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Final

Remedial Investigation Report
Area of Concern (AOC) R

Former Naval Ammunition Support Detachment
Vieques, Puerto Rico

Volume 1 of 3
Text

Prepared for

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Prepared by

CH2MHILL

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Acronyms and Abbreviations

AOC	Area of Concern
amsl	above mean sea level
AST	aboveground storage tank
atm-m^3/M	atmospheric cubic meters per mole
BERA	baseline ecological risk assessment
bgs	below ground surface
bls	below land surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action—Navy
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
°C	degrees Celsius
DO	dissolved oxygen
DoD	Department of Defense
DOI	Department of Interior
DPT	direct push technology
DRO	diesel range organics
e.g.	exempli gratia (for example)
EBS	Environmental Baseline Survey
Eco-SSLs	Ecological Soil Screening Levels
E_h	oxidation potential
ELCR	excess lifetime cancer risk
ERA	Ecological Risk Assessment
ERP	Environmental Restoration Program
ESS	explosive safety submission
ESVs	ecological screening values
F_{oc}	fraction of organic carbon
FFA	Federal Facility Agreement
FID	flame ionization detector
ft	foot or feet
ft/yr	foot (or feet) per year
°F	degrees Fahrenheit
g/ml	grams per millimeter
g/cm^3	grams per cubic centimeter
g/mole	grams per mole
gal	gallon(s)
GI	gastrointestinal

GPS	Global Positioning System
GRO	gasoline range organics
HHRA	Human Health Risk Assessment
HI	Hazard Index
HSA	hollow stem auger
HQ	Hazard Quotient
IDW	investigation-derived waste
i.e.	id est (that is)
INRMP	Integrated Natural Resources Management Plan
IR	Installation Restoration
K_d	distribution coefficient
K_h	Henry's Law Constant
K_{oc}	carbon partition coefficient
K_{ow}	octanol-water partition coefficient
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter
MCL	maximum contaminant level
MEC	munitions and explosives of concern
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
mL/g	milliliters per gram
mL/min	milliliters per minute
mm Hg	millimeters of mercury
MPPEH	Materials Potentially Presenting an Explosive Hazard
MOV	Municipality of Vieques
NASD	Naval Ammunition Support Detachment
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCRS	Natural Resource Conservation Service
n_e	effective porosity
NFA	no further action
NPL	National Priority List
NRHP	National Register of Historic Places
NTU	nephelometric turbidity unit
NGVD	National Geodetic Vertical Datum
OD	outer diameter
ORO	oil range organics
ORP	oxidation reduction potential
PA/SI	Preliminary Assessment/Site Investigation
PAHs	polycyclic aromatic hydrocarbons
p_b	Soil bulk density

PCB	polychlorinated biphenyls
PDF	portable document format
pH	potential of hydrogen
PID	photoionization detector
ppt	parts per thousand
PRASA	Puerto Rico Aqueduct Sewer Authority
PREQB	Puerto Rico Environmental Quality Board
PVC	polyvinyl chloride
QA	quality assurance
Qa	quaternary aged deposits
QAPP	Quality Assurance Project Plan
QC	quality control
RAGS	Risk Assessment Guidance for Superfund
RI	Remedial Investigation
ROD	Record of Decision
RSL	regional screening level
SERA	screening ecological risk assessment
SHAW	Shaw Environmental & Infrastructure, Inc
SOP	standard operating procedure
SSL	soil screening levels
SVOC	semivolatile organic compounds
SWMU	solid waste management unit
TAL	target analyte list
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRVs	toxicity reference values
R	retardation coefficient
U.S.	United States
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTLs	upper tolerance limits
UTM	Universal Transverse Mercator
UXO	unexploded ordinance
V_c	Contaminant velocity
VOC	volatile organic compound
WM	Waste Management

Executive Summary

This Remedial Investigation (RI) report presents the data and findings obtained from historical activities and recent investigations conducted to characterize the nature and extent of contamination and to assess potential risks to human health and the environment at Area of Concern (AOC) R, located at the former Naval Ammunition Support Detachment (NASD) in the western portion of Vieques, Puerto Rico (**Figures ES-1 and ES-2**).

AOC R is approximately 12 acres in size and is a former construction staging area and public works operational area where carpentry and light vehicle maintenance activities were conducted from 1965 to 1971. An aboveground storage (AST) was once located near Building 401, south of Highway 200. Inert munitions and explosives of concern (MEC) items were identified in the vicinity of AOC R at three locations, as well as several debris piles around the site (**Figure ES-3**).

Results of the Expanded Preliminary Assessment/Site Investigation (PA/SI) for AOC R determined that inorganic constituents and semi-volatile organic compounds (SVOCs) were observed above screening criteria within soil, and recommended further evaluations in a RI. The RI activities were initiated in August 2004, but upon discovery of munitions-related items, the field work was postponed until December 2005 while an Explosive Safety Submission (ESS) was submitted and resolved. The RI field activities were then conducted from December 2005 to March 2006, followed by supplemental investigations in June and August 2009, to assess the nature and extent of contamination and potential environmental and human health risks associated with exposure to site media. Debris and SVOC impacted soil removal actions were conducted in 2009, prior to the implementation of the supplemental investigations. In total, 187 soil, 16 groundwater, 7 surface water, and 4 sediment samples were collected at AOC R (including duplicates) (**Figure ES-4**).

The topography of AOC R is relatively flat and slightly slopes to the north and northwest to an ephemeral stream. Groundwater at AOC R was encountered within the poorly graded to well graded sands of the alluvium and within the sands encountered beneath the weathered bedrock in the southern portion of the site, ranging in elevation from 6.25 (MW01) to 1.69 (MW05) feet (ft) above mean sea level (amsl) in August 2009. Groundwater flows north to northwestward towards the coastline with an average hydraulic gradient of 0.005 ft/ft and at an estimated groundwater flow velocity of approximately 15 feet per year (ft/yr). **Figure ES-5** shows a conceptual model of AOC R.

Analytical data collected during the Expanded Phase II PA/SI, RI and supplemental investigations, and removal action confirmatory sampling provide the primary basis for the evaluation of the nature and extent of contamination in soil, surface water, sediment, and groundwater. A total of 168 soil samples were used to characterize site conditions. Soil data that was removed as part of the removal action activities was excluded since it does not represent current site conditions.

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NOTA: ESTE RESUMEN SE PRESENTA EN INGLÉS Y EN ESPAÑOL PARA LA CONVENIENCIA DEL LECTOR. SE HA HECHO TODO LO POSIBLE PARA QUE LA TRADUCCIÓN SEA PRECISA EN LO MÁS RAZONABLEMENTE POSIBLE. SIN EMBARGO, LOS LECTORES DEBEN ESTAR AL TANTO QUE EL TEXTO EN INGLÉS ES LA VERSIÓN OFICIAL.

- Nine SVOCs exceeded a screening criterion in soil at AOC R; most of which were polycyclic aromatic hydrocarbons (PAHs) at concentrations much lower than pre-removal concentrations. Benzo(a)pyrene was the most frequently observed PAH above a screening criterion. Other PAHs with exceedances included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. No PAHs were observed in groundwater, sediment, and surface water. Atrazine was likely used as a herbicide to control weeds, and not a site related constituent. Carbazole, 4-nitroaniline, and 2,4-DNT were only observed above the Site-specific Soil Screening Levels (SSL); but not observed in groundwater. Only bis(2-ethylhexyl)phthalate and 4-nitrophenol were observed above screening criteria in groundwater; however, bis(2-ethylhexyl)phthalate is a common laboratory contaminant and not a likely site related constituent, and 4-nitrophenol was used as a fungicide and its occurrence is likely from normal pesticide application and not from a CERCLA-related release.
- Inorganic constituents detected above background concentrations (if available) and screening criteria in environmental media include:
  - **Soil** – aluminum, antimony, arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, vanadium, and zinc.
  - **Groundwater** – aluminum, arsenic, chromium, cobalt, iron, and manganese.
  - **Surface Water and Sediment** – arsenic, barium, chromium, cobalt, iron, and manganese.
  - Copper exceeded screening criteria in 23 soil samples in the area of the concrete pad, but was below screening criteria in all other environmental media. All other inorganic constituents were generally slightly above background levels and are associated with background. Although aluminum, iron, and manganese can be associated with the metal debris formerly present at the site, these inorganics are also commonly associated with the chemical weathering of volcanic rocks and can be highly variable due to the occurrence of aluminum rich clays as well as iron and manganese oxides.
- Only the volatile organic compounds (VOCs) methylene chloride (in soil) and chloroform (in surface water) exceeded screening criteria at AOC R. However, methylene chloride is a common laboratory contaminant and is not site related. Chloroform is a common byproduct of potable water chlorination and is likely to have been the result of discharge from the potable water lift/chlorination station adjacent to the site. This is supported by the presence of a discharge pipe from the station upstream of stream sample locations and the fact that chloroform was not detected in any other site media.
- Pesticides were observed above screening criteria in soil and sediment at AOC R; however, concentrations are consistent with concentrations detected across multiple sites and attributed to normal pesticide application. Therefore, pesticides applied at AOC R were most likely a result of normal pesticide application, not a CERCLA-related release.
- No Poly Chlorinated Biphenyls (PCBs) were observed above screening criteria in the environmental media at AOC R

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- Perchlorate was the only explosive constituent observed in soil and groundwater at the site, but below screening criteria.

The potential for contaminant migration from wind erosion, surface runoff, and groundwater is minimal. PAHs and inorganics are not readily mobile and tend to bind to the soil. In addition, the potential future sources of contamination (debris) were removed from the site, PAH impacted soils potentially posing unacceptable risk were removed from the site, and the vegetative cover and relatively flat topography reduce the potential for migration.

Based on the nature, extent, and concentrations of constituents observed in environmental media at AOC R, potential human health and ecological risks were assessed. For human receptors, future hypothetical child residents exceeded a risk threshold from exposure to groundwater due to aluminum, iron, and manganese. However, these inorganic constituents were not identified as chemicals of concern (COCs) because they are naturally-occurring and their presence is likely due to the chemical weathering of volcanic rocks. No other COCs were identified for human receptors based on soil, surface water, or groundwater exposure scenarios at AOC R. For ecological receptors, both terrestrial and aquatic habitats were evaluated, and no COCs were identified for soil, surface water, and sediment and for food web exposure at AOC R. No unacceptable ecological risks were identified and no further evaluation is warranted for ecological receptors.

Based on the above information, the data collected at AOC R indicate that all potentially affected media have been adequately characterized, both spatially and temporally. The removal action completed at AOC R eliminated potential future sources of contamination and soil containing contaminant concentrations posing potentially unacceptable risk to human health and ecological receptors. Based on current site conditions, no unacceptable risks remain. As a result, no further action is warranted for AOC R. The site will proceed to a No Further Action Proposed Plan and Record of Decision.

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Resumen Ejecutivo

Este reporte de Investigación para la Remediación (RI, por sus siglas en inglés) presenta la información obtenida y los hallazgos encontrados durante las actividades que se realizaron en el pasado, y las investigaciones que se han llevado a cabo recientemente con el objetivo de caracterizar la naturaleza y extensión de la contaminación para poder evaluar los riesgos potenciales a la salud humana y al ambiente en el Área de Preocupación (AOC, por sus siglas en inglés) R. AOC R está localizado en el Antiguo Destacamento de Apoyo de Municiones Navales (NASD, por sus siglas en inglés) en la porción oeste de Vieques, Puerto Rico (**Figuras ES-1 y ES-2**).

AOC R consiste de aproximadamente 12 acres y era una antigua área de construcción y área operaciones de obras públicas donde se realizaban trabajos de carpintería y actividades de mantenimiento liviano de vehículos desde el 1965 hasta el 1971. Un tanque sobre tierra (AST, por sus siglas en inglés) está ubicado cerca del Edificio 401, al sur de la Carretera 200. En tres localizaciones se identificaron municiones inertes y explosivos de preocupación (MEC, por sus siglas en inglés) en las cercanías de AOC R, así como también varias pilas de desperdicios alrededor del sitio (**Figura ES-3**).

Los resultados de la Evaluación Preliminar Expandida/Investigación del Sitio (PA/SI, por sus siglas en inglés) para AOC R determinaron la presencia en el suelo de compuestos inorgánicos y compuestos orgánicos semi-volátiles (SVOC, por sus siglas en inglés) sobre los criterios de evaluación, por lo que se recomendaron evaluaciones adicionales en el RI. Las actividades del RI se iniciaron en agosto del 2004, pero debido a que se descubrieron artículos relacionados a municiones, el trabajo de campo fue pospuesto hasta diciembre del 2005 mientras se sometió y resolvió una Evaluación de Seguridad de Explosivos (ESS, por sus siglas en inglés). Las actividades de campo del RI se llevaron a cabo desde diciembre del 2005 hasta marzo del 2006, seguido por las investigaciones suplementarias en junio y agosto del 2009. Las acciones de remoción de suelos impactados por desperdicios y SVOCs se llevaron a cabo en el 2009, antes de la implementación de las investigaciones suplementarias. En total se recogieron 187 muestras de suelos, 16 de aguas subterráneas, 7 de aguas de superficie y 4 muestras de sedimento en el AOC R (incluyendo duplicados) (**Figura ES-4**).

La topografía del AOC R es relativamente llana y con una pendiente ligera hacia el norte y noroeste hacia una corriente efímera. En agosto del 2009 se encontró agua subterránea en el AOC R dentro de un aluvión que contenía arenas sueltas y compactadas arenas y dentro de las arenas debajo del lecho rocoso en la porción sureste del sitio, que varían en elevación desde un 6.25 (MW01) hasta un 1.69 (MW05) pies sobre el nivel del mar. El agua subterránea fluye del norte al noroeste hacia la línea de la costa con un promedio de vertiente hidráulica de 0.005 pies/pies y a un flujo estimado de velocidad de aproximadamente 15 pies/año. La **Figura ES-5** muestra un modelo conceptual del AOC R.

Los datos analíticos recogidos durante la Fase II PA/SI Expandida/SI, RI junto con las investigaciones suplementarias y muestreos confirmatorios de las acciones de remoción proveen la base principal para la evaluación de la naturaleza y extensión de la contaminación

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de suelos, aguas de superficie, sedimentos y aguas subterráneas. Se usó un total 168 muestras de suelos para caracterizar las condiciones del sitio. La información de la tierra que fue removida como parte de las actividades de acción de remoción fue excluida ya que no representa las condiciones actuales del sitio.

- Nueve SVOCs excedieron los criterios de evaluación en suelos del AOC R; la mayoría de los cuales eran hidrocarburos policíclicos aromáticos (PAHs, por sus siglas en inglés) en concentraciones mucho más bajas a las concentraciones que se encontraban antes de la remoción. El Benzo(a)pireno fue el PAH observado con más frecuencia sobre los criterios de evaluación. Otros PAHs con excedentes incluyen benzo(a)antraceno, benzo(a)pyreno, benzo(b)fluoranthene, dibenz(a,h)anthracene, e indeno(1,2,3-cd)pyreno. No se observaron PAHs en aguas subterráneas, sedimentos, ni en aguas de superficie. El atraceno probablemente fue utilizado como un herbicida para controlar la maleza y no representa un constituyente relacionado al sitio. Solamente se observó carbazole, 4-nitroaniline, y 2,4-DNT sobre los Niveles de Evaluación de Suelo para Sitio Específico (SSL, por sus siglas en inglés); pero éste no se observó en aguas subterráneas. Solamente se observaron bis(2-ethylhexyl)phthalate y 4-nitrophenol sobre los criterios de evaluación en aguas subterráneas; sin embargo, bis(2-ethylhexyl)phthalate es un contaminante común de laboratorio y posiblemente no representa un constituyente relacionado al sitio, y 4-nitrofenol fue usado como un fungicida y su presencia posiblemente se deba a aplicaciones normales de pesticidas y no a un escape relacionado a CERCLA.

- Los constituyentes inorgánicos detectados sobre las concentraciones de trasfondo (de estar disponibles) y criterios de evaluación en medios ambientales incluyen:

  – **Suelo** – aluminio, antimonio, arsénico, bario, cromo, cobalto, cobre, hierro, plomo, manganeso, níquel, selenio, vanadio, y zinc.

  – **Agua Subterránea** – aluminio, arsénico, cromo, cobalto, hierro, y manganeso.

  – **Agua de Superficie y Sedimento** – arsénico, bario, cromo, cobalto, hierro, y manganeso.

  – El cobre excedió los criterios de evaluación en 23 muestras de suelos en el área de la loza de concreto, pero estaba por debajo de los criterios de evaluación de todos los otros medios ambientales. Todos los otros constituyentes inorgánicos estaban ligeramente sobre los niveles de trasfondo y están asociados al trasfondo. Aunque el aluminio, hierro y el manganeso pueden ser asociados con los desechos de metal presentes en el sitio, estos inorgánicos también son comúnmente asociados con las sustancias químicas de las rocas volcánicas y pueden ser altamente variables debido a la presencia de arcilla rica en aluminio y óxidos de hierro y manganeso.

- Sólo los compuestos orgánicos volátiles (VOCs, por sus siglas en inglés) cloro metileno (en suelos) y el cloroformo (en aguas de superficie) excedieron los criterios de evaluación en el AOC R. Sin embargo, el cloro metileno es un contaminante común de laboratorio y no está relacionado al sitio. El cloroformo es un bi-producto común de la clorinización del agua potable y probablemente es el resultado de las descargas de las estaciones de clorinización de agua potable adyacente al sitio. Esta conclusión se sustenta por la presencia de tuberías de descarga de la estación pendiente arriba del riachuelo donde se ubican las localizaciones

NOTE: THIS SUMMARY IS PRESENTED IN ENGLISH AND SPANISH FOR THE CONVENIENCE OF THE READER. EVERY EFFORT HAS BEEN MADE FOR THE TRANSLATIONS TO BE AS ACCURATE AS REASONABLY POSSIBLE. HOWEVER, READERS SHOULD BE AWARE THAT THE ENGLISH VERSION OF THE TEXT IS THE OFFICIAL VERSION.
NOTA: ESTE RESUMEN SE PRESENTA EN INGLÉS Y EN ESPAÑOL PARA LA CONVENIENCIA DEL LECTOR. SE HA HECHO TODO LO POSIBLE PARA QUE LA TRADUCCIÓN SEA PRECISA EN LO MÁS RAZONABLEMENTE POSIBLE. SIN EMBARGO, LOS LECTORES DEBEN ESTAR AL TANTO QUE EL TEXTO EN INGLÉS ES LA VERSIÓN OFICIAL.

de muestreo, y por el hecho de que el cloroformo no fue detectado en ningún otro medio del sitio.

- Se observaron pesticidas sobre los criterios de evaluación en suelos y sedimentos en el AOC R; sin embargo, las concentraciones son consistentes con las concentraciones detectadas a través de múltiples sitios y pueden ser atribuidas a la aplicación normal de pesticidas. Por lo tanto, los pesticidas aplicados en el AOC R son probablemente el resultado de aplicaciones normales de pesticidas y no relacionadas un escape relacionado a CERCLA.
- No se observaron PCBs sobre los criterios de evaluación en los medios ambientales en el AOC R
- Perclorato fue el único constituyente explosivo observado en suelos y aguas subterráneas en el sitio, pero por debajo de los criterios de evaluación.

El potencial de migración de contaminantes por la erosión del viento, escorrentías de superficies y aguas subterráneas es mínimo. PAHs e inorgánicos no son móviles y tienden a anexarse a la tierra. También se removieron del sitio fuentes potenciales de contaminación futura (escombros), al igual que los PAHs que impactaron los suelos y que presentaban riesgos inaceptables, y la cubierta vegetativa y una topografía relativamente llana reducen el potencial de migración.

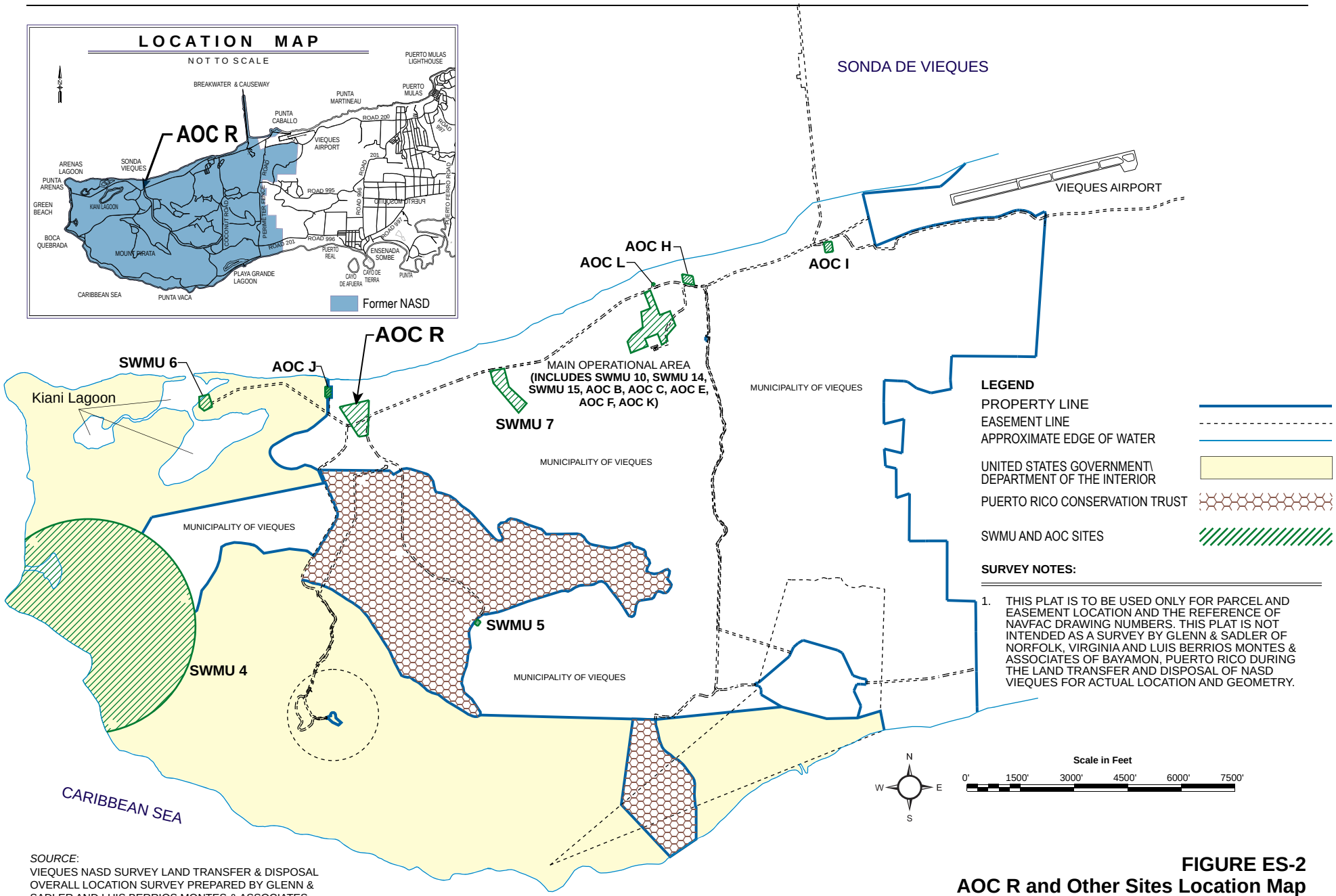
En base a la naturaleza, extensión y concentraciones de constituyentes observados en el medio ambiental en el AOC R, se atendieron los riesgos potenciales a la salud humana y ecológicos. Para receptores humanos, las concentraciones excedieron en riesgo de exposición a aquas subterráneas debido al aluminio, hierro y manganeso para niños que hipotéticamente residan en el sitio en el futuro. Sin embargo, estos constituyentes inorgánicos no se identificaron como sustancias químicas de preocupación (COCs, por sus siglas en inglés) ya que ocurren naturalmente y su presencia probablemente se deba a los agentes químicos de las rocas volcánicas. No se identificaron otros COCs para receptores humanos en base a su exposición a suelos, agua de superficie, tampoco en escenarios de exposición a aguas subterráneas en el AOC R. Para receptores ecológicos, se evaluaron tanto los hábitats terrestres como acuáticos, y no se identificaron COCs para suelos, agua de superficie y sedimentos, o como parte de la exposición a la cadena alimentaria en AOC R. No se identificaron riesgos ecológicos inaceptables, por lo tanto no se necesita evaluación adicional para receptores ecológicos.

En base a la información presentada anteriormente, los datos recogidos en el AOC R indican que todos los medios potencialmente afectados se han caracterizado adecuadamente, espacial y temporalmente. La acción de remoción completada en AOC R eliminó las fuentes potenciales de contaminación futura y los suelos que contenían concentraciones de contaminación que presentaban riesgos inaceptables a la salud humana y a receptores ecológicos. En base a las condiciones actuales del sitio, no permanecen riesgos inaceptables. Como resultado, no se necesita ninguna acción adicional para AOC R. Se procederá con un Plan Propuesto de Ninguna Acción Adicional y Récord de Decisión.

FIGURE ES-1
Regional Location Map
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA ES1-1 Regional Location Map.ai mstuart



SOURCE:
VIEQUES NASD SURVEY LAND TRANSFER & DISPOSAL OVERALL LOCATION SURVEY PREPARED BY GLENN & SADLER AND LUIS BERRIOS MONTES & ASSOCIATES

FIGURE ES-2
AOC R and Other Sites Location Map
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA ES-2 AOC R and Other Sites Location Map.ai mstuart

Legend

- AOC R Use and Access Restriction Boundary
- Debris Area Removed, Sampled by Shaw
- Debris Area Removed, Sampled by CH2M HILL
- Debris Piles Removed by CH2M HILL
- Trash Area Removed by Shaw

N W E S

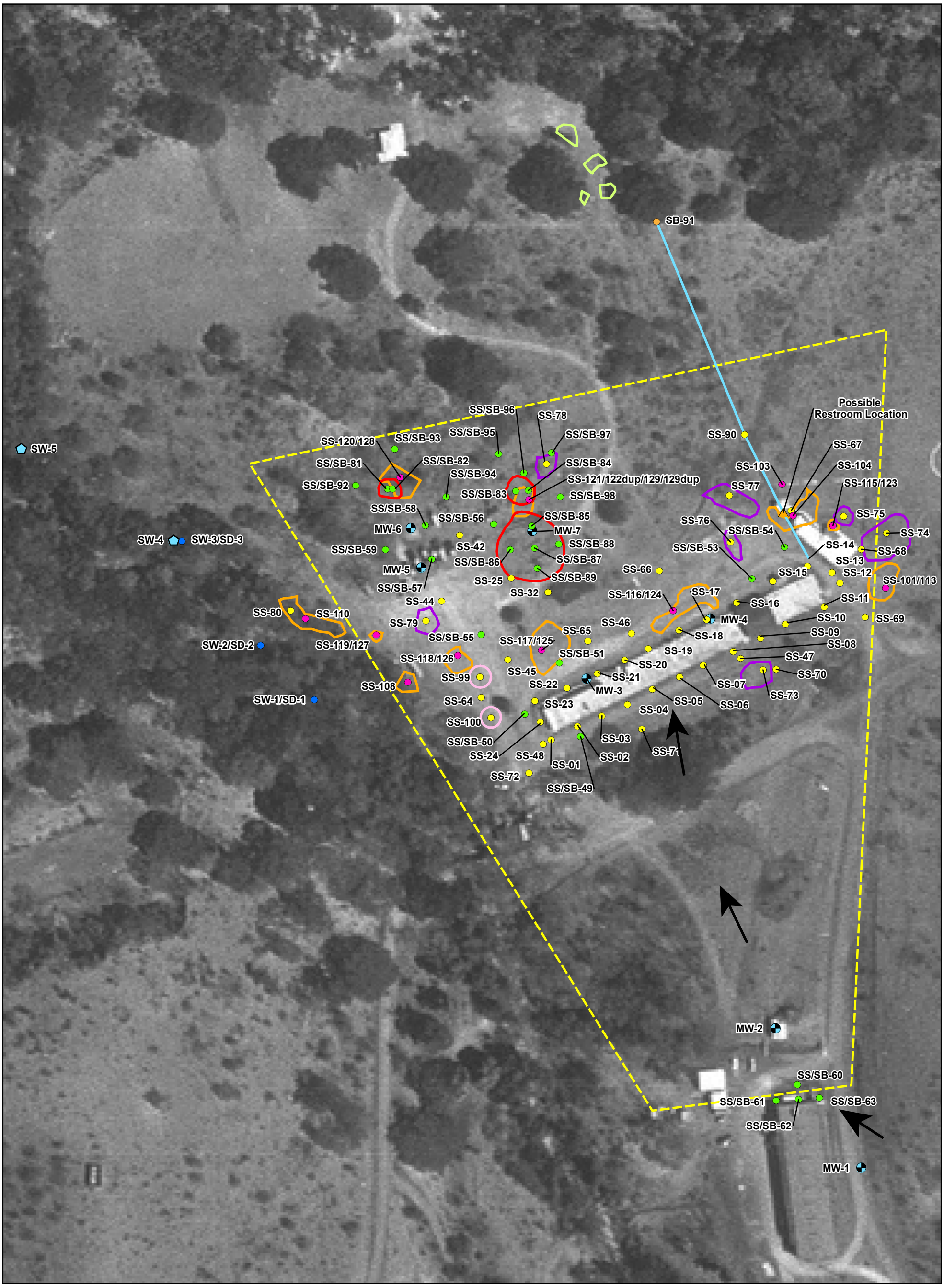
0 50 100 Feet

1 inch = 120 feet

FIGURE ES-3
2007 Aerial Photograph of AOC R
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA ES-3 2007 Aerial Photo.ai mstuart



Legend

- Surface Soil Sample
- Surface Soil Sample Collected by Shaw
- Surface Soil and Subsurface Soil Sample
- Subsurface Soil Sample
- Surface Water and Sediment Sample
- Surface Water Sample
- Monitoring Well
- Possible Restroom Location
- Buried Drain Line

- Area of elevated soil PAHs, Soil excavated to a depth of 2 feet bls
- Debris Area Removed, Sampled by Shaw
- Debris Area Removed, Sampled by CH2M HILL
- Debris Piles Removed by CH2M HILL
- Trash Area Removed by Shaw
- AOC R Use and Access Restriction Boundary
- Direction of Groundwater Flow

Note: 1967 Aerial Photograph. Several Surface Soil Sample Locations were excavated and not shown on this figure. They include SS-26 to SS-31, SS-33 to SS-41, SS-43, SS-52, SS-102, SS-105 to SS-107, SS-109, SS-111, SS-112, and SS-114.

N W E S

0 60 120 Feet

1 inch = 120 feet

FIGURE ES-4
AOC R Sample Locations
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES102109032652TPA ES-4 AOC R Sample Locations.ai mstuart

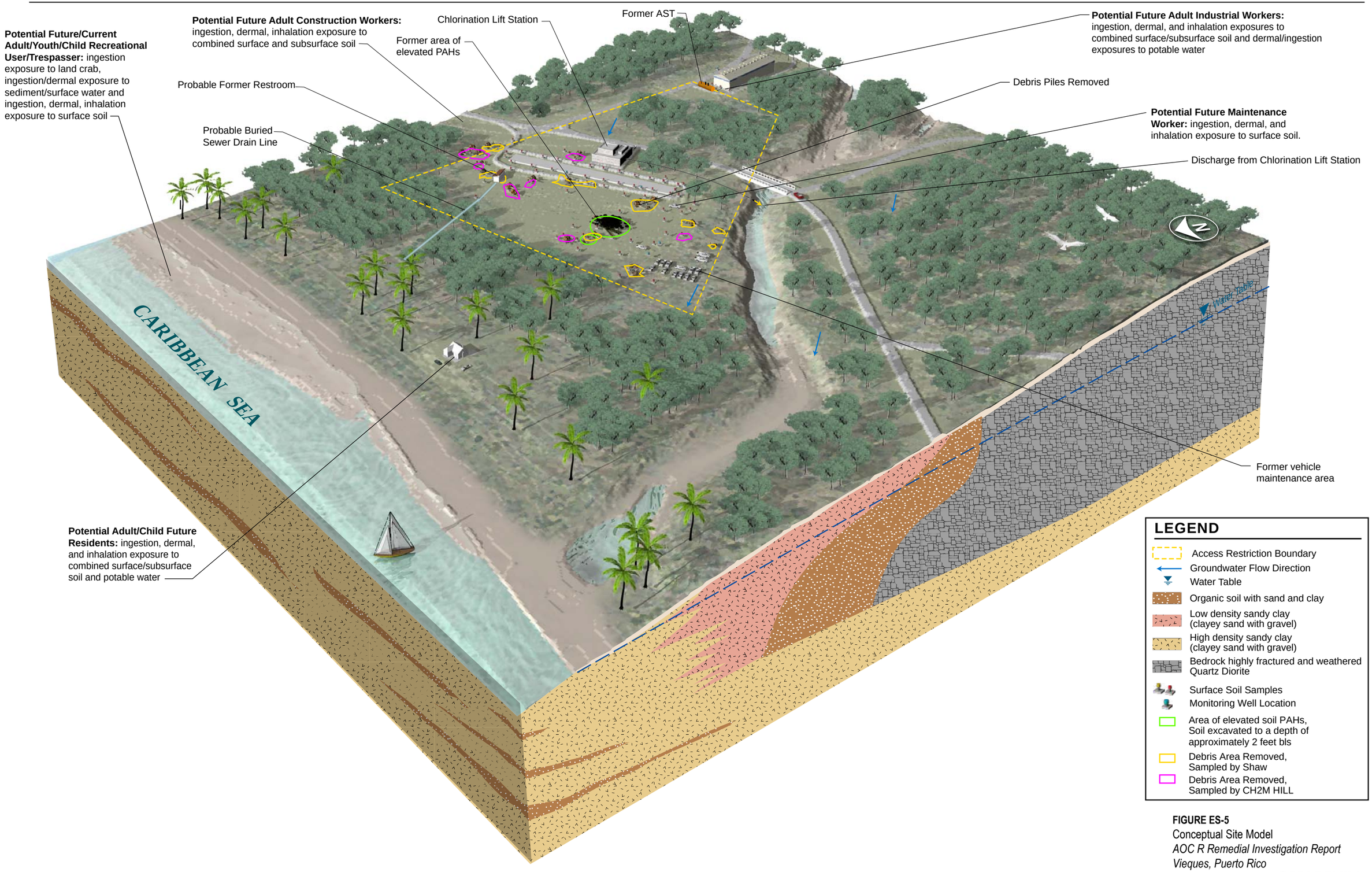


FIGURE ES-5
Conceptual Site Model
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES102109032652TPA F 5-1 AOC_R_Conceptual_Site_Model.ai

SECTION 1

Introduction

This Remedial Investigation (RI) report presents the data and findings obtained from historical activities and recent investigations conducted to characterize the nature and extent of contamination and to assess potential risks to human health and the environment at Area of Concern (AOC) R, located at the former Naval Ammunition Support Detachment (NASD) in the western portion of Vieques, Puerto Rico (Figures 1-1 and 1-2). AOC R was a former construction staging area and public works operational area where carpentry and light vehicle maintenance activities were conducted from 1965 to 1971.

This report is prepared under the United States (U.S.) Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC), Atlantic Division, Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract N62470-08-D-1000, Contract Task Order 111, for submittal to NAVFAC, United States Environmental Protection Agency (USEPA) Region 2, the Commonwealth of Puerto Rico Environmental Quality Board (PREQB), and the United States Fish and Wildlife Service (USFWS), and ultimately the public via the Vieques Administrative Record File. The Navy, USEPA, PREQB, and USFWS work jointly as the former NASD Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Environmental Restoration Program (ERP) Team.

Results of the Expanded Preliminary Assessment/Site Investigation (PA/SI) for AOC R (CH2M HILL, 2002b) determined that inorganic constituents and semi-volatile organic compounds (SVOCs) were observed above screening criteria within soil, and recommended further evaluations in a RI. The RI activities were initiated in August 2004, but upon discovery of munitions-related items, the field work was postponed until December 2005 while an Explosive Safety Submission (ESS) was submitted and resolved. An After Action Report was submitted in 2009 by USA Environmental which included documentation of the Materials Potentially Presenting an Explosive Hazard (MPPEH) at the AOC R site. The After Action Report is included in Appendix A. The RI field activities were then conducted from December 2005 to March 2006, in accordance with an updated work plan (CH2M HILL, 2005), followed by supplemental investigations in June and August 2009, to assess the nature and extent of contamination and potential environmental and human health risks associated with exposure to site media. Debris and SVOC impacted soil removal actions were conducted in 2009, prior to the implementation of the supplemental investigations (SHAW 2010). Data resulting from these removal actions have been included, as appropriate, in this RI Report in order to accurately portray current site conditions.

1.1 Objectives and Approach

The overall objective of this RI is to sufficiently characterize the nature and extent of potential contamination in soil, groundwater, surface water, and sediment at AOC R, and to assess the potential risks posed by contamination to human health and the environment. The comprehensive nature of this evaluation is intended to support development of risk-based cleanup decisions, if warranted.

The detailed objectives and approach of the RI are as follows:

- Review and incorporate relevant results from previous investigations and removal actions at AOC R. These investigations comprised the Environmental Baseline Survey (EBS) (Program Management Company, 2000), the Expanded (PA/SI) (CH2M HILL, 2002), and the removal action (Shaw, 2010).
- Collection of surface soil, subsurface soil, groundwater, surface water, and sediment samples to sufficiently delineate the nature and extent of contamination.
- Obtain subsurface characterization data, specifically lithologic, hydraulic, and chemical data.
- Delineation of a buried drainage line.
- Quantitatively assess the potential human health and ecological risks associated with exposure to constituents detected in site media, and determine if potentially unacceptable risks remain on site following the removal action.

1.1.1 Background Documents

Planning documents that provide the basis for the implementation of this RI, including the quantitative risk assessments, are provided below:

- Site-Specific Work Plan for the U.S. Naval Ammunition Support Detachment, Vieques Island, Puerto Rico (CH2M HILL, April 2000).
- Final Master Work Plan for the Former U.S. Naval Ammunition Support Detachment, Vieques, Puerto Rico (CH2M HILL, January 2001).
- Remedial Investigation Work Plan for Area of Concern (AOC) R at Former U.S. Naval Ammunition Support Detachment, Vieques Island, Puerto Rico (CH2M HILL, November 2005).
- AOC R RI Data Evaluation and Recommendation for Additional Sample Collection, Presentation to Environmental Subcommittee (CH2M HILL, December 2006).
- Final Meeting Summary for the Vieques ERP Technical Subcommittee Meeting, January 18, 2007.
- Master Quality Assurance Project Plan, Environmental Restoration Program, Vieques, Puerto Rico (CH2M HILL, May 2007).
- Work Plan, Removal Actions SWMU-6, SWMU-7, AOC-J, AOC-R (Shaw, December 2007).
- Final Meeting Summary for the Vieques ERP Technical Subcommittee Conference Call August 11, 2009.
- Master Standard Operating Procedures, Protocols, and Plans, Environmental Restoration Program, Vieques, Puerto Rico (CH2M HILL, April 2010).

1.2 Site Background

This subsection provides a general summary of the former NASD and AOC R, including site descriptions, environmental history, and previous investigations.

1.2.1 Former Naval Ammunitions Support Detachment

Vieques is located in the Caribbean Sea approximately 7 miles southeast of the eastern tip of the island of Puerto Rico and 20 miles southwest of St. Thomas, U.S. Virgin Islands. Vieques is the largest offshore island of the Commonwealth of Puerto Rico. It is approximately 20 miles long and 4.5 miles wide, and has an area of approximately 33,088 acres (51 square miles). **Figure 1-1** presents the location of Vieques with respect to the island of Puerto Rico.

The Navy purchased large portions of Vieques in the early 1940s to conduct activities related to military training. The eastern end of Vieques was used for various aspects of naval gunfire training, including air-to-ground ordnance delivery and amphibious landings, as well as housing the main base of operations for these activities, Camp Garcia. Site operations on the western end of Vieques within the former NASD consisted mainly of ammunition loading and storage, vehicle and facility maintenance, and some training. The Navy ceased facility-wide operations on the former NASD on April 30, 2001, when the land was transferred to the Department of Interior (DOI), Municipality of Vieques (MOV), and the Puerto Rico Conservation Trust, as required by the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (Public Law 106-398) and amended by Section 1049 of the National Defense Authorization Act for Fiscal Year 2002 (Public Law 107-107). The division of land among these entities is shown in **Figure 1-2**.

On March 14, 2005, Vieques was placed on the National Priority List (NPL), which required all subsequent environmental restoration activities for Navy Installation Restoration (IR) sites on Vieques be conducted under CERCLA unless and until removed from CERCLA authority. The Navy, DOI, USEPA, and the Commonwealth of Puerto Rico executed a Federal Facility Agreement (FFA) on September 7, 2007 that establishes the procedural framework and schedule for implementing the CERCLA response actions for Vieques. Although the DOI is directed to protect and conserve the transferred land as a wildlife refuge, the Navy retains the responsibility for conducting environmental clean-up of the property, as warranted.

1.2.2 AOC R

AOC R is approximately 12 acres in size and located in the northwestern portion of Vieques within the boundaries of the former NASD. The site was used as a construction staging area and public works operational area from approximately 1965 to 1971. In the late 1960s, a carpentry shop and an enlisted club were located on a rectangular pad within the site. Light vehicle maintenance activities, such as oil changes, were conducted just northwest of the pad. An aboveground storage (AST) was once located near Building 401, south of Highway 200. The large concrete pad north of Highway 200 was present before the Navy owned the area, and can be seen in 1937 aerial photographs (Program Management Company, 2000). Pad use prior to the 1960s is unknown. Aerial photographs of AOC R through time are shown in **Figures 1-3 and 1-4**. A potable water lift/chlorination building was constructed by the Puerto Rico Aqueduct Sewer Authority (PRASA) within the Remedial Land Use Restriction boundary, as shown in **Figure 1-4**. Activities associated with operation of this building were not related to historic Navy use of the area and, therefore, are not associated with the CERCLA investigation.

In preparation for transfer of portions of the former NASD to the MOV, a survey plot of the area that includes AOC R was performed in September 2000. The survey plot identified a subjective boundary within which was defined a "Remedial Land Use Restriction." When the Navy transferred ownership of the former NASD on April 30, 2001, the Quitclaim Deed contained this survey plot (NAVY et al. 2001). As set forth in the Quitclaim Deed, the MOV agreed that use and access to the area defined by the Remedial Land Use Restriction shall be limited to non-residential until:

a. A risk assessment in accordance with CERCLA is completed and the PREQB concurs that a No Further Action (NFA) letter is required, allowing for unrestricted use

-or-

b. A Record of Decision (ROD) is signed that sets forth less stringent land use restrictions

-or-

c. The Navy completes remedial actions in accordance with CERCLA and other applicable laws that will allow unrestricted use

During the initiation of field investigations for the RI in August 2004, munitions and explosives of concern (MEC) items were identified in the vicinity of AOC R at three locations, as well as several debris piles around the site. Due to the identification of the MEC items, the RI was temporarily postponed until submittal of an Explosive Safety Submission (ESS). Subsequent inspection of the MEC items by an Unexploded Ordnance (UXO) Technician determined the items to be inert. The main features at AOC R discussed above are shown on **Figure 1-4**.

1.2.3 Previous Investigations and Simultaneous Removal Actions

Previous environmental investigations and concurrent removal actions conducted at AOC R are summarized in **Table 1-1**; more detailed descriptions of each are provided below.

1.2.3.1 Environmental Baseline Survey

As a result of the property transfer of the former NASD, an environmental baseline survey (EBS) was conducted in 2000 to disclose relevant information regarding the environmental condition of the site prior to transfer (Program Management Company, 2000). The EBS was based on records reviews, site inspections and investigations, including environmental sampling, witness interviews and other existing environmental information related to operations and the potential storage, release, treatment or disposal of hazardous substances or petroleum products on the property.

The EBS identified AOC R as a site recommended for a full investigation under the Navy's IR program, based on a site visit, review of suspect areas from aerial photography analysis, and interviews with several employees of the former NASD. The 1967 aerial photographs identified a construction staging area at the north end of the site. This area was used as a temporary public works and motor vehicle area from approximately 1965-1971. Activities in this area included a carpentry shop and light vehicle maintenance. Visual observations of the area did not identify any concerns.

1.2.3.2 Expanded Preliminary Assessment/Site Investigation

The Phase I Expanded PA/SI of the former NASD was conducted prior to the EBS in June 2000 and did not include AOC R. Based on the findings of the EBS, a Phase II Expanded PA/SI was conducted in November 2000 to further assess potential impacts to site surface soils at seven sites within the former NASD, including AOC R (CH2M HILL, 2002). The field activities included the collection of 10 surface soil samples within the vehicle operations area, and 24 surface soil samples spaced approximately every 50 feet around the concrete pad. Soil samples were analyzed for volatile organic compounds (VOCs), SVOCs, pesticides, and polychlorinated biphenyls (PCBs).

Results of the Phase II Expanded PA/SI found that inorganic constituents (arsenic, chromium, iron, lead, and vanadium) and SVOCs (primarily polycyclic aromatic hydrocarbons [PAHs]) exceeded screening criteria concentrations within surface soil. An RI was recommended to further evaluate the extent of SVOC exceedances in site soil and to assess whether the SVOCs posed an unacceptable risk to human health and the environment. Relevant data collected from this investigation are included in the evaluations within this RI Report.

1.2.3.3 Background Investigation

A background study was conducted in 2000 for the western portion of Vieques to develop a set of background values for inorganic constituents that occur naturally in environmental media, for comparison with sites investigated within the former NASD (CH2M HILL, 2002). The background data were collected specifically from the western portion of Vieques to represent soil types similar to those where environmental sites are located in the former NASD. The background inorganic constituent concentrations are used for comparison with soil inorganic constituent concentrations collected during the RI and previous investigations at AOC R.

1.2.3.4 Removal Action

A removal action was conducted in 2009 to remove debris and associated soil at AOC R (Shaw, 2010). Approximately 1,986 tons of excavated soil (to a depth of 1 to 2 feet below ground surface [bgs]) and debris were removed. The debris piles consisted of rail road ties, metal pipes, wood power poles, tires, corrugated roofing sheet material, other miscellaneous metal debris, and the aforementioned munitions-related items. The areas of soil (associated with debris) for excavation were determined using pre-removal waste characterization human health and ecological risk assessments (CH2M HILL, 2008). Following the excavation, confirmation soil samples at each of the eleven debris areas excavated were collected. In addition to excavation of soil associated with debris removal, three areas of soil containing relatively high SVOC concentrations (based on RI and historical investigation data) were also excavated. Confirmation samples in these areas were collected during the supplemental RI field activities in 2009. Data collected from the confirmation sampling are included in the evaluations within this RI Report because they best represent current site conditions. The removal action eliminated potential future sources of contamination and areas of soil potentially posing unacceptable risks. Photographs of the removal action at the site are shown in **Figure 1-5**.

1.3 Report Organization

The RI Report is organized as follows:

- Section 1 – Introduction

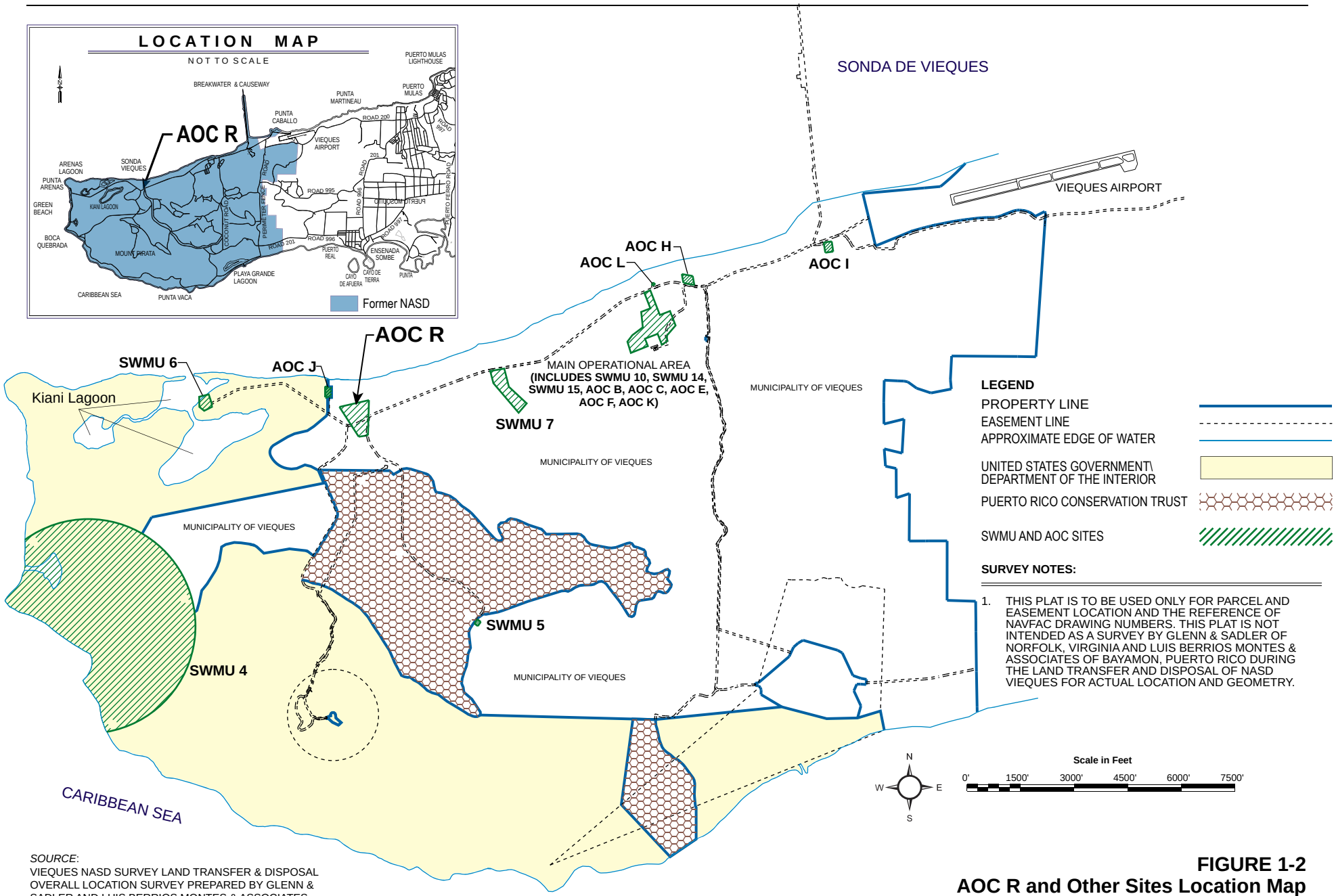
- Section 2 – Summary of RI Field Activities
- Section 3 – Physical Characteristics
- Section 4 – Nature and Extent of Contamination
- Section 5 – Chemical Fate and Transport
- Section 6 – Human Health Risk Assessment Summary
- Section 7 – Ecological Risk Assessment Summary
- Section 8 – Summary, Conclusions, and Recommendations
- Section 9 - References

Tables and figures are provided at the end of each respective section. Appendices are provided electronically in PDF format on CD-ROM.

Table 1-1
Study/Activity Timeline
AOC R Remedial Investigation Report
Vieques, Puerto Rico

Study/Activity	Author	Purpose of Study/Activity	Field Work Date(s)	Report Date
Environmental Baseline Survey (EBS)	Program Management Company	Document environmental conditions of property in support of land transfer from Navy.	March 2000	October 2000
Expanded Preliminary Assessment/Site Investigation (PA/SI) Phase II Seven Sites	CH2M HILL	Further assess potential releases at various sites, including AOC R.	November 2000	November 18, 2002
Quitclaim Deed (Public Law 106-398)	U.S. Government acting by and through the Department of the Navy	On April 30, 2001, 8,114 acres of the former Naval Ammunition Support Detachment (NASD) on the west side of Vieques were apportioned and transferred to the DOI, the Municipality of Vieques (MOV), and the Puertro Rico Conservation Trust (PRCT) in accordance with Public Law 106-398	Not applicable	April 30, 2001
Explosive Safety Submission, Solid Waste Management Unit 4 (SWMU 4) and Area of Concern "R" (AOC R) (Draft Final, later finalized by letter on September 29, 2006; no final document was submitted)	CH2M HILL	To address MEC avoidance and site inspection activities in the vicinity of AOC R and address the disposal/demilitarization of MEC items, and any similar items found during the site inspection.	Not applicable	Draft Final submitted January 2006 and final letter submitted September 29, 2006
Removal Action	Shaw Environmental & Infrastructure, Inc.	Removal action activities at the AOC R site	February 2009 through July 2009	September 2009 (Draft Final Construction Completion Report)
Remedial Investigation	CH2M HILL	To characterize the horizontal and vertical extent of soil, groundwater, surface water, and sediment contamination such that potential human health and ecological risks can be appropriately assessed and the need for remedial action determined.	December 2005 through August 2009	April 2010 (Draft RI Report)

FIGURE 1-1
Regional Location Map
AOC R Remedial Investigation Report
Vieques, Puerto Rico

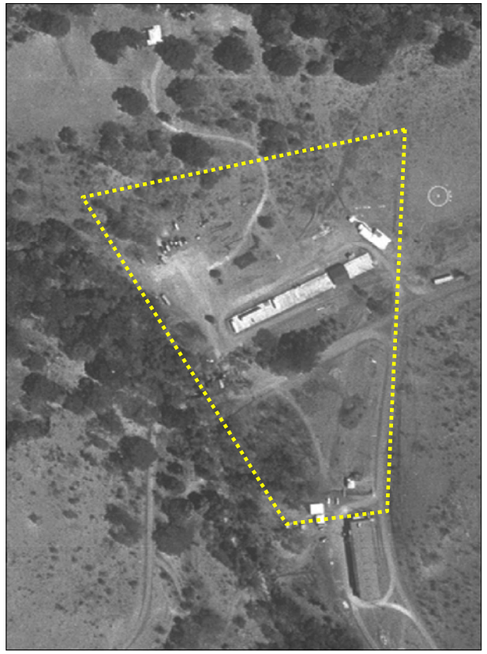


SOURCE:
VIEQUES NASD SURVEY LAND TRANSFER & DISPOSAL OVERALL LOCATION SURVEY PREPARED BY GLENN & SADLER AND LUIS BERRIOS MONTES & ASSOCIATES

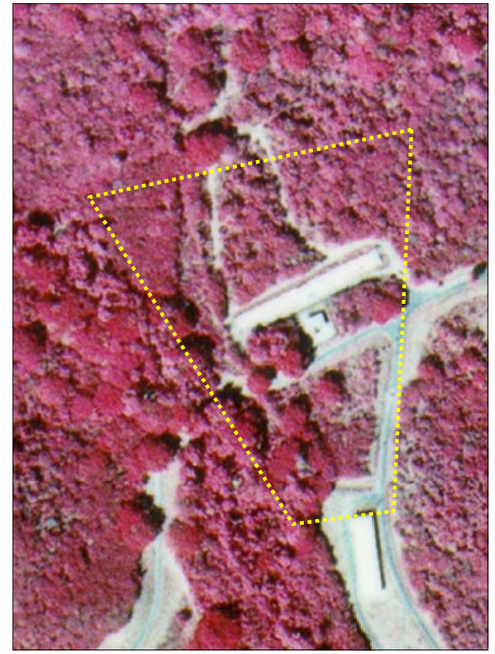
FIGURE 1-2
AOC R and Other Sites Location Map
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

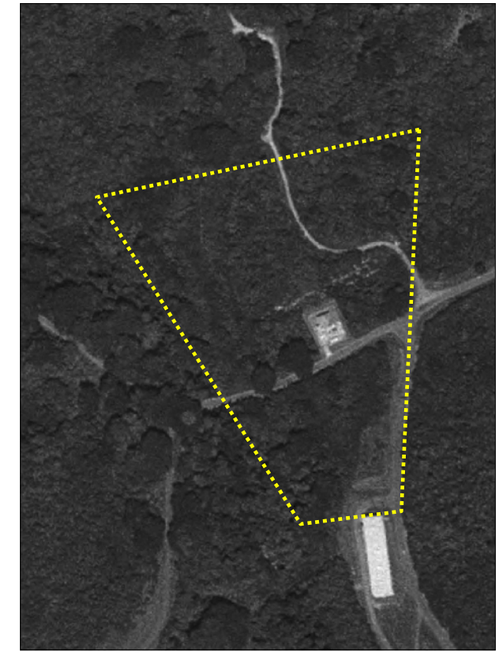
ES052510032918TPA F1-2 AOC R and Other Sites Location Map.ai mstuart



1967

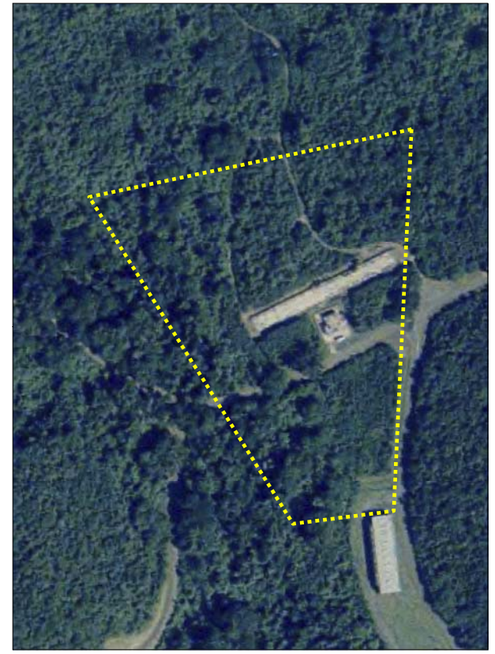


1985



1994

1999



2000

2004

N
W E
S

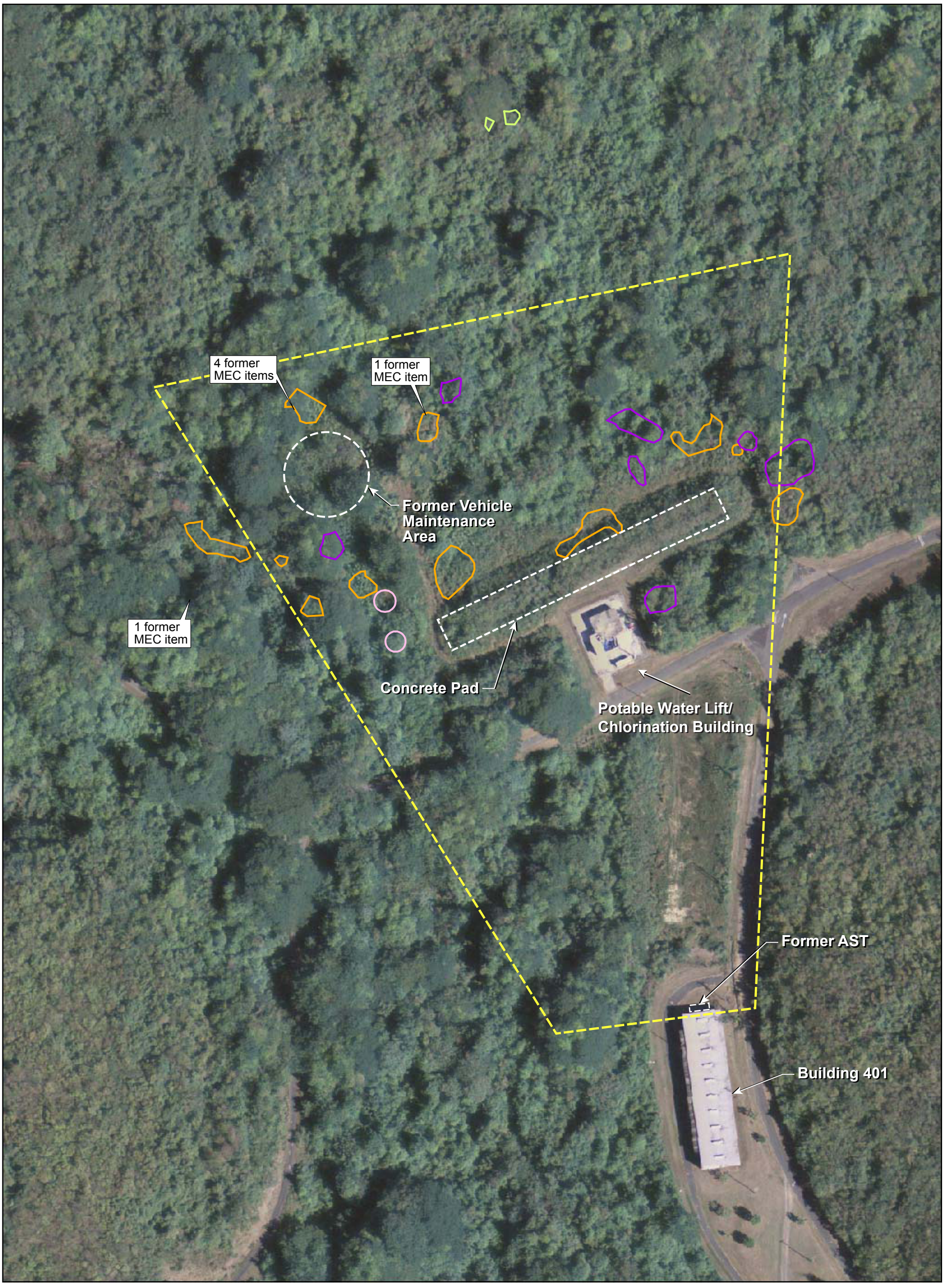
0 100 200
Feet

Legend

AOC R Use and Access Restriction Boundary

FIGURE 1-3
AOC R Historical Aerial Photography
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL



Legend

- AOC R Use and Access Restriction Boundary
- Debris Area Removed, Sampled by Shaw
- Debris Area Removed, Sampled by CH2M HILL
- Debris Piles Removed by CH2M HILL
- Trash Area Removed by Shaw

N W E S

0 50 100 Feet

1 inch = 120 feet

FIGURE 1-4
2007 Aerial Photograph of AOC R
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F1-4 2007 Aerial Photo.ai mstuart

Metal debris removed from the stream bank at AOC R. The photograph was taken March 4, 2009.

Above ground storage tank at AOC R. The photograph was taken March 3, 2009.

Creosote timbers and metal podebris consolidated at AOC R. The photograph was taken March 5, 2009.

Silt fencing installed at the base of the stream bank at AOC R. The photograph was taken March 6, 2009.

Additional excavation of soils at AOC R. The edges of the excavation were slpoed so that there were no walls. The photograph was taken April 3, 2009.

Areas excavated of additional soil at AOC R. The photograph was taken April 3, 2009.

Source: Photographs and Descriptions taken from Appendix A of the Draft Final Completion Report, Shaw 2009

FIGURE 1-5
AOC R Site Photographs
AOC R Remedial Investigation Report
Vieques, Puerto Rico

SECTION 2

Summary of RI Field Activities

This section describes the approach and methodology of the field investigation activities conducted as part of the RI at AOC R. The RI sample collection activities were performed from December 2005 to March 2006 and June and August 2009 to delineate the nature and extent of contamination within AOC R. Sample locations were designed to sufficiently characterize the nature and extent of contamination and migration pathways and determine if potentially unacceptable risks remain on site following the removal action.

Initial investigation activities included collection of surface and subsurface soil, sediment, and surface water samples; installation of monitoring wells and sampling of groundwater; and surveying of the sampling locations. Supplemental investigations were conducted to confirm that the removal action sufficiently addressed potential contaminant sources and associated impacts at the site, verify historical information (e.g., groundwater conditions), and to refine the delineation of the extent of contamination.

Specific details of the sampling objectives are presented in the RI Work Plan (CH2M HILL, 2005d). The objectives of the supplemental investigations were discussed and concurred upon by the ERP Technical Subcommittee in January 2007 and August 2009. Initial field activities were conducted in general accordance with the Standard Operating Procedures (SOPs) presented in the Final Master Work Plan (CH2M HILL, 2001). The supplemental RI activities were conducted in accordance with the Final Master Quality Assurance Project Plan (QAPP) (CH2M HILL, 2007b) and later the Draft Master Standard Operating Procedures, Protocols, and Plans for the Environmental Restoration Program (CH2M HILL, 2009b). Evaluation of the data was performed in accordance with Final Master Standard Operating Procedures, Protocols, and Plans for the Environmental Restoration Program (CH2M HILL, 2010).

Although historical data from the Expanded Phase II PA/SI and removal action are included in figures and tables of this section and in the data evaluation sections, the reader is referred to the *Expanded Preliminary Assessment/Site Investigation, Phase II Seven Sites, Former U.S. Naval Ammunition Support Detachment, Vieques, Puerto Rico* (CH2M HILL, 2002b) and the *Final Completion Report, Removal Action SWMU 6, SWMU 7, AOC J, and AOC R, Former Naval Ammunitions Support Detachment, Vieques, Puerto Rico* (Shaw, 2010) for detailed information on the data collection and analysis processes that were part of these activities. For efficiency, those details are not included herein.

Table 2-1 summarizes the investigations and associated samples that were collected, the media sampled, sampling rationale, analyses performed, sample identifications, and depth of sampling (for soil and sediment samples) for the data included in the RI Report. **Figure 2-1** presents all of the sample locations at AOC R. **Figures 2-2 through 2-5** present the surface soil, subsurface soil, surface water and sediment, and groundwater sampling locations, respectively.

All samples collected during the initial RI sampling were submitted for analysis to CompuChem Laboratories, Inc. of Cary, North Carolina. All samples collected during the

supplemental RI sampling were submitted for analysis to Katahdin Analytical Services, Inc. of Scarborough, Maine.

2.1 Drain Line Delineation

During the removal action activities, a buried drain line was identified. As part of the RI activities, the origin and extent of the drainage line was further delineated. Visual inspection, with backhoe and magnetometer assistance, was used to delineate the extent of the drain line. The drain line was found to originate from the suspected former restroom facilities and extend approximately 480 feet to the northwest (**Figure 2-1**). A small concrete structure, likely for solids settling, was found partway along the length of the drain line. During the supplemental RI sampling activities, soil samples were collected from within the sump and at the point of discharge, as discussed below.

2.2 Soil

Surface and subsurface soil samples were collected to assess the nature and extent of potential contamination and as confirmation samples in areas where debris and impacted soils were removed. The locations of surface soil samples and subsurface soil samples collected during the PA/SI, RI, and removal action are shown in **Figures 2-1 through 2-3**.

Surface soil samples were collected from 0 to 6 inches bgs, 0 to 12 inches bgs, and 0 to 24 inches bgs (depending on the investigation and location, and in accordance with the applicable work plan); subsurface soil samples were collected up to a maximum depth of 21 feet bgs. Soil samples were submitted for various combinations of VOCs, SVOCs, pesticides, PCBs, explosives, inorganics, pH, and/or total organic carbon (TOC), as listed in **Table 2-1**. Soil was screened in the field using a photo-ionization detector (PID) and flame ionization detector (FID) to help identify potential zones of contamination for targeted sampling.

Surface soil samples were collected using a stainless steel hand auger (SS35 through SS45 and SS80) and a Direct Push Technology (DPT) drill rig (SS46 through SS67, SS81 through SS90, and SS92 through SS100). DPT services were provided by Geoworks Inc. of Toa Baja, Puerto Rico and JFA Geological and Environmental Scientist of Aguadilla, Puerto Rico. Twenty nine surface soil samples were collected at AOC R during the RI and 37 surface soil samples were collected during the supplemental RI. Each soil sample location is summarized below.

- Four surface soil samples (SS60 through SS63) were collected adjacent to the former AST south of Highway 200.
- Six surface soil samples (SS35 through SS40) were collected at the locations of munitions items, three at each location.
- Twenty-eight surface soil samples (SS41 through SS59 and SS64 through SS72) were collected in the vicinity of the potential source areas, near where samples were previously collected during the Expanded Phase II PA/SI.
- Nine surface soil samples (SS73 through SS79, SS99 and SS100) were collected in areas of additional debris found and removed during the supplemental RI field activities
- One surface soil sample (SS80) was collected within the ephemeral stream

- Nine surface soil samples (SS81 through SS89) were collected following the removal of PAH impacted soil
- One surface soil sample (SS90) was collected along the former drainage line.
- Seven surface soil samples (SS92 through SS98) were collected along the northern border of the site to delineate the extent of PAH contamination.

Subsurface soil samples were collected using a DPT drill rig. Fifteen subsurface soil samples (SB49 through SB63) were collected at AOC R during the RI and 27 subsurface soil samples (SB81 through SB89 and SB91 through SB98) were collected during the supplemental RI. Most subsurface samples were collected at the corresponding locations of the like-numbered surface soil samples (e.g., SB81 was collected at the SS81 location). Subsurface soil sample SB91 was collected at the end of the buried drain line to characterize potential environmental contamination from the former discharge at the depth where the discharge would have taken place. Subsurface soil samples were generally collected at 2-foot intervals, unless the soil was wet, or bedrock/refusal was encountered.

Deviations from the SOPs and work plans were as follows:

- Soil classification information was inadvertently not recorded for SS35, SS36, and SS37. However, there are sufficient other samples to facilitate soil classification across AOC R.
- A subsurface soil sample was not collected at SS90; refusal (likely the bottom of the small solids settling tank) was encountered at about 12 inches bgs.

2.3 Surface Water and Sediment

Surface water samples were collected from three locations within the ephemeral stream during the RI and from two locations during the supplemental RI (**Figure 2-4**), sampling logs are provided in **Appendix B**. Three sediment samples were collected within the ephemeral stream to a depth of 6 inches bgs (**Table 2-1 and Figure 2-4**), sampling logs are provided in **Appendix B.** The three RI surface water samples comprised: one sample (SW/SD02) from where a munitions item was identified in the stream bed, one sample (SW/SD01) upstream of this location, and one sample (SW/SD03) downstream of this location in a depositional area. Samples were analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, inorganics, pH, and TOC (**Table 2-1**). Surface water samples collected during the supplemental RI were located at the former SW/SD03 location (SW/SD04) and further downstream (SW05) and analyzed for total and dissolved inorganics (**Table 2-1**). All locations were concurred upon by the ERP Technical Subcommittee.

Surface water samples were also measured for field parameters including temperature, pH, dissolved oxygen, redox potential, conductivity, salinity, and turbidity.

Surface water and sediment samples were collected in accordance with the Final Master Work Plan (CH2M HILL, 2001) and RI Work Plan (CH2M HILL, 2005).

2.4 Groundwater

This subsection summarizes the monitoring well installation and groundwater sampling activities conducted during the RI. All groundwater sample nomenclature, rationale, and

analyses are summarized in **Table 2-1**. The monitoring well network at AOC R is shown in **Figure 2-5**.

2.4.1 Monitoring Well Installation

Seven monitoring wells (MW01 through MW07) were installed at AOC R to sufficiently characterize potential groundwater quality impacts at the site. Monitoring wells MW01 through MW07 were installed in December 2005. A summary of the monitoring well construction details, including survey data, is provided in Table 2-2.

Geoworks, Inc. of Toa Baja, Puerto Rico provided hollow stem auger (HSA) and air hammer well drilling and installation services with a 4.25-inch outer diameter (OD) and continuous split-spoon sampling to provide lithologic descriptions. In areas where bedrock was encountered, the wells were drilled or reamed with a 6-inch OD air hammer. Soil and rock boring logs are included in Appendix C. Photographs of rock cores collected are provided in Appendix D. Grain size analyses of soil samples are provided in Appendix E.

Each monitoring well was constructed with 2-inch diameter Schedule 40 polyvinyl chloride (PVC) casing and well screen. The well screen consisted of 0.010-inch slot size and was 10 ft in length. Screen intervals were selected based on water level measurements collected during drilling. A silica sand filter pack was placed into the annular space around the well screen from the bottom of the boring/well screen extending to a depth of 2 to 4 ft above the top of the screen. A 2 ft bentonite layer was placed above the top of the sand pack. After the bentonite was hydrated, a cement-bentonite grout was placed in the remaining annular space. Each monitoring well was completed with a protective casing and locking cap, protective bollards, and a concrete pad. Monitoring well completion diagrams are included in Appendix F.

The rationale for the monitoring well location selection is as follows:

- Monitoring well NDARMW01 was installed upgradient of the area for use in site-specific background comparisons.
- Monitoring well NDARMW02 was installed just north (directly downgradient) of the former AST location to assess potential groundwater impacts from the former AST.
- Monitoring wells NDARMW03 and NDARMW04 were installed within approximately 10 feet north of the concrete pad along Highway 200 to provide data downgradient of the concrete pad.
- Monitoring well NDARMW05 was installed approximately in the center of the vehicle maintenance area to assess potential groundwater impacts from vehicle maintenance activities.
- Monitoring well NDARMW06 was installed downgradient of the vehicle maintenance area to assess potential groundwater impacts from vehicle maintenance activities.
- Monitoring well NDARMW07 was installed within 10 feet, in the downgradient direction, of where soil samples were collected during the PA/SI were shown to have elevated metals and SVOCs.

Monitoring wells were developed using a combination of pumping and surging with an electric submersible pump. In monitoring wells with an abundance of sediment, a surge block or swab

was used. Field parameters (temperature, pH, conductivity, and turbidity) were monitored during development. Well development logs are provided in **Appendix G**.

Notable deviations from the work plan include:

- The SOP indicates installation of a 1 ft thick fine-grained secondary sand pack above the coarse-grained primary sand pack. This is commonly done to provide an additional barrier to the grout that is added above the bentonite layer. A fine-grained secondary pack was not installed in the AOC R monitoring wells. However, no grout contamination was observed (e.g., pH levels were normal) during well development or sampling activities.
- Well development activities commenced 15 and 22 hours after the installation of grout at MW06 and MW07, respectively; the work plan specified a minimum of 24 hours after grout installation to allow for the grout to stiffen and reduce the chance of grout migration through the bentonite and sand pack and into the well. However, as noted above, no grout contamination was observed during well development or sampling activities.

2.4.2 Groundwater Monitoring

Groundwater samples and water-level measurements were collected from each monitoring well. **Table 2-1** presents a summary of each sampling event and analyzed constituents.

Groundwater level measurements were obtained from all seven monitoring wells at AOC R during multiple events using an electronic water level meter, from the top of casing of each monitoring well, to the nearest 0.01 ft. **Table 2-3** summarizes the groundwater level measurements from each well.

Groundwater samples were collected from each monitoring well during the RI and supplemental RI. Groundwater samples from the RI were analyzed in accordance with the work plan for VOCs, SVOCs, pesticides, PCBs, explosives, inorganics, and total dissolved solids (TDS). At MW02, the groundwater sample was also analyzed for total petroleum hydrocarbons (TPH). The groundwater samples collected during the supplemental RI were analyzed in accordance with the work plan for the same parameters, along with TPH and chloride.

Each monitoring well was purged at a pumping rate ranging from 50 to 600 milliliters per minute (mL/min). Field parameters were measured prior to the sample collection and are summarized in **Table 2-4**. Samples for dissolved parameters were field-filtered prior to preservation using a 0.45-micron filter. The monitoring well groundwater sampling logs are provided in **Appendix H**.

Groundwater samples collected during the RI were in general accordance with the RI Work Plan and Draft Master SOPs (CH2M HILL, 2001), Protocols, and Plans (CH2M HILL, 2009). Notable deviations from the work plans are summarized below:

- Turbidity readings exceeded 10% for last three readings at well MW01 through MW07; but at the relatively low turbidity values recorded (e.g., between 0.96 nephelometric turbidity units (NTUs) and 11.8 NTUs), greater than 10% difference can occur at very small actual differences.
- A flow rate (600 mL/min) just above the maximum of 500 ml/min suggested by the Low Flow SOP was used during purging of MW04 and MW06.

- Maximum drawdown suggested by the Low Flow SOP (0.3 ft) was exceeded in MW01, MW02 and MW07. Drawdown was 1.15 ft, 5.20 and 0.77 ft respectively. Although maximum drawdown was exceeded, water levels did stabilize before sampling activities were initiated.
- A flow rate (50 mL/min) below the minimum of 100 mL/min suggested by the Low Flow SOP was used during purging of well MW01 in order to maintain the drawdown limit. Additionally, sampling took place at this same flow rate.

Although there were deviations from the low flow sampling procedures, their effects on the quality of data are negligible and are commonly observed because aquifers do not necessarily conform to the conditions stipulated in the Low Flow SOP. Further, multiple rounds of data were collected from each well, which showed that any deviation in a particular event did not affect the ability to characterize the groundwater conditions.

2.4.3 Hydraulic Conductivity Testing

Aquifer hydraulic conductivity properties were estimated through slug testing. Rising and falling-head slug tests were performed at MW02 through MW07 in January 2006. Because the well screen interval was not completely submerged (with the exception of MW04), the tests conducted were rising head tests in wells screened across the water table.

The static depth to water and total depth of the well were determined with an electronic water level indicator before testing began on each well. Each test included installing a 0-to-15-pound-per-square-inch (psi) pressure transducer with a data logger programmed to measure and record water levels. Rising head (slug-out) tests were performed in monitoring wells MW02 through MW07. For each slug-out test, after the initial water level was measured, a 1-inch diameter by 5-ft long solid polyvinyl chloride (PVC) slug was lowered into the monitoring well. The falling water level in the well was recorded until the water level recovered to within 90 percent of the original water level. The slug was then quickly removed from the monitoring well (slug-out test), causing the water level to drop rapidly in response to the removal of the slug, and then rise as the water level returned to equilibrium. The rise of the water level in the well was recorded until the water level had recovered to within 90 percent of the original water level. The tests were performed multiple times at each well to determine reproducibility and verify results.

Data were electronically downloaded from the transducer and the processed field data were analyzed. The test data were analyzed using the Bouwer-Rice (Bouwer and Rice, 1976) analytical methods. It is noted that slug tests can be influenced by monitoring well filter packs that may affect hydraulic conductivity calculations (Butler, 1997). However, although the tests were conducted because they were specified in the work plan, the uncertainty associated with slug test data did not affect the ability to sufficiently characterize the groundwater conditions at AOC R such that determinations for the site can be made. The data plots from each tested monitoring well are presented in **Appendix I** and the results are discussed in Section 3 of this report.

2.4.4 Surveying

The locations and elevations of the monitoring wells installed were surveyed by TranSystems, Inc. of Norfolk, Virginia. The survey established the spatial northing and easting coordinates for each well location utilizing Universal Transverse Mercator (UTM) in NAD 83, zone 20Q. In

addition, the elevation in ft amsl was established to the nearest 0.01 ft for the top of the monitoring well casings. Soil borings were horizontally located using the Global Positioning System (GPS). Survey data for the monitoring well locations are included in **Appendix J**.

2.5 Decontamination and Waste Management

In accordance with the RI Work plan, all downhole and non-disposable sampling equipment was decontaminated immediately after each use. Tubing used for low-flow sampling was disposed of following use after each monitoring well.

Aqueous and soil investigation-derived waste (IDW) was contained in 55-gallon drums and temporarily stored on site for characterization. Composite soil samples were collected from each drum of soil. Aqueous and soil IDW were analyzed for the full TCLP list and reactivity, ignitability, and corrosivity and the analytical results are provided in **Appendix K**. The IDW was disposed of properly as nonhazardous waste at the Waste Management (WM) Peñuelas Valley Landfill, Inc. in Peñuelas, Puerto Rico. Records from the handling, lab analysis and transfer of IDW from AOC R are included in **Appendix K**.

2.6 Environmental Data and Management

Information on the evaluation of the analytical data collected during the environmental investigations to meet the Data Quality Objectives, as described in the project-specific QAPP (CH2M HILL, 2007), is discussed below.

2.6.1 Data Tracking and Validation

The management and tracking of data from the time of field collection to receipt of validated electronic analytical results were performed. Field samples and their corresponding analytical tests were recorded on chain-of-custody forms for submission to the laboratory. Chain-of-custody entries were checked to verify that all designated samples were collected and submitted for the appropriate analyses. Upon receipt of the samples by the laboratory, a comparison to the field information was made to ensure that each sample would be analyzed for the correct parameters and the proper number of quality assurance/quality control (QA/QC) samples.

Third-party validation was performed on the analytical data reports from each investigation. Validation procedures referenced the appropriate guidance considering the most-recent version of guidance available at the time of validation and the actual analytical method performed. Validation provides proper perspective on data availability and usability. Validation was performed by various third-party subcontract data validators. The full data validation reports are presented in **Appendix L**.

A data quality evaluation was performed on the analytical data in accordance with the Final Master QAPP (CH2M HILL, 2007). Areas of review (when applicable to the method) include holding time compliance, calibration, verification, blank results, matrix spike precision and accuracy, method accuracy as demonstrated by laboratory confirmation samples, field duplicate results, surrogate recoveries, internal standard performance, and interference checks. Results of the evaluation are summarized in **Appendix M**. Precision, accuracy, representativeness, completeness and comparability were met for all of the analytical data.

2.6.2 Regulatory Standards and Risk-Based Screening Values

The screening process used to evaluate risks to human and ecological receptors and the consideration of a constituent as a Chemical of Concern (COC) are discussed in Sections 6 and 7. However, to determine the nature of soil, sediment, surface water, and groundwater contamination within AOC R, analytes were compared, as applicable, to the following screening values:

- Soil sample results were screened against:
  - USEPA Regional Screening Levels (RSLs) for residential and industrial soil (May 2010), adjusted as appropriate (for non-carcinogenic effects)
  - Site-specific Soil Screening Levels (SSLs), Migration to Groundwater – Site-specific Dilution Attenuation Factor of 1 calculated as per USEPA guidance (USEPA, 2002); details of the SSL calculation are included in **Appendix N**.
  - Ecological Screening Levels (surface soil only)
  - West Vieques background soil inorganics upper tolerance limits (CH2M HILL, 2002b)
  - PREQB Land Pollution Control Corrective Action Level for total petroleum hydrocarbons.
- Groundwater sample results were screened against:
  - USEPA Regional Screening Levels for Tap Water (May 2010), adjusted as appropriate (for non-carcinogenic effects)
  - Federal Safe Drinking Water Act (Title 40 of the Code of Federal Regulations [CFR], Part 141) MCLs and Secondary MCLs
  - Puerto Rico Class SB Water Quality Standards, March 2010.
  - Background concentrations measured from upgradient AOC R monitoring well MW01, supplemented with background concentrations measured from monitoring wells QA-MW-01, QA-MW-02, and AOC–K-MW03 (**Figure 3-2**), completed within the same geologic unit, as reported in the west Vieques background study report (CH2M HILL, 2002). For any particular inorganic constituent, true background is a range of concentrations, not a single concentration. The concentration from a single well, such as AOC R MW01, represents only a point in that range of concentrations. Therefore, inorganics data from wells QA-MW-01, QA-MW-02, and AOC-K-MW03 were considered in order to better represent the range of concentrations that may be found within the Qa (quaternary aged deposits and rocks) geologic unit.
- Sediment and surface water sample results were screened against:
  - USEPA Regional Screening Levels for Residential Soil and Tap Water (May 2010), adjusted as appropriate (for non-carcinogenic effects)
  - Ecological Screening Values

Table 2-1
Site Sample Summary
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Site	Investigation Field Work and Associated Report	Media Samples[1]	Rationale	Analytes	Sample Identification[2]	Soil Sample Depth (ft bls)
	Phase II Expanded PA/SI sample collection November 2000 (CH2M HILL, 2002)	34 SS	Assess potential impacts to site surface soil	VOCs, SVOCs, Pesticides, PCBs by CLP SOW OLM04.2, Metals by CLP SOW ILM04.0	NDE133(SS01) thru NDE142(SS10) NDE144(SS11) thru NDE153(SS20) NDE155(SS21) thru NDE164(SS30) NDE166(SS31) thru NDE169(SS34)	Varying Depth Intervals, from 0-1' bgs, as required to sample surface interval below fill material / gravel
	RI sample collection December 2005 thru March 2006	25 SS	Near former PA/SI samples and locations of munitions items	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, pH, grain size and TOC	WAR-SS35-0002 thru WAR-SS59-0002	0 to 2 feet bgs
		4 SS	Adjacent to former AST	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, pH, grain size, TOC, TPH DRO, TPH GRO, and TPH ORO	WAR-SS60-0002 thru WAR-SS63-0002	0 to 2 feet bgs
		11 SB	Near former PA/SI samples and locations of munitions items	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, pH, and TOC	WAR-SB49-0406 thru WAR-SB59-0406	4 to 6 feet bls
		4 SB	Adjacent to former AST	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, pH, TOC, TPH DRO, TPH GRO, and TPH ORO	WAR-SB60-0406 thru WAR-SB63-0406	4 to 6 feet bls
		6 GW	MW-01 - upgradient MW-03 and MW-04 - concrete pad area MW-05 - vehicle maintenance area MW-06 - downgradient of vehicle maintenance area MW-07 - downgradient of PA/SI soil samples	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals (total and dissoleved), and TDS	WAR-GW01-06A, WAR-GW03-06A thru WAR-GW07-06A	
		1 GW	MW-02 - adjacent to AST	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals (total and dissoleved), TPH and TDS	WAR-GW02-06A	
		3 SW	Within the ephemeral stream to evaluate potential transport	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals (total and dissoleved), hardness, pH, TDS, and TOC	WAR-SW01, WAR-SW02, WAR-SW03	
		3 SD	Within the ephemeral stream to evaluate potential transport	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, pH, and TOC	WAR-SD01, WAR-SD02, WAR-SD03	0 to 6 inches bgs
	Supplemental RI sample collection June 2009	8 SS	Concrete pad area	TCL Pesticides, TAL Metals	VWAR-SS65-01-0609 thru VWAR-SS72-01-0609	0 to 1 foot bgs
		1 SS	Concrete pad area	TCL Pesticides, TAL Metals, pH, TOC, and grain size	VWAR-SS64-01-0609	0 to 1 foot bgs
		7 SS	Post-debris removal and confirmatory sampling	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, TPH DRO, and TPH GRO	VWAR-SS73-0H-0609, VWAR-SS75-0H-0609, VWAR-SS76-0H-0609, VWAR-SS78-0H-0609, VWAR-SS80-0H-0609, VWAR-SS99-0H-0609, VWAR-SS100-0H-0609	0 to 0.5 feet bgs
		2 SS	Post-debris removal	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, pH, TOC, grain size, TPH DRO, and TPH GRO	VWAR-SS74-0H-0609 and VWAR-SS77-0H-0609	0 to 0.5 feet bgs
		1 SS	Post-debris removal	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, pH, TOC, TPH DRO, and TPH GRO	VWAR-SS79-0H-0609	0 to 0.5 feet bgs
		15 SS	Post-PAH impacted soil removal ; SS81 through SS84 collected as post-MEC removal	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, and TAL metals	VWAR-SS81-01-0609 thru VWAR-SS88-0609; VWAR-SS90-01-0609; VWAR-SS92-01-0609 thru VWAR-SS94-01-0609; VWAR-SS96-01-0609 thru VWAR-SS98-01-0609	0 to 1 foot bgs
		2 SS	Adjacent/within removal areas	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, pH, TOC, and grain size	VWAR-SS89-01-0609, and VWAR-SS95-01-0609	0 to 1 foot bgs
		25 SB	Post-debris removal/removal of PAH impacted soil	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, and TAL metals	VWAR-SB81-46-0609, VWAR-SB82-46-0609, VWAR-SB83-46-0609, VWAR-SB84-1718-0609, VWAR-SB84-46-0609, VWAR-SB85-9H10H-0609, VWAR-SB86-1617-0609, VWAR-SB86-46-0609, VWAR-SB87-46-0609, VWAR-SB88-1415-0609, VWAR-SB88-46-0609, VWAR-SB89-46-0609, VWAR-SB91-1314-0609, VWAR-SB91-23-0609, VWAR-SB91-46-0609, VWAR-SB92-46-0609, VWAR-SB93-46-0609, VWAR-SB94-46-0609, VWAR-SB95-1516-0609, VWAR-SB95-46-0609, VWAR-SB96-2021-0609, VWAR-SB96-46-0609, VWAR-SB97-46-0609, VWAR-SB98-1718-0609	Samples with -12- in the sample identification were collected from 1 to 2 feet bgs. Samples with -23- in the sample identification were collected from 2 to 3 feet bgs. Samples with -46- in the sample identifiaction were collected from 4 to 6 feet bgs. Samples with -9H10H- in the sample identification were collected from 9.5 to 10.5 feet bgs. Samples with -1314- in the sample identification were collected from 13 to 14 feet bgs. Samples with -1415- in the sample identification were collected from 14 to 15 feet bgs. Samples with -1516- in the sample identification were collected from 15 to 16 feet bgs. Samples with -1617- in the sample identification were collected from 16 to 17 feet bgs. Samples with -1718- in the sample identification were collected from 17 to 18 feet bgs. Samples with -2021- in the sample identification were collected from 20 to 21 feet bgs.
		2 SB	Post-PAH impacted soil removal	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, pH, TOC, and grain size	VWAR-SB87-1011-0609 and VWAR-SB98-46-0609	Samples with -46- in the sample identification were collected from 4 to 6 feet bgs. Samples with -1011- in the sample identification were collected from 10 to 11 feet bgs.
	Removal Action sample collection March 2009, April 2009, and July 2009	5 SS	Confirmatory sample collected within debris areas, Sample 103 collected down slope of unidentified cement storage tank	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals, TPH DRO, and TPH GRO	116701-OR-Z-101, 116701-OR-Z-103, 116701-OR-Z-104, 116701-OR-Z-108, and 116701-OR-Z-110	0 to 6 inches bgs
		7 SS	Confirmatory sample collected within debris areas	Gamma Chlordane, Methoxylclor, TPH-DRO and TPH-GRO	116701-OR-Z-102, 116701-OR-Z-105, 116701-OR-Z-106, 116701-OR-Z-107, 116701-OR-Z-109, 116701-OR-Z-111, and 116701-OR-Z-112	0 to 6 inches bgs
		7 SS	Confirmatory sample collected within debris areas	TCL VOCs, SVOCs, Pesticides, Explosives, TAL metals	116701-OR-Z-115, 116701-OR-Z-116,116701-OR-Z-117,116701-OR-Z-118,116701-OR-Z-119,116701-OR-Z-120,and 116701-OR-Z-121	0 to 6 inches bgs
		7 SS	Confirmatory sample collected within debris areas	TCL PCBs	116701-OR-Z-123,116701-OR-Z-124,116701-OR-Z-125,116701-OR-Z-126,116701-OR-Z-127,116701-OR-Z-128, and 116701-OR-Z-129	0 to 6 inches bgs
		2 SW	Within ephemeral stream to evaluate potential transport	TAL Metals (total and dissolved)	VWAR-SW04-0609, and VWAR-SW05-0609	
	Supplemental RI sample collection August 2009	7 GW	Additional round of groundwater sampling following removal actions	TCL VOCs, SVOCs, Pesticides, PCBs, Explosives, TAL metals (total and dissoleved), TPH-DRO, TPH-ORO, TPH-GRO, Chloride, and TDS	WAR-GW01-09A thru WAR-GW07-09A	

[1] SS = surface soil sample, SB - subsurface soil sample, GW - groundwater sample, SW - surface water sample, SD - sediment sample.

Table 2-2

Summary of Monitoring Well Construction Details
AOC R Remedial Investigation Report
Vieques, Puerto Rico

Well ID	Date Installed	Top of Casing Elevation (ft amsl)	Boring Depth (ft bls)	Well Depth (ft bls)	Total Depth Below Top of Casing	Screen Interval Depth (ft bls)	Screen Interval Depth (ft amsl)	Depth to Bentonite (ft bls)	Depth to Sand Pack (ft bls)	Northing UTM NAD 83 Meter*	Easting UTM NAD 83 Meter*
NDARMW01	12/8/2005	37.43	34	32	35.27	22 - 32	12.43 - (2.43)	17.5	19.5	2004763.1	230344.1
NDARMW02	12/8/2005	33.16	32	32	35.30	22 - 32	8.16 - (-1.84)	18	20	2004818.4	230310.0
NDARMW03	12/12/2005	21.41	25	24	26.33	14 - 24	4.41 - (-5.59)	9.5	11.5	2004957.5	230317.2
NDARMW04	12/7/2005	21.27	28	27	30.25	17 - 27	1.27 - (-8.73)	13	15	2004981.3	230284.1
NDARMW05	12/13/2005	20.48	23	22	25.62	12 - 22	5.48 - (-4.52)	8	10	2005001.6	230169.1
NDARMW06	12/14/2005	20.69	24	24	27.11	14 - 24	3.69 - (-6.31)	8	10	2005017.4	230165.0
NDARMW07	12/14/2005	20.69	26	25	27.96	15 - 25	2.69 - (-7.31)	11	13	2005016.2	230213.3

ft amsl = feet above mean sea level (NGVD 1929)

ft bls = feet below land surface

Northing and Easting coordinates in UTM meters

* Coordinates were obtained by CH2M HILL in 2006.

Table 2-3
Summary of Monitoring Well Groundwater Elevations
AOC R Remedial Investigation Report
Vieques, Puerto Rico

Monitoring Well ID	Top-of-casing Elevation (ft amsl)	January 13, 2006		March 17, 2006		June 12, 2009		August 24, 2009	
		Depth to Water	GW Elevation (ft amsl)	Depth to Water	GW Elevation (ft amsl)	Depth to Water	GW Elevation (ft amsl)	Depth to Water	GW Elevation (ft amsl)
NDARMW01	37.43	27.53	9.90	29.23	8.20	30.34	7.09	31.18	6.25
NDARMW02	33.16	26.31	6.85	27.70	5.46	28.41	4.75	28.83	4.33
NDARMW03	21.41	18.33	3.08	19.25	2.16	19.49	1.92	19.62	1.79
NDARMW04	21.27	17.86	3.41	19.00	2.27	19.41	1.86	19.28	1.99
NDARMW05	20.48	18.02	2.46	18.73	1.75	18.85	1.63	18.79	1.69
NDARMW06	20.69	17.99	2.70	18.68	2.01	18.46	2.23	18.45	2.24
NDARMW07	20.69	17.71	2.98	18.59	2.10	18.89	1.80	18.98	1.71

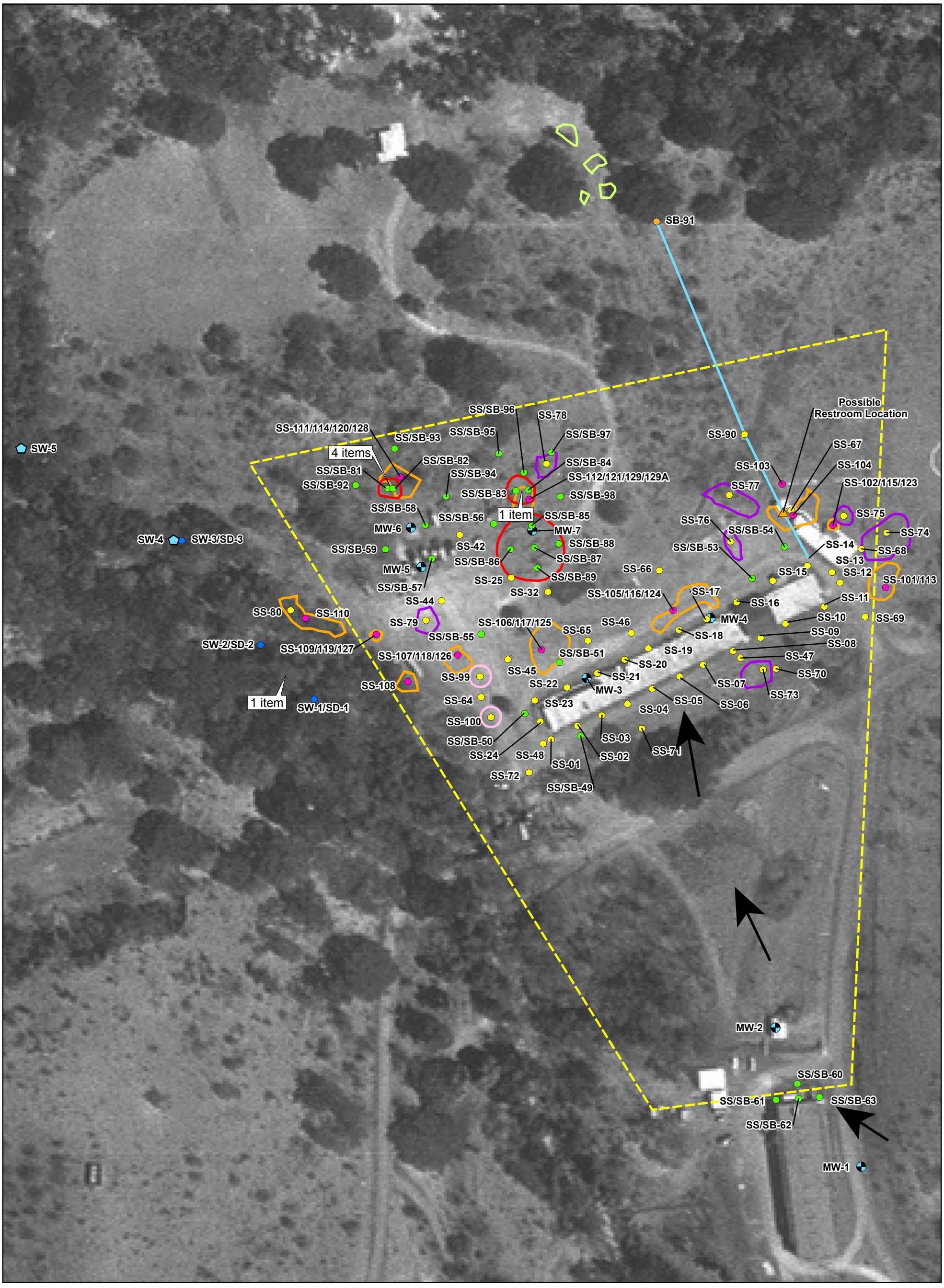
Notes:
NA - Not applicable
NM - Not measured

Table 2-4

Monitoring Well Parameters
AOC R Remedial Investigation Report
Vieques, Puerto Rico

Investigation	Well ID	Date	Purged Vol. (gals)	Temp. (°C)	SpCond (uS/cm)	Salinity (ppt)	DO (%)	DO (mg/L)	pH	ORP	TDS	Turbidity (NTU)
2006 RI	WAR-MW01	1/11/2006	9.5	27.55	1267	0.63	7.90	0.63	6.83	170.7	735	1.47
	WAR-MW02	1/13/2006	6	29.39	1511	0.75	77.30*	5.88*	7.09	156.0	958	35.3
	WAR-MW03	1/11/2006	16	27.43	1090	0.54	12.20	0.97	6.51	12.9	677	94.7
	WAR-MW04	1/11/2006	5.5	28.20	563	0.27	12.00	0.94	6.49	110.8	337	19.1
	WAR-MW05	1/12/2006	10	26.98	1031	0.51	3.14	0.25	7.02	28.3	604	7.32
	WAR-MW06	1/12/2006	22.75	27.38	948	0.46	11.20	0.89	6.91	-27.4	569	24.3
	WAR-MW07	1/12/2006	13	27.06	748	0.36	13.18	1.05	6.64	83.5	457	83.4
2009 RI	WAR-MW01	8/24/2009	1.2	30.76	1772	0.90	13.9	1.02	6.59	168.4	530	1.00
	WAR-MW02	8/25/2009	1.75	30.20	2624	1.37	28.1	2.09	6.90	166.2	1100	2.51
	WAR-MW03	8/26/2009	3.25	28.18	1640	0.82	13.1	1.00	6.47	-7.8	840	3.76
	WAR-MW04	8/25/2009	1.25	28.89	645	0.31	9.7	0.74	6.55	120.7	360	9.12
	WAR-MW05	8/31/2009	3.1	27.94	1689	0.85	10.6	0.78	6.74	-57.3	870	1.51
	WAR-MW06	8/31/2009	3.1	28.35	1594	0.80	13.4	1.04	6.58	-39.4	820	3.93
	WAR-MW07	8/27/2009	1.5	29.17	2028	1.01	15.6	1.19	6.66	162.8	920	8.51

* DO % and DO mg/l are erroneous readings



Legend

- Surface Soil Sample
- Surface Soil Sample Collected by Shaw
- Surface Soil and Subsurface Soil Sample
- Subsurface Soil Sample
- Surface Water and Sediment Sample
- Surface Water Sample
- Monitoring Well
- Possible Restroom Location
- Buried Drain Line

- Area of elevated soil PAHs, Soil excavated to a depth of 2 feet bls
- Debris Area Removed, Sampled by Shaw
- Debris Area Removed, Sampled by CH2M HILL
- Debris Piles Removed by CH2M HILL
- Trash Area Removed by Shaw
- AOC R Use and Access Restriction Boundary
- Direction of Groundwater Flow

N W E S

0 60 120 Feet

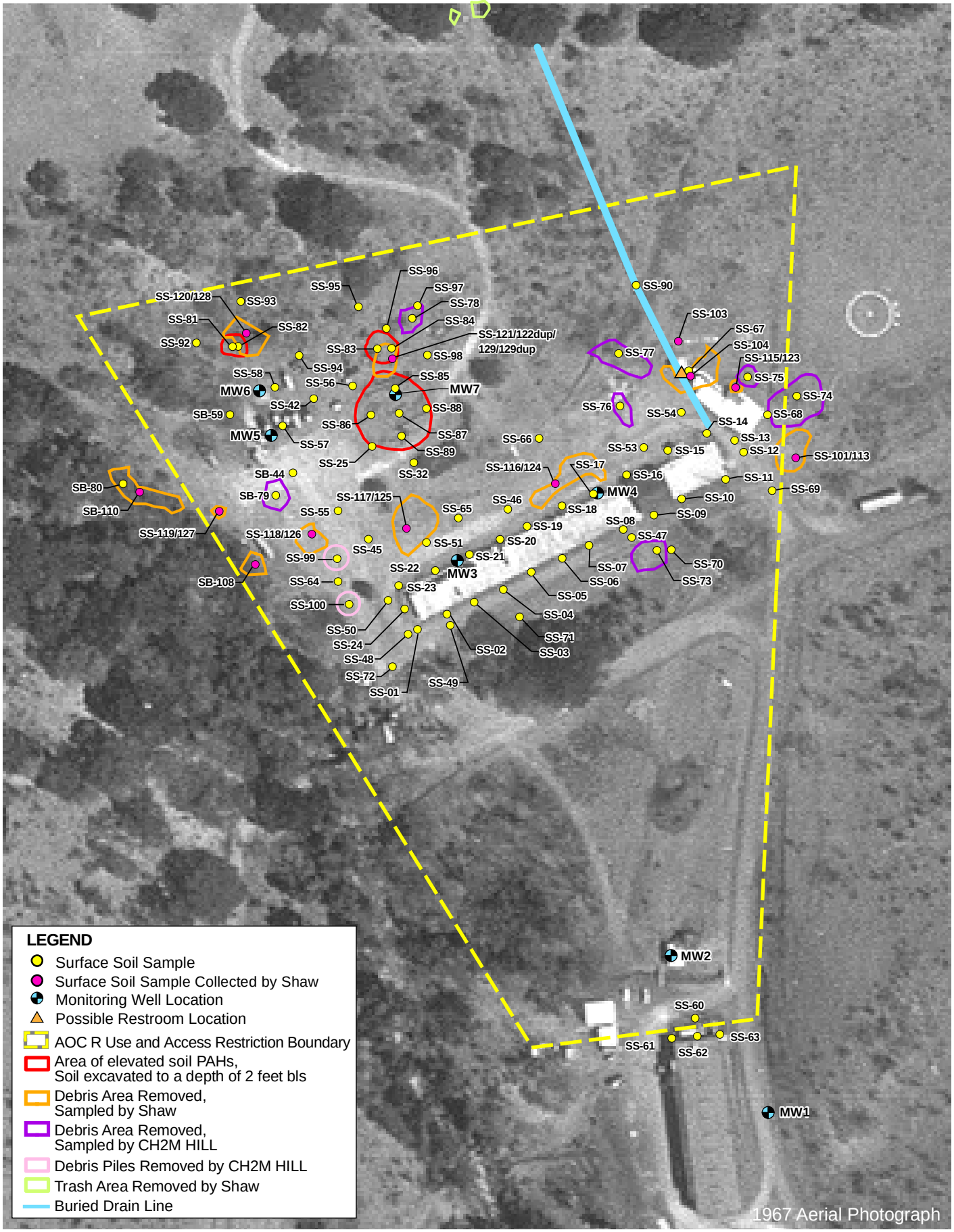
1 inch = 120 feet

Note: 1967 Aerial Photograph. Several Surface Soil Sample Locations were excavated and not shown on this figure. They include SS-26 to SS-31, SS-33 to SS-41, SS-43, and S-52.

FIGURE 2-1
AOC R Sample Locations
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F2-1 AOC R Sample Locations.ai mstuart



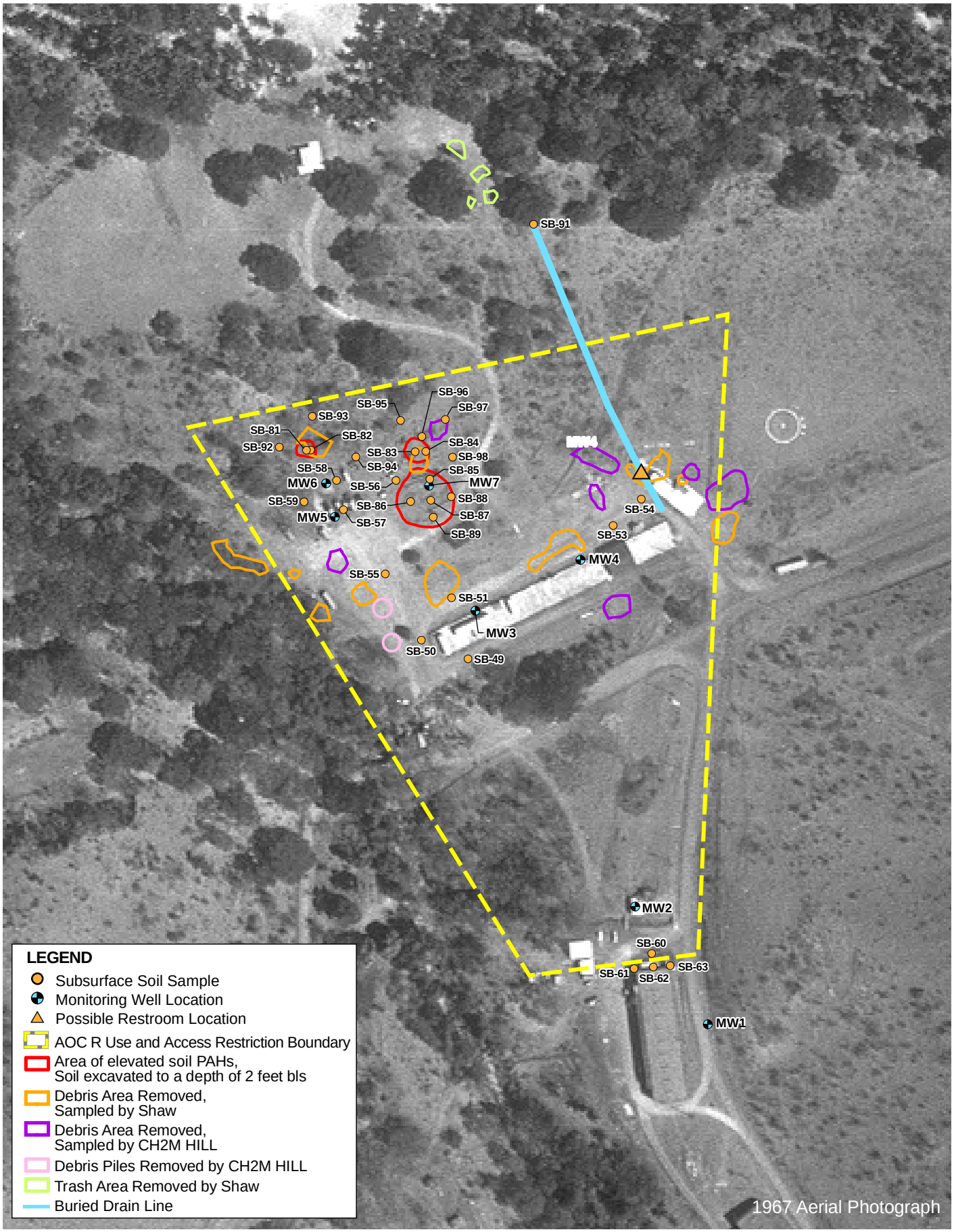
N
W E
S

0 75 150
Feet

FIGURE 2-2
Surface Soil Sample Location Map
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F2-2 Surface Soil Location Map.ai mstuart

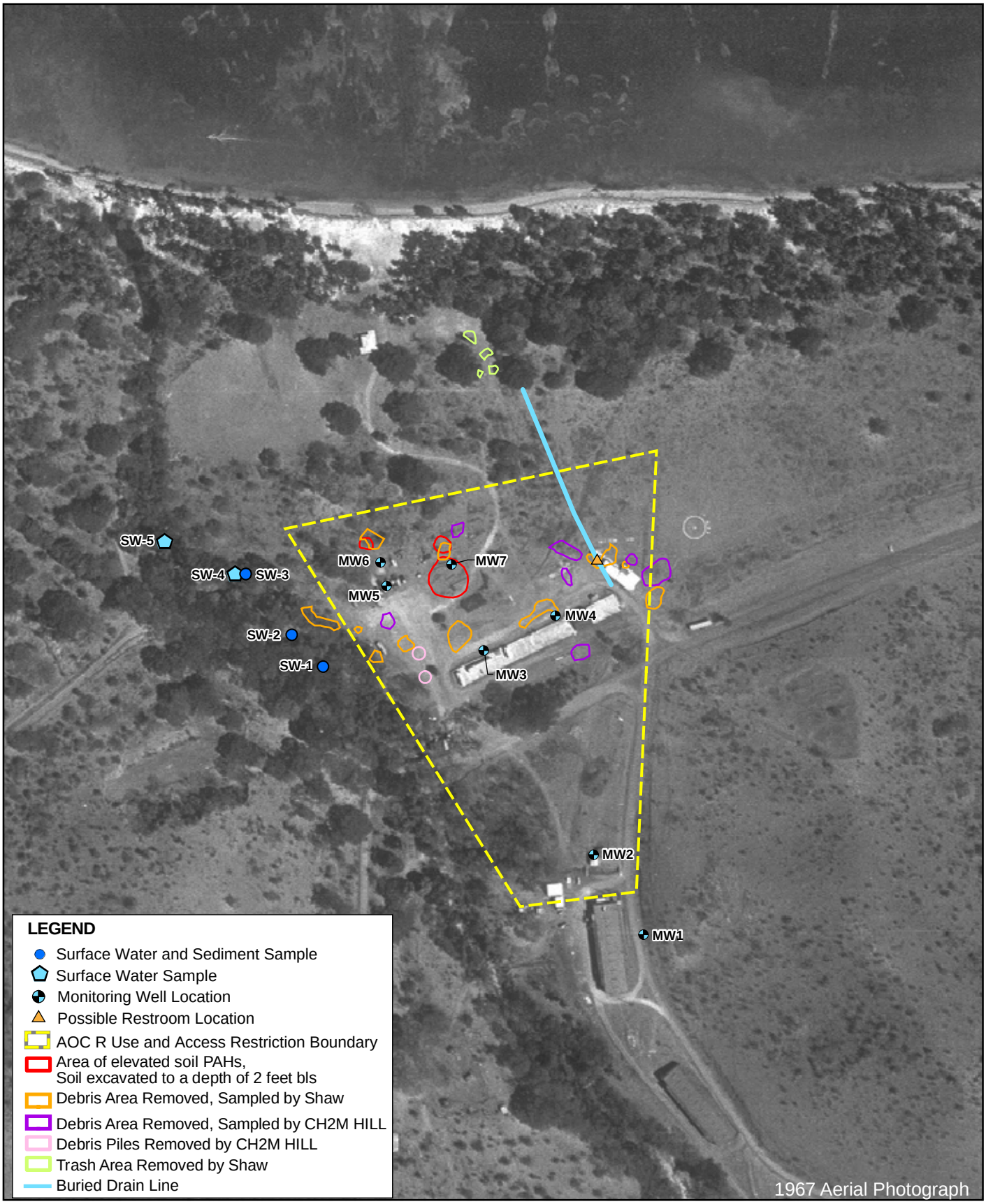


N
W E
S

0 100 200
Feet

CH2MHILL

FIGURE 2-3
Subsurface Soil Sample Location Map
AOC R Remedial Investigation Report
Vieques, Puerto Rico



N
W E
S

0 150 300
Feet

FIGURE 2-4
Surface Water and Sediment Sample Location Map
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

Legend

- Monitoring Well
- AOC R Use and Access Restriction Boundary

N
W E
S

0 150 300
Feet

FIGURE 2-5
AOC R Monitoring Well Locations
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F2-5 Monitoring Well Locations.ai mstuart

SECTION 3

Physical Characteristics

This section presents an evaluation of the AOC R physical characteristics pertaining to the surface features and conceptual hydrogeology of the site. A detailed hydrogeologic conceptual model helps describe the primary mechanisms that control the fate and migration of contaminants in groundwater. The hydrogeologic conceptual model provides the foundation for the development of the overall conceptual site model for AOC R. The physical and ecological characteristics also support the human health and ecological risk assessments.

3.1 Physical Setting

This subsection summarizes the physical setting of AOC R, including meteorology, topography, surface water drainage, geology and hydrogeology.

3.1.1 Meteorology

The climate of Vieques is tropical-marine. Temperatures are nearly constant with an annual average temperature of about 79°F; August is the warmest month, with an average temperature of 82°F and February the coolest, with an average temperature of 76°F (Greenleaf/Telesca et. al., 1984). Vieques lies in the path of the prevailing easterly trade winds, regulating the climate. The trade winds result in a rainfall pattern characterized by a dry season from December through April and a rainy season from May through November. Due to tropical low pressure systems carried by the trade winds, heavy precipitation results from tropical storms to occasional hurricanes from July to November (Bonnin, 2006). The western part of the island, where AOC R is located, averages approximately 43 inches of rainfall per year (Geo-Marine, Inc., 2003).

3.1.2 Topography

The topography of western Vieques and the former NASD property is characterized by a series of rolling hills, peaks, small valleys that are intersected by a series of ephemeral stream drainage features (known locally as quebradas), and narrow, low lying coastal areas. The most elevated areas occur along a west to east axis near the center of the former NASD with the highest point being Mount Pirata, which has an elevation of 987 ft above mean sea level (msl). In general, the former NASD slopes gradually downward from the center of the island to the coastal areas, with the exception of the steep slopes in the vicinity of Mount Pirata.

The topography of AOC R is relatively flat, with less than one meter (3 ft) of change over the site, sloping to the north and northwest (**Figure 3-1**). The ground elevation at the site ranges between 7 and 10 meters (21 to 30 ft) amsl, and drops to below 1 meter (3 ft) amsl within the ephemeral stream to the northwest of the site.

3.1.3 Land and Water Use

The former NASD occupies approximately 8,000 acres, most of which is undeveloped, and is bound by the Vieques Sound to the north, Vieques Passage to the west, and the Caribbean Sea to the south. The east-land-based border is controlled by the Puerto Rico Department of Natural Resources, the Puerto Rico Port Authority, and private landowners.

The Navy ceased military operations in April 2001 and transferred the land containing AOC R to the MOV (**Figure 1-2**). The site is currently restricted to the public; however, access roads to the beaches are located adjacent to the site.

Groundwater is currently not used as a potable water source at or in the vicinity of AOC R, and there are no plans for potable use of groundwater in this area. The Navy plugged and abandoned all potable groundwater supply wells installed on its land in 2000 as part of the land transfer process. The potable water supply on Vieques is derived from the Rio Blanco on the main island of Puerto Rico. Groundwater beneath AOC R is classified as SG by PREQB.

A potable water lift/chlorination facility located adjacent to AOC R was observed discharging chlorinated water to the ephemeral stream immediately adjacent to Route 200 and upstream of the majority of AOC R (see March 2005 Meeting Minutes [CH2M HILL, 2005a]).

3.1.4 Surface Water Hydrology

Surface water present on the former NASD consists of several lagoons (Kiani Lagoon complex) that occur within much of the northwestern corner of Vieques, and a series of intermittent streams. The lagoons are an estuarine wetland system that is predominantly subtidal and occur over 1,500 ft to the west of AOC R (**Figure 1-2**). Most of the streams on the former NASD are ephemeral, flowing only for a short period of time after precipitation events. An unnamed ephemeral stream occurs along the western portion of AOC R (**Figure 3-1**). No permanent surface water bodies are present at the site.

3.1.5 Geology & Hydrogeology

3.1.5.1 Geology

The geology of Vieques is characterized by volcanic rocks intruded later by plutonic rocks, and generally overlain by marine sedimentary rocks and alluvial deposits. Volcanic andesites of late Cretaceous age were deposited in a marine environment and intruded by a quartz-diorite pluton of late Cretaceous to Eocene age (U.S. Geological Survey [USGS], 1989).

Much of the igneous bedrock is exposed over the island with exceptions where it is overlain by limestone of Tertiary age and alluvial, beach, and swamp deposits of Quaternary age. Limestone only occurs within portions of the north, south, and eastern parts of the island. Alluvial sedimentary deposits generally consist of a mixture of gravel, sand, silt, and clay from the weathering of bedrock and occur in valleys and near the ocean. Geophysical surveys show that the alluvial deposits average about 30 ft in thickness and overlie bedrock composed of granodiorite and quartz diorite (USGS, 1989).

The generalized geology of western Vieques and AOC R is shown in **Figure 3-2** and summarized below (USGS, 1989):

- Qa – Quaternary age alluvial deposits (sand, silt, and clay)
- Qb – Quaternary age beach and dune deposits (calcite, quartz, volcanic rock fragments and minor magnetite)
- Qs – Quaternary age swamp and marsh deposits, organic muck, sandy or silty, and peat
- Ti – Tertiary age marine sedimentary rocks, undivided (commonly limestones)

- KTd – Tertiary and Cretaceous age plutonic rock made up largely of granodiorite and quartz diorite, locally deeply weathered

Soil on Vieques is predominantly chemically weathered remnants of parent bedrock due to the climate conditions and that the parent rock type is susceptible to chemical weathering. AOC R soil is defined as udepts inceptisol, which has altered horizons that have lost iron and aluminum but retain weatherable minerals.

Monitoring well lithologic data from the RI provide descriptions of the AOC R subsurface geology. Two simplified geologic cross-sections of the site and the cross-section locations are shown in **Figures 3-3 and 3-4**. Within the southern portion of the site, weathered bedrock (likely an andesite intrusion) was encountered at monitoring wells MW01 and MW02 at approximate depths of 5 and 18 ft bgs, respectively. However, unconsolidated well to poorly graded sands were encountered beneath the bedrock and may possibly be beach or marine deposited sands of an unknown age. Bedrock was not encountered at the other monitoring wells. Alluvium (Qa), which consisted of gravely sands, silts, and clays, was encountered to total depth of the borings. The sands underlying the bedrock and the alluvium are hydraulically connected.

3.1.5.2 Hydrostratigraphy

The two main aquifers on Vieques are the Esperenza and Resolucion Valley aquifers that are recharged by rainfall. The location of AOC R in relation to these two aquifers is shown in **Figure 3-5**. The Esperenza aquifer occurs within the central portion of the island, and the Resolucion Valley aquifer occurs within the western portion of the island where it slopes from Mount Pirata toward the Vieques Passage. The Resolucion Valley aquifer is approximately 8 square miles in size and the only known aquifer on the former NASD property. The semi-confined aquifer is approximately 30 ft thick and consists of fine-grained alluvium derived from the weathering of dioritic rock that overlies saprolite (USGS, 1989).

Groundwater at AOC R was encountered within the poorly graded to well graded sands of the alluvium and within the sands encountered beneath the weathered bedrock in the southern portion of the site. Groundwater at AOC R is likely associated with the Resolucion Valley aquifer.

3.1.5.3 Aquifer Properties

Aquifer hydraulic conductivity ("slug") testing was performed at monitoring wells MW-02 through MW-07 and the results are summarized in **Table 3-1**. The Bouwer-Rice method plots are provided in **Appendix I**.

The hydraulic conductivity values were estimated to range from 0.1 to 31.9 ft/day with an average (geometric mean) hydraulic conductivity of 2.3 ft/day. The hydraulic conductivity values are spatially variable at the site due to the amount of clay within the sands of the alluvial aquifer and its heterogeneous nature.

3.1.5.4 Groundwater Flow

Groundwater flow direction was estimated based on the groundwater elevations from the seven monitoring wells installed at the site. Groundwater level data were collected during three rounds in March 2006, June 2009, and August 2009, and are presented in **Table 2-3**. Groundwater elevation contour maps for the three rounds are shown in **Figures 3-6 through 3-8**.

The first encountered groundwater at AOC R ranged in elevation from 6.25 (MW01) to 1.69 (MW05) ft amsl in August 2009. Groundwater flow in the unconfined aquifer was generally similar for the three rounds and flowed north to northwestward toward the coastline and the Vieques Passage, with an average hydraulic gradient of 0.005 ft/ft. Based on the average hydraulic conductivity (2.3 ft/day), assumed effective porosity (0.30), and the average hydraulic gradient (0.005 ft/ft), the estimated groundwater flow velocity is approximately 15 ft/year.

Groundwater levels at MW06 were slightly higher than adjacent monitoring wells. The anomalous groundwater levels are likely related to surveyor error and were therefore removed from the piezometric surface estimations.

3.1.5.5 General Groundwater Geochemistry

The general groundwater geochemistry at AOC R ranges from fresh to brackish. TDS concentrations measured from the monitoring wells in 2009 are shown in **Table 2-4**. TDS concentrations ranged from 330 (MW04) to 1,100 (MW02) milligrams per liter (mg/L).

3.2 Ecological Setting

Most of the former NASD property is undeveloped and heavily vegetated with trees and low-lying thorny bush (Geo-Marine, 2000). AOC R is located within a thorn scrub and coastal forest area. Shrubs and trees were found mostly on and along the edge of the concrete pad and its immediate surroundings. The dominant shrub species was wild-tantan (*Leucaena leucocephala*). Sweet acacia (*Acacia farnesiana*), red manjack (*Cordia collococca*), be-still tree (*Rauvolfia tetraphylla*), and papaya (*Carica papaya)* were also observed but at lower densities. Species of herbaceous plants observed in the cleared area in the northern part of AOC R included garlic weed (*Petiveria alliacea*), better man better (*Achyrantes aspera*), bretonica prieta (*Melochia nodiflora*), and *Jatropha* spp. Two habitat characterization studies were accomplished by Geo-Marine at the AOC R site, one in 2001 and the other in 2005; both studies are included in **Appendix O**.

Various wildlife species were observed utilizing the vegetated areas, concrete pad, edges of the cleared areas, and the adjacent habitat. The sides of the concrete pad provide shade, foraging areas, and cover for the common, garden, and spotted anoles, which were abundant. A mongoose was observed crossing the trail that led to the northern cleared area. No specific habitat for individual bat species was identified on AOC R during the habitat characterization. Habitat for birds included thorn scrub and coastal forest adjacent to the concrete pad. Many birds were observed using the edges of the cleared area around the concrete pad, trails, and brush piles for perches. The most common birds at the site were gray kingbirds (*Tyrannus dominicensus*), bananaquits (*Coereba flaveola*), and greater Antillean grackles (*Quiscalus niger*). Bird species included those that would typically be found in coastal forest and thorn scrub habitat. An osprey (*Pandion haliaetus*) was observed flying northward toward the ocean over the adjacent vegetation.

Land crabs were not observed in the vicinity of the ephemeral stream. This stream, which appears to be regularly scoured by surface runoff from the drainage basin, is unlikely to support fish but may support some aquatic invertebrates during wet periods.

Fourteen federally listed species are known to occur or have the potential to occur on or near NASD Vieques. No federally protected species or preferred habitats were observed at AOC R. A

terrestrial forested plant community, which is not preferred habitat for any of these species, dominated AOC R.

More details of the ecological setting are provided in Section 7.

3.3 Cultural and Archeological Resources

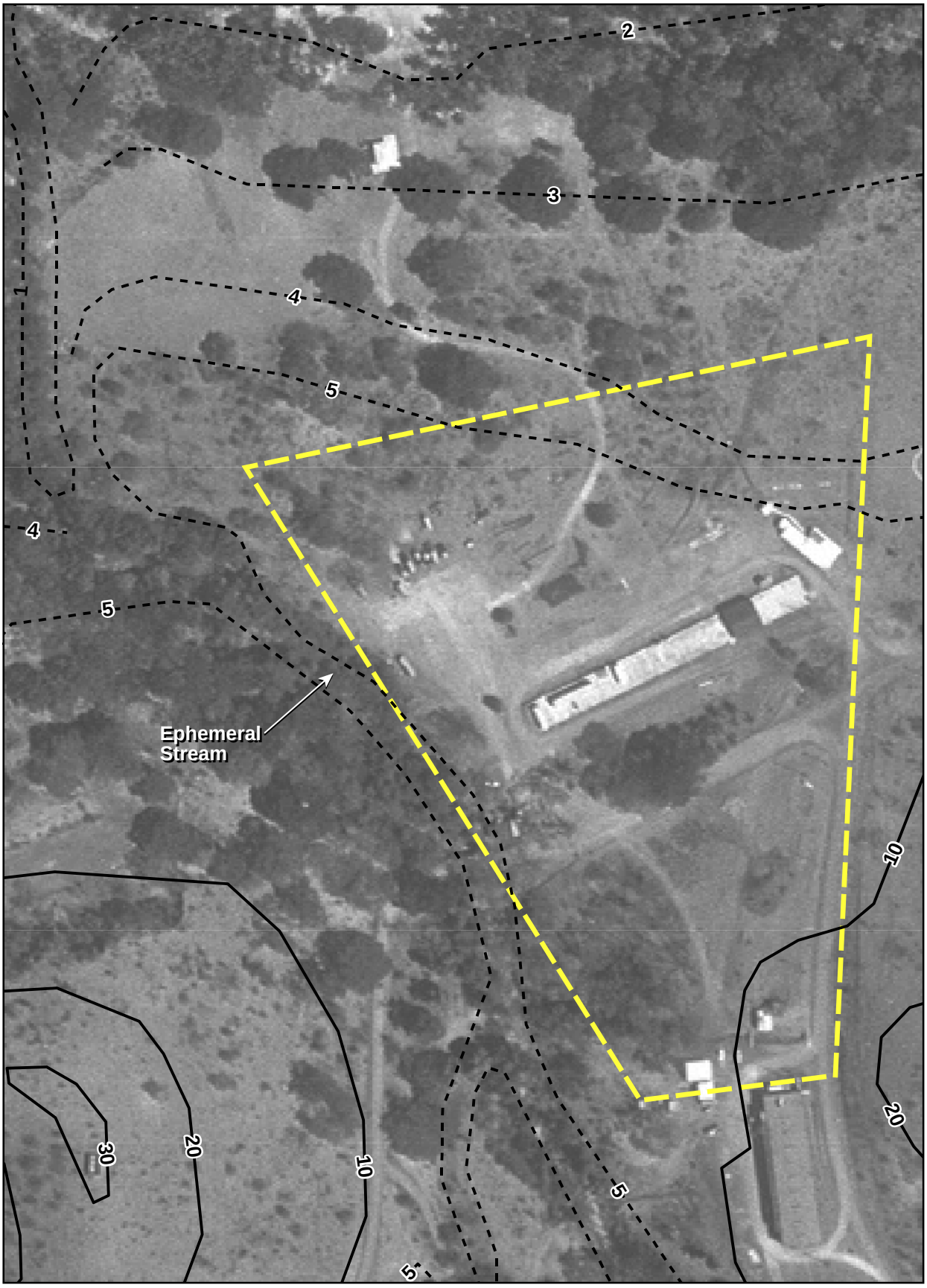
Although twelve archeological sites and districts are listed on the National Register of Historic Places (NRHP) for western Vieques (Geo-Marine, 1996), none are located at AOC R.

Table 3-1

Monitoring Well Hydraulic Conductivity Test Results
AOC R Remedial Investigation Report
Vieques, Puerto Rico

Monitoring Well	Test Type	Test Date	Test Duration[1]	Depth to Water (feet)	Hydraulic Conductivity (feet/day)	Average Hydraulic Conductivity (ft/day)
MW02	Slug Out Test 1	1/17/2006	28 min 33 sec	26.42	0.60	
	Slug Out Test 2	1/17/2006	42 min 45 sec	26.37	1.61	
	Slug Out Test 3	1/18/2006	37 min 36 sec	26.31	0.70	1.0
MW03	Slug Out Test 1	1/19/2006	4 min 6 sec	18.43	4.80	
	Slug Out Test 2	1/19/2006	4 min 9 sec	18.43	11.9	
	Slug Out Test 3	1/19/2006	4 min 6 sec	18.43	9.90	8.9
MW04	Slug Out Test 1	1/18/2006	13 min 9 sec	17.92	0.46	
	Slug Out Test 2	1/18/2006	12 min 30 sec	17.91	0.40	
	Slug Out Test 3	1/18/2006	8 min 48 sec	17.90	0.42	0.4
MW05	Slug Out Test 1	1/19/2006	2 min 3 sec	18.01	13.1	
	Slug Out Test 2	1/19/2006	1 min 21 sec	18.01	31.9	
	Slug Out Test 3	1/19/2006	3 min 54 sec	18.02	17.3	20.8
MW06	Slug Out Test 1	1/20/2006	3 min 0 sec	18.06	17.3	
	Slug Out Test 2	1/20/2006	8 min 21 sec	18.06	26.5	
	Slug Out Test 3	1/20/2006	4 min 0 sec	18.03	21.8	21.9
MW07	Slug Out Test 1	1/18/2006	8 min 42 sec	17.71	0.088	
	Slug Out Test 2	1/18/2006	15 min 51 sec	17.68	0.226	
	Slug Out Test 3	1/18/2006	11 min 36 sec	17.61	0.10	0.1

[1] Time required to attain 90 percent water level recovery
Note: Only slug out tests were performed. No slug tests were preformed on WAR-MW01.



LEGEND

- AOC R Use and Access Restriction Boundary
- 1 Meter Contours
- 10 Meter Contours

Note:
1967 Aerial Photograph Contours U.S. Geological 7.5 Minutes Quadrangle map of Vieques Island, Puerto Rico. Map updated 1982

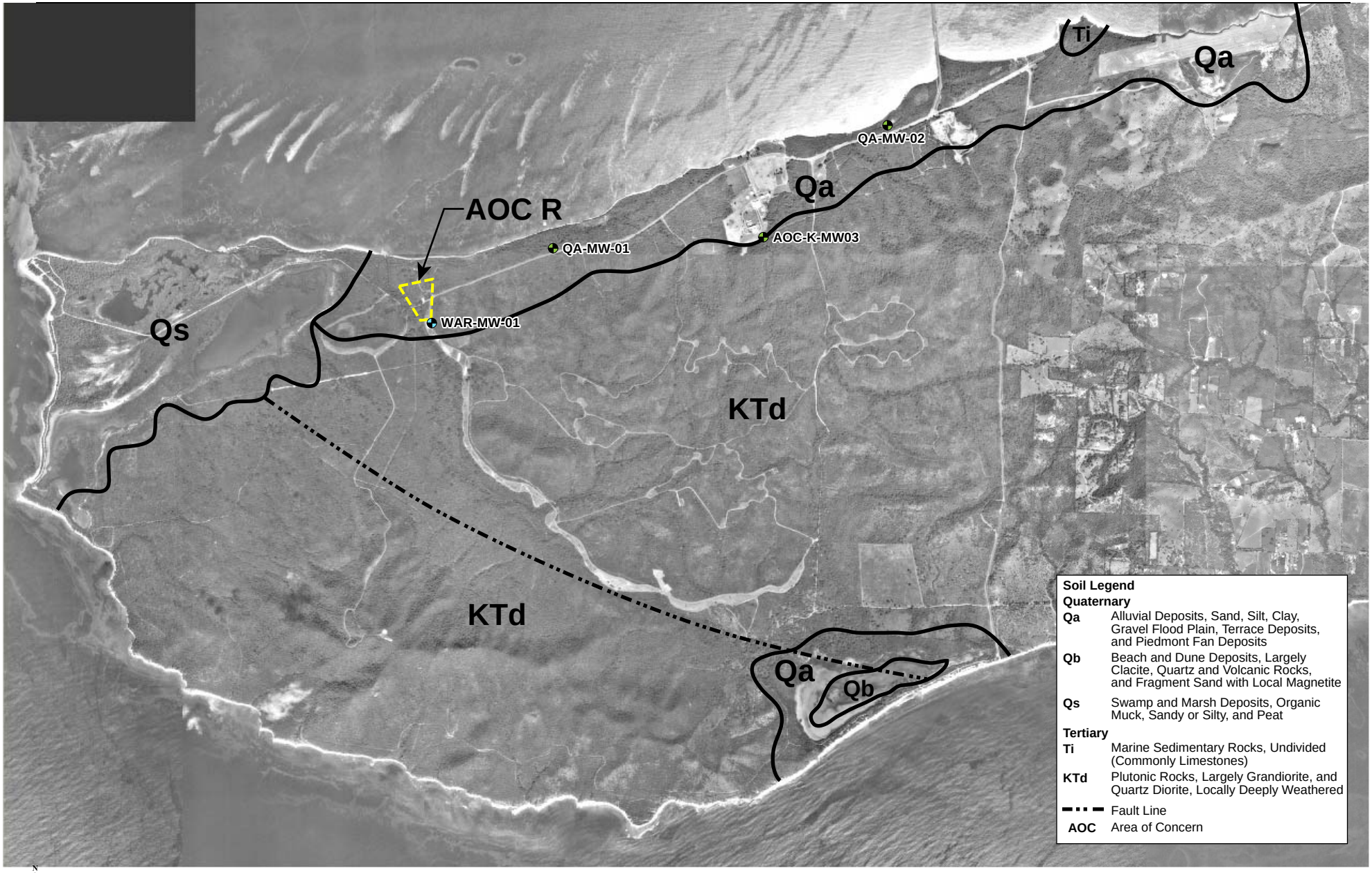
N
W E
S

0 60 120
Feet

FIGURE 3-1
AOC R Topographic Map
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F3-1 AOC R Topographic Map.ai mstuart



N W E S

0 1000 2000 Feet

Generalized Geology Source: (USGS, 1989)

LEGEND

- AOC R Use and Access Restriction Boundary
- AOC R Site Specific Background Well Location
- West Vieques Geologic Zone Qa Background Monitoring Well Location

CH2MHILL

FIGURE 3-2
Generalized Geology and Background Monitoring Well Location Information
AOC R Remedial Investigation Report
Vieques, Puerto Rico

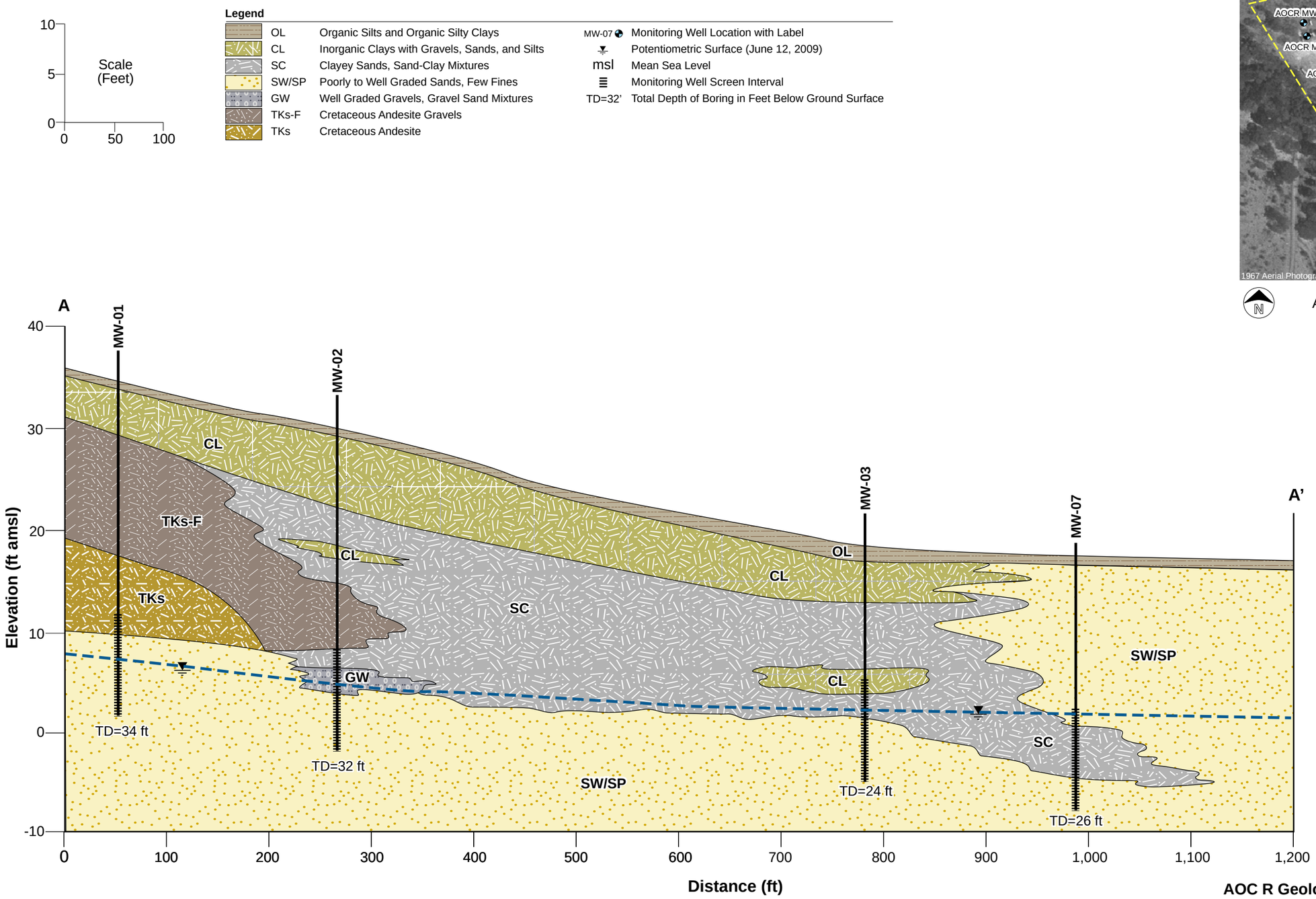
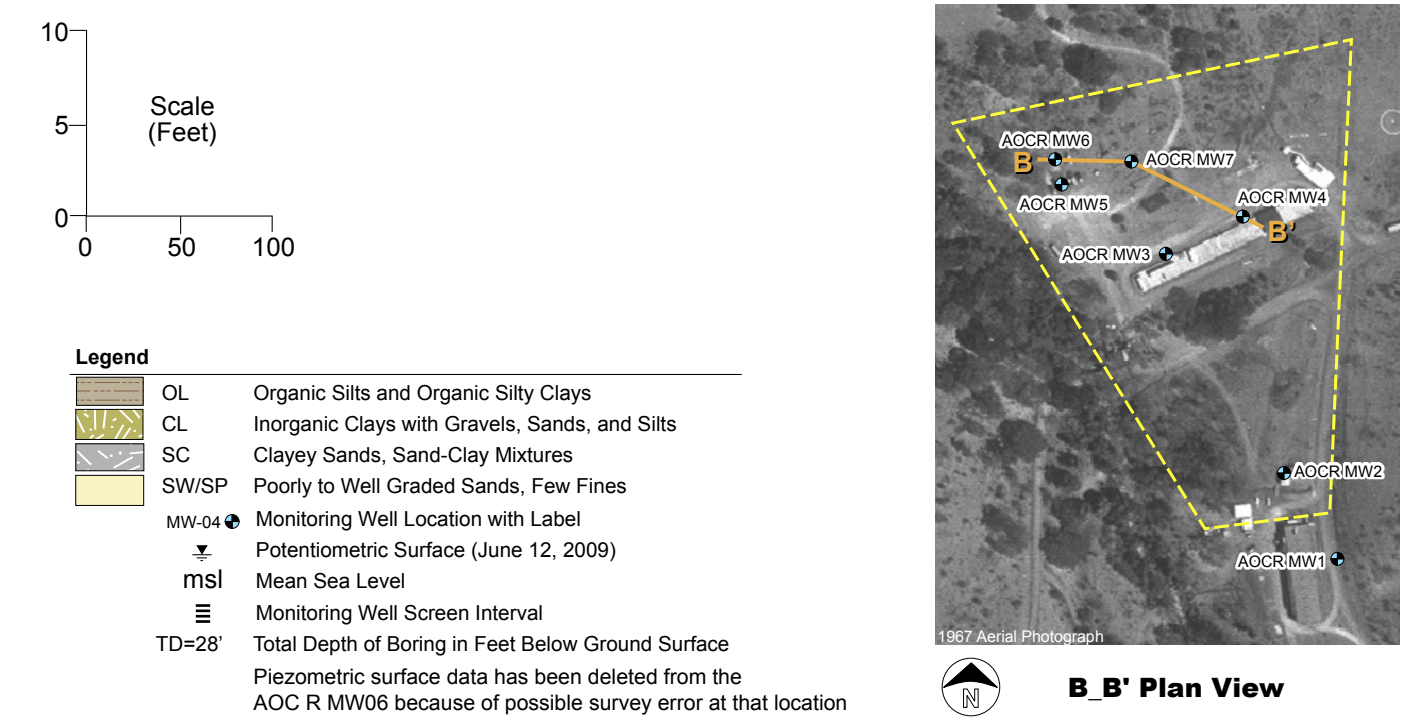


FIGURE 3-3
AOC R Geologic Cross Section A-A'
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F3-3 AOC R Geologic Cross Section A-A.ai



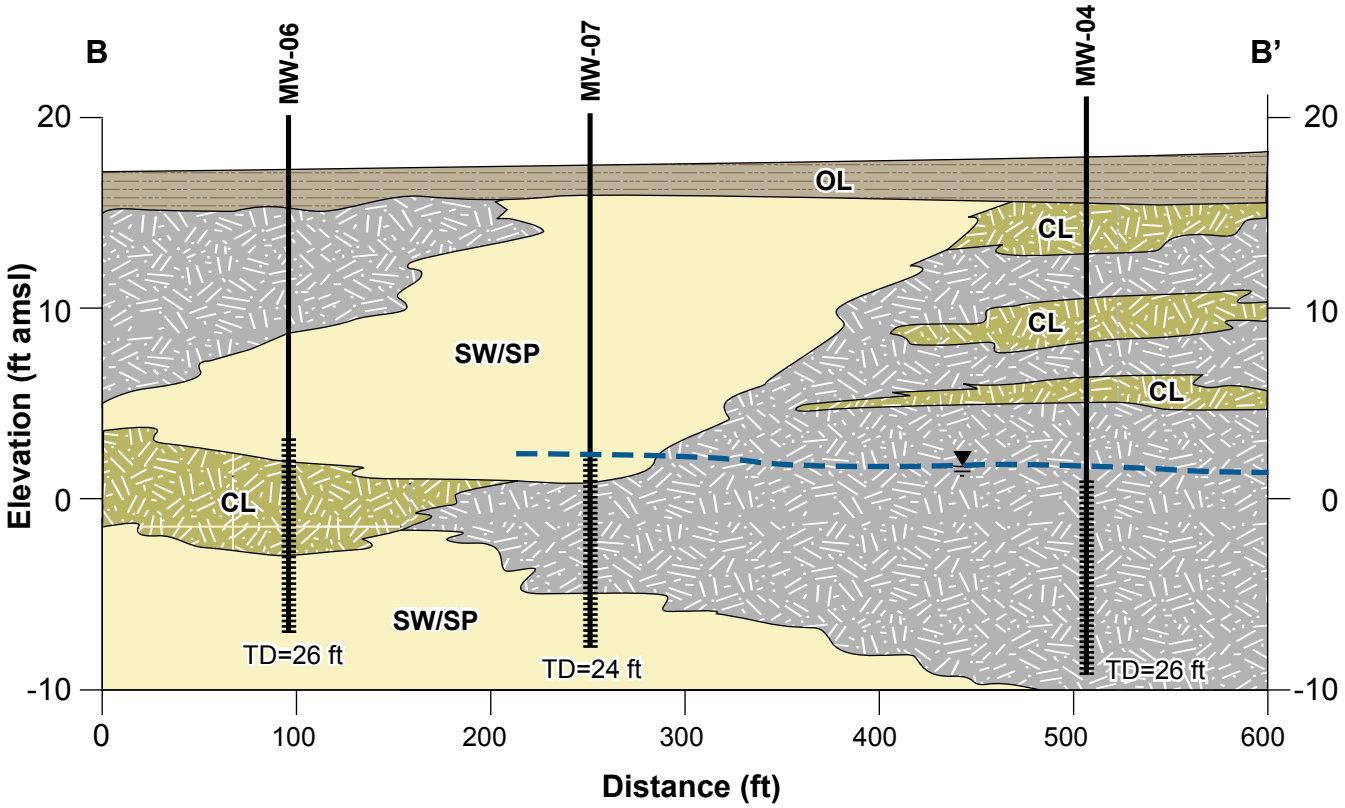
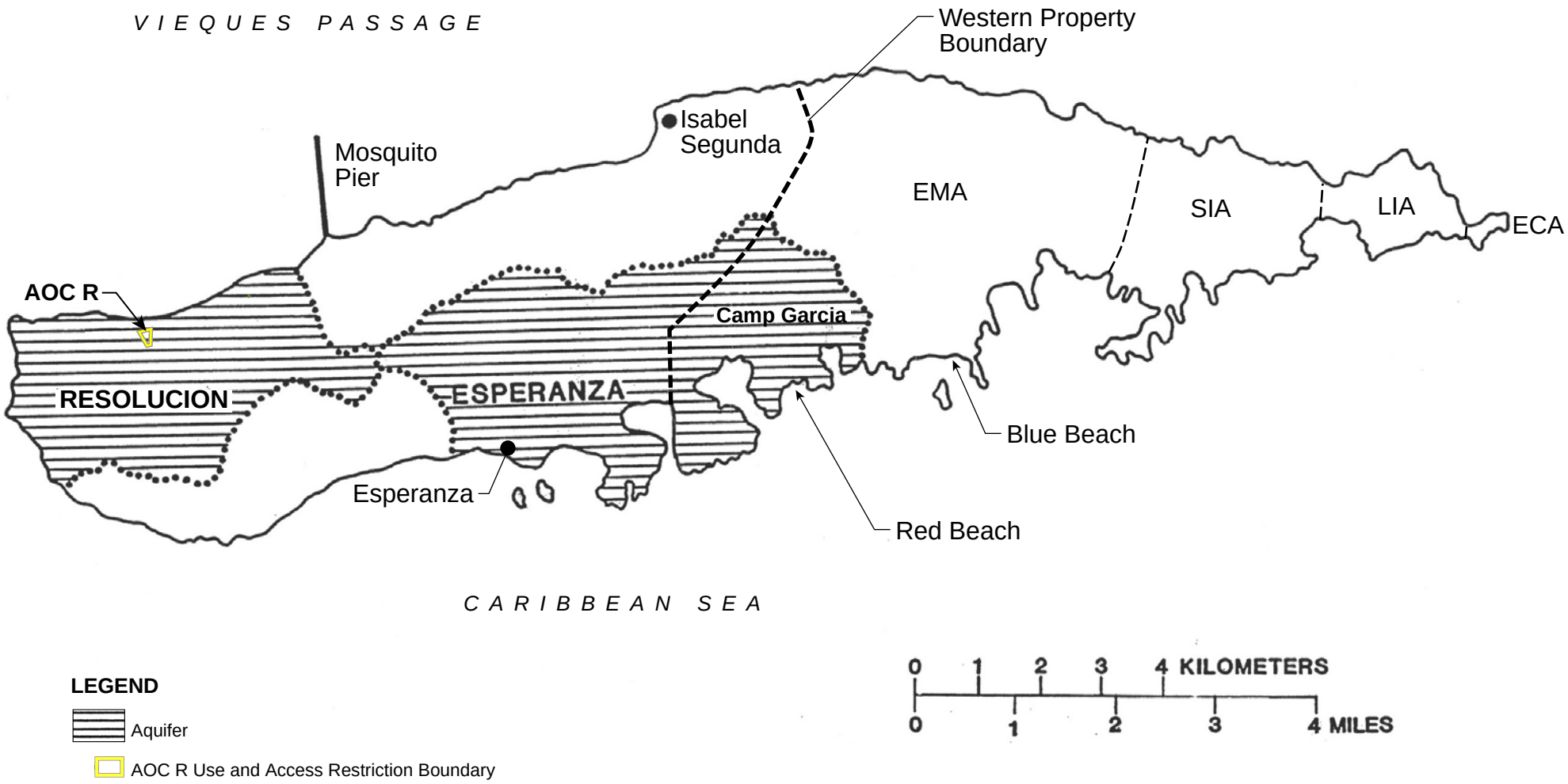


FIGURE 3-4
AOC R Geologic Cross Section B-B'
AOC R Remedial Investigation Report
Vieques, Puerto Rico

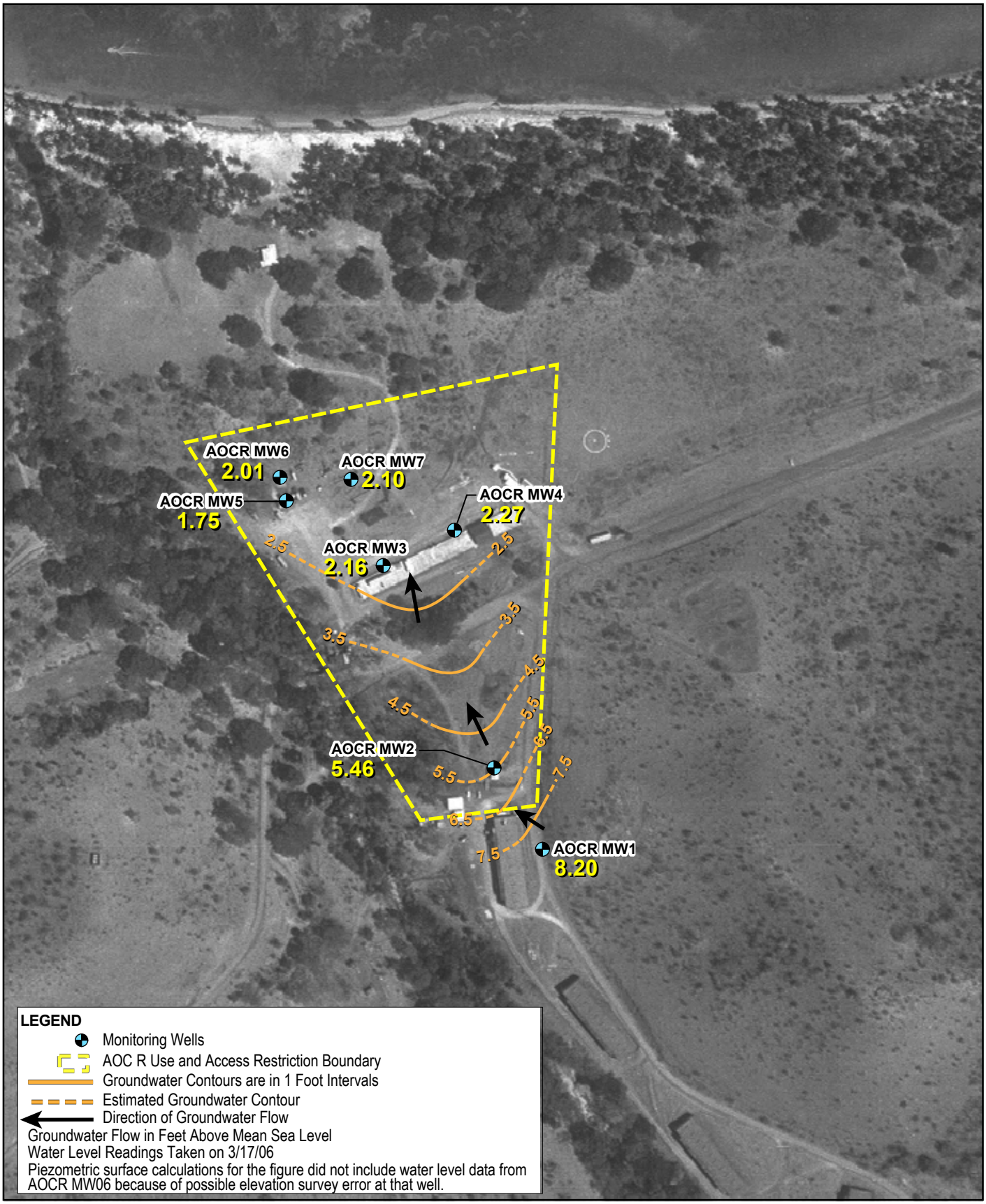


(Reference: USGS, 1989)

FIGURE 3-5
Resolución and Esperanza Aquifers
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F3-5 Resolucion and Esperanza Aquifers.ai mstuart



Source: 1967 Aerial Photograph

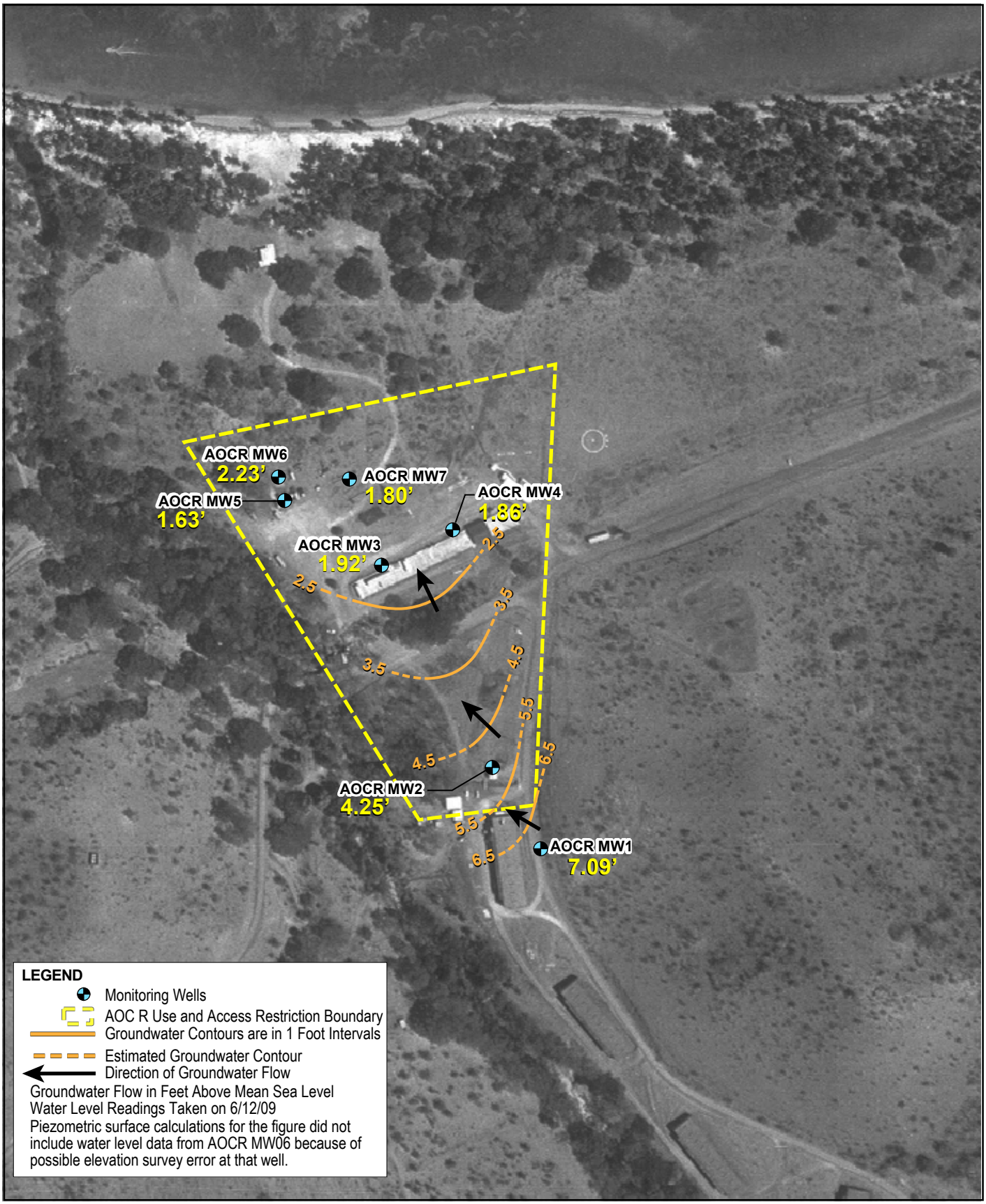
N
W E
S

0 150 300
Feet

FIGURE 3-6
AOC R Estimated Potentiometric Surface
March 17, 2006
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F3-6 AOC R Potentiometric Surface 3-17-06.ai mstuart



Source: 1967 Aerial Photograph

N
W E
S

0 150 300
Feet

FIGURE 3-7
AOC R Estimated Potentiometric Surface
June 12, 2009
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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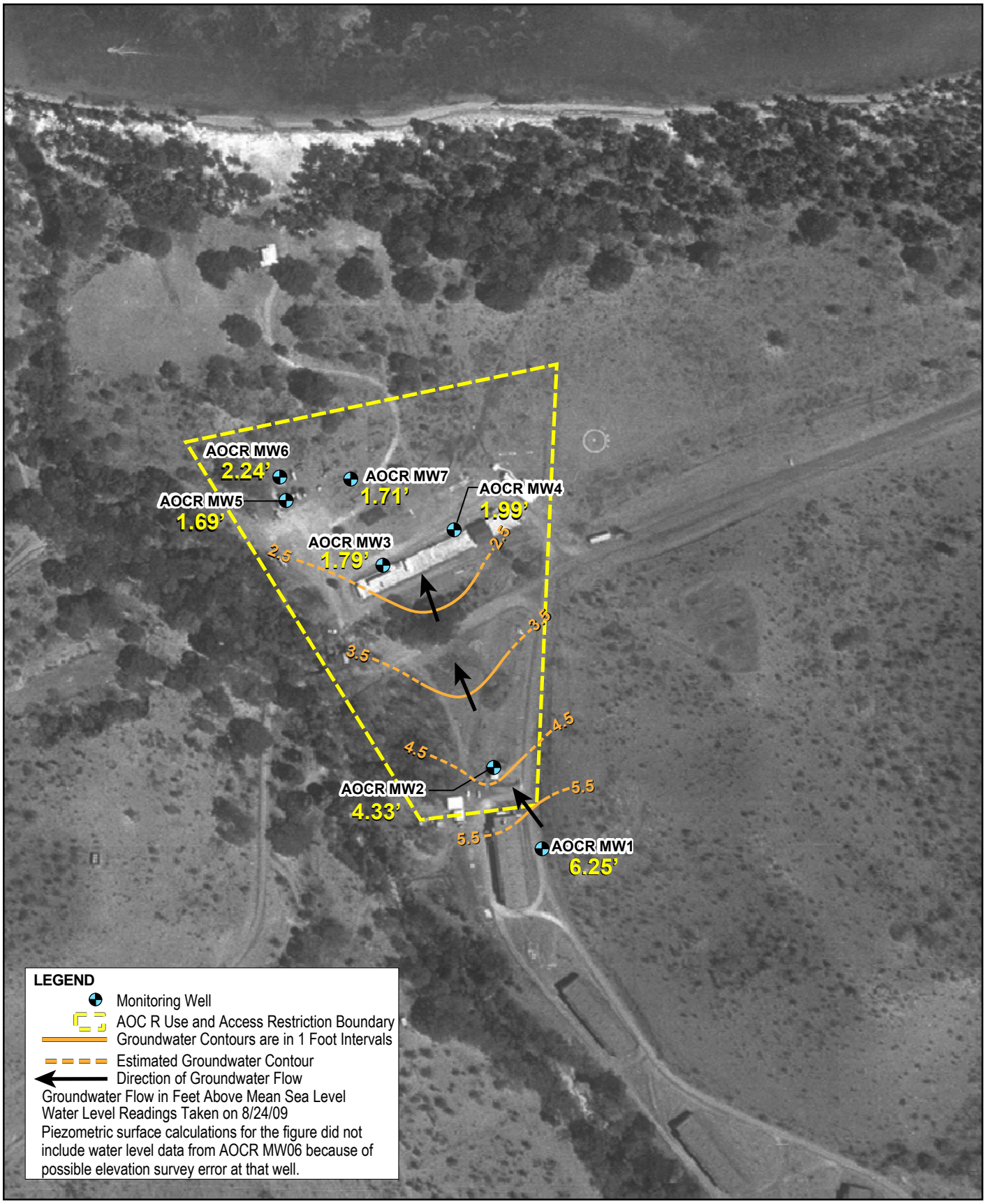
ES052510032918TPA F3-7 AOC R Potentiometric Surface 6-12-09.ai mstuart



Source: 1967 Aerial Photograph

N
W E
S

0 150 300
Feet

FIGURE 3-8
AOC R Estimated Potentiometric Surface
August 24, 2009
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F3-8 AOC R Potentiometric Surface 8-24-09.ai mstuart

SECTION 4

Nature and Extent of Contamination

This section presents an evaluation of the nature and extent of contamination at AOC R. The nature and extent of contamination provides fundamental information to the evaluation of contaminant fate, transport and potential exposure pathways for risk.

4.1 Distribution of Contamination

This subsection discusses the nature and extent of contamination based on the summary of analytical results from the previous investigations, RI, and confirmatory sampling following the removal action. The spatial distribution of samples collected at AOC R provides sufficient coverage of the environmental media at the site to assess the nature and extent of contamination. In total, 187 soil, 16 groundwater, 7 surface water, and 4 sediment samples were collected at AOC R (including duplicates).

Constituent concentrations detected in environmental media at AOC R are summarized in **Tables 4-1 through 4-6**, and shown spatially in **Figures 4-1 through 4-18**. Laboratory analytical reports from the RI are included in **Appendix P**.

The data from 19 surface soil samples were excluded from the nature and extent evaluation, since the associated soil was removed as part of the removal action activities; therefore the data from these 19 samples do not represent current site conditions. **Table 4-2 and Figure 4-19** summarize the soil data from the samples that have been excavated from the site. In total, 168 soil samples were used for the nature and extent evaluation and are only included in **Figures 4-1 through 4-18**.

4.1.1 Soil

Tables 4-1 through 4-3 and **Figures 4-1 through 4-11** present the VOCs, SVOCs, pesticides, PCBs, explosives, and inorganics that were observed in surface and/or subsurface soil at AOC R and identify the Chemicals of Potential Concern (COPCs) (i.e., screening criteria exceedances). **Table 4-1 and Figures 4-1 through 4-3b** summarize the detections and exceedances in surface soil, taking into account the removal action (i.e., excluding the surface soil samples representing soil removed as part of the removal action). **Table 4-2** presents the detections and exceedances in surface soil samples removed as part of the removal action. These data are not included in the following discussion of the nature and extent of contamination because they do not represent current site conditions.

4.1.1.1 Volatile Organic Compounds

Ten VOCs were detected in surface and subsurface soil at AOC R (**Tables 4-1 and 4-3 and Figures 4-1 and 4-4**). Only methylene chloride was observed above a screening criterion (SSL of 2.0 micrograms per kilogram [µg/kg]) in surface soil only. Note that the duplicate soil sample of the 68 µg/kg result (highest concentration) was non-detect. Further, methylene chloride was not detected in subsurface soil or groundwater. This information provides a weight of evidence that

the methylene chloride was more likely associated with laboratory contamination than actually present in the site sample.

4.1.1.2 Semi-Volatile Organic Compounds

Figures 4-2a through 4-2c present the detections and exceedances of SVOCs in surface soil in the northern, concrete pad, and southern areas of AOC R, respectively; the screening criteria are shown in **Figure 4-2c**. The detections and exceedances of SVOCs in subsurface soil are shown in **Figure 4-4**.

Twenty-two and 15 SVOCs were observed in surface and subsurface soil, respectively, the majority of which were PAHs. Nine SVOCs (atrazine, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, carbazole, 4-nitroaniline, and 2,4-dinitrotoluene [2,4-DNT]) exceeded at least one screening criterion in soil at AOC R.

Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene are PAHs that are typically associated with petroleum or its combustion by-products, creosote used for wood preservation, or from the burning of wood and paper. Benzo(a)pyrene was the most frequently observed above a screening criterion (above the residential and industrial RSLs) in surface soil with a maximum concentration of 750 µg/kg. PAHs were not observed above screening criteria in subsurface soil. In areas where PAH impacted soils were removed, confirmation samples observed PAHs above screening criteria, but the concentrations were much lower than the pre-removal concentrations.

Atrazine was observed above only the SSL screening criterion (6.1 µg/kg) in two surface soil and seven subsurface soil samples. Atrazine was used as a herbicide to control weeds and its presence is not likely associated with a CERCLA-related release. Furthermore, it was not detected in groundwater.

Carbazole and 4-nitroaniline were observed above only the SSL screening criterion (93 µg/kg and 2.1 µg/kg, respectively) in only one and two soil samples, respectively. Carbazole occurs from the incomplete combustion of nitrogen containing organic matter. 4-nitroaniline was used as a pesticide and can also be found in dyes and varnishes. It should be noted that neither carbazole or 4-nitroaniline was detected in groundwater.

Although listed as an SVOC, 2,4-DNT is also an explosive and was generally used as an artillery, mortar, and rocket propellant. 2,4-DNT was observed in only one subsurface soil sample above a screening criterion (SSL of 0.68 µg/kg) with a concentration of 8.0J µg/kg. However, 2,4-DNT was not detected in groundwater.

4.1.1.3 Pesticides/PCBs

Ten pesticides were observed in soil at AOC R; eight were above screening criteria in soil (**Tables 4-1 and 4-3; Figures 4-3a and 4-3b**). Dieldrin, 4,4′-DDE, and 4,4′-DDT were most frequently observed above screening criteria. Dieldrin only exceeded the SSL screening criterion and was the only pesticide observed above a screening criterion in subsurface soil. However, dieldrin was not detected in groundwater.

The maximum concentrations of 4,4′-DDE and 4,4′-DDT were 370 and 600 µg/kg, respectively, similar to concentrations observed at other west Vieques sites (CH2M HILL, 2010), which suggests their concentrations are attributable to normal pesticide use and not a CERCLA-related

release. Pesticides and herbicides were commonly applied to the soil at the Department of Defense (DoD) facilities to control pests and weeds, which may have resulted in pesticides and herbicides accumulating in environmental media. The legal application of pesticides and herbicides are not CERCLA-related releases and are, therefore, not subject to regulation under CERCLA.

Three PCBs (one detection each of aroclor-1242, -1254, and -1260) were observed in surface soil below screening criteria at AOC R (**Table 4-1** and **Figure 4-3b**).

4.1.1.4 Explosives

Perchlorate was the only explosive observed in surface and subsurface soil at AOC R, but was detected below screening criteria (**Tables 4-1 and 4-3, and Figures 4-5 and 4-6**).

Although listed as an SVOC, 2,4-DNT is also an explosive and was generally used as an artillery, mortar, and rocket propellant. 2,4-DNT was observed in only one subsurface soil sample above a screening criterion (SSL of 0.68 µg/kg) with a concentration of 8.0J µg/kg. However, 2,4-DNT was not detected in groundwater.

4.1.1.5 Total Petroleum Hydrocarbons

Diesel or oil range TPHs were detected in 18 surface soil samples at AOC R, but below screening criteria (**Table 4-1 and Figure 4-7**).

4.1.1.6 Inorganic Constituents

Inorganic constituents (also referred to as "metals") detected at AOC R may be either site-related (i.e., associated with historic activities) or non-site related (i.e., background). In addition to risk-based criteria, concentrations of inorganics detected at AOC R (**Tables 4-1 and 4-3**) were compared to the background soil inorganic dataset compiled for the former NASD (CH2M HILL, 2002) to help distinguish site-related inorganics concentrations from background.

Aluminum, antimony, arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, vanadium, and zinc were observed above screening criteria at AOC R. Each detected inorganic constituent above screening criteria is discussed below.

- Aluminum exceeded screening criteria and the background upper tolerance limit (UTL) in only 7 (5 surface and 2 subsurface) of the 168 soil samples, with a minimum detected concentration of 2,040 milligrams per kilogram (mg/kg) and a maximum detected concentration of 34,400 mg/kg (SS93). However, the majority of the samples were slightly above the west Vieques background UTL concentration of 29,000 mg/kg (background soil concentrations ranged from 1,600 to 29,000 mg/kg) but the site soil concentrations did not exceed the east Vieques background UTL (35,000 mg/kg; concentration range of 2,340 to 41,500 mg/kg) in similar lithology (CH2M HILL, 2007). Although some of the aluminum may be associated with former metal debris present at the site, aluminum rich clays (such as kaolinite) are common from the chemical weathering of volcanic bedrock. Therefore, the occurrence of aluminum in soil at AOC R is likely to be primarily associated with background.

- Antimony exceeded screening criteria and the background UTL in only 3 of the 168 soil samples, with a minimum detected concentration of 0.03 mg/kg and a maximum detected concentration of 2.8J mg/kg (SS015 and SS016). The maximum detected concentration is only slightly above the west Vieques background UTL concentration of 2.3 mg/kg

(background concentration range of 0.35 to 2.30 mg/kg) but is less than the maximum detected concentration (5.80 mg/kg) in east Vieques background soil. This information suggests that all occurrences of antimony in soil at AOC R are likely associated with background. Further, the three exceedances were only for the SSL. However, no antimony was detected in AOC R groundwater samples.

- Arsenic exceeded screening criteria and the background UTL in only 6 of the 168 soil samples, with a minimum detected concentration of 1.6 mg/kg and a maximum detected concentration of 9.8 mg/kg (SS73). The maximum detected concentration exceeded the west Vieques surface soil background UTL concentration of 2.2 mg/kg (background surface soil concentrations ranged from 0.57 to 2.20 mg/kg). No specific arsenic-related sources are known to have occurred or likely occurred at AOC R. Note that arsenic concentrations up to 9.60 mg/kg (range of 0.47 to 9.60 mg/kg) were detected during the east Vieques background study (CH2M HILL, 2007). Arsenic exceedances were spatially variable throughout the site. Naturally occurring arsenic is commonly found in volcanic rocks, adsorbed to metal oxides and clay-mineral surfaces, and associated with sulfide minerals and organic carbon. This information suggests the occurrence of arsenic in soil at AOC R is primarily associated with background.
- Barium exceeded screening criteria and the background UTL in only 2 of 168 soil samples, with a minimum detected concentration of 24J mg/kg and a maximum detected concentration of 522J mg/kg (SS94). The maximum detected concentration exceeded the west Vieques background UTL concentration of 320 mg/kg (background soil concentrations ranged from 6.40 to 320 mg/kg). Barium is released to the environment through weathering of volcanic rocks. Barium is strongly influenced by the presence of sulfate and generally occurs as barium sulfate. Precipitation of barium as an insoluble salt is accelerated in areas where water interacts with higher sulfate content water (such as with brackish water). Historically, barium had few industrial uses, the most common of which include fireworks, drilling muds, and vacuum tubes which were not used at the site. Based on the above information, the presence of barium at AOC R is likely to be primarily associated with background.
- Chromium exceeded screening criteria and the background UTL in only 6 of 168 soil samples, with a minimum detected concentration of 1.2J mg/kg and a maximum detected concentration of 106J mg/kg (SS70). Four of the 6 concentrations for samples that exceeded screening criteria and background were less than 10 mg/kg above the west Vieques background UTL concentration of 74 mg/kg (background soil concentrations ranged from 2.20 to 74.0 mg/kg). The one sample with the highest chromium concentration was collected adjacent to a former debris pile that was removed during the removal action. Although chromium can be associated with anthropogenic sources such as stainless steel, chrome plating, and pigments, that only six samples contained chromium above the background UTL and that the majority of those were just above the background UTL suggest the presence of chromium at AOC R is primarily associated with background.
- Cobalt exceeded screening criteria and the background UTL in only 2 of 168 soil samples, with a minimum detected concentration of 2.80 mg/kg and a maximum detected concentration of 27.8 mg/kg (SS94). The maximum detected concentration is slightly above the west Vieques background UTL concentration (25 mg/kg; background soil

concentrations ranged from 1.00 to 25.0 mg/kg). Based on this information, the presence of cobalt at AOC R is likely attributable to background.

- Copper exceeded screening criteria and the background UTL in 21 surface and 2 subsurface soil samples (out of a total of 168 soil samples), with a minimum detected concentration of 6.7 mg/kg and a maximum detected concentration of 103 mg/kg (SS54), with most concentrations slightly above the west Vieques background UTL concentration (68 mg/kg; background soil concentrations ranged from 1.80 to 68.0 mg/kg). However, copper concentrations of up to 102 mg/kg have been detected in east Vieques background soils (range of 3.30 to 102 mg/kg). Copper was generally observed above screening criteria only in the area of the concrete pad, which may be the result of copper's use in applications such as copper piping and heating/air conditioning equipment.
- Iron exceeded screening criteria and the background UTL in only 4 of 168 soil samples (2 surface soil samples and 2 subsurface soil samples), with a minimum detected concentration of 4,730J mg/kg and a maximum detected concentration of 41,100 mg/kg (SB98). The maximum concentration slightly exceeded the west Vieques background UTL concentration of 37,531 mg/kg for the combined background set (the soil type Qa UTL is 39,000 mg/kg), background soil concentrations ranged from 2,500 to 39,000 mg/kg. Iron oxides can be variable within soil as a result of chemical weathering ("rusting" appearance) of volcanic sediments. Although iron is the primary component of many metallic items, that only four samples contained iron above the background UTL and that the iron concentrations in these four samples were just above the background UTL suggest the presence of iron at AOC R is primarily associated with background.
- Lead exceeded screening criteria in 8 of 168 soil samples (7 surface and 1 subsurface), with a minimum detected concentration of 1.1J mg/kg and a maximum detected concentration of 150J mg/kg (SS009). Samples that exceeded screening criteria ranged from 28 mg/kg (SS010) to 150J mg/kg (SS009), all of which were above the west Vieques background UTL concentration of 6.9 mg/kg (background soil concentrations ranged from 0.30 to 6.90 mg/kg). This suggests most lead concentrations at the site are attributable to background, but that a few are likely site-related. It is notable that of the eight exceedances, all but one exceeded only the SSL. However, lead was not detected in any site groundwater above its action level. Lead was detected in only two site wells and all concentrations were approximately an order of magnitude or more below its action level. Lead was not detected in the site background monitoring well. Lead was detected in site groundwater at concentrations of 2.0J and 0.15J µg/L at MW03 (not detected in the dissolved phase) and 0.050J µg/L at MW02. Since lead concentrations in groundwater were detected at low concentrations, it is unknown if lead in groundwater is attributable to site related or background conditions. However, lead was not detected in any site groundwater above its action level; all concentrations were approximately an order of magnitude or more below the action level.
- Manganese exceeded screening criteria and the background UTL in 11 of 168 soil samples (6 surface and 5 subsurface), with a minimum detected concentration of 119J mg/kg and a maximum detected concentration of 4,500 mg/kg (SS94). The maximum detected concentration exceeded the west Vieques background UTL concentration of 1,167 mg/kg (for the combined background set; the soil type Qa UTL is 1,200 mg/kg); background soil

concentrations ranged from 48.0 to 1,200 mg/kg). Manganese concentrations of up to 1,630 mg/kg have been detected in east Vieques background soils (range of 32.2 to 1,630 mg/kg); only three site samples exceeded a value of 1,630 mg/kg. Manganese oxides are common from the chemical weathering of volcanic rocks and can be highly variable due to the occurrence of manganese oxides.

- Nickel exceeded screening criteria in 3 of 168 soil samples, at concentrations of 40.2 mg/kg (SS68), 44.7 mg/kg (SS69), and 49.4 mg/kg (SS70), slightly above the west Vieques background UTL concentration (40 mg/kg). Although nickel is most commonly used to make steel, only three samples contained nickel above the background UTL and were just above the background UTL, which suggests that the presence of nickel at AOC R is associated with background.
- Selenium exceeded screening criteria and the background UTL in only 1 of 168 soil samples, with a concentration of 7.0J mg/kg (SS103) relative to the west Vieques background UTL concentration of 2 mg/kg. Although selenium can be associated with pigments in a variety of industrial products, as well as in pesticide formulations, that only one sample contained selenium above the background UTL suggests the presence of selenium at AOC R is primarily associated with background.
- Vanadium exceeded screening criteria and the background UTL in only 3 of 168 soil samples, with a minimum detected concentration of 16.1 mg/mg and a maximum detected concentration of 143J mg/kg (SS68). The maximum detected concentration slightly exceeded the west Vieques background UTL concentration of 130 mg/kg (background soil concentrations range from (9.00 to 130 mg/kg). However, vanadium concentrations of up to 142 mg/kg have been detected in east Vieques background soils (range of 4.90 to 142 mg/kg). Although vanadium is commonly used to make steel, that only three samples contained vanadium above the west Vieques background UTL and that all three of these concentrations were just above the west Vieques background UTL suggest the presence of vanadium at AOC R is primarily associated with background.
- Zinc exceeded screening criterion in only 1 of 168 soil samples, with a concentration of 135 mg/kg (SS104), which is also above the west Vieques background UTL concentration of 65.1 mg/kg (for the combined background set; the soil type Qa UTL is 71.0 mg/kg). Zinc is commonly used as a corrosion inhibitor and in various metal alloys, so its single exceedance may be associated with the former debris pile beneath which it was detected. However, that only one sample contained zinc above both screening criteria (ratio of 1.13) and the background UTL suggests the presence of zinc at AOC R is not problematic.

4.1.2 Groundwater

The monitoring well network at AOC R consists of seven wells that provide the basis for defining the nature and extent of contamination in groundwater. One of the wells, MW01 is located upgradient of the site and serves as the site specific background well. **Table 4-4** and **Figures 4-10 through 4-13** present the VOCs, SVOCs, pesticides, PCBs, explosives, and inorganics observed in groundwater, and identify COPCs (i.e., screening criteria exceedances).

Only two SVOCs (bis(2-ethylhexyl)phthalate and 4-nitrophenol) and seven inorganics (aluminum, arsenic, chromium, cobalt, iron, manganese, and vanadium) were observed above

screening criteria. A discussion of the nature and extent of contamination, by contaminant type, in groundwater is presented below.

4.1.2.1 Volatile Organic Compounds

Two VOCs, carbon disulfide and chloromethane, were observed in groundwater (**Figure 4-10**). However, all three detections of the VOCs were more than one order of magnitude (chloromethane) to more than two orders of magnitude (carbon disulfide) below the screening criteria.

4.1.2.2 Semi Volatile Organic Compounds

Five SVOCs were observed in groundwater. Only bis(2-ethylhexyl)phthalate and 4-nitrophenol were observed above screening criteria. However, bis(2-ethylhexyl)phthalate is a common laboratory contaminant and not a likely site-related constituent. Of the 187 soil, 16 groundwater, 7 surface water, and 4 sediment samples, bis(2-ethylhexyl)phthalate was detected above screening criteria in one groundwater sample (62J micrograms per liter [µg/L] at MW07, above the RSL for Tap Water of 4.8 µg/L and the MCL of 6.0 µg/L). The previous sampling round at this monitoring well did not detect the chemical (5.0U µg/L). In addition, bis(2-ethylhexyl)phthalate was only detected in 13 of the 187 soil samples, and all concentrations were at least two orders of magnitude below the SSL.

In addition, as discussed in Section 5.2.1, the potential source of contamination at AOC R was the former debris piles composed of timbers, metal debris, corrugated roofing sheet material, several munitions items, and tires. Bis(2-ethylhexyl)phthalate is a plasticizer associated with plastic products. There was no known or likely use of plasticizers at AOC R and plastics were not an observed component of the debris piles at the site. Bis(2-ethylhexyl)phthalate is also a known common laboratory contaminant associated with plastics in the laboratory ware and bottle ware.

In addition, during the laboratory analysis of the groundwater sample from MW07, the initial concentration exceeded the linear range of the instrument and was also detected in an associated laboratory blank and received a flag of "EB." This value was ultimately rejected by the data validation. The second analysis had continuing calibration issues and included a dilution that resulted in a concentration of 62J µg/L. Therefore, the laboratory result of 62J µg/L is considered suspect.

Since this concentration of bis(2-ethylhexyl)phthalate was an anomaly at the site (including from within the same well) in that it was above screening criteria in only one sample out of the multiple samples collected across AOC R, was detected in only 7 percent of soil samples, is not a likely component of the potential source material at the site, is a common laboratory contaminant, and was associated with laboratory analytical issues for the detected concentration of 62J µg/L, it is appropriate to consider that the chemical is not likely site related. This is further supported by the lack of widespread contamination of any type at the site.

4-nitrophenol was used as a fungicide and its occurrence is likely from normal pesticide application and not from a CERCLA-related release. However, its two low (estimated) detections were just above the tap water RSL. No PAHs, the type of SVOCs with the highest concentrations detected in the soil removed as part of the removal action, were observed in groundwater.

4.1.2.3 Pesticides/PCBs

Endosulfan I was the only pesticide observed in groundwater. However, it was detected only in 2006, in only one well, and at a concentration four orders of magnitude below the tap water RSL. No PCBs were detected in groundwater.

4.1.2.4 Explosives

Perchlorate was observed at three monitoring wells (including the background well), but at concentrations below screening criteria. No other explosives were detected in groundwater at AOC R. The highest concentration of perchlorate was detected at the background monitoring well (0.24 µg/L). The potential source of the low detection in the background and site monitoring wells are unknown. Perchlorate does occur naturally in some minerals, is formed under evaporative conditions, and can be produced in the atmosphere or from surface oxidation. Numerous studies are currently underway by other agencies to investigate the natural occurrence of perchlorate. The above information suggests the perchlorate detections are not site-related.

4.1.2.5 Inorganic Constituents

One groundwater sample was collected from upgradient monitoring well MW01 for comparison to site groundwater data. However, the discussion below includes the three other wells within the Qa geologic unit that are suitable for background comparisons. Inorganic constituents observed above screening criteria at this well included arsenic, manganese, and vanadium. Inorganics observed above screening criteria within groundwater at the site included aluminum, arsenic, chromium, cobalt, iron, manganese, and vanadium.

When there is a large discrepancy between total inorganics and dissolved inorganics and the turbidity is relatively high (i.e., greater than about 10 NTU), the dissolved inorganics data are likely more representative of inorganic concentrations migrating in groundwater. Each detected inorganic constituent above screening criteria is discussed below.

- Only total aluminum exceeded a screening criterion (adjusted RSL for tap water of 3,700 µg/L) at only one location (MW03), with a concentration of 5,860 µg/L); dissolved concentrations were below screening criteria. The subsequent sampling event did not detect aluminum. The elevated occurrence of total aluminum was likely related to the presence of naturally occurring aluminum in suspended solids caused by sampling.
- Total and dissolved arsenic concentrations exceeded a screening criterion (adjusted RSL for tap water of 0.045 µg/L) at three monitoring wells, with a maximum concentration of 2.6 µg/L (MW04). The maximum concentration was slightly above the AOC R upgradient monitoring well concentration of 1.5J µg/L. Arsenic is likely naturally occurring at the site.
- Total chromium concentrations exceeded a screening criterion (adjusted RSL for tap water of 0.043 µg/L) at MW02, with a concentration of 23 µg/L. However, dissolved chromium concentrations did not exceed screening criteria. The subsequent sampling event did not detect chromium, which suggests the totals concentrations may have been elevated due to naturally occurring suspended solids.
- Total and dissolved cobalt concentrations exceeded a screening criterion (adjusted RSL for tap water of 1.1 µg/L) at three monitoring wells (MW03, MW05, and MW06), with a

maximum concentration of 3.3 µg/L. Total cobalt concentrations of 20J µg/L were observed at background monitoring well QA-MW01 (CH2M HILL, 2002). Cobalt is naturally occurring at the site.

- Total and/or dissolved iron was observed in MW02 and MW03 at concentrations that exceeded the adjusted RSL for tap water of 2,600 µg/L and background concentration (165 µg/L [total]; non-detect [dissolved]), with a maximum concentration of 14,300 µg/L (MW03). It should be noted that the 14,300 µg/L result was for total iron; the corresponding dissolved iron concentration in MW03 was 3,930 µg/L, which indicates the higher concentration in the total analysis was primarily the result of suspended solids in the sample. In addition, the iron concentrations detected in subsequent samples from wells MW02 and MW03 (i.e., from non-detect to 435 µg/L) were much lower and similar to background. The groundwater samples collected in 2006 had higher turbidity measurements than the sample event in 2009. Further, elevated iron concentrations were not observed in soil in the vicinity of MW03. Iron is primarily attributable to natural conditions at the site and highly variable due to weathering of the minerals in the soil.
- Total and/or dissolved manganese concentrations were detected above a screening criterion (adjusted RSL for tap water of 88 µg/L) at five monitoring wells (MW01, and MW03 through MW06) with a maximum concentration of 2,090 µg/L (MW05), including the upgradient background well. Total manganese concentrations of 3,200J µg/L were observed at background monitoring well QA-MW01 (CH2M HILL, 2002). Manganese is likely naturally occurring at the site from the chemical weathering of the soil.
- Total and dissolved vanadium concentrations exceeded screening criterion (adjusted RSL for tap water of 18 µg/L) at the upgradient monitoring well (MW01) and two site monitoring wells (MW02 and MW03). The vanadium concentrations in the site monitoring wells (maximum concentration of 57 µg/L) were less than the upgradient, background monitoring well concentration (62 µg/L). Therefore, vanadium at the site is likely attributable to background.

4.1.3 Surface Water and Sediment

Surface water and sediment samples were collected from the ephemeral stream west of AOC R to determine if any impacts were associated from transport and deposition by overland flow and from munitions items found in the stream bed. As noted previously, chlorinated potable water from the potable water lift/chlorination station adjacent to AOC R was observed discharging water to the ephemeral stream upgradient of the majority of the site. Therefore, the constituents detected (e.g., chloroform) in the surface water and sediment samples may have been influenced by this discharge.

Tables 4-5 and 4-6 summarize the VOCs, SVOCs, pesticides, PCBs, explosives, and inorganics that were observed in surface water and sediment at AOC R. **Figures 4-14 through 4-18** present the detections and exceedances in surface water and sediment. The nature and extent of constituents in surface water and sediment are discussed below.

It is also important to note that use of the tap water RSL for screening of surface water is highly conservative given that the ephemeral stream water would not be used as a drinking water source.

4.1.3.1 Volatile Organic Compounds

Acetone, chloroform, and methylene chloride were the only VOCs observed in surface water of the ephemeral stream; chloroform was the only VOC that exceeded a screening criterion. However, this constituent was not detected in AOC R soil or groundwater. A potable water lift/chlorination facility located adjacent (not owned by the Navy) to AOC R was observed discharging water to the ephemeral stream. Chloroform is a common byproduct during the water chlorination process. This is supported by the presence of a discharge pipe from the station upstream of stream sample locations and the fact that chloroform was not detected in any other site media. Acetone, chloroform, and methylene chloride were not detected in groundwater. Additionally, acetone and methylene chloride are common laboratory contaminants. Neither constituents is likely site-related.

4.1.3.2 Semi-Volatile Organic Compounds

No SVOCs were observed in sediment or surface water at AOC R.

4.1.3.3 Pesticides/PCBs

4-4′-DDT was the only pesticide observed in sediment (detected in only one sediment sample), at a concentration below the screening criteria. No pesticides were observed in surface water. PCBs were not observed in surface water or sediment.

4.1.3.4 Explosives

No explosives were observed in surface water or sediment of the ephemeral stream.

4.1.3.5 Inorganic Constituents

No background data are available for the surface water and sediment inorganic constituents of the ephemeral stream. To determine potential impacts in sediment and surface water from overland flow transport, concentrations of inorganics observed in soil at the site are considered in the following discussion.

Inorganics detected above screening criteria within surface water and sediments of the ephemeral stream are arsenic, barium, chromium, cobalt, iron, and manganese (**Tables 4-5 and 4-6** and **Figures 4-16 through 4-18**). Each detected inorganic constituent above screening criteria is discussed below.

- Total and/or dissolved arsenic concentrations exceeded a screening criterion (RSL for tap water of 0.045 µg/L) in surface water samples from three locations (SDSW03, SW04, and SW05), with a maximum concentration of 4.7 J µg/L (SW04). Arsenic did not exceed screening criteria in sediment. As noted previously, arsenic concentrations in soil at the site are primarily attributable to background.
- Barium exceeded the ecological screening value (4.0 µg/L) in each of the surface water samples collected within the ephemeral stream, with a maximum total concentration of 314 µg/L (SDSW01). Barium exceeded the ecological screening value (20 mg/kg) in sediment at two locations (SDSW01 and SDSW02), with a maximum concentration of 95J mg/kg (SDSW01). As noted previously, barium was detected above background in only 2 of 137 soil samples and there are no likely anthropogenic sources of barium at AOC R. Therefore, the barium detected in the ephemeral stream is likely attributable to background.

- Chromium exceeded the adjusted RSL for residential soil (0.29 mg/kg) in the three sediment samples collected within the ephemeral stream, with a maximum concentration of 2.4 mg/kg (SDSW01). Chromium did not exceed screening criteria in surface water. As noted previously, chromium is primarily attributable to background at the site.
- Cobalt exceeded the adjusted RSL for tap water of 1.1 µg/L in three surface water samples in the ephemeral stream (SDSW01 through SDSW03), with a maximum concentration of 4.8J µg/L at SDSW01. Two locations (SDSW01 and SDSW02) had sediment concentrations above the RSL for residential soil (2.3 mg/kg), with a maximum concentration of 7.0 mg/kg (SDSW01). As noted previously, cobalt was detected above background in only 2 of 137 soil samples. Therefore, the cobalt detected in the ephemeral stream is likely attributable to background.
- Iron was only observed above the adjusted RSL for residential soil (5,500 mg/kg) in ephemeral stream sediment samples SDSW01 and SDSW02 (maximum concentration of 7,430 mg/kg). No iron concentrations exceeded screening criteria in surface water. As noted previously, iron was detected above background in only 4 of 137 soil samples. Therefore, the iron detected in the ephemeral stream is likely attributable to background.
- Total and dissolved manganese exceeded the adjusted RSL for Tap Water (88 µg/L) and the ecological screening level (120 µg/L) in all five surface water samples collected in the ephemeral stream west of AOC R (maximum concentration of 2,390 µg/L at SDSW01). Manganese exceeded the adjusted RSL for residential soil (180 mg/kg) in two sediment samples (SDSW01 and SDSW02), and the ecological screening level (460 mg/kg) in one sediment samples, with a maximum concentration of 731J mg/kg (SDSW01). Because of similarities in manganese concentrations in surface water samples collected from approximately the same locations in 2005 (pre-removal) and 2009 (post-removal), it is unlikely the manganese concentrations detected in the ephemeral stream are site-related, especially considering manganese oxides are common from the chemical weathering of volcanic rocks, which would be a prevalent occurrence in the ephemeral stream.

Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	AOCRSS001	AOCRSS002	AOCRSS003	AOCRSS004	AOCRSS005	AOCRSS006	AOCRSS007	AOCRSS008	AOCRSS009	AOCRSS010		AOCRSS011	AOCRSS012	AOCRSS013	AOCRSS014	AOCRSS015
Sample ID							NDE133	NDE134	NDE135	NDE136	NDE137	NDE138	NDE139	NDE140	NDE141	NDE142	NDE143FD1	NDE144	NDE145	NDE146	NDE147	NDE148
Sample Date							11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00
Chemical Name																						
Volatile Organic Compounds (µg/kg)																						
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	10 U	11 U	11 U	10 U	19 U	10 UJ	15 U	10 U	10 UJ	11 UJ	10 U	12 U	10 U	12 U	10 U	10 U
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	10 U	11 U	11 U	10 U	19 U	10 UJ	15 U	10 U	10 UJ	11 UJ	10 U	12 U	10 U	12 U	10 U	10 U
Acetone	6,100,000	63,000,000	--	4,752	--	--	10 R	11 R	11 R	10 R	19 R	61 R	15 R	10 R	10 R	10 R	10 R	12 R	10 R	12 R	10 R	10 R
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	10 U	11 U	11 U	10 U	19 U	10 UJ	15 U	10 U	10 UJ	11 UJ	0.20 J	12 U	10 U	12 U	10 U	10 U
Methylene chloride	11,000	53,000	1,250	2.0	--	--	10 U	11 U	11 U	10 U	19 U	10 UJ	15 U	10 U	10 UJ	11 UJ	10 U	12 U	10 U	12 U	10 U	10 U
o-Xylene	380,000	434,000	2,400	37,616	--	--	10 U	11 U	11 U	10 U	19 U	10 UJ	15 U	10 U	10 UJ	11 UJ	0.20 J	12 U	10 U	12 U	10 U	10 U
Tetrachloroethene	550	2,600	200	5.6	--	--	10 U	11 U	11 U	10 U	19 U	10 UJ	15 U	10 U	10 UJ	11 UJ	10 U	12 U	10 U	12 U	10 U	0.27 J
Toluene	500,000	818,000	40,000	2,367	--	--	10 U	11 U	11 U	10 U	19 U	10 UJ	15 U	10 U	10 UJ	11 UJ	10 U	12 U	10 U	12 U	10 U	10 U
Trichloroethene	2,800	14,000	10	3.9	--	--	10 U	11 U	11 U	10 U	0.62 J	10 UJ	15 U	10 U	10 UJ	11 UJ	10 U	12 U	0.29 J	0.36 J	10 U	2.5 J
Xylene, total	63,000	258,000	2,400	37,670	--	--	10 U	11 U	11 U	10 U	19 U	10 UJ	15 U	10 U	10 UJ	11 UJ	0.40 J	12 U	10 U	12 U	10 U	10 U
Semivolatile Organic Compounds (µg/kg)																						
2-Nitroaniline	61,000	600,000	--	230	--	--	1,370 U	1,860 U	1,800 U	1,650 U	1,660 U	1,430 U	1,490 U	1,490 U	1,220 U	1,330 U	1,330 U	1,350 U	1,250 U	1,340 U	1,540 U	1,580 U
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	451 U	416 U	447 U	512 U	527 U
4-Nitroaniline	24,000	86,000	--	2.1	--	--	1,370 U	1,860 U	1,800 U	1,650 U	1,660 U	1,430 U	1,490 U	1,490 U	1,220 U	1,330 U	1,330 U	1,350 U	1,250 U	1,340 U	1,540 U	1,580 U
Acenaphthene	340,000	3,300,000	--	110,000	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	451 U	416 U	447 U	512 U	527 U
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	451 U	416 U	447 U	512 U	527 U
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	451 U	416 U	447 U	512 U	527 U
Atrazine	2,100	7,500	12	6.1	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	150	2,100	--	54	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	**205 J**	416 U	447 U	512 U	527 U
Benzo(a)pyrene	15	210	--	1,259	--	--	**67 J**	619 U	599 U	550 U	**42 J**	475 U	498 U	497 U	408 U	**32 J**	442 U	**288 J**	416 U	447 U	512 U	527 U
Benzo(b)fluoranthene	150	2,100	--	186	--	--	144 J	619 U	599 U	550 U	48 J	475 U	498 U	497 U	408 U	40 J	442 U	**399 J**	416 U	447 U	512 U	527 U
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	193 J	619 U	599 U	550 U	38 J	475 U	498 U	497 U	408 U	27 J	442 U	253 J	416 U	447 U	512 U	527 U
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	86 J	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	276 J	416 U	447 U	512 U	527 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	451 U	416 U	447 U	512 U	527 U
Carbazole	24,000	86,000	--	93	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	451 U	416 U	447 U	512 U	527 U
Chrysene	15,000	210,000	--	5,476	--	--	66 J	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	264 J	416 U	447 U	512 U	527 U
Dibenz(a,h)anthracene	15	210	--	61	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	**62 J**	416 U	447 U	512 U	527 U
Dibenzofuran	7,800	100,000	--	3,351	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	451 U	416 U	447 U	512 U	527 U
Fluoranthene	230,000	2,200,000	--	900,000	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	148 J	416 U	447 U	512 U	527 U
Fluorene	230,000	2,200,000	--	140,000	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	451 U	416 U	447 U	512 U	527 U
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	**156 J**	619 U	599 U	550 U	32 J	475 U	498 U	497 U	408 U	24 J	25 J	**268 J**	416 U	447 U	512 U	527 U
PAH Total (HMW)	--	--	18,000	--	--	--	1,398	2,786 U	2,696 U	2,475 U	1,548	2,138 U	2,241 U	2,237 U	1,836 U	1,231	1,793	2,179	1,872 U	2,012 U	2,304 U	2,372 U
PAH Total (LMW)	--	--	29,000	--	--	--	2,057 U	2,786 U	2,696 U	2,475 U	2,498 U	2,138 U	2,241 U	2,237 U	1,836 U	1,994 U	1,989 U	1,952	1,872 U	2,012 U	2,304 U	2,372 U
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	451 U	416 U	447 U	512 U	527 U
Pyrene	170,000	1,700,000	--	610,000	--	--	457 U	619 U	599 U	550 U	555 U	475 U	498 U	497 U	408 U	443 U	442 U	164 J	416 U	447 U	512 U	527 U

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
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Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E) and SSL DAF 1

NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
NJ - Presumptively present at approximate quantity
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

Table 4-1
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Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	AOCRSS001	AOCRSS002	AOCRSS003	AOCRSS004	AOCRSS005	AOCRSS006	AOCRSS007	AOCRSS008	AOCRSS009	AOCRSS010		AOCRSS011	AOCRSS012	AOCRSS013	AOCRSS014	AOCRSS015
Sample ID							NDE133	NDE134	NDE135	NDE136	NDE137	NDE138	NDE139	NDE140	NDE141	NDE142	NDE143FD1	NDE144	NDE145	NDE146	NDE147	NDE148
Sample Date							11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00	11/28/00
Chemical Name																						
Pesticide/Polychlorinated Biphenyls (µg/kg)																						
4,4'-DDD	2,000	7,200	583	342	--	--	12 J	4.0 U	4.0 U	3.7 U	7.4 J	3.7 U	4.0 U	0.80 J	2.1 J	2.2 J	2.6 J	3.5 J	14 J	6.4 J	3.8 U	9.4 J
4,4'-DDE	1,400	5,100	114	244	--	--	46	0.66 J	4.0 U	1.5 J	43	3.7 U	0.85 J	1.1 J	22	49	52	50	83	48	2.4 J	57
4,4'-DDT	1,700	7,000	100	352	--	--	34 J	4.0 UJ	4.0 UJ	0.70 J	19 J	3.7 UJ	4.0 UJ	0.50 J	7.6 J	9.2 J	11 J	22 J	48 J	44 J	3.8 UJ	32
alpha-Chlordane	1,600	6,500	11	1,386	--	--	1.9 U	2.1 U	2.1 U	1.9 U	2.0 U	1.9 U	2.1 U	2.0 U	2.0 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	2.0 U	2.1 U
Aroclor-1242	220	740	8,000	179	--	--	37 U	40 U	40 U	37 U	38 U	37 U	40 U	38 U	38 U	36 U	37 U	36 U	35 U	37 U	38 U	41 U
Aroclor-1254	110	740	8,000	302	--	--	37 U	40 U	40 U	37 U	38 U	37 U	40 U	38 U	38 U	36 U	37 U	36 U	35 U	37 U	38 U	41 U
Aroclor-1260	220	740	8,000	828	--	--	37 U	40 U	40 U	37 U	38 U	37 U	40 U	38 U	38 U	36 U	37 U	36 U	35 U	37 U	38 U	41 U
beta-BHC	270	960	342	1.0	--	--	1.9 U	2.1 U	2.1 U	1.9 U	2.0 U	1.9 U	2.1 U	2.0 U	2.0 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	2.0 U	2.1 U
Dieldrin	30	110	11	0.36	--	--	3.7 U	4.0 U	4.0 U	3.7 U	3.8 U	3.7 U	4.0 U	3.8 U	3.8 U	3.6 U	3.7 U	3.6 U	3.5 U	3.7 U	3.8 U	4.1 U
Endosulfan I	37,000	370,000	6.3	38,734	--	--	1.9 U	2.1 U	2.1 U	1.9 U	2.0 U	1.9 U	2.1 U	2.0 U	2.0 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	2.0 U	2.1 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	3.7 U	4.0 U	4.0 U	3.7 U	3.8 U	3.7 U	4.0 U	3.8 U	3.8 U	3.6 U	3.7 U	3.6 U	3.5 U	3.7 U	3.8 U	4.1 U
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	1.9 U	2.1 U	2.1 U	1.9 U	2.0 U	1.9 U	2.1 U	2.0 U	2.0 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	2.0 U	2.1 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	1.9 U	2.1 U	2.1 U	1.9 U	2.0 U	1.9 U	2.1 U	2.0 U	2.0 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	2.0 U	2.1 U
Explosives (µg/kg)																						
Perchlorate	5,500	72,000	1,000	17	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)																						
Aluminum	7,700	99,000	--	56,000	--	29,000	14,000	26,000	9,300	21,000	11,000	10,000	11,000	16,000	18,000	14,000	15,000	24,000	19,000	15,000	21,000	26,000
Antimony	3.1	41	78	0.27	--	2.3	0.83 J	1.7 J	0.40 J	1.5 J	0.98 J	0.90 J	0.80 J	1.1 J	1.3 J	1.5 J	2.0 J	1.6 J	2.1 J	1.2 J	**2.5 J**	**2.8 J**
Arsenic	0.39	1.6	18	0.31	--	2.2	0.64 J	1.2 J	0.63 J	0.32 U	0.95 J	0.33 U	0.35 U	0.58 J	1.4 J	1.4 J	1.2 J	1.2 J	1.8 J	0.87 J	1.9 J	1.8 J
Barium	1,500	19,000	330	100	--	320	69	87	75	51	44 J	25 J	24 J	32 J	38 J	47	51	78	51	49	59	98
Beryllium	16	200	40	400	--	0.45	0.25 J	0.36 J	0.27 J	0.21 J	0.16 J	0.19 J	0.20 J	0.20 J	0.26 J	0.24 J	0.24 J	0.35 J	0.23 J	0.16 J	0.16 J	0.22 J
Cadmium	7	80	32	20	--	0.040	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.020 U	0.030 U	0.030 U	0.030 U
Calcium	--	--	--	--	--	210,000	26,000	38,000	5,100	8,100	8,900	6,900	11,000	9,600	20,000	30,000	27,000	36,000	55,000	13,000	8,000	8,500
Chromium	0.29	5.6	64	430,000	--	74	19 J	40 J	9.6 J	50 J	21 J	1.2 J	2.9 J	35 J	32 J	24 J	30 J	36 J	64 J	33 J	**82 J**	70 J
Cobalt	2.3	30	13	0.50	--	25	12	24	9.0 J	19	9.5 J	12	11 J	14	14	12	13	22	16	14	19	**26**
Copper	310	4,100	70	52	--	68	44	**90**	24	**100**	54	**80**	**88**	52	55	45	49	**81**	67	65	**69**	67
Cyanide	160	2,000	16	2.0	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	5,500	72,000	--	660	--	37,531	21,000	**39,000**	17,000	36,000	18,000	22,000	19,000	21,000	24,000	23,000	22,000	36,000	26,000	25,000	36,000	37,000
Lead	400	800	120	27	--	6.9	**14 J**	3.8 J	2.8 J	1.4 J	4.1 J	1.1 J	2.0 J	1.7 J	**150 J**	**23 J**	**28 J**	3.5 J	**75 J**	**7.6 J**	3.5 J	**18 J**
Magnesium	--	--	--	--	--	12,834	6,700	**19,000**	2,600	**19,000**	5,600	5,900	6,200	7,600	12,000	9,100	9,000	**18,000**	**14,000**	7,900	8,800	7,000
Manganese	180	2,300	220	57	--	1,167	580	1,000	580	590	480	580	520	430	540	580	530	940	600	510	510	920
Mercury	0.78	10	0.10	0.40	--	0.031	0.012 J	0.017 J	0.020 J	0.0028 UJ	0.013 J	0.0028 U	0.0030 U	0.0066 J	0.0094 J	0.014 J	0.014 J	0.020 J	0.0051 J	0.013 J	0.0069 J	0.023 J
Nickel	150	2,000	38	1,400	--	40	13	29	5.1 J	28	7.1 J	1.7 J	2.3 J	22	24	14	16	27	26	18	31	32
Potassium	--	--	--	--	--	1,700	770 J	800 J	590 J	640 J	470 J	360 J	520 J	390 J	510 J	700 J	570 J	720 J	790 J	1,100	360 J	660 J
Selenium	39	510	0.52	0.12	--	2.0	0.80 J	0.55 U	0.56 U	0.76 J	0.74 J	0.52 U	0.56 U	0.53 U	0.64 J	0.72 J	0.52 U	0.51 U	0.49 U	0.86 J	0.54 U	0.57 U
Silver	39	510	560	20	--	0.077	0.060 U	0.060 U	0.070 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.070 U
Sodium	--	--	--	--	--	6,300	590 J	600 J	92 J	520 J	510 J	22 U	69 J	810 J	360 J	270 J	400 J	550 J	490 J	310 J	24 U	34 J
Vanadium	39	520	2.0	180	--	130	62	100	50	100	45	57	49	72	64	57	59	96	79	78	120	**140**
Zinc	2,300	31,000	120	5,800	--	65	45	**71**	28	55	45	41	39	30	46	58	64	64	42	63	43	44
Total Petroleum Hydrocarbons (µg/kg)																						
TPH-diesel range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and SSL DAF 1
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Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E) and SSL DAF 1

NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
NJ - Presumptively present at approximate quantity
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U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	AOCRSS016	AOCRSS017	AOCRSS018	AOCRSS019	AOCRSS020		AOCRSS021	AOCRSS022	AOCRSS023	AOCRSS024	AOCRSS025	AOCRSS032	WAR-SO42	WAR-SO44
Sample ID							NDE149	NDE150	NDE151	NDE152	NDE153	NDE154FD1	NDE155	NDE156	NDE157	NDE158	NDE159	NDE167	WAR-SS42-0002	WAR-SS44-0002
Sample Date							11/28/00	11/28/00	11/29/00	11/29/00	11/29/00	11/29/00	11/29/00	11/29/00	11/29/00	11/29/00	12/01/00	12/01/00	12/07/05	12/07/05
Chemical Name																				
Volatile Organic Compounds (µg/kg)																				
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	0.47 J	10 U	0.51 J	10 U	10 U
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	1.5 J	10 U	10 U	10 UJ	10 U	10 U
Acetone	6,100,000	63,000,000	--	4,752	--	--	16 R	10 R	12 R	30 R	15 R	14 R	24 R	11 R	10 R	11 R	14 R	11 R	10 U	10 U
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	10 U	10 U	10 U	10 U	0.35 J	0.32 J	10 UJ	10 UJ	10 UJ	10 U	10 U	10 UJ	NA	NA
Methylene chloride	11,000	53,000	1,250	2.0	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	0.48 J	10 UJ	10 U	10 U
o-Xylene	380,000	434,000	2,400	37,616	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U	10 UJ	NA	NA
Tetrachloroethene	550	2,600	200	5.6	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U	10 UJ	10 U	10 U
Toluene	500,000	818,000	40,000	2,367	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	0.27 J	10 UJ	10 U	10 U
Trichloroethene	2,800	14,000	10	3.9	--	--	1.3 J	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U	10 UJ	10 U	10 U
Xylene, total	63,000	258,000	2,400	37,670	--	--	10 U	10 U	10 U	10 U	0.35 J	0.32 J	10 UJ	10 UJ	10 UJ	10 U	10 U	10 UJ	10 U	10 U
Semivolatile Organic Compounds (µg/kg)																				
2-Nitroaniline	61,000	600,000	--	230	--	--	1,560 U	1,540 U	1,340 U	1,340 U	1,260 U	1,360 U	1,310 U	1,260 U	1,180 U	1,340 U	1,260 U	1,530 UJ	1,000 U	990 U
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	519 U	512 U	445 U	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	509 UJ	400 U	390 U
4-Nitroaniline	24,000	86,000	--	2.1	--	--	1,560 U	1,540 U	1,340 U	1,340 U	1,260 U	1,360 U	1,310 U	1,260 U	1,180 U	1,340 U	1,260 U	1,530 UJ	1,000 UJ	990 UJ
Acenaphthene	340,000	3,300,000	--	110,000	--	--	519 U	512 U	445 U	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	509 UJ	400 U	390 U
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	519 U	512 U	151 J	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	509 UJ	400 U	390 U
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	519 U	512 U	184 J	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	30 J	400 U	390 U
Atrazine	2,100	7,500	12	6.1	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	400 UJ	390 UJ
Benzo(a)anthracene	150	2,100	--	54	--	--	519 U	**62 J**	**569**	35 J	31 J	34 J	48 J	419 U	394 U	448 U	420 U	**164 J**	400 U	390 U
Benzo(a)pyrene	15	210	--	1,259	--	--	519 U	**75 J**	**458**	**36 J**	**56 J**	**76 J**	**62 J**	419 U	394 U	448 U	420 U	**260 J**	400 U	390 U
Benzo(b)fluoranthene	150	2,100	--	186	--	--	519 U	93 J	**902**	60 J	88 J	104 J	78 J	419 U	394 U	448 U	25 J	**440 J**	400 U	390 U
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	519 U	66 J	398 J	39 J	70 J	115 J	40 J	419 U	394 U	448 U	420 U	80 J	400 U	390 U
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	519 U	71 J	755	51 J	70 J	105 J	90 J	419 U	394 U	448 U	420 U	278 J	400 U	390 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	519 U	512 U	445 U	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	509 UJ	400 U	390 U
Carbazole	24,000	86,000	--	93	--	--	519 U	512 U	68 J	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	509 UJ	400 U	390 U
Chrysene	15,000	210,000	--	5,476	--	--	519 U	78 J	1,010	61 J	69 J	82 J	91 J	419 U	394 U	448 U	420 U	303 J	400 U	390 U
Dibenz(a,h)anthracene	15	210	--	61	--	--	519 U	512 U	**163 J**	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	509 UJ	400 U	390 U
Dibenzofuran	7,800	100,000	--	3,351	--	--	519 U	512 U	445 U	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	509 UJ	400 U	390 U
Fluoranthene	230,000	2,200,000	--	900,000	--	--	519 U	76 J	758	31 J	44 J	38 J	112 J	419 U	394 U	448 U	420 U	210 J	400 U	390 U
Fluorene	230,000	2,200,000	--	140,000	--	--	519 U	512 U	445 U	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	509 UJ	400 U	390 U
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	519 U	69 J	**398 J**	37 J	59 J	91 J	40 J	419 U	394 U	448 U	420 U	108 J	400 U	390 U
PAH Total (HMW)	--	--	18,000	--	--	--	2,336 U	885	5,693	590	699	874	761	1,886 U	1,773 U	2,016 U	1,705	2,144	1,800 U	1,755 U
PAH Total (LMW)	--	--	29,000	--	--	--	2,336 U	2,124	2,255	1,819	1,724	1,850	1,856	1,886 U	1,773 U	2,016 U	1,890 U	2,022	1,800 U	1,755 U
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	519 U	512 U	49 J	447 U	420 U	453 U	436 U	419 U	394 U	448 U	420 U	509 UJ	400 U	390 U
Pyrene	170,000	1,700,000	--	610,000	--	--	519 U	115 J	1,040	47 J	46 J	40 J	94 J	419 U	394 U	448 U	420 U	256 J	400 U	390 U

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
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AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

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Sample ID							NDE149	NDE150	NDE151	NDE152	NDE153	NDE154FD1	NDE155	NDE156	NDE157	NDE158	NDE159	NDE167	WAR-SS42-0002	WAR-SS44-0002
Sample Date							11/28/00	11/28/00	11/29/00	11/29/00	11/29/00	11/29/00	11/29/00	11/29/00	11/29/00	11/29/00	12/01/00	12/01/00	12/07/05	12/07/05
Chemical Name																				
Pesticide/Polychlorinated Biphenyls (µg/kg)																				
4,4'-DDD	2,000	7,200	583	342	--	--	4.0 U	3.8 U	4.0 J	3.7 U	3.7 U	3.7 U	18	3.7 U	3.5 U	3.7 U	3.6 U	3.9 UJ	4.0 U	3.9 U
4,4'-DDE	1,400	5,100	114	244	--	--	54	10	70	18	48 J	89 J	**328**	45	**161**	3.7 U	3.6 U	**157 J**	4.0 U	1.9 J
4,4'-DDT	1,700	7,000	100	352	--	--	19 J	6.6 J	34	12	32 J	27	**111 J**	46	42	3.7 U	3.6 U	54 J	4.0 U	3.9 U
alpha-Chlordane	1,600	6,500	11	1,386	--	--	2.1 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.8 U	2.0 UJ	2.1 U	2.0 U
Aroclor-1242	220	740	8,000	179	--	--	40 U	38 U	37 U	37 U	37 U	37 U	37 U	37 U	35 U	37 U	36 U	39 UJ	40 U	39 U
Aroclor-1254	110	740	8,000	302	--	--	40 U	38 U	37 U	37 U	37 U	37 U	37 U	37 U	35 U	37 U	36 U	39 UJ	40 U	39 U
Aroclor-1260	220	740	8,000	828	--	--	40 U	38 U	37 U	37 U	37 U	37 U	37 U	37 U	35 U	37 U	36 U	39 UJ	40 U	39 U
beta-BHC	270	960	342	1.0	--	--	2.1 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.8 U	2.0 UJ	2.1 U	2.0 U
Dieldrin	30	110	11	0.36	--	--	4.0 U	3.8 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.5 U	3.7 U	3.6 U	3.9 UJ	4.0 U	3.9 U
Endosulfan I	37,000	370,000	6.3	38,734	--	--	2.1 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.8 U	2.0 UJ	2.1 U	2.0 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	4.0 U	3.8 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.5 U	3.7 U	3.6 U	3.9 UJ	4.0 U	3.9 U
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	2.1 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.8 U	2.0 UJ	2.1 U	2.0 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	2.1 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.8 U	2.0 UJ	2.1 U	2.0 U
Explosives (µg/kg)																				
Perchlorate	5,500	72,000	1,000	17	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)																				
Aluminum	7,700	99,000	--	56,000	--	29,000	24,000	10,000	17,000	11,000	11,000	15,000	10,000	11,000	10,000	17,000	3,600	6,600	8,700	14,200
Antimony	3.1	41	78	0.27	--	2.3	**2.8 J**	1.2 J	0.99 J	0.76 J	0.82 J	1.2 J	1.6 J	0.82 J	0.76 J	1.1 J	0.26 UJ	0.40 J	0.41 J	0.49 J
Arsenic	0.39	1.6	18	0.31	--	2.2	2.0 J	1.0 J	0.89 J	0.32 U	0.81 J	0.86 J	0.86 J	0.55 J	**6.3**	0.32 U	0.32 U	0.75 J	1.2 U	0.56 J
Barium	1,500	19,000	330	100	--	320	75	55	62	51	54	36 J	34 J	48	48	47	55	62	67	129
Beryllium	16	200	40	400	--	0.45	0.24 J	0.18 J	0.12 J	0.13 J	0.17 J	0.13 J	0.030 U	0.030 U	0.030 U	0.18 J	0.030 U	0.17 J	0.61 U	0.60 U
Cadmium	7	80	32	20	--	0.040	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.020 U	0.030 U	0.020 U	0.030 U	0.61 U	0.60 U
Calcium	--	--	--	--	--	210,000	11,000	16,000	17,000	9,100	16,000	13,000	6,800	19,000	6,500	6,400	2,500	5,100	3,030	8,560
Chromium	0.29	5.6	64	430,000	--	74	**82 J**	12 J	20	15	20	24	18	25	3.8	51	4.0 J	9.1 J	3.7	7.0
Cobalt	2.3	30	13	0.50	--	25	19	8.5 J	12	10 J	10 J	13	12	10 J	13	21	5.0 J	7.7 J	6.7	14
Copper	310	4,100	70	52	--	68	**77**	46	66	40	41	**69**	59	46	**98**	**72**	12 J	26	23	36
Cyanide	160	2,000	16	2.0	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.0 U	3.0 U
Iron	5,500	72,000	--	660	--	37,531	**40,000**	19,000	21,000	19,000	19,000	22,000	20,000	18,000	25,000	30,000	9,700	15,000	13,900	22,100
Lead	400	800	120	27	--	6.9	**12 J**	**11 J**	**9.0**	5.3	5.2	**12**	**12**	**19**	1.8	0.18 U	3.0 J	**11**	3.3	5.9
Magnesium	--	--	--	--	--	12,834	7,400	2,500	8,000	5,700	5,800	8,600	6,200	6,800	6,500	11,000	1,200	2,400	1,720	3,160
Manganese	180	2,300	220	57	--	1,167	530	500	570	570	580	500	510	600	630	600	440	620	522 J	935 J
Mercury	0.78	10	0.10	0.40	--	0.031	**0.053**	0.030 J	0.013 J	0.015 J	0.011 J	0.0061 J	0.011 J	0.010 J	0.0027 U	0.0058 J	0.0038 J	0.016 J	**0.040 J**	**0.033 J**
Nickel	150	2,000	38	1,400	--	40	31	6.0 J	14	9.5	12	18	12	16	3.2 J	30	2.2 J	5.5 J	2.8 J	4.7 J
Potassium	--	--	--	--	--	1,700	690 J	730 J	830 J	650 J	680 J	560 J	470 J	680 J	930 J	570 J	760 J	580 J	627	850
Selenium	39	510	0.52	0.12	--	2.0	0.56 U	0.53 U	0.71 J	0.82 J	0.95 J	0.95 J	1.4 J	0.97 J	1.1 J	0.99 J	0.71 J	0.55 U	4.2 U	4.2 U
Silver	39	510	560	20	--	0.077	0.070 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	1.2 U	1.2 U
Sodium	--	--	--	--	--	6,300	260 J	200 J	890 J	140 J	220 J	330 J	110 J	300 J	21 U	240 J	41 J	99 J	607 U	598 U
Vanadium	39	520	2.0	180	--	130	**140**	54	61	57	59	67	56	50	57	110	29 J	42	40	75
Zinc	2,300	31,000	120	5,800	--	65	59	43	56	40	40	54	**80**	43	65	46	20 J	36	24	34
Total Petroleum Hydrocarbons (µg/kg)																				
TPH-diesel range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
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Sample ID							WAR-SS45-0002	WAR-SS45P-0002	WAR-SS46-0002	WAR-SS47-0002	WAR-SS48-0002	WAR-SS49-0002	WAR-SS50-0002	WAR-SS51-0002	WAR-SS53-0002	WAR-SS54-0002	WAR-SS55-0002	WAR-SS55P-0002
Sample Date							12/07/05	12/07/05	12/15/05	12/16/05	12/15/05	12/15/05	12/15/05	12/15/05	12/15/05	12/16/05	12/16/05	12/16/05
Chemical Name																		
Volatile Organic Compounds (µg/kg)																		
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Acetone	6,100,000	63,000,000	--	4,752	--	--	10 UJ	10 U	10 U	10 U	10 U	10 U	14 U	10 U	10 U	10 U	10 U	10 U
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	11,000	53,000	1,250	2.0	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
o-Xylene	380,000	434,000	2,400	37,616	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	550	2,600	200	5.6	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Toluene	500,000	818,000	40,000	2,367	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	2,800	14,000	10	3.9	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Xylene, total	63,000	258,000	2,400	37,670	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Semivolatile Organic Compounds (µg/kg)																		
2-Nitroaniline	61,000	600,000	--	230	--	--	910 U	910 U	910 U	890 U	940 U	940 U	930 U	930 U	970 U	910 U	970 U	990 U
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	360 U	360 U	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
4-Nitroaniline	24,000	86,000	--	2.1	--	--	910 UJ	910 UJ	910 U	890 UJ	940 U	940 U	930 UJ	930 U	970 U	910 U	970 U	990 U
Acenaphthene	340,000	3,300,000	--	110,000	--	--	360 U	360 U	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	360 U	360 U	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	360 U	360 U	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Atrazine	2,100	7,500	12	6.1	--	--	360 UJ	360 UJ	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Benzo(a)anthracene	150	2,100	--	54	--	--	**300 J**	**150 J**	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Benzo(a)pyrene	15	210	--	1,259	--	--	**370**	**170 J**	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Benzo(b)fluoranthene	150	2,100	--	186	--	--	**560**	**320 J**	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	180 J	89 J	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	540	270 J	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	360 U	360 U	360 U	75 U	92 J	78 J	110 J	370 U	110 J	360 U	380 U	390 U
Carbazole	24,000	86,000	--	93	--	--	360 U	360 U	360 UJ	350 U	380 UJ	380 UJ	370 U	370 UJ	380 UJ	360 U	380 U	390 U
Chrysene	15,000	210,000	--	5,476	--	--	480	290 J	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Dibenz(a,h)anthracene	15	210	--	61	--	--	360 U	360 U	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Dibenzofuran	7,800	100,000	--	3,351	--	--	360 U	360 U	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Fluoranthene	230,000	2,200,000	--	900,000	--	--	260 J	350 J	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Fluorene	230,000	2,200,000	--	140,000	--	--	360 U	360 U	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	**230 J**	120 J	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
PAH Total (HMW)	--	--	18,000	--	--	--	3,230	1,949	1,620 U	1,575 U	1,710 U	1,710 U	1,665 U	1,665 U	1,710 U	1,620 U	1,710 U	1,755 U
PAH Total (LMW)	--	--	29,000	--	--	--	1,700	1,790	1,620 U	1,575 U	1,710 U	1,710 U	1,665 U	1,665 U	1,710 U	1,620 U	1,710 U	1,755 U
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	360 U	360 U	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U
Pyrene	170,000	1,700,000	--	610,000	--	--	390	360 J	360 U	350 U	380 U	380 U	370 U	370 U	380 U	360 U	380 U	390 U

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E) and SSL DAF 1

NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
NJ - Presumptively present at approximate quantity
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	WAR-SO45		WAR-SO46	WAR-SO47	WAR-SO48	WAR-SO49	WAR-SO50	WAR-SO51	WAR-SO53	WAR-SO54	WAR-SO55	
Sample ID							WAR-SS45-0002	WAR-SS45P-0002	WAR-SS46-0002	WAR-SS47-0002	WAR-SS48-0002	WAR-SS49-0002	WAR-SS50-0002	WAR-SS51-0002	WAR-SS53-0002	WAR-SS54-0002	WAR-SS55-0002	WAR-SS55P-0002
Sample Date							12/07/05	12/07/05	12/15/05	12/16/05	12/15/05	12/15/05	12/15/05	12/15/05	12/15/05	12/16/05	12/16/05	12/16/05
Chemical Name																		
Pesticide/Polychlorinated Biphenyls (µg/kg)																		
4,4'-DDD	2,000	7,200	583	342	--	--	3.6 U	3.6 U	3.6 U	4.9	3.8 U	3.8 U	3.7 U	3.7 U	3.8 U	3.6 U	3.8 U	3.9 U
4,4'-DDE	1,400	5,100	114	244	--	--	8.0 J	6.8	34	6.6	21	15	7.2	6.4	14	13	4.5	1.8 J
4,4'-DDT	1,700	7,000	100	352	--	--	3.6 U	2.3 J	24 J	4.6	8.8	3.9	5.5	3.8	5.7	4.7	2.9 J	3.9 U
alpha-Chlordane	1,600	6,500	11	1,386	--	--	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	2.0 U	1.9 U	2.0 U	2.0 U
Aroclor-1242	220	740	8,000	179	--	--	36 U	36 U	36 U	35 U	38 U	38 U	37 U	37 U	38 U	36 U	38 U	39 U
Aroclor-1254	110	740	8,000	302	--	--	36 U	36 U	56	35 U	38 U	38 U	37 U	37 U	38 U	36 U	38 U	39 U
Aroclor-1260	220	740	8,000	828	--	--	36 U	36 U	27 J	35 U	38 U	38 U	37 U	37 U	38 U	36 U	38 U	39 U
beta-BHC	270	960	342	1.0	--	--	1.9 U	1.9 U	0.64 J	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	2.0 U	1.9 U	2.0 U	2.0 U
Dieldrin	30	110	11	0.36	--	--	3.6 U	3.6 U	3.6 U	3.5 U	3.8 U	3.8 U	3.7 U	3.7 U	3.8 U	3.6 U	3.8 U	3.9 U
Endosulfan I	37,000	370,000	6.3	38,734	--	--	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	2.0 U	1.9 U	2.0 U	2.0 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	3.6 U	3.6 U	3.6 U	3.5 U	3.8 U	3.8 U	3.7 U	3.7 U	3.8 U	3.6 U	3.8 U	3.9 U
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	2.0 U	1.9 U	2.0 U	2.0 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	1.9 U	0.38 J	1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	2.0 U	1.9 U	2.0 U	2.0 U
Explosives (µg/kg)																		
Perchlorate	5,500	72,000	1,000	17	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)																		
Aluminum	7,700	99,000	--	56,000	--	29,000	9,030	11,600	13,900	15,000	13,400	11,400	7,900	12,000	12,600	12,600	14,000	13,800
Antimony	3.1	41	78	0.27	--	2.3	0.41 J	0.43 J	0.55 J	0.64 J	0.42 J	0.40 J	0.32 J	0.62 J	0.50 J	0.63 J	0.36 J	0.61 J
Arsenic	0.39	1.6	18	0.31	--	2.2	0.44 J	0.45 J	0.50 J	0.96 J	0.63 J	0.41 J	0.36 J	1.1 U	1.2 U	1.1 U	1.2 U	1.2 U
Barium	1,500	19,000	330	100	--	320	111	43	72	40	66	65	74	56	90	31	67	86
Beryllium	16	200	40	400	--	0.45	0.55 U	0.55 U	0.55 U	0.54 U	0.57 U	0.57 U	0.56 U	0.56 U	0.58 U	0.55 U	0.58 U	0.59 U
Cadmium	7	80	32	20	--	0.040	0.55 U	0.55 U	0.55 U	0.54 U	0.57 U	0.57 U	0.56 U	0.56 U	0.58 U	0.55 U	0.58 U	0.59 U
Calcium	--	--	--	--	--	210,000	6,030	7,090	6,890	8,100	20,600	4,730	4,880	6,420	7,300	7,710	7,970	6,180
Chromium	0.29	5.6	64	430,000	--	74	14 J	31 J	25	19	22	12	8.1	20	9.9	14	25	21
Cobalt	2.3	30	13	0.50	--	25	15	11	14	13	13	9.5	8.4	10	10	14	14	13
Copper	310	4,100	70	52	--	68	31	40	25	**81**	49	32	25	61	34	**103**	47	39
Cyanide	160	2,000	16	2.0	--	--	2.8 U	2.8 U	2.8 U	2.7 U	2.9 U	2.9 U	2.8 U	2.8 U	2.9 U	2.7 U	2.9 U	3.0 U
Iron	5,500	72,000	--	660	--	37,531	16,900	17,700	19,800	21,800	20,100	17,500	13,200	17,600	19,100	20,800	21,500	21,400
Lead	400	800	120	27	--	6.9	**9.5 J**	6.3 J	5.1	**7.2**	4.2	4.8	6.5	**24**	5.0	3.3	6.9	**7.1**
Magnesium	--	--	--	--	--	12,834	3,360 J	6,340 J	6,440	6,640	5,320	4,210	2,670	6,090	3,170	7,520	6,400	4,550
Manganese	180	2,300	220	57	--	1,167	**1,190 J**	498 J	693 J	444	597 J	546 J	651	573 J	899 J	594	629	782
Mercury	0.78	10	0.10	0.40	--	0.031	0.11 U	**0.049 J**	0.028 J	0.11 U	0.026 J	0.027 J	0.11 U	0.023 J	**0.033 J**	0.11 U	0.12 U	0.12 U
Nickel	150	2,000	38	1,400	--	40	9.3	17	20	16	13	8.7	5.2	13	6.6	9.3	19	15
Potassium	--	--	--	--	--	1,700	480 J	465 J	582	421 J	712	676	610 J	924	631	362 J	1,170 J	1,100 J
Selenium	39	510	0.52	0.12	--	2.0	3.9 U	3.9 U	3.9 U	3.8 U	4.0 U	4.0 U	3.9 U	0.39 J	4.1 U	3.8 U	4.1 U	4.1 U
Silver	39	510	560	20	--	0.077	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.2 U	1.1 U	1.2 U	1.2 U
Sodium	--	--	--	--	--	6,300	552 U	551 U	589	666	571 U	570 U	564 U	563 U	583 U	546 U	581 U	592 U
Vanadium	39	520	2.0	180	--	130	59	55	51	75	69	51	41	51	58	61	69	65
Zinc	2,300	31,000	120	5,800	--	65	31	38	48	42	58	35	36	49	33	44	39	43
Total Petroleum Hydrocarbons (µg/kg)																		
TPH-diesel range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E) and SSL DAF 1

NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
NJ - Presumptively present at approximate quantity
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	WAR-SO56	WAR-SO57	WAR-SO58	WAR-SO59	WAR-SO60	WAR-SO61	WAR-SO62	WAR-SO63	VWAR-SO64	VWAR-SO65	VWAR-SO66
Sample ID							WAR-SS56-0002	WAR-SS57-0002	WAR-SS58-0002	WAR-SS59-0002	WAR-SS60-0002	WAR-SS61-0002	WAR-SS62-0002	WAR-SS63-0002	VWAR-SS64-01-0609	VWAR-SS65-01-0609	VWAR-SS66-01-0609
Sample Date							12/16/05	12/16/05	12/16/05	12/16/05	12/15/05	12/15/05	12/15/05	12/15/05	06/01/09	06/01/09	06/01/09
Chemical Name																	
Volatile Organic Compounds (µg/kg)																	
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	10 U	10 U	11 U	11 U	11 U	10 U	10 U	12 U	NA	NA	NA
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	10 U	10 UJ	11 UJ	11 UJ	11 UJ	10 UJ	10 UJ	12 UJ	NA	NA	NA
Acetone	6,100,000	63,000,000	--	4,752	--	--	10 U	10 U	11 U	11 U	19 U	19 U	17 U	28 U	NA	NA	NA
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	11,000	53,000	1,250	2.0	--	--	10 U	10 U	11 U	11 U	11 U	10 U	10 U	12 U	NA	NA	NA
o-Xylene	380,000	434,000	2,400	37,616	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	550	2,600	200	5.6	--	--	10 U	10 U	11 U	11 U	11 U	10 U	10 U	12 U	NA	NA	NA
Toluene	500,000	818,000	40,000	2,367	--	--	10 U	10 U	11 U	11 U	11 U	10 U	10 U	12 U	NA	NA	NA
Trichloroethene	2,800	14,000	10	3.9	--	--	10 U	10 U	11 U	11 U	11 U	10 U	10 U	12 U	NA	NA	NA
Xylene, total	63,000	258,000	2,400	37,670	--	--	10 U	10 U	11 U	11 U	11 U	10 U	10 U	12 U	NA	NA	NA
Semivolatile Organic Compounds (µg/kg)																	
2-Nitroaniline	61,000	600,000	--	230	--	--	900 U	980 U	1,100 U	1,000 U	990 U	1,000 U	970 U	1,000 U	NA	NA	NA
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
4-Nitroaniline	24,000	86,000	--	2.1	--	--	900 U	980 U	1,100 U	1,000 UJ	990 U	1,000 U	970 U	1,000 U	NA	NA	NA
Acenaphthene	340,000	3,300,000	--	110,000	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Atrazine	2,100	7,500	12	6.1	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Benzo(a)anthracene	150	2,100	--	54	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Benzo(a)pyrene	15	210	--	1,259	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Benzo(b)fluoranthene	150	2,100	--	186	--	--	360 U	95 J	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	360 U	110 J	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	360 U	390 U	420 U	400 U	390 U	83 J	440	410 U	NA	NA	NA
Carbazole	24,000	86,000	--	93	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Chrysene	15,000	210,000	--	5,476	--	--	360 U	100 J	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Dibenz(a,h)anthracene	15	210	--	61	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Dibenzofuran	7,800	100,000	--	3,351	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Fluoranthene	230,000	2,200,000	--	900,000	--	--	360 U	110 J	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Fluorene	230,000	2,200,000	--	140,000	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
PAH Total (HMW)	--	--	18,000	--	--	--	1,620 U	1,363	1,890 U	1,800 U	1,755 U	1,800 U	1,710 U	1,845 U	NA	NA	NA
PAH Total (LMW)	--	--	29,000	--	--	--	1,620 U	1,670	1,890 U	1,800 U	1,755 U	1,800 U	1,710 U	1,845 U	NA	NA	NA
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	360 U	390 U	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA
Pyrene	170,000	1,700,000	--	610,000	--	--	360 U	83 J	420 U	400 U	390 U	400 U	380 U	410 U	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E)
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Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E) and SSL DAF 1

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B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
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mg/kg - Milligrams per kilogram
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[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	WAR-SO56	WAR-SO57	WAR-SO58	WAR-SO59	WAR-SO60	WAR-SO61	WAR-SO62	WAR-SO63	VWAR-SO64	VWAR-SO65	VWAR-SO66
Sample ID							WAR-SS56-0002	WAR-SS57-0002	WAR-SS58-0002	WAR-SS59-0002	WAR-SS60-0002	WAR-SS61-0002	WAR-SS62-0002	WAR-SS63-0002	VWAR-SS64-01-0609	VWAR-SS65-01-0609	VWAR-SS66-01-0609
Sample Date							12/16/05	12/16/05	12/16/05	12/16/05	12/15/05	12/15/05	12/15/05	12/15/05	06/01/09	06/01/09	06/01/09
Chemical Name																	
Pesticide/Polychlorinated Biphenyls (µg/kg)																	
4,4'-DDD	2,000	7,200	583	342	--	--	3.6 U	3.9 U	2.1 J	4.0 U	3.9 U	4.0 U	3.8 U	4.1 U	4.5	3.4 U	1.0 J
4,4'-DDE	1,400	5,100	114	244	--	--	3.6 U	7.8	4.2 J	4.0 U	1.7 J	4.0 U	3.8 U	4.1 U	7.2 J	2.5 J	4.1 J
4,4'-DDT	1,700	7,000	100	352	--	--	3.6 U	6.4	4.2 U	4.0 U	5.2	4.0 U	3.8 U	4.1 U	7.0	1.5 J	1.8 J
alpha-Chlordane	1,600	6,500	11	1,386	--	--	3.3	2.0 U	2.2 U	2.1 U	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U	1.8 U	1.8 UJ
Aroclor-1242	220	740	8,000	179	--	--	36 U	39 U	42 U	40 U	39 U	40 U	38 U	41 U	NA	NA	NA
Aroclor-1254	110	740	8,000	302	--	--	36 U	39 U	42 U	40 U	39 U	40 U	38 U	41 U	NA	NA	NA
Aroclor-1260	220	740	8,000	828	--	--	36 U	39 U	42 U	40 U	39 U	40 U	38 U	41 U	NA	NA	NA
beta-BHC	270	960	342	1.0	--	--	1.8 U	0.59 J	2.2 U	2.1 U	2.0 U	2.0 U	2.0 U	0.79 J	2.0 U	1.8 U	1.8 U
Dieldrin	30	110	11	0.36	--	--	3.6 U	3.9 U	4.2 U	4.0 U	3.9 U	4.0 U	3.8 U	4.1 U	**1.0 J**	3.4 U	**0.48 J**
Endosulfan I	37,000	370,000	6.3	38,734	--	--	1.8 U	2.0 U	2.2 U	2.1 U	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U	1.8 U	1.8 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	3.6 U	3.9 U	4.2 U	4.0 U	3.9 U	4.0 U	3.8 U	4.1 U	3.8 U	3.4 U	3.5 U
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	1.8 U	2.0 U	2.2 U	2.1 U	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U	1.8 U	1.8 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	1.8 U	2.0 U	2.2 U	2.1 U	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U	1.8 U	1.8 UJ
Explosives (µg/kg)																	
Perchlorate	5,500	72,000	1,000	17	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)																	
Aluminum	7,700	99,000	--	56,000	--	29,000	4,970	13,100	15,700	14,900	13,200	14,900	15,100	17,600	21,700 J	22,700 J	28,400 J
Antimony	3.1	41	78	0.27	--	2.3	6.5 UJ	0.44 J	0.39 J	0.32 J	0.55 J	7.3 UJ	0.40 J	0.49 J	0.16 J	0.12 J	0.21 J
Arsenic	0.39	1.6	18	0.31	--	2.2	1.1 U	0.60 J	0.48 J	1.2 U	0.50 J	1.2 U	1.2 U	1.2 U	0.62	0.87	0.90
Barium	1,500	19,000	330	100	--	320	65	78	96	167	70	142	204	169	99	38	54
Beryllium	16	200	40	400	--	0.45	0.54 U	0.59 U	0.64 U	0.61 U	0.59 U	0.60 U	0.58 U	0.62 U	0.20	0.15	0.16
Cadmium	7	80	32	20	--	0.040	0.54 U	0.59 U	0.64 U	0.61 U	0.59 U	0.60 U	0.58 U	0.62 U	**0.15**	0.082 U	0.10 U
Calcium	--	--	--	--	--	210,000	1,670	18,100	46,000	4,660	15,400 J	5,520 J	3,200 J	2,400 J	8,540	19,800	11,600
Chromium	0.29	5.6	64	430,000	--	74	2.5	10	8.3	6.1	8.5	14	17	21	10 J	53 J	**83 J**
Cobalt	2.3	30	13	0.50	--	25	5.8	8.6	8.3	13	8.8	14	15	14	9.0	13	18
Copper	310	4,100	70	52	--	68	13	38	24	25	38	32	39	44	43	**83**	**80**
Cyanide	160	2,000	16	2.0	--	--	2.7 U	3.0 U	3.2 U	3.1 U	3.0 U	3.0 U	2.9 U	3.1 U	1.1 U	1.0 U	1.0 U
Iron	5,500	72,000	--	660	--	37,531	9,760	21,400	17,000	17,700	19,700	19,700	27,000	31,000	22,200 J	27,200 J	33,000 J
Lead	400	800	120	27	--	6.9	2.9	**7.0**	4.8	4.5	4.9 J	3.0 J	2.3 J	2.3 J	**38 J**	4.2 J	3.9 J
Magnesium	--	--	--	--	--	12,834	1,030	3,510	4,130	2,920	4,780	3,810	5,420	5,550	3,840 J	12,100 J	**16,200 J**
Manganese	180	2,300	220	57	--	1,167	577	556	530	1,040	454	606	485	401	749	624	780
Mercury	0.78	10	0.10	0.40	--	0.031	0.11 U	0.12 U	**0.034 J**	0.025 J	0.12 U	0.12 U	0.12 U	0.12 U	0.030 J	0.033 U	0.036 U
Nickel	150	2,000	38	1,400	--	40	4.3 U	7.0	5.1 U	4.9 U	5.9 J	9.0 J	8.3 J	8.7 J	7.2	26	38
Potassium	--	--	--	--	--	1,700	556 J	771 J	1,060 J	854 J	381 J	949 J	334 J	282 J	1,080 J	618 J	695 J
Selenium	39	510	0.52	0.12	--	2.0	3.8 U	4.1 U	4.5 U	4.3 U	4.1 UJ	4.2 UJ	4.1 UJ	4.4 U	0.54 U	0.41 U	0.50 U
Silver	39	510	560	20	--	0.077	1.1 U	1.2 U	1.3 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.6 U	2.5 U	3.0 U
Sodium	--	--	--	--	--	6,300	542 U	642	1,080	611 U	125 J	732	811	1,840	240 J	788 J	790 J
Vanadium	39	520	2.0	180	--	130	31	56	55	58	60	56	91	100	46 J	111 J	120 J
Zinc	2,300	31,000	120	5,800	--	65	15	35	30	28	33	30	34	38	45	44	55
Total Petroleum Hydrocarbons (µg/kg)																	
TPH-diesel range			--	--	100,000	--	NA	NA	NA	NA	12,000 U	10,000 U	10,000 U	10,000 U	NA	NA	NA
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	66,000	10,000 U	10,000 U	10,000 U	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
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mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

Table 4-1
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AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO67	VWAR-SO68	VWAR-SO69	VWAR-SO70	VWAR-SO71	VWAR-SO72	VWAR-SO73	VWAR-SO74
Sample ID							VWAR-SS67-01-0609	VWAR-SS68-01-0609	VWAR-SS69-01-0609	VWAR-SS70-01-0609	VWAR-SS71-01-0609	VWAR-SS72-01-0609	VWAR-SS73-0H-0609	VWAR-SS74-0H-0609
Sample Date							06/01/09	06/01/09	06/01/09	06/01/09	06/01/09	06/01/09	06/10/09	06/10/09
Chemical Name														
Volatile Organic Compounds (µg/kg)														
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	NA	NA	NA	NA	NA	NA	5.0 UJ	5.0 UJ
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	NA	NA	NA	NA	NA	NA	28 UJ	27 UJ
Acetone	6,100,000	63,000,000	--	4,752	--	--	NA	NA	NA	NA	NA	NA	31 UJ	31 UJ
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	NA	NA	NA	NA	NA	NA	10 UJ	10 UJ
Methylene chloride	11,000	53,000	1,250	2.0	--	--	NA	NA	NA	NA	NA	NA	24 UJ	23 UJ
o-Xylene	380,000	434,000	2,400	37,616	--	--	NA	NA	NA	NA	NA	NA	5.0 UJ	5.0 UJ
Tetrachloroethene	550	2,600	200	5.6	--	--	NA	NA	NA	NA	NA	NA	6.0 UJ	6.0 UJ
Toluene	500,000	818,000	40,000	2,367	--	--	NA	NA	NA	NA	NA	NA	5.0 UJ	5.0 UJ
Trichloroethene	2,800	14,000	10	3.9	--	--	NA	NA	NA	NA	NA	NA	6.0 UJ	6.0 UJ
Xylene, total	63,000	258,000	2,400	37,670	--	--	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (µg/kg)														
2-Nitroaniline	61,000	600,000	--	230	--	--	NA	NA	NA	NA	NA	NA	23 UJ	22 U
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	NA	NA	NA	NA	NA	NA	120 U	110 U
4-Nitroaniline	24,000	86,000	--	2.1	--	--	NA	NA	NA	NA	NA	NA	23 U	22 U
Acenaphthene	340,000	3,300,000	--	110,000	--	--	NA	NA	NA	NA	NA	NA	380 UJ	370 UJ
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	NA	NA	NA	NA	NA	NA	380 U	370 U
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	NA	NA	NA	NA	NA	NA	2.7 J	18 J
Atrazine	2,100	7,500	12	6.1	--	--	NA	NA	NA	NA	NA	NA	23 UJ	22 UJ
Benzo(a)anthracene	150	2,100	--	54	--	--	NA	NA	NA	NA	NA	NA	380 U	**98 J**
Benzo(a)pyrene	15	210	--	1,259	--	--	NA	NA	NA	NA	NA	NA	**23 J**	**80**
Benzo(b)fluoranthene	150	2,100	--	186	--	--	NA	NA	NA	NA	NA	NA	46	110 J
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	NA	NA	NA	NA	NA	NA	380 U	370 U
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	NA	NA	NA	NA	NA	NA	380 U	95 J
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	NA	NA	NA	NA	NA	NA	380 U	370 U
Carbazole	24,000	86,000	--	93	--	--	NA	NA	NA	NA	NA	NA	3.0 J	6.6 J
Chrysene	15,000	210,000	--	5,476	--	--	NA	NA	NA	NA	NA	NA	380 U	160 J
Dibenz(a,h)anthracene	15	210	--	61	--	--	NA	NA	NA	NA	NA	NA	11 J	**16 J**
Dibenzofuran	7,800	100,000	--	3,351	--	--	NA	NA	NA	NA	NA	NA	380 U	370 U
Fluoranthene	230,000	2,200,000	--	900,000	--	--	NA	NA	NA	NA	NA	NA	19 J	180 J
Fluorene	230,000	2,200,000	--	140,000	--	--	NA	NA	NA	NA	NA	NA	380 U	370 U
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	NA	NA	NA	NA	NA	NA	54 J	86
PAH Total (HMW)	--	--	18,000	--	--	--	NA	NA	NA	NA	NA	NA	906	990
PAH Total (LMW)	--	--	29,000	--	--	--	NA	NA	NA	NA	NA	NA	995	1,179
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	NA	NA	NA	NA	NA	NA	23 UJ	45 J
Pyrene	170,000	1,700,000	--	610,000	--	--	NA	NA	NA	NA	NA	NA	12 J	160

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
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Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
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B - Analyte not detected above the level reported in blanks
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Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO67	VWAR-SO68	VWAR-SO69	VWAR-SO70	VWAR-SO71	VWAR-SO72	VWAR-SO73	VWAR-SO74
Sample ID							VWAR-SS67-01-0609	VWAR-SS68-01-0609	VWAR-SS69-01-0609	VWAR-SS70-01-0609	VWAR-SS71-01-0609	VWAR-SS72-01-0609	VWAR-SS73-0H-0609	VWAR-SS74-0H-0609
Sample Date							06/01/09	06/01/09	06/01/09	06/01/09	06/01/09	06/01/09	06/10/09	06/10/09
Chemical Name														
Pesticide/Polychlorinated Biphenyls (µg/kg)														
4,4'-DDD	2,000	7,200	583	342	--	--	3.5 UJ	3.5 UJ	1.6 UJ	3.7 J	5.7 J	5.0 J	3.8 UJ	2.5 J
4,4'-DDE	1,400	5,100	114	244	--	--	1.0 J	16 J	6.7 J	19 J	14 J	29 J	2.4 J	5.4
4,4'-DDT	1,700	7,000	100	352	--	--	0.93 J	60 J	5.4 J	10 J	19 J	22 J	0.82 J	47
alpha-Chlordane	1,600	6,500	11	1,386	--	--	1.8 UJ	1.9 UJ	1.8 UJ	1.9 UJ	1.8 UJ	1.8 UJ	2.0 U	1.9 U
Aroclor-1242	220	740	8,000	179	--	--	NA	NA	NA	NA	NA	NA	20 U	48 J
Aroclor-1254	110	740	8,000	302	--	--	NA	NA	NA	NA	NA	NA	35 U	34 U
Aroclor-1260	220	740	8,000	828	--	--	NA	NA	NA	NA	NA	NA	20 UJ	19 UJ
beta-BHC	270	960	342	1.0	--	--	1.8 U	1.9 U	1.8 U	1.9 U	1.8 U	1.8 U	2.0 U	1.9 U
Dieldrin	30	110	11	0.36	--	--	3.5 UJ	3.6 UJ	3.6 UJ	**1.3 J**	**1.4 J**	**1.1 J**	3.8 U	3.7 U
Endosulfan I	37,000	370,000	6.3	38,734	--	--	1.8 U	1.9 U	1.8 U	1.9 U	1.8 U	1.8 U	2.0 U	1.9 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	3.5 U	3.6 U	3.6 U	3.6 U	3.5 U	3.5 U	3.8 U	3.7 U
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	1.8 U	0.54 J	1.8 U	1.9 U	1.8 U	1.8 U	2.0 U	1.9 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	1.8 UJ	1.9 UJ	1.8 UJ	1.9 UJ	1.8 UJ	1.8 UJ	2.0 U	0.84 J
Explosives (µg/kg)														
Perchlorate	5,500	72,000	1,000	17	--	--	NA	NA	NA	NA	NA	NA	1.5 U	1.9 U
Total Metals (mg/kg)														
Aluminum	7,700	99,000	--	56,000	--	29,000	12,200 J	**30,400 J**	24,300 J	**32,500 J**	23,100 J	28,300 J	27,900	**29,300**
Antimony	3.1	41	78	0.27	--	2.3	0.10 J	0.11 J	0.27 J	0.20 J	0.12 J	0.20 J	0.32 J	0.21 J
Arsenic	0.39	1.6	18	0.31	--	2.2	0.40 J	1.0	**7.2**	**5.2**	**3.4**	**3.4**	**9.8**	1.4
Barium	1,500	19,000	330	100	--	320	90	71	52	64	45	77	84 J	102 J
Beryllium	16	200	40	400	--	0.45	0.16	0.14	0.17	0.18	0.15	0.15	0.29	0.21
Cadmium	7	80	32	20	--	0.040	0.082 U	0.090 U	**0.16**	**0.13**	0.088 U	**0.18**	0.10 U	0.11 U
Calcium	--	--	--	--	--	210,000	3,940	11,500	16,800	20,900	16,000	30,200	11,200	11,400
Chromium	0.29	5.6	64	430,000	--	74	3.7 J	**89 J**	**80 J**	**106 J**	65 J	70 J	63 J	**74 J**
Cobalt	2.3	30	13	0.50	--	25	5.6	17	16	20	13	14	16	18
Copper	310	4,100	70	52	--	68	26	**89**	**71**	**98**	55	**73**	41	**74**
Cyanide	160	2,000	16	2.0	--	--	1.0 U	1.1 U	1.0 U	1.1 U	1.1 U	1.0 U	1.2 U	1.1 U
Iron	5,500	72,000	--	660	--	37,531	17,600 J	35,500 J	31,600 J	35,500 J	27,300 J	31,000 J	30,600	36,500
Lead	400	800	120	27	--	6.9	2.6 J	4.6 J	**7.6 J**	**37 J**	**20 J**	**38 J**	**7.9**	**9.1**
Magnesium	--	--	--	--	--	12,834	3,630 J	**13,700 J**	**15,900 J**	**15,000 J**	**13,800 J**	**15,300 J**	7,630 J	11,800 J
Manganese	180	2,300	220	57	--	1,167	644	660	681	816	607	793	670 J	770 J
Mercury	0.78	10	0.10	0.40	--	0.031	0.033 U	0.036 U	0.034 U	0.035 U	0.035 U	0.031 U	0.010 J	0.033 U
Nickel	150	2,000	38	1,400	--	40	3.3 U	**40**	**45**	**49**	30	33	26	34
Potassium	--	--	--	--	--	1,700	580 J	565 J	821 J	1,000 J	724 J	1,010 J	476 J	422 J
Selenium	39	510	0.52	0.12	--	2.0	0.41 U	0.45 U	0.46 U	0.51 U	0.44 U	0.46 U	0.52 U	0.55 U
Silver	39	510	560	20	--	0.077	**0.11 J**	2.7 U	2.7 U	3.0 U	2.6 U	2.7 U	**0.61 J**	**0.89 J**
Sodium	--	--	--	--	--	6,300	151 J	827 J	502 J	478 J	455 J	751 J	549	550
Vanadium	39	520	2.0	180	--	130	44 J	**143 J**	111 J	93 J	89 J	114 J	116 J	122 J
Zinc	2,300	31,000	120	5,800	--	65	41	60	**72**	56	48	47	41	61
Total Petroleum Hydrocarbons (µg/kg)														
TPH-diesel range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	4,900 J	35,000
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
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Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E) and SSL DAF 1

NA - Not analyzed
B - Analyte not detected above the level reported in blanks
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mg/kg - Milligrams per kilogram
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[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO75		VWAR-SO76	VWAR-SO77	VWAR-SO78	VWAR-SO79	VWAR-SO80		VWAR-SO81
Sample ID							VWAR-SS75-0H-0609	VWAR-SS75P-0H-0609	VWAR-SS76-0H-0609	VWAR-SS77-0H-0609	VWAR-SS78-0H-0609	VWAR-SS79-0H-0609	VWAR-SS80-0H-0609	VWAR-SS80P-0H-0609	VWAR-SS81-01-0609
Sample Date							06/10/09	06/10/09	06/10/09	06/10/09	06/10/09	06/10/09	06/10/09	06/10/09	06/01/09
Chemical Name															
Volatile Organic Compounds (µg/kg)															
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	6.0 UJ	5.0 UJ	4.0 UJ	4.0 U	5.0 UJ	5.0 UJ	4.0 UJ	5.0 U	5.0 U
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	35 UJ	31 UJ	25 UJ	25 U	27 UJ	30 UJ	26 UJ	28 U	31 U
Acetone	6,100,000	63,000,000	--	4,752	--	--	40 UJ	35 UJ	28 UJ	28 U	31 UJ	35 UJ	30 UJ	32 U	35 U
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	13 UJ	12 UJ	9.0 UJ	9.0 U	10 UJ	12 UJ	10 UJ	11 U	12 U
Methylene chloride	11,000	53,000	1,250	2.0	--	--	30 UJ	27 UJ	22 UJ	21 U	23 UJ	26 UJ	23 UJ	24 U	27 U
o-Xylene	380,000	434,000	2,400	37,616	--	--	6.0 UJ	5.0 UJ	4.0 UJ	4.0 U	5.0 UJ	5.0 UJ	4.0 UJ	5.0 U	5.0 U
Tetrachloroethene	550	2,600	200	5.6	--	--	7.0 UJ	6.0 UJ	5.0 UJ	5.0 U	6.0 UJ	6.0 UJ	5.0 UJ	6.0 U	6.0 U
Toluene	500,000	818,000	40,000	2,367	--	--	6.0 UJ	5.0 UJ	4.0 UJ	4.0 U	5.0 UJ	5.0 UJ	4.0 UJ	5.0 U	5.0 U
Trichloroethene	2,800	14,000	10	3.9	--	--	7.0 UJ	6.0 UJ	5.0 UJ	5.0 U	6.0 UJ	6.0 UJ	5.0 UJ	6.0 U	6.0 U
Xylene, total	63,000	258,000	2,400	37,670	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (µg/kg)															
2-Nitroaniline	61,000	600,000	--	230	--	--	29 U	23 U	22 U	22 UJ	21 UJ	25 U	23 UJ	24 UJ	25 U
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	140 U	120 U	110 U	110 U	110 U	130 U	120 U	120 U	120 U
4-Nitroaniline	24,000	86,000	--	2.1	--	--	29 U	23 U	22 U	22 U	21 U	25 U	23 U	24 U	25 U
Acenaphthene	340,000	3,300,000	--	110,000	--	--	480 UJ	380 UJ	360 UJ	360 UJ	350 UJ	420 UJ	380 UJ	400 UJ	420 U
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	480 U	380 UJ	360 U	360 U	350 U	420 U	380 U	400 U	420 U
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	5.5 J	5.0 J	4.6 J	22 U	6.1 J	26	23 U	24 U	25 U
Atrazine	2,100	7,500	12	6.1	--	--	29 UJ	23 UJ	22 UJ	22 UJ	21 UJ	25 UJ	23 UJ	24 UJ	25 UJ
Benzo(a)anthracene	150	2,100	--	54	--	--	480 U	380 UJ	360 U	360 U	350 U	**260 J**	380 U	400 U	420 U
Benzo(a)pyrene	15	210	--	1,259	--	--	**38**	**40**	**82**	22 U	**48**	**280 J**	23 U	24 U	25 U
Benzo(b)fluoranthene	150	2,100	--	186	--	--	52 J	51 J	130 J	22 U	66	**430 J**	23 U	24 U	25 U
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	480 U	380 UJ	360 U	360 U	350 U	190 J	380 U	400 U	420 U
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	480 U	380 UJ	100 J	360 U	350 U	370 J	380 U	400 U	420 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	480 U	380 UJ	360 U	360 U	350 U	420 U	380 U	400 U	420 U
Carbazole	24,000	86,000	--	93	--	--	2.2 J	1.8 J	4.3 J	22 U	6.3 J	19 J	23 U	24 U	25 U
Chrysene	15,000	210,000	--	5,476	--	--	480 U	380 UJ	360 U	360 U	350 U	470	380 U	400 U	420 U
Dibenz(a,h)anthracene	15	210	--	61	--	--	29 UJ	11 J	**31 J**	22 UJ	15 J	**88**	23 UJ	24 UJ	25 U
Dibenzofuran	7,800	100,000	--	3,351	--	--	480 U	380 UJ	360 U	360 U	350 U	420 U	380 U	400 U	420 U
Fluoranthene	230,000	2,200,000	--	900,000	--	--	80 J	74 J	30 J	5.1 J	83 J	360 J	23 UJ	24 UJ	25 U
Fluorene	230,000	2,200,000	--	140,000	--	--	480 U	380 UJ	360 U	360 U	350 U	420 U	380 U	400 U	420 U
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	41	42	140	3.9 J	80 J	**430 J**	7.6 J	3.3 J	25 U
PAH Total (HMW)	--	--	18,000	--	--	--	1,176	964	1,053	761	964	2,818	814	851	903 U
PAH Total (LMW)	--	--	29,000	--	--	--	1,314	1,057	948	938	998	1,480	996 U	1,048 U	1,100 U
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	14 J	16 J	4.4 UJ	22 UJ	23 J	31 J	23 UJ	24 UJ	25 U
Pyrene	170,000	1,700,000	--	610,000	--	--	70	60	30	4.1 J	55 J	300 J	23 UJ	24 UJ	25 U

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
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AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO75		VWAR-SO76	VWAR-SO77	VWAR-SO78	VWAR-SO79	VWAR-SO80		VWAR-SO81
Sample ID							VWAR-SS75-0H-0609	VWAR-SS75P-0H-0609	VWAR-SS76-0H-0609	VWAR-SS77-0H-0609	VWAR-SS78-0H-0609	VWAR-SS79-0H-0609	VWAR-SS80-0H-0609	VWAR-SS80P-0H-0609	VWAR-SS81-01-0609
Sample Date							06/10/09	06/10/09	06/10/09	06/10/09	06/10/09	06/10/09	06/10/09	06/10/09	06/01/09
Chemical Name															
Pesticide/Polychlorinated Biphenyls (µg/kg)															
4,4'-DDD	2,000	7,200	583	342	--	--	2.0 J	2.0 J	38 J	3.6 UJ	31	4.2 U	3.8 UJ	1.0 J	4.2 U
4,4'-DDE	1,400	5,100	114	244	--	--	13	13	**350**	1.2 J	**370**	2.9 J	0.88 J	1.2 J	4.2 U
4,4'-DDT	1,700	7,000	100	352	--	--	14	12	64	1.2 J	**600**	2.4 J	3.2 J	5.0	4.2 U
alpha-Chlordane	1,600	6,500	11	1,386	--	--	2.5 U	2.0 U	1.8 U	1.9 U	1.8 U	2.2 U	2.0 U	2.0 U	2.1 U
Aroclor-1242	220	740	8,000	179	--	--	25 U	20 U	18 U	19 U	18 U	22 U	20 UJ	20 UJ	21 U
Aroclor-1254	110	740	8,000	302	--	--	44 U	35 U	33 U	33 U	32 U	38 U	35 U	36 U	38 U
Aroclor-1260	220	740	8,000	828	--	--	25 UJ	20 UJ	18 UJ	19 UJ	18 UJ	22 UJ	20 UJ	20 UJ	21 U
beta-BHC	270	960	342	1.0	--	--	2.5 U	2.0 U	1.8 U	1.9 U	1.8 U	2.2 U	2.0 U	2.0 U	2.1 U
Dieldrin	30	110	11	0.36	--	--	4.8 U	3.8 U	**12**	3.6 U	3.5 U	4.2 U	3.8 U	4.0 U	4.2 U
Endosulfan I	37,000	370,000	6.3	38,734	--	--	2.5 U	2.0 U	1.8 U	1.9 U	1.8 J	2.2 U	2.0 U	2.0 U	2.1 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	4.8 U	3.8 U	3.6 U	3.6 U	3.5 U	0.89 J	3.8 U	4.0 U	4.2 U
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	2.5 U	2.0 U	1.8 U	1.9 U	2.4	2.2 U	2.0 U	2.0 U	2.1 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	2.5 U	2.0 U	3.4	1.9 U	1.8 U	2.2 U	2.0 U	2.0 U	2.1 U
Explosives (µg/kg)															
Perchlorate	5,500	72,000	1,000	17	--	--	0.37 J	0.23 J	0.45 J	0.57 J	0.45 J	2.5 U	1.5 U	1.6 U	2.0 U
Total Metals (mg/kg)															
Aluminum	7,700	99,000	--	56,000	--	29,000	26,600	19,200	25,600	9,410	18,400	23,100	15,500	17,600	29,000 J
Antimony	3.1	41	78	0.27	--	2.3	0.28 J	0.27 J	0.21 J	0.040 J	0.13 J	0.050 J	0.10 UJ	0.12 UJ	0.10 UJ
Arsenic	0.39	1.6	18	0.31	--	2.2	2.2	1.8	1.3	0.50 U	0.87	0.63	0.51 U	0.58 U	0.68
Barium	1,500	19,000	330	100	--	320	134 J	126 J	47 J	72 J	51 J	137 J	76 J	210 J	170 J
Beryllium	16	200	40	400	--	0.45	0.32	0.25	0.20	0.15	0.26	0.35	0.25	0.29	**0.49**
Cadmium	7	80	32	20	--	0.040	**0.17**	**0.14**	**0.22**	0.099 U	0.10 U	0.12 U	0.10 U	0.12 U	0.10 U
Calcium	--	--	--	--	--	210,000	51,200 J	31,000 J	22,500	5,020	17,200	9,430	3,260	30,300 J	4,030
Chromium	0.29	5.6	64	430,000	--	74	28 J	27 J	35 J	5.6 J	25 J	14 J	6.2 J	6.6 J	11
Cobalt	2.3	30	13	0.50	--	25	12	12	11	5.8	9.3	13	7.1	7.2	11
Copper	310	4,100	70	52	--	68	**70**	51	**69**	18	49	42	26	29	26
Cyanide	160	2,000	16	2.0	--	--	1.4 U	1.1 U	1.1 U	1.1 U	1.0 U	1.3 U	1.2 U	1.2 U	1.2 U
Iron	5,500	72,000	--	660	--	37,531	29,700	23,900	23,500	12,700	21,200	27,300	23,700	22,700	26,400
Lead	400	800	120	27	--	6.9	**12**	**12**	**9.6**	4.3	6.0	6.1	2.5	2.4	4.0
Magnesium	--	--	--	--	--	12,834	7,650 J	5,810 J	8,950 J	1,840 J	6,010 J	5,920 J	2,780 J	3,540 J	4,250
Manganese	180	2,300	220	57	--	1,167	766 J	728 J	484 J	412 J	554 J	1,150 J	531 J	556 J	614 J
Mercury	0.78	10	0.10	0.40	--	0.031	0.020 J	0.020 J	0.033 U	0.020 J	0.010 J	0.030 J	0.035 U	0.037 U	0.030 J
Nickel	150	2,000	38	1,400	--	40	15	13	19	4.0 U	12	9.0	4.1 U	4.6 U	8.0 U
Potassium	--	--	--	--	--	1,700	799 J	614 J	505 J	485 J	1,100 J	1,080 J	503 J	571 J	1,100
Selenium	39	510	0.52	0.12	--	2.0	0.24 J	0.28 J	0.49 U	0.18 J	0.38 J	0.36 J	0.51 U	0.58 U	0.50 U
Silver	39	510	560	20	--	0.077	**1.3 J**	**1.0 J**	**1.1 J**	**0.57 J**	**0.90 J**	**1.2 J**	**0.84 J**	**0.78 J**	3.0 U
Sodium	--	--	--	--	--	6,300	418 J	270 J	1,650	199	328	357	326	380	1,950
Vanadium	39	520	2.0	180	--	130	97 J	83 J	89 J	39 J	73 J	89 J	82 J	83 J	86 J
Zinc	2,300	31,000	120	5,800	--	65	**85**	**71**	**72**	29	50	46	28	29	37
Total Petroleum Hydrocarbons (µg/kg)															
TPH-diesel range			--	--	100,000	--	20,000	16,000	20,000	6,600 U	22,000	45,000	7,000 U	7,200 U	NA
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

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Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO82		VWAR-SO83	VWAR-SO84	VWAR-SO85	VWAR-SO86	VWAR-SO87	VWAR-SO88	VWAR-SO89	VWAR-SO90
Sample ID							VWAR-SS82-01-0609	VWAR-SS82P-01-0609	VWAR-SS83-01-0609	VWAR-SS84-01-0609	VWAR-SS85-01-0609	VWAR-SS86-01-0609	VWAR-SS87-01-0609	VWAR-SS88-01-0609	VWAR-SS89-01-0609	VWAR-SS90-01-0609
Sample Date							06/01/09	06/01/09	06/01/09	06/02/09	06/02/09	06/03/09	06/03/09	06/03/09	06/04/09	06/10/09
Chemical Name																
Volatile Organic Compounds (µg/kg)																
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	6.0 U	6.0 U	5.0 U	4.0 U	4.0 U	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	4.0 UJ
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	32 U	32 U	29 U	25 U	26 U	31 UJ	29 UJ	29 UJ	29 UJ	26 UJ
Acetone	6,100,000	63,000,000	--	4,752	--	--	36 U	36 U	33 U	28 U	30 U	36 UJ	33 UJ	33 UJ	33 UJ	30 J
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	12 U	12 U	11 U	9.0 U	10 U	12 UJ	11 UJ	11 UJ	11 UJ	10 UJ
Methylene chloride	11,000	53,000	1,250	2.0	--	--	28 U	28 U	25 U	22 U	23 U	27 UJ	25 UJ	25 UJ	25 UJ	22 UJ
o-Xylene	380,000	434,000	2,400	37,616	--	--	6.0 U	6.0 U	5.0 U	4.0 U	4.0 U	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	4.0 UJ
Tetrachloroethene	550	2,600	200	5.6	--	--	7.0 U	7.0 U	6.0 U	5.0 U	5.0 U	6.0 UJ	6.0 UJ	6.0 UJ	6.0 UJ	5.0 UJ
Toluene	500,000	818,000	40,000	2,367	--	--	2.0 J	6.0 U	5.0 U	4.0 U	4.0 U	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	4.0 UJ
Trichloroethene	2,800	14,000	10	3.9	--	--	7.0 U	7.0 U	6.0 U	5.0 U	5.0 U	6.0 UJ	6.0 UJ	6.0 UJ	6.0 UJ	5.0 UJ
Xylene, total	63,000	258,000	2,400	37,670	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (µg/kg)																
2-Nitroaniline	61,000	600,000	--	230	--	--	25 U	25 U	21 U	21 U	21 U	21 UJ	21 UJ	7.2 J	22 UJ	22 U
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	120 U	120 U	100 U	100 U	100 U	100 UJ	110 UJ	7.9 J	6.3 J	110 U
4-Nitroaniline	24,000	86,000	--	2.1	--	--	25 U	25 U	21 U	21 U	21 U	21 R	21 UJ	23 R	22 R	22 UJ
Acenaphthene	340,000	3,300,000	--	110,000	--	--	420 U	420 U	340 U	350 U	340 U	340 UJ	350 UJ	390 UJ	360 UJ	370 U
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	420 U	420 U	340 U	350 U	340 U	340 UJ	350 UJ	390 UJ	360 UJ	370 U
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	25 U	25 U	21 U	21 U	21 U	21 UJ	8.2 J	23 UJ	2.9 J	3.0 J
Atrazine	2,100	7,500	12	6.1	--	--	25 UJ	25 UJ	21 UJ	21 UJ	21 UJ	21 UJ	21 UJ	**6.5 J**	5.9 J	22 UJ
Benzo(a)anthracene	150	2,100	--	54	--	--	420 U	420 U	340 U	350 U	340 U	340 UJ	**110 J**	390 UJ	360 UJ	370 U
Benzo(a)pyrene	15	210	--	1,259	--	--	25 U	25 U	21 U	21 U	21 U	21 UJ	**110 J**	23 UJ	**32 J**	**22 J**
Benzo(b)fluoranthene	150	2,100	--	186	--	--	25 U	25 U	21 U	21 U	21 U	6.2 J	140 J	9.2 J	48 J	36
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	420 U	420 U	340 U	350 U	340 U	340 UJ	140 J	390 UJ	360 UJ	370 U
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	420 U	420 U	340 U	350 U	340 U	340 UJ	170 J	390 UJ	360 UJ	370 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	420 U	420 U	340 U	350 U	340 U	340 UJ	350 UJ	390 UJ	360 UJ	370 U
Carbazole	24,000	86,000	--	93	--	--	25 U	25 U	21 U	21 U	21 U	21 UJ	2.6 J	23 UJ	22 UJ	2.0 J
Chrysene	15,000	210,000	--	5,476	--	--	420 U	420 U	340 U	350 U	340 U	340 UJ	160 J	390 UJ	360 UJ	370 U
Dibenz(a,h)anthracene	15	210	--	61	--	--	25 U	25 U	21 U	21 U	21 U	21 UJ	**24 J**	23 UJ	7.6 J	9.0 J
Dibenzofuran	7,800	100,000	--	3,351	--	--	420 U	420 U	340 U	350 U	340 U	340 UJ	350 UJ	390 UJ	360 UJ	370 U
Fluoranthene	230,000	2,200,000	--	900,000	--	--	25 U	25 U	21 U	21 U	21 U	3.6 J	94 J	6.1 J	27 J	19 J
Fluorene	230,000	2,200,000	--	140,000	--	--	420 U	420 U	340 U	350 U	340 U	340 UJ	350 UJ	390 UJ	360 UJ	370 U
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	25 U	25 U	21 U	21 U	21 U	21 UJ	140 J	23 UJ	42 J	39 J
PAH Total (HMW)	--	--	18,000	--	--	--	903 U	903 U	733 U	753 U	733 U	723	1,084	830	878	860
PAH Total (LMW)	--	--	29,000	--	--	--	1,100 U	1,100 U	892 U	917 U	892 U	885	994	1,016	952	962
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	25 U	25 U	21 U	21 U	21 U	21 UJ	6.3 J	23 UJ	22 UJ	4.0 J
Pyrene	170,000	1,700,000	--	610,000	--	--	25 U	25 U	21 U	21 U	21 U	5.3 J	90 J	6.5 J	28 J	14 J

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted and Eco (E) and SSL DAF 1

NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
NJ - Presumptively present at approximate quantity
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO82		VWAR-SO83	VWAR-SO84	VWAR-SO85	VWAR-SO86	VWAR-SO87	VWAR-SO88	VWAR-SO89	VWAR-SO90
Sample ID							VWAR-SS82-01-0609	VWAR-SS82P-01-0609	VWAR-SS83-01-0609	VWAR-SS84-01-0609	VWAR-SS85-01-0609	VWAR-SS86-01-0609	VWAR-SS87-01-0609	VWAR-SS88-01-0609	VWAR-SS89-01-0609	VWAR-SS90-01-0609
Sample Date							06/01/09	06/01/09	06/01/09	06/02/09	06/02/09	06/03/09	06/03/09	06/03/09	06/04/09	06/10/09
Chemical Name																
Pesticide/Polychlorinated Biphenyls (µg/kg)																
4,4'-DDD	2,000	7,200	583	342	--	--	4.2 U	4.2 U	6.8	1.3 J	3.4 U	3.4 UJ	3.5 UJ	3.9 UJ	3.6 UJ	2.9 J
4,4'-DDE	1,400	5,100	114	244	--	--	4.2 U	4.2 U	35	4.6	0.81 J	3.4 UJ	2.5 J	3.9 UJ	1.6 J	5.6
4,4'-DDT	1,700	7,000	100	352	--	--	4.2 U	4.2 U	91 J	20	0.85 J	3.4 U	2.9 J	3.9 U	1.7 J	3.3 J
alpha-Chlordane	1,600	6,500	11	1,386	--	--	2.1 U	2.1 U	1.8 U	1.8 U	1.8 U	1.8 UJ	1.8 UJ	2.0 UJ	1.8 UJ	1.9 U
Aroclor-1242	220	740	8,000	179	--	--	21 U	21 U	18 U	18 U	18 U	18 U	18 U	20 U	18 U	19 U
Aroclor-1254	110	740	8,000	302	--	--	38 U	38 U	31 U	32 U	31 U	31 U	32 U	35 U	32 U	33 U
Aroclor-1260	220	740	8,000	828	--	--	21 U	21 U	18 U	18 UJ	18 UJ	18 UJ	18 UJ	20 UJ	18 UJ	19 UJ
beta-BHC	270	960	342	1.0	--	--	2.1 U	2.1 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	2.0 U	1.8 U	1.9 U
Dieldrin	30	110	11	0.36	--	--	4.2 U	4.2 U	**1.9 J**	**0.68 J**	3.4 U	3.4 UJ	3.5 UJ	3.9 UJ	3.6 UJ	3.7 U
Endosulfan I	37,000	370,000	6.3	38,734	--	--	2.1 U	2.1 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	2.0 U	1.8 U	1.9 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	4.2 U	4.2 U	3.4 U	3.5 U	3.4 U	3.4 U	3.5 U	3.9 U	3.6 U	3.7 U
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	2.1 U	2.1 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	2.0 U	1.8 U	1.9 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	2.1 U	2.1 U	1.8 U	1.8 U	1.8 U	1.8 UJ	1.8 UJ	2.0 UJ	1.8 UJ	1.8 J
Explosives (µg/kg)																
Perchlorate	5,500	72,000	1,000	17	--	--	2.3 U	2.1 U	1.7 U	0.24 J	1.7 U	0.22 J	1.8 U	0.63 J	1.7 U	2.0 U
Total Metals (mg/kg)																
Aluminum	7,700	99,000	--	56,000	--	29,000	25,300 J	**31,600 J**	8,090 J	5,060 J	2,780 J	3,700	6,200	25,700	6,920	18,900
Antimony	3.1	41	78	0.27	--	2.3	0.098 UJ	0.072 UJ	0.066 UJ	0.096 UJ	0.097 UJ	0.089 UJ	0.072 UJ	0.10 UJ	0.085 UJ	0.14 J
Arsenic	0.39	1.6	18	0.31	--	2.2	0.60	0.89	0.33 U	0.48 U	0.48 U	0.16 J	0.25 J	0.51 J	0.20 J	0.86
Barium	1,500	19,000	330	100	--	320	164 J	**433 J**	43 J	76 J	63 J	40	70	170	58	128 J
Beryllium	16	200	40	400	--	0.45	0.40	0.44	0.15	0.12	0.080 J	0.10	0.12	0.32	0.15	0.27
Cadmium	7	80	32	20	--	0.040	0.098 U	0.072 U	0.066 U	0.096 U	0.097 U	0.89 U	0.072 U	0.10 U	0.085 U	**0.29**
Calcium	--	--	--	--	--	210,000	6,280 J	16,000 J	2,320	1,890	1,210	1,710	2,630	5,210	2,010	8,160
Chromium	0.29	5.6	64	430,000	--	74	10	12	3.4 J	2.5 J	1.7 J	2.0	2.7	14	3.2	15 J
Cobalt	2.3	30	13	0.50	--	25	9.3	15	4.3	4.5	3.5	2.8	4.2	8.0	5.4	11
Copper	310	4,100	70	52	--	68	24	26	13	10	10	8.4	13	23	15	30
Cyanide	160	2,000	16	2.0	--	--	1.1 U	1.2 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U
Iron	5,500	72,000	--	660	--	37,531	21,700	25,100	13,600	10,900	8,030	8,360	10,700	22,300	12,800	20,000
Lead	400	800	120	27	--	6.9	4.2	5.6	2.4	2.0	1.4	1.6	2.8	3.6	2.6	**19**
Magnesium	--	--	--	--	--	12,834	3,480	3,780	1,240	780	449	549	962	3,650	1,120	2,800 J
Manganese	180	2,300	220	57	--	1,167	692 J	**1,240 J**	310 J	541 J	441 J	327 J	529 J	550 J	496 J	914 J
Mercury	0.78	10	0.10	0.40	--	0.031	0.030 J	0.036 U	0.032 U	0.032 U	0.031 U	0.033 U	0.034 U	0.020 J	0.010 J	0.030 J
Nickel	150	2,000	38	1,400	--	40	5.3	7.2	1.5 J	1.1 J	0.73 J	0.68 J	1.3 J	5.0	1.6 J	5.9
Potassium	--	--	--	--	--	1,700	1,070	1,360	456	328	262	406 J	452 J	1,360 J	590 J	824 J
Selenium	39	510	0.52	0.12	--	2.0	0.49 U	0.36 U	0.33 U	0.48 U	0.48 U	0.44 U	0.36 U	0.53 U	0.43 U	0.54
Silver	39	510	560	20	--	0.077	**0.20 J**	2.2 U	**0.26 J**	**0.22 J**	**0.16 J**	**0.18 J**	**0.25 J**	**0.20 J**	**0.21 J**	**0.80 J**
Sodium	--	--	--	--	--	6,300	1,250	1,380	93	96 U	97 U	89 U	87	877	85 U	223
Vanadium	39	520	2.0	180	--	130	73 J	103 J	46 J	37 J	30 J	33	41	75	50	70 J
Zinc	2,300	31,000	120	5,800	--	65	33	37	16	12	7.6	8.2	13	30	14	**98**
Total Petroleum Hydrocarbons (µg/kg)																
TPH-diesel range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
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B - Analyte not detected above the level reported in blanks
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NJ - Presumptively present at approximate quantity
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mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

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Surface Soil Detection and Exceedance Summary
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Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO92	VWAR-SO93	VWAR-SO94	VWAR-SO95	VWAR-SO96	VWAR-SO97	VWAR-SO98	VWAR-SO99
Sample ID							VWAR-SS92-01-0609	VWAR-SS93-01-0609	VWAR-SS94-01-0609	VWAR-SS95-01-0609	VWAR-SS96-01-0609	VWAR-SS97-01-0609	VWAR-SS98-01-0609	VWAR-SS99-0H-0609
Sample Date							06/04/09	06/08/09	06/08/09	06/08/09	06/09/09	06/09/09	06/09/09	06/10/09
Chemical Name														
Volatile Organic Compounds (µg/kg)														
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	5.0 UJ	6.0 U	4.0 U	5.0 U	5.0 UJ	4.0 UJ	5.0 UJ	5.0 UJ
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	27 UJ	32 UJ	26 UJ	27 UJ	27 UJ	26 UJ	31 UJ	28 UJ
Acetone	6,100,000	63,000,000	--	4,752	--	--	31 UJ	37 U	30 U	31 U	31 UJ	29 UJ	35 UJ	32 UJ
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	10 UJ	12 U	10 U	10 U	10 UJ	10 UJ	12 UJ	11 UJ
Methylene chloride	11,000	53,000	1,250	2.0	--	--	23 UJ	28 U	22 U	24 U	23 UJ	22 UJ	26 UJ	24 UJ
o-Xylene	380,000	434,000	2,400	37,616	--	--	5.0 UJ	6.0 U	4.0 U	5.0 U	5.0 UJ	4.0 UJ	5.0 UJ	5.0 UJ
Tetrachloroethene	550	2,600	200	5.6	--	--	6.0 UJ	7.0 U	5.0 U	6.0 U	6.0 UJ	5.0 UJ	6.0 UJ	6.0 UJ
Toluene	500,000	818,000	40,000	2,367	--	--	5.0 UJ	6.0 U	4.0 U	5.0 U	5.0 UJ	4.0 UJ	5.0 UJ	5.0 UJ
Trichloroethene	2,800	14,000	10	3.9	--	--	6.0 UJ	7.0 U	5.0 U	6.0 U	6.0 UJ	5.0 UJ	6.0 UJ	6.0 UJ
Xylene, total	63,000	258,000	2,400	37,670	--	--	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (µg/kg)														
2-Nitroaniline	61,000	600,000	--	230	--	--	23 UJ	28 U	23 U	21 U	21 U	21 U	26 U	23 UJ
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	120 UJ	8.0 J	110 U	100 U	6.2 J	100 U	7.5 J	120 U
4-Nitroaniline	24,000	86,000	--	2.1	--	--	23 UJ	28 UJ	23 UJ	21 UJ	21 UJ	21 UJ	**6.2 J**	23 U
Acenaphthene	340,000	3,300,000	--	110,000	--	--	380 UJ	460 UJ	370 UJ	350 UJ	350 UJ	350 U	420 UJ	390 UJ
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	380 UJ	460 UJ	370 UJ	350 UJ	350 UJ	350 U	420 UJ	390 U
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	3.3 J	28 U	32	21 U	2.2 J	4.0 J	26 U	4.6 J
Atrazine	2,100	7,500	12	6.1	--	--	23 UJ	28 UJ	23 UJ	21 UJ	21 UJ	21 UJ	**7.2 J**	23 UJ
Benzo(a)anthracene	150	2,100	--	54	--	--	380 UJ	460 U	**320 J**	350 U	350 U	350 U	420 U	390 U
Benzo(a)pyrene	15	210	--	1,259	--	--	**25 J**	28 U	**370**	21 U	**16 J**	**26**	26 U	**36**
Benzo(b)fluoranthene	150	2,100	--	186	--	--	50 J	28 U	**530**	5.8 J	23	29	7.1 J	52
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	380 UJ	460 U	200 J	350 U	350 U	350 U	420 U	390 U
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	380 UJ	460 U	410	350 U	350 U	350 U	420 U	390 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	380 UJ	460 U	370 U	350 U	120 J	350 U	420 U	390 U
Carbazole	24,000	86,000	--	93	--	--	23 UJ	28 U	16 J	21 U	2.5 J	2.0 J	1.8 J	5.3 J
Chrysene	15,000	210,000	--	5,476	--	--	380 UJ	460 UJ	460 J	350 UJ	350 UJ	350 U	420 UJ	390 U
Dibenz(a,h)anthracene	15	210	--	61	--	--	11 J	28 U	**85**	21 U	21 U	9.0 J	4.2 J	**19 J**
Dibenzofuran	7,800	100,000	--	3,351	--	--	380 UJ	460 UJ	370 UJ	350 UJ	350 UJ	350 U	420 UJ	390 U
Fluoranthene	230,000	2,200,000	--	900,000	--	--	20 J	28 UJ	460	3.1 J	26 J	47 J	8.0 J	37 J
Fluorene	230,000	2,200,000	--	140,000	--	--	380 UJ	460 U	370 U	350 U	350 U	350 U	420 U	390 U
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	46 J	28 U	**510**	21 U	24	43 J	26 UJ	69 J
PAH Total (HMW)	--	--	18,000	--	--	--	932	990 U	3,295	741	793	838	883	978
PAH Total (LMW)	--	--	29,000	--	--	--	996	1,206 U	1,457	910	922	944	1,097	1,031
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	23 UJ	28 UJ	28 J	21 UJ	8.5 J	7.0 J	26 UJ	3.3 J
Pyrene	170,000	1,700,000	--	610,000	--	--	40 J	28 UJ	410	3.8 J	19 J	31 J	6.0 J	22 J

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
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NA - Not analyzed
B - Analyte not detected above the level reported in blanks
J - Analyte present, value may or may not be accurate or precise
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U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds Vieques (West) Bkgd Zone Ktd.

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AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO92	VWAR-SO93	VWAR-SO94	VWAR-SO95	VWAR-SO96	VWAR-SO97	VWAR-SO98	VWAR-SO99
Sample ID							VWAR-SS92-01-0609	VWAR-SS93-01-0609	VWAR-SS94-01-0609	VWAR-SS95-01-0609	VWAR-SS96-01-0609	VWAR-SS97-01-0609	VWAR-SS98-01-0609	VWAR-SS99-0H-0609
Sample Date							06/04/09	06/08/09	06/08/09	06/08/09	06/09/09	06/09/09	06/09/09	06/10/09
Chemical Name														
Pesticide/Polychlorinated Biphenyls (µg/kg)														
4,4'-DDD	2,000	7,200	583	342	--	--	3.8 UJ	4.6 U	3.7 J	3.5 UJ	2.6 J	2.0 J	4.2 UJ	2.6 J
4,4'-DDE	1,400	5,100	114	244	--	--	0.81 J	4.6 U	12 J	3.5 UJ	110	55	2.8 J	89
4,4'-DDT	1,700	7,000	100	352	--	--	0.70 J	4.6 U	41 J	3.5 UJ	80	43	3.4 J	26
alpha-Chlordane	1,600	6,500	11	1,386	--	--	2.0 U	2.4 U	1.9 UJ	1.8 UJ	1.8 UJ	1.8 U	2.2 U	2.0 U
Aroclor-1242	220	740	8,000	179	--	--	20 U	24 U	19 U	18 U	18 U	18 U	22 U	20 U
Aroclor-1254	110	740	8,000	302	--	--	34 U	42 U	34 U	32 U	32 U	32 U	38 U	35 U
Aroclor-1260	220	740	8,000	828	--	--	20 UJ	24 UJ	19 UJ	18 UJ	18 UJ	18 UJ	22 UJ	20 UJ
beta-BHC	270	960	342	1.0	--	--	2.0 U	2.4 U	1.9 UJ	1.8 UJ	1.8 UJ	1.8 U	2.2 U	2.0 U
Dieldrin	30	110	11	0.36	--	--	3.8 U	4.6 U	3.7 UJ	3.5 UJ	3.5 UJ	3.5 U	4.2 U	3.9 U
Endosulfan I	37,000	370,000	6.3	38,734	--	--	2.0 U	2.4 U	1.9 UJ	1.8 UJ	1.8 UJ	1.8 U	2.2 U	2.0 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	3.8 U	4.6 U	3.7 UJ	3.5 UJ	3.5 UJ	3.5 U	4.2 U	**3.0 J**
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	2.0 U	2.4 U	1.9 UJ	1.8 UJ	1.8 UJ	1.8 U	2.2 U	2.0 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	2.0 U	2.4 U	1.9 UJ	1.8 UJ	1.8 UJ	1.8 U	2.2 U	2.0 U
Explosives (µg/kg)														
Perchlorate	5,500	72,000	1,000	17	--	--	2.1 U	0.31 J	0.38 J	0.29 J	0.41 J	0.30 J	0.60 J	2.0 U
Total Metals (mg/kg)														
Aluminum	7,700	99,000	--	56,000	--	29,000	23,100	**34,400**	20,700	9,700	9,830	13,900	14,800	21,500
Antimony	3.1	41	78	0.27	--	2.3	0.094 UJ	0.12 UJ	0.069 UJ	0.064 UJ	0.030 J	0.12 J	0.10 UJ	0.18 J
Arsenic	0.39	1.6	18	0.31	--	2.2	0.75 J	0.80	0.59	0.23 J	0.41 J	0.82	0.64	1.2
Barium	1,500	19,000	330	100	--	320	125	165 J	**522 J**	35 J	58 J	144 J	95 J	88 J
Beryllium	16	200	40	400	--	0.45	0.34	**0.50**	0.33	0.15	0.17	0.18	0.27	0.19
Cadmium	7	80	32	20	--	0.040	0.094 U	0.12 U	**0.14**	0.064 U	0.093 U	**0.11**	0.10 U	**0.16**
Calcium	--	--	--	--	--	210,000	5,510	6,460 R	4,580 R	2,270 R	3,290 R	19,400	4,970 R	29,900
Chromium	0.29	5.6	64	430,000	--	74	9.0	12	7.0	2.9	5.4	18 J	6.1	40 J
Cobalt	2.3	30	13	0.50	--	25	8.6	13	**28**	4.3	6.9	11	9.7	13
Copper	310	4,100	70	52	--	68	29	37	33	16	28	35	29	58
Cyanide	160	2,000	16	2.0	--	--	1.1 U	1.2 U	1.1 U	1.0 U	1.0 U	1.0 U	1.2 U	1.1 U
Iron	5,500	72,000	--	660	--	37,531	21,900	30,800	25,600	12,600	17,600	20,600	20,900	26,400
Lead	400	800	120	27	--	6.9	4.7	**7.5**	5.8	2.3	4.2	5.1	**7.4**	**15**
Magnesium	--	--	--	--	--	12,834	3,180	4,240 J	2,500 J	1,180 J	2,140 J	4,770 J	2,250 J	9,680 J
Manganese	180	2,300	220	57	--	1,167	626 J	1,120	**4,500**	378	617	**1,210 J**	983	597 J
Mercury	0.78	10	0.10	0.40	--	0.031	**0.040**	**0.040 J**	0.020 J	0.020 J	0.010 J	0.020 J	0.020 J	0.010 J
Nickel	150	2,000	38	1,400	--	40	4.2	9.8 U	6.4	2.5 U	3.7 U	11	4.2 U	21
Potassium	--	--	--	--	--	1,700	996 J	1,550 J	919 J	515 J	1,500 J	970 J	1,330 J	723 J
Selenium	39	510	0.52	0.12	--	2.0	0.47 U	0.61 U	0.35 U	0.32 U	0.47 U	0.34 J	0.53 U	0.53 U
Silver	39	510	560	20	--	0.077	**0.21 J**	3.7 U	**1.0 J**	**0.28 J**	**0.45 J**	**0.94 J**	**0.59 J**	**1.1 J**
Sodium	--	--	--	--	--	6,300	684	562	242	115	122	315	165	533
Vanadium	39	520	2.0	180	--	130	77	98	77	39	56	68 J	65	98 J
Zinc	2,300	31,000	120	5,800	--	65	33	46 J	38 J	16 J	30 J	40	37 J	55
Total Petroleum Hydrocarbons (µg/kg)														
TPH-diesel range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	19,000 J
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
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AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO100		VWAR-SO101		VWAR-SO102			VWAR-SO103	VWAR-SO104
Sample ID							VWAR-SS100-0H-0609	VWAR-SS100P-0H-0609	116701-0R-Z-101	116701-0R-Z-113	116701-0R-Z-102	116701-0R-Z-115	116701-0R-Z-123	116701-0R-Z-103	116701-0R-Z-104
Sample Date							06/10/09	06/10/09	03/18/09	03/18/09	03/18/09	04/06/09	07/01/09	03/18/09	03/18/09
Chemical Name															
Volatile Organic Compounds (µg/kg)															
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	5.0 UJ	5.0 UJ	6.2 U	5.8 U	NA	6.0 U	NA	7.9 U	5.6 U
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	29 UJ	28 UJ	31 U	29 U	NA	30 U	NA	39 U	28 U
Acetone	6,100,000	63,000,000	--	4,752	--	--	33 UJ	32 UJ	62 U	58 U	NA	60 UJ	NA	79 U	56 U
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	11 UJ	11 UJ	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	11,000	53,000	1,250	2.0	--	--	25 UJ	24 UJ	**68**	12 U	NA	12 U	NA	**39**	**22**
o-Xylene	380,000	434,000	2,400	37,616	--	--	5.0 UJ	5.0 UJ	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	550	2,600	200	5.6	--	--	6.0 UJ	6.0 UJ	6.2 U	5.8 U	NA	6.0 U	NA	7.9 U	5.6 U
Toluene	500,000	818,000	40,000	2,367	--	--	5.0 UJ	5.0 UJ	6.2 U	5.8 U	NA	6.0 U	NA	7.9 U	5.6 U
Trichloroethene	2,800	14,000	10	3.9	--	--	6.0 UJ	6.0 UJ	6.2 U	5.8 U	NA	6.0 U	NA	7.9 U	5.6 U
Xylene, total	63,000	258,000	2,400	37,670	--	--	NA	NA	19 U	17 U	NA	18 U	NA	24 U	17 U
Semivolatile Organic Compounds (µg/kg)															
2-Nitroaniline	61,000	600,000	--	230	--	--	23 UJ	21 UJ	350 U	350 U	NA	370 U	NA	380 U	370 U
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	120 U	100 U	170 U	180 U	NA	180 U	NA	190 U	180 U
4-Nitroaniline	24,000	86,000	--	2.1	--	--	23 U	21 U	350 U	350 U	NA	370 U	NA	380 U	370 U
Acenaphthene	340,000	3,300,000	--	110,000	--	--	380 UJ	340 UJ	170 U	180 U	NA	1,440	NA	190 U	180 U
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	380 U	340 U	170 U	180 U	NA	91.5 J	NA	190 U	180 U
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	9.3 J	18 J	170 U	180 U	NA	1,900	NA	190 U	180 U
Atrazine	2,100	7,500	12	6.1	--	--	23 UJ	21 UJ	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	150	2,100	--	54	--	--	380 U	**100 J**	27 U	28 U	NA	**1,830**	NA	31 U	22 J
Benzo(a)pyrene	15	210	--	1,259	--	--	**69**	**140**	27 U	28 U	NA	**750**	NA	31 U	**22 J**
Benzo(b)fluoranthene	150	2,100	--	186	--	--	100	**190**	21 J	20 J	NA	**1,460**	NA	31 U	24 J
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	380 U	340 U	27 U	28 U	NA	324	NA	31 U	29 U
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	380 U	140 J	27 U	28 U	NA	520	NA	31 U	24 J
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	380 U	340 U	350 U	350 U	NA	370 U	NA	380 U	1,080
Carbazole	24,000	86,000	--	93	--	--	5.8 J	9.0 J	170 U	180 U	NA	**218**	NA	190 U	180 U
Chrysene	15,000	210,000	--	5,476	--	--	380 U	200 J	27 U	28 U	NA	2,120	NA	31 U	26 J
Dibenz(a,h)anthracene	15	210	--	61	--	--	**22 J**	**39 J**	27 U	28 U	NA	**81 J**	NA	31 U	29 U
Dibenzofuran	7,800	100,000	--	3,351	--	--	380 U	340 U	170 U	180 U	NA	1,170	NA	190 U	180 U
Fluoranthene	230,000	2,200,000	--	900,000	--	--	64 J	150 J	170 U	180 U	NA	8,870	NA	190 U	45 J
Fluorene	230,000	2,200,000	--	140,000	--	--	380 U	340 U	170 U	180 U	NA	2,020	NA	190 U	180 U
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	120 J	**220 J**	27 U	28 U	NA	**373**	NA	31 U	29 U
PAH Total (HMW)	--	--	18,000	--	--	--	1,114	1,309	200	208	NA	13,848	NA	219 U	251
PAH Total (LMW)	--	--	29,000	--	--	--	1,040	1,040	765 U	810 U	NA	27,692	NA	855 U	765
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	5.1 J	11 J	170 U	180 U	NA	13,100	NA	190 U	180 U
Pyrene	170,000	1,700,000	--	610,000	--	--	43 J	110 J	170 U	180 U	NA	6,390	NA	190 U	180 U

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
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Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF [1]	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO100		VWAR-SO101		VWAR-SO102			VWAR-SO103	VWAR-SO104
Sample ID							VWAR-SS100-0H-0609	VWAR-SS100P-0H-0609	116701-0R-Z-101	116701-0R-Z-113	116701-0R-Z-102	116701-0R-Z-115	116701-0R-Z-123	116701-0R-Z-103	116701-0R-Z-104
Sample Date							06/10/09	06/10/09	03/18/09	03/18/09	03/18/09	04/06/09	07/01/09	03/18/09	03/18/09
Chemical Name															
Pesticide/Polychlorinated Biphenyls (µg/kg)				**SSL DAF 1**											
4,4'-DDD	2,000	7,200	583	342	--	--	6.8 J	31	3.4 U	3.5 U	NA	7.2 U	NA	10	6.1
4,4'-DDE	1,400	5,100	114	244	--	--	49	57	2.5 J	6.0	NA	25	NA	106	**334**
4,4'-DDT	1,700	7,000	100	352	--	--	28	58	1.2 J	5.2	NA	11	NA	**351**	**137**
alpha-Chlordane	1,600	6,500	11	1,386	--	--	2.0 U	1.8 U	1.7 U	1.7 U	NA	3.6 U	NA	1.9 U	1.8 U
Aroclor-1242	220	740	8,000	179	--	--	20 U	18 UJ	17 U	17 U	NA	NA	18 U	19 U	18 U
Aroclor-1254	110	740	8,000	302	--	--	35 U	31 U	17 U	17 U	NA	NA	18 U	19 U	18 U
Aroclor-1260	220	740	8,000	828	--	--	20 UJ	18 UJ	17 U	17 U	NA	NA	18 U	19 U	18 U
beta-BHC	270	960	342	1.0	--	--	2.0 U	1.8 U	1.7 U	1.7 U	NA	3.6 U	NA	1.9 U	1.8 U
Dieldrin	30	110	11	0.36	--	--	**2.2 J**	**9.4**	1.7 U	1.7 U	NA	3.6 U	NA	**2.6**	1.8 U
Endosulfan I	37,000	370,000	6.3	38,734	--	--	2.0 U	1.8 U	1.7 U	1.7 U	NA	3.6 U	NA	1.9 U	1.8 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	3.8 U	3.4 U	3.4 U	3.5 U	NA	7.2 U	NA	3.8 U	3.7 U
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	2.0 U	1.8 U	1.7 U	1.7 U	NA	3.6 U	NA	1.9 U	1.8 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	2.0 U	1.8 U	1.7 U	1.7 U	1.8 U	3.6 U	NA	1.9 U	1.8 U
Explosives (µg/kg)															
Perchlorate	5,500	72,000	1,000	17	--	--	1.9 U	1.8 U	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)															
Aluminum	7,700	99,000	--	56,000	--	29,000	17,300	17,400	18,600	18,700	NA	11,400 J	NA	8,710	15,200
Antimony	3.1	41	78	0.27	--	2.3	0.16 J	0.30 J	12 U	12 U	NA	0.43 J	NA	35 U	13 U
Arsenic	0.39	1.6	18	0.31	--	2.2	1.7	1.5	0.89 J	1.6 U	NA	1.1 J	NA	2.1 J	1.7 U
Barium	1,500	19,000	330	100	--	320	110 J	120 J	79	66	NA	154 J	NA	55	60
Beryllium	16	200	40	400	--	0.45	0.17	0.14	0.17 J	0.18 J	NA	0.44	NA	0.29 U	0.17 J
Cadmium	7	80	32	20	--	0.040	**0.20**	**0.16**	0.79 U	0.82 U	NA	0.21 U	NA	**0.73**	0.87 U
Calcium	--	--	--	--	--	210,000	56,100	40,200	8,390	6,840	NA	5,140 J	NA	177,000	16,100
Chromium	0.29	5.6	64	430,000	--	74	34 J	30 J	52	46	NA	33 J	NA	9.9	26
Cobalt	2.3	30	13	0.50	--	25	8.8	9.6	16	17	NA	18 J	NA	3.8	14
Copper	310	4,100	70	52	--	68	43	42	65	59	NA	31 J	NA	16	61
Cyanide	160	2,000	16	2.0	--	--	1.2 U	1.0 U	0.13	0.12 U	NA	0.20 J	NA	0.13 U	0.13 U
Iron	5,500	72,000	--	660	--	37,531	21,600	20,500	25,400	27,700	NA	23,200 J	NA	7,330	23,200
Lead	400	800	120	27	--	6.9	**20**	**26**	4.3 J	2.1 J	NA	5.3 J	NA	**39 J**	**26**
Magnesium	--	--	--	--	--	12,834	7,830 J	8,770 J	9,310	11,300	NA	2,900 J	NA	3,930	8,810
Manganese	180	2,300	220	57	--	1,167	465 J	484 J	629	668	NA	954 J	NA	293	720
Mercury	0.78	10	0.10	0.40	--	0.031	0.010 J	0.034 U	0.011 J	0.013	NA	**0.034 J**	NA	**0.052 J**	**0.039 J**
Nickel	150	2,000	38	1,400	--	40	15	17	28	27	NA	14 J	NA	3.5	19
Potassium	--	--	--	--	--	1,700	632 J	522 J	505	405 J	NA	292 J	NA	**1,870**	979
Selenium	39	510	0.52	0.12	--	2.0	0.54 U	0.44 U	20 U	21 U	NA	5.2 UJ	NA	**7.0 J**	22 U
Silver	39	510	560	20	--	0.077	**0.84 J**	**0.82 J**	0.49 U	0.51 U	NA	0.52 U	NA	0.58 U	0.54 U
Sodium	--	--	--	--	--	6,300	712	631	261 J	229 J	NA	215 J	NA	1,790	74 J
Vanadium	39	520	2.0	180	--	130	88 J	70 J	79	77	NA	115 J	NA	22	69
Zinc	2,300	31,000	120	5,800	--	65	42	43	50	50	NA	35 J	NA	55	**135**
Total Petroleum Hydrocarbons (µg/kg)															
TPH-diesel range			--	--	100,000	--	24,000	21,000	14,500	18,400	15,100	NA	NA	12,200	9,200 U
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1

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mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
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Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO105			VWAR-SO106			VWAR-SO107			VWAR-SO108
Sample ID							116701-0R-Z-105	116701-0R-Z-116	116701-0R-Z-124	116701-0R-Z-106	116701-0R-Z-117	116701-0R-Z-125	116701-0R-Z-107	116701-0R-Z-118	116701-0R-Z-126	116701-0R-Z-108
Sample Date							03/18/09	04/06/09	07/01/09	03/18/09	04/06/09	07/01/09	03/18/09	04/06/09	07/01/09	03/18/09
Chemical Name																
Volatile Organic Compounds (µg/kg)																
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	NA	6.0 U	NA	NA	5.6 U	NA	NA	6.1 U	NA	6.6 U
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	NA	30 U	NA	NA	28 U	NA	NA	31 U	NA	33 U
Acetone	6,100,000	63,000,000	--	4,752	--	--	NA	60 U	NA	NA	56 UJ	NA	NA	61 UJ	NA	66 U
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	11,000	53,000	1,250	2.0	--	--	NA	12 U	NA	NA	11 U	NA	NA	12 U	NA	**53**
o-Xylene	380,000	434,000	2,400	37,616	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	550	2,600	200	5.6	--	--	NA	6.0 U	NA	NA	5.6 U	NA	NA	6.1 U	NA	6.6 U
Toluene	500,000	818,000	40,000	2,367	--	--	NA	6.0 U	NA	NA	5.6 U	NA	NA	6.1 U	NA	6.6 U
Trichloroethene	2,800	14,000	10	3.9	--	--	NA	6.0 U	NA	NA	5.6 U	NA	NA	6.1 U	NA	6.6 U
Xylene, total	63,000	258,000	2,400	37,670	--	--	NA	18 U	NA	NA	17 U	NA	NA	18 U	NA	20 U
Semivolatile Organic Compounds (µg/kg)																
2-Nitroaniline	61,000	600,000	--	230	--	--	NA	350 U	NA	NA	340 U	NA	NA	370 U	NA	370 U
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	NA	180 U	NA	NA	170 U	NA	NA	190 U	NA	190 U
4-Nitroaniline	24,000	86,000	--	2.1	--	--	NA	350 U	NA	NA	340 U	NA	NA	370 U	NA	370 U
Acenaphthene	340,000	3,300,000	--	110,000	--	--	NA	180 U	NA	NA	170 U	NA	NA	190 U	NA	190 U
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	NA	37 J	NA	NA	170 U	NA	NA	190 U	NA	190 U
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	NA	180 U	NA	NA	170 U	NA	NA	48 J	NA	190 U
Atrazine	2,100	7,500	12	6.1	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	150	2,100	--	54	--	--	NA	50 J	NA	NA	35 J	NA	NA	**114**	NA	25 J
Benzo(a)pyrene	15	210	--	1,259	--	--	NA	**80 J**	NA	NA	**16 J**	NA	NA	**104**	NA	**30**
Benzo(b)fluoranthene	150	2,100	--	186	--	--	NA	148 J	NA	NA	62 J	NA	NA	**176 J**	NA	70 J
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	NA	80 J	NA	NA	27 U	NA	NA	62	NA	17 J
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	NA	49 J	NA	NA	21 J	NA	NA	133	NA	29
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	NA	350 U	NA	NA	340 U	NA	NA	370 U	NA	370 U
Carbazole	24,000	86,000	--	93	--	--	NA	180 U	NA	NA	170 U	NA	NA	190 U	NA	190 U
Chrysene	15,000	210,000	--	5,476	--	--	NA	71 J	NA	NA	38 J	NA	NA	190	NA	45 J
Dibenz(a,h)anthracene	15	210	--	61	--	--	NA	29 U	NA	NA	27 U	NA	NA	**15 J**	NA	29 U
Dibenzofuran	7,800	100,000	--	3,351	--	--	NA	180 U	NA	NA	170 U	NA	NA	190 U	NA	190 U
Fluoranthene	230,000	2,200,000	--	900,000	--	--	NA	59.5 J	NA	NA	39.8 J	NA	NA	615	NA	58 J
Fluorene	230,000	2,200,000	--	140,000	--	--	NA	180 U	NA	NA	170 U	NA	NA	190 U	NA	190 U
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	NA	73 J	NA	NA	27 U	NA	NA	79	NA	22 J
PAH Total (HMW)	--	--	18,000	--	--	--	NA	648	NA	NA	257	NA	NA	1,283	NA	307
PAH Total (LMW)	--	--	29,000	--	--	--	NA	727	NA	NA	720	NA	NA	1,766	NA	818
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	NA	180 U	NA	NA	170 U	NA	NA	533	NA	190 U
Pyrene	170,000	1,700,000	--	610,000	--	--	NA	82 J	NA	NA	44 J	NA	NA	410	NA	55 J

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1

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Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF [1]	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO105			VWAR-SO106			VWAR-SO107			VWAR-SO108
Sample ID							116701-0R-Z-105	116701-0R-Z-116	116701-0R-Z-124	116701-0R-Z-106	116701-0R-Z-117	116701-0R-Z-125	116701-0R-Z-107	116701-0R-Z-118	116701-0R-Z-126	116701-0R-Z-108
Sample Date							03/18/09	04/06/09	07/01/09	03/18/09	04/06/09	07/01/09	03/18/09	04/06/09	07/01/09	03/18/09
Chemical Name																
Pesticide/Polychlorinated Biphenyls (µg/kg)				**SSL DAF 1**												
4,4'-DDD	2,000	7,200	583	342	--	--	NA	3.5 U	NA	NA	3.4 U	NA	NA	3.6 U	NA	3.7 U
4,4'-DDE	1,400	5,100	114	244	--	--	NA	2.2 J	NA	NA	3.0 J	NA	NA	2.7 J	NA	7.6
4,4'-DDT	1,700	7,000	100	352	--	--	NA	1.8 J	NA	NA	2.4 J	NA	NA	1.9 J	NA	4.4
alpha-Chlordane	1,600	6,500	11	1,386	--	--	NA	1.7 U	NA	NA	1.7 U	NA	NA	1.8 U	NA	1.8 U
Aroclor-1242	220	740	8,000	179	--	--	NA	NA	18 U	NA	NA	17 U	NA	NA	20 U	18 U
Aroclor-1254	110	740	8,000	302	--	--	NA	NA	18 U	NA	NA	17 U	NA	NA	20 U	18 U
Aroclor-1260	220	740	8,000	828	--	--	NA	NA	18 U	NA	NA	17 U	NA	NA	20 U	18 U
beta-BHC	270	960	342	1.0	--	--	NA	1.7 U	NA	NA	1.7 U	NA	NA	1.8 U	NA	1.8 U
Dieldrin	30	110	11	0.36	--	--	NA	1.7 U	NA	NA	1.7 U	NA	NA	1.8 U	NA	1.8 U
Endosulfan I	37,000	370,000	6.3	38,734	--	--	NA	1.7 U	NA	NA	1.7 U	NA	NA	1.8 U	NA	1.8 U
Endrin aldehyde	1,800	18,000	2.0	170	--	--	NA	3.5 U	NA	NA	3.4 U	NA	NA	3.6 U	NA	3.7 U
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	NA	1.7 U	NA	NA	1.7 U	NA	NA	1.8 U	NA	1.8 U
gamma-Chlordane	1,600	6,500	11	1,386	--	--	36 U	1.7 U	NA	1.7 U	1.7 U	NA	1.9 U	1.8 U	NA	1.8 U
Explosives (µg/kg)																
Perchlorate	5,500	72,000	1,000	17	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)																
Aluminum	7,700	99,000	--	56,000	--	29,000	NA	9,760 J	NA	NA	4,590 J	NA	NA	12,000 J	NA	14,700
Antimony	3.1	41	78	0.27	--	2.3	NA	3.1 U	NA	NA	3.0 U	NA	NA	3.3 U	NA	13 U
Arsenic	0.39	1.6	18	0.31	--	2.2	NA	1.3	NA	NA	0.34 J	NA	NA	0.89	NA	1.7 U
Barium	1,500	19,000	330	100	--	320	NA	63 J	NA	NA	40 J	NA	NA	110 J	NA	167
Beryllium	16	200	40	400	--	0.45	NA	0.29	NA	NA	0.17 J	NA	NA	0.37	NA	0.34
Cadmium	7	80	32	20	--	0.040	NA	0.21 U	NA	NA	0.20 U	NA	NA	0.22 U	NA	0.85 U
Calcium	--	--	--	--	--	210,000	NA	11,300 J	NA	NA	1,790 J	NA	NA	7,640 J	NA	15,700
Chromium	0.29	5.6	64	430,000	--	74	NA	6.6 J	NA	NA	2.5 J	NA	NA	7.3 J	NA	6.3
Cobalt	2.3	30	13	0.50	--	25	NA	8.3 J	NA	NA	4.5 J	NA	NA	11 J	NA	14
Copper	310	4,100	70	52	--	68	NA	46 J	NA	NA	11 J	NA	NA	32 J	NA	32
Cyanide	160	2,000	16	2.0	--	--	NA	0.32 J	NA	NA	0.25 J	NA	NA	0.40 J	NA	0.12 U
Iron	5,500	72,000	--	660	--	37,531	NA	18,100 J	NA	NA	7,290 J	NA	NA	17,300 J	NA	22,400
Lead	400	800	120	27	--	6.9	NA	**7.1 J**	NA	NA	1.8 J	NA	NA	4.6 J	NA	**7.0 J**
Magnesium	--	--	--	--	--	12,834	NA	1,910 J	NA	NA	962 J	NA	NA	3,340 J	NA	3,010
Manganese	180	2,300	220	57	--	1,167	NA	689	NA	NA	389	NA	NA	1,010	NA	**1,490**
Mercury	0.78	10	0.10	0.40	--	0.031	NA	0.014 J	NA	NA	0.014 J	NA	NA	0.029 J	NA	**0.038 J**
Nickel	150	2,000	38	1,400	--	40	NA	3.4 J	NA	NA	1.6 J	NA	NA	5.3 J	NA	5.5
Potassium	--	--	--	--	--	1,700	NA	591 J	NA	NA	376 J	NA	NA	766 J	NA	1,110
Selenium	39	510	0.52	0.12	--	2.0	NA	5.2 U	NA	NA	5.0 U	NA	NA	5.6 U	NA	21 U
Silver	39	510	560	20	--	0.077	NA	0.52 U	NA	NA	0.50 U	NA	NA	0.56 U	NA	0.53 U
Sodium	--	--	--	--	--	6,300	NA	53 J	NA	NA	500 U	NA	NA	215 J	NA	275 J
Vanadium	39	520	2.0	180	--	130	NA	55 J	NA	NA	24 J	NA	NA	51 J	NA	76
Zinc	2,300	31,000	120	5,800	--	65	NA	32 J	NA	NA	13 J	NA	NA	33 J	NA	39
Total Petroleum Hydrocarbons (µg/kg)																
TPH-diesel range			--	--	100,000	--	13,100	NA	NA	97,100	NA	NA	35,100	NA	NA	9,200 U
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
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Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1

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Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO109			VWAR-SO110	VWAR-SO111			
Sample ID							116701-0R-Z-109	116701-0R-Z-119	116701-0R-Z-127	116701-0R-Z-110	116701-0R-Z-111	116701-0R-Z-114	116701-0R-Z-120	116701-0R-Z-128
Sample Date							03/18/09	04/06/09	07/01/09	03/18/09	03/18/09	03/18/09	04/06/09	07/01/09
Chemical Name														
Volatile Organic Compounds (µg/kg)														
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	NA	6.3 U	NA	5.5 U	NA	NA	6.4 U	NA
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	NA	31 U	NA	28 U	NA	NA	32 U	NA
Acetone	6,100,000	63,000,000	--	4,752	--	--	NA	63 UJ	NA	55 U	NA	NA	64 UJ	NA
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	11,000	53,000	1,250	2.0	--	--	NA	13 U	NA	**11 J**	NA	NA	13 U	NA
o-Xylene	380,000	434,000	2,400	37,616	--	--	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	550	2,600	200	5.6	--	--	NA	6.3 U	NA	5.5 U	NA	NA	6.4 U	NA
Toluene	500,000	818,000	40,000	2,367	--	--	NA	6.3 U	NA	5.5 U	NA	NA	6.4 U	NA
Trichloroethene	2,800	14,000	10	3.9	--	--	NA	6.3 U	NA	5.5 U	NA	NA	6.4 U	NA
Xylene, total	63,000	258,000	2,400	37,670	--	--	NA	19 U	NA	17 U	NA	NA	19 U	NA
Semivolatile Organic Compounds (µg/kg)														
2-Nitroaniline	61,000	600,000	--	230	--	--	NA	380 U	NA	360 U	NA	NA	370 U	NA
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	NA	190 U	NA	180 U	NA	NA	180 U	NA
4-Nitroaniline	24,000	86,000	--	2.1	--	--	NA	380 U	NA	360 U	NA	NA	370 U	NA
Acenaphthene	340,000	3,300,000	--	110,000	--	--	NA	190 U	NA	180 U	NA	NA	180 U	NA
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	NA	190 U	NA	180 U	NA	NA	180 U	NA
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	NA	190 U	NA	180 U	NA	NA	180 U	NA
Atrazine	2,100	7,500	12	6.1	--	--	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	150	2,100	--	54	--	--	NA	**60 J**	NA	29 U	NA	NA	48 J	NA
Benzo(a)pyrene	15	210	--	1,259	--	--	NA	**62 J**	NA	29 U	NA	NA	**38 J**	NA
Benzo(b)fluoranthene	150	2,100	--	186	--	--	NA	129 J	NA	29 U	NA	NA	82 J	NA
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	NA	41 J	NA	29 U	NA	NA	29 U	NA
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	NA	45 J	NA	29 U	NA	NA	22 J	NA
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	NA	380 U	NA	360 U	NA	NA	370 U	NA
Carbazole	24,000	86,000	--	93	--	--	NA	190 U	NA	180 U	NA	NA	180 U	NA
Chrysene	15,000	210,000	--	5,476	--	--	NA	79 J	NA	29 U	NA	NA	55 J	NA
Dibenz(a,h)anthracene	15	210	--	61	--	--	NA	30 U	NA	29 U	NA	NA	29 U	NA
Dibenzofuran	7,800	100,000	--	3,351	--	--	NA	190 U	NA	180 U	NA	NA	180 U	NA
Fluoranthene	230,000	2,200,000	--	900,000	--	--	NA	55 J	NA	180 U	NA	NA	64 J	NA
Fluorene	230,000	2,200,000	--	140,000	--	--	NA	190 U	NA	180 U	NA	NA	180 U	NA
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	NA	43 J	NA	29 U	NA	NA	29 U	NA
PAH Total (HMW)	--	--	18,000	--	--	--	NA	546	NA	206 U	NA	NA	367	NA
PAH Total (LMW)	--	--	29,000	--	--	--	NA	815	NA	810 U	NA	NA	784	NA
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	NA	190 U	NA	180 U	NA	NA	180 U	NA
Pyrene	170,000	1,700,000	--	610,000	--	--	NA	72 J	NA	180 U	NA	NA	79 J	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1

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mg/kg - Milligrams per kilogram
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Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF [1]	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO109			VWAR-SO110	VWAR-SO111			
Sample ID							116701-0R-Z-109	116701-0R-Z-119	116701-0R-Z-127	116701-0R-Z-110	116701-0R-Z-111	116701-0R-Z-114	116701-0R-Z-120	116701-0R-Z-128
Sample Date							03/18/09	04/06/09	07/01/09	03/18/09	03/18/09	03/18/09	04/06/09	07/01/09
Chemical Name														
Pesticide/Polychlorinated Biphenyls (µg/kg)				**SSL DAF 1**										
4,4'-DDD	2,000	7,200	583	342	--	--	NA	3.8 U	NA	0.87 J	NA	NA	3.7 U	NA
4,4'-DDE	1,400	5,100	114	244	--	--	NA	1.1 J	NA	1.5 J	NA	NA	1.6 J	NA
4,4'-DDT	1,700	7,000	100	352	--	--	NA	1.7 J	NA	3.6 U	NA	NA	6.3	NA
alpha-Chlordane	1,600	6,500	11	1,386	--	--	NA	1.9 U	NA	1.8 U	NA	NA	1.8 U	NA
Aroclor-1242	220	740	8,000	179	--	--	NA	NA	21 U	18 U	NA	NA	NA	20 U
Aroclor-1254	110	740	8,000	302	--	--	NA	NA	21 U	18 U	NA	NA	NA	20 U
Aroclor-1260	220	740	8,000	828	--	--	NA	NA	21 U	18 U	NA	NA	NA	20 U
beta-BHC	270	960	342	1.0	--	--	NA	1.9 U	NA	1.8 U	NA	NA	1.8 U	NA
Dieldrin	30	110	11	0.36	--	--	NA	1.9 U	NA	1.8 U	NA	NA	1.8 U	NA
Endosulfan I	37,000	370,000	6.3	38,734	--	--	NA	1.9 U	NA	1.8 U	NA	NA	1.8 U	NA
Endrin aldehyde	1,800	18,000	2.0	170	--	--	NA	3.8 U	NA	3.6 U	NA	NA	3.7 U	NA
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	NA	1.9 U	NA	1.8 U	NA	NA	1.8 U	NA
gamma-Chlordane	1,600	6,500	11	1,386	--	--	1.9 U	1.9 U	NA	1.8 U	1.9 U	1.9 U	1.8 U	NA
Explosives (µg/kg)														
Perchlorate	5,500	72,000	1,000	17	--	--	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)														
Aluminum	7,700	99,000	--	56,000	--	29,000	NA	19,900 J	NA	8,740	NA	NA	13,800 J	NA
Antimony	3.1	41	78	0.27	--	2.3	NA	3.4 U	NA	3.2 U	NA	NA	3.2 U	NA
Arsenic	0.39	1.6	18	0.31	--	2.2	NA	1.3	NA	0.42 U	NA	NA	1.2	NA
Barium	1,500	19,000	330	100	--	320	NA	145 J	NA	98	NA	NA	125 J	NA
Beryllium	16	200	40	400	--	0.45	NA	**0.54**	NA	0.26	NA	NA	0.40	NA
Cadmium	7	80	32	20	--	0.040	NA	0.23 U	NA	**0.16 J**	NA	NA	0.21 U	NA
Calcium	--	--	--	--	--	210,000	NA	7,920 J	NA	11,200	NA	NA	14,700 J	NA
Chromium	0.29	5.6	64	430,000	--	74	NA	7.1 J	NA	3.0	NA	NA	6.2 J	NA
Cobalt	2.3	30	13	0.50	--	25	NA	16 J	NA	4.7	NA	NA	7.7 J	NA
Copper	310	4,100	70	52	--	68	NA	36 J	NA	17	NA	NA	23 J	NA
Cyanide	160	2,000	16	2.0	--	--	NA	0.35 J	NA	0.12 U	NA	NA	0.20 J	NA
Iron	5,500	72,000	--	660	--	37,531	NA	26,300 J	NA	10,200	NA	NA	14,800 J	NA
Lead	400	800	120	27	--	6.9	NA	4.5 J	NA	1.6 J	NA	NA	3.6 J	NA
Magnesium	--	--	--	--	--	12,834	NA	3,360 J	NA	1,750	NA	NA	2,630 J	NA
Manganese	180	2,300	220	57	--	1,167	NA	**1,620**	NA	357	NA	NA	542	NA
Mercury	0.78	10	0.10	0.40	--	0.031	NA	**0.035 J**	NA	0.091 U	NA	NA	**0.034 J**	NA
Nickel	150	2,000	38	1,400	--	40	NA	5.0 J	NA	2.5	NA	NA	3.7 J	NA
Potassium	--	--	--	--	--	1,700	NA	970 J	NA	488 J	NA	NA	885 J	NA
Selenium	39	510	0.52	0.12	--	2.0	NA	5.7 U	NA	5.3 U	NA	NA	5.3 U	NA
Silver	39	510	560	20	--	0.077	NA	0.57 U	NA	0.53 U	NA	NA	0.53 U	NA
Sodium	--	--	--	--	--	6,300	NA	602	NA	226 J	NA	NA	1,090	NA
Vanadium	39	520	2.0	180	--	130	NA	82 J	NA	33	NA	NA	49 J	NA
Zinc	2,300	31,000	120	5,800	--	65	NA	39 J	NA	18	NA	NA	25 J	NA
Total Petroleum Hydrocarbons (µg/kg)														
TPH-diesel range			--	--	100,000	--	42,800	NA	NA	9,000 U	41,600	44,500	NA	NA
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1

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Table 4-1
Surface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO112				
Sample ID							116701-0R-Z-112	116701-0R-Z-121	116701-0R-Z-122	116701-0R-Z-129	116701-0R-Z-129A
Sample Date							03/18/09	04/06/09	04/06/09	07/01/09	07/01/09
Chemical Name											
Volatile Organic Compounds (µg/kg)											
1,1-Dichloroethene	24,000	110,000	173	4.0	--	--	NA	5.6 U	5.6 U	NA	NA
4-Methyl-2-pentanone	530,000	3,360,000	--	576	--	--	NA	28 U	28 U	NA	NA
Acetone	6,100,000	63,000,000	--	4,752	--	--	NA	56 UJ	56 UJ	NA	NA
m- and p-Xylene	63,000	258,000	2,400	36,968	--	--	NA	NA	NA	NA	NA
Methylene chloride	11,000	53,000	1,250	2.0	--	--	NA	11 U	**15 J**	NA	NA
o-Xylene	380,000	434,000	2,400	37,616	--	--	NA	NA	NA	NA	NA
Tetrachloroethene	550	2,600	200	5.6	--	--	NA	5.6 U	5.6 U	NA	NA
Toluene	500,000	818,000	40,000	2,367	--	--	NA	5.6 U	5.6 U	NA	NA
Trichloroethene	2,800	14,000	10	3.9	--	--	NA	5.6 U	5.6 U	NA	NA
Xylene, total	63,000	258,000	2,400	37,670	--	--	NA	17 U	17 U	NA	NA
Semivolatile Organic Compounds (µg/kg)											
2-Nitroaniline	61,000	600,000	--	230	--	--	NA	340 U	340 U	NA	NA
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986	--	--	NA	170 U	170 U	NA	NA
4-Nitroaniline	24,000	86,000	--	2.1	--	--	NA	340 U	340 U	NA	NA
Acenaphthene	340,000	3,300,000	--	110,000	--	--	NA	170 U	170 U	NA	NA
Acenaphthylene	340,000	3,300,000	--	110,000	--	--	NA	170 U	170 U	NA	NA
Anthracene	1,700,000	17,000,000	--	2,600,000	--	--	NA	170 U	170 U	NA	NA
Atrazine	2,100	7,500	12	6.1	--	--	NA	NA	NA	NA	NA
Benzo(a)anthracene	150	2,100	--	54	--	--	NA	21 J	19 J	NA	NA
Benzo(a)pyrene	15	210	--	1,259	--	--	NA	**21 J**	**18 J**	NA	NA
Benzo(b)fluoranthene	150	2,100	--	186	--	--	NA	45 J	60 J	NA	NA
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000	--	--	NA	16 J	27 U	NA	NA
Benzo(k)fluoranthene	1,500	21,000	--	1,825	--	--	NA	29	26 J	NA	NA
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000	--	--	NA	340 U	340 U	NA	NA
Carbazole	24,000	86,000	--	93	--	--	NA	170 U	170 U	NA	NA
Chrysene	15,000	210,000	--	5,476	--	--	NA	30	47 J	NA	NA
Dibenz(a,h)anthracene	15	210	--	61	--	--	NA	28 U	27 U	NA	NA
Dibenzofuran	7,800	100,000	--	3,351	--	--	NA	170 U	170 U	NA	NA
Fluoranthene	230,000	2,200,000	--	900,000	--	--	NA	34 J	52 J	NA	NA
Fluorene	230,000	2,200,000	--	140,000	--	--	NA	170 U	170 U	NA	NA
Indeno(1,2,3-cd)pyrene	150	2,100	--	621	--	--	NA	17 J	15 J	NA	NA
PAH Total (HMW)	--	--	18,000	--	--	--	NA	235	274	NA	NA
PAH Total (LMW)	--	--	29,000	--	--	--	NA	714	732	NA	NA
Phenanthrene	1,700,000	17,000,000	--	1,800,000	--	--	NA	170 U	170 U	NA	NA
Pyrene	170,000	1,700,000	--	610,000	--	--	NA	43 J	62 J	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
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AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF [1]	PREQB Land Pollution Control Corrective Action Level	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO112				
Sample ID							116701-0R-Z-112	116701-0R-Z-121	116701-0R-Z-122	116701-0R-Z-129	116701-0R-Z-129A
Sample Date							03/18/09	04/06/09	04/06/09	07/01/09	07/01/09
Chemical Name											
Pesticide/Polychlorinated Biphenyls (µg/kg)				**SSL DAF 1**							
4,4'-DDD	2,000	7,200	583	342	--	--	NA	3.4 U	4.9	NA	NA
4,4'-DDE	1,400	5,100	114	244	--	--	NA	22	20	NA	NA
4,4'-DDT	1,700	7,000	100	352	--	--	NA	**128**	**140**	NA	NA
alpha-Chlordane	1,600	6,500	11	1,386	--	--	NA	1.7 U	1.7 U	NA	NA
Aroclor-1242	220	740	8,000	179	--	--	NA	NA	NA	17 U	17 U
Aroclor-1254	110	740	8,000	302	--	--	NA	NA	NA	17 U	17 U
Aroclor-1260	220	740	8,000	828	--	--	NA	NA	NA	17 U	17 U
beta-BHC	270	960	342	1.0	--	--	NA	1.7 U	1.7 U	NA	NA
Dieldrin	30	110	11	0.36	--	--	NA	1.7 U	1.7 U	NA	NA
Endosulfan I	37,000	370,000	6.3	38,734	--	--	NA	1.7 U	1.7 U	NA	NA
Endrin aldehyde	1,800	18,000	2.0	170	--	--	NA	3.4 U	3.4 U	NA	NA
gamma-BHC (Lindane)	520	2,100	7.8	5.4	--	--	NA	1.7 U	1.7 U	NA	NA
gamma-Chlordane	1,600	6,500	11	1,386	--	--	1.8 U	1.7 U	1.7 U	NA	NA
Explosives (µg/kg)											
Perchlorate	5,500	72,000	1,000	17	--	--	NA	NA	NA	NA	NA
Total Metals (mg/kg)											
Aluminum	7,700	99,000	--	56,000	--	29,000	NA	3,580 J	4,940 J	NA	NA
Antimony	3.1	41	78	0.27	--	2.3	NA	3.0 U	2.9 U	NA	NA
Arsenic	0.39	1.6	18	0.31	--	2.2	NA	0.25 J	0.49	NA	NA
Barium	1,500	19,000	330	100	--	320	NA	46 J	39 J	NA	NA
Beryllium	16	200	40	400	--	0.45	NA	0.15 J	0.18 J	NA	NA
Cadmium	7	80	32	20	--	0.040	NA	0.20 U	0.20 U	NA	NA
Calcium	--	--	--	--	--	210,000	NA	1,590 J	2,240 J	NA	NA
Chromium	0.29	5.6	64	430,000	--	74	NA	1.8 J	2.3 J	NA	NA
Cobalt	2.3	30	13	0.50	--	25	NA	3.8 J	4.2 J	NA	NA
Copper	310	4,100	70	52	--	68	NA	11 J	12 J	NA	NA
Cyanide	160	2,000	16	2.0	--	--	NA	0.31 J	0.27 J	NA	NA
Iron	5,500	72,000	--	660	--	37,531	NA	6,600 J	11,200 J	NA	NA
Lead	400	800	120	27	--	6.9	NA	1.8 J	1.9 J	NA	NA
Magnesium	--	--	--	--	--	12,834	NA	847 J	884 J	NA	NA
Manganese	180	2,300	220	57	--	1,167	NA	415	375	NA	NA
Mercury	0.78	10	0.10	0.40	--	0.031	NA	0.075 U	0.076 U	NA	NA
Nickel	150	2,000	38	1,400	--	40	NA	1.1 J	1.2 J	NA	NA
Potassium	--	--	--	--	--	1,700	NA	315 J	368 J	NA	NA
Selenium	39	510	0.52	0.12	--	2.0	NA	5.0 U	4.9 U	NA	NA
Silver	39	510	560	20	--	0.077	NA	0.50 U	0.49 U	NA	NA
Sodium	--	--	--	--	--	6,300	NA	500 U	490 U	NA	NA
Vanadium	39	520	2.0	180	--	130	NA	21 J	37 J	NA	NA
Zinc	2,300	31,000	120	5,800	--	65	NA	13 J	14 J	NA	NA
Total Petroleum Hydrocarbons (µg/kg)											
TPH-diesel range			--	--	100,000	--	21,200	NA	NA	NA	NA
TPH-oil range			--	--	100,000	--	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E)
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and Eco (E) and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and Eco (E) and SSL DAF 1

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Table 4-2
Surface Soil Detections in Excavated Samples
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Station ID	AOCRSS026	AOCRSS027	AOCRSS028	AOCRSS029	AOCRSS030		AOCRSS031	AOCRSS033	AOCRSS034	WAR-SO35		WAR-SO36	WAR-SO37	WAR-SO38	WAR-SO39	WAR-SO40	WAR-SO41	WAR-SO43	WAR-SO52
Sample ID	NDE160	NDE161	NDE162	NDE163	NDE164	NDE165FD1	NDE166	NDE168	NDE169	WAR-SS35-0002	WAR-SS35P-0002	WAR-SS36-0002	WAR-SS37-0002	WAR-SS38-0002	WAR-SS39-0002	WAR-SS40-0002	WAR-SS41-0002	WAR-SS43-0002	WAR-SS52-0002
Sample Date	12/01/00	12/01/00	12/01/00	12/01/00	12/01/00	12/01/00	12/01/00	12/01/00	12/01/00	03/03/06	03/03/06	03/03/06	03/03/06	12/08/05	12/08/05	12/08/05	12/07/05	12/05/05	12/15/05
Chemical Name																			
Volatile Organic Compounds (µg/kg)																			
1,1-Dichloroethene	0.42 J	0.43 J	10 UJ	0.85 J	10 UJ	10 U	0.74 J	10 U	11 UJ	11 U	10 U	10 U	10 U	10 U	10 U	18 U	12 U	10 U	10 U
2-Hexanone	10 U	0.67 J	10 UJ	1.1 J	10 UJ	10 U	12 UJ	10 U	11 UJ	11 U	10 U	10 U	10 U	10 U	10 U	18 U	12 U	10 U	10 U
m- and p-Xylene	10 U	10 U	10 UJ	10 U	0.42 J	10 U	12 UJ	10 U	11 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	10 U	10 U	10 UJ	10 U	10 J	10 U	12 UJ	10 U	11 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	0.24 J	10 U	1.1 J	0.59 J	10 UJ	10 U	12 UJ	10 U	11 UJ	11 U	10 U	10 U	10 U	10 U	10 U	18 U	12 U	10 U	10 U
Xylene, total	10 U	10 U	10 UJ	10 U	0.59 J	10 U	12 UJ	10 U	11 UJ	11 U	10 U	10 U	10 U	10 U	10 U	18 U	12 U	10 U	10 U
Semivolatile Organic Compounds (µg/kg)																			
2-Methylnaphthalene	526 U	1,130	468 U	623 U	482 UJ	497 UJ	587 UJ	446 UJ	510 UJ	400 U	380 U	1,900 U	380 U	11,000 UJ	1,100 U	1,900 U	370 U	360 U	380 U
3,3'-Dichlorobenzidine	49 J	989 U	936 U	1,250 U	964 UJ	994 UJ	1,170 UJ	891 UJ	1,020 UJ	400 U	380 U	1,900 U	380 U	11,000 UJ	1,100 UJ	1,900 UJ	370 U	360 UJ	380 U
Acenaphthene	526 U	1,040	468 U	623 U	482 UJ	497 UJ	587 UJ	446 UJ	510 UJ	400 U	380 U	1,900 U	380 U	11,000 UJ	1,100 U	1,900 U	370 U	360 U	380 U
Acenaphthylene	165 J	690	468 U	623 U	331 J	208 J	134 J	446 UJ	510 UJ	400 U	380 U	670 J	150 J	11,000 UJ	1,000 J	550 J	370 U	360 U	380 U
Acetophenone	NA	NA	NA	NA	NA	NA	NA	NA	NA	400 UJ	380 U	1,900 UJ	140 J	11,000 UJ	1,100 U	1,900 U	370 U	360 U	380 U
Anthracene	140 J	1,230	468 U	623 U	289 J	184 J	107 J	446 UJ	510 UJ	400 U	380 U	720 J	270 J	11,000 UJ	1,900	1,700 J	370 U	360 U	380 U
Benzo(a)anthracene	861	5,230	67 J	52 J	2,170 J	1,400 J	793 J	131 J	160 J	140 J	110 J	5,900	2,000	16,000 J	13,000	11,000	220 J	350 J	380 U
Benzo(a)pyrene	1,130	4,930	81 J	57 J	2,040 J	1,360 J	1,000 J	182 J	200 J	160 J	140 J	6,100	2,000	12,000 J	14,000	10,000	280 J	330 J	380 U
Benzo(b)fluoranthene	1,910	8,820	115 J	78 J	3,780 J	2,210 J	1,380 J	270 J	313 J	260 J	250 J	14,000	3,700	18,000 J	25,000	15,000 R	340 J	520	380 U
Benzo(g,h,i)perylene	334 J	1,210	468 U	623 U	515 J	322 J	276 J	162 J	170 J	140 J	97 J	3,800	900	4,400 J	6,400	5,900	130 J	180 J	380 U
Benzo(k)fluoranthene	1,010	4,750	110 J	74 J	2,730 J	1,680 J	1,250 J	186 J	285 J	330 J	240 J	5,900 J	1,800	16,000 J	16,000	11,000	410	500	380 U
Carbazole	67 J	561	468 U	623 U	160 J	99 J	51 J	446 UJ	88 J	400 U	380 UJ	1,900 U	220 J	11,000 UJ	520 J	820 J	370 U	360 U	380 UJ
Chrysene	1,180	6,780 R	116 J	77 J	2,640 J	1,770 J	1,110 J	223 J	484 J	240 J	200 J	7,500	3,400	19,000 J	14,000	13,000	330 J	450	380 U
Dibenz(a,h)anthracene	133 J	565	468 U	623 U	224 J	148 J	83 J	44 J	35 J	400 U	380 U	1,300 J	450	11,000 UJ	2,600	2,200	370 U	360 U	380 U
Dibenzofuran	526 U	1,010	468 U	623 U	482 UJ	497 UJ	587 UJ	446 UJ	510 UJ	400 U	380 U	1,900 U	380 U	11,000 UJ	1,100 U	1,900 U	370 U	360 U	380 U
Fluoranthene	747	8,820	146 J	60 J	1,540 J	1,110 J	750 J	129 J	782 J	220 J	170 J	6,700	5,300	16,000 J	11,000	19,000	270 J	390	380 U
Fluorene	526 U	965	468 U	623 U	482 UJ	497 UJ	587 UJ	446 UJ	510 UJ	400 U	380 U	1,900 U	380 U	11,000 UJ	1,100 U	1,900 U	370 U	360 U	380 U
Indeno(1,2,3-cd)pyrene	403 J	1,520	24 J	623 U	755 J	471 J	380 J	184 J	193 J	170 J	110 J	4,200	1,000	8,800 J	8,500	7,000	180 J	230 J	380 U
Naphthalene	526 U	834	468 U	623 U	482 UJ	497 UJ	587 UJ	446 UJ	510 UJ	400 U	380 U	1,900 U	380 U	11,000 UJ	1,100 U	1,900 U	370 U	360 U	380 U
Phenanthrene	46 J	4,400	468 U	623 U	93 J	61 J	44 J	446 UJ	79 J	400 U	380 U	1,900 U	530	11,000 UJ	310 J	1,800 J	370 U	360 U	380 U
Pyrene	962	9,790	159 J	82 J	1,800 J	1,300 J	1,030 J	151 J	720 J	250 J	220 J	9,600	5,200	26,000 J	22,000	22,000	350 J	530	380 U
Pesticide/Polychlorinated Biphenyls (µg/kg)																			
4,4'-DDD	3.7 U	7.7 UJ	3.5 UJ	4.2 U	3.6 UJ	3.8 UJ	4 UJ	3.6 UJ	3.9 UJ	4 U	3.8 U	4 NJ	7.3	7.8	40	6.2 U	3.7 U	2.6 J	3.8 U
4,4'-DDE	19 J	9.4 J	1 J	4.2 U	83 J	85 J	76 J	4.9 J	6 J	4 U	3.8 U	13	8 J	180	230	98 NJ	13	84	14
4,4'-DDT	8.9 J	8.7 J	3.5 J	4.2 U	82 J	61 J	89 J	3.6 J	3.9 UJ	4 U	3.8 U	8.6 J	51 J	110	180	200	8	76	11
Endosulfan sulfate	3.7 U	7.7 UJ	3.5 UJ	4.2 U	3.6 UJ	3.8 UJ	4 UJ	3.6 UJ	3.9 UJ	4 U	3.8 U	3.9 U	3.8 U	63 R	61 R	90 NJ	3.7 U	3.6 U	3.8 U
Endrin	3.7 U	7.7 UJ	3.5 UJ	4.2 U	3.6 UJ	3.8 UJ	4 UJ	3.6 UJ	3.9 UJ	4 U	2.5 J	3.9 U	3.8 U	26 R	28 R	16 NJ	3.7 U	3.9 R	3.8 U
gamma-Chlordane	1.9 U	3.9 UJ	1.8 UJ	2.1 U	1.9 UJ	2 UJ	2.1 UJ	1.8 UJ	2 UJ	2.1 U	1.9 U	2 U	1.9 U	19 U	270	270 J	1.9 U	1.9 U	0.51 J
Methoxychlor	19 U	39 UJ	18 UJ	21 U	19 UJ	20 UJ	21 UJ	18 UJ	20 UJ	21 U	19 U	230 NJ	210 R	140 R	170 R	240 J	19 U	19 U	20 U
Total Metals (mg/kg)																			
Aluminum	5,800	12,000	4,000	5,000	6,500	7,100	7,800	5,100	7,500	14,200 J	10,900 J	13,100 J	11,100 J	7,300	9,310	16,600	4,650	5,880	13,600
Antimony	0.38 J	0.62 J	0.26 UJ	0.31 UJ	0.61 J	0.88 J	0.61 J	0.35 J	0.67 J	0.46 J	0.27 J	0.41 J	0.29 J	0.35 J	0.52 J	0.66 J	6.7 UJ	0.25 J	0.74 J
Arsenic	0.91 J	1.2 J	0.31 U	0.37 U	15	11	3.6	0.31 U	0.74 J	1.1 J	0.97 J	1 J	1.6 J	0.57 J	0.81 J	0.66 J	1.1 U	1.1 U	0.56 J
Barium	54	85	38 J	85	52	50	60	59	52	403 J	159 J	123 J	66.5 J	43.4	54.4	100 J	51.7	43.4	55.8
Beryllium	0.03 U	0.28 J	0.03 U	0.14 J	0.19 J	0.14 J	0.21 J	0.12 J	0.17 J	0.25 J	0.1 J	0.11 J	0.048 J	0.56 U	0.57 U	0.5 U	0.56 U	0.55 U	0.57 U
Cadmium	0.03 U	0.03 U	0.02 U	0.03 U	0.02 U	0.03 U	0.18 J	0.02 U	0.03 U	0.26 J	0.34 J	0.28 J	0.32 J	0.56 U	0.57 U	0.94 U	0.56 U	0.55 U	0.57 U
Calcium	10,000	39,000	1,800	3,200	17,000	23,000	37,000	4,300	4,100	20,900 J	85,300 J	24,800 J	116,000 J	27,800	34,000	35,800 J	2,000	5,050	21,500
Chromium	7.5 J	10 J	2.5 J	4.1 J	10 J	16 J	12 J	5.5 J	38 J	8.2 J	8.2 J	13.2 J	10.8 J	7.9	12.2	11.8	3.4	4.2	20.4
Cobalt	6.7 J	9.1 J	4.8 J	7 J	7.5 J	7.3 J	8 J	6.6 J	7.2 J	24.4 J	14.4 J	14 J	9.7 J	6.1	8	12.5	5.3 J	5.6	12.4
Copper	21 J	30 J	12 J	20 J	26	29	29	19	18	34.6 J	27.6 J	39.6 J	31.6 J	22.3	30.4	50	13.3	14.6	62.3
Iron	21,000	20,000	9,800	12,000	13,000	17,000	16,000	13,000	14,000	21,600 J	16,100 J	19,400 J	15,800 J	11,400	14,100	25,000	9,020	10,600	21,500
Lead	7.2 J	14 J	6.2 J	3.8 J	20	29	33	5.8	3.7	8.2 J	7.7 J	7 J	8.5 J	11	22.1	15.7	4	4.1	22
Magnesium	2,100	3,800	1,000 B	1,500	2,600	3,400	3,700	1,600	1,500	3,760 J	3,550 J	4,550 J	5,510 J	2,800	3,770	4,900	1,330	1,510	8,120
Manganese	630	630	420	680	520	480	550	580	610	2,800 J	1,630 J	1,070 J	570 J	419 J	517 J	878 J	461 J	466 J	592 J
Mercury	0.011 J	0.011 J	0.012 J	0.021 UJ	0.018 J	0.014 J	0.021 J	0.01 J	0.016 J	0.12 UJ	0.11 UJ	0.12 UJ	0.11 UJ	0.028 J	0.038 J	0.1 U	0.025 J	0.024 J	0.036 J
Nickel	4.6 J	5.2 J	1.5 J	2.7 J	5.2 J	7.4 J	6.8 J	2.9 J	7.9 J	6.7 J	6.6 J	8.8 J	6.9 J	4.3 J	6.5	7.7	2.1 J	2.5 J	12.5
Potassium	840 J	1,100 J	650 J	800 J	750 J	740 J	1,100 J	750 J	870 J	685 J	568 U	591 U	579 J	1,150	1,100	2,020	475 J	594	925
Selenium	1.6 J	1.2 J	0.88 J	0.58 U	0.5 U	0.53 U	0.55 U	0.49 U	1.3	1.8 J	1.7 J	1.5 J	0.78 J	4 U	4 U	3.5 U	3.9 U	3.8 U	4 U
Sodium	110 J	430 J	27 J	52 J	210 J	290 J	450 J	96 J	140 J	887 J	1,140 J	591 U	978 J	565 U	568 U	346 J	560 U	547 U	572 U
Thallium	0.38 U	0.39 U	0.37 U	0.43 U	0.37 U	0.39 U	0.41 U	0.36 U	0.4 U	0.61 U	0.57 U	0.59 U	0.57 U	0.56 U	0.57 U	0.94	0.56 U	0.55 U	0.57 U
Vanadium	36 J	54 J	28 J	32 J	40	42	42	38	42	87.1 J	54.9 J	63.1 J	47.1 J	31.5	40	69.4	26.5	32.4	60.9
Zinc	36 J	42 J	19 J	25 J	42	47	63	26	23	38.2 J	35.2 J	66.8 J	78.6 J	40.6	78.1	222 J	18.9	25.6	65.6

Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

NJ - Presumptively present at approximate quantity

R - Unreliable Result

U - Not detected or not detected at significantly greater than that in an associated blank

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

Table 4-3
Subsurface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, West Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	SSL DAF 1	Vieques (West) Bkgd Zone Qa[1]	WAR-SO49	WAR-SO50		WAR-SO51	WAR-SO52	WAR-SO53	WAR-SO54	WAR-SO55	WAR-SO56	WAR-SO57	WAR-SO58	WAR-SO59
Sample ID					WAR-SB49-0406	WAR-SB50-0406	WAR-SB50P-0406	WAR-SB51-0406	WAR-SB52-0406	WAR-SB53-0406	WAR-SB54-0406	WAR-SB55-0406	WAR-SB56-0406	WAR-SB57-0406	WAR-SB58-0406	WAR-SB59-0406
Sample Date					12/15/05	12/15/05	12/15/05	12/15/05	12/15/05	12/15/05	12/16/05	12/16/05	12/16/05	12/16/05	12/16/05	12/16/05
Chemical Name																
Volatile Organic Compounds (µg/kg)																
Toluene	500,000	818,000	2,367	--	10 U	12 U	10 U	10 U	12 U	10 U	11 U	10 U	10 U	12 U	10 U	10 U
Semivolatile Organic Compounds (µg/kg)																
2,4-Dinitrotoluene	1,600	5,500	0.68	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
2-Nitroaniline	61,000	600,000	230	--	950 U	950 U	860 U	930 U	970 U	1,000 U	1,000 U	970 U	940 U	1,000 U	930 U	920 U
4-Chloro-3-methylphenol	610,000	6,200,000	21,986	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
4-Nitroaniline	24,000	86,000	2.1	--	950 U	950 UJ	860 UJ	930 UJ	970 UJ	1,000 U	1,000 U	970 U	940 UJ	1,000 UJ	930 UJ	920 UJ
Atrazine	2,100	7,500	6.1	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
Benzo(b)fluoranthene	150	2,100	186	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
Benzo(k)fluoranthene	1,500	21,000	1,825	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	10,000	--	380 U	130 J	340 U	440	380 U	93 J	400 U	380 U	380 U	410 U	370 U	370 U
Carbazole	24,000	86,000	93	--	380 UJ	380 U	340 U	370 U	380 U	400 UJ	400 U	380 U	380 U	410 U	370 U	370 U
Chrysene	15,000	210,000	5,476	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
Dibenz(a,h)anthracene	15	210	61	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
Di-n-octylphthalate	35,000	120,000	6,350	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
Fluoranthene	230,000	2,200,000	900,000	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
Hexachlorocyclopentadiene	37,000	370,000	682	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
Pyrene	170,000	1,700,000	610,000	--	380 U	380 U	340 U	370 U	380 U	400 U	400 U	380 U	380 U	410 U	370 U	370 U
Pesticide/Polychlorinated Biphenyls (µg/kg)																
4,4'-DDD	2,000	7,200	342	--	3.8 U	3.8 U	3.4 U	3.7 U	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U	4.1 U	3.7 U	3.7 U
4,4'-DDE	1,400	5,100	244	--	1.1 J	3.8 U	1.3 J	3.2 J	1.7 J	1.7 J	4.0 U	3.8 U	3.8 U	0.98 J	3.7 U	3.7 U
4,4'-DDT	1,700	7,000	352	--	3.8 U	3.8 U	3.4 U	2.6 J	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U	4.1 U	3.7 U	3.7 U
alpha-Chlordane	1,600	6,500	1,386	--	2.0 U	2.0 U	1.8 U	1.9 U	2.0 U	2.1 U	2.1 U	2.0 U	1.9 U	2.1 U	1.9 U	1.9 U
Dieldrin	30	110	0.36	--	3.8 U	3.8 U	3.4 U	3.7 U	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U	4.1 U	3.7 U	3.7 U
Endrin ketone	1,800	18,000	170	--	3.8 U	3.8 U	3.4 U	3.7 U	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U	4.1 U	3.7 U	3.7 U
Explosives (µg/kg)																
Perchlorate	5,500	72,000	17	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)																
Aluminum	7,700	99,000	56,000	29,000	13,000	2,350	2,040	8,120	7,890	14,700	13,400	12,400	11,900	16,400	10,600	10,700
Antimony	3.1	41	0.27	2.3	0.26 J	6.9 UJ	6.3 UJ	0.29 J	0.26 J	0.39 J	0.48 J	0.46 J	0.28 J	0.33 J	6.8 UJ	0.38 J
Arsenic	0.39	1.6	0.31	2.2	0.63 J	1.2 U	1.0 U	1.1 U	1.2 U	1.2 U	1.2 U	1.2 U	1.1 U	1.3 U	1.1 U	1.1 U
Barium	1,500	19,000	100	320	227	57	44	79	109	190	62	75	121	70	114	154
Beryllium	16	200	400	0.45	0.57 U	0.58 U	0.52 U	0.56 U	0.58 U	0.61 U	0.61 U	0.58 U	0.57 U	0.62 U	0.56 U	0.56 U
Calcium	--	--	--	210,000	5,620	1,010	901	3,100	4,030	5,670	2,470	4,820	12,700	8,500	37,400	6,750
Chromium	0.29	5.6	430,000	74	8.6	2.2	1.5	5.3	6.2	17	8.8	5.0	5.0	7.9	3.7	4.8
Cobalt	2.3	30	0.50	25	15	3.9 J	3.8 J	8.8	12	13	10	5.7 J	7.4	11	4.6 J	10
Copper	310	4,100	52	68	23	9.0	6.7	29	21	24	28	27	23	25	20	25
Cyanide	160	2,000	2.0	--	2.9 U	2.9 U	2.6 U	2.8 U	2.9 U	3.0 U	3.0 U	2.9 U	2.8 U	3.1 U	2.8 U	2.8 U
Iron	5,500	72,000	660	37,531	22,000	6,900 J	4,730 J	15,500	17,600	20,000	22,400	20,400	16,800	18,700	16,000	19,900
Lead	400	800	27	6.9	4.4	1.9	1.5	2.8	2.4	3.9	3.4	2.9	2.5	3.8	2.1	3.6
Magnesium	--	--	--	12,834	2,120	576 U	522 U	2,280	2,310	3,510	4,030	3,300	3,620	3,630	3,350	2,990
Manganese	180	2,300	57	1,167	859 J	448	395	491	581	839 J	654	249	487	512	231	741
Mercury	0.78	10	0.40	0.031	0.12 U	0.12 U	0.10 U	0.11 U	0.12 U	0.12 U	0.12 U	0.12 U	0.11 U	0.12 U	0.11 U	0.11 U
Nickel	150	2,000	1,400	40	6.4	4.6 U	4.2 U	4.9	7.1	8.8	5.8	4.7 U	4.5 U	5.0 U	4.5 U	4.5 U
Potassium	--	--	--	1,700	747	324 J	240 J	602 J	455 J	779	610 U	662 J	625 J	1,200 J	615 J	616 J
Selenium	39	510	0.12	2.0	4.0 U	4.0 U	3.7 U	3.9 U	4.1 U	4.2 U	4.3 U	4.1 U	4.0 U	4.4 U	3.9 U	3.9 U
Silver	39	510	20	0.077	1.1 U	1.2 U	1.0 U	1.1 U	1.2 U	1.2 U	1.2 U	1.2 U	1.1 U	1.3 U	1.1 U	1.1 U
Sodium	--	--	--	6,300	573 U	576 U	522 U	563 U	581 U	607 U	1,270	585 U	568 U	2,430	1,110	557 U
Vanadium	39	520	180	130	85	24	16	60	65	67	76	67	53	55	53	67
Zinc	2,300	31,000	5,800	65	26	8.6	6.9	25	20	29	31	30	32	29	25	30
Total Petroleum Hydrocarbons (µg/kg)																
No Detections			--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1

NA - Not analyzed
ND - Not detected
J - Analyte present, value may or may not be accurate or precise
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
µg/kg - Micrograms per kilogram
mg/kg - Milligrams per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds

Table 4-3
Subsurface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, West Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	SSL DAF 1	Vieques (West) Bkgd Zone Qa[1]	WAR-SO60		WAR-SO61	WAR-SO62	WAR-SO63	VWAR-SO81	VWAR-SO82	VWAR-SO83	VWAR-SO84		
Sample ID					WAR-SB60-0406	WAR-SB60P-0406	WAR-SB61-0406	WAR-SB62-0406	WAR-SB63-0406	VWAR-SB81-46-0609	VWAR-SB82-46-0609	VWAR-SB83-46-0609	VWAR-SB84-1718-0609	VWAR-SB84-46-0609	VWAR-SB84P-46-0609
Sample Date					12/15/05	12/15/05	12/15/05	12/15/05	12/15/05	06/01/09	06/01/09	06/01/09	06/02/09	06/02/09	06/02/09
Chemical Name															
Volatile Organic Compounds (µg/kg)															
Toluene	500,000	818,000	2,367	--	10 U	10 U	10 U	11 U	12 U	4.0 U	2.0 J	2.0 J	5.0 U	5.0 U	5.0 U
Semivolatile Organic Compounds (µg/kg)															
2,4-Dinitrotoluene	1,600	5,500	0.68	--	380 U	400 U	400 U	410 U	410 U	28 U	28 U	27 U	28 U	26 U	**8.0 J**
2-Nitroaniline	61,000	600,000	230	--	970 U	1,000 U	1,000 U	1,000 U	1,000 U	22 U	22 U	22 U	23 U	21 U	7.5 J
4-Chloro-3-methylphenol	610,000	6,200,000	21,986	--	380 U	400 U	400 U	410 U	410 U	110 U	110 U	110 U	110 U	110 U	110 U
4-Nitroaniline	24,000	86,000	2.1	--	970 U	1,000 U	1,000 U	1,000 U	1,000 U	22 U	22 U	22 U	23 U	21 U	**2.6 J**
Atrazine	2,100	7,500	6.1	--	380 U	400 U	400 U	410 U	410 U	22 UJ	22 UJ	22 UJ	23 UJ	21 UJ	21 UJ
Benzo(b)fluoranthene	150	2,100	186	--	380 U	400 U	400 U	410 U	410 U	22 U	22 U	22 U	23 U	21 U	21 U
Benzo(k)fluoranthene	1,500	21,000	1,825	--	380 U	400 U	400 U	410 U	95 J	370 U	370 U	360 U	370 U	350 U	350 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	10,000	--	98 J	400 U	400 U	410 U	410 U	370 U	370 U	360 U	240 J	350 U	350 U
Carbazole	24,000	86,000	93	--	380 U	400 U	400 U	410 U	410 U	22 U	22 U	22 U	23 U	21 U	21 U
Chrysene	15,000	210,000	5,476	--	380 U	400 U	400 U	410 U	120 J	370 U	370 U	360 U	370 U	350 U	350 U
Dibenz(a,h)anthracene	15	210	61	--	380 U	400 U	400 U	410 U	410 U	22 U	22 U	22 U	23 U	21 U	21 U
Di-n-octylphthalate	35,000	120,000	6,350	--	380 U	400 UJ	400 UJ	410 UJ	410 UJ	170 U	170 U	160 U	170 UJ	160 U	160 UJ
Fluoranthene	230,000	2,200,000	900,000	--	380 U	400 U	400 U	410 U	190 J	22 U	22 U	22 U	23 U	21 U	21 U
Hexachlorocyclopentadiene	37,000	370,000	682	--	380 U	400 U	400 U	410 U	410 U	22 U	22 U	22 U	23 U	21 U	21 U
Pyrene	170,000	1,700,000	610,000	--	380 U	400 U	400 U	410 U	120 J	22 U	22 U	22 U	23 U	21 U	21 U
Pesticide/Polychlorinated Biphenyls (µg/kg)															
4,4'-DDD	2,000	7,200	342	--	3.8 U	4.0 U	4.0 U	4.1 U	4.1 U	3.7 U	3.7 U	3.6 U	1.9 J	3.5 U	3.5 U
4,4'-DDE	1,400	5,100	244	--	3.8 U	4.0 U	4.5	0.94 J	1.9 J	3.7 U	3.7 U	0.83 J	4.1	3.5 U	3.5 U
4,4'-DDT	1,700	7,000	352	--	3.8 U	4.0 U	7.9	1.8 J	3.2 J	3.7 U	3.7 U	2.0 J	24	3.5 U	3.5 U
alpha-Chlordane	1,600	6,500	1,386	--	2.0 U	2.0 U	0.92 J	2.1 U	2.1 U	1.9 U	1.9 U	1.8 U	1.9 U	1.8 U	1.8 U
Dieldrin	30	110	0.36	--	3.8 U	4.0 U	4.0 U	4.1 U	4.1 U	3.7 U	3.7 U	3.6 U	**0.72 J**	3.5 U	3.5 U
Endrin ketone	1,800	18,000	170	--	3.8 U	4.0 U	1.4 J	4.1 U	4.1 U	3.7 U	3.7 UJ	3.6 UJ	3.7 UJ	3.5 UJ	3.5 UJ
Explosives (µg/kg)															
Perchlorate	5,500	72,000	17	--	NA	NA	NA	NA	NA	2.0 U	1.7 U	0.49 J	2.3 U	0.60 J	0.33 J
Total Metals (mg/kg)															
Aluminum	7,700	99,000	56,000	29,000	16,400	16,100	12,400	10,300	9,360	18,400 J	17,400 J	16,500 J	**30,700 J**	7,810 J	7,490 J
Antimony	3.1	41	0.27	2.3	0.41 J	0.38 J	0.59 J	0.38 J	7.4 UJ	0.96 UJ	0.090 UJ	0.083 UJ	0.11 UJ	0.092 UJ	0.094 UJ
Arsenic	0.39	1.6	0.31	2.2	0.35 J	1.2 U	0.51 J	1.2 U	0.57 J	0.48 U	0.45 U	0.42 U	0.53 U	0.46 U	0.47 U
Barium	1,500	19,000	100	320	149 J	274 J	74	88	55	54 J	153 J	77 J	188 J	47 J	39 J
Beryllium	16	200	400	0.45	0.58 U	0.60 U	0.61 U	0.61 U	0.62 U	0.32	0.33	0.27	0.40	0.15	0.16
Calcium	--	--	--	210,000	12,200 J	10,600 J	5,620 J	7,600 J	9,480 J	2,760	3,180	2,680	3,760	2,650	2,430
Chromium	0.29	5.6	430,000	74	15	15	17	5.5	5.8	5.4 J	12	4.8 J	12	3.8 J	3.7 J
Cobalt	2.3	30	0.50	25	13	16	13	9.3	6.9	9.0	8.2	7.5	18	5.2	4.6
Copper	310	4,100	52	68	42	35	51	38	35	33	22	25	**74**	13	13
Cyanide	160	2,000	2.0	--	2.9 U	3.0 U	3.1 U	3.1 U	3.1 U	1.1 U	1.1 U	1.0 U	1.1 U	1.1 U	1.1 U
Iron	5,500	72,000	660	37,531	23,700	22,000	21,400	16,100	14,200	24,200	20,600	21,000	**40,100**	15,800	15,200
Lead	400	800	27	6.9	5.0 J	**8.7 J**	**28 J**	3.3 J	**12 J**	4.1	3.2	2.6	3.5	2.3	2.4
Magnesium	--	--	--	12,834	5,400	4,160	6,160	4,520	4,470	3,040	2,530	2,370	6,080	1,260	1,180
Manganese	180	2,300	57	1,167	759	887	514	576	421	735 J	581 J	458 J	**1,280 J**	295 J	242 J
Mercury	0.78	10	0.40	0.031	0.12 U	**0.034 J**	0.12 U	0.028 J	0.12 U	0.034 U	0.034 U	0.033 U	0.030 U	0.035 U	0.035 U
Nickel	150	2,000	1,400	40	9.5 J	8.4 J	11 J	3.9 J	4.2 J	7.7 U	3.8	6.7 U	8.5 U	1.5 J	1.4 J
Potassium	--	--	--	1,700	685 J	640 J	907 J	730 J	507 J	557	978	511	1,000	514	469
Selenium	39	510	0.12	2.0	4.1 U	4.2 UJ	4.3 UJ	4.3 UJ	4.3 UJ	0.48 U	0.45 U	0.42 U	0.53 U	0.46 U	0.47 U
Silver	39	510	20	0.077	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	2.9 U	**0.23 J**	2.5 U	3.2 U	**0.32 J**	**0.32 J**
Sodium	--	--	--	6,300	597	714	120 J	75 J	110 J	668	1,250	194	855	104	102
Vanadium	39	520	180	130	75	72	50	41	34	83 J	61 J	69 J	124 J	57 J	55 J
Zinc	2,300	31,000	5,800	65	40	31	**75**	40	42	35	30	28	55	16	15
Total Petroleum Hydrocarbons (µg/kg)															
No Detections			--	--	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1

NA - Not analyzed
ND - Not detected
J - Analyte present, value may or may not be accurate or precise
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
µg/kg - Micrograms per kilogram
mg/kg - Milligrams per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds

Table 4-3
Subsurface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, West Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	SSL DAF 1	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO85		VWAR-SO86		VWAR-SO87		VWAR-SO88		
Sample ID					VWAR-SB85-12-0609	VWAR-SB85-9H10H-0609	VWAR-SB86-1617-0609	VWAR-SB86-46-0609	VWAR-SB87-1011-0609	VWAR-SB87-46-0609	VWAR-SB88-1415-0609	VWAR-SB88-46-0609	VWAR-SB88P-46-0609
Sample Date					06/02/09	06/02/09	06/03/09	06/03/09	06/03/09	06/03/09	06/03/09	06/03/09	06/03/09
Chemical Name													
Volatile Organic Compounds (µg/kg)													
Toluene	500,000	818,000	2,367	--	6.0 U	6.0 U	4.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ
Semivolatile Organic Compounds (µg/kg)													
2,4-Dinitrotoluene	1,600	5,500	0.68	--	26 U	26 U	26 UJ	26 UJ	110 U	110 U	120 U	110 U	110 U
2-Nitroaniline	61,000	600,000	230	--	21 U	6.8 J	21 UJ	21 UJ	23 UJ	22 UJ	24 UJ	22 UJ	21 UJ
4-Chloro-3-methylphenol	610,000	6,200,000	21,986	--	100 U	100 U	100 UJ	100 UJ	6.8 J	6.5 J	7.2 J	8.0 J	6.5 J
4-Nitroaniline	24,000	86,000	2.1	--	21 U	21 U	21 R	21 R	23 R	22 R	24 R	22 UJ	21 R
Atrazine	2,100	7,500	6.1	--	21 UJ	21 UJ	21 UJ	21 UJ	**6.3 J**	22 UJ	**6.6 J**	**7.0 J**	5.8 J
Benzo(b)fluoranthene	150	2,100	186	--	21 U	21 U	21 UJ	21 UJ	6.0 J	3.3 J	24 UJ	4.1 J	21 UJ
Benzo(k)fluoranthene	1,500	21,000	1,825	--	340 U	350 U	340 UJ	340 UJ	380 UJ	360 UJ	390 UJ	360 UJ	350 UJ
bis(2-Ethylhexyl)phthalate	35,000	120,000	10,000	--	340 U	350 U	340 UJ	340 UJ	380 UJ	580 J	390 UJ	360 UJ	350 UJ
Carbazole	24,000	86,000	93	--	21 U	21 U	21 UJ	21 UJ	23 UJ	22 UJ	24 UJ	1.9 J	21 UJ
Chrysene	15,000	210,000	5,476	--	340 U	350 U	340 UJ	340 UJ	380 UJ	360 UJ	390 UJ	360 UJ	350 UJ
Dibenz(a,h)anthracene	15	210	61	--	21 U	21 U	21 UJ	21 UJ	5.0 J	6.1 J	24 UJ	22 UJ	21 UJ
Di-n-octylphthalate	35,000	120,000	6,350	--	150 UJ	160 UJ	160 UJ	160 UJ	170 UJ	160 UJ	180 UJ	160 UJ	160 UJ
Fluoranthene	230,000	2,200,000	900,000	--	21 U	21 U	21 UJ	21 UJ	2.3 J	22 UJ	3.8 J	22 UJ	21 UJ
Hexachlorocyclopentadiene	37,000	370,000	682	--	21 U	21 U	21 UJ	21 UJ	23 UJ	22 UJ	24 UJ	6.4 J	21 UJ
Pyrene	170,000	1,700,000	610,000	--	21 U	21 U	21 UJ	21 UJ	3.3 J	22 UJ	3.9 J	2.4 J	21 UJ
Pesticide/Polychlorinated Biphenyls (µg/kg)													
4,4'-DDD	2,000	7,200	342	--	3.4 U	3.5 U	3.4 UJ	3.4 UJ	3.8 UJ	3.6 UJ	3.9 UJ	3.6 UJ	3.5 UJ
4,4'-DDE	1,400	5,100	244	--	3.4 U	3.5 U	3.4 UJ	3.4 UJ	3.8 UJ	3.6 UJ	3.9 UJ	3.6 UJ	3.5 UJ
4,4'-DDT	1,700	7,000	352	--	3.4 U	3.5 U	3.4 U	3.4 U	3.8 U	3.6 U	3.9 U	3.6 U	3.5 U
alpha-Chlordane	1,600	6,500	1,386	--	1.8 U	1.8 U	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ	2.0 UJ	1.9 UJ	1.8 UJ
Dieldrin	30	110	0.36	--	3.4 U	3.5 U	3.4 UJ	3.4 UJ	3.8 UJ	3.6 UJ	3.9 UJ	3.6 UJ	3.5 UJ
Endrin ketone	1,800	18,000	170	--	3.4 UJ	3.5 UJ	3.4 UJ	3.4 UJ	3.8 UJ	3.6 UJ	3.9 UJ	3.6 UJ	3.5 UJ
Explosives (µg/kg)													
Perchlorate	5,500	72,000	17	--	1.7 U	1.9 U	2.1 U	0.34 J	1.9 U	0.52 J	2.2 U	0.43 J	0.46 J
Total Metals (mg/kg)													
Aluminum	7,700	99,000	56,000	29,000	3,980 J	3,250 J	10,900	3,440	8,690	8,610	15,800	15,400	11,600
Antimony	3.1	41	0.27	2.3	0.077 UJ	0.095 UJ	0.084 UJ	0.073 UJ	0.095 UJ	0.096 UJ	0.084 UJ	0.095 UJ	0.091 UJ
Arsenic	0.39	1.6	0.31	2.2	0.39 U	0.47 U	0.27 J	0.19 J	0.27 J	0.24 J	0.47 J	0.35 J	0.29 J
Barium	1,500	19,000	100	320	132 J	108 J	28	39	48	54	88	55	54
Beryllium	16	200	400	0.45	0.13	0.080 J	0.24	0.10	0.17	0.15	0.22	0.28	0.22
Calcium	--	--	--	210,000	1,520	1,540	2,120	1,740	2,780	2,500	3,220	2,240	2,160
Chromium	0.29	5.6	430,000	74	2.2 J	2.1 J	6.6	2.2	5.6	3.9	11	5.4	6.1
Cobalt	2.3	30	0.50	25	6.5	3.6	6.2	3.0	5.3	4.1	9.0	7.6	7.4
Copper	310	4,100	52	68	7.8	9.6	25	8.6	16	14	31	30	25
Cyanide	160	2,000	2.0	--	1.0 U	1.0 U	1.0 U	1.0 U	1.1 U	1.0 U	1.2 U	1.0 U	1.1 U
Iron	5,500	72,000	660	37,531	11,200	8,170	18,100	9,930	15,000	13,800	23,700	21,300	21,400
Lead	400	800	27	6.9	1.6	1.6	2.7	1.5	2.5	2.4	3.6	3.0	2.6
Magnesium	--	--	--	12,834	536	532	1,950	518	1,450	1,360	3,130	2,590	1,950
Manganese	180	2,300	57	1,167	814 J	1,030 J	119 J	343 J	369 J	300 J	651 J	872 J	691 J
Mercury	0.78	10	0.40	0.031	0.032 U	0.030 U	0.034 U	0.034 U	0.036 U	0.036 U	0.035 U	0.036 U	0.034 U
Nickel	150	2,000	1,400	40	3.1 U	1.4 J	2.9 J	0.83 J	1.8 J	1.4 J	4.9 J	7.0	5.6
Potassium	--	--	--	1,700	346	245	583 J	326 J	558 J	525 J	597 J	640 J	542 J
Selenium	39	510	0.12	2.0	0.39 U	0.47 U	0.42 U	0.36 U	0.48 U	0.48 U	0.42 U	0.47 U	0.45 U
Silver	39	510	20	0.077	**0.28 J**	**0.34 J**	**0.13 J**	**0.15 J**	**0.26 J**	**0.18 J**	**0.35 J**	**0.40 J**	**0.35 J**
Sodium	--	--	--	6,300	77 U	95 U	314	78	149	100	373	532	401
Vanadium	39	520	180	130	46 J	27 J	82	39	59	54	91	85	89
Zinc	2,300	31,000	5,800	65	10	7.3	19	6.9	16	15	29	28	21
Total Petroleum Hydrocarbons (µg/kg)													
No Detections			--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1

NA - Not analyzed
ND - Not detected
J - Analyte present, value may or may not be accurate or precise
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
µg/kg - Micrograms per kilogram
mg/kg - Milligrams per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds

Table 4-3
Subsurface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, West Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	SSL DAF 1	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO89		VWAR-SO91			VWAR-SO92	VWAR-SO93	VWAR-SO94	VWAR-SO95	
Sample ID					VWAR-SB89-46-0609	VWAR-SB89P-46-0609	VWAR-SB91-1314-0609	VWAR-SB91-23-0609	VWAR-SB91-46-0609	VWAR-SB92-46-0609	VWAR-SB93-46-0609	VWAR-SB94-46-0609	VWAR-SB95-1516-0609	VWAR-SB95-46-0609
Sample Date					06/04/09	06/04/09	06/10/09	06/10/09	06/10/09	06/04/09	06/08/09	06/08/09	06/08/09	06/08/09
Chemical Name														
Volatile Organic Compounds (µg/kg)														
Toluene	500,000	818,000	2,367	--	2.0 J	1.0 J	4.0 UJ	2.0 J	4.0 U	1.0 J	4.0 U	4.0 U	5.0 U	1.0 J
Semivolatile Organic Compounds (µg/kg)														
2,4-Dinitrotoluene	1,600	5,500	0.68	--	110 U	110 U	29 U	28 U	28 U	100 U	27 UJ	28 U	30 U	27 U
2-Nitroaniline	61,000	600,000	230	--	22 UJ	22 UJ	23 U	22 U	7.8 J	21 UJ	21 UJ	22 U	24 U	22 U
4-Chloro-3-methylphenol	610,000	6,200,000	21,986	--	7.4 J	6.8 J	120 U	110 U	110 U	6.4 J	7.0 J	110 U	7.5 J	6.9 J
4-Nitroaniline	24,000	86,000	2.1	--	22 R	22 UJ	23 U	22 U	23 U	21 UJ	21 R	22 UJ	24 UJ	22 UJ
Atrazine	2,100	7,500	6.1	--	**6.4 J**	**6.2 J**	23 UJ	22 UJ	23 UJ	5.9 J	21 UJ	22 UJ	24 UJ	22 UJ
Benzo(b)fluoranthene	150	2,100	186	--	22 UJ	22 UJ	23 UJ	22 UJ	23 UJ	21 UJ	21 U	5.0 J	24 U	22 U
Benzo(k)fluoranthene	1,500	21,000	1,825	--	370 UJ	360 UJ	380 U	370 U	380 U	350 UJ	350 UJ	360 UJ	400 U	360 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	10,000	--	370 UJ	360 UJ	380 U	370 U	380 U	350 UJ	350 U	360 U	400 U	360 U
Carbazole	24,000	86,000	93	--	22 UJ	22 UJ	23 U	22 U	23 U	21 UJ	21 U	22 U	24 U	22 U
Chrysene	15,000	210,000	5,476	--	370 UJ	360 UJ	380 U	370 U	380 U	350 UJ	350 UJ	360 UJ	400 UJ	360 UJ
Dibenz(a,h)anthracene	15	210	61	--	22 UJ	3.1 J	23 UJ	22 U	23 UJ	5.1 J	21 UJ	8.0 J	24 U	22 U
Di-n-octylphthalate	35,000	120,000	6,350	--	170 UJ	60 J	170 U	170 U	170 U	160 UJ	160 UJ	160 UJ	180 U	160 UJ
Fluoranthene	230,000	2,200,000	900,000	--	22 UJ	22 UJ	23 UJ	22 UJ	23 UJ	21 UJ	21 UJ	2.3 J	24 UJ	22 UJ
Hexachlorocyclopentadiene	37,000	370,000	682	--	22 UJ	22 UJ	23 U	22 U	23 U	21 UJ	21 U	22 U	24 U	22 U
Pyrene	170,000	1,700,000	610,000	--	22 UJ	22 UJ	23 U	22 UJ	23 U	21 UJ	21 U	3.0 J	24 UJ	22 UJ
Pesticide/Polychlorinated Biphenyls (µg/kg)														
4,4'-DDD	2,000	7,200	342	--	3.7 UJ	3.6 UJ	3.8 UJ	3.7 UJ	3.8 UJ	3.5 UJ	3.5 UJ	3.6 UJ	4.0 UJ	3.6 UJ
4,4'-DDE	1,400	5,100	244	--	3.7 UJ	3.6 U	3.8 U	3.7 U	3.8 U	3.5 U	3.5 UJ	3.6 UJ	4.0 UJ	3.6 UJ
4,4'-DDT	1,700	7,000	352	--	3.7 U	3.6 U	3.8 U	3.7 U	3.8 U	3.5 U	3.5 UJ	3.6 UJ	4.0 UJ	3.6 UJ
alpha-Chlordane	1,600	6,500	1,386	--	1.9 UJ	1.9 U	2.0 U	1.9 U	1.9 U	1.8 U	1.8 UJ	1.9 UJ	2.0 UJ	1.8 UJ
Dieldrin	30	110	0.36	--	3.7 UJ	3.6 U	3.8 U	3.7 U	3.8 U	3.5 U	3.5 UJ	3.6 UJ	4.0 UJ	3.6 UJ
Endrin ketone	1,800	18,000	170	--	3.7 UJ	3.6 U	3.8 U	3.7 U	3.8 U	3.5 U	3.5 UJ	3.6 UJ	4.0 UJ	3.6 UJ
Explosives (µg/kg)														
Perchlorate	5,500	72,000	17	--	0.75 J	0.90 J	1.5 U	0.29 J	0.65 J	0.19 J	0.24 J	0.26 J	2.2 U	2.0 U
Total Metals (mg/kg)														
Aluminum	7,700	99,000	56,000	29,000	20,800	21,000	10,300	22,900	23,200	11,200	13,800	18,300	16,600	17,200
Antimony	3.1	41	0.27	2.3	0.11 UJ	0.096 UJ	0.10 UJ	0.030 J	0.040 J	0.081 UJ	0.095 UJ	0.077 UJ	0.095 UJ	0.091 UJ
Arsenic	0.39	1.6	0.31	2.2	0.34 J	0.34 J	0.50 U	0.74	0.50	0.36 J	0.48 U	0.33 J	0.32 J	0.20 J
Barium	1,500	19,000	100	320	97	63	25 J	163 J	137 J	111	89 J	210 J	126 J	37 J
Beryllium	16	200	400	0.45	0.35	0.30	0.19	0.34	0.39	0.22	0.22	0.32	0.29	0.28
Calcium	--	--	--	210,000	2,800	2,710	1,830	3,700	7,840	3,090	18,500 R	9,500 R	4,600 R	3,650 R
Chromium	0.29	5.6	430,000	74	5.0	4.9	3.9 J	11 J	7.8 J	4.6	4.9	6.3	6.5	5.3
Cobalt	2.3	30	0.50	25	8.7	11	3.7	16	14	6.2	5.7	9.7	7.8	4.5
Copper	310	4,100	52	68	34	32	16	21	34	20	21	25	30	28
Cyanide	160	2,000	2.0	--	0.26 J	1.1 U	1.1 U	1.1 U	1.1 U	1.0 U	1.0 U	1.0 U	1.2 U	1.3 U
Iron	5,500	72,000	660	37,531	20,200	22,600	17,600	21,300	26,300	16,800	17,200	21,800	25,100	20,500
Lead	400	800	27	6.9	3.6	4.2	1.7	4.0	4.6	2.5	2.6	2.8	3.5	2.4
Magnesium	--	--	--	12,834	2,580	2,940	1,410 J	3,160 J	5,380 J	1,890	2,150 J	2,810 J	3,700 J	2,670 J
Manganese	180	2,300	57	1,167	790 J	850 J	145 J	**1,340 J**	**1,200 J**	480 J	495	**1,650**	915	340
Mercury	0.78	10	0.40	0.031	0.035 U	0.034 U	0.039 U	0.020 J	0.038 U	0.033 U	0.034 U	0.036 U	0.040 U	0.033 U
Nickel	150	2,000	1,400	40	3.3 J	2.8 J	4.0 U	6.8	7.7 U	2.4 J	3.8 U	4.7	7.6 U	3.6 U
Potassium	--	--	--	1,700	918 J	981 J	377 J	786 J	540 J	505 J	664 J	592 J	503 J	891 J
Selenium	39	510	0.12	2.0	0.55 U	0.48 U	0.17 J	0.12 J	0.48 U	0.41 U	0.48 U	0.38 U	0.48 U	0.46 U
Silver	39	510	20	0.077	**0.35 J**	**0.39 J**	**0.62 J**	**0.82 J**	**0.45 J**	**0.24 J**	**0.39 J**	**0.45 J**	**0.20 J**	**0.42 J**
Sodium	--	--	--	6,300	216	200	244	1,100	1,850	639	729	1,350	610	662
Vanadium	39	520	180	130	72	80	60 J	78 J	89 J	64	57	62	83	64
Zinc	2,300	31,000	5,800	65	29	30	17	25	36	22	25 J	31 J	35 J	28 J
Total Petroleum Hydrocarbons (µg/kg)														
No Detections			--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1

NA - Not analyzed
ND - Not detected
J - Analyte present, value may or may not be accurate or precise
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
µg/kg - Micrograms per kilogram
mg/kg - Milligrams per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds

Table 4-3
Subsurface Soil Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, West Vieques, Puerto Rico

Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	SSL DAF 1	Vieques (West) Bkgd Zone Qa[1]	VWAR-SO96			VWAR-SO97	VWAR-SO98	
Sample ID					VWAR-SB96-2021-0609	VWAR-SB96-46-0609	VWAR-SB96P-46-0609	VWAR-SB97-46-0609	VWAR-SB98-1718-0609	VWAR-SB98-46-0609
Sample Date					06/09/09	06/09/09	06/09/09	06/09/09	06/09/09	06/09/09
Chemical Name										
Volatile Organic Compounds (µg/kg)										
Toluene	500,000	818,000	2,367	--	5.0 UJ	1.0 J	4.0 UJ	4.0 UJ	5.0 U	5.0 U
Semivolatile Organic Compounds (µg/kg)										
2,4-Dinitrotoluene	1,600	5,500	0.68	--	31 U	28 U	28 U	26 U	30 U	32 U
2-Nitroaniline	61,000	600,000	230	--	25 U	22 U	22 U	21 U	7.7 J	8.2 J
4-Chloro-3-methylphenol	610,000	6,200,000	21,986	--	120 U	110 U	6.4 J	100 U	8.1 J	8.1 J
4-Nitroaniline	24,000	86,000	2.1	--	25 UJ	22 UJ	22 UJ	21 UJ	24 UJ	**6.5 J**
Atrazine	2,100	7,500	6.1	--	25 UJ	**6.2 J**	6.1 J	21 UJ	**6.8 J**	**7.5 J**
Benzo(b)fluoranthene	150	2,100	186	--	25 U	22 U	22 U	21 U	24 U	25 U
Benzo(k)fluoranthene	1,500	21,000	1,825	--	410 UJ	370 UJ	370 U	340 U	390 UJ	420 U
bis(2-Ethylhexyl)phthalate	35,000	120,000	10,000	--	410 U	370 U	370 U	340 U	390 U	420 U
Carbazole	24,000	86,000	93	--	25 U	22 U	22 U	21 U	24 U	25 U
Chrysene	15,000	210,000	5,476	--	410 UJ	370 UJ	370 UJ	340 U	390 UJ	420 UJ
Dibenz(a,h)anthracene	15	210	61	--	25 U	5.5 J	22 U	21 U	24 U	25 U
Di-n-octylphthalate	35,000	120,000	6,350	--	190 U	170 U	170 UJ	160 U	180 U	190 U
Fluoranthene	230,000	2,200,000	900,000	--	25 UJ	22 UJ	22 UJ	21 UJ	24 UJ	25 UJ
Hexachlorocyclopentadiene	37,000	370,000	682	--	25 U	22 U	22 U	21 U	24 U	25 U
Pyrene	170,000	1,700,000	610,000	--	25 UJ	22 UJ	22 UJ	21 UJ	24 UJ	25 UJ
Pesticide/Polychlorinated Biphenyls (µg/kg)										
4,4'-DDD	2,000	7,200	342	--	4.1 UJ	3.7 UJ	3.7 UJ	3.4 UJ	3.9 UJ	4.2 UJ
4,4'-DDE	1,400	5,100	244	--	4.1 UJ	3.7 UJ	3.7 UJ	3.4 U	3.9 U	4.2 U
4,4'-DDT	1,700	7,000	352	--	4.1 UJ	3.7 UJ	3.7 UJ	3.4 U	3.9 UJ	4.2 UJ
alpha-Chlordane	1,600	6,500	1,386	--	2.1 UJ	1.9 UJ	1.9 UJ	1.8 U	2.0 U	2.2 U
Dieldrin	30	110	0.36	--	4.1 UJ	3.7 UJ	3.7 UJ	3.4 U	3.9 U	4.2 U
Endrin ketone	1,800	18,000	170	--	4.1 UJ	3.7 UJ	3.7 UJ	3.4 U	3.9 UJ	4.2 UJ
Explosives (µg/kg)										
Perchlorate	5,500	72,000	17	--	2.2 U	0.38 J	0.53 J	1.8 U	0.36 J	0.47 J
Total Metals (mg/kg)										
Aluminum	7,700	99,000	56,000	29,000	19,600	24,200	19,600	3,440	**29,800**	18,700
Antimony	3.1	41	0.27	2.3	0.090 UJ	0.11 UJ	0.062 UJ	0.082 UJ	0.095 UJ	0.10 UJ
Arsenic	0.39	1.6	0.31	2.2	0.31 J	0.48 J	0.43	0.41 U	0.48	0.51 U
Barium	1,500	19,000	100	320	49 J	179 J	211 J	54 J	238 J	145 J
Beryllium	16	200	400	0.45	0.36	0.33	0.26	0.080	0.43	0.28
Calcium	--	--	--	210,000	3,840 R	6,680 R	10,500 R	1,550	5,770 R	3,760 R
Chromium	0.29	5.6	430,000	74	7.6	8.0	7.4	2.0 J	10	5.6
Cobalt	2.3	30	0.50	25	7.4	11	9.8	3.9	22	7.3
Copper	310	4,100	52	68	38	27	23	8.0	**72**	34
Cyanide	160	2,000	2.0	--	1.3 U	1.0 U	1.0 U	1.0 U	1.1 U	1.2 U
Iron	5,500	72,000	660	37,531	28,900	24,300	19,500	8,900	**41,100**	23,200
Lead	400	800	27	6.9	5.0	3.2	3.5	1.5	3.9	2.8
Magnesium	--	--	--	12,834	3,470 J	2,460 J	2,460 J	541 J	6,760 J	2,370 J
Manganese	180	2,300	57	1,167	234	1,110 J	737 J	393 J	**1,780**	519
Mercury	0.78	10	0.40	0.031	0.037 U	0.035 U	0.033 U	0.032 U	0.038 U	0.035 U
Nickel	150	2,000	1,400	40	7.2 U	4.2 U	5.0 U	3.3 U	7.6 U	4.1 U
Potassium	--	--	--	1,700	803 J	882 J	700 J	263 J	1,080 J	672 J
Selenium	39	510	0.12	2.0	0.45 U	0.53 U	0.31 U	0.41 U	0.47 U	0.51 U
Silver	39	510	20	0.077	2.7 U	**0.61 J**	**0.11 J**	**0.35 J**	2.8 U	**0.55 J**
Sodium	--	--	--	6,300	330	256	225	80 J	873	223
Vanadium	39	520	180	130	91	80	67	30 J	122	72
Zinc	2,300	31,000	5,800	65	53 J	30 J	26 J	7.6	57 J	31 J
Total Petroleum Hydrocarbons (µg/kg)										
No Detections			--	--	NA	NA	NA	NA	NA	NA

Notes:

Exceeds Vieques (West) Bkgd Zone Qa
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted
Exceeds Vieques (West) Bkgd Zone Qa and SSL DAF 1
Exceeds Vieques (West) Bkgd Zone Qa and RSL Residential Soil Adjusted and SSL DAF 1

NA - Not analyzed
ND - Not detected
J - Analyte present, value may or may not be accurate or precise
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an associated blank
UJ - Analyte not detected, quantitation limit may be inaccurate
µg/kg - Micrograms per kilogram
mg/kg - Milligrams per kilogram
[1]Total Metals exceedances are noted only if the parameter concentration exceeds

Table 4-4
Ground Water Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, West Vieques, Puerto Rico

Station ID	MCL-Groundwater[2]	May RSL for Tap Water Adj.[3]	Puerto Rico Water Quality Standards, Class SG	WAR-MW01 [1]			WAR-MW02		WAR-MW03		WAR-MW04			WAR-MW05		WAR-MW06		WAR-MW07	
Sample ID				WAR-GW01-06A	WAR-GW01P-06A	WAR-GW01-09A	WAR-GW02-06A	WAR-GW02-09A	WAR-GW03-06A	WAR-GW03-09A	WAR-GW04-06A	WAR-GW04-09A	WAR-GW04P-09A	WAR-GW05-06A	WAR-GW05-09A	WAR-GW06-06A	WAR-GW06-09A	WAR-GW07-06A	WAR-GW07-09A
Sample Date				01/11/06	01/11/06	08/24/09	01/13/06	08/25/09	01/11/06	08/26/09	01/11/06	08/25/09	08/25/09	01/12/06	08/31/09	01/12/06	08/31/09	01/12/06	08/27/09
Chemical Name																			
Volatile Organic Compounds (µg/l)																			
Carbon disulfide	--	100		0.50 U	0.50 U	1.0 U	0.50 U	1.0 U	0.50 U	1.0 U	0.50 U	1.0 U	1.0 U	0.50 U	0.30 J	0.50 U	0.30 J	0.50 U	1.0 U
Chloromethane	--	19		0.50 U	0.50 U	2.0 U	0.50 U	2.0 U	0.50 U	2.0 U	0.50 U	1.0 J	2.0 U	0.50 U	2.0 U	0.50 U	2.0 U	0.50 U	2.0 U
Semivolatile Organic Compounds (µg/l)																			
4-Nitrophenol	--	0.12		20 U	20 U	0.94 U	20 U	0.95 U	20 U	0.94 U	20 U	0.96 U	0.96 U	20 U	**0.39 J**	20 U	**0.38 J**	20 U	0.95 U
Benzaldehyde	--	370		5.0 UJ	5.0 UJ	9.0 UJ	5.0 U	10 UJ	5.0 UJ	9.0 UJ	5.0 U	10 UJ	10 UJ	5.0 UJ	9.0 UJ	5.0 U	9.0 UJ	5.0 U	1.0 J
bis(2-Ethylhexyl)phthalate	6.0	4.8	12	5.0 U	5.0 U	1.4 U	5.0 U	1.4 U	5.0 UJ	**6.1 J**	5.0 U	1.4 U	1.4 U	5.0 U	1.4 U	5.0 U	1.4 U	5.0 U	**62 J**
Dimethyl phthalate	--	2,900	270,000	5.0 U	5.0 U	0.19 U	5.0 U	0.19 U	5.0 UJ	0.19 U	5.0 U	0.19 U	0.19 U	5.0 U	0.19 U	5.0 U	0.19 U	5.0 U	0.053 J
Phenol	--	1,100		5.0 U	5.0 U	9.0 U	5.0 U	10 U	5.0 U	9.0 U	5.0 U	10 U	10 U	5.0 U	9.0 R	5.0 U	9.0 R	5.0 U	2.0 J
Pesticide/Polychlorinated Biphenyls (µg/l)																			
Endosulfan I	--	22		0.010 UJ	0.010 UJ	0.048 U	0.010 U	0.048 U	0.010 U	0.048 U	0.010 U	0.048 U	0.048 U	0.0022 J	0.047 U	0.010 UJ	0.047 U	0.010 U	0.047 U
Explosives (µg/l)																			
Perchlorate	--	2.6		NA	NA	0.24	NA	0.18 J	NA	0.20 U	NA	0.20 U	0.044 J	NA	0.20 U	NA	0.20 U	NA	0.20 U
Total Metals (µg/l)																			
Aluminum	--	3,700		200 U	200 U	300 U	2,580	58 J	**5,860**	300 U	711	49 J	68 J	200 U	300 U	475	300 U	273	300 U
Arsenic	10	0.045	10	10 U	10 U	**1.5 J**	10 U	**2.1 J**	10 U	5.0 U	10 U	5.0 U	**2.6 J**	10 U	5.0 U	10 U	5.0 U	10 U	5.0 U
Barium	2,000	730		11 J	12 J	13	27 J	22	129 J	107	47 J	32	32	113 J	164	116 J	197	81 J	139
Beryllium	4.0	7.3		5.0 U	5.0 U	1.0 U	5.0 U	1.0 U	0.34 J	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	5.0 U	1.0 U	5.0 U	1.0 U
Cadmium	5.0	1.8	5.0	5.0 U	5.0 U	0.11 J	5.0 U	1.0 U	50 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	5.0 U	1.0 U	5.0 U	1.0 U
Calcium	--	--		53,300	52,800	35,100	34,800	44,600	53,800	81,800	44,500	43,600	43,400	49,000	80,900	43,700	76,600	48,100	101,000
Chromium	100	0.043	100	10 U	10 U	3.0 U	**23**	3.0 U	10 U	3.0 U	10 U	3.0 U	3.0 U	10 U	3.0 U	10 U	3.0 U	10 U	3.0 U
Cobalt	--	1.1		50 U	50 U	0.74 J	50 U	0.18 J	50 U	**3.0**	50 U	1.0	1.1	50 U	**1.7**	50 U	**3.3**	10 U	0.35 J
Copper	1,300	150	1,300	25 U	25 U	9.2 J	11 J	1.0 U	25 U	1.3	25 U	2.6	0.93 J	25 U	1.2	25 U	1.0 U	25 U	2.0 J
Iron	--	2,600		108	165	100 U	**3,990**	141 J	**14,300**	435 J	1,090	106 J	148 J	144	718	832	990	437	277
Lead [4]	15	--	15.0	10 U	10 U	1.0 U	10 U	1.0 U	2.0 J	0.15 J	10 U	1.0 U	1.0 U	10 U	1.0 U	10 U	1.0 U	10 U	1.0 U
Magnesium	--	--		42,200	41,900	28,700	35,700	44,900	35,500	56,600	31,100	32,400	32,300	32,000	53,000	30,100	52,800	27,000	55,400
Manganese	--	88		**258**	**252**	**352**	153	12 J	**1,080**	**1,060**	**713**	**1,140**	**1,190**	**1,370**	**2,090**	**1,010**	**1,720**	194	51
Mercury	2.0	0.37	0.050	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.020 J	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Nickel	--	73	610	1.3 J	1.7 J	4.4	15 J	1.6	4.2 J	1.7 J	2.9 J	0.99 J	1.0	1.1 J	1.9 J	1.1 J	1.7 J	1.0 J	2.0 J
Potassium	--	--		682 J	677 J	656 J	432 J	444 J	1,440 J	1,440	638 J	553 J	533 J	979 J	1,730	1,660 J	2,490	1,500 J	1,070
Silver	--	18		0.56 J	10 U	1.0 U	0.57 J	1.0 U	0.69 J	1.0 U	0.87 J	1.0 U	1.0 U	10 U	1.0 U	0.53 J	1.0 U	0.55 J	1.0 U
Sodium	--	--		180,000	181,000	144,000	290,000	392,000	154,000	170,000	36,900	39,500	38,600	146,000	191,000	134,000	173,000	96,500	212,000
Thallium	2.0	--	0.24	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium	--	18		50 U	50 U	**61**	50 U	29	57	3.1 J	50 U	8.8	9.4	50 U	0.91 J	50 U	1.5 J	50 U	11
Zinc	--	1,100		60 U	60 U	11 U	12 J	11 U	25 J	11 U	60 U	11 U	11 U	60 U	11 U	60 U	11 U	60 U	11 U
Dissolved Metals (µg/l)																			
Aluminum, Dissolved	--	3,700		200 U	200 U	300 U	160 J	300 U	1,430	300 U	107 J	300 U	300 U	200 U	300 U	200 U	300 U	139 J	300 U
Arsenic, Dissolved	10	0.045	10	10 U	10 U	**1.7 J**	10 U	**1.9 J**	10 U	5.0 U	10 U	**1.9 J**	5.0 U	10 U	5.0 U	10 U	5.0 U	10 U	5.0 U
Barium, Dissolved	2,000	730		200 U	200 U	13	200 U	23	200 U	104	200 U	25	27	200 U	156	200 U	193	200 U	137
Cadmium, Dissolved	5.0	1.8	5.0	5.0 U	5.0 U	0.11 J	5.0 U	1.0 U	5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	5.0 U	1.0 U	5.0 U	1.0 U
Calcium, Dissolved	--	--		52,100	54,100	35,700	33,400	46,500	52,600	83,700	44,400	43,200	44,600	47,400	77,200	44,500	75,000	47,100	100,000
Cobalt, Dissolved	--	1.1		50 U	50 U	0.54 J	50 U	1.0 U	50 U	**3.1**	50 U	0.52 J	0.61 J	50 U	**1.7**	50 U	**3.2**	50 U	0.21 J
Copper, Dissolved	1,300	150	1,300	4.0 J	4.3 J	9.3 J	3.9 J	1.0 U	9.0 J	1.1	25 U	0.94 J	0.77 J	25 U	0.69 J	25 U	1.0 U	25 U	1.9 J
Iron, Dissolved	--	2,600		100 U	100 U	100 U	244	100 U	**3,930**	417 J	185	100 U	100 U	35 J	648	73 J	863	246	100 U
Lead, Dissolved [4]	15	--	15.0	10 U	10 U	1.0 U	10 U	0.050 J	10 U	1.0 U	10 U	1.0 U	1.0 U	10 U	1.0 U	10 U	1.0 U	10 U	1.0 U
Magnesium, Dissolved	--	--		41,200	42,800	29,200	33,400	46,700	33,900	56,400	30,800	31,700	33,300	30,900	50,900	30,200	52,000	26,300	55,800
Manganese, Dissolved	--	88		**256**	**265**	**349**	22	5.2	**963**	**1,060**	**682**	**844**	**874**	**1,390**	**1,980**	**1,000**	**1,710**	187	15
Nickel, Dissolved	--	73	610	40 U	40 U	3.5	40 U	1.8	40 U	2.0 J	40 U	0.91 J	1.2	40 U	1.7 J	40 U	1.5 J	40 U	1.8 J
Potassium, Dissolved	--	--		5,000 U	5,000 U	666 J	5,000 U	457 J	5,000 U	1,480	5,000 U	529 J	557 J	5,000 U	1,640	5,000 U	2,430	5,000 U	1,090
Selenium, Dissolved	50	18		35 U	35 U	5.0 U	35 U	5.0 U	35 U	5.0 U	35 U	2.5 J	2.0 J	35 U	5.0 U	35 U	5.0 U	35 U	5.0 U
Silver, Dissolved	--	18		0.60 J	10 U	1.0 U	10 U	1.0 U	10 U	1.0 U	10 U	1.0 U	1.0 U	10 U	1.0 U	10 U	1.0 U	10 U	1.0 U
Sodium, Dissolved	--	--		177,000	183,000	148,000	280,000	411,000	152,000	172,000	36,700	38,200	39,600	141,000	183,000	134,000	171,000	94,000	210,000
Vanadium, Dissolved	--	18		50 U	50 U	**62**	50 U	29	50 U	3.4 J	50 U	8.8	8.8	50 U	5.0 U	50 U	0.84 J	50 U	9.0
Zinc, Dissolved	--	1,100		60 U	60 U	4.3 J	60 U	11 U	12 J	11 U	60 U	11 U	11 U	60 U	11 U	60 U	11 U	60 U	11 U
Wet Chemistry (mg/l)																			
Chloride	--	--		NA	NA	73	NA	330	NA	230	NA	20	19	NA	260	NA	240	NA	300
Total dissolved solids (TDS)	--	--		719	735	530	958	1,100	677	840	337	360	330	604	870	569	820	457	920
Total Petroleum Hydrocarbons (µg/l)																			
No Detections	--	--		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Exceeds RSL for Tap Water Adj.

Exceeds MCL-Groundwater and RSL for Tap Water Adj.

Exceeds MCL-Groundwater and RSL for Tap Water Adj. and Puerto Rico Water Quality Standards, Class SG

NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
R - Unreliable Result
U - Not detected or not detected at significantly greater than that in an
UJ - Analyte not detected, quantitation limit may be inaccurate
mg/l - Milligrams per liter
µg/l - Micrograms per liter

[1] - Exceedances are noted only if the parameter concentration exceeds the most conservative background well (WAR-MW01) concentration.

[2] - MCL= Maximum Contaminant Level, from EPA 816-F-09-004 (May 2009)

[3] Regional Screening Levels for Tapwater (Oak Ridge National Laboratory, December 2009). Concentrations based on non-carcinogenic health effects are adjusted using HQ= 0.1.

[4] - The action level for lead is the same as the MCL.

Table 4-5
Surface Water Detection and Exceedance Summary
AOC R Remedial Investigation Report
Former NASD, West Vieques, Puerto Rico

Station ID	**May RSL Tap Water Adjusted**	**Eco (E)**	WAR-SDSW01		WAR-SDSW02	WAR-SDSW03	VWAR-SW04		VWAR-SW05
Sample ID			WAR-SW01	WAR-SW01P	WAR-SW02	WAR-SW03	VWAR-SW04-0609	VWAR-SW04P-0609	VWAR-SW05-0609
Sample Date			12/06/05	12/06/05	12/05/05	12/05/05	06/11/09	06/11/09	06/11/09
Chemical Name									
Volatile Organic Compounds (µg/l)									
Acetone	2,200	1,500	4.0 J	10 UJ	10 U	10 U	NA	NA	NA
Chloroform	0.19	28	**2.0 J**	**3.0 J**	10 U	10 U	NA	NA	NA
Methylene chloride	4.8	2,200	10 U	1.0 J	10 U	10 U	NA	NA	NA
Semivolatile Organic Compounds (µg/l)									
No Detections	--	--	ND	ND	ND	ND	NA	NA	NA
Pesticide/Polychlorinated Biphenyls (µg/l)									
No Detections	--	--	ND	ND	ND	ND	NA	NA	NA
Explosives (µg/l)									
No Detections	--	--	ND	ND	ND	ND	NA	NA	NA
Total Metals (µg/l)									
Arsenic	0.045	150	10 U	10 U	10 U	10 U	**3.3 J**	2.7 R	5.0 U
Barium	730	4.0	**314**	**314**	**239**	**234**	**48**	**49**	**29**
Calcium	--	--	64,900	65,100	85,100	107,000	15,400	15,900	13,300
Cobalt	1.1	23	**4.8 J**	**4.6 J**	**1.9 J**	**2.2 J**	30 U	30 U	30 U
Copper	150	9.3	25 U	25 U	25 U	25 U	25 U	25 U	0.83 J
Iron	2,600	1,000	505	509	672	956	1,130 R	**1,190**	988
Lead	15	3.2	10 U	10 U	10 U	10 U	5.0 U	1.8 J	2.0 J
Magnesium	--	--	28,200	28,200	35,700	103,000	6,850	7,040	5,960
Manganese	88	120	**2,380**	**2,390**	**565**	**883**	**910**	**942**	**894**
Nickel	73	52	1.7 J	2.0 J	1.3 J	0.95 J	40 U	40 U	40 U
Potassium	--	--	6,560 J	6,440 J	5,390 J	29,900 J	2,180	2,010	2,460
Sodium	--	--	141,000	139,000	113,000	556,000	24,800	25,500	24,800
Thallium	--	12	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.68 J	0.23 J
Vanadium	18	20	2.8 J	2.6 J	2.3 J	1.4 J	5.0 U	5.0 U	5.5
Zinc	1,100	120	60 U	60 U	60 U	60 U	25 U	25 U	3.5 J
Dissolved Metals (µg/l)									
Arsenic, Dissolved	0.045	150	10 U	10 U	10 U	**2.3 J**	**4.7 J**	4.1 R	**4.2 J**
Barium, Dissolved	730	4.0	**289**	**288**	**233**	**222**	**41**	**40**	**28**
Calcium, Dissolved	--	--	62,100	61,600	85,500	105,000	15,500	14,300	12,400
Cobalt, Dissolved	1.1	23	**3.5 J**	**3.8 J**	**1.7 J**	**2.2 J**	30 U	30 U	30 U
Copper, Dissolved	150	9.0	25 U	25 U	25 U	25 U	25 U	1.5 J	25 U
Iron, Dissolved	2,600	1,000	381	376	108	229	100 U	100 U	404
Lead, Dissolved	15	2.5	10 U	10 U	10 U	10 U	2.3 J	1.4 J	1.1 J
Magnesium, Dissolved	--	--	26,500	26,400	35,500	96,900	6,710	6,780	6,270
Manganese, Dissolved	88	120	**2,230**	**2,210**	**529**	**819**	**829**	**841**	**906**
Nickel, Dissolved	73	52	1.5 J	1.5 J	1.5 J	1.2 J	40 U	40 U	40 U
Potassium, Dissolved	--	--	6,140 J	6,270 J	5,400 J	28,300 J	2,060	1,990	2,450
Sodium, Dissolved	--	--	136,000	136,000	116,000	536,000	25,000	23,100	23,200
Thallium, Dissolved	--	12	0.063 J	1.0 U	1.0 U	1.0 U	1.0 U	0.45 J	1.0 U
Vanadium, Dissolved	18	20	1.9 J	2.0 J	1.4 J	1.2 J	5.0 U	5.0 U	5.0 U

Notes:

Exceeds RSL Tap Water Adjusted
Exceeds Eco (E)
Exceeds RSL Tap Water Adjusted and Eco (E)

NA - Not analyzed
ND - Not detected
J - Analyte present, value may or may not be accurate or
R - Unreliable Result
U - Not detected or not detected at significantly greater than
UJ - Analyte not detected, quantitation limit may be
µg/l - Micrograms per liter

Table 4-6
Sediment Detection Summary
AOC R Remedial Investigation Report
Former NASD, West Vieques, Puerto Rico

Station ID	**May RSL Residential Soil Adjusted**	**May RSL Industrial Soil Adjusted**	**Eco (E)**	WAR-SDSW01		WAR-SDSW02	WAR-SDSW03
Sample ID				WAR-SD01	WAR-SD01P	WAR-SD02	WAR-SD03
Sample Date				12/06/05	12/06/05	12/05/05	12/05/05
Chemical Name							
Volatile Organic Compounds (µg/kg)							
No Detections	--		--	ND	ND	ND	ND
Semivolatile Organic Compounds (µg/kg)							
No Detections	--		--	ND	ND	ND	ND
Pesticide/Polychlorinated Biphenyls (µg/kg)							
4,4'-DDT	1,700	7,000	4.2	4.1 U	4.2 U	4.1 U	2.3 J
Explosives (µg/kg)							
No Detections	--		--	ND	ND	ND	ND
Total Metals (mg/kg)							
Aluminum	7,700	99,000	25,500	1,630	1,980	2,530	1,830
Antimony	3.1	41	3.0	7.5 UJ	7.6 UJ	0.28 J	7.4 UJ
Barium	1,500	19,000	20	**27 J**	**95 J**	**76**	25 U
Calcium	--	--	--	891	1,110	1,080	953
Chromium	0.29	5.6	43	**1.6**	**2.4**	**1.7**	**1.4**
Cobalt	2.3	30	50	**2.5 J**	**7.0**	**5.0 J**	2.2 J
Copper	310	4,100	32	5.2	6.0	6.7	6.9
Iron	5,500	72,000	20,000	4,290	**5,650**	**7,430**	**5,680**
Lead	400	800	36	1.3	1.6	1.6	1.4
Magnesium	--	--	--	624 U	634	805	616 U
Manganese	180	2,300	460	**191 J**	**731 J**	**392 J**	73 J
Nickel	150	2,000	23	0.81 J	1.1 J	1.1 J	0.64 J
Potassium	--	--	--	253 J	316 J	302 J	253 J
Vanadium	39	520	--	17	22	28	22
Zinc	2,300	31,000	121	5.3 J	7.6	11	7.3 J

Notes:

Exceeds RSL Residential Soil Adjusted

Exceeds Eco (E)

Exceeds RSL Residential Soil Adjusted and Eco (E)

NA - Not analyzed

ND - Not detected

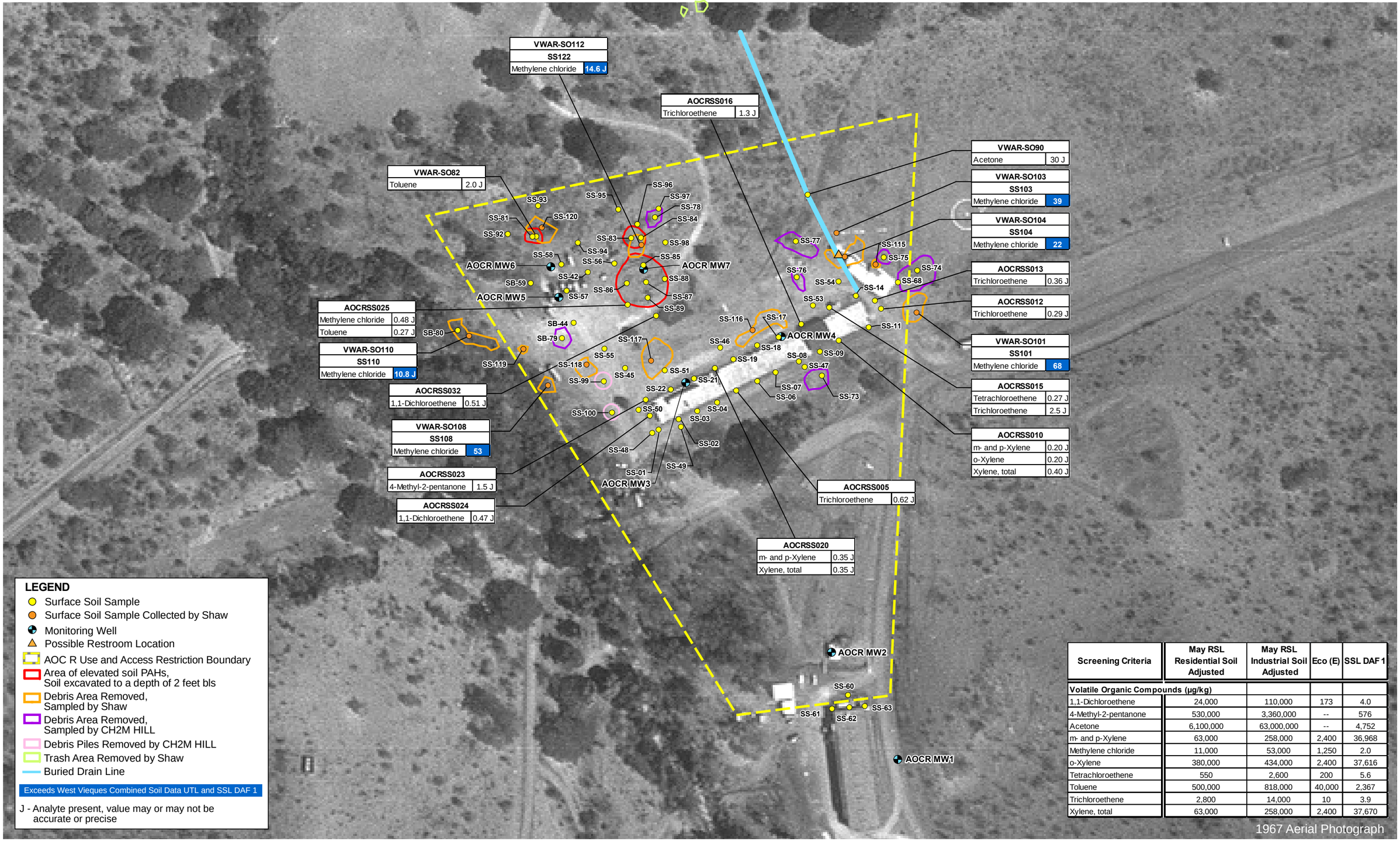
J - Analyte present, value may or may not be accurate or precise

U - Not detected or not detected at significantly greater than that in an associated blank

UJ - Analyte not detected, quantitation limit may be inaccurate

µg/kg - Micrograms per kilogram

mg/kg - Milligrams per kilogram



Screening Criteria	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1
Volatile Organic Compounds (µg/kg)				
1,1-Dichloroethene	24,000	110,000	173	4.0
4-Methyl-2-pentanone	530,000	3,360,000	--	576
Acetone	6,100,000	63,000,000	--	4,752
m- and p-Xylene	63,000	258,000	2,400	36,968
Methylene chloride	11,000	53,000	1,250	2.0
o-Xylene	380,000	434,000	2,400	37,616
Tetrachloroethene	550	2,600	200	5.6
Toluene	500,000	818,000	40,000	2,367
Trichloroethene	2,800	14,000	10	3.9
Xylene, total	63,000	258,000	2,400	37,670

N W E S

0 75 150 Feet

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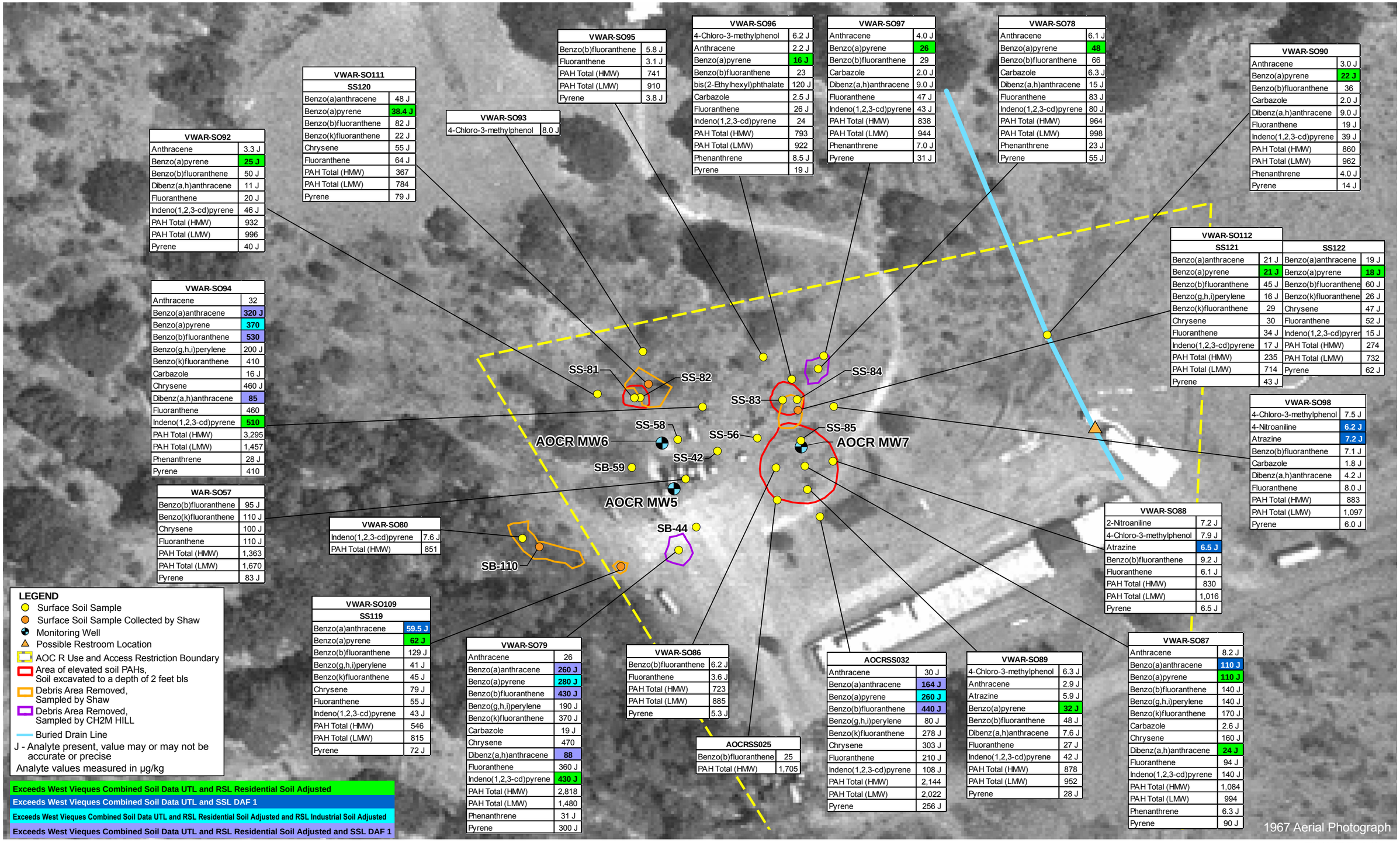
FIGURE 4-1
VOC Detections and Exceedances in Surface Soil Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico



VWAR-SO92	
Anthracene	3.3 J
Benzo(a)pyrene	25 J
Benzo(b)fluoranthene	50 J
Dibenz(a,h)anthracene	11 J
Fluoranthene	20 J
Indeno(1,2,3-cd)pyrene	46 J
PAH Total (HMW)	932
PAH Total (LMW)	996
Pyrene	40 J

VWAR-SO111	
SS120	
Benzo(a)anthracene	48 J
Benzo(a)pyrene	38.4 J
Benzo(b)fluoranthene	82 J
Benzo(k)fluoranthene	22 J
Chrysene	55 J
Fluoranthene	64 J
PAH Total (HMW)	367
PAH Total (LMW)	784
Pyrene	79 J

VWAR-SO93	
4-Chloro-3-methylphenol	8.0 J

VWAR-SO95	
Benzo(b)fluoranthene	5.8 J
Fluoranthene	3.1 J
PAH Total (HMW)	741
PAH Total (LMW)	910
Pyrene	3.8 J

VWAR-SO96	
4-Chloro-3-methylphenol	6.2 J
Anthracene	2.2 J
Benzo(a)pyrene	16 J
Benzo(b)fluoranthene	23
bis(2-Ethylhexyl)phthalate	120 J
Carbazole	2.5 J
Fluoranthene	26 J
Indeno(1,2,3-cd)pyrene	24
PAH Total (HMW)	793
PAH Total (LMW)	922
Phenanthrene	8.5 J
Pyrene	19 J

VWAR-SO97	
Anthracene	4.0 J
Benzo(a)pyrene	26
Benzo(b)fluoranthene	29
Carbazole	2.0 J
Dibenz(a,h)anthracene	9.0 J
Fluoranthene	47 J
Indeno(1,2,3-cd)pyrene	43 J
PAH Total (HMW)	838
PAH Total (LMW)	944
Phenanthrene	7.0 J
Pyrene	31 J

VWAR-SO78	
Anthracene	6.1 J
Benzo(a)pyrene	48
Benzo(b)fluoranthene	66
Carbazole	6.3 J
Dibenz(a,h)anthracene	15 J
Fluoranthene	83 J
Indeno(1,2,3-cd)pyrene	80 J
PAH Total (HMW)	964
PAH Total (LMW)	998
Phenanthrene	23 J
Pyrene	55 J

VWAR-SO90	
Anthracene	3.0 J
Benzo(a)pyrene	22 J
Benzo(b)fluoranthene	36
Carbazole	2.0 J
Dibenz(a,h)anthracene	9.0 J
Fluoranthene	19 J
Indeno(1,2,3-cd)pyrene	39 J
PAH Total (HMW)	860
PAH Total (LMW)	962
Phenanthrene	4.0 J
Pyrene	14 J

VWAR-SO112			
SS121		SS122	
Benzo(a)anthracene	21 J	Benzo(a)anthracene	19 J
Benzo(a)pyrene	21 J	Benzo(a)pyrene	18 J
Benzo(b)fluoranthene	45 J	Benzo(b)fluoranthene	60 J
Benzo(g,h,i)perylene	16 J	Benzo(k)fluoranthene	26 J
Benzo(k)fluoranthene	29	Chrysene	47 J
Chrysene	30	Fluoranthene	52 J
Fluoranthene	34 J	Indeno(1,2,3-cd)pyrene	15 J
Indeno(1,2,3-cd)pyrene	17 J	PAH Total (HMW)	274
PAH Total (HMW)	235	PAH Total (LMW)	732
PAH Total (LMW)	714	Pyrene	62 J
Pyrene	43 J		

VWAR-SO94	
Anthracene	32
Benzo(a)anthracene	320 J
Benzo(a)pyrene	370
Benzo(b)fluoranthene	530
Benzo(g,h,i)perylene	200 J
Benzo(k)fluoranthene	410
Carbazole	16 J
Chrysene	460 J
Dibenz(a,h)anthracene	85
Fluoranthene	460
Indeno(1,2,3-cd)pyrene	510
PAH Total (HMW)	3,295
PAH Total (LMW)	1,457
Phenanthrene	28 J
Pyrene	410

WAR-SO57	
Benzo(b)fluoranthene	95 J
Benzo(k)fluoranthene	110 J
Chrysene	100 J
Fluoranthene	110 J
PAH Total (HMW)	1,363
PAH Total (LMW)	1,670
Pyrene	83 J

VWAR-SO80	
Indeno(1,2,3-cd)pyrene	7.6 J
PAH Total (HMW)	851

VWAR-SO109	
SS119	
Benzo(a)anthracene	59.5 J
Benzo(a)pyrene	62 J
Benzo(b)fluoranthene	129 J
Benzo(g,h,i)perylene	41 J
Benzo(k)fluoranthene	45 J
Chrysene	79 J
Fluoranthene	55 J
Indeno(1,2,3-cd)pyrene	43 J
PAH Total (HMW)	546
PAH Total (LMW)	815
Pyrene	72 J

VWAR-SO79	
Anthracene	26
Benzo(a)anthracene	260 J
Benzo(a)pyrene	280 J
Benzo(b)fluoranthene	430 J
Benzo(g,h,i)perylene	190 J
Benzo(k)fluoranthene	370 J
Carbazole	19 J
Chrysene	470
Dibenz(a,h)anthracene	88
Fluoranthene	360 J
Indeno(1,2,3-cd)pyrene	430 J
PAH Total (HMW)	2,818
PAH Total (LMW)	1,480
Phenanthrene	31 J
Pyrene	300 J

VWAR-SO86	
Benzo(b)fluoranthene	6.2 J
Fluoranthene	3.6 J
PAH Total (HMW)	723
PAH Total (LMW)	885
Pyrene	5.3 J

AOCRSS025	
Benzo(b)fluoranthene	25
PAH Total (HMW)	1,705

AOCRSS032	
Anthracene	30 J
Benzo(a)anthracene	164 J
Benzo(a)pyrene	260 J
Benzo(b)fluoranthene	440 J
Benzo(g,h,i)perylene	80 J
Benzo(k)fluoranthene	278 J
Chrysene	303 J
Fluoranthene	210 J
Indeno(1,2,3-cd)pyrene	108 J
PAH Total (HMW)	2,144
PAH Total (LMW)	2,022
Pyrene	256 J

VWAR-SO89	
4-Chloro-3-methylphenol	6.3 J
Anthracene	2.9 J
Atrazine	5.9 J
Benzo(a)pyrene	32 J
Benzo(b)fluoranthene	48 J
Dibenz(a,h)anthracene	7.6 J
Fluoranthene	27 J
Indeno(1,2,3-cd)pyrene	42 J
PAH Total (HMW)	878
PAH Total (LMW)	952
Pyrene	28 J

VWAR-SO98	
4-Chloro-3-methylphenol	7.5 J
4-Nitroaniline	6.2 J
Atrazine	7.2 J
Benzo(b)fluoranthene	7.1 J
Carbazole	1.8 J
Dibenz(a,h)anthracene	4.2 J
Fluoranthene	8.0 J
PAH Total (HMW)	883
PAH Total (LMW)	1,097
Pyrene	6.0 J

VWAR-SO88	
2-Nitroaniline	7.2 J
4-Chloro-3-methylphenol	7.9 J
Atrazine	6.5 J
Benzo(b)fluoranthene	9.2 J
Fluoranthene	6.1 J
PAH Total (HMW)	830
PAH Total (LMW)	1,016
Pyrene	6.5 J

VWAR-SO87	
Anthracene	8.2 J
Benzo(a)anthracene	110 J
Benzo(a)pyrene	110 J
Benzo(b)fluoranthene	140 J
Benzo(g,h,i)perylene	140 J
Benzo(k)fluoranthene	170 J
Carbazole	2.6 J
Chrysene	160 J
Dibenz(a,h)anthracene	24 J
Fluoranthene	94 J
Indeno(1,2,3-cd)pyrene	140 J
PAH Total (HMW)	1,084
PAH Total (LMW)	994
Phenanthrene	6.3 J
Pyrene	90 J

N W E S

0 50 100 Feet

FIGURE 4-2a
SVOC Detections and Exceedances in Surface Soil Samples
Page 1 of 3 (Northern Area)
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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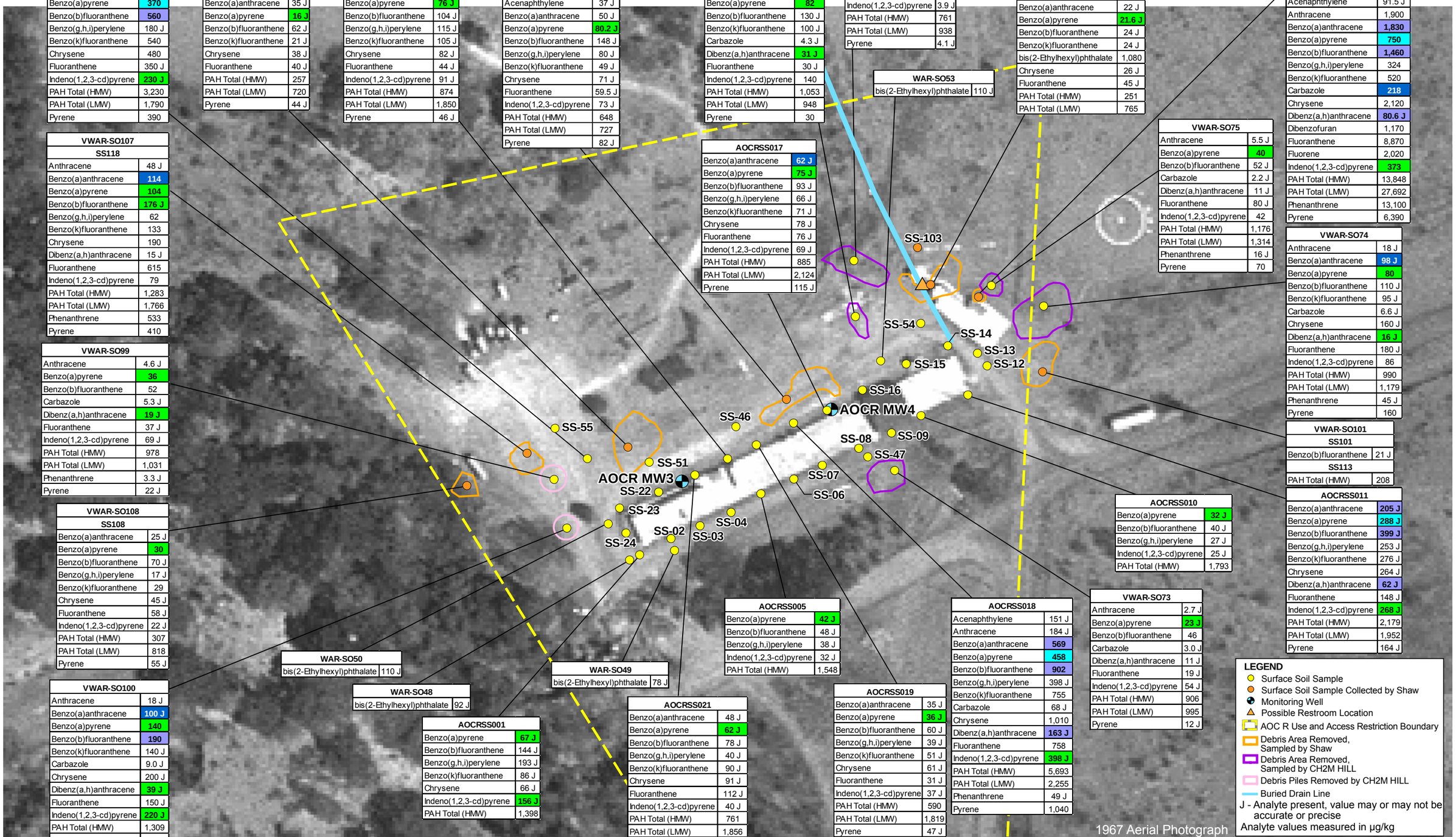

WAR-SO45	
Benzo(a)anthracene	300 J
Benzo(a)pyrene	370
Benzo(b)fluoranthene	560
Benzo(g,h,i)perylene	180 J
Benzo(k)fluoranthene	540
Chrysene	480
Fluoranthene	350 J
Indeno(1,2,3-cd)pyrene	230 J
PAH Total (HMW)	3,230
PAH Total (LMW)	1,790
Pyrene	390

VWAR-SO106	
SS117	
Benzo(a)anthracene	35 J
Benzo(a)pyrene	16 J
Benzo(b)fluoranthene	62 J
Benzo(k)fluoranthene	21 J
Chrysene	38 J
Fluoranthene	40 J
PAH Total (HMW)	257
PAH Total (LMW)	720
Pyrene	44 J

AOCRSS020	
Benzo(a)anthracene	34 J
Benzo(a)pyrene	76 J
Benzo(b)fluoranthene	104 J
Benzo(g,h,i)perylene	115 J
Benzo(k)fluoranthene	105 J
Chrysene	82 J
Fluoranthene	44 J
Indeno(1,2,3-cd)pyrene	91 J
PAH Total (HMW)	874
PAH Total (LMW)	1,850
Pyrene	46 J

VWAR-SO105	
SS116	
Acenaphthylene	37 J
Benzo(a)anthracene	50 J
Benzo(a)pyrene	80.2 J
Benzo(b)fluoranthene	148 J
Benzo(g,h,i)perylene	80 J
Benzo(k)fluoranthene	49 J
Chrysene	71 J
Fluoranthene	59.5 J
Indeno(1,2,3-cd)pyrene	73 J
PAH Total (HMW)	648
PAH Total (LMW)	727
Pyrene	82 J

VWAR-SO76	
Anthracene	4.6 J
Benzo(a)pyrene	82
Benzo(b)fluoranthene	130 J
Benzo(k)fluoranthene	100 J
Carbazole	4.3 J
Dibenz(a,h)anthracene	31 J
Fluoranthene	30 J
Indeno(1,2,3-cd)pyrene	140
PAH Total (HMW)	1,053
PAH Total (LMW)	948
Pyrene	30

VWAR-SO77	
Fluoranthene	5.1 J
Indeno(1,2,3-cd)pyrene	3.9 J
PAH Total (HMW)	761
PAH Total (LMW)	938
Pyrene	4.1 J

VWAR-SO104	
SS104	
Benzo(a)anthracene	22 J
Benzo(a)pyrene	21.6 J
Benzo(b)fluoranthene	24 J
Benzo(k)fluoranthene	24 J
bis(2-Ethylhexyl)phthalate	1,080
Chrysene	26 J
Fluoranthene	45 J
PAH Total (HMW)	251
PAH Total (LMW)	765

WAR-SO53	
bis(2-Ethylhexyl)phthalate	110 J

VWAR-SO102	
SS115	
Acenaphthene	1,440
Acenaphthylene	91.5 J
Anthracene	1,900
Benzo(a)anthracene	1,830
Benzo(a)pyrene	750
Benzo(b)fluoranthene	1,460
Benzo(g,h,i)perylene	324
Benzo(k)fluoranthene	520
Carbazole	218
Chrysene	2,120
Dibenz(a,h)anthracene	80.6 J
Dibenzofuran	1,170
Fluoranthene	8,870
Fluorene	2,020
Indeno(1,2,3-cd)pyrene	373
PAH Total (HMW)	13,848
PAH Total (LMW)	27,692
Phenanthrene	13,100
Pyrene	6,390

VWAR-SO107	
SS118	
Anthracene	48 J
Benzo(a)anthracene	114
Benzo(a)pyrene	104
Benzo(b)fluoranthene	176 J
Benzo(g,h,i)perylene	62
Benzo(k)fluoranthene	133
Chrysene	190
Dibenz(a,h)anthracene	15 J
Fluoranthene	615
Indeno(1,2,3-cd)pyrene	79
PAH Total (HMW)	1,283
PAH Total (LMW)	1,766
Phenanthrene	533
Pyrene	410

AOCRSS017	
Benzo(a)anthracene	62 J
Benzo(a)pyrene	75 J
Benzo(b)fluoranthene	93 J
Benzo(g,h,i)perylene	66 J
Benzo(k)fluoranthene	71 J
Chrysene	78 J
Fluoranthene	76 J
Indeno(1,2,3-cd)pyrene	69 J
PAH Total (HMW)	885
PAH Total (LMW)	2,124
Pyrene	115 J

VWAR-SO75	
Anthracene	5.5 J
Benzo(a)pyrene	40
Benzo(b)fluoranthene	52 J
Carbazole	2.2 J
Dibenz(a,h)anthracene	11 J
Fluoranthene	80 J
Indeno(1,2,3-cd)pyrene	42
PAH Total (HMW)	1,176
PAH Total (LMW)	1,314
Phenanthrene	16 J
Pyrene	70

VWAR-SO74	
Anthracene	18 J
Benzo(a)anthracene	98 J
Benzo(a)pyrene	80
Benzo(b)fluoranthene	110 J
Benzo(k)fluoranthene	95 J
Carbazole	6.6 J
Chrysene	160 J
Dibenz(a,h)anthracene	16 J
Fluoranthene	180 J
Indeno(1,2,3-cd)pyrene	86
PAH Total (HMW)	990
PAH Total (LMW)	1,179
Phenanthrene	45 J
Pyrene	160

VWAR-SO99	
Anthracene	4.6 J
Benzo(a)pyrene	36
Benzo(b)fluoranthene	52
Carbazole	5.3 J
Dibenz(a,h)anthracene	19 J
Fluoranthene	37 J
Indeno(1,2,3-cd)pyrene	69 J
PAH Total (HMW)	978
PAH Total (LMW)	1,031
Phenanthrene	3.3 J
Pyrene	22 J

VWAR-SO101	
SS101	
Benzo(b)fluoranthene	21 J
SS113	
PAH Total (HMW)	208

AOCRSS010	
Benzo(a)pyrene	32 J
Benzo(b)fluoranthene	40 J
Benzo(g,h,i)perylene	27 J
Indeno(1,2,3-cd)pyrene	25 J
PAH Total (HMW)	1,793

AOCRSS011	
Benzo(a)anthracene	205 J
Benzo(a)pyrene	288 J
Benzo(b)fluoranthene	399 J
Benzo(g,h,i)perylene	253 J
Benzo(k)fluoranthene	276 J
Chrysene	264 J
Dibenz(a,h)anthracene	62 J
Fluoranthene	148 J
Indeno(1,2,3-cd)pyrene	268 J
PAH Total (HMW)	2,179
PAH Total (LMW)	1,952
Pyrene	164 J

VWAR-SO108	
SS108	
Benzo(a)anthracene	25 J
Benzo(a)pyrene	30
Benzo(b)fluoranthene	70 J
Benzo(g,h,i)perylene	17 J
Benzo(k)fluoranthene	29
Chrysene	45 J
Fluoranthene	58 J
Indeno(1,2,3-cd)pyrene	22 J
PAH Total (HMW)	307
PAH Total (LMW)	818
Pyrene	55 J

AOCRSS005	
Benzo(a)pyrene	42 J
Benzo(b)fluoranthene	48 J
Benzo(g,h,i)perylene	38 J
Indeno(1,2,3-cd)pyrene	32 J
PAH Total (HMW)	1,548

AOCRSS018	
Acenaphthylene	151 J
Anthracene	184 J
Benzo(a)anthracene	569
Benzo(a)pyrene	458
Benzo(b)fluoranthene	902
Benzo(g,h,i)perylene	398 J
Benzo(k)fluoranthene	755
Carbazole	68 J
Chrysene	1,010
Dibenz(a,h)anthracene	163 J
Fluoranthene	758
Indeno(1,2,3-cd)pyrene	398 J
PAH Total (HMW)	5,693
PAH Total (LMW)	2,255
Phenanthrene	49 J
Pyrene	1,040

VWAR-SO73	
Anthracene	2.7 J
Benzo(a)pyrene	23 J
Benzo(b)fluoranthene	46
Carbazole	3.0 J
Dibenz(a,h)anthracene	11 J
Fluoranthene	19 J
Indeno(1,2,3-cd)pyrene	54 J
PAH Total (HMW)	906
PAH Total (LMW)	995
Pyrene	12 J

WAR-SO50	
bis(2-Ethylhexyl)phthalate	110 J

WAR-SO49	
bis(2-Ethylhexyl)phthalate	78 J

WAR-SO48	
bis(2-Ethylhexyl)phthalate	92 J

VWAR-SO100	
Anthracene	18 J
Benzo(a)anthracene	100 J
Benzo(a)pyrene	140
Benzo(b)fluoranthene	190
Benzo(k)fluoranthene	140 J
Carbazole	9.0 J
Chrysene	200 J
Dibenz(a,h)anthracene	39 J
Fluoranthene	150 J
Indeno(1,2,3-cd)pyrene	220 J
PAH Total (HMW)	1,309
PAH Total (LMW)	1,040
Phenanthrene	11 J
Pyrene	110 J

AOCRSS001	
Benzo(a)pyrene	67 J
Benzo(b)fluoranthene	144 J
Benzo(g,h,i)perylene	193 J
Benzo(k)fluoranthene	86 J
Chrysene	66 J
Indeno(1,2,3-cd)pyrene	156 J
PAH Total (HMW)	1,398

AOCRSS021	
Benzo(a)anthracene	48 J
Benzo(a)pyrene	62 J
Benzo(b)fluoranthene	78 J
Benzo(g,h,i)perylene	40 J
Benzo(k)fluoranthene	90 J
Chrysene	91 J
Fluoranthene	112 J
Indeno(1,2,3-cd)pyrene	40 J
PAH Total (HMW)	761
PAH Total (LMW)	1,856
Pyrene	94 J

AOCRSS019	
Benzo(a)anthracene	35 J
Benzo(a)pyrene	36 J
Benzo(b)fluoranthene	60 J
Benzo(g,h,i)perylene	39 J
Benzo(k)fluoranthene	51 J
Chrysene	61 J
Fluoranthene	31 J
Indeno(1,2,3-cd)pyrene	37 J
PAH Total (HMW)	590
PAH Total (LMW)	1,819
Pyrene	47 J

LEGEND

- Surface Soil Sample
- Surface Soil Sample Collected by Shaw
- Monitoring Well
- Possible Restroom Location
- AOC R Use and Access Restriction Boundary
- Debris Area Removed, Sampled by Shaw
- Debris Area Removed, Sampled by CH2M HILL
- Debris Piles Removed by CH2M HILL
- Buried Drain Line

J - Analyte present, value may or may not be accurate or precise

Analyte values measured in µg/kg

N W E S

0 50 100 Feet

Exceeds West Vieques Combined Soil Data UTL and RSL Residential Soil Adjusted

Exceeds West Vieques Combined Soil Data UTL and SSL DAF 1

Exceeds West Vieques Combined Soil Data UTL and RSL Residential Soil Adjusted and RSL Industrial Soil Adjusted

Exceeds West Vieques Combined Soil Data UTL and RSL Residential Soil Adjusted and SSL DAF 1

FIGURE 4-2b
SVOC Detections and Exceedances in Surface Soil Samples
Page 2 of 3 (Concrete Pad Area)
AOC R Remedial Investigation Report
Vieques, Puerto Rico

Screening Criteria	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1
Semivolatile Organic Compounds (µg/kg)				
2-Nitroaniline	61,000	600,000	--	230
4-Chloro-3-methylphenol	610,000	6,200,000	500	21,986
4-Nitroaniline	24,000	86,000	--	2.1
Acenaphthene	340,000	3,300,000	--	110,000
Acenaphthylene	340,000	3,300,000	--	110,000
Anthracene	1,700,000	17,000,000	--	2,600,000
Atrazine	2,100	7,500	12	6.1
Benzo(a)anthracene	150	2,100	--	54
Benzo(a)pyrene	15	210	--	1,259
Benzo(b)fluoranthene	150	2,100	--	186
Benzo(g,h,i)perylene	170,000	1,700,000	--	24,000,000
Benzo(k)fluoranthene	1,500	21,000	--	1,825
bis(2-Ethylhexyl)phthalate	35,000	120,000	30,000	10,000
Carbazole	24,000	86,000	--	93
Chrysene	15,000	210,000	--	5,476
Dibenz(a,h)anthracene	15	210	--	61
Dibenzofuran	7,800	100,000	--	3,351
Fluoranthene	230,000	2,200,000	--	900,000
Fluorene	230,000	2,200,000	--	140,000
Indeno(1,2,3-cd)pyrene	150	2,100	--	621
PAH Total (HMW)	--	--	18,000	--
PAH Total (LMW)	--	--	29,000	--
Phenanthrene	1,700,000	17,000,000	--	1,800,000
Pyrene	170,000	1,700,000	--	610,000

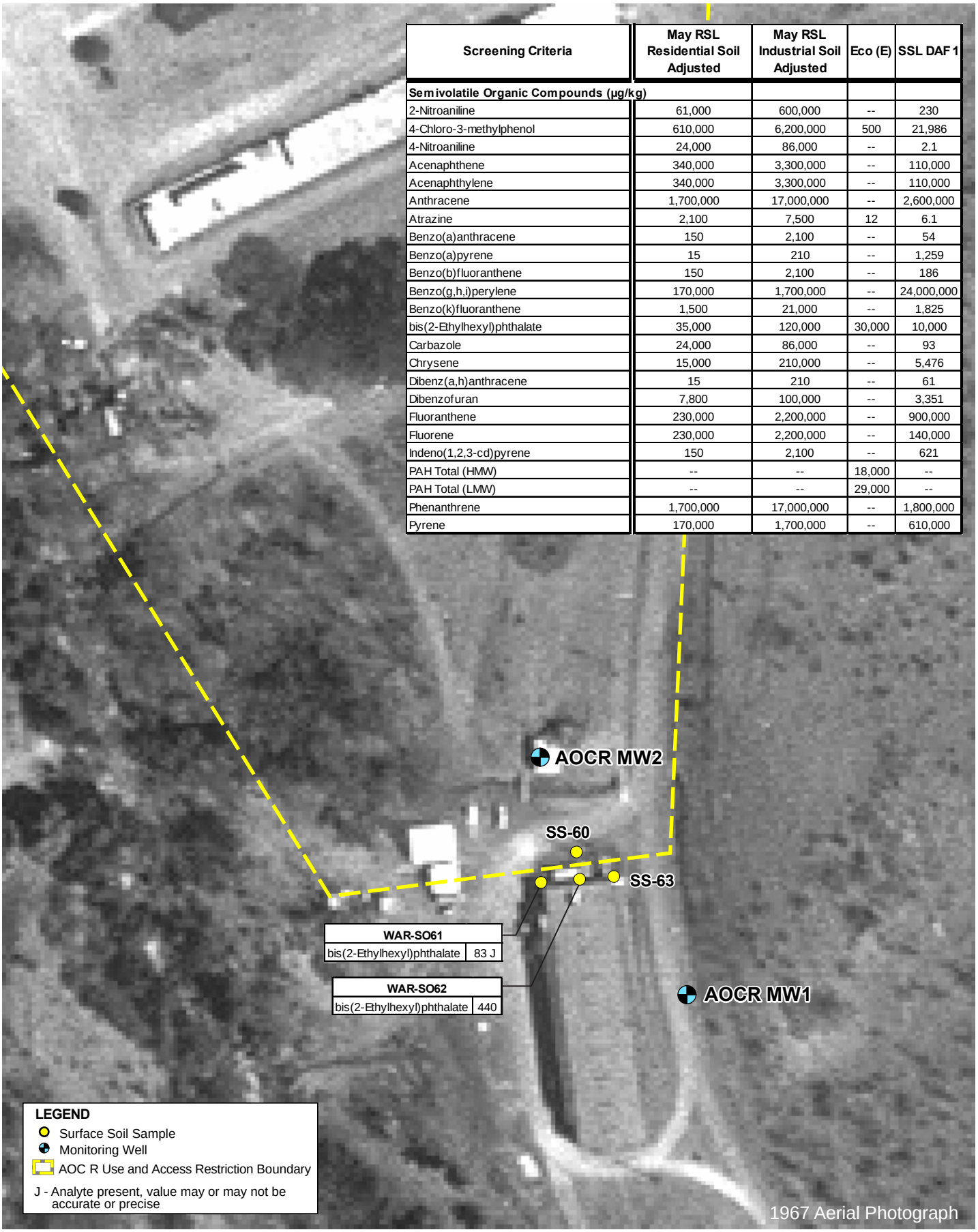

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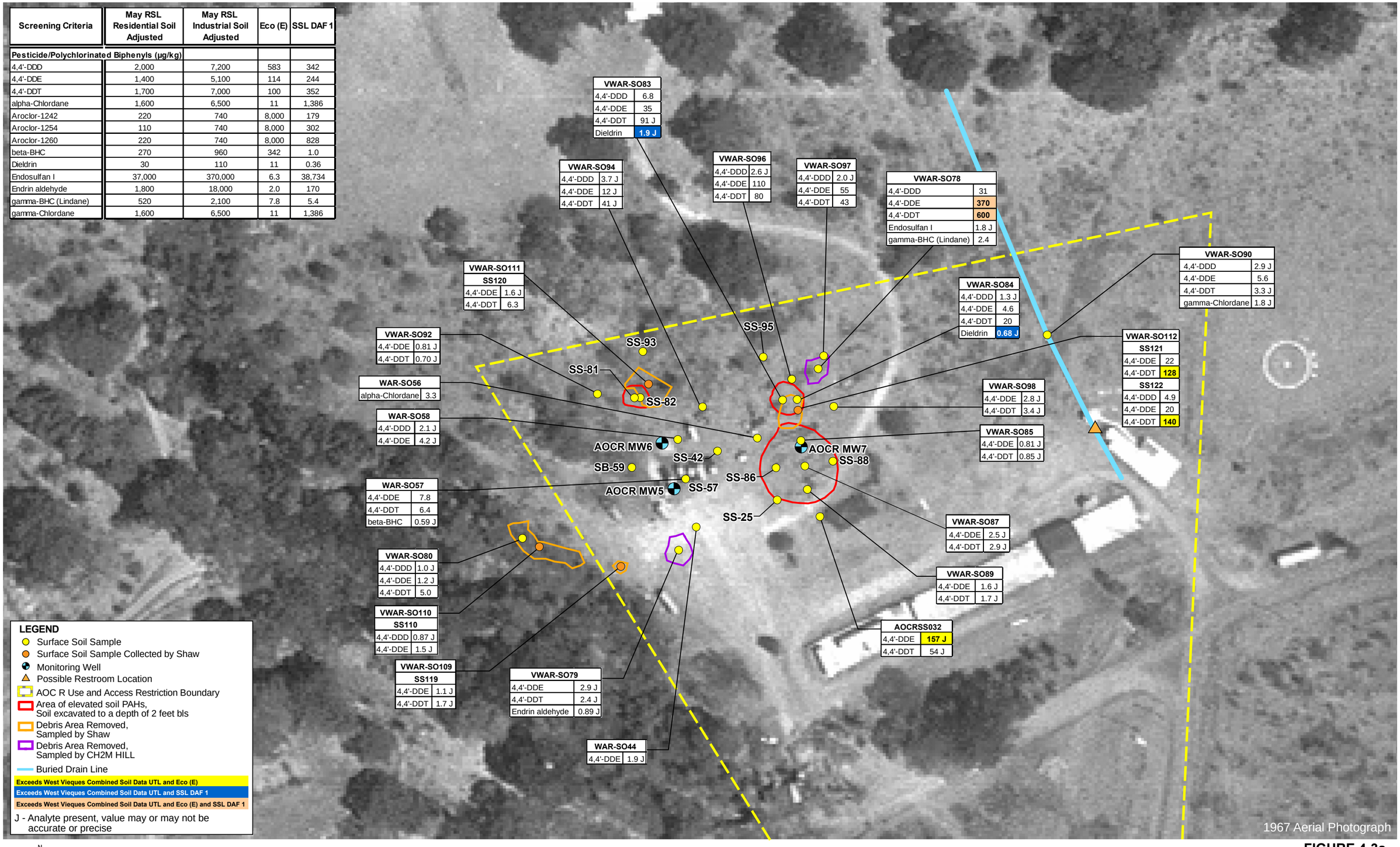
FIGURE 4-2c
SVOC Detections in Surface Soil Samples
Page 3 of 3 (Southern Area)
AOC R Remedial Investigation Report
Vieques, Puerto Rico

Screening Criteria	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1
Pesticide/Polychlorinated Biphenyls (µg/kg)				
4,4'-DDD	2,000	7,200	583	342
4,4'-DDE	1,400	5,100	114	244
4,4'-DDT	1,700	7,000	100	352
alpha-Chlordane	1,600	6,500	11	1,386
Aroclor-1242	220	740	8,000	179
Aroclor-1254	110	740	8,000	302
Aroclor-1260	220	740	8,000	828
beta-BHC	270	960	342	1.0
Dieldrin	30	110	11	0.36
Endosulfan I	37,000	370,000	6.3	38,734
Endrin aldehyde	1,800	18,000	2.0	170
gamma-BHC (Lindane)	520	2,100	7.8	5.4
gamma-Chlordane	1,600	6,500	11	1,386



N W E S

0 50 100 Feet

FIGURE 4-3a
Pesticides/PCB Detections and Exceedances in Surface Soil Samples
Page 1 of 2 (Northern Area)
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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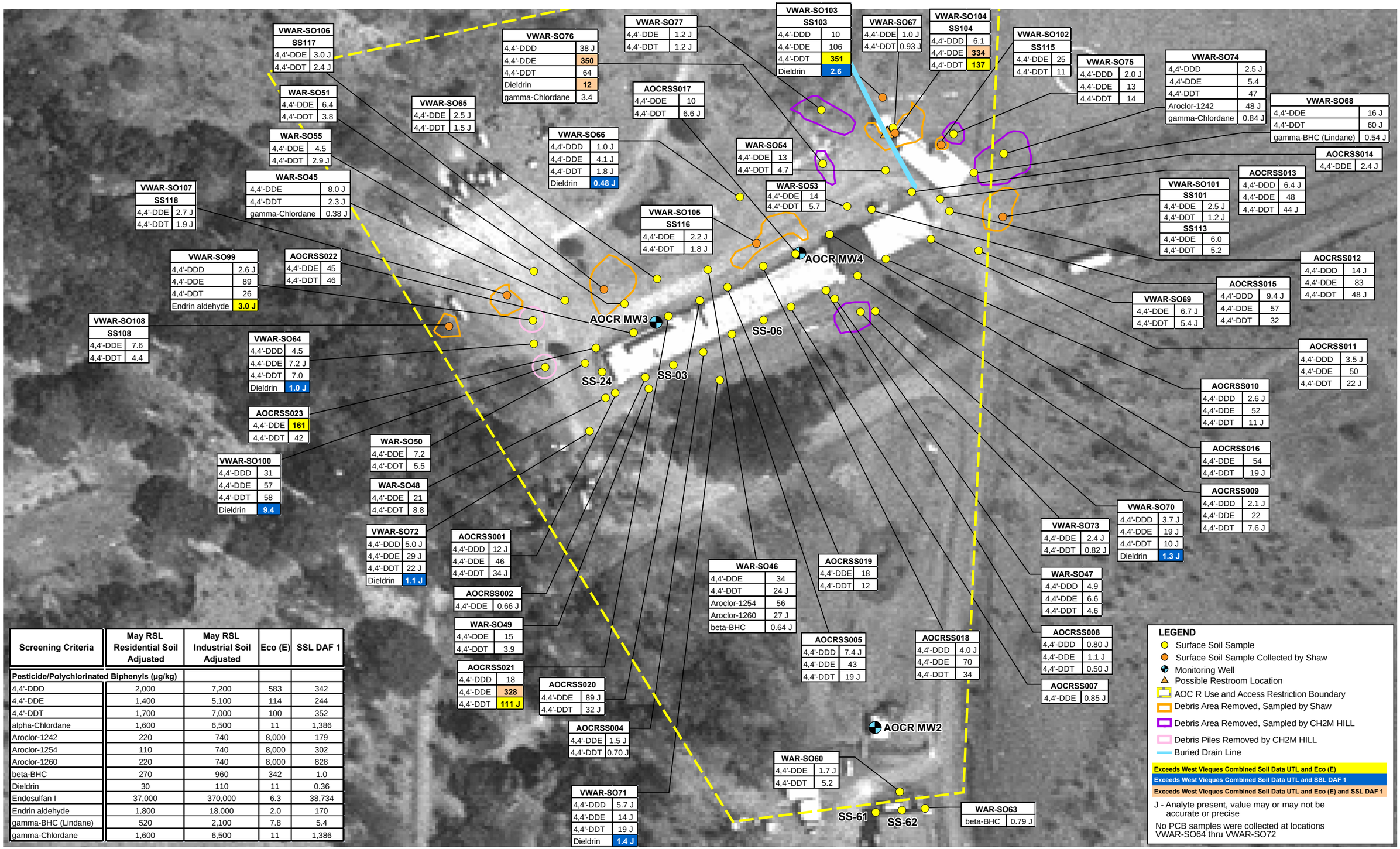

Screening Criteria	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1
Pesticide/Polychlorinated Biphenyls (µg/kg)				
4,4'-DDD	2,000	7,200	583	342
4,4'-DDE	1,400	5,100	114	244
4,4'-DDT	1,700	7,000	100	352
alpha-Chlordane	1,600	6,500	11	1,386
Aroclor-1242	220	740	8,000	179
Aroclor-1254	110	740	8,000	302
Aroclor-1260	220	740	8,000	828
beta-BHC	270	960	342	1.0
Dieldrin	30	110	11	0.36
Endosulfan I	37,000	370,000	6.3	38,734
Endrin aldehyde	1,800	18,000	2.0	170
gamma-BHC (Lindane)	520	2,100	7.8	5.4
gamma-Chlordane	1,600	6,500	11	1,386

N W E S 0 50 100 Feet

FIGURE 4-3b
Pesticides/PCB Detections and Exceedances in Surface Soil Samples
Page 2 of 2 (Concrete Pad and Southern Area)
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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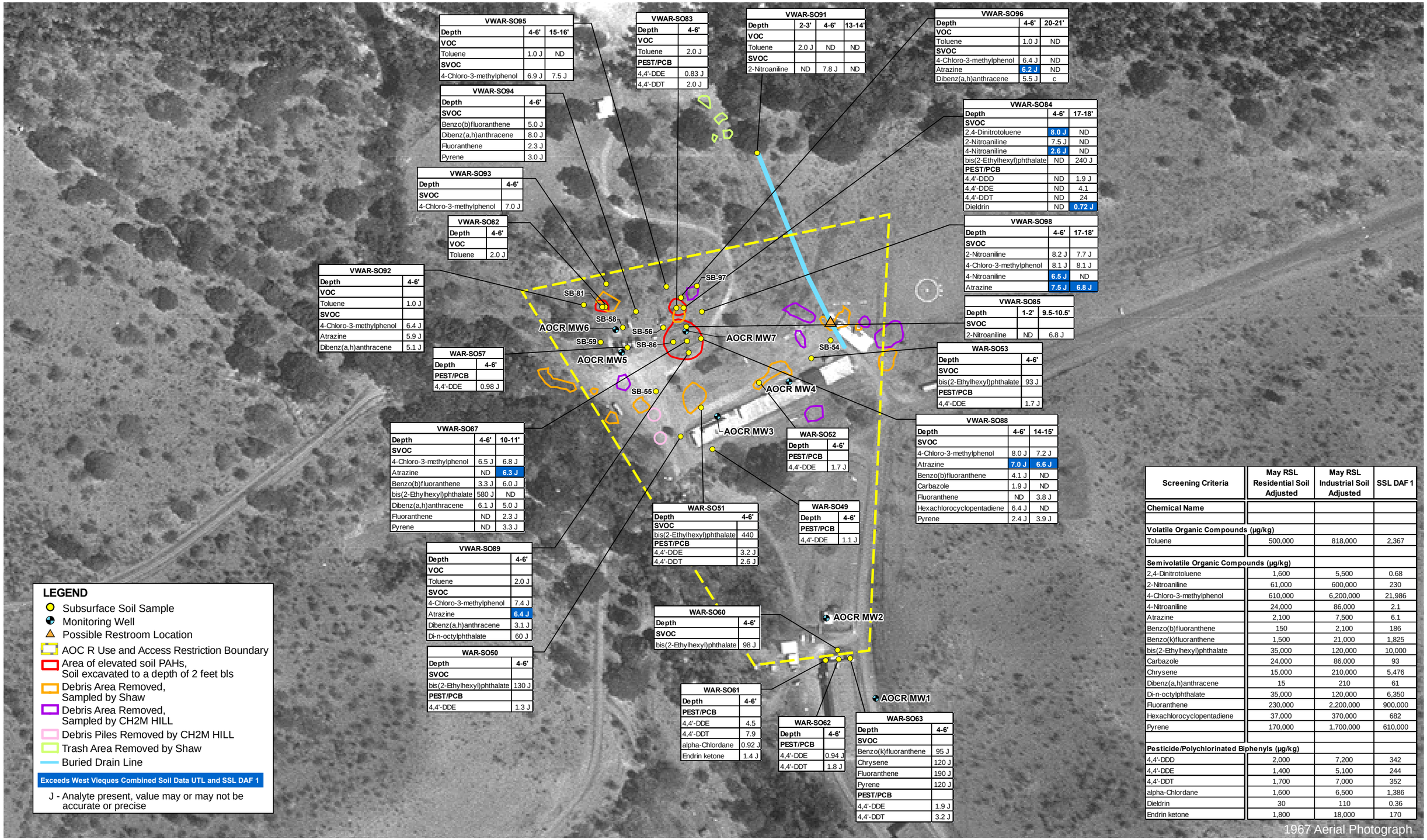

VWAR-SO95		
Depth	4-6'	15-16'
VOC		
Toluene	1.0 J	ND
SVOC		
4-Chloro-3-methylphenol	6.9 J	7.5 J

VWAR-SO83	
Depth	4-6'
VOC	
Toluene	2.0 J
PEST/PCB	
4,4'-DDE	0.83 J
4,4'-DDT	2.0 J

VWAR-SO91			
Depth	2-3'	4-6'	13-14'
VOC			
Toluene	2.0 J	ND	ND
SVOC			
2-Nitroaniline	ND	7.8 J	ND

VWAR-SO96		
Depth	4-6'	20-21'
VOC		
Toluene	1.0 J	ND
SVOC		
4-Chloro-3-methylphenol	6.4 J	ND
Atrazine	6.2 J	ND
Dibenz(a,h)anthracene	5.5 J	c

VWAR-SO94	
Depth	4-6'
SVOC	
Benzo(b)fluoranthene	5.0 J
Dibenz(a,h)anthracene	8.0 J
Fluoranthene	2.3 J
Pyrene	3.0 J

VWAR-SO84		
Depth	4-6'	17-18'
SVOC		
2,4-Dinitrotoluene	8.0 J	ND
2-Nitroaniline	7.5 J	ND
4-Nitroaniline	2.6 J	ND
bis(2-Ethylhexyl)phthalate	ND	240 J
PEST/PCB		
4,4'-DDD	ND	1.9 J
4,4'-DDE	ND	4.1
4,4'-DDT	ND	24
Dieldrin	ND	0.72 J

VWAR-SO93	
Depth	4-6'
SVOC	
4-Chloro-3-methylphenol	7.0 J

VWAR-SO82	
Depth	4-6'
VOC	
Toluene	2.0 J

VWAR-SO98		
Depth	4-6'	17-18'
SVOC		
2-Nitroaniline	8.2 J	7.7 J
4-Chloro-3-methylphenol	8.1 J	8.1 J
4-Nitroaniline	6.5 J	ND
Atrazine	7.5 J	6.8 J

VWAR-SO92	
Depth	4-6'
VOC	
Toluene	1.0 J
SVOC	
4-Chloro-3-methylphenol	6.4 J
Atrazine	5.9 J
Dibenz(a,h)anthracene	5.1 J

VWAR-SO85		
Depth	1-2'	9.5-10.5'
SVOC		
2-Nitroaniline	ND	6.8 J

WAR-SO57	
Depth	4-6'
PEST/PCB	
4,4'-DDE	0.98 J

WAR-SO53	
Depth	4-6'
SVOC	
bis(2-Ethylhexyl)phthalate	93 J
PEST/PCB	
4,4'-DDE	1.7 J

VWAR-SO87		
Depth	4-6'	10-11'
SVOC		
4-Chloro-3-methylphenol	6.5 J	6.8 J
Atrazine	ND	6.3 J
Benzo(b)fluoranthene	3.3 J	6.0 J
bis(2-Ethylhexyl)phthalate	580 J	ND
Dibenz(a,h)anthracene	6.1 J	5.0 J
Fluoranthene	ND	2.3 J
Pyrene	ND	3.3 J

WAR-SO52	
Depth	4-6'
PEST/PCB	
4,4'-DDE	1.7 J

VWAR-SO88		
Depth	4-6'	14-15'
SVOC		
4-Chloro-3-methylphenol	8.0 J	7.2 J
Atrazine	7.0 J	6.6 J
Benzo(b)fluoranthene	4.1 J	ND
Carbazole	1.9 J	ND
Fluoranthene	ND	3.8 J
Hexachlorocyclopentadiene	6.4 J	ND
Pyrene	2.4 J	3.9 J

WAR-SO51	
Depth	4-6'
SVOC	
bis(2-Ethylhexyl)phthalate	440
PEST/PCB	
4,4'-DDE	3.2 J
4,4'-DDT	2.6 J

WAR-SO49	
Depth	4-6'
PEST/PCB	
4,4'-DDE	1.1 J

VWAR-SO89	
Depth	4-6'
VOC	
Toluene	2.0 J
SVOC	
4-Chloro-3-methylphenol	7.4 J
Atrazine	6.4 J
Dibenz(a,h)anthracene	3.1 J
Di-n-octylphthalate	60 J

WAR-SO60	
Depth	4-6'
SVOC	
bis(2-Ethylhexyl)phthalate	98 J

WAR-SO50	
Depth	4-6'
SVOC	
bis(2-Ethylhexyl)phthalate	130 J
PEST/PCB	
4,4'-DDE	1.3 J

WAR-SO61	
Depth	4-6'
PEST/PCB	
4,4'-DDE	4.5
4,4'-DDT	7.9
alpha-Chlordane	0.92 J
Endrin ketone	1.4 J

WAR-SO62	
Depth	4-6'
PEST/PCB	
4,4'-DDE	0.94 J
4,4'-DDT	1.8 J

WAR-SO63	
Depth	4-6'
SVOC	
Benzo(k)fluoranthene	95 J
Chrysene	120 J
Fluoranthene	190 J
Pyrene	120 J
PEST/PCB	
4,4'-DDE	1.9 J
4,4'-DDT	3.2 J

Screening Criteria	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	SSL DAF 1
Chemical Name			
Volatile Organic Compounds (µg/kg)			
Toluene	500,000	818,000	2,367
Semivolatile Organic Compounds (µg/kg)			
2,4-Dinitrotoluene	1,600	5,500	0.68
2-Nitroaniline	61,000	600,000	230
4-Chloro-3-methylphenol	610,000	6,200,000	21,986
4-Nitroaniline	24,000	86,000	2.1
Atrazine	2,100	7,500	6.1
Benzo(b)fluoranthene	150	2,100	186
Benzo(k)fluoranthene	1,500	21,000	1,825
bis(2-Ethylhexyl)phthalate	35,000	120,000	10,000
Carbazole	24,000	86,000	93
Chrysene	15,000	210,000	5,476
Dibenz(a,h)anthracene	15	210	61
Di-n-octylphthalate	35,000	120,000	6,350
Fluoranthene	230,000	2,200,000	900,000
Hexachlorocyclopentadiene	37,000	370,000	682
Pyrene	170,000	1,700,000	610,000
Pesticide/Polychlorinated Biphenyls (µg/kg)			
4,4'-DDD	2,000	7,200	342
4,4'-DDE	1,400	5,100	244
4,4'-DDT	1,700	7,000	352
alpha-Chlordane	1,600	6,500	1,386
Dieldrin	30	110	0.36
Endrin ketone	1,800	18,000	170

N W E S

0 100 200 Feet

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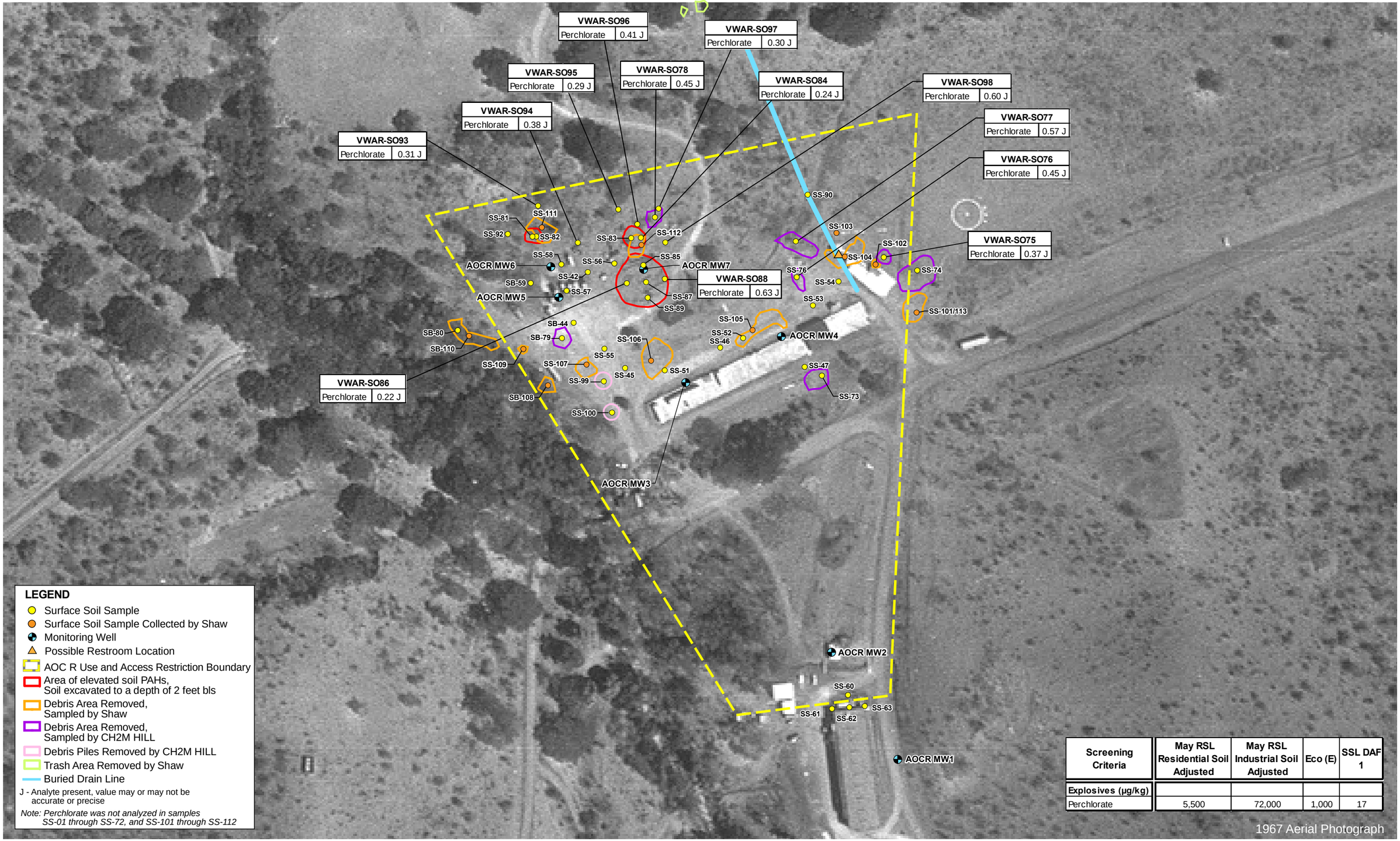
FIGURE 4-4
VOC, SVOC, and Pesticides/PCB Detections and Exceedances in Subsurface Soil
AOC R Remedial Investigation Report
Vieques, Puerto Rico



Screening Criteria	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1
Explosives (µg/kg)				
Perchlorate	5,500	72,000	1,000	17

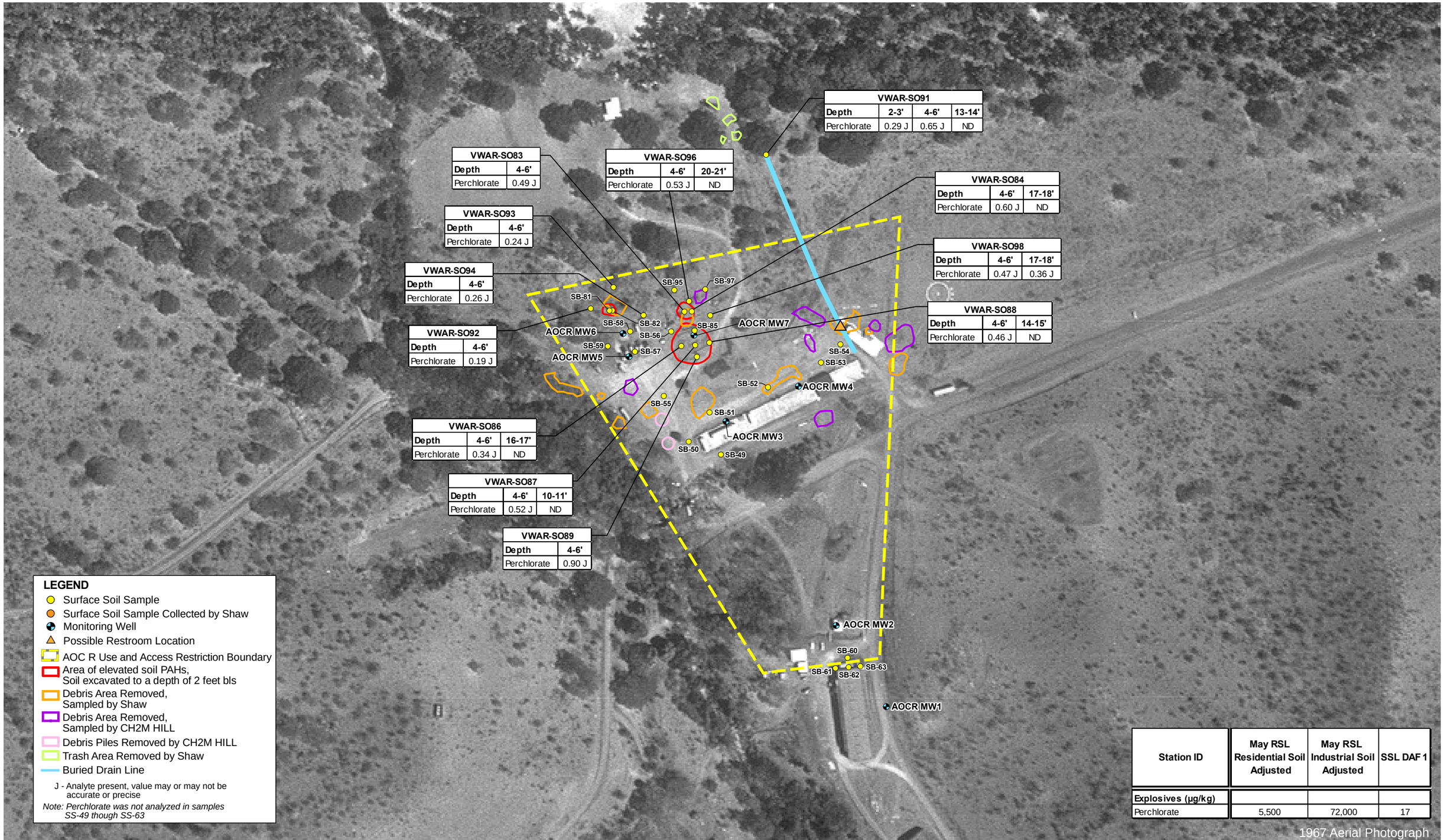
N
W E
S

0 75 150
Feet

CH2MHILL

FIGURE 4-5
Explosive Detections in Surface Soil Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico

ES052510032918TPA F4-5 Explosives in Surface Soil.ai mstuart



Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	SSL DAF 1
Explosives (µg/kg)			
Perchlorate	5,500	72,000	17

N W E S

0 100 200 Feet

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ES052510032918TPA F4-6 Explosives in SB.ai mstuart

FIGURE 4-6
Explosive Detections in Subsurface Soil
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Vieques, Puerto Rico

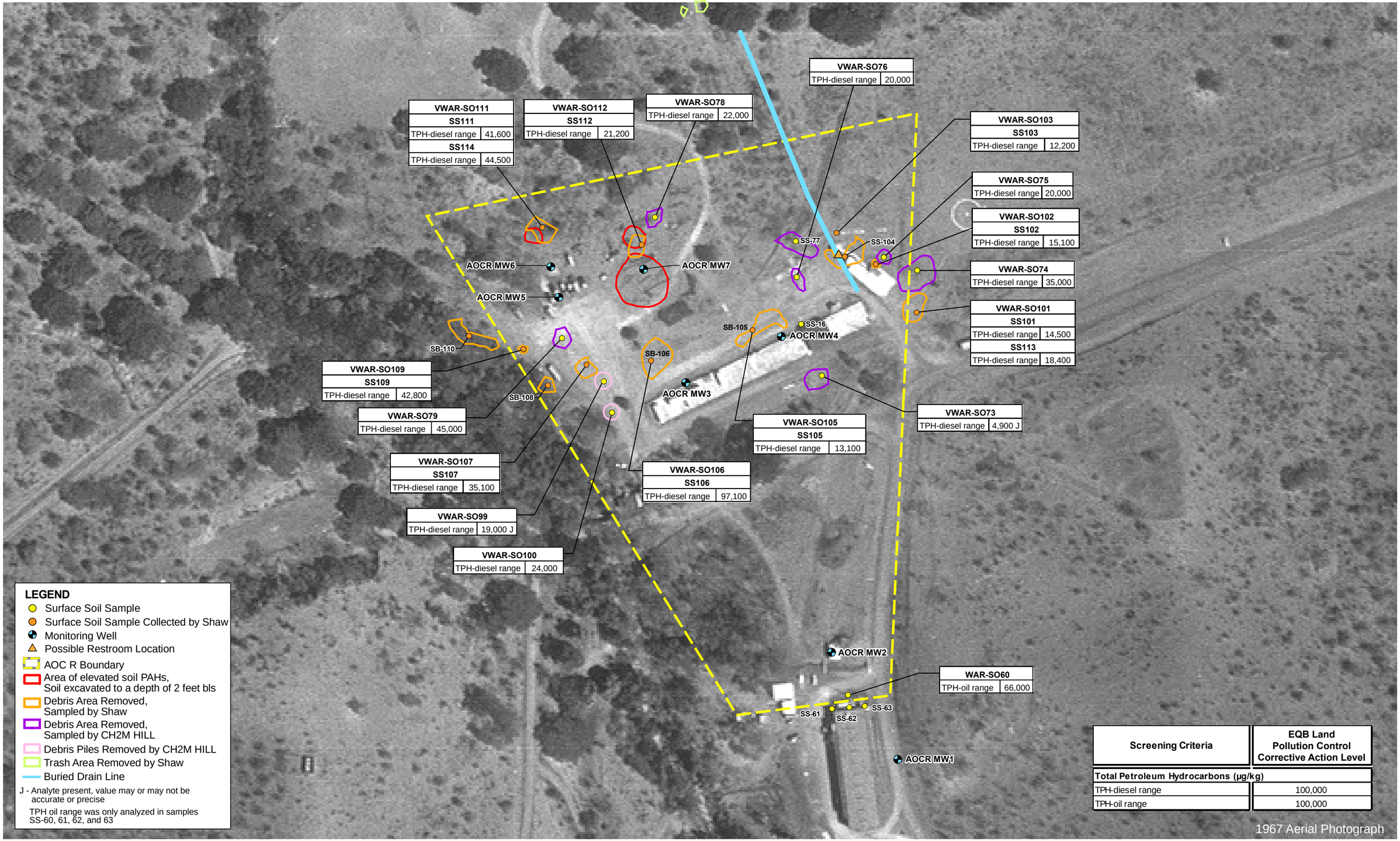

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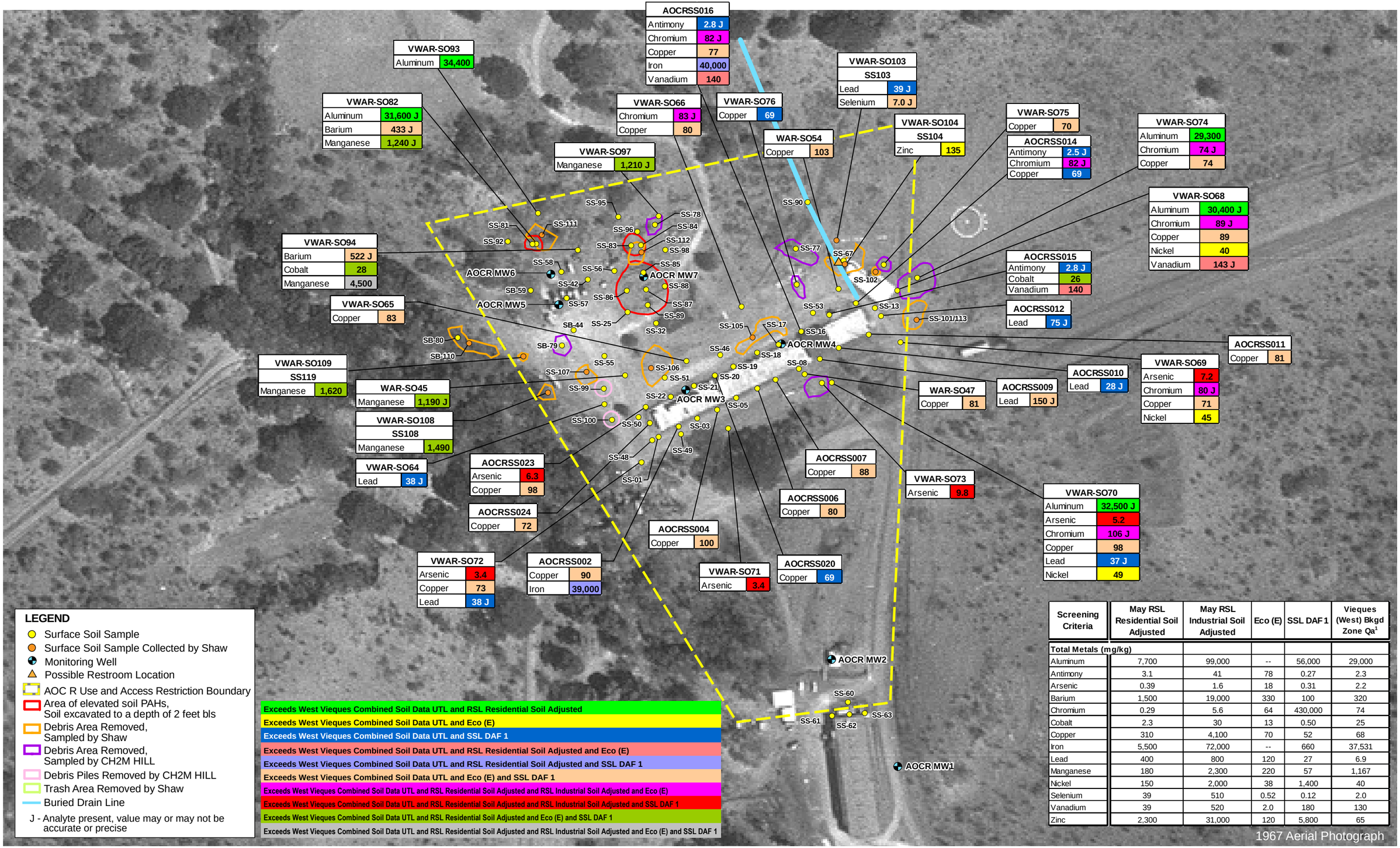
FIGURE 4-7
TPH Detections in Surface Soil Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico

ES052510032918TPA F4-7 TPH in Surface Soil.ai mstuart



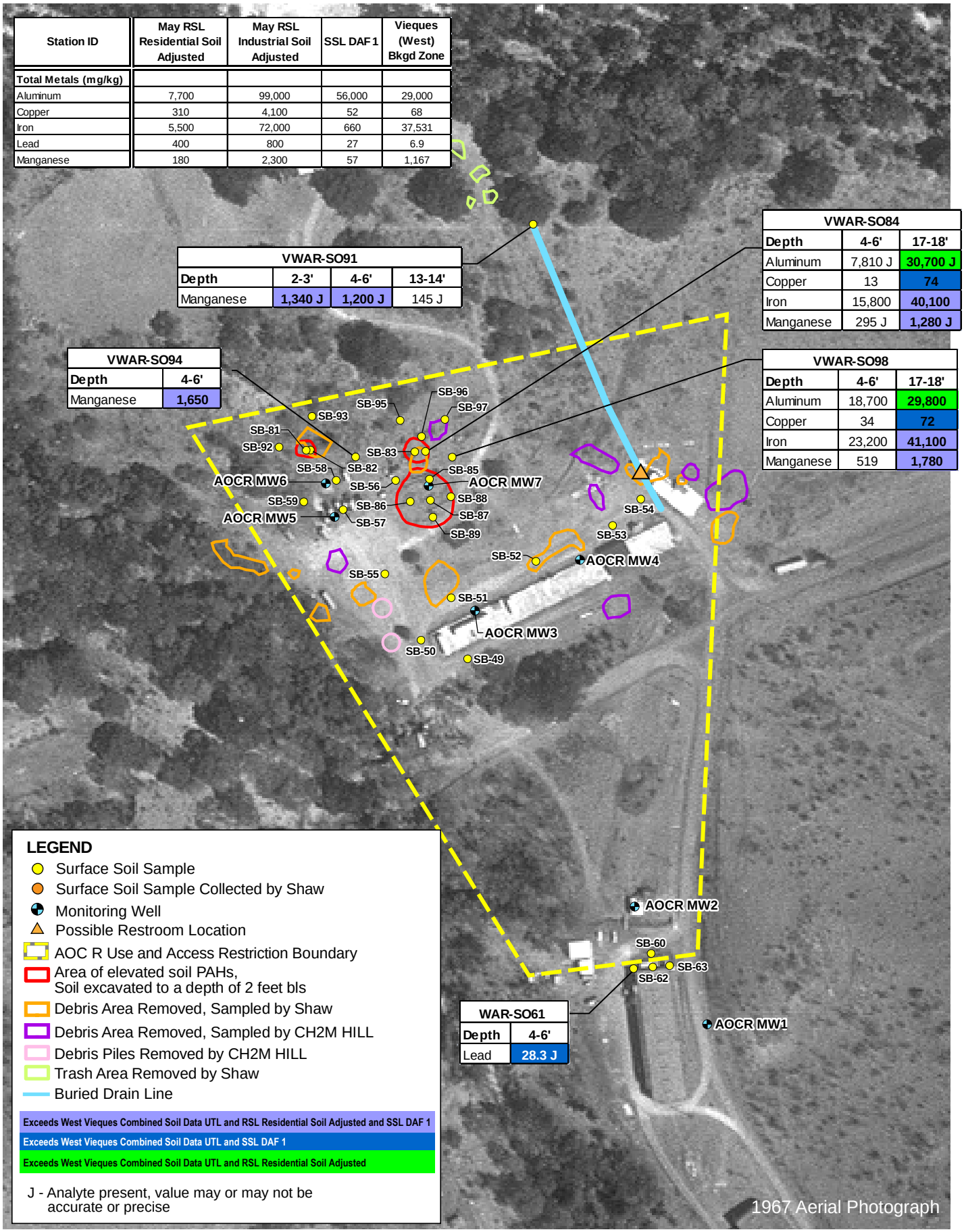
Screening Criteria	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	Eco (E)	SSL DAF 1	Vieques (West) Bkgd Zone Qa[1]
Total Metals (mg/kg)					
Aluminum	7,700	99,000	--	56,000	29,000
Antimony	3.1	41	78	0.27	2.3
Arsenic	0.39	1.6	18	0.31	2.2
Barium	1,500	19,000	330	100	320
Chromium	0.29	5.6	64	430,000	74
Cobalt	2.3	30	13	0.50	25
Copper	310	4,100	70	52	68
Iron	5,500	72,000	--	660	37,531
Lead	400	800	120	27	6.9
Manganese	180	2,300	220	57	1,167
Nickel	150	2,000	38	1,400	40
Selenium	39	510	0.52	0.12	2.0
Vanadium	39	520	2.0	180	130
Zinc	2,300	31,000	120	5,800	65

N W E S

0 75 150 Feet

CH2MHILL

FIGURE 4-8
Total Metals Exceedances in Surface Soil Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico



Station ID	May RSL Residential Soil Adjusted	May RSL Industrial Soil Adjusted	SSL DAF 1	Vieques (West) Bkgd Zone
Total Metals (mg/kg)				
Aluminum	7,700	99,000	56,000	29,000
Copper	310	4,100	52	68
Iron	5,500	72,000	660	37,531
Lead	400	800	27	6.9
Manganese	180	2,300	57	1,167

VWAR-SO91			
Depth	**2-3'**	**4-6'**	**13-14'**
Manganese	**1,340 J**	**1,200 J**	145 J

VWAR-SO84		
Depth	**4-6'**	**17-18'**
Aluminum	7,810 J	**30,700 J**
Copper	13	**74**
Iron	15,800	**40,100**
Manganese	295 J	**1,280 J**

VWAR-SO94	
Depth	**4-6'**
Manganese	**1,650**

VWAR-SO98		
Depth	**4-6'**	**17-18'**
Aluminum	18,700	**29,800**
Copper	34	**72**
Iron	23,200	**41,100**
Manganese	519	**1,780**

WAR-SO61	
Depth	**4-6'**
Lead	**28.3 J**

LEGEND

- Surface Soil Sample
- Surface Soil Sample Collected by Shaw
- Monitoring Well
- Possible Restroom Location
- AOC R Use and Access Restriction Boundary
- Area of elevated soil PAHs, Soil excavated to a depth of 2 feet bls
- Debris Area Removed, Sampled by Shaw
- Debris Area Removed, Sampled by CH2M HILL
- Debris Piles Removed by CH2M HILL
- Trash Area Removed by Shaw
- Buried Drain Line

Exceeds West Vieques Combined Soil Data UTL and RSL Residential Soil Adjusted and SSL DAF 1

Exceeds West Vieques Combined Soil Data UTL and SSL DAF 1

Exceeds West Vieques Combined Soil Data UTL and RSL Residential Soil Adjusted

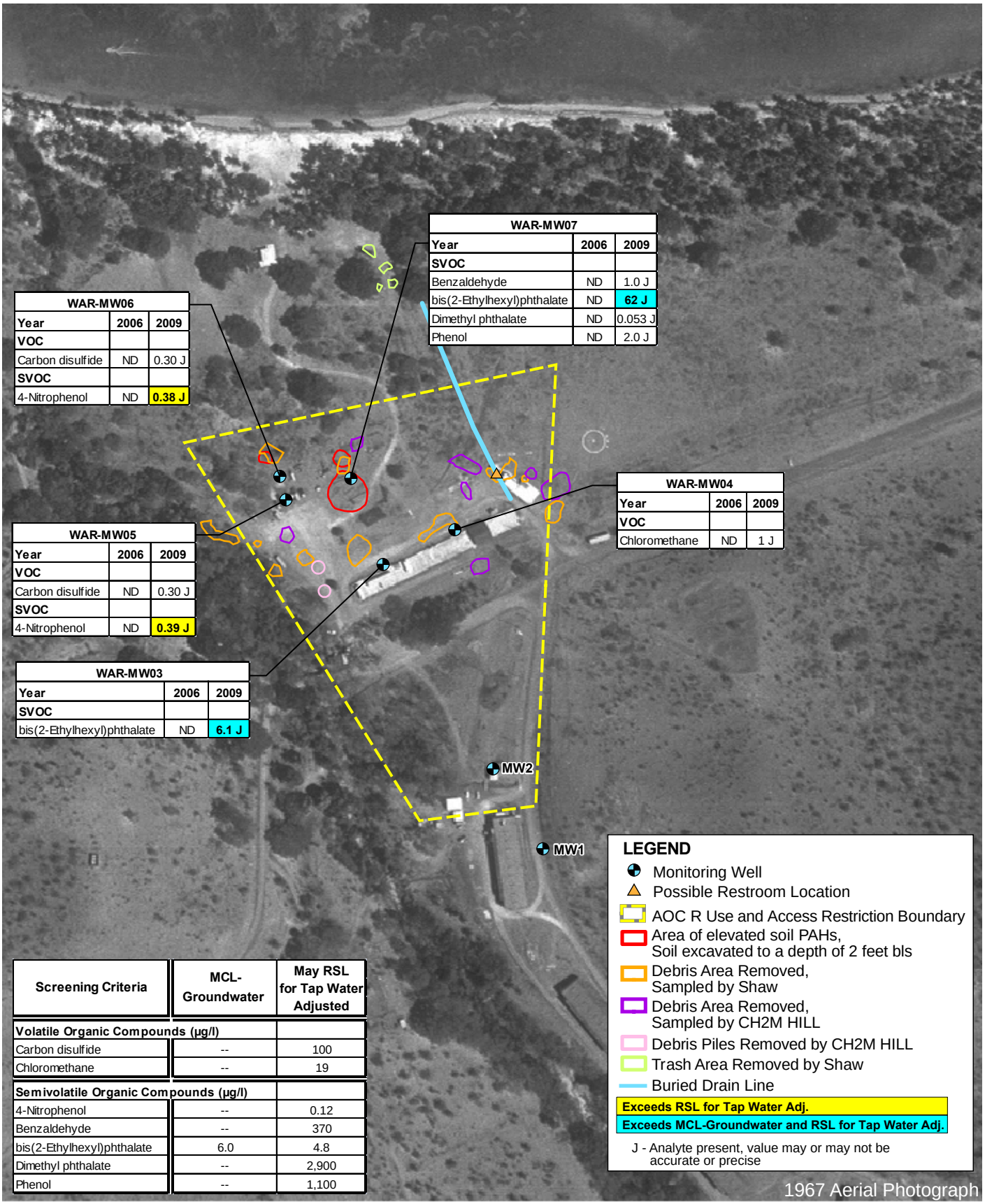
J - Analyte present, value may or may not be accurate or precise

N W E S

0 100 200 Feet

FIGURE 4-9
Total Metals Exceedances in Subsurface Soil Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL



Screening Criteria	MCL-Groundwater	May RSL for Tap Water Adjusted
Volatile Organic Compounds (µg/l)		
Carbon disulfide	--	100
Chloromethane	--	19
Semivolatile Organic Compounds (µg/l)		
4-Nitrophenol	--	0.12
Benzaldehyde	--	370
bis(2-Ethylhexyl)phthalate	6.0	4.8
Dimethyl phthalate	--	2,900
Phenol	--	1,100

N W E S

0 150 300 Feet

FIGURE 4-10
VOC and SVOC Detections and Exceedances in Groundwater
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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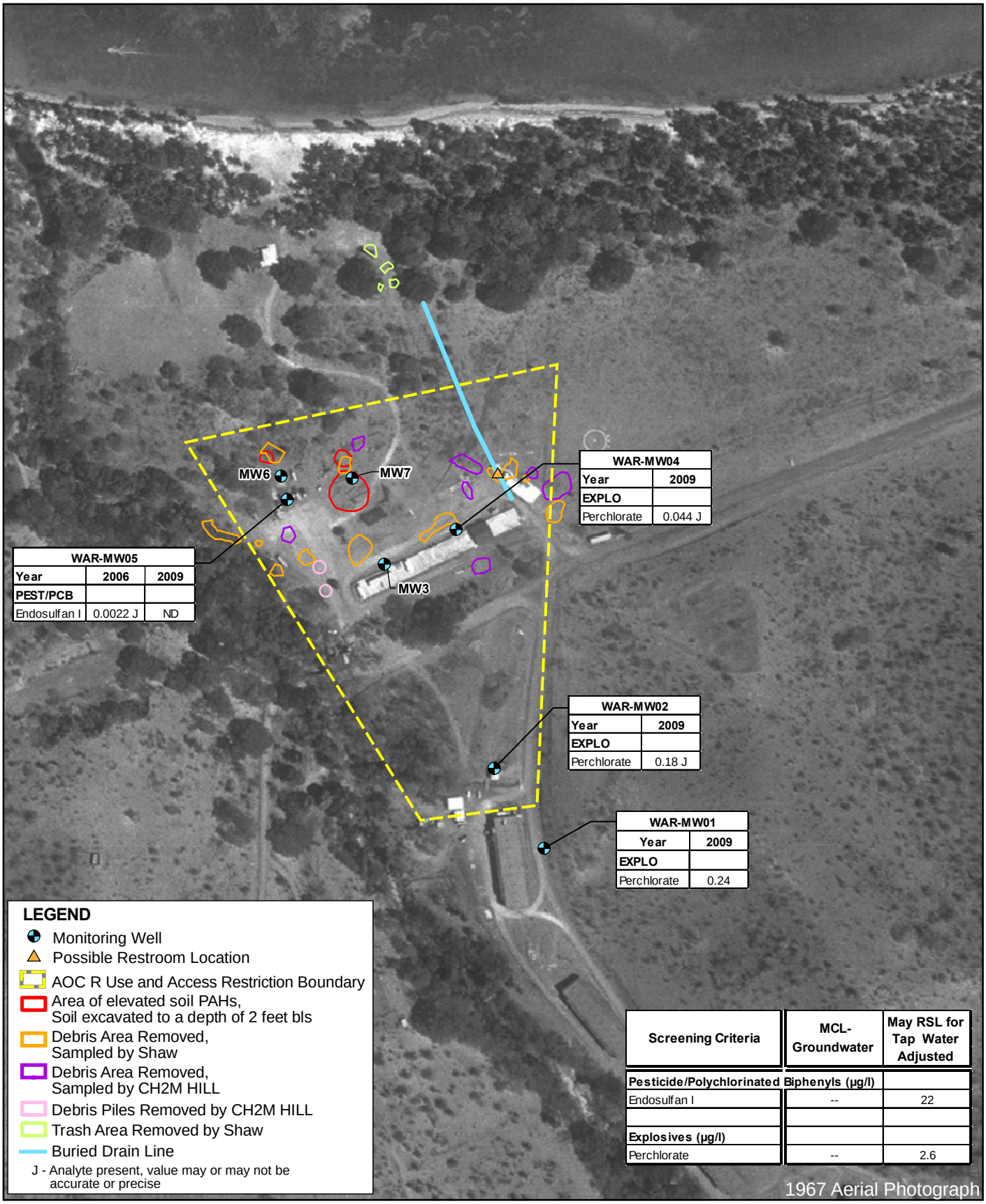

Screening Criteria	MCL-Groundwater	May RSL for Tap Water Adjusted
Pesticide/Polychlorinated Biphenyls (µg/l)		
Endosulfan I	--	22
Explosives (µg/l)		
Perchlorate	--	2.6

N
W E
S

0 150 300
Feet

FIGURE 4-11
Pesticide/PCB and Explosive Detections in Groundwater
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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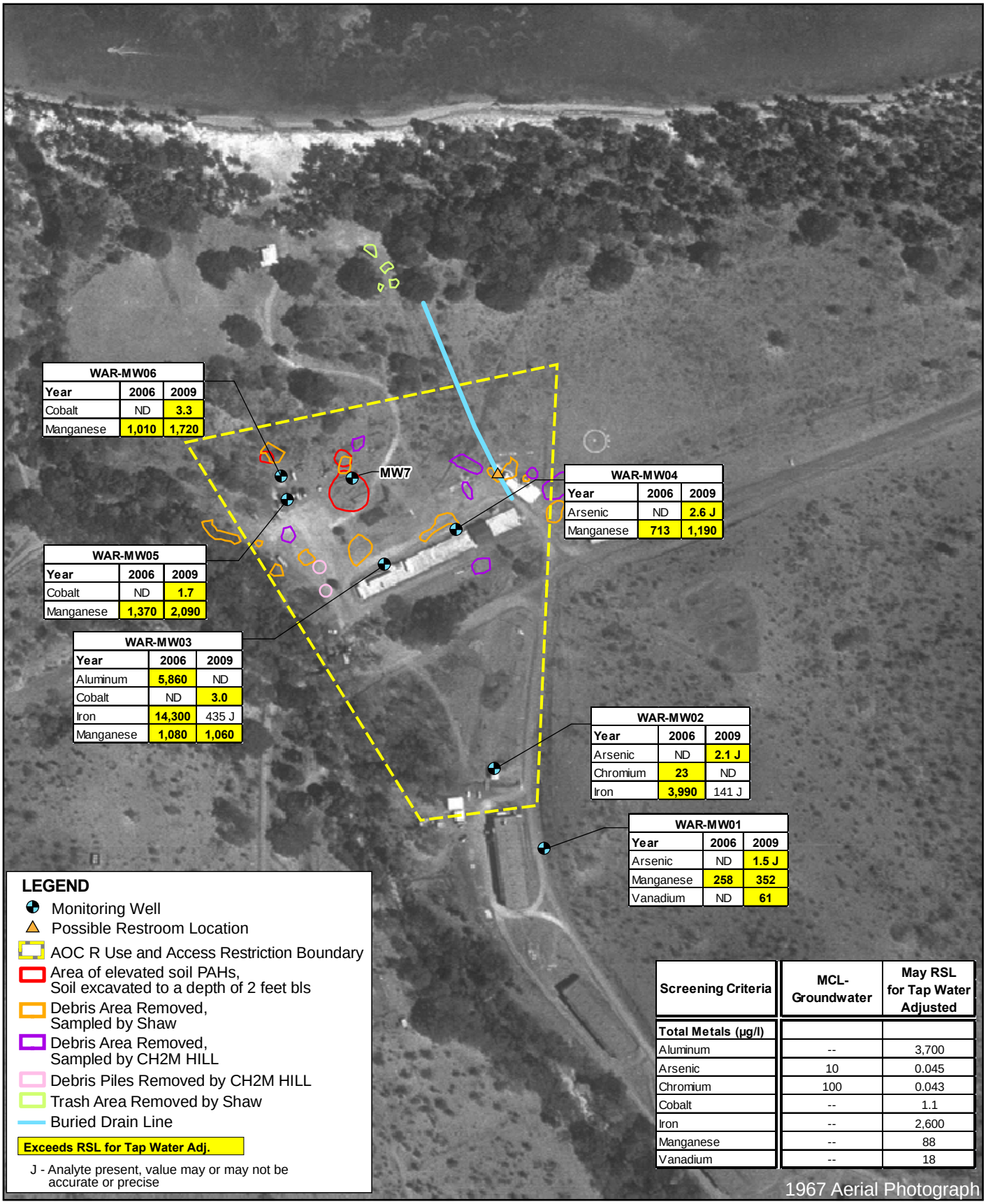

WAR-MW06		
Year	2006	2009
Cobalt	ND	3.3
Manganese	1,010	1,720

WAR-MW05		
Year	2006	2009
Cobalt	ND	1.7
Manganese	1,370	2,090

WAR-MW03		
Year	2006	2009
Aluminum	5,860	ND
Cobalt	ND	3.0
Iron	14,300	435 J
Manganese	1,080	1,060

WAR-MW04		
Year	2006	2009
Arsenic	ND	2.6 J
Manganese	713	1,190

WAR-MW02		
Year	2006	2009
Arsenic	ND	2.1 J
Chromium	23	ND
Iron	3,990	141 J

WAR-MW01		
Year	2006	2009
Arsenic	ND	1.5 J
Manganese	258	352
Vanadium	ND	61

Screening Criteria	MCL-Groundwater	May RSL for Tap Water Adjusted
Total Metals (µg/l)		
Aluminum	--	3,700
Arsenic	10	0.045
Chromium	100	0.043
Cobalt	--	1.1
Iron	--	2,600
Manganese	--	88
Vanadium	--	18

N W E S

0 150 300 Feet

FIGURE 4-12
Total Metals Exceedances in Groundwater
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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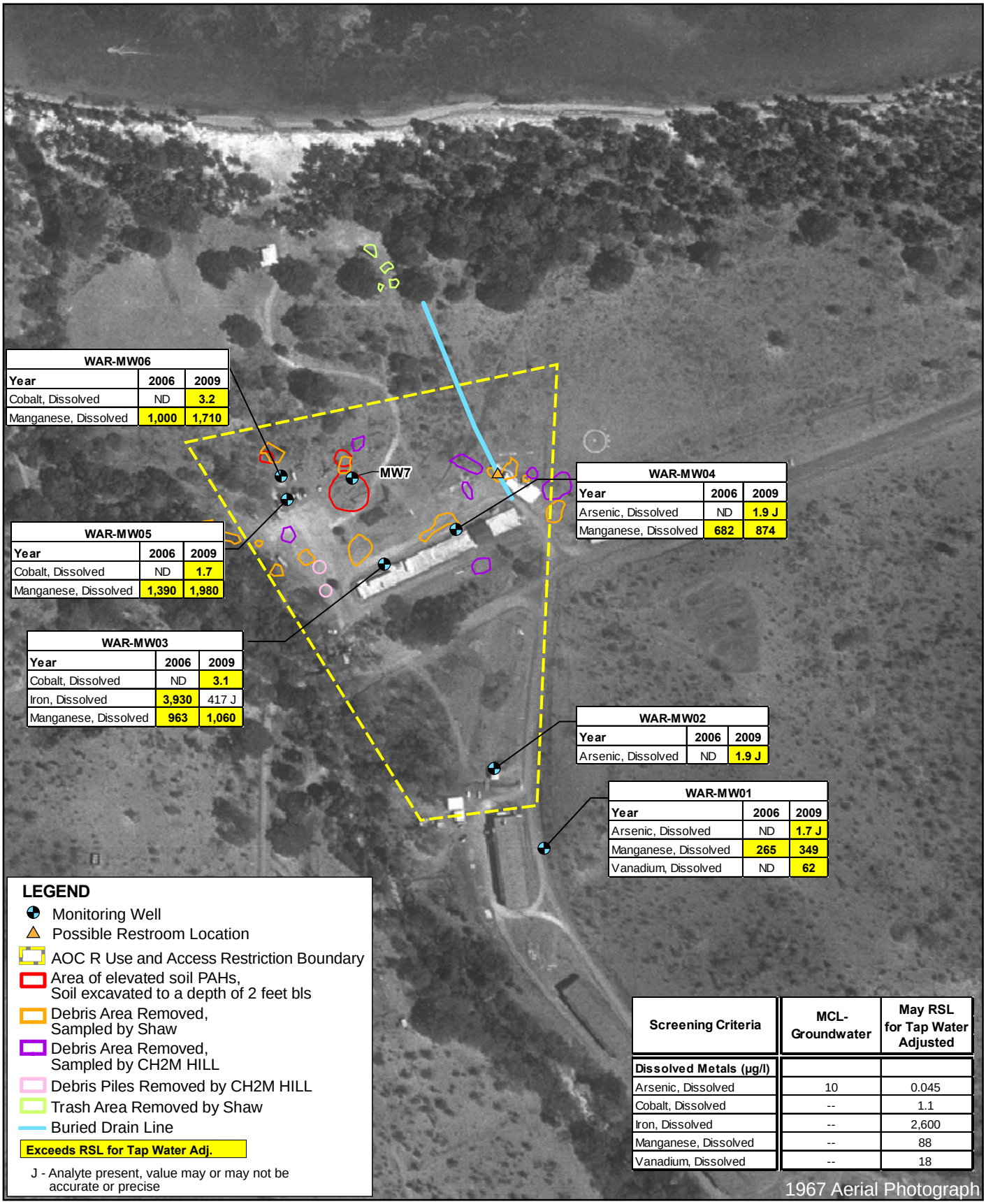
ES052510032918TPA F4-12 Total Metals in Groundwater.ai mstuart



WAR-MW06		
Year	2006	2009
Cobalt, Dissolved	ND	3.2
Manganese, Dissolved	1,000	1,710

WAR-MW05		
Year	2006	2009
Cobalt, Dissolved	ND	1.7
Manganese, Dissolved	1,390	1,980

WAR-MW03		
Year	2006	2009
Cobalt, Dissolved	ND	3.1
Iron, Dissolved	3,930	417 J
Manganese, Dissolved	963	1,060

WAR-MW04		
Year	2006	2009
Arsenic, Dissolved	ND	1.9 J
Manganese, Dissolved	682	874

WAR-MW02		
Year	2006	2009
Arsenic, Dissolved	ND	1.9 J

WAR-MW01		
Year	2006	2009
Arsenic, Dissolved	ND	1.7 J
Manganese, Dissolved	265	349
Vanadium, Dissolved	ND	62

Screening Criteria	MCL-Groundwater	May RSL for Tap Water Adjusted
Dissolved Metals (µg/l)		
Arsenic, Dissolved	10	0.045
Cobalt, Dissolved	--	1.1
Iron, Dissolved	--	2,600
Manganese, Dissolved	--	88
Vanadium, Dissolved	--	18

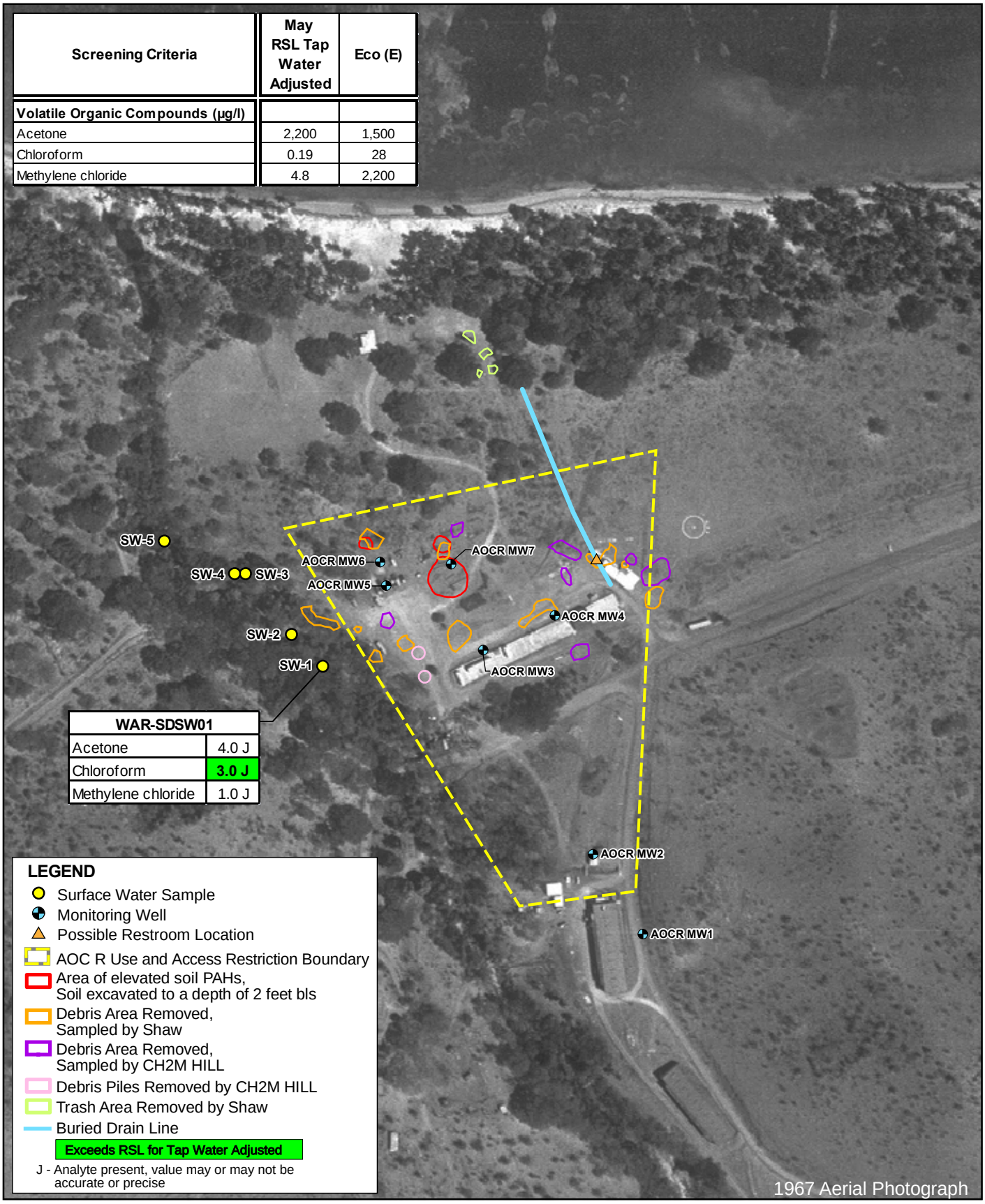
N W E S

0 150 300 Feet

FIGURE 4-13
Dissolved Metals Exceedances in Groundwater
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F4-13 Dissolved Metals in Groundwater.ai mstuart



Screening Criteria	May RSL Tap Water Adjusted	Eco (E)
Volatile Organic Compounds (µg/l)		
Acetone	2,200	1,500
Chloroform	0.19	28
Methylene chloride	4.8	2,200

WAR-SDSW01	
Acetone	4.0 J
Chloroform	**3.0 J**
Methylene chloride	1.0 J

N
W E
S

0 150 300
Feet

FIGURE 4-14
VOC Detections and Exceedances in Surface Water Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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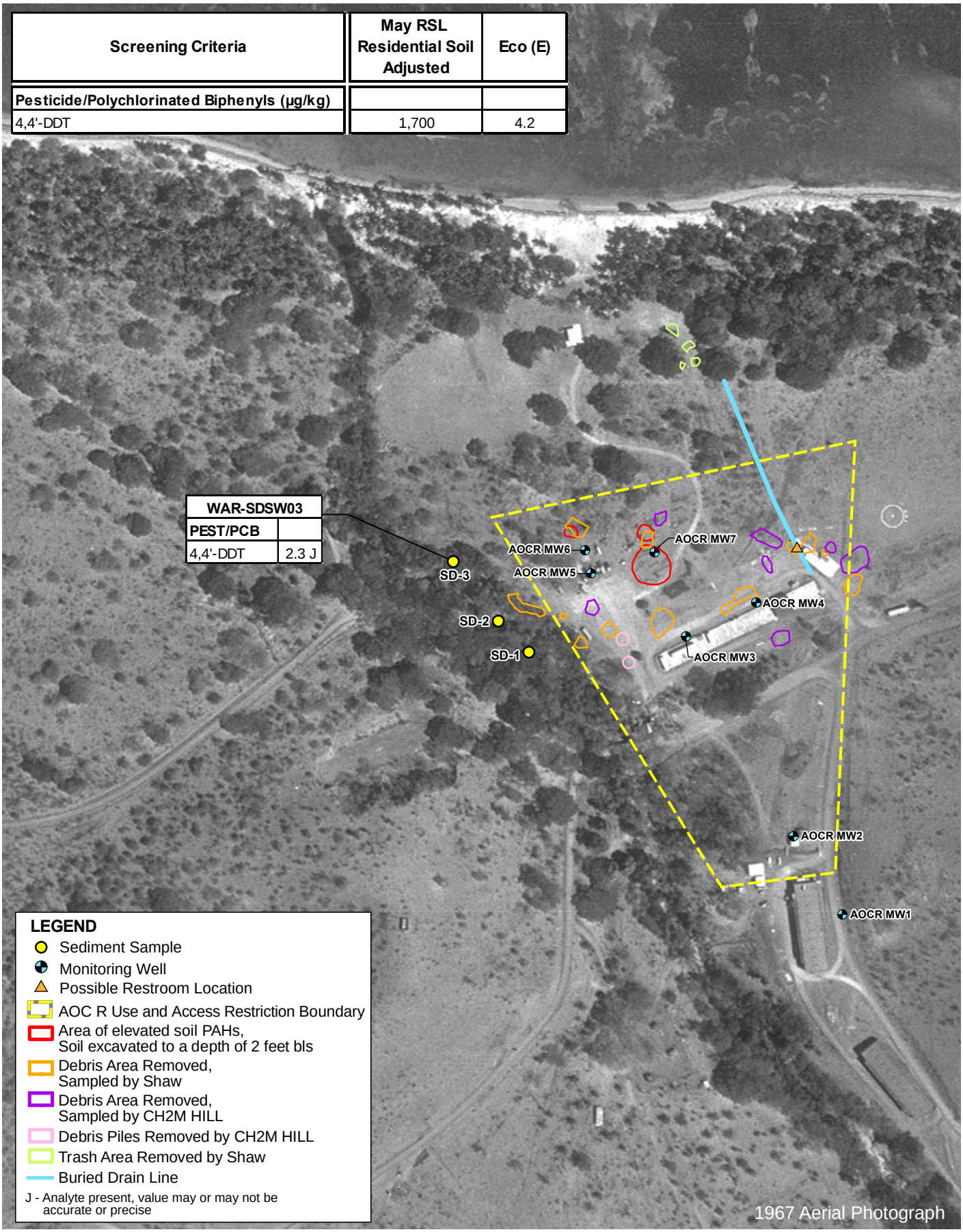


Screening Criteria	May RSL Residential Soil Adjusted	Eco (E)
Pesticide/Polychlorinated Biphenyls (µg/kg)		
4,4'-DDT	1,700	4.2

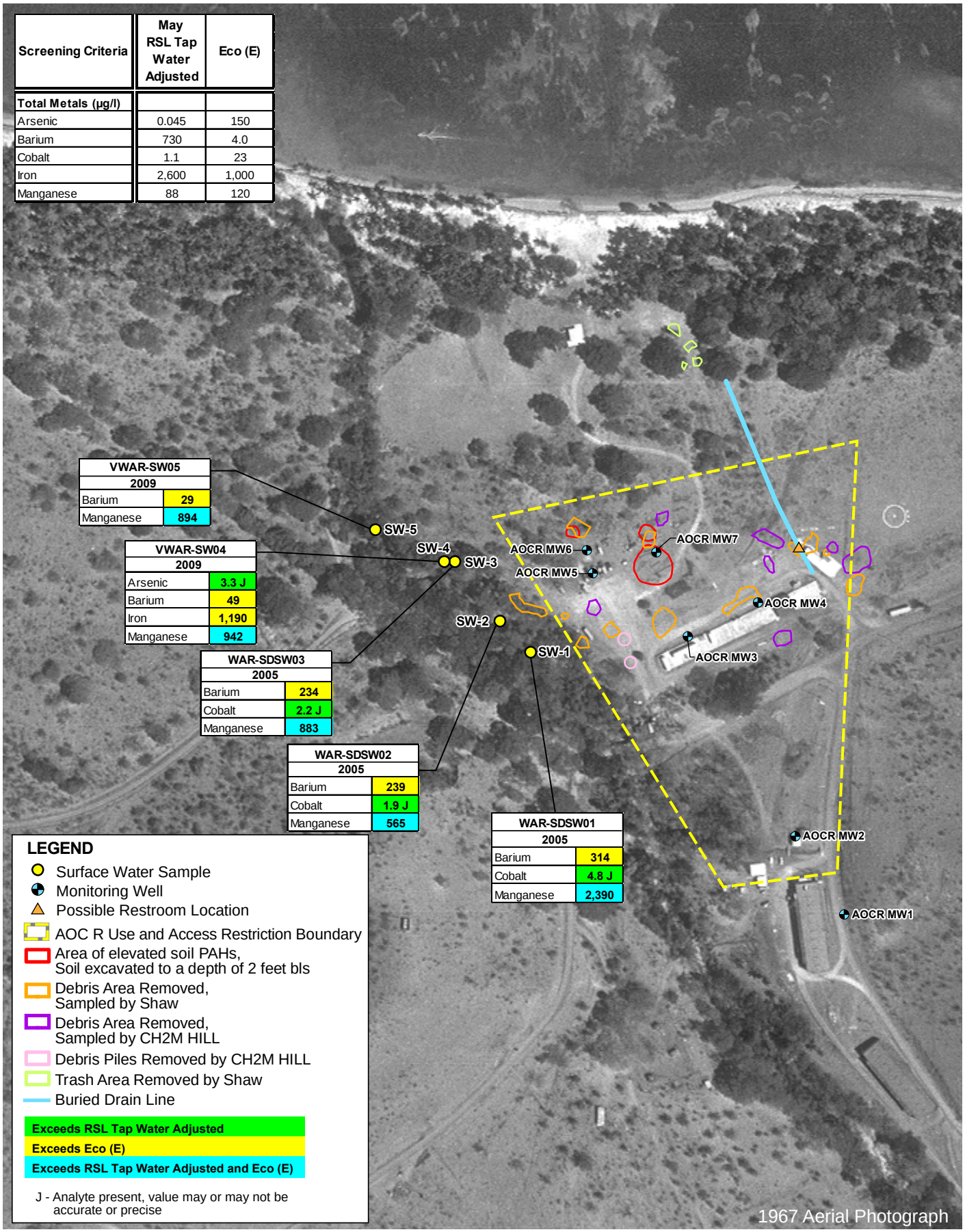
N W E S

0 150 300 Feet

FIGURE 4-15
Pesticide/PCB Detections in Sediment Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F4-15 Pesticides in Sediment Samples.ai mstuart



Screening Criteria	May RSL Tap Water Adjusted	Eco (E)
Total Metals (µg/l)		
Arsenic	0.045	150
Barium	730	4.0
Cobalt	1.1	23
Iron	2,600	1,000
Manganese	88	120

VWAR-SW05	
2009	
Barium	29
Manganese	894

VWAR-SW04	
2009	
Arsenic	3.3 J
Barium	49
Iron	1,190
Manganese	942

WAR-SDSW03	
2005	
Barium	234
Cobalt	2.2 J
Manganese	883

WAR-SDSW02	
2005	
Barium	239
Cobalt	1.9 J
Manganese	565

WAR-SDSW01	
2005	
Barium	314
Cobalt	4.8 J
Manganese	2,390

N W E S

0 150 300 Feet

FIGURE 4-16
Total Metals Exceedances in Surface Water Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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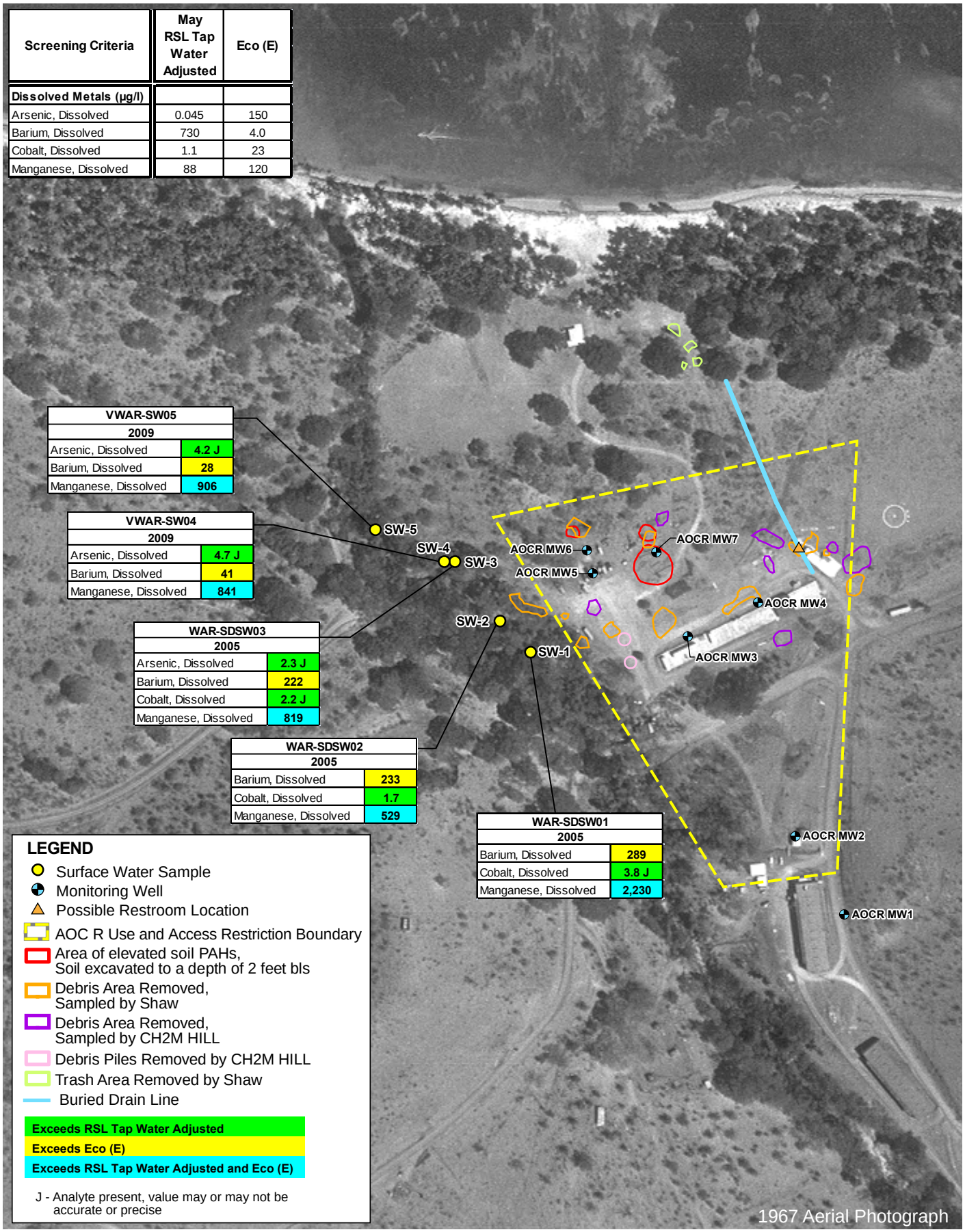

Screening Criteria	May RSL Tap Water Adjusted	Eco (E)
Dissolved Metals (µg/l)		
Arsenic, Dissolved	0.045	150
Barium, Dissolved	730	4.0
Cobalt, Dissolved	1.1	23
Manganese, Dissolved	88	120

VWAR-SW05	
2009	
Arsenic, Dissolved	4.2 J
Barium, Dissolved	28
Manganese, Dissolved	906

VWAR-SW04	
2009	
Arsenic, Dissolved	4.7 J
Barium, Dissolved	41
Manganese, Dissolved	841

WAR-SDSW03	
2005	
Arsenic, Dissolved	2.3 J
Barium, Dissolved	222
Cobalt, Dissolved	2.2 J
Manganese, Dissolved	819

WAR-SDSW02	
2005	
Barium, Dissolved	233
Cobalt, Dissolved	1.7
Manganese, Dissolved	529

WAR-SDSW01	
2005	
Barium, Dissolved	289
Cobalt, Dissolved	3.8 J
Manganese, Dissolved	2,230

N W E S

0 150 300 Feet

FIGURE 4-17
Dissolved Metals Exceedances in Surface Water Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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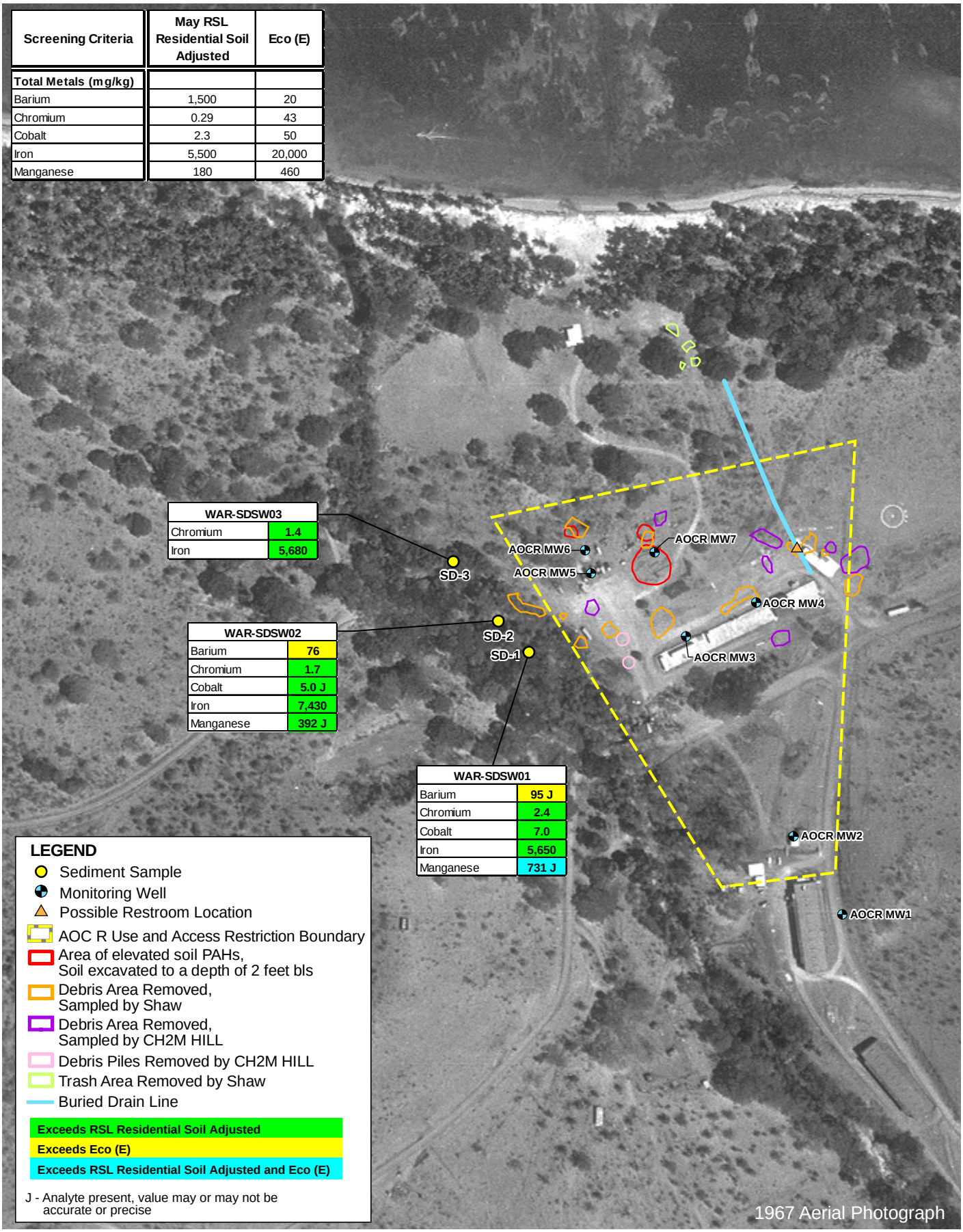
ES052510032918TPA F4-17 Dissolved Metals in SW.ai mstuart



Screening Criteria	May RSL Residential Soil Adjusted	Eco (E)
Total Metals (mg/kg)		
Barium	1,500	20
Chromium	0.29	43
Cobalt	2.3	50
Iron	5,500	20,000
Manganese	180	460

WAR-SDSW03	
Chromium	1.4
Iron	5,680

WAR-SDSW02	
Barium	76
Chromium	1.7
Cobalt	5.0 J
Iron	7,430
Manganese	392 J

WAR-SDSW01	
Barium	95 J
Chromium	2.4
Cobalt	7.0
Iron	5,650
Manganese	731 J

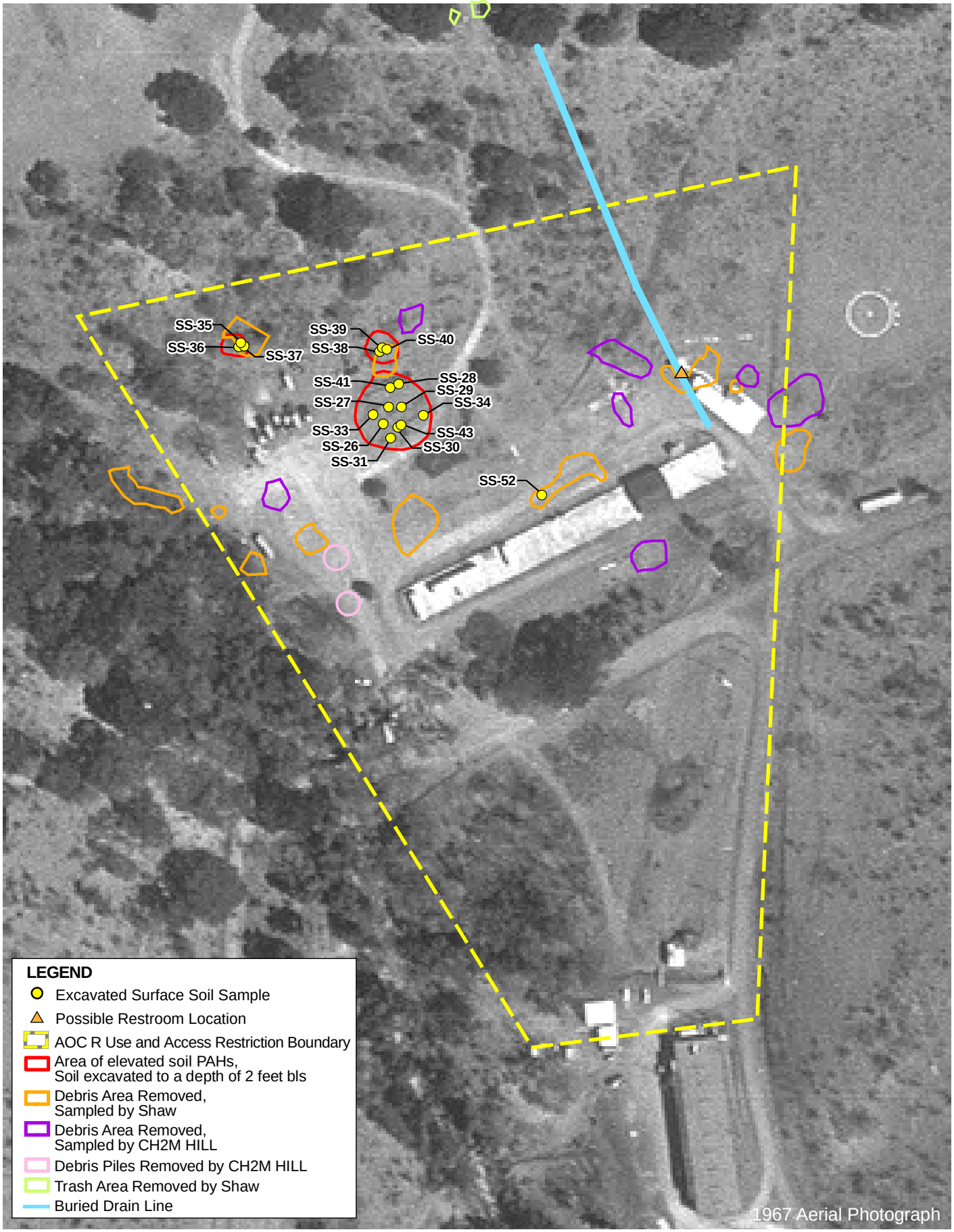
N W E S

0 150 300 Feet

FIGURE 4-18
Total Metals Exceedances in Sediment Samples
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

ES052510032918TPA F4-18 Total Metals in Sediment Samples.ai mstuart



N
W E
S

0 75 150
Feet

FIGURE 4-19
Excavated Surface Soil Samples Not Used in Data Evaluation
AOC R Remedial Investigation Report
Vieques, Puerto Rico

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ES052510032918TPA F4-19 Excavated SS Sample Locations.ai mstuart

SECTION 5

Chemical Fate and Transport

This section discusses the fate and transport of chemicals observed in soil, groundwater, sediment, and surface water at AOC R. Fate and transport consists of identification of theoretical chemical phases and migration and degradation pathways. An understanding of the mobility and persistence of a chemical in the subsurface is part of the overall assessment of the potential for that chemical to cause an adverse human health or environmental effect.

This section also includes the conceptual site model of the various media at AOC R (**Figure 5-1**). The conceptual site model qualitatively combines and interprets the compendium of information presented in this section and earlier sections of the report, including the hydrogeologic conceptual model, contaminant sources, potential migration of the contaminants, and the potential receptors and exposure pathways. The conceptual site model is used to support potential risk management decisions and aids in defining the effectiveness of remedial alternatives, if necessary.

Chemical groups detected in environmental media at AOC R include VOCs, SVOCs, pesticides, PCBs, explosives, TPH and inorganic constituents, as discussed in Section 4. These chemicals are also discussed as part of this section. The constituents detected in the various media at AOC R are summarized in **Table 5-1**. Constituents considered COPCs (exceeding screening criteria) and their chemical properties are summarized in **Table 5-2**.

5.1 Chemical Mobility and Persistence

The mobility and persistence of the potential contaminants at the site are determined by their physical, chemical, and biological interaction with the environment. Mobility is the potential for a chemical to migrate from a site, and persistence is a measure of how long a chemical will remain in the environment. Because physical and chemical properties of contaminants and the environment affect the movement of a contaminant in groundwater, predicting contaminant behavior and migration can be difficult. Some of the mechanisms controlling mobility and persistence are described below.

5.1.1 Solubility

Solubility is a measure of the degree to which a constituent will dissolve in water. Highly soluble chemicals are more likely to be leached from soil by precipitation or runoff that infiltrates into the subsurface. The SVOCs considered COPCs generally have very low solubilities (less than 0.2 mg/L), except for 4-nitrophenol (solubility of 16,000 mg/L).

The solubilities of inorganics are dependent on several factors. In general, solubility is highly dependent on the oxidation state of the inorganic, which is dependent on subsurface conditions. The solubility of cations decreases as pH increases. Some cations may complex with oxygen and hydroxide, forming insoluble oxyhydroxides, or phosphate, sulfate, and carbonate, forming insoluble mineral precipitates. Metal sulfide complexes, which form in reducing environments, are extremely insoluble and tend to reduce the total metals concentrations (USEPA, 1979).

5.1.2 Sorption

Sorption occurs when a constituent adheres to and becomes associated with solid particles in the formation. The subsurface materials likely to sorb chemicals are clays and organic matter. In addition, some inorganic constituents, such as arsenic species, can sorb to iron and oxyhydroxide or oxide coatings on soil and sediment grains.

The conventional measure of sorption is the distribution coefficient (K_d). The K_d for organic chemicals is the product of the soil organic carbon partition coefficient (K_{oc}) of the chemical and the fraction of organic carbon (f_{oc}) in the soil. The average f_{oc} content in AOC R soil is 0.0034 gram/gram (g/g). In general, chemicals with a K_{oc} greater than 10,000 milliliters per gram (mL/g) have high degrees of adsorption and consequentially low mobility, whereas chemicals with a K_{oc} lower than 1,000 mL/g have lower degrees of adsorption and consequentially higher mobility. The majority of the SVOCs have high to very high K_{oc} values (range from 1,000 to greater than 100,000 mL/g). 2,4-DNT, 4-nitrophenol, and bis(2-ethylhexyl)phthalate have relatively low K_{oc} values.

The K_d for inorganic chemicals is a complex function of pH, organic content, oxide coatings, and other factors; therefore, K_d is not easily estimated by methods other than site-specific testing. Due to the number of factors which impact the K_d values for inorganics, these values range from 0.1 mL/g to greater than 100,000 mL/g (**Table 5-2**). Generally, metal adsorption increases with pH. Inorganics most often sorb to clay minerals, organic matter, and iron and manganese oxyhydroxides. Metals may be sorbed on the surface of the soil or fixed to the interior of the soil, where they are unavailable for release to water. After available sorption sites are filled, most metals are incorporated into the structures of major mineral precipitates, as coprecipitates.

5.1.3 Volatilization

Volatilization occurs when a compound transfers from the aqueous phase to the gas phase. Measures of a chemical's tendency to volatilize from water and soil include its vapor pressure and Henry's Law Constant (K_h). Compounds with K_h values higher than 10^{-3} atmosphere-cubic meter per mole (atm-m^3/M) are expected to volatilize readily from water to air, whereas those with K_h values lower than 10^{-5} atm-m^3/M are relatively non-volatile. Compounds with K_h values in between these values are expected to be moderately volatile. At a given temperature, the higher the vapor pressure of a compound, the higher the volatility of that compound.

Volatilization tends to occur more readily from surface water, sediment, or shallow soil than from deeper soil or groundwater. In groundwater, volatilization can occur only at the air/water interface between the saturated and unsaturated zones, and movement of aqueous-phase contaminants from bulk groundwater to the interface is largely diffusion-limited. In unsaturated shallow soil, the soil gas pressure generally approximates the ambient air pressure. With depth, the soil gas pressure tends to increase and it becomes more difficult for the gas to escape and equalize with the ambient air pressure.

Values of vapor pressure and K_h for site SVOC COPCs are provided in **Table 5-2**. All constituents have low volatility. Due to the complexity of inorganics and their variable forms in the environment, no K_h values can be provided. However, these constituents are typically not volatile under normal temperature and pressure conditions.

5.1.4 Transformation

Transformation occurs when the valence state of inorganics is increased (oxidation) or decreased (reduction). It can be caused by changes in E_h (oxidation potential) and/or pH (potential hydrogen) and by microbial or non-microbial (abiotic) processes. Transformation may have a significant effect on the mobility of a metal, either increasing or decreasing it.

5.1.4.1 Aluminum, Iron, and Manganese

The solid form of iron (iron hydroxides), aluminum (aluminum hydroxides and imogolite) and manganese (manganese oxides) are usually present in the natural soil matrix. If sufficient amounts of oxygen and nitrate are not present in the subsurface, iron hydroxides and manganese oxides will be used as electron acceptors by metabolic activity and reductively dissolved into soluble forms. Sulfides present in groundwater can also reductively dissolve iron hydroxides. The soluble form of aluminum can be released to groundwater through either complexation to organic acids or dissolution of aluminum minerals. As the pH of the subsurface decreases, the amount of soluble aluminum is generally increased.

Several inorganics (such as arsenic) have a tendency to sorb to these iron and aluminum hydroxides and manganese oxides. If these compounds are reductively dissolved, then the inorganics which are bound to these hydroxides and oxides will also be released.

5.1.4.2 Arsenic, Antimony, Chromium, Selenium, and Vanadium

In oxidizing environments, these constituents primarily exist as oxyanions (hard anions that contain oxygen) and are relatively mobile. However, they can be adsorbed by clays, iron hydroxides, aluminum hydroxides, manganese compounds, and organic material at acidic and neutral pHs.

Arsenic, chromium, and vanadium can be reduced from higher to lower valance states by organic matter, divalent metals, and dissolved sulfide. Under reducing conditions, insoluble arsenic and antimony sulfides are precipitated in the presence of sulfides. Chromium will form insoluble chromium hydroxide or be sorbed by manganese oxides. Selenium will react with metal cations to form insoluble metal selenides.

5.1.4.3 Barium

Barium is most often found in inorganic complexes and is likely to precipitate out of solution as an insoluble salt. The maximum concentration of barium in groundwater is often limited by the solubility of the mineral barite (ERG, 2003).

5.1.4.4 Cobalt, Nickel, Lead, and Zinc

These inorganics form insoluble metal sulfides in anaerobic environments. They tend to sorb and will be transported in water primarily with suspended colloidal particles (ERG, 2003). The concentrations of cadmium, nickel, and zinc in groundwater are usually controlled by the adsorption or coprecipitation of these metals with iron, manganese, and aluminum. However, cadmium and zinc carbonates are relatively soluble at pH below 8. Lead is relatively immobile in all matrices due to its strong tendency to be sorbed by iron and manganese oxides and the insolubility of many lead minerals.

5.1.4.5 Copper

Copper is highly insoluble in reduced environments, where it precipitate as metals sulfides. Copper is strongly adsorbed by organic matter, iron and manganese oxides, and clays, but complexing of these metals to ammonia, chloride, and humic acids can increase their solubility and thus mobility. Copper is insoluble above a pH of 7 to 8 and in the presence of abundant carbonate.

5.1.5 Degradation

Degradation is the deterioration or destruction of a chemical either biologically (biodegradation) or abiotically through such processes as hydrolysis and photolysis. Biodegradation of chemicals by microbial organisms occurs through metabolic or enzymatic processes. Hydrolysis is the reaction of a chemical with water and photolysis is the result of exposing the chemical to light. The rate of degradation can be expressed as a half life and is dependent on the existing chemical, biological, and physical conditions of the media in which the contaminant is located.

PAHs can be biodegraded under aerobic and anaerobic conditions. However, aerobic biodegradation occurs at a much faster rate. Abiotic degradation is not considered to be an important mechanism. While all of the PAHs in **Table 5-2** can aerobically biodegrade, only benzo(a)pyrene has been shown to undergo anaerobic biodegradation. Low molecular weight PAHs typically biodegrade faster than heavier PAHs.

5.1.6 Bioaccumulation

Bioaccumulation is the extent to which a chemical will partition from water into the lipophilic parts (e.g., fat) of an organism. Bioaccumulation commonly is estimated by the octanol-water partition coefficient (K_{ow}). Chemicals with high values of K_{ow} tend to avoid the aqueous phase and remain in soil longer or bioaccumulate in the lipid tissue of exposed organisms. **Table 5-2** lists the log K_{ow} values for the COPCs.

5.2 Contaminant Migration

This subsection discusses the site-specific sources and potential mechanisms for contaminant release and migration from these sources. **Figure 5-1** presents the CSM for AOC R and supports the discussion in this subsection.

5.2.1 Potential Sources of Contamination

Debris piles, inert MEC items, a former AST, and former activities related to construction and vehicle maintenance activities from 1965 to 1971 resulted in the distribution of PAHs and inorganics. Based on the removal action, the debris piles at the site included timbers, metal debris, corrugated roofing sheet material, several munitions items, and tires. Debris piles and impacted soils potentially posing unacceptable risks were removed from the site as part of the 2009 removal action (Shaw, 2010).

5.2.2 Migration from Potential Source Areas

The migration pathways at AOC R were assessed by identifying potential sources of contamination, evaluating the COPC horizontal and vertical distributions, and incorporating

the hydrogeologic conceptual model. A generalized description of the potential contaminant migration pathways are discussed below.

5.2.2.1 Migration from Ground Surface to Atmosphere

Wind erosion was a former potential mechanism for release of site contaminants to the atmosphere from soil, since PAHs and inorganics tend to bind to the soil. During windy conditions, soil particles could be released to the atmosphere. However, the potential future sources of contamination (debris) were removed from the site, PAH impacted soils potentially posing unacceptable risk were removed from the site, and the potential for release of site contaminants to the atmosphere is not likely due to the vegetative cover normally present at the site.

5.2.2.2 Migration via Surface Runoff

Contaminants within site soil may be transported by runoff to sediment and surface water of the ephemeral streams. Surface drainage at the site is directed by the ground topography. Contaminants would likely be transported as suspended particles. The degree to which surface soil can be eroded and contribute to the runoff pathway at a particular location depends on a variety of site-specific factors including topography, soil type, climate, and nature of surface cover, such as a concrete pad or vegetation. However, the potential future sources of contamination (debris) were removed from the site, PAH impacted soils potentially posing unacceptable risk were removed from the site, and the potential for the migration of site contaminants via runoff is minimal due to the relative flat topography and vegetative cover normally present at the site.

5.2.2.3 Migration from Ground Surface to Groundwater

Contaminants within soil may migrate downward through the unsaturated zone by leaching from infiltration. Evapotranspiration from vegetation may limit infiltration rates at depths below the rooting zone. Once in the unsaturated zone, contaminants may sorb to soil or organic matter, become trapped in residual pore space, or continued to leach to the groundwater. Sorption, for contaminants with high K_{oc} values and some inorganics, is expected to be significant due to the presence of clay.

PAHs will likely remain sorbed to soil and are not likely to migrate through soil. No PAHs were detected in groundwater. The presence and mobility of inorganics in the unsaturated zone is highly dependent on the subsurface conditions. As discussed in Section 4.1.1.6 for each specific inorganic, inorganics with SSL exceedances in soil at the site do not correlate with exceedances in groundwater. Inorganic detections in groundwater are a result of natural conditions (i.e., aquifer matrix, geochemical conditions, etc.).

5.2.2.4 Migration in Groundwater

Contaminant transport in groundwater is primarily by advection and dispersion. Advection is the primary transport mechanism and includes the transport of dissolved contaminants by the bulk motion of flowing groundwater. Dispersion is the spreading of dissolved contaminants from the path they would be expected to follow during advection, due to the spatial variation in aquifer permeability, fluid mixing, and molecular diffusion.

Once in groundwater, contaminants typically will not move as rapidly as groundwater because of retardation, or the adsorption of the contaminant to the solid media. The advective migration

rates of different dissolved contaminants vary depending on the K_d and the rate of groundwater flow. For each contaminant detected at the site, it is theoretically possible to calculate a retardation coefficient, which is an estimate of the degree to which the contaminant is slowed by adsorption in relation to the groundwater flow velocity. The retardation coefficient is calculated according to the following equation:

$$R = 1 + p_b \times K_d / n_e$$

Where :

R = Retardation coefficient (dimensionless)
p_b = Bulk density (grams per cubic centimeter [g/mL])
K_d = Distribution coefficient (mL/g)
n_e = effective porosity (dimensionless)

Assuming a bulk density of 1.3 g/mL and an effective porosity of 0.30, the estimated retardation coefficients are listed in **Table 5-2**. The retardation of inorganics is variable depending on the form of the chemical in the subsurface and may range from 1 to greater than 1,000,000. The effect of retardation is estimated by dividing the groundwater flow velocity by R, which provides a value of migration that is either equal to (in the case of no retardation) or less than (in the presence of retardation) the groundwater flow velocity (**Table 5-2**). Based on the information presented in Section 3.1.5, the average groundwater flow velocity was estimated at 15 feet per year (ft/yr).

Only SVOCs and inorganics were detected above screening values in groundwater. The SVOCs are not site-related constituents and the inorganics observed in groundwater are likely all or primarily attributable to background. Transport and partitioning of inorganics in water is dependent on the oxidation state of the inorganic and on interactions with other materials present.

5.2.2.5 Potential Exposure and Receptor Pathways

Potential exposure media at AOC R include soil, surface water, sediment, and groundwater. Exposure at AOC R may occur under current and actual/theoretical future land use scenarios. Human receptors include potential future adult construction workers, future adult site industrial workers, future adult maintenance workers, future adult/child residents, and future/current adult recreation users/trespassers. Ecological receptors include soil invertebrates, terrestrial plants, reptiles, invertivores, omniovores, insectivores, benthic invertebrates, and aquatic plants. These are discussed in more detail in the human health and ecological risk assessments in Sections 6 and 7.

Table 5-1
Detected Chemicals by Media
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Chemical	Media				
	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
Volatile Organic Compounds					
1,1-Dichloroethene	X				
4-Methyl-2-pentanone	X				
Acetone	X			X	
Carbon disulfide			X		
Chloroform				X	
Chloromethane			X		
m- and p-Xylene	X				
Methylene chloride	X			X	
o-Xylene	X				
Tetrachloroethene	X				
Toluene	X	X			
Trichloroethene	X				
Xylene, total	X				
Semivolatile Organic Compounds					
2,4-Dinitrotoluene		X			
2-Nitroaniline	X	X			
4-Chloro-3-methylphenol	X	X			
4-Nitroaniline	X	X			
Acenaphthene	X				
Acenaphthylene	X				
Anthracene	X				
Atrazine	X	X			
Benzo(a)anthracene	X				
Benzo(a)pyrene	X				
Benzo(b)fluoranthene	X	X			
Benzo(g,h,i)perylene	X				
Benzo(k)fluoranthene	X	X			
bis(2-Ethylhexyl)phthalate	X	X			
Carbazole	X	X			
Chrysene	X	X			
Dibenz(a,h)anthracene	X	X			
Dibenzofuran	X				
Di-n-octylphthalate		X			
Fluoranthene	X	X			
Fluorene	X				
Hexachlorocyclopentadiene		X			
Indeno(1,2,3-cd)pyrene	X				
PAH Total (HMW)	X				
PAH Total (LMW)	X				
Phenanthrene	X				
Pyrene	X	X			
4-Nitrophenol			X		
Benzaldehyde			X		
bis(2-Ethylhexyl)phthalate			X		
Dimethyl phthalate			X		
Phenol			X		
Pesticides/Polychlorinated Biphenyls					
4,4'-DDD	X	X			
4,4'-DDE	X	X			
4,4'-DDT	X	X			X
alpha-Chlordane	X	X			
Aroclor-1242	X				
Aroclor-1254	X				
Aroclor-1260	X				
beta-BHC	X				
Dieldrin	X	X			
Endosulfan I	X		X		
Endrin aldehyde	X				
Endrin ketone		X			
gamma-BHC (Lindane)	X				
gamma-Chlordane	X				
Explosives					
Perchlorate	X	X	X		

Table 5-1
Detected Chemicals by Media
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Chemical	Media				
	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
Inorganics					
Aluminum	X	X	X		X
Antimony	X	X			X
Arsenic	X	X	X	X	
Barium	X	X	X	X	X
Beryllium	X	X	X		
Cadmium	X		X		
Calcium	X	X	X	X	X
Chromium	X	X	X		X
Cobalt	X	X	X	X	X
Copper	X	X	X	X	X
Cyanide	X	X			
Iron	X	X	X	X	X
Lead	X	X	X	X	X
Magnesium	X	X	X	X	X
Manganese	X	X	X	X	X
Mercury	X	X	X		
Nickel	X	X	X	X	X
Potassium	X	X	X	X	X
Selenium	X	X	X		
Silver	X	X	X		
Sodium	X	X	X	X	
Thallium			X	X	
Vanadium	X	X	X	X	X
Zinc	X	X	X	X	X
Total Petroleum Hydrocarbons (TPH)					
TPH-diesel range	X				
TPH-oil range	X				

Table 5-2
Physical and Chemical Data of Representative Contaminants
AOC R Remedial Investigation Report
Former NASD, Vieques, Puerto Rico

Representative COPCs	Molecular Weight (g/mole)	Density (g/cm^3)	Water Solubility (mg/L)	Vapor Pressure (mm Hg)	K_h (atm-m3/mole)	Log K_{oc} (---)	K_d (mL/g)	R (---)	V_c (ft/yr)	Log K_{ow} (---)
Semivolatile Organic Compounds										
2,4-Dinitrotoluene	182.14	1.32	270	1.10E-04	8.79E-08	2.45	0.96	5.2	2.7	1.98
4-Nitroaniline	138.12	1.42	390	3.20E-06	1.26E-09	-	-	-	-	-
4-Nitrophenol	139.11	1.48	16,000	1.00E-04	1.30E-08	2.33	0.73	4.1	3.4	1.91
Benzo(a)anthracene	228.30	1.27	0.0094	2.10E-07	8.00E-06	5.81	2,195	9,513.6	1.5E-03	5.61
Benzo(a)pyrene	252.32	1.35	0.0016	5.49E-09	3.36E-07	5.95	3,030	13,132.1	1.1E-03	6.00
Benzo(b)fluoranthene	252.36	-	0.0012	5.00E-07	7.39E-07	6.60	13,536	58,655.5	2.4E-04	6.00
bis(2-Ethylhexyl)phthalate	390.57	0.98	0.40	2.00E-07	1.10E-05	5.00	340	1,474.3	9.5E-03	1.37
Carbazole	167.20	1.10	insoluble	1.37E-06	8.65E-08	6.40	8,540	37,009.5	3.8E-04	1.46
Dibenz(a,h)anthracene	278.33	1.28	0.0005	9.55E-10	7.30E-08	6.75	19,120	82,852.6	1.7E-04	6.50
Indeno(1,2,3-cd)pyrene	276.34	-	0.062	-	3.48E-07	7.49	105,070	455,304.5	3.1E-05	6.58
Metals										
Aluminum	26.98	2.70	U	U	U	NA	NA	NA	NA	U
Antimony	121.75	6.68	U	U	U	NA	1.3 - 500	4.7 - 1,400	0.01 - 3.0	U
Arsenic	74.92	5.78	U	U	U	NA	2.0 - 20,000	6.8 - 57,800	0.0002 - 2.1	U
Barium	137.33	3.62	U	U	U	NA	5.0 - 2,500	15.4 - 7,200	0.002 - 0.9	U
Chromium	52.00	7.14	U	U	U	NA	0.20 - 63,000	1.6 - 182,000	0.00008 - 8.8	U
Cobalt	59.00	8.90	U	U	U	NA	0.063 - 12,600	1.2 - 36,400	0.001 - 222	U
Copper	63.55	8.94	U	U	U	NA	1.6 - 4,000	5.6 - 11,600	0.004 - 8.8	U
Iron	55.85	7.87	U	U	U	NA	1.4 - 10,000	5.0 - 28,900	0.0001 - 2.8	U
Lead	207.20	11.34	U	U	U	NA	5.0 - 100,000	15 - 288,900	1.4E-04 - 0.9	U
Manganese	54.94	7.26	U	U	U	NA	NA	NA	NA	U
Nickel	58.69	8.91	U	U	U	NA	10 - 6,300	30 - 18,200	7.7E-04 - 0.5	U
Selenium	78.96	4.39	U	U	U	NA	0.5 - 250	2.4 - 723	0.02 - 5.8	U
Vanadium	50.94	6.11	U	U	U	NA	4.0 - 500	13 - 1,400	0.01 - 1.1	U
Zinc	65.39	7.13	U	U	U	NA	0.1 - 100,000	1.3 - 288,900	4.8E-05 - 10.8	U

foc = fraction organic carbon = 0.0034 g/g (average of total organic carbon subsurface soil data)
K_d = Soil-Water partition coefficient = K_{oc} x foc for organics
K_h= Henry's Law Constant
K_{oc} = Organic carbon partition coefficient
K_{ow} = Octanol-water partition coefficient
NA = no information available
n_e = Effective porosity = 0.30
R = Retardation coefficient = $1 + K_d \times \rho_b / n_e$
ρ_b = Soil bulk density = 1.3 grams per cubic centimeter (sandy clay)
U = No value is provided because of the uncertainty in the form of these chemicals in the environment.
Vc = Contaminant velocity = seepage velocity (estimated at 14 ft/yr) / R

Data sources (Sources 3 and 6 are primary references):
(1) Agency of Toxic Substances and Disease Registry. 2009. Toxicological Profiles. *http://www.atsdr.cdc.gov/toxpro2.html*
(2) Dragun, James. 1998. *The Soil Chemistry of Hazardous Materials 2nd Edition*.
(3) Interstate Technology and Regulatory Council. 2002. *A Systematic Approach to In Situ Bioremediation in Groundwater Including Decision Trees on In Situ Bioremediation for Nitrates, Carbon Tetrachloride, and Perchlorate.* In Situ Bioremediation Team.
(4) Montgomery. 2000. *Groundwater Chemicals Desk Reference. Third Edition.*
(5) United States Environmental Protection Agency. 1999. *Partition Coefficients for Metals in Surface Water, Soil, and Waste.*
(6) United States National Library of Medicine. 2009. Hazardous Substances Data Bank (HSDB). *http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB*

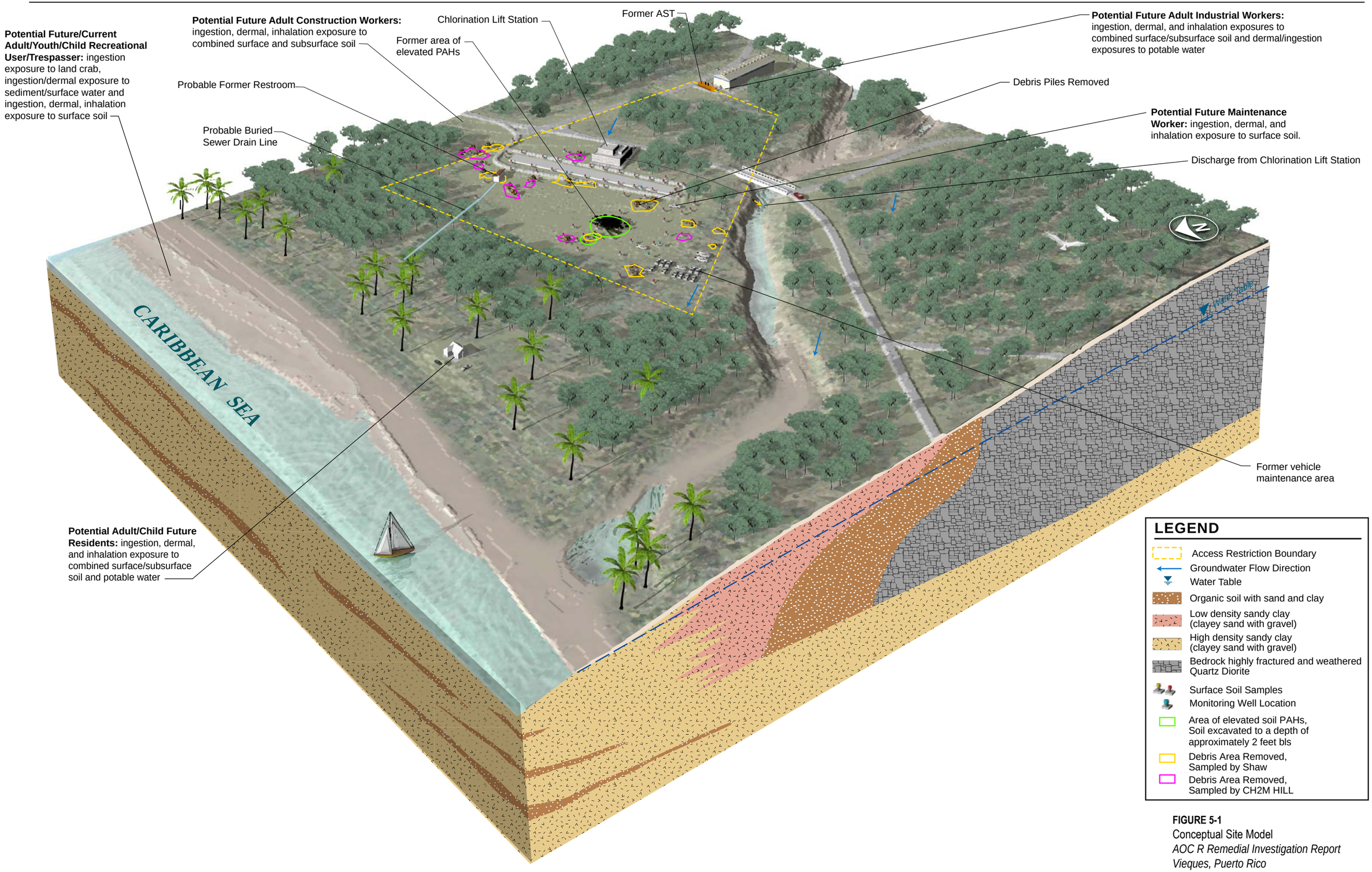


FIGURE 5-1
Conceptual Site Model
AOC R Remedial Investigation Report
Vieques, Puerto Rico

CH2MHILL

SECTION 6

Human Health Risk Assessment Summary

A baseline Human Health Risk Assessment (HHRA) was conducted for AOC R. The HHRA evaluated potential current and future health risks from exposure to site media potentially affected by former site operations. The HHRA was conducted in accordance with the protocol presented in the *Master Standard Operating Procedures, Protocols, and Plans* (CH2M HILL, 2010) (hereinafter referred to as the Vieques Master HHRA Protocol) for sites in the Vieques Environmental Restoration Program (ERP), the HHRA interim deliverable for AOC R (submitted March, 2010), and the regulator comments on the AOC R interim deliverable. The protocol is consistent with EPA Region II policy and EPA guidance, primarily: *Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual, Parts A, D, E, and F* (USEPA, 1989, 2001, 2004, 2009a), *Exposure Factors Handbook* (USEPA, 1997a), and *Human Health Evaluation Manual*, *Standard Default Exposure Factors* (USEPA, 1991). The complete HHRA is presented in **Appendix Q** of this RI Report. This section summarizes the key components and findings of the HHRA.

6.1 Chemicals of Potential Concern

Soil samples collected in the 0–6 ft interval as part of the Phase II Expanded PA/SI (CH2M HILL, 2002), RI, supplemental RI, and removal action confirmatory sampling (Shaw, 2010) were used in the HHRA. Data representing soil that was removed as part of the removal action were excluded from the HHRA because their inclusion would misrepresent current site conditions. The soil dataset for the 0-6 ft interval consists of 137 soil samples, of which 102 are surface soil (within the 0-2 ft interval) samples, 32 are subsurface soil (within the 2-6 ft interval) samples, and 3 are sediment samples collected from an ephemeral streambed (dry at the time of sampling) located immediately west of AOC R.

The groundwater dataset used in the HHRA consists of two rounds of groundwater data collected from six monitoring wells (MW02 through MW07) in January 2006 and August 2009. Groundwater samples collected from MW01 represent background groundwater and were therefore not included in the HHRA.

The surface water dataset used in the HHRA consists of five surface water samples collected in December 2005 and June 2009 from ponded water in the ephemeral stream. It should be noted that ponded water is present only after storm events and does not persist.

COPCs were identified for soil, groundwater, and surface water using the screening process presented in the Vieques Master HHRA protocol (CH2M HILL, 2010). The maximum detected concentrations in each exposure medium were compared to EPA RSLs to identify COPCs for the HHRA. The RSLs available on the EPA website were adjusted based on a target ELCR of $1x10^{-6}$ and a non-cancer Hazard Quotient (HQ) of 0.1 to account for cumulative non-cancer effects. The maximum detected concentrations of inorganics in surface soil and total soil were also compared to background soil concentrations established for soil type Qa on West Vieques. However, no chemical was eliminated as a COPC based on comparison to background. The

conceptual site model in **Figure 6-1** presents the receptor groups that were evaluated in the HHRA. The following COPCs were identified for the indicated receptors and data groupings:

- **Recreational Users/Trespassers–** Five SVOCs and seven inorganics were identified as COPCs in surface soil. Three inorganics and chloroform were identified as COPCs in surface water.
- **Maintenance Workers –** One SVOC and three inorganics were identified as COPCs in surface soil.
- **Residents –** Five SVOCs and seven inorganics were identified as COPCs in both surface soil and total soil. Two SVOCs and seven inorganics were identified as COPCs in groundwater.
- **Industrial Workers and Construction Workers –** One SVOC and three inorganics were identified as COPCs in total soil. Two SVOCs and seven inorganics were identified as COPCs in groundwater for the industrial worker.

6.2 Exposure Evaluation

Potential current and future receptors were evaluated in the HHRA. As noted in Section 6.1 and in the *Conceptual Model for Potential Human Receptors* (**Figure 6-1**), current/future receptors evaluated in the HHRA consisted of recreational users/trespassers (adult, youth [6-16 years old], and child [1-6 years old]). Maintenance workers, industrial workers, construction workers, and residents (adult and child) were identified as potential future receptors. The following potential exposure pathways were quantified for potential receptors identified at AOC R.

Recreational Users/Trespassers (Adult/Youth/Child; Current/Future):

- ***Soil*** - Ingestion, dermal contact, and inhalation exposures to COPCs in surface soil (0-2 ft).
- ***Surface water*** - Ingestion and dermal contact exposures to COPCs in surface water.

Residents (Adult/Child; Hypothetical Future):

- ***Soil*** - Ingestion, dermal contact, and inhalation exposures to COPCs in surface soil (0-2 ft) and total soil (0-6 ft).
- ***Groundwater*** - Ingestion and dermal contact exposures to COPCs in groundwater via potable use. Inhalation exposures to bathroom air from tap water were not quantified because VOCs were not identified as COPCs in groundwater.

Maintenance Workers (Future) – Ingestion, dermal contact, and inhalation exposures to COPCs in surface soil (0-2 ft).

Industrial Workers (Future):

- ***Soil*** **–** Ingestion, dermal contact, and inhalation exposures to COPCs in total soil (0-6 ft).
- ***Groundwater*** - Ingestion and dermal contact exposures to COPCs in groundwater via drinking water and hand washing scenarios.

Construction Workers (Future) – Ingestion, dermal contact, and inhalation exposures to COPCs in total soil (0-6 ft).

6.3 Risk Estimates

EPA's target range for ELCR associated with CERCLA sites is 1-in-10,000 ($1x10^{-4}$) to 1-in-1,000,000 ($1x10^{-6}$). Similarly, the target non-cancer hazard index (HI) is 1.0 or less. Risk estimates were calculated for potential receptors and exposure pathways using conservative assumptions for exposure factors and exposure point concentrations. The following risk estimates were calculated for potential site receptors. Because site-related chemicals environmental media did not exceed EPA risk targets (ELCR of $1x10^{-4}$ and target organ-specific HI of 1.0), site media do not warrant remedial action and chemicals of concern were not identified.

- **Recreational Users/Trespassers – Current/Future Scenario**
  - Adult - $2x10^{-6}$ cumulative ELCR and all target organ-specific HIs<1.0
  - Youth - $2x10^{-6}$ cumulative ELCR and all target organ-specific HIs<1.0
  - Child - $5x10^{-6}$ cumulative ELCR and all target organ-specific HIs<1.0
- **Residents – Hypothetical Future Scenario**
  - Adult - All target organ-specific HIs<1.0
  - Child - All target organ-specific HIs<1.0 for total soil and two target organ-specific HIs>1.0 for groundwater due to aluminum, iron, and manganese. However, these inorganics are naturally-occurring and their presence is likely due to the chemical weathering of volcanic rocks.
  - $1x10^{-4}$ cumulative ELCR
- **Maintenance Workers – Future Scenario**
  - ELCR <$1x10^{-6}$ and all target organ-specific HIs<1.0
- **Construction Workers – Future Scenario**
  - ELCR <$1x10^{-6}$ and all target organ-specific HIs<1.0
- **Industrial Workers – Future Scenario**
  - $2x10^{-5}$ cumulative ELCR and all target organ-specific HIs<1.0

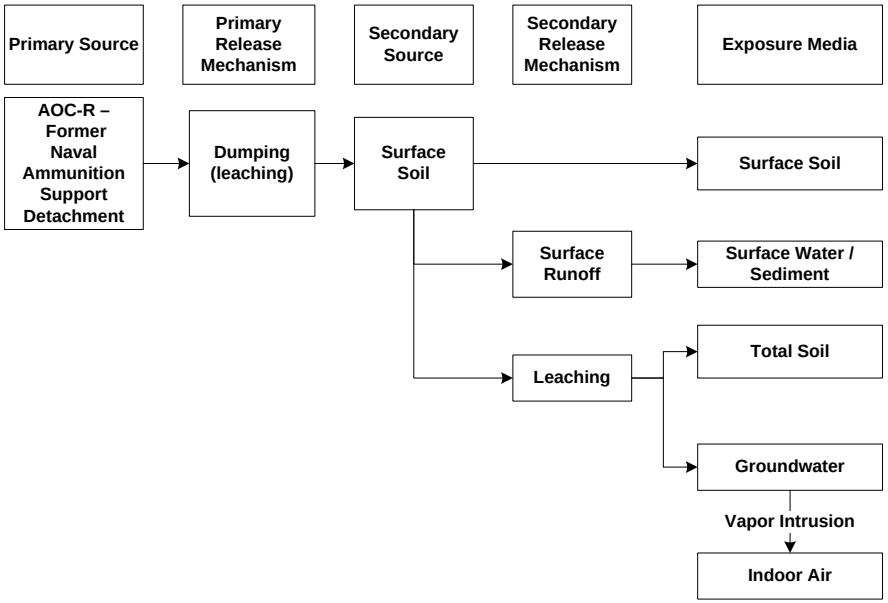
6.4 Chemicals of Concern

COCs were identified where the potential site-related ELCR or HI for an environmental medium/receptor group combination exceeded threshold values (a total ELCR of $1x10^{-4}$ and a target organ-specific HI of 1.0 were used as threshold values). When a potential site-related ELCR of $1x10^{-4}$ was exceeded for an exposure medium for a receptor group, the COPCs posing an individual ELCR greater than $1x10^{-6}$ in the environmental medium responsible for the unacceptable risks were identified as COCs. When a potential site-related target organ-specific HI exceeded 1.0 for an exposure medium for a receptor group, the COPCs posing a HQ greater than 0.10 for that target organ in the environmental medium responsible for the unacceptable risk were identified as COCs.

Factors such as background concentrations, data quality, and common pesticide use (unrelated to spills, and unrelated to improper storage/disposal/use) were considered when identifying COCs. Additional detail regarding these factors is provided in the nature and extent section of this RI Report. The list of COCs was reduced based on the following considerations.

- Inorganic COPCs that are wholly or primarily attributable to background levels were not identified as COCs. Chemicals are considered primarily attributable to background when elevated site concentrations are not primarily due to site-related sources and levels are comparable to those observed in non-impacted areas with similar soil characteristics. Although there is a small contribution of risk or hazard from chemicals within background levels, the site contribution is considered insignificant and was therefore not quantified.
- COPCs that are expected to be laboratory contaminants and not site-related were not identified as COCs.
- COPCs that are not associated with a CERCLA releases were not identified as COCs. Pesticides are present in environmental media as a result of application to soil to control pests. This type of regulated and approved pesticide use is distinct from pesticide contamination that is the result of a spill or improper storage, disposal, or use, and detecting their presence does not indicate a CERCLA release nor require a CERCLA response action.

Groundwater was the only exposure medium posing risk estimates exceeding threshold values. The only receptor group with a risk threshold exceedance in groundwater was child residents, and the threshold exceeded was a target organ-specific HI of 1.0 (gastrointestinal (GI) system and nervous system). The groundwater COPCs contributing at least 0.10 to the GI system HI or the nervous system HI are aluminum, iron, and manganese. However, these inorganics were not identified as COCs because their presence at the site is attributable primarily to background (e.g., chemical weathering of volcanic rocks). Additionally, aluminum was not detected in dissolved-phase groundwater, which suggests its single detection in groundwater in the total phase was the result of suspended particulates. A similar pattern was observed for iron, although dissolved iron was detected in one well. However, its detection in 2009 was below the tap water RSL. Therefore, no COCs were identified for soil, surface water, sediment, or groundwater at AOC R based on the concentrations detected and exposure scenarios evaluated in the HHRA.



Exposure Route	Potential Human Receptors: Current/Future, Recreational Users, Adult	Current/Future, Recreational Users, Youth	Current/Future, Recreational Users, Child	Future, Maintenance Worker	Future, Industrial Worker	Future, Construction Worker	Future, Residential, Adult	Future, Residential, Child
Ingestion (Surface Soil)	X	X	X	X				
Dermal Contact (Surface Soil)	X	X	X	X				
Inhalation (Surface Soil)	X	X	X	X				
Ingestion (Surface Water / Sediment)	X	X	X					
Dermal Contact (Surface Water / Sediment)	X	X	X					
Ingestion (Total Soil)					X	X	X	X
Dermal Contact (Total Soil)					X	X	X	X
Inhalation (Total Soil)					X	X	X	X
Ingestion (Groundwater)					X		X	X
Dermal Contact (Groundwater)					X		X	X
Inhalation (Groundwater)							X	X
Inhalation (Indoor Air)					X1		X1	X1

Legend
X – Potentially complete exposure pathways identified
1 – Exposure is considered insignificant

FIGURE 6-1
Potential Exposure Pathways for AOC R
AOC R Remedial Investigation Report
Vieques, Puerto Rico

SECTION 7

Ecological Risk Assessment Summary

A screening ecological risk assessment (SERA), constituting Steps 1 and 2 of the ecological risk assessment (ERA) process, and the first step (Step 3A) of a baseline ecological risk assessment (BERA), were conducted for AOC R. The ERA was conducted to evaluate the potential for adverse effects to the environment at AOC R following the removal actions. The complete ERA is presented in **Appendix R** of this RI Report. This section summarizes the key components and findings of the ERA.

7.1 ERA Process and Objectives

This ERA was conducted in accordance with the ERA protocol for Vieques (CH2M HILL, 2010), the ERA interim deliverable for AOC R (April 2010), the regulator comments on the AOC R interim deliverable, the *Navy Policy for Conducting Ecological Risk Assessments* (CNO, 1999), and the Navy guidance for implementing this ERA policy (NAVFAC, 2003). The two guidance documents describe a process consisting of eight steps, of which Steps 1, 2, and 3A were conducted for this ERA. Steps 1 and 2 of the ERA process comprise the SERA, which is conducted using intentionally conservative assumptions. If the results of the SERA indicate that unacceptable risks are possible, the site normally continues on to Step 3A, the first step in the BERA.

The objectives of a SERA are to:

- Determine if potential risks to ecological receptors warrant either: (1) additional assessment beyond the conservative screening steps of the ERA process (unacceptable ecological risks are possible); or (2) the removal of the site from further ecological consideration (no unacceptable ecological risks likely).
- Focus subsequent steps of the ERA process on the specific chemicals, pathways, and receptors of potential concern if unacceptable ecological risks are possible.
- Identify any data gaps or areas of unacceptable uncertainty that may require the collection of additional data to support ERA evaluations beyond the screening level.

The general objectives of a Step 3A ERA are to:

- Refine the risk estimates from the SERA to determine if risks to ecological receptors from site-related chemicals are likely to be unacceptable based upon realistic exposure scenarios.
- Focus subsequent data collection activities if potentially unacceptable risks are indicated, uncertainties are unacceptably high, and/or data gaps are identified.

7.2 Ecological Setting

AOC R has been disturbed during historic site investigations and recent (2009) debris/soil removal activities, with much of the vegetation cleared to allow access to these areas. The

description of the ecological setting for the site contained in this ERA is based upon pre-removal conditions. It is assumed that the habitats and biota present on AOC R prior to the removal action will reestablish themselves in a relatively short period of time following completion of the removal action. This assumption is based upon past observations during the multiple site visits conducted between sampling events, which showed rapid regrowth of the vegetation following the clearing done to provide site access for sampling.

The description of the (pre-investigation and removal) ecological setting is based upon a detailed habitat characterization conducted at AOC R by Geo-Marine (2001). The habitat characterization was conducted in order to determine the presence of plant and animal species and to determine whether preferred habitat was present for any federally endangered or threatened plant and animal species.

AOC R, located north of Highway 200, was used as a construction staging area and public works operational area from approximately 1965 to 1971. A large concrete pad that extends the full width of the site was present before the Navy owned the area, and can be seen in 1937 aerial photographs.

The topography of AOC R is relatively flat, with surface water runoff flowing mostly to the northeast toward the coastline of Vieques Passage. Groundwater also flows generally toward the north. No permanent surface water bodies are present on the site. However, a typically dry ephemeral stream is located at the west side of the site. Since some debris was found along the eastern embankment and bed of this stream, this potential semi-aquatic exposure pathway was evaluated, along with surface soil, in this ERA. Debris and associated soil removal activities were conducted at AOC R in March 2009. Debris removal from the bank and bed of the ephemeral stream was followed by installation of silt fencing to prevent soil transport to the streambed.

AOC R is located within a thorn scrub and coastal forest area. The vegetation immediately surrounding the concrete pad had been cleared for soil sampling shortly before the ecological survey. The concrete pad was dominated by a sparse cover of herbaceous plants. Six vine species were recorded at AOC R. Shrubs and trees were found mostly along the edge of the concrete pad and its immediate surroundings. The dominant shrub species was wild-tantan (*Leucaena leucocephala*). Sweet acacia (*Acacia farnesiana*), red manjack (*Cordia collococca*), be-still tree (*Rauvolfia tetraphylla*), and papaya (*Carica papaya)* were also observed but at lower densities. Species of herbaceous plants observed in the cleared area in the northern part of AOC R included garlic weed (*Petiveria alliacea*), better man better (*Achyrantes aspera*), bretonica prieta (*Melochia nodiflora*), and *Jatropha* spp. The vegetation on the site prior to clearing was probably very similar to the adjacent scrub forest.

Many wildlife species were observed utilizing the vegetated areas, concrete pad, edges of the cleared areas, and the adjacent habitat. The sides of the concrete pad provide shade, foraging areas, and cover for the common, garden, and spotted anoles, which were abundant. A mongoose was observed crossing the trail that led to the northern cleared area. No specific habitat for individual bat species was identified on AOC R during the habitat characterization. Habitat for birds included thorn scrub and coastal forest adjacent to the concrete pad. Many birds were observed using the edges of the cleared area around the concrete pad, trails, and brush piles for perches. The most common birds at the site were gray kingbirds (*Tyrannus dominicensus*), bananaquits (*Coereba flaveola*), and greater Antillean grackles (*Quiscalus niger*).

Bird species included those that would typically be found in coastal forest and thorn scrub habitat. An osprey (*Pandion haliaetus*) was observed flying northward toward the ocean over the adjacent vegetation.

Land crabs were not observed in the vicinity of the ephemeral stream. This stream, which appears to be regularly scoured by surface runoff from the drainage basin, is unlikely to support fish but may support some aquatic invertebrates during wet periods.

No federally protected species or preferred habitats were observed at AOC R. **Figure 7-1** illustrates a diagrammatic conceptual model for potential ecological exposure.

7.3 Analytical Data Used in the ERA

Five surface water samples from four locations and three substrate samples (termed substrate in the ERA since sediment was compared to both soil and sediment ecological screening values) from three locations were collected within the ephemeral stream. Two of the five surface water samples were collected during 2009 post-removal sampling activities. The purpose of these 2009 samples was to resample the most downgradient 2005 location (where arsenic exceedances were identified) and to sample a new location even further downgradient. The 2009 surface water samples were only analyzed for total and dissolved metals, and cyanide.

Available post-removal (confirmation) surface soil samples collected within the debris removal areas and historical surface soil samples collected across AOC R (but not removed as part of the interim removal action) were used in the ERA. In accordance with the *Final Removal Action Work Plan* (Shaw, 2007), all post-removal confirmation soil samples were collected from a depth of 0 to 6 inches to represent conditions immediately under the debris (i.e., potential contaminant source). Samples collected in 2000 used a different sampling protocol. Gravel that was present at the sampling location was scraped away from the surface and not included in the sample. Thus, the sample interval for most of these samples does not start at 0 inches (the top depth indicates how much gravel was removed) but all samples utilized were located in the top one foot depth interval. Samples collected in 2005 were from 0 to 24 inches. This interval was determined by the Navy and regulatory agencies to be representative of surface soil exposures at the site. Therefore, these data were also used in the ERA to increase spatial coverage (all samples from the southern portion of the site were from this sampling event).

7.4 Results

7.4.1 Terrestrial Habitats

Seven assessment endpoints were developed for terrestrial habitats at AOC R. Lines of evidence for terrestrial habitats included: (1) comparison of surface soil concentrations with ecological screening values (ESVs); (2) comparison of modeled dietary doses with ingestion toxicity reference values (TRVs); and (3) comparison of site surface soil concentrations with background concentrations (upper tolerance limits [UTLs]).

The VOCs 4-methyl-2-pentanone and acetone; SVOCs 2-nitroaniline, 4-nitroaniline, carbazole, and dibenzofuran; inorganics manganese and selenium, and total petroleum hydrocarbons (TPHs) were identified as COPCs for further risk evaluation in surface soil following Step 3A.

Two VOCs were detected in surface soil samples (4-methyl-2-pentanone and acetone) but could not be evaluated quantitatively because soil screening values were not available. However, the maximum concentrations of these two VOCs (1.5 and 30 µg/kg, respectively) were less than soil screening values for other, similar VOCs. In addition, the frequency of detection was less than 5 percent for both 4-methyl-2-pentanone (1 of 85 samples) and acetone (1 of 59 samples). Thus, neither of these VOCs was identified as a COC. Four SVOCs were detected in soil samples (2-nitroaniline, 4-nitroaniline, carbazole, and dibenzofuran) but could not be evaluated quantitatively because soil screening values were not available. However, the maximum concentrations of 2-nitroaniline and 4-nitroaniline (7.2 and 6.2 µg/kg, respectively) were less than soil screening values for other, similar SVOCs. In addition, the frequency of detection was less than 5 percent for both 2-nitroaniline (1 of 85 samples) and 4-nitroaniline (1 of 82 samples). Thus, neither of these SVOCs was identified as a COC.

Carbazole and dibenzofuran were detected in 16 and 1 (of 85) surface soil samples, at maximum concentrations of 218 and 1,170 µg/kg (0.218 and 1.170 mg/kg), respectively. While there is little information regarding the potential toxicity to soil invertebrates and/or terrestrial plants following direct exposure to these two chemicals, available data suggest that the maximum observed concentrations of these two chemicals are too low to elicit adverse effects. In studies with oligochaete worms exposed to carbazole-spiked soils, the resulting LC_{50} (survival) and EC_{50} (reproduction) values were greater than 2,100 and 52 mg/kg, respectively. Comparable values for dibenzofuran were 400 and 130 mg/kg, respectively. In a similar study exposing collembolans or springtails to spiked soils, the LC_{50} and EC_{50} values were 2,500 and 35 mg/kg, respectively, for carbazole and 50 and 23 mg/kg, respectively, for dibenzofuran. Maximum carbazole and dibenzofuran surface soil concentrations at the site were well below these effect concentrations. Thus, neither of these SVOCs was identified as a COC.

Manganese was detected in all site surface soil samples but occurred above the background UTL in just 5 of the 94 site samples at ratios of 1.01, 1.03 (0.58 in the field duplicate), 1.24, 1.35, and 3.75. Thus, with the exception of the maximum concentration, the other four exceedances of the background UTL were of low magnitude. With so few detections above the background concentration, manganese is unlikely to result in unacceptable risks to ecological receptors at levels above background on a site-wide basis and was therefore not identified as a COC.

Selenium was detected in 22 of 94 site surface soil samples, but was above the background UTL in only 1 of these samples at a ratio of 3.50. Thus, selenium is unlikely to result in unacceptable risks to ecological receptors at levels above background on a site-wide basis and was therefore not identified as a COC.

There are no available soil screening values for TPH. However, PAHs (which are typically the most toxic fraction of the TPH) did not exceed ecological screening values in surface soil samples. Thus, TPH was not identified as a COC.

The results of terrestrial food web modeling did not identify any COPCs. Therefore, the likelihood of population-level effects (the assessment endpoint evaluated) for terrestrial receptors is negligible. Thus, no unacceptable risks were identified for terrestrial wildlife receptors associated with AOC R.

7.4.2 Ephemeral Stream

Two assessment endpoints were developed for the ephemeral stream at AOC R. Lines of evidence for this stream included: (1) comparison of surface water and substrate (soil and sediment samples from stream) concentrations with ESVs; and (2) comparison of stream substrate concentrations with background soil concentrations.

Barium and manganese were identified as COPCs for further risk evaluation in surface water following the completion of Step 3A. Barium compounds have low toxicity to aquatic organisms, with the barium ion responsible for the toxic effects. In aquatic media, barium compounds are unlikely to be present in the ionic form and are likely to precipitate out of solution as barium sulfate ($BaSO_4$) or barium carbonate ($BaCO_3$) when they react with the sulfate or carbonate present in surface water. Thus, the barium is rendered essentially non-toxic and does not represent a risk to aquatic organisms. In addition, the primary transport pathway of site-related chemicals into the stream is expected to be via storm water runoff (overland flow). Barium in surface soils, however, was generally consistent with background, with only two exceedances of the background soil UTL. This suggests that any contribution of barium from AOC R to the surface water of the stream would be at background levels. Based upon these factors, barium was not identified as a COC in ephemeral stream surface water.

Manganese in surface soils was generally consistent with background (see Section 7.4.1). The one site soil sample with manganese concentrations significantly above background (SS-94) was not in close proximity to the ephemeral stream. This suggests that any contribution of manganese from AOC R to the surface water of the ephemeral stream would be at background levels. This is further supported by the fact that manganese was less than the background soil UTL in stream substrate samples. In addition, the ephemeral nature of the stream would result in a low exposure potential for water column-based aquatic receptors due to the infrequent and transitory presence of standing or flowing water in the stream. Based upon these factors, manganese was not identified as a COC in ephemeral stream surface water.

No chemicals were identified as COPCs for further risk evaluation in ephemeral stream sediment. Thus, risks from this exposure pathway are acceptable.

7.5 ERA Summary and Conclusions

In summary, no COCs were identified for surface soil, surface water, or sediment exposures at AOC R. Similarly, no COCs were identified for food web exposures. Thus, risks to ecological receptors are acceptable at AOC R and no further evaluation or remediation is warranted with respect to ecological receptors.

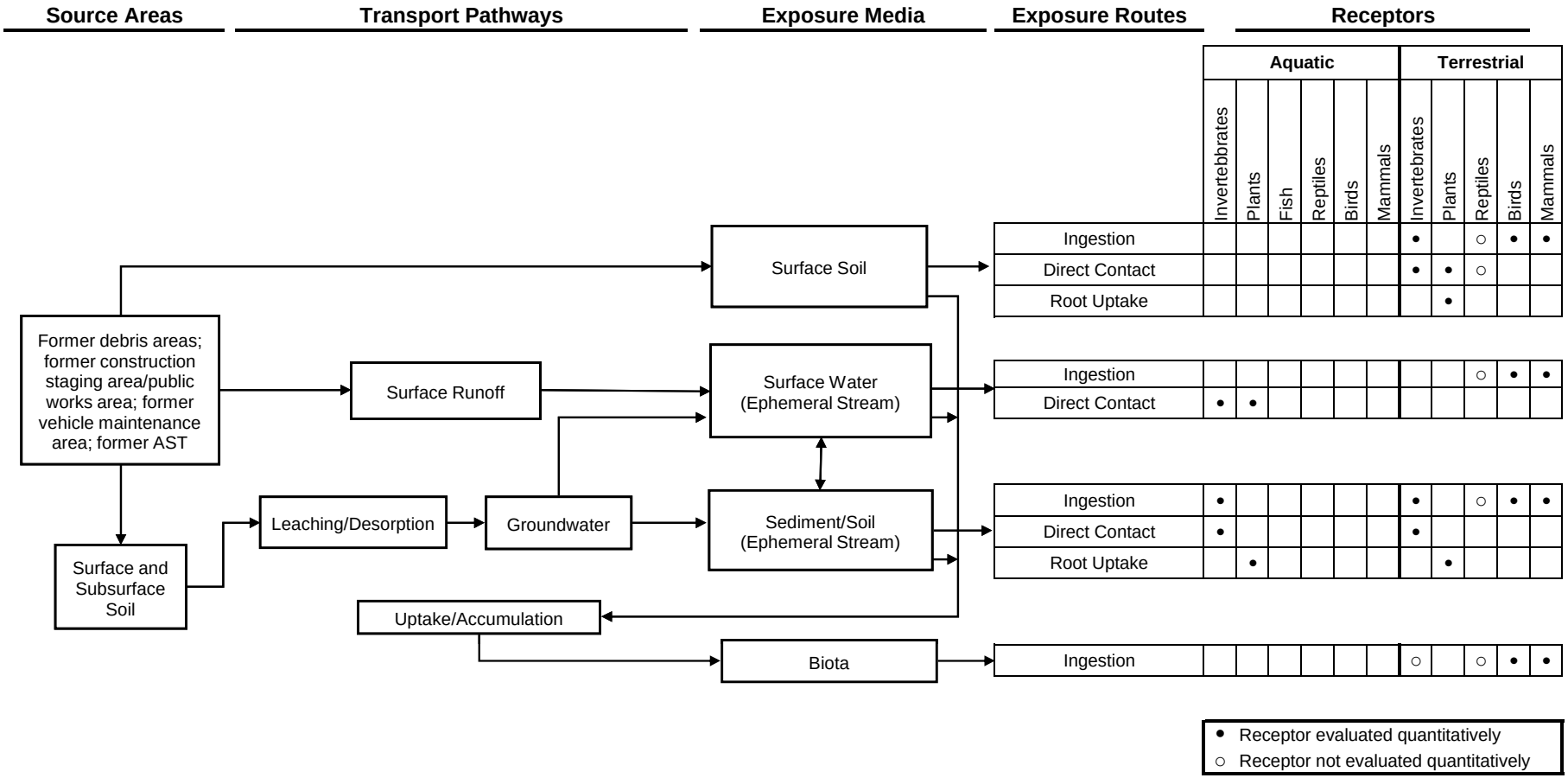


FIGURE 7-1
Ecological Conceptual Site Model
AOC R Remedial Investigation Report
Vieques, Puerto Rico

SECTION 8

Summary, Conclusions, and Recommendations

The overall objective of this RI is to present the data and findings obtained from previous and recent investigations conducted to characterize the nature and extent of contamination in soil, groundwater, surface water, and sediment, and to assess potential risks to human health and the environment that may remain following the 2009 removal action at AOC R.

This section presents the summary and conclusions of the RI conducted at AOC R and the proposed path forward for the site.

8.1 Summary of Remedial Investigation Activities

The RI activities were conducted from December 2005 to March 2006, followed by supplemental investigations in June and August 2009. Below is a summary of the RI activities conducted to meet the project objectives.

- Development of a conceptual site model, upon which the site characterization was based.
- Collection of 187 soil samples (surface and subsurface including duplicates) to characterize potential source areas, which included the collection of confirmatory samples in areas where debris and impacted soil were removed, to confirm the findings of the Expanded Phase II PA/SI, and to provide sufficient information for conservatively assessing the nature and extent of contamination and potential risks.
- Collection of 7 surface water and 4 sediment samples (including duplicates) from the ephemeral stream to provide sufficient information for assessing nature and extent of contamination and potential risks.
- Installation of 7 monitoring wells; groundwater sampling and monitoring from these wells during two events to provide sufficient information for assessing the subsurface conditions, nature and extent of contamination, and potential risks

8.2 Conclusions

8.2.1 Physical Characteristics

- The topography of AOC R is relatively flat and slightly slopes to the north and northwest toward the coastline. An unnamed ephemeral stream occurs along the western portion of the site and flows only for a short period of time after precipitation events.
- Groundwater at AOC R was encountered within the poorly graded to well graded sands of the alluvium and within the sands encountered beneath the weathered bedrock in the southern portion of the site, ranging in elevation from 6.25 (MW01) to 1.69 (MW05) ft amsl in August 2009. Groundwater flows north to northwestward toward the coastline with an average hydraulic gradient of 0.005 ft/ft and at an estimated groundwater flow velocity of approximately 15 ft/yr.

8.2.2 Environmental Media Contamination

Analytical data collected during the Expanded Phase II PA/SI, RI and supplemental investigations, and removal action confirmatory sampling provide the primary basis for the evaluation of the nature and extent of contamination in soil, surface water, sediment, and groundwater. A total of 168 soil samples were used to characterize site conditions. Data associated with soil that was removed as part of the removal action activities were excluded since they do not represent current site conditions.

8.2.2.1 Volatile Organic Compounds

- Only methylene chloride (in soil) and chloroform (in surface water) exceeded screening criteria at AOC R. However, methylene chloride is a common laboratory contaminant. Chloroform is a common byproduct of potable water chlorination and is likely the result of discharge from the potable water lift/chlorination station adjacent to the site. Methylene chloride and chloroform are not likely site-related constituents.

8.2.2.2 Semi-Volatile Organic Compounds

- Nine SVOCs, most of which were PAHs, exceeded a screening criterion in soil at AOC R; however, post-removal PAH concentrations were much lower than pre-removal concentrations. Benzo(a)pyrene was the most frequently observed PAH above a screening criterion (above the residential and industrial RSLs) in surface soil with a maximum concentration of 750 µg/kg. Other PAHs with exceedances included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Atrazine was observed above the SSL; however, it was not observed in groundwater, and was likely used as a herbicide to control weeds. As noted in Section 4.1.1.2 the presence of atrazine is not associated with a CERCLA-related release. Carbazole, 4-nitroaniline, and 2,4-DNT were observed above only the SSL, but not observed in groundwater.

- Only bis(2-ethylhexyl)phthalate and 4-nitrophenol were observed above screening criteria in groundwater. However, bis(2-ethylhexyl)phthalate is a common laboratory contaminant and not a likely site-related constituent, and 4-nitrophenol was used as a fungicide and its occurrence is likely from normal pesticide application and not from a CERCLA-related release. No PAHs were observed in groundwater.

- No SVOCs were observed in sediment or surface water at AOC R.

8.2.2.3 Pesticides/PCBs

- Pesticides were observed above screening criteria in soil and sediment at AOC R. Within soil, dieldrin, 4,4'-DDE, and 4'4-DDT were most frequently observed above screening criteria. Within sediment, only 4,4;-DDT was observed above screening criteria. No historical information at AOC R indicates that the site was used for pesticide handling, storage, or disposal. Further, the concentrations of pesticides observed in AOC R media are consistent with concentrations detected across multiple sites and attributed to normal pesticide application. Therefore, pesticides applied at AOC R were most likely a result of normal pesticide application, not a CERCLA-related release.

- No PCBs were observed above screening criteria in the environmental media at AOC R.

8.2.2.4 Explosives

- Perchlorate was observed in soil and groundwater at the site, but below screening criteria.

8.2.2.5 Inorganic Constituents

- Inorganic constituents detected above background concentrations (if available) and screening criteria in environmental media comprise:
  - **Soil** – aluminum, antimony, arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, vanadium, and zinc.
  - **Groundwater** – aluminum, arsenic, chromium, cobalt, iron, and manganese.
  - **Surface Water and Sediment** – arsenic, barium, chromium, cobalt, iron, and manganese.
- Copper exceeded screening criteria in 23 soil samples in the area of the concrete pad, but was below screening criteria in all other environmental media.
- Aluminum, antimony, arsenic, barium, chromium, cobalt, iron, lead, manganese, nickel, selenium, vanadium, and zinc are associated with background, as concentrations were generally within to slightly above background levels. Although aluminum, iron, and manganese can be associated with the metal debris formerly present at the site, these inorganics are also commonly associated with the chemical weathering of volcanic rocks and can be highly variable due to the occurrence of aluminum rich clays and iron and manganese oxides.

8.2.3 Contaminant Migration

- The potential sources of contamination at AOC R include the former debris piles, former AST, and former activities related to construction and vehicle maintenance from 1965 to 1971. However, the debris piles and soil containing high levels of PAHs were removed from the site as part of the 2009 removal action.
- The potential for contaminant migration from wind erosion, surface runoff, and groundwater is minimal. PAHs and inorganics are not readily mobile and tend to bind to the soil. In addition, the potential future sources of contamination (debris) were removed from the site, PAH impacted soils potentially posing unacceptable risk were removed from the site, and vegetative cover and relatively flat topography reduce the potential for migration.

8.2.4 Land Use

- The Navy ceased military operations in April 2001 and transferred the land containing AOC R to the MOV. The site is currently restricted to the public; however, access roads to the beaches are located adjacent to the site. Groundwater is currently not used as a potable water source at or in the vicinity of AOC R, and there are no plans for potable use of groundwater in this area.

8.2.5 Human Health Risk Assessment

- A baseline HHRA was conducted for AOC R to evaluate the magnitude and probability of actual or potential harm to public health, safety, and welfare posed by contamination at the

site. The HHRA evaluated potential current and future health risks from exposure to environmental media.

- Potential current/future receptors evaluated in the HHRA consisted of recreational users/trespassers (adult, youth [6-16 years old], and child [1-6 years old]), hypothetical future residents (adult and child), future maintenance workers, future industrial workers, and future construction workers. Conservative exposure pathways included (variously based on the receptor) ingestion, dermal contact, and inhalation of COPCs in soil; ingestion and dermal contact of COPCs in groundwater, surface water, sediment, and inhalation exposures to bathroom air from tap water.
- Inorganic constituents considered to be naturally occurring, identified as a laboratory contaminant and not site related; and pesticides were not considered COCs.
- The only receptor group with a risk threshold exceedance was child residents from exposure to groundwater, with a target organ-specific HI of 1.0 (GI system and nervous system). The groundwater COPCs contributing at least 0.10 to the GI system HI or the nervous system HI were aluminum, iron, and manganese. However, these inorganics were not identified as COCs because they are naturally-occurring and their presence is likely due to the chemical weathering of volcanic rocks. Therefore, no COCs were identified for soil, surface water, or groundwater at AOC R based on the exposure scenarios evaluated in the HHRA.

8.2.6 Ecological Risk Assessment

- A SERA, constituting Steps 1 and 2 of the ERA process, and the first step (Step 3A) of a BERA were conducted for AOC R. The ERA was conducted to evaluate the potential for adverse effects to the environment at AOC R following the removal action. The objectives of the SERA were to determine if potential risks to ecological receptors warrant additional assessment beyond the conservative screening steps of the ERA process or the removal of the site from further ecological consideration, focus subsequent steps of the ERA process on the specific chemicals, pathways, and receptors if unacceptable ecological risks are possible, and identify any data gaps.
- The ERA evaluated both terrestrial and aquatic habitats. In summary, no COCs were identified for soil, surface water, and sediment, and no COCs were indentified for food web exposure at AOC R. Therefore, no unacceptable ecological risks were indentified and no further evaluation is warranted for ecological receptors.

8.3 Recommendations

The data collected at AOC R indicate that all potentially affected media have been adequately characterized, both spatially and temporally. Most importantly is that a significant removal action was conducted at the site. This removal action eliminated not only the potential future sources of contamination (i.e., debris), but also soil containing contaminant concentrations posing potentially unacceptable risks to human health and/or ecological receptors. Based on current site conditions, no unacceptable risks remain. As a result, no further action is warranted for AOC R. The site will proceed to a No Further Action Proposed Plan and Record of Decision.

SECTION 9

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