where:

K_{oc} = organic carbon partition coefficient, liters per kilogram (L/kg)

f_{oc} = fraction of organic carbon

A higher K_d, indicates that a chemical is more likely to bind to soil/sediment rather than to remain in the dissolved phase, thereby reducing its transport capability. Using an average site-specific TOC value of 3,306 mg/kg, K_d values were calculated for site site-related VOCs. TOC was analyzed in 126 soil samples collected from the unconsolidated overburden unit. Values ranged from 140J to 18,300 mg/kg. Results indicated that the adsorption potential of site-related VOCs is low (Table 5-1).

Octanol-Water Partition Coefficient

The octanol-water partition coefficient (K_{ow}) provides a measure of the extent of chemical partitioning between water and octanol at equilibrium. The greater the K_{ow}, the more likely a chemical is to partition to octanol rather than to remain in water. Octanol is used as a surrogate for lipids, and the K_{ow} is used to predict the rate of bioacummulation in living organisms. All site-related VOCs have relatively low K_{ow} indicating that they have low potential to bioaccumulate.

5.3 Environmental Fate of Contaminants

Contaminant fate describes the length of time a specific chemical will remain in its original state in the environment. The fate of site site-related VOCs is described in this section.

5.3.1 Processes that Affect Fate

The major processes that affect the fate or persistence, of site-related VOCs are volatilization, biodegradation, dissolution, and abiotic degradation. The most persistent chemicals are those that do not volatilize, biodegrade, dissolve, or hydrolyze.

Volatilization is the conversion of a liquid or solid to a gas or vapor by application of heat, by reducing pressure, by chemical reaction, or by a combination of these processes. A chemical's volatility is measured with the Henry's Law constant and vapor pressure.

Biodegradation is the breakdown of organic contaminants by microbial organisms into smaller compounds through metabolic or enzymatic processes. Biodegradation processes vary greatly, but frequently, the final product of degradation is carbon dioxide or methane. Biodegradation can occur under aerobic conditions, where oxygen is present in sufficient concentration, or under anaerobic conditions, where oxygen is lacking.

Dissolution is the process of dissolving, changing, or separating a substance into component parts or changing it from a solid to a solution. Mechanisms that cause or enhance dissolution include solution by heat, moisture liquefaction, melting, or decomposition.

Abiotic Degradation is the chemical transformation that degrades contaminants without microbial facilitation. Chlorinated VOCs dissolved in groundwater may also be degraded by abiotic mechanisms. The most common reactions affecting chlorinated compounds are hydrolysis (a substitution reaction) and dehydrohalogenation (an elimination reaction). Abiotic degradation can result in partial or complete degradation of contaminants. However, abiotic degradation rates typically are much slower than biodegradation rates.

5.3.2 Fate of Site-Related Contaminants

The fate of chlorinated VOCs is driven primarily by their ability to volatilize and degrade. The fate of the site site-related VOCs is discussed below.

PCE

Under atmospheric conditions, PCE is expected to be present primarily in the vapor phase and not sorbed to particulates because of its high vapor pressure of 19 mm Hg. Vapor-phase PCE will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals. Direct photolysis is not expected to be an important environmental fate process since PCE only absorbs light weakly in the environmental ultraviolet (UV) spectrum (HSDB 2013).

The dominant fate of PCE in soils is dissolution and volatilization. Based on its low solubility, the rate of dissolution is likely to be low and PCE will persist in soil for a long time. Biodegradation under anaerobic conditions in soil and groundwater may occur at a relatively slow rate. The half-lives in soil and groundwater were reported to be 180 to 360 days and 270 days, respectively (HSDB 2013).

PCE is soluble in groundwater. It has a moderate K_d and sorption to organic matter or clay will not substantially retard its movement through the aquifer.

Due to its low molecular weight, low water solubility, and high vapor pressure, PCE in soil and groundwater, in particular in the unsaturated zone, tends to partition into the gaseous phase and migrate as vapor. PCE has the potential to accumulate beneath structures or foundations and migrate into interiors of structures via advection and convection transport mechanisms and preferential pathways.

In soil, PCE was mainly detected at Ramallo/CCC and IDC properties, with the highest concentration of 3,300,000 µg/kg at Ramallo/CCC and 1,700,000 µg/kg at the IDC. In groundwater, PCE was detected in groundwater at concentrations above the screening criterion in wells in the southern portion of the site. The highest concentration of 1,700 µg/L was detected at SMW-10. PCE was detected in surface water and sediment samples (SW/SD-5 to SW/SD-10) collected from the Rio Arroyata at concentrations below the screening criteria.

PCE can be progressively dechlorinated via reductive dechlorination to TCE which subsequently degrades to DCE, with the cis isomer (cis-1,2-DCE) predominant over the trans isomer. As reductive dechlorination proceeds, vinyl chloride is produced, and ultimately, ethene and carbon dioxide.

TCE

Under atmospheric conditions, TCE is expected to be present primarily in the vapor phase rather than sorbed to particulates because of its high vapor pressure. Some removal during precipitation events is expected because of the moderate solubility of TCE in water. The major degradation process affecting vapor phase TCE is photo-oxidation by hydroxyl radicals; the half-life for this reaction in air is estimated to be seven days (HSDB 2013).

The dominant fates of TCE in soils are dissolution and volatilization. Because of its moderate solubility, TCE has the potential to migrate through the soil into groundwater. Biodegradation in soil and groundwater may occur at a relatively slow rate with half-lives on the order of months to a year (Lucius et al. 1990).

The dominant fate of TCE in surface water is volatilization with a predicted half-life of minutes to hours. TCE may degrade via aerobic biodegradation, but rates are unknown. TCE's ability to bioconcentrate or sorb to suspended solids and sediments is low based on its log K_{ow} value and K_{oc} value.

TCE is soluble in groundwater. It has a low K_d and sorption to organic matter or clay will not substantially retard its movement through the aquifer. TCE's Henry's Law constant indicates that partitioning from water to air is likely (USGS 2002).

TCE slowly biodegrades through aerobic cometabolic biodegradation processes. Under anaerobic conditions, as might be seen in groundwater, TCE slowly biodegrades via reductive dechlorination; however, the extent and rate of degradation are dependent upon the strength of the reducing environment (HSDB 2013).

Due to its low molecular weight, low water solubility, and high vapor pressure, TCE in soil and groundwater, in particular in the unsaturated zone, tends to partition into the gaseous phase and migrate as vapor. TCE has the potential to accumulate beneath structures or foundations and migrate into interiors of structures via advection and convection transport mechanisms and preferential pathways.

In soil, TCE was mainly detected at Ramallo/CCC and IDC properties, with the highest concentration of 2,700 µg/kg at Ramallo/CCC and 39,000 µg/kg at IDC. In groundwater, TCE was detected in groundwater at concentrations above the screening criterion in wells in the southern portion of the site. The highest concentration of 31 µg/L was detected at SMW-10. TCE was detected in one surface water sample (SW-7) collected from the Rio Arroyata at a concentration below the screening criterion.

TCE may be further reduced to cis-1,2-DCE, and to a lesser extent trans-1,2-DCE, via reductive dechlorination under methanogenic conditions.

cis-1,2-DCE

Under atmospheric conditions, cis-1,2-DCE is expected to be present primarily in the vapor phase rather than sorbed to particulates because of its high vapor pressure. The major degradation process affecting vapor phase 1,2-DCE is photo-oxidation by hydroxyl radicals; the half-life for this reaction in air is estimated to be six to seven days (HSDB 2013).

The dominant fate of cis-1,2-DCE in surface soils is dissolution and volatilization. Because of its high solubility, cis-1,2-DCE has the potential to migrate through the soil into groundwater. Biodegradation in soil and groundwater may occur at a relatively slow rate with half-lives on the order of months to 10 years (HSDB 2013).

The dominant fate of cis-1,2-DCE in surface water is volatilization with a predicted half-life of minutes to hours. 1,2-DCE's ability to bioaccumulate or to sorb to suspended solids and sediments is low based on its log K_{ow} value and K_{oc} value.

cis-1,2-DCE may degrade via aerobic biodegradation, but rates are unknown. Under anaerobic conditions, cis- 1,2-DCE are slowly biodegraded via reductive dechlorination; however, the extent and rate of degradation are dependent upon the strength of the reducing environment (HSDB 2013).

cis-1,2-DCE is soluble in groundwater and it has a low K_d, and sorption to organic matter or clay will not retard its movement through the aquifer. Its Henry's Law constant indicates that partitioning from water to air is likely.

Due to its low molecular weight and high vapor pressure, cis-1,2-DCE in soil and groundwater, in particular in the unsaturated zone and shallow perched groundwater, tends to partition into the gaseous phase and migrate as vapor. cis-1,2-DCE has the potential to accumulate beneath structures or foundations and migrate into interiors of structures via advection and convection transport mechanisms and preferential pathways.

In soil, cis-1,2-DCE was mainly detected at Ramallo/CCC and IDC properties, with the highest concentration of 41,000 µg/kg at Ramallo/CCC and 29,000 J µg/kg at IDC. In groundwater, cis-1,2-DCE was only detected at concentrations above the screening criterion at SMW-9. Cis-1,2-DCE was detected in surface water samples (SW-5 to SW-7) collected from the Rio Arroyata at concentrations below the screening criterion.

Cis-1,2-DCE is formed via reductive dechlorination of TCE facilitated by microorganisms. In the reductive dechlorination process, production of the *cis* isomer of 1,2-DCE predominates over production of the *trans* isomer. Since cis-1,2-DCE was detected much more frequently and at higher concentrations than trans-1,2-DCE, this suggests that 1,2-DCE is the result of biological degradation of TCE.

cis- 1,2-DCE may be reduced to vinyl chloride via reductive dechlorination under methanogenic conditions. Under anaerobic conditions, field-scale biodegradation half-lives for cis-1,2-DCE range from 0.14 to 9.9 years (HSDB 2013).

1,1-DCE

Under atmospheric conditions, 1,1-DCE is expected to be present primarily in the vapor phase rather than sorbed to particulates because of its high vapor pressure. The major degradation process affecting vapor phase 1,1-DCE is photo-oxidation by hydroxyl radicals; the half-life for this reaction in air is estimated to be 2 to 27 days (HSDB 2013).

The dominant fate of 1,1-DCE in surface soils is volatilization. Because of its high mobility in soils, 1,1-DCE has the potential to migrate through the soil into groundwater.

The dominant fate of 1,1-DCE in surface waters is volatilization with a predicted half-life of hours to 4 days. 1,1-DCE's ability to bioconcentrate or to sorb to suspended solids and sediments is not thought to be significant based on its log K_{ow} value and K_{oc} value.

1,1-DCE may degrade via aerobic biodegradation, but rates are unknown. Under anaerobic conditions, 1,1-DCE are slowly biodegraded via reductive dechlorination; however, the extent and rate of degradation are dependent upon the strength of the reducing environment (HSDB 2013).

1,1-DCE is soluble in groundwater and is characterized by a low K_{oc} suggesting that any sorption to organic matter or clay will not substantially retard its movement through the aquifer. The Henry's Law constant for 1,1-DCE indicates partitioning from water to air is likely.

Due to its relatively high vapor pressure, 1,1-DCE in groundwater, in particular in the shallow groundwater, has the potential to diffuse into the air spaces in the unsaturated zone, accumulate beneath structures or foundations and migrate into interiors of structures via advection/convection transport mechanisms and migration through preferential pathways.

In soil, 1,1-DCE was detected at Ramallo/CCC property, with the highest concentration of 120 µg/kg at Ramallo/CCC. In groundwater, 1,1-DCE was detected in groundwater at concentrations above the screening criterion in wells in the southeastern portion of the site. The highest concentration of 393 µg/L was detected at IVAX-2. 1,1-DCE was not detected in surface water or sediment samples from the Rio Arroyata.

1,1-DCE may be formed as a minor daughter product during the anaerobic biodegradation of TCE and by abiotic degradation of TCE. 1,1-DCE may also be directly released into the environment in wastewater during its production and use in the manufacture of plastic wrap, adhesives, and synthetic fiber. 1,1-DCE may be reduced to vinyl chloride via reductive dechlorination under methanogenic conditions.

Vinyl Chloride

Because of its high vapor pressure, under atmospheric conditions vinyl chloride is expected to be present primarily in the vapor phase rather than sorbed to particulates. The major degradation process affecting vapor phase vinyl chloride is photo-oxidation by hydroxyl radicals; the half-life for this reaction in air is estimated to be 55 hours (HSDB 2013).

The dominant fate of vinyl chloride in surface soil is dissolution and volatilization. Because of its high solubility, vinyl chloride has high potential to migrate through the soil and into groundwater. Biodegradation in soil and groundwater may occur at a relatively slow rate with half-lives of 28 days in aerobic waters and 110 days in anaerobic waters (HSDB 2013).

The dominant fate of vinyl chloride in surface waters is volatilization with a predicted half-life of hours to 3 days. Vinyl chloride is not expected to bioaccumulate or to sorb to suspended solids and sediments based on its log K_{ow} value and K_{oc} value.

Vinyl chloride is highly soluble in groundwater and has low affinity for soil, as characterized by a low K_d. Sorption to organic matter or clay will not retard vinyl chloride movement through the aquifer; however, its Henry's Law constant indicates that partitioning from water to air is likely.

Vinyl chloride is likely to persist in groundwater. Volatilization and biodegradation are important fate processes for vinyl chloride in groundwater. Due to its low molecular weight and high vapor pressure, vinyl chloride in soil and groundwater, in particular in the unsaturated zone, tends to partition into the gaseous phase and migrate as vapor. Vinyl chloride has the potential to accumulate beneath structures or foundations and migrate into interiors of structures via advection and convection transport mechanisms and preferential pathways.

In soil, vinyl chloride was mainly detected at Ramallo/CCC and IDC properties, with the highest concentration of 2,000 µg/kg at Ramallo/CCC and 1,200 µg/kg at IDC. In groundwater, vinyl chloride was only detected once at a concentration below the screening criterion at SMW-9. Vinyl chloride was not detected in surface water or sediment samples from the Rio Arroyata.

Vinyl chloride is formed via reductive dechlorination of cis-1,2-DCE facilitated by microorganisms. Vinyl chloride can be degraded rapidly under aerobic conditions and very slowly under anaerobic conditions.

5.4 Contaminant Transport

Potential migration/exposure mechanisms that impact contaminant transport for chemicals in soil and groundwater are discussed below.

5.4.1 Contaminants in Soil

Based on the high levels of PCE at the IDC and Ramallo/CCC facilities, PCE is assumed to have been released to the ground as a raw or waste product; however, there has been no documentation of PCE use at these source areas. Potential migration mechanisms for site contaminants in soil include leaching to groundwater, volatilization, direct discharge and surface runoff, and degradation.

5.4.1.1 Soil Leaching to Groundwater

PCE and other site-related contaminants exhibit relatively moderate solubilities in water and low K_{oc} values and, therefore, will leach into the groundwater. Transport of PCE in the subsurface is further governed by the fact that this compound is denser than water. The viscosity of PCE is less than water, which facilitates and accelerates its penetration into and migration through porous media. Leaching and movement of the VOC contaminants through the unconsolidated zone is an important process at the site.

The soil data indicated that significant masses of PCE and its degradation daughter products are retained by capillary forces in the pores of soil, primarily in the shallow intervals in the Ramallo/CCC and IDC source areas. Additionally, these contaminants have migrated downward to deeper subsurface soils to depths of at least 56 to 60 feet in IDC and 68 to 72 feet in Ramallo/CCC. The chlorinated VOCs have leached from soil and moved down into groundwater, mainly at the Ramallo/CCC area. In the IDC area, the majority of the land surface is low permeability asphalt and concrete and impermeable building slabs, which minimize percolation of rainwater through soil. As a

result, the bulk of precipitation drains via overland flow toward the northern drainage area. This limits dissolution of chlorinated VOCs in rainwater and their subsequent transport to groundwater. Precipitation that does not run off, and instead migrates downward through the overburden in unpaved areas, becomes contaminated as it flows through the source area soils. Vertical contaminant transport may be hindered in this area due to greater overburden thickness and tighter soils at depth.

PCE and other chlorinated VOCs in the source areas, especially possible free phase PCE, will constitute a source for continuous dissolution of contaminants to the water phase, resulting in contamination that could persist for decades.

5.4.1.2 Volatilization

Volatilization is an important transport process for chlorinated VOCs in soil. Due to their low molecular weight and high vapor pressure, chlorinated VOCs in the unconsolidated zone tend to partition into the gaseous phase and migrate as vapor. They will volatilize into the atmosphere or accumulate beneath structures or foundations and migrate into interiors of structures via vapor intrusion.

5.4.2 Contaminants in Groundwater

Chlorinated VOCs can reach the groundwater zone either dissolved in water or as pure liquid phase. The mechanisms that govern contaminant transport in the groundwater flow regime (i.e., solute transport) include various physical and chemical processes. These processes include advection, dispersion, diffusion, dilution, retardation (primarily via adsorption), volatilization, and degradation.

5.4.2.1 Advection

Advection describes the process of solute migration, which, due to the average bulk movement of groundwater, is typically the most important factor governing the transport of contaminants in groundwater. Groundwater generally flows from regions of the subsurface where the water level is high to regions where the water level is low. Hydraulic gradient is the term used to describe the magnitude of this driving force. Average linear groundwater velocity (v) is a function of hydraulic conductivity, effective porosity (η_e) and hydraulic gradient. Effective porosity values fall within the range of values of specific yield and total porosity. Specific yield (i.e., the amount of water released from storage per unit drop in piezometric head) represents the lower limit of reasonable effective porosity values.

The dissolved PCE plume currently extends approximately 1,600 feet downgradient from the Ramallo/CCC source area. It suggests that advection has played an important role in the migration of chlorinated VOCs at the site.

5.4.2.2 Dispersion

Dispersion describes the spread of contaminants around an average groundwater flow path, beyond the region they would normally occupy due to advection alone. Dispersion is the sum of two processes, mechanical mixing and molecular diffusion. Mechanical mixing occurs as a consequence of local variations in groundwater velocity and the aquifer's matrix. Molecular diffusion results from variations in solute concentrations within the groundwater system (Mackay et al. 1985).

Dispersion and spreading during transport result in the dilution of contaminant plumes and the attenuation of concentration peaks; the maximum concentrations diminish with increasing distance from the source. Anderson et al. (1992) concluded that dispersion is one of the important processes for attenuating chlorinated VOC concentrations in groundwater.

A dispersion term is incorporated to account for variability of flow (Reilly, et al. 1987). The most important variable in this respect is hydraulic conductivity. The coefficient of hydrodynamic dispersion is, therefore, typically reduced to the following equation:

$$\boldsymbol{D = \alpha v}$$

where: D = coefficient of hydrodynamic dispersion

α = dispersivity

v = average linear groundwater velocity

In evaluating solute transport, dispersion is quantified by specifying longitudinal dispersivity and transverse dispersivity. Longitudinal dispersion (i.e., the magnitude of dispersion along, or parallel to, the average direction of groundwater flow in the horizontal plane) depends on longitudinal dispersivity (multiplied by advective velocity [v]). Similarly, transverse dispersion, or the magnitude of dispersion perpendicular to the average direction of groundwater flow, depends on transverse dispersivity. Typically, for fully three-dimensional solute transport evaluations involving dispersion, values are specified for longitudinal dispersivity (αL), and the ratios of both horizontal transverse dispersivity (αTh) and vertical transverse dispersivity (αTv) to the longitudinal dispersivity are specified.

5.4.2.3 Diffusion

Diffusion results from the movement of chemicals from higher concentration zones to lower concentration zones. Diffusion is solely dependent on concentration gradients and will occur even in materials of low hydraulic conductivities. Diffusion as a contaminant migration mechanism is most important when groundwater velocities are low, typically less than a few centimeters a year. Diffusion allows for the migration of contaminants out of the flowpath into less permeable portions of the aquifer. Although diffusion can also spread contaminants longitudinally and transversely, given the molecular scale of spreading, the whole scale amount of spreading is significantly less than dispersion.

5.4.2.4 Dilution (Recharge)

Contaminant concentrations in groundwater can be attenuated through dilution when additional water entering the system due to infiltration of precipitation or from surface water. Additionally, the infiltration of precipitation through the unsaturated zone brings the water into contact with the soil and thus may allow dissolution of additional electron acceptors (e.g., dissolved oxygen, nitrate, or sulfate), and possibly organic soil matter. Infiltration, therefore, provides fluxes of water, inorganic species, and possibly organic species into the groundwater. The surface water may be connected to part of the groundwater system, or it may be perched above the water table. In either case, the water entering the groundwater system will not only aid in dilution of a contaminant plume but it may foster geochemical changes in the aquifer.

Dispersion, diffusion, and dilution appear to have influenced contaminant transport in groundwater at the site, given the extended length of the PCE plume and comparatively low to moderate concentrations for the PCE plume. PCE concentrations were as high as 1,700 µg/L in the Ramallo/CCC property (SMW-10), decreased to 680 µg/L approximately 260 feet downgradient (SMW-1), and continuously decreased to 3.6 J µg/L 400 feet downgradient (SMW-4). The elongated nature of the plume suggests significant longitudinal spreading through dispersion, diffusion, and dilution. The plume has maintained its width of approximately 250 feet, suggesting lateral dispersion is not significant.

5.4.2.5 Retardation

Dissolved contaminants may interact with aquifer solids encountered along the flow path via adsorption, partitioning, ion-exchange reactions, and other chemical and physical processes that remove the dissolved constituent from groundwater. These interactions distribute the contaminant between the aqueous phase and the aquifer solids, diminish concentrations of the contaminants in the aqueous phase, and retard the movement of the contaminant relative to groundwater flow (MacKay et al. 1985). The higher the fraction of contaminant sorbed, the more its transport is retarded. Due to the various physical and chemical removal processes (primarily adsorption), a solute may move more slowly than the groundwater. A typical method of generally describing this phenomenon in solute transport evaluations is by using a retardation factor. This factor, which has the form of a correction of the velocity of the movement of groundwater, is shown in the following equation (Freeze and Cherry 1979):

$$\boldsymbol{R = 1 + \frac{\rho b}{\eta} Kd}$$

where: ρ_b = bulk density

η = porosity

K_d = distribution coefficient

R = retardation factor

The distribution coefficient is a function of soil and solute chemistry, and is compound-specific. Generally, the distribution coefficient is controlled by the hydrophobicity of the contaminant and the total surface area of the aquifer matrix available for sorption. Because of their extremely high specific surface areas, the organic carbon and clay mineral fractions of the aquifer matrix generally present the majority of sorption sites in the aquifer.

For VOCs, the primary adsorptive surface is the organic carbon fraction of the aquifer matrix. The distribution coefficient is defined by:

$$\boldsymbol{Kd = \frac{Cs}{Cw} = foc\ x\ Koc}$$

where: C_s = concentration by weight in soil
C_w = concentration by volume in water
f_{oc} = fraction of organic carbon
K_{oc} = partitioning coefficient

This equation assumes rapid reversible adsorption with a linear isotherm. Generally, the larger the K_d value, the greater the compound's affinity for the solid matrix (Rutgers University 1993).

The retardation factor for each contaminant was calculated and presented in Table 5-1. TOC samples were not collected from the saprolite or bedrock units. Using an average TOC of 0.33 percent for the unconsolidated overburden unit, the retardation factors of the chlorinated VOCs range from 1.5 to 3. This indicates that PCE has modest affinity for organic material in soils while other VOCs have low affinity for TOC.

In areas with high clay and low organic carbon content, it is possible that the sorption of chlorinated VOCs onto clay minerals may be greater than the physical partitioning with the organic carbon fraction of the aquifer matrix (Bourg et al., 1992). Under such conditions, the use of K_{oc} to compute K_d may result in underestimating the importance of sorption in retardation calculations. Based the research efforts of McCarty et al. (1981), there is a "critical level of organic matter" below which sorption onto mineral surfaces is the dominant mechanism. The critical level of organic matter, below which sorption appears to be dominated by mineral-solute interaction, and above which sorption is dominated by organic carbon-solute interaction, is given by (McCarty et al. 1981):

$$f_{oc-c} = \frac{A_s}{200} \frac{1}{K_{ow}^{0.84}}$$

where: f_{oc-c} = critical level of fraction of organic carbon
A_s = surface area of mineralogical component of the aquifer matrix
K_{ow} = octanol-water partitioning coefficient

For chlorinated VOCs with low K_{ow}, it is apparent from the above relationship that the organic carbon content of the aquifer matrix is not the only factor controlling sorption. The critical level of organic matter increases as the surface area of the mineralogical fraction of the aquifer matrix increases. At the site, the overburden unit contains a thick layer of silty clay ranging from 55 to 105 feet bgs. The saprolite unit also contains clay-rich material. Under these conditions, sorption to clay minerals may predominate over organic partitioning since the surface area of the mineralogical component of the aquifer matrix is mostly influenced by the presence of clay. Thus, sorption to the clay mineral surfaces could be an important factor causing retardation of contaminants at the site.

Because of their sorptive and diffusive properties, however, clay minerals can act as long-term reservoirs for contaminants. Once contaminated, they can be sources for slow diffusion of pollutants into the aquifer.

5.4.2.6 Volatilization

Volatilization can be a factor in several ways, including when groundwater contaminated with VOCs is withdrawn from the aquifer; when VOCs volatilize at the top of the water table into the unsaturated zone; and when groundwater discharges to surface water. Vapors in the unsaturated zone are subject to volatilization, especially when they reach the surface or other discharge points.

Due to their low molecular weight and high vapor pressure, chlorinated VOCs in groundwater tend to partition into the gaseous phase and migrate as vapor. Chlorinated VOCs have the potential accumulate beneath structures or foundations and migrate into interiors of structures via advection/convection transport mechanisms and migration through preferential pathways. Therefore, vapor intrusion is a potential concern for occupied buildings at the site.

5.4.2.7 Discharge to Surface Water

Groundwater discharges to the surface water bodies. PCE was detected in surface water and sediment samples while TCE and cis-1,2-DCE were detected only in surface water samples collected from the Rio Arroyata.

Chlorinated VOCs have poor affinity for organic matter and are unlikely to adsorb to sediment. Once in surface water, chlorinated VOCs will rapidly volatilize, based on estimated half-lives of several hours and several days for a model river (HSDB 2013). Chlorinated VOCs are not expected to bioaccumulate in fish or aquatic invertebrates, based on their low octanol/water partition coefficients.

5.5 Monitored Natural Attenuation

Natural attenuation refers to the naturally occurring processes in soil and groundwater that affect the fate and transport of contaminants, and achieve a reduction in the total mass, toxicity, mobility, volume, or concentration of contaminants. Under favorable conditions, these processes can be effective in containing and remediating contamination in a reasonable time frame. Natural attenuation may include biodegradation by subsurface microorganisms, reactions with naturally occurring chemicals, and sorption on the geologic media that store groundwater in the subsurface. Since biodegradation is generally the most important natural process to reduce chlorinated organic chemical concentrations in groundwater, the following natural attenuation evaluation focuses on biodegradation.

5.5.1 Background on Natural Attenuation Processes

Naturally occurring biochemical reactions are capable of completely transforming organic contaminants to less harmful or innocuous byproducts. Microorganisms in the subsurface use enzymes to accelerate the rates of these chemical reactions. The most important reactions are “reduction” and “oxidation”, together known as “redox” reactions. The reactions involve transfer of electrons from one molecule to another. The electron donor loses electrons and is oxidized whereas the electron acceptor gains electron and reduced. These transfers allow the microorganisms to generate energy and grow. In an uncontaminated aquifer, microorganisms use native organic carbon as an electron donor and dissolved oxygen (DO) as the primary electron acceptor. After the DO is consumed, anaerobic microorganisms use additional electron acceptors such as nitrate, ferric iron, sulfate, and carbon dioxides.

Chlorinated organic compounds such as PCE and TCE are predominantly biodegraded by reductive processes. For example, PCE can be reductively dechlorinated to TCE. During this process, one chlorine atom is removed from PCE as the molecule accepts two electrons from an electron donor, converting it to TCE. Thus, PCE degrades to TCE which subsequently degrades to DCE. As reductive dechlorination proceeds, vinyl chloride is eventually produced, and then ultimately, ethene and carbon dioxide, as shown below (Chapelle 1993; Wiedemeier et al. 1998).

PCE(C_2Cl_4)→TCE (C_2HCl_3)→cis-1,2-DCE($C_2H_2Cl_2$)→vinyl chloride (C_2H_3Cl)→Ethene (C_2H_4)→ CO_2

Although either trans-1,2-DCE or 1,1-DCE may be formed from reductive dechlorination of TCE, cis-1,2-DCE tends to be the dominant DCE intermediate (National Academy of Science [NAS] 2000).

Generally, the more chlorinated compounds are more susceptible to reductive dechlorination. For instance, PCE is the most susceptible to reductive dechlorination, followed by TCE, cis-1,2-DCE and then vinyl chloride (USGS 2002). Reductive dechlorination can occur under a range of reducing conditions; however, it occurs more rapidly under sulfate-reducing and methanogenic conditions, as opposed to nitrate-reducing and iron-reducing conditions (Bouwer 1994).

During the reductive dechlorination process, the chlorinated organic compound acts as an electron acceptor and needs other sources of carbon to act as electron donors. Potential carbon sources include natural organic matter and anthropogenic organic compounds such as petroleum hydrocarbons (benzene, toluene, ethylbenzene, and xylenes [BTEX]).

Source mass and contaminant biodegradability are the two key factors that control the persistence of a contaminant plume. In order for biodegradation to occur, the following subsurface requirements need to be met (Bedient et al. 1994).

- Presence of an appropriate microbial population - generally, microorganisms that are able to degrade chlorinated organic compounds are ubiquitous in the subsurface environment.
- Energy source and a carbon source - organic carbon is used both to provide an energy source (as electron donors) and to maintain and grow cells.
- Electron acceptor - electrons released by the biodegradation must be taken up by some other chemical.
- Nutrients - certain nutrients are needed for the microbial population growth to occur (e.g., nitrogen, phosphorous, calcium, potassium, magnesium, and iron).
- Appropriate environmental conditions - microbial activity is dependent upon many environmental conditions, such as temperature, pH, salinity, pressure, concentration of contaminants, and presence of inhibitors such as metals and high concentrations of nitrate.

5.5.2 Monitored Natural Attenuation Evaluation

During the RI investigation, monitored natural attenuation (MNA) indicator parameters were collected and analyzed in the field and by an off-site laboratory in order to evaluate whether subsurface conditions are conducive to in-situ natural degradation of chlorinated VOCs. MNA field parameters

included pH, specific conductivity, DO, temperature, ORP (Eh), and ferrous ion (Fe[II]). MNA parameters analyzed by an off-site laboratory included TDS, TSS, total Kjeldahl nitrogen (TKN), ammonia, nitrate/nitrite, chloride, sulfate, sulfide, alkalinity, TOC, methane, ethane, and ethane.

A preliminary screening assessment of MNA potential of chemicals in site groundwater was performed for both the saprolite and bedrock units, to determine whether evidence of the potential biodegradation processes exists. The screening evaluation consisted of evaluating detected concentrations of PCE, TCE, cis-1,2-DCE, and vinyl chloride in conjunction with natural attenuation indicator parameter data. The screening evaluation was performed based on the criteria presented in Table 5-2 as provided in the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (EPA 1998a). The following wells were selected for the evaluation:

- Three saprolite wells - SMW-10 is located on the Ramallo/CCC property source area with consistently high concentrations of PCE and TCE. SMW-1 and SMW-9 are located downgradient of SMW-10.
- Two bedrock wells - MPW-1 and MPW-5 had consistent detections of PCE. Three depth intervals were evaluated in each bedrock well.
- Background conditions – One saprolite well (SMW-12) and one bedrock well (MPW-2) were selected to evaluate background conditions.

Tables 5-3 and 5-4 present the MNA indicator parameters for each well. The locations of monitoring wells are depicted in Figure 2-2. Background conditions are summarized in Table 5-5.

The DO concentration near the source area was below 0.5 mg/L, which is supportive of reductive dechlorination. Oxygen levels fluctuated slightly around 0.5 mg/L in the downgradient plume area saprolite wells and bedrock wells. The concentrations of nitrate were above the criterion of 1 mg/L in all wells, which may inhibit reductive dechlorination. The concentrations of ferrous iron (Fe II) were uniformly low in saprolite wells and were not detected in bedrock wells, indicating that a highly reduced geochemical environment generally associated with iron-reduction is not present. Sulfate concentrations were all below the criterion of 20 mg/L. Sulfide was not detected at any location. As such, it is uncertain if anaerobic biodegradation using sulfate as an electron receptor is occurring or has occurred. None of the saprolite groundwater samples had methane concentrations approaching the criterion of 0.5 mg/L. On the contrary, methane was detected in all bedrock wells at concentrations up to 4.3 mg/L. The methane data indicate that anaerobic degradation of chlorinated VOCs by methanogenesis, if is occurring, is limited to the bedrock aquifer.

As indicated in Tables 5-3 and 5-4, there is no accumulation of chloride above background levels. Similarly, there is minimal difference in the alkalinity in the contaminated wells and in the background wells. Thus, changes in chloride and alkalinity in groundwater from the wells offer little indication that reductive dechlorination has produced carbon dioxide and chloride.

The pH and temperature of groundwater samples were mostly within optimal ranges for active biological growth. Exceptions are SMW-10 and SMW-9 where higher pH values were reported. TOC concentrations in groundwater were uniformly low, which indicate that there is insufficient organic

carbon in groundwater as electron donors to drive reductive dechlorination processes to completion. Alternatively, petroleum hydrocarbons (BTEX) can serve as electron donors to support reductive dechlorination. However, BTEX were not detected above the criterion of 100 µg/L. Thus, the BTEX compounds are not available to support reductive dechlorination.

The total scores for the saprolite and bedrock groundwater range from 6 to 13. Based on EPA criteria summarized in Table 5-6, there is limited evidence that anaerobic biodegradation of chlorinated VOCs is occurring at the site. Despite the weak indication, TCE and cis-1,2-DCE are present in the source area and downgradient monitoring wells in both the saprolite and bedrock groundwater. TCE is most likely produced as a degradation product of PCE and cis-1,2-DCE as a daughter product of TCE. There is very little vinyl chloride in groundwater. If vinyl chloride is formed, it does not accumulate. The lack of organic carbon concentrations in groundwater is probably the primary reason that complete and sustainable reductive dechlorination of chlorinated VOCs has not occurred at the site.

5.6 Fate and Transport Summary

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 the site, including geological and hydrogeological characteristics. The primary fate and transport aspects are summarized below.

- PCE and its degradation daughter products have migrated from the ground surface through the unconsolidated zone and into groundwater. Some of the PCE mass is retained by capillary forces in the pores of soil.
- The greatest potential for the transport of the chlorinated VOCs is through continuous dissolution of contaminants in soil and vertical migration to groundwater, groundwater migration, and volatilization.
- Dissolved contaminants move with the groundwater flow in the saprolite toward the southwest and eventually discharge into Rio Arroyata. Dissolved contaminants in the saprolite may enter the shallow bedrock groundwater through bedrock bedding planes and fractures.
- Chlorinated VOCs in soil and groundwater may migrate as vapor. Vapor intrusion is a potential concern for occupied buildings at the site, although the initial vapor intrusion testing in buildings at or near the two source areas indicated that no indoor vapors exceeded EPA vapor criteria.
- Based on an evaluation of MNA there is limited evidence that anaerobic biodegradation of chlorinated VOCs is occurring at the site. However, TCE and cis-1,2-DCE are present in the source area and downgradient monitoring wells in both the saprolite and bedrock groundwater. TCE is most likely produced as a degradation product of PCE and cis-1,2-DCE as a daughter product of TCE. There is very little vinyl chloride in groundwater, indicating an incomplete dechlorination process.

5.7 Conceptual Site Model

The CSM (Figure 5-1) is developed to integrate the information collected during the RI, including the site physical setting, the nature and extent of contamination, and contaminant fate and transport.

5.7.1 Physical Setting

Bedrock underlying the site consists of pre-Robles fractured volcanic breccias. The bedrock is overlain by 45 to 60 feet of chemically weathered saprolite. Approximately 55 to 105 feet of unconsolidated silty clay overlies the saprolite; this unit contains remnant high angle fracture structures or lineations that may increase the downward migration of water and contaminants. The silty clay is over 100 feet thick in the northern drainage area by IDC, but approximately 70 feet thick in the southern area by Ramallo/CCC.

The Cidra site is located within the Central Volcanic Province, which contains numerous major strike-slip faults, including the Arroyata fault located approximately 0.25 mile south of the Cidra commercial district. Over most of the site, bedrock strikes northeast/southwest, and net groundwater flow in the bedrock is to the west/southwest; however, in the IVAX area, bedrock strikes perpendicular to this orientation (northwest/southeast), and groundwater in the bedrock is presumed to flow to the southeast. Groundwater flow in the bedrock is dominated by secondary permeability in fractures, lineations, and bedding planes. Within the saprolite layer, groundwater flows to the southwest and discharges through seeps to the Rio Arroyata. The saprolite is a major water-bearing unit that provides storage to the underlying bedrock.

5.7.2 Contaminant Sources

Two main sources of contamination were identified in soils at IDC and at Ramallo/CCC. Both properties are located upgradient of documented groundwater contamination at the site.

At the IDC, PCE levels in soil were as high as 1,700,000 µg/kg; the highest levels were concentrated in the top 12 feet in the southeastern corner in an alley. However, samples as deep as 60 feet bgs in other areas still exceeded the screening criterion.

At Ramallo/CCC, the highest level of PCE, 3,300,000 µg/kg, was found in the top two feet along the eastern side of the site. Screening criteria exceedances were found as deep as 72 feet bgs.

5.7.3 Groundwater

The general contaminant transport in groundwater in the two source areas is summarized below.

Ramallo/CCC Area

- Contaminants were likely discharged directly to the ground at the Ramallo/CCC source area, and migrated downward with precipitation through lineations in the overburden, drawing dissolved contamination deeper into the soils. Along these flow paths, contamination diffuses into the surrounding low permeability clay matrix. Contamination then migrated into the groundwater aquifer in the underlying saprolite.

- PCE contamination moves southwest with groundwater flow in the saprolite, as evidenced by PCE levels in SMW-10 and SMW-1, 1,700 µg/L and 680 µg/L, respectively. The saprolite layer contains the highest levels of PCE in groundwater at the site, and recharges the underlying bedrock aquifer. Figure 4-11 shows the general orientation of the PCE contaminant plume in the saprolite zone, which extends horizontally to the Rio Arroyata.

- Contamination enters bedrock bedding planes and fractures just upgradient of MPW-1 between Ramallo and MPW-1, as evidenced by PCE in shallow bedrock in this well. Contamination spreads along strike (primarily to the south), and downdip (west). MPW-5 and Cidra 8 are along this contaminant migration pathway, and exhibit contamination at deeper depths.

International Dry Cleaner Area

Contaminant transport is slightly different in this area.

- Contaminants were likely discharged directly to the ground at IDC. The majority of the surface in the vicinity of IDC is overlain by buildings and roads, which prohibit the majority of precipitation from infiltrating into the overburden. As a result, the bulk of precipitation drains via overland flow toward the northern drainage area. The remainder migrates downward through the overburden in unpaved areas and through areas where contaminants were discharged, resulting in the accumulation of dissolved contamination in the infiltrating water. Infiltration into the soil is possibly enhanced by lineations. Along the infiltration pathways, contamination diffuses into the surrounding low permeability clay matrix. Contaminant transport to the depth of groundwater through this unit may be hindered in this area, as compared to Ramallo, due to greater overburden thickness in this area (approximately 30 feet thicker) and gradation to finer-grained soils with depth.

- Low-levels of contamination are presumed to eventually reach the saprolite zone and migrate to the top of bedrock (site-related contaminants did not exceed screening criteria in SMW-2, located downgradient of IDC).

- Once in bedding planes and fractures, contamination spreads along strike and moves down dip. The overall flow direction is to the southwest, resulting in low levels of PCE in downgradient wells: MPW-2 (0.68 µg/L was highest concentration), MPW-3 (2.8 µg/L was highest concentration), MPW-4 (2 µg/L was highest concentration), and Cidra 3 (1.4 µg/L).

5.6.4 Surface Water /Sediment

Groundwater contamination migrating in the saprolite zone from Ramallo/CCC discharges to the Rio Arroyata via seeps. Contaminant levels in the surface water, which are below screening criteria, are highest in areas adjacent to nearby saprolite wells, and generally decrease downstream.

Section 6

Summary of Risk Assessments

6.1 Summary of Human Health Risk Assessment

The HHRA is developed to characterize potential human health risks associated with the site in the absence of any remedial action. The HHRA is conducted in accordance with current EPA guidance outlined in Risk Assessment Guidance for Superfund (RAGS), Parts A, D, E, and F and other EPA guidance pertinent to human health risk assessments.

6.1.1 Exposure Assessment

Based on the RI results, the site is divided into the following four exposure areas for soil for the risk evaluation:

- Exposure Area 1: Ramoncito, Don Quixote Pizza, Coffee Shop, and ESSO
- Exposure Area 2: IDC
- Exposure Area 3: CCL Label, Ramallo/CCC) and ENCO
- Exposure Area 4: Shellfoam, DJ Manufacturing, IVAX, and Pepsi

Chemicals of potential concern (COPCs) are identified based on criteria outlined in RAGS, primarily through comparison to risk-based screening levels. Potential exposure pathways at the site are defined based on potential source areas, release mechanisms, and current and potential future uses of the site. Potential receptors evaluated in the risk assessment include:

- Current Land-Use Scenario
  - Workers, Trespassers, and Residents at Exposure Area 2
  - Workers at Exposure Areas 3 and 4
  - Recreational Users at Rio Arroyata
- Future Land-Use Scenario
  - Workers, Trespassers, Residents, and Construction Workers at All Exposure Areas
  - Recreational Users at Rio Arroyata

Exposure pathways evaluated for soil include ingestion of and dermal contact with soil, inhalation of particulates from soil by commercial/industrial workers, trespassers, residents, and construction workers. Exposure pathways evaluated for groundwater include ingestion of and dermal contact with groundwater, inhalation of vapor released during showering and bathing, and inhalation of vapor through vapor intrusion by commercial/industrial workers and residents. Exposure pathways

evaluated for surface water and sediment include ingestion of and dermal contact by recreational users.

Quantification of exposure includes evaluation of exposure parameters that describe the exposed population (e.g., contact rate, exposure frequency and duration, and body weight). Daily intakes are calculated based on the reasonable maximum exposure (RME) scenario (the highest exposure reasonably expected to occur at a site). The intent is to estimate a conservative exposure case that is still within the range of possible exposures. Central tendency exposure (CTE) assumptions are also developed, when the estimated risks under RME scenario exceed EPA's threshold risk range. CTE scenarios reflect more typical exposures.

6.1.2 Toxicity Assessment

COPCs are quantitatively evaluated on the basis of their noncancer and/or cancer potential. The reference dose and reference concentration are the toxicity values used to evaluate noncancer health hazards in humans. Inhalation unit risk and slope factor are the toxicity values used to evaluate cancer health effects in humans. These toxicity values are obtained from various sources following the hierarchy order specified by EPA.

6.1.3 Risk Characterization

To characterize potential noncancer health effects, comparisons are made between estimated intakes of substances and toxicity thresholds. Potential cancer effects are evaluated by calculating probabilities that an individual will develop cancer over a lifetime exposure based on projected intakes and chemical specific dose-response information. In general, EPA recommends target risk values (i.e., cancer risk of 10^{-6} (1 in a million) to 10^{-4} (1 in a 10,000) or noncancer health hazard index [HI] of unity) as threshold values for potential human health impacts. These target values aid in determining whether additional remedial action is necessary at the site.

As presented Table 6-1, under the RME scenario, receptors having cancer risks above the EPA's target range of 1×10^{-6} to 1×10^{-4} are future workers and residents at all exposure areas. Cancer risk for future residents is due to exposure to arsenic (68%) and chloroform (19%) in groundwater, and cancer risk for future workers is due to exposure to arsenic in groundwater. When a more typical exposure is considered under the CTE scenario, cancer risks for workers are within EPA's target range, but cancer risks for residents are still above EPA's target range with arsenic being the risk driver. Risks associated with arsenic are overestimated because the arsenic is most likely remnants from the blank FLUTe ™ liners placed in the boreholes to prevent cross contamination between fracture zones. At the time the FLUTe ™ liners were purchased for Cidra, arsenic was used as a fungicide in the FLUTe ™ Liner urethane coating to resist mildew.

The total HIs for all current and future receptors, except current receptors at Exposure Area 2 and future trespassers at Exposure Area 1 under the RME scenario, are above EPA's threshold of unity (1). The current and future workers at Exposure Areas 3 and 4, the current and future recreational users, and the future construction workers have noncancer HIs exceeding EPA's threshold under the RME scenario for the kidney and respiratory system due to exposure to vanadium in soil. Under the CTE scenario, the total HIs are at or below EPA's threshold. The future residents have noncancer HIs

exceeding EPA's threshold under the RME scenario for the cardiovascular system, central nervous system (CNS), developmental, heart, immune system, kidney, liver, lung, nervous system, respiratory system, skin, and thyroid due to exposure to PCE, 1,1,2-trichloroethane, TCE, arsenic, cobalt, and vanadium. Under the CTE scenario, the total HIs are still above EPA's threshold. The potential health hazards to cardiovascular system, CNS, development, kidney, liver, lung, nervous system, respiratory system, and skin are due to exposure to arsenic, PCE, and vanadium in soil and groundwater. Risks associated with arsenic and vanadium are most likely overestimated.

Future residents may potentially be exposed to volatile COPCs via inhalation of vapor emanating from groundwater into enclosed structures via vapor intrusion and into ambient air via vaporization.

6.2 Summary of Screening Level Ecological Risk Assessment

A SLERA was conducted for the site to evaluate the potential for risk to ecological receptors from exposure to site media. Conservative assumptions were used to identify exposure pathways and, where possible, quantify potential ecological risks. The SLERA was prepared in accordance with the following documents:

- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final (EPA 1997)
- Guidelines for Ecological Risk Assessment (EPA 1998b)

The SLERA evaluated the potential for risk from exposure to chemicals through direct contact with site sediment and surface water via one assessment endpoint aimed at the protection of aquatic receptors utilizing the Rio Arroyata. All data used in the SLERA was collected in support of the RI. Sediment and surface water data were evaluated using a single maximum value of chemicals detected in each medium via comparison with media and chemical-specific ecological screening levels (ESLs).

PCE was detected in one sediment sample, and cis-1,2-DCE, PCE, and TCE were detected in surface water samples taken from the Rio Arroyata;. However, all concentrations were orders of magnitude below their respective ESLs. Therefore, the site poses no site-related risk to ecological receptors.

Results of the SLERA indicated potential risk from exposure to several metals. In general, concentrations of these metals in background samples were either higher than, or similar to the maximum concentrations of metals detected in site sediment and surface water. The concentrations of metals detected are most likely reflective of natural conditions, or non site-related sources.

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Section 7

Conclusions

Based on the soil data, the RI identified the IDC and Ramallo/CCC properties as sources of contamination at the site. Site-related contaminants, PCE, TCE, and cis-1,2-DCE, were found at levels above screening criteria in soils at both facilities; 1,1-DCE and vinyl chloride were found at levels above screening criteria at Ramallo/CCC. Ramallo/CCC is located upgradient of groundwater contamination exceeding screening levels, whereas the levels in groundwater downgradient of IDC are below screening criteria. The two source areas differ with respect to migration of site-related contaminants, as described below.

International Dry Cleaners Source Area

- Site-related contaminants exceed soil screening criteria in several soil samples at IDC. The highest levels of site-related contaminants at IDC are concentrated in the top 12 feet of soil in an alley located along the southeast corner of the property: 1,700,000 µg/kg of PCE, 39,000 µg/kg of TCE, and 29,000J µg/kg of cis-1,2-DCE. The vertical extent of contamination in this area is not defined due to depth limitations of hand auger sampling methods. In areas that were accessible to the DPT rig, and deeper samples were collected (as deep as 60 feet bgs), contaminant levels were several orders of magnitude lower, although many still exceeded soil screening criteria.

- Lineations, such as those observed in soils at IDC, generally tend to enhance transport of contaminants through the soil to the underlying groundwater. However, the bulk of soil contamination at IDC does not appear to have migrated to downgradient wells, as evidenced by the fact that site-related contaminants in wells downgradient of IDC do not exceed groundwater screening criteria. Possible reasons for this are outlined below.

  - The majority of the surface in the vicinity of IDC is overlain by buildings and roads, which prohibit the majority of precipitation from infiltrating into overburden soil. As a result, the bulk of precipitation drains via overland flow toward the northern drainage area, with a limited amount available to migrate vertically through the overburden.

  - Any vertical migration is further hindered by the underlying soil thickness (over 100 feet thick) and its tendency to grade to finer material with depth.

Ramallo Source Area

- Site-related contaminants exceed soil screening criteria in several soil samples at Ramallo/CCC. The highest levels of site-related contaminants at Ramallo/CCC are concentrated in the top 8 feet in a boring located in the northeastern corner of the property: 3,300,000 µg/kg of PCE, 2,700J µg/kg of TCE, 41,000 µg/kg of cis-1,2-DCE, 120 µg/kg of 1,1-DCE, and 2,000 µg/kg of vinyl chloride. The vertical extent of contamination in the northern and eastern areas of the property is not fully defined, as evidenced by screening criteria exceedances in the bottom of several borings in these areas; soil contamination extends to depths of 72 feet bgs in some borings.

- Levels of site-related contaminants exceed screening criteria in several bedrock and saprolite wells in the vicinity of Ramallo/CCC. The highest level of groundwater contamination (1,700 µg/L of PCE) occurs in SMW-10 located on the Ramallo/CCC property; this well is screened from 62 to 72 feet bgs, the bottom of which extends into the underlying saprolite zone. The saprolite thickness ranges from 45 to 60 feet; groundwater is semi-confined under the overlying soils. Once in the saprolite zone, contaminants move southwest with groundwater, as described below.

- Some of the contaminated groundwater then enters the bedrock aquifer via fractures and bedding planes at the base of the saprolite zone. Contaminants then migrate with groundwater flow in the bedrock: to the south along strike, and to the west-northwest along bedding planes. Cidra-8 and MPW-5, which are in this flow path, contain the highest levels of contaminants in the bedrock; PCE exceedances in MPW-5 range from 11 to 120 µg/L, and up to 85 µg/L in Cidra-8.

- Still other contaminated groundwater continues to flow southwest in the saprolite zone toward the Rio Arroyata. Based on the hydrologic connection between groundwater and the Rio Arroyata, observed seeps along the river, and the presence of low levels (below screening criteria) of site-related contaminants in surface water, contaminated groundwater is discharging to the Rio Arroyata. Although contaminated groundwater from the saprolite zone has reached the river, it is unknown whether the plume has migrated under the river.

The vertical extent of groundwater contamination has not been defined in saprolite or bedrock aquifers, given that saprolite wells are completed in the top of this zone, and given that contamination exists at levels above screening criteria in the bottom of MPW-5 and MPW-6.

Although the vertical extent of contamination has not been defined in some areas, contamination has been characterized to the extent needed to complete the RI/FS and risk assessments. Additional characterization may be necessary during the pre-design stage.

Section 8
References

Anderson, M.R., Johnson, R.L., and Pankow, J.F. 1992. Dissolution of Dense Chlorinated Solvents into Groundwater. 3. Modeling Contaminant Plumes from Fingers and Pools of Solvent. Environmental Science Technology, 26, 901-906.

Bedient, P. B. 1994. Rifai H. S.; Newell, C.J. Ground Water Contamination. Transport and Remediation. Prentice Hall. Engelwood Cliffs, New Jersey, 1994.

Bourg, A.C., C. Mounvet and D.N. Lerner. 1992. A Review of the Attenuation of Trichloroethylene in Soils and Aquifers. Quarterly Journal of Engineering Geology and Hydrogeology, v. 25, p. 359-370.

Bouwer 1994., Bouwer, E.J. 1994 Bioremediation of Chlorinated Solvents Using Alternate Electron Acceptors Handbook of Bioremediation R.D. Norris, R.E. Hinchee, R. Brown, P.L. McCarty, L. Semprini, J.T. Wilson, D.H. Kampbell, M. Reinhard, E.J. Bouwer, R.C. Borden, T.M. Vogel, J.M. Thomas, and C.H. Ward eds Lewis Publishers, Boca Raton, Florida pp. 149-175

CDM Smith. 2006. Final Work Plan Volume I. Cidra Groundwater Contamination Site, Remedial Investigation Feasibility Study, Cidra, Puerto Rico. June 13.

_____. 2007. Final Quality Assurance Project Plan. Cidra Groundwater Contamination Site, Remedial Investigation Feasibility Study, Cidra, Puerto Rico. April.

_____. 2009. Stage 1 Technical Memorandum. Cidra Groundwater Contamination site, Remedial Investigation Feasibility Study, Cidra Puerto Rico. April 2009.

_____. 2010a. Final Quality Assurance Project Plan Addendum. Cidra Groundwater Contamination Site, Remedial Investigation Feasibility Study, Cidra, Puerto Rico. March 18.

_____. 2010b. Work Plan Letter. Cidra Groundwater Contamination site, Remedial Investigation Feasibility Study, Cidra Puerto Rico. March 4.

_____. 2011. Stage 2 Technical Memorandum. Cidra Groundwater Contamination Site, Remedial Investigation Feasibility Study, Cidra Puerto Rico. April 2011.

_____. 2012. Final QAPP Addendum 2 – Stage 2a Vapor Intrusion Investigation. Cidra Groundwater Contamination Site, Remedial Investigation Feasibility Study, Cidra Puerto Rico. September 7, 2012

Chapelle 1993., Francis H. Chapelle Ground-Water Microbiology and Geochemistry. John Wiley & Sons Incorporated

Driscoll F. G. 1986. Groundwater and Wells. Second Edition. Johnson Filtration Systems, Inc. p. 1021.

Efroymson et al. 1997. Preliminary Remediation Goals for Ecological Endpoints (Efroymson et al. 1997)

U.S. Environmental Protection Agency (EPA). 1996. Assessment and Remediation of Contaminated Sediments (ARCS) Program. 905/R96/008.

_____. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. EPA 540-R-97-006. June.

_____. 1998a. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. September.

_____. 1998b. Guidelines for Ecological Risk Assessment. EPA/630-R-95/002F. April.

_____. 1999. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. OSWER Directive Number 9200.4-17P. April.

_____ . 2000. Pre-CERCLIS Screening Report, Puerto Rico Well Field Survey Project, Cidra Puerto Rico. Cidra, Puerto Rico. Region 2 Site Assessment Team (SAT), Weston Solutions, Inc. October.

_____. 2002. Generic SSLs for the Residential and Commercial/Industrial Scenario, Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Appendix A-C. Accessed August 2007. http://www.epa.gov/superfund/health/conmedia/soil/index.html

_____. 2003a. Hazard Ranking System Documentation Package (HRS), Cidra Groundwater Contamination Site, Cidra, Puerto Rico: Region 2 Site Assessment Team (SAT), Weston Solutions, Inc. December.

_____. 2003b. Expanded Site Inspection/Remedial Investigation Report (ESI), Cidra Groundwater Plume, Cidra, Puerto Rico: Region 2 Site Assessment Team (SAT), Weston Solutions, Inc. September.

_____. 2003c. EPA Region 5 Resource Conservation Recovery Act (RCRA) Ecological Screening Levels.

_____. 2007. EPA Ecological Soil Screening Levels (EcoSSLs).

_____. 2009. National Primary Drinking Water Regulations.

_____. 2012a. Vapor Intrusion Screening Levels. November.

_____. 2012b. Regional Screening Levels for Chemical Contaminants at Superfund Sites. November.

Freeze, R.A. and J.A. Cherry. 1979. Groundwater, Prentice Hall, Inc., Englewood Cliffs, New Jersey.

The Geological Society of America. 1998. Tectonics and Geochemistry of the Northeastern Caribbean. Special Paper 322, edited by E.G. Lidiak and D.K. Larue.

Glover, L. 1971. Geology of the Coamo Area, Puerto Rico, and its Relation to the Volcanic Arc-Trench Association: U.S. Geological Professional Paper 636. 47 pp.

Hazardous Substance Databank (HSDB). 2013. A database of the National Library of Medicine's TOXNET system. http://toxnet.nlm.nih.gov.

Johnson, R.L. and Pankow, J.F. 1992. Dissolution of Dense Chlorinated Solvents into Groundwater. 2. Source Functions for Pools of Solvent. Environmental Science Technology, 26, 896-901.

Lucius, J.E. et al. 1990. Properties and Hazards of 108 Selected Substances. USGS Open File Report 90-4089, pp 559.

MacDonald et al. 2000. Consensus-based threshold effects concentrations (TEC), (MacDonald et al. 2000)

MacKay, D.M., P.V. Robert, and J.A. Cherry. 1985. Transport of Organic Contaminants in Groundwater, Environmental Science and Technology, Vol. 19, No. 5.

McCarty, P.L., Reinhard, M. and Rittman, B.L. 1981. Trace Organics in Groundwater. Environmental Science and Technology, v. 15, p, 40-51.

Miller J. A. et al. 1997. Groundwater Atlas of the United States. Segment 13, Alaska, Hawaii, Puerto Rico, and the US Virgin Islands. US Geological Survey Hydrogeologic Investigations Atlas 730-N.

National Oceanic and Atmospheric Administration (NOAA) website - http://www.srh.noaa.gov/sju/?n=climo_cidra#1e.

Pease, M.H and Briggs, R. P. 1960. Geologic Map of the Comerio Quadrangle, Puerto Rico: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-320.

Persaud et al. 1993. Ontario Lowest Effect Levels (LELs) (Persaud et al. 1993)

Ramos-Gines, O. 1997. Water balance and quantification of total phosphorous and total nitrogen loads entering and leaving the Lago de Cidra, Central Puerto Rico: U.S. Geological Survey Water Resources Investigation Report 96-4222, 28 pp.

Reilly, T.E., Frank, H.T. Buxton, and G.D. Bennett. 1987. A Conceptual Framework for Groundwater Solute-Transport Studies with Emphasis on Physical Mechanisms of Solute Movement, USGS Water Resources Investigations Report 87-419.

Rutgers University. 1993. Site-Specific Retardation Factor Study - Final Report King of Prussia Technical Corporation Site. Winslow Township. New Jersey.

University of Idaho. Soils information available at the Collected of Agricultural and Life Sciences website. http://soils.cals.uidaho.edu/soilorders/oxisols_07.htm

2010 U.S. Census. http://www.census.gov/2010census/

US Geological Society. 1957. 7.5-minute Series topographic Map, comerio Quadrangle, Puerto Rico. Photorevised 1982.

United States Geological Survey (USGS). 2002. Natural Attenuation of Chlorinated Volatile Organic Compounds in Ground Water at Operable Unit 1, Naval Undersea Warfare Center, Division Keyport, Washington.

USDA. 2012. Custom Soil Resource Report for the San Juan Area, Cidra Groundwater Contamination Site. September 4.

Veve, Thalia V. and Taggart, Bruce E., 1996. Atlas of Ground-Water Resources in Puerto Rico and the U.S. Virgin Islands: U.S. Geological Survey Water Resources Investigation Report 94-4198, 151 pp.

Wiedemeier et al. 1999., Todd Wiedemeier et al. Natural Attenuation of fuels and chlorinated solvents in the subsurface. John Wiley Corp.

Tables

Table 2-1
Stage 1 and Stage 2 Soil Boring Sample Summary - Former Dry Cleaners
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TCL SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
Coffee Shop	Stage 1	CSSB-01-A	12/12/2007	1-2	X	X	X	X	
		CSSB-01-B	12/12/2007	5-6	X	X	X	-	
		CSSB-02-A	12/12/2007	1-2	X	X	X	-	MS/MSD
		CSSB-02-B	12/12/2007	5-6	X	X	X	X	
Don Quixote Pizza	Stage 1	DQSB-01-A	12/13/2007	2-4	X	X	X	-	
		DQSB-02-A	12/13/2007	2-4	X	X	X	-	
		DQSB-03-A	12/13/2007	2-4	X	X	X	-	
Ramoncito	Stage 1	RCTSB-01-A	12/14/2007	0-2	X	X	X	-	
		RCTSB-02-A	12/14/2007	0-3	X	X	X	-	
		RCTSB-101-A	12/14/2007	0-2	X	X	X	-	Duplicate of RCT-01-A
IDC	Stage 1	IDCSB-01-A	12/13/2007	1-4	X	X	X	X	
		IDCSB-03-A	12/13/2007	3-4	X	X	X	-	
		IDCSB-03-B	12/13/2007	4-6	X	X	X	-	
		IDCSB-04-A	12/13/2007	2-4	X	X	X	X	
		IDCSB-103-B	12/13/2007	4-6	X	X	X	-	Duplicate of IDCSB-03-B
	Stage 2	IDCSB-05-A	6/3/2010	0-4	X	-	-	-	
		IDCSB-05-B	6/3/2010	4-8	X	-	-	-	
		IDCSB-05-C	6/3/2010	8-12	X	-	-	X	
		IDCSB-005-C	6/3/2010	8-12	X	-	-	-	Duplicate of IDCSB-05-C
		IDCSB-05-D	6/3/2010	20-24	X	-	-	-	
		IDCSB-05-E	6/3/2010	32-36	X	-	-	X	
		IDCSB-05-F	6/3/2010	44-48	X	-	-	-	
		IDCSB-05-G	6/3/2010	56-60	X	-	-	-	
		IDCSB-06-A	6/3/2010	0-4	X	-	-	-	
		IDCSB-06-B	6/3/2010	4-8	X	-	-	-	
		IDCSB-06-C	6/3/2010	8-12	X	-	-	X	
		IDCSB-06-D	6/4/2010	20-24	X	-	-	-	
		IDCSB-06-E	6/4/2010	32-36	X	-	-	-	
		IDCSB-06-F	6/4/2010	44-48	X	-	-	X	
		IDCSB-06-G	6/4/2010	56-60	X	-	-	-	
		IDCSB-07-A	6/4/2010	0-4	X	-	-	-	
		IDCSB-07-B	6/4/2010	4-8	X	-	-	-	
		IDCSB-07-C	6/4/2010	8-12	X	-	-	X	
		IDCSB-007-C	6/4/2010	8-12	X	-	-	-	Duplicate of IDCSB-07-C (VOCs only)
		IDCSB-07-D	6/4/2010	20-24	X	-	-	-	
		IDCSB-07-E	6/4/2010	32-36	X	-	-	-	
		IDCSB-07-F	6/4/2010	44-48	X	-	-	X	
		IDCSB-08-A	6/7/2010	0-4	X	-	-	-	
		IDCSB-08-B	6/7/2010	4-8	X	-	-	-	
		IDCSB-08-C	6/7/2010	8-12	X	-	-	X	
		IDCSB-08-D	6/7/2010	20-24	X	-	-	X	
		IDCSB-008-D	6/7/2010	20-24	X	-	-	X	Duplicate of IDCSB-08-D
		IDCSB-08-E	6/7/2010	32-36	X	-	-	-	
		IDCSB-08-F	6/7/2010	44-48	X	-	-	-	

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Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TCL SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
IDC (continued)	Stage 2 (continued)	IDCSB-08-G	6/7/2010	56-60	X	-	-	-	
		IDCSB-09-A	6/7/2010	0-4	X	-	-	-	
		IDCSB-09-B	6/7/2010	4-8	X	-	-	-	
		IDCSB-09-C	6/7/2010	8-12	X	-	-	X	
		IDCSB-09-D	6/8/2010	20-24	X	-	-	-	
		IDCSB-09-E	6/8/2010	32-36	X	-	-	X	
		IDCSB-09-F	6/8/2010	44-48	X	-	-	-	
		IDCSB-10-A	6/8/2010	0-2	X	-	-	-	
		IDCSB-10-B	6/8/2010	2-4	X	-	-	-	
		IDCSB-10-C	6/8/2010	4-6	X	-	-	X	
		IDCSB-11-A	6/8/2010	0-2	X	-	-	-	
		IDCSB-11-B	6/8/2010	2-4	X	-	-	-	
		IDCSB-11-C	6/8/2010	4-6	X	-	-	X	
		IDCSB-12-A	6/8/2010	0-2	X	-	-	-	
		IDCSB-12-B	6/8/2010	2-4	X	-	-	-	
		IDCSB-13-A	6/8/2010	0-2	X	-	-	-	
		IDCSB-13-B	6/8/2010	2-4	X	-	-	-	
		IDCSB-13-C	6/8/2010	4-6	X	-	-	X	
		IDCSB-14-A	6/8/2010	0-2	X	-	-	-	
		IDCSB-14-B	6/8/2010	2-4	X	-	-	X	

Notes:
[1] TAL Inorganics include metals and cyanide

Abbreviations:
ID - identification
bgs - below ground surface
TCL - Target Compound List
TAL - Target Analyte List
TOC - total organic carbon
IDC - the former International Dry Cleaners
MS/MSD - matrix spike/matrix spike duplicate
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
PCBs - polychlorinated biphenyls

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
Shellfoam	Stage 1	SHSB-01-A	12/6/2007	0-1	X	X	X	-	
		SHSB-01-B	12/6/2007	5-7	X	X	X	X	
		SHSB-01-C	12/6/2007	14-16	X	X	X	-	
		SHSB-02-A	12/6/2007	0-1	X	X	X	-	
		SHSB-02-B	12/6/2007	5-7	X	X	X	-	
		SHSB-02-C	12/6/2007	22-24	X	X	X	-	
		SHSB-02-D	12/6/2007	62-64	X	X	X	-	
		SHSB-03-A	12/6/2007	0-1	X	X	X	-	
		SHSB-03-B	12/6/2007	9-11	X	X	X	-	
		SHSB-03-C	12/6/2007	26-28	X	X	X	X	
		SHSB-04-A	12/7/2007	0-1	X	X	X	-	
		SHSB-04-B	12/7/2007	6-8	X	X	X	-	
		SHSB-04-C	12/7/2007	20-22	X	X	X	-	
		SHSB-04-D	12/7/2007	40-42	X	X	X	-	
		SHSB-05-A	12/7/2007	0-1	X	X	X	-	
		SHSB-05-B	12/7/2007	9-11	X	X	X	-	
		SHSB-05-C	12/7/2007	23-24	X	X	X	-	
		SHSB-05-D	12/7/2007	40-42	X	X	X	-	
		SHSB-06-A	12/7/2007	0-1	X	X	X	-	
		SHSB-06-B	12/7/2007	5-7	X	X	X	-	
		SHSB-06-C	12/7/2007	41-43	X	X	X	-	
		SHSB-06-D	12/7/2007	52-54	X	X	X	-	
		SHSB-07-A	12/6/2007	0-2	X	X	X	-	
		SHSB-07-B	12/6/2007	4-6	X	X	X	-	
		SHSB-08-A	12/7/2007	2-4	X	X	X	-	
		SHSB-09-A	12/10/2007	2-4	X	X	X	-	
		SHSB-10-A	12/10/2007	2-4	X	X	X	-	
IVAX	Stage 1	IVSB-01-A	12/3/2007	0-1	X	X	X	-	
		IVSB-01-B	12/3/2007	8-9.25	X	X	X	X	
		IVSB-01-C	12/3/2007	41-43	X	X	X	-	
		IVSB-01-D	12/3/2007	62-64	X	X	X	-	
		IVSB-02-A	12/3/2007	0-1	X	X	X	-	
		IVSB-02-B	12/3/2007	5-7	X	X	X	X	MS/MSD
		IVSB-02-C	12/3/2007	21-23	X	X	X	-	
		IVSB-02-D	12/3/2007	41-43	X	X	X	-	
		IVSB-03-A	12/3/2007	0-2.5	X	X	X	-	
		IVSB-03-B	12/3/2007	5-7	X	X	X	-	
		IVSB-03-C	12/3/2007	42-44	X	X	X	-	
		IVSB-103-C	12/3/2007	42-44	X	X	X	-	Duplicate of IVSB-03-C
		IVSB-04-A	12/4/2007	0-1	X	X	X	-	
		IVSB-04-B	12/4/2007	5-7	X	X	X	-	
		IVSB-04-C	12/4/2007	41-43	X	X	X	X	
		IVSB-04-D	12/4/2007	62-64	X	X	X	-	
		IVSB-05-A	12/4/2007	1-2	X	X	X	-	
		IVSB-05-B	12/4/2007	9-11	X	X	X	X	
		IVSB-05-C	12/4/2007	41-43	X	X	X	-	
		IVSB-05-D	12/4/2007	62-64	X	X	X	-	
		IVSB-06-A	12/4/2007	1-2	X	X	X	-	
		IVSB-06-B	12/4/2007	5-7	-	X	X	-	

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
IVAX (continued)	Stage 1	IVSB-06-B-RS	12/5/2007	5-7	X	-	-	-	Recollected sample IVSB-06-B (VOCs only)
		IVSB-06-C	12/4/2007	41-43	X	X	X	-	
		IVSB-06-D	12/4/2007	62-64	X	X	X	X	
		IVSB-07-A	12/4/2007	1-2	X	X	X	-	
		IVSB-07-B	12/4/2007	9-11	X	X	X	-	
		IVSB-07-C	12/4/2007	21-23	X	X	X	-	
		IVSB-07-D	12/4/2007	53-55	X	X	X	-	
		IVSB-08-A	12/5/2007	2-4	X	X	X	-	
		IVSB-08-B	12/5/2007	6-8	X	X	X	-	
		IVSB-08-C	12/5/2007	21-23	X	X	X	-	
		IVSB-08-D	12/5/2007	40-42	X	X	X	-	
		IVSB-108-B	12/5/2007	40-42	X	X	X	-	Duplicate of IVSB-08-D
		IVSB-09-A	12/4/2007	0-0.1	X	X	X	-	
		IVSB-09-B	12/5/2007	9-11	X	X	X	X	
		IVSB-09-C	12/5/2007	21-23	X	X	X	-	
		IVSB-09-D	12/5/2007	32-34	X	X	X	X	
		IVSB-10-A	12/5/2007	1-2	X	X	X	-	MS/MSD
		IVSB-10-B	12/5/2007	8-10	X	X	X	X	
		IVSB-10-C	12/5/2007	22-24	X	X	X	-	
		IVSB-10-D	12/5/2007	32-34	X	X	X	-	
Pepsi	Stage 1	PESB-01-A	11/16/2007	0.2-1	X	X	X	-	
		PESB-01-B	11/16/2007	5-7	X	X	X	-	
		PESB-01-C	11/16/2007	21-23	X	X	X	-	
		PESB-01-D	11/16/2007	60-62	X	X	X	-	
		PESB-02-A	11/16/2007	0.2-1	X	X	X	-	
		PESB-02-B	11/16/2007	5-7	X	X	X	-	
		PESB-02-C	11/16/2007	21-23	X	X	X	-	
		PESB-02-D	11/16/2007	60-63	X	X	X	-	
		PESB-03-A	11/15/2007	0.5-1.5	X	X	X	-	
		PESB-03-B	11/15/2007	5-7	X	X	X	X	
		PESB-03-C	11/15/2007	21-23	X	X	X	-	MS/MSD
		PESB-03-D	11/15/2007	62-64	X	X	X	-	
		PESB-04-A	11/15/2007	3.5-4	X	X	X	-	
		PESB-04-B	11/15/2007	9-11	X	X	X	-	
		PESB-04-C	11/15/2007	21-23	X	X	X	X	
		PESB-04-D	11/15/2007	41-43	X	X	X	-	
		PESB-05-A	11/15/2007	0.2-1	X	X	X	-	
		PESB-05-B	11/15/2007	2-4	X	X	X	X	
		PESB-05-C	11/15/2007	5-7	X	X	X	-	
		PESB-105-C	11/15/2007	5-7	X	X	X	-	Duplicate of PESB-05-C
		PESB-05-D	11/15/2007	60-62	X	X	X	-	
		PESB-06-A	11/14/2007	0-1	X	X	X	-	
		PESB-06-B	11/14/2007	5-7	X	X	X	-	
		PESB-06-C	11/14/2007	21-22	X	X	X	-	
		PESB-06-D	11/14/2007	62-64	X	X	X	X	
		PESB-07-A	11/14/2007	0-1	X	X	X	-	
		PESB-07-B	11/14/2007	5-7	X	X	X	-	

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
Pepsi (continued)	Stage 1	PESB-07-C	11/14/2007	21-23	X	X	X	X	
		PESB-07-D	11/14/2007	62-64	X	X	X	-	
		PESB-08-A	11/14/2007	0.2-1	X	X	X	-	
		PESB-08-B	11/14/2007	5-7	X	X	X	X	
		PESB-08-C	11/14/2007	9-11	X	X	X	-	
		PESB-08-D	11/14/2007	51.5-53.5	X	X	X	-	
		PESB-09-A	11/13/2007	0.2-1	X	X	X	-	
		PESB-09-B	11/13/2007	9-11	X	X	X	X	
		PESB-09-C	11/13/2007	41-43	X	X	X	-	
		PESB-109-B	11/13/2007	41-43	X	X	X	-	Duplicate of PESB-09-C
		PESB-09-D	11/13/2007	62-64	X	X	X	-	
		PESB-10-A	11/13/2007	0-1	X	X	X	-	
		PESB-10-B	11/13/2007	5-7	X	X	X	-	
		PESB-10-C	11/13/2007	21-23	X	X	X	-	
		PESB-10-D	11/13/2007	39-40	X	X	X	-	
ESSO Gas Station	Stage 1	ESSB-01-A	11/19/2007	4-6	X	X	X	-	
		ESSB-01-B	11/19/2007	9-11	X	X	X	X	
		ESSB-01-C	11/19/2007	41-43	X	X	X	-	MS/MSD
		ESSB-01-D	11/26/2007	60-62	X	X	X	-	
		ESSB-02-A	11/19/2007	4-6	X	X	X	-	
		ESSB-02-B	11/19/2007	9-11	X	X	X	X	
		ESSB-02-C	11/19/2007	21-23	X	X	X	-	
		ESSB-02-D	11/19/2007	56-58	X	X	X	-	
		ESSB-03-A	11/19/2007	4-5	X	X	X	-	
		ESSB-03-B	11/19/2007	9-11	X	X	X	-	
		ESSB-03-C	11/19/2007	41-43	X	X	X	-	
		ESSB-03-D	11/19/2007	56-58	X	X	X	-	
		ESSB-04-A	11/20/2007	0-1	X	X	X	-	
		ESSB-04-A	11/20/2007	2-4	X	X	X	-	
		ESSB-04-B	11/20/2007	9-11	X	X	X	-	
		ESSB-04-C	11/20/2007	21-23	X	X	X	X	
		ESSB-104-C	11/20/2007	21-23	X	X	X	X	Duplicate of ESSB-04-C
		ESSB-04-D	11/20/2007	52-54	X	X	X	-	
		ESSB-05-A	11/20/2007	0.2-4	X	X	X	-	
		ESSB-05-B	11/20/2007	5-7	X	X	X	-	
		ESSB-05-C	11/20/2007	21-23	X	X	X	X	
		ESSB-05-D	11/20/2007	52-54	X	X	X	-	
		ESSB-06-A	11/26/2007	0-1	X	X	X	-	
		ESSB-06-B	11/26/2007	9-11	X	X	X	-	
		ESSB-06-C	11/26/2007	21-23	X	X	X	-	
		ESSB-06-D	11/26/2007	52-54	X	X	X	-	
		ESSB-07-A	11/29/2007	2-4	X	X	X	-	
		ESSB-07-B	11/29/2007	6-8	X	X	X	-	
		ESSB-08-A	11/26/2007	0-1	X	X	X	-	
		ESSB-08-B	11/26/2007	5-7	X	X	X	-	
		ESSB-08-C	11/26/2007	21-23	X	X	X	-	
		ESSB-08-D	11/26/2007	62-64	X	X	X	-	
		ESSB-09-A	11/28/2007	0-1	X	X	X	-	MS/MSD
		ESSB-09-B	11/28/2007	9-11	X	X	X	X	

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
ESSO Gas Station (continued)	Stage 1	ESSB-09-C	11/28/2007	21-23	X	X	X	-	
		ESSB-09-D	11/28/2007	42-44	X	X	X	-	
		ESSB-10-A	11/28/2007	0-1	X	X	X	-	
		ESSB-10-B	11/28/2007	5-7	X	X	X	-	
		ESSB-10-C	11/28/2007	21-23	X	X	X	-	
		ESSB-10-D	11/28/2007	62-64	X	X	X	-	
		ESSB-11-A	11/28/2007	2-4	X	X	X	-	
		ESSB-11-B	11/28/2007	9-11	X	X	X	X	
		ESSB-11-C	11/28/2007	21-24	X	X	X	-	MS/MSD
		ESSB-11-D	11/28/2007	62-64	X	X	X	-	
		ESSB-12-A	11/29/2007	0-1	X	X	X	-	
		ESSB-12-B	11/29/2007	6-8	X	X	X	X	
		ESSB-13-A	11/30/2007	2-4	X	X	X	-	
		ESSB-13-B	11/30/2007	9-11	X	X	X	-	
		ESSB-13-C	11/30/2007	21-23	X	X	X	-	
		ESSB-13-D	11/30/2007	59-61	X	X	X	-	
		ESSB-14-A	11/29/2007	0-1	X	X	X	-	
		ESSB-14-B	11/29/2007	9-11	X	X	X	-	
		ESSB-14-C	11/29/2007	21-23	X	X	X	X	
		ESSB-140-C	11/29/2007	21-23	X	X	X	X	Duplicate of ESSB-14-C
	Stage 2	ESSB-15-A	5/27/2010	0-4	X	-	-	-	
		ESSB-15-B	5/27/2010	4-8	X	-	-	-	
		ESSB-15-C	5/27/2010	8-12	X	-	-	X	
		ESSB-015-C	5/27/2010	8-12	X	-	-	-	Duplicate of ESSB-15-C (VOCs only)
		ESSB-15-D	5/27/2010	20-24	X	-	-	-	
		ESSB-15-F	5/27/2010	44-48	X	-	-	X	
		ESSB-015-F	5/27/2010	44-48	-	-	-	X	Duplicate of ESSB-15-F (TOC, pH, Grain Size only)
		ESSB-15-G	5/27/2010	56-60	X	-	-	-	
		ESSB-16-C	5/28/2010	8-12	X	-	-	X	
		ESSB-16-D	5/28/2010	20-24	X	-	-	-	
		ESSB-16-E	5/28/2010	32-36	X	-	-	-	
		ESSB-16-F	5/28/2010	44-48	X	-	-	X	
		ESSB-16-G	5/28/2010	56-60	X	-	-	-	
CCL Label	Stage 1	CCSB-01-A	11/8/2007	0-1	X	X	X	-	
		CCSB-01-B	11/8/2007	5-7	X	X	X	X	MS/MSD
		CCSB-01-C	11/8/2007	41-43	X	X	X	-	
		CCSB-01-D	11/8/2007	72-74	X	X	X	X	
		CCSB-02-A	11/8/2007	0-1	X	X	X	-	
		CCSB-02-B	11/8/2007	9-11	X	X	X	-	
		CCSB-02-C	11/8/2007	21-23	X	X	X	X	
		CCSB-102-C	11/8/2007	21-23	X	X	X	X	Duplicate of CCSB-02-C
		CCSB-02-D	11/8/2007	55-57	X	X	X	X	
		CCSB-03-A	11/9/2007	0-1	X	X	X	-	
		CCSB-03-B	11/9/2007	9-11	X	X	X	-	
		CCSB-03-C	11/9/2007	21-23	X	X	X	-	
		CCSB-103-C	11/9/2007	21-23	X	X	X	-	Duplicate of CCSB-03-C
		CCSB-03-D	11/9/2007	62-64	X	X	X	-	
		CCSB-04-A	11/9/2007	0-1	X	X	X	-	

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
CCL Label (continued)	Stage 1	CCSB-04-B	11/9/2007	5-7	X	X	X	-	
		CCSB-104-B	11/9/2007	5-7	X	X	X	-	Duplicate of CCSB-04-B
		CCSB-04-C	11/9/2007	21-23	X	X	X	-	
		CCSB-04-D	11/9/2007	62-64	X	X	X	-	
		CCSB-05-A	11/12/2007	0-1	X	X	X	-	
		CCSB-05-B	11/12/2007	2-4	X	X	X	X	
		CCSB-05-C	11/12/2007	4-5.5	X	X	X	-	
		CCSB-06-A	11/12/2007	0-1	X	X	X	X	
		CCSB-06-B	11/12/2007	1-2.5	X	X	X	X	MS/MSD
		CCSB-07-A	11/12/2007	0-1	X	X	X	-	
		CCSB-07-B	11/12/2007	2-4	X	X	X	-	
		CCSB-07-C	11/12/2007	4-5.5	X	X	X	-	MS/MSD
		CCSB-08-A	11/6/2007	0-1	X	X	X	-	
		CCSB-08-B	11/6/2007	9-11	X	X	X	-	
		CCSB-08-C	11/6/2007	41-43	X	X	X	-	
		CCSB-08-D	11/6/2007	72-74	X	X	X	-	
		CCSB-09-A	11/6/2007	0-1	X	X	X	-	
		CCSB-09-B	11/6/2007	5-7	X	X	X	-	
		CCSB-09-C	11/6/2007	21-23	X	X	X	-	
		CCSB-09-D	11/6/2007	71-73	X	X	X	-	
		CCSB-10-A	11/12/2007	0-1	X	X	X	-	
		CCSB-10-B	11/12/2007	5-7	X	X	X	X	
		CCSB-10-C	11/12/2007	41-43	X	X	X	-	
		CCSB-10-D	11/12/2007	62-64	X	X	X	-	
	Stage 2	CCSB-11-A	4/23/2010	0-4	X	-	-	-	
		CCSB-11-B	4/23/2010	4-8	X	-	-	X	
		CCSB-11-C	4/23/2010	8-12	X	-	-	-	
		CCSB-11-D	4/23/2010	20-24	X	-	-	X	
		CCSB-11-F	4/23/2010	44-48	X	-	-	-	
		CCSB-11-G	4/23/2010	56-60	X	-	-	-	
		CCSB-12-A	4/23/2010	0-4	X	-	-	-	
		CCSB-12-B	4/23/2010	4-8	X	-	-	-	
		CCSB-12-C	4/23/2010	8-12	X	-	-	X	
		CCSB-012-C	4/23/2010	8-12	X	-	-	-	Duplicate of CCSB-12-C (VOCs only)
		CCSB-12-D	4/23/2010	20-24	X	-	-	-	
		CCSB-12-E	4/23/2010	32-36	X	-	-	-	
		CCSB-12-F	4/23/2010	44-48	X	-	-	X	
		CCSB-13-A	4/26/2010	0-4	X	-	-	-	
		CCSB-13-B	4/26/2010	4-8	X	-	-	X	
		CCSB-13-C	4/26/2010	8-12	X	-	-	-	
		CCSB-13-D	4/26/2010	20-24	X	-	-	-	
		CCSB-13-E	4/26/2010	32-36	X	-	-	-	
		CCSB-13-F	4/26/2010	44-48	X	-	-	X	
		CCSB-14-A	4/26/2010	0-4	X	-	-	-	
		CCSB-14-B	4/26/2010	4-8	X	-	-	-	
		CCSB-14-C	4/26/2010	8-12	X	-	-	X	
		CCSB-014-C	4/26/2010	8-12	X	-	-	-	Duplicate of CCSB-14-C (VOCs only)
		CCSB-14-D	4/26/2010	20-24	X	-	-	-	
		CCSB-14-E	4/26/2010	32-36	X	-	-	-	

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
CCL Label (continued)	Stage 2	CCSB-14-F	4/26/2010	44-48	X	-	-	X	
		CCSB-14-G	4/26/2010	56-60	X	-	-	-	
		CCSB-15-A	4/27/2010	0-4	X	-	-	-	
		CCSB-15-B	4/27/2010	4-8	X	-	-	X	
		CCSB-15-C	4/27/2010	8-12	X	-	-	-	
		CCSB-15-D	4/27/2010	20-24	X	-	-	-	
		CCSB-15-E	4/27/2010	32-36	X	-	-	-	
		CCSB-15-F	4/27/2010	44-48	X	-	-	X	
		CCSB-15-G	4/27/2010	56-60	X	-	-	-	
		CCSB-15-H	4/27/2010	68-72	X	-	-	-	
		CCSB-16-A	4/27/2010	0-4	X	-	-	-	
		CCSB-16-B	4/27/2010	4-8	X	-	-	X	
		CCSB-16-C	4/27/2010	8-12	X	-	-	-	
		CCSB-016-C	4/27/2010	8-12	X	-	-	-	Duplicate of CCSB-16-C
		CCSB-16-D	4/27/2010	20-24	X	-	-	-	
		CCSB-16-E	4/27/2010	32-36	X	-	-	-	
		CCSB-16-F	4/27/2010	44-48	X	-	-	X	
		CCSB-16-G	4/27/2010	56-60	X	-	-	-	
		CCSB-16-H	4/27/2010	68-72	X	-	-	-	
		CCSB-17-A	4/28/2010	0-4	X	-	-	-	
		CCSB-17-B	4/28/2010	4-8	X	-	-	X	
		CCSB-17-C	4/28/2010	8-12	X	-	-	-	
		CCSB-17-D	4/28/2010	20-24	X	-	-	-	
		CCSB-17-E	4/28/2010	32-36	X	-	-	X	
		CCSB-17-F	4/28/2010	44-48	X	-	-	-	
		CCSB-17-G	4/28/2010	56-60	X	-	-	-	
		CCSB-17-H	4/28/2010	68-72	X	-	-	-	
		CCSB-18-A	4/28/2010	0-4	X	-	-	-	
		CCSB-18-B	4/28/2010	4-8	X	-	-	X	
		CCSB-18-C	4/28/2010	8-12	X	-	-	-	
		CCSB-18-D	4/28/2010	20-24	X	-	-	X	
		CCSB-018-D	4/28/2010	20-24	-	-	-	X	Duplicate of CCSB-18-D (TOC, pH, Grain Size only)
		CCSB-18-E	4/28/2010	32-36	X	-	-	-	
		CCSB-18-F	4/28/2010	44-48	X	-	-	-	
		CCSB-18-G	4/28/2010	56-60	X	-	-	-	
		CCSB-18-H	4/28/2010	68-72	X	-	-	-	
Ramallo/ CCC	Stage 1	RMSB-01-A	12/18/2007	1-3	X	X	X	-	
		RMSB-01-B	12/18/2007	5-8	X	X	X	-	
		RMSB-01-C	12/18/2007	21-23	X	X	X	X	MS/MSD
		RMSB-01-D	12/18/2007	58-60	X	X	X	-	
		RMSB-02-A	12/18/2007	1-3	X	X	X	-	
		RMSB-02-B	12/18/2007	5-7	X	X	X	X	
		RMSB-02-C	12/18/2007	42-44	X	X	X	-	
		RMSB-102-C	12/18/2007	42-44	X	X	X	-	Duplicate of RMSB-02-C
		RMSB-03-A	12/19/2007	1-3	X	X	X	-	
		RMSB-03-B	12/19/2007	5-8	X	X	X	-	
		RMSB-03-C	12/19/2007	21-23	X	X	X	X	
		RMSB-03-D	12/19/2007	58-60	X	X	X	-	

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
Ramallo/CCC (continued)	Stage 1	RMSB-04-A	12/20/2007	0-1	X	X	X	-	
		RMSB-04-B	12/20/2007	5-7	X	X	X	X	
		RMSB-04-C	12/20/2007	21-23	X	X	X	-	
		RMSB-04-D	12/20/2007	42-44	X	X	X	-	
		RMSB-05-A	12/20/2007	0-1	X	X	X	-	
		RMSB-05-B	12/20/2007	9-11	X	X	X	-	
		RMSB-05-C	12/20/2007	21-23	X	X	X	X	
		RMSB-05-D	12/20/2007	62-64	X	X	X	-	
		RMSB-06-A	12/20/2007	0-1	X	X	X	-	
		RMSB-06-B	12/20/2007	17-19	X	X	X	X	
		RMSB-106-B	12/20/2007	17-19	X	X	X	X	Duplicate of RMSB-06-B
		RMSB-07-A	12/19/2007	0-1	X	X	X	-	
		RMSB-07-B	12/19/2007	5-8	X	X	X	X	
		RMSB-07-C	12/19/2007	21-23	X	X	X	-	
		RMSB-07-D	12/19/2007	62-64	X	X	X	-	
		RMSB-08-A	12/19/2007	0-2	X	X	X	-	
		RMSB-08-B	12/19/2007	8-11	X	X	X	-	
		RMSB-08-C	12/19/2007	21-23	X	X	X	-	
		RMSB-08-D	12/19/2007	58-60	X	X	X	-	
		RMSB-09-A	12/19/2007	0-1	X	X	X	-	
		RMSB-09-B	12/19/2007	9-11	X	X	X	-	
		RMSB-09-C	12/19/2007	21-23	X	X	X	-	
		RMSB-09-D	12/12/2007	58-60	X	X	X	X	
		RMSB-10-A	12/20/2007	0-1	X	X	X	-	
		RMSB-10-B	12/20/2007	5-7	X	X	X	-	
		RMSB-10-C	12/20/2007	32-34	X	X	X	X	
	Stage 2	RMSB-11-A	4/29/2010	0-4	X	-	-	-	
		RMSB-11-B	4/29/2010	4-8	X	-	-	-	
		RMSB-11-C	4/29/2010	8-12	X	-	-	X	
		RMSB-11-E	4/29/2010	32-36	X	-	-	X	
		RMSB-11-F	4/29/2010	44-48	X	-	-	-	
		RMSB-11-G	4/29/2010	56-60	X	-	-	-	
		RMSB-11-H	4/29/2010	68-72	X	-	-	-	
		RMSB-12-A	4/30/2010	0-4	X	-	-	-	
		RMSB-12-B	4/30/2010	4-8	X	-	-	X	
		RMSB-12-C	4/30/2010	8-12	X	-	-	-	
		RMSB-012-C	4/30/2010	8-12	X	-	-	-	Duplicate of RMSB-12-C
		RMSB-12-D	4/30/2010	20-24	X	-	-	-	
		RMSB-12-E	4/30/2010	32-36	X	-	-	X	
		RMSB-12-F	4/30/2010	44-48	X	-	-	-	
		RMSB-12-G	4/30/2010	56-60	X	-	-	-	
		RMSB-13-A	4/30/2010	0-4	X	-	-	-	
		RMSB-13-B	4/30/2010	4-8	X	-	-	X	
		RMSB-13-C	4/30/2010	8-12	X	-	-	-	
		RMSB-13-D	4/30/2010	20-24	X	-	-	-	
		RMSB-13-E	4/30/2010	32-36	X	-	-	X	
		RMSB-13-F	5/3/2010	44-48	X	-	-	-	
		RMSB-13-G	5/12/2010	56-60	X	-	-	-	
		RMSB-14-A	5/6/2010	0-4	X	-	-	X	

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
Ramallo/CCC (continued)	Stage 2	RMSB-14-B	5/6/2010	4-8	X	-	-	-	
		RMSB-14-C	5/6/2010	8-12	X	-	-	-	
		RMSB-014-C	5/6/2010	8-12	X	-	-	-	Duplicate of RMSB-14-C
		RMSB-14-D	5/6/2010	20-24	X	-	-	-	
		RMSB-14-E	5/6/2010	32-36	X	-	-	-	
		RMSB-14-F	5/6/2010	44-48	X	-	-	X	
		RMSB-14-G	5/6/2010	56-60	X	-	-	-	
		RMSB-14-H	5/6/2010	68-72	X	-	-	-	
		RMSB-15-A	5/6/2010	0-4	X	-	-	X	
		RMSB-15-B	5/6/2010	4-8	X	-	-	-	
		RMSB-15-C	5/6/2010	8-12	X	-	-	-	
		RMSB-15-E	5/6/2010	32-36	X	-	-	-	
		RMSB-15-F	5/6/2010	44-48	X	-	-	-	
		RMSB-15-G	5/6/2010	56-60	X	-	-	X	
		RMSB-15-H	5/6/2010	68-72	X	-	-	-	
		RMSB-16-A	5/7/2010	0-4	X	-	-	-	
		RMSB-16-B	5/7/2010	4-8	X	-	-	X	
		RMSB-16-C	5/7/2010	8-12	X	-	-	-	
		RMSB-16-D	5/7/2010	20-24	X	-	-	-	
		RMSB-16-E	5/7/2010	32-36	X	-	-	-	
		RMSB-16-F	5/7/2010	44-48	X	-	-	X	
		RMSB-16-G	5/7/2010	56-60	X	-	-	-	
		RMSB-16-H	5/7/2010	68-72	X	-	-	-	
		RMSB-17-A	5/7/2010	0-4	X	-	-	X	
		RMSB-17-B	5/7/2010	4-8	X	-	-	-	
		RMSB-17-C	5/7/2010	8-12	X	-	-	-	
		RMSB-17-D	5/7/2010	20-24	X	-	-	-	
		RMSB-17-E	5/7/2010	32-36	X	-	-	X	
		RMSB-18-A	5/10/2010	0-4	X	-	-	X	
		RMSB-18-B	5/10/2010	4-8	X	-	-	-	
		RMSB-18-C	5/10/2010	8-12	X	-	-	-	
		RMSB-018-C	5/10/2010	8-12	X	-	-	-	Duplicate of RMSB-18-C
		RMSB-18-D	5/10/2010	20-24	X	-	-	-	
		RMSB-18-E	5/10/2010	32-36	X	-	-	-	
		RMSB-18-F	5/10/2010	44-48	X	-	-	X	
		RMSB-18-G	5/10/2010	56-60	X	-	-	-	
		RMSB-18-H	5/10/2010	68-72	X	-	-	-	
		RMSB-19-A	5/12/2010	0-4	X	-	-	-	
		RMSB-19-B	5/11/2010	4-8	X	-	-	X	
		RMSB-19-C	5/11/2010	8-12	X	-	-	-	
		RMSB-19-D	5/11/2010	20-24	X	-	-	-	
		RMSB-19-E	5/11/2010	32-36	X	-	-	-	
		RMSB-19-F	5/11/2010	44-48	X	-	-	-	
		RMSB-19-G	5/11/2010	56-60	X	-	-	X	
		RMSB-20-A	5/11/2010	0-4	X	-	-	X	
		RMSB-20-B	5/11/2010	4-8	X	-	-	-	
		RMSB-20-C	5/11/2010	8-12	X	-	-	-	
		RMSB-20-D	5/11/2010	20-24	X	-	-	-	
		RMSB-20-E	5/11/2010	32-36	X	-	-	-	

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
Ramallo/CCC (continued)	Stage 2	RMSB-20-F	5/11/2010	44-48	X	-	-	X	
		RMSB-21-A	5/13/2010	0-4	X	-	-	-	
		RMSB-21-B	5/13/2010	4-8	X	-	-	-	
		RMSB-21-C	5/13/2010	8-12	X	-	-	X	
		RMSB-21-D	5/13/2010	20-24	X	-	-	-	
		RMSB-21-E	5/13/2010	32-36	X	-	-	X	
		RMSB-21-F	5/13/2010	44-48	X	-	-	-	
		RMSB-21-G	5/13/2010	56-60	X	-	-	-	
		RMSB-21-H	5/13/2010	68-72	X	-	-	-	
		RMSB-22-A	6/2/2010	0-4	X	-	-	-	
		RMSB-22-B	6/2/2010	4-8	X	-	-	-	
		RMSB-22-C	6/2/2010	8-12	X	-	-	X	
		RMSB-22-D	6/2/2010	20-24	X	-	-	-	
		RMSB-22-E	6/2/2010	32-36	X	-	-	-	
		RMSB-22-F	6/2/2010	44-48	X	-	-	X	
		RMSB-22-G	6/2/2010	56-60	X	-	-	-	
		RMSB-23-A	6/2/2010	0-4	X	-	-	-	
		RMSB-23-B	6/2/2010	4-8	X	-	-	-	
		RMSB-23-C	6/2/2010	8-12	X	-	-	X	
		RMSB-23-D	6/2/2010	20-24	X	-	-	X	
		RMSB-023-D	6/2/2010	20-24	X	-	-	-	Duplicate of RMSB-23-D (VOCs only)
ENCO	Stage 2	ENSB-01-A	5/20/2010	0-4	X	-	-	-	
		ENSB-01-B	5/20/2010	4-8	X	-	-		
		ENSB-01-C	5/20/2010	8-12	X	-	-	X	
		ENSB-001-C	5/20/2010	8-12	X	-	-	-	Duplicate of ENSB-01-C (VOCs only)
		ENSB-01-D	5/20/2010	20-24	X	-	-	-	
		ENSB-01-E	5/24/2010	32-36	X	-	-	X	
		ENSB-02-A	5/24/2010	0-4	X	-	-	-	
		ENSB-02-B	5/24/2010	4-8	X	-	-	-	
		ENSB-02-C	5/24/2010	8-12	X	-	-	X	
		ENSB-002-C	5/24/2010	8-12	X	-	-	-	Duplicate of ENSB-02-C (VOCs only)
		ENSB-02-D	5/24/2010	20-24	X	-	-	-	
		ENSB-02-E	5/24/2010	32-36	X	-	-	-	
		ENSB-02-F	5/24/2010	44-48	X	-	-	X	
		ENSB-02-G	5/24/2010	56-60	X	-	-	-	
		ENSB-03-A	5/25/2010	0-4	X	-	-	-	
		ENSB-03-B	5/25/2010	4-8	X	-	-	-	
		ENSB-03-C	5/25/2010	8-12	X	-	-	X	
		ENSB-03-D	5/25/2010	20-24	X	-	-	-	
		ENSB-03-E	5/25/2010	32-36	X	-	-	-	
		ENSB-03-F	5/25/2010	44-48	X	-	-	-	
		ENSB-03-G	5/25/2010	56-60	X	-	-	X	
		ENSB-04-A	5/25/2010	0-4	X	-	-	-	
		ENSB-04-B	5/25/2010	4-8	X	-	-	-	
		ENSB-04-C	5/26/2010	8-12	X	-	-	-	
		ENSB-05-A	5/26/2010	0-4	X	-	-	-	
		ENSB-05-B	5/26/2010	4-8	X	-	-	-	
		ENSB-05-C	5/26/2010	8-12	X	-	-	X	

Table 2-2
Stage 1 and Stage 2 Soil Boring Sample Summary - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Facility Name	Field Activity	Sample ID	Sample Date	Depth (feet bgs)	TCL VOCs	TLC SVOCs, Pesticides, PCBs	TAL Inorganics[1]	TOC, pH, Grain Size	Notes
ENCO (continued)	Stage 2	ENSB-005-C	5/26/2010	8-12	-	-	-	X	Duplicate of ENSB-05-C (TOC, pH, Grain Size only)
		ENSB-06-A	5/27/2010	0-4	X	-	-	X	
		ENSB-06-B	5/27/2010	4-8	X	-	-	-	
		ENSB-07-A	5/28/2010	0-4	X	-	-	-	
		ENSB-07-B	5/28/2010	4-8	X	-	-	-	
		ENSB-07-C	5/28/2010	8-12	X	-	-	X	
		ENSB-007-C	5/28/2010	8-12	X	-	-	-	Duplicate of ENSB-07-C (VOCs only)
		ENSB-07-D	6/1/2010	20-24	X	-	-	-	
		ENSB-07-E	6/1/2010	32-36	X	-	-	-	
		ENSB-07-F	6/1/2010	44-48	X	-	-	X	
		ENSB-07-G	6/1/2010	56-60	X	-	-	-	
		ENSB-07-H	6/1/2010	68-72	X	-	-	-	
DJ Manufacturing	Stage 2	DJSB-01-A	5/13/2010	0-4	X	-	-	X	
		DJSB-01-B	5/13/2010	4-8	X	-	-	-	
		DJSB-01-C	5/13/2010	8-12	X	-	-	X	
		DJSB-001-C	5/13/2010	8-12	X	-	-	-	Duplicate of DJSB-01-C (VOCs only)
		DJSB-02-A	5/14/2010	0-4	X	-	-	-	
		DJSB-02-B	5/14/2010	4-8	X	-	-	-	
		DJSB-02-C	5/14/2010	8-12	X	-	-	X	
		DJSB-002-C	5/14/2010	8-12	X	-	-	-	Duplicate of DJSB-02-C (VOCs only)
		DJSB-02-D	5/14/2010	20-24	X	-	-	-	
		DJSB-02-E	5/14/2010	36-40	X	-	-	X	
		DJSB-03-A	5/14/2010	0-4	X	-	-	-	
		DJSB-03-B	5/14/2010	4-8	X	-	-	-	
		DJSB-03-C	5/14/2010	8-12	X	-	-	X	
		DJSB-03-D	5/17/2010	20-24	X	-	-	-	
		DJSB-03-E	5/17/2010	32-36	X	-	-	X	
		DJSB-03-F	5/17/2010	39-43	X	-	-	-	
		DJSB-04-A	5/18/2010	0-4	X	-	-	-	
		DJSB-04-B	5/18/2010	4-8	X	-	-	-	
		DJSB-04-C	5/18/2010	8-12	X	-	-	X	
		DJSB-04-D	5/18/2010	20-24	X	-	-	-	
		DJSB-04-E	5/18/2010	29-33	X	-	-	X	
		DJSB-05-A	5/18/2010	0-4	X	-	-	-	
		DJSB-05-B	5/18/2010	4-8	X	-	-	-	
		DJSB-05-C	5/18/2010	8-12	X	-	-	X	
		DJSB-05-D	5/19/2010	20-24	X	-	-	-	
		DJSB-05-E	5/19/2010	32-36	X	-	-	X	
		DJSB-05-F	5/19/2010	39-43	X	-	-	-	

Notes:
[1] TAL Inorganics include metals and cyanide

Abbreviations:
bgs - below ground surface
TCL - Target Compound List
TAL - Target Analyte List
TOC - total organic carbon
CCC - Cidra Convention Center
MS/MSD - matrix spike/matrix spike duplicate
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
PCBs - polychlorinated biphenyls

Table 2-3
Stage 1 Existing Supply Well Evaluation Sample Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Well Name	Sample ID	Sample Date	Sample Depth (feet bgs)	TCL VOCs (trace)	TCL SVOCs, Pesticides, PCBs	TAL Inorganics[1]	Notes
Cidra #3	CIDR3-1964-A	7/17/07	123	X	X	X	
	CIDR3-1964-B	7/17/07	115	X	X	X	
	CIDR3-1964-C	7/17/07	90	X	X	X	
Cidra #4	CIDR4-A	7/18/07	180	X	X	X	
	CIDR4-B	7/18/07	90	X	X	X	
	CIDR4-C	7/18/07	53	X	X	X	
Cidra #6	CIDR6-1967-A	7/13/07	180	X	X	X	
	CIDR6-1967-B	7/13/07	170	X	X	X	
	CIDR6-1967-C	7/13/07	120	X	X	X	
Cidra #8	CIDR8-A	7/20/07	230	X	X	X	
	CIDR8-B	7/20/07	155	X	X	X	
	CIDR8-C	7/20/07	118	X	X	X	
IVAX (former)	IVAX-D	7/19/07	204	X	X	X	
	IVAX-I	7/19/07	175	X	X	X	
	IVAX-S	7/19/07	100	X	X	X	
	IVAX-S1	7/19/07	100	X	X	X	Duplicate of IVAX-S
IVAX #1	ZENI1	7/16/07	Unknown	X	X	X	
IVAX #2	ZENI2	7/16/07	Unknown	X	X	X	
PEPSI	PEPS	7/12/07	Unknown	X	X	X	
Villa Carmen	VILL	8/1/07	Unknown	X	X	X	
Rabanal	RABA	8/1/07	Unknown	X	X	X	
Mylan	MYLA	7/12/07	Unknown	X	X	X	
	CIDR9	7/12/07	Unknown	X	X	X	Duplicate of MYLA
Ciba Vision 1	CIBA I	7/12/07	Unknown	X	X	X	
Ciba Vision 2	CIBA II	7/12/07	Unknown	X	X	X	
Caribbean Refrescos	CARI	7/12/07	Unknown	X	X	X	
Zapera	ZAPA	8/1/07	Unknown	X	X	X	
Pelegrin 1	PELL	7/24/07	Unknown	X	X	X	

Notes:
[1]TAL Inorganics = metals and cyanide

Abbreviations:
ID - identification
bgs - below ground surface
TCL - Total Compound List
TAL - Target Analyte List
VOCs (trace) - volatile organic compounds
SVOCs - semivolatile organic compounds
PCBs - polychlorinated biphenyls

Table 2-4a
Packer Test Interval Rationale
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Zone	Packer Sampling Priority*	Packer Testing (Preliminary)	Interval (feet bgs)	Target (feet bgs)	Rationale/Comments
MPW-1					
1	A	Yes	122-132	Low angle fracture at 123 feet bgs High angle fracture at 127 feet bgs	Low angle and high angle fracture produced about 0.3 gpm during pumped HPFM. Ambient HPFM shows no activity in this zone.
2	A	Yes	130-140	Fracture at 135 feet bgs Fracture at 137 feet bgs	Between 132 and 139 feet bgs borehole produced about 0.3 gpm during pumped HPFM. Ambient HPFM shows flow out of about 0.08 gpm, but this may also be due to bypass**.
3	A	No	140-150	Fracture at 141 feet bgs Fracture at 146 feet bgs	HPFM data indicate inflow of 0.01 and 0.1 gpm, under ambient and pumped conditions, respectively, in the zone from 140 to 160 feet bgs. This may be real or may be due to bypass.
4	A	No	150-160	Two fractures between 151 and 155 feet bgs	HPFM data indicate inflow of 0.01 and 0.1 gpm, under ambient and pumped conditions, respectively, in the zone from 140 to 160 feet bgs. This may be real or may be due to bypass.
5	B	No	170-180	No open fractures identified in OTV or ATV	Ambient HPFM data shows upflow of about 0.03 gpm between 162 and 192 feet bgs. However, this may be due to bypass. Pumped HPFM suggests no change in flow between 162 and 192 feet bgs.
6	A	No	210-220	Fracture at 216 feet bgs	Ambient and pumped HPFM data suggest minor outflow zone in the zone between 192 and 226 feet bgs. However, the amount of outflow, about 0.05 gpm, is so low that it may be due to bypass.
7	A	No	230-240	Fracture at 232 feet bgs Fracture at 235 feet bgs	Pumped and ambient HPFM data indicate inflow of 0.1 gpm in the zone between 226 and 238 feet bgs.
8	A	Yes	242-252	Rough zone from 242-248 feet bgs Fracture at 249 feet bgs	Ambient and pumped HPFM data indicate this is the deepest transmissive zone in the borehole. Inflow to the borehole was 0.05 gpm under ambient conditions and 0.1 gpm under pumped conditions.
9	A	No	276-286	Fracture at 280 feet bgs	Ambient HPFM indicate upflow at 256 feet bgs and no flow at 292 feet bgs. Fracture at 280 feet bgs may be transmissive zone producing water causing upflow observed at 256 feet bgs. Under pumped conditions, HPFM data indicate no flow from this zone. This may be due to influence of more transmissive zones at shallower depths.
10	A	No	300-bottom	Fracture at 301 feet bgs Fracture at 310 feet bgs	Check factures at bottom of borehole to see if they are water bearing.

Table 2-4a
Packer Test Interval Rationale
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Zone	Packer Sampling Priority	Packer Testing (Preliminary)	Interval (feet bgs)	Target (bgs)	Rationale/Comments
MPW-2					
1	A	No	138 (near bottom of casing) - 148	Fracture at 140-145 feet bgs	Ambient HPFM data hint at water exit but this may just be bypass, pumped HPFM suggest water producing zone but this may also be due to bypass. Testing this zone will help validate interpretation of HPFM data.
2	A	No	156-166	Fracture at 155-160 feet bgs	Ambient HPFM data suggest possible water entrance, pumped HPFM don't support this, bypass maybe occurring.
3	B	No	165-175	Three fractures from 165 to 175 feet bgs, rough zone on caliper	Pumped HFFM data suggest water loss in this zone or drop in flow may be due to bypass.
4	A	Yes	179-189	Two fractures at 179-183 feet bgs	Pumped HPFM indicates significant water producing zone. Ambient HPFM data suggest water exit but this does not make sense in light of pumped HPFM data, bypass may be occurring under pumped conditions.
5	B	No	190-200	Fracture at 190-192 feet bgs	Ambient data suggest water exit in the vicinity of 200 feet, pumped data may also support exit in this vicinity.
6	A	No	194-204	Three fractures at 200-210 feet bgs	Ambient data suggest water exit in the vicinity of 200 feet, pumped data may also support exit in this vicinity.
7	A	Yes	206-bottom	Three fractures at 218-223 feet bgs	Pumped HPFM indicates transmissive zone yielding about 0.4 gpm, ambient data show no change. This may be because composite head and head in this interval are the same which would mean that this fracture zone is the most transmissive and maybe the drain for the borehole. Alternatively, ambient data may be compromised by bypass.
MPW-3					
1	A	Yes	134-144	Fracture at 135 feet bgs	Pumped HPFM indicates a significant transmissive zone, upflow jumps from 0 gpm at 145 feet bgs to 0.21 gpm at 133 feet bgs.
2	B	No	148-158	OTV indicates sealed fractures	HPFM data indicate the presence of a water producing zone in the interval from 148 to 162 feet bgs, sampling in this interval will determine if the interval is in this zone.
3	A	No	158-168	Fracture at 164 feet bgs	HPFM data indicate the presence of a water producing zone in the interval from 148 to 162 feet bgs, sampling in this interval will determine if this fracture is transmissive.
4	A	No	164-174	Fracture at 172 feet bgs	Potential water exit although decrease in flow may be due to bypass.
5	A	No	178-188	Rough zone, from 178 to 188 feet bgs. Fracture from 186 to 188 feet bgs	Down flow increases, indicating water entry zone in this interval.

Table 2-4a
Packer Test Interval Rationale
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Zone	Packer Sampling Priority	Packer Testing (Preliminary)	Interval (feet bgs)	Target (bgs)	Rationale/Comments
MPW-3 (continued)					
6	A	Yes	194-204	Fracture at 200-202 feet bgs	Ambient and pumped HPFM data indicate water exists the borehole at this fracture.
7	A	Yes	206-bottom	Fracture at 210-214 feet bgs	HPFM data indicate that this fracture is hydraulically inactive. The bottom packer will not be inflated to check if any water bearing fractures are present.
MPW-4					
1	A	No	130 (inside casing) - 140	Fracture at 136-138 feet bgs	Pumped HPFM indicates significant transmissive zone yielding about 0.5 gpm in the interval from 137 to 149 feet bgs.
2	A	Yes	140-150	Three fractures at 143-149 feet bgs	Pumped HPFM indicates significant transmissive zone yielding about 0.5 gpm in the interval from 137 to 149 feet bgs.
3	A	No	150-160	Fracture at 153-155 feet bgs Fracture at 157-158 feet bgs	Ambient HPFM indicates that down flow begins in the interval from 149 to 159 feet bgs.
4	A	Yes	160-170	4 fractures from 161 to 169 feet bgs	Ambient and pumped HPFM data indicate a significant transmissive zone in the interval from 159 to 170 feet bgs. Water entry observed under both pumped and ambient conditions. Under ambient conditions down flow increased by 0.12 gpm. Under pumped conditions up flow increased by 0.5 gpm from 0.49 to 0.99 feet bgs.
5	B	No	190-200	Fracture at 192 feet bgs Fracture at 196-198 feet bgs	Ambient HPFM data show no change over this interval, pumped HPFM show decrease of about 0.1 gpm. However, this may be due to bypass.
6	A	No	208-bottom	Fracture at 207-211 feet bgs Fracture at 211-215 feet bgs Fracture at 216-220 feet bgs Fracture at 221 feet bgs	Ambient HPFM data show no change over this interval, Pumped HPFM show increase of about 0.08 gpm. However, this may be due to bypass. Possible transmissive zone (216-221 feet bgs) serving as an exit under ambient conditions and water entry zone under pumped conditions. The bottom packer will not be inflated to check if any water bearing fractures are present.

Table 2-4a
Packer Test Interval Rationale
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Zone	Packer Sampling Priority	Packer Testing (Preliminary)	Interval (feet bgs)	Target (bgs)	Rationale/Comments
MPW-5					
1	A	No	126-136	Fracture at 132 feet bgs	Ambient HPFM indicates down flow begins in this zone.
2	A	Yes	134-144	Fracture at 140 feet bgs	Ambient HPFM data indicates a significant transmissive zone present between 135 and 146 feet bgs.
3	A	No	144-154	Fracture at 148-152 feet bgs	Ambient and pumped HPFM data indicate transmissive zone present between 146 and 169 feet bgs.
4	A	No	158-168	Fracture at 158-159 feet bgs Fracture at 160 feet bgs Fracture at 163 feet bgs Fracture at 166-168 feet bgs	Ambient and pumped HPFM data indicate transmissive zone present between 146 and 169 feet bgs.
5	B	No	170-180	Fracture zone at 173-176 feet bgs	HPFM data indicate this is probably not a significant transmissive zone.
6	A	Yes	185-195	Fracture at 190 feet bgs	Ambient HPFM shows a loss of 0.2 gpm in this interval. This could be real or bypass. Pumped HPFM shows a gain of 0.04 gpm but this may also be due to bypass. Ill samples this interval to help assess if these observations are real or due to bypass.
7	B	No	202-212	Fractures at 205, 206, 207, and 210 feet bgs	Ambient HPFM shows a loss of 0.06 gpm in this interval. This could be real or bypass. Pumped HPFM shows a gain of 0.06 gpm but this may also be due to bypass.
8	B	No	230-240	Fractures from 231-233 feet and at 239 feet bgs	Ambient HPFM shows a loss of 0.07 gpm in this interval. This could be real or bypass. Pumped HPFM shows a gain of 0.12 gpm but this may also be due to bypass.
9	A	No	250-260	Fracture at 252-257 feet bgs	Ambient HPFM shows a loss of 0.09 gpm in this interval. This could be real or bypass. Pumped HPFM shows a loss of 0.02 gpm but this may also be due to bypass. Will sample this interval to help assess if these observations are real or due to bypass.
10	A	Yes	268-278	Fracture at 270 feet bgs Fracture at 273 feet bgs	Ambient HPFM shows a loss of 0.11 gpm in this interval. This is a significant loss and suggests a water exit. Pumped HPFM shows a gain of 0.22 gpm. This may be the deepest significant transmissive zone.

Table 2-4a
Packer Test Interval Rationale
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Zone	Packer Sampling Priority	Packer Testing (Preliminary)	Interval (feet bgs)	Target (bgs)	Rationale/Comments
MPW-5 (continued)					
11	A	No	278-288	Fracture at 279 feet bgs Fracture at 280-283 feet bgs	Ambient HPFM shows a loss of 0.05 gpm in this interval. This is a very small loss and may indicate a water exit or it may be due to bypass. Pumped HPFM shows a gain of 0.02 gpm. Again, this is a small change and may be due to bypass. If these data are real and not due to bypass this is the deepest significant transmissive zone. A significant increase in fluid conductivity occurs at 279 feet bgs. This supports the interpretation of this fracture as a transmissive zone.
12	B	No	296-306	Fracture at 301 feet bgs	HPFM data indicate that this fracture has either low transmissivity or is neutral.
13	A	No	308-bottom	Fracture at 313 feet bgs	HPFM data indicate that this fracture has either low transmissivity or is neutral. The bottom packer will not be inflated to check if any water bearing fractures are present.
MPW-6					
1	A	Yes	78-88	Bottom of casing at 80 feet bgs	Ambient HPFM data don't indicate location of exit for observed upflow. Fracture at base of casing may be the exit or it may just be an effect of drilling.
2	B	No	104-114	Fracture at 107 feet bgs	HPFM data indicate that this fracture is not transmissive. However, on the ATV is appears open.
3	A	No	154-164	Fracture at 157 feet bgs	Possible water entry zone under pumped conditions, no activity under ambient conditions.
4	A	No	172-182	Fracture at 176 feet bgs Fracture at 178 feet bgs	Both ambient and pumped HPFM showed an increase in upflow suggesting this is a transmissive zone.
5	A	No	190-200	Fractures at 192, 193, 196, and 198 feet bgs	Ambient HPFM suggest this may be a transmissive zone but pumped HPFM data don't support this interpretation.
6	A	Yes	214-224	Two fractures at 215 feet bgs Possible void at 218-221 feet bgs	Ambient and pumped HPFM data indicate that this is a significant transmissive zone.
7	A	No	236-246	Fracture at 240 feet bgs	HPFM data indicate that this is not a significant transmissive zone but it may be masked by the more transmissive zones above and below.
8	B	No	260-270	Fracture at 265 feet bgs	HPFM data indicate that this is not a significant transmissive zone but it may be masked by the more transmissive zones above and below.

Table 2-4a
Packer Test Interval Rationale
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Zone	Packer Sampling Priority	Packer Testing (Preliminary)	Interval (feet bgs)	Target (bgs)	Rationale/Comments
MPW-6 (continued)					
9	B	No	270-280	Fracture at 275 feet bgs	HPFM data indicate that this is not a significant transmissive zone but it may be masked by the more transmissive zones above and below.
10	A	Yes	294-304	Fracture at 298-300 feet bgs	HPFM data suggest this is a transmissive zone where water is exiting the borehole under ambient flow conditions.
11	A	No	302 - bottom	Fracture at 310 feet bgs Fracture at 315-317 feet bgs	The fracture at 310 feet bgs may also be draining water from the borehole. Pumped and ambient HPFM tests at 316 feet bgs shows no flow indicating that the fractures from 315-317 feet bgs are probably not significantly transmissive. The bottom packer will not be inflated to check if any water bearing fractures are present.

Notes:
*A – attempt packer sampling; B – attempt sampling if sampling at A zone does not work, and if time allows; N – do not test
**Bypass is the process by which flow by passes the HPFM instead of flowing through the central channel in the device. Bypass occurs due to a poor seal between the borehole wall and the baffles on the instrument.

Acronyms:
bgs – below ground surface
gpm – gallons per minute
HPFM – heat pulse flow meter
OTV – optical televiewer
ATV – acoustic televiewer

Table 2-4b
Stage I Packer Sample Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Multiport Well Borehole ID	Packer Sample ID	Top of Interval (feet bgs)	Bottom of Interval (feet bgs)	Specific Capacity (gpm/foot of drawdown)	Estimated Transmisivity ($feet^2$/ day)	TCL VOCs (trace) *	Notes
MPW-1	PS-MPW1-127	122	132	NM	NM	X	
	PS-MPW1-135	130	140	NM	NM	X	
	PS-MPW1-145	140	150	NM	NM	X	
	PS-MPW1-155	150	160	NM	NM	X	
	PS-MPW1-215	210	220	NM	NM	X	
	PS-MPW1-235	230	240	NM	NM	X	
	PS-MPW1-247	242	252	NM	NM	X	
	PS-MPW1-281	276	286	NM	NM	X	
	PS-MPW1-305	300	324	NM	NM	X	
MPW-2	PS-MPW2-141	136	146	NM	NM	X	
	PS-MPW2-163	158	168	NM	NM	X	
	PS-MPW2-183	178	188	NM	NM	X	
	PS-MPW2-199	194	204	NM	NM	X	
	PS-MPW2-211	206	224	NM	NM	X	
MPW-3	PS-MPW3-139	134	144	NM	NM	X	
	PS-MPW3-163	158	168	NM	NM	X	
	PS-MPW3-425	158	168	NM	NM	X	Duplicate of PS-MPW3-163
	PS-MPW3-169	164	174	NM	NM	X	
	PS-MPW3-183	178	188	NM	NM	X	
	PS-MPW3-199	194	204	NM	NM	X	
	PS-MPW3-211	206	223	NM	NM	X	
MPW-4	PS-MPW4-135	130	140	NM	NM	X	
	PS-MPW4-145	140	150	0.18	47.7	X	
	PS-MPW4-155	150	160	NM	NM	X	
	PS-MPW4-165	162	172	2.09	559.3	X	
	PS-MPW4-213	208	224	0.99	264.3	X	
MPW-5	PS-MPW5-131	126	136	NM	NM	X	
	PS-MPW5-139	134	144	0.84	223.5	X	
	PS-MPW5-149	144	154	NM	NM	X	
	PS-MPW5-163	158	168	NM	NM	X	
	PS-MPW5-190	185	195	0.05	14.3	X	
	PS-MPW5-255	250	260	NM	NM	X	
	PS-MPW5-270	265	275	1.62	413.9	X	
	PS-MPW5-283	278	288	NM	NM	X	
	PS-MPW5-425	278	288	NM	NM	X	Duplicate of PS-MPW5-163
	PS-MPW5-313	308	325	NM	NM	X	
MPW-6	PS-MPW6-109	104	114	0.03	6.8	X	
	PS-MPW6-425	104	114	0.03	6.8	X	Duplicate of PS-MPW6-109
	PS-MPW6-159	154	164	NM	NM	X	
	PS-MPW6-177	172	182	NM	NM	X	
	PS-MPW6-195	190	200	NM	NM	X	
	PS-MPW6-219	214	224	3.06	818.6	X	
	PS-MPW6-241	236	246	NM	NM	X	
	PS-MPW6-299	294	304	1.11	6.8	X	
	PS-MPW6-311	306	323	NM	NM	X	

Abbreviations:
bgs - below ground surface
gpm - gallons per minute
NM - not measured
TCL VOCs (trace)* - Target Compound List volatile organic compounds (trace), with a 24-hour turnaround time

Table 2-5a
Multiport Monitoring Well Port Interval Rationale
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Multiport Well ID	Port #	Port Interval (feet bgs)	Rationale				
			Overview	Packer Information			
				Packer Interval	Packer Results (ppb)	Target (feet bgs)	Specific Capacity
MPW-1	1	121-129	HPFM data under pumped conditions indicate significant transmissive zones are present from 123 to 127 feet and from 132 to 139 feet. Under pumped conditions inflow to the borehole was measured at 0.3 gpm from both zones. Ambient HPFM data indicate inflow from the zone from 123 to 127 feet and outflow, at about 0.08 gpm, from the zone from 132 to 139 feet. Less significant transmissive zones are present from 139 to 162 feet, from 162 to 192 feet, from 226 to 238 feet, from 242 to 249 feet, and at 280 feet. Ambient and pumped HPFM data suggest minor outflow from the zone between 192 and 226 possibly via a fracture at 216 feet.	122-132	1,2 DCE – 0.36J CF – 6.7 CT – 1.2 TCE – 0.44J PCE - 10	Low angle fracture at 123 and high angle fracture at 127	NA
	2	132-144		130-140	1,2 DCE – 0.12J CF – 7.4 CT – 1.3 TCE – 0.17J PCE - 3.3	Fractures at 135, 137, and 141	NA
	3	148-160		150-160	1,2 DCE – 0.96J CF – 6.5 CT – 1.2 TCE – 0.15 PCE - 3.4	Two fractures from 151 - 155	NA
	4	228-237		230-240	1,2 DCE – 0.088J CF – 7.3 CT – 1 TCE – 0.16J PCE - 0.73	Fractures at 232 and 235	NA
	5	241-253		242-252	CF – 7.9 CT – 1.3 TCE – 0.12J PCE - 0.37J	Rough zone from 242-248 Fracture at 249	NA
	6	276-286		276-286	1,2 DCE – 0.5J CF – 6 CT – 0.51 TCE – 0.29J PCE - 2.9	Fracture at 280	Little to no productivity was observed in this zone during packer testing
MPW-2	1	144-154	The ambient HPFM data are difficult to interpret because it shows small flows in and out of the well with no consistent pattern. This may be due to scatter in the data or to bypass. The pumped HPFM data shows significant transmissive zones at 181 feet and 219 feet.	136-146	CF – 28D CT – 0.13J PCE - 0.14J	Fracture at 104-145	NA
	2	165-175		158-168	CF – 27D CT – 0.16J PCE - 0.17J	Fracture at 155-160	NA
	3	178-188		178-188	CF – 25D CT – 0.18J TCE – 0.12J PCE - 0.17J	Two fractures from 179-183	NA
	4	214-222		206-222	CF – 23D CT – 0.12J	Three fractures from 218-223 In-flow zone at 219	NA
MPW-3	1	131-146	HPFM data under pumped conditions indicate a significant transmissive zone in the range of 130 to 140 feet. This zone from 130 to 140 is not evident on the ambient flow log indicating head in the fracture maybe near the composite head in the borehole. Ambient flow data suggest a water entry zone in the depth range from 148 to 165 feet with weak up flow and down flow above and below this zone respectively. The OTV log shows an open fracture at 164 feet and apparently filled fractures from 145 to 163. Both ambient and pumped HPFM data indicate significant water exit from 200 to 203 feet where the OTV shows three fractures. During pumping all the water produced by the pump cam from the zone from 130 to 140 feet. Below this zone, during ambient and pumping, down flow occurred and the ambient and pumped HPFM readings were not significantly different indicating no influence by the pump. Below about 203 feet both ambient and pumped HPFM indicate the borehole is hydraulically inactive. Finally, the pumping rate was reported as 0.5 gpm but the HPFM reading of 0.21 gpm at 133 feet (this is right below the bottom of casing at 131 feet.) One would expect the reading from the HPFM to be about 0.5 gpm. The difference in readings suggests significant bypass may have occurred or that significant drawdown was occurring in the casing whereby the additional flow was made up by casing storage.	134-144	1,2 DCE – 0.15J CF – 4.3 CT – 0.13J TCE – 0.13J PCE - 1.2	Fracture at 135	NA
	2	150-162		158-168	1,2 DCE – 0.18J CF – 45.2 CT – 0.16J TCE – 0.17J PCE - 1.3	Fracture at 164 Rough zone from 150 to 162	NA
	3	168-174		164-174	1,2 DCE – 0.19J CF – 4.3 CT – 0.15J TCE – 0.13J PCE - 1.4	One fracture at 172	NA
	4	178-188		178-188	1,2 DCE – 0.18J CF – 4.9 CT – 0.18J TCE – 0.19J PCE - 1.5	Rough zone from 178 to 188 Fracture at 186 to 188	NA
	5	194-204		194-204	1,2 DCE – 0.19J CF – 4.9 CT – 0.19J TCE – 0.24J PCE - 1.5	Fracture at 210-214	NA
MPW-4	1	138-149	Ambient HPFM data show no flow at 137 feet and 149 feet. Down flow was detected 159 feet, indicating water entry between 149 feet and 159 feet. Down flow increased from 0.05 gpm at 159 feet to 0.17 gpm at 170 feet indicating a significant transmissive zone probably from 166 to 168 feet. Below 170 feet down flow dropped slightly from 0.17 gpm at 170 feet to 0.13 gpm at 215 feet. Pumped HPFM (flow rate 1 gpm) data show significant transmissive zones in the interval from 135 feet to 149 feet (ambient indicated no activity in this interval) and in the interval from 159 to 170 feet. From 170 downward up flow ranged from 0.49 gpm to 0.68 gpm. HPFM readings were not collected below 215 feet but a significant transmissive zone may be a fracture at about 220 feet. This fracture is not visible on the OTV but is visible on the ATV and on the caliper log. Under ambient conditions this fracture would serve as an exit and under pumped as an entrance.	140-150	1,2 DCE – 0.1J CF – 15 CT – 0.26J TCE – 0.12J PCE - 1.3	Three fractures from 143-149	Zone cannot handle valve completely open. S_c1 = 0.20 gpm/ft S_c2 = 0.16 gpm/ft
	2	152-160		150-160	1,2 DCE – 0.11J CF – 14 CT – 0.28J TCE – 0.11J PCE - 1.4	Fracture at 153-155 Fracture at 157-158	NA
	3	164-174		160-170	1,2 DCE – 0.12J CF – 15 CT – 0.34J TCE – 0.11J PCE - 1.5	Four fractures from 161-169	S_c1 = 2.73 gpm/ft S_c2 = 1.76 gpm/ft
	4	210-224		208-224	1,2 DCE – 0.12J CF – 14 CT – 0.27J TCE – 0.11J PCE - 1.2	Fractures at 207-211, 211-215, 216-220, and 221	S_c1 = 4.03 gpm/ft S_c2 = 0.52 gpm/ft

Table 2-5a
Multiport Monitoring Well Port Interval Rationale
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Multiport Well ID	Port #	Port Interval (feet bgs)	Rationale: Overview	Packer Information: Packer Interval	Packer Results (ppb)	Target (feet bgs)	Specific Capacity
MPW-5	1	130-144	Ambient HPFM data shows down flow beginning in the interval from 135 to 146 feet probably from a low lying fracture at 140 feet. Down flow increases steadily from 0.36 gpm at 146 feet, to 0.58 gpm at 169 feet, to 0.61 gpm at 181 feet. From 181 feet down flow decreases steadily from 0.61 gpm to 0.02 gpm at 288 feet. Water loss over this interval is probably via a series of fractures at 190 (low angle), 200, 214, 218, 233, 254, 282, and 302 feet. Below 302 feet ambient HPFM data indicate the borehole is hydraulically neutral. Pumped HPFM (flow rate 1 gpm) show a similar pattern but in reverse. Up flow begins in the interval from 288 to 308 feet, increases significantly (0.05 to 0.27 gpm) in the interval from 263 to 276 feet. The up flow ranges from 0.27 gpm at 263 feet to 0.45 gpm at 181 feet. Between 169 feet and 135 feet up flow increases significantly from 0.32 gpm to 1.64 gpm. No significant change in up flow was observed at 127 feet, the shallowest reading. These data indicate the most transmissive zones in the borehole are present at about 140 feet, 150 feet, 166 feet, and 270 feet.	134-144	1,2 DCE – 1.2 CF – 6.2 CT – 0.29J TCE – 0.53 PCE - 12	Fracture at 140	S_c1 = 0.89 gpm/ft S_c2 = 0.67 gpm/ft
	2	148-154		144-154	1,2 DCE – 0.88 CF – 6.1 CT – 0.31J TCE – 0.49J PCE - 9.7	Fracture at 148-152	NA
	3	157-170		158-168	1,2 DCE – 0.85J CF – 6.3 CT – 0.33J TCE – 0.42J PCE - 9.9	Fractures at 158-159, 160,163, and 166-168	NA
	4	202-212		NA - zone not packer tested			
	5	260-274		265-275	1,2 DCE – 1.1 CF – 6.2 CT – 0.3J TCE – 0.57 PCE - 15	Fracture at 270 Fracture at 273	S_c1 = 1.48 gpm/ft S_c2 = 1.63 gpm/ft
	6	277-287		278-288	1,1 DCE – 0.71 1,2 DCE – 3.7 CF – 5.6 CT – 0.28 TCE – 1.2 PCE - 32D	Fracture at 279 Fracture at 280-283	NA
	7	302-324		308-open	1,1 DCE – 2.2 1,2 DCE – 14 CF – 3.6 CT – 0.28J TCE – 3.9 PCE - 92D	Fracture at 313	NA
MPW-6	1	154-164	Earth Data reported that during logging the water level in the well rose and fell in response to pumping in a nearby well, and therefore, the pump was turned off during HPFM logging. HPFM data indicate that the most significant transmissive zone in this borehole is located at a depth of 218 to 221 feet. Under ambient flow conditions the HPFM reading above this zone was zero indicating no flow. Readings below this zone were negative but small ranging from 0.02 to 0.03 gpm. The ambient HPFM data indicates that water is entering the borehole from the zone at 218-220 feet, moving downward and then exiting the borehole at transmissive zones at 298-300 feet or 310 feet. The same data indicate that water is entering the borehole from a multiple fracture zone between 192 and 198 feet and then moving upward at a low flow rate of 0.03 to 0.04 gpm. Up flow increased from 0.03 to 0.04 gpm in the interval between 165 and 184 feet. Two fractures occur in this interval at 176 and 178 feet. The ambient HPFM data don't indicate where the exit for the up flow is which suggests an exit at the base of the casing. Pumped HPFM data, flow rate reported at 1 gpm, indicate the most transmissive zone is the interval from 218 to 221. During pumping no flow was observed below this zone indicating that this zone produced all the water needed to meets the demand of the pump. Above the interval from 218 to 221 feet a drop in flow of 0.13 gpm was observed above the zone between 192 and 198. This is decrease in flow is probably due to bypass because if the head in the fracture was greater than the head in the borehole, as suggested by the ambient HPFM data, then pumping water from the borehole (which effectively lowers the head in the borehole) would only promote more flow from this zone. This observation throws doubt on the interpretation of the HPFM data and suggests that 1) the zone between 192 and 198 is not a significant transmissive zone and 2) that the ambient HPFM observations above this zone may be instrument noise. Up flow increased by 0.09 gpm in the zone between 165 and 184 feet probably due to water entry via fractures at 176 and 178 feet. A small increase in up flow was also observed in this interval during ambient HPFM testing. Up flow increased by 0.39 gpm in the zone between 137 and 165 feet probably due to water entry at a fracture zone between 156 and 158 feet (no change in flow was observed in this zone under ambient testing. At 137 feet the up flow is 2.07 gpm and at 86 feet it is 1.99 gpm. These values are essentially the same indicating no significant additional input of water to the borehole. The observed flow of 1.99 gpm at 86 feet is not consistent with the reported pump flow rate of 1 gpm.	154-164	1,1 DCE – 3.9 1,1 DCA - 0.42J CF – 2.0 TCE – 0.15J PCE - 0.46J	Fracture at 157	Little to no productivity was observed in this zone
	2	172-182		172-182	1,1 DCE – 12 1,1 DCA - 0.41J 1,2 CF – 2.8 PCE - 0.13J	Fracture at 176 Fracture at 178	NA
	3	190-200		190-200	1,1 DCE – 7.5 1,1 DCA - 0.28J CF – 1.9 TCE – 0.0J PCE - 0.12	Fractures at 192, 193, 196, and 198	NA
	4	215-225		214-224	1,1 DCE – 9.6 1,1 DCA - 0.69 CF – 12 PCE - 0.36J	Fracture at 215; Possible void from 218-221	S_c1 = 7.51 gpm/ft S_c2 = 3.12 gpm/ft
	5	236-246		236-246	1,1 DCE – 7.9 1,1 DCA - 0.51 CF – 9 PCE - 0.14J	Fracture at 240	NA
	6	260-270				Fracture at 267; Fluid conductivity deviation at 267; Formation resistivity dip at 264;	NA
	7	294-304		294-304	1,1 DCE – 2.9 1,1 DCA - 0.11J CF – 1.2 PCE - 0.19J	Fracture from 298-300	S_c1 = 1.68 gpm/ft S_c2 = 0.68 gpm/ft

Notes:
*Bypass is the process by which flow passes by the HPFM instead of flowing through the central channel in the device. This occurs due to a poor seal between the borehole wall and the baffles on the instrument.

Acronyms:

1,1 DCE - 1,1-dichloroethene	gpm - gallons per minute
1,1 DCA - 1,1-dichloroethane	ppb - parts per billion
1,2 DCE - 1,2-dichloroethene	J - estimated value
CF - chloroform	D - diluted sample
CT - carbon tetrachloride	S_c - specific capacity
TCE - trichloroethene	NA - no applicable
PCE - tetrachloroethylene	OTV - optical televiewer
HPFM - heat pulse flow meter	ATV - acoustic televiewer
ft bgs - feet below ground surface	

Table 2-5b
Multiport Monitoring Well Construction Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Well	Port	Ground Surface Elevation (feet amsl)	Port Tag Elevation (feet amsl)	Well Depth (feet bgs)	Top of Port Interval (feet bgs)	Bottom of Port Interval (feet bgs)
MPW-1	1	1373.997	1376.631	324	121	129
	2	1373.997	1376.631	324	132	144
	3	1373.997	1376.631	324	148	160
	4	1373.997	1376.631	324	228	237
	5	1373.997	1376.631	324	241	253
	6	1373.997	1376.631	324	276	288
MPW-2	1	1372.858	1375.434	224	144	154
	2	1372.858	1375.434	224	165	175
	3	1372.858	1375.434	224	178	188
	4	1372.858	1375.434	224	214	222
MPW-3	1	1359.499	1361.881	223	131	146
	2	1359.499	1361.881	223	150	162
	3	1359.499	1361.881	223	168	174
	4	1359.499	1361.881	223	178	188
	5	1359.499	1361.881	223	194	204
MPW-4	1	1382.025	1364.584	224	138	149
	2	1382.025	1364.584	224	152	160
	3	1382.025	1364.584	224	164	174
	4	1382.025	1364.584	224	210	224
MPW-5	1	1369.335	1371.995	325	130	144
	2	1369.335	1371.995	325	148	154
	3	1369.335	1371.995	325	157	170
	4	1369.335	1371.995	325	202	212
	5	1369.335	1371.995	325	260	274
	6	1369.335	1371.995	325	277	287
	7	1369.335	1371.995	325	302	324
MPW-6	1	1398.997	1401.277	323	154	164
	2	1398.997	1401.277	323	172	182
	3	1398.997	1401.277	323	190	200
	4	1398.997	1401.277	323	215	225
	5	1398.997	1401.277	323	236	246
	6	1398.997	1401.277	323	260	270
	7	1398.997	1401.277	323	294	304

Acronyms:
bgs - below ground surface
amsl - above mean sea level

Table 2-6
Stage 1 Groundwater Sample Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Multiport Well ID	Port	Sample ID	Sample Date	Top of Interval (feet bgs)	Bottom of Interval (feet bgs)	TCL Organics[1]	TAL Inorganics[2]	Wet Chemistry/ MNA Parameters[3]	Notes
MPW-1	1	MPW-1-P1-S1	1/13/2009	121	129	X	X	X	
	2	MPW-1-P2-S1	1/13/2009	132	144	X	X		
	3	MPW-1-P3-S1	1/13/2009	148	160	X	X	X	
	4	MPW-1-P4-S1	1/13/2009	228	237	X	X		
	5	MPW-1-P5-S1	1/13/2009	241	253	X	X		
	6	MPW-1-P6-S1	1/13/2009	276	288	X	X	X	
MPW-2	1	MPW-2-P1-S1	1/16/2009	144	154	X	X	X	
	2	MPW-2-P2-S1	1/16/2009	165	175	X	X		
	3	MPW-2-P3-S1	1/16/2009	178	188	X	X		
	4	MPW-2-P4-S1	1/16/2009	214	222	X	X	X	
MPW-3	1	MPW-3-P1-S1	1/19/2009	131	146	X	X	X	MS/MSD
	2	MPW-3-P2-S1	1/16/2009	150	162	X	X		
	3	MPW-3-P3-S1	1/16/2009	168	174	X	X	X	
	4	MPW-3-P4-S1	1/16/2009	178	188	X	X		
	5	MPW-3-P5-S1	1/16/2009	194	204	X	X	X	
MPW-4	1	MPW-4-P1-S1	1/15/2009	138	149	X	X	X	MS/MSD
	2	MPW-4-P2-S1	1/15/2009	152	160	X	X		
	3	MPW-4-P3-S1	1/15/2009	164	174	X	X		
	4	MPW-4-P4-S1	1/15/2009	210	224	X	X	X	
MPW-5	1	MPW-5-P1-S1	1/14/2009	130	144	X	X	X	
	2	MPW-5-P2-S1	1/14/2009	148	154	X	X		
	3	MPW-5-P3-S1	1/14/2009	157	170	X	X		
	4	MPW-5-P4-S1	1/14/2009	202	212	X	X	X	
	5	MPW-5-P5-S1	1/14/2009	260	274	X	X		
	6	MPW-5-P6-S1	1/14/2009	277	287	X	X	X	
	7	MPW-5-P7-S1	1/15/2009	302	324	X	X	X	
	7	MPW-55-P7-S1	1/15/2009	302	324	X	X	X	Duplicate of MPW-5-P7-S1
MPW-6	1	MPW-6-P1-S1	1/20/2009	154	164	X	X		
	2	MPW-6-P2-S1	1/20/2009	172	182	X	X	X	
	2	MPW-66-P2-S1	1/20/2009	172	182	X	X	X	Duplicate of MPW-6-P2-S1
	3	MPW-6-P3-S1	1/20/2009	190	200	X	X		
	4	MPW-6-P4-S1	1/19/2009	215	225	X	X	X	
	5	MPW-6-P5-S1	1/19/2009	236	246	X	X	X	
	6	MPW-6-P6-S1	1/19/2009	260	270	X	X		
	7	MPW-6-P7-S1	1/19/2009	294	304	X	X	X	

Table 2-6
Stage 1 Groundwater Sample Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Notes:

[1]TCL Organics = Trace VOCs, SVOCs, and pesticide/PCBs

[2]TAL Inorganics = metals and cyanide

[3] Wet Chemistry/MNA = chloride, methane/ethane/ethene, nitrate/nitrite, sulfate/sulfide, TOC, TDS, TSS, alkalinity, ammonia, hardness, and TKN

Abbreviations:

bgs - below ground surface
ID - identification
mg/L - milligrams per liter
MNA - Monitored Natural Attenuation
MS/MSD - Matrix spike/ matrix spike duplicate
TCL - Total Compound List
TAL - Target Analyte List
VOCs - volatile organic compounds
SVOCs - semi-volatile organic compounds
PCBs - polychlorinated biphenyls
TDS - total dissolved solids
TKN - total Kjeldahl nitrogen
TOC - total organic carbon
TSS - total suspended solids

Table 2-7
Saprolite Monitoring Well Construction Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Well Installation Stage	Well ID	Top of Casing Elevation (feet amsl)	Casing Diameter and Material	Screen Slot Size	Top of Well Screen (feet bgs)	Bottom of Well Screen (feet bgs)	Well Depth (feet bgs)
Stage 2	SMW-1	1373.99	4-inch PVC	0.01	48	58	62
	SMW-2	1383.78	4-inch PVC	0.01	94	104	108
	SMW-3	1370.52	4-inch PVC	0.01	65	75	77
	SMW-5	1369.58	4-inch PVC	0.01	48	58	61
	SMW-9	1375.96	4-inch PVC	0.01	82	92	94.6
	SMW-10	1375.54	4-inch PVC	0.01	62	72	77
	SMW-12	1376.79	4-inch PVC	0.01	78	88	92
Stage 2a	SMW-4	1375.60	4-inch PVC	0.01	48	58	58
	SMW-6	1348.98	4-inch PVC	0.01	39	49	49
	SMW-7	1357.04	4-inch PVC	0.01	41	51	51
	SMW-8	1357.54	4-inch PVC	0.01	46	56	56

Note:

SMW-11 (the planned background well) was not installed due to the lack of water in upgradient areas.

Acronyms:

bgs - below ground surface

amsl - above mean sea level

Table 2-8
Stage 2 Groundwater Sample Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Well Type	Well ID	Port	Sample ID	Sample Date	Top of Interval (feet bgs)	Bottom of Interval (feet bgs)	TCL VOCs (trace)	TAL Inorganics[1]	Wet Chemistry[2]	Hardness Only	Notes
Multiport Monitoring Wells	MPW-1	1	MPW-1-P1-S2	7/20/10	121	129	X	X	X		
		2	MPW-1-P2-S2	7/20/10	132	144	X	X		X	
		3	MPW-1-P3-S2	7/20/10	148	160	X	X	X		
		4	MPW-1-P4-S2	7/20/10	228	237	X	X		X	
		5	MPW-1-P5-S2	7/20/10	241	253	X	X		X	
		6	MPW-1-P6-S2	7/20/10	276	288	X	X	X		
	MPW-2	1	MPW-2-P1-S2	7/22/10	144	154	X	X	X		
		2	MPW-2-P2-S2	7/22/10	165	175	X	X		X	
		3	MPW-2-P3-S2	7/22/10	178	188	X	X		X	
		4	MPW-2-P4-S2	7/22/10	214	222	X	X	X		
	MPW-3	1	MPW-3-P1-S2	7/22/10	131	146	X	X	X		
		2	MPW-3-P2-S2	7/22/10	150	162	X	X		X	
		3	MPW-3-P3-S2	7/22/10	168	174	X	X	X		
		4	MPW-3-P4-S2	7/22/10	178	188	X	X		X	
		5	MPW-3-P5-S2	7/22/10	194	204	X	X	X		
	MPW-4	1	MPW-4-P1-S2	7/23/10	138	149	X	X	X		
		2	MPW-4-P2-S2	7/23/10	152	160	X	X		X	
		3	MPW-4-P3-S2	7/23/10	164	174	X	X		X	
		4	MPW-4-P4-S2	7/23/10	210	224	X	X	X		
	MPW-5	1	MPW-5-P1-S2	7/21/10	130	144	X	X	X		
		2	MPW-5-P2-S2	7/21/10	148	154	X	X		X	
		3	MPW-5-P3-S2	7/21/10	157	170	X	X		X	
		4	MPW-5-P4-S2	7/21/10	202	212	X	X	X		
		5	MPW-5-P5-S2	7/21/10	260	274	X	X		X	
		6	MPW-5-P6-S2	7/21/10	277	287	X	X	X		
		7	MPW-5-P7-S2	7/21/10	302	324	X	X	X		
		7	MPW-55-P7-S2-DUP	7/21/10	302	324	X	X	X		Duplicate of MPW-5-P7-S2

Table 2-8
Stage 2 Groundwater Sample Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Well Type	Well ID	Port	Sample ID	Sample Date	Top of Interval (feet bgs)	Bottom of Interval (feet bgs)	TCL VOCs (trace)	TAL Inorganics[1]	Wet Chemistry[2]	Hardness Only	Notes
Saprolite Monitoring Wells	SMW-1	NA	SMW-1-S2	7/26/10	48	58	X	X	X		
			SMW-01-S2-DUP	7/26/10	48	58	X	X	X		Duplicate of SMW-1-S2
	SMW-2		SMW-2-S2	7/26/10	94	104	X	X	X		
	SMW-3		SMW-3-S2	7/26/10	65	75	X	X	X		
	SMW-5		SMW-5-S2	7/26/10	48	58	X	X	X		
	SMW-9		SMW-9-S2	7/27/10	82	92	X	X	X		
	SMW-10		SMW-10-S2	7/29/10	62	72	X	X	X		
			SMW-010-S2-DUP	7/29/10	62	72	X	X	X		Duplicate of SMP-10-S2
	SMW-12		SMW-12-S2	7/28/10	78	88	X	X	X		
MPW-6	MPW-6-P5*		MPW-6-P5-S2	7/30/10	236	246	X	X	X		
Supply Wells	Cidra-3	NA	CIDRA-3-S2	7/27/10	42	124	X	X		X	
	Cidra-4		CIDRA-4-S2	7/27/10	68	188	X	X		X	
	Cidra-6		CIDRA-6-S2	7/28/10	161	189	X	X		X	
	Cidra-8		CIDRA-8-S2	7/28/10	97	276	X	X		X	
	IVAX-2		IVAX-2-S2	7/23/10	Unknown		X	X		X	
			IVAX-02-S2-DUP	7/23/10	Unknown		X	X		X	Duplicate of IVAX-2-S2
	IVAX (former)		IVAX-Abandoned-S2	7/28/10	69	206	X	X		X	

Notes:

[1]TAL Inorganics = metals, mercury, and cyanide

[2]Wet Chemistry/MNA = chloride, methane/ethane/ethene, nitrate, nitrite, sulfate, sulfide, TOC, TDS, TSS, alkalinity, ammonia, hardness and TKN)

* MPW-06 was abandoned and reinstalled as a conventional well with a screen interval from 236-246 feet bgs (same as for Port 5)

Abbreviations:

NA - Not applicable
TCL VOCs (trace) - Target Compound List volatile organic compounds (trace)
TAL - Target Analyte List
ID - identification
bgs - below ground surface
MNA - monitored natural attenuation
TOC - total organic carbon
TDS - total dissolved solids
TKN - total Kjeldahl nitrogen
TSS - total suspended solids

Table 2-9
Stage 2a Groundwater Sample Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Well Type	Well ID	Sample ID	Sample Date	Top of Interval (feet bgs)	Bottom of Interval (feet bgs)	TCL VOCs (trace)	TAL Inorganics[1]	Notes
Saprolite Monitoring Wells	SMW-4	SMW-4-S2a	6/1/2012	48	58	X	X	MS/MSD
	SMW-6	SMW-6-S2a	6/1/2012	39	49	X	X	
	SMW-7	SMW-7-S2a	6/5/2012	41	51	X	X	
	SMW-8	SMW-8-S2a	6/1/2012	46	56	X	X	
		SMW-28-S2a	6/1/2012	46	56	X	X	Duplicate of SMW-8-S2a

Notes:
[1]TAL Inorganics = metals and cyanide

Abbreviations:
ID - identification
bgs - below ground surface
TCL VOCs (trace) - Target Compound List volatile organic compounds (trace)
TAL - Target Analyte List
MS/MSD - matrix spike/matrix spike duplicate

R2-0007244

Table 2-10
Stage 2a Surface Water and Sediment Sample Summary
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Matrix	Sample ID	Sample Date	TCL VOCs (trace)	TAL Inorganics[1]	Grain Size, pH, TOC	Wet Chemistry[2]	Notes
Sediment	SD-1	6/1/2012	X	X	X		
	SD-2	6/1/2012	X	X	X		
	SD-3	5/31/2012	X	X	X		
	SD-23	5/31/2012	X	X	X		Duplicate of SD-3
	SD-4	5/31/2012	X	X	X		
	SD-5	5/31/2012	X	X	X		
	SD-6	5/31/2012	X	X	X		
	SD-7	5/30/2012	X	X	X		MS/MSD
	SD-8	5/30/2012	X	X	X		
	SD-9	5/30/2012	X	X	X		
	SD-10	5/30/2012	X	X	X		
Surface Water	SW-1	6/1/2012	X	X		X	
	SW-2	6/1/2012	X	X		X	
	SW-3	5/31/2012	X	X		X	MS/MSD
	SW-4	5/31/2012	X	X		X	
	SW-5	5/31/2012	X	X		X	
	SW-6	5/31/2012	X	X		X	
	SW-7	5/30/2012	X	X		X	
	SW-27	5/30/2012	X	X		X	Duplicate of SW-7
	SW-8	5/30/2012	X	X		X	
	SW-9	5/30/2012	X	X		X	
	SW-10	5/30/2012	X	X		X	

Notes:
[1]TAL Inorganics = metals, mercury, and cyanide
[2]Wet Chemistry = methane/ethane/ethene, nitrate, nitrite, sulfate, sulfide, alkalinity, chloride, ammonia, TDS, TOC, and TKN

Abbreviations:
ID - identification
bgs - below ground surface
TCL VOCs (trace) - Target Compound List volatile organic compounds (trace)
TAL - Target Analyte List
TOC - total organic carbon
TDS - total dissolved solids
TKN - total Kjeldahl nitrogen
MS/MSD - matrix spike/matrix spike duplicate

Table 3-1
Multiport Monitoring Well Potentiometric Water Level Elevations - Stage 1, 2, and 2a
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Well	Port	Port Tag Elevation (feet msl)	Port Depth (feet bgs)	Port Elevation (feet msl)	Stage 1		Stage 2		Stage 2a	
					Depth to Water (feet bgs)	Water Level Elevation (feet msl)	Depth to Water (feet bgs)	Water Level Elevation (feet amsl)	Depth to Water (feet bgs)	Water Level Elevation (feet amsl)
MPW-1	1	1376.631	125	1248.997	45.3	1331.33	42.13	1334.50	42.95	1333.68
	2	1376.631	138	1235.997	45.38	1331.25	42.11	1334.52	42.94	1333.69
	3	1376.631	154	1219.997	45.3	1331.33	42.11	1334.52	42.92	1333.71
	4	1376.631	232.5	1141.497	44.74	1331.89	41.55	1335.08	42.41	1334.22
	5	1376.631	247	1126.997	44.8	1331.83	41.51	1335.12	42.36	1334.27
	6	1376.631	281	1092.997	46.88	1329.75	41.5	1335.13	42.44	1334.19
MPW-2	1	1375.434	149	1223.858	44.51	1330.93	41.62	1333.81	42.31	1333.12
	2	1375.434	170	1202.858	44.42	1331.01	41.58	1333.85	42.26	1333.17
	3	1375.434	183	1189.858	44.48	1330.95	41.63	1333.80	42.33	1333.10
	4	1375.434	218	1154.858	44.56	1330.87	41.75	1333.68	42.46	1332.97
MPW-3	1	1361.881	138.5	1220.999	32.01	1329.88	29.26	1332.62	29.95	1331.93
	2	1361.881	156	1203.499	32.13	1329.76	29.45	1332.43	30.1	1331.78
	3	1361.881	171	1188.499	32.04	1329.85	29.53	1332.35	30.3	1331.58
	4	1361.881	183	1176.499	32.11	1329.77	29.55	1332.33	30.25	1331.63
	5	1361.881	199	1160.499	32.22	1329.66	29.53	1332.35	30.29	1331.59
MPW-4	1	1364.584	143.5	1238.525	33.9	1330.69	31.14	1333.44	No Measurement*	No Measurement*
	2	1364.584	156	1226.025	33.88	1330.71	31.08	1333.50		
	3	1364.584	169	1213.025	33.88	1330.7	30.94	1333.64		
	4	1364.584	217	1165.025	34	1330.58	30.84	1333.74		
MPW-5	1	1371.995	137	1232.335	41.12	1330.88	38.28	1333.72	40	1332.00
	2	1371.995	151	1218.335	41.13	1330.86	38.2	1333.80	39.98	1332.02
	3	1371.995	163.5	1205.835	41.03	1330.97	38.17	1333.83	39.94	1332.06
	4	1371.995	207	1162.335	41.32	1330.68	38.56	1333.44	39.24	1332.76
	5	1371.995	267	1102.335	41.28	1330.72	38.54	1333.46	39.28	1332.72
	6	1371.995	282	1087.335	41.28	1330.72	38.54	1333.46	39.29	1332.71
	7	1371.995	313	1056.335	41.21	1330.79	38.51	1333.49	39.29	1332.71
MPW-6	1	1401.277	159	1239.997	73.39	1327.89	No Measurement*	No Measurement*	No Measurement*	No Measurement*
	2	1401.277	177	1221.997	70.2	1331.08				
	3	1401.277	195	1203.997	70.09	1331.19				
	4	1401.277	220	1178.997	70	1331.28				
	5	1401.277	241	1157.997	73.1	1328.18				
	6	1401.277	265	1133.997	69.9	1331.38				
	7	1401.277	299	1099.997	69.67	1331.61				

Acronyms
bgs - below ground surface
msl - mean sea level
MPW - multiport well
*No measurement was made. MPW-4 was damaged prior to Stage 2a; MPW-6 was damaged prior to Stage 2, and was converted to a conventional monitoring well screened in the bedrock (at Port 5) (see Table 3-2 for Stage 2 and 2a water level measurement in MPW-6).

CDM Smith

Table 3-2
Saprolite Monitoring Well and Supply Well Potentiometric Water Level Elevations – Stage 2 and 2a
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Well	Inner Casing Elevation (feet amsl)	Stage 2				Stage 2a	
		8/3/2010		10/20/2010		5/29/2012	
		Depth to Water (feet bgs)	Water Level Elevation (feet amsl)	Depth to Water (feet bgs)	Water Level Elevation (feet amsl)	Depth to Water (feet bgs)	Water Level Elevation (feet amsl)
SMW-1	1,376.92	42.31	1,334.61	41.56	1,335.36	43.12	1,333.80
SMW-2	1,383.61	49.23	1,334.38	48.61	1,335.00	50.00	1,333.61
SMW-3	1,370.29	36.50	1,333.79	35.74	1,334.55	36.82	1,333.47
SMW-4	1,375.60	-	-	-	-	42.06	1,333.54
SMW-5	1,372.18	38.22	1,333.96	37.55	1,334.63	38.91	1,333.27
SMW-6	1,348.98	-	-	-	-	31.47	1,317.51
SMW-7	1,357.04	-	-	-	-	32.23	1,324.81
SMW-8	1,357.54	-	-	-	-	26.53	1,331.01
SMW-9	1,375.70	41.18	1,334.52	39.38	1,336.32	41.70	1,334.00
SMW-10	1,375.43	39.75	1,335.68	38.80	1,336.63	40.79	1,334.64
SMW-12	1,379.15	45.12	1,334.03	44.50	1,334.65	45.86	1,333.29
MPW-6	1,401.28	No Measurement*		65.53	1,335.70	65.31	1,335.92
Cidra-3	1,360.35	26.98	1,333.37	26.98	1,333.37	27.67	1,332.68
Cidra-4	1,373.78	39.84	1,333.94	39.84	1,333.94	40.55	1,333.23
Cidra-6	1,371.44	37.42	1,334.02	37.42	1,334.02	-	-
Cidra-8	1,360.81	29.00	1,331.81	29.00	1,331.81	29.64	1,331.17
IVAX-2	-	63.15	-	-	-	-	-
IVAX-former	1,398.78	63.14	1,335.64	63.14	1,335.64	62.90	1,335.88

Acronyms

bgs - below ground surface

amsl - above mean sea level

SMW - saprolite monitoring well

*No measurement was made. MPW-6 was damaged prior to Stage 2, and was converted to a conventional monitoring well screened in the bedrock (at Port 5) (see Table 3-1 for Stage 1 water level measurement in MPW-6).

Table 4-1a
Soil Screening Criteria - Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Volatile Organic Compounds (All in µg/kg)	CAS Number	Human Health Screening Level[1]		Soil Protective of Groundwater[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
1,1,1-Trichloroethane	71-55-6	615,000		1,400		700	1400
1,1,2,2-Tetrachloroethane	79-34-5	560		0.52		0.26	0.52
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	906,000		2,600,000		453000	906000
1,1,2-Trichloroethane	79-00-5	160		32		16	32
1,1-Dichloroethane	75-34-3	3,300		14		6.8	13.6
1,1-Dichloroethylene	75-35-4	24,000		50		25	50
1,2,3-Trichlorobenzene	87-61-6	4,900		300		150	300
1,2,4-Trichlorobenzene	120-82-1	6,200		4,000		2000	4000
1,2-Dibromo-3-chloropropane	96-12-8	5.4		1.72		0.86	1.72
1,2-Dibromoethane	106-93-4	34		0.28		0.14	0.28
1,2-Dichlorobenzene	95-50-1	190,000		11,600		5800	11600
1,2-Dichloroethane	107-06-2	430		28		14	28
1,2-Dichloropropane	78-87-5	940		34		17	34
1,3-Dichlorobenzene	541-73-1	NL		NL		n/a	n/a
1,4-Dichlorobenzene	106-46-7	2,400		1440		720	1440
1,4-Dioxane	123-91-1	4,900		2.8		1.4	2.8
2-Butanone	78-93-3	2,800,000		20,000		10000	20000
2-Hexanone	591-78-6	21,000		158		79	158
4-Methyl-2-pentanone	108-10-1	530,000		4,600		2300	4600
Acetone (2-propanone)	67-64-1	6,100,000		48,000		24000	48000
Benzene	71-43-2	1,100		52		26	52
Bromochloromethane	74-97-5	16,000		420		210	420
Bromodichloromethane	75-27-4	270		440		135	270
Bromoform (tribromomethane)	75-25-2	62,000		420		210	420
Bromomethane	74-83-9	730		36		18	36
Carbon disulfide	75-15-0	82,000		4,200		2100	4200
Carbon tetrachloride	56-23-5	610		38		19	38
Chlorobenzene	108-90-7	29,000		1,360		680	1360
Chlorodibromomethane	124-48-1	680		420		210	420
Chloroethane	75-00-3	1,500,000		118,000		59000	118000
Chloroform	67-66-3	290		440		145	290
Chloromethane	74-87-3	12,000		980		490	980
cis-1,2-Dichloroethylene	156-59-2	16,000		420		210	420
cis-1,3-Dichloropropene	10061-01-5	1,700	a	3	a	1.5	3
Cyclohexane	110-82-7	117,000		260,000		58500	117000
Dichlorodifluoromethane	75-71-8	9,400		6,000		3000	6000
Ethylbenzene	100-41-4	5,400		15,600		2700	5400
Isopropylbenzene	98-82-8	199,000		12,800		6400	12800
Methyl acetate	79-20-9	7,800,000		64,000		32000	64000
Methyl tert-butyl ether	1634-04-4	43,000		56		28	56
Methylcyclohexane	108-87-2	NL		NL		n/a	n/a
Methylene chloride	75-09-2	36,000		26		13	26
m,p-Xylene	179601-23-1	59,000	b	3,600	b	1800	3600
o-Xylene	95-47-6	69,000		3,800		1900	3800
Styrene	100-42-5	562,000		2,200		1100	2200
Tetrachloroethylene	127-18-4	8,600		46		23	46
Toluene	108-88-3	356,000		13,800		6900	13800
trans-1,2-Dichloroethylene	156-60-5	15,000		580		290	580
trans-1,3-Dichloropropene	10061-02-6	1,700	a	3	a	1.5	3
Trichloroethylene	79-01-6	440		36		18	36
Trichlorofluoromethane	75-69-4	79,000		13,800		6900	13800
Vinyl chloride (chloroethene)	75-01-4	60		13.8		6.9	13.8

Table 4-1a
Soil Screening Criteria - Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Notes:

(1) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for residential soil, based on a cancer risk of $1x10^{-6}$ and/or a hazard quotient of 0.1

(2) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for protection of groundwater soil screening levels, based on a dilution factor of 20.
The Maximum Contaminanat Level (MCL)-based value is used unless one is not available, in which case the risk-based value is used.

(3) Cidra site screening value for surface soil is based on the lowest value of human health, ecological and soil protective of groundwater screening levels; while screening value for subsurface soil is based on the lower value of human health and soil protective of groundwater screening levels.

(a) screening value for 1,3-dichloropropene

(b) screening value for m-xylene

(c) Preliminary Remediation Goals for Ecological Endpoints (Efroymson et al. 1997)

(d) EPA Region 5, Resource, Conservation, Recovery, Act (RCRA) Ecological Screening Levels (EPA 2003c)

(e) screening value for total xylenes

Acronyms:

µg/kg = microgram per kilogram
EPA = United States Environmental Protection Agency
n/a = value not available
NL = not listed or chemical name listed but no value available
CAS = Chemical Abstract Service

Table 4-1b
Soil Screening Criteria - Semi-Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Semi-Volatile Organic Compounds (All in µg/kg)	CAS Number	Human Health Screening Level[1]	Soil Protective of Groundwater[2]	Project Quantitation Limit Goal	Cidra Site Screening Value[3]
1,1'-Biphenyl	92-52-4	5,100	174	87	174
1,2,4,5-Tetrachlorobenzene	95-94-3	1,800	116	58	116
2,2'-Oxybis (1-chloropropane)	108-60-1	4,600	2.2	1.1	2
2,3,4,6-Tetrachlorophenol	58-90-2	180,000	22,000	11000	22,000
2,4,5-Trichlorophenol	95-95-4	610,000	66,000	33000	66,000
2,4,6-Trichlorophenol	88-06-2	6,100	260	130	260
2,4-Dichlorophenol	120-83-2	18,000	820	410	820
2,4-Dimethylphenol	105-67-9	120,000	6,400	3200	6,400
2,4-Dinitrophenol	51-28-5	12000	680	340	680
2,4-Dinitrotoluene	121-14-2	1,600	5.6	2.8	6
2,6-Dinitrotoluene	606-20-2	6,100	400	200	400
2-Chloronapthalene	91-58-7	630,000	58,000	29000	58,000
2-Chlorophenol	95-57-8	39,000	1,140	570	1,140
2-Methylnapthalene	91-57-6	23,000	2,800	1400	2,800
2-Methylphenol (o-cresol)	95-48-7	310,000	11,600	5800	11,600
2-Nitroaniline	88-74-4	61,000	1,240	620	1,240
2-Nitrophenol	88-75-5	NL	NL	n/a	n/a
3,3-Dichlorobenzidine	91-94-1	1,100	14.2	7.1	14
3-Nitroaniline	99-09-2	NL	NL	n/a	n/a
4,6-Dinitro-2-methylphenol	534-52-1	490	40	20	40
4-Bromophenyl-phenylether	101-55-3	NL	NL	n/a	n/a
4-Chloro-3-methylphenol	59-50-7	610,000	26,000	13000	26,000
4-Chloroaniline	106-47-8	2,400	2.6	1.3	3
4-Chlorophenyl-phenyl ether	7005-72-3	NL	NL	n/a	n/a
4-Methylphenol	106-44-5	610,000	22,000	11000	22,000
4-Nitroaniline	100-01-6	24,000	28	14	28
4-Nitrophenol	100-02-7	NL	NL	n/a	n/a
Acenaphthene	83-32-9	340,000	82,000	41000	82,000
Acenaphthylene	208-96-8	NL	NL	n/a	n/a
Acetophenone	98-86-2	780,000	9,000	4500	9,000
Anthracene	120-12-7	1,700,000	840,000	420000	840,000
Atrazine	1912-24-9	2,100	38	19	38
Benzaldehyde	100-52-7	780,000	6,600	3300	6,600
Benz(a)anthracene	56-55-3	150	200	75	150
Benzo(a)pyrene	50-32-8	15	4,800	7.5	15
Benzo(b)fluoranthene	205-99-2	150	700	75	150
Benzo (g,h,i) perylene	191-24-2	NL	NL	n/a	n/a
Benzo(k)fluoranthene	207-08-9	1,500	7,000	750	1,500
Bis (2-chloroethoxy) methane	111-91-1	18,000	220	110	220
Bis(2-chloroethyl)ether	111-44-4	210	0.062	0.031	0
Bis(2-ethylhexyl)phthalate	117-81-7	35,000	28,000	14000	28,000
Butyl benzyl phthalate	85-68-7	260,000	4,000	2000	4,000
Caprolactam	105-60-2	3,100,000	38,000	19000	38,000
Carbazole	86-74-8	NL	NL	n/a	n/a
Chrysene	218-01-9	15,000	22,000	7500	15,000
Dibenz(a,h)anthracene	53-70-3	15	220	7.5	15
Diethylphthalate	84-66-2	4,900,000	94,000	47000	94,000
Dimethylphyhalate	131-00-3	NL	NL	n/a	n/a
Di-n-butyl phthalate	84-74-2	610,000	34,000	17000	34,000
Di-n-octyl phthalate	117-84-0	NL	NL	n/a	n/a
Fluoranthene	206-44-0	230,000	1,400,000	115000	230,000
Fluorene	86-73-7	230,000	80,000	40000	80,000
Hexachloro-1,3-butadiene	87-68-3	6,100	10	5	10

Table 4-1b
Soil Screening Criteria - Semi-Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Semi-Volatile Organic Compounds (All in µg/kg)	CAS Number	Human Health Screening Level[1]		Soil Protective of Groundwater[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
Hexachlorobenzene	118-74-1	300		260		130	260
Hexachlorocyclopentadiene	77-47-4	37,000		3,200		1600	3,200
Hexachloroethane	67-72-1	4,300		10		4.8	10
Indeno(1,2,3-cd)pyrene	193-39-5	150		2400		75	150
Isophorone	78-59-1	510,000		440		220	440
Naphthalene	91-20-3	3,600		9.4		4.7	9
Nitrobenzene	98-95-3	4,800		1.58		0.79	2
N-Nitrosodi-n-propylamine	621-64-7	69		0.14		0.07	0
N-Nitrosodiphenylamine	86-30-6	99,000		1,140		570	1,140
Pentachlorophenol	87-86-5	890		200		100	200
Phenanthrene	85-01-8	NL		NL		n/a	n/a
Phenol	108-95-2	1,800,000		52,000		26000	52,000
Pyrene	129-00-0	170,000		190,000		85000	170,000

Notes:

(1) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for residential soil, based on a cancer risk of $1x10^{-6}$ and/or a hazard quotient of 0.1

(2) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for protection of groundwater soil screening levels, based on a dilution factor of 20.The Maximum Contaminanat Level (MCL)-based value is used unless one is not available, in which case the risk-based value is used.

(3) Cidra site screening value for surface soil is based on the lowest value of human health, ecological and soil protective of groundwater screening levels; screening value for subsurface soil is based on the lower value of human health and soil protective of groundwater screening levels.

(a) Preliminary Remediation Goals for Ecological Endpoints (Efroymson et al. 1997)

(b) EPA Region 5, Resource, Conservation, Recovery, Act (RCRA) Ecological Screening Levels (EPA 2003c)

(c) EPA Ecological Soil Screening Levels (EcoSSLs) (EPA 2007)

(d) Screening value for low molecular weight PAHs

(e) Screening value for high molecular weight PAHs

(f) Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process (Erfoymson et al. 1997)

Acronyms:

µg/kg = microgram per kilogram
EPA = United States Environmental Protection Agency
n/a = value not available
NL = not listed or chemical name listed but no value available
CAS = Chemical Abstract Service
PAH = polyaromatic hydrocarbon

Table 4-1c
Soil Screening Criteria - Pesticides and PCBs
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Pesticides/ Polychlorinated Biphenyls (All in µg/kg)	CAS Number	Human Health Screening Level[1]		Soil Protective of Groundwater[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
Pesticides							
4,4'-DDD	72-54-8	2,000		1320		660	1,320
4,4'-DDE	72-55-9	1,400		920		460	920
4,4'-DDT	50-29-3	1,700		1340		670	1,340
Aldrin	309-00-2	29		1		0.34	0.68
alpha-BHC	319-84-6	77		0.72		0.36	0.72
alpha-Chlordane	5103-71-9	1,600	a	2,800	a	800	1600
beta-BHC	319-85-7	270		2.6		1.3	2.6
delta-BHC	319-86-8	NL		NL		n/a	n/a
Dieldrin	60-57-1	30		1.22		0.61	1.22
Endosulfan	115-29-7	37,000		22,000		11000	22,000
Endosulfan I	959-98-8	37,000	b	22,000	b	11000	22,000
Endosulfan II	33213-65-9	37,000	b	22,000	b	11000	22,000
Endosulfan sulfate	1031-07-8	37,000	b	22,000	b	11000	22,000
Endrin	72-20-8	1,800		1,620		810	1,620
Endrin aldehyde	7421-93-4	1,800	c	1,620	c	810	1,620
Endrin ketone	53494-70-5	1,800	c	1,620	c	810	1,620
gamma-BHC (Lindane)	58-89-9	520		24		12	24
gamma-Chlordane	5103-74-2	1,600	a	2,800	a	800	1600
Heptachlor	76-44-8	110		660		55	110
Heptachlor epoxide	1024-57-3	53		82		26.5	53
Methoxychlor	72-43-5	31,000		44,000		15500	31,000
Toxaphene	8001-35-2	440		9200		220	440
Polychlorinated Biphenyls (PCBs)							
Aroclor-1016	12674-11-2	390		1,840		195	390
Aroclor-1221	11104-28-2	140		1.48		0.74	1.48
Aroclor-1232	11141-16-5	140		1.48		0.74	1.48
Aroclor-1242	53469-21-9	220		106		53	106
Aroclor-1248	12672-29-6	220		104		52	104
Aroclor-1254	11097-69-1	110		176		55	110
Aroclor-1260	11096-82-5	220		480		110	220
Aroclor-1262	37324-23-5	220	d	480	d	110	220
Aroclor-1268	11100-14-4	220	d	480	d	110	220

Notes:

(1) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for residential soil, based on a cancer risk of $1x10^{-6}$ and/or a hazard quotient of 0.1

(2) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for protection of groundwater soil screening levels, based on a dilution factor of 20.The Maximum Contaminanat Level (MCL)-based value is used unless one is not available, in which case the risk-based value is used.

(3) Cidra site screening value for surface soil is based on the lowest value of human health, ecological and soil protective of groundwater screening levels; while screening value for subsurface soil is based on the lower value of human health and soil protective of groundwater screening levels.

(a) screening value for chlordane

(b) screening value for endosulfan

(c) screening value for endrin

(d) screening value for Aroclor-1260

(e) EPA Ecological Soil Screening Levels (EcoSSLs) (EPA 2005-2008)

(f) EPA Region 5, Resource, Conservation, Recovery, Act (RCRA) Ecological Screening Levels (EPA 2003c)

(g) screening value for endosulfan

(h) Preliminary Remediation Goals for Ecological Endpoints (Efroymson et al. 1997

(i) screening value for total PCBs

Acronyms:

µg/kg = microgram per kilogram

EPA = United States Environmental Protection Agency

n/a = value not available

NL = not listed or chemical name listed but no value available

PCB = polychlorinated biphenyl

CAS = Chemical Abstract Service

Table 4-1d
Soil Screening Criteria - Inorganics
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Inorganics (All in mg/kg)	CAS No.	Human Health Screening Level[1]		Soil Protective of Groundwater[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
Aluminum	7429-90-5	7,700		460,000		3850	7700
Antimony	7440-36-0	3.1		5.4		1.55	3.1
Arsenic	7440-38-2	0.39		5.8		0.195	0.39
Barium	7440-39-3	1,500		1,640		750	1500
Beryllium	7440-41-7	16		64		8	16
Cadmium	7440-43-9	7		NL		3.5	7
Calcium	7440-70-2	NL		NL		n/a	n/a
Chromium (total)	7440-47-3	0.29	a	3,600,000		0.145	0.29
Cobalt	7440-48-4	2.3		4.2		1.15	2.3
Copper	7440-50-8	310		920		155	310
Cyanide (amenable)	57-12-5	4.7	b	40	b	2.35	4.7
Iron	7439-89-6	5,500		5,400		2700	5400
Lead	7439-92-1	400	c	280		140	280
Magnesium	7439-95-4	NL		NL		n/a	n/a
Manganese	7439-96-5	180		21		10.5	21
Mercury	7439-97-6	2.3	d	2	d	1	2
Nickel	7440-02-0	150	e	150	e	75	150
Potassium	7440-09-7	NL		NL		n/a	n/a
Selenium	7782-49-2	39		5		2.6	5.2
Silver	7440-22-4	39		12		6	12
Sodium	7440-23-5	NL		NL		n/a	n/a
Thallium	7440-28-0	0.078		2.8		0.039	0.078
Vanadium	7440-62-2	39		1560		19.5	39
Zinc	7440-66-6	2,300		5,800		1150	2300

Notes:

(1) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for residential soil, based on a cancer risk of $1x10^{-6}$ and/or a hazard quotient of 0.1

(2) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for protection of groundwater soil screening levels, based on a dilution factor of 20.
The Maximum Contaminanat Level (MCL)-based value is used unless one is not available, in which case the risk-based value is used.

(3) Cidra site screening value for surface soil is based on the lowest value of human health, ecological and soil protective of groundwater screening levels; screening value for subsurface soil is based on the lower value of human health and soil protective of groundwater screening levels.

(a) screening value for chromium (VI)

(b) screening value for cyanide (CN^-)

(c) OSWER screening value for residential soil

(d) screening value for mercuric chloride (and other mercury salts)

(e) screening value for soluble nickel salts

(f) Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants (Efroymson et al. 1997)

(g) EPA Ecological Soil Screening Levels (EcoSSLs) (EPA 2005-2008)

(h) screening value for chromium III

(i) EPA Region 5, Resource, Conservation, Recovery, Act (RCRA) Ecological Screening Levels (EPA 2003c)

Acronyms:

mg/kg = milligram per kilogram
EPA = United States Environmental Protection Agency
n/a = value not available
NL = not listed or chemical name listed but no value available
CAS = Chemical Abstract Service

Table 4-2a
Groundwater Screening Criteria - Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Volatile Organic Compounds (All in µg/L)	CAS Number	Puerto Rico Water Quality Standard[1]	National Primary Drinking Water Regulations[2]	Human Health Screening Level[3]	Project Quantitation Limit Goal	Cidra Site Screening Value[4]
1,1,1-Trichloroethane	71-55-6	200	200	750	100	200
1,1,2,2-Tetrachloroethane	79-34-5	1.7	NL	0.066	0.85	1.7
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NL	NL	5,300	2,650	5,300
1,1,2-Trichloroethane	79-00-5	5	5	0.041	2.5	5
1,1-Dichloroethane	75-34-3	NL	NL	2.4	1.2	2.4
1,1-Dichloroethylene	75-35-4	7	7	26	3.5	7
1,2,3-Trichlorobenzene	87-61-6	NL	NL	0.52	0.26	0.52
1,2,4-Trichlorobenzene	120-82-1	35	70	0.39	17.5	35
1,2-Dibromo-3-chloropropane	96-12-8	NL	0.2	0.00032	0.1	0.2
1,2-Dibromoethane	106-93-4	NL	0.05	0.0065	0.025	0.05
1,2-Dichlorobenzene	95-50-1	420	600	28	210	420
1,2-Dichloroethane	107-06-2	3.8	5	0.15	1.9	3.8
1,2-Dichloropropane	78-87-5	5	5	0.38	2.5	5
1,3-Dichlorobenzene	541-73-1	320	NL	NL	160	320
1,4-Dichlorobenzene	106-46-7	63	75	0.42	31.5	63
1,4-Dioxane	123-91-1	NL	NL	0.67	0.335	0.67
2-Butanone	78-93-3	NL	NL	490	245	490
2-Hexanone	591-78-6	NL	NL	3.4	1.7	3.4
4-Methyl-2-pentanone	108-10-1	NL	NL	100	50	100
Acetone	67-64-1	NL	NL	1,200	600	1,200
Benzene	71-43-2	5	5	0.39	2.5	5
Bromochloromethane	74-97-5	NL	NL	8.3	4.15	8.3
Bromodichloromethane	75-27-4	5.5	80 [c]	0.12	2.75	5.5
Bromoform	75-25-2	43	80 [c]	7.9	21.5	43
Bromomethane	74-83-9	47	NL	0.7	23.5	47
Carbon Disulfide	75-15-0	NL	NL	72	36	72
Carbon Tetrachloride	56-23-5	2.3	5	0.39	1.15	2.3
Chlorobenzene	108-90-7	100	100	7.2	50	100
Chloroethane	75-00-3	NL	NL	2,100	1,050	2,100
Chloroform	67-66-3	57	80 [c]	0.19	28.5	57
Chloromethane	74-87-3	NL	NL	19	9.5	19
cis-1,2-Dichloroethene	156-59-2	NL	70	2.8	35	70
cis-1,3-Dichloropropene	10061-01-5	3.4 [a]	NL	0.41 [a]	1.7	3.4
Cyclohexane	110-82-7	NL	NL	1,300	650	1,300
Dibromochloromethane	124-48-1	4	80 [c]	0.15	2	4
Dichlorodifluoromethane	75-71-8	NL	NL	19	9.5	19
Ethylbenzene	100-41-4	530	700	1.3	265	530
Isopropylbenzene	98-82-8	NL	NL	39	19.5	39
m,p-Xylene	179601-23-1	NL	10,000 [b]	19 [b]	5,000	10,000
Methyl Acetate	79-20-9	NL	NL	1,600	800	1,600
Methyl Tert-Butyl Ether	1634-04-4	NL	NL	12	6	12
Methylcyclohexane	108-87-2	NL	NL	NL	NL	n/a
Methylene Chloride	75-09-2	46	5	8.4	23	46
o-Xylene	95-47-6	NL	10,000 [b]	19	5,000	10,000
Styrene	100-42-5	NL	100	110	50	100
Tetrachloroethene	127-18-4	5	5	3.5	2.5	5
Toluene	108-88-3	1,000	1,000	86	500	1,000
trans-1,2-Dichloroethene	156-60-5	100	100	8.6	50	100
trans-1,3-Dichloropropene	10061-02-6	3.4 [a]	NL	0.41 [a]	1.7	3.4
Trichloroethene	79-01-6	5	5	0.26	2.5	5
Trichlorofluoromethane	75-69-4	NL	NL	110	55	110
Vinyl Chloride	75-01-4	0.25	2	0.015	0.125	0.25

Table 4-2a
Groundwater Screening Criteria - Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Notes:

(1) Commonwealth of Puerto Rico, Office of the Governor, Environmental Quality Board, March 2010, Puerto Rico Water Quality Standards Regulation. Screening values are based on water quality standards for Class SG groundwater.

(2) National Primary Drinking Water Regulations (EPA 2009)

(3) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for tap water, based on a cancer risk of $1x10^{-6}$ and/or a hazard quotient of 0.1

(4) Cidra site screening value is based on the Puerto Rico Water Quality Standards for groundwater, when available. Otherwise, it is based on the Maximum Contaminant Level from National Primary Drinking Water Regulations. Regional Screening Level for tap water is used if none of the values is available from the aforementioned sources.

(a) screening value for 1,3-dichloropropene

(b) screening valude for m-xylene

(c) screening value for total trihalomethanes

Acronyms:

µg/L = microgram per liter

EPA = United States Environmental Protection Agency

n/a = value not available

NL = not listed or chemical name listed but no value available

CAS = Chemical Abstract Service

Table 4-2b
Groundwater Screening Criteria - Semi-Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Semi-volatile Organic Compounds (All in µg/L)	CAS Number	Puerto Rico Water Quality Standard[1]	National Primary Drinking Water Regulations[2]	Human Health Screening Level[3]	Project Quantitation Limit Goal	Cidra Site Screening Value[4]
1,1-Biphenyl	92-52-4	NL	NL	0.083	0.0415	0.083
1,2,4,5-Tetrachlorobenzene	95-94-3	NL	NL	0.12	0.06	0.12
2,2'-oxybis(1-Chloropropane)	108-60-1	1,400	NL	0.31	700	1,400
2,3,4,6-Tetrachlorophenol	58-90-2	NL	NL	17	8.5	17
2,4,5-Trichlorophenol	95-95-4	NL	NL	89	44.5	89
2,4,6-Trichlorophenol	88-06-2	14	NL	0.9	7	14
2,4-Dichlorophenol	120-83-2	77	NL	3.5	38.5	77
2,4-Dimethylphenol	105-67-9	380	NL	27	190	380
2,4-Dinitrophenol	51-28-5	69	NL	3	34.5	69
2,4-Dinitrotoluene	121-14-2	1.1	NL	0.2	0.55	1.1
2,6-Dinitrotoluene	606-20-2	NL	NL	1.5	0.75	1.5
2-Chloronaphthalene	91-58-7	1,000	NL	55	500	1,000
2-Chlorophenol	95-57-8	81	NL	7.1	40.5	81
2-Methylnaphthalene	91-57-6	NL	NL	2.7	1.35	2.7
2-Methylphenol	95-48-7	NL	NL	72	36	72
2-Nitroaniline	88-74-4	NL	NL	15	7.5	15
2-Nitrophenol	88-75-5	NL	NL	NL	NL	n/a
3,3'-Dichlorobenzidine	91-94-1	0.21	NL	0.11	0.105	0.21
3-Nitroaniline	99-09-2	NL	NL	NL	NL	n/a
4,6-Dinitro-2-methylphenol	534-52-1	13	NL	0.12	6.5	13
4-Bromophenyl-phenylether	101-55-3	NL	NL	NL	NL	n/a
4-Chloro-3-methylphenol	59-50-7	NL	NL	110	55	110
4-Chloroaniline	106-47-8	NL	NL	0.32	0.16	0.32
4-Chlorophenyl-phenylether	7005-72-3	NL	NL	NL	NL	n/a
4-Methylphenol	106-44-5	NL	NL	140	70	140
4-Nitroaniline	100-01-6	NL	NL	3.3	1.65	3.3
4-Nitrophenol	100-02-7	NL	NL	NL	NL	n/a
Acenaphthene	83-32-9	670	NL	40	335	670
Acenaphthylene	208-96-8	NL	NL	NL	NL	n/a
Acetophenone	98-86-2	NL	NL	150	75	150
Anthracene	120-12-7	8,300	NL	130	4,150	8,300
Atrazine	1912-24-9	NL	3	0.26	1.5	3
Benzaldehyde	100-52-7	NL	NL	150	75	150
Benzo(a)anthracene	56-55-3	0.038	NL	0.029	0.019	0.038
Benzo(a)pyrene	50-32-8	0.038	0.2	0.0029	0.019	0.038
Benzo(b)fluoranthene	205-99-2	0.038	NL	0.029	0.019	0.038
Benzo(g,h,i)perylene	191-24-2	NL	NL	NL	NL	n/a
Benzo(k)fluoranthene	207-08-9	0.038	NL	0.29	0.019	0.038
bis(2-Chloroethoxy)methane	111-91-1	NL	NL	4.7	2.35	4.7
bis(2-Ethylhexyl)phthalate	117-81-7	12	6	0.071	6	12
bis(2-Chloroethyl)ether	111-44-4	0.3	NL	0.012	0.15	0.3
Butylbenzylphthalate	85-68-7	1,500	NL	14	750	1,500
Caprolactam	105-60-2	NL	NL	770	385	770
Carbazole	86-74-8	NL	NL	NL	NL	n/a
Chrysene	218-01-9	0.038	NL	2.9	0.019	0.038
Dibenz(a,h)anthracene	53-70-3	0.038	NL	0.0029	0.019	0.038
Dibenzofuran	132-64-9	NL	NL	0.58	0.29	0.58
Diethylphthalate	84-66-2	17,000	NL	1,100	8,500	17,000
Dimethylphthalate	131-11-3	270,000	NL	NL	135,000	270,000
Di-n-butylphthalate	84-74-2	2,000	NL	67	1,000	2,000

Table 4-2b
Groundwater Screening Criteria - Semi-Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Semi-volatile Organic Compounds (All in µg/L)	CAS Number	Puerto Rico Water Quality Standard[1]	National Primary Drinking Water Regulations[2]	Human Health Screening Level[3]	Project Quantitation Limit Goal	Cidra Site Screening Value[4]
Di-n-octyl phthalate	117-84-0	NL	NL	NL	NL	n/a
Fluoranthene	206-44-0	130	NL	63	65	130
Fluorene	86-73-7	1,100	NL	22	550	1,100
Hexachlorobenzene	118-74-1	0.0028	1	0.042	0.0014	0.0028
Hexachlorobutadiene	87-68-3	4.4	NL	0.26	2.2	4.4
Hexachlorocyclopentadiene	77-47-4	40	50	2.2	20	40
Hexachloroethane	67-72-1	14	NL	0.51	7	14
Indeno(1,2,3-cd)pyrene	193-39-5	0.038	NL	0.029	0.019	0.038
Isophorone	78-59-1	350	NL	67	175	350
Naphthalene	91-20-3	NL	NL	0.14	0.07	0.14
Nitrobenzene	98-95-3	17	NL	0.12	8.5	17
N-Nitroso-di-n-propylamine	621-64-7	0.05	NL	0.0093	0.025	0.05
N-Nitrosodiphenylamine	86-30-6	33	NL	10	16.5	33
Pentachlorophenol	87-86-5	1	1	0.17	0.5	1
Phenanthrene	85-01-8	NL	NL	NL	NL	n/a
Phenol	108-95-2	21,000	NL	450	10,500	21,000
Pyrene	129-00-0	830	NL	8.7	415	830

Notes:

[1] Commonwealth of Puerto Rico, Office of the Governor, Environmental Quality Board, March 2010, Puerto Rico Water Quality Standards Regulation. Screening values are based on water quality standards for Class SG groundwater.

[2] National Primary Drinking Water Regulations (EPA 2009)

[3] Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for tap water, based on a cancer risk of $1x10^{-6}$ and/or a hazard quotient of 0.1

[4] Cidra site screening value is based on the Puerto Rico Water Quality Standards for groundwater, when available. Otherwise, it is based on the Maximum Contaminant Level from National Primary Drinking Water Regulations. Regional Screening Level for tap water is used if none of the values is available from the aforementioned sources.

Acronyms:

µg/L = microgram per liter
EPA = United States Environmental Protection Agency
n/a = value not available
NL = not listed or chemical name listed but no value available
CAS = Chemical Abstract Service

Table 4-2c
Groundwater Screening Criteria - Pesticides and PCBs
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Pesticides/ Polychlorinated Biphenyls (All in µg/L)	CAS Number	Puerto Rico Water Quality Standard[1]	National Primary Drinking Water Regulations[2]	Human Health Screening Level[3]	Project Quantitation Limit Goal	Cidra Site Screening Value[4]
Pesticides						
4,4'-DDD	72-54-8	0.0022	NL	0.28	0.0011	0.0022
4,4'-DDE	72-55-9	0.0022	NL	0.2	0.0011	0.0022
4,4'-DDT	50-29-3	0.0022	NL	0.2	0.0011	0.0022
Aldrin	309-00-2	0.00049	NL	0.00021	0.000245	0.00049
alpha-BHC	319-84-6	0.026	NL	0.0062	0.013	0.026
alpha-Chlordane	5103-71-9	0.008 [a]	2 [a]	0.027 [a]	0.004	0.008
beta-BHC	319-85-7	0.091	NL	0.022	0.0455	0.091
delta-BHC	319-86-8	NL	NL	NL	NL	n/a
Dieldrin	60-57-1	0.00052	NL	0.0015	0.00026	0.00052
Endosulfan I	959-98-8	62 [b]	NL	7.8 [b]	31	62
Endosulfan II	33213-65-9	62 [b]	NL	7.8 [b]	31	62
Endosulfan sulfate	1031-07-8	62	NL	7.8 [b]	31	62
Endrin	72-20-8	0.059	2	0.17	0.0295	0.059
Endrin aldehyde	7421-93-4	0.29	2 [c]	0.17 [c]	0.145	0.29
Endrin ketone	53494-70-5	0.059 [c]	2 [c]	0.17 [c]	0.0295	0.059
gamma-BHC (Lindane)	58-89-9	0.2	0.2	0.036	0.1	0.2
gamma-Chlordane	5103-74-2	0.008 [a]	2 [a]	0.027 [a]	0.004	0.008
Heptachlor	76-44-8	0.00079	0.4	0.0018	0.000395	0.00079
Heptachlor epoxide	1024-57-3	0.2	0.2	0.0033	0.1	0.2
Methoxychlor	72-43-5	40	40	2.7	20	40
Toxaphene	8001-35-2	0.0028	3	0.013	0.0014	0.0028
Polychlorinated Biphenyls (PCBs)						
Aroclor-1016	12674-11-2	0.00064 [d]	0.5 [d]	0.11	0.00032	0.00064
Aroclor-1221	11104-28-2	0.00064 [d]	0.5 [d]	0.0043	0.00032	0.00064
Aroclor-1232	11141-16-5	0.00064 [d]	0.5 [d]	0.0043	0.00032	0.00064
Aroclor-1242	53469-21-9	0.00064 [d]	0.5 [d]	0.034	0.00032	0.00064
Aroclor-1248	12672-29-6	0.00064 [d]	0.5 [d]	0.034	0.00032	0.00064
Aroclor-1254	11097-69-1	0.00064 [d]	0.5 [d]	0.031	0.00032	0.00064
Aroclor-1260	11096-82-5	0.00064 [d]	0.5 [d]	0.034	0.00032	0.00064
Aroclor-1262	37324-23-5	0.00064 [d]	0.5 [d]	0.034 [d]	0.00032	0.00064
Aroclor-1268	11100-14-4	0.00064 [d]	0.5 [d]	0.034 [d]	0.00032	0.00064

Notes:

[1] Commonwealth of Puerto Rico, Office of the Governor, Environmental Quality Board, March 2010, Puerto Rico Water Quality Standards Regulation. Screening values are based on water quality standards for Class SG groundwater.

[2] National Primary Drinking Water Regulations (EPA 2009)

[3] Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for tap water, based on a cancer risk of $1x10^{-6}$ and/or a hazard quotient of 0.1

[4] Cidra site screening value is based on the Puerto Rico Water Quality Standards for groundwater, when available. Otherwise, it is based on the Maximum Contaminant Level from National Primary Drinking Water Regulations. Regional Screening Level for tap water is used if none of the values is available from the aforementioned sources.

[a] screening value for chlordane

[b] screening value for endosulfan

[c] screening value for endrin

[d] screening value for Aroclor-1260

Acronyms:

µg/L = microgram per liter

EPA = United States Environmental Protection Agency

n/a = value not available

NL = not listed or chemical name listed but no value available

CAS = Chemical Abstract Service

PCB = polychlorinated biphenyl

Table 4-2d
Groundwater Screening Criteria - Inorganics
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Inorganics (All in µg/L)	CAS Number	Puerto Rico Water Quality Standard[1]	National Primary Drinking Water Regulations[2]	Human Health Screening Level[3]	Project Quantitation Limit Goal	CidraSite Screening Value[4]
Aluminum	7429-90-5	NL	NL	1,600	800	1,600
Antimony	7440-36-0	5.6	6	0.6	2.8	5.6
Arsenic	7440-38-2	10	10	0.045	5	10
Barium	7440-39-3	NL	2,000	290	1,000	2,000
Beryllium	7440-41-7	NL	4	1.6	2	4
Cadmium	7440-43-9	5	5	0.69	2.5	5
Calcium	7440-70-2	NL	NL	NL	NL	n/a
Chromium	7440-47-3	100	100	0.031 [a]	50	100
Cobalt	7440-48-4	NL	NL	0.47	0.235	0.47
Copper	7440-50-8	1300	1,300	62	650	1,300
Cyanide	57-12-5	200	200	0.93	100	200
Iron	7439-89-6	NL	NL	1,100	550	1,100
Lead	7439-92-1	15	15	NL	7.5	15
Magnesium	7439-95-4	NL	NL	NL	NL	n/a
Manganese	7439-96-5	NL	NL	32	16	32
Mercury	7439-97-6	0.05	2	0.43 [b]	0.025	0.05
Nickel	7440-02-0	610	NL	30	305	610
Potassium	7440-09-7	NL	NL	NL	NL	n/a
Selenium	7782-49-2	50	50	7.8	25	50
Silver	7440-22-4	NL	NL	7.1	3.55	7.1
Sodium	7440-23-5	NL	NL	NL	NL	n/a
Thallium	7440-28-0	0.24	2	0.016	0.12	0.24
Vanadium	7440-62-2	NL	NL	7.8	3.9	7.8
Zinc	7440-66-6	NL	NL	470	235	470

Notes:

(1) Commonwealth of Puerto Rico, Office of the Governor, Environmental Quality Board, March 2010, Puerto Rico Water Quality Standards Regulation. Screening values are based on water quality standards for Class SG groundwater.

(2) National Primary Drinking Water Regulations (EPA 2009)

(3) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for tap water, based on a cancer risk of $1x10^{-6}$ and/or a hazard quotient of 0.1

(4) Cidra site screening value is based on the Puerto Rico Water Quality Standards for groundwater, when available. Otherwise, it is based on the Maximum Contaminant Level from National Primary Drinking Water Regulations. Regional Screening Level for tap water is used if none of the values is available from the aforementioned sources.

(a) screening value for chromium (VI)

(b) screening value for mercuric chloride (and other mercury salts)

Acronyms:

µg/L = microgram per liter
EPA = United States Environmental Protection Agency
n/a = value not available
NL = not listed or chemical name listed but no value available
CAS = Chemical Abstract Service

Table 4-3a
Surface Water Screening Criteria - Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Volatile Organic Compounds (All in µg/L)	CAS No.	Puerto Rico Water Quality Standard[1]	National Recommended Water Quality Criteria[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
			Freshwater Aquatic Life Use Chronic Criteria	Human Health for the Consumption of Water + Organism		
1,1,1-Trichloroethane	71-55-6	200	NL	NL	100	200
1,1,2,2-Tetrachloroethane	79-34-5	1.7	NL	0.17	0.85	1.7
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NL	NL	NL	NL	n/a
1,1,2-Trichloroethane	79-00-5	5	NL	0.59	2.5	5
1,1-Dichloroethane	75-34-3	NL	NL	NL	NL	n/a
1,1-Dichloroethylene	75-35-4	7	NL	330	3.5	7
1,2,3-Trichlorobenzene	87-61-6	NL	NL	NL	NL	n/a
1,2,4-Trichlorobenzene	120-82-1	35	NL	35	17.5	35
1,2-Dibromo-3-chloropropane	96-12-8	NL	NL	NL	NL	n/a
1,2-Dibromoethane	106-93-4	NL	NL	NL	NL	n/a
1,2-Dichlorobenzene	95-50-1	420	NL	420	210	420
1,2-Dichloroethane	107-06-2	3.8	NL	0.38	1.9	3.8
1,2-Dichloropropane	78-87-5	5	NL	0.5	2.5	5
1,3-Dichlorobenzene	541-73-1	320	NL	320	160	320
1,4-Dichlorobenzene	106-46-7	63	NL	63	31.5	63
2-Butanone	78-93-3	NL	NL	NL	NL	n/a
2-Hexanone	591-78-6	NL	NL	NL	NL	n/a
4-Methyl-2-pentanone	108-10-1	NL	NL	NL	NL	n/a
Acetone	67-64-1	NL	NL	NL	NL	n/a
Benzene	71-43-2	5	NL	2.2	2.5	5
Bromochloromethane	74-97-5	NL	NL	NL	NL	n/a
Bromodichloromethane	75-27-4	5.5	NL	0.55	2.75	5.5
Bromoform	75-25-2	43	NL	NL	21.5	43
Bromomethane	74-83-9	47	NL	47	23.5	47
Carbon Disulfide	75-15-0	NL	NL	NL	NL	n/a
Carbon Tetrachloride	56-23-5	2.3	NL	0.23	1.15	2.3
Chlorobenzene	108-90-7	100	NL	130	50	100
Chloroethane	75-00-3	NL	NL	NL	NL	n/a
Chloroform	67-66-3	57	NL	5.7	28.5	57
Chloromethane	74-87-3	NL	NL	NL	NL	n/a
cis-1,2-Dichloroethene	540-59-0	NL	NL	NL	NL	n/a
cis-1,3-Dichloropropene	26952-23-8	3.4 [a]	NL	NL	1.7	3.4
Cyclohexane	110-82-7	NL	NL	NL	NL	n/a
Dibromochloromethane	124-48-1	4	NL	0.4	2	4
Dichlorodifluoromethane	75-71-8	NL	NL	NL	NL	n/a
Ethylbenzene	100-41-4	530	NL	530	265	530
Isopropylbenzene	98-82-8	NL	NL	NL	NL	n/a
Methyl Acetate	79-20-9	NL	NL	NL	NL	n/a
Methyl Tert-Butyl Ether	1634-04-4	NL	NL	NL	NL	n/a
Methylcyclohexane	108-87-2	NL	NL	NL	NL	n/a
Methylene Chloride	75-09-2	46	NL	4.6	23	46
m,p-Xylene	179601-23-1	NL	NL	NL	NL	n/a
o-Xylene	1330-20-7	NL	NL	NL	NL	n/a
Styrene	100-42-5	NL	NL	NL	NL	n/a
Tetrachloroethene	127-18-4	5	NL	0.69	2.5	5
Toluene	108-88-3	1,000	NL	1300	500	1000
trans-1,2-Dichloroethene	156-60-5	100	NL	140	50	100
trans-1,3-Dichloropropene	10061-02-6	3.4 [a]	NL	NL	1.7	3.4
Trichloroethene	79-01-6	5	NL	2.5	2.5	5
Trichlorofluoromethane	75-69-4	NL	NL	NL	NL	n/a
Vinyl Chloride	75-01-4	0.25	NL	0.025	0.125	0.25

Notes:

(1) Commonwealth of Puerto Rico, Office of the Governor, Environmental Quality Board, 2010, Puerto Rico Water Quality Standards Regulation. Screening values are based on water quality standards for Class SD surface water.

(2) National Recommended Water Quality Criteria for Priority Pollutants (EPA 2009)

(3) Cidra site screening value is based on the Puerto Rico Water Quality Standards when available. Otherwise, it is based on the National Recommended Water Quality Criteria.

(a) screening value for 1,3-dichloropropene

Acronyms:

µg/L = microgram per liter

CAS = Chemical Abstract Service

EPA = United States Environmental Protection Agency

n/a = value not available

NL = not listed or chemical name listed but no value available

Table 4-3b
Surface Water Screening Criteria - Semi-Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Semi-volatile Organic Compounds (All in µg/L)	CAS No.	Puerto Rico Water Quality Standard[1]	National Recommended Water Quality Criteria[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
			Freshwater Aquatic Life Use Chronic Criteria	Human Health for the Consumption of Water + Organism		
1,1'Biphenyl	92-52-4	NL	NL	NL	NL	n/a
1,2,4,5-Tetrachlorobenzene	95-94-3	NL	NL	NL	NL	n/a
2,2'-oxybis(1-Chloropropane)	108-60-1	NL	NL	1,400	700	1,400
2,3,4,6-Tetrachlorophenol	58-90-2	NL	NL	NL	NL	n/a
2,4,5-Trichlorophenol	95-95-4	NL	NL	NL	NL	n/a
2,4,6-Trichlorophenol	88-06-2	14	NL	1.4	7	14
2,4-Dichlorophenol	120-83-2	77	NL	77	38.5	77
2,4-Dimethylphenol	105-67-9	380	NL	380	190	380
2,4-Dinitrophenol	51-28-5	69	NL	69	34.5	69
2,4-Dinitrotoluene	121-14-2	1.1	NL	0.11	0.55	1.1
2,6-Dinitrotoluene	606-20-2	NL	NL	NL	NL	n/a
2-Chloronaphthalene	91-58-7	1,000	NL	1,000	500	1,000
2-Chlorophenol	95-57-8	81	NL	81	40.5	81
2-Methylnaphthalene	91-57-6	NL	NL	NL	NL	n/a
2-Methylphenol	95-48-7	NL	NL	NL	NL	n/a
2-Nitroaniline	88-74-4	NL	NL	NL	NL	n/a
2-Nitrophenol	88-75-5	NL	NL	NL	NL	n/a
3,3'-Dichlorobenzidine	91-94-1	0.21	NL	0.021	0.105	0.21
3-Nitroaniline	99-09-2	NL	NL	NL	NL	n/a
4,6-Dinitro-2-methylphenol	534-52-1	13	NL	13	6.5	13
4-Bromophenyl-phenylether	101-55-3	NL	NL	NL	NL	n/a
4-Chloro-3-methylphenol	59-50-7	NL	NL	NL	NL	n/a
4-Chloroaniline	106-47-8	NL	NL	NL	NL	n/a
4-Chlorophenyl-phenylether	7005-72-3	NL	NL	NL	NL	n/a
4-Methylphenol	106-44-5	NL	NL	NL	NL	n/a
4-Nitroaniline	100-01-6	NL	NL	NL	NL	n/a
4-Nitrophenol	100-02-7	NL	NL	NL	NL	n/a
Acenaphthene	83-32-9	670	NL	670	335	670
Acenaphthylene	208-96-8	NL	NL	NL	NL	n/a
Acetophenone	98-86-2	NL	NL	NL	NL	n/a
Anthracene	120-12-7	8,300	NL	8,300	4,150	8,300
Atrazine	1912-24-9	NL	NL	NL	NL	n/a
Benzaldehyde	100-52-7	NL	NL	NL	NL	n/a
Benzo(a)anthracene	56-55-3	0.038	NL	0.0038	0.019	0.038
Benzo(a)pyrene	50-32-8	0.038	NL	0.0038	0.019	0.038
Benzo(b)fluoranthene	205-99-2	0.038	NL	0.0038	0.019	0.038
Benzo(g,h,i)perylene	191-24-2	NL	NL	NL	NL	n/a
Benzo(k)fluoranthene	207-08-9	0.038	NL	0.0038	0.019	0.038
bis(2-Chloroethoxy)methane	111-91-1	NL	NL	NL	NL	n/a
bis(2-Chloroethyl)ether	111-44-4	0.3	NL	0.03	0.15	0.3
bis(2-Ethylhexyl)phthalate	117-81-7	12	NL	1.2	6	12
Butylbenzylphthalate	85-68-7	1,500	NL	1500	750	1,500
Caprolactam	105-60-2	NL	NL	NL	NL	n/a
Carbazole	86-74-8	NL	NL	NL	NL	n/a
Chrysene	218-01-9	0.038	NL	0.0038	0.019	0.038
Dibenz(a,h)anthracene	53-70-3	0.038	NL	0.0038	0.019	0.038
Dibenzofuran	132-64-9	NL	NL	NL	NL	n/a
Diethylphthalate	84-66-2	17,000	NL	17,000	8,500	17,000
Dimethylphthalate	131-11-3	270,000	NL	270,000	135,000	270,000
Di-n-butylphthalate	84-74-2	2,000	NL	2,000	1,000	2,000
Di-n-octyl phthalate	117-84-0	NL	NL	NL	NL	n/a
Fluoranthene	206-44-0	130	NL	130	65	130
Fluorene	86-73-7	1,100	NL	1100	550	1,100
Hexachlorobenzene	118-74-1	0.0028	NL	0.00028	0.0014	0.0028
Hexachlorobutadiene	87-68-3	4.4	NL	0.44	2.2	4.4
Hexachlorocyclopentadiene	77-47-4	40	NL	40	20	40
Hexachloroethane	67-72-1	14	NL	1.4	7	14
Indeno(1,2,3-cd)pyrene	193-39-5	0.038	NL	0.0038	0.019	0.038
Isophorone	78-59-1	350	NL	35	175	350
Naphthalene	91-20-3	NL	NL	NL	NL	n/a
Nitrobenzene	98-95-3	17	NL	17	8.5	17
N-Nitroso-di-n-propylamine	621-64-7	0.05	NL	0.005	0.025	0.05
N-Nitrosodiphenylamine	86-30-6	33	NL	3.3	16.5	33
Pentachlorophenol	87-86-5	1	15	0.27	0.5	1
Phenanthrene	85-01-8	NL	NL	NL	NL	n/a
Phenol	108-95-2	21,000	NL	10,000	10,500	21,000
Pyrene	129-00-0	830	NL	830	415	830

Table 4-3b
Surface Water Screening Criteria - Semi-Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Notes:

(1) Commonwealth of Puerto Rico, Office of the Governor, Environmental Quality Board, 2010, Puerto Rico Water Quality Standards Regulation. Screening values are based on water quality standards for Class SD surface water.

(2) National Recommended Water Quality Criteria for Priority Pollutants (EPA 2009)

(3) Cidra site screening value is based on the Puerto Rico Water Quality Standards when available. Otherwise, it is based on the National Recommended Water Quality Criteria.

Acronyms:

µg/L = microgram per liter
EPA = United States Environmental Protection Agency
n/a = value not available
NL = not listed or chemical name listed but no value available
CAS = Chemical Abstract Service

Table 4-3c
Surface Water Screening Criteria - Pesticides and PCBs
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Pesticides/ Polychlorinated Biphenyls (All in µg/L)	CAS No.	Puerto Rico Water Quality Standard[1]		National Recommended Water Quality Criteria[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
				Freshwater Aquatic Life Use Chronic Criteria	Human Health for the Consumption of Water + Organism		
Pesticides							
4,4'-DDD	72-54-8	0.001		NL	0.00031	0.0005	0.001
4,4'-DDE	72-55-9	0.001		NL	0.00022	0.0005	0.001
4,4'-DDT	50-29-3	0.001		0.001	0.00022	0.0005	0.001
Aldrin	309-00-2	0.00049		NL	0.000049	0.000245	0.00049
alpha-BHC	319-84-6	0.026		NL	0.0026	0.013	0.026
alpha-Chlordane	5103-71-9	0.0043	a	NL	NL	0.00215	0.0043
beta-BHC	319-85-7	0.091		NL	0.0091	0.0455	0.091
delta-BHC	319-86-8	NL		NL	NL	NL	NL
Dieldrin	60-57-1	0.00052		0.056	0.000052	0.00026	0.00052
Endosulfan I	959-98-8	0.056	b	0.056	62	0.028	0.056
Endosulfan II	33213-65-9	0.056	b	0.056	62	0.028	0.056
Endosulfan sulfate	1031-07-8	62		NL	62	31	62
Endrin	72-20-8	0.036		0.036	0.059	0.018	0.036
Endrin aldehyde	7421-93-4	0.29		NL	0.29	0.145	0.29
Endrin ketone	53494-70-5	0.036	c	NL	NL	0.018	0.036
gamma-BHC (Lindane)	58-89-9	0.2		NL	0.98	0.1	0.2
gamma-Chlordane	5103-74-2	0.0043	a	NL	NL	0.00215	0.0043
Heptachlor	76-44-8	0.00079		0.0038	0.000079	0.000395	0.00079
Heptachlor epoxide	1024-57-3	0.0038		0.0038	0.000039	0.0019	0.0038
Methoxychlor	72-43-5	0.03		NL	NL	0.015	0.03
Toxaphene	8001-35-2	0.0002		0.0002	0.00028	0.0001	0.0002
Polychlorinated Biphenyls (PCBs)							
Aroclor-1016	12674-11-2	0.00064	d	0.014	0.000064	0.00032	0.00064
Aroclor-1221	11104-28-2	0.00064	d	0.014	0.000064	0.00032	0.00064
Aroclor-1232	11141-16-5	0.00064	d	0.014	0.000064	0.00032	0.00064
Aroclor-1242	53469-21-9	0.00064	d	0.014	0.000064	0.00032	0.00064
Aroclor-1248	12672-29-6	0.00064	d	0.014	0.000064	0.00032	0.00064
Aroclor-1254	11097-69-1	0.00064	d	0.014	0.000064	0.00032	0.00064
Aroclor-1260	11096-82-5	0.00064	d	0.014	0.000064	0.00032	0.00064
Aroclor-1262	37324-23-5	0.00064	d	0.014	0.000064	0.00032	0.00064
Aroclor-1268	11100-14-4	0.00064	d	0.014	0.000064	0.00032	0.00064

Notes:

(1) Commonwealth of Puerto Rico, Office of the Governor, Environmental Quality Board, 2010, Puerto Rico Water Quality Standards Regulation. Screening values are based on water quality standards for Class SD surface water.

(2) National Recommended Water Quality Criteria for Priority Pollutants (EPA 2009)

(3) Cidra site screening value is based on the Puerto Rico Water Quality Standards when available. Otherwise, it is based on the National Recommended Water Quality Criteria.

(a) screening level for chlordane

(b) screening value for endosulfan

(6) screening value for endrin

(d) screening value for polychlorinated biphenyls

Acronyms:

µg/L = microgram per liter

EPA = United States Environmental Protection Agency

n/a = value not available

NL = not listed or chemical name listed but no value available

CAS = Chemical Abstract Service

PCB = polychlorinated biphenyl

Table 4-3d
Surface Water Screening Criteria - Inorganics
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Inorganics (All in µg/L)	CAS No.	Puerto Rico Water Quality Standard[1]		National Recommended Water Quality Criteria[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
				Freshwater Aquatic Life Use Chronic Criteria	Human Health for the Consumption of Water + Organism		
Aluminum	7429-90-5	NL		NL	NL	NL	NL
Antimony	7440-36-0	5.6		NL	5.6	2.8	5.6
Arsenic	7440-38-2	10		150	0.018	5	10
Barium	7440-39-3	NL		NL	NL	NL	NL
Beryllium	7440-41-7	NL		NL	NL	NL	NL
Cadmium	7440-43-9	0.92	a	0.25	NL	0.46	0.92
Calcium	7440-70-2	NL		NL	NL	NL	NL
Chromium	7440-47-3	11.43	b	11	NL	5.72	11.43
Cobalt	7440-48-4	NL		NL	NL	NL	NL
Copper	7440-50-8	11.95	a	NL	1300	5.98	11.95
Cyanide	57-12-5	5.2		5.2	140	2.6	5.2
Iron	7439-89-6	NL		NL	NL	NL	NL
Lead	7439-92-1	0.97	a	2.5	NL	0.49	0.97
Magnesium	7439-95-4	NL		NL	NL	NL	NL
Manganese	7439-96-5	NL		NL	NL	NL	NL
Mercury	7439-97-6	0.05		0.77	NL	0.03	0.05
Nickel	7440-02-0	51.70	a	52	610	25.85	51.70
Potassium	7440-09-7	NL		NL	NL	NL	NL
Selenium	7782-49-2	5.00		5	170	2.5	5
Silver	7440-22-4	0.24	a	NL	NL	0.12	0.24
Sodium	7440-23-5	NL		NL	NL	NL	NL
Sulfate		NL		NL	NL	NL	NL
Thallium	7440-28-0	0.24		NL	0.24	0.12	0.24
Vanadium	7440-62-2	NL		NL	NL	NL	NL
Zinc	7440-66-6	104.69	a	120	7400	52.34	104.69

Notes:

(1) Commonwealth of Puerto Rico, Office of the Governor, Environmental Quality Board, 2010, Puerto Rico Water Quality Standards Regulation. Screening values are based on water quality standards for Class SD surface water.

(2) National Recommended Water Quality Criteria for Priority Pollutants (EPA 2009)

(3) Cidra site screening value is based on the Puerto Rico Water Quality Standards when available. Otherwise, it is based on the National Recommended Water Quality Criteria.

(a) Freshwater standards for these metals that are hardness-dependent, the screening levels are calculated assuming a hardness of 100 mg/L as $CaCO_3$.

(b) screening value for chromium VI

Acronyms:

µg/L = microgram per liter

EPA = United States Environmental Protection Agency

n/a = value not available

NL = not listed or chemical name listed but no value available

CAS = Chemical Abstract Service

Table 4-4a
Sediment Screening Criteria - Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Volatile Organic Compounds (All in µg/kg)	CAS No.	Human Health Screening Level[1]		Ecological Screening Level[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
1,1,1-Trichloroethane	71-55-6	615,000		213	c	107	213
1,1,2,2-Tetrachloroethane	79-34-5	560		850	c	280	560
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	906,000		NL		453,000	906,000
1,1,2-Trichloroethane	79-00-5	160		518	c	80	160
1,1-Dichloroethane	75-34-3	3,300		0.575	c	0.2875	0.575
1,1-Dichloroethylene	75-35-4	24,000		19.4	c	10	19.4
1,2,3-Trichlorobenzene	87-61-6	4,900		5062	c,d	2,450	4,900
1,2,4-Trichlorobenzene	120-82-1	6,200		5062	c	2,531	5,062
1,2-Dibromo-3-chloropropane	96-12-8	5.4		NL		2.7	5.4
1,2-Dibromoethane	106-93-4	34		NL		17	34
1,2-Dichlorobenzene	95-50-1	190,000		1315	c	658	1,315
1,2-Dichloroethane	107-06-2	430		260	c	130	260
1,2-Dichloropropane	78-87-5	940		333	c	167	333
1,3-Dichlorobenzene	541-73-1	NL		294	c	147	294
1,4-Dichlorobenzene	106-46-7	2,400		318	c	159	318
2-Butanone	78-93-3	2,800,000		42.4	c	21	42.4
2-Hexanone	591-78-6	21,000		58.2	c	29	58.2
4-Methyl-2-pentanone	108-10-1	530,000		25.1	c	12.55	25.1
Acetone	67-64-1	6,100,000		9.9	c	4.95	9.9
Benzene	71-43-2	1,100		142	c	71	142
Bromochloromethane	74-97-5	16,000		NL		8,000	16,000
Bromodichloromethane	75-27-4	270		NL		135	270
Bromoform	75-25-2	62,000		492	c	246	492
Bromomethane	74-83-9	730		1.37	c	0.685	1.37
Carbon Disulfide	75-15-0	82,000		23.9	c	11.95	23.9
Carbon Tetrachloride	56-23-5	610		1450	c	305	610
Chlorobenzene	108-90-7	29,000		291	c	146	291
Chloroethane	75-00-3	1,500,000		NL		750,000	1,500,000
Chloroform	67-66-3	290		121	c	61	121
Chloromethane	74-87-3	12,000		NL		6,000	12,000
cis-1,2-Dichloroethene	156-59-2	16,000		NL		8,000	16,000
cis-1,3-Dichloropropene	10061-01-5	1,700	a	NL		0	
Cyclohexane	110-82-7	117,000		NL		58,500	117,000
Dibromochloromethane	124-48-1	680		NL		340	680
Dichlorodifluoromethane	75-71-8	9,400		NL		4,700	9,400
Ethylbenzene	100-41-4	5,400		175	c	88	175
Isopropylbenzene	98-82-8	199,000		NL		99,500	199,000
Methyl Acetate	79-20-9	7,800,000		NL		3,900,000	7,800,000
Methyl Tert-Butyl Ether	1634-04-4	43,000		NL		21,500	43,000
Methylcyclohexane	108-87-2	NL		NL		NL	n/a
Methylene Chloride	75-09-2	36,000		159	c	80	159
m,p-Xylene	179601-23-1	59,000	b	433	c,e	217	433
o-Xylene	95-47-6	69,000		433	c,e	217	433
Styrene	100-42-5	562,000		254	c	127	254
Tetrachloroethene	127-18-4	8,600		990	c	495	990
Toluene	108-88-3	356,000		1220	c	610	1,220
trans-1,2-Dichloroethene	156-60-5	15,000		654	c	327	654
trans-1,3-Dichloropropene	10061-02-6	1,700	a	NL		850	1,700
Trichloroethene	79-01-6	440		112	c	56	112
Trichlorofluoromethane	75-69-4	79,000		NL		39,500	79,000
Vinyl Chloride	75-01-4	60		202	c	30	60

Table 4-4a
Sediment Screening Criteria - Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Notes:

(1) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for residential soil, based on a cancer risk of $1x10^6$ and/or a hazard quotient of 0.1

(2) Ecological Screening Levels consists of those values taken from sources identified by the corresponding footnote.

(3) Cidra site screening value is based on the lower value of human health and ecological screening levels.

(a) screening value for 1,3-dichloropropene

(b) screening value for m-xylene

(c) EPA Region 5, Resource, Conservation, Recovery, Act (RCRA) Ecological Screening Levels (EPA 2003c)

(d) screening value for 1,2,4-trichlorobenzene

(e) screening value for total xylenes

Acronyms:

µg/kg = microgram per kilogram

EPA = United States Environmental Protection Agency

n/a = value not available

NL = not listed or chemical name listed but no value available

Table 4-4b
Sediment Screening Criteria - Semi-Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Semi-Volatile Organic Compounds (All in µg/kg)	CAS No.	Human Health Screening Level[1]		Ecological Screening Level[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
1,1'Biphenyl	92-52-4	5,100		NL		2,550	5,100
1,2,4,5-Tetrachlorobenzene	95-94-3	1,800		1,252	a	626	1,252
2,2'-oxybis(1-Chloropropane)	108-60-1	4,600		NL		2,300	4,600
2,3,4,6-Tetrachlorophenol	58-90-2	180,000		129	a	65	129
2,4,5-Trichlorophenol	95-95-4	610,000		NL		305,000	610,000
2,4,6-Trichlorophenol	88-06-2	6,100		208	a	104	208
2,4-Dichlorophenol	120-83-2	18,000		81.7	a	41	81.7
2,4-Dimethylphenol	105-67-9	120,000		304	a	152	304
2,4-Dinitrophenol	51-28-5	12,000		6.21	a	3.105	6.21
2,4-Dinitrotoluene	121-14-2	1,600		14.4	a	7.2	14.4
2,6-Dinitrotoluene	606-20-2	6,100		39.8	a	20	39.8
2-Chloronaphthalene	91-58-7	630,000		417	a	209	417
2-Chlorophenol	95-57-8	39,000		31.9	a	15.95	31.9
2-Methylnaphthalene	91-57-6	23,000		20.2	a	10.1	20.2
2-Methylphenol	95-48-7	310,000		NL		155,000	310,000
2-Nitroaniline	88-74-4	61,000		NL		30,500	61,000
2-Nitrophenol	88-75-5	NL		13.3	a,b	6.65	13.3
3,3'-Dichlorobenzidine	91-94-1	1,100		127	a	64	127
3-Nitroaniline	99-09-2	NL		NL		NL	n/a
4,6-Dinitro-2-methylphenol	534-52-1	490		NL		245	490
4-Bromophenyl-phenylether	101-55-3	NL		1,550	a	775	1,550
4-Chloro-3-methylphenol	59-50-7	610,000		388	a	194	388
4-Chloroaniline	106-47-8	2,400		146	a	73	146
4-Chlorophenyl-phenylether	7005-72-3	NL		NL		NL	n/a
4-Methylphenol	106-44-5	610,000		NL		305,000	610,000
4-Nitroaniline	100-01-6	24,000		NL		12,000	24,000
4-Nitrophenol	100-02-7	NL		13.3	a	6.65	13.3
Acenaphthene	83-32-9	340,000		6.71	a	3.355	6.71
Acenaphthylene	208-96-8	NL		5.87	a	2.935	5.87
Acetophenone	98-86-2	780,000		NL		390,000	780,000
Anthracene	120-12-7	1,700,000		57.2	c	28.6	57.2
Atrazine	1912-24-9	2,100		NL		0	
Benzaldehyde	100-52-7	780,000		NL		390,000	780,000
Benzo(a)anthracene	56-55-3	150		108	c	54	108
Benzo(a)pyrene	50-32-8	15		150	c	7.5	15
Benzo(b)fluoranthene	205-99-2	150		10,400	a	75	150
Benzo(g,h,i)perylene	191-24-2	NL		170	d	85	170
Benzo(k)fluoranthene	207-08-9	1,500		27.2	e	13.6	27.2
bis(2-Chloroethoxy)methane	111-91-1	18,000		NL		9,000	18,000
bis(2-Chloroethyl)ether	111-44-4	210		3,520	a	105	210
bis(2-Ethylhexyl)phthalate	117-81-7	35,000		NL		17,500	35,000
Butylbenzylphthalate	85-68-7	260,000		1,970	a	985	1,970
Caprolactam	105-60-2	3,100,000		NL		1,550,000	3,100,000
Carbazole	86-74-8	NL		NL		NL	n/a
Chrysene	218-01-9	15,000		166	c	83	166
Dibenz(a,h)anthracene	53-70-3	15		33	c	7.5	15
Dibenzofuran	132-64-9	7,800		449	a	225	449
Diethylphthalate	84-66-2	4,900,000		295	a	148	295
Dimethylphthalate	131-11-3	NL		NL		NL	n/a
Di-n-butylphthalate	84-74-2	610,000		1,114	a	557	1,114

Table 4-4b
Sediment Screening Criteria - Semi-Volatile Organic Compounds
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Semi-Volatile Organic Compounds (All in µg/kg)	CAS No.	Human Health Screening Level[1]		Ecological Screening Level[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
Di-n-octyl phthalate	117-84-0	NL		40,600	a	20,300	40,600
Fluoranthene	206-44-0	230,000		423	c	212	423
Fluorene	86-73-7	230,000		77.4	c	38.7	77.4
Hexachlorobenzene	118-74-1	300		20	a	10	20
Hexachlorobutadiene	87-68-3	6,100		26.5	a	13.25	26.5
Hexachlorocyclopentadiene	77-47-4	37,000		901	a	451	901
Hexachloroethane	67-72-1	4,300		584	a	292	584
Indeno(1,2,3-cd)pyrene	193-39-5	150		17.32	e	8.66	17.32
Isophorone	78-59-1	510,000		432	a	216	432
Naphthalene	91-20-3	3,600		176	c	88	176
Nitrobenzene	98-95-3	4,800		145	a	73	145
N-Nitroso-di-n-propylamine	621-64-7	69		NL		34.5	69
N-Nitrosodiphenylamine	86-30-6	99,000		NL		49,500	99,000
Pentachlorophenol	87-86-5	890		23,000	a	445	890
Phenanthrene	85-01-8	NL		204	c	102	204
Phenol	108-95-2	1,800,000		49.1	a	24.55	49.1
Pyrene	129-00-0	170,000		195	c	98	195

Notes:

(1) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for residential soil, based on a cancer risk of $1x10^6$ and/or a hazard quotient of 0.1

(2) Ecological Screening Levels consists of those values taken from sources identified by the corresponding footnote.

(3) Cidra site screening value is based on the lower value of human health and ecological screening levels.

(a) EPA Region 5, Resource, Conservation, Recovery, Act (RCRA) Ecological Screening Levels (EPA 2003c)

(b) Screening value for 4-nitrophenol is applied to 2 nitrophenol.

(c) Consensus-based threshold effects concentrations (TEC), (MacDonald et al. 2000)

(d) Ontario Lowest Effect Levels (LELs) (Persaud et al. 1993)

(e) Assessment and Remediation of Contaminated Sediments (ARCS) Program. 905/R96/008. (EPA 1996)

Acronyms:

µg/kg = microgram per kilogram
EPA = United States Environmental Protection Agency
n/a = value not available
NL = not listed or chemical name listed but no value available
CAS = Chemical Abstract Service

Table 4-4c
Sediment Screening Criteria - Pesticides and PCBs
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Pesticides/ Polychlorinated Biphenyls (All in µg/kg)	CAS No.	Human Health Screening Level[1]		Ecological Screening Level[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
Pesticides							
4,4'-DDD	72-54-8	2,000		4.88	e	2.44	4.88
4,4'-DDE	72-55-9	1,400		3.16	e	1.58	3.16
4,4'-DDT	50-29-3	1,700		4.16	e	2.08	4.16
Aldrin	309-00-2	29		2	f	1	2
alpha-BHC	319-84-6	77		6	f	3	6
alpha-Chlordane	5103-71-9	1,600	a	3.24	a,e	1.62	3.24
beta-BHC	319-85-7	270		5	f	2.5	5
delta-BHC	319-86-8	NL		6	f	3	6
Dieldrin	60-57-1	30		1.9	e	0.95	1.9
Endosulfan I	959-98-8	37,000	b	3.26	g	1.63	3.26
Endosulfan II	33213-65-9	37,000	b	1.94	g	0.97	1.94
Endosulfan sulfate	1031-07-8	37,000	b	34.6	g	17.3	34.6
Endrin	72-20-8	1,800		2.22	e	1.11	2.22
Endrin aldehyde	7421-93-4	1,800	c	2.22	c,e	1.11	2.22
Endrin ketone	53494-70-5	1,800	c	2.22	c,e	1.11	2.22
gamma-BHC (Lindane)	58-89-9	520		2.37	e	1.185	2.37
gamma-Chlordane	5103-74-2	1,600	a	3.24	a,e	1.62	3.24
Heptachlor	76-44-8	110		2.47	e,h	1.235	2.47
Heptachlor epoxide	1024-57-3	53		2.47	e	1.235	2.47
Methoxychlor	72-43-5	31,000		13.6	g	6.8	13.6
Toxaphene	8001-35-2	440		0.077	g	0.0385	0.077
Polychlorinated Biphenyls (PCBs)							
Aroclor-1016	12674-11-2	390		59.8	e,i	29.9	59.8
Aroclor-1221	11104-28-2	140		59.8	e,i	29.9	59.8
Aroclor-1232	11141-16-5	140		59.8	e,i	29.9	59.8
Aroclor-1242	53469-21-9	220		59.8	e,i	29.9	59.8
Aroclor-1248	12672-29-6	220		59.8	e,i	29.9	59.8
Aroclor-1254	11097-69-1	110		59.8	e,i	29.9	59.8
Aroclor-1260	11096-82-5	220		59.8	e,i	29.9	59.8
Aroclor-1262	37324-23-5	220	d	59.8	e,i	29.9	59.8
Aroclor-1268	11100-14-4	220	d	59.8	e,i	29.9	59.8

Notes:

(1) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for residential soil, based on a cancer risk of $1x10^{6}$ and/or a hazard quotient of 0.1

(2) Ecological Screening Levels consists of those values taken from sources identified by the corresponding footnote.

(3) Cidra site screening value is based on the lower value of human health and ecological screening levels

(a) screening value for chlordane

(b) screening value for endosulfan

(c) screening value for endrin

(d) screening value for Aroclor-1260

(e) Consensus-based threshold effects concentrations (TEC), (MacDonald et al. 2000)

(f) Ontario Lowest Effect Levels (LELs) (Persaud et al. 1993)

(g) EPA Region 5, Resource, Conservation, Recovery, Act (RCRA) Ecological Screening Levels (EPA 2003c)

(h) screening value for heptachlor epoxide

(i) screening value for total PCBs

Acronyms:

µg/kg - microgram per kilogram
EPA - United States Environmental Protection Agency
n/a - value not available
NL - not listed or chemical name listed but no value available
CAS = Chemical Abstract Service
BHC - benzene hexachloride
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
PCB - polychlorinated biphenyl

Table 4-4d
Sediment Screening Criteria - Inorganics
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Inorganics (All in mg/kg)	CAS No.	Human Health Screening Level[1]		Ecological Screening Level[2]		Project Quantitation Limit Goal	Cidra Site Screening Value[3]
Aluminum	7429-90-5	7,700		25,500	f	3,850	7,700
Antimony	7440-36-0	3.1		NL		1.55	3.1
Arsenic	7440-38-2	0.39		9.79	g	0.195	0.39
Barium	7440-39-3	1,500		NL		750	1,500
Beryllium	7440-41-7	16		NL		8	16
Cadmium	7440-43-9	7		0.99	g	0.495	0.99
Calcium	7440-70-2	NL		NL		NL	n/a
Chromium (total)	7440-47-3	0.29	a	43.4	g	0.145	0.29
Cobalt	7440-48-4	2.3		50	h	1.15	2.3
Copper	7440-50-8	310		31.6	g	15.8	31.6
Cyanide	57-12-5	4.7	b	100	h	2.35	4.7
Iron	7439-89-6	5,500		18,840	f	2,750	5,500
Lead	7439-92-1	400	c	35.8	g	17.9	35.8
Magnesium	7439-95-4	NL		NL		NL	n/a
Manganese	7439-96-5	180		630	f	90	180
Mercury	7439-97-6	2.3	d	0.18	g	0.09	0.18
Nickel	7440-02-0	150	e	22.7	g	11.35	22.7
Potassium	7440-09-7	NL		NL		NL	n/a
Selenium	7782-49-2	39		NL		19.5	39
Silver	7440-22-4	39		500	h	19.5	39
Sodium	7440-23-5	NL		NL		NL	n/a
Thallium	7440-28-0	0.078		NL		0.039	0.078
Vanadium	7440-62-2	39		NL		19.5	39
Zinc	7440-66-6	2,300		121	g	60.5	121

Notes:

(1) Regional Screening Levels for Contaminants at Superfund Sites (EPA May 2012) for residential soil, based on a cancer risk of $1x10^{-6}$ and/or a hazard quotient of 0.1

(2) Ecological Screening Levels consists of those values taken from sources identified by the corresponding footnote.

(3) Cidra site screening value is based on the lower value of human health and ecological screening levels.

(a) screening value for chromium (VI)

(b) screening value for cyanide (CN^-)

(c) OSWER screening value for residential soil

(d) screening value for mercuric chloride (and other mercury salts)

(e) screening value for soluble nickel salts

(f) Assessment and Remediation of Contaminated Sediments (ARCS) Program. 905/R96/008. (EPA 1996)

(g) Consensus-based threshold effects concentrations (TEC), (MacDonald et al. 2000)

(h) EPA Region 5, Resource, Conservation, Recovery, Act (RCRA) Ecological Screening Levels (EPA 2003c)

Acronyms:

mg/kg = milligram per kilogram

EPA = United States Environmental Protection Agency

n/a = value not available

NL = not listed or chemical name listed but no value available

CAS = Chemical Abstract Service

OSWER = Office of Solid Waste and Emergency Response

Table 4-5a
International Dry Cleaners - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IDCSB-01-A 1 to 4 feet bgs		IDCSB-03-A 3 to 4 feet bgs		IDCSB-03-B 4 to 6 feet bgs		IDCSB-04-A 2 to 4 feet bgs		IDCSB-05-A 0 to 4 feet bgs		IDCSB-05-B 4 to 8 feet bgs		IDCSB-05-C 8 to 12 feet bgs		IDCSB-05-D 20 to 24 feet bgs		IDCSB-05-E 32 to 36 feet bgs	
Volatile Organic Compounds (µg/kg)																			
Vinyl Chloride	13.8	5	U	980	U	19000	U	6.5	U	**18**		**39**		**100**		**21**		8	U
cis-1,2-Dichloroethene	420	3.9	J	**14000**		**14000**	J	15		260	J	**1200**	J	**750**		**770**		190	
Trichloroethene	36	2.3	J	**12000**		**39000**		2.5	J	5.6	J	**240**	J	**210**	J	**220**	J	**65**	
Tetrachloroethene	46	5	U	**16000**		**270000**		6.5	U	6	U	**1200**	J	**1600**		**2800**		**1200**	
Semi-Volatile Organic Compounds (µg/kg)																			
Naphthalene	9.4	240	U	230	U	**89**	J	240	U										
Benzo(a)anthracene	150	240	U	**370**		250	UJ	240	U										
Benzo(b)fluoranthene	150	240	U	**510**		250	U	240	U										
Benzo(a)pyrene	15	240	U	**400**		250	U	240	U										
Indeno(1,2,3-cd)pyrene	150	240	U	**270**		250	U	240	U										
Dibenz(a,h)anthracene	15	240	U	**87**	J	250	U	240	U										
Pesticides (µg/kg)																			
Dieldrin	1.22	4.7	U	**6.2**		**2.4**	J	4.6	U										
Inorganic Analytes (mg/kg)																			
Aluminum	7700	**13000**		**12200**		**12400**		5150											
Arsenic	0.39	**2.1**		**3.5**		**1.2**	J	1.5	U										
Chromium	0.29	**23.7**		**26.6**		**18.5**		**11.5**											
Cobalt	2.3	**36.2**		**16.6**		**31.2**		**32.7**											
Iron	5400	**56700**		**44900**		**43300**		**36500**											
Manganese	21	**2720**	J	**922**	J	**2370**	J	**2250**	J										
Vanadium	39	**197**		**115**		**157**		**103**											

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

U - not detected above the given reporting limit

J - estimated value

bgs - below ground surface

CDM Smith

R2-0007271

Table 4-5a
International Dry Cleaners - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IDCSB-05-F 44 to 48 feet bgs		IDCSB-05-G 56 to 60 feet bgs		IDCSB-06-A 0 to 4 feet bgs		IDCSB-06-B 4 to 8 feet bgs		IDCSB-06-C 8 to 12 feet bgs		IDCSB-06-D 20 to 24 feet bgs		IDCSB-06-E 32 to 36 feet bgs		IDCSB-06-F 44 to 48 feet bgs		IDCSB-06-G 56 to 60 feet bgs	
Volatile Organic Compounds (µg/kg)																			
Vinyl Chloride	13.8	7	U	7.5	U	**410**		**1200**		**490**	J	**210**		**22**		7.7	U	7	U
cis-1,2-Dichloroethene	420	8.3		7.5	U	**690**		**4700**		**4000**		**2900**		280		2.9	J	7	U
Trichloroethene	36	7.1		7.5	U	15		**490**		**450**		**450**		**150**		3.1	J	0.99	J
Tetrachloroethene	46	**570**		7.5	U	6.4	U	**670**		**1400**		**2800**		**2000**		**290**		**170**	
Semi-Volatile Organic Compounds (µg/kg)																			
Naphthalene	9.4																		
Benzo(a)anthracene	150																		
Benzo(b)fluoranthene	150																		
Benzo(a)pyrene	15																		
Indeno(1,2,3-cd)pyrene	150																		
Dibenz(a,h)anthracene	15																		
Pesticides (µg/kg)																			
Dieldrin	1.22																		
Inorganic Analytes (mg/kg)																			
Aluminum	7700																		
Arsenic	0.39																		
Chromium	0.29																		
Cobalt	2.3																		
Iron	5400																		
Manganese	21																		
Vanadium	39																		

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

U - not detected above the given reporting limit

J - estimated value

bgs - below ground surface

CDM Smith

R2-0007272

Table 4-5a
International Dry Cleaners - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IDCSB-07-A 0 to 4 feet bgs		IDCSB-07-B 4 to 8 feet bgs		IDCSB-07-C 8 to 12 feet bgs		IDCSB-07-D 20 to 24 feet bgs		IDCSB-07-E 32 to 36 feet bgs		IDCSB-07-F 44 to 48 feet bgs		IDCSB-08-A 0 to 4 feet bgs		IDCSB-08-B 4 to 8 feet bgs		IDCSB-08-C 8 to 12 feet bgs	
Volatile Organic Compounds (µg/kg)																			
Vinyl Chloride	13.8	**85**		**43**		**120**		**42**		6.6	U	6.1	U	5.8	J	12		**20**	
cis-1,2-Dichloroethene	420	210	J	51		**430**	J	330	J	**430**	J	240	J	96		**560**		**1200**	
Trichloroethene	36	2.3	J	6.5	U	**56**		**110**		30		27		**140**		**650**		**760**	
Tetrachloroethene	46	0.89	J	6.5	U	**110**		**290**	J	**200**	J	**660**	J	**150**	J	**2600**		**5100**	
Semi-Volatile Organic Compounds (µg/kg)																			
Naphthalene	9.4																		
Benzo(a)anthracene	150																		
Benzo(b)fluoranthene	150																		
Benzo(a)pyrene	15																		
Indeno(1,2,3-cd)pyrene	150																		
Dibenz(a,h)anthracene	15																		
Pesticides (µg/kg)																			
Dieldrin	1.22																		
Inorganic Analytes (mg/kg)																			
Aluminum	7700																		
Arsenic	0.39																		
Chromium	0.29																		
Cobalt	2.3																		
Iron	5400																		
Manganese	21																		
Vanadium	39																		

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

U - not detected above the given reporting limit

J - estimated value

bgs - below ground surface

CDM Smith

R2-0007273

Table 4-5a
International Dry Cleaners - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IDCSB-08-D 20 to 24 feet bgs		IDCSB-08-E 32 to 36 feet bgs		IDCSB-08-F 44 to 48 feet bgs		IDCSB-08-G 56 to 60 feet bgs		IDCSB-09-A 0 to 4 feet bgs		IDCSB-09-B 4 to 8 feet bgs		IDCSB-09-C 8 to 12 feet bgs		IDCSB-09-D 20 to 24 feet bgs		IDCSB-09-E 32 to 36 feet bgs	
Volatile Organic Compounds (µg/kg)																			
Vinyl Chloride	13.8	6.1	U	6.5	U	8	U	7.4	U	8.2	U	340	U	430	U	450	U	440	U
cis-1,2-Dichloroethene	420	**540**		360	J	8	U	7.4	U	310		340	U	430	U	290	J	250	J
Trichloroethene	36	**310**	J	**230**	J	8	U	7.4	U	**1400**		340	U	430	U	**180**	J	440	U
Tetrachloroethene	46	**2700**		**1300**		**270**		6	J	**3500**		**1300**		**1300**		**3500**		**1800**	
Semi-Volatile Organic Compounds (µg/kg)																			
Naphthalene	9.4																		
Benzo(a)anthracene	150																		
Benzo(b)fluoranthene	150																		
Benzo(a)pyrene	15																		
Indeno(1,2,3-cd)pyrene	150																		
Dibenz(a,h)anthracene	15																		
Pesticides (µg/kg)																			
Dieldrin	1.22																		
Inorganic Analytes (mg/kg)																			
Aluminum	7700																		
Arsenic	0.39																		
Chromium	0.29																		
Cobalt	2.3																		
Iron	5400																		
Manganese	21																		
Vanadium	39																		

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

U - not detected above the given reporting limit

J - estimated value

bgs - below ground surface

CDM Smith

R2-0007274

Table 4-5a
International Dry Cleaners - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IDCSB-09-F 44 to 48 feet bgs		IDCSB-10-A 0 to 4 feet bgs		IDCSB-10-B 4 to 8 feet bgs		IDCSB-10-C 8 to 12 feet bgs		IDCSB-11-A 0 to 4 feet bgs		IDCSB-11-B 4 to 8 feet bgs		IDCSB-11-C 8 to 12 feet bgs		IDCSB-12-A 0 to 4 feet bgs		IDCSB-12-B 4 to 8 feet bgs	
Volatile Organic Compounds (µg/kg)																			
Vinyl Chloride	13.8	7.2	U	2000	U	8900	U	8100	U	470	U	1000	U	890	U	6.7	U	6.8	U
cis-1,2-Dichloroethene	420	6	J	**900**	J	**18000**		**21000**		**580**		**16000**		**11000**		6.7	U	65	
Trichloroethene	36	4.8	J	**3000**		**13000**		**25000**		470	U	1000	U	**1800**		0.98	J	0.89	J
Tetrachloroethene	46	**130**		**40000**		**140000**		**170000**		470	U	1000	U	**1700**		10		2.6	J
Semi-Volatile Organic Compounds (µg/kg)																			
Naphthalene	9.4																		
Benzo(a)anthracene	150																		
Benzo(b)fluoranthene	150																		
Benzo(a)pyrene	15																		
Indeno(1,2,3-cd)pyrene	150																		
Dibenz(a,h)anthracene	15																		
Pesticides (µg/kg)																			
Dieldrin	1.22																		
Inorganic Analytes (mg/kg)																			
Aluminum	7700																		
Arsenic	0.39																		
Chromium	0.29																		
Cobalt	2.3																		
Iron	5400																		
Manganese	21																		
Vanadium	39																		

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

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mg/kg - milligram per kilogram

U - not detected above the given reporting limit

J - estimated value

bgs - below ground surface

CDM Smith

R2-0007275

Table 4-5a
International Dry Cleaners - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IDCSB-13-A 0 to 4 feet bgs		IDCSB-13-B 4 to 8 feet bgs		IDCSB-13-C 8 to 12 feet bgs		IDCSB-14-A 0 to 4 feet bgs		IDCSB-14-B 4 to 8 feet bgs	
Volatile Organic Compounds (µg/kg)											
Vinyl Chloride	13.8	3000	U	2600	U	7300	U	7	U	59000	U
cis-1,2-Dichloroethene	420	**3700**		**23000**		**14000**		**4200**		**29000**	J
Trichloroethene	36	**2100**	J	**9000**		**7300**	J	**920**		**28000**	J
Tetrachloroethene	46	**64000**		**45000**		**120000**		**180**	J	**1700000**	
Semi-Volatile Organic Compounds (µg/kg)											
Naphthalene	9.4										
Benzo(a)anthracene	150										
Benzo(b)fluoranthene	150										
Benzo(a)pyrene	15										
Indeno(1,2,3-cd)pyrene	150										
Dibenz(a,h)anthracene	15										
Pesticides (µg/kg)											
Dieldrin	1.22										
Inorganic Analytes (mg/kg)											
Aluminum	7700										
Arsenic	0.39										
Chromium	0.29										
Cobalt	2.3										
Iron	5400										
Manganese	21										
Vanadium	39										

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

U - not detected above the given reporting limit

J - estimated value

bgs - below ground surface

CDM Smith

R2-0007276

Table 4-5b
Soil Sample Summary Statistics – International Dry Cleaners
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
Tetrachloroethene	**46**	**42 / 50**	**38**	**0.89 J**	**1700000**	**IDCSB-14-B**	**5 - 1000**
Trichloroethene	**36**	**41 / 50**	**28**	**0.89 J**	**39000**	**IDCSB-03-B**	**6.5 - 1000**
cis-1,2-Dichloroethene	**420**	**43 / 50**	**25**	**2.9 J**	**29000 J**	**IDCSB-14-B**	**6.7 - 430**
Vinyl Chloride	**13.8**	**16 / 50**	**14**	**5.8 J**	**1200**	**IDCSB-06-B**	**5 - 59000**
1,4-Dichlorobenzene	1440	1 / 50	0	0.78 J	0.78 J	IDCSB-01-A	5.9 - 59000
2-Butanone	20000	2 / 50	0	3.2 J	19	IDCSB-12-B	10 - 120000
Acetone	48000	15 / 50	0	3.7 J	120	IDCSB-12-B	10 - 120000
Carbon Disulfide	4200	4 / 50	0	0.85 J	12	IDCSB-12-B	5 - 59000
Chloromethane	980	3 / 50	0	270 J	310 J	IDCSB-09-D	5 - 59000
Cyclohexane	117000	2 / 50	0	1.2 J	21	IDCSB-14-A	5 - 59000
Isopropylbenzene	12800	1 / 50	0	16	16	IDCSB-14-A	5 - 59000
m,p-Xylene	3600	3 / 50	0	0.43 J	0.91 J	IDCSB-05-D	5 - 59000
Methyl Acetate	64000	2 / 50	0	1.3 J	460 J	IDCSB-03-A	5 - 59000
Methylcyclohexane	N/A	1 / 50	0	170	170	IDCSB-14-A	5 - 59000
o-Xylene	3800	3 / 50	0	0.82 J	14	IDCSB-14-A	5 - 59000
trans-1,2-Dichloroethene	580	23 / 50	0	0.87 J	160	IDCSB-14-A	5 - 59000
Semivolatile Organic Compounds (µg/kg)							
1,1'-Biphenyl	174	2 / 4	0	49 J	120 J	IDCSB-03-B	240 - 240
2-Methylnaphthalene	2800	2 / 4	0	150 J	390	IDCSB-03-B	240 - 240
Benzo(a)anthracene	**150**	**1 / 4**	**1**	**370**	**370**	**IDCSB-03-A**	**240 - 250**
Benzo(a)pyrene	**15**	**1 / 4**	**1**	**400**	**400**	**IDCSB-03-A**	**240 - 250**
Benzo(b)fluoranthene	**150**	**1 / 4**	**1**	**510**	**510**	**IDCSB-03-A**	**240 - 250**
Benzo(g,h,i)perylene	N/A	1 / 4	0	150 J	150 J	IDCSB-03-A	240 - 250
Benzo(k)fluoranthene	1500	1 / 4	0	380	380	IDCSB-03-A	240 - 250
bis(2-Ethylhexyl) phthalate	28000	1 / 4	0	1200	1200	IDCSB-03-A	240 - 850
Butylbenzylphthalate	4000	2 / 4	0	53 J	77 J	IDCSB-03-A	240 - 240
Chrysene	15000	1 / 4	0	430	430	IDCSB-03-A	240 - 250
Di-n-butylphthalate	34000	1 / 4	0	46 J	46 J	IDCSB-03-A	240 - 250
Di-n-octylphthalate	N/A	2 / 4	0	140 J	170 J	IDCSB-03-A	240 - 240
Dibenz(a,h)anthracene	**15**	**1 / 4**	**1**	**87 J**	**87 J**	**IDCSB-03-A**	**240 - 250**
Fluoranthene	230000	1 / 4	0	510	510	IDCSB-03-A	240 - 250
Indeno(1,2,3-cd)pyrene	**150**	**1 / 4**	**1**	**270**	**270**	**IDCSB-03-A**	**240 - 250**
n-Nitrosodiphenylamine	1140	2 / 4	0	130 J	180 J	IDCSB-03-B	240 - 240
Naphthalene	**9.4**	**1 / 4**	**1**	**89 J**	**89 J**	**IDCSB-03-B**	**230 - 240**
Phenanthrene	N/A	2 / 4	0	150 J	210 J	IDCSB-03-A	240 - 240
Pyrene	170000	2 / 4	0	83 J	490	IDCSB-03-A	240 - 240
Pesticides (µg/kg)							
4,4'-DDD	1320	2 / 4	0	1.1 J	1.6 J	IDCSB-03-B	4.6 - 4.7
4,4'-DDE	920	2 / 4	0	4.2 J	5.2	IDCSB-03-B	4.6 - 4.7
4,4'-DDT	1340	1 / 4	0	2.6 J	2.6 J	IDCSB-03-A	4.6 - 4.9
alpha-Chlordane	1600	1 / 4	0	0.49 J	0.49 J	IDCSB-03-A	2.4 - 2.5
beta-BHC	2.6	1 / 4	0	1.9 J	1.9 J	IDCSB-03-B	2.3 - 2.4
Dieldrin	**1.22**	**2 / 4**	**2**	**2.4 J**	**6.2**	**IDCSB-03-A**	**4.6 - 4.7**
Endosulfan sulfate	22000	1 / 4	0	1.1 J	1.1 J	IDCSB-03-A	4.6 - 4.9
Endrin ketone	1620	1 / 4	0	1.3 J	1.3 J	IDCSB-03-A	4.6 - 4.9
Heptachlor epoxide	53	1 / 4	0	1.3 J	1.3 J	IDCSB-03-B	2.3 - 2.4
Inorganics (mg/kg)							
Aluminum	**7700**	**4 / 4**	**3**	**5150**	**13000**	**IDCSB-01-A**	**NA - NA**
Arsenic	**0.39**	**3 / 4**	**3**	**1.2 J**	**3.5**	**IDCSB-03-A**	**1.5 - 1.5**
Barium	1500	4 / 4	0	85.6	195	IDCSB-01-A	NA - NA
Calcium	N/A	4 / 4	0	656 J	44100	IDCSB-03-A	NA - NA
Chromium	**0.29**	**4 / 4**	**4**	**11.5**	**26.6**	**IDCSB-03-A**	**NA - NA**
Cobalt	**2.3**	**4 / 4**	**4**	**16.6**	**36.2**	**IDCSB-01-A**	**NA - NA**
Copper	310	4 / 4	0	27.2	74.4	IDCSB-03-A	NA - NA
Iron	**5400**	**4 / 4**	**4**	**36500**	**56700**	**IDCSB-01-A**	**NA - NA**
Lead	280	3 / 4	0	24.1	62.5	IDCSB-01-A	1.5 - 1.5
Magnesium	N/A	4 / 4	0	183 J	3080	IDCSB-03-A	NA - NA
Manganese	**21**	**4 / 4**	**4**	**922 J**	**2720 J**	**IDCSB-01-A**	**NA - NA**
Mercury	2	3 / 4	0	0.24 J	0.67	IDCSB-03-A	0.14 - 0.14
Nickel	150	4 / 4	0	2.2 J	11	IDCSB-03-A	NA - NA
Potassium	N/A	4 / 4	0	171 J	726 J	IDCSB-01-A	NA - NA
Silver	12	4 / 4	0	4.9 J	7.4 J	IDCSB-01-A	NA - NA
Vanadium	**39**	**4 / 4**	**4**	**103**	**197**	**IDCSB-01-A**	**NA - NA**
Zinc	2300	4 / 4	0	13.7	518	IDCSB-03-A	NA - NA

Notes:
Highlight and bold font indicates an exceedance.
J - value is estimated
µg/kg - microgram per kilogram

Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-01-A 1 to 3 feet bgs		RMSB-01-B 5 to 8 feet bgs		RMSB-01-C 21 to 23 feet bgs		RMSB-01-D 58 to 60 feet bgs		RMSB-02-A 1 to 3 feet bgs		RMSB-02-B 5 to 7 feet bgs		RMSB-02-C 42 to 44 feet bgs		RMSB-03-A 1 to 3 feet bgs		RMSB-03-B 5 to 8 feet bgs		RMSB-03-C 21 to 23 feet bgs		RMSB-03-D 58 to 60 feet bgs		RMSB-04-A 0 to 1 feet bgs	
Volatile Organic Compounds (µg/kg)																									
Vinyl Chloride	13.8	6.3	U	5.6	U	6.8	U	6.4	U	5.9	U	6.8	U	6.6	U	7.8	U	8	U	7.3	U	7.9	U	5.4	U
1,1-Dichloroethene	50	6.3	U	5.6	U	6.8	U	6.4	U	5.9	U	6.8	U	6.6	U	7.8	U	8	U	7.3	U	7.9	U	5.4	U
1,1-Dichloroethane	13.6	6.3	U	5.6	U	6.8	U	6.4	U	5.9	U	6.8	U	6.6	U	7.8	U	8	U	7.3	U	7.9	U	5.4	U
cis-1,2-Dichloroethene	420	6.3	U	5.6	U	6.8	U	6.4	U	5.9	U	1.1	J	56		7.8	U	8	U	7.3	U	7.9	U	5.4	U
1,4-Dioxane	2.8		R		R		R		R		R		R		R		R		R		R		R		R
Trichloroethene	36	6.3	U	5.6	U	6.8	U	6.4	U	5.9	U	6.8	U	6.1	J	7.8	U	8	U	7.3	U	7.9	U	5.4	U
Tetrachloroethene	46	6.3	U	5.6	U	6.8	U	6.4	U	5.9	U	6.8	U	24		7.8	U	8	U	11		12		5.4	U
Inorganic Analytes (mg/kg)																									
Aluminum	7700	**21000**	J	**23200**	J	**44300**	J	**34200**	J	**23600**	J	**9130**	J	**26400**	J	**12700**	J	**11000**	J	**11900**	J	**33200**	J	**13100**	J
Arsenic	0.39	**2.2**		**1.6**		1.6	U	1.5	U	1.4	U	1.5	U	1.5	U	1.5	U	1.5	U	1.6	U	1.6	U	1.4	U
Cadmium	7	4.6		4.2		**8**		5.4		4.6		2		3		1.9		1.7		1.7		4.2		1.7	
Chromium	0.29	**39.4**		**27.3**		**156**		**21.4**		**54.2**		**10**		**25.8**		**21.9**	J	**25.9**	J	**11.1**	J	**18.1**	J	**15.1**	J
Cobalt	2.3	**44.4**	J	**29**	J	**110**	J	**32.7**	J	**27**	J	**12.9**	J	**67.5**	J	**16.3**	J	7.7	UJ	**45.6**	J	**86.8**	J	**99.8**	J
Copper	310	104		129		**549**		166		117		72.5		155		73.1		44.9		131		**314**		47.5	
Iron	5400		R		R		R		R		R		R		R	**31100**	J	**32900**	J	**32700**	J	**61800**	J	**34400**	J
Manganese	21	**1110**	J	**1010**	J	**2420**	J	**965**	J	**970**	J	**266**	J	**921**	J	**402**	J	**420**	J	**856**	J	**1300**	J	**2760**	J
Nickel	150	15.1		20		**239**		55.4		18		5.1	J	105		10.9	J	6.1	UJ	14.1	J	37.5	J	5.7	UJ
Vanadium	39	**241**		**188**		**277**		**194**		**209**		**97.4**		**123**		**112**	J	**122**	J	**110**	J	**232**	J	**137**	J

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
Shading indicates the sample was not analyzed for the given parameter
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value
R - rejected value

CDM Smith

R2-0007278

Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-04-B 5 to 7 feet bgs		RMSB-04-C 21 to 23 feet bgs		RMSB-04-D 42 to 44 feet bgs		RMSB-05-A 0 to 1 feet bgs		RMSB-05-B 9 to 11 feet bgs		RMSB-05-C 21 to 23 feet bgs		RMSB-05-D 62 to 64 feet bgs		RMSB-06-A 0 to 1 feet bgs		RMSB-06-B 17 to 19 feet bgs		RMSB-07-A 0 to 1 feet bgs		RMSB-07-B 5 to 8 feet bgs		RMSB-07-C 21 to 23 feet bgs	
Volatile Organic Compounds (µg/kg)																									
Vinyl Chloride	13.8	6.1	U	6.9	U	5.9	U	5.6	U	5.6	U	6.5	U	5.3	U	480	U	430	U	6.6	U	6.4	U	7.9	U
1,1-Dichloroethene	50	6.1	U	6.9	U	5.9	U	5.6	U	5.6	U	6.5	U	5.3	U	480	U	430	U	6.6	U	6.4	U	7.9	U
1,1-Dichloroethane	13.6	6.1	U	6.9	U	5.9	U	5.6	U	5.6	U	6.5	U	5.3	U	480	U	430	U	6.6	U	6.4	U	7.9	U
cis-1,2-Dichloroethene	420	6.1	U	6.9	U	5.9	U	5.6	U	2.3	J	14		16		480	U	430	U	4.4	J	6.4	U	2.7	J
1,4-Dioxane	2.8		R		R		R		R		R		R		R		R		R		R		R		R
Trichloroethene	36	6.1	U	6.9	U	5.9	U	5.6	U	5.6	U	5	J	8.9		480	U	430	U	3.9	J	1.9	J	7.9	U
Tetrachloroethene	46	6.1	U	9.1		5.9	U	5.6	U	5.6	U	34		**110**		**1900**		**3800**		6.6	U	6.4	U	7.9	U
Inorganic Analytes (mg/kg)																									
Aluminum	7700	**9530**	J	**8440**	J	**16000**	J	**8860**	J	**8750**	J	**9770**	J	**29900**	J	**9550**	J	**10100**	J	**9390**	J	**12300**	J	**13400**	J
Arsenic	0.39	1.4	U	1.5	U	1.5	U	1.3	U	1.4	U	1.5	U	1.4	U	1.5	U	**1.4**	U	1.6	U	1.4	U	1.7	U
Cadmium	7	1.9		1.3		2		2		2.2		1.8		4.6		1.5		1.6		2.1		2.4		2	
Chromium	0.29	**9.8**	J	**8.5**	J	**13.8**	J	**10**	J	**12.7**	J	**10.7**	J	**18.6**	J	**15**	J	**15**	J	**25.4**		**10.2**		**8.1**	
Cobalt	2.3	**7.4**	J	**9.4**	J	**26.7**	J	6.7	UJ	7.2	UJ	**17.3**	J	**28.8**	J	**9.3**	J	**10.9**	J	7.9	UJ	7.1	UJ	**64.6**	J
Copper	310	76.1		70.2		58.2		55.3		77.8		96.8		191		64.1		59.5		48.8		71.5		224	
Iron	5400	**36300**	J	**28600**	J	**33500**	J	**39000**	J	**43400**	J	**40500**	J	**60700**	J	**39000**	J	**37600**	J		R		R		R
Manganese	21	**165**	J	**181**	J	**1010**	J	**267**	J	**261**	J	**471**	J	**1420**	J	**500**	J	**449**	J	**237**	J	**261**	J	**1020**	J
Nickel	150	7.5	J	5.9	UJ	14.4	J	5.4	UJ	5.8	UJ	6.1	UJ	10.8	J	5.8	UJ	6.8	J	3.1	J	9.8		18	
Vanadium	39	**143**	J	**105**	J	**113**	J	**157**	J	**177**	J	**186**	J	**228**	J	**145**	J	**144**	J	**134**		**135**		**117**	

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
Shading indicates the sample was not analyzed for the given parameter
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value
R - rejected value

CDM Smith

R2-0007279

Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-07-D 62 to 64 feet bgs		RMSB-08-A 0 to 2 feet bgs		RMSB-08-B 8 to 11 feet bgs		RMSB-08-C 21 to 23 feet bgs		RMSB-08-D 58 to 60 feet bgs		RMSB-09-A 0 to 1 feet bgs		RMSB-09-B 9 to 11 feet bgs		RMSB-09-C 21 to 23 feet bgs		RMSB-09-D 58 to 60 feet bgs		RMSB-10-A 0 to 1 feet bgs		RMSB-10-B 5 to 7 feet bgs		RMSB-10-C 32 to 34 feet bgs	
Volatile Organic Compounds (µg/kg)																									
Vinyl Chloride	13.8	6.5	U	5.3	U	7.1	U	7.6	U	7	U	5	U	6.6	U	6.6	U	6.6	U	5.7	U	5.9	U	6.6	U
1,1-Dichloroethene	50	6.5	U	5.3	U	7.1	U	7.6	U	7	U	5	U	6.6	U	6.6	U	6.6	U	5.7	U	5.9	U	6.6	U
1,1-Dichloroethane	13.6	6.5	U	5.3	U	7.1	U	7.6	U	7	U	5	U	6.6	U	6.6	U	6.6	U	5.7	U	5.9	U	6.6	U
cis-1,2-Dichloroethene	420	19		5.3	U	7.1	U	7.5	J	4.7	J	5	U	6.6	U	6.6	U	6.6	U	5.7	U	5.9	U	12	
1,4-Dioxane	2.8		R		R		R		R		R		R		R		R		R		R		R		R
Trichloroethene	36	22		5.3	U	0.82	J	5	J	10		5	U	6.6	U	6.6	U	6.6	U	2.4	J	5.9	U	7.5	
Tetrachloroethene	46	**52**		5.3	U	7.1	U	11		20		5	U	6.6	U	6.6	U	6.6	U	45		29		**230**	
Inorganic Analytes (mg/kg)																									
Aluminum	7700	**16300**	J	**11800**	J	**10600**	J	**14300**	J	**11800**	J	**11800**	J	**11400**	J	**11300**	J	**17600**	J	**12000**	J	**18900**	J	**20300**	J
Arsenic	0.39	1.6	U	1.4	U	**1.4**	U	1.4	U	1.5	U	1.2	U	1.4	U	1.5	U	1.4	U	1.4	U	1.4	U	1.4	U
Cadmium	7	2		2.2		2.5		2.1		1.2		1.5		2.4		2.4		2.3		2.4		2.1		2.5	
Chromium	0.29	**10.5**		**21.2**		**8.6**		**7**		**8.7**		**20.8**		**45**		**34.8**		**8.5**		**16.5**	J	**22.1**	J	**12.9**	J
Cobalt	2.3	**14.5**	J	**12.2**	J	**44.9**	J	**62.6**	J	**13.8**	J	**14.1**	J	7.1	UJ	**32.7**	J	**18.4**	J	**22**	J	**69.9**	J	**32.4**	J
Copper	310	58.1		52.8		87.5		214		44.6		49.7		110		97.2		49.2		64.3		**322**		142	
Iron	5400		R		R		R		R		R		R		R		R		R	**48600**	J	**35400**	J	**30900**	J
Manganese	21	**310**	J	**473**	J	**428**	J	**933**	J	**445**	J	**480**	J	**225**	J	**732**	J	**682**	J	**1070**	J	**1060**	J	**692**	J
Nickel	150	18.9		8.6		11.4		16.1		13.3		12.1		10.1		14		23.2		8.1	J	64.6	J	105	J
Vanadium	39	**94.1**		**118**		**115**		**94.4**		**82.5**		**88.5**		**144**		**148**		**90**		**145**	J	**152**	J	**128**	J

Notes:
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U - not detected above the given reporting limit
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Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-11-A 0 to 4 feet bgs		RMSB-11-B 4 to 8 feet bgs		RMSB-11-C 8 to 12 feet bgs		RMSB-11-E 32 to 36 feet bgs		RMSB-11-F 44 to 48 feet bgs		RMSB-11-G 56 to 60 feet bgs		RMSB-11-H 68 to 72 feet bgs		RMSB-12-A 0 to 4 feet bgs		RMSB-12-B 4 to 8 feet bgs		RMSB-12-C 8 to 12 feet bgs		RMSB-12-D 20 to 24 feet bgs		RMSB-12-E 32 to 36 feet bgs		RMSB-12-F 44 to 48 feet bgs	
Volatile Organic Compounds (µg/kg)																											
Vinyl Chloride	13.8	6.2	U	6.5	U	8.2		8.9		7.1	U	8.3	U	5.3	U	5.8	U	470	U	5.4	U	480	U	7.1	U	7.2	U
1,1-Dichloroethene	50	6.2	U	6.5	U	6.8	U	6.6	U	7.1	U	8.3	U	5.3	U	5.8	U	470	U	5.4	U	480	U	7.1	U	7.2	U
1,1-Dichloroethane	13.6	6.2	U	6.5	U	6.8	U	6.6	U	7.1	U	8.3	U	5.3	U	5.8	U	470	U	5.4	U	480	U	7.1	U	7.2	U
cis-1,2-Dichloroethene	420	15		13		25		7.1		11		3	J	5.3	U	9.8		470	U	3.1	J	480	U	140		190	
1,4-Dioxane	2.8		R		R		R		R		R		R		R	**4200**	J		R	**4300**	J		R	**97**	J		R
Trichloroethene	36	4.4	J	3.8	J	7		8.3		7	J	2.5	J	5.3	U	19		470	U	2.2	J	480	U	23		**96**	
Tetrachloroethene	46	6.2	U	6.5	U	1.6	J	12		35		2.5	J	5.3	U	**140**	J	**1200**		**310**	J	**2800**		**10000**		**12000**	
Inorganic Analytes (mg/kg)																											
Aluminum	7700																										
Arsenic	0.39																										
Cadmium	7																										
Chromium	0.29																										
Cobalt	2.3																										
Copper	310																										
Iron	5400																										
Manganese	21																										
Nickel	150																										
Vanadium	39																										

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CDM Smith

R2-0007281

Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-12-G 36 to 60 feet bgs		RMSB-13-A 2 to 4 feet bgs		RMSB-13-B 4 to 8 feet bgs		RMSB-13-C 8 to 12 feet bgs		RMSB-13-D 20 to 24 feet bgs		RMSB-13-E 32 to 36 feet bgs		RMSB-13-F 44 to 48 feet bgs		RMSB-13-G 56 to 60 feet bgs		RMSB-14-A 0 to 4 feet bgs		RMSB-14-B 4 to 8 feet bgs		RMSB-14-C 8 to 12 feet bgs		RMSB-14-D 20 to 24 feet bgs		RMSB-14-E 32 to 36 feet bgs	
Volatile Organic Compounds (µg/kg)																											
Vinyl Chloride	13.8	6.8	U	5.6	U	6.9	U	7.1	U	6.7	U	7.9	U	7.4	U	390	U	7.7	U	6.9	U	6.4	U	7.6	U	8.1	U
1,1-Dichloroethene	50	6.8	U	5.6	U	6.9	U	7.1	U	6.7	U	7.9	U	7.4	U	390	U	7.7	U	6.9	U	6.4	U	7.6	U	8.1	U
1,1-Dichloroethane	13.6	0.86	J	5.6	U	6.9	U	7.1	U	6.7	U	7.9	U	7.4	U	390	U	7.7	U	6.9	U	6.4	U	7.6	U	8.1	U
cis-1,2-Dichloroethene	420	190		5.6	U	7.9		4.1	J	25		190		190		270	J	7.7	U	6.9	U	6.4	U	7.6	U	8.1	U
1,4-Dioxane	2.8		R		R		R		R		R		R		R		R		R		R		R		R		R
Trichloroethene	36	**190**		5.6	U	2.7	J	7.1	U	3.8	J	34		**59**		390	U	7.7	UJ	6.9	UJ	6.4	UJ	1.8	J	8.1	UJ
Tetrachloroethene	46	**14000**		5.6	U	13		4.5	J	**46**		**420**	J	**740**	J	**2000**		7.7	U	6.9	U	6.9		**71**		32	
Inorganic Analytes (mg/kg)																											
Aluminum	7700																										
Arsenic	0.39																										
Cadmium	7																										
Chromium	0.29																										
Cobalt	2.3																										
Copper	310																										
Iron	5400																										
Manganese	21																										
Nickel	150																										
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CDM Smith

Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-14-F 44 to 48 feet bgs		RMSB-14-G 56 to 60 feet bgs		RMSB-14-H 68 to 72 feet bgs		RMSB-15-A 0 to 4 feet bgs		RMSB-15-B 4 to 8 feet bgs		RMSB-15-C 8 to 12 feet bgs		RMSB-15-E 32 to 36 feet bgs		RMSB-15-F 44 to 48 feet bgs		RMSB-15-G 56 to 60 feet bgs		RMSB-15-H 68 to 72 feet bgs		RMSB-16-A 0 to 4 feet bgs		RMSB-16-B 4 to 8 feet bgs		RMSB-16-C 8 to 12 feet bgs	
Volatile Organic Compounds (µg/kg)																											
Vinyl Chloride	13.8	7.5	U	6.8	U	6.8	U	5.9	U	7.3	U	6.6	U	6.9	U	6.7	U	400	U	7.1	U	6.3	U	5.6	U	6.3	U
1,1-Dichloroethene	50	7.5	U	6.8	U	6.8	U	5.9	U	7.3	U	6.6	U	6.9	U	6.7	U	400	U	7.1	U	6.3	U	5.6	U	6.3	U
1,1-Dichloroethane	13.6	7.5	U	6.8	U	6.8	U	5.9	U	7.3	U	6.6	U	6.9	U	6.7	U	400	U	7.1	U	6.3	U	5.6	U	6.3	U
cis-1,2-Dichloroethene	420	7.5	U	6.8	U	6.8	U	5.9	U	7.3	U	6.6	U	58		34		400	U	8.6		6.3	U	5.6	U	6.3	U
1,4-Dioxane	2.8		R		R		R		R		R		R		R		R		R		R		R		R		R
Trichloroethene	36	7.5	UJ	6.8	UJ	6.8	UJ	5.9	UJ	7.3	UJ	6.6	UJ	26	J	16	J	400	U	7	J	6.3	U	5.6	U	6.3	UJ
Tetrachloroethene	46	**51**		**120**		**290**	J	14		14		21		**220**	J	**380**	J	**410**		**230**	J	5.5	J	5.3	J	5.3	J
Inorganic Analytes (mg/kg)																											
Aluminum	7700																										
Arsenic	0.39																										
Cadmium	7																										
Chromium	0.29																										
Cobalt	2.3																										
Copper	310																										
Iron	5400																										
Manganese	21																										
Nickel	150																										
Vanadium	39																										

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Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-16-D 20 to 24 feet bgs		RMSB-16-E 32 to 36 feet bgs		RMSB-16-F 44 to 48 feet bgs		RMSB-16-G 56 to 60 feet bgs		RMSB-16-H 68 to 72 feet bgs		RMSB-17-A 0 to 4 feet bgs		RMSB-17-B 4 to 8 feet bgs		RMSB-17-C 8 to 12 feet bgs		RMSB-17-D 20 to 24 feet bgs		RMSB-17-E 32 to 36 feet bgs		RMSB-18-A 0 to 4 feet bgs		RMSB-18-B 4 to 8 feet bgs		RMSB-18-C 8 to 12 feet bgs	
Volatile Organic Compounds (µg/kg)																											
Vinyl Chloride	13.8	7.6	U	7.6	U	7.6	U	7	U	6.3	U	5.5	U	7	U	7.1	U	7.7	U	8.3	U	**910**	J	**2000**		**400**	J
1,1-Dichloroethene	50	7.6	U	7.6	U	7.6	U	7	U	6.3	U	5.5	U	7	U	7.1	U	7.7	U	8.3	U	**74**		26		**120**	
1,1-Dichloroethane	13.6	7.6	U	7.6	U	7.6	U	7	U	6.3	U	5.5	U	7	U	7.1	U	7.7	U	8.3	U	11		**17**		**47**	J
cis-1,2-Dichloroethene	420	7.6	U	7.6	U	7.6	U	0.57	J	6.3	U	5.5	U	7	U	7.1	U	7.7	U	8.3	U	**6900**	J	**41000**		**620**	
1,4-Dioxane	2.8		R		R		R		R		R		R		R		R		R		R		R	**120**	J	**100**	J
Trichloroethene	36	7.6	UJ	7.6	U	7.6	U	7	U	6.3	U	5.5	U	7	U	7.1	U	7.7	U	8.3	U	**2700**	J	3.3	J	**1400**	J
Tetrachloroethene	46	22		0.97	J	12		34		37		2	J	2.9	J	4.9	J	6.2	J	8.3	U	**3300000**		**790**	J	**210**	J
Inorganic Analytes (mg/kg)																											
Aluminum	7700																										
Arsenic	0.39																										
Cadmium	7																										
Chromium	0.29																										
Cobalt	2.3																										
Copper	310																										
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CDM Smith

R2-0007284

Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-18-D 20 to 24 feet bgs		RMSB-18-E 32 to 36 feet bgs		RMSB-18-F 44 to 48 feet bgs		RMSB-18-G 56 to 60 feet bgs		RMSB-18-H 68 to 72 feet bgs		RMSB-19-A 0 to 4 feet bgs		RMSB-19-B 4 to 8 feet bgs		RMSB-19-C 8 to 12 feet bgs		RMSB-19-D 20 to 24 feet bgs		RMSB-19-E 32 to 36 feet bgs		RMSB-19-F 44 to 48 feet bgs		RMSB-19-G 56 to 60 feet bgs		RMSB-20-A 0 to 4 feet bgs	
Volatile Organic Compounds (µg/kg)																											
Vinyl Chloride	13.8	**100**	J	**160**	J	**42**	J	530	U	490	U	5.4	U	6.2	U	6.7	U	6.6	U	7.6	U	8.3	U	8.3	U	6.2	U
1,1-Dichloroethene	50	7.2	U	7.3	U	7.4	U	530	U	490	U	5.4	U	6.2	U	6.7	U	6.6	U	7.6	U	8.3	U	8.3	U	6.2	U
1,1-Dichloroethane	13.6	5	J	6.4	J	2.6	J	530	U	490	U	5.4	U	6.2	U	6.7	U	6.6	U	7.6	U	8.3	U	8.3	U	6.2	U
cis-1,2-Dichloroethene	420	**2600**		**6300**		**760**		**1300**		380	J	5.4	U	6.2	U	6.7	U	0.51	J	3.2	J	1.4	J	1.4	J	6.2	U
1,4-Dioxane	2.8	**690**	J	**410**	J		R		R		R		R		R		R		R		R		R		R		R
Trichloroethene	36	1.9	J	**120**		**100**		530	U	490	U	1.5	J	6.2	U	6.7	U	6.6	U	3.8	J	1.4	J	2.4	J	6.2	U
Tetrachloroethene	46	**340**	J	**830**		**320**	J	**2700**		**1300**		9.2		23		15		29		**110**		37		**59**		13	
Inorganic Analytes (mg/kg)																											
Aluminum	7700																										
Arsenic	0.39																										
Cadmium	7																										
Chromium	0.29																										
Cobalt	2.3																										
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CDM Smith

Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-20-B 4 to 8 feet bgs		RMSB-20-C 8 to 12 feet bgs		RMSB-20-D 20 to 24 feet bgs		RMSB-20-E 32 to 36 feet bgs		RMSB-20-F 44 to 48 feet bgs		RMSB-21-A 0 to 4 feet bgs		RMSB-21-B 4 to 8 feet bgs		RMSB-21-C 8 to 12 feet bgs		RMSB-21-D 20 to 24 feet bgs		RMSB-21-E 30 to 36 feet bgs		RMSB-21-F 44 to 48 feet bgs		RMSB-21-G 56 to 60 feet bgs		RMSB-21-H 68 to 72 feet bgs	
Volatile Organic Compounds (µg/kg)																											
Vinyl Chloride	13.8	5.5	U	7	U	6.7	U	7.3	U	6.9	U	6.1	U	6.5	U	4.8	U	7.5	U	8	U	7.4	U	6	U	6.2	U
1,1-Dichloroethene	50	5.5	U	7	U	6.7	U	7.3	U	6.9	U	6.1	U	6.5	U	4.8	U	7.5	U	8	U	7.4	U	6	U	6.2	U
1,1-Dichloroethane	13.6	5.5	U	7	U	6.7	U	7.3	U	6.9	U	6.1	U	6.5	U	4.8	U	7.5	U	8	U	7.4	U	6	U	6.2	U
cis-1,2-Dichloroethene	420	5.5	U	0.7	J	4.1	J	56		7.5		6.1	U	6.5	U	0.6	J	7.5	U	8	U	0.58	J	6	U	6.2	U
1,4-Dioxane	2.8		R		R		R		R		R		R		R	97	R	150	R	160	R	150	R	120	R	120	R
Trichloroethene	36	5.5	U	7	U	1.3	J	15		2	J	6.1	U	6.5	U	4.8	U	7.5	U	8	U	7.4	U	6	U	6.2	U
Tetrachloroethene	46	1.9	J	8.7		13		**110**		22		6.1	U	1.7	J	2	J	0.66	J	0.86	J	0.82	J	0.79	J	6.2	U
Inorganic Analytes (mg/kg)																											
Aluminum	7700																										
Arsenic	0.39																										
Cadmium	7																										
Chromium	0.29																										
Cobalt	2.3																										
Copper	310																										
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CDM Smith

Table 4-6a
Ramallo/CCC - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RMSB-22-A 0 to 4 feet bgs		RMSB-22-B 4 to 8 feet bgs		RMSB-22-C 8 to 12 feet bgs		RMSB-22-D 20 to 24 feet bgs		RMSB-22-E 32 to 36 feet bgs		RMSB-22-F 44 to 48 feet bgs		RMSB-22-G 56 to 60 feet bgs		RMSB-23-A 0 to 4 feet bgs		RMSB-23-B 4 to 8 feet bgs		RMSB-23-C 8 to 12 feet bgs		RMSB-23-D 20 to 24 feet bgs	
Volatile Organic Compounds (µg/kg)																							
Vinyl Chloride	13.8	7.5	U	6.7	U	6.9	U	1000	R	7.4	U	7.8	U	7	U	6.6	U	7.3	U	7.4	U	6.7	U
1,1-Dichloroethene	50	7.5	U	6.7	U	6.9	U	1000	R	7.4	U	7.8	U	7	U	6.6	U	7.3	U	7.4	U	6.7	U
1,1-Dichloroethane	13.6	7.5	U	6.7	U	6.9	U	1000	R	7.4	U	7.8	U	7	U	6.6	U	7.3	U	7.4	U	6.7	U
cis-1,2-Dichloroethene	420	7.5	U	6.7	U	0.81	J	**1600**	J	21		30		18		6.6	U	7.3	U	7.4	U	0.95	J
1,4-Dioxane	2.8	150	R	130	R	140	R	20000	R	150	R	160	R	140	R	130	R	150	R	150	R	130	R
Trichloroethene	36	7.5	U	1	J	2.8	J	**2400**	J	21		32		**37**		6.6	U	7.3	U	0.92	J	1	J
Tetrachloroethene	46	**1600**	J	**620**		**940**		**120000**	J	**2200**		**3300**	J	**2600**		**95**		**120**		**180**		**85**	
Inorganic Analytes (mg/kg)																							
Aluminum	7700																						
Arsenic	0.39																						
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Vanadium	39																						

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
Shading indicates the sample was not analyzed for the given parameter
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value
R - rejected value

Table 4-6b
Soil Sample Summary Statistics – Ramallo
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
Tetrachloroethene	**46**	**94 / 125**	**45**	**0.66 J**	**3300000**	**RMSB-18-A**	**5 - 8.3**
Trichloroethene	**36**	**51 / 125**	**9**	**0.82 J**	**2700 J**	**RMSB-18-A**	**4.8 - 530**
cis-1,2-Dichloroethene	**420**	**56 / 125**	**8**	**0.51 J**	**41000**	**RMSB-18-B**	**5 - 480**
1,1-Dichloroethene	**50**	**3 / 125**	**2**	**26**	**120**	**RMSB-18-C**	**4.8 - 530**
Vinyl Chloride	**13.8**	**8 / 125**	**6**	**8.2**	**2000**	**RMSB-18-B**	**4.8 - 530**
1,1,1-Trichloroethane	1400	2 / 125	0	10 J	45	RMSB-18-A	4.8 - 530
1,1-Dichloroethane	**13.6**	**7 / 125**	**2**	**0.86 J**	**47 J**	**RMSB-18-C**	**4.8 - 530**
1,4-Dichlorobenzene	1440	31 / 125	0	0.62 J	2.7 J	RMSB-03-A	4.8 - 530
1,4-Dioxane	**2.8**	**7 / 125**	**7**	**97 J**	**4300 J**	**RMSB-12-C**	**NA - NA**
2-Butanone	20000	11 / 125	0	2.5 J	4600	RMSB-18-D	9.7 - 1100
2-Hexanone	158	1 / 125	0	7.3 J	7.3 J	RMSB-18-D	9.7 - 1100
4-Methyl-2-pentanone	4600	4 / 125	0	2.9 J	18	RMSB-18-D	9.7 - 1100
Acetone	48000	48 / 125	0	4 J	3600 J	RMSB-18-D	9.7 - 1100
Benzene	52	1 / 125	0	1.1 J	1.1 J	RMSB-18-C	4.8 - 530
Bromodichloromethane	270	1 / 125	0	1.5 J	1.5 J	RMSB-21-F	4.8 - 530
Carbon Disulfide	4200	9 / 125	0	0.64 J	69	RMSB-18-C	4.8 - 530
Chloroform	290	2 / 125	0	4.5 J	8.1 J	RMSB-18-C	4.8 - 530
Chloromethane	980	5 / 125	0	250 J	570	RMSB-12-D	4.8 - 490
Dichlorodifluoromethane	6000	1 / 125	0	0.77 J	0.77 J	RMSB-09-D	4.8 - 530
Ethylbenzene	5400	3 / 125	0	1.5 J	11	RMSB-18-C	4.8 - 530
Isopropylbenzene	12800	3 / 125	0	0.8 J	2.1 J	RMSB-18-C	4.8 - 530
m,p-Xylene	3600	6 / 125	0	0.58 J	64	RMSB-18-C	4.8 - 530
Methyl Acetate	64000	5 / 125	0	1.8 J	8.4 J	RMSB-18-D	4.8 - 530
Methylcyclohexane	N/A	2 / 125	0	3 J	5.2 J	RMSB-18-C	4.8 - 530
o-Xylene	3800	3 / 125	0	3 J	29	RMSB-18-C	4.8 - 530
Toluene	13800	15 / 125	0	0.59 J	390 J	RMSB-18-C	4.8 - 1000
trans-1,2-Dichloroethene	580	10 / 125	0	0.63 J	92	RMSB-18-C	4.8 - 530
Semivolatile Organic Compounds (µg/kg)							
Acetophenone	9000	1 / 36	0	43 J	43 J	RMSB-06-B	210 - 270
bis(2-Ethylhexyl) phthalate	28000	7 / 36	0	120 J	1200 J	RMSB-06-B	210 - 270
Di-n-butylphthalate	34000	1 / 36	0	89 J	89 J	RMSB-03-A	210 - 270
Phenol	52000	2 / 36	0	38 J	48 J	RMSB-04-A	210 - 270
Pesticides (µg/kg)							
4,4'-DDD	1320	1 / 36	0	1.3 J	1.3 J	RMSB-10-C	4 - 5.3
Endosulfan I	22000	3 / 36	0	0.58 J	2.8	RMSB-10-B	2.1 - 6.7
gamma-Chlordane	1600	3 / 36	0	0.5 J	2.9	RMSB-06-A	2.1 - 2.6
Inorganics (mg/kg)							
Aluminum	**7700**	**36 / 36**	**36**	**8440 J**	**44300 J**	**RMSB-01-C**	**NA - NA**
Arsenic	**0.39**	**2 / 36**	**2**	**1.6**	**2.2**	**RMSB-01-A**	**1.2 - 1.7**
Barium	1500	34 / 36	0	9.5 J	710	RMSB-02-C	29.2 - 32
Beryllium	16	6 / 36	0	0.84 J	1.6 J	RMSB-10-B	0.61 - 0.79
Cadmium	**7**	**36 / 36**	**1**	**1.2**	**8**	**RMSB-01-C**	**NA - NA**
Calcium	N/A	36 / 36	0	47.6 J	10600 J	RMSB-01-B	NA - NA
Chromium	**0.29**	**36 / 36**	**36**	**7**	**156**	**RMSB-01-C**	**NA - NA**
Cobalt	**2.3**	**30 / 36**	**30**	**7.4 J**	**110 J**	**RMSB-01-C**	**6.7 - 7.9**
Copper	**310**	**36 / 36**	**3**	**44.6**	**549**	**RMSB-01-C**	**NA - NA**
Cyanide	4.7	25 / 36	0	0.14 J	2 J	RMSB-10-C	3 - 4
Iron	**5400**	**17 / 36**	**17**	**28600 J**	**61800 J**	**RMSB-03-D**	**NA - NA**
Lead	280	4 / 36	0	1.5 J	10.1	RMSB-03-A	1.2 - 1.7
Magnesium	N/A	36 / 36	0	412 J	11500 J	RMSB-05-D	NA - NA
Manganese	**21**	**36 / 36**	**36**	**165 J**	**2760 J**	**RMSB-04-A**	**NA - NA**
Mercury	2	6 / 36	0	0.086 J	0.41	RMSB-03-A	0.12 - 0.17
Nickel	**150**	**29 / 36**	**1**	**3.1 J**	**239**	**RMSB-01-C**	**5.4 - 6.1**
Potassium	N/A	36 / 36	0	25.4 J	778	RMSB-05-D	NA - NA
Silver	12	36 / 36	0	2.6 J	9.7 J	RMSB-01-C	NA - NA
Sodium	N/A	36 / 36	0	101 J	1020	RMSB-05-D	NA - NA
Vanadium	**39**	**36 / 36**	**36**	**82.5**	**277**	**RMSB-01-C**	**NA - NA**
Zinc	2300	36 / 36	0	21.5	364 J	RMSB-10-C	NA - NA

Notes:
Highlight and bold font indicates an exceedance.
J - value is estimated
µg/kg - microgram per kilogram

CDM Smith

Table 4-7a
CCL Label - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	CCSB-01-A 0 to 1 feet bgs	CCSB-01-B 5 to 7 feet bgs	CCSB-01-C 41 to 43 feet bgs	CCSB-01-D 72 to 74 feet bgs	CCSB-02-A 0 to 1 feet bgs	CCSB-02-B 9 to 11 feet bgs	CCSB-02-C 21 to 23 feet bgs	CCSB-02-D 55 to 57 feet bgs	CCSB-03-A 0 to 1 feet bgs	CCSB-03-B 9 to 11 feet bgs	CCSB-03-C 21 to 23 feet bgs	CCSB-03-D 62 to 64 feet bgs	CCSB-04-A 0 to 1 feet bgs	CCSB-04-B 5 to 7 feet bgs	CCSB-04-C 21 to 23 feet bgs	CCSB-04-D 62 to 64 feet bgs	CCSB-05-A 0 to 1 feet bgs	CCSB-05-B 2 to 4 feet bgs
Volatile Organic Compounds (µg/kg)																			
Tetrachloroethene	46	7.1 U	6.4 U	30	110	6 U	6.3 U	7.4 U	6.8 U	6.6 U	6.4 U	7.4 U	33	6.6 U	6.9 U	7.7 U	6.2 U	6.6 U	7.2 U
Polychlorinated Biphenyls (µg/kg)																			
Aroclor-1268	220	46 UJ	42 U	47 U	49 U	45 U	49 U	51 U	47 U	40 U	46 U	51 U	51 U	47 U	51 U	51 U	47 U	50 U	51 U
Inorganic Analytes (mg/kg)																			
Aluminum	7700	16400	14700	37700	48800	11900	21100	18100	31000	22600	15400	29100	46300	11200	14500 J	21600	36000	14100	14000
Arsenic	0.39	2	6.8	1.4 U	1.5 U	0.85 J	1.5 U	1.6 U	1.4 U	1.2 U	1.4 U	1.6 U	1.5 U	1.5 U	1.5 U	1.6 U	1.4 U	1.2 J	1.5 U
Chromium	0.29	65.4	74.9	79.6	104	88.5	47	33.9	35.9	28.2 J	65.9 J	86.2 J	81.9 J	88.3 J	39.8 J	13 J	17.5 J	60.7 J	39.2 J
Cobalt	2.3	29.1 J	57.1 J	40.6 J	63.7 J	26.2 J	11.4 J	82 J	54.6 J	28.1	60.1	89.9	75.5	2.4 J	60.1	192	32.9	4.9 J	5.2 J
Copper	310	105	114	130	149	121	146	202	186	106	195	499	157	132	192 J	245	91.7	119	125
Manganese	21	1740 J	4350 J	1350 J	2200 J	2190 J	1140 J	1880 J	1270 J	1000 J	1150 J	1670 J	1750 J	593 J	1050 J	3120 J	865 J	599 J	524 J
Nickel	150	19.4	14.1	58.4	52.9	14.7	18	35.7	21.1	21.1	47.1	102	192	11.3	17.2 R	17	84.1	13.5	19.1
Vanadium	39	214 J	240 J	165 J	201 J	219 J	218 J	196 J	217 J	154	209	238	214	237	232	180	178	247	258

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
Shading indicates the sample was not analyzed for the given parameter
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-7a
CCL Label - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	CCSB-05-C 4 to 5.5 feet bgs	CCSB-06-A 0 to 1 feet bgs	CCSB-06-B 1 to 2.5 feet bgs	CCSB-07-A 0 to 1 feet bgs	CCSB-07-B 2 to 4 feet bgs	CCSB-07-C 4 to 5.5 feet bgs	CCSB-08-A 0 to 1 feet bgs	CCSB-08-B 9 to 11 feet bgs	CCSB-08-C 41 to 43 feet bgs	CCSB-08-D 72 to 74 feet bgs	CCSB-09-A 0 to 1 feet bgs	CCSB-09-B 5 to 7 feet bgs	CCSB-09-C 21 to 23 feet bgs	CCSB-09-D 71 to 73 feet bgs	CCSB-10-A 0 to 1 feet bgs	CCSB-10-B 5 to 7 feet bgs
Volatile Organic Compounds (µg/kg)																	
Tetrachloroethene	46	6.9 U	6.7 U	6.1 U	7.4 U	7.9 U	7.1 U	7 U	4.7 U	6.8 U	7.1 U	3.3 U	6.9 U	5.6 U	5.4 U	5.8 U	7.5 U
Polychlorinated Biphenyls (µg/kg)																	
Aroclor-1268	220	49 U	47 U	41 U	590	53 U	58	48 UJ	51 UJ	52 UJ	50 UJ	48 UJ	51 UJ	52 UJ	51 UJ	44 U	48 U
Inorganic Analytes (mg/kg)																	
Aluminum	7700	15200	10600	11800	14300	17200	14500	12200	11000	26500	36700	14300	18400	19500	34700	6890	11700
Arsenic	0.39	5.3	2.1	1.5 U	1.3 J	1.6 U	1.6 U	1.1 J	1.5 U	1.6 U	1.5 U	1.5 U	0.79 J	1.6 U	1.5 U	1.4 U	1.4 U
Chromium	0.29	67.7 J	97 J	88.3 J	89.2 J	78.3 J	83.2 J	113	86.2	140	194	40.1	39.5	64.3	105	31.8 J	56
Cobalt	2.3	5.8 J	7.5	6 J	7.6 U	8 U	7.8 U	15.9 J	117 J	148 J	99.3 J	2.2 J	17.2 J	64.5 J	56 J	92.7	146 J
Copper	310	153	123	170	123	120	130	188	198	944	178	147	164	382	154	90.8	194
Manganese	21	909 J	1270 J	1500 J	870 J	802 J	961 J	1730 J	1980 J	1370 J	1870 J	652 J	1940 J	2040 J	1660 J	1740 J	2430 J
Nickel	150	23	16.5	18.6	19.4	22.4	20.4	13.9	17.6	76.1	232	12.7	18.7	40.9	232	18.8	42.9
Vanadium	39	260	205	234	233	213	221	226 J	220 J	224 J	165 J	184 J	228 J	205 J	180 J	113	161 J

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
Shading indicates the sample was not analyzed for the given parameter
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-7a
CCL Label - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	CCSB-10-C 41 to 43 feet bgs	CCSB-10-D 62 to 64 feet bgs	CCSB-11-A 0 to 4 feet bgs	CCSB-11-B 4 to 8 feet bgs	CCSB-11-C 8 to 12 feet bgs	CCSB-11-D 20 to 24 feet bgs	CCSB-11-F 44 to 48 feet bgs	CCSB-11-G 56 to 60 feet bgs	CCSB-12-A 0 to 4 feet bgs	CCSB-12-B 4 to 8 feet bgs	CCSB-12-C 8 to 12 feet bgs	CCSB-12-D 20 to 24 feet bgs	CCSB-12-E 32 to 36 feet bgs	CCSB-12-F 44 to 48 f eet bgs	CCSB-13-A 0 to 4 feet bgs	CCSB-13-B 4 to 8 feet bgs	CCSB-13-C 8 to 12 feet bgs	CCSB-13-D 20 to 24 feet bgs
Volatile Organic Compounds (µg/kg)																			
Tetrachloroethene	46	7.1 U	6.7 U	6 U	5.8 U	6.4 U	7.8 U	7.5 U	6.6 U	6.2 U	6.2 U	5.2 U	5.6 U	7.9 U	7.5 U	6.2 U	5.8 U	5.3 U	7.2 U
Polychlorinated Biphenyls (µg/kg)																			
Aroclor-1268	220	48 U	48 U																
Inorganic Analytes (mg/kg)																			
Aluminum	7700	**36600**	**30100**																
Arsenic	0.39	1.5 U	**1.3** J																
Chromium	0.29	**112**	**108**																
Cobalt	2.3	**177** J	**45.5** J																
Copper	310	**413**	162																
Manganese	21	**2310** J	**2200** J																
Nickel	150	**296**	150																
Vanadium	39	**177** J	**157** J																

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
Shading indicates the sample was not analyzed for the given parameter
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-7a
CCL Label - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	CCSB-13-E 32 to 36 feet bgs	CCSB-13-F 44 to 48 feet bgs	CCSB-14-A 0 to 4 feet bgs	CCSB-14-B 4 to 8 feet bgs	CCSB-14-C 8 to 12 feet bgs	CCSB-14-D 20 to 24 feet bgs	CCSB-14-E 32 to 36 feet bgs	CCSB-14-F 44 to 48 feet bgs	CCSB-14-G 56 to 60 feet bgs	CCSB-15-A 0 to 4 feet bgs	CCSB-15-B 4 to 8 feet bgs	CCSB-15-C 8 to 12 feet bgs	CCSB-15-D 20 to 24 feet bgs	CCSB-15-E 32 to 36 feet bgs	CCSB-15-F 44 to 48 feet bgs	CCSB-15-G 56 to 60 feet bgs	CCSB-15-H 68 to 72 feet bgs	CCSB-16-A 0 to 4 feet bgs	CCSB-16-B 4 to 8 feet bgs	CCSB-16-C 8 to 12 feet bgs
Volatile Organic Compounds (µg/kg)																					
Tetrachloroethene	46	1.2 J	6.1	6.4 U	7.1 U	6.8 U	6.8 U	6.9 U	7.4 U	5.4 U	6.3 U	7.2 U	7.7 U	7.4 U	8.3 U	7.7 U	7.9 U	7 U	7.1 U	6.9 U	8.4 U
Polychlorinated Biphenyls (µg/kg)																					
Aroclor-1268	220																				
Inorganic Analytes (mg/kg)																					
Aluminum	7700																				
Arsenic	0.39																				
Chromium	0.29																				
Cobalt	2.3																				
Copper	310																				
Manganese	21																				
Nickel	150																				
Vanadium	39																				

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
Shading indicates the sample was not analyzed for the given parameter
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-7a
CCL Label - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	CCSB-16-D 20 to 24 feet bgs	CCSB-16-E 32 to 36 feet bgs	CCSB-16-F 44 to 48 feet bgs	CCSB-16-G 56 to 60 feet bgs	CCSB-16-H 68 to 72 feet bgs	CCSB-17-A 0 to 4 feet bgs	CCSB-17-B 4 to 8 feet bgs	CCSB-17-C 8 to 12 feet bgs	CCSB-17-D 20 to 24 feet bgs	CCSB-17-E 32 to 36 feet bgs	CCSB-17-F 44 to 48 feet bgs	CCSB-17-G 56 to 60 feet bgs	CCSB-17-H 68 to 72 feet bgs	CCSB-18-A 0 to 4 feet bgs	CCSB-18-B 4 to 8 feet bgs	CCSB-18-C 8 to 12 feet bgs	CCSB-18-D 20 to 24 feet bgs	CCSB-18-E 32 to 36 feet bgs	CCSB-18-F 44 to 48 feet bgs	CCSB-18-G 56 to 60 feet bgs	CCSB-18-H 68 to 72 feet bgs
Volatile Organic Compounds (µg/kg)																						
Tetrachloroethene	46	8.4 U	7.8 U	7.2 U	6.4 U	32	6.2 U	6.7 U	0.61 J	0.95 J	7.1 U	7.6 U	7.3 U	6.7 U	6.6 U	8	6.9 U	2.6 J	2.4 J	23	19	60
Polychlorinated Biphenyls (µg/kg)																						
Aroclor-1268	220																					
Inorganic Analytes (mg/kg)																						
Aluminum	7700																					
Arsenic	0.39																					
Chromium	0.29																					
Cobalt	2.3																					
Copper	310																					
Manganese	21																					
Nickel	150																					
Vanadium	39																					

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
Shading indicates the sample was not analyzed for the given parameter
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-7b
Soil Sample Summary Statistics – CCL Label
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
Tetrachloroethene	**46**	**14 / 93**	**2**	**0.61 J**	**110**	**CCSB-01-D**	**3.3 - 8.4**
Trichloroethene	36	9 / 93	0	0.67 J	20	CCSB-18-H	3.3 - 8.4
cis-1,2-Dichloroethene	420	12 / 93	0	0.56 J	180	CCSB-18-H	3.3 - 8.4
2-Butanone	20000	4 / 93	0	3.3 J	37	CCSB-11-C	6.6 - 17
Acetone	48000	31 / 93	0	3.5 J	250	CCSB-11-C	6.6 - 17
Carbon Disulfide	4200	3 / 93	0	0.44 J	11	CCSB-11-C	3.3 - 8.4
Chloroform	290	1 / 93	0	53	53	CCSB-09-D	3.3 - 8.4
m,p-Xylene	3600	3 / 93	0	1.1 J	1.3 J	CCSB-14-C	3.3 - 8.4
Methyl Acetate	64000	1 / 93	0	3.3 J	3.3 J	CCSB-11-C	3.3 - 8.4
Methylene Chloride	26	1 / 93	0	8.3 J	8.3 J	CCSB-02-D	3.3 - 8.4
Toluene	13800	15 / 93	0	14	240	CCSB-17-C	3.3 - 8.3
Semivolatile Organic Compounds (µg/kg)							
Acetophenone	9000	1 / 36	0	110 J	110 J	CCSB-03-A	210 - 270
bis(2-Ethylhexyl) phthalate	28000	6 / 36	0	82 J	200 J	CCSB-07-A	200 - 270
Polychlorinated Biphenyls (µg/kg)							
Aroclor-1268	**220**	**2 / 36**	**1**	**58**	**590**	**CCSB-07-A**	**40 - 53**
Inorganics (mg/kg)							
Aluminum	**7700**	**36 / 36**	**35**	**6890**	**48800**	**CCSB-01-D**	**NA - NA**
Arsenic	**0.39**	**10 / 36**	**10**	**0.79 J**	**6.8**	**CCSB-01-B**	**1.2 - 1.6**
Barium	1500	32 / 36	0	11.1 J	1030	CCSB-02-D	30.2 - 32
Beryllium	16	6 / 36	0	0.93	2	CCSB-10-C	0.6 - 0.8
Cadmium	7	34 / 36	0	0.89	4.5	CCSB-04-D	0.68 - 0.72
Calcium	N/A	36 / 36	0	159 J	8190 J	CCSB-03-A	NA - NA
Chromium	**0.29**	**36 / 36**	**36**	**13 J**	**194**	**CCSB-08-D**	**NA - NA**
Cobalt	**2.3**	**33 / 36**	**32**	**2.2 J**	**192**	**CCSB-04-C**	**7.6 - 8**
Copper	**310**	**36 / 36**	**4**	**90.8**	**944**	**CCSB-08-C**	**NA - NA**
Cyanide	4.7	7 / 36	0	0.13 J	1.9 J	CCSB-07-C	3 - 4
Lead	280	7 / 36	0	0.61 J	17.3	CCSB-07-A	1.2 - 1.6
Magnesium	N/A	36 / 36	0	288 J	21600	CCSB-01-C	NA - NA
Manganese	**21**	**36 / 36**	**36**	**524 J**	**4350 J**	**CCSB-01-B**	**NA - NA**
Mercury	**2**	**19 / 36**	**1**	**0.051 J**	**2.3**	**CCSB-07-A**	**0.12 - 0.16**
Nickel	**150**	**35 / 36**	**4**	**11.3**	**296**	**CCSB-10-C**	**NA - NA**
Potassium	N/A	12 / 36	0	97.7 J	1850 J	CCSB-02-D	598 - 800
Silver	12	36 / 36	0	1.7	5 J	CCSB-10-D	NA - NA
Sodium	N/A	33 / 36	0	34 J	604	CCSB-03-A	790 - 800
Vanadium	**39**	**36 / 36**	**36**	**113**	**260**	**CCSB-05-C**	**NA - NA**
Zinc	2300	36 / 36	0	26.1	1050 J	CCSB-10-C	NA - NA

Notes:
Highlight and bold font indicates an exceedance.
J - value is estimated
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

Table 4-8a
ENCO - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	ENSB-01-A 0 to 4 feet bgs	ENSB-01-B 4 to 8 feet bgs	ENSB-01-C 8 to 12 feet bgs	ENSB-01-D 20 to 24 feet bgs	ENSB-01-E 32 to 36 feet bgs	ENSB-02-A 0 to 4 feet bgs	ENSB-02-B 4 to 8 feet bgs	ENSB-02-C 8 to 12 feet bgs	ENSB-02-D 20 to 24 feet bgs
Volatile Organic Compounds (µg/kg)										
Vinyl Chloride	13.8	5.2 U	7.2 U	6.5 U	6.6 U	7.2 U	5.9 U	6.2 U	7.1 U	7.5 U

	Cidra Soil Screening Criteria	ENSB-02-E 32 to 36 feet bgs	ENSB-02-F 44 to 48 feet bgs	ENSB-02-G 56 to 60 feet bgs	ENSB-03-A 0 to 4 feet bgs	ENSB-03-B 4 to 8 feet bgs	ENSB-03-C 8 to 12 feet bgs	ENSB-03-D 20 to 24 feet bgs	ENSB-03-E 32 to 36 feet bgs	ENSB-03-F 44 to 48 feet bgs
Volatile Organic Compounds (µg/kg)										
Vinyl Chloride	13.8	7.8 U	6.5 U	5.2 U	7 U	7 U	6.2 U	8 U	7.1 U	7.1 U

	Cidra Soil Screening Criteria	ENSB-03-G 56 to 60 feet bgs	ENSB-04-A 0 to 4 feet bgs	ENSB-04-B 4 to 8 feet bgs	ENSB-04-C 8 to 12 feet bgs	ENSB-05-A 0 to 4 feet bgs	ENSB-05-B 4 to 8 feet bgs	ENSB-05-C 8 to 12 feet bgs	ENSB-06-A 0 to 4 feet bgs	ENSB-06-B 4 to 8 feet bgs
Volatile Organic Compounds (µg/kg)										
Vinyl Chloride	13.8	6.4 U	7 U	7.2 U	7.1 UJ	4.7 UJ	7.7 UJ	**16** J	5.3 U	5 U

	Cidra Soil Screening Criteria	ENSB-07-A 0 to 4 feet bgs	ENSB-07-B 4 to 8 feet bgs	ENSB-07-C 8 to 12 feet bgs	ENSB-07-D 20 to 24 feet bgs	ENSB-07-E 32 to 36 feet bgs	ENSB-07-F 44 to 48 feet bgs	ENSB-07-G 56 to 60 feet bgs	ENSB-07-H 68 to 72 feet bgs
Volatile Organic Compounds (µg/kg)									
Vinyl Chloride	13.8	6.4 UJ	7 U	6.1 U	7.3 UJ	7.1 U	7.5 U	6.4 U	5.5 U

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

µg/kg - microgram per kilogram

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

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R2-0007295

Table 4-8b
Soil Sample Summary Statistics – ENCO
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
Tetrachloroethene	46	16 / 35	0	0.54 J	28	ENSB-07-G	5.2 - 8
Trichloroethene	36	2 / 35	0	0.64 J	1.1 J	ENSB-07-B	4.7 - 8
cis-1,2-Dichloroethene	420	1 / 35	0	0.83 J	0.83 J	ENSB-05-B	4.7 - 8
Vinyl Chloride	**13.8**	**1 / 35**	**1**	**16 J**	**16 J**	**ENSB-05-C**	**4.7 - 8**
2-Butanone	20000	5 / 35	0	1.7 J	19	ENSB-07-B	9.3 - 16
Acetone	48000	22 / 35	0	3.9 J	180	ENSB-05-C	10 - 16
Carbon Disulfide	4200	4 / 35	0	0.85 J	3.9 J	ENSB-05-C	4.7 - 8

Notes:

Highlight and bold font indicates an exceedance.

J - value is estimated

µg/kg - microgram per kilogram

Table 4-9
Soil Sample Summary Statistics – DJ Manufacturing
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
Tetrachloroethene	46	1 / 25	0	0.48 J	0.48 J	DJSB-01-A	4.4 - 7
2-Butanone	20000	1 / 25	0	6 J	6 J	DJSB-04-A	8.8 - 14
Acetone	48000	6 / 25	0	3.7 J	150	DJSB-02-A	8.8 - 14
Bromodichloromethane	270	3 / 25	0	1.2 J	1.5 J	DJSB-05-F	4.4 - 7
Cyclohexane	117000	1 / 25	0	0.54 J	0.54 J	DJSB-04-B	4.4 - 7
m,p-Xylene	3600	1 / 25	0	0.59 J	0.59 J	DJSB-04-B	4.4 - 7

Notes:

Highlight and bold font indicates an exceedance.

J - value is estimated

µg/kg - microgram per kilogram

Table 4-10a
ESSO Gas Station - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	ESSB-01-A 4 to 6 feet bgs	ESSB-01-B 9 to 11 feet bgs	ESSB-01-C 41 to 43 feet bgs	ESSB-01-D 60 to 62 feet bgs	ESSB-02-A 4 to 6 feet bgs	ESSB-02-B 9 to 11 feet bgs	ESSB-02-C 21 to 23 feet bgs	ESSB-02-D 56 to 58 feet bgs	ESSB-03-A 4 to 5 feet bgs	ESSB-03-B 9 to 11 feet bgs	ESSB-03-C 41 to 43 feet bgs	ESSB-03-D 56 to 58 feet bgs	ESSB-04-A 0 to 1 feet bgs	ESSB-04-B 9 to 11 feet bgs	ESSB-04-C 21 to 23 feet bgs
Volatile Organic Compounds (µg/kg)																
Methyl tert-Butyl Ether	56	5.5 U	6 U	6.7 U	5.6 U	6.1 U	5.9 U	8.7 U	6.3 U	5.9 U	6.3 U	7.8 U	5.6 U	6.5 U	6.4 U	7.3 U
Benzene	52	5.5 U	6 U	6.7 U	5.6 U	6.1 U	5.9 U	8.7 U	13	5.9 U	6.3 U	7.8 U	5.6 U	6.5 U	6.4 U	7.3 U
Toluene	13800	5.5 U	6 U	6.7 U	5.6 U	6.1 U	5.9 U	8.7 U	6.3 U	5.9 U	6.3 U	7.8 U	5.6 U	6.6 J	6.4 U	7.3 U
1,1,2-Trichloroethane	32	5.5 U	6 U	6.7 U	5.6 U	6.1 U	5.9 U	8.7 U	6.3 U	5.9 U	6.3 U	7.8 U	5.6 U	6.5 U	6.4 U	7.3 U
Ethylbenzene	5400	5.5 U	6 U	6.7 U	5.6 U	6.1 U	5.9 U	8.7 U	6.3 U	5.9 U	6.3 U	7.8 U	5.6 U	6.5 U	6.4 U	7.3 U
o-Xylene	3800	5.5 U	6 U	6.7 U	5.6 U	6.1 U	5.9 U	8.7 U	6.3 U	5.9 U	6.3 U	7.8 U	5.6 U	6.5 U	6.4 U	7.3 U
m,p-Xylene	3600	5.5 U	6 U	6.7 U	5.6 U	6.1 U	5.9 U	8.7 U	6.3 U	5.9 U	6.3 U	7.8 U	5.6 U	6.5 U	6.4 U	7.3 U
Isopropylbenzene	12800	5.5 U	6 U	6.7 U	5.6 U	6.1 U	5.9 U	8.7 U	6.3 U	5.9 U	6.3 U	7.8 U	5.6 U	6.5 U	6.4 U	7.3 U
Semi-Volatile Organic Compounds (µg/kg)																
Naphthalene	9.4	220 U	230 U	250 U	220 U	240 U	240 U	270 U	240 U	240 U	240 U	260 U	230 U	230 U	240 UJ	260 UJ
2-Methylnaphthalene	2800	220 U	230 U	250 U	220 U	240 U	240 U	270 U	240 U	240 U	240 U	260 U	230 U	230 U	240 UJ	260 UJ
Benzo(a)pyrene	15	220 U	230 U	250 U	220 UJ	240 U	240 U	270 U	240 U	240 U	240 U	260 U	230 U	230 U	240 UJ	260 UJ
Pesticides (µg/kg)																
Dieldrin	1.22	4.2 U	4.4 U	4.9 U	4.3 U	4.6 U	4.6 U	5.1 U	4.7 U	4.6 U	4.6 U	5.1 U	4.5 U	4.4 U	4.6 U	5 U
Inorganic Analytes (mg/kg)																
Aluminum	7700	**9300**	6000	**15000**	**12500**	6140	5320	**8280**	**9990**	**9910**	**9260**	**10400**	**11200**	6010	5410	**12200**
Antimony	3.1	1.9 U	2 U	2.3 U	2.1 U	2.1 U	2.1 U	2.4 U	2.1 U	2.1 U	2.1 U	2.3 U	2 U	2 U	2.2 U	2.3 U
Arsenic	0.39	**4.1**	1.4 U	**1.2** J	1.4 U	1.4 U	1.4 U	1.6 U	1.4 U	**1.7**	1.4 U	1.6 U	1.4 U	**6.8**	1.4 U	1.5 U
Barium	1500	247	27.1 U	259	488	28.2 U	27.7 U	129	271	83.9	77.6	187	175	87.9	63.1	199
Beryllium	16	0.64 U	0.68 U	1	0.7 U	0.7 U	0.69 U	0.79 U	0.71 U	0.68 U	0.71 U	0.78 U	0.68 U	0.67 U	0.72 U	0.83
Cadmium	7	1	0.68 U	0.76 U	0.94	0.7 U	0.69 U	0.79 U	0.71 U	0.68 U	0.71 U	0.78 U	0.68 U	0.67 U	0.72 U	0.75 U
Calcium	N/A	20400	481 J	773	2050	1150	530 J	401 J	1020	4430	1690	966	1080	3460	753	472 J
Chromium	0.29	**29.8** J	**21.8** J	**19.8** J	**11.6** J	**15.2** J	**15.4** J	**13.8** J	**6.7** J	**21.2** J	**19.4** J	**8** J	**6.2** J	**15.1** J	**12.9** J	**8.4** J
Cobalt	2.3	**39.7**	6.8 U	**65.1**	**36.2**	**20.1**	6.9 U	**39.8**	**30.2**	**27.6**	**17.7**	**40.4**	**10.5**	**21.7**	7.2 U	**44.9**
Copper	310	55.8	74.2	254	86.8	41	46.3	133	61.7	50.7	55.4	195	71.6	34.3	33.4	133
Cyanide	4.7	0.18 J	3.4 U	3.8 U	1.5 J	3.5 U	3.5 U	3.9 U	3.6 U	0.18 J	3.6 U	3.9 U	3.4 U	0.36 J	3.6 U	3.8 U
Iron	5400	**35600**	**49200**	**61800**	**31600**	**41500**	**44300**	**29700**	**27900**	**43900**	**51400**	**46600**	**29600**	**29900**	**32900**	**27000**
Lead	280	100 J	1.4 UJ	1.5 UJ	1.4 UJ	1.4 UJ	1.4 UJ	1.6 UJ	1.4 UJ	6 J	1.4 UJ	1.6 UJ	1.4 UJ	22 J	1.4 UJ	1.5 UJ
Magnesium	N/A	2990	489 J	6490	9820	901	658 J	2480	6600	1440	1650	4290	8050	1220	501 J	5990
Manganese	21	**2880**	**274**	**1190**	**1660**	**1070**	**214**	**784**	**878**	**2550**	**1020**	**1050**	**260**	**1500**	**568**	**1250**
Mercury	2	0.51	0.13 U	0.14 U	0.14 U	0.072 J	0.072 J	0.16 U	0.14 U	0.34	0.13 J	0.16 U	0.14 U	0.45	0.2	0.15 U
Nickel	150	11.1	4.2 J	31.7	44.9	3.2 J	3.1 J	15.7	28.7	6.9	4.3 J	19.9	24.3	4.9 J	3.4 J	25.9
Potassium	N/A	644 UJ	678 UJ	756 UJ	695 UJ	704 UJ	694 UJ	786 UJ	710 UJ	682 UJ	712 UJ	776 UJ	679 UJ	666 UJ	718 UJ	752 UJ
Selenium	5.2	4.5 U	4.7 U	5.3 U	4.9 U	4.9 U	4.9 U	5.5 U	5 U	4.8 U	5 U	5.4 U	4.8 U	4.7 U	5 U	5.3 U
Silver	12	3.6 J	4.7 J	5.6 J	3.2 J	4.1 J	4.3 J	3 J	2.8 J	4.2 J	4.5 J	4.2 J	2.7 J	3 J	3.3 J	2.8 J
Sodium	N/A	644 U	678 U	756 U	695 U	704 U	694 U	786 U	710 U	682 U	712 U	776 U	679 U	666 U	718 U	752 U
Thallium	0.08	0.32 U	0.34 U	0.38 U	0.34 U	0.35 U	0.35 U	0.39 U	0.36 U	0.35 U	0.35 U	0.39 U	0.34 U	0.33 U	0.36 U	0.38 U
Vanadium	39	**118**	**149**	**212**	**89.1**	**185**	**152**	**90.1**	**92.8**	**163**	**194**	**171**	**98.4**	**110**	**108**	**81.2**
Zinc	2300	371	22.7	250	269	28.4	19.8	77.7	244	51.8	32.1	134	241	90.6	19	168

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

U - not detected above the given reporting limit

J - estimated value

R - rejected value

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

bgs - below ground surface

CDM Smith

R2-0007298

Table 4-10a
ESSO Gas Station - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	ESSB-04-D 52 to 54 feet bgs	ESSB-05-A 2 to 4 feet bgs	ESSB-05-B 5 to 7 feet bgs	ESSB-05-C 21 to 23 feet bgs	ESSB-05-D 52 to 54 feet bgs	ESSB-06-A 0 to 1 feet bgs	ESSB-06-B 9 to 11 feet bgs	ESSB-06-C 21 to 23 feet bgs	ESSB-06-D 52 to 54 feet bgs	ESSB-07-A 2 to 4 feet bgs	ESSB-07-B 6 to 8 feet bgs	ESSB-08-A 0 to 1 feet bgs	ESSB-08-B 5 to 7 feet bgs	ESSB-08-C 21 to 23 feet bgs	ESSB-08-D 62 to 64 feet bgs	ESSB-09-A 0 to 1 feet bgs	ESSB-09-B 9 to 11 feet bgs
Volatile Organic Compounds (µg/kg)																		
Methyl tert-Butyl Ether	56	7 U	7.1 U	7.2 U	**160**	6.6 U	5 U	6.3 U	9.2	6 U	6.3 U	7 U	5.4 U	6.8 U	6.8 U	**750**	1.1 J	0.54 J
Benzene	52	7 U	7.1 U	7.2 U	24	6.6 U	5 U	6.3 U	3.3 J	2.4 J	6.3 U	7 U	5.4 U	6.8 U	6.8 U	32	0.73 J	6.7 U
Toluene	13800	7 U	7.1 U	7.2 U	6.6 U	6.6 U	5 U	6.3 U	7.2 U	6 U	6.3 U	7 U	5.4 U	6.8 U	6.8 U	6.3 U	5.5 U	6.7 U
1,1,2-Trichloroethane	32	7 U	7.1 U	7.2 U	6.6 U	6.6 U	5 U	6.3 U	7.2 U	6 U	6.3 U	7 U	5.4 U	6.8 U	6.8 U	6.3 U	5.5 U	6.7 U
Ethylbenzene	5400	7 U	7.1 U	7.2 U	6.6 U	6.6 U	5 U	6.3 U	7.2 U	6 U	6.3 U	7 U	5.4 U	6.8 U	6.8 U	6.3 U	5.5 U	6.7 U
o-Xylene	3800	7 U	7.1 U	7.2 U	17	6.6 U	5 U	6.3 U	0.52 J	6 U	6.3 U	7 U	5.4 U	6.8 U	0.57 J	32	5.5 U	6.7 U
m,p-Xylene	3600	7 U	7.1 U	7.2 U	83	6.6 U	5 U	6.3 U	0.57 J	0.69 J	6.3 U	7 U	5.4 U	6.8 U	0.69 J	21	0.68 J	6.7 U
Isopropylbenzene	12800	7 U	7.1 U	7.2 U	6.6 U	6.6 U	5 U	6.3 U	7.2 U	6 U	6.3 U	7 U	5.4 U	6.8 U	0.97 J	9.1	24	6.7 U
Semi-Volatile Organic Compounds (µg/kg)																		
Naphthalene	9.4	260 U	230 U	250 U	250 UJ	250 UJ	190 U	240 U	260 U	250 U	230 UJ	240 UJ	220 U	250 U	250 U	260 U	230 U	240 U
2-Methylnaphthalene	2800	260 U	230 U	250 U	250 UJ	250 UJ	190 U	240 U	260 U	250 U	230 UJ	240 UJ	220 U	250 U	250 U	260 U	230 U	240 U
Benzo(a)pyrene	15	260 UJ	230 U	250 UJ	250 UJ	250 UJ	**43** J	**56** J	260 UJ	250 UJ	**89** J	240 UJ	220 UJ	250 UJ	250 UJ	260 UJ	230 UJ	240 UJ
Pesticides (µg/kg)																		
Dieldrin	1.22	5.1 U	4.4 U	4.8 U	4.8 U	4.8 U	3.7 U	4.7 U	5.1 U	4.8 U	4.4 U	4.6 U	4.3 U	4.8 U	4.9 U	5 U	4.4 U	4.7 U
Inorganic Analytes (mg/kg)																		
Aluminum	7700	**13300**	**9440**	**10000**	**11200**	**13800**	**15000**	**21600**	**29300**	**30700**	**14500**	**15200**	**16900**	**17500**	**26800**	**35300**	**16500**	**17400**
Antimony	3.1	2.3 U	1.9 U	2.2 U	2.1 U	2.2 U	1.7 U	2.2 U	2.3 U	2.1 U	2 U	2.1 U	2 U	2.2 U	2.3 U	2.2 U	2 U	2.1 U
Arsenic	0.39	1.6 U	**8.9**	**0.67** J	**0.58** J	1.4 U	**1.1** J	1.5 UJ	1.5 UJ	1.4 UJ	**6**	1.4 U	**0.54** J	1.4 UJ	1.5 UJ	1.4 UJ	**0.9** J	1.5 UJ
Barium	1500	251	144	41.4	150	219	136	57.5	312	479	150	28.4 U	115	66.4	494	569	209	67.3
Beryllium	16	0.78 U	0.65 U	0.74 U	0.69 U	0.72 U	0.48 J	1	2.1	0.69 J	0.68 U	0.7 U	0.66	1.1	0.69 J	0.78	0.54 J	0.79
Cadmium	7	0.78 U	0.65 U	0.74 U	0.69 U	0.72 U	R	R	R	R	0.68 U	0.7 U	R	R	R	R	R	R
Calcium	N/A	626 J	4590	800	1060	902	50700	1260	892	576 J	19100	1880	6510	1730	343 J	1280	7680	577 J
Chromium	0.29	**10.7** J	**23.5** J	**21.4** J	**9.7** J	**18.5** J	**33.5**	**30.7**	**35.2**	**20.9**	**37.6**	**29.9**	**34.7**	**39.3**	**15.6**	**22.2**	**35.9**	**20.6**
Cobalt	2.3	**22.9**	**27.3**	**58.3**	**50.8**	**28.4**	**17.1** J	**40.6** J	**218** J	**51.9** J	**31.8** J	**3.1** J	**31.1** J	**22.8** J	**27.5** J	**38.9** J	**35.2** J	**6.9** J
Copper	310	44.4	59.4	150	221	65.4	77.3	159	**440**	147	78.8	86.9	80.8	113	103	97.1	78.7	84.3
Cyanide	4.7	3.9 U	0.23 J	3.7 U	3.5 U	3.6 U	2.9 U	3.7 U	3.8 U	3.5 U	0.28 J	3.5 U	3.3 U	3.6 U	3.8 U	3.7 U	3.4 U	3.6 U
Iron	5400	**24500**	**41500**	**40700**	**28800**	**27700**	**33900** J	**54400** J	**54400** J	**44500** J	**56800**	**75500**	**45600** J	**67800** J	**47100** J	**53900** J	**46500** J	**62400** J
Lead	280	1.6 UJ	59.9 J	1.5 UJ	1.4 UJ	1.4 UJ	234	2.5	1.2 J	1 J	116 J	1.4 UJ	106	1.6	0.79 J	0.79 J	94.8	1.9
Magnesium	N/A	5990	1800	2790	4120	8940	5310	2810	8010	15400	2210 J	615 J	2420	1260	15700	17900	3970	1500
Manganese	21	**896**	**3280**	**721**	**1030**	**412**	R	R	R	R	**3390** J	**422** J	R	R	R	R	R	R
Mercury	2	0.16 U	0.66	0.15 U	0.14 U	0.14 U	0.41	0.14 U	0.15 U	0.14 U	0.6	0.14 U	0.39	0.13 U	0.15 U	0.15 U	0.53	0.15 U
Nickel	150	43	7.1	8.7	22.4	34.3	44.2	18.5	45.3	61.8	10.5	8.1	13.4	12.9	86.6	74.3	15	9.6
Potassium	N/A	776 UJ	647 UJ	736 UJ	694 UJ	723 UJ	1330	743 U	766 U	704 U	378 J	177 J	658 U	724 U	752 U	736 U	914	726 U
Selenium	5.2	5.4 U	4.5 U	5.2 U	4.9 U	5.1 U	4 UJ	5.1 UJ	5.4 UJ	4.9 UJ	4.8 UJ	4.9 UJ	4.5 UJ	5 UJ	5.3 UJ	5.1 UJ	4.8 UJ	5.1 UJ
Silver	12	2.5 J	4.3 J	4 J	2.9 J	2.8 J	0.37 J	0.55 J	0.67 J	0.53 J	5.7 J	7.1 J	0.66 J	0.52 J	0.51 J	0.72 J	0.81 J	0.84 J
Sodium	N/A	776 U	647 U	736 U	694 U	723 U	581 U	743 U	766 U	704 U	285 J	702 U	658 U	724 U	752 U	736 U	680 U	726 U
Thallium	0.08	0.39 U	0.32 UJ	0.36 UJ	0.35 UJ	0.36 UJ	0.29 U	0.37 U	0.38 U	0.35 U	0.34 U	0.35 U	0.33 U	0.36 U	0.38 U	0.37 U	0.34 U	0.36 U
Vanadium	39	**68.2**	**143**	**127**	**79.2**	**74.5**	**107**	**254**	**208**	**163**	**208**	**240**	**191**	**314**	**141**	**199**	**186**	**243**
Zinc	2300	165	225	67.8	128	202	917	68.4	236	364	425	34.6	347	49.5	410	174	278	35.7

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

U - not detected above the given reporting limit

J - estimated value

R - rejected value

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

bgs - below ground surface

CDM Smith

Table 4-10a
ESSO Gas Station - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	ESSB-09-C 21 to 23 feet bgs	ESSB-09-D 42 to 44 feet bgs	ESSB-10-A 0 to 1 feet bgs	ESSB-10-B 5 to 7 feet bgs	ESSB-10-C 21 to 23 feet bgs	ESSB-10-D 64 to 66 feet bgs	ESSB-11-A 2 to 4 feet bgs	ESSB-11-B 9 to 11 feet bgs	ESSB-11-C 21 to 24 feet bgs	ESSB-11-D 62 to 64 feet bgs	ESSB-12-A 0 to 1 feet bgs	ESSB-12-B 6 to 8 feet bgs	ESSB-13-A 2 to 4 feet bgs	ESSB-13-B 9 to 11 feet bgs	ESSB-13-C 21 to 23 feet bgs	ESSB-13-D 59 to 61 feet bgs	ESSB-14-A 0 to 1 feet bgs
Volatile Organic Compounds (µg/kg)																		
Methyl tert-Butyl Ether	56	7.2 U	2.6 J	5.8 U	3200 U	3.2 J	43000 U	6.3 U	3.9 J	40	8.1 U	6.8 U	6.3 U	6 U	6.8 U	8.1 U	8.3	5.3 U
Benzene	52	1.8 J	**70**	5.8 U	3200 UJ	**79**	**23000** J	6.3 U	6.3 U	19	**280**	6.8 U	6.3 U	6 U	6.8 U	8.1 U	7.5 U	5.3 U
Toluene	13800	7.2 U	6.2 U	5.8 U	3200 U	5.9 U	**260000**	6.3 U	6.3 U	7.1 U	8.1 U	6.8 U	6.3 U	6 U	6.8 U	8.1 U	7.5 U	5.3 U
1,1,2-Trichloroethane	32	7.2 U	6.2 U	5.8 U	3200 U	5.9 U	**65000**	6.3 U	6.3 U	7.1 U	8.1 U	6.8 U	6.3 U	6 UJ	6.8 U	8.1 U	7.5 U	5.3 U
Ethylbenzene	5400	7.2 U	8.7	5.8 U	**6600**	5.9 U	**110000**	6.3 U	6.3 U	7.1 U	8.1 U	6.8 U	6.3 U	6 U	6.8 U	8.1 U	7.5 U	5.3 U
o-Xylene	3800	7.2 U	2.7 J	5.8 U	3200 U	0.66 J	**190000**	6.3 U	6.3 U	1.6 J	8.1 U	6.8 U	6.3 U	6 U	6.8 U	8.1 U	7.5 U	5.3 U
m,p-Xylene	3600	7.2 U	24	5.8 U	3200 U	25	**550000**	6.3 U	6.3 U	5.8 J	57	6.8 U	6.3 U	6 U	6.8 U	8.1 U	7.5 U	5.3 U
Isopropylbenzene	12800	7.2 U	2.2 J	5.8 U	7200	2.5 J	**14000** J	6.3 U	6.3 U	0.38 J	4.6 J	6.8 U	6.3 U	6 U	6.8 U	8.1 U	7.5 U	5.1 J
Semi-Volatile Organic Compounds (µg/kg)																		
Naphthalene	9.4	240 U	250 U	190 U	210 U	210 U	**5800**	240 U	250 U	240 U	250 U	250 UJ	240 UJ	230 UJ	250 UJ	250 UJ	240 UJ	230 UJ
2-Methylnaphthalene	2800	240 U	250 U	190 U	210 U	210 U	**5400**	240 U	250 U	240 U	250 U	250 UJ	240 UJ	230 UJ	250 UJ	250 UJ	240 UJ	230 UJ
Benzo(a)pyrene	15	240 UJ	250 UJ	190 UJ	210 UJ	210 UJ	490 UJ	240 UJ	250 UJ	240 UJ	250 UJ	250 UJ	240 UJ	230 UJ	250 UJ	250 UJ	240 UJ	230 UJ
Pesticides (µg/kg)																		
Dieldrin	1.22	4.6 U	4.9 U	3.7 U	4.1 U	4.1 U	4.8 U	4.7 U	4.8 U	4.7 U	4.9 U	4.9 U	4.7 U	**1.4** J	4.8 U	4.9 U	4.7 U	4.5 U
Inorganic Analytes (mg/kg)																		
Aluminum	7700	**20900**	**31900**	**9540**	**15000**	**31000**	**28800**	**15200**	**16900**	**18100**	**33200**	**16400**	**13600**	**11300**	**10600**	**12400**	**19600**	**15000**
Antimony	3.1	2.1 U	2.2 U	1.6 U	2.1 U	2.3 U	2.2 U	2.2 U	2.2 U	2.1 U	2.2 U	2.1 U	2.1 U	8.3 U	8.7 U	8.5 U	8.2 U	2 U
Arsenic	0.39	1.4 UJ	1.4 UJ	1.1 UJ	1.4 UJ	1.5 UJ	1.4 UJ	1.4 UJ	1.5 UJ	1.4 UJ	1.5 U	**4.7**	1.4 U	**5.9**	1.4 U	1.4 U	1.4 U	**2.5**
Barium	1500	82.7	298	25.1	261	342	388	96.3	120	53.8	460	153	87.3	58.8	214	260	398	151
Beryllium	16	1.2	0.85	0.19 J	0.19 J	0.82	0.7 J	0.81	0.76	0.86	0.74 U	0.71 U	0.71 U	0.69 U	0.72 U	0.72 U	0.69 U	0.68 U
Cadmium	7	R	R	R	R	R	R	R	R	R	0.74 U	0.71 U	0.71 U	1.2	0.72 U	0.16 J	1.6	0.68 U
Calcium	N/A	329 J	2580	25100	4750	2280	3020	3240	760	711 U	2500	4360	2130	46500	630 J	5130	3040	5450
Chromium	0.29	**38.3**	**23.6**	**14.4**	**14**	**26.9**	**16**	**26**	**29.8**	**30.2**	**34.9**	**29.1**	**25.3**	**22**	**27.9**	**19.8**	**13.6**	**33.6**
Cobalt	2.3	**54.8** J	**32.7** J	**6.1** J	**45.8** J	**35.3** J	**28.8** J	**41.2** J	**37.3** J	**33.4** J	**31.1** J	**73.3** J	**29.2** J	**19.6**	**36.4**	**88.4**	**31.4**	**42.5** J
Copper	310	168	99.4	20.8	72.7	86.8	83.9	98.4	82.5	127	89.3	101	96.8	71.9	109	209	90.7	75.9
Cyanide	4.7	3.5 U	3.6 U	2.7 U	3.5 U	3.9 U	3.6 U	3.6 U	3.6 U	3.6 U	3.7 U	0.24 J	3.6 U	0.19 J	0.25 J	3.6 U	3.5 U	3.4 U
Iron	5400	**60700** J	**55400** J	**12000** J	**40200** J	**50300** J	**47600** J	**55100** J	**59500** J	**51100** J	**55100**	**66800**	**49800**	**45100**	**58900**	**47000**	**41300**	**62200**
Lead	280	1.2 J	0.99 J	0.95 J	10.3	1.2 J	0.85 J	13.3	2.6	0.96 J	1.5 UJ	21.7 J	1.4 UJ	82.6 J	1.4 UJ	2.3 J	1.4 UJ	16.2 J
Magnesium	N/A	3410	12900	3730	1500	11500	15900	2630	1630	2400	12700 J	2220 J	1920 J	2330	1630	3750	11000	2540 J
Manganese	21	R	R	R	R	R	R	R	R	R	**1020** J	**2810** J	**1240** J	**1190**	**1470**	**1600**	**703**	**5700** J
Mercury	2	0.14 U	0.15 U	0.1 U	0.13 U	0.14 U	0.15 U	0.32	0.21	0.14 U	0.15 U	0.087 J	0.078 J	0.22	0.094 J	0.55	0.056 J	0.55
Nickel	150	26.6	46.3	8.8	30.7	44.9	26.4	14.2	10.4	21	28.3	17.2	13	8.3	10.6	21.9	43.2	11.1
Potassium	N/A	696 U	737 U	270 J	320 J	458 J	468 J	243 J	139 J	319 J	454 J	253 J	220 J	297 J	181 J	341 J	529 J	366 J
Selenium	5.2	4.9 UJ	5 UJ	3.8 UJ	4.8 UJ	5.4 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ	5.2 UJ	5 UJ	5 UJ	4.8 U	5.1 U	5 U	4.8 U	4.8 UJ
Silver	12	0.81 J	0.77 J	1.1 UJ	1.2 J	0.63 J	0.59 J	0.7 J	0.78 J	0.61 J	4.9 J	6.5 J	4.7 J	4.1 J	5.2 J	4.3 J	3.7 J	6.4 J
Sodium	N/A	696 U	727 U	597	703 U	774 U	728 U	717 U	726 U	711 U	433 J	324 J	367 J	330 J	440 J	367 J	418 J	323 J
Thallium	0.08	0.35 U	0.36 U	0.27 U	0.35 U	0.38 U	0.36 U	0.36 U	0.36 U	0.36 U	0.37 U	0.35 U	0.36 U	3.5 U	3.6 U	3.6 U	3.4 U	0.34 U
Vanadium	39	**260**	**208**	38.7	**118**	**179**	**162**	**245**	**268**	**196**	**184**	**244**	**202**	**164**	**215**	**147**	**116**	**196**
Zinc	2300	127	287	18.1	108	237	71.1	177	45.6	64.4	70.8	134	58.5	208	54.8	112	149	100

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

U - not detected above the given reporting limit

J - estimated value

R - rejected value

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

bgs - below ground surface

CDM Smith

Table 4-10a
ESSO Gas Station - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	ESSB-14-B 9 to 11 feet bgs	ESSB-14-C 21 to 23 feet bgs	ESSB-14-D 42 to 44 feet bgs	ESSB-15-A 0 to 4 feet bgs	ESSB-15-B 4 to 8 feet bgs	ESSB-15-C 8 to 12 feet bgs	ESSB-15-D 20 to 24 feet bgs	ESSB-15-F 44 to 48 feet bgs	ESSB-15-G 56 to 60 feet bgs	ESSB-16-C 8 to 12 feet bgs	ESSB-16-D 20 to 24 feet bgs	ESSB-16-E 32 to 36 feet bgs	ESSB-16-F 44 to 48 feet bgs	ESSB-16-G 56 to 60 feet bgs
Volatile Organic Compounds (µg/kg)															
Methyl tert-Butyl Ether	56	5.4 U	15	6.4 UJ	5.2 UJ	6.5 UJ	11 U	0.83 J	15 J	17 J	400 U	7.2 UJ	7.9 J	6.8 J	40
Benzene	52	5.4 U	14	**100** J	5.2 U	6.5 U	11 U	7.6 U	2.8 J	12	400 U	7.2 U	8.3 U	7.9 U	7.2 U
Toluene	13800	5.4 U	7.1	120	5.2 U	6.5 U	11 U	7.6 U	6.5 U	6.7 U	400 U	7.2 U	8.3 U	7.9 U	7.2 U
1,1,2-Trichloroethane	32	5.4 U	7.1 U	6.4 U	5.2 U	6.5 U	11 U	7.6 U	6.5 U	6.7 U	400 U	7.2 U	8.3 U	7.9 U	7.2 U
Ethylbenzene	5400	5.4 U	7.1 U	6.4 U	5.2 U	6.5 U	11 U	7.6 U	6.5 U	6.7 U	210 J	7.2 U	8.3 U	7.9 U	7.2 U
o-Xylene	3800	5.4 U	5.2 J	44	5.2 U	6.5 U	11 U	10	1.8 J	4.8 J	430	58	8.3 U	7.9 U	7.2 U
m,p-Xylene	3600	5.4 U	13	94	5.2 U	6.5 U	11 U	2.5 J	6.5 U	0.6 J	570	16	8.3 U	7.9 U	7.2 U
Isopropylbenzene	12800	5.4 U	7.1 U	6.4 U	5.2 U	6.5 U	11 U	2.9 J	6.5 U	6.7 U	310 J	39	8.3 U	7.9 U	7.2 U
Semi-Volatile Organic Compounds (µg/kg)															
Naphthalene	9.4	240 UJ	260 UJ	250 UJ											
2-Methylnaphthalene	2800	240 UJ	260 UJ	250 UJ											
Benzo(a)pyrene	15	240 UJ	260 UJ	250 UJ											
Pesticides (µg/kg)															
Dieldrin	1.22	4.6 U	5.1 U	4.9 U											
Inorganic Analytes (mg/kg)															
Aluminum	7700	**11300**	**18400**	**20400**											
Antimony	3.1	2.1 U	2.2 U	2.2 U											
Arsenic	0.39	1.4 U	1.5 U	1.5 U											
Barium	1500	27.7 U	181	746											
Beryllium	16	0.69 U	0.75 U	0.92											
Cadmium	7	0.69 U	0.75 U	0.73 U											
Calcium	N/A	491 J	1010	2000											
Chromium	0.29	**37.5**	**20.1**	**13.8**											
Cobalt	2.3	**4.2** J	**51.5** J	**177** J											
Copper	310	87.1	256	188											
Cyanide	4.7	3.5 U	3.8 U	3.7 U											
Iron	5400	**86400**	**61700**	**50000**											
Lead	280	1.4 UJ	1.5 UJ	1.5 UJ											
Magnesium	N/A	1100 J	5360 J	9430 J											
Manganese	21	**446** J	**1270** J	**3650** J											
Mercury	2	0.14 U	0.15 U	0.15 U											
Nickel	150	6.3	28.3	104											
Potassium	N/A	142 J	444 J	577 J											
Selenium	5.2	4.8 UJ	5.3 UJ	5.1 UJ											
Silver	12	8 J	6 J	5 J											
Sodium	N/A	216 J	231 J	368 J											
Thallium	0.08	0.34 U	0.37 U	0.37 U											
Vanadium	39	**270**	**186**	**170**											
Zinc	2300	36.4	166	406											

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

Shading indicates the sample was not analyzed for the given parameter

U - not detected above the given reporting limit

J - estimated value

R - rejected value

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

bgs - below ground surface

CDM Smith

Table 4-10b
Soil Sample Summary Statistics – ESSO Gas Station
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
Tetrachloroethene	46	2 / 63	0	3.6 J	8.9 J	ESSB-04-A	5 - 43000
Trichloroethene	36	1 / 63	0	1.1 J	1.1 J	ESSB-07-B	5 - 43000
1,1,2-Trichloroethane	**32**	**1 / 63**	**1**	**65000**	**65000**	**ESSB-10-D**	**5 - 3200**
1,2,4-Trichlorobenzene	4000	1 / 63	0	1.8 J	1.8 J	ESSB-09-D	5 - 43000
1,3-Dichlorobenzene	N/A	1 / 63	0	0.54 J	0.54 J	ESSB-09-D	5 - 43000
1,4-Dichlorobenzene	1440	12 / 63	0	0.54 J	1.2 J	ESSB-06-C	5.2 - 43000
2-Butanone	20000	7 / 63	0	5.5 J	58	ESSB-14-B	10 - 86000
2-Hexanone	158	2 / 63	0	4.3 J	130	ESSB-11-D	10 - 86000
4-Methyl-2-pentanone	4600	3 / 63	0	45	130	ESSB-14-D	6.2 - 86000
Acetone	48000	22 / 63	0	6.7 J	2000	ESSB-09-C	11 - 86000
Benzene	**52**	**16 / 63**	**5**	**0.73 J**	**23000 J**	**ESSB-10-D**	**5 - 3200**
Bromodichloromethane	270	1 / 63	0	1.7 J	1.7 J	ESSB-15-B	5 - 43000
Carbon Disulfide	4200	5 / 63	0	1.2 J	2.6 J	ESSB-09-C	5 - 43000
Chloroform	290	3 / 63	0	7.8	15	ESSB-02-C	5 - 43000
Chloromethane	980	1 / 63	0	610	610	ESSB-16-C	5 - 43000
Cyclohexane	117000	4 / 63	0	1.9 J	36000	ESSB-10-B	5 - 43000
Dichlorodifluoromethane	6000	1 / 63	0	0.95 J	0.95 J	ESSB-09-C	5 - 43000
Ethylbenzene	**5400**	**4 / 63**	**2**	**8.7**	**110000**	**ESSB-10-D**	**5 - 11**
Isopropylbenzene	**12800**	**13 / 63**	**1**	**0.38 J**	**14000 J**	**ESSB-10-D**	**5 - 11**
m,p-Xylene	**3600**	**17 / 63**	**1**	**0.57 J**	**550000**	**ESSB-10-D**	**5 - 3200**
Methyl tert-Butyl Ether	**56**	**17 / 63**	**2**	**0.54 J**	**750**	**ESSB-08-D**	**5 - 43000**
Methylcyclohexane	N/A	6 / 63	0	2.1 J	210000	ESSB-10-D	5 - 400
o-Xylene	**3800**	**15 / 63**	**1**	**0.52 J**	**190000**	**ESSB-10-D**	**5 - 3200**
Toluene	**13800**	**4 / 63**	**1**	**6.6 J**	**260000**	**ESSB-10-D**	**5 - 3200**
Semivolatile Organic Compounds (µg/kg)							
2-Methylnaphthalene	**2800**	**1 / 52**	**1**	**5400**	**5400**	**ESSB-10-D**	**190 - 270**
Acetophenone	9000	2 / 52	0	360	710	ESSB-09-D	190 - 490
Benzaldehyde	6600	1 / 52	0	41 J	41 J	ESSB-06-B	190 - 490
Benzo(a)anthracene	150	3 / 52	0	69 J	130 J	ESSB-06-B	190 - 490
Benzo(a)pyrene	**15**	**3 / 52**	**3**	**43 J**	**89 J**	**ESSB-07-A**	**190 - 490**
Benzo(b)fluoranthene	150	3 / 52	0	57 J	150 J	ESSB-07-A	190 - 490
Benzo(g,h,i)perylene	N/A	1 / 52	0	81 J	81 J	ESSB-06-B	190 - 490
Benzo(k)fluoranthene	1500	1 / 52	0	140 J	140 J	ESSB-07-A	190 - 490
bis(2-Ethylhexyl) phthalate	28000	3 / 52	0	68 J	380 J	ESSB-14-B	190 - 780
Butylbenzylphthalate	4000	2 / 52	0	94 J	97 J	ESSB-04-A	190 - 490
Chrysene	15000	3 / 52	0	78 J	120 J	ESSB-07-A	190 - 490
Di-n-octylphthalate	N/A	1 / 52	0	52 J	52 J	ESSB-11-A	190 - 490
Fluoranthene	230000	2 / 52	0	85 J	140 J	ESSB-06-B	190 - 490
Indeno(1,2,3-cd)pyrene	150	1 / 52	0	91 J	91 J	ESSB-07-A	190 - 490
Naphthalene	**9.4**	**1 / 52**	**1**	**5800**	**5800**	**ESSB-10-D**	**190 - 270**
Phenanthrene	N/A	2 / 52	0	42 J	56 J	ESSB-06-B	190 - 490
Pyrene	170000	3 / 52	0	75 J	410	ESSB-06-B	190 - 490

Table 4-10b
Soil Sample Summary Statistics – ESSO Gas Station
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Pesticides (µg/kg)							
4,4'-DDD	1320	2 / 52	0	1.2 J	4.9	ESSB-13-A	3.7 - 5.1
4,4'-DDE	920	6 / 52	0	0.76 J	98	ESSB-05-A	3.7 - 5.1
4,4'-DDT	1340	6 / 52	0	1.5 J	630	ESSB-13-A	3.7 - 5.1
alpha-Chlordane	1600	2 / 52	0	0.8 J	14	ESSB-05-A	1.9 - 2.7
beta-BHC	2.6	2 / 52	0	1.4 J	1.9 J	ESSB-10-B	1.9 - 2.7
delta-BHC	N/A	1 / 52	0	0.44 J	0.44 J	ESSB-10-B	1.9 - 2.7
Dieldrin	**1.22**	**1 / 52**	**1**	**1.4 J**	**1.4 J**	**ESSB-13-A**	**3.7 - 5.1**
Endosulfan I	22000	4 / 52	0	0.61 J	3.7	ESSB-11-B	1.9 - 2.7
Endosulfan II	22000	4 / 52	0	1.4 J	6.7	ESSB-04-C	3.7 - 5.1
Endrin aldehyde	1620	3 / 52	0	0.92 J	1 J	ESSB-06-A	3.7 - 5.1
gamma-Chlordane	1600	2 / 52	0	0.67 J	6.3	ESSB-05-A	1.9 - 2.7
Inorganics (mg/kg)							
Aluminum	**7700**	**52 / 52**	**47**	**5320**	**35300**	**ESSB-08-D**	**NA - NA**
Arsenic	**0.39**	**14 / 52**	**14**	**0.54 J**	**8.9**	**ESSB-05-A**	**1.1 - 1.6**
Barium	1500	47 / 52	0	25.1	746	ESSB-14-D	27 - 28.4
Beryllium	16	22 / 52	0	0.19 J	2.1	ESSB-06-C	0.6 - 0.79
Cadmium	7	5 / 52	0	0.16 J	1.6	ESSB-13-D	0.7 - 0.79
Calcium	N/A	51 / 52	0	329 J	50700	ESSB-06-A	711 - 711
Chromium	**0.29**	**52 / 52**	**52**	**6.2 J**	**39.3**	**ESSB-08-B**	**NA - NA**
Cobalt	**2.3**	**49 / 52**	**49**	**3.1 J**	**218 J**	**ESSB-06-C**	**6.8 - 7.2**
Copper	**310**	**52 / 52**	**1**	**20.8**	**440**	**ESSB-06-C**	**NA - NA**
Cyanide	4.7	9 / 52	0	0.18 J	1.5 J	ESSB-01-D	2.7 - 3.9
Iron	**5400**	**52 / 52**	**52**	**12000 J**	**86400**	**ESSB-14-B**	**NA - NA**
Lead	280	28 / 52	0	0.79 J	234	ESSB-06-A	1.4 - 1.6
Magnesium	N/A	52 / 52	0	489 J	17900	ESSB-08-D	NA - NA
Manganese	**21**	**33 / 52**	**33**	**214**	**5700 J**	**ESSB-14-A**	**NA - NA**
Mercury	2	21 / 52	0	0.056 J	0.66	ESSB-05-A	0.1 - 0.16
Nickel	150	52 / 52	0	3.1 J	104	ESSB-14-D	NA - NA
Potassium	N/A	22 / 52	0	139 J	1330	ESSB-06-A	644 - 786
Silver	12	51 / 52	0	0.37 J	8 J	ESSB-14-B	1.1 - 1.1
Sodium	N/A	13 / 52	0	216 J	597	ESSB-10-A	581 - 786
Vanadium	**39**	**52 / 52**	**51**	**38.7**	**314**	**ESSB-08-B**	**NA - NA**
Zinc	2300	52 / 52	0	18.1	917	ESSB-06-A	NA - NA

Notes:
Highlight and bold font indicates an exceedance.
J - value is estimated
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

Table 4-11a
Don Quixote Pizza - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	DQSB-01-A 2 to 4 feet bgs		DQSB-02-A 2 to 4 feet bgs		DQSB-03-A 2 to 4 feet bgs	
Inorganics (mg/kg)							
Aluminum	7700	**12900**		**18100**		**16800**	
Arsenic	0.39	**0.61**	J	**0.82**	J	**1.2**	J
Chromium	0.29	**28**		**20.9**		**24.9**	
Cobalt	2.3	**12.6**		**24**		**53.7**	
Iron	5400	**62100**		**61800**		**63400**	
Manganese	21	**3780**	J	**6180**	J	**6720**	J
Vanadium	39	**171**		**155**		**152**	

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

mg/kg - milligram per kilogram

bgs - below ground surface

R - rejected value

U - not detected above the given reporting limit

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Table 4-11b
Soil Sample Summary Statistics – Don Quixote Pizza
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
cis-1,2-Dichloroethene	420	1 / 3	0	0.87 J	0.87 J	DQSB-03-A	6.5 - 6.7
1,4-Dichlorobenzene	1440	2 / 3	0	0.57 J	0.79 J	DQSB-01-A	7 - 7
Inorganics (mg/kg)							
Aluminum	**7700**	**3 / 3**	**3**	**12900**	**18100**	**DQSB-02-A**	**NA - NA**
Arsenic	**0.39**	**3 / 3**	**3**	**0.61 J**	**1.2 J**	**DQSB-03-A**	**NA - NA**
Barium	1500	3 / 3	0	57.1	147	DQSB-02-A	NA - NA
Calcium	N/A	3 / 3	0	1730	2940	DQSB-02-A	NA - NA
Chromium	**0.29**	**3 / 3**	**3**	**20.9**	**28**	**DQSB-01-A**	**NA - NA**
Cobalt	**2.3**	**3 / 3**	**3**	**12.6**	**53.7**	**DQSB-03-A**	**NA - NA**
Copper	310	3 / 3	0	50.7	69.6	DQSB-02-A	NA - NA
Iron	**5400**	**3 / 3**	**3**	**61800**	**63400**	**DQSB-03-A**	**NA - NA**
Lead	280	3 / 3	0	3	4.2	DQSB-01-A	NA - NA
Magnesium	N/A	3 / 3	0	244 J	333 J	DQSB-03-A	NA - NA
Manganese	**21**	**3 / 3**	**3**	**3780 J**	**6720 J**	**DQSB-03-A**	**NA - NA**
Mercury	2	3 / 3	0	0.11 J	0.16	DQSB-03-A	NA - NA
Nickel	150	3 / 3	0	6.2	13.2	DQSB-02-A	NA - NA
Potassium	N/A	3 / 3	0	348 J	569 J	DQSB-02-A	NA - NA
Silver	12	3 / 3	0	7.8 J	8.2 J	DQSB-03-A	NA - NA
Vanadium	**39**	**3 / 3**	**3**	**152**	**171**	**DQSB-01-A**	**NA - NA**
Zinc	2300	3 / 3	0	28.1	35.8	DQSB-02-A	NA - NA

Notes:

Highlight and bold font indicates an exceedance.

J - value is estimated

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

Table 4-12a
Shellfoam - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	SHSB-01-A 0 to 1 feet bgs		SHSB-01-B 5 to 7 feet bgs		SHSB-01-C 14 to 16 feet bgs		SHSB-02-A 0 to 1 feet bgs		SHSB-02-B 5 to 7 feet bgs		SHSB-02-C 22 to 24 feet bgs		SHSB-02-D 62 to 64 feet bgs		SHSB-03-A 0 to 1 feet bgs		SHSB-03-B 9 to 11 feet bgs		SHSB-03-C 26 to 28 feet bgs	
Semi-Volatile Organic Compounds (µg/kg)																					
Naphthalene	9.4	240	U	200	U	190	U	240	U	240	U	240	U	240	U	230	U	250	U	200	U
2-Methylnaphthalene	2800	240	U	200	U	190	U	240	U	240	U	240	U	240	U	230	U	250	U	200	U
n-Nitrosodiphenylamine	1140	240	U	200	U	190	U	240	U	240	U	240	U	240	U	230	U	250	U	200	U
Benzo(a)anthracene	150	240	U	200	U	190	U	240	U	240	U	240	U	240	U	230	U	250	U	200	U
Benzo(b)fluoranthene	150	240	U	200	U	190	U	240	U	240	U	240	U	240	U	230	U	250	U	200	U
Benzo(a)pyrene	15	240	U	200	U	190	U	240	U	240	U	240	U	240	U	230	U	250	U	200	U
alpha-BHC	0.72	2.4	U	2	U	1.9	U	2.4	U	2.4	U	2.4	U	2.4	U	2.3	U	2.5	U	2	U
beta-BHC	2.6	2.4	U	2	U	1.9	U	2.4	U	2.4	U	2.4	U	2.4	U	2.3	U	2.5	U	2	U
Aldrin	0.68	2.4	U	2	U	1.9	U	2.4	U	2.4	U	2.4	U	2.4	U	2.3	U	2.5	U	2	U
Inorganic Analytes (mg/kg)																					
Aluminum	7700	**16400**		**9010**		**8890**		**15200**		**39400**		**10800**		**18100**		**9060**		**16500**		**8750**	
Arsenic	0.39	1.5	U	**0.65**	J	**0.63**	J	1.5	U	**1.3**	J	1.4	U	1.4	U	**1.5**		1.5	U	1.2	U
Chromium	0.29	**27.9**		**10.8**		**14.3**		**64.1**		**107**		**21.7**		**45.4**		**30.8**		**23.1**		**17.2**	
Cobalt	2.3	**15.3**		**11.1**		**9.9**		**5**	J	**21.1**		**9.7**		**21.7**		**40.6**		**14.5**		**9.6**	
Iron	5400	**30600**		**18400**		**18400**		**43300**		**65100**		**18900**		**31500**		**27000**		**24300**		**19100**	
Manganese	21	**449**		**395**		**338**		**70.6**		**314**		**260**		**688**		**1400**		**237**		**414**	
Vanadium	39	**98.6**		**71.5**		**69.1**		**135**		**159**		**52.5**		**79.9**		**114**		**71.8**		**42.3**	

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-12a
Shellfoam - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	SHSB-04-A 0 to 1 feet bgs		SHSB-04-B 6 to 8 feet bgs		SHSB-04-C 20 to 22 feet bgs		SHSB-04-D 40 to 42 feet bgs		SHSB-05-A 0 to 1 feet bgs		SHSB-05-B 9 to 11 feet bgs		SHSB-05-C 23 to 24 feet bgs		SHSB-05-D 40 to 42 feet bgs		SHSB-06-A 0 to 1 feet bgs	
Semi-Volatile Organic Compounds (µg/kg)																			
Naphthalene	9.4	230	U	230	U	230	U	200	U	**370**	J	250	U	250	U	210	U	230	U
2-Methylnaphthalene	2800	230	U	230	U	230	U	200	U	2700		250	U	250	U	210	U	230	U
n-Nitrosodiphenylamine	1140	230	U	230	U	230	U	200	U	880		250	U	250	U	210	U	230	U
Benzo(a)anthracene	150	230	U	230	U	230	U	200	U	**310**	J	250	U	250	U	210	U	230	U
Benzo(b)fluoranthene	150	230	U	230	U	230	U	200	U	**250**	J	250	U	250	U	210	U	230	U
Benzo(a)pyrene	15	230	U	230	U	230	U	200	U	**280**	J	250	U	250	U	210	U	230	U
alpha-BHC	0.72	2.3	U	2.3	U	2.3	U	2	U	2.2	U	2.5	U	2.5	U	2.1	U	2.3	U
beta-BHC	2.6	**4.5**	J	2.3	U	2.3	U	2	U		R	2.5	U	2.5	U	2.1	U	2.3	U
Aldrin	0.68	**1.4**	J	2.3	U	2.3	U	2	U	2.2	U	2.5	U	2.5	U	2.1	U	2.3	U
Inorganic Analytes (mg/kg)																			
Aluminum	7700	**14400**		**22700**		**14100**		**22800**		**17100**		**9580**		**9810**		**16800**		**35200**	
Arsenic	0.39	**1.7**		1.4	U	**0.52**	J	**1.8**		**1.5**		1.4	U	1.4	U	**1.1**	J	1.4	U
Chromium	0.29	**38.5**		**39.7**		**40.7**		**72.6**		**31.3**		**19.4**		**33.9**		**41.2**		**55.8**	
Cobalt	2.3	**19.8**		**29**		**8.7**		**33.6**		**26.3**		**17.8**		6.8	U	**22.1**		**30.5**	
Iron	5400	**42700**		**47200**		**54500**		**49800**		**35800**		**31200**		**35000**		**35700**		**58700**	
Manganese	21	**901**	J	**934**	J	**299**	J	**1110**	J	**661**	J	**1710**		**135**		**739**		**1030**	
Vanadium	39	**246**		**168**		**211**		**151**		**183**		**114**		**120**		**113**		**189**	

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

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Table 4-12a
Shellfoam - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	SHSB-06-B 5 to 7 feet bgs		SHSB-06-C 41 to 43 feet bgs		SHSB-06-D 52 to 54 feet bgs		SHSB-07-A 0 to 2 feet bgs		SHSB-07-B 4 to 6 feet bgs		SHSB-08-A 2 to 4 feet bgs		SHSB-09-A 2 to 4 feet bgs		SHSB-10-A 2 to 4 feet bgs	
Semi-Volatile Organic Compounds (µg/kg)																	
Naphthalene	9.4	270	U	250	U	200	U	**1800**		**1100**		240	U	230	U	220	U
2-Methylnaphthalene	2800	270	U	250	U	200	U	**7600**		**6400**		240	U	230	U	220	U
n-Nitrosodiphenylamine	1140	270	U	250	U	200	U	720	U	**2900**		240	U	230	U	220	U
Benzo(a)anthracene	150	270	U	250	U	200	U	**370**	J	**280**	J		R		R	220	U
Benzo(b)fluoranthene	150	270	U	250	U	200	U	720	U	720	U		R		R	220	U
Benzo(a)pyrene	15	270	U	250	U	200	U	**210**	J	720	U		R		R	220	U
alpha-BHC	0.72	2.7	U	2.5	U	2	U	**1.9**	J	2.4	U	2.4	U	2.3	U	2.2	U
beta-BHC	2.6	2.7	U	2.5	U	2	U		R		R	2.4	U	2.3	U	2.2	U
Aldrin	0.68	2.7	U	2.5	U	2	U	2.4	U	2.4	U	2.4	U	2.3	U	2.2	U
Inorganic Analytes (mg/kg)																	
Aluminum	7700	**34500**		**12200**		**10900**		**17500**		**9440**		**31000**		**26500**		**19100**	
Arsenic	0.39	1.6	U	**1.2**	J	**1.3**		**1.8**		**1.7**		1.4	U	**0.72**	J	1.3	U
Chromium	0.29	**36.7**		**28**		**27.4**		**32.5**		**19.3**		**49.1**		**44.9**		**13.5**	
Cobalt	2.3	**20.9**		**36.3**		**12.6**		**25**		**17**		**35**		**36.4**		**21.7**	
Iron	5400	**58700**		**30300**		**21900**		**38100**		**34700**		**56300**		**45600**		**34900**	
Manganese	21	**691**		**456**		**386**		**1690**		**1370**		**774**		**1710**	J	**724**	J
Vanadium	39	**196**		**90.6**		**64.1**		**247**		**144**		**213**		**150**		**138**	

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-12b
Soil Sample Summary Statistics – Shellfoam
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
1,2-Dichlorobenzene	11600	2 / 27	0	5.8 J	17	SHSB-06-A	4.6 - 440
1,3-Dichlorobenzene	N/A	1 / 27	0	0.63 J	0.63 J	SHSB-06-A	4.6 - 440
1,4-Dichlorobenzene	1440	11 / 27	0	0.66 J	35	SHSB-06-A	4.6 - 440
2-Butanone	20000	7 / 27	0	6.5 J	760 J	SHSB-07-A	9.2 - 14
Acetone	48000	9 / 27	0	24	1500	SHSB-07-A	9.3 - 19
Benzene	52	2 / 27	0	0.71 J	8.9	SHSB-07-B	4.6 - 440
Carbon Disulfide	4200	2 / 27	0	1.3 J	3 J	SHSB-03-A	4.6 - 440
Chlorobenzene	1360	2 / 27	0	0.83 J	47	SHSB-06-A	4.6 - 440
Cyclohexane	117000	1 / 27	0	34	34	SHSB-07-B	4.6 - 440
Ethylbenzene	5400	2 / 27	0	160	3100	SHSB-07-A	4.6 - 7.2
Isopropylbenzene	12800	2 / 27	0	85	2000	SHSB-07-A	4.6 - 7.2
Methyl Acetate	64000	1 / 27	0	480	480	SHSB-07-A	4.6 - 7.2
Methyl tert-Butyl Ether	56	1 / 27	0	1.9 J	1.9 J	SHSB-03-B	4.6 - 440
Methylcyclohexane	N/A	2 / 27	0	130	650	SHSB-07-A	4.6 - 7.2
Toluene	13800	1 / 27	0	0.68 J	0.68 J	SHSB-03-A	4.6 - 440
Semivolatile Organic Compounds (µg/kg)							
2-Methylnaphthalene	**2800**	**3 / 27**	**2**	**2700**	**7600**	**SHSB-07-A**	**190 - 270**
Acenaphthene	82000	3 / 27	0	290 J	640 J	SHSB-07-B	190 - 270
Acetophenone	9000	1 / 27	0	2400	2400	SHSB-04-A	190 - 720
Anthracene	840000	3 / 27	0	150 J	250 J	SHSB-07-B	190 - 270
Benzaldehyde	6600	1 / 27	0	120 J	120 J	SHSB-04-A	190 - 720
Benzo(a)anthracene	**150**	**3 / 27**	**3**	**280 J**	**370 J**	**SHSB-07-A**	**190 - 270**
Benzo(a)pyrene	**15**	**2 / 27**	**2**	**210 J**	**280 J**	**SHSB-05-A**	**190 - 720**
Benzo(b)fluoranthene	**150**	**1 / 27**	**1**	**250 J**	**250 J**	**SHSB-05-A**	**190 - 720**
Chrysene	15000	3 / 27	0	460 J	720	SHSB-05-A	190 - 270
Di-n-octylphthalate	N/A	2 / 27	0	160 J	1300	SHSB-05-A	190 - 720
Dibenzofuran	2200	2 / 27	0	390 J	440 J	SHSB-07-A	190 - 650
Fluoranthene	230000	1 / 27	0	290 J	290 J	SHSB-05-A	190 - 720
Fluorene	80000	3 / 27	0	320 J	1300	SHSB-07-A	190 - 270
Nitrosodiphenylamine	**1140**	**2 / 27**	**1**	**880**	**2900**	**SHSB-07-B**	**190 - 720**
Naphthalene	**9.4**	**3 / 27**	**3**	**370 J**	**1800**	**SHSB-07-A**	**190 - 270**
Phenanthrene	N/A	4 / 27	0	140 J	3000	SHSB-07-B	190 - 270
Pyrene	170000	4 / 27	0	99 J	1200	SHSB-05-A	190 - 270

Table 4-12b
Soil Sample Summary Statistics – Shellfoam
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Pesticides (µg/kg)							
4,4'-DDD	1320	1 / 27	0	2.6 J	2.6 J	SHSB-07-B	3.8 - 5.2
4,4'-DDE	920	1 / 27	0	8.8	8.8	SHSB-01-A	3.8 - 5.2
4,4'-DDT	1340	3 / 27	0	3.8 J	12 N	SHSB-05-A	3.8 - 5.2
Aldrin	**0.68**	**1 / 27**	**1**	**1.4 J**	**1.4 J**	**SHSB-04-A**	**1.9 - 2.7**
alpha-BHC	**0.72**	**1 / 27**	**1**	**1.9 J**	**1.9 J**	**SHSB-07-A**	**1.9 - 2.7**
alpha-Chlordane	1600	3 / 27	0	0.55 J	11 N	SHSB-04-A	1.9 - 2.7
beta-BHC	**2.6**	**1 / 27**	**1**	**4.5 J**	**4.5 J**	**SHSB-04-A**	**1.9 - 2.7**
delta-BHC	N/A	1 / 27	0	0.89 J	0.89 J	SHSB-07-A	1.9 - 2.7
Endosulfan II	22000	1 / 27	0	1.4 J	1.4 J	SHSB-04-A	3.8 - 5.2
Endrin	1620	1 / 27	0	1.2 J	1.2 J	SHSB-07-B	3.8 - 5.2
Endrin aldehyde	1620	1 / 27	0	13 J	13 J	SHSB-05-A	3.8 - 5.2
gamma-BHC (Lindane)	24	2 / 27	0	0.92 J	1.8 J	SHSB-07-A	1.9 - 2.7
gamma-Chlordane	1600	1 / 27	0	0.48 J	0.48 J	SHSB-02-D	1.9 - 2.7
Heptachlor	110	2 / 27	0	1.2 J	1.6 J	SHSB-07-A	1.9 - 2.7
Methoxychlor	31000	1 / 27	0	6.8 J	6.8 J	SHSB-01-C	20 - 27
Inorganics (mg/kg)							
Aluminum	**7700**	**27 / 27**	**27**	**8750**	**39400**	**SHSB-02-B**	**NA - NA**
Arsenic	**0.39**	**14 / 27**	**14**	**0.52 J**	**1.8**	**SHSB-07-A**	**1.2 - 1.6**
Barium	1500	27 / 27	0	29	301	SHSB-06-A	NA - NA
Cadmium	7	25 / 27	0	0.33 J	2.6	SHSB-05-A	0.7 - 0.65
Calcium	N/A	27 / 27	0	283 J	12500	SHSB-09-A	NA - NA
Chromium	**0.29**	**27 / 27**	**27**	**10.8**	**107**	**SHSB-02-B**	**NA - NA**
Cobalt	**2.3**	**26 / 27**	**26**	**5 J**	**40.6**	**SHSB-03-A**	**6.8 - 6.8**
Copper	310	27 / 27	0	10.3	158	SHSB-08-A	NA - NA
Cyanide	4.7	1 / 27	0	0.14 J	0.14 J	SHSB-01-A	2.9 - 3.9
Iron	**5400**	**27 / 27**	**27**	**18400**	**65100**	**SHSB-02-B**	**NA - NA**
Lead	280	6 / 27	0	0.41 J	26.3 J	SHSB-04-A	1.1 - 1.6
Magnesium	N/A	27 / 27	0	1100	16600	SHSB-09-A	NA - NA
Manganese	**21**	**27 / 27**	**27**	**70.6**	**1710 J**	**SHSB-09-A**	**NA - NA**
Mercury	2	18 / 27	0	0.045 J	0.17	SHSB-05-B	0.1 - 0.14
Nickel	150	27 / 27	0	7	67.2	SHSB-04-A	NA - NA
Potassium	N/A	27 / 27	0	20.8 J	639 J	SHSB-07-A	NA - NA
Silver	12	27 / 27	0	2 J	6.8 J	SHSB-02-B	NA - NA
Sodium	N/A	26 / 27	0	25.7 J	2300 J	SHSB-07-A	652 - 652
Vanadium	**39**	**27 / 27**	**27**	**42.3**	**247**	**SHSB-07-A**	**NA - NA**
Zinc	2300	27 / 27	0	18	276	SHSB-04-A	NA - NA

Notes:

Highlight and bold font indicates an exceedance.

J - value is estimated

µg/kg - microgram per kilogram mg/kg - milligram per kilogram

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Table 4-13a
IVAX - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IVSB-01-A 0 to 1 feet bgs	IVSB-01-B 8 to 9.25 feet bgs	IVSB-01-C 41 to 43 feet bgs	IVSB-01-D 62 to 64 feet bgs	IVSB-02-A 0 to 1 feet bgs	IVSB-02-B 5 to 7 feet bgs	IVSB-02-C 21 to 23 feet bgs	IVSB-02-D 41 to 43 feet bgs	IVSB-03-A 0 to 2.5 feet bgs	IVSB-03-B 5 to 7 feet bgs	IVSB-03-C 42 to 44 feet bgs
Semi-Volatile Organic Compounds (µg/kg)												
Benzo(a)pyrene	15	220 UJ	260 UJ	240 UJ	240 UJ	230 UJ	240 UJ	240 U	220 U	230 U	240 U	230 U
Dibenz(a,h)anthracene	15	220 UJ	260 UJ	240 UJ	240 UJ	230 UJ	240 UJ	240 U	220 U	230 U	240 U	230 U
Inorganic Analytes (mg/kg)												
Aluminum	7700	**11000**	**11600**	**10200**	**22100**	**10100**	**19300**	**23700**	**22300**	**15400**	**9000**	**19200**
Arsenic	0.39	**1.2** J	**0.83** J	1.4 U	1.4 U	**4.4**	1.5 U	1.4 U	1.3 U	**0.66** J	1.4 U	1.4 U
Chromium	0.29	**21.6**	**38.4**	**27.3**	**23**	**15.4**	**36.6**	**29.7**	**54.5**	**41.6**	**35.8**	**26.5**
Cobalt	2.3	**14.1**	**24**	**5.5** J	**26.7**	**6.4** J	**10.9**	**20.1**	**26.2**	**29.9**	**10.2**	**32.2**
Iron	5400	**45300**	**61200**	**50300**	**40000**	**42900**	**48600**	**41200**	**40700**	**49300**	**63800**	**45900**
Manganese	21	**608**	**1050**	**278**	**1050**	**190**	**504**	**552**	**771**	**865**	**701**	**1770**
Vanadium	39	**143**	**186**	**151**	**86.5**	**150**	**146**	**115**	**94.8**	**147**	**155**	**139**

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-13a
IVAX - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IVSB-04-A 0 to 1 feet bgs	IVSB-04-B 5 to 7 feet bgs	IVSB-04-C 41 to 43 feet bgs	IVSB-04-D 62 to 64 feet bgs	IVSB-05-A 1 to 2 feet bgs	IVSB-05-B 9 to 11 feet bgs	IVSB-05-C 41 to 43 feet bgs	IVSB-05-D 62 to 64 feet bgs	IVSB-06-A 1 to 2 feet bgs
Semi-Volatile Organic Compounds (µg/kg)										
Benzo(a)pyrene	15	220 U	240 U	270 U	230 U	230 UJ	240 UJ	180 U	210 U	240 U
Dibenz(a,h)anthracene	15	220 U	240 U	270 U	230 U	230 UJ	240 UJ	180 U	210 U	240 U
Inorganic Analytes (mg/kg)										
Aluminum	7700	**11300**	**15800**	**34100**	**26500**	**15400**	**13200**	**25600**	**15800**	**9960**
Arsenic	0.39	**15.2**	**2.3**	**2.1**	**1.9**	1.3 U	**0.74** J	1.5 U	1.2 U	1.4 U
Chromium	0.29	**26.6**	**45.8**	**20.6**	**22.6**	**31.7**	**23**	**5.1**	**8.5**	**41.1**
Cobalt	2.3	**41** J	**25** J	**34** J	**27.6** J	**5.1** J	**47** J	**19.3** J	**18.7** J	**3.1** J
Iron	5400	**49900**	**75000**	**63200**	**54800**	**72000**	**58000**	**50200**	**39600**	**82300**
Manganese	21	**3430** J	**1580** J	**2000** J	**1260** J	**265** J	**959** J	**760** J	**874** J	**809** J
Vanadium	39	**181**	**274**	**249**	**200**	**229**	**186**	**180**	**114**	**248**

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-13a
IVAX - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IVSB-06-B 5 to 7 feet bgs	IVSB-06-C 41 to 43 feet bgs	IVSB-06-D 62 to 64 feet bgs	IVSB-07-A 1 to 2 feet bgs	IVSB-07-B 9 to 11 feet bgs	IVSB-07-C 21 to 23 feet bgs	IVSB-07-D 53 to 55 feet bgs	IVSB-08-A 2 to 4 feet bgs	IVSB-08-B 6 to 8 feet bgs	IVSB-08-C 21 to 23 feet bgs
Semi-Volatile Organic Compounds (µg/kg)											
Benzo(a)pyrene	15	**93** J	270 U	270 U	250 UJ	240 U	260 UJ	220 UJ	240 UJ	230 UJ	240 UJ
Dibenz(a,h)anthracene	15	**93** J	270 U	270 U	250 UJ	240 U	260 UJ	220 UJ	240 UJ	230 UJ	240 UJ
Inorganic Analytes (mg/kg)											
Aluminum	7700	**10600**	**16000**	**23600**	**18400**	**14200**	**15800**	**19500**	**11100**	**15300**	**18600**
Arsenic	0.39	**0.7** J	1.5 U	1.6 U	1.4 U	1.4 U	**0.66** J	1.4 U	1.5 U	1.3 U	1.4 U
Chromium	0.29	**25.9**	**69.3**	**83.8**	**80.6**	**47.9**	**50.9**	**86**	**23.5**	**40.6** J	**55.6**
Cobalt	2.3	**2.4** J	**84.7**	**114**	**38.2**	**192**	**50.1**	**37.4**	**605**	**118** J	**49.4**
Iron	5400	**85000**	**71100**	**56100**	**63800**	**63200**	**72200**	**59900**	**34000**	**54800**	**54600**
Manganese	21	**1040** J	**2890**	**2360**	**1120**	**1980**	**1980** J	**1510** J	**4250** J	**1910** J	**1370** J
Vanadium	39	**201**	**221**	**139**	**185**	**174**	**195**	**150**	**88.1**	**126**	**124**

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-13a
IVAX - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	IVSB-08-D 40 to 42 feet bgs		IVSB-09-A 0 to 0.1 feet bgs		IVSB-09-B 9 to 11 feet bgs		IVSB-09-C 21 to 23 feet bgs		IVSB-09-D 32 to 34 feet bgs		IVSB-10-A 1 to 2 feet bgs		IVSB-10-B 8 to 10 feet bgs		IVSB-10-C 22 to 24 feet bgs		IVSB-10-D 32 to 34 feet bgs	
Semi-Volatile Organic Compounds (µg/kg)																			
Benzo(a)pyrene	15	230	UJ	220	UJ	250	UJ	240	UJ	210	UJ	240	UJ	230	UJ	250	UJ	210	UJ
Dibenz(a,h)anthracene	15	230	UJ	220	UJ	250	UJ	240	UJ	210	UJ	240	UJ	230	UJ	250	UJ	210	UJ
Inorganic Analytes (mg/kg)																			
Aluminum	7700	**17000**		**18600**		**20700**		**15600**		**16500**		**14600**		**11800**		**25400**		**19100**	
Arsenic	0.39	1.3	U	1.3	U	1.5	U	1.4	U	1.2	U	**1.7**		**6**		1.5	U	1.3	U
Chromium	0.29	**44.4**		**72.8**		**71**		**40.3**		**37.9**		**47.3**		**25.8**		**24.1**		**17.7**	
Cobalt	2.3	**32**		**80**		**70.2**		**140**		**112**		**24.2**		**9**		**300**		**37.6**	
Iron	5400	**51300**		**42900**		**55600**		**43500**		**36800**		**64600**		**62500**		**59100**		**42600**	
Manganese	21	**1360**	J	**1190**	J	**1170**	J	**1320**	J	**1770**	J	**3160**	J	**673**	J	**4930**	J	**622**	J
Vanadium	39	**116**		**137**		**196**		**132**		**132**		**190**		**189**		**204**		**137**	

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value

Table 4-13b
Soil Sample Summary Statistics – IVAX
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
1,4-Dichlorobenzene	1440	26 / 39	0	0.59 J	2 J	IVSB-06-C	5.8 - 11
2-Butanone	20000	1 / 39	0	25	25	IVSB-10-B	8.9 - 21
Acetone	48000	8 / 39	0	7.1 J	130	IVSB-10-B	8.9 - 21
Cyclohexane	117000	3 / 39	0	0.66 J	1.9 J	IVSB-04-A	4.5 - 11
m,p-Xylene	3600	3 / 39	0	0.37 J	0.57 J	IVSB-04-C	4.5 - 11
Semivolatile Organic Compounds (µg/kg)							
Acetophenone	9000	2 / 39	0	54 J	55 J	IVSB-09-B	180 - 270
Benzo(a)anthracene	150	1 / 39	0	81 J	81 J	IVSB-06-B	180 - 270
Benzo(a)pyrene	**15**	**1 / 39**	**1**	**93 J**	**93 J**	**IVSB-06-B**	**180 - 270**
Benzo(k)fluoranthene	1500	1 / 39	0	91 J	91 J	IVSB-06-B	180 - 270
phthalate	28000	5 / 39	0	74 J	850	IVSB-06-C	180 - 270
Butylbenzylphthalate	4000	1 / 39	0	78 J	78 J	IVSB-06-B	180 - 270
Chrysene	15000	1 / 39	0	83 J	83 J	IVSB-06-B	180 - 270
Dibenz(a,h)anthracene	**15**	**1 / 39**	**1**	**93 J**	**93 J**	**IVSB-06-B**	**180 - 270**
Fluoranthene	230000	1 / 39	0	73 J	73 J	IVSB-06-B	180 - 270
Indeno(1,2,3-cd)pyrene	150	1 / 39	0	88 J	88 J	IVSB-06-B	180 - 270
Pentachlorophenol	200	1 / 39	0	120 J	120 J	IVSB-10-A	350 - 520
Pyrene	170000	1 / 39	0	76 J	76 J	IVSB-06-B	180 - 270
Pesticides (µg/kg)							
alpha-Chlordane	1600	5 / 39	0	0.59 J	1.4 J	IVSB-07-B	1.8 - 2.7
gamma-Chlordane	1600	1 / 39	0	0.45 N	0.45 JN	IVSB-05-D	1.8 - 2.7
Heptachlor epoxide	53	1 / 39	0	1.3 J	1.3 J	IVSB-05-B	1.8 - 2.7

Table 4-13b
Soil Sample Summary Statistics – IVAX
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Inorganics (mg/kg)							
Aluminum	**7700**	**39 / 39**	**39**	**9000**	**34100**	**IVSB-04-C**	**NA - NA**
Arsenic	**0.39**	**13 / 39**	**13**	**0.66 J**	**15.2**	**IVSB-04-A**	**1.2 - 1.6**
Barium	1500	37 / 39	0	29.2	1050	IVSB-10-C	28 - 30
Beryllium	16	8 / 39	0	0.65	1.6	IVSB-10-C	0.6 - 0.8
Cadmium	7	19 / 39	0	0.08 J	2.8	IVSB-08-D	0.6 - 0.8
Calcium	N/A	39 / 39	0	117 J	9420 J	IVSB-09-D	NA - NA
Chromium	**0.29**	**39 / 39**	**39**	**5.1**	**86**	**IVSB-07-D**	**NA - NA**
Cobalt	**2.3**	**39 / 39**	**39**	**2.4 J**	**605**	**IVSB-08-A**	**NA - NA**
Copper	310	39 / 39	0	35.4	276	IVSB-06-D	NA - NA
Cyanide	4.7	2 / 39	0	0.12 J	0.35 J	IVSB-04-A	3.1 - 3.9
Iron	**5400**	**39 / 39**	**39**	**34000**	**85000**	**IVSB-06-B**	**NA - NA**
Lead	280	5 / 39	0	0.44 J	10.3 J	IVSB-04-A	1.2 - 1.6
Magnesium	N/A	39 / 39	0	240 J	20300	IVSB-02-D	NA - NA
Manganese	**21**	**39 / 39**	**39**	**190**	**4930 J**	**IVSB-10-C**	**NA - NA**
Mercury	2	26 / 39	0	0.038 J	0.45	IVSB-04-A	0.1 - 0.2
Nickel	150	39 / 39	0	3.2 J	81.4	IVSB-08-C	NA - NA
Potassium	N/A	39 / 39	0	80 J	2080 J	IVSB-10-D	NA - NA
Silver	12	39 / 39	0	3.6 J	7.9 J	IVSB-06-A	NA - NA
Sodium	N/A	25 / 39	0	44.5 J	690	IVSB-09-D	611 - 773
Thallium	**0.078**	**1 / 39**	**1**	**2.9 J**	**2.9 J**	**IVSB-10-B**	**0.3 - 3.9**
Vanadium	**39**	**39 / 39**	**39**	**86.5**	**274**	**IVSB-04-B**	**NA - NA**
Zinc	2300	39 / 39	0	24.1	402 J	IVSB-08-B	NA - NA

Notes:

Highlight and bold font indicates an exceedance.

J - value is estimated

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

Table 4-14a
Pepsi - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	PESB-01-A 0.2 to 1 feet bgs		PESB-01-B 5 to 7 feet bgs		PESB-01-C 21 to 23 feet bgs		PESB-01-D 60 to 62 feet bgs		PESB-02-A 0.2 to 1 feet bgs		PESB-02-B 5 to 7 feet bgs		PESB-02-C 21 to 23 feet bgs		PESB-02-D 60 to 63 feet bgs		PESB-03-A 0.5 to 1.5 feet bgs		PESB-03-B 5 to 7 feet bgs		PESB-03-C 21 to 23 feet bgs	
Inorganic Analytes (mg/kg)																							
Aluminum	7700	**8400**		**9530**		**11800**		**20300**		6130		6010		6220		**18000**		**8430**		**12600**		6250	
Arsenic	0.39	1.8	U	1.5	U	1.6	U	1.4	U	1.4	U	1.4	U	1.8	U	1.5	U	1.4	U	1.4	U	1.4	U
Chromium	0.29	**65.3**		**29.3**		**52.4**		**52.5**		**25.1**		**19.9**		**26.9**		**54.7**		**17.4**		**54.5**		**37.9**	
Cobalt	2.3	2.1	J	2	J	**163**		**239**		1.3	J	0.79	J	**42.2**		**245**		**103**		**25**		**9.2**	
Copper	310	87.1		74		232		**474**		69.7		56.9		83.1		**528**		100		76		62.6	
Iron	5400	**69200**		**60200**		**57900**		**49900**		**70200**		**67600**		**64800**		**57500**		**55800**		**79600**		**45500**	
Manganese	21	**843**		**966**		**3410**		**2440**		**756**		**998**		**2250**		**3050**		**1090**		**6960**		**1020**	
Vanadium	39	**159**		**136**		**186**		**109**		**154**		**130**		**124**		**187**		**151**		**250**		**126**	

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

mg/kg - milligram per kilogram

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

CDM Smith

Table 4-14a
Pepsi - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	PESB-03-D 62 to 64 feet bgs		PESB-04-A 3.5 to 4 feet bgs		PESB-04-B 9 to 11 feet bgs		PESB-04-C 21 to 23 feet bgs		PESB-04-D 41 to 43 feet bgs		PESB-05-A 0.2 to 1 feet bgs		PESB-05-B 2 to 4 feet bgs		PESB-05-C 5 to 7 feet bgs		PESB-05-D 60 to 62 feet bgs		PESB-06-A 0 to 1 feet bgs		PESB-06-B 5 to 7 feet bgs	
Inorganic Analytes (mg/kg)																							
Aluminum	7700	3650		6030		4230		6370		**9480**		**9500**		5440		**10800**		**23100**		**10300**		5200	
Arsenic	0.39	1.5	U	1.3	U	1.3	U	1.5	U	1.5	U	1.4	U	1.3	U	1.4	U	1.5	U	**1.6**		1.4	U
Chromium	0.29	**12.6**		**29**		**22**		**23.3**		**21**		**20.5**	J	**36**	J	**43.8**		**72**		**44.1**		**7.1**	
Cobalt	2.3	**40**		**7.9**		**2.5**	J	**74.7**		**116**		**13.9**		**85.9**		**36.2**		**36.7**		**56**		0.47	J
Copper	310	66.8		53.3		80.3		159		**348**		68.2		70.5		105		217		97.3		55.7	
Iron	5400	**38800**		**63900**		**51000**		**43600**		**21000**		**43000**		**51600**		**56200**		**56100**		**88000**		**44900**	
Manganese	21	**1290**		**912**		**402**		**2090**		**1480**		**1110**		**1410**		**856**		**927**		**4380**		**470**	
Vanadium	39	**96.7**		**193**		**140**		**105**		**53.7**		**139**		**159**		**153**		**139**		**282**		**77.6**	

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting li
J - estimated value

CDM Smith

R2-0007318

Table 4-14a
Pepsi - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	PESB-06-C 21 to 22 feet bgs		PESB-06-D 62 to 64 feet bgs		PESB-07-A 0 to 1 feet bgs		PESB-07-B 5 to 7 feet bgs		PESB-07-C 21 to 23 feet bgs		PESB-07-D 62 to 64 feet bgs		PESB-08-A 0.2 to 1 feet bgs		PESB-08-B 5 to 7 feet bgs		PESB-08-C 9 to 11 feet bgs		PESB-08-D 51.5 to 53.5 feet bgs		PESB-09-A 2 to 1 feet bgs	
Inorganic Analytes (mg/kg)																							
Aluminum	7700	**8620**		7660		5870		3470		3360		**11300**		6200		**8870**		4590		**12900**		5840	
Arsenic	0.39	1.6	U	1.6	U	**2.5**		1.4	U	1.6	U	1.4	U	1.4	U	1.5	U	1.4	U	**1.4**		**10.5**	
Chromium	0.29	**4.3**		**6.3**		**20.5**		**17.9**		**15**		**14.8**		**26.7**		**26.4**		**31.2**		**26.3**		**23.9**	
Cobalt	2.3	**41.5**		**74.8**		**3.7**	J	0.74	J	**188**		**316**		1.7	J	**6.1**	J	**10.2**		**32.1**		0.79	J
Copper	310	161		121		68.1		65		145		**408**		66.4		102		134		108		62.6	
Iron	5400	**51100**		**53400**		**58800**		**52100**		**43600**		**40200**		**43100**		**62400**		**52200**		**41200**		**57800**	
Manganese	21	**2760**		**1910**		**952**		**713**		**4440**		**4310**		**80.4**		**187**		**806**		**1030**		**479**	
Vanadium	39	**127**		**138**		**151**		**129**		**107**		**114**		**121**		**165**		**164**		**133**		**122**	

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting li
J - estimated value

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R2-0007319

Table 4-14a
Pepsi - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	PESB-09-B 9 to 11 feet bgs		PESB-09-C 41 to 43 feet bgs		PESB-09-D 62 to 64 feet bgs		PESB-10-A 0 to 1 feet bgs		PESB-10-B 5 to 7 feet bgs		PESB-10-C 21 to 23 feet bgs		PESB-10-D 39 to 40 feet bgs	
Inorganic Analytes (mg/kg)															
Aluminum	7700	6610		**14200**		**16200**		**13300**		**20000**		**8140**		**9610**	
Arsenic	0.39	**5.2**		**1.8**		1.4	U	**3.2**		1.5	U	1.3	U	1.3	U
Chromium	0.29	**41.9**		**43.7**		**22**		**47.9**		**53.1**		**17.1**		**20.8**	
Cobalt	2.3	**60.7**		**64**		**53.9**		**68.6**		**199**		**18**		**20.7**	
Copper	310	83.9		214		79.1		228		224		172		71.3	
Iron	5400	**68800**		**48400**		**36900**		**65000**		**45000**		**25200**		**29800**	
Manganese	21	**2820**		**1700**		**1510**		**1150**		**2910**		**472**		**843**	
Vanadium	39	**146**		**106**		**71.9**		**190**		**123**		**43.7**		**71.7**	

Notes:
Highlight indicates exceedance of the site-specific soil screening criteria
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting li
J - estimated value

CDM Smith

Table 4-14b
Soil Sample Summary Statistics – Pepsi
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
2-Butanone	20000	1 / 40	0	27	27	PESB-03-C	10 - 15
Acetone	48000	1 / 40	0	15	15	PESB-03-C	10 - 15
Inorganics (mg/kg)							
Aluminum	**7700**	**40 / 40**	**22**	**3360**	**23100**	**PESB-05-D**	**NA - NA**
Arsenic	**0.39**	**7 / 40**	**7**	**1.4**	**10.5**	**PESB-09-A**	**1.3 - 1.8**
Barium	1500	36 / 40	0	3 J	848	PESB-07-C	28.1 - 36
Beryllium	16	7 / 40	0	0.85	2.3	PESB-01-D	0.61 - 0.9
Cadmium	7	13 / 40	0	0.13 J	0.91	PESB-10-A	0.64 - 0.8
Calcium	N/A	36 / 40	0	54 J	4320	PESB-10-A	703 - 765
Chromium	**0.29**	**40 / 40**	**40**	**4.3**	**72**	**PESB-05-D**	**NA - NA**
Cobalt	**2.3**	**40 / 40**	**32**	**0.47 J**	**316**	**PESB-07-D**	**NA - NA**
Copper	**310**	**40 / 40**	**4**	**53.3**	**528**	**PESB-02-D**	**NA - NA**
Cyanide	4.7	4 / 40	0	0.14 J	0.32 J	PESB-08-B	3 - 4.6
Iron	**5400**	**40 / 40**	**40**	**21000**	**88000**	**PESB-06-A**	**NA - NA**
Lead	280	1 / 40	0	1.7 J	1.7 J	PESB-10-A	1.2 - 1.8
Magnesium	N/A	38 / 40	0	57.6 J	13800	PESB-08-D	703 - 720
Manganese	**21**	**40 / 40**	**40**	**80.4**	**6960**	**PESB-03-B**	**NA - NA**
Mercury	2	8 / 40	0	0.044 J	0.14	PESB-05-C	0.12 - 0.2
Nickel	150	39 / 40	0	2.4 J	63.3	PESB-05-D	5.6 - 5.6
Potassium	N/A	22 / 40	0	19 J	956	PESB-01-D	642 - 911
Silver	12	40 / 40	0	1.8 J	7.2 J	PESB-06-A	NA - NA
Sodium	N/A	16 / 40	0	35.9 J	300 J	PESB-08-D	642 - 911
Vanadium	**39**	**40 / 40**	**40**	**43.7**	**282**	**PESB-06-A**	**NA - NA**
Zinc	2300	40 / 40	0	11.6	415	PESB-01-D	NA - NA

Notes:
Highlight and bold font indicates an exceedance.
J - value is estimated
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

Table 4-15a
Ramoncito - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	RCT-01-A 0 to 2 feet bgs		RCT-02-A 0 to 3 feet bgs	
Semi-Volatile Organic Compounds (µg/kg)					
Benzo(a)pyrene	15	**100**	J	250	U
Inorganic Analytes (mg/kg)					
Aluminum	7700	5470		**7730**	
Arsenic	0.39	1.5	U	**1.6**	
Chromium	0.29	**38.7**		**43.5**	
Iron	5400	**32000**		**36400**	
Manganese	21	**107**	J	**526**	J
Vanadium	39	**138**		**141**	

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

CDM Smith

Table 4-15b
Soil Sample Summary Statistics – Ramoncito
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Semivolatile Organic Compounds (µg/kg)							
Benzo(a)anthracene	150	1 / 2	0	130 J	130 J	RCT-01-A	250 - 250
Benzo(a)pyrene	**15**	**1 / 2**	**1**	**100 J**	**100 J**	**RCT-01-A**	**250 - 250**
Benzo(b)fluoranthene	150	1 / 2	0	120 J	120 J	RCT-01-A	250 - 250
Benzo(k)fluoranthene	1500	1 / 2	0	90 J	90 J	RCT-01-A	250 - 250
Chrysene	15000	1 / 2	0	120 J	120 J	RCT-01-A	250 - 250
Fluoranthene	230000	1 / 2	0	310	310	RCT-01-A	250 - 250
Indeno(1,2,3-cd)pyrene	150	1 / 2	0	69 J	69 J	RCT-01-A	250 - 250
Phenanthrene	N/A	1 / 2	0	170 J	170 J	RCT-01-A	250 - 250
Pyrene	170000	1 / 2	0	240 J	240 J	RCT-01-A	250 - 250
Pesticides (µg/kg)							
4,4'-DDE	920	1 / 2	0	2.1 J	2.1 J	RCT-02-A	4.9 - 4.9
Inorganics (mg/kg)							
Aluminum	**7700**	**2 / 2**	**1**	**5470**	**7730**	**RCT-02-A**	**NA - NA**
Arsenic	**0.39**	**1 / 2**	**1**	**1.6**	**1.6**	**RCT-02-A**	**1.5 - 1.5**
Calcium	N/A	2 / 2	0	759	2000	RCT-02-A	NA - NA
Chromium	**0.29**	**2 / 2**	**2**	**38.7**	**43.5**	**RCT-02-A**	**NA - NA**
Cobalt	2.3	1 / 2	0	0.29 J	0.29 J	RCT-02-A	7.3 - 7.3
Copper	310	2 / 2	0	19	23.8	RCT-02-A	NA - NA
Iron	**5400**	**2 / 2**	**2**	**32000**	**36400**	**RCT-02-A**	**NA - NA**
Lead	280	2 / 2	0	0.85 J	3.6	RCT-02-A	NA - NA
Magnesium	N/A	2 / 2	0	281 J	365 J	RCT-02-A	NA - NA
Manganese	**21**	**2 / 2**	**2**	**107 J**	**526 J**	**RCT-02-A**	**NA - NA**
Mercury	2	2 / 2	0	0.086 J	0.16	RCT-01-A	NA - NA
Nickel	150	2 / 2	0	0.83 J	1.6 J	RCT-02-A	NA - NA
Potassium	N/A	2 / 2	0	90.1 J	197 J	RCT-02-A	NA - NA
Silver	12	2 / 2	0	4.1 J	5.2 J	RCT-02-A	NA - NA
Vanadium	**39**	**2 / 2**	**2**	**138**	**141**	**RCT-02-A**	**NA - NA**
Zinc	2300	2 / 2	0	14.1	35.4	RCT-02-A	NA - NA

Notes:

Highlight and bold font indicates an exceedance.

J - value is estimated

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

Table 4-16a
Coffee Shop - Soil Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Soil Screening Criteria	CSSB-01-A 1 to 2 feet bgs		CSSB-01-B 5 to 6 feet bgs		CSSB-02-A 1 to 2 feet bgs		CSSB-02-B 5 to 6 feet bgs	
Inorganic Analytes (mg/kg)									
Arsenic	0.39	1.4	U	1.4	U	1.4	U	**0.7**	J
Chromium	0.29	**14.6**		**15.2**		**18.6**		**32.2**	
Cobalt	2.3	**18.8**		**26.8**		**22.3**		7	U
Iron	5400	**34300**		**29300**		**40000**		**32000**	
Manganese	21	**978**	J	**2170**	J	**1220**	J	**143**	J
Vanadium	39	**91.9**		**77.8**		**105**		**121**	

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

mg/kg - milligram per kilogram

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

CDM Smith

Table 4-16b
Soil Soil Sample Summary Statistics – Coffee Shop
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Pesticides (µg/kg)							
4,4'-DDE	920	1 / 4	0	0.99 J	0.99 J	CSSB-02-B	4.6 - 4.8
Inorganics (mg/kg)							
Aluminum	7700	4 / 4	0	4350	5540	CSSB-02-A	NA - NA
Arsenic	**0.39**	**1 / 4**	**1**	**0.7 J**	**0.7 J**	**CSSB-02-B**	**1.4 - 1.4**
Barium	1500	1 / 4	0	41.5	41.5	CSSB-01-B	27.9 - 28.9
Calcium	N/A	4 / 4	0	515 J	2560	CSSB-02-B	NA - NA
Chromium	**0.29**	**4 / 4**	**4**	**14.6**	**32.2**	**CSSB-02-B**	**NA - NA**
Cobalt	**2.3**	**3 / 4**	**3**	**18.8**	**26.8**	**CSSB-01-B**	**7 - 7**
Copper	310	4 / 4	0	20.8	39.5	CSSB-02-A	NA - NA
Iron	**5400**	**4 / 4**	**4**	**29300**	**40000**	**CSSB-02-A**	**NA - NA**
Lead	280	2 / 4	0	2.3	5.7	CSSB-01-B	1.4 - 1.4
Magnesium	N/A	4 / 4	0	89.5 J	1120	CSSB-02-B	NA - NA
Manganese	**21**	**4 / 4**	**4**	**143 J**	**2170 J**	**CSSB-01-B**	**NA - NA**
Mercury	2	2 / 4	0	0.2	0.29	CSSB-01-A	0.14 - 0.14
Nickel	150	4 / 4	0	1.5 J	3.5 J	CSSB-01-B	NA - NA
Potassium	N/A	4 / 4	0	95.5 J	189 J	CSSB-01-B	NA - NA
Silver	12	4 / 4	0	4 J	5.1 J	CSSB-02-A	NA - NA
Vanadium	**39**	**4 / 4**	**4**	**77.8**	**121**	**CSSB-02-B**	**NA - NA**
Zinc	2300	4 / 4	0	12.7	83.5	CSSB-01-B	NA - NA

Notes:

Highlight and bold font indicates an exceedance.

J - value is estimated

µg/kg - microgram per kilogram

mg/kg - microgram per kilogram

CDM Smith

Table 4-17a
Initial Supply Well Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	Cidra 3						Cidra 4						Cidra 6					
		CIDR3 1964-A		CIDR3 1964-B		CIDR3 1964-C		CIDR4-A		CIDR4-B		CIDR4-C		CIDR6 1967-A		CIDR6 1967-B		CIDR6 1967-C	
Volatile Organic Compounds (µg/L)																			
1,1-Dichloroethane	2.4	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
1,1-Dichloroethene	7	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Chloroform	57	6.4		6.6		6.7		2.3		7.9		3.3		6.9		7.1		6.3	
Tetrachloroethene	5	2.2		2.2		2.3		0.5	U	0.5	U	0.5	U	0.9		0.55		0.4	J
Trichloroethene	5	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Inorganic Analytes (µg/L)																			
Cobalt	0.47	50	U	50	U	50	U	50	U	50	U	50	U	50	U	**2.2**	J	50	U
Iron	1100	258		144		222		**16900**		**2950**		**7790**			R		R		R
Lead	15	10	U	10	U	10	U	10	U	10	U	10	U	10	U	**26.4**		4.6	J
Manganese	32	4.3	J	2.9	J	11.1	J	**650**		**616**		**796**		19.5		**154**		**35.4**	
Mercury	0.05	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	**0.1**	J	**0.45**		0.2	U
Vanadium	7.8	**21.5**	J	**20.5**	J	**17.7**	J	2.2	J	5.1	J	2.2	J	**9.8**	J	**23.4**	J	**11**	J
Zinc	470	43.3	J	40.7	J	36	J	30.7	J	28.3	J	22.1	J	60	U	61		30.4	J

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria.

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

R - rejected value

Table 4-17a
Initial Supply Well Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	Cidra 8			IVAX-former			IVAX 1	IVAX 2	Pepsi	Rabanal
		CIDR8-A	CIDR8-B	CIDR8-C	IVAXD	IVAXI	IVAXS	ZENI1	ZENI2	PEPS	RABA
Volatile Organic Compounds (µg/L)											
1,1-Dichloroethane	2.4	1 U	1 U	1 U	**2.9** J	**5.9** J	**6.9** J	0.49 J	1.3 J	0.5 U	0.5 U
1,1-Dichloroethene	7	2.6	2.5	2.6	**25**	**56**	**49**	5.1	**17**	0.5 U	0.5 U
Chloroform	57	3.8	3.4	3.7	**67**	**150**	**160**	13	39	1.1 U	0.5 U
Tetrachloroethene	5	**120**	**120**	**120**	1.7	3.3	3.5	0.5 U	0.89	0.5 U	0.5 U
Trichloroethene	5	**5**	**4.6**	**4.6**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Inorganic Analytes (µg/L)											
Cobalt	0.47	**2** J	**2.4** J	**2** J	**2.3** J	50 U	50 U	50 U	50 U	50 U	50 U
Iron	1100	**3440**	**2480**	**2380**	79.3 J	107	150	R	R	R	654
Lead	15	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Manganese	32	20	16	15.9	15 U	15 U	5 U	15 U	15 U	15 U	**6600**
Mercury	0.05	0.2 U	0.2 U	0.2 U	**0.09** J	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Vanadium	7.8	**29.9** J	**28.1** J	**28** J	**19.8** J	**19.4** J	**20.7** J	**20** J	**20.8** J	**14.8** J	**34.6** J
Zinc	470	39 J	39.7 J	36.3 J	31.2 J	31.6 J	35.1 J	**842**	219	60 U	89.9

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria.

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

R - rejected value

Table 4-17a
Initial Supply Well Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	Villa Carmen		Zapera		Mylan		Pelegrin 1		Caribbean Refrescos		Ciba Vision 1		Ciba Vision 2	
		VILL		ZAPA		MYLA		PELL		CARI		CIBA1		CIBA2	
Volatile Organic Compounds (µg/L)															
1,1-Dichloroethane	2.4	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
1,1-Dichloroethene	7	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Chloroform	57	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Tetrachloroethene	5	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Trichloroethene	5	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Inorganic Analytes (µg/L)															
Cobalt	0.47	50	U	50	U	50	U	50	U	50	U	50	U	50	U
Iron	1100	374		267			R	100	U		R		R		R
Lead	15	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Manganese	32	15	U	**87.6**		**445**		15	U	15	U	**321**		**364**	
Mercury	0.05	**0.2**		0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Vanadium	7.8	**24.1**	J	**34.4**	J	**12**	J	**29.5**	J	**11.1**	J	50	U	50	U
Zinc	470	60.2		41.9	J	60	U	38.7	J	**71.5**		60	U	**883**	

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria.

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

R - rejected value

Table 4-17b
Sample Summary Statistics - Initial Supply Well Groundwater Sampling Event
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/L)							
Tetrachloroethene	**5**	**13 / 26**	**3**	**0.4 J**	**120**	**CIDR8**	**0.5 - 0.5**
Trichloroethene	5	3 / 26	0	4.6	5	CIDR8-A	0.5 - 0.5
cis-1,2-Dichloroethene	70	3 / 26	0	15	17	CIDR8-A	0.5 - 0.5
1,1,2-Trichloro-1,2,2-trifluoroethane	5300	4 / 26	0	0.16 J	0.76	CIBA1	0.5 - 1
1,1,2-Trichloroethane	5	3 / 26	0	0.22 J	0.5 J	IVAXI	0.5 - 1
1,1-Dichloroethane	**2.4**	**5 / 26**	**3**	**0.49 J**	**6.9 J**	**IVAXS**	**0.5 - 1**
1,1-Dichloroethene	**7**	**8 / 26**	**4**	**2.5**	**56**	**IVAXI**	**0.5 - 0.5**
Bromodichloromethane	5.5	12 / 26	0	0.13 J	1	IVAXS	0.5 - 1
Carbon Disulfide	72	1 / 26	0	0.17 J	0.17 J	PELL	0.5 - 1
Carbon Tetrachloride	2.3	5 / 26	0	0.12 J	0.2 J	CIDR3 1964-C	0.5 - 1
Chloroethane	2100	3 / 26	0	0.14 J	0.23 J	ZAPA	0.5 - 1
Chloroform	**57**	**17 / 26**	**3**	**2.3**	**160**	**IVAXS**	**0.5 - 1.1**
Chloromethane	19	8 / 26	0	0.31 J	1.2	ZENI2	0.5 - 1
Dibromochloromethane	4	2 / 26	0	0.16 J	0.19 J	IVAXS	0.5 - 1
Dichlorodifluoromethane	19	3 / 26	0	3.3	3.4	CIDR3 1964-B	0.5 - 1
Methylene Chloride	46	1 / 26	0	1	1	CIDR4-A	0.5 - 1
Trichlorofluoromethane	110	9 / 26	0	0.19 J	0.47 J	CIDR8-A	0.5 - 0.5
Semivolatile Organic Compounds (µg/L)							
2-Methylnaphthalene	2.7	1 / 26	0	0.032 J	0.032 J	PEPS	0.1 - 0.1
Acenaphthene	670	2 / 26	0	0.023 J	0.07 J	CIDR6 1967-C	0.1 - 0.1
bis(2-Ethylhexyl) phthalate	12	3 / 26	0	0.42 J	0.71 J	CIDR3 1964-A	5 - 5
Butylbenzylphthalate	1500	3 / 26	0	0.36 J	0.47 J	IVAXI	5 - 5
Caprolactam	770	1 / 26	0	0.46 J	0.46 J	ZAPA	5 - 5
Diethylphthalate	17000	3 / 26	0	0.21 J	0.35 J	CIDR8-A	5 - 5
Di-n-butylphthalate	2000	1 / 26	0	0.31 J	0.31 J	CIDR4-A	5 - 5
Fluoranthene	130	1 / 26	0	0.03 J	0.03 J	RABA	0.1 - 0.1
Fluorene	1100	1 / 26	0	0.029 J	0.029 J	PEPS	0.1 - 0.1
Naphthalene	0.14	1 / 26	0	0.024 J	0.024 J	ZAPA	0.1 - 0.1
Pentachlorophenol	1	2 / 26	0	0.038 J	0.15 J	CIDR6 1967-C	0.2 - 0.2
Phenanthrene	N/A	1 / 26	0	0.02 J	0.02 J	PEPS	0.1 - 0.1
Pesticides (µg/L)							
Endosulfan II	62	2 / 26	0	0.016 J	0.11	PEPS	0.1 - 0.1
Endosulfan sulfate	62	1 / 26	0	0.033 J	0.033 J	CIDR6 1967-C	0.1 - 0.1
Inorganics (µg/L)							
Aluminum	1600	8 / 26	0	6.7 J	25.3 J	CIDR8-A	200 - 200
Arsenic	10	7 / 26	0	0.53 J	2.7 J	CIDR8-C	1 - 2.8
Barium	2000	22 / 26	0	16.2 J	245	IVAXS	10 - 10
Beryllium	4	3 / 26	0	0.05 J	0.065 J	PELL	5 - 5
Calcium	N/A	26 / 26	0	20600	109000	CIDR6 1967-B	NA - NA
Chromium	100	18 / 26	0	1.1 J	14.8	IVAXS	10 - 10
Cobalt	**0.47**	**5 / 26**	**5**	**2 J**	**2.4 J**	**CIDR8-B**	**50 - 50**
Copper	1300	14 / 26	0	0.8 J	57.8	RABA	25 - 25
Cyanide	200	22 / 26	0	1.9 J	103	CIDR6 1967-C	10 - 10
Iron	**1100**	**15 / 26**	**6**	**79.3 J**	**16900**	**CIDR4-A**	**100 - 100**
Lead	**15**	**2 / 26**	**1**	**4.6 J**	**26.4**	**CIDR6 1967-B**	**10 - 10**
Magnesium	N/A	26 / 26	0	10900	35100	ZAPA	NA - NA
Manganese	**32**	**17 / 26**	**10**	**2.9 J**	**6600**	**RABA**	**5 - 15**
Mercury	**0.05**	**4 / 26**	**4**	**0.09 J**	**0.45**	**CIDR6 1967-B**	**0.2 - 0.2**
Nickel	610	18 / 26	0	1.6 J	14.8 J	IVAXS	40 - 40
Potassium	N/A	26 / 26	0	571 J	2640 J	IVAXS	NA - NA
Selenium	50	8 / 26	0	0.48 J	0.74 J	CIDR8-B	5 - 5
Silver	7.1	1 / 26	0	1.6 J	1.6 J	IVAXD	10 - 10
Sodium	N/A	26 / 26	0	14500	42600	CIDR6 1967-B	NA - NA
Vanadium	**7.8**	**24 / 26**	**21**	**2.2 J**	**34.6 J**	**RABA**	**50 - 50**
Zinc	**470**	**22 / 26**	**2**	**22.1 J**	**883**	**CIBA2**	**60 - 60**

Notes:
Highlight and bold font indicates an exceedance.
J - value is estimated µg/L - microgram per liter
NA - not applicable

Table 4-18a
Packer Sample Results
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Multiport Well Boring ID	Sample ID	Depth (feet bgs)	Volatile Organic Compounds and Corresponding Screening Criteria (µg/L)																			
			Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	1,1-Dichloroethene	1,1-Dichloroethane	Dichlorodifluoromethane	Chloromethane	Trichlorofluoromethane	1,1,2-Trichloro-1,2,2-trifluoroethane	Carbon Disulfide	Methyl tert-Butyl Ether	Chloroform	Carbon Tetrachloride	Benzene	Bromodichloromethane	Toluene	Dibromochloromethane	Ethylbenzene	o-Xylene	m,p-Xylene
			5	*5*	*70*	*7*	*2.4*	*19*	*19*	*110*	*5,300*	*72*	*12*	*57*	*2.3*	*5*	*5.5*	*1,000*	*4*	*530*	*10,000*	*10,000*
MPW-1	PS-MPW1-127	122 to 132	10	0.44 J	0.36 J	0.5 U	0.5 U	0.41 J	0.5 U	0.5 U	0.5 U	0.081 J	0.5 U	6.7	1.2	0.54	0.55	6.3	0.5 U	0.65	0.95	2.8
	PS-MPW1-135	130 to 140	3.3	0.19 J	0.12 J	0.5 U	0.5 U	0.44 J	0.22 J	0.5 U	0.5 U	0.5 U	0.5 U	7.4	1.3	0.44 J	0.56	7	0.5 U	0.59	0.88	2.4
	PS-MPW1-145	140 to 150	3.3	0.17 J	0.084 J	0.5 U	0.5 U	0.41 J	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	6.5	1.3 J	0.49 J	0.53	8	0.5 U	0.58	0.85	2.4
	PS-MPW1-155	150 to 160	3.4	0.15 J	0.096 J	0.5 U	0.5 U	0.39 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	6.5	1.2	0.51	0.56	7.3	0.5 U	0.57	0.87	2.4
	PS-MPW1-215	210 to 220	0.88	0.16 J	0.14 J	0.5 U	0.5 U	0.33 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	6.3	0.67	0.24 J	0.39 J	2.2	0.5 U	0.38 J	0.47 J	1.4
	PS-MPW1-235	230 to 240	0.73	0.16 J	0.088 J	0.5 U	0.5 U	0.47 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	7.3	1	0.45 J	0.46 J	8.1	0.5 U	0.52	0.74	2.1
	PS-MPW1-247	242 to 252	0.37 J	0.12 J	0.5 U	0.5 U	0.5 U	0.51	0.5 U	0.5 U	0.5 U	1.2	0.5 U	7.9	1.3	0.33 J	0.59	5.6	0.5 U	0.28 J	0.38 J	1.1
	PS-MPW1-281	276 to 286	2.9	0.29 J	0.5 J	0.5 U	0.5 U	0.34 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	6	0.51	0.35 J	0.27 J	2.1	0.5 U	0.29 J	0.38 J	1.1
	PS-MPW1-305	300 to 324	0.35 J	0.5 U	0.5 U	0.5 U	0.5 U	0.47 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	7.4	1.1	0.23 J	0.54	1.4	0.5 U	0.1 J	0.13 J	0.5 U
MPW-2	PS-MPW2-141	136 to 146	0.14 J	0.5 U	0.5 U	0.5 U	0.5 U	0.38 J	0.5 U	0.21 J	0.5 U	0.2 J	0.5 U	28	0.13 J	0.5 U	1.4	2.8	0.5 U	0.12 J	0.15 J	0.43 J
	PS-MPW2-163	158 to 168	0.17 J	0.5 U	0.5 U	0.5 U	0.5 U	0.49 J	0.5 U	0.21 J	0.5 U	0.33 J	0.5 U	27	0.16 J	0.5 U	1.4	4.3	0.1 J	0.14 J	0.19 J	0.51
	PS-MPW2-183	178 to 188	0.17 J	0.12 J	0.5 U	0.5 U	0.5 U	0.45 J	0.5 U	0.19 J	0.5 U	0.29 J	0.5 U	25	0.18 J	0.5 U	1.3	6.5	0.1 J	0.17 J	0.21 J	0.61
	PS-MPW2-199	194 to 204	0.15 J	0.12 J	0.5 U	0.5 U	0.5 U	0.26 J	0.5 U	0.12 J	0.5 U	0.21 J	0.5 U	20	0.13 J	0.5 U	1.1	7.5	0.5 U	0.17 J	0.23 J	0.58
	PS-MPW2-211	206 to 244	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.15 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	23	0.12 J	0.5 U	1.6	7	0.14 J	0.11 J	0.16 J	0.35 J
MPW-3	PS-MPW3-139	134 to 144	1.2	0.13 J	0.15 J	0.5 U	0.5 U	0.65	0.5 U	0.092 J	0.5 U	0.5 U	0.5 U	4.3	0.13 J	0.31 J	0.57	4.6	0.5 U	0.4 J	0.61	1.7
	PS-MPW3-163	158 to 168	1.3	0.17 J	0.18 J	0.5 U	0.5 U	0.67	0.5 U	0.092 J	0.5 U	0.5 U	0.5 U	5.2	0.16 J	0.4 J	0.69	7.1	0.5 U	0.5 J	0.8	2.1
	PS-MPW3-169	164 to 174	1.4	0.13 J	0.19 J	0.5 U	0.5 U	0.65	0.5 U	0.099 J	0.5 U	0.5 U	0.5 U	5.1	0.15 J	0.49 J	0.68	9	0.5 U	0.61	0.97	2.6
	PS-MPW3-183	178 to 188	1.5	0.19 J	0.18 J	0.5 U	0.5 U	0.66	0.5 U	0.097 J	0.5 U	0.5 U	0.5 U	4.9	0.18 J	0.56	0.7	12	0.5 U	0.62	0.96	2.6
	PS-MPW3-199	194 to 204	1.5	0.24 J	0.19 J	0.5 U	0.5 U	0.77	0.5 U	0.11 J	0.5 U	0.5 U	0.5 U	4.9	0.19 J	0.7	0.7	13	0.5 U	0.56	0.87	2.2
	PS-MPW3-211	206 to 223	1.6	0.11 J	0.19 J	0.5 U	0.5 U	1.2	0.5 U	0.12 J	0.5 U	0.5 U	0.5 U	5	0.17 J	0.5 U	0.72	5.1	0.5 U	0.15 J	0.22 J	0.58
MPW-4	PS-MPW4-135	130 to 140	1.4	0.16 J	0.11 J	0.5 U	0.5 U	0.77	0.21 J	0.3 J	0.5 U	0.5 U	0.5 U	15	0.3 J	0.61	0.27 J	6.2	0.5 U	0.68	1	2.7
	PS-MPW4-145	145 to 150	1.3	0.12 J	0.1 J	0.5 U	0.5 U	0.78	0.5 U	0.27 J	0.5 U	0.15 J	0.5 U	15	0.26 J	0.65	0.25 J	7.4	0.5 U	0.59	0.93	2.5
	PS-MPW4-155	150 to 160	1.4	0.11 J	0.11 J	0.5 U	0.5 U	0.84	0.44 J	0.3 J	0.5 U	0.5 U	0.5 U	14	0.28 J	0.35 J	0.28 J	5.4	0.5 U	0.35 J	0.51	1.4
	PS-MPW4-165	160 to 170	1.5	0.11 J	0.12 J	0.5 U	0.5 U	0.88	0.5 U	0.33 J	0.5 U	0.5 U	0.5 U	15	0.34 J	0.29 J	0.49 J	2.9	0.5 U	0.28 J	0.43 J	1.2
	PS-MPW4-213	208 to 224	1.2	0.11 J	0.12 J	0.5 U	0.5 U	0.74	0.5 U	0.29 J	0.5 U	0.5 U	0.5 U	14	0.27 J	0.39 J	0.42 J	2.9	0.5 U	0.27 J	0.43 J	1.1
MPW-5	PS-MPW5-131	126 to 136	12	0.61	1.5	0.5 U	0.5 U	0.19 J	0.5 U	0.5 U	0.5 U	0.5 U	0.22 J	5.7	0.22 J	0.4 J	0.58	3.9	0.5 U	0.42 J	0.53	1.7
	PS-MPW5-139	134 to 144	12	0.53	1.2	0.5 U	0.5 U	0.27 J	0.5 U	0.5 U	0.5 U	0.5 U	0.26 J	6.2	0.29 J	0.5 U	0.68	2.1	0.5 U	0.19 J	0.22 J	0.76
	PS-MPW5-149	144 to 154	9.7	0.49 J	0.88	0.5 U	0.5 U	0.28 J	0.5 U	0.5 U	0.5 U	0.5 U	0.22 J	6.1	0.31 J	0.3 J	0.64	3.7	0.5 U	0.37 J	0.47 J	1.6
	PS-MPW5-163	158 to 168	9.9	0.42 J	0.85	0.5 U	0.5 U	0.29 J	0.5 U	0.5 U	0.5 U	0.5 U	0.26 J	6.3	0.33 J	0.24 J	0.67	2.8	0.5 U	0.23 J	0.29 J	0.85
	PS-MPW5-190	185 to 195	15	0.58	1.4	0.5 U	0.5 U	0.25 J	0.5 U	0.5 U	0.5 U	0.13 J	0.23 J	6.1	0.3 J	0.27 J	0.64	2.9	0.5 U	0.24 J	0.3 J	0.88
	PS-MPW5-255	250 to 260	14	0.6	1.3	0.5 U	0.5 U	0.29 J	0.5 U	0.5 U	0.5 U	0.18 J	0.23 J	6.1	0.3 J	0.33 J	0.64	4.8	0.5 U	0.32 J	0.43 J	1.2
	PS-MPW5-270	265 to 275	15	0.57	1.4	0.5 U	0.5 U	0.29 J	0.5 U	0.5 U	0.5 U	0.28 J	0.25 J	6.2	0.3 J	0.48 J	0.64	6.5	0.5 U	0.44 J	0.61	1.9
	PS-MPW5-283	278 to 288	31	1.3	3.6	0.73	0.5 U	0.25 J	0.5 U	0.5 U	0.5 U	0.21 J	0.23 J	5.8	0.28 J	0.39 J	0.54	6.8	0.5 U	0.37 J	0.53	1.6
	PS-MPW5-313	308 to 325	92	3.9	14	2.2	0.5 U	0.11 J	0.5 U	0.15 J	0.5 U	0.5 U	0.5 U	3.6	0.28 J	0.31 J	0.5 U	3.7	0.5 U	0.48 J	0.54	2.3
MPW-6	PS-MPW6-109	104 to 114	0.79	0.5 U	0.5 U	4.1	0.43 J	0.5 U	0.5 U	0.5 U	0.5 U	0.25 J	0.5 U	1.4	0.5 U	0.88	0.5 U	10	0.5 U	1.1	1.3	3.2
	PS-MPW6-159	154 to 164	0.46 J	0.15 J	0.5 U	3.9	0.42 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2	0.5 U	1.5	0.5 U	9.4	0.5 U	0.75	0.66	1.2
	PS-MPW6-177	172 to 182	0.13 J	0.5 U	0.5 U	12 J	0.41 J	0.5 U	0.5 U	0.5 U	0.53	0.5 U	0.5 U	2.8	0.5 U	0.22 J	0.24 J	2.5	0.5 U	0.39 J	0.56	1.6
	PS-MPW6-195	190 to 200	0.12 J	0.5 U	0.5 U	7.5 J	0.28 J	0.5 U	0.5 U	0.5 U	0.45 J	0.5 U	0.5 U	1.9	0.5 U	0.34 J	0.22 J	3.2	0.5 U	0.43 J	0.63	1.7
	PS-MPW6-219	214 to 224	0.36 J	0.5 U	0.5 U	9.6 J	0.69	0.5 U	0.5 U	0.5 U	0.27 J	0.13 J	0.5 U	12	0.5 U	0.42 J	0.22 J	4.5	0.5 U	0.57	0.82	2.4
	PS-MPW6-241	236 to 246	0.14 J	0.5 U	0.5 U	7.9 J	0.51	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	9	0.5 U	0.84	0.19 J	5.5	0.5 U	0.51	0.78	2.1
	PS-MPW6-299	294 to 304	0.25 J	0.5 U	0.5 U	2.9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.3	0.5 U	0.62	0.18 J	6.7	0.5 U	0.62	0.89	2.5
	PS-MPW6-311	306 to 323	0.19 J	0.5 U	0.5 U	1.9	0.11 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.2	0.5 U	1	0.13 J	11	0.5 U	0.71	0.95	2.4

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-18b
Sample Summary Statistics - Packer Samples
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Unit	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds								
Tetrachloroethene	**5**	**41 / 42**	**10**	**0.12 J**	**92**	**µg/L**	**PS-MPW5-313**	**0.5 - 0.5**
Trichloroethene	5	31 / 42	0	0.11 J	3.9	µg/L	PS-MPW5-313	0.5 - 0.5
cis-1,2-Dichloroethene	70	27 / 42	0	0.084 J	14	µg/L	PS-MPW5-313	0.5 - 0.5
1,1,2-Trichloro-1,2,2-trifluoroethane	5300	3 / 42	0	0.27 J	0.53	µg/L	PS-MPW6-177	0.5 - 0.5
1,1-Dichloroethane	2.4	7 / 42	0	0.11 J	0.69	µg/L	PS-MPW6-219	0.5 - 0.5
1,1-Dichloroethene	**7**	**10 / 42**	**4**	**0.73**	**12 J**	**µg/L**	**PS-MPW6-177**	**0.5 - 0.5**
Benzene	5	35 / 42	0	0.22 J	1.5	µg/L	PS-MPW6-159	0.5 - 0.5
Bromodichloromethane	5.5	39 / 42	0	0.13 J	1.6	µg/L	PS-MPW2-211	0.5 - 0.5
Carbon Disulfide	72	13 / 42	0	0.081 J	1.2	µg/L	PS-MPW1-247	0.5 - 0.5
Carbon Tetrachloride	2.3	34 / 42	0	0.12 J	1.3	µg/L	PS-MPW1-247	0.5 - 0.5
Chloroform	57	42 / 42	0	1.2	28	µg/L	PS-MPW2-141	NA - NA
Chloromethane	19	3 / 42	0	0.21 J	0.44 J	µg/L	PS-MPW4-155	0.5 - 0.5
Dibromochloromethane	4	3 / 42	0	0.1 J	0.14 J	µg/L	PS-MPW2-211	0.5 - 0.5
Dichlorodifluoromethane	19	34 / 42	0	0.11 J	1.2	µg/L	PS-MPW3-211	0.5 - 0.5
Ethylbenzene	530	42 / 42	0	0.1 J	1.1	µg/L	PS-MPW6-109	NA - NA
m,p-Xylene	10000	41 / 42	0	0.35 J	3.2	µg/L	PS-MPW6-109	0.5 - 0.5
Methyl tert-Butyl Ether	12	8 / 42	0	0.22 J	0.26 J	µg/L	PS-MPW5-163	0.5 - 0.5
o-Xylene	10000	42 / 42	0	0.13 J	1.3	µg/L	PS-MPW6-109	NA - NA
Toluene	1000	42 / 42	0	1.4	13	µg/L	PS-MPW3-199	NA - NA
Trichlorofluoromethane	110	16 / 42	0	0.092 J	0.33 J	µg/L	PS-MPW4-165	0.5 - 0.5

Notes:

Highlight and bold font indicates an exceedance.

J - value is estimated

NA - not applicable

µg/L - microgram per liter

CDM Smith

Table 4-19a
Groundwater Exceedances - Stage 1
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	MPW-1-P1-S1 121 to 129 feet bgs		MPW-1-P2-S1 132 to 144 feet bgs		MPW-1-P3-S1 148 to 160 feet bgs		MPW-1-P4-S1 228 to 237 feet bgs		MPW-1-P5-S1 241 to 253 feet bgs		MPW-1-P6-S1 276 to 286 feet bgs		MPW-2-P1-S1 144 to 154 feet bgs		MPW-2-P2-S1 165 to 175 feet bgs	
Volatile Organic Compounds (µg/L)																	
1,1-Dichloroethene	7	0.37	J	0.32	J	0.19	J	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Tetrachloroethene	5	**14**		4.4		0.67		0.5	U	0.11	J	0.5	U	0.5	U	0.5	U
PCBs (µg/L)																	
Aroclor-1016	0.00064	1.1	U	1	U	1.1	U	1	U	1	U	1.1	U	1.1	U	1.1	U
Aroclor-1260	0.00064	1.1	U	1	U	1.1	U	1	U	1	U	1.1	U	1.1	U	1.1	U
Inorganic Analytes (µg/L)																	
Arsenic	10	4.5		2.5		**90.7**		**11.6**		3.3		**266**		**10.3**		8	
Manganese	32	12.1	J	10.4	J	**1380**		0.68	J	1.3	J	**42.6**		6.4	J	2.3	J
Mercury	0.05	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	**0.087**	J
Vanadium	7.8	**23.8**	J	**24.9**	J	**16.9**	J	**21.8**	J	**22**	J	**12.4**	J	**20.1**	J	**20.4**	J

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-19a
Groundwater Exceedances - Stage 1
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	MPW-2-P3-S1 178 to 188 feet bgs		MPW-2-P4-S1 214 to 222 feet bgs		MPW-3-P1-S1 131 to 146 feet bgs		MPW-3-P2-S1 150 to 162 feet bgs		MPW-3-P3-S1 168 to 174 feet bgs		MPW-3-P4-S1 178 to 188 feet bgs		MPW-3-P5-S1 194 to 204 feet bgs		MPW-4-P1-S1 138 to 149 feet bgs		MPW-4-P2-S1 152 to 160 feet bgs	
Volatile Organic Compounds (µg/L)																			
1,1-Dichloroethene	7	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Tetrachloroethene	5	0.5	U	0.5	UJ	1.7		1.9	J	2	J	0.9	J	0.5	UJ	0.96		0.86	
PCBs (µg/L)																			
Aroclor-1016	0.00064	1.1	U	1	U	**3.4**		1	U	0.95	U	0.95	U	0.95	U	1.1	U	1	U
Aroclor-1260	0.00064	1.1	U	1	U	**3.4**		1	U	0.95	U	0.95	U	0.95	U	1.1	U	1	U
Inorganic Analytes (µg/L)																			
Arsenic	10	**10.3**		2.1		3		4.6		8.3		**44.5**		**74.4**		9.2		4.4	
Manganese	32	6.1	J	1.1	J	15	U	15	U	15	U	9.6	J	26.4		**41**		17.1	
Mercury	0.05	**0.15**	J	0.2	U	0.2	U	0.2	U	0.2	U	**0.13**	J	**0.12**	J	**0.082**	J	0.2	U
Vanadium	7.8	**19.4**	J	**18.9**	J	**19.2**	J	**18.9**	J	**18.8**	J	**20.2**	J	**20.2**	J	**18.1**	J	**19.3**	J

Notes:

Highlight indicates exceedance of the site-specif

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-19a
Groundwater Exceedances - Stage 1
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	MPW-4-P3-S1 164 to 174 feet bgs		MPW-4-P4-S1 210 to 224 feet bgs		MPW-5-P1-S1 130 to 144 feet bgs		MPW-5-P2-S1 148 to 154 feet bgs		MPW-5-P3-S1 157 to 170 feet bgs		MPW-5-P4-S1 202 to 212 feet bgs		MPW-5-P5-S1 260 to 274 feet bgs		MPW-5-P6-S1 277 to 287 feet bgs		MPW-5-P7-S1 302 to 324 feet bgs	
Volatile Organic Compounds (µg/L)																			
1,1-Dichloroethene	7	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.62		1.2		1.3		0.5	U
Tetrachloroethene	5	1.7		1.4		1.2		1.2		2.5		**11**		**56**		**32**		**29**	
PCBs (µg/L)																			
Aroclor-1016	0.00064	1	U	1	U	1	U	1	U	1.1	U	1	U	1	U	1	U	1	U
Aroclor-1260	0.00064	1	U	1	U	1	U	1	U	1.1	U	1	U	1	U	1	U	1	U
Inorganic Analytes (µg/L)																			
Arsenic	10	4.1		**15.2**		5		**20.7**		2.5		**106**		**14.7**		**15**		**36.2**	
Manganese	32	1.8	J	14.9	J	15	U	11.4	J	0.41	J	**301**		2.6	J	4.3	J	24.1	
Mercury	0.05	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	**0.17**	J	0.2	U
Vanadium	7.8	**20.4**	J	**20.9**	J	**26.8**	J	**27.1**	J	**26.3**	J	**24.4**	J	**24.6**	J	**24**	J	**24.2**	J

Notes:

Highlight indicates exceedance of the site-specif

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-19a
Groundwater Exceedances - Stage 1
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	MPW-6-P1-S1 154 to 164 feet bgs		MPW-6-P2-S1 172 to 182 feet bgs		MPW-6-P3-S1 190 to 200 feet bgs		MPW-6-P4-S1 215 to 225 feet bgs		MPW-6-P5-S1 236 to 246 feet bgs		MPW-6-P6-S1 260 to 270 feet bgs		MPW-6-P7-S1 294 to 304 feet bgs	
Volatile Organic Compounds (µg/L)															
1,1-Dichloroethene	7	4.9		6.9	J	3.6		**16**	J	5.3	J	2.7		3.3	
Tetrachloroethene	5	0.17	J	0.11	J	0.5	U	0.48	J	0.14	J	0.26	J	0.36	J
PCBs (µg/L)															
Aroclor-1016	0.00064	0.98	U	0.91	U	0.95	U	1	U	1	U	0.91	U	0.95	U
Aroclor-1260	0.00064	0.98	U	0.91	U	0.95	U	1	U	1	U	0.91	U	0.95	U
Inorganic Analytes (µg/L)															
Arsenic	10	**140**		**23.9**		1.6		**16.3**		**64.2**		7.2		**73.7**	
Manganese	32	**321**		**43.8**	J	6.1	J	8.5	J	21.5		15	U	**103**	
Mercury	0.05	**0.12**	J	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Vanadium	7.8	**22**	J	**22.9**	J	**22.6**	J	**19.2**	J	**20.8**	J	**21.1**	J	**17.9**	J

Notes:

Highlight indicates exceedance of the site-specif

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-19b
Sample Summary Statistics - Stage 1 Groundwater Sampling Event
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/L)							
Tetrachloroethene	**5**	**25 / 33**	**5**	**0.11 J**	**56**	**MPW-5-P5-S1**	**0.5 - 0.5**
Trichloroethene	5	12 / 33	0	0.1 J	1.7	MPW-5-P5-S1	0.5 - 0.5
cis-1,2-Dichloroethene	70	12 / 33	0	0.13 J	9.5	MPW-5-P6-S1	0.5 - 0.5
1,1,2-Trichloro-1,2,2-trifluoroethane	5300	4 / 33	0	0.19 J	0.51	MPW-6-P2-S1	0.5 - 0.5
1,1-Dichloroethane	2.4	5 / 33	0	0.11 J	1.4 J	MPW-6-P4-S1	0.5 - 0.5
1,1-Dichloroethene	**7**	**13 / 33**	**1**	**0.19 J**	**16 J**	**MPW-6-P4-S1**	**0.5 - 0.5**
1,2,4-Trichlorobenzene	35	2 / 33	0	0.11 J	0.21 J	MPW-1-P2-S1	0.5 - 0.5
1,2-Dichlorobenzene	420	3 / 33	0	0.13 J	0.14 J	MPW-6-P7-S1	0.5 - 0.5
1,3-Dichlorobenzene	320	6 / 33	0	0.1 J	0.18 J	MPW-6-P7-S1	0.5 - 0.5
1,4-Dichlorobenzene	63	5 / 33	0	0.11 J	0.23 J	MPW-6-P7-S1	0.5 - 0.5
2-Butanone	490	4 / 33	0	1.5 J	5.5	MPW-1-P6-S1	5 - 5
Acetone	1200	8 / 33	0	2.3 J	19	MPW-1-P6-S1	5 - 5
Benzene	5	6 / 33	0	0.12 J	0.34 J	MPW-1-P3-S1	0.5 - 0.5
Bromodichloromethane	5.5	28 / 33	0	0.11 J	1.7	MPW-2-P2-S1	0.5 - 0.5
Carbon Disulfide	72	4 / 33	0	0.1 J	0.13 J	MPW-5-P4-S1	0.5 - 0.5
Carbon Tetrachloride	2.3	27 / 33	0	0.11 J	1	MPW-1-P5-S1	0.5 - 0.5
Chlorobenzene	100	1 / 33	0	0.1 J	0.1 J	MPW-6-P7-S1	0.5 - 0.5
Chlorobromomethane	8.3	1 / 33	0	0.36 J	0.36 J	MPW-6-P5-S1	0.5 - 0.5
Chloroform	57	33 / 33	0	1	38	MPW-6-P4-S1	NA - NA
cis-1,3-Dichloropropene	3.4	1 / 33	0	0.21 J	0.21 J	MPW-6-P5-S1	0.5 - 0.5
Cyclohexane	1300	1 / 33	0	0.12 J	0.12 J	MPW-6-P2-S1	0.5 - 0.5
Dibromochloromethane	4	6 / 33	0	0.11 J	0.28 J	MPW-6-P1-S1	0.5 - 0.5
Dichlorodifluoromethane	19	12 / 33	0	0.15 J	0.79	MPW-4-P4-S1	0.5 - 0.5
Ethylbenzene	530	3 / 33	0	0.1 J	0.17 J	MPW-6-P7-S1	0.5 - 0.5
Isopropylbenzene	39	1 / 33	0	0.12 J	0.12 J	MPW-6-P7-S1	0.5 - 0.5
m,p-Xylene	10000	4 / 33	0	0.11 J	0.26 J	MPW-6-P7-S1	0.5 - 0.5
Methyl tert-Butyl Ether	12	21 / 33	0	0.1 J	0.28 J	MPW-5-P3-S1	0.5 - 0.5
Metylcyclohexane	N/A	4 / 33	0	0.1 J	0.21 J	MPW-6-P7-S1	0.5 - 0.5
o-Xylene	10000	2 / 33	0	0.12 J	0.13 J	MPW-6-P7-S1	0.5 - 0.5
Toluene	1000	25 / 33	0	0.12 J	58	MPW-1-P6-S1	0.5 - 5
trans-1,2-Dichloroethene	100	2 / 33	0	0.1 J	0.11 J	MPW-1-P2-S1	0.5 - 0.5
Trichlorofluoromethane	110	16 / 33	0	0.12 J	0.38 J	MPW-4-P3-S1	0.5 - 0.5
Semivolatile Organic Compounds (µg/L)							
Atrazine	3	3 / 33	0	0.0012 J	0.0027 J	MPW-5-P1-S1	2.7 - 3.3
bis(2-Ethylhexyl) phthalate	12	3 / 33	0	2.8 J	8	MPW-5-P2-S1	4.5 - 5.6
Caprolactam	770	10 / 33	0	1.4 J	80	MPW-6-P1-S1	4.5 - 5.6
Isophorone	350	2 / 33	0	9.5	17	MPW-1-P6-S1	4.5 - 5.6
Phenol	21000	2 / 33	0	4.1 J	5.1	MPW-6-P5-S1	4.5 - 5.6
Polychlorinated Biphenyls (µg/L)							
Aroclor-1016	**0.00064**	**1 / 33**	**1**	**3.4**	**3.4**	**MPW-3-P1-S1**	**0.91 - 1.1**
Aroclor-1260	**0.00064**	**1 / 33**	**1**	**3.4**	**3.4**	**MPW-3-P1-S1**	**0.91 - 1.1**
Pesticides (µg/L)							
beta-BHC	0.091	3 / 33	0	0.0082 J	0.027	MPW-1-P6-S1	0.01 - 0.011
delta-BHC	N/A	4 / 33	0	0.0037 J	0.042 NJ	MPW-5-P6-S1	0.01 - 0.011
Endosulfan I	62	2 / 33	0	0.0078 J	0.0082 J	MPW-4-P3-S1	0.01 - 0.011
Heptachlor epoxide	0.2	1 / 33	0	0.0031 J	0.0031 J	MPW-1-P6-S1	0.01 - 0.011

Table 4-19b
Sample Summary Statistics - Stage 1 Groundwater Sampling Event
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Inorganics (µg/L)							
Antimony	5.6	1 / 33	0	2.5	2.5	MPW-6-P5-S1	2 - 4
Arsenic	**10**	**33 / 33**	**18**	**1.6**	**266**	**MPW-1-P6-S1**	**NA - NA**
Barium	2000	28 / 33	0	0.13 J	41.8 J	MPW-5-P1-S1	200 - 200
Beryllium	4	2 / 33	0	0.023 J	0.023 J	MPW-3-P3-S1	1 - 2
Calcium	N/A	33 / 33	0	35700	71500	MPW-1-P6-S1	NA - NA
Copper	1300	14 / 33	0	0.67 J	2.4 J	MPW-6-P4-S1	25 - 25
Cyanide	200	2 / 33	0	2.2 J	3.3 J	MPW-3-P5-S1	10 - 10
Lead	15	3 / 33	0	2 J	2.2 J	MPW-5-P2-S1	10 - 10
Magnesium	N/A	33 / 33	0	15100	28900	MPW-1-P4-S1	NA - NA
Manganese	**32**	**28 / 33**	**7**	**0.41 J**	**1380**	**MPW-1-P3-S1**	**15 - 15**
Mercury	**0.05**	**7 / 33**	**7**	**0.082 J**	**0.17 J**	**MPW-5-P6-S1**	**0.2 - 0.2**
Nickel	610	5 / 33	0	0.61 J	0.83 J	MPW-6-P1-S1	40 - 40
Potassium	N/A	33 / 33	0	840 J	1880 J	MPW-5-P2-S1	NA - NA
Selenium	50	33 / 33	0	0.69 J	1.3 J	MPW-5-P6-S1	NA - NA
Silver	7.1	1 / 33	0	0.6 J	0.6 J	MPW-5-P5-S1	10 - 10
Sodium	N/A	33 / 33	0	16700	25600	MPW-1-P6-S1	NA - NA
Thallium	0.24	6 / 33	0	0.0081 J	0.021 J	MPW-3-P3-S1	1 - 2
Vanadium	**7.8**	**33 / 33**	**33**	**12.4 J**	**27.1 J**	**MPW-5-P2-S1**	**NA - NA**
Zinc	470	2 / 33	0	2.6 J	9.8 J	MPW-6-P4-S1	60 - 60

Notes:
Highlight and bold font indicates an exceedance.
J - value is estimated
NA - not applicable
µg/L - microgram per liter

Table 4-20a
Groundwater Exceedances - Stage 2
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	CIDRA-3-S2 42 to 124 feet bgs		CIDRA-4-S2 168 to 188 feet bgs		CIDRA-6-S2 161-189 feet bgs		CIDRA-8-S2 97 to 276 feet bgs		IVAX-2-S2 unknown depth		IVAX-abandon-S2 69 to 206 feet bgs		MPW-1-P1-S2 121 to 129 feet bgs		MPW-1-P2-S2 132 to 144 feet bgs		MPW-1-P3-S2 148 to 160 feet bgs		MPW-1-P4-S2 228 to 237 feet bgs	
Volatile Organic Compounds (µg/L)																					
1,1-Dichloroethene	7	0.5	U	0.5	U	0.5	U	0.5	U	**39**	J	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Methyl tert-Butyl Ether	12	0.5	U	0.5	U	0.5	U	0.18	J	0.5	U	0.46	J	0.5	U	0.5	U	0.5	U	0.5	U
1,1-Dichloroethane	2.4	0.5	U	0.5	U	0.5	U	0.5	U	**2.8**	J	**6.6**	J	0.5	U	0.5	U	0.08	J	0.5	U
cis-1,2-Dichloroethene	70	0.5	U	0.5	U	0.5	U	16		0.5	U	0.06	J	0.5	U	0.66		1.6		0.72	
Chloroform	57	5.9		0.5	U	5.2		4.3		**68**	J	**210**	J	2.9		3.7		4.7		7.2	
Trichloroethene	5	0.5	U	0.5	U	0.5	U	3.3		0.5	U	0.084	J	0.51		0.5	U	0.5	U	0.5	U
Tetrachloroethene	5	1.4		0.5	U	0.21	J	**85**		0.78		1.6		**12**		3.2		2		0.47	J
Inorganic Analytes (µg/L)																					
Aluminum	1600	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U	160	
Arsenic	10	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U	**11**		8	U
Iron	1100	**4000**		**20000**		150		**2700**		50	U	380		50	U	50	U	50	U	50	U
Manganese	32	**100**		**780**		5	U	11		5	U	5	U	5	U	5	U	**62**		5	U
Mercury	0.05	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Vanadium	7.8	20	U	20	U	20	U	**30**		**20**		20	U	**26**		**26**		**22**		**22**	

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-20a
Groundwater Exceedances - Stage 2
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	MPW-1-P5-S2 241 to 253 feet bgs		MPW-1-P6-S2 276 to 283 feet bgs		MPW-2-P1-S2 144 to 154 feet bgs		MPW-2-P2-S2 165 to 175 feet bgs		MPW-2-P3-S2 178 to 188 feet bgs		MPW-2-P4-S2 214 to 222 feet bgs		MPW-3-P1-S2 131 to 146 feet bgs		MPW-3-P2-S2 150 to 162 feet bgs		MPW-3-P3-S2 168 to 174 feet bgs	
Volatile Organic Compounds (µg/L)																			
1,1-Dichloroethene	7	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Methyl tert-Butyl Ether	12	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
1,1-Dichloroethane	2.4	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
cis-1,2-Dichloroethene	70	0.5	U	1.7	J	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Chloroform	57	10		2.9		24	J	25	J	12		11		6.8		7.1		6.1	
Trichloroethene	5	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Tetrachloroethene	5	0.13	J	0.33	J	0.45	J	0.23	J	0.68		0.5	U	2.1		2.8		2.6	
Inorganic Analytes (µg/L)																			
Aluminum	1600	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U
Arsenic	10	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U
Iron	1100	50	U	50	U	50	U	50	U	870		50	U	50	U	50	U	50	U
Manganese	32	5	U	**48**		5	U	5	U	5	U	5	U	5	U	5	U	5	U
Mercury	0.05	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Vanadium	7.8	**23**		20	U	**21**		**20**		**20**		20	U	20	U	20	U	20	U

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-20a
Groundwater Exceedances - Stage 2
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	MPW-3-P4-S2 178 to 188 feet bgs		MPW-3-P5-S2 194 to 204 feet bgs		MPW-4-P1-S2 138 to 149 feet bgs		MPW-4-P2-S2 152 to 160 feet bgs		MPW-4-P3-S2 164 to 174 feet bgs		MPW-4-P4-S2 210 to 224 feet bgs		MPW-5-P1-S2 130 to 144 feet bgs		MPW-5-P2-S2 148 to 154 feet bgs		MPW-5-P3-S2 157 to 170 feet bgs		MPW-5-P4-S2 202 to 212 feet bgs	
Volatile Organic Compounds (µg/L)																					
1,1-Dichloroethene	7	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	UJ	0.5	U	0.5	U
Methyl tert-Butyl Ether	12	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.27	J	0.27	J	0.26	J	0.24	J
1,1-Dichloroethane	2.4	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.073	J	0.5	U	0.5	U
cis-1,2-Dichloroethene	70	0.33	J	0.36	J	0.5	U	0.5	U	0.5	U	0.5	U	0.27	J	0.24	J	0.24	J	2.8	
Chloroform	57	3.9		3		19		18		19		7.6		7.6		7.6		7		7.1	
Trichloroethene	5	0.18	J	0.15	J	0.5	U	0.5	U	0.5	U	0.5	U	0.17	J	0.15	J	0.11	J	0.42	J
Tetrachloroethene	5	2.3		2		1.3		1.4		2		1.8		1.6		1.5		2.6		**8.5**	
Inorganic Analytes (µg/L)																					
Aluminum	1600	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U
Arsenic	10	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U
Iron	1100	50	U	50	U	50	U	50	U	50	U	50	U	50	U	50	U	50	U	50	U
Manganese	32	8.9		12		5	U	5	U	5	U	7.3		12		11		5	U	**54**	
Mercury	0.05	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Vanadium	7.8	**20**		**21**		**20**		**21**		**21**		**21**		**26**		**27**		**27**		**25**	

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-20a
Groundwater Exceedances - Stage 2
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	MPW-5-P5-S2 260 to 274 feet bgs		MPW-5-P6-S2 277 to 287 feet bgs		MPW-5-P7-S2 302 to 324 feet bgs		MPW-6-P5-S2 236 to 246 feet bgs		SMW-10-S2 62 to 72 feet bgs		SMW-12-S2 78 to 88 feet bgs		SMW-1-S2 48 to 58 feet bgs		SMW-2-S2 94 to 104 feet bgs		SMW-3-S2 65 to 75 feet bgs		SMW-5-S2 48 to 58 feet bgs		SMW-9-S2 82 to 92 feet bgs	
Volatile Organic Compounds (µg/L)																							
1,1-Dichloroethene	7	0.5	U	0.5	U	3.6	J	**17**	J	**31**		0.5	U	5	U	0.5	U	0.5	U	0.5	U	0.5	U
Methyl tert-Butyl Ether	12	0.5	U	0.5	U	0.5	U	0.5	U	5	U	0.5	U	5	U	0.5	U	**350**		0.5	U	0.5	U
1,1-Dichloroethane	2.4	0.5	U	0.5	U	0.092	J	2	J	5	U	0.5	U	5	U	0.5	U	0.5	U	0.5	U	0.5	U
cis-1,2-Dichloroethene	70	20		28		32	J	0.5	U	60		0.5	U	21		0.5	U	0.5	U	0.5	U	**74**	
Chloroform	57	4.8		4.1		3.5		**65**	J	5	U	3.6		9.4		12		1.7		0.5	U	15	
Trichloroethene	5	5		3.9		**5.3**		0.5	U	**31**		0.5	U	**14**		0.5	U	0.5	U	0.5	U	**9.7**	
Tetrachloroethene	5	**120**		**73**		**86**		0.82		**1700**		0.5	U	**680**		0.5	U	0.5	U	0.5	U	**57**	
Inorganic Analytes (µg/L)																							
Aluminum	1600	100	U	100	U	100	U	100	U	1200		780		240		**13000**		1500		160		**6200**	
Arsenic	10	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U
Iron	1100	50	U	50	U	50	U	300		89		1000		380		**17000**		**1800**		170		**8000**	
Manganese	32	5	U	6.6		17		6.3		7.3		**230**		**260**		**1200**		**1600**		17		**390**	
Mercury	0.05	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	**0.54**		**2.3**		0.2	U	0.2	U
Vanadium	7.8	**24**		**24**		**24**		20	U	**67**		20	U	**20**		**54**		20	U	20	U	**20**	

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-20b
Sample Summary Statistics - Stage 2 Groundwater Sampling Event
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/L)							
Tetrachloroethene	**5**	**34 / 40**	**9**	**0.13 J**	**1700**	**SMW-10-S2**	**0.5 - 0.5**
Trichloroethene	**5**	**15 / 40**	**4**	**0.084 J**	**31**	**SMW-10-S2**	**0.5 - 0.5**
cis-1,2-Dichloroethene	**70**	**18 / 40**	**1**	**0.06 J**	**74**	**SMW-9-S2**	**0.5 - 0.5**
Vinyl Chloride	0.25	1 / 40	0	0.17 J	0.17 J	SMW-9-S2	0.5 - 5
1,1,2-Trichloro-1,2,2-trifluoroethane	5300	3 / 40	0	0.22 J	0.41 J	IVAX-2-S2	0.5 - 5
1,1,2-Trichloroethane	5	3 / 40	0	0.16 J	0.52 J	IVAX-Abandon-S2	0.5 - 5
1,1-Dichloroethane	**2.4**	**6 / 40**	**2**	**0.073 J**	**6.6 J**	**IVAX-Abandon-S2**	**0.5 - 5**
1,1-Dichloroethene	**7**	**4 / 40**	**3**	**3.6 J**	**39 J**	**IVAX-2-S2**	**0.5 - 5**
Acetone	1200	1 / 40	0	41	41	SMW-3-S2	5 - 50
Benzene	5	6 / 40	0	0.079 J	3.3	SMW-3-S2	0.5 - 5
Bromodichloromethane	5.5	30 / 40	0	0.1 J	1.5	MPW-2-P4-S2	0.5 - 5
Bromomethane	47	7 / 40	0	0.074 J	0.1 J	MPW-5-P1-S2	0.5 - 5
Carbon Disulfide	72	2 / 40	0	0.17 J	0.18 J	CIDRA-6-S2	0.5 - 5
Carbon Tetrachloride	2.3	21 / 40	0	0.16 J	1.5	MPW-1-P5-S2	0.5 - 5
Chlorobenzene	100	6 / 40	0	0.14 J	0.49 J	MPW-1-P6-S2	0.5 - 5
Chloroform	**57**	**37 / 40**	**3**	**1.7**	**210 J**	**IVAX-Abandon-S2**	**0.5 - 5**
Chloromethane	19	2 / 40	0	0.11 J	0.15 J	MPW-6-P5-S2	0.5 - 5
Dibromochloromethane	4	19 / 40	0	0.066 J	0.18 J	IVAX-Abandon-S2	0.5 - 5
Dichlorodifluoromethane	19	29 / 40	0	0.082 J	1.2	MPW-2-P4-S2	0.5 - 5
Isopropylbenzene	39	1 / 40	0	2.1	2.1	SMW-3-S2	0.5 - 5
m,p-Xylene	10000	1 / 40	0	0.32 J	0.32 J	MPW-1-P6-S2	0.5 - 5
Methyl tert-Butyl Ether	**12**	**7 / 40**	**1**	**0.18 J**	**350**	**SMW-3-S2**	**0.5 - 5**
Methylene Chloride	46	12 / 40	0	0.068 J	0.17 J	MPW-1-P3-S2	0.5 - 5
o-Xylene	10000	1 / 40	0	0.87	0.87	SMW-3-S2	0.5 - 5
Toluene	1000	16 / 40	0	0.11 J	18	MPW-1-P6-S2	0.5 - 5
trans-1,2-Dichloroethene	100	6 / 40	0	0.093 J	0.61	SMW-9-S2	0.5 - 5
Trichlorofluoromethane	110	13 / 40	0	0.085 J	0.28 J	MPW-4-P3-S2	0.5 - 5
Inorganics (µg/L)							
Aluminum	**1600**	**8 / 40**	**2**	**160**	**13000**	**SMW-2-S2**	**100 - 100**
Arsenic	**10**	**1 / 40**	**1**	**11**	**11**	**MPW-1-P3-S2**	**8 - 8**
Barium	2000	10 / 40	0	120	640	SMW-3-S2	100 - 100
Calcium	N/A	40 / 40	0	17000	100000	CIDRA-6-S2	NA - NA
Chromium	100	6 / 40	0	5.7	46	SMW-2-S2	5 - 5
Copper	1300	2 / 40	0	18	42	SMW-2-S2	10 - 10
Iron	**1100**	**14 / 40**	**6**	**89**	**20000**	**CIDRA-4-S2**	**50 - 50**
Magnesium	N/A	40 / 40	0	6200	60000	SMW-2-S2	NA - NA
Manganese	**32**	**21 / 40**	**10**	**6.3**	**1600**	**SMW-3-S2**	**5 - 5**
Mercury	**0.05**	**2 / 40**	**2**	**0.54**	**2.3**	**SMW-3-S2**	**0.2 - 0.2**
Nickel	610	1 / 40	0	26	26	SMW-2-S2	20 - 20
Potassium	N/A	40 / 40	0	1000	51000	SMW-10-S2	NA - NA
Sodium	N/A	40 / 40	0	13000	120000	SMW-10-S2	NA - NA
Vanadium	**7.8**	**27 / 40**	**27**	**20**	**67**	**SMW-10-S2**	**20 - 20**
Zinc	470	4 / 40	0	25	41	SMW-2-S2	20 - 20

Notes:
Highlight and bold font indicates an exceedance.
J - value is estimated
NA - not applicable
µg/L - microgram per liter

Table 4-21a
Groundwater Exceedances - Stage 2a
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Groundwater Screening Criteria	SMW-4-S2a 48 to 58 feet bgs		SMW-6-S2a 39 to 49 feet bgs		SMW-7-S2a 41 to 51 feet bgs		SMW-8-S2a 44 to 54 feet bgs	
Volatile Organic Compounds (µg/L)									
2-Hexanone	3.4	**3.6**	J	5	U	5	U	5	U
Tetrachloroethene	5	3.6	J	**70**		**63**		0.1	J
Inorganic Analytes (µg/L)									
Aluminum	1600	**4610**		457		127		390	
Cobalt	0.47	**6.4**	J	**0.68**	J	**0.54**	J	**1.6**	J
Iron	1100	**4450**		558		221		514	
Manganese	32	**1520**		**337**		**422**		**1240**	
Mercury	0.05	**0.064**	J	0.2	U	0.2	U	0.2	U
Vanadium	7.8	**34.3**	J	**23.8**	J	**27**	J	**18.2**	J

Notes:

Highlight indicates exceedance of the site-specific soil screening criteria

µg/L - microgram per liter

bgs - below ground surface

U - not detected above the given reporting limit

J - estimated value

Table 4-21b
Sample Summary Statistics - Stage 2a Groundwater Sampling Event
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/L)							
Tetrachloroethene	**5**	**2 / 2**	**2**	**0.1 J**	**70**	**SMW-6-S2a**	**NA - NA**
Trichloroethene	5	2 / 4	0	1.6	2.3	SMW-6-S2a	0.5 - 0.5
cis-1,2-Dichloroethene	70	2 / 4	0	3.1	6.6	SMW-6-S2a	0.5 - 0.5
2-Hexanone	**3.4**	**1 / 4**	**1**	**3.6 J**	**3.6 J**	**SMW-4-S2a**	**5 - 5**
Chloroform	57	4 / 4	0	0.21	3.6	SMW-6-S2a	NA - NA
Methyl tert-Butyl Ether	12	1 / 4	0	0.57	0.57	SMW-4-S2a	0.5 - 0.5
Trichlorofluoromethane	110	1 / 4	0	0.74	0.74	SMW-4-S2a	0.5 - 0.5
Inorganics (µg/L)							
Aluminum	**1600**	**4 / 4**	**1**	**127**	**4610**	**SMW-4-S2a**	**NA - NA**
Arsenic	10	4 / 4	0	0.41 J	1.1	SMW-4-S2a	NA - NA
Barium	2000	4 / 4	0	5.6 J	121	SMW-4-S2a	NA - NA
Calcium	N/A	4 / 4	0	41100	61800	SMW-8-S2a	NA - NA
Chromium	100	3 / 4	0	6.3	13.1 J	SMW-4-S2a	2 - 2
Cobalt	**0.47**	**4 / 4**	**4**	**0.54 J**	**6.4 J**	**SMW-4-S2a**	**NA - NA**
Copper	1300	4 / 4	0	2.6 J	17.6 J	SMW-4-S2a	NA - NA
Iron	**1100**	**4 / 4**	**1**	**221**	**4450**	**SMW-4-S2a**	**NA - NA**
Lead	15	4 / 4	0	0.15 J	0.93 J	SMW-4-S2a	NA - NA
Magnesium	N/A	4 / 4	0	22800	37000	SMW-8-S2a	NA - NA
Manganese	**32**	**4 / 4**	**4**	**337**	**1520**	**SMW-4-S2a**	**NA - NA**
Mercury	**0.05**	**1 / 4**	**1**	**0.064 J**	**0.064 J**	**SMW-4-S2a**	**0.2 - 0.2**
Nickel	610	4 / 4	0	2.5	14.9 J	SMW-4-S2a	NA - NA
Potassium	N/A	4 / 4	0	1600	7100	SMW-4-S2a	NA - NA
Selenium	50	2 / 4	0	0.63 J	0.72 J	SMW-8-S2a	5 - 5
Sodium	N/A	4 / 4	0	27100	56300	SMW-4-S2a	NA - NA
Vanadium	**7.8**	**4 / 4**	**4**	**18.2 J**	**34.3 J**	**SMW-4-S2a**	**NA - NA**
Zinc	470	4 / 4	0	10.2 J	30.8 J	SMW-4-S2a	NA - NA

Notes:

Highlight and bold font indicates an exceedance.

J - value is estimated

NA - not applicable

µg/L - microgram per liter

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Table 4-22a
Surface Water Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Surface Water Screening Criteria	SW-1		SW-2		SW-3		SW-4		SW-5		SW-6		SW-7		SW-8		SW-9		SW-10	
Inorganics (µg/L)																					
Antimony	5.6	3.7		4.3		**6.6**	J	5.6	J	**6.9**	J	**6.1**	J		R		R		R		R

Notes:
Highlight indicates exceedance of the site-specific surface water screening criteria
µg/L - milligram per liter
J - estimated value
R - rejected value

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Table 4-22b
Surface Water Sample Summary Statistics
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/L)							
Tetrachloroethene	5	6 / 10	0	1.8	4.6	SW-7	0 - 0
Trichloroethene	5	1 / 10	0	0.25 J	0.25 J	SW-7	0.5 - 0.5
cis-1,2-Dichloroethene	N/A	3 / 10	0	0.27 J	0.65	SW-7	0.5 - 0.5
1,1,2-Trichloroethane	5	1 / 10	0	0.062 J	0.062 J	SW-6	0.2 - 0.2
2-Hexanone	N/A	3 / 10	0	3.4 J	4.2 J	SW-6	5 - 5
Toluene	1000	1 / 10	0	0.18 J	0.18 J	SW-6	0.5 - 0.5
Inorganics (µg/L)							
Aluminum	N/A	10 / 10	0	27.6	153	SW-1	0 - 0
Antimony	**5.6**	**6 / 10**	**3**	**3.7**	**6.9 J**	**SW-5**	**0 - 0**
Arsenic	10	10 / 10	0	0.88 J	1.1	SW-8	0 - 0
Barium	N/A	10 / 10	0	28.5	32.7	SW-6	0 - 0
Calcium	N/A	10 / 10	0	38400	69700	SW-1	0 - 0
Chromium	11.43	8 / 10	0	0.3 J	0.41 J	SW-9	2 - 2
Cobalt	N/A	10 / 10	0	0.21 J	0.4 J	SW-1	0 - 0
Copper	11.95	10 / 10	0	1.4 J	2.6 J	SW-1	0 - 0
Cyanide	5.2	1 / 8	0	1 J	1 J	SW-4	10 - 10
Iron	N/A	2 / 10	0	60.5 J	191 J	SW-1	200 - 200
Lead	0.97	2 / 10	0	0.05 J	0.11 J	SW-1	1 - 1
Magnesium	N/A	10 / 10	0	17300	25700	SW-2	0 - 0
Manganese	N/A	10 / 10	0	13.7	205	SW-9	0 - 0
Nickel	51.7	10 / 10	0	0.93 J	1.7	SW-4	0 - 0
Potassium	N/A	10 / 10	0	1950	3110	SW-1	0 - 0
Selenium	5	1 / 10	0	0.28 J	0.28 J	SW-3	5 - 5
Sodium	N/A	10 / 10	0	26500	35400	SW-1	0 - 0
Vanadium	N/A	10 / 10	0	8.8 J	16.2 J	SW-9	0 - 0
Zinc	104.69	5 / 10	0	2.3	8.9 J	SW-1	2 - 2

Notes:
Highlight and bold font indicates an exceedance.
µg/L - microgram per kilogram
J - value is estimated
NA - not applicable

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R2-0007346

Table 4-23a
Sediment Exceedances
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

	Cidra Sediment Screening Criteria	SD-1 0 to 0.5 feet bgs		SD-2 0 to 0.5 feet bgs		SD-3 0 to 0.5 feet bgs		SD-4 0 to 0.5 feet bgs		SD-5 0 to 0.5 feet bgs		SD-6 0 to 0.5 feet bgs		SD-7 0 to 0.5 feet bgs		SD-8 0 to 0.5 feet bgs		SD-9 0 to 0.5 feet bgs		SD-10 0 to 0.5 feet bgs	
Inorganics (mg/kg)																					
Aluminum	7700	**20200**		**19900**		**15300**	J	**18800**	J	**15400**	J	**17500**	J	**11700**	J	**13800**	J	**10600**	J	**18400**	J
Arsenic	0.39	**5**	J	**3.9**	J	2.9	R	**3.1**	J	**4.7**	J		R		R		R	**3**	J	**4.6**	J
Chromium	0.29	**43.7**		**35.7**			R		R		R		R		R		R		R		R
Cobalt	2.3	**35**		**19.3**			R		R		R		R		R		R		R		R
Copper	31.6	**52.6**	J	**83.4**	J	**57.3**	J	**56**	J	**35.4**	J	**54.3**	J	**40**	J	**41.3**	J	31.2	J	**77.3**	J
Iron	5500	**42300**	J	**38900**	J	**34200**	J	**37300**	J	**33300**	J	**36300**	J	**22200**	J	**30100**	J	**22900**	J	**33500**	J
Manganese	180	**2170**		**918**		**866**	J	**1020**	J	**848**	J	**1040**	J	**748**	J	**1250**	J	**729**	J	**998**	J
Mercury	0.18	0.022	J	0.017	J	0.12	U	0.12	U	0.12	U	**0.92**		0.12	U	0.12	U	0.11	U	0.11	U
Nickel	22.7	**34.5**		**26.5**			R		R		R		R		R		R		R		R
Vanadium	39	**234**	J	**122**	J	**119**	J	**125**	J	**87.7**	J	**140**	J	**103**	J	**104**	J	**83.3**	J	**149**	J

Notes:
Highlight indicates exceedance of the site-specific sediment screening criteria
mg/kg - milligram per kilogram
bgs - below ground surface
U - not detected above the given reporting limit
J - estimated value
R - rejected value

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Table 4-23b
Sediment Sample Summary Statistics
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Criteria	Detection Frequency	Number of Exceedances	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Range of Detection Limit
Volatile Organic Compounds (µg/kg)							
Tetrachloroethene	990	1 / 10	0	1.9 J	1.9 J	SD-9	5.1 - 6.2
Inorganics (mg/kg)							
Aluminum	**7700**	**10 / 10**	**10**	**10600 J**	**20200**	**SD-1**	**NA - NA**
Arsenic	**0.39**	**6 / 10**	**6**	**3 J**	**5 J**	**SD-1**	**NA - NA**
Barium	1500	2 / 10	0	61.8 J	80.4 J	SD-1	NA - NA
Calcium	N/A	10 / 10	0	6630 J	19300 J	SD-3	NA - NA
Chromium	**0.29**	**2 / 10**	**2**	**35.7**	**43.7**	**SD-1**	**NA - NA**
Cobalt	**2.3**	**2 / 10**	**2**	**19.3**	**35**	**SD-1**	**NA - NA**
Copper	**31.6**	**10 / 10**	**9**	**31.2 J**	**83.4 J**	**SD-2**	**NA - NA**
Cyanide	4.7	1 / 10	0	0.62	0.62	SD-10	0.55 - 0.62
Iron	**5500**	**10 / 10**	**10**	**22200 J**	**42300 J**	**SD-1**	**NA - NA**
Lead	35.8	1 / 10	0	24.4 J	24.4 J	SD-5	NA - NA
Magnesium	N/A	10 / 10	0	4590 J	9820	SD-1	NA - NA
Manganese	**180**	**10 / 10**	**10**	**729 J**	**2170**	**SD-1**	**NA - NA**
Mercury	**0.18**	**3 / 10**	**1**	**0.017 J**	**0.92**	**SD-6**	**0.11 - 0.12**
Nickel	**22.7**	**2 / 10**	**2**	**26.5**	**34.5**	**SD-1**	**NA - NA**
Potassium	N/A	2 / 10	0	700 J	863	SD-1	546 - 622
Vanadium	**39**	**10 / 10**	**10**	**83.3 J**	**234 J**	**SD-1**	**NA - NA**
Zinc	121	10 / 10	0	36.6 J	116 J	SD-5	NA - NA

Notes:
Highlight and bold font indicates an exceedance.
µg/L - microgram per kilogram
J - value is estimated
NA - not applicable

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Table 4-24a
Summary of Vapor Intrusion Results for Site-Related Contaminants - Residential and Mixed Use Properties
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical	Units	Screening Level[1]	IDC AI-01/VI-01	579 Store AI-02/VI-02	Public Housing AI-03/VI-03	Public Housing AI-04/VI-04
Indoor Air						
1,1-Dichloroethene	µg/m^3	209 NC	0.079 U	0.079 U	0.079 U	0.079 U
cis-1,2-Dichloroethene	µg/m^3	N/A	0.13	0.21	0.093	0.079 U
Tetrachloroethene	µg/m^3	9.4 C	4.8	0.18	1.1	0.21
Trichloroethene	µg/m^3	0.43 C	0.2	0.14	0.11 U	0.22
Vinyl Chloride	µg/m^3	0.16 C	0.1 U	0.1 U	0.1 U	0.1 U
Subslab Soil Vapor						
1,1-Dichloroethene	µg/m^3	2086 NC	7.9 U	0.79 U	1.4 U	1.4 U
cis-1,2-Dichloroethene	µg/m^3	N/A	89	0.79 U	1.4 U	1.4 U
Tetrachloroethene	µg/m^3	94 C	9400 D	20	38	2.9
Trichloroethene	µg/m^3	4.3 C	520	1.1 U	1.9 U	1.9 U
Vinyl Chloride	µg/m^3	1.6 C	5.1 U	0.51 U	0.91 U	0.91 U

N/A - not available
µg/m^3 - microgram per cubic meter

U - qualifier for non-detected value
D - qualifier for diluted sample

Notes:
(1) Screening levels are obtained from EPA OSWER Vapor Intrusion Assessment, Vapor Intrusion Screening Level Calculator Ve
Indoor Air screening level - target indoor air concentrations for residential scenario
Subslab Soil Vapor screening level - target subslab soil vapor concentration for residential scenario
C - Target concentration is based on a cancer risk of 1 in 1,000,000
NC - Target concentration is based on a noncancer hazard index of 1.0

Yellow highlight indicates exceedance of screening level.

Table 4-24b
Summary of Vapor Intrusion Results for Site-Related Contaminants - Industrial and Commercial Use Properties
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical	Units	Screening Level[1]	CCL Label AI-05/VI-05	CCL Label AI-06/VI-06	Ramallo AI-07/VI-07	Ramallo AI-08/VI-08	ENCO AI-09/VI-09	ENCO AI-10/VI-10
Indoor Air								
1,1-Dichloroethene	µg/m^3	876 NC	4 U	3.2 U	0.079 U	0.079 U	1.6 U	1.6 U
cis-1,2-Dichloroethene	µg/m^3	N/A -	4 U	3.2 U	0.16	0.13	1.6 U	1.6 U
Tetrachloroethene	µg/m^3	47 C	6.8 U	5.4 U	31 D	9.3	2.7 U	2.7 U
Trichloroethene	µg/m^3	3.0 C	5.4 U	4.3 U	0.69	0.13	2.1 U	2.1 U
Vinyl Chloride	µg/m^3	2.8 C	2.6 U	2 U	0.1 U	0.1 U	1 U	1 U
Subslab Soil Vapor								
1,1-Dichloroethene	µg/m^3	8760 NC	0.79 U	1.6 U	1700 U	55 U	0.79 U	0.79 U
cis-1,2-Dichloroethene	µg/m^3	N/A -	0.79 U	1.6 U	1700 U	55 U	0.79 U	0.79 U
Tetrachloroethene	µg/m^3	472 C	49	8.8	2200000 D	63000 D	220	26
Trichloroethene	µg/m^3	30 C	3.6	2.1 U	2300 U	75 U	1.1 U	1.1 U
Vinyl Chloride	µg/m^3	28 C	0.51 U	1 U	1100 U	36 U	0.51 U	0.51 U

N/A - not available
µg/m^3 - microgram per cubic meter
U - qualifier for non-detected value
D - qualifier for diluted sample

Notes:
(1) Screening levels are obtained from EPA OSWER Vapor Intrusion Assessment, Vapor Intrusion Screening Level Calculator Version 3.0. November 2
Indoor Air screening level - target indoor air concentrations for commercial scenario
Subslab Soil Vapor screening level - target subslab soil vapor concentration for commercial scenario
C - Target concentration is based on a cancer risk of 1 in 1,000,000
NC - Target concentration is based on a noncancer hazard index of 1.0

Yellow highlight indicates exceedance of screening level.

Table 4-24c
Summary of Ambient Air Sample Results for Site-Related Contaminants
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical Name	Units	Screening Level[1]		Upgradient - IDC AA-01	Upgradient - Ramallo AA-02	Upgradient - Ramallo AA-03
1,1-Dichloroethene	µg/m^3	209	NC	0.079 U	0.079 U	0.079 U
cis-1,2-Dichloroethene	µg/m^3	N/A	-	0.079 U	0.079 U	0.079 U
Tetrachloroethene	µg/m^3	9.4	C	0.14 U	0.14 U	0.14 U
Trichloroethene	µg/m^3	0.43	C	0.62	0.11 U	0.21
Vinyl Chloride	µg/m^3	0.16	C	0.1 U	0.1 U	0.1 U

N/A - not available
µg/m^3 - microgram per cubic meter
U - qualifier for non-detected value
IDC - International Dry Cleaners

Notes:
(1) Based on target indoor air concentration for residential scenario. Source: EPA OSWER Vapor Intrusion Assessment, Vapor Intrus
Level Calculator Version 3.0. November 2012.
C - Target indoor air concentration is based on a cancer risk of 1 in 1,000,000
NC - Target indoor air concentration is based on a noncancer hazard index of 1.0

Yellow highlight indicates exceedance of screening level.

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R2-0007351

Table 5-1
Fate and Transport Properties for Site Related Contaminants
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Chemical	Molecular Weight (g/mole)	Water Solubility @25^0 C (mg/L)	Vapor Pressure @25^0 C (mm Hg)	Henry's Law Constant (atm-m^3/mol)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	Octanol-Water Partition Coefficient log K_{ow}	Soil-Water Partition Coefficient (K_d) (cm^3/g)	Retardation Factor	Density (g/cm^3)	Soil Saturation Limit (mg/kg)	Adsorption	Volatilization from Water	Mobility
1,1-Dichloroethene	96.9	2,420	634	0.026	32	2.1	0.11	1.7	1.21	1,190	Low	High	High
cis-1,2-Dichloroethene	97	6,410	201	0.004	40	1.9	0.13	1.8	1.28	2,370	Low	High	High
Tetrachloroethene	166	206	19	0.009	95	3.4	0.31	3.0	1.62	166	Low	High	High
Trichloroethene	131	1,280	69	0.018	61	2.4	0.20	2.3	1.46	692	Low	High	High
Vinyl Chloride	63	8,800	2,980	0.028	22	1.6	0.07	1.5	0.91	3,920	Low	High	High

VARIABLES FOR THE UNCONSOLIDATED OVERBURDEN UNIT

Fraction Organic Carbon, 0.33% f_{oc} (%) = TOC (mg/kg) × 10^{-6} kg/mg x 100

Soil Bulk Density, Rho_b = 1.38 (g/cm^3)

Effective Porosity, Eta_e = 22%

Adsorption is	"Low"	if K_d <	0.5
	"High"	if K_d >	2
	"Moderate'	if K_d is in-between	
Volatilization from Water	"Low"	if H <	1E-07
	"High"	if H >	1E-03
	"Moderate'	if H is in-between	
Mobility is	"High"	if R_f <	10
	"Low"	if Rf >	1000
	"Moderate'	if R_f is in-between	

NOTATION

K_{oc} - Soil Organic Carbon/Water Partition Coefficient, cm^3/g

K_{ow} - n-Octanol/Water Partition Coefficient, dimensionless

K_d - Soil/Water Partition Coefficient [- K_{oc} X f_{oc} for organics], cm^3/g

The f_{oc} value used above is for soil average TOC result of 3,306 mg/kg

R_f - Retardation Factor - 1 + (Rho_b x Kd/Eta_e) dimensionless - 1+(ρb/η)Kd

TOC - total organic carbon

Notes:

g/mole - gram per mole

mg/L- milligram per liter

mm Hg - millimeter of mercury

atm-m^3/mol - atmosphere cubic meters per mole

mL/g - milliliter per gram

cm^3/g - cubic centimeter per gram

^{0}C - degrees Celsius

L/kg - liter per kilogram

References:

EPA. 2004. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February

EPA. 2012. Regional Screening Levels for Chemical Contaminants at Superfund Sites. November

Freeze, R.A. and Cherry, J.A. 1979. Groundwater.

The Risk Assessment Information System (http://rais.ornl.gov/)

Table 5-2
Analytical Parameters and Weighting for Preliminary Screening for Anaerobic Biodegradation Processes
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Analysis	Concentration in Most Contaminated Zone	Interpretation	Value
Oxygen	<0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations	3
Oxygen	>5 mg/L	Not tolerated; however, VC may be oxidized aerobically	-3
Nitrate	<1 mg/L	At higher concentrations may compete with reductive pathway	2
Iron II	>1 mg/L	Reductive pathway possible; VC may be oxidized under Fe(III)-reducing conditions	3
Sulfate	<20 mg/L	At higher concentrations may compete with reductive pathway	2
Sulfide	>1 mg/L	Reductive pathway possible	3
Methane	<0.5 mg/L >0.5 mg/L	VC oxidizes Ultimate reductive daughter product, VC accumulates	0 3
ORP	<50 mV <-100 mV	Reductive pathway possible Reductive pathway likely	1 2
pH	5<pH<9 5>pH>9	Optimal range for reductive pathway Outside optimal range for reductive pathway	0 -2
TOC	>20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2
Temperature	>20°C	At T >20°C biochemical process is accelerated	1
Carbon Dioxide (CO_2)	>2x background	Ultimate oxidative daughter product	1
Alkalinity	>2x background	Results from interaction between CO_2 and aquifer minerals	1
Chloride	>2x background	Daughter product of organic chlorine	2
Hydrogen	>1 nM	Reductive pathway possible, VC may accumulate	3
Hydrogen	<1 nM	VC oxidized	0
Volatile Fatty Acids	>0.1 mg/L	Intermediates resulting from biodegradation of more complex compounds; carbon and energy source	2
BTEX	>0.1 mg/L	Carbon and energy source; drives dechlorination	2
Tetrachloroethene (PCE)		Material released	0
Trichloroethene (TCE)		Material released Daughter product of PCE	0 2[(1)]
Dichloroethene (DCE)		Material released Daughter product of TCE If cis is > 80% of total DCE it is likely a daughter product 1,1-DCE can be chemical reaction product of TCA	0 2[(1)]
Vinyl Chloride (VC)		Material released Daughter product of DCE	0 2[(1)]
1,1,1-Trichloroethane (TCA)		Material released	0
Dichloroethane (DCA)		Daughter product of TCA under reducing conditions	2
Carbon Tetrachloride		Material released	0
Chloroethane		Daughter product of DCA or VC under reducing conditions	2
Ethene/Ethane	>0.01 mg/L >0.1 mg/L	Daughter product of VC/ethene	2 3
Chloroform		Material released Daughter product of carbon tetrachloride	0 2[(1)]
Dichloromethane		Material released Daughter product of chloroform	0 2[(1)]

mg/L - milligram per liter
mV - millivolts
ORP - oxidation reduction potential
BTEX - benzene, toluene, ethylbenzene, xylenes
°C - degrees Celsius
nM - nanomoles
TOC - total organic carbon
Fe(III) - Iron III

[(1)] Points awarded only if it can be shown that the compound is a daughter product.

Source: EPA. 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water. Table 2.3

Table 5-3
Analytical Parameters and Scoring for Preliminary Screening for Anaerobic Degradation of Chlorinated Organic Compounds in Saprolite Unit
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Analysis	Unit	Source Area		Downgradient Plume Area			
		SMW-10		SMW-1		SMW-9	
		Concentration	Point	Concentration	Point	Concentration	Point
Dissolved Oxygen	mg/L	0.07	3	0.8	0	0.13	3
Nitrate	mg/L	4.5	0	3.4	0	2.8	0
Ferrous Iron	mg/L	0.04	0	No data	0	0.2	0
Sulfate	mg/L	8.8	2	18	2	7	2
Sulfide	mg/L	ND	0	ND	0	0.016	0
Methane	mg/L	0.0082	0	0.0043	0	0.0026	0
Oxidation-Reduction Potential	mV	107	0	114.6	0	90.5	0
pH	-	11.69[1]	-2	6	0	10.4[1]	-2
Total Organic Carbon	mg/L	1.3	0	2	0	1.5	0
Temperature	^{o}C	28	1	28.35	1	27.88	1
Alkalinity	mg/L	230	0	180	0	150	0
Chloride	mg/L	24	0	36	0	28	0
BTEX	mg/L	ND	0	ND	0	ND	0
Tetrachloroethene	µg/L	1700	0	680	0	57	0
Trichloroethene	µg/L	31	2	14	2	9.7	2
cis-1,2-Dichloroethene	µg/L	60	2	24	2	74	2
Vinyl Chloride	µg/L	ND	0	ND	0	0.17	2
		Total Points	**8**		**7**		**10**

ND - not detected
mg/L - milligram per liter
µg/L - microgram per liter
mV - millivolts
^{o}C - degrees Celsius
BTEX - benzene, toluene, ethylbenzene, xylenes

[1] Strongly alkaline and alkaline conditions were reported at SMW-9 and SMW-10 during groundwater sampling. The presence of high pH in groundwater at these locations may be attributable to alkaline grout contamination during well installation.

Table 5-4
Analytical Parameters and Scoring for Preliminary Screening for Anaerobic Degradation of Chlorinated Organic Compounds in Bedrock Unit
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Analysis	Unit	MPW-1						MPW-5					
		Port 1		Port 3		Port 6		Port 4		Port 6		Port 7	
		Concentration	Point	Concentration	Point	Concentration	Point	Concentration	Point	Concentration	Point	Concentration	Point
Dissolved Oxygen	mg/L	0.58	0	0.37	3	0.78	0	0.67	0	0.89	0	0.39	3
Nitrate	mg/L	6.7	0	7.5	0	8.9	0	7.6	0	4.9	0	4.6	0
Ferrous Iron	mg/L	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
Sulfate	mg/L	9.7	2	11	2	9.4	2	4.2	2	7	2	9.1	2
Sulfide	mg/L	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
Methane	mg/L	0.1	0	1	3	4.3	3	0.5	3	0.5	3	0.6	3
Oxidation-Reduction Potential	mV	32.4	1	26.7	1	35.4	1	75.9	0	118.2	0	120.3	0
pH	-	6.23	0	6.72	0	6.87	0	6.64	0	6.57	0	7.1	0
Total Organic Carbon	mg/L	1.3	0	3.2	0	11	0	1.3	0	1.7	0	1.8	0
Temperature	^{o}C	24.68	1	23.93	1	23.55	1	24.9	1	25	1	25	1
Alkalinity	mg/L	190	0	220	0	230	0	190	0	240	0	250	0
Chloride	mg/L	47	0	58	0	59	0	50	0	40	0	41	0
BTEX	mg/L	0.0002	0	0.0002	0	0.019	0	0.0027	0	0.0016	0	0.0016	0
Tetrachloroethene	µg/L	12	0	2	0	0.33	0	8.5	0	73	0	86	0
Trichloroethene	µg/L	0.51	2	nd	0	nd	0	0.42	2	3.9	2	5.3	2
cis-1,2-Dichloroethene	µg/L	ND	0	1.6	2	1.7	2	2.8	2	28	2	32	2
Vinyl Chloride	µg/L	ND	0	nd	0	nd	0	ND	0	ND	0	ND	0
		Total Points	**6**		**12**		**9**		**10**		**10**		**13**

ND - not detected
mg/L - milligram per liter
µg/L - microgram per liter
mV - millivolts
^{o}C - degrees Celsius
BTEX - benzene, toluene, ethylbenzene, xylenes

Table 5-5
Analytical Parameters at Background Locations
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Analysis	Unit	Saprolite Unit SMW-12	Bedrock Unit MPW-2-P4
Dissolved Oxygen	mg/L	0	0.46
Nitrate	mg/L	3.9	7.8
Ferrous Iron	mg/L	0.03	ND
Sulfate	mg/L	10	3.3
Sulfide	mg/L	ND	ND
Methane	mg/L	0.0029	0.0
Oxidation-Reduction Potential	mV	69.5	97.1
pH	-	8.11	6.58
Total Organic Carbon	mg/L	1.5	ND
Temperature	^{o}C	27	23
Alkalinity	mg/L	210	150
Chloride	mg/L	38	49
BTEX	mg/L	ND	ND
Tetrachloroethene	µg/L	ND	ND
Trichloroethene	µg/L	ND	ND
cis-1,2-Dichloroethene	µg/L	ND	ND
Vinyl Chloride	µg/L	ND	ND

ND - not detected
mg/L - milligram per liter
µg/L - microgram per liter
mV - millivolts
^{o}C - degrees Celsius
BTEX - benzene, toluene, ethylbenzene, xylenes

Table 5-6
Interpretation of Points Awarded During Preliminary Screening Evaluation
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Score	Interpretation
0 to 5	Inadequate evidence for anaerobic biodegradation[(1)] of chlorinated organics
6 to 14	Limited evidence for anaerobic biodegradation[(1)] of chlorinated organics
15 to 20	Adequate evidence for anaerobic biodegradation[(1)] of chlorinated organics
>20	Strong evidence for anaerobic biodegradation[(1)] of chlorinated organics

[(1)] reductive dechlorination

Source: EPA. 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water. Table 2.4

Table 6-1
Summary of Cancer Risks and Noncancer Health Hazards
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Land Use	Exposure Area	Receptor	Cancer Risk [1]				Noncancer Hazard Index [2]			
			RME		CTE		RME		CTE	
			Value	Risk Driver	Value	Risk Driver	Total HI	HI Organ/Effect (Risk Driver)	Total HI	HI Organ/Effect (Risk Driver)
Current	Exposure Area 2	Worker	1×10^{-6}	--	--	--	0.3	--	--	--
		Trespasser	3×10^{-8}	--	--	--	0.6	--	--	--
		Resident [3]	6×10^{-6}	--	--	--	1	--	--	--
	Exposure Area 3	Worker	2×10^{-5}	--	--	--	3	kidney: 3 (vanadium) respiratory system: 3 (vanadium)	1	--
	Exposure Area 4	Worker	1×10^{-5}	--	--	--	3	kidney: 3 (vanadium) respiratory system: 3 (vanadium)	1	--
	Rio Arroyata	Recreational User	1×10^{-6}	--	--	--	2	kidney: 2 (vanadium) respiratory system: 2 (vanadium)	0.6	--
Future	Exposure Area 1	Worker	1×10^{-4}	arsenic (1×10^{-4})	5×10^{-5}	--	8	kidney: 6 (vanadium) respiratory system: 6 (vanadium)	5	kidney: 4 (vanadium) respiratory system: 4 (vanadium)
		Trespasser	9×10^{-7}	--	--	--	1	--	--	--
		Resident [3]	1×10^{-3}	chloroform (2×10^{-4}) arsenic (6×10^{-4})	2×10^{-4}	arsenic (2×10^{-4})	80	cardiovascular system: 6 (arsenic) CNS: 8 (PCE) developmental: 9 (TCE, arsenic) heart, immune system: 2 (TCE) kidney: 66 (PCE, TCE, vanadium) liver: 11 (1,1,2-TCA, PCE, TCE) lung: 9 (arsenic, cobalt) nervous system: 13 (PCE, arsenic) respiratory system: 60 (1,1,2-TCA, cobalt, vanadium) skin: 6 (arsenic) thyroid: 2 (cobalt)	33	cardiovascular system: 2 (arsenic) CNS: 2 (PCE) developmental: 3 (arsenic) kidney: 27 (PCE, vanadium) liver: 2 (PCE) lung: 4 (arsenic) nervous system: 4 (PCE, arsenic) respiratory system: 27 (vanadium) skin: 3 (arsenic)
		Construction Worker	4×10^{-7}	--	--	--	4	kidney: 3 (vanadium) respiratory system: 4 (vanadium)	--	--
	Exposure Area 2	Worker	2×10^{-4}	arsenic (1×10^{-4})	5×10^{-5}	--	8	kidney: 6 (vanadium) respiratory system: 6 (vanadium)	6	kidney: 4 (vanadium) respiratory system: 4 (vanadium)
		Trespasser	6×10^{-7}	--	--	--	2	kidney: 2 (vanadium)	0.8	--
		Resident [3]	1×10^{-3}	chloroform (2×10^{-4}) arsenic (6×10^{-4})	2×10^{-4}	arsenic (2×10^{-4})	85	cardiovascular system: 6 (arsenic) CNS: 8 (PCE) developmental: 9 (TCE, arsenic) heart, immune system: 3 (TCE) kidney: 71 (PCE, TCE, vanadium) liver: 12 (1,1,2-TCA, PCE, TCE) lung: 9 (arsenic, cobalt) nervous system: 13 (PCE, arsenic) respiratory system: 64 (1,1,2-TCA, cobalt, vanadium) skin: 6 (arsenic) thyroid: 2 (cobalt)	35	cardiovascular system: 2 (arsenic) CNS: 2 (PCE) developmental: 3 (arsenic) kidney: 30 (PCE, vanadium) liver: 2 (PCE) lung: 4 (arsenic) nervous system: 4 (PCE, arsenic) respiratory system: 29 (vanadium) skin: 3 (arsenic)
		Construction Worker	6×10^{-7}	--	--	--	5	kidney: 5 (vanadium) respiratory system: 4 (vanadium)	--	--

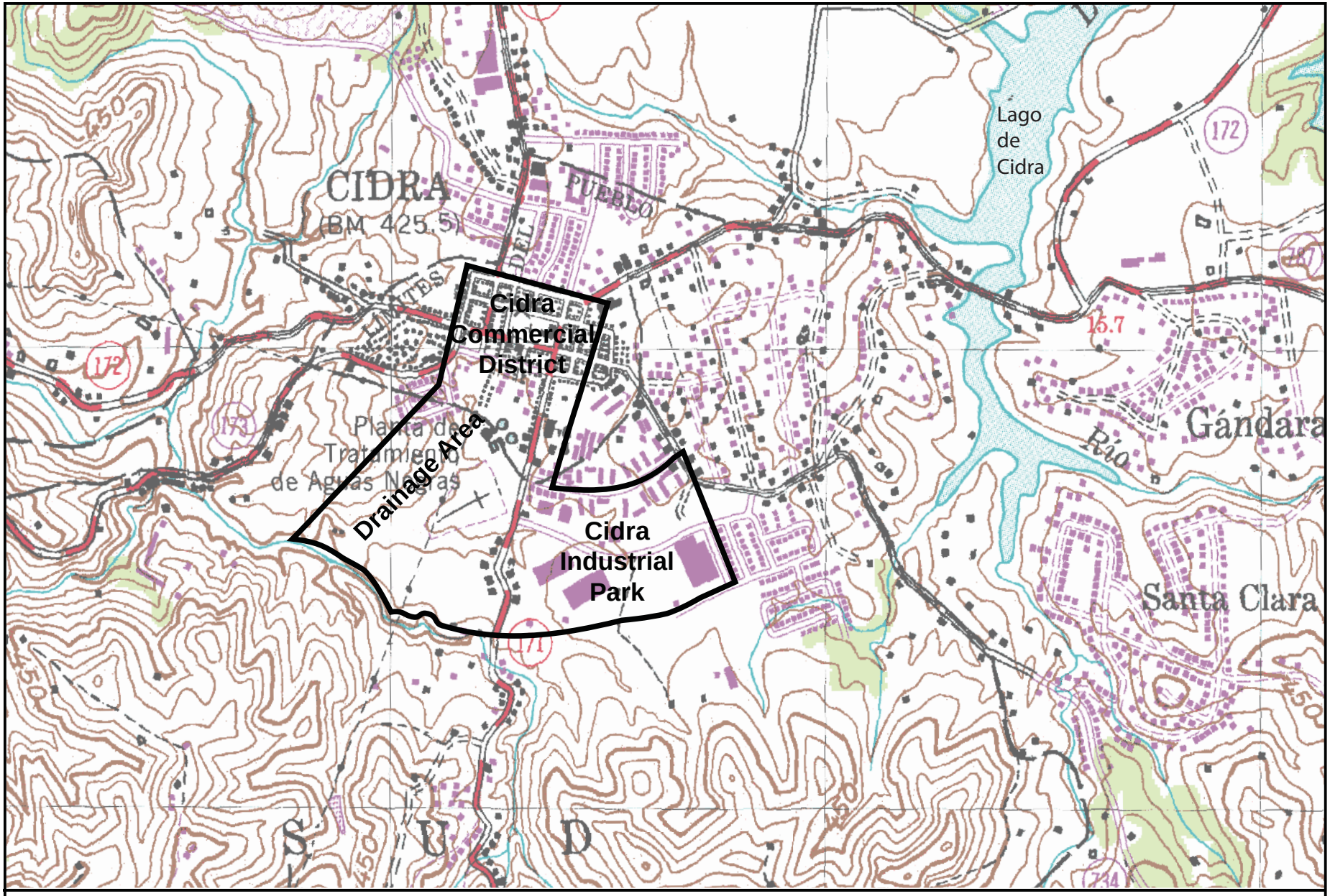
Table 6-1
Summary of Cancer Risks and Noncancer Health Hazards
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

Land Use	Exposure Area	Receptor	Cancer Risk [1]				Noncancer Hazard Index [2]			
			RME		CTE		RME		CTE	
			Value	Risk Driver	Value	Risk Driver	Total HI	HI Organ/Effect (Risk Driver)	Total HI	HI Organ/Effect (Risk Driver)
Future (cont'd)	Exposure Area 3	Worker	2×10^{-4}	arsenic (1×10^{-4})	5×10^{-5}	--	10	CNS: 2 (PCE) kidney: 8 (PCE, vanadium) liver: 2 (PCE) nervous system: 3 (PCE) respiratory system: 6 (vanadium)	6	kidney: 5 (PCE, vanadium) nervous system: 2 (PCE) respiratory system: 4 (vanadium)
		Trespasser	2×10^{-6}	--	--	--	2	kidney: 2 (vanadium)	0.5	--
		Resident [3]	1×10^{-3}	chloroform (2×10^{-4}) arsenic (6×10^{-4})	3×10^{-4}	arsenic (2×10^{-4})	93	cardiovascular system: 6 (arsenic) CNS: 16 (PCE) developmental: 9 (TCE, arsenic) heart, immune system: 2 (TCE) kidney: 79 (PCE, TCE, vanadium) liver: 20 (1,1,2-TCA, PCE, TCE) lung: 9 (arsenic, cobalt) nervous system: 22 (PCE, arsenic) respiratory system: 64 (1,1,2-TCA, cobalt, vanadium) skin: 6 (arsenic) thyroid: 3 (cobalt)	43	cardiovascular system: 2 (arsenic) CNS: 9 (PCE) developmental: 3 (arsenic) kidney: 37 (PCE, vanadium) liver: 10 (PCE) lung: 4 (arsenic) nervous system: 12 (PCE, arsenic) respiratory system: 29 (vanadium) skin: 2 (arsenic)
		Construction Worker	6×10^{-7}	--	--	--	4	kidney: 4 (vanadium) respiratory system: 4 (vanadium)	--	--
	Exposure Area 4	Worker	2×10^{-4}	arsenic (1×10^{-4})	5×10^{-5}	--	8	kidney: 6 (vanadium) lung: 2 (arsenic) respiratory system: 6 (vanadium)	6	kidney: 4 (vanadium) respiratory system: 4 (vanadium)
		Trespasser	1×10^{-6}	--	--	--	2	individual equal to 1	0.4	--
		Resident [3]	1×10^{-3}	chloroform (2×10^{-4}) arsenic (6×10^{-4})	3×10^{-4}	arsenic (2×10^{-4})	87	cardiovascular system: 6 (arsenic) CNS: 7 (PCE) developmental: 9 (TCE, arsenic) heart, immune system: 2 (TCE) kidney: 68 (PCE, TCE, vanadium) liver: 11 (1,1,2-TCA, PCE, TCE) lung: 13 (arsenic, cobalt) nervous system: 13 (PCE, arsenic) respiratory system: 67 (1,1,2-TCA, cobalt, vanadium) skin: 6 (arsenic) thyroid: 7 (cobalt)	39	cardiovascular system: 2 (arsenic) CNS: 3 (PCE) developmental: 3 (arsenic) kidney: 30 (PCE, vanadium) liver: 4 (PCE) lung: 6 (arsenic, cobalt) nervous system: 5 (PCE, arsenic) respiratory system: 31 (cobalt, vanadium) skin: 3 (arsenic) thyroid: 3 (cobalt)
		Construction Worker	4×10^{-7}	--	--	--	4	kidney: 3 (vanadium) respiratory system: 4 (vanadium)	--	--
	Rio Arroyata	Recreational User	1×10^{-6}	--	--	--	2	kidney: 2 (vanadium) respiratory system: 2 (vanadium)	0.6	--

RME = reasonable maximum exposure
CTE = central tendency exposure
CNS = central nervous system
TCE = trichloroethene
1,1,2-TCA = 1,1,2-trichloroethane
PCE = tetrachloroethene

Notes:
-- not calculated
[1] Bolded values exceed EPA's target range of $1x10^{-6}$ to $1x10^{-4}$
[2] Bolded values exceed EPA's threshold of unity (1)
[3] For residents, carcinogenic risk is based on age-adjusted scenario and non-carcinogenic hazard index is based on child exposure scenario
Exposure Area 1 includes Ramoncito, Don Quijote Pizza, Coffee Shop, and ESSO
Exposure Area 2 includes International Dry Cleaners
Exposure Area 3 includes CCL Label, Ramallo/Cidra Convention Center, and ENCO
Exposure Area 4 includes Shellfoam, DJ Manufacturing, IVAX, and Pepsi

Figures



Source USGS 7.5 Minute Series Topographic Map, Comerio Quadrangle, Puerto Rico

Site Area

N

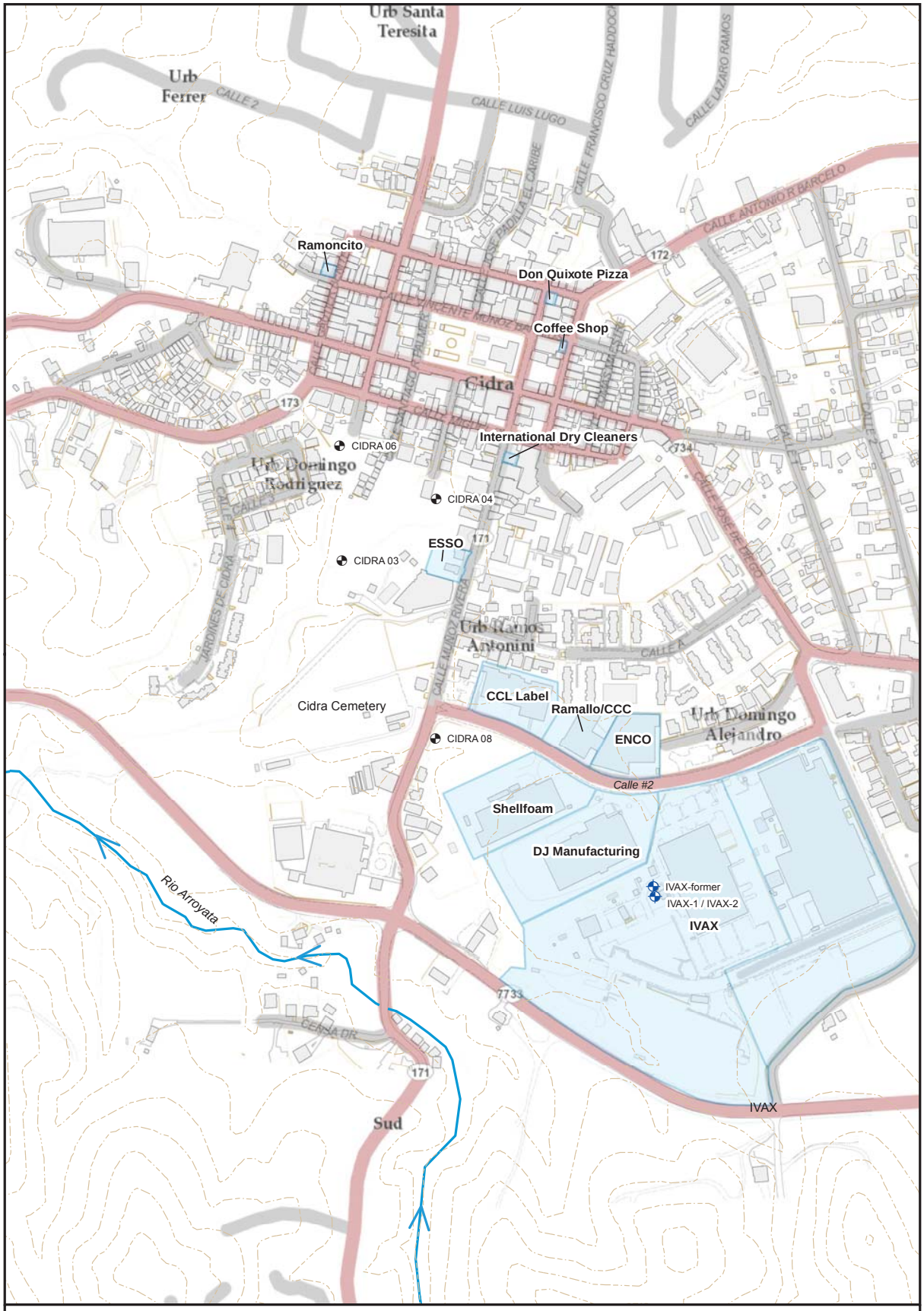
approximate scale

0 0.25 0.5 miles

Figure 1-1
Site Location Map
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007361



Legend

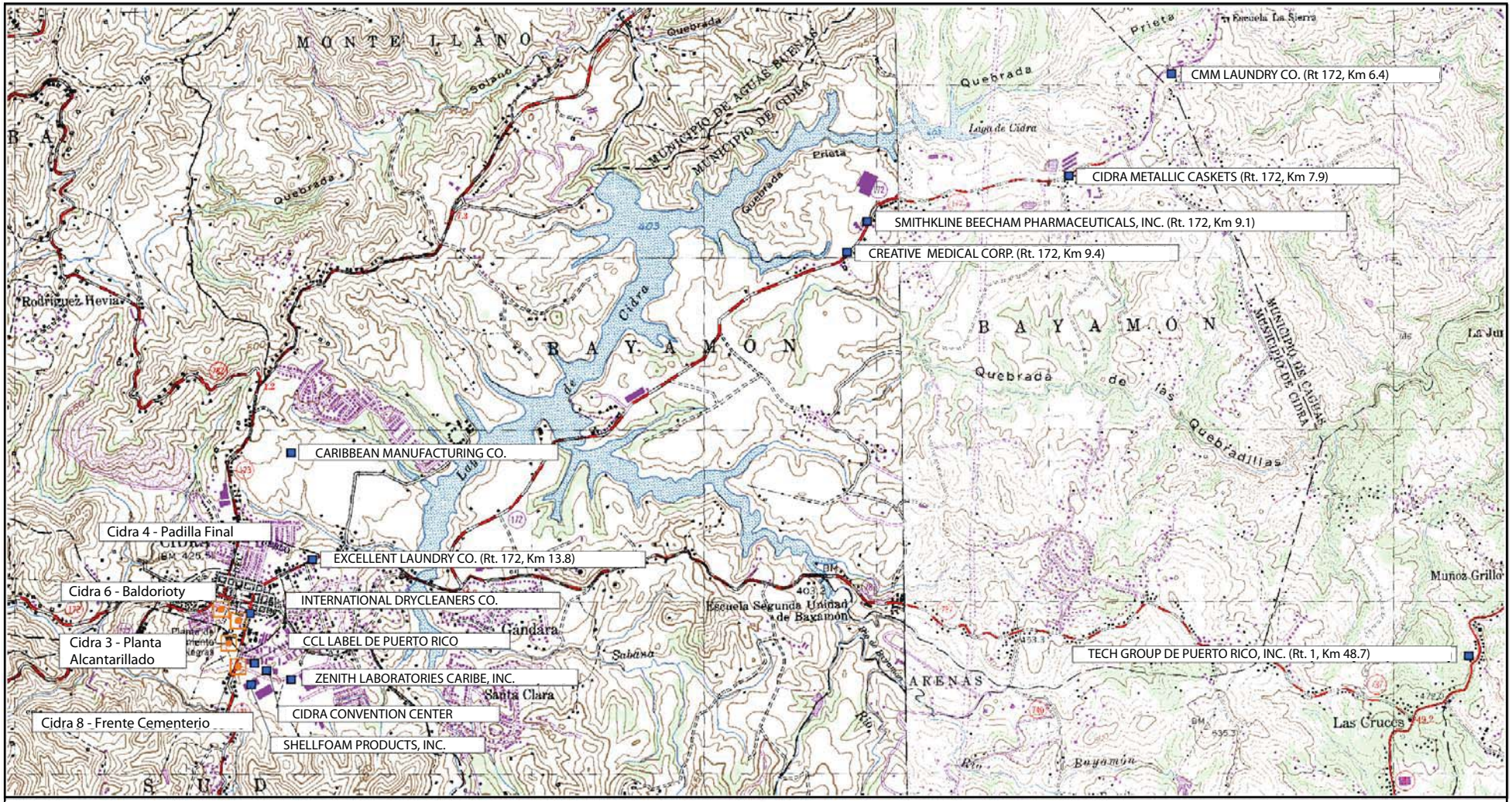
- Cidra Public Supply Well (out of service)
- Industrial Supply Well
- Topographic contour line (10 meter intervals)
- Rio Arroyata flow direction

0 100 200 400 600 800 Feet

Figure 1-2
Site Map
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007362

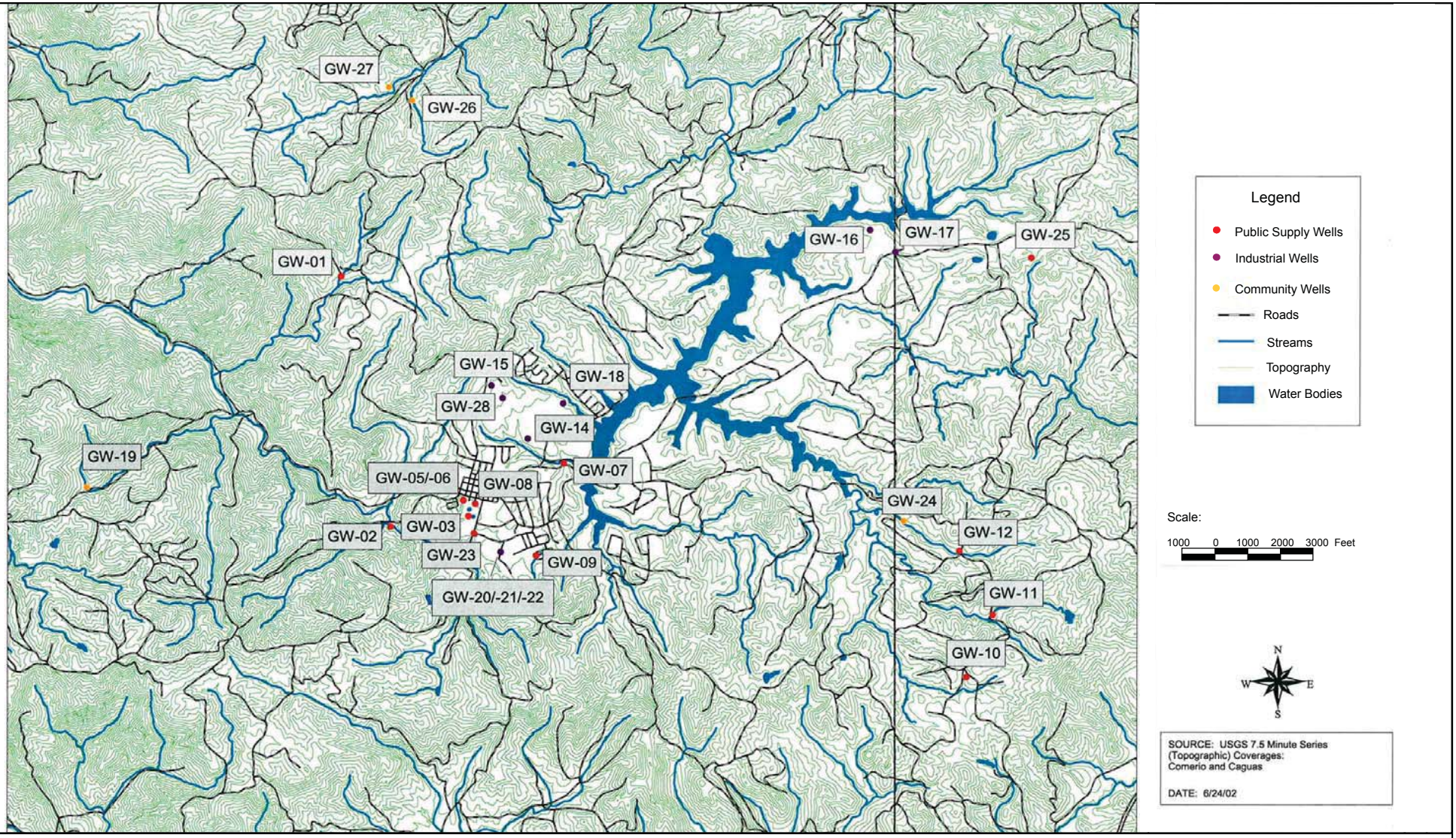


Source: EPA 2003a

Figure 1-3
Expanded Site Inspection Facility Locations, June 2002
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

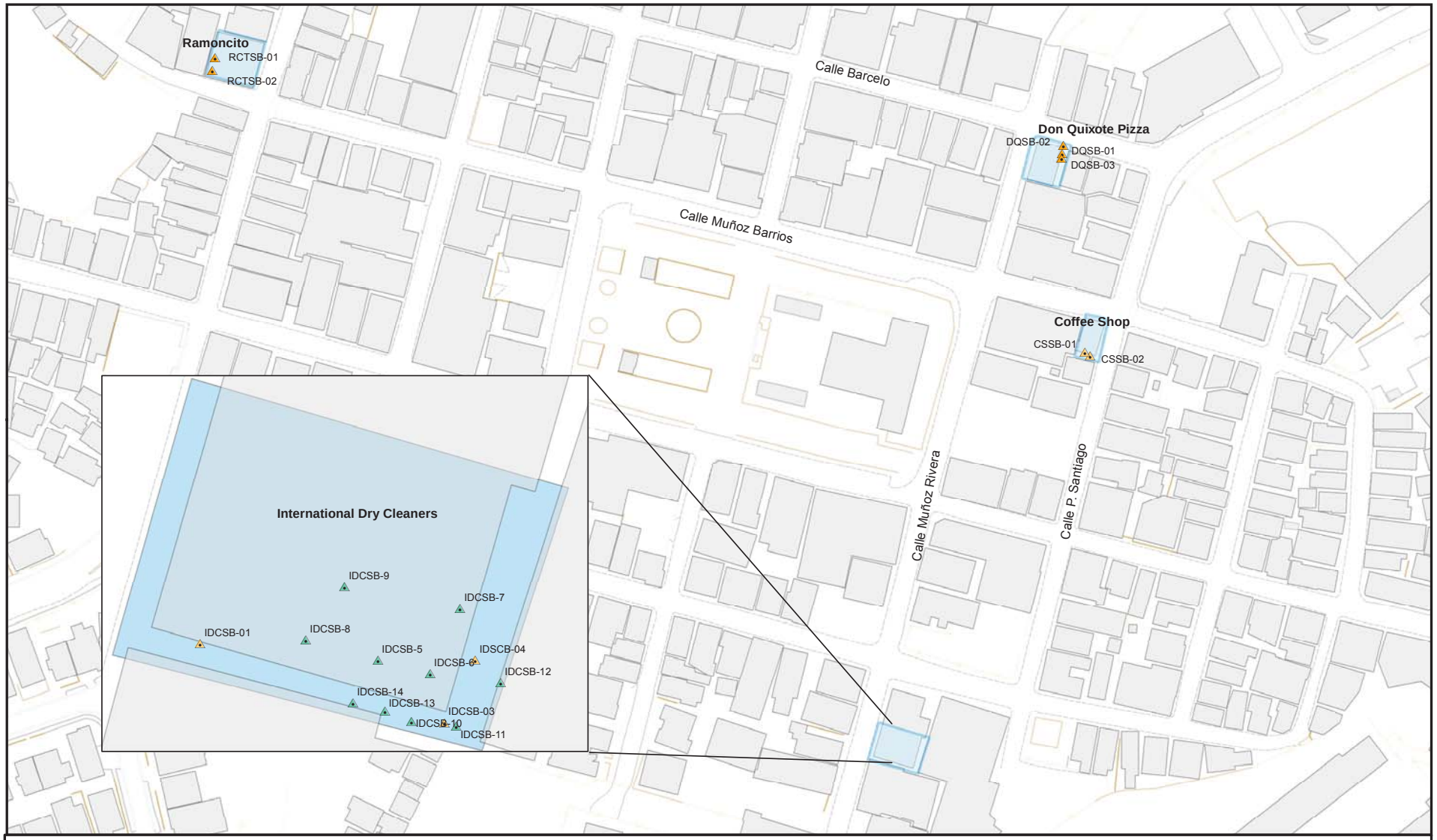
R2-0007363



Source: EPA 2003a

Figure 1-4
Expanded Site Inspection Supply Well Locations, June 2002
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith



Legend

- Stage 1 Soil Boring Location
- Stage 2 Soil Boring Location

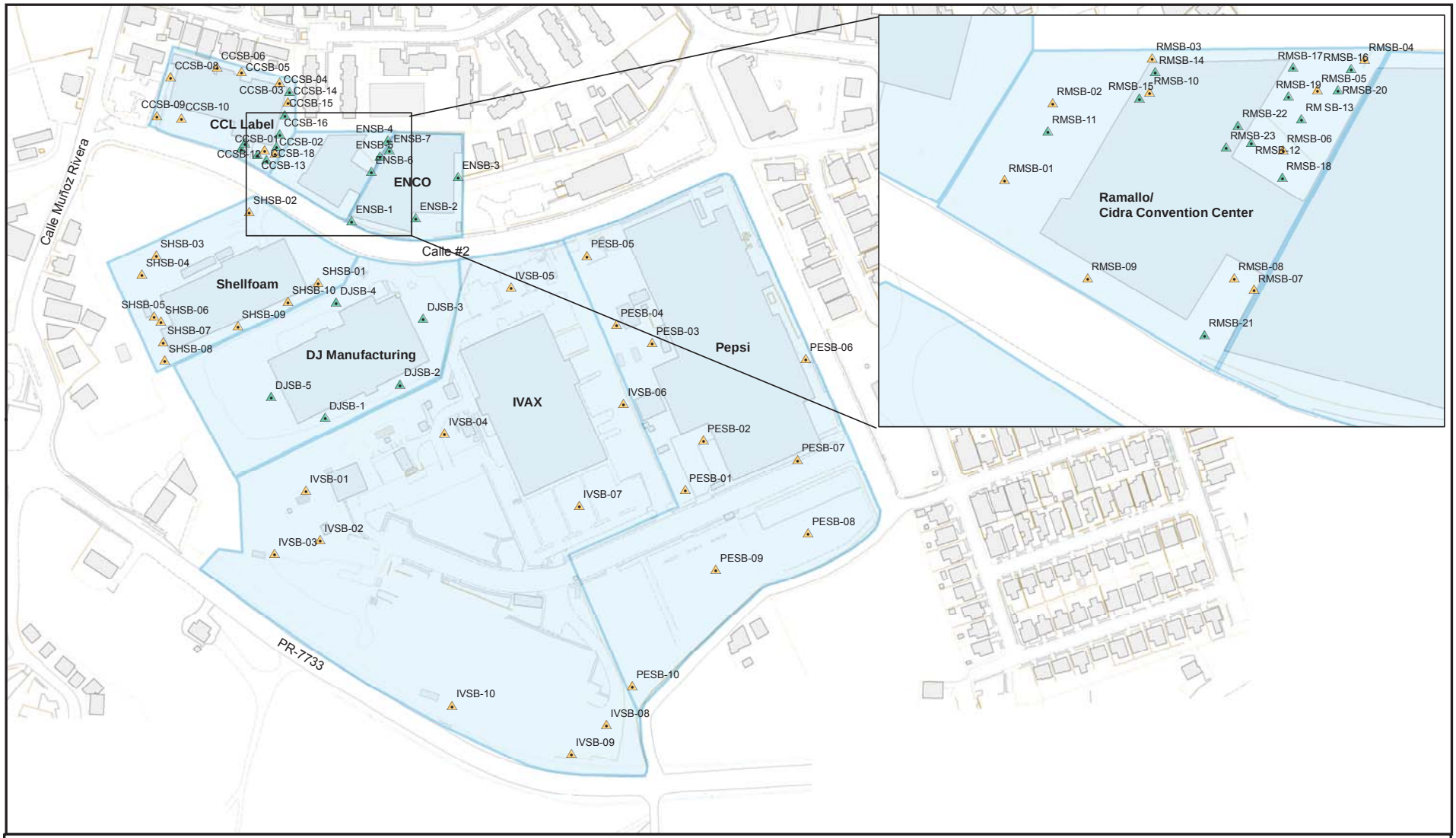
N

0 5 10 20 30 40 Feet

Figure 2-1a
Soil Boring Locations - Former Dry Cleaners
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007365



Legend

- Stage 1 - Soil Boring Location
- Stage 2 - Soil Boring Location

N

0 25 50 100 150 200 Feet

Figure 2-1b
Soil Boring Locations - Industrial Facilities
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007366

Legend

- Stage 1 - Soil Boring Location
- Stage 2 - Soil Boring Location

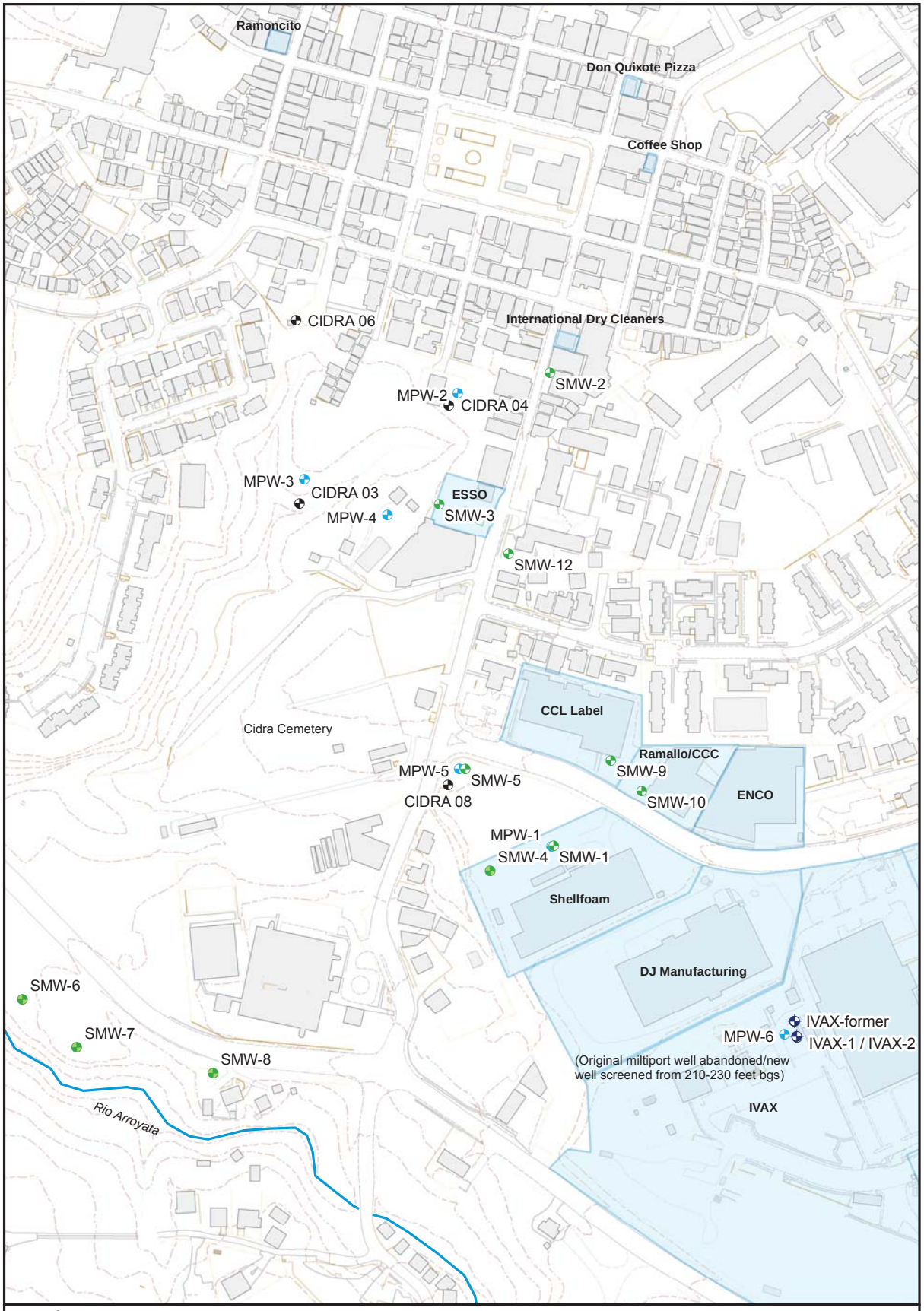
N

0 10 20 40 60 80 Feet

Figure 2-1c
Soil Boring Locations - ESSO Gas Station
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007367



Legend

- Cidra Public Supply Well Location (out of service)
- Industrial Supply Well
- MPW - Multiport Monitoring Well Location (Installed during Stage 1)
- SMW- Saprolite Monitoring Well Location (Installed during Stage 2)
- SMW - Saprolite Monitoring Well Location (Installed during Stage 2a)
- Topographic contour line (10 foot interval)

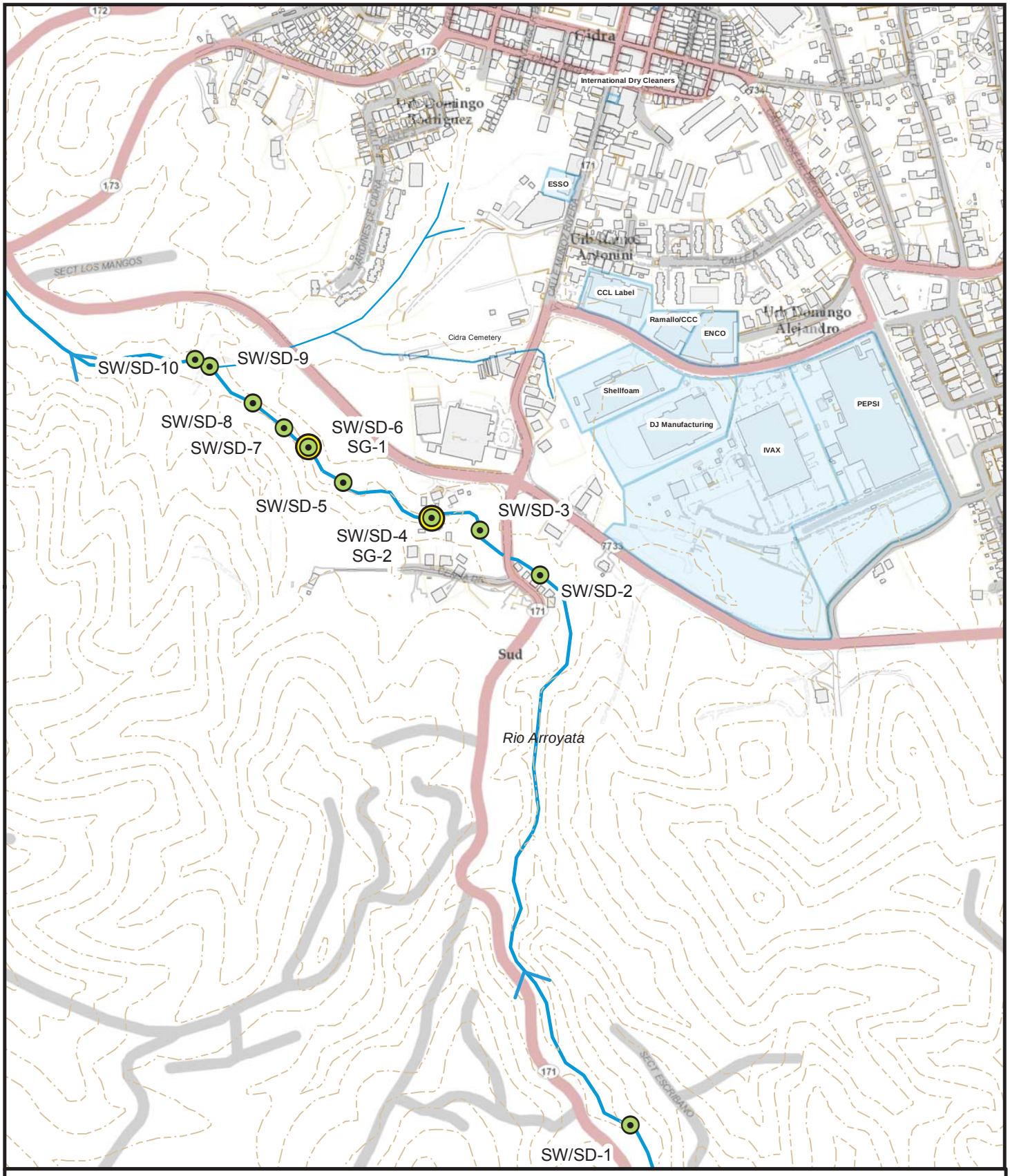
N

0 62.5 125 250 375 500 Feet

Figure 2-2
Monitoring Well Locations
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007368



Legend

- Stage 2a - Surface Water/Sediment Sampling Location (SW/SD)
- Stage 2a - Staff Gauge Location (SG)
- Unnamed drainage areas
- Rio Arroyata flow direction

0 112.5 225 450 675 900 Feet

Figure 2-3
Surface Water and Sediment Sample Locations
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

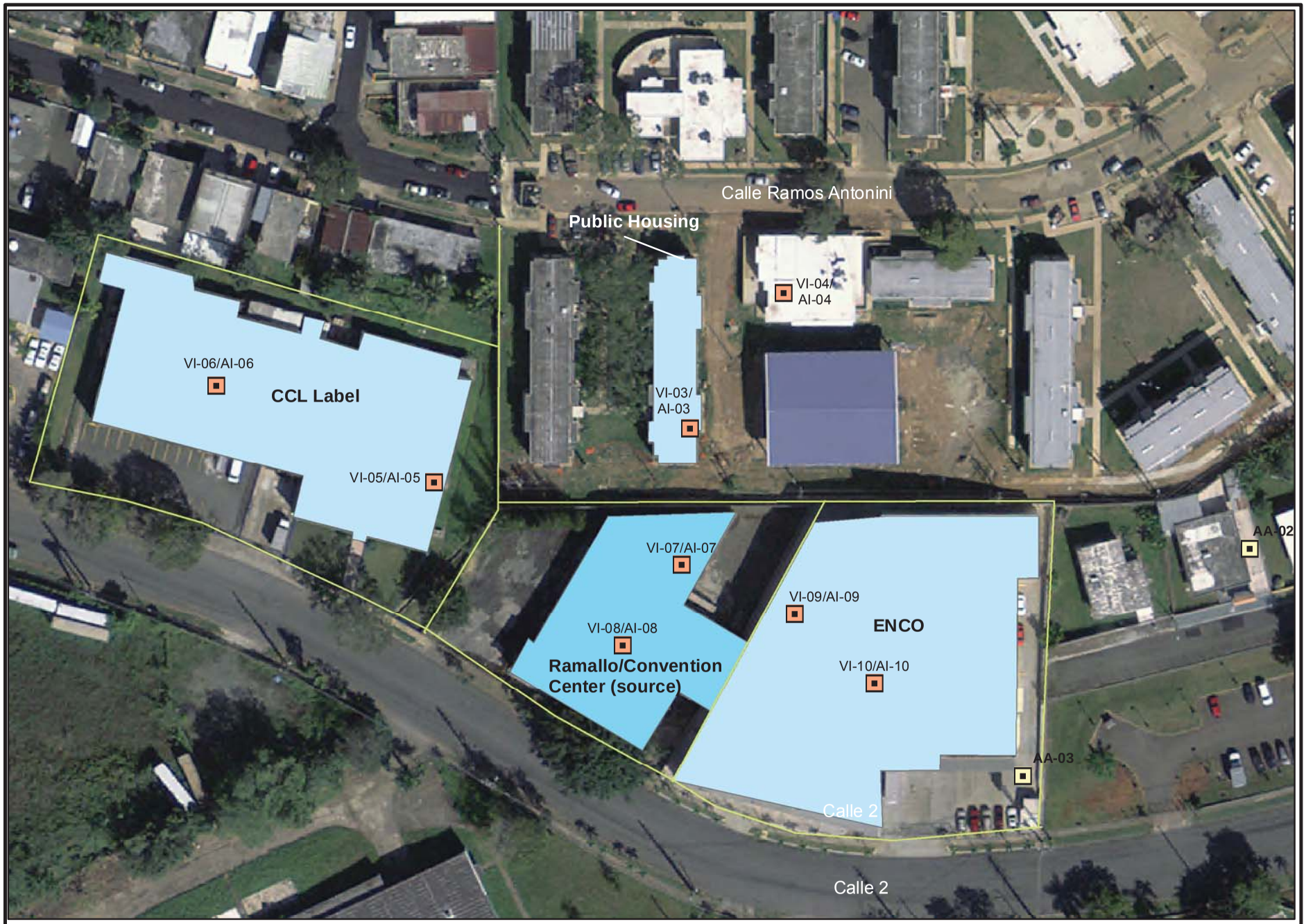
R2-0007369

Legend

- Subslab/Indoor air sample location
- Ambient air sample location
- Property limit

Figure 2-4
Subslab, Indoor and Ambient Air Sample Locations (North)
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith



Legend

- Subslab/Indoor air sample location
- Ambient air sample location
- Property limit

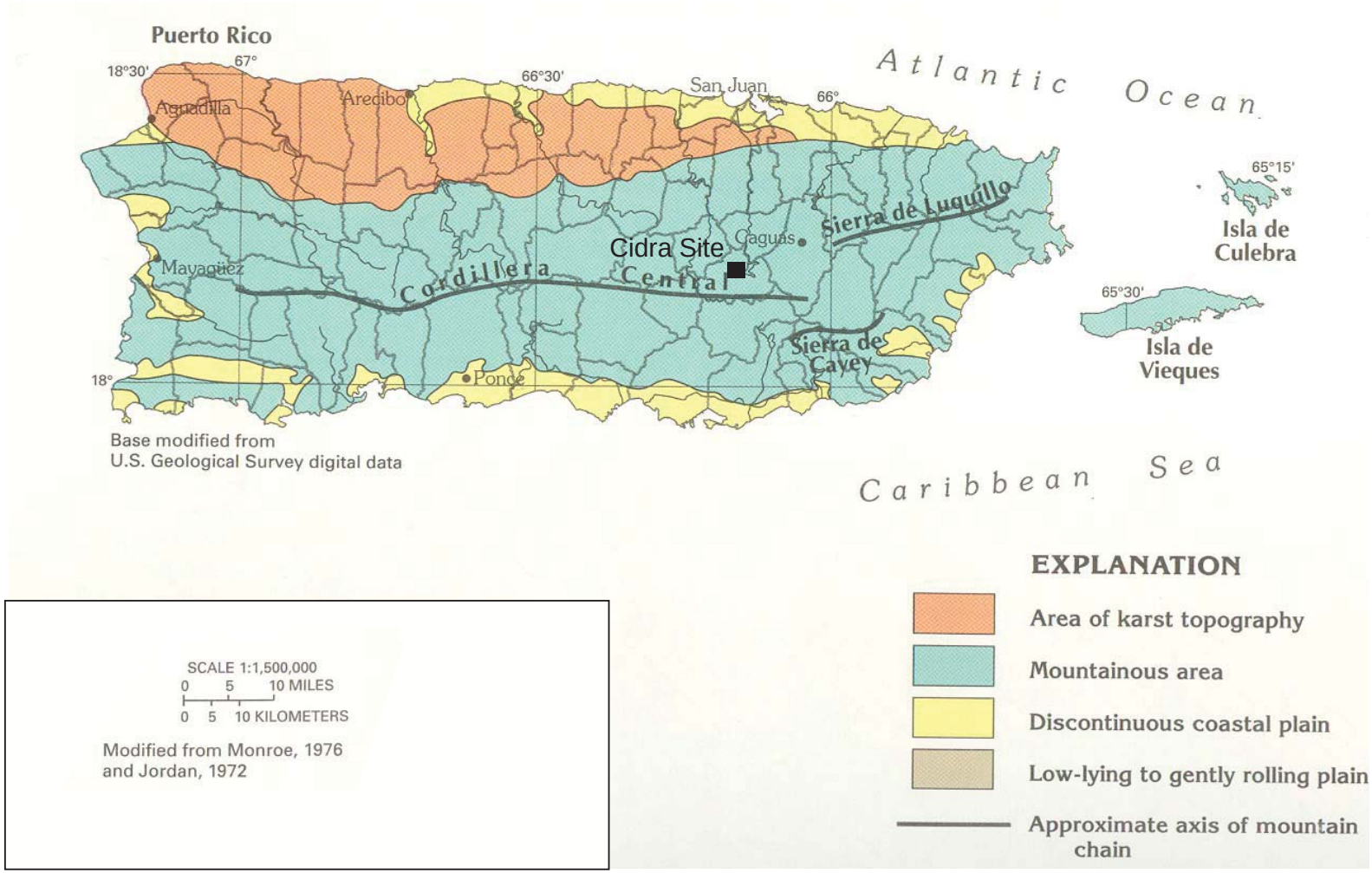
N

0 12.525 50 75 100 Feet

Figure 2-5
Subslab, Indoor and Ambient Air Sample Locations (South)
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007371



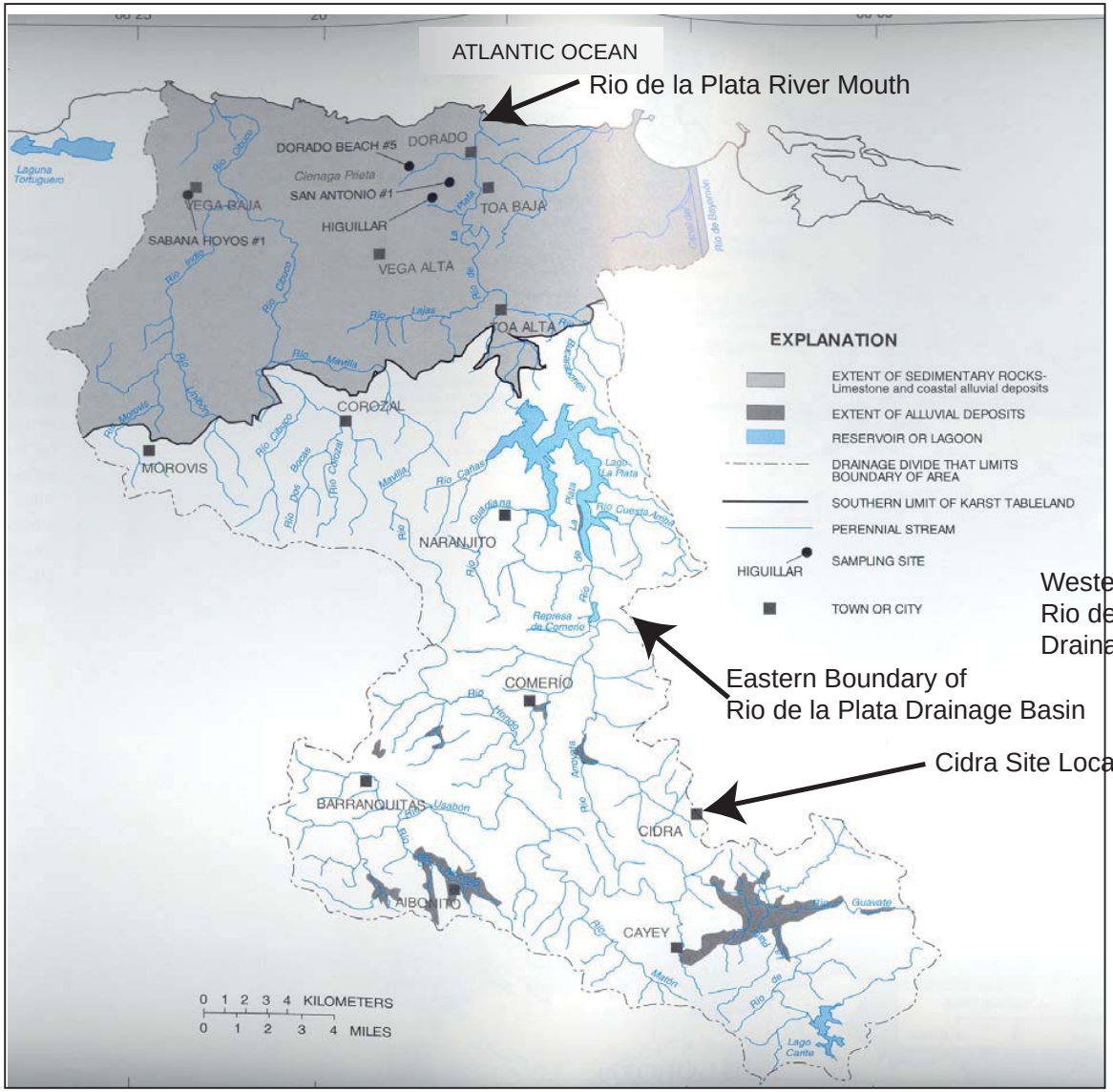
Adapted from Miller et al., (1997)

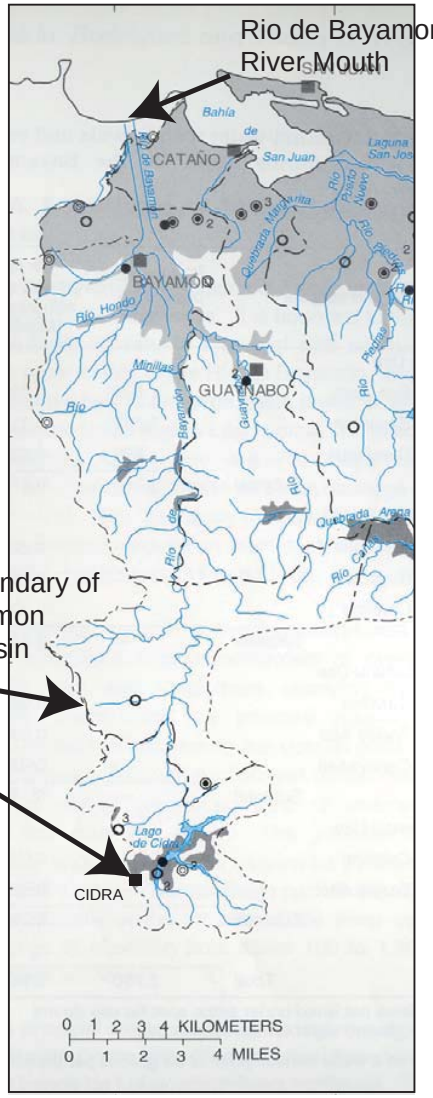
N

Figure 3-1
Topographic Featues of Puerto Rico
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007372





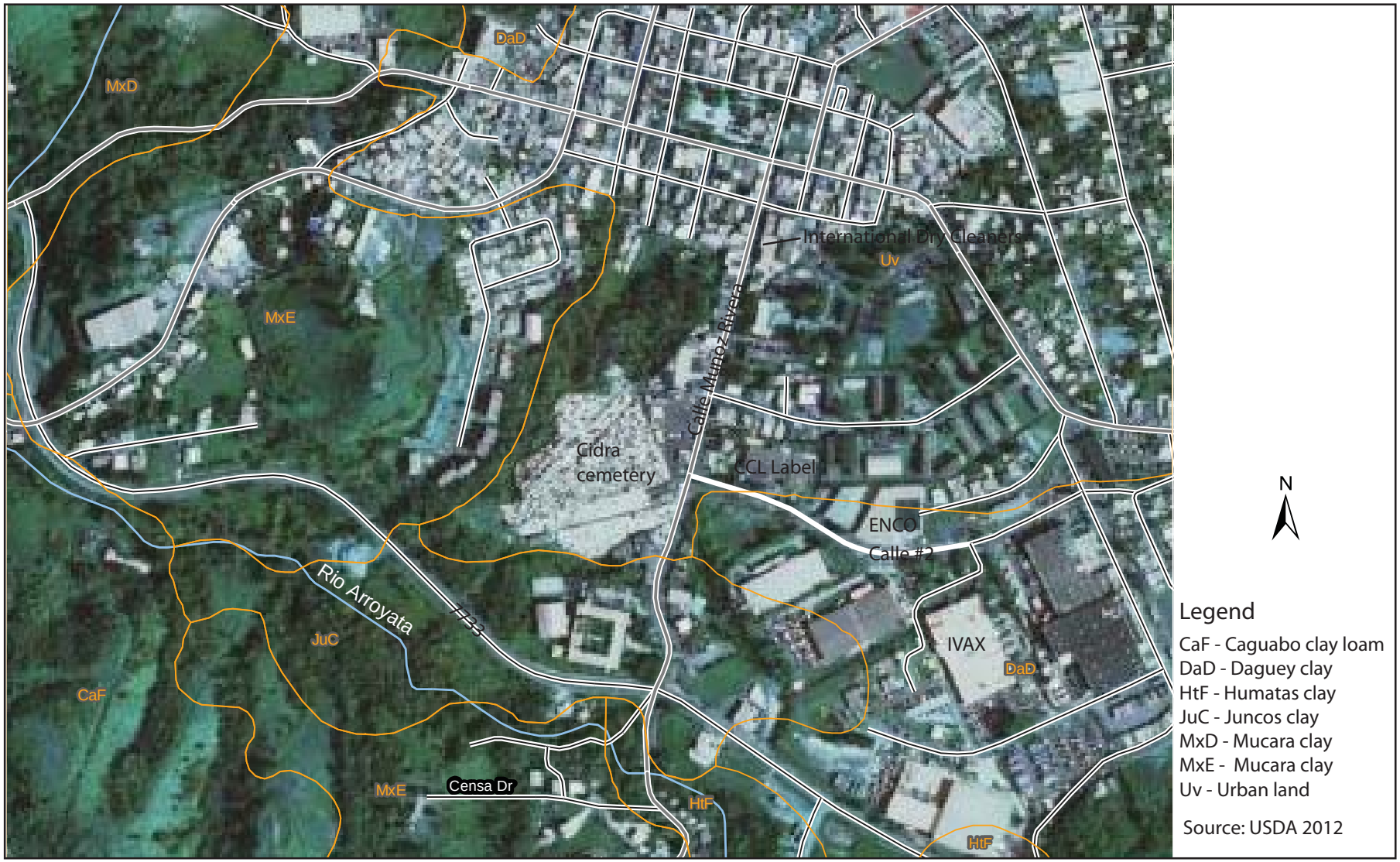
Adapted from Veve and Taggart (1996)

N

Figure 3-2
Cidra Site Location in Relation to Major Surface Water Drainages
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007373



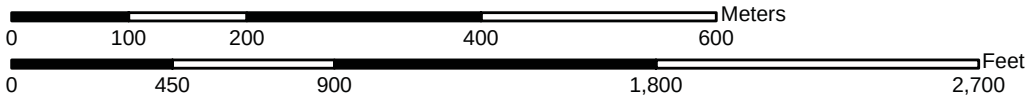
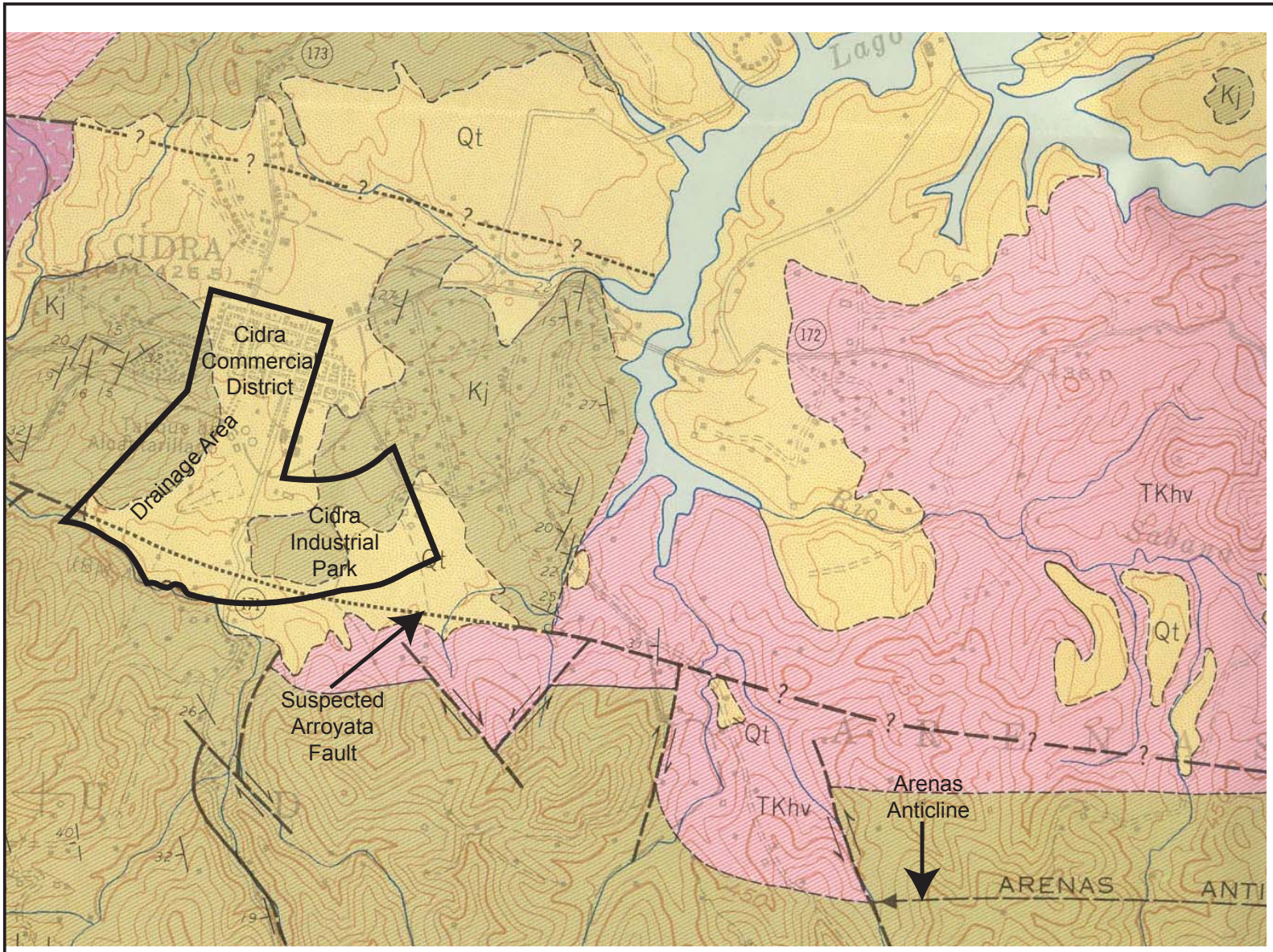


Figure 3-3
Soil Map
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007374



LEGEND

Qt

Terrace Deposits: Unconsolidated sand, gravel, and silt including large cobbles and boulders of volcanic rock; restricted to deposits generally above the level of present stream action

Kjl
Kjf
Kj

Formation J: Principally massive volcanic breccia and lava flows. Contains layers of poorly stratified tuff and volcanic conglomerate; fine-grained bedded rock occurs locally; a thin limestone lense, Kjl, and a lava flow, Kjf, delineated on the geologic map.

TKhv

Hydrothermally altered rocks: Light-gray clayey rock, mottled when weathered by shades of red, brown, and grayish purple; locally highly siliceous and well-indurated; banded in part at Cerro La Tiza

Note: Adapted from Pease and Briggs (1960)

Site

N

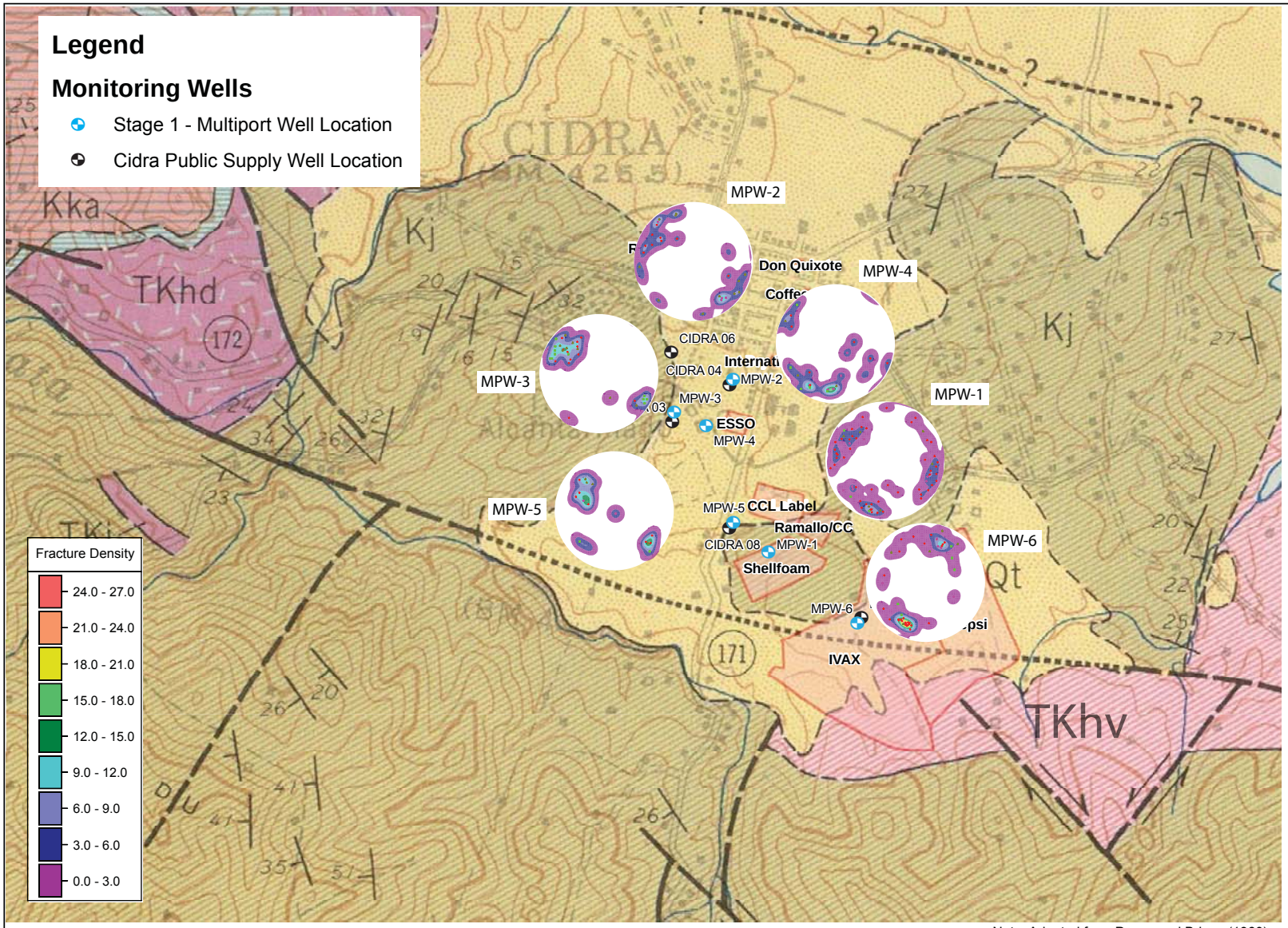
approximate scale

0 0.25 0.5 miles

Figure 3-4
Geologic Map
Cidra Groundwater Contamination Site
Remedial Investigation/ Feasibility Study
Cidra, Puerto Rico

CDM Smith

R2-0007375



LEGEND

Qt

Terrace Deposits: Unconsolidated sand, gravel, and silt including large cobbles and boulders of volcanic rock; restricted to deposits generally above the level of present stream action

Kjl Kjf Kj

Formation J: Principally massive volcanic breccia and lava flows. Contains layers of poorly stratified tuff and volcanic conglomerate; fine-grained bedded rock occurs locally; a thin limestone lense, Kjl, and a lava flow, Kjf, delineated on the geologic map.

TKhv

Hydrothermally altered rocks: Light-gray clayey rock, mottled when weathered by shades of red, brown, and grayish purple; locally highly siliceous and well-indurated; banded in part at Cerro La Tiza

TKhd

Hornblende diorite: Light olive-gray to medium-gray, fine grained generally porphyritic rock; phenocrysts of plagioclase and hornblende

Kkl Kk Kka

Formation K: Chiefly crudely stratified coarsely clastic volcanic breccia; intercalated with lava flows, volcanic conglomerate, massive tuff and a few layers of bedded fine grained rocks; thin lenticular bodies fo impure limestone, tuff, and limestone breccia, Kkl; Aguas Buenas limestone member, Kka, at the base of formation

Note: Adapted from Pease and Briggs (1960)

N

600 300 0 600 Feet

Stream

Fault (existance certain, location accurate)

Fault (existance certain, location approximate)

Fault (existance certain, location concealed)

Fault (existance questionable, location inferral)

Strike slip fault, left lateral offset, existance certain, location approximate, arrows show relative motion

Strike slip fault, right lateral offset, existance certain, location approximate, arrows show relative motion

U Upthrown Block

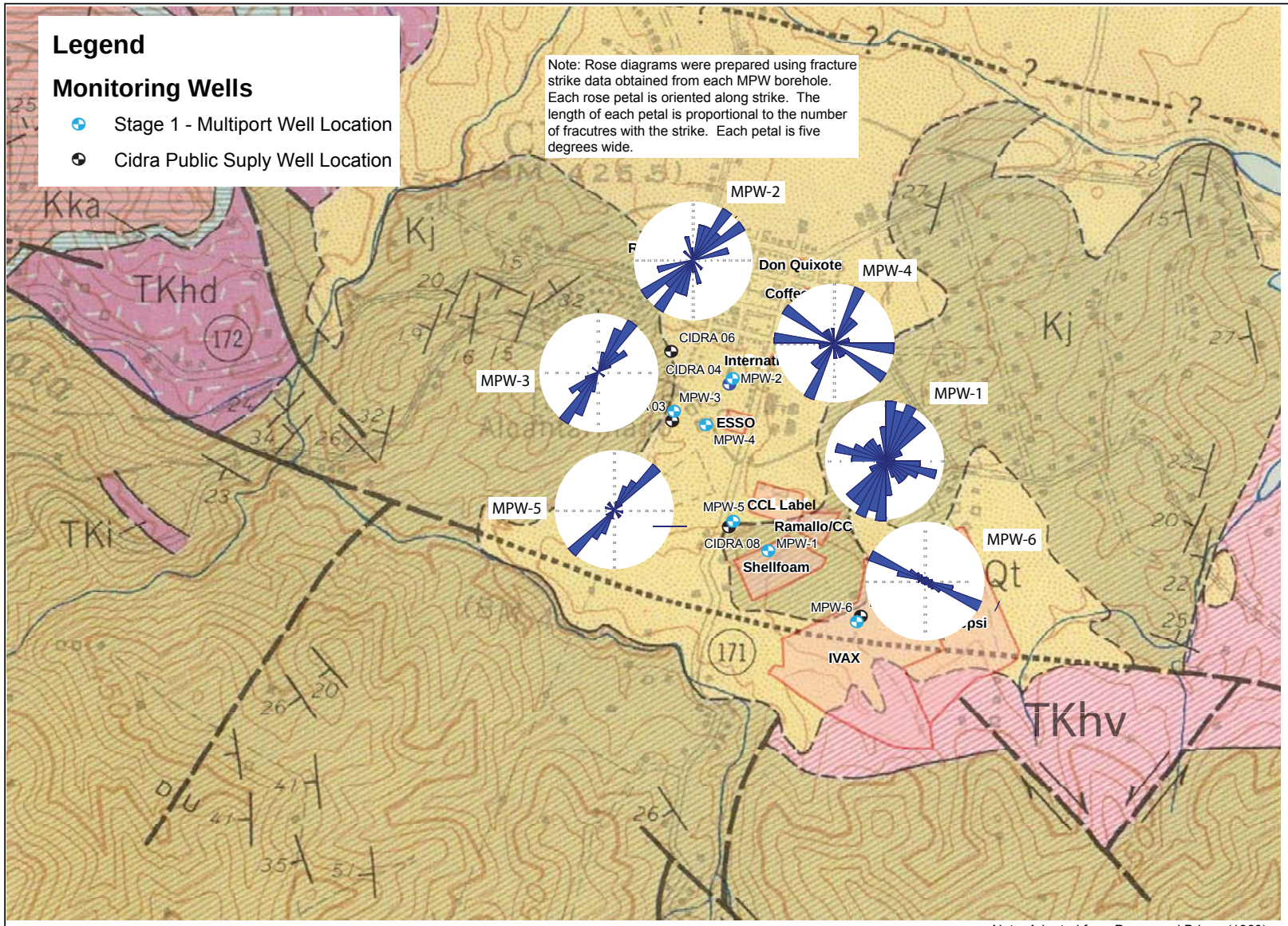
D Downthrown Block

20 Bedding Strike and Dip

Figure 3-5
Fracture Stereonets
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007376



LEGEND

Qt

Terrace Deposits: Unconsolidated sand, gravel, and silt including large cobbles and boulders of volcanic rock; restricted to deposits generally above the level of present stream action

Kjl Kj

Formation J: Principally massive volcanic breccia and lava flows. Contains layers of poorly stratified tuff and volcanic conglomerate; fine-grained bedded rock occurs locally; a thin limestone lense, Kjl, and a lava flow, Kjf, delineated on the geologic map.

TKhv

Hydrothermally altered rocks: Light-gray clayey rock, mottled when weathered by shades of red, brown, and grayish purple; locally highly siliceous and well-indurated; banded in part at Cerro La Tiza

TKhd

Hornblende diorite: Light olive-gray to medium-gray, fine grained generally porphyritic rock; phenocrysts of plagioclase and hornblende

Kkl Kk Kka

Formation K: Chiefly crudely stratified coarsely clastic volcanic breccia; intercalated with lava flows, volcanic conglomerate, massive tuff and a few layers of bedded fine grained rocks; thin lenticular bodies fo impure limestone, tuff, and limestone breccia, Kkl; Aguas Buenas limestone member, Kka, at the base of formation

Note: Adapted from Pease and Briggs (1960)

N

600 300 0 600 Feet

Stream

Fault (existance certain, location accurate)

Fault (existance certain, location approximate)

Fault (existance certain, location concealed)

Fault (existance questionable, location inferral)

Strike slip fault, left lateral offset, existance certain, location approximate, arrows show relative motion

Strike slip fault, right lateral offset, existance certain, location approximate, arrows show relative motion

U Upthrown Block

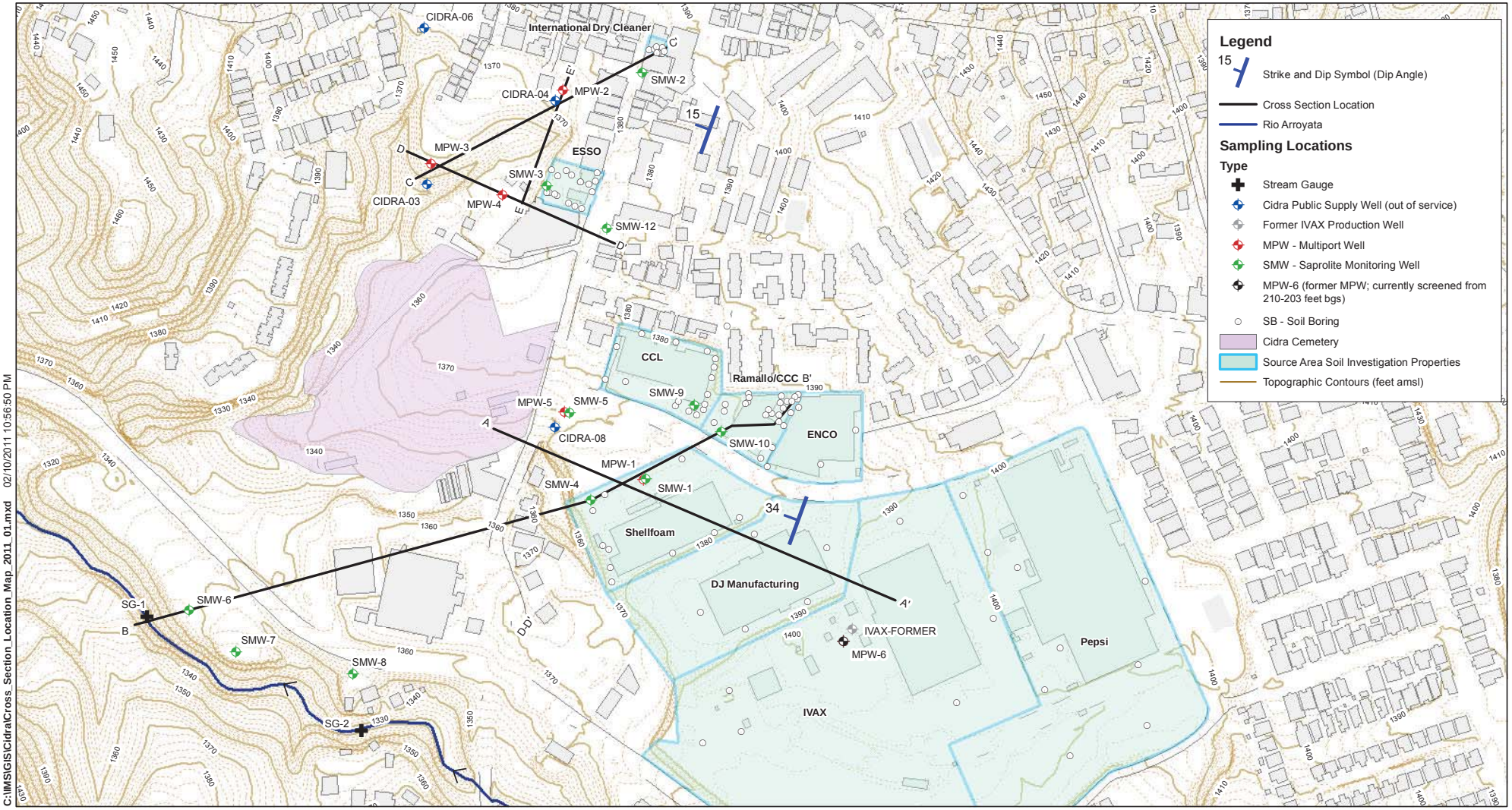
D Downthrown Block

20 Bedding Strike and Dip

Figure 3-6
Fracture Rose Diagrams
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007377



Note: Cross sections A-A' and D-D' are subparallel to dip azimuth. Dip azimuth is west/northwest. Cross section E-E' is subparallel to strike.

Note: Strike and dip symbols are based on geologic map and borehore geophysical data. For additional strike and dip information, see Figure 3-4.

0 125 250 500 Feet

1:3000

N

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Figure 3-7
Cross Section Location Map
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

R2-0007378

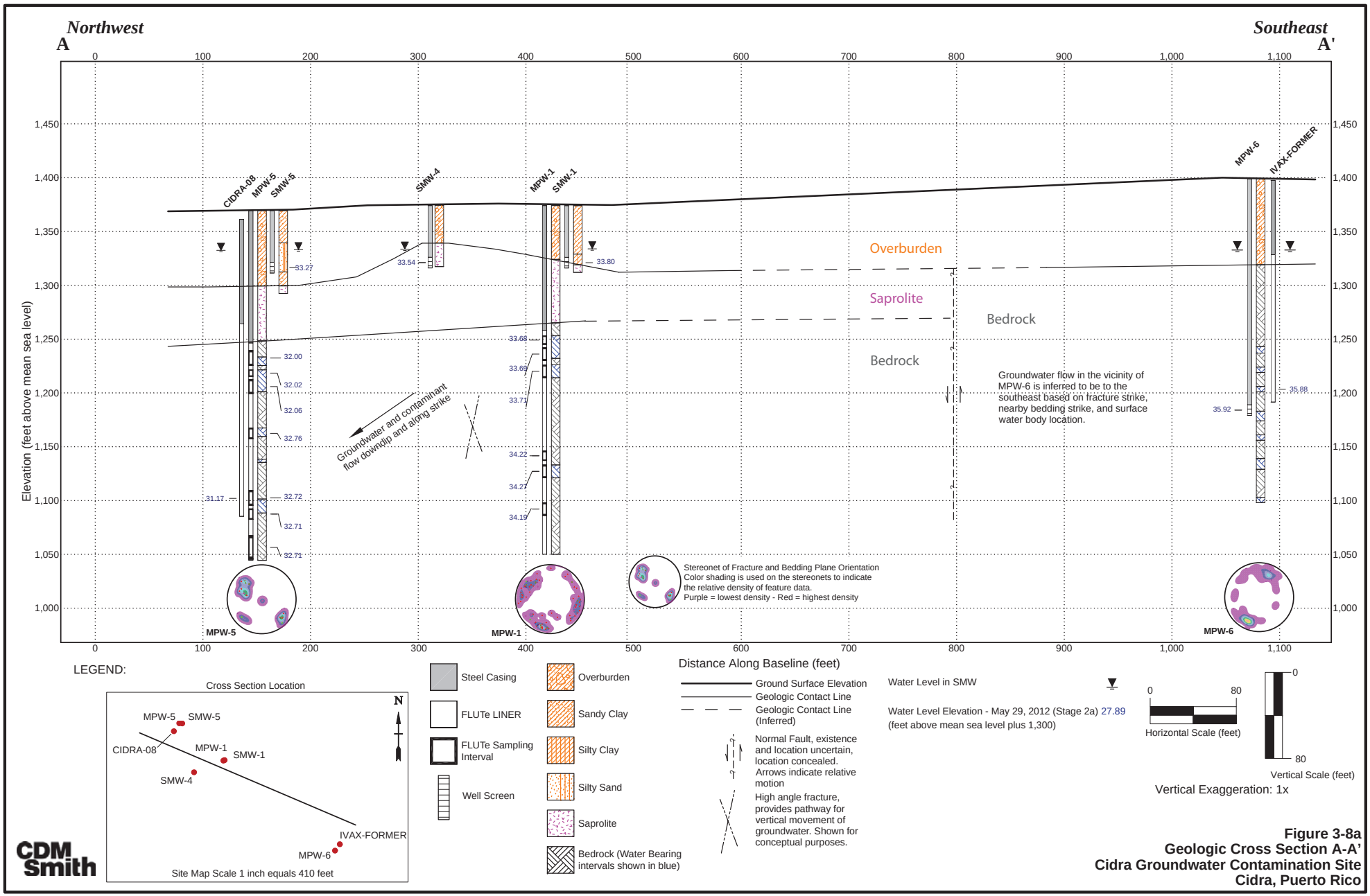
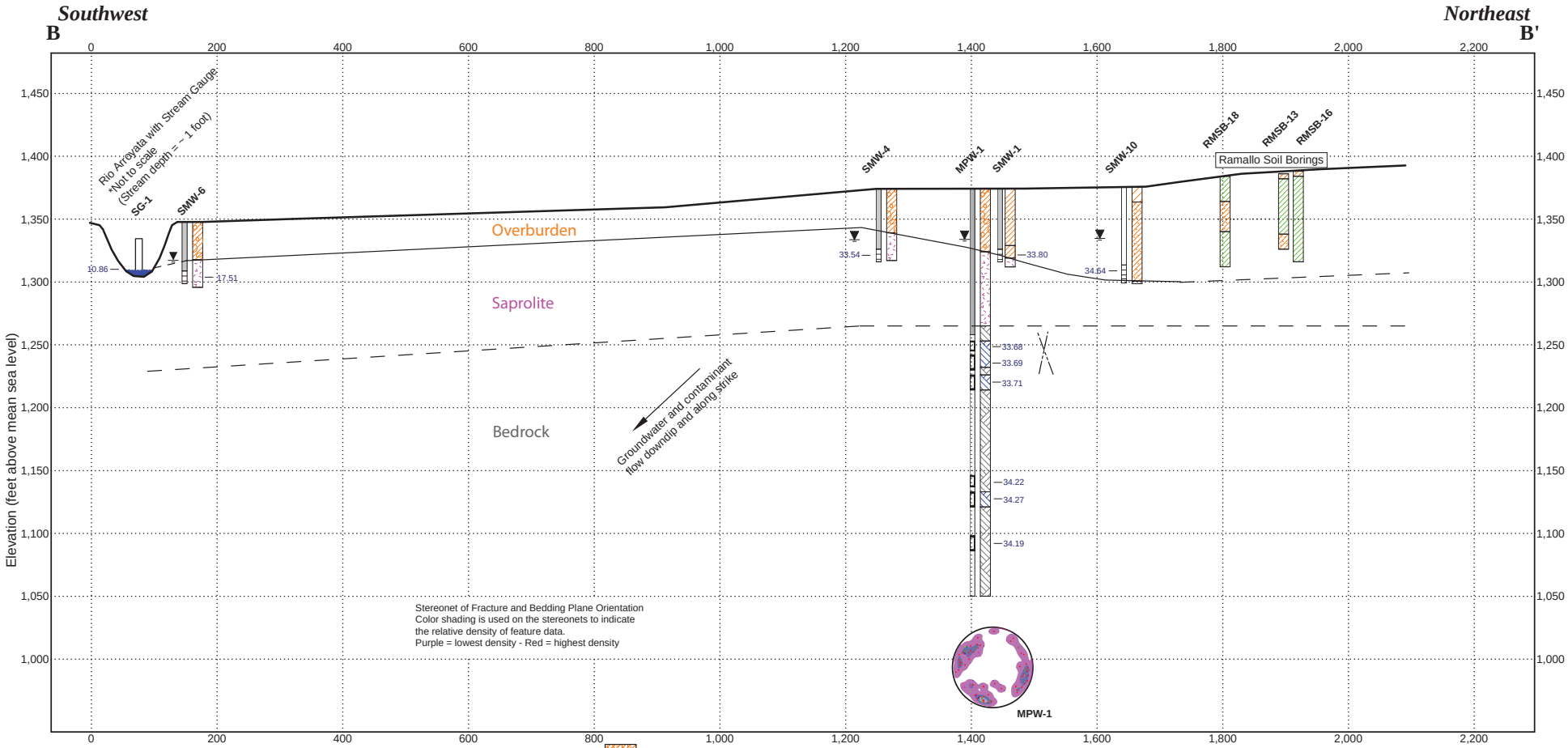


Figure 3-8a
Geologic Cross Section A-A'
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

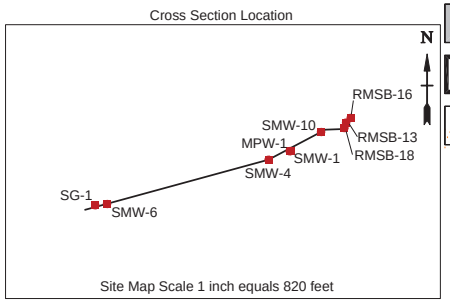
STANDARD CROSS SECTION: CIDRA CIDRA-2010.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 8/31/12 REV.

R2-0007379



LEGEND:

Cross Section Location



Steel Casing

FLUTe Sampling Interval

FLUTe LINER

Well Screen

Overburden

Clay

Sandy Clay

Silty Clay

Clayey Sand

Saprolite

Bedrock (Water Bearing intervals shown in blue)

Ground Surface Elevation

Geologic Contact Line

Geologic Contact Line (Inferred)

High angle fracture, provides pathway for vertical movement of groundwater. Shown for conceptual purposes.

Water Level in MW

Water Level Elevation - May 29, 2012 (Stage 2a) 27.89
(feet above mean sea level plus 1,300)

Horizontal Scale (feet) 0 160

Vertical Scale (feet) 0 80

Vertical Exaggeration: 2x

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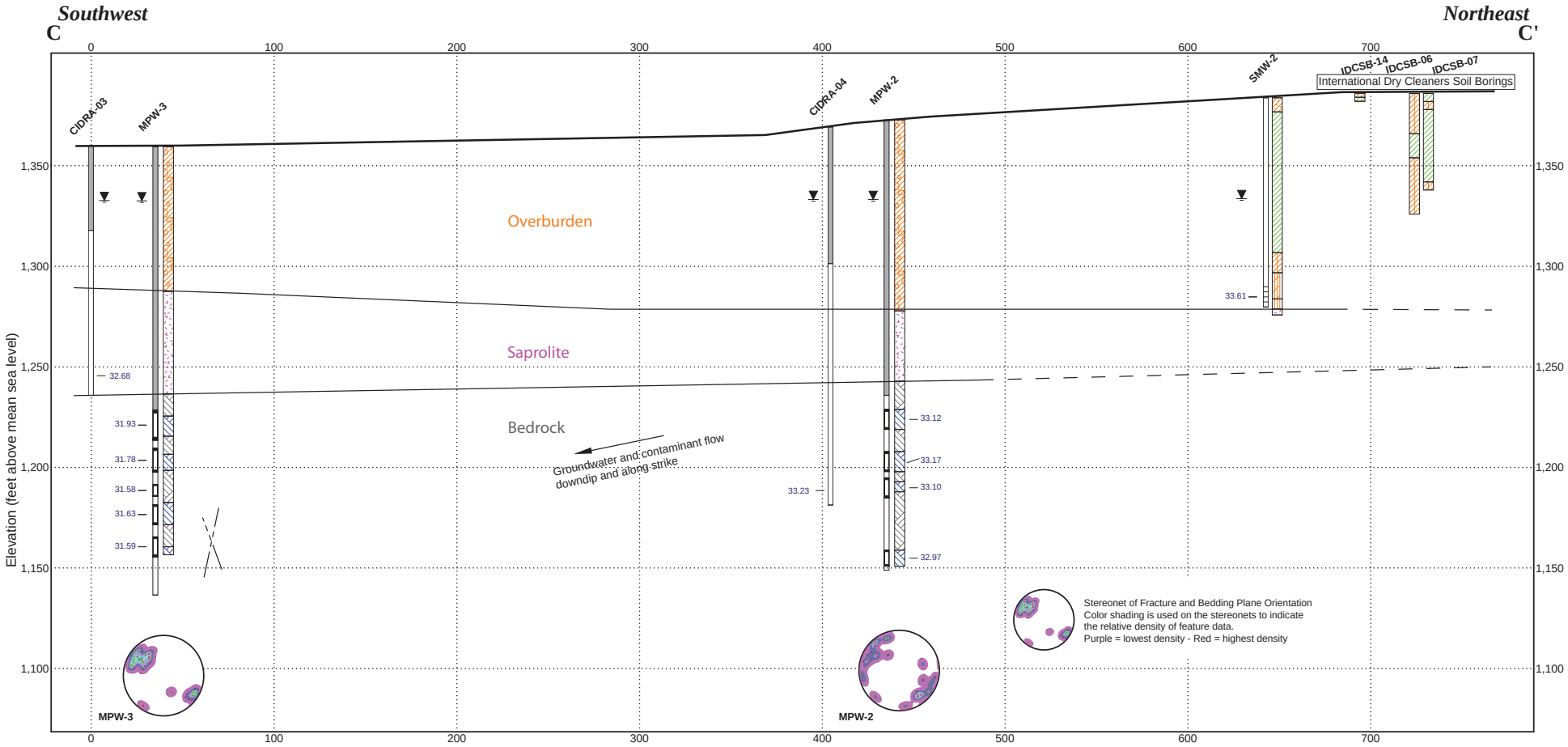
Figure 3-8b
Geologic Cross Section B-B'
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

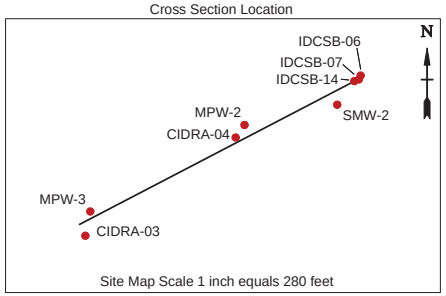
STANDARD CROSS SECTION: CIDRA CIDRA-2010.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 9/6/12 REV.

R2-0007380



LEGEND:

Cross Section Location



Site Map Scale 1 inch equals 280 feet

- Steel Casing
- FLUTe Sampling Interval
- FLUTe LINER
- Well Screen
- Overburden
- Clay
- Sandy Clay
- Silty Clay
- Clayey Silt
- Sandy Silt
- Saprolite
- Bedrock (Water Bearing intervals shown in blue)

Distance Along Baseline (feet)

- Ground Surface Elevation
- Geologic Contact Line
- Geologic Contact Line (Inferred)
- High angle fracture, provides pathway for vertical movement of groundwater. Shown for conceptual purposes.

Water Level in SMW

Water Level Elevation - May 29, 2012 (Stage 2a) 27.89
(feet above mean sea level plus 1,300)

0 55
Horizontal Scale (feet)

0 50
Vertical Scale (feet)

Vertical Exaggeration: 1x

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Figure 3-8c
Geologic Cross Section C-C'
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

STANDARD CROSS SECTION: CIDRA CIDRA-2010.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 9/6/12 REV.

R2-0007381

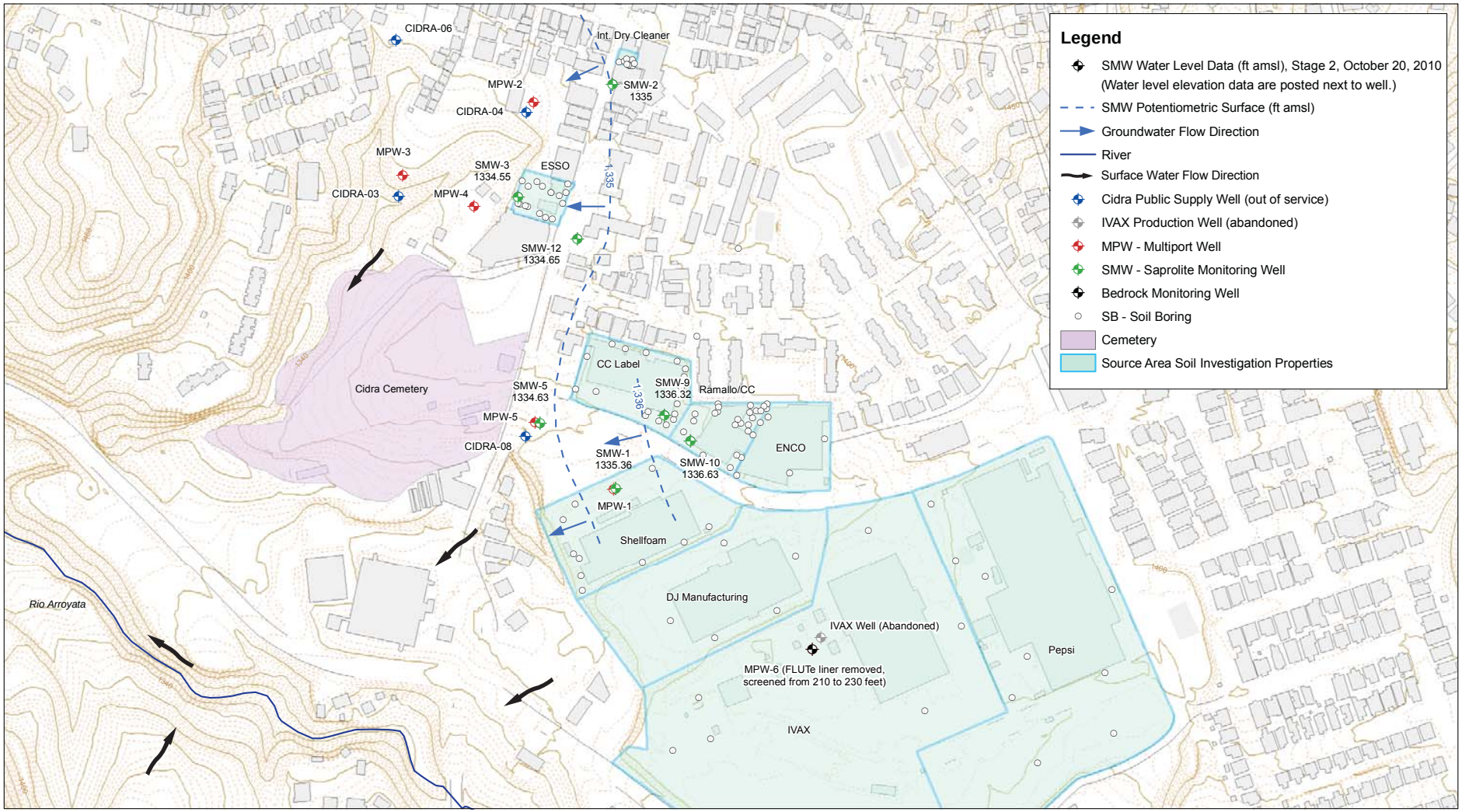
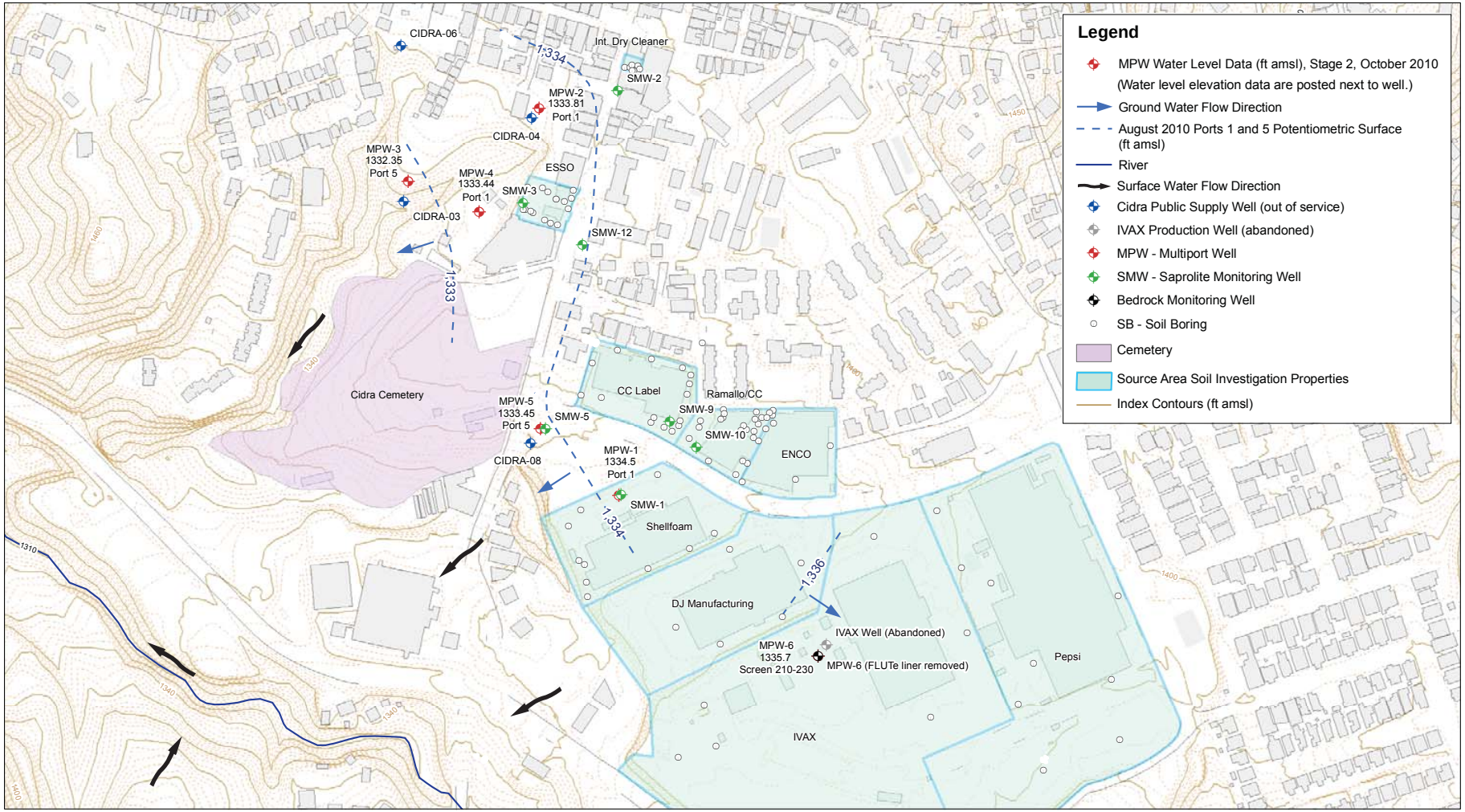


Figure 3-9a
Saprolite Monitoring Well Potentiometric Surface - Stage 2
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007382



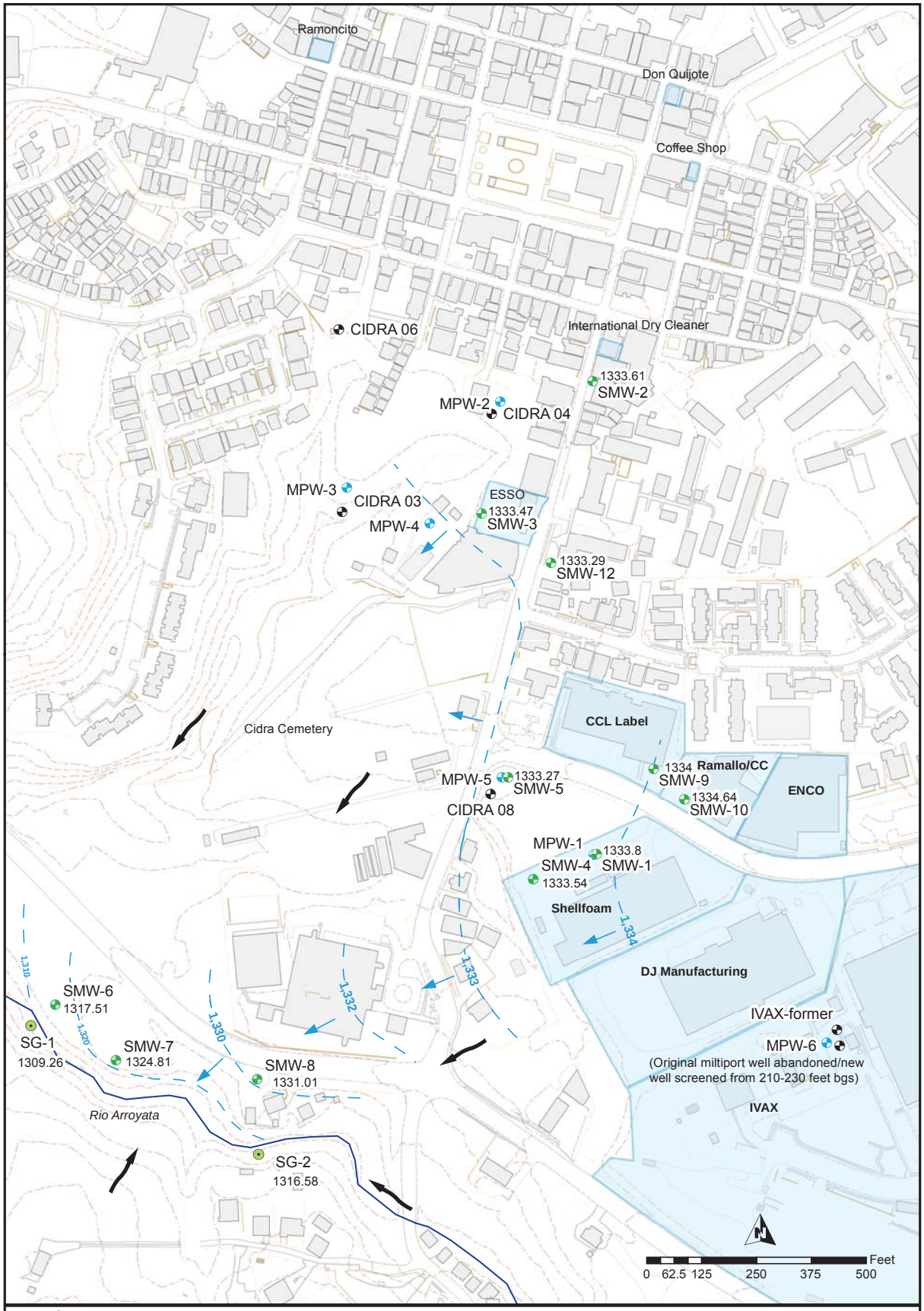
250 125 0 250 Feet

N

FIgure 3-9b
Bedrock Well Potentiometric Surface - Stage 2
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007383



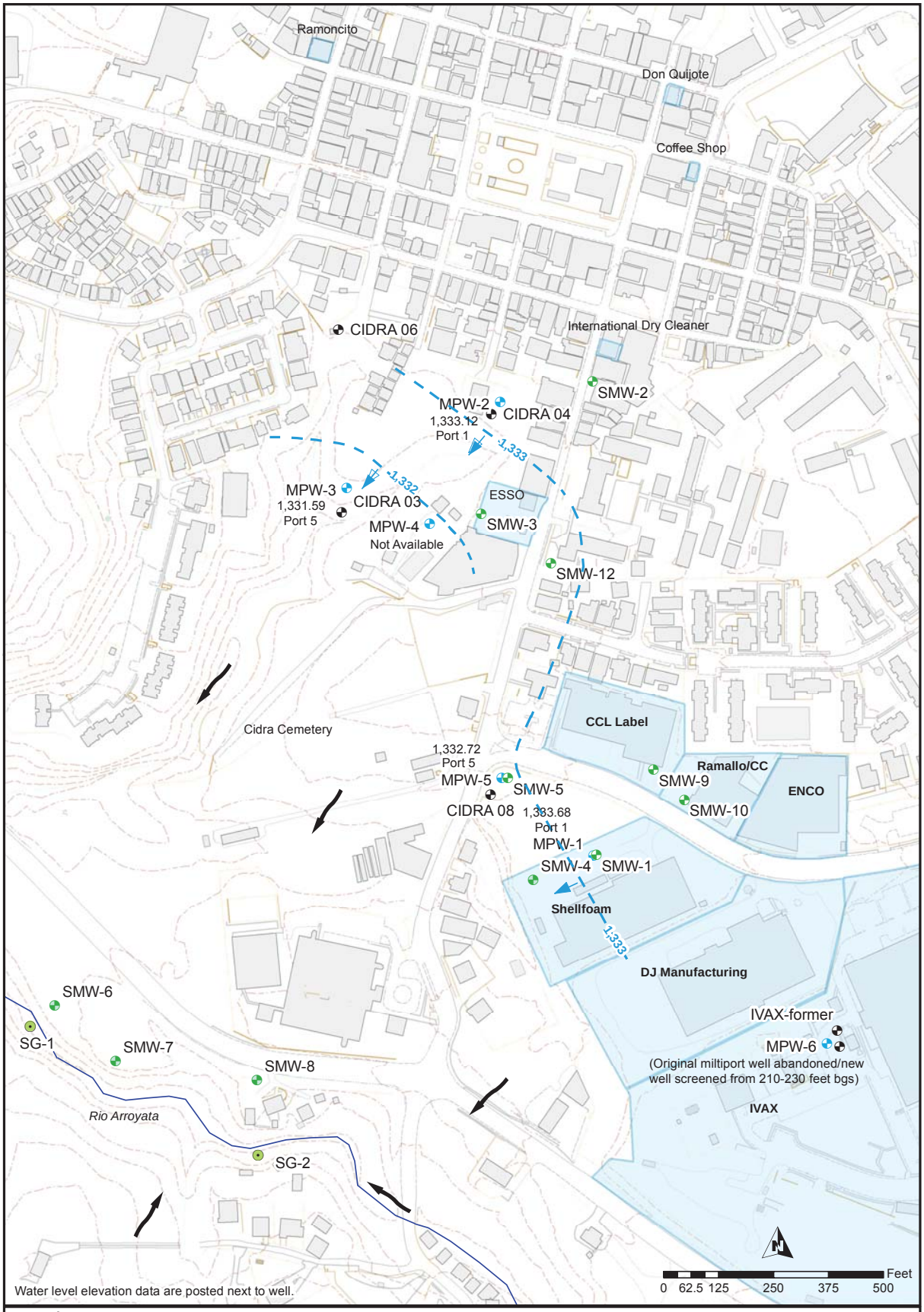
Legend

- Cidra Public Supply Well Location (out of service)
- MPW - Multiport Well Location (Stage 1)
- SMW- Saprolite Monitoring Well Location (Stage 2)
- SMW - Saprolite Monitoring Well Location (Stage 2a)
- SG-1 - Staff Gauge Location (Stage 2a)
- Ground Water Flow Direction
- Surface Water Flow Direction
- Topographic Contour Line (10 ft interval)
- Potentiometric Surface (ft amsl)
- River

Figure 3-10a
Saprolite Well and Stream Gauge Potentiometric Surface
Stage 2a
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007384



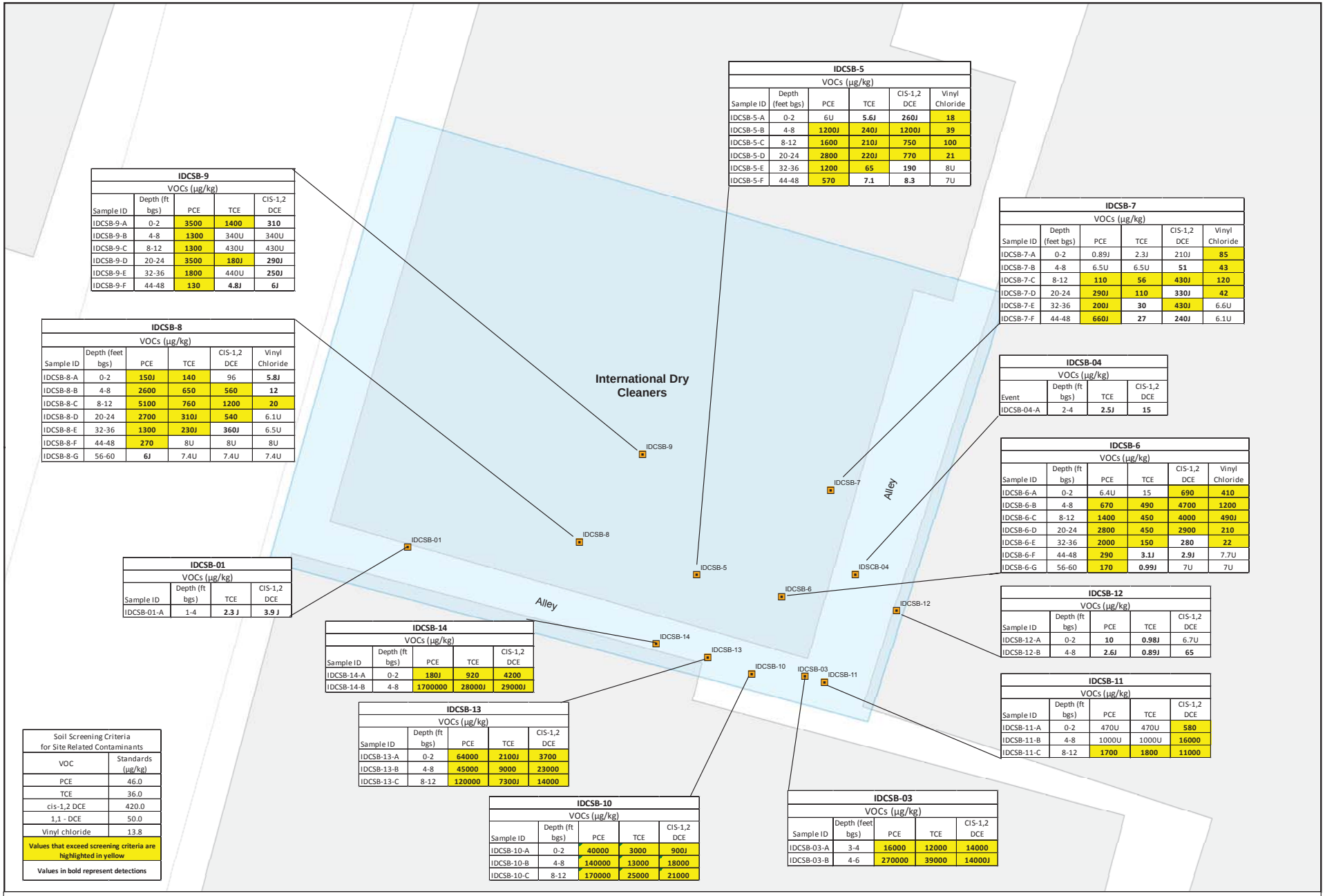
Legend

- Cidra Public Supply Well Location (out of service)
- MPW - Multiport Well Location (Stage 1)
- SMW- Saprolite Monitoring Well Location (Stage 2)
- SMW - Saprolite Monitoring Well Location (Stage 2a)
- SG-1 - Staff Gauge Location (Stage 2a)
- Ground Water Flow Direction
- Surface Water Flow Direction
- Topographic Contour Line (10 ft interval)
- Potentiometric Surface (ft amsl)
- River

Figure 3-10b
Bedrock Well Potentiometric Surface - Stage 2a
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007385



IDCSB-5

VOCs (µg/kg)

Sample ID	Depth (feet bgs)	PCE	TCE	CIS-1,2 DCE	Vinyl Chloride
IDCSB-5-A	0-2	6U	**5.6J**	**260J**	**18**
IDCSB-5-B	4-8	**1200J**	**240J**	**1200J**	**39**
IDCSB-5-C	8-12	**1600**	**210J**	**750**	**100**
IDCSB-5-D	20-24	**2800**	**220J**	**770**	**21**
IDCSB-5-E	32-36	**1200**	**65**	**190**	8U
IDCSB-5-F	44-48	**570**	**7.1**	**8.3**	7U

IDCSB-9

VOCs (µg/kg)

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
IDCSB-9-A	0-2	**3500**	**1400**	**310**
IDCSB-9-B	4-8	**1300**	340U	340U
IDCSB-9-C	8-12	**1300**	430U	430U
IDCSB-9-D	20-24	**3500**	**180J**	**290J**
IDCSB-9-E	32-36	**1800**	440U	**250J**
IDCSB-9-F	44-48	**130**	**4.8J**	**6J**

IDCSB-7

VOCs (µg/kg)

Sample ID	Depth (feet bgs)	PCE	TCE	CIS-1,2 DCE	Vinyl Chloride
IDCSB-7-A	0-2	0.89J	2.3J	210J	**85**
IDCSB-7-B	4-8	6.5U	6.5U	**51**	**43**
IDCSB-7-C	8-12	**110**	**56**	**430J**	**120**
IDCSB-7-D	20-24	**290J**	**110**	**330J**	**42**
IDCSB-7-E	32-36	**200J**	**30**	**430J**	6.6U
IDCSB-7-F	44-48	**660J**	**27**	**240J**	6.1U

IDCSB-8

VOCs (µg/kg)

Sample ID	Depth (feet bgs)	PCE	TCE	CIS-1,2 DCE	Vinyl Chloride
IDCSB-8-A	0-2	**150J**	**140**	96	**5.8J**
IDCSB-8-B	4-8	**2600**	**650**	**560**	**12**
IDCSB-8-C	8-12	**5100**	**760**	**1200**	**20**
IDCSB-8-D	20-24	**2700**	**310J**	**540**	6.1U
IDCSB-8-E	32-36	**1300**	**230J**	**360J**	6.5U
IDCSB-8-F	44-48	**270**	8U	8U	8U
IDCSB-8-G	56-60	**6J**	7.4U	7.4U	7.4U

IDCSB-04

VOCs (µg/kg)

Event	Depth (ft bgs)	TCE	CIS-1,2 DCE
IDCSB-04-A	2-4	**2.5J**	**15**

IDCSB-6

VOCs (µg/kg)

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE	Vinyl Chloride
IDCSB-6-A	0-2	6.4U	15	**690**	**410**
IDCSB-6-B	4-8	**670**	**490**	**4700**	**1200**
IDCSB-6-C	8-12	**1400**	**450**	**4000**	**490J**
IDCSB-6-D	20-24	**2800**	**450**	**2900**	**210**
IDCSB-6-E	32-36	**2000**	**150**	**280**	**22**
IDCSB-6-F	44-48	**290**	**3.1J**	**2.9J**	7.7U
IDCSB-6-G	56-60	**170**	**0.99J**	7U	7U

IDCSB-01

VOCs (µg/kg)

Sample ID	Depth (ft bgs)	TCE	CIS-1,2 DCE
IDCSB-01-A	1-4	**2.3 J**	**3.9 J**

IDCSB-12

VOCs (µg/kg)

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
IDCSB-12-A	0-2	**10**	**0.98J**	6.7U
IDCSB-12-B	4-8	**2.6J**	**0.89J**	**65**

IDCSB-14

VOCs (µg/kg)

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
IDCSB-14-A	0-2	**180J**	**920**	**4200**
IDCSB-14-B	4-8	**1700000**	**28000J**	**29000J**

IDCSB-11

VOCs (µg/kg)

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
IDCSB-11-A	0-2	470U	470U	**580**
IDCSB-11-B	4-8	1000U	1000U	**16000**
IDCSB-11-C	8-12	**1700**	**1800**	**11000**

IDCSB-13

VOCs (µg/kg)

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
IDCSB-13-A	0-2	**64000**	**2100J**	**3700**
IDCSB-13-B	4-8	**45000**	**9000**	**23000**
IDCSB-13-C	8-12	**120000**	**7300J**	**14000**

IDCSB-10

VOCs (µg/kg)

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
IDCSB-10-A	0-2	**40000**	**3000**	**900J**
IDCSB-10-B	4-8	**140000**	**13000**	**18000**
IDCSB-10-C	8-12	**170000**	**25000**	**21000**

IDCSB-03

VOCs (µg/kg)

Sample ID	Depth (feet bgs)	PCE	TCE	CIS-1,2 DCE
IDCSB-03-A	3-4	**16000**	**12000**	**14000**
IDCSB-03-B	4-6	**270000**	**39000**	**14000J**

Soil Screening Criteria for Site Related Contaminants	
VOC	Standards (µg/kg)
PCE	46.0
TCE	36.0
cis-1,2 DCE	420.0
1,1 - DCE	50.0
Vinyl chloride	13.8
Values that exceed screening criteria are highlighted in yellow	
Values in bold represent detections	

Notes:
Detections are in bold
ft bgs - feet below ground surface
J - estimated value
µg/kg - micrograms per kilograms
U - not detected above the listed detection limit

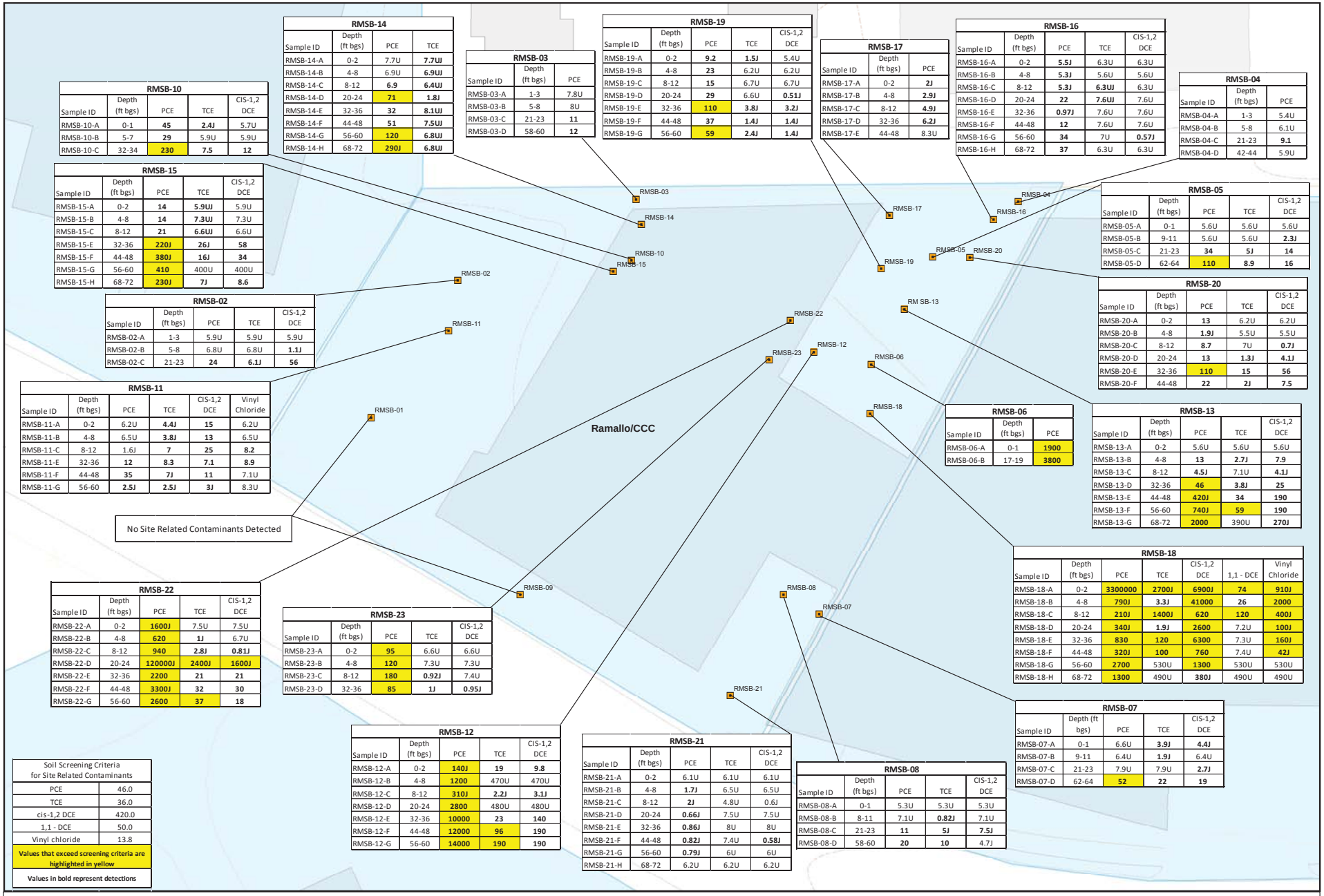
VOC - volatile organic compound
PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene
SRC - Site Related Contaminants

0 3.75 7.5 15 22.5 30 Feet

Figure 4-1
Site-Related Contaminant Soil Results - International Dry Cleaners
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007386



RMSB-14

Sample ID	Depth (ft bgs)	PCE	TCE
RMSB-14-A	0-2	7.7U	**7.7UJ**
RMSB-14-B	4-8	6.9U	**6.9UJ**
RMSB-14-C	8-12	**6.9**	**6.4UJ**
RMSB-14-D	20-24	**71**	**1.8J**
RMSB-14-E	32-36	**32**	**8.1UJ**
RMSB-14-F	44-48	**51**	**7.5UJ**
RMSB-14-G	56-60	**120**	**6.8UJ**
RMSB-14-H	68-72	**290J**	**6.8UJ**

RMSB-03

Sample ID	Depth (ft bgs)	PCE
RMSB-03-A	1-3	7.8U
RMSB-03-B	5-8	8U
RMSB-03-C	21-23	**11**
RMSB-03-D	58-60	**12**

RMSB-19

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-19-A	0-2	**9.2**	**1.5J**	5.4U
RMSB-19-B	4-8	**23**	6.2U	6.2U
RMSB-19-C	8-12	**15**	6.7U	6.7U
RMSB-19-D	20-24	**29**	6.6U	**0.51J**
RMSB-19-E	32-36	**110**	**3.8J**	**3.2J**
RMSB-19-F	44-48	**37**	**1.4J**	**1.4J**
RMSB-19-G	56-60	**59**	**2.4J**	**1.4J**

RMSB-17

Sample ID	Depth (ft bgs)	PCE
RMSB-17-A	0-2	**2J**
RMSB-17-B	4-8	**2.9J**
RMSB-17-C	8-12	**4.9J**
RMSB-17-D	32-36	**6.2J**
RMSB-17-E	44-48	8.3U

RMSB-16

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-16-A	0-2	**5.5J**	6.3U	6.3U
RMSB-16-B	4-8	**5.3J**	5.6U	5.6U
RMSB-16-C	8-12	**5.3J**	**6.3UJ**	6.3U
RMSB-16-D	20-24	**22**	**7.6UJ**	7.6U
RMSB-16-E	32-36	**0.97J**	7.6U	7.6U
RMSB-16-F	44-48	**12**	7.6U	7.6U
RMSB-16-G	56-60	**34**	7U	**0.57J**
RMSB-16-H	68-72	**37**	6.3U	6.3U

RMSB-04

Sample ID	Depth (ft bgs)	PCE
RMSB-04-A	1-3	5.4U
RMSB-04-B	5-8	6.1U
RMSB-04-C	21-23	**9.1**
RMSB-04-D	42-44	5.9U

RMSB-10

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-10-A	0-1	**45**	**2.4J**	5.7U
RMSB-10-B	5-7	**29**	5.9U	5.9U
RMSB-10-C	32-34	**230**	**7.5**	**12**

RMSB-15

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-15-A	0-2	**14**	**5.9UJ**	5.9U
RMSB-15-B	4-8	**14**	**7.3UJ**	7.3U
RMSB-15-C	8-12	**21**	**6.6UJ**	6.6U
RMSB-15-E	32-36	**220J**	**26J**	**58**
RMSB-15-F	44-48	**380J**	**16J**	**34**
RMSB-15-G	56-60	**410**	400U	400U
RMSB-15-H	68-72	**230J**	**7J**	**8.6**

RMSB-05

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-05-A	0-1	5.6U	5.6U	5.6U
RMSB-05-B	9-11	5.6U	5.6U	**2.3J**
RMSB-05-C	21-23	**34**	**5J**	**14**
RMSB-05-D	62-64	**110**	**8.9**	**16**

RMSB-02

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-02-A	1-3	5.9U	5.9U	5.9U
RMSB-02-B	5-8	6.8U	6.8U	**1.1J**
RMSB-02-C	21-23	**24**	**6.1J**	**56**

RMSB-20

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-20-A	0-2	**13**	6.2U	6.2U
RMSB-20-B	4-8	**1.9J**	5.5U	5.5U
RMSB-20-C	8-12	**8.7**	7U	**0.7J**
RMSB-20-D	20-24	**13**	**1.3J**	**4.1J**
RMSB-20-E	32-36	**110**	**15**	**56**
RMSB-20-F	44-48	**22**	**2J**	**7.5**

RMSB-11

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE	Vinyl Chloride
RMSB-11-A	0-2	6.2U	**4.4J**	**15**	6.2U
RMSB-11-B	4-8	6.5U	**3.8J**	**13**	6.5U
RMSB-11-C	8-12	1.6J	**7**	**25**	**8.2**
RMSB-11-E	32-36	**12**	**8.3**	**7.1**	**8.9**
RMSB-11-F	44-48	**35**	**7J**	**11**	7.1U
RMSB-11-G	56-60	**2.5J**	**2.5J**	**3J**	8.3U

RMSB-06

Sample ID	Depth (ft bgs)	PCE
RMSB-06-A	0-1	**1900**
RMSB-06-B	17-19	**3800**

RMSB-13

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-13-A	0-2	5.6U	5.6U	5.6U
RMSB-13-B	4-8	**13**	**2.7J**	**7.9**
RMSB-13-C	8-12	**4.5J**	7.1U	**4.1J**
RMSB-13-D	32-36	**46**	**3.8J**	**25**
RMSB-13-E	44-48	**420J**	**34**	**190**
RMSB-13-F	56-60	**740J**	**59**	**190**
RMSB-13-G	68-72	**2000**	390U	**270J**

No Site Related Contaminants Detected

RMSB-18

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE	1,1 - DCE	Vinyl Chloride
RMSB-18-A	0-2	**3300000**	**2700J**	**6900J**	**74**	**910J**
RMSB-18-B	4-8	**790J**	**3.3J**	**41000**	**26**	**2000**
RMSB-18-C	8-12	**210J**	**1400J**	**620**	**120**	**400J**
RMSB-18-D	20-24	**340J**	**1.9J**	**2600**	7.2U	**100J**
RMSB-18-E	32-36	**830**	**120**	**6300**	7.3U	**160J**
RMSB-18-F	44-48	**320J**	**100**	**760**	7.4U	**42J**
RMSB-18-G	56-60	**2700**	530U	**1300**	530U	530U
RMSB-18-H	68-72	**1300**	490U	**380J**	490U	490U

RMSB-22

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-22-A	0-2	**1600J**	7.5U	7.5U
RMSB-22-B	4-8	**620**	**1J**	6.7U
RMSB-22-C	8-12	**940**	**2.8J**	**0.81J**
RMSB-22-D	20-24	**120000J**	**2400J**	**1600J**
RMSB-22-E	32-36	**2200**	**21**	**21**
RMSB-22-F	44-48	**3300J**	**32**	**30**
RMSB-22-G	56-60	**2600**	**37**	**18**

RMSB-23

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-23-A	0-2	**95**	6.6U	6.6U
RMSB-23-B	4-8	**120**	7.3U	7.3U
RMSB-23-C	8-12	**180**	**0.92J**	7.4U
RMSB-23-D	32-36	**85**	**1J**	**0.95J**

RMSB-07

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-07-A	0-1	6.6U	**3.9J**	**4.4J**
RMSB-07-B	9-11	6.4U	**1.9J**	6.4U
RMSB-07-C	21-23	7.9U	7.9U	**2.7J**
RMSB-07-D	62-64	**52**	**22**	**19**

RMSB-12

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-12-A	0-2	**140J**	**19**	**9.8**
RMSB-12-B	4-8	**1200**	470U	470U
RMSB-12-C	8-12	**310J**	**2.2J**	**3.1J**
RMSB-12-D	20-24	**2800**	480U	480U
RMSB-12-E	32-36	**10000**	**23**	**140**
RMSB-12-F	44-48	**12000**	**96**	**190**
RMSB-12-G	56-60	**14000**	**190**	**190**

RMSB-21

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-21-A	0-2	6.1U	6.1U	6.1U
RMSB-21-B	4-8	**1.7J**	6.5U	6.5U
RMSB-21-C	8-12	**2J**	4.8U	0.6J
RMSB-21-D	20-24	**0.66J**	7.5U	7.5U
RMSB-21-E	32-36	**0.86J**	8U	8U
RMSB-21-F	44-48	**0.82J**	7.4U	**0.58J**
RMSB-21-G	56-60	**0.79J**	6U	6U
RMSB-21-H	68-72	6.2U	6.2U	6.2U

RMSB-08

Sample ID	Depth (ft bgs)	PCE	TCE	CIS-1,2 DCE
RMSB-08-A	0-1	5.3U	5.3U	5.3U
RMSB-08-B	8-11	7.1U	**0.82J**	7.1U
RMSB-08-C	21-23	**11**	**5J**	**7.5J**
RMSB-08-D	58-60	**20**	**10**	4.7J

Soil Screening Criteria for Site Related Contaminants	
PCE	46.0
TCE	36.0
cis-1,2 DCE	420.0
1,1 - DCE	50.0
Vinyl chloride	13.8
Values that exceed screening criteria are highlighted in yellow	
Values in bold represent detections	

Notes:
All results in micrograms per kilogram (µg/kg)
ft bgs - feet below ground surface
J - estimated value
U - not detected above the listed detection limit

PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene

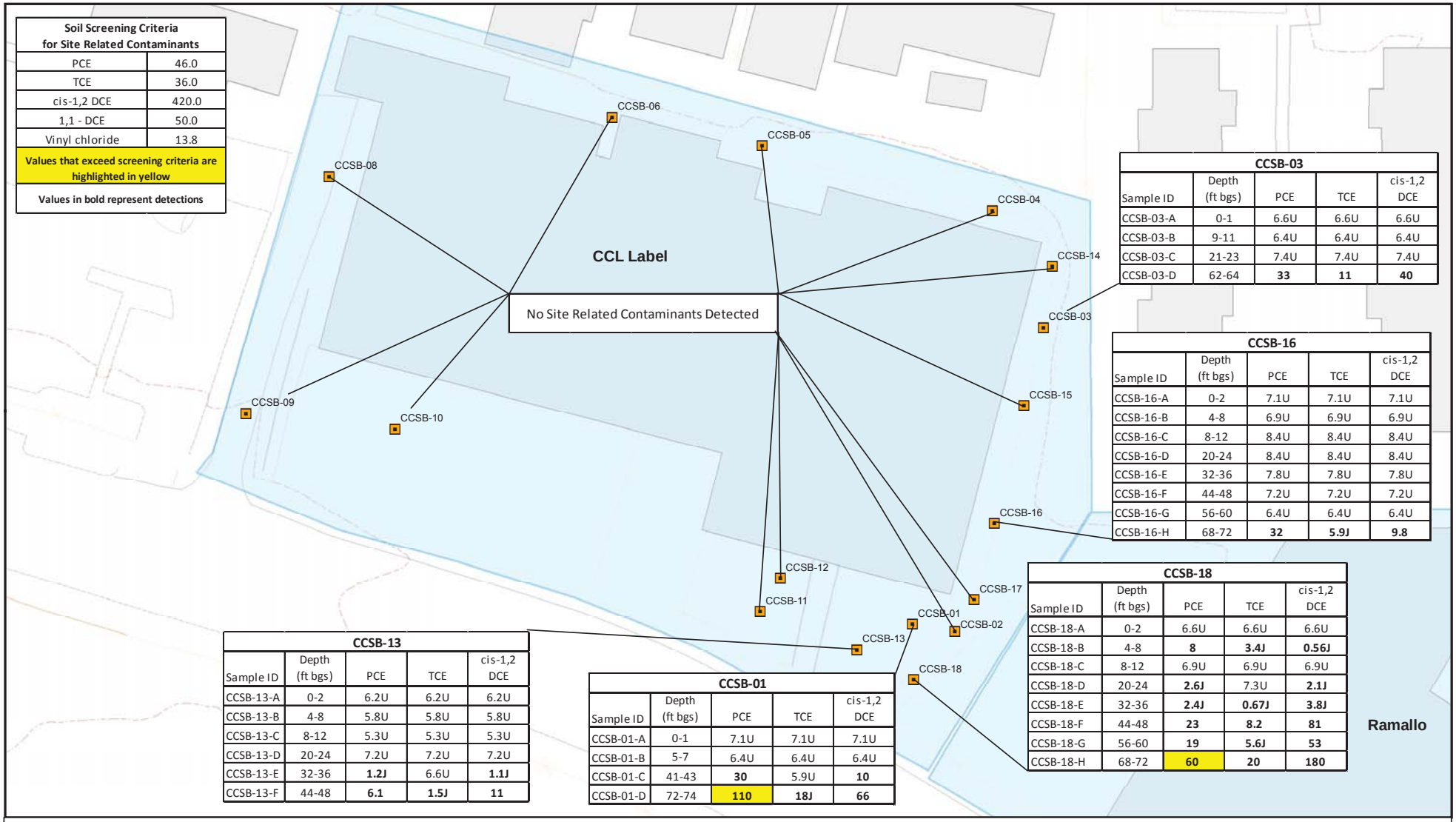
0 15 30 60 90 120 Feet

Figure 4-2
Site-Related Contaminant Soil Results - Ramallo/Cidra Convention Center
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007387

Soil Screening Criteria for Site Related Contaminants	
PCE	46.0
TCE	36.0
cis-1,2 DCE	420.0
1,1 - DCE	50.0
Vinyl chloride	13.8
Values that exceed screening criteria are highlighted in yellow	
Values in bold represent detections	



CCSB-03				
Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
CCSB-03-A	0-1	6.6U	6.6U	6.6U
CCSB-03-B	9-11	6.4U	6.4U	6.4U
CCSB-03-C	21-23	7.4U	7.4U	7.4U
CCSB-03-D	62-64	**33**	**11**	**40**

CCSB-16				
Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
CCSB-16-A	0-2	7.1U	7.1U	7.1U
CCSB-16-B	4-8	6.9U	6.9U	6.9U
CCSB-16-C	8-12	8.4U	8.4U	8.4U
CCSB-16-D	20-24	8.4U	8.4U	8.4U
CCSB-16-E	32-36	7.8U	7.8U	7.8U
CCSB-16-F	44-48	7.2U	7.2U	7.2U
CCSB-16-G	56-60	6.4U	6.4U	6.4U
CCSB-16-H	68-72	**32**	**5.9J**	**9.8**

CCSB-18				
Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
CCSB-18-A	0-2	6.6U	6.6U	6.6U
CCSB-18-B	4-8	**8**	**3.4J**	**0.56J**
CCSB-18-C	8-12	6.9U	6.9U	6.9U
CCSB-18-D	20-24	**2.6J**	7.3U	**2.1J**
CCSB-18-E	32-36	**2.4J**	**0.67J**	**3.8J**
CCSB-18-F	44-48	**23**	**8.2**	**81**
CCSB-18-G	56-60	**19**	**5.6J**	**53**
CCSB-18-H	68-72	**60**	**20**	**180**

CCSB-13				
Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
CCSB-13-A	0-2	6.2U	6.2U	6.2U
CCSB-13-B	4-8	5.8U	5.8U	5.8U
CCSB-13-C	8-12	5.3U	5.3U	5.3U
CCSB-13-D	20-24	7.2U	7.2U	7.2U
CCSB-13-E	32-36	**1.2J**	6.6U	**1.1J**
CCSB-13-F	44-48	**6.1**	**1.5J**	**11**

CCSB-01				
Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
CCSB-01-A	0-1	7.1U	7.1U	7.1U
CCSB-01-B	5-7	6.4U	6.4U	6.4U
CCSB-01-C	41-43	**30**	5.9U	**10**
CCSB-01-D	72-74	**110**	**18J**	**66**

Notes:
All results in micrograms per kilogram (µg/kg)
ft bgs - feet below ground surface
J - estimated value
U - not detected above the listed detection limit

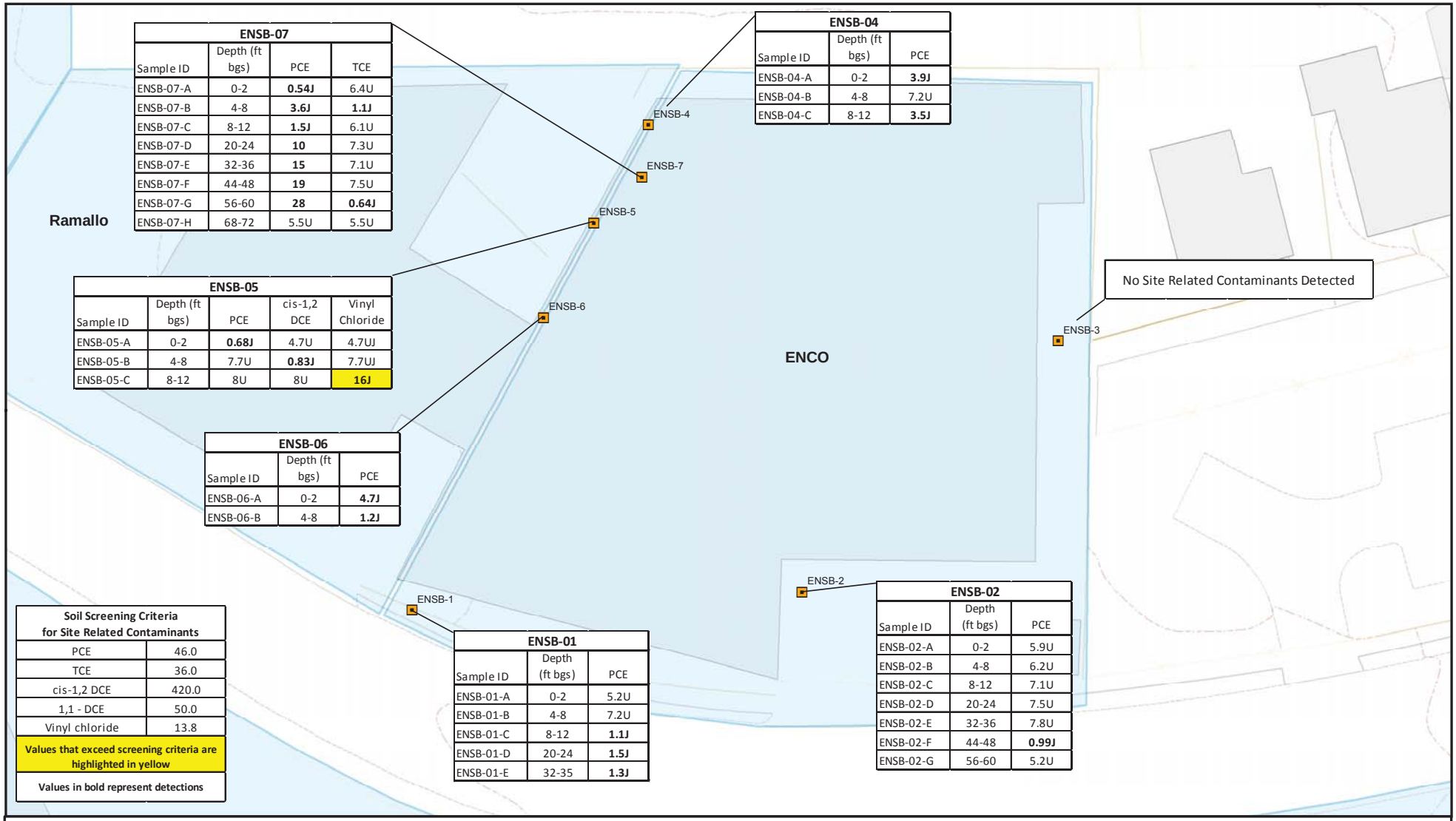
PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene

0 12.5 25 50 75 100 Feet

Figure 4-3
Site-Related Contaminant Soil Results - CCL Label
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007388



ENSB-07

Sample ID	Depth (ft bgs)	PCE	TCE
ENSB-07-A	0-2	**0.54J**	6.4U
ENSB-07-B	4-8	**3.6J**	**1.1J**
ENSB-07-C	8-12	**1.5J**	6.1U
ENSB-07-D	20-24	**10**	7.3U
ENSB-07-E	32-36	**15**	7.1U
ENSB-07-F	44-48	**19**	7.5U
ENSB-07-G	56-60	**28**	**0.64J**
ENSB-07-H	68-72	5.5U	5.5U

ENSB-04

Sample ID	Depth (ft bgs)	PCE
ENSB-04-A	0-2	**3.9J**
ENSB-04-B	4-8	7.2U
ENSB-04-C	8-12	**3.5J**

ENSB-05

Sample ID	Depth (ft bgs)	PCE	cis-1,2 DCE	Vinyl Chloride
ENSB-05-A	0-2	**0.68J**	4.7U	4.7UJ
ENSB-05-B	4-8	7.7U	**0.83J**	7.7UJ
ENSB-05-C	8-12	8U	8U	**16J**

ENSB-06

Sample ID	Depth (ft bgs)	PCE
ENSB-06-A	0-2	**4.7J**
ENSB-06-B	4-8	**1.2J**

ENSB-01

Sample ID	Depth (ft bgs)	PCE
ENSB-01-A	0-2	5.2U
ENSB-01-B	4-8	7.2U
ENSB-01-C	8-12	**1.1J**
ENSB-01-D	20-24	**1.5J**
ENSB-01-E	32-35	**1.3J**

ENSB-02

Sample ID	Depth (ft bgs)	PCE
ENSB-02-A	0-2	5.9U
ENSB-02-B	4-8	6.2U
ENSB-02-C	8-12	7.1U
ENSB-02-D	20-24	7.5U
ENSB-02-E	32-36	7.8U
ENSB-02-F	44-48	**0.99J**
ENSB-02-G	56-60	5.2U

Soil Screening Criteria for Site Related Contaminants

PCE	46.0
TCE	36.0
cis-1,2 DCE	420.0
1,1 - DCE	50.0
Vinyl chloride	13.8

Values that exceed screening criteria are highlighted in yellow

Values in bold represent detections

Notes:
All result in micrograms per kilogram (µg/kg)
ft bgs - feet below ground surface
J - estimated value
U - not detected above the listed detection limit

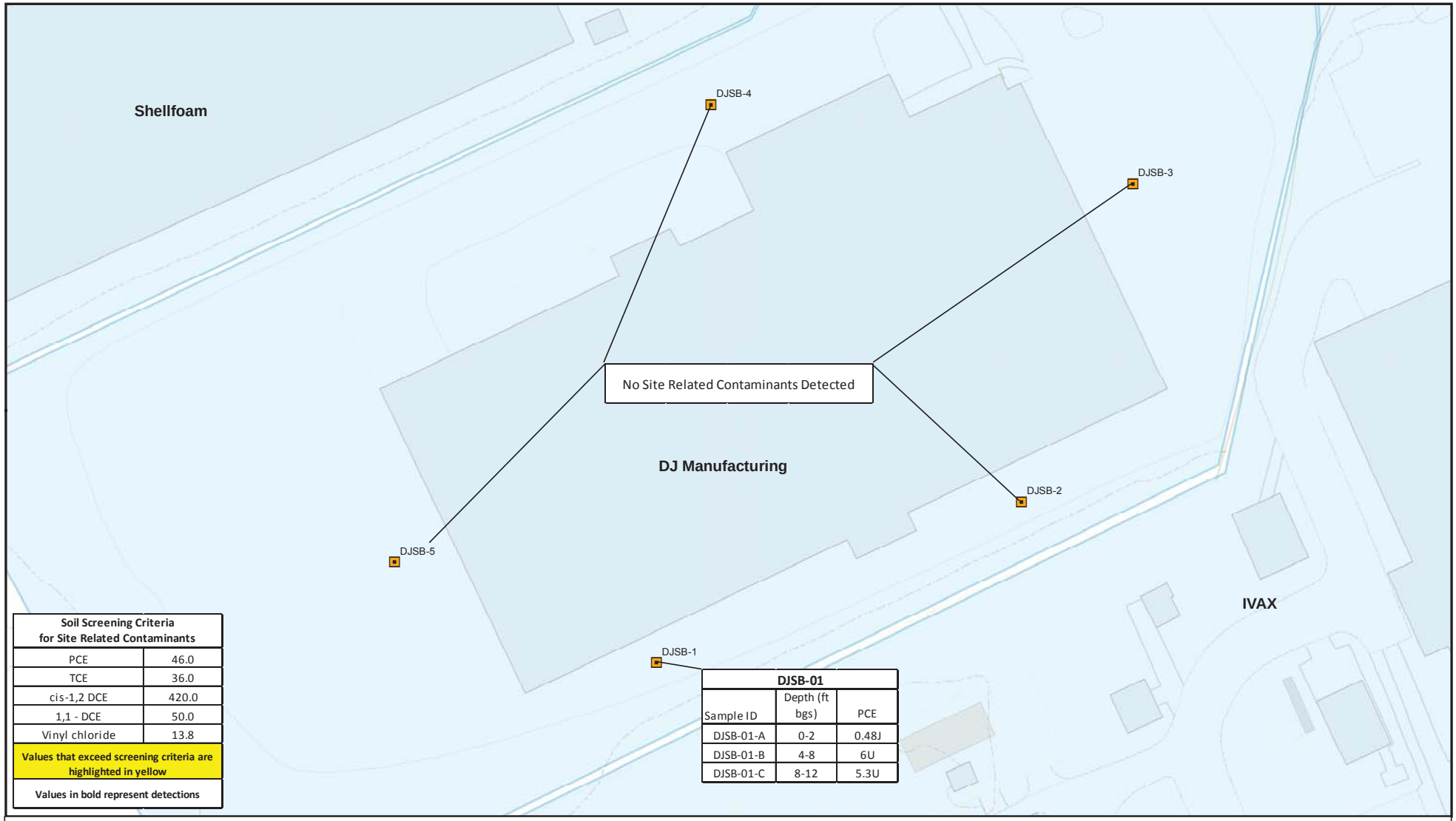
PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene

0 12.5 25 50 75 100 Feet

Figure 4-4
Site-Related Contaminant Soil Results - ENCO
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007389



Soil Screening Criteria for Site Related Contaminants	
PCE	46.0
TCE	36.0
cis-1,2 DCE	420.0
1,1 - DCE	50.0
Vinyl chloride	13.8
Values that exceed screening criteria are highlighted in yellow	
Values in bold represent detections	

DJSB-01		
Sample ID	Depth (ft bgs)	PCE
DJSB-01-A	0-2	0.48J
DJSB-01-B	4-8	6U
DJSB-01-C	8-12	5.3U

Notes:
All results in micrograms per kilogram (µg/kg)
ft bgs - feet below ground surface
J - estimated value
U - not detected above the listed detection limit

PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene

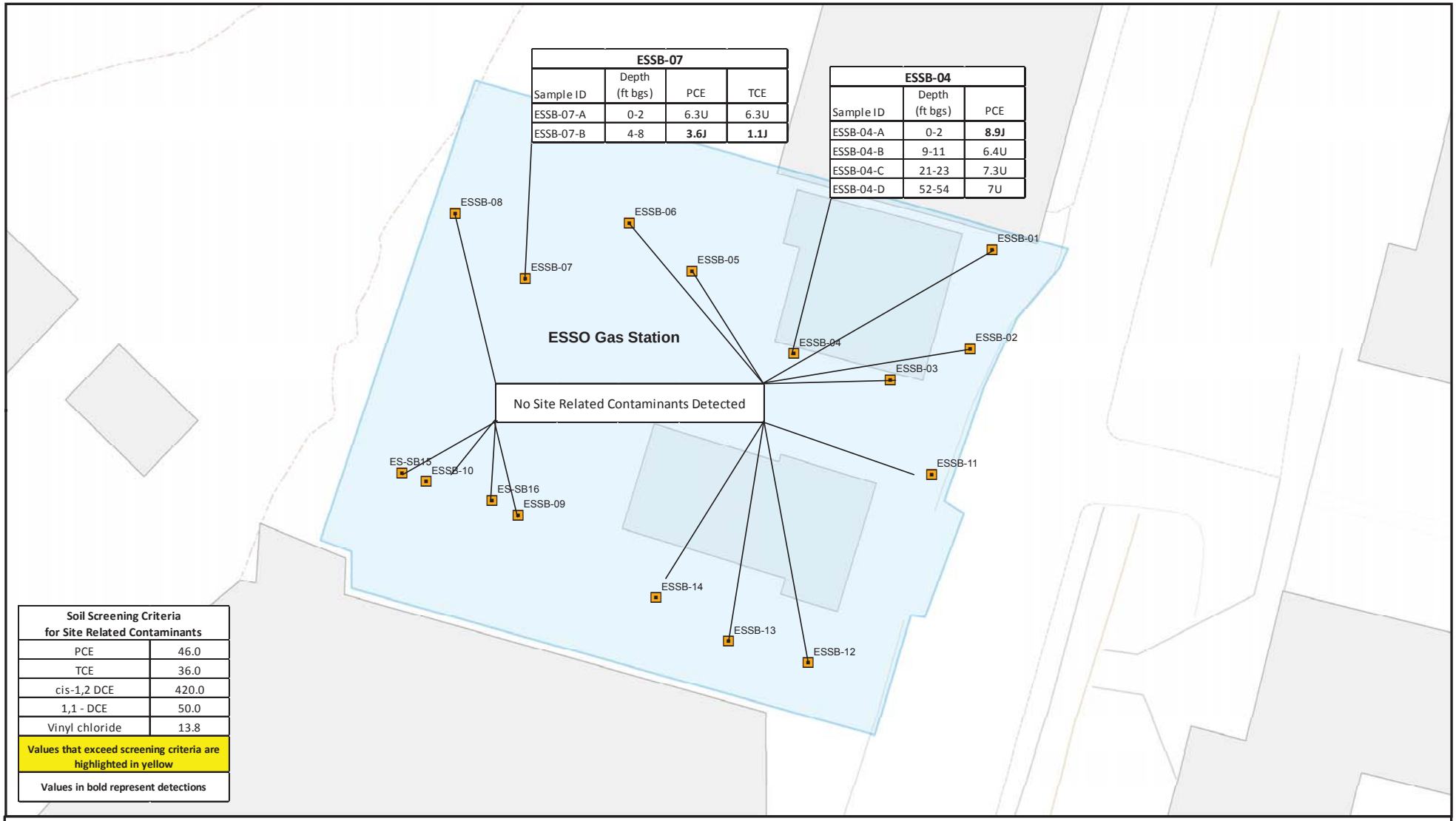
N

0 15 30 60 90 120 Feet

Figure 4-5
Site-Related Contaminant Soil Results - DJ Manufacturing
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007390



ESSB-07			
Sample ID	Depth (ft bgs)	PCE	TCE
ESSB-07-A	0-2	6.3U	6.3U
ESSB-07-B	4-8	**3.6J**	**1.1J**

ESSB-04		
Sample ID	Depth (ft bgs)	PCE
ESSB-04-A	0-2	**8.9J**
ESSB-04-B	9-11	6.4U
ESSB-04-C	21-23	7.3U
ESSB-04-D	52-54	7U

Soil Screening Criteria for Site Related Contaminants	
PCE	46.0
TCE	36.0
cis-1,2 DCE	420.0
1,1 - DCE	50.0
Vinyl chloride	13.8
Values that exceed screening criteria are highlighted in yellow	
Values in bold represent detections	

Notes:
All results in micrograms per kilogram (µg/kg)
ft bgs - feet below ground surface
J - estimated value
U - not detected above the listed detection limit

PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene

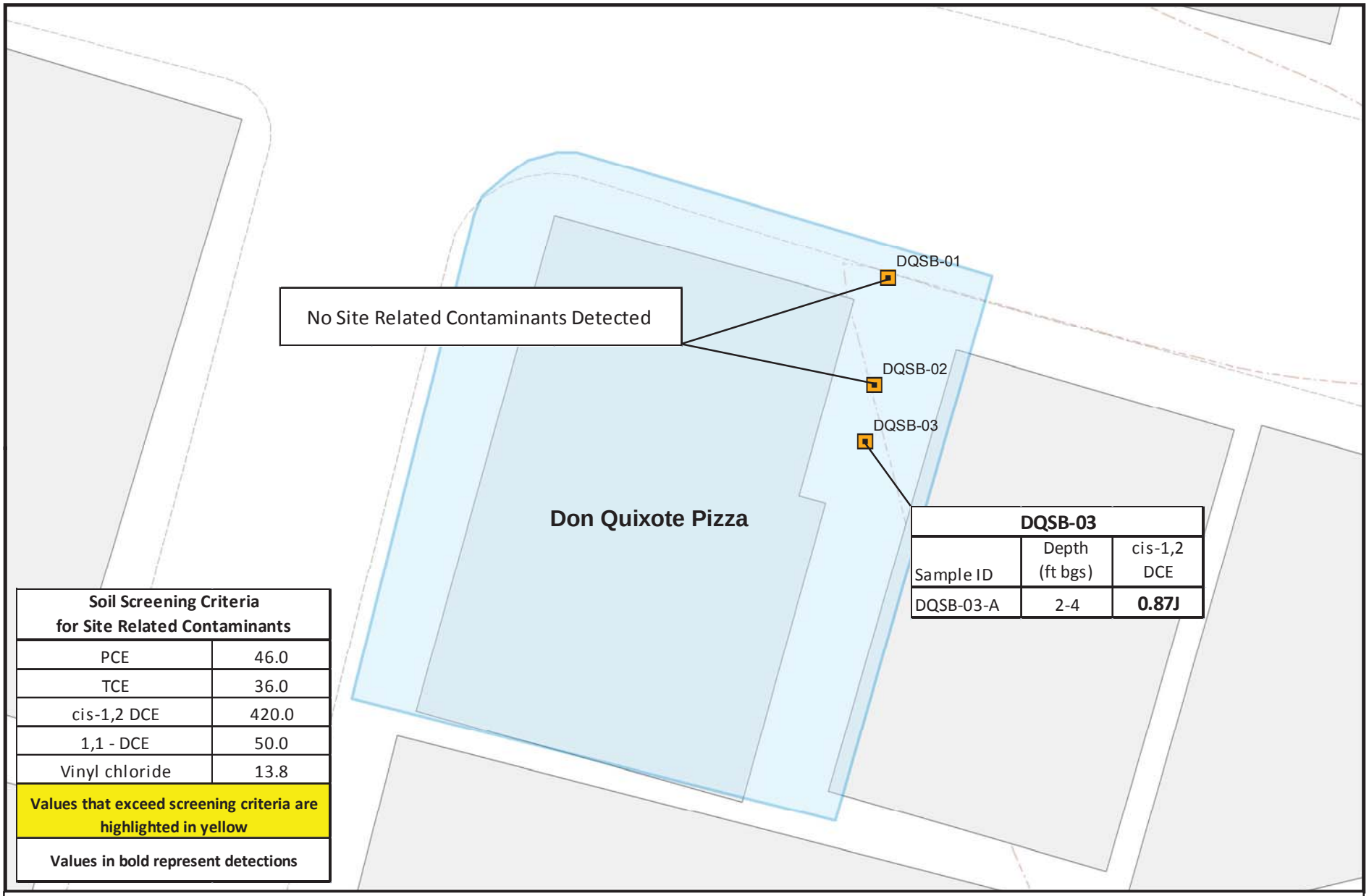
N

0 5 10 20 30 40 Feet

Figure 4-6
Site-Related Contaminant Soil Results - ESSO Gas Station
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007391



DQSB-03		
Sample ID	Depth (ft bgs)	cis-1,2 DCE
DQSB-03-A	2-4	**0.87J**

Soil Screening Criteria for Site Related Contaminants	
PCE	46.0
TCE	36.0
cis-1,2 DCE	420.0
1,1 - DCE	50.0
Vinyl chloride	13.8
Values that exceed screening criteria are highlighted in yellow	
Values in bold represent detections	

Notes:
All results in micrograms per kilogram (µg/kg)
ft bgs - feet below ground surface
J - estimated value
U - not detected above the listed detection limit

PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene

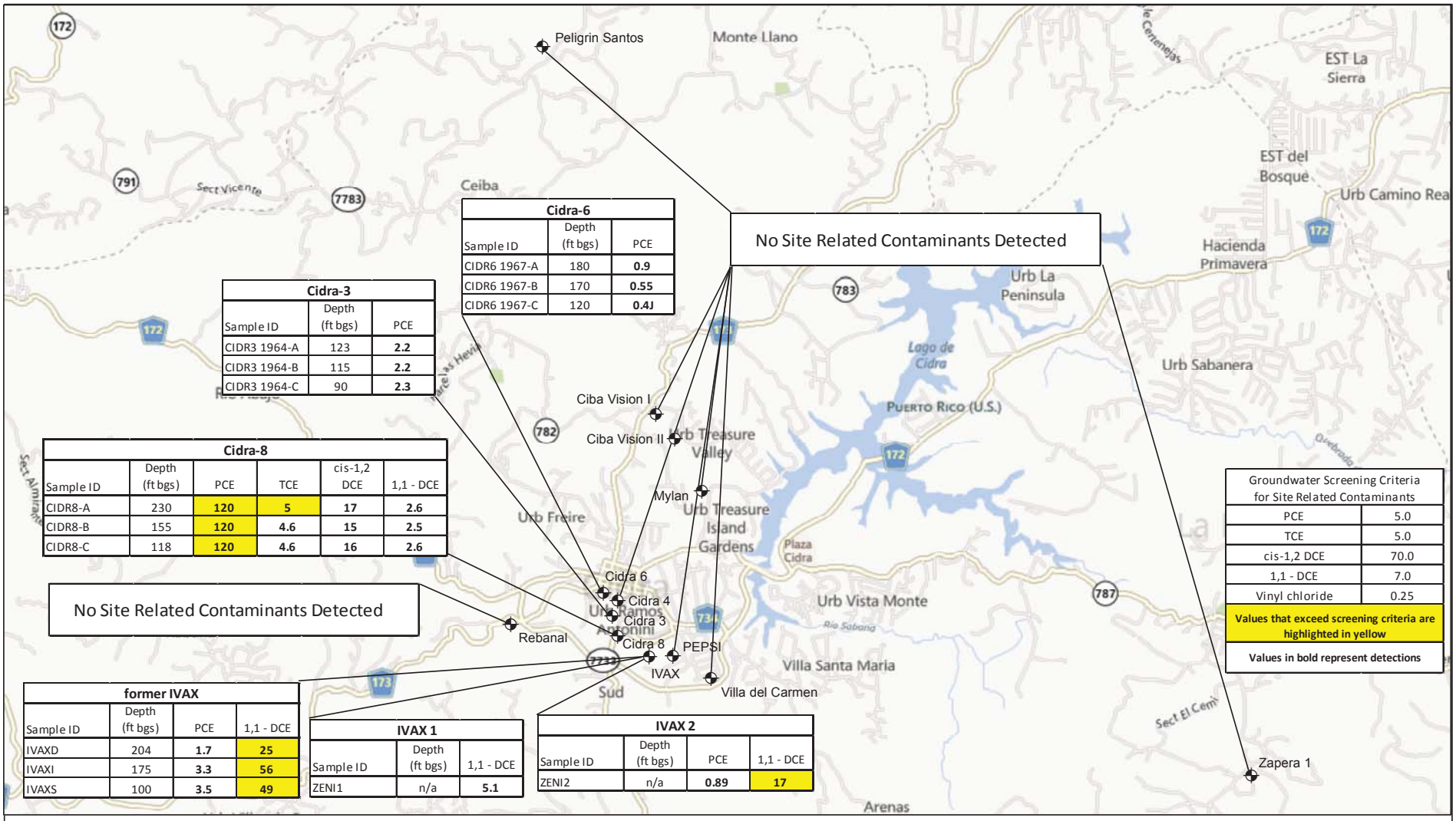
N

0 2 4 8 12 16 Feet

Figure 4-7
Site-Related Contaminant Soil Results - Don Quixote Pizza
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007392



Cidra-6		
Sample ID	Depth (ft bgs)	PCE
CIDR6 1967-A	180	**0.9**
CIDR6 1967-B	170	**0.55**
CIDR6 1967-C	120	**0.4J**

Cidra-3		
Sample ID	Depth (ft bgs)	PCE
CIDR3 1964-A	123	**2.2**
CIDR3 1964-B	115	**2.2**
CIDR3 1964-C	90	**2.3**

Cidra-8					
Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE	1,1 - DCE
CIDR8-A	230	**120**	**5**	**17**	**2.6**
CIDR8-B	155	**120**	**4.6**	**15**	**2.5**
CIDR8-C	118	**120**	**4.6**	**16**	**2.6**

Groundwater Screening Criteria for Site Related Contaminants	
PCE	5.0
TCE	5.0
cis-1,2 DCE	70.0
1,1 - DCE	7.0
Vinyl chloride	0.25
Values that exceed screening criteria are highlighted in yellow	
Values in bold represent detections	

former IVAX			
Sample ID	Depth (ft bgs)	PCE	1,1 - DCE
IVAXD	204	**1.7**	**25**
IVAXI	175	**3.3**	**56**
IVAXS	100	**3.5**	**49**

IVAX 1		
Sample ID	Depth (ft bgs)	1,1 - DCE
ZENI1	n/a	**5.1**

IVAX 2			
Sample ID	Depth (ft bgs)	PCE	1,1 - DCE
ZENI2	n/a	**0.89**	**17**

Notes:
All results in micrograms per liter (µg/L)
ft bgs - feet below ground surface
J - estimated value
U - not detected above the listed detection limit

PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene

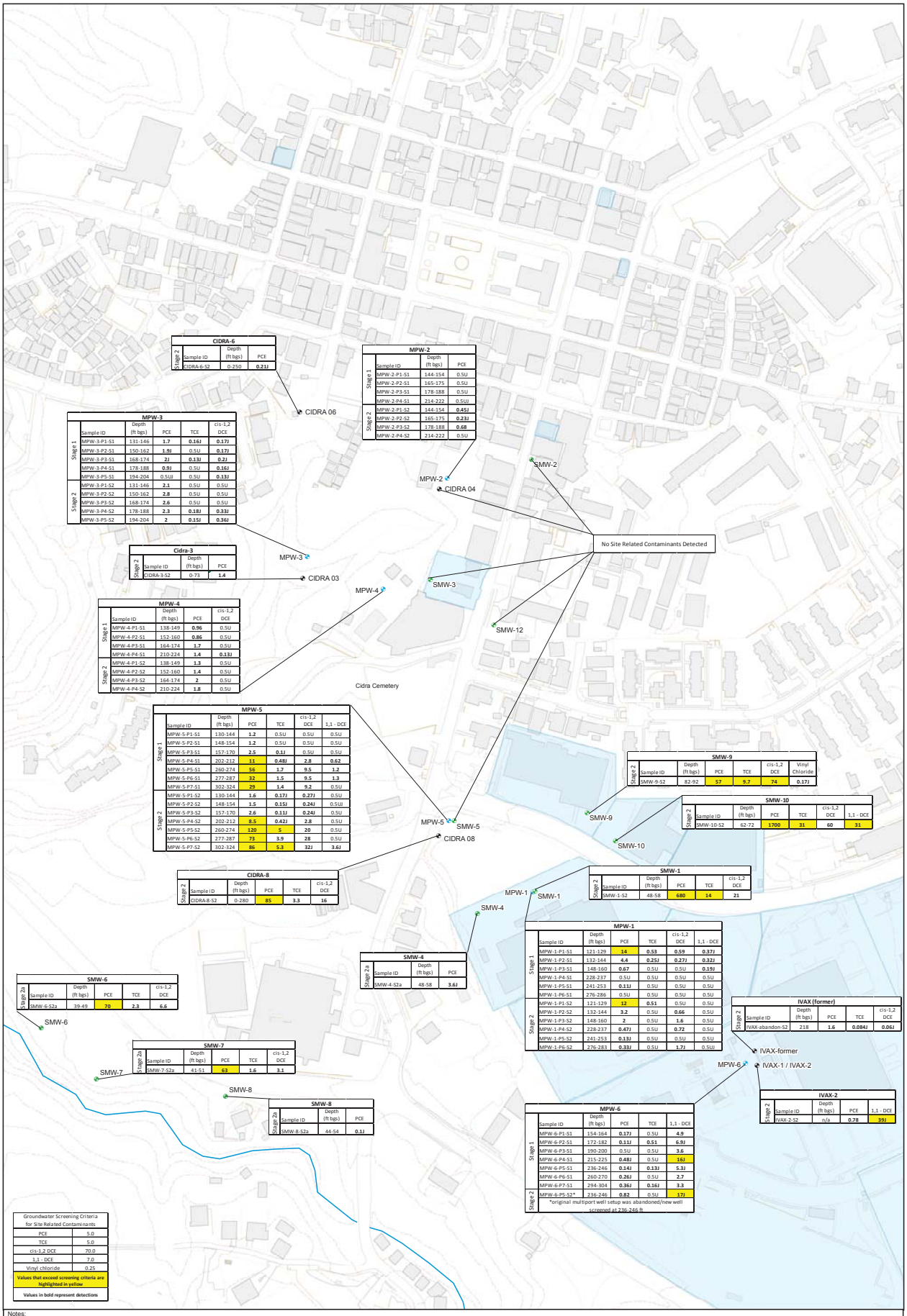
N

0 0.25 0.5 1 Miles

Figure 4-8
Site-Related Contaminant Groundwater Results - Supply Wells (Initial Round)
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007393



CIDRA-6

	Sample ID	Depth (ft bgs)	PCE
Stage 2	CIDRA-6-S2	0-250	**0.21J**

MPW-2

	Sample ID	Depth (ft bgs)	PCE
Stage 1	MPW-2-P1-S1	144-154	0.5U
	MPW-2-P2-S1	165-175	0.5U
	MPW-2-P3-S1	178-188	0.5U
	MPW-2-P4-S1	214-222	0.5U
Stage 2	MPW-2-P1-S2	144-154	**0.45J**
	MPW-2-P2-S2	165-175	**0.23J**
	MPW-2-P3-S2	178-188	**0.68**
	MPW-2-P4-S2	214-222	0.5U

MPW-3

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
Stage 1	MPW-3-P1-S1	131-146	**1.7**	**0.16J**	**0.17J**
	MPW-3-P2-S1	150-162	**1.9J**	0.5U	**0.17J**
	MPW-3-P3-S1	168-174	**2J**	**0.13J**	**0.2J**
	MPW-3-P4-S1	178-188	**0.9J**	0.5U	**0.16J**
	MPW-3-P5-S1	194-204	0.5UJ	0.5U	**0.13J**
Stage 2	MPW-3-P1-S2	131-146	**2.1**	0.5U	0.5U
	MPW-3-P2-S2	150-162	**2.8**	0.5U	0.5U
	MPW-3-P3-S2	168-174	**2.6**	0.5U	0.5U
	MPW-3-P4-S2	178-188	**2.3**	**0.18J**	**0.33J**
	MPW-3-P5-S2	194-204	**2**	**0.15J**	**0.36J**

Cidra-3

	Sample ID	Depth (ft bgs)	PCE
Stage 2	CIDRA-3-S2	0-73	**1.4**

MPW-4

	Sample ID	Depth (ft bgs)	PCE	cis-1,2 DCE
Stage 1	MPW-4-P1-S1	138-149	**0.96**	0.5U
	MPW-4-P2-S1	152-160	**0.86**	0.5U
	MPW-4-P3-S1	164-174	**1.7**	0.5U
	MPW-4-P4-S1	210-224	**1.4**	**0.13J**
Stage 2	MPW-4-P1-S2	138-149	**1.3**	0.5U
	MPW-4-P2-S2	152-160	**1.4**	0.5U
	MPW-4-P3-S2	164-174	**2**	0.5U
	MPW-4-P4-S2	210-224	**1.8**	0.5U

MPW-5

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE	1,1 - DCE
Stage 1	MPW-5-P1-S1	130-144	**1.2**	0.5U	0.5U	0.5U
	MPW-5-P2-S1	148-154	**1.2**	0.5U	0.5U	0.5U
	MPW-5-P3-S1	157-170	**2.5**	**0.1J**	0.5U	0.5U
	MPW-5-P4-S1	202-212	**11**	**0.48J**	**2.8**	**0.62**
	MPW-5-P5-S1	260-274	**56**	**1.7**	**9.5**	**1.2**
	MPW-5-P6-S1	277-287	**32**	**1.5**	**9.5**	**1.3**
	MPW-5-P7-S1	302-324	**29**	**1.4**	**9.2**	0.5U
Stage 2	MPW-5-P1-S2	130-144	**1.6**	**0.17J**	**0.27J**	0.5U
	MPW-5-P2-S2	148-154	**1.5**	**0.15J**	**0.24J**	0.5UJ
	MPW-5-P3-S2	157-170	**2.6**	**0.11J**	**0.24J**	0.5U
	MPW-5-P4-S2	202-212	**8.5**	**0.42J**	**2.8**	0.5U
	MPW-5-P5-S2	260-274	**120**	**5**	**20**	0.5U
	MPW-5-P6-S2	277-287	**73**	**3.9**	**28**	0.5U
	MPW-5-P7-S2	302-324	**86**	**5.3**	**32J**	**3.6J**

SMW-9

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE	Vinyl Chloride
Stage 2	SMW-9-S2	82-92	**57**	**9.7**	**74**	**0.17J**

SMW-10

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE	1,1 - DCE
Stage 2	SMW-10-S2	62-72	**1700**	**31**	**60**	**31**

CIDRA-8

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
Stage 2	CIDRA-8-S2	0-280	**85**	**3.3**	**16**

SMW-1

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
Stage 2	SMW-1-S2	48-58	**680**	**14**	**21**

MPW-1

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE	1,1 - DCE
Stage 1	MPW-1-P1-S1	121-129	**14**	**0.53**	**0.59**	**0.37J**
	MPW-1-P2-S1	132-144	**4.4**	**0.25J**	**0.27J**	**0.32J**
	MPW-1-P3-S1	148-160	**0.67**	0.5U	0.5U	**0.19J**
	MPW-1-P4-S1	228-237	0.5U	0.5U	0.5U	0.5U
	MPW-1-P5-S1	241-253	**0.11J**	0.5U	0.5U	0.5U
	MPW-1-P6-S1	276-286	0.5U	0.5U	0.5U	0.5U
Stage 2	MPW-1-P1-S2	121-129	**12**	**0.51**	0.5U	0.5U
	MPW-1-P2-S2	132-144	**3.2**	0.5U	**0.66**	0.5U
	MPW-1-P3-S2	148-160	**2**	0.5U	**1.6**	0.5U
	MPW-1-P4-S2	228-237	**0.47J**	0.5U	**0.72**	0.5U
	MPW-1-P5-S2	241-253	**0.13J**	0.5U	0.5U	0.5U
	MPW-1-P6-S2	276-283	**0.33J**	0.5U	**1.7J**	0.5UJ

SMW-4

	Sample ID	Depth (ft bgs)	PCE
Stage 2a	SMW-4-S2a	48-58	**3.6J**

SMW-6

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
Stage 2a	SMW-6-S2a	39-49	**70**	**2.3**	**6.6**

SMW-7

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
Stage 2a	SMW-7-S2a	41-51	**63**	**1.6**	**3.1**

SMW-8

	Sample ID	Depth (ft bgs)	PCE
Stage 2a	SMW-8-S2a	44-54	**0.1J**

IVAX (former)

	Sample ID	Depth (ft bgs)	PCE	TCE	cis-1,2 DCE
Stage 2	IVAX-abandon-S2	218	**1.6**	**0.084J**	**0.06J**

IVAX-2

	Sample ID	Depth (ft bgs)	PCE	1,1 - DCE
Stage 2	IVAX-2-S2	n/a	**0.78**	**39J**

MPW-6

	Sample ID	Depth (ft bgs)	PCE	TCE	1,1 - DCE
Stage 1	MPW-6-P1-S1	154-164	**0.17J**	0.5U	**4.9**
	MPW-6-P2-S1	172-182	**0.11J**	**0.51**	**6.9J**
	MPW-6-P3-S1	190-200	0.5U	0.5U	**3.6**
	MPW-6-P4-S1	215-225	**0.48J**	0.5U	**16J**
	MPW-6-P5-S1	236-246	**0.14J**	**0.13J**	**5.3J**
	MPW-6-P6-S1	260-270	**0.26J**	0.5U	**2.7**
	MPW-6-P7-S1	294-304	**0.36J**	**0.16J**	**3.3**
Stage 2	MPW-6-P5-S2*	236-246	**0.82**	0.5U	**17J**

*original multiport well setup was abandoned/new well screened at 236-246 ft

Groundwater Screening Criteria for Site Related Contaminants	
PCE	5.0
TCE	5.0
cis-1,2 DCE	70.0
1,1 - DCE	7.0
Vinyl chloride	0.25
Values that exceed screening criteria are highlighted in yellow	
Values in bold represent detections	

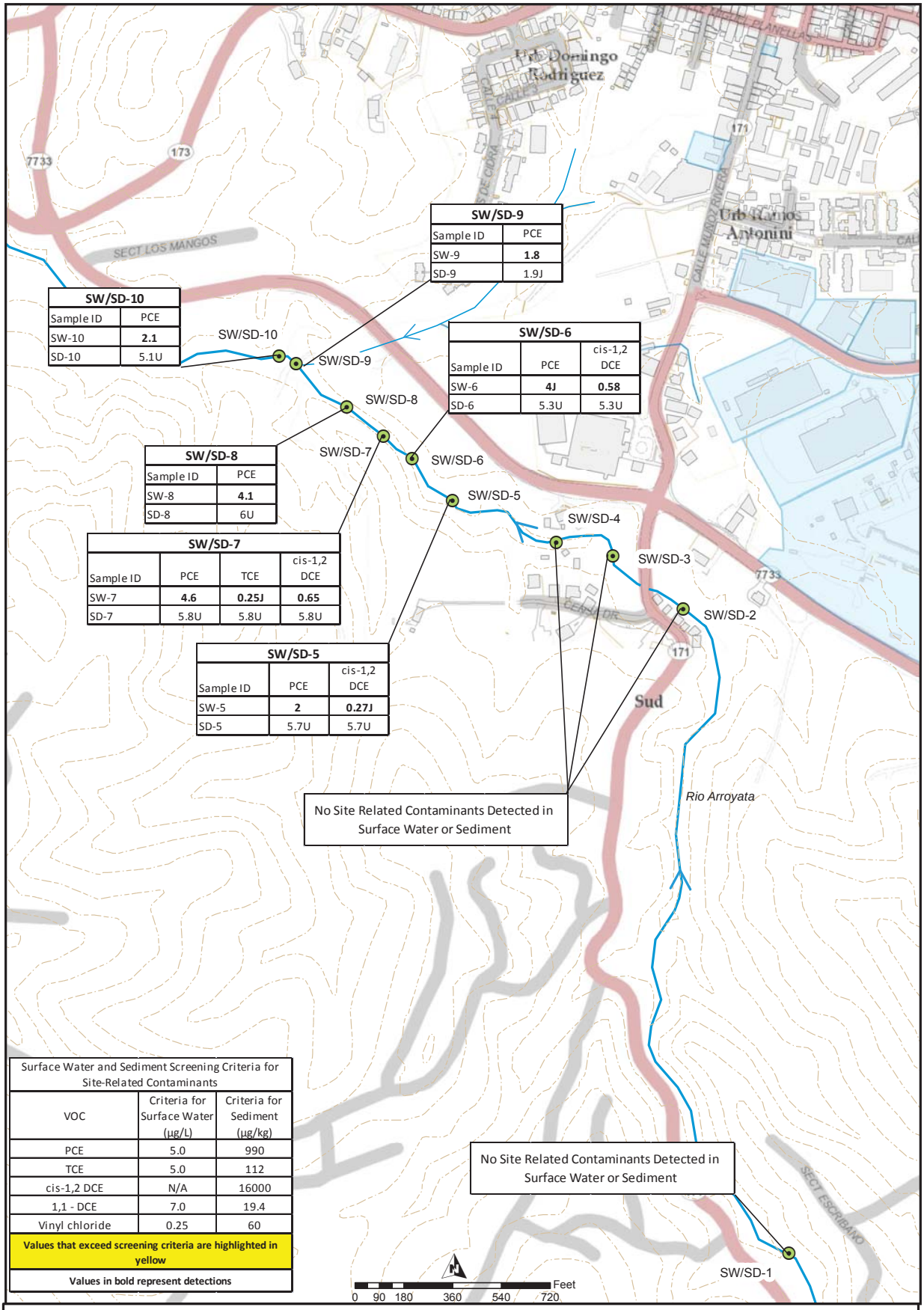
Notes:
All results in micrograms per liter (µg/L)
ft bgs - feet below ground surface
J - estimated value
U - not detected above the listed detection limit
PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene

0 50 100 200 300 400 Feet

Figure 4-9
Site-Related Contaminant Groundwater Results - Stage 1, Stage 2 and Stage 2a
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007394



SW/SD-9	
Sample ID	PCE
SW-9	**1.8**
SD-9	1.9J

SW/SD-10	
Sample ID	PCE
SW-10	**2.1**
SD-10	5.1U

SW/SD-6		
Sample ID	PCE	cis-1,2 DCE
SW-6	**4J**	**0.58**
SD-6	5.3U	5.3U

SW/SD-8	
Sample ID	PCE
SW-8	**4.1**
SD-8	6U

SW/SD-7			
Sample ID	PCE	TCE	cis-1,2 DCE
SW-7	**4.6**	**0.25J**	**0.65**
SD-7	5.8U	5.8U	5.8U

SW/SD-5		
Sample ID	PCE	cis-1,2 DCE
SW-5	**2**	**0.27J**
SD-5	5.7U	5.7U

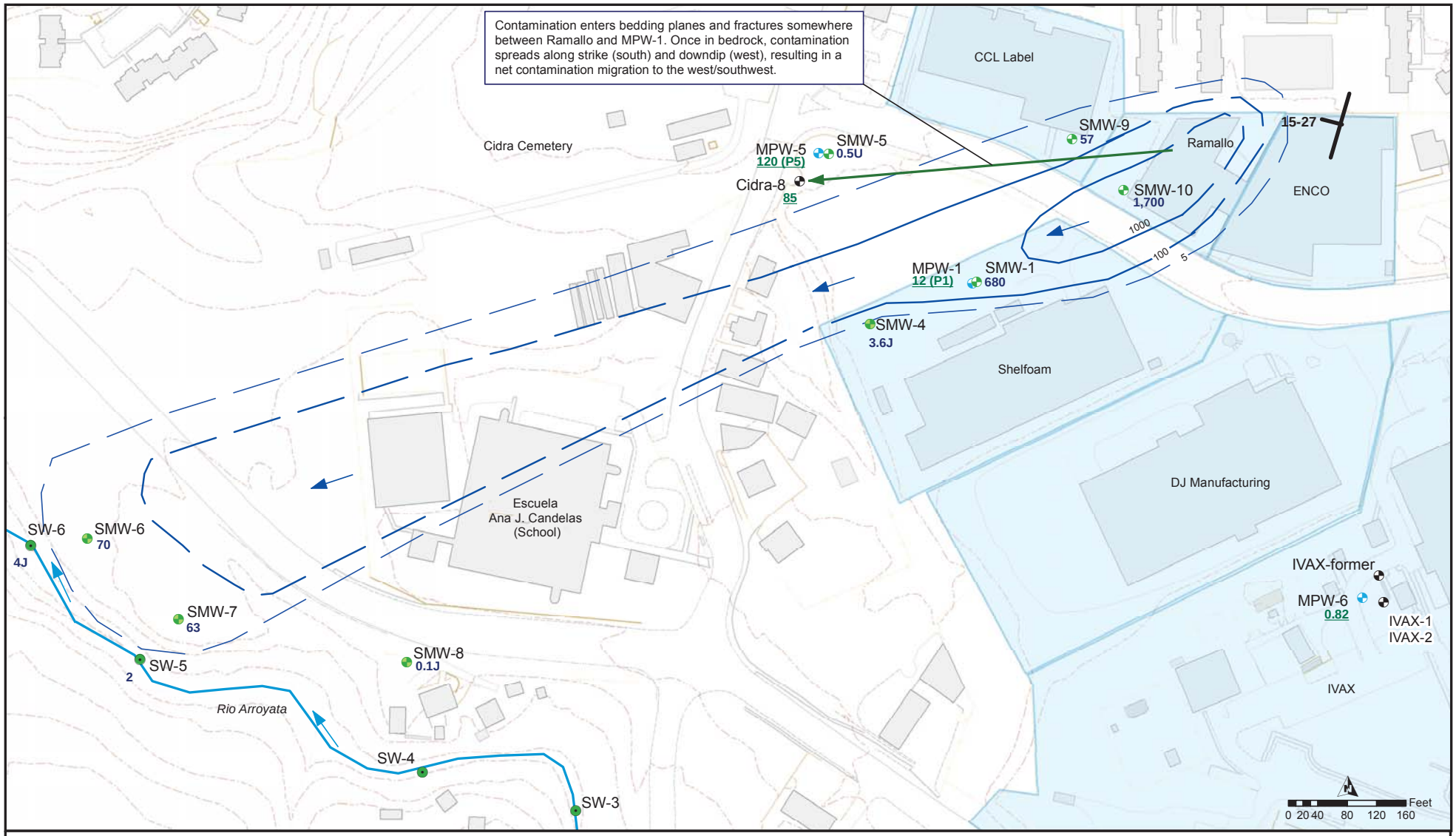
Surface Water and Sediment Screening Criteria for Site-Related Contaminants		
VOC	Criteria for Surface Water (µg/L)	Criteria for Sediment (µg/kg)
PCE	5.0	990
TCE	5.0	112
cis-1,2 DCE	N/A	16000
1,1 - DCE	7.0	19.4
Vinyl chloride	0.25	60
Values that exceed screening criteria are highlighted in yellow		
Values in bold represent detections		

Notes:
All sediment results in micrograms per liter (µg/L)
All surface water results in micrograms per kilogram (µg/kg)
U - not detected above the listed detection limit
VOC - volatile organic compound
PCE - tetrachloroethene
TCE - trichloroethene
DCE - dichloroethene
J- estimated value

Figure 4-10
Site-Related Contaminant Surface Water and Sediment Results
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

CDM Smith

R2-0007395



Legend

- Cidra Public Supply Well Location (out of service)
- Industrial Supply Well
- MPW - Multiport Well Location (Installed during Stage 1)
- SMW- Saprolite Monitoring Well Location (Installed during Stage 2)
- SMW - Saprolite Monitoring Well Location (Installed during Stage 2a)
- SW - Surface Water Sample Location (Collected during Stage 2a)
- Contaminant Movement in Saprolite
- Net Contaminant Movement in Bedrock
- 1,700 PCE Level in Saprolite Well
- 1,700 PCE Level in Bedrock Well (highest level & port #)
- PCE Contour in Saprolite
- Topographic contour line (10 foot interval)

Figure 4-11
PCE Plume in Saprolite
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

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R2-0007396

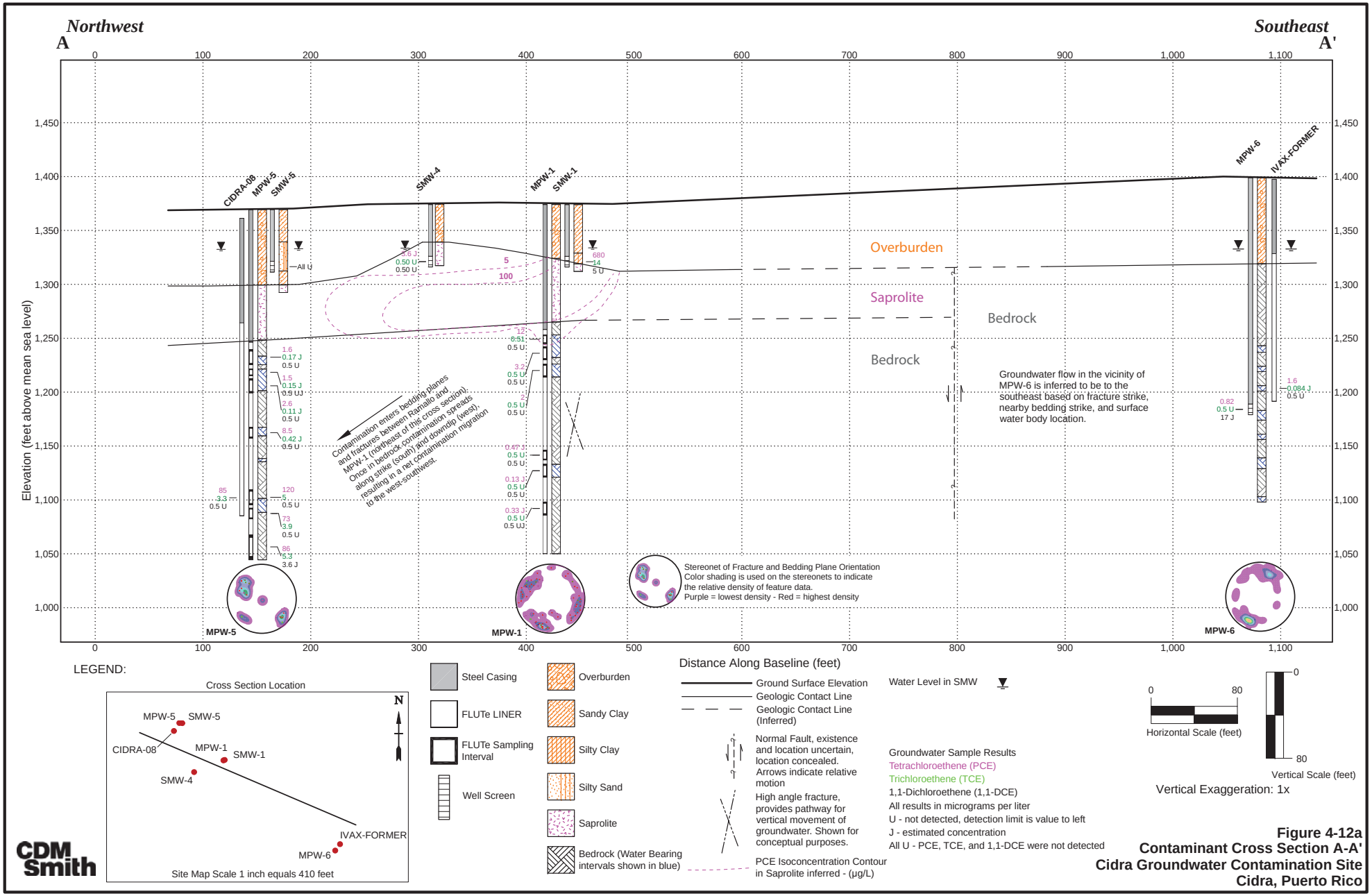
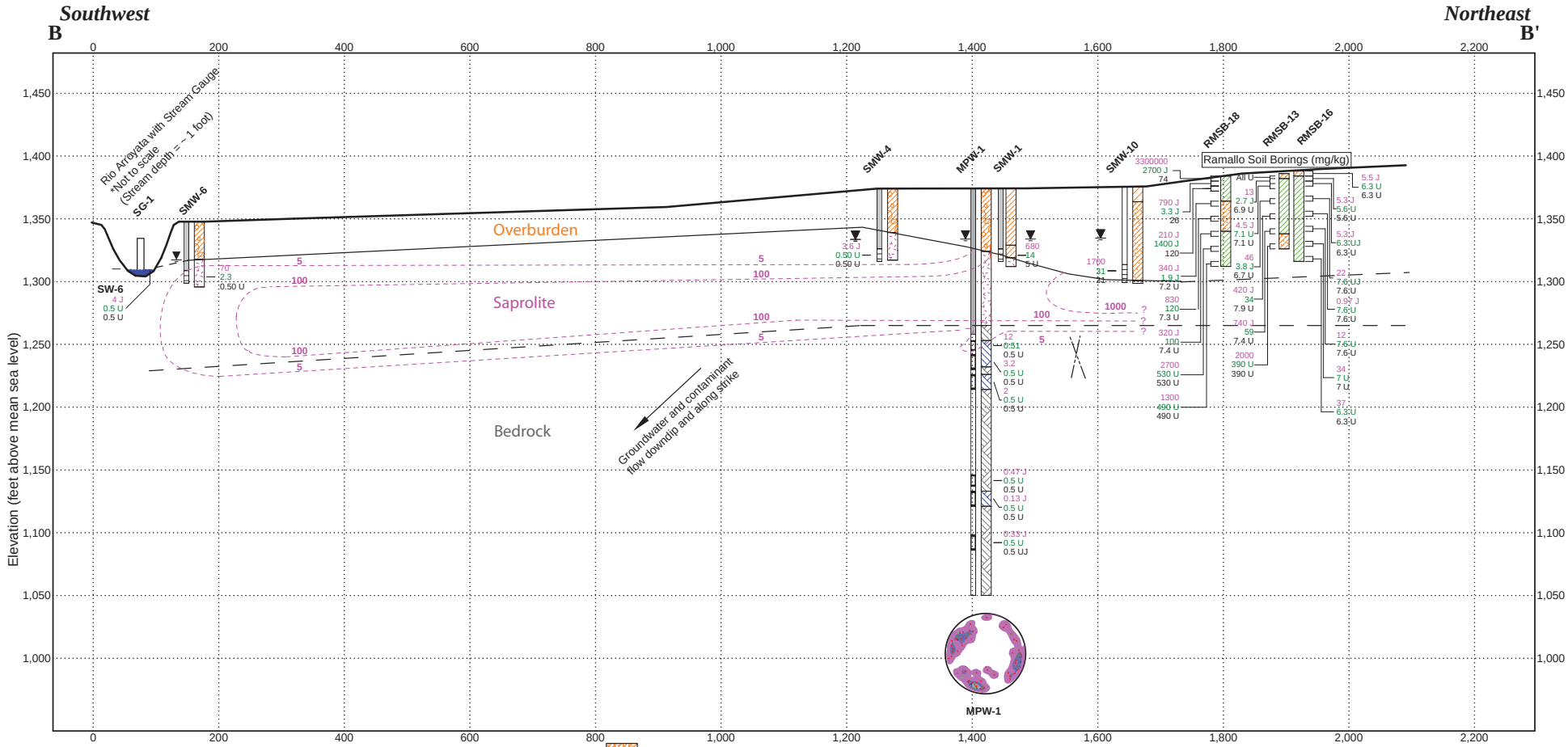


Figure 4-12a
Contaminant Cross Section A-A'
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

STANDARD CROSS SECTION: CIDRA CIDRA-2010.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 8/31/12 REV.

R2-0007397



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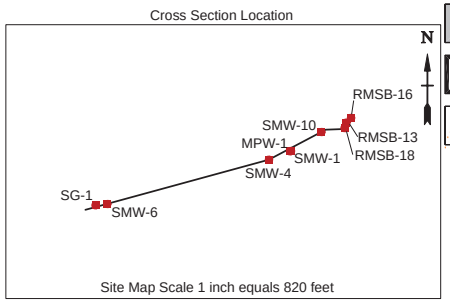

- Steel Casing
- FLUTe Sampling Interval
- FLUTe LINER
- Well Screen
- Overburden
- Clay
- Sandy Clay
- Silty Clay
- Clayey Sand
- Saprolite
- Bedrock (Water Bearing intervals shown in blue)

Ground Surface Elevation
Geologic Contact Line
Geologic Contact Line (Inferred)

High angle fracture, provides pathway for vertical movement of groundwater. Shown for conceptual purposes.

PCE Isoconcentration Contour in Saprolite - inferred (µg/L)

Stereonet of Fracture and Bedding Plane Orientation
Color shading is used on the stereonets to indicate the relative density of feature data.
Purple = lowest density - Red = highest density

Horizontal Scale (feet): 0 – 160

Vertical Scale (feet): 0 – 80

Vertical Exaggeration: 2x

Sample Results
Tetrachloroethene (PCE)
Trichloroethene (TCE)
1,1-Dichloroethene (1,1-DCE)
All groundwater results in micrograms per liter
All soil results in micrograms per kilogram
RMSB - Ramallo soil boring results
U - not detected, detection limit is value to left
J - estimated concentration
All U - PCE, TCE, and 1,1-DCE were not detected

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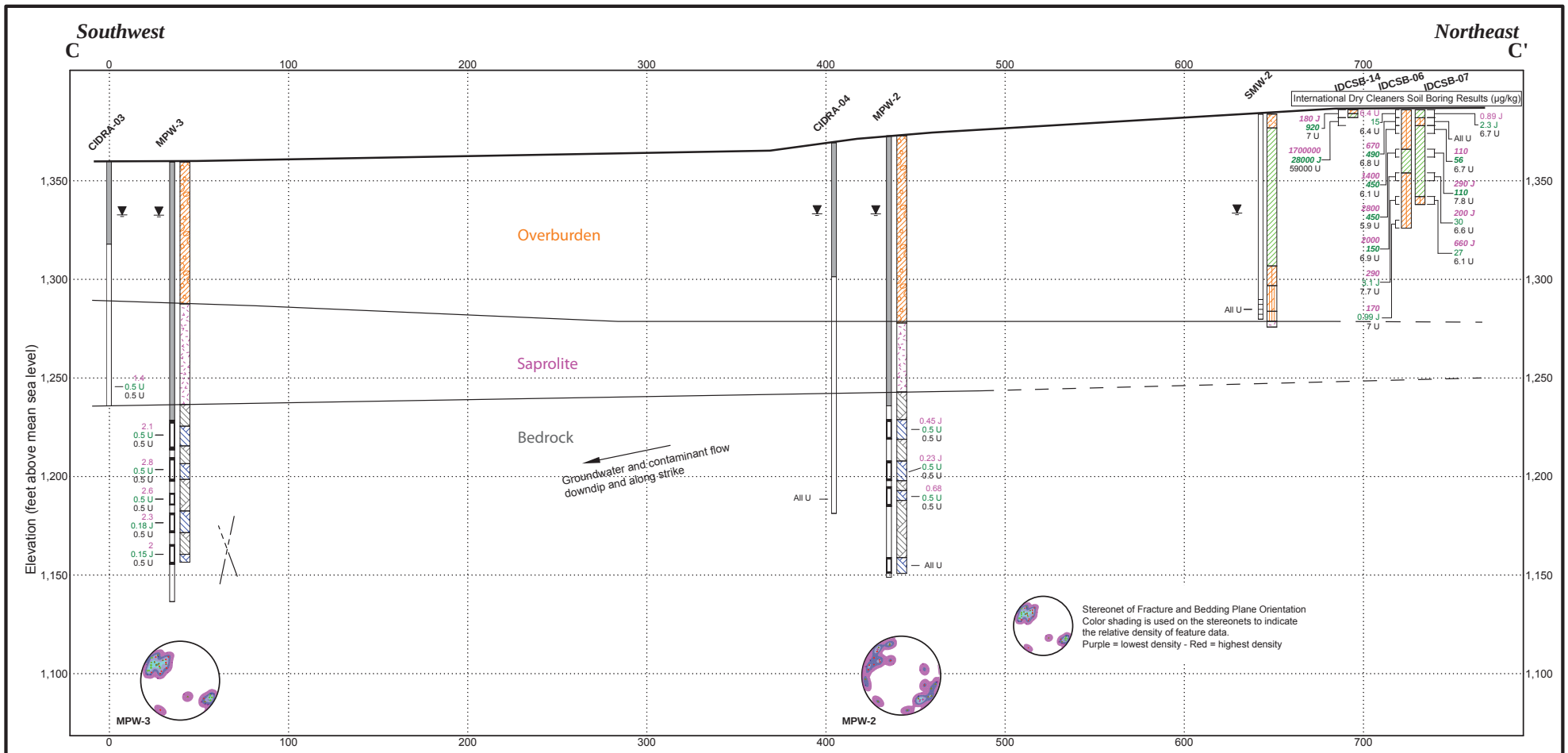
Figure 4-12b
Contaminant Cross Section B-B'
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

STANDARD CROSS SECTION: CIDRA CIDRA-2010.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 9/6/12 REV.

R2-0007398



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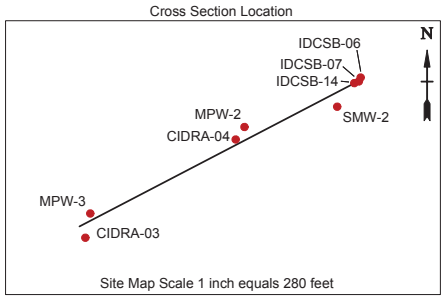

- Steel Casing
- FLUTe Sampling Interval
- FLUTe LINER
- Well Screen
- Overburden
- Clay
- Sandy Clay
- Silty Clay
- Clayey Silt
- Sandy Silt
- Saprolite
- Bedrock (water-bearing intervals shown in blue)

- Ground Surface Elevation
- Geologic Contact Line
- Geologic Contact Line (Inferred)
- High angle fracture, provides pathway for vertical movement of groundwater. Shown for conceptual purposes.
- Potentiometric Surface in Well (confined under overburden)

Groundwater and Soil Sample Results -
Tetrachloroethene (PCE)
Trichloroethene (TCE)
1,1-Dichloroethene (1,1-DCE)
All groundwater results in µg/L.
All soil results in µg/kg.
U - not detected, detection limit is value to left
J - estimated concentration
All U - PCE, TCE, and 1,1-DCE were not detected
Bolded and italicized values meet or exceed the following site screening criteria for:
Soil
PCE = 46 µg/kg, TCE = 36 µg/kg, 1,1-DCE = 50 µg/kg
Groundwater
PCE, TCE = 5 µg/L, 1,1-DCE = 7 µg/L

0 55
Horizontal Scale (feet)

0 50
Vertical Scale (feet)

Vertical Exaggeration: 1x

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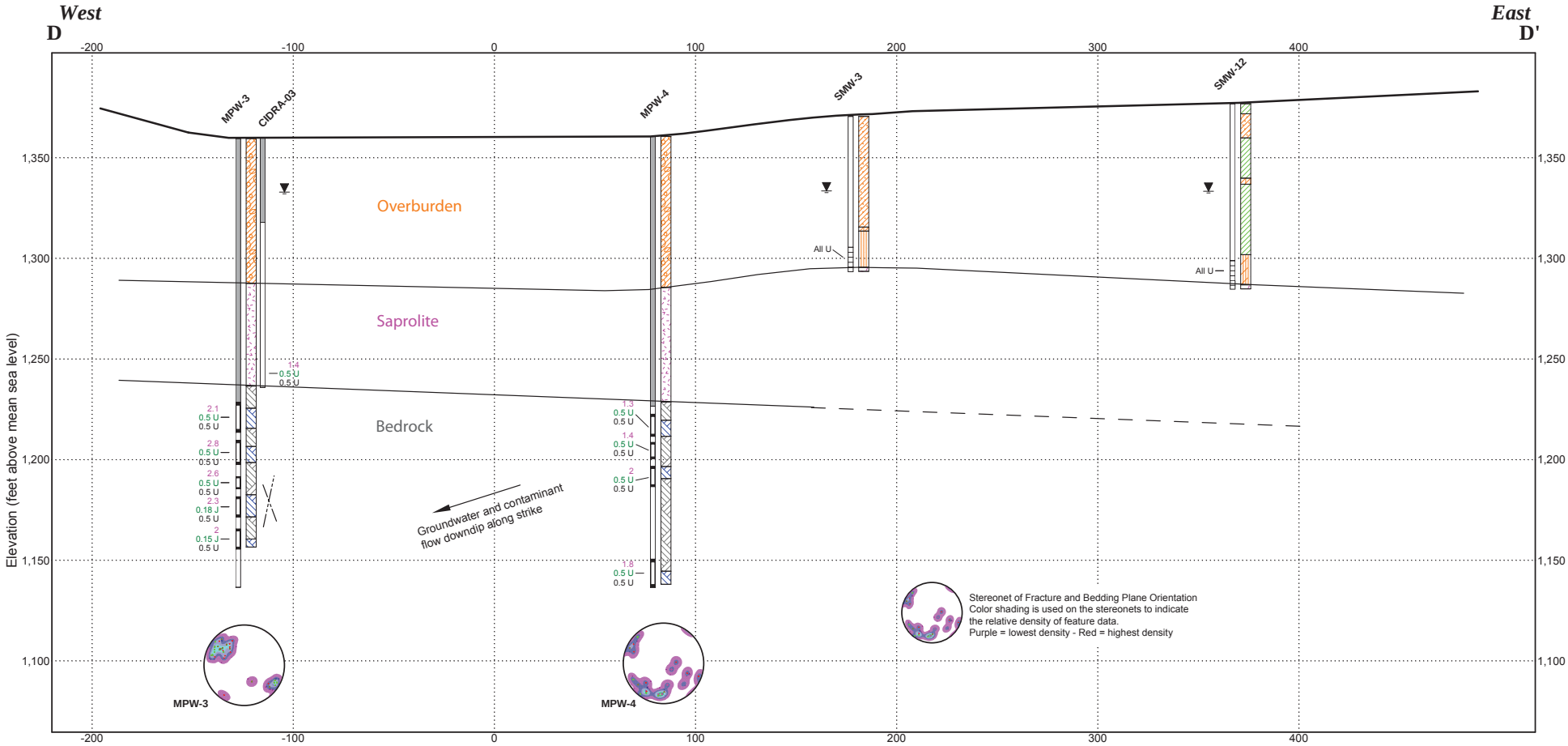
Figure 4-12c
Contaminant Cross Section C-C'
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

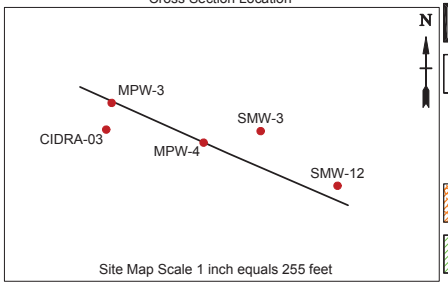
STANDARD CROSS SECTION: CIDRA CIDRA-2010.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 9/6/12 REV.

R2-0007399



LEGEND:

Cross Section Location



Site Map Scale 1 inch equals 255 feet

- Steel Casing
- FLUTe Sampling Interval
- FLUTe LINER
- Well Screen
- Overburden
- Clay
- Sandy Clay
- Silty Clay
- Sandy Silt
- Clayey Silt
- Saprolite
- Bedrock (Water Bearing intervals shown in blue)

Distance Along Baseline (ft)

- Ground Surface Elevation
- Geologic Contact Line
- Geologic Contact Line (Inferred)
- High angle fracture, provides pathway for vertical movement of groundwater. Shown for conceptual purposes.
- Potentiometric Surface in Well (confined under overburden)

Groundwater Sample Results -
Tetrachloroethene (PCE)
Trichloroethene (TCE)
1,1-Dichloroethene (1,1-DCE)
All results in µg/L.
U - not detected, detection limit is value to left
J - estimated concentration
All U - PCE, TCE, and 1,1-DCE were not detected
No results exceed the groundwater site screening criteria of 5 µg/L for PCE, TCE or 7 µg/L for 1,1-DCE.

0 50
Horizontal Scale (feet)

0 50
Vertical Scale (feet)

Vertical Exaggeration: 1x

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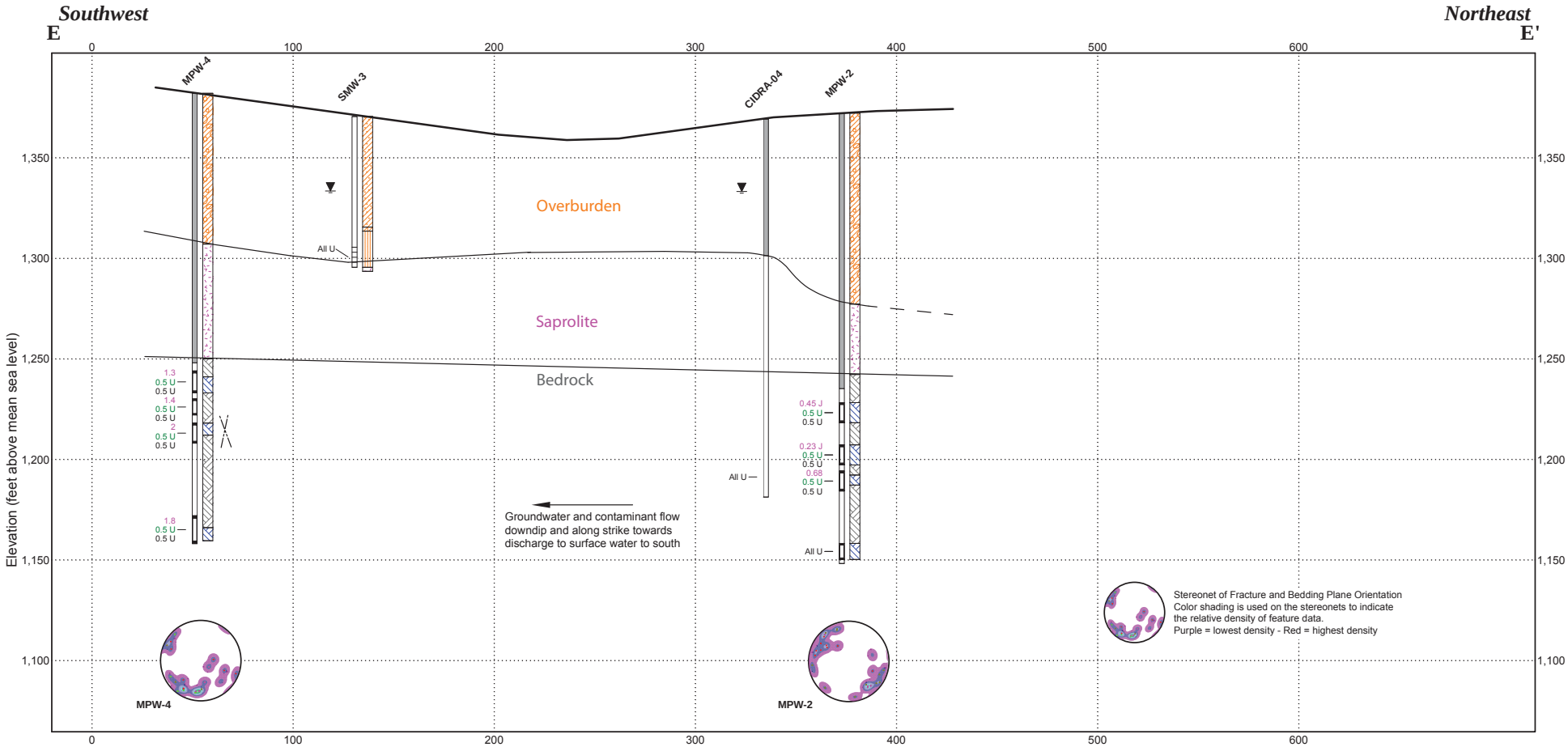
Figure 4-12d
Contaminant Cross Section D-D'
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

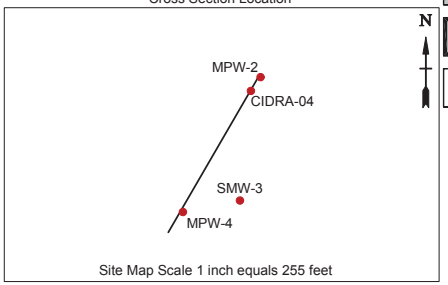
STANDARD CROSS SECTION: CIDRA CIDRA-2010.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 9/5/12 REV.

R2-0007400



LEGEND:

Cross Section Location



Steel Casing

FLUTe Sampling Interval

FLUTe LINER

Well Screen

Overburden

Sandy Clay

Silty Clay

Sandy Silt

Saprolite

Bedrock (Water Bearing intervals shown in blue)

Ground Surface Elevation

Geologic Contact Line

Geologic Contact Line (Inferred)

High angle fracture, provides pathway for vertical movement of groundwater. Shown for conceptual purposes.

Potentiometric Surface in Well (confined under overburden)

Groundwater Sample Results -

Tetrachloroethene (PCE)

Trichloroethene (TCE)

1,1-Dichloroethene (1,1-DCE)

All results in µg/L.

U - not detected, detection limit is value to left

J - estimated concentration

All U - PCE, TCE, and 1,1-DCE were not detected

No results exceed the groundwater site screening criteria of 5 µg/L for PCE, TCE or 7 µg/L for 1,1-DCE.

0 50

Horizontal Scale (feet)

0 50

Vertical Scale (feet)

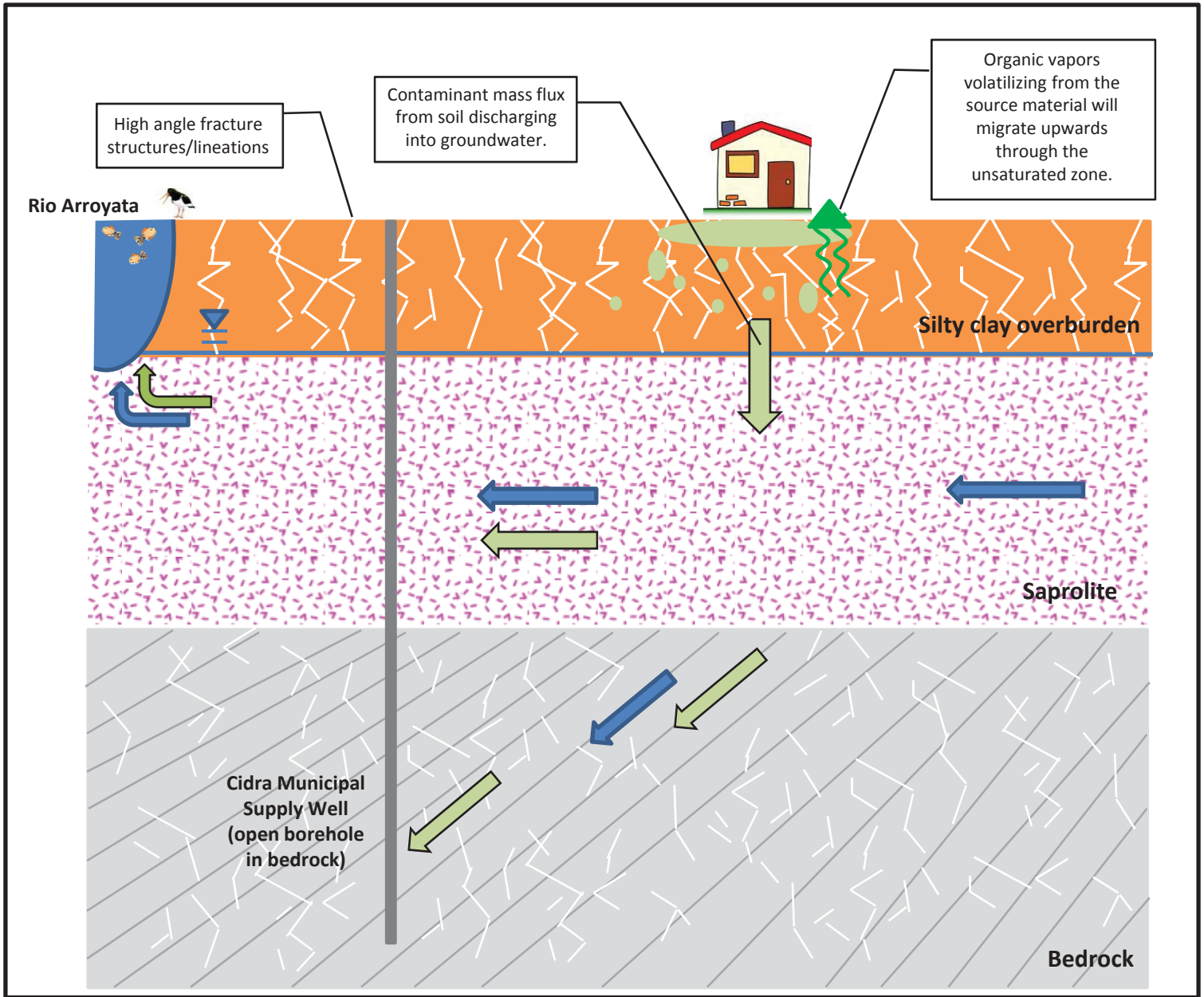
Vertical Exaggeration: 1x

CDM Smith

Figure 4-12e
Contaminant Cross Section E-E'
Cidra Groundwater Contamination Site
Cidra, Puerto Rico

STANDARD CROSS SECTION: CIDRA CIDRA-2010.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 9/5/12 REV.

R2-0007401



Groundwater Flow Pathway

Contaminant Migration Pathway

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Note: Not to scale.

Figure 5-1
Conceptual Site Model
Cidra Groundwater Contamination Site
Cidra, Puerto Rico